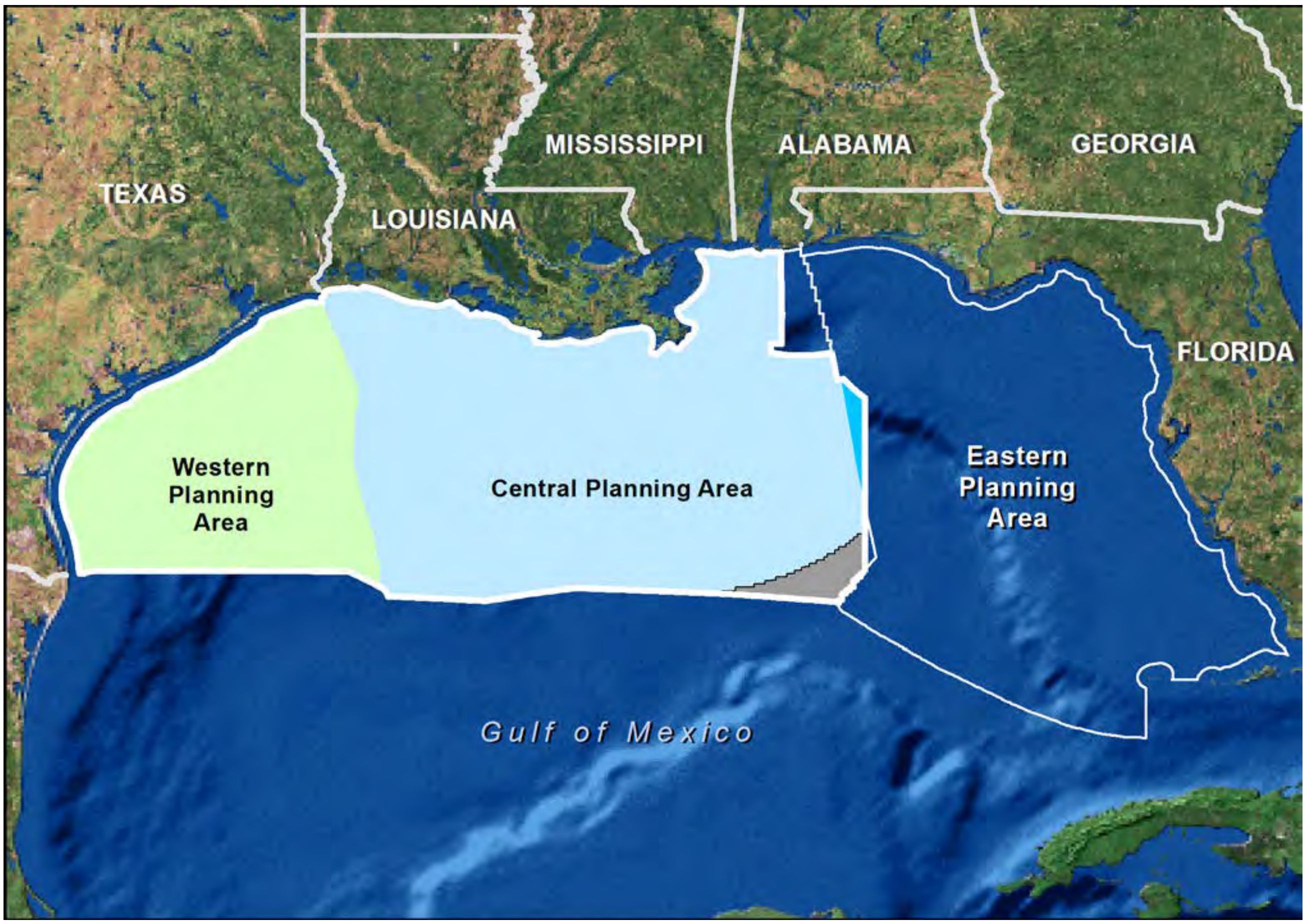
OCS EIS/EA
BOEM 2017-074

Gulf of Mexico OCS Lease Sale

Final Supplemental Environmental Impact Statement 2018

Volume II: Appendices A-E



U.S. Department of the Interior
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

OCS EIS/EA
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Gulf of Mexico OCS Region

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COOPERATING AGENCY MEMORANDUM OF AGREEMENT

A COOPERATING AGENCY MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT
BETWEEN
THE BUREAU OF OCEAN ENERGY MANAGEMENT
GULF OF MEXICO OCS REGION
AND
THE NATIONAL PARK SERVICE
SOUTHEAST REGION
DURING COMPLETION OF THE
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE OUTER CONTINENTAL SHELF OIL AND GAS
PROPOSED 2018-2022 GULF OF MEXICO LEASE SALES

INTRODUCTION

The Bureau of Ocean Energy Management (BOEM) is preparing a Supplemental Environmental Impact Statement (EIS) for Outer Continental Shelf (OCS) oil and gas proposed 2018-2022 Gulf of Mexico (GOM) Lease Sales 250, 251, 252, 253, 254, 256, 257, 259, and 261 (2018-2022 GOM Supplemental EIS). On August 19, 2016, a Notice of Intent to prepare this Supplemental EIS was published in the *Federal Register* for initial scoping and identification of scheduled scoping meetings.

The Council on Environmental Quality's regulations at 40 CFR § 1501.6 emphasize agency cooperation in the National Environmental Policy Act (NEPA) process between Federal agencies either having overlapping jurisdiction or special expertise related to a proposed action. The National Park Service (NPS) requested to be a cooperating agency on this Supplement EIS and BOEM has agreed to accept their request.

This Memorandum of Agreement (MOA) outlines the responsibilities of BOEM and NPS for this Supplemental EIS. Executing this MOA does not affect NPS's independent review and comment responsibilities under NEPA or its responsibilities for any other environmental consultations required by law. This MOA does not affect BOEM's responsibilities under the Outer Continental Shelf Lands Act and regulations under 30 CFR parts 550 or 560, or any other statutory or regulatory authorities.

BOEM RESPONSIBILITIES

(1) BOEM will designate a primary point of contact (POC) for matters related to this MOA. At the present time, Michelle Nannen is the POC for the Gulf of Mexico OCS Region. BOEM will notify NPS if the POC changes during the period of time this MOA is in effect.

(2) BOEM will provide an EIS preparation schedule for all solicited inputs and review periods, including administrative reviews.

(3) BOEM will set up and hold public meetings for the Draft Supplemental EIS.

(4) BOEM will provide NPS a copy of pertinent comments received during preparation of this Supplemental EIS (including scoping and the Draft Supplemental EIS public comment period).

(5) BOEM will publish a copy of this MOA in an appendix to this Supplemental EIS.

(6) BOEM will provide NPS with early versions of relevant Draft Supplemental EIS chapters, as arranged between the BOEM and NPS Points of Contact.

(7) BOEM will provide NPS with a preliminary copy of the Final Supplemental EIS for review prior to final lead agency approval and distribution of the document.

NPS RESPONSIBILITIES

(1) NPS will designate a primary POC to represent NPS in matters related to this MOA. At the present time, the NPS's Point of Contact is Bryan Faehner. The NPS will notify BOEM if the POC changes during the period of time this MOA is in effect.

(2) NPS will provide applicable data, information, and analyses regarding their expertise on potential impacts to the Gulf Islands National Seashore and the experience of park visitors.

(3) NPS will comply with BOEM's Supplemental EIS preparation schedule for all solicited inputs and review periods, including administrative reviews.

(4) NPS shall be responsible for any expenses incurred by NPS related to this MOA.

TERMINATION

This MOA is designed to establish expectations between the two agencies that apply for the duration of the 2018-2022 GOM Supplemental EIS, whereupon it terminates upon publication of the Final Supplemental EIS or upon written notice of termination. This MOA may be terminated by written notice by either of the below signatories or their successor at any time. This MOA terminates with publication of the Final 2018-2022 GOM Supplemental EIS.

LIMITATIONS

All commitments made in this MOA are subject to the availability of appropriated funds and each agency's budget priorities. Nothing in this MOA obligates BOEM or NPS to expend appropriations or to enter into any contract, assistance agreement, or interagency agreement, or to incur other financial obligations. This MOA is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds between the parties of this MOA will be handled in accordance with applicable laws, regulations, and procedures, and will be subject to separate subsidiary agreements that will be effected in writing by representatives of both parties. This MOA does not create any right or benefit enforceable against BOEM or NPS, their officers or employees, or any other person. This MOA does not apply to any person outside BOEM and NPS.

RESOLUTION OF DISPUTES

The parties agree to make every attempt to settle any disputes regarding this MOA at the lowest operational level. In the case of a substantial disagreement between BOEM and NPS, each agency will designate a senior management official at the regional level to seek resolution. If these officials do not resolve the dispute within 30 days, the agencies will further elevate the matter to the Director of BOEM and the Director of NPS for prompt resolution.

NOTICES

Except as otherwise provided herein, all notices relating to this MOA must be provided to the following:

To BOEM: Michelle Nannen
1201 Elmwood Park Blvd.
New Orleans, Louisiana 70123
michelle.nannen@boem.gov
504-731-6682

To NPS: Bryan Faehner
1201 Eye Street NW
11th Floor, Room 48
Washington, DC 20005
bryan_faehner@nps.gov
202-513-7256

PREDECISIONAL MATERIALS

The undersigned hereby agree to maintain the confidentiality of pre-decisional information and documents shared in furtherance of this MOA during completion of this Supplemental EIS. This agreement to maintain confidentiality of information and documents applies to all pre-decisional documents and communications, including, but not limited to, the following: email messages; notes to the file; agendas, pre-meeting materials, presentations, meeting notes, and summaries; letters; review evaluations; drafts of documents; and all documents created and shared as part of the collaboration established in this MOA. Any information that is required to be released to the public due to Agency legal obligations should not contain confidential or privileged information, including deliberative process privilege materials related to preparation of the Draft and Final Supplemental EISs. Upon receipt of a Freedom of Information Act request requesting information related to the activities carried out under this MOA, each agency will coordinate with or refer the request to the agency who generated the information prior to releasing the information to the requester.

* * *

This MOA may be executed in counterparts, each of which will be deemed to be an original. The signatures on this MOA may be executed on separate pages and all of which together will constitute one and the same agreement.

Michael A. Celata
Regional Director
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

12/29/16
Date

Stan Austin
Regional Director
National Park Service
Southeast Region

12/28/16
Date

APPENDIX B

AIR QUALITY:
WRF MODEL PERFORMANCE

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ABBREVIATIONS AND ACRONYMS

ARW	Advanced Research WRF
BOEM	Bureau of Ocean Energy Management
CAI	Climatologically Aided Interpolation
CAAA	Clean Air Act Amendments
CAMx	Comprehensive Air Quality Model with Extensions
CFL	Courant-Friedrichs-Lewy
CFSR	Climate Forecast System Reanalysis
CFSv2	Climate Forecast System Version 2
CMAQ	Community Multi-scale Air Quality model
ECMWF	European Center for Medium-Range Weather Forecasting
EIS	Environmental Impact Statement
ERA	European Center for Medium-Range Weather Forecasting Re-Analysis
ERG	Eastern Research Group, Inc.
ESRL	Earth System Research Laboratory
FDDA	Four-Dimensional Data Assimilation
FNMOC	Fleet Numerical Meteorology and Oceanography Center
IC/BC	Initial Conditions/Boundary Conditions
IOA	Index of Agreement
ISHO	Integrated Surface Hourly Observation
KBRO	Meteorological Call Sign for Brownsville
KSIL	Meteorological Call Sign for Slidell
KTPA	Meteorological Call Sign for Tampa
KEYW	Meteorological Call Sign for Key West
LCC	Lambert Conformal Conic
LSM	Land-Surface Model
MADIS	Meteorological Assimilation Data Ingest System
METSTAT	Meteorological Statistical Program
MM5	Mesoscale Meteorological Model version 5
MMIF	Mesoscale Model Interface Program
MPE	Model Performance Evaluation
NAAQS	National Ambient Air Quality Standards
NAM	North American Model
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCDC	National Climatic Data Center
NCEP	National Centers for Environmental Prediction
NDBC	National Data Buoy Center
NEPA	National Environmental Policy Act
NMM	Nonhydrostatic Mesoscale Model

NOAA	National Oceanographic Atmospheric Administration
NWS	National Weather Service
OCS	Outer Continental Shelf
OCSLA	OCS Lands Act
PBL	Planetary Boundary Layer
PGM	Photochemical Grid Model
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RMSE	Root Mean Square Error
RRTMG	Rapid Radiative Transfer Model for GCMs
SCAS-OSU	Spatial Climate Analysis Service at Oregon State University
SST	Sea-Surface Temperature
TRMM	Tropical Rainfall Measurement Mission
USEPA	United States Environmental Protection Agency
USDOC	United States Department of Commerce
USGS	United States Geological Survey
UTC	Universal Time Coordinate
WPS	WRF Pre-processing System
WRAP	Western Regional Air Partnership
WRF	Weather Research and Forecasting model

B AIR QUALITY: WRF MODEL PERFORMANCE

B.1 INTRODUCTION

The U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM) is required under the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. § 1334(a)(8)) to comply with the National Ambient Air Quality Standards (NAAQS) to the extent that Outer Continental Shelf (OCS) offshore oil and gas exploration, development, and production sources do not significantly affect the air quality of any state. The Gulf of Mexico OCS Region's area of possible influence includes the States of Texas, Louisiana, Mississippi, Alabama, and Florida. BOEM's Gulf of Mexico Region manages the responsible development of oil, gas, and mineral resources for the 430 million acres in the Western, Central, and Eastern Planning Areas on the OCS, including the areas under moratoria (shown in **Figure B-1**). The Clean Air Act Amendments (CAAA) of 1990 designate air quality authorities, giving BOEM air quality jurisdiction westward of 87°30'W. longitude and the U.S. Environmental Protection Agency (USEPA) air quality jurisdiction eastward of 87°30'W. longitude. In 2006, oil and gas leasing operations within 125 miles (201 kilometers [km]) of the Florida coastline were banned until 2022 under the Gulf of Mexico Energy Security Act (GOMESA). The GOMESA moratoria area is depicted on **Figure B-1**.

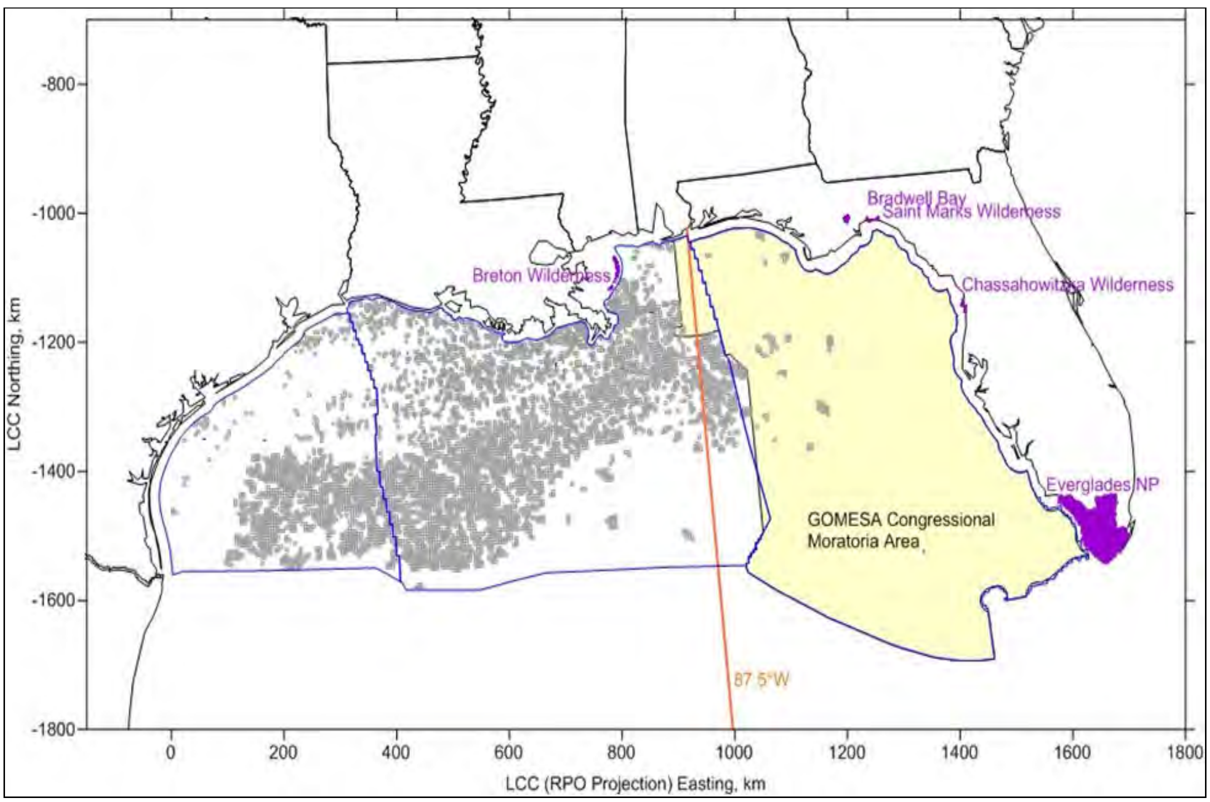


Figure B-1. Location of the "Air Quality Modeling in the Gulf of Mexico Region" Study with Class I Areas (purple) and Platform Locations (gray dots).

The USEPA has set NAAQS for six regulated air quality pollutants: ozone; particulate matter with an aerodynamic diameter of 2.5 micrometers and smaller ($PM_{2.5}$); particulate matter with an aerodynamic diameter of 10 micrometers and smaller (PM_{10}); sulfur dioxide (SO_2); nitrogen dioxide (NO_2); carbon monoxide (CO); and lead (Pb). After promulgation of a NAAQS, the USEPA designates areas that fail to achieve the NAAQS as nonattainment areas (NAAs) and States are required to submit State Implementation Plans (SIPs) to the USEPA that contain emission control plans and a demonstration that the NAA will achieve the NAAQS by the required date. After an area comes into attainment of the NAAQS, the area can be redesignated as a maintenance area and must continue to demonstrate compliance with the NAAQS.

In 1997, the USEPA promulgated the first 8-hour ozone NAAQS with a threshold of 0.08 parts per million (ppm) (84 parts per billion [ppb]). On March 12, 2008, the USEPA promulgated a more stringent 0.075 ppm (75 ppb) 8-hour ozone NAAQS. **Figure B-2** presents the current ozone nonattainment areas in the southeastern U.S. On October 1, 2015, the USEPA strengthened the 8-hour NAAQS for ozone to 0.07 ppm (70 ppb). Under this more stringent ozone NAAQS, there may be more areas in the southeastern U.S. that will be in nonattainment. The USEPA plans to make attainment and nonattainment designations for the revised standards by October 2017, with the designations based on 2014-2016 air quality data.

On December 14, 2012, the USEPA revised the $PM_{2.5}$ primary NAAQS by lowering the annual $PM_{2.5}$ NAAQS threshold from 15.0 micrograms per cubic meter (μg/m^3) to 12.0 μg/m^3. The USEPA retained the 24-hour $PM_{2.5}$ primary NAAQS at 35 μg/m^3. The 24-hour coarse PM NAAQS (PM_{10}) was also retained at 150 μg/m^3.

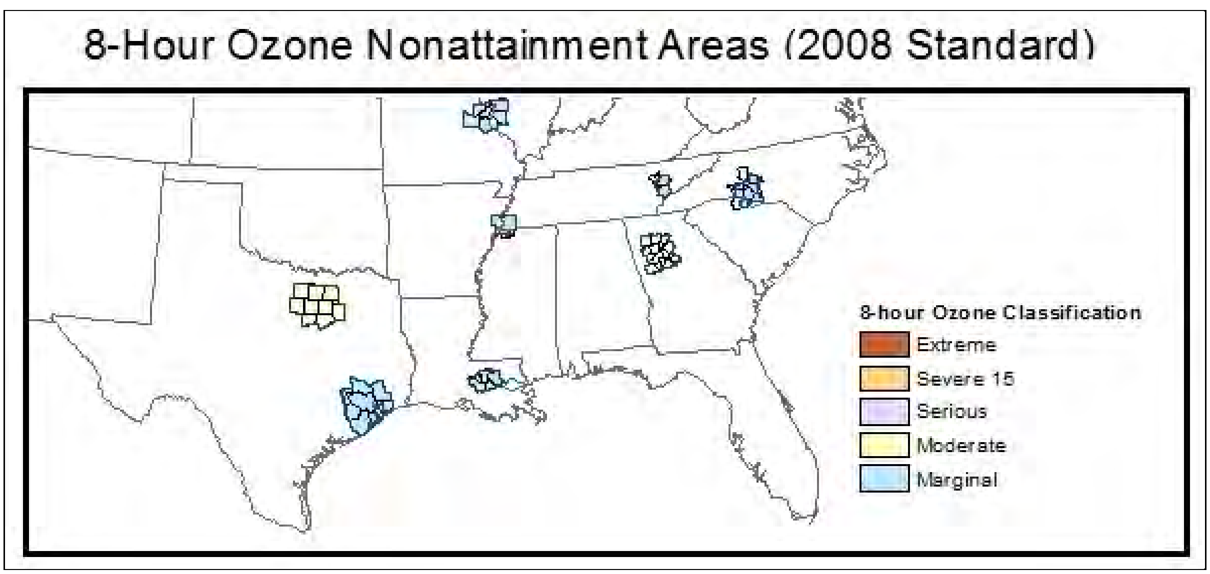


Figure B-2. Ozone Nonattainment Areas in the Southeastern U.S. (USEPA, 2016a).

In February 2010, the USEPA issued a new 1-hour NO_2 NAAQS with a threshold of 100 ppb (98th percentile daily maximum average over three-years) and a new 1-hour SO_2 NAAQS was promulgated in June 2010 with a threshold of 75 ppb (99th percentile averaged over 3 years). The USEPA has not yet designated the nonattainment areas for the 1-hour NO_2 and 1 hour SO_2 NAAQS.

A new lead NAAQS was issued in 2008; NAAs for lead are associated with specific industrial sources. As oil and gas sources in the Gulf of Mexico OCS region produce negligible amounts of lead emissions and to be consistent with onshore oil and gas analysis, which does not include lead, lead was not included in the air quality analysis. The NAAQS for carbon monoxide has remained essentially unchanged since it was originally promulgated in 1971. As of September 27, 2010, all NAAs for carbon monoxide have been redesignated as maintenance areas. **Table B-1** summarizes the nonattainment and maintenance areas in the southeastern U.S.

Table B-1. Nonattainment and Maintenance Areas in the Southeastern U.S.

State	Area	8-hr O_3 (1997)	8-hr O_3 (2008)	SO_2 (2010)	Lead (2008)
Alabama	Troy, AL				NAA[a]
Florida	Tampa, FL				NAA
	Hillsborough County, FL			NAA	
	Nassau County, FL			NAA	
Louisiana	Baton Rouge, LA	M[b]	NAA		
	St. Bernard Parish, LA			NAA	
Texas	Beaumont-Port Arthur, TX	M			
	Houston-Galveston-Brazoria, TX	NAA	NAA		
	Frisco, TX				NAA

[a] NAA = nonattainment area
[b] M = maintenance area
Blank cells indicate the area is in attainment of the NAAQS.

The CAAA designated 156 Class I areas consisting of National Parks and Wilderness Areas that are offered special protection for air quality and air quality-related values (AQRVs). The Class I areas, compared to Class II areas, have lower Prevention of Significant Deterioration (PSD) air quality increments that new sources may not exceed and are protected against excessive increases in several AQRVs, including visibility impairment, acid (sulfur and nitrogen) deposition, and nitrogen eutrophication. The Regional Haze Rule (RHR) has a goal of natural visibility conditions by 2064 at Class I areas, and States must submit RHR SIPs that demonstrate progress towards that goal. **Figure B-1** displays the locations of the mandatory Class I areas (in purple) in the Gulf of Mexico OCS region. In addition to the Class I areas, Federal Land Management (FLM) agencies have designated certain other areas as sensitive Class II areas for tracking PSD increment consumption and AQRV impacts.

On August 26, 2014, BOEM contracted with Eastern Research Group, Inc. (ERG) and team members Ramboll Environ US Corporation (Ramboll Environ) and Alpine Geophysics, LLC to complete a comprehensive air quality modeling study in the Gulf of Mexico OCS region. Under BOEM Contract Number M14PC00007, air quality photochemical grid modeling (PGM) will be conducted in the region to assess the impacts to nearby States of OCS oil and gas exploration, development, and production as required under OCSLA. This assessment is used by BOEM in the cumulative and visibility impacts analyses of the National Environmental Policy Act (NEPA) environmental impact statements (EIS), which are the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022; Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261—Final Multisale Environmental Impact Statement* (2017-2022 GOM Multisale EIS) and this Supplemental EIS. These analyses address both current and proposed NAAQS.

Air quality modeling requires several input datasets, including meteorology, emissions inventories, and ambient pollutant concentrations. **Figure B-3** presents an overview of how these project datasets fit together for the "Air Quality Modeling in the Gulf of Mexico Region" study.

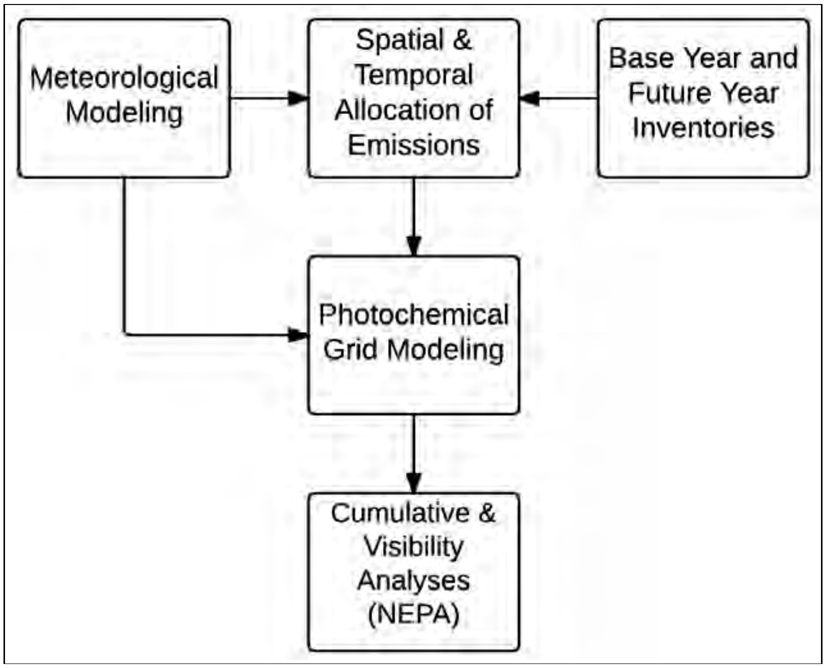


Figure B-3. Overview of the "Air Quality Modeling in the Gulf of Mexico Region" Study Tasks.

This report details the meteorological modeling performance evaluation (MPE) of a Weather and Research Forecast (WRF) model for 2012, the PGM year. A separate report (referred to herein as the "full WRF modeling report") will provide a more comprehensive evaluation of the full 5-year WRF dataset.

Meteorological information is needed for air quality modeling. Parameters such as wind speed, wind direction, air temperature, and humidity are required by models to determine the rate that pollutants disperse and react in the atmosphere. Sources of meteorological information include datasets of measurements gathered at various locations within the Gulf of Mexico OCS Region's domain. However, the spatial coverage of measurements is insufficient to describe the three-dimensional structure of the atmosphere away from measurement locations. Using measurement data as inputs, gridded meteorological models capable of simulating the fluid dynamics of the atmospheric data can be used to estimate meteorological conditions over a complete modeling domain—including regions far from measurement sites—in a physically consistent fashion. The results of these models are often used to establish conditions near remote pollutant sources or remote locations downwind of pollutant sources. Within the domain of the Gulf of Mexico OCS Region, the WRF meteorological model has been identified and was used to provide meteorological inputs for the air quality models.

Ramboll Environ previously evaluated the existing meteorological datasets and concluded that enough deficiencies were present in the datasets and there were not enough positive attributes to select any of them for air quality modeling in the study area (Brashers et al., official communication, 2014) and, therefore, new meteorological modeling was required. One purpose of the modeling is to provide the meteorological dataset for the 2012 simulation using PGM modeling in the OCS region.

B.2 WRF MODELING METHODOLOGY

Over the past decade, emergent requirements for numerical simulation of urban and regional scale air quality have led to intensified efforts to construct high-resolution emissions, meteorological and air quality datasets. It is now possible, for example, to exercise sophisticated mesoscale prognostic meteorological models and Eulerian and Lagrangian photochemical/aerosol models for multi-seasonal periods over near-continental scale domains in a matter of weeks with the application tailored to a specific air quality modeling project.

The WRF model is the current preferred model for atmospheric research and operational forecasting needs at mesoscale resolution (approximately 5 to several hundred km). The model is the state-of-the-art atmospheric simulation system, commonly used to drive air quality dispersion models on the regional level.

The operational version of the model is the Nonhydrostatic Mesoscale Model (NMM) WRF core version 3, developed and maintained by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) and the National Centers for Environmental Prediction (NCEP). The Advanced Research WRF (ARW) core, currently version WRF 3.7.1, is supported by the National Center for Atmospheric Research (NCAR), Mesoscale and Microscale Meteorology Division (NCAR, 2015). The modeling described in this report used WRF version 3.7.

The WRF model contains separate modules to compute different physical processes such as surface energy budgets and soil interactions, turbulence, cloud microphysics, and atmospheric radiation. Within WRF, the user has many options for selecting the different schemes for each type of physical process. There is a WRF Pre-processing System (WPS) that generates the initial and boundary conditions used by WRF, based on topographic datasets, land use information, and larger-scale atmospheric and oceanic models.

B.2.1 Gulf of Mexico Region Air Quality Meteorological Modeling

The USEPA CONUS WRF and Ramboll Environ Training WRF datasets were previously examined in detail and evaluated using both quantitative and qualitative techniques. Both datasets were identified as being inadequate for the study area, particularly in the offshore portions (Brashers et al., official communication, 2014). The development of a new high-resolution dataset was necessary to more accurately represent meteorological conditions in the over-water portions of the OCS region for use in air quality modeling.

B.2.2 Model Domain Configuration

The WRF domain configuration is comprised of a system of simultaneous nested grids. **Figure B-3** shows the WRF modeling grids at 36/12/4 km. All WRF grids are defined on a Lambert Conformal Conic (LCC) projection centered at 40°N. latitude, 97°W. longitude with true latitudes at 33°N. and 45°N. (the "standard RPO" projection). The outermost domain (outer box) with 36-km resolution includes the entire continental U.S. and parts of Canada and Mexico, and captures synoptic-scale (storm system-scale) structures in the atmosphere. The inner 12-km regional grid (d02) covers the southeastern U.S. and was used to ensure that large-scale meteorological patterns across the region are adequately represented and to provide boundary conditions to the 4-km domain.

The 4-km domain (d03) shown in **Figure B-4** is centered on the coastal areas of the southeastern U.S. and over-water portions of the Gulf of Mexico. **Table B-2** provides the input configurations for this WRF domain. The NX and NY are the number of east-west and north-south staggered grid points, respectively, in each domain. I-start and J-start indicate the western and southern nested grid starting indices with respect to the parent grid. Geographic resolution relates to the geographic datasets employed for each grid in terms of minutes or seconds of degrees.

The 36-, 12-, and 4-km grids were run simultaneously with one-way nesting, meaning that meteorological information flows down-scale via boundary conditions introduced from the coarser to finer grids without feedback from the finer to coarser grids. The WRF modeling domain was defined to be slightly larger than the CAMx/CMAQ PGM modeling domains to eliminate boundary artifacts in the meteorological fields. Such boundary artifacts occur for both numerical reason (the 3:1 grid spacing ratio) and because the imposed boundary conditions require some time/space to come into dynamic balance with WRF's atmospheric equations.

Table B-2. BOEM's Gulf of Mexico OCS Region WRF Domain Configuration.

Grid Resolution	NX	NY	I-start	J-start	Geographic Resolution	Coverage
36 km	165	129	1	1	10 minute	CONUS
12 km	265	187	55	9	2 minute	SE CONUS
4 km	481	211	72	27	30 second	OCS Region

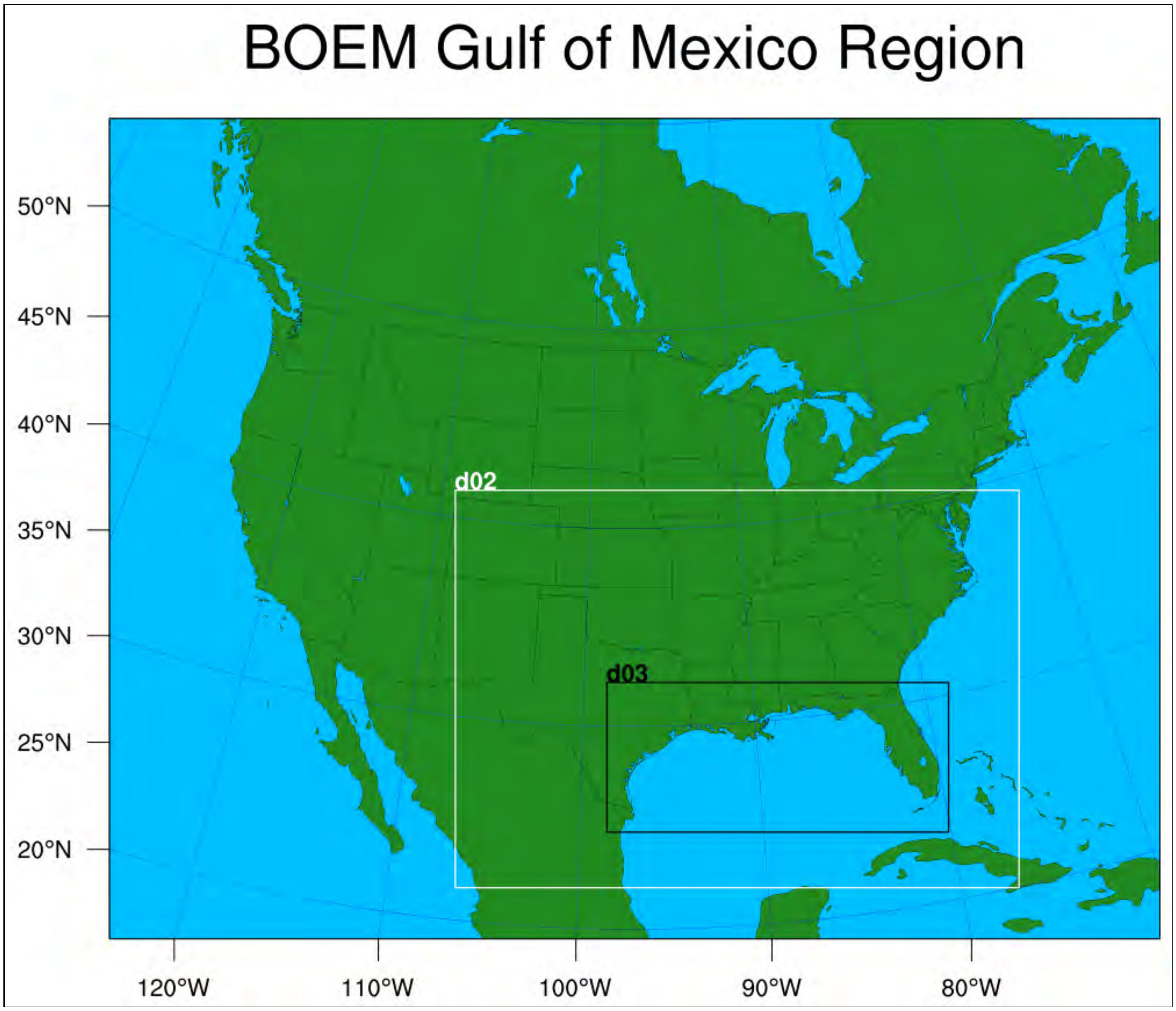


Figure B-4. WRF 36-km CONUS (d01), 12-km SE Regional (d02), and 4-km Gulf of Mexico Region (d03) Domains.

B.2.3 Model Application

The publicly available version of WRF, version 3.7, was used in the Gulf of Mexico OCS Region's meteorological modeling. The WRF pre-processor programs, including GEOGRID, UNGRIB, METGRID, and OBSGRID, were used to develop model inputs.

B.2.3.1 Model Vertical Resolution

The dataset was tested using both 33 and 37 vertical layers. Thirty-seven vertical layers allowed for higher vertical resolutions near the surface, which enabled the model to more accurately capture low-level inversions frequently present during winter. Additional layers in the mid-levels also allowed the model to more accurately re-create the convective updraft velocities seen in the summer months. The dataset model levels are shown in **Table B-3**.

Table B-3. BOEM Gulf of Mexico OCS Region WRF Dataset Model Levels.

Level	eta	Pressure (mb)	Height (m)	Mid Height (m)	Thickness (m)
0	1	1,000	0.0		
1	0.9985	999	12.2	6.1	12.2
2	0.9970	997	24.5	18.4	12.2
3	0.9950	995	40.8	32.7	16.4
4	0.9930	993	57.2	49.0	16.4
5	0.9910	991	73.6	65.4	16.4
6	0.9880	989	98.3	85.9	24.7
7	0.9850	986	123.0	110.6	24.7
8	0.9800	981	164.3	143.6	41.3
9	0.9700	972	247.4	205.9	83.1
10	0.9600	962	331.2	289.3	83.8
11	0.9500	953	415.7	373.4	84.5
12	0.9400	943	500.8	458.2	85.1
13	0.9300	934	586.6	543.7	85.8
14	0.9100	915	760.5	673.5	173.8
15	0.8900	896	937.2	848.8	176.8
16	0.8700	877	1,117.1	1,027.1	179.8
17	0.8400	848	1,392.8	1,254.9	275.8
18	0.8000	810	1,772.4	1,582.6	379.6
19	0.7600	772	2,166.7	1,969.6	394.3
20	0.7200	734	2,577.0	2,371.9	410.3
21	0.6800	696	3,005.0	2,791.0	427.9
22	0.6400	658	3,452.2	3,228.6	447.3
23	0.6000	620	3,921.0	3,686.6	468.7
24	0.5500	573	4,540.7	4,230.8	619.8
25	0.5000	525	5,203.7	4,872.2	662.9
26	0.4500	478	5,917.1	5,560.4	713.4
27	0.4000	430	6,690.5	6,303.8	773.4
28	0.3500	383	7,536.4	7,113.5	846.0
29	0.3000	335	8,472.3	8,004.4	935.8
30	0.2500	288	9,522.5	8,997.4	1,050.2
31	0.2000	240	10,724.1	10,123.3	1,201.6
32	0.1500	193	12,136.7	11,430.4	1,412.6
33	0.1000	145	13,866.9	13,001.8	1,730.1
34	0.0600	107	15,621.6	14,744.2	1,754.7
35	0.0270	76	17,503.4	16,562.5	1,881.8
36	0.0000	50	19,594.2	18,548.8	2,090.8

B.2.3.2 Topographic Inputs

Topographic information for WRF was developed using the standard WRF terrain databases available from NCAR. The 36-km CONUS domain was based on the 10-min (18-km) global data. The 12-km southeastern CONUS domain was based on the 2 min (~4-km) data. The 4-km Gulf of Mexico OCS region domain was based on the 30-sec (~900-m) data.

B.2.3.3 Vegetation Type and Land Use Inputs

Vegetation type and land-use information was developed using the U.S. Department of the Interior, Geological Survey (USGS) land-use database from the most recently released WRF databases provided with the WRF distribution. The number of land categories in input data was the USGS default of 24. Standard WRF surface characteristics corresponding to each land-use category were employed.

B.2.3.4 Atmospheric Data Inputs

The WRF relies on some other model or re-analysis output to provide initial and boundary conditions (IC/BC). Sensitivity tests were performed on several datasets to evaluate their effectiveness over the Gulf of Mexico. The datasets tested include the ERA-Interim reanalysis product, available from the European Center for Medium-range Weather Forecasting (ECMWF) Data Portal website; the Climate Forecast System Reanalysis (CFSR, ended in 2010), and the Climate Forecast System model version 2 (CFSv2, after 2010) (Saha et al., 2014); and the 12-km North American Model (NAM) archives available from the National Climatic Data Center (NCDC) NOMADS server.

The NAM dataset was chosen for the lowest bias and error in model performance and was used as first guess fields for WRF. This dataset was objectively re-analyzed using traditional observation site data (meteorological towers) to the higher resolution of each WRF grid, using the OBSGRID program. These fields are then used both to initialize the model and to conduct analysis nudging to guide the model to best match the observations.

B.2.3.5 Time Integration

Adaptive time stepping was used to maximize the time step that the model can use while keeping the model numerically stable. The model time step was adjusted based on the domain-wide horizontal and vertical stability Courant-Friedrichs-Lewy (CFL) target value of 0.8.

B.2.3.6 Diffusion Options

Horizontal Smagorinsky first-order closure (km_opt = 4) with sixth-order numerical diffusion and suppressed up-gradient diffusion (diff_6th_opt = 2) was used.

B.2.3.7 Lateral Boundary Conditions

Lateral boundary conditions were specified from the initialization dataset on the 36-km domain with continuous updates nested from the 36-km domain to the 12-km domain and from the 12-km domain to the 4-km domain, using one-way nesting (feedback = 0).

B.2.3.8 Top and Bottom Boundary Conditions

The top boundary condition was selected as an implicit Rayleigh dampening for the vertical velocity. Consistent with the model application for non-idealized cases, the bottom boundary condition was selected as physical, not free-slip.

B.2.3.9 Sea-Surface Temperature Inputs

High-resolution, sea-surface temperature (SST) inputs aid in improving meteorological conditions for the over-water portions of the Gulf of Mexico OCS region. The Fleet Numerical Meteorology and Oceanography Center (FNMOC) dataset, available from the Global Ocean Data Assimilation Experiment (GODAE) archives, was selected after extensive testing of several SST databases. The FNMOC high-resolution database is updated every 6 hours using satellite-derived (AVHRR) SST and in-situ SST from ships and buoys with resolutions, ranging from 12 km at the equator to 9 km at the mid-latitudes. The FNMOC SST database was chosen for the lowest SST bias and error in model performance evaluation tests, which used open water observations from the National Data Buoy Center (NDBC) archives.

B.2.3.10 FDDA Data Assimilation

The WRF was created as a forecast tool, but it can also be applied in “hindcast” mode. In forecast mode, the initial conditions for a run might be the most recent analysis (a gridded version of the current state of the atmosphere). In hindcast mode, we know the state of the atmosphere both at the beginning and end of (and during) the WRF run. Using these 6-hourly analyses, an extra error term is introduced into the WRF equations, nudging the WRF atmosphere toward the real atmosphere. This is known as Four Dimensional Data Assimilation (FDDA) or analysis nudging and is applied to every grid cell in the domain. It works best at larger grid spacing scales and for larger domains.

Observational nudging is the process of nudging just the single grid cell toward a single-point observation. The observation could be taken at a traditional meteorological tower or by a weather balloon or other non-traditional sources. Observation nudging works best at finer grid spacing scales and could have been performed on higher resolution domains using the Meteorological Assimilation Data Ingest System (MADIS) observation archive.

The WRF model was run with analysis nudging and no observation nudging. For winds and temperature, analysis nudging coefficients of 5×10^{-4} and 3.0×10^{-4} were used on the 36- and 12-km domains, respectively. For mixing ratio, an analysis nudging coefficient of 1.0×10^{-5} was used for both the 36- and 12-km domains. Analysis nudging of winds was applied both at near the surface and aloft, but nudging for temperature and mixing ratio was not performed in the lower atmosphere (i.e., within the boundary layer).

Significant sensitivity testing was used to evaluate impacts of observational nudging on the 4-km domain. The observational nudging coefficients for winds were tested at values set from 0 to

$1.2x10^{-3}$ with a radius of influence at 50 km. Ramboll Environ concluded that any observational nudging coefficient for winds above zero caused excessive convection in the offshore portions of the Gulf of Mexico, resulting in an extreme overstatement of precipitation. Additionally, humidity nudging was tested at values ranging from 0 to $1.0x10^{-5}$. The lower nudging values also prevented excess moisture in the model, primarily through the summer months. Setting wind, temperature, and moisture coefficients all to zero produced the most accurate precipitation results and are very similar to the nudging used in the USEPA 2011 CONUS WRF dataset (Gilliam and Pleim, 2010).

B.2.3.11 WRF Physics Options

The WRF model contains many different physics options. Model tests for the months of January and July 2012 were performed to evaluate various cumulus parameterizations, times between radiation physics calls, and land surface models to achieve the best WRF performance in the dataset. **Table B-4** lists the BOEM Gulf of Mexico OCS Region WRF physics options.

Table B-4. BOEM Gulf of Mexico OCS Region WRF Physics Options.

Option	Scheme	Notes
Microphysics	Thompson	State-of-the-art microphysics model
Longwave Radiation	RRTMG	Rapid Radiative Transfer Model for GCMs includes random cloud overlap and improved efficiency over RRTM.
Shortwave Radiation	RRTMG	Same as above, but for shortwave radiation.
Land Surface Model (LSM)	Noah	Four-layer scheme with vegetation and sub-grid tiling.
Planetary Boundary Layer (PBL) scheme	YSU	Yonsie University (Korea) Asymmetric Convective Model with non-local upward mixing and local downward mixing.
Cumulus Parameterization	Kain-Fritsch in the 36-km and 12-km domains.	Deep and shallow convection sub-grid scheme using a mass flux approach with downdrafts and CAPE removal time scale.
Analysis Nudging	Nudging applied to winds, temperature and moisture in the 36-km and 12-km domains.	Temperature and moisture nudged above PBL only.
Observation Nudging	No nudging applied	Surface wind and moisture observational nudging can induce excessive convection, leading to increased rainfall.
Surface Layer	Revised MM5 Monin-Obukhov scheme	In conjunction with YSU PBL scheme.

B.2.3.12 WRF Application Methodology

The WRF model was executed in 5-day blocks initialized at 12Z every 5 days for calendar year 2012. Model results are output every 60 minutes and output files are split at 12-hour intervals. Twelve (12) hours of spin-up were included in each 5-day block before the data were used in the subsequent evaluation.

B.3 WRF MODEL PERFORMANCE EVALUATION RESULTS

A quantitative and qualitative evaluation of the BOEM Gulf of Mexico OCS Region WRF simulation was conducted. The quantitative evaluation compared integrated surface hourly meteorological observations and offshore buoy observations with WRF predictions matched by time and location. The qualitative evaluation compared twice daily vertical profiles with upper-air data with WRF predictions matched by time and location and wind roses of coastal sites. Additionally, monthly and daily total spatial precipitation fields based on observations and satellite were compared with the WRF gridded monthly and daily total precipitation fields. Below, we summarize the main features of the WRF simulation model performance evaluation.

B.3.1 Quantitative Evaluation Using Metstat

A quantitative model performance evaluation of the BOEM Gulf of Mexico OCS Region WRF simulation was performed using integrated hourly surface and on-site meteorological measurements and the publicly available METSTAT software (Ramboll Environ, 2015) evaluation tool. METSTAT calculates statistical performance metrics for bias, error and correlation for surface winds, temperature, and mixing ratio (i.e., water vapor or humidity). To evaluate the performance of a meteorological model simulation for air quality model applications, a number of performance benchmarks for comparison are typically used. **Table B-5** lists the meteorological model performance benchmarks for simple (Emery et al., 2001) and complex (Kemball-Cook et al., 2005) situations. The simple benchmarks were developed by analyzing well-performing meteorological model evaluation results for simple, mostly flat terrain conditions and simple meteorological conditions (e.g., stationary high pressure) that were mostly conducted to support air quality modeling studies (e.g., ozone SIP modeling). The complex benchmarks were developed during the Western Regional Air Partnership (WRAP) regional haze modeling and are performance benchmarks for more complex conditions, such as the complex terrain of the Rocky Mountains and Alaska (Kemball-Cook et al., 2005). McNally (2009) analyzed multiple annual runs that included complex terrain conditions and suggested an alternative set of benchmarks for temperature under more complex conditions. The purpose of the benchmarks is to understand how good or poor the results are relative to other model applications run for the U.S.

In this section, Ramboll Environ compare the WRF meteorological variables to the benchmarks as an indication of the BOEM Gulf of Mexico OCS Region WRF model performance. These benchmarks include bias and error in temperature, wind direction, and mixing ratio, as well as the wind speed bias and Root Mean Squared Error (RMSE) between the models and databases.

Table B-5. Meteorological Model Performance Benchmarks for Simple and Complex Conditions.

Parameter	Emery et al. (2001)	Kemball-Cook et al. (2005)	McNally (2009)
Conditions	Simple	Complex	Both
Temperature Bias	≤ ±0.5 K	≤ ±2.0 K	≤ ±1.0 K
Temperature Error	≤ 2.0 K	≤ 3.5 K	≤ 3.0 K
Temperature IOA	≥ 0.8	(not addressed)	(not addressed)
Humidity Bias	≤ ±1.0 g/kg	≤ ±0.8 g/kg	≤ ±1.0 g/kg

Parameter	Emery et al. (2001)	Kemball-Cook et al. (2005)	McNally (2009)
Humidity Error	≤ 2.0 g/kg	≤ 2.0 g/kg	≤ 2.0 g/kg
Humidity IOA	≥ 0.6	(not addressed)	(not addressed)
Wind Speed Bias	≤ ±0.5 m/s	≤ ±1.5 m/s	(not addressed)
Wind Speed RMSE	≤ 2.0 m/s	≤ 2.5 m/s	(not addressed)
Wind Speed IOA	≥ 0.6	(not addressed)	(not addressed)
Wind Dir. Bias	≤ ±10 degrees	(not addressed)	(not addressed)
Wind Dir. Error	≤ 30 degrees	≤ 55 degrees	(not addressed)

The output from the BOEM Gulf of Mexico OCS Region WRF simulation was compared against the NCDC's global-scale, quality-controlled DS3505 integrated surface hourly observational (ISHO) data (USDOC, NOAA, NCDC, 2015) and the NDBC's buoy database (USDOC, NOAA, NDBC, 2015) as verification data. Global hourly and synoptic observations are compiled from numerous sources into a single common ASCII format and common data model. The DS3505 database contains records of most official surface meteorological stations from airports, military bases, reservoirs/dams, agricultural sites, and other sources dating from 1901 to the present, and quality control has corrected well over 99% of the errors present in the original data. The NDBC database contains records of moored buoys, coastal-marine automated network stations, and other sources dating from 1970 to the present.

B.3.1.1 Quantitative Statistics

Several statistical measures are calculated as part of the meteorological model evaluation. Additional plots and graphs are used to present these statistics on both hourly and daily timeframes. These measures are calculated for wind speed, wind direction, temperature, and humidity at the surface. The various statistical measures used for this evaluation are described below.

The statistics used to evaluate meteorological model performance are all given in absolute terms (e.g., wind speed error in meters per second [m/s]) rather than in relative terms (percent error) as is commonly shown for air quality assessments. The major reason for this is that a very different significance is associated with a given relative error for different meteorological parameters. For example, a 10 percent error for wind speed measured at 10 m/s is an absolute error of 1 m/s, a minor error. Yet a 10 percent error for temperature at 300 K is an absolute error of 30 K, an unacceptably large error. On the other hand, pollutant concentration errors of 10 percent at 1 ppb or 10 ppm carry practically the same significance.

Statistical Measures

Mean Observation (M_o): Calculated from all sites with valid data within a given analysis region and for a given time period (hourly or daily):

$$M_o = \frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I} O_j^i$$

where O^i_j is the individual observed quantity at site *i* and time *j*, and the summations are over all sites (I) and over time periods (*J*).

Mean Prediction (M_p): Calculated from simulation results that are interpolated to each observation used to calculate the mean observation (hourly or daily):

$$M_p = \frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I} P_j^i$$

where P^i_j is the individual predicted quantity at site *i* and time *j*. Note that mean observed and predicted winds are vector-averaged (for east-west component u and north-south component v), from which the mean wind speed and mean resultant direction are derived.

Least Square Regression: Performed to fit the prediction set to a linear model that describes the observation set for all sites with valid data within a given analysis region and for a given time period (daily or episode). The y-intercept a and slope b of the resulting straight line fit is calculated to describe the regressed prediction for each observation:

$$P_j^i = a + bO_j^i$$

The goal is for a 1:1 slope and a "0" y-intercept (no net bias over the entire range of observations), and a regression coefficient of 1 (a perfect regression). The slope and intercept facilitate the calculation of several error and skill statistics described below.

Bias Error (B): Calculated as the mean difference in prediction-observation pairings with valid data within a given analysis region and for a given time period (hourly or daily):

$$B = \frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I}\left(P_j^i - O_j^i\right)$$

Gross Error (E): Calculated as the mean absolute difference in prediction-observation pairings with valid data within a given analysis region and for a given time period (hourly or daily):

$$E = \frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I}\left|P_j^i - O_j^i\right|$$

Note that the bias and gross error for winds are calculated from the predicted-observed residuals in speed and direction (not from vector components u and v). The direction error for a given prediction-observation pairing is limited to range from 0 to 180.

Root Mean Square Error (RMSE): Calculated as the square root of the mean squared difference in prediction-observation pairings with valid data within a given analysis region and for a given time period (hourly or daily):

$$RMSE = \left[\frac{1}{IJ} \sum_{j=1}^{J} \sum_{i=1}^{I} \left(P_j^i - O_j^i \right)^2 \right]^{1/2}$$

The RMSE, as with the gross error, is a good overall measure of model performance. However, since large errors are weighted heavily (due to squaring), large errors in a small sub-region may produce a large RMSE even though the errors may be small and quite acceptable elsewhere.

It is important that RMSE is analyzed. For example, if only RMSE is estimated (and it appears acceptable), it could consist largely of the systemat¬ic component. This error might be removed through improvements in the model inputs or use of more appropriate options, thereby reducing the error transferred to the photochemical model. On the other hand, if the RMSE consists largely of the unsystematic component, this indicates that further error reduction may require model refinement (new algorithms, higher resolution grids, etc.) or that the phenomena to be replicated cannot be fully addressed by the model. It also provides error bars that may be used with the inputs in subsequent sensitivity analyses.

B.3.1.2 METSTAT Evaluation Using Integrated Surface Hourly Observations and Offshore Buoy Observations

The METSTAT results for 2012 are presented in **Figures B-5 through B-16**. The WRF wind direction performed very well, with the majority of months falling within the simple conditions threshold for all spatial domains (36, 12, and 4 km). For all domains, WRF wind speed, temperature, and humidity also performed very well. For most months, there are slight positive biases in wind speed and humidity in all three spatial domains. Overall, the WRF model performed exceptionally well in the 36- and 12-km domains and well in the 4-km domain for onshore surface wind direction, wind speed, humidity and temperature observation comparisons.

METSTAT was also used to evaluate WRF performance in the innermost 4-km domain using observations from meteorological buoys throughout the Gulf of Mexico for 2012. Overall, WRF wind direction performed well with over half of all months falling with the simple conditions benchmark. Wind speed performance was acceptable with all months falling within the complex conditions benchmark. Temperature bias and error is slightly higher (warmer) in the winter months compared to the summer months, suggesting that the model is over-forecasting surface temperatures, or is an influence from the SST database input to WRF. Humidity performed well with a majority of months, falling within the simple conditions benchmark. In general, the offshore METSTAT evaluation is very similar to the onshore evaluation, suggesting consistent performance over both the land and sea portions of the Gulf of Mexico OCS region.

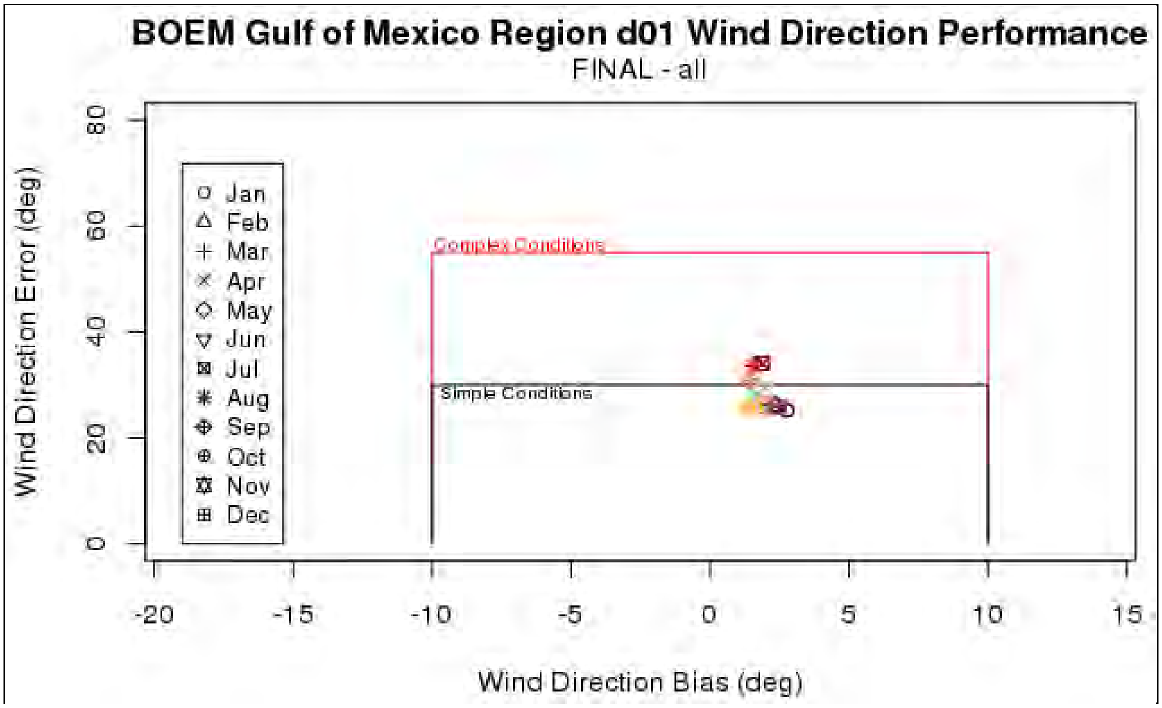


Figure B-5. BOEM Gulf of Mexico OCS Region WRF 36-km METSTAT Wind Direction Performance for 2012.

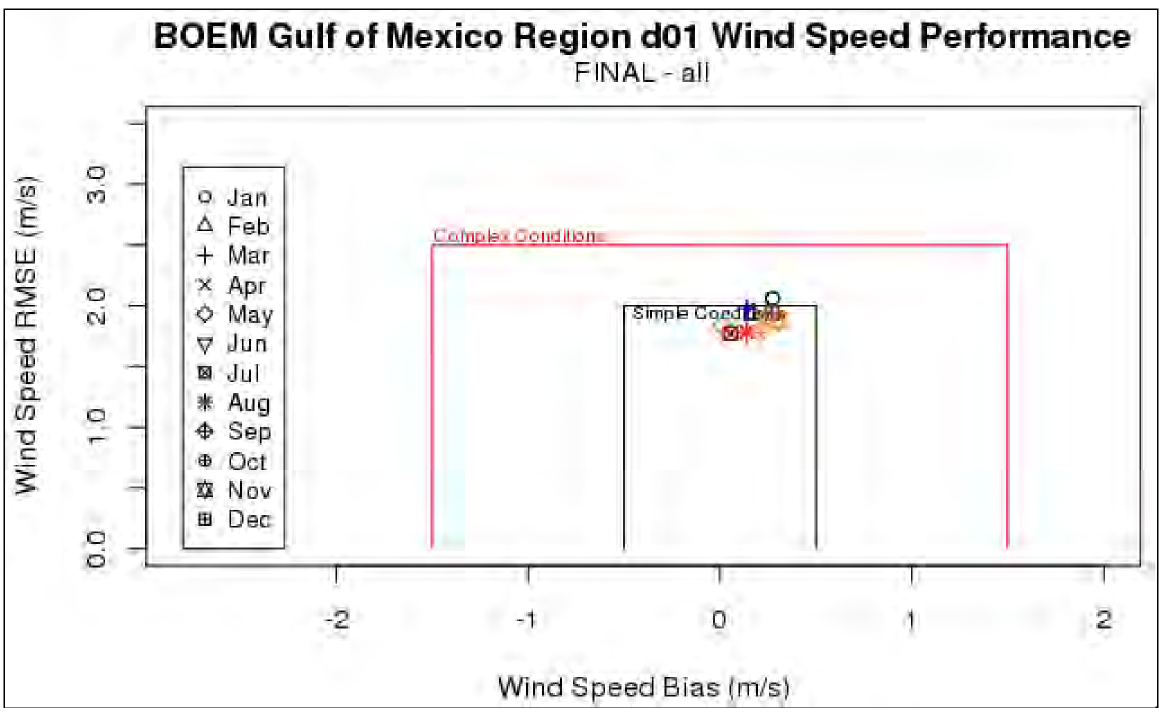


Figure B-6. BOEM Gulf of Mexico OCS Region WRF 36-km METSTAT Wind Speed Performance for 2012.

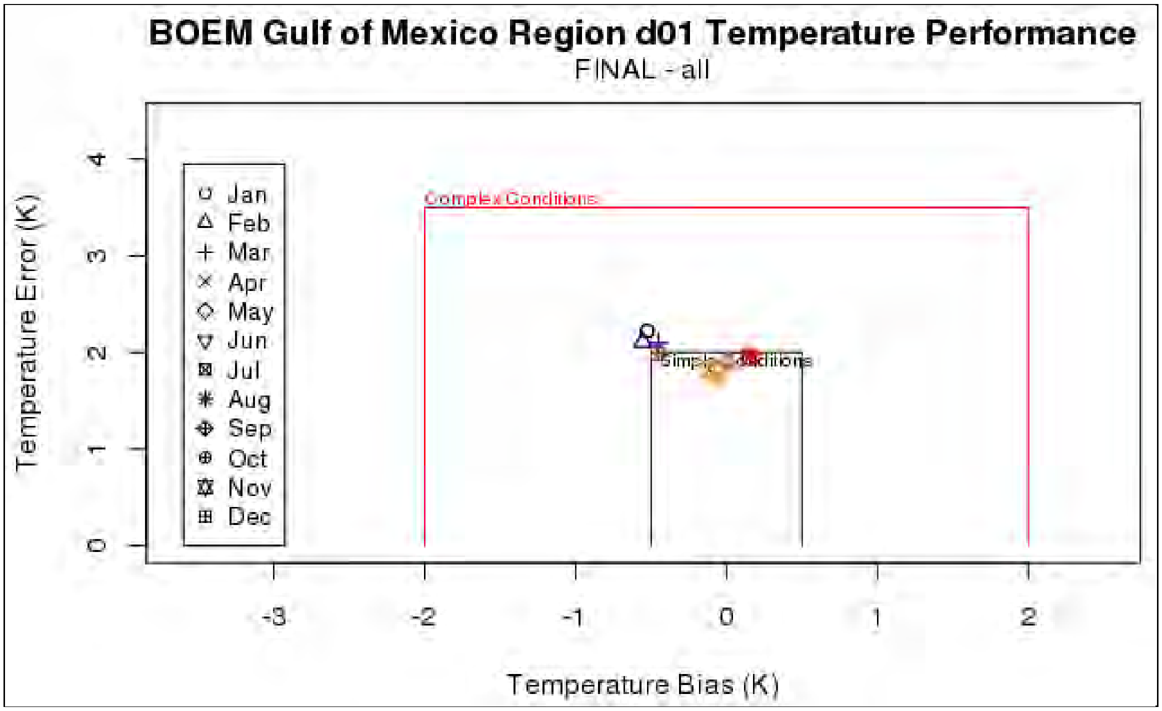


Figure B-7. BOEM Gulfof Mexico OCS Region WRF 36-km METSTAT Temperature Performance for 2012.

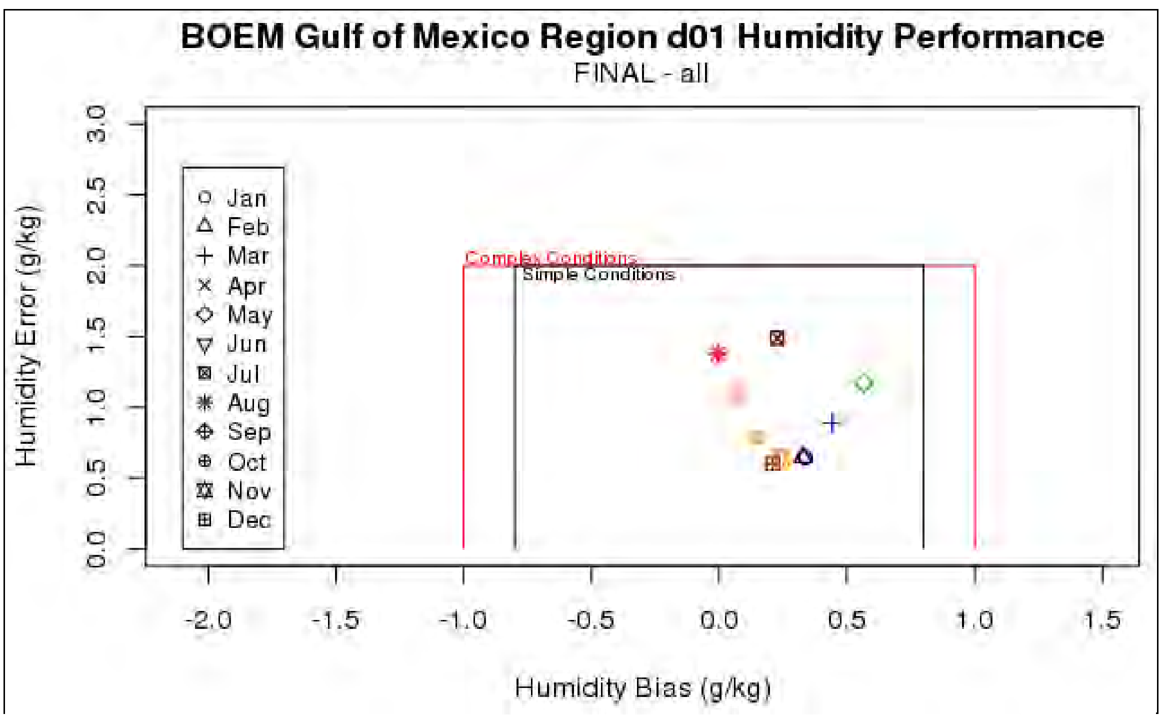


Figure B-8. BOEM Gulf of Mexico OCS Region WRF 36-km METSTAT Humidity Performance for 2012.

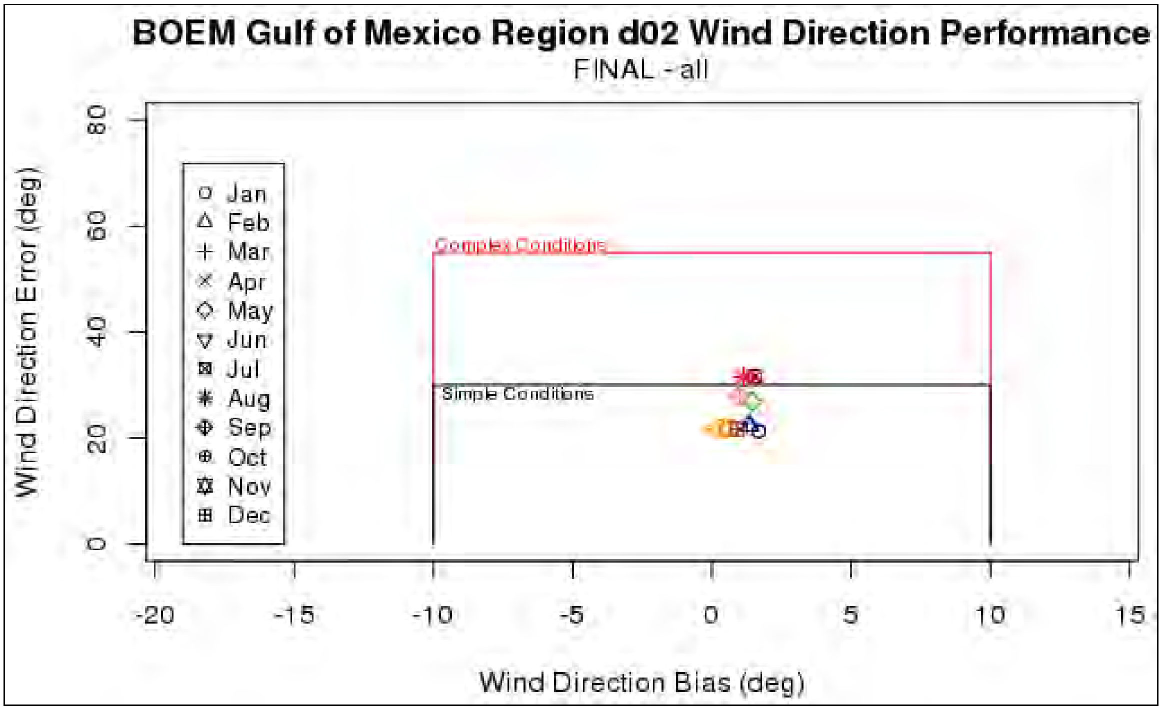


Figure B-9. BOEM Gulf of Mexico OCS Region WRF 12-km METSTAT Wind Direction Performance for 2012.

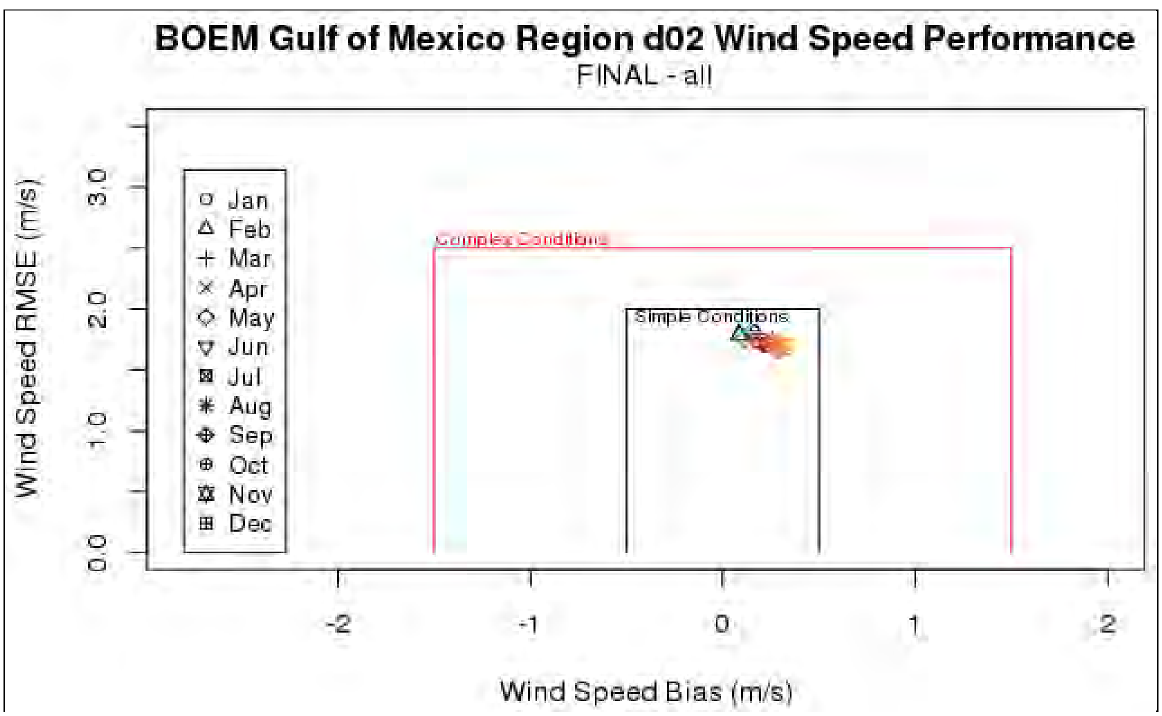


Figure B-10. BOEM Gulf of Mexico OCS Region WRF 12-km METSTAT Wind Speed Performance for 2012.

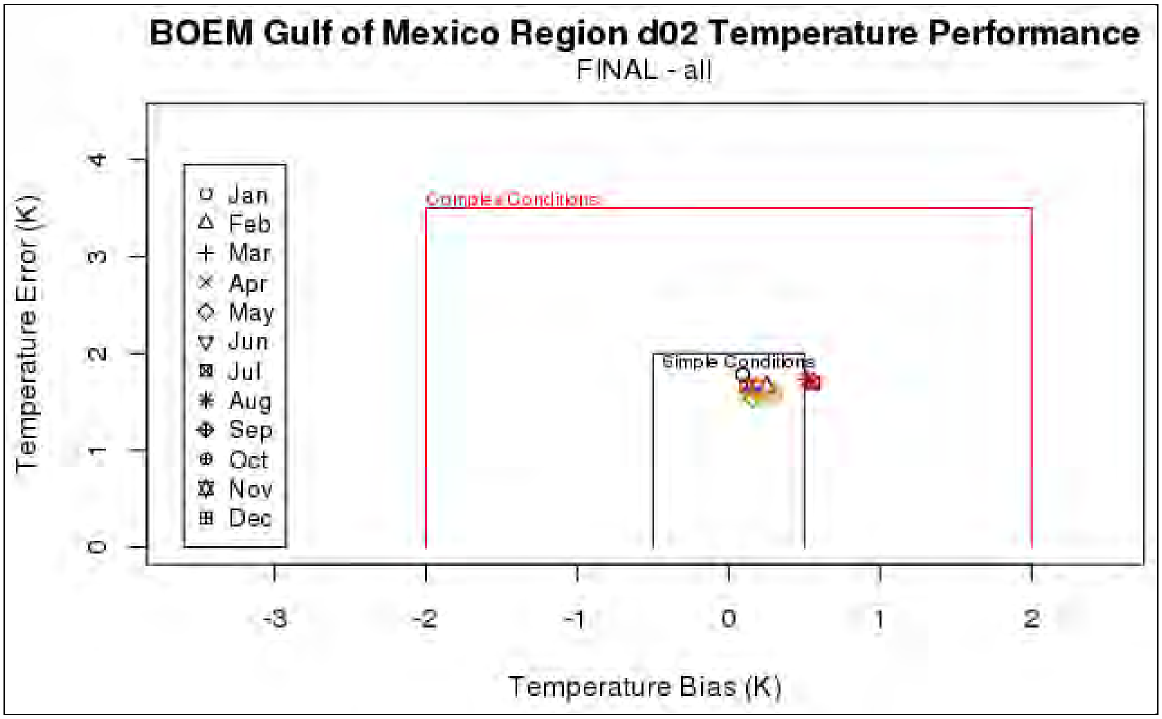


Figure B-11. BOEM Gulf of Mexico OCS Region WRF 12-km METSTAT Temperature Performance for 2012.

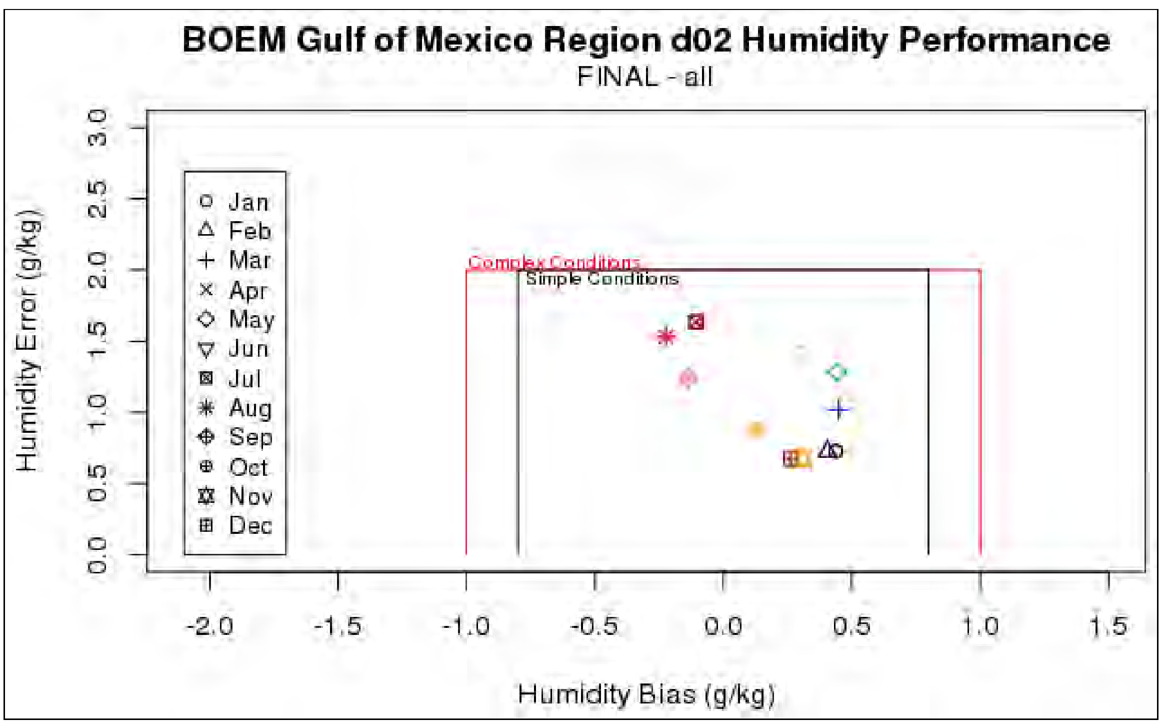


Figure B-12. BOEM Gulf of Mexico OCS Region WRF 12-km METSTAT Humidity Performance for 2012.

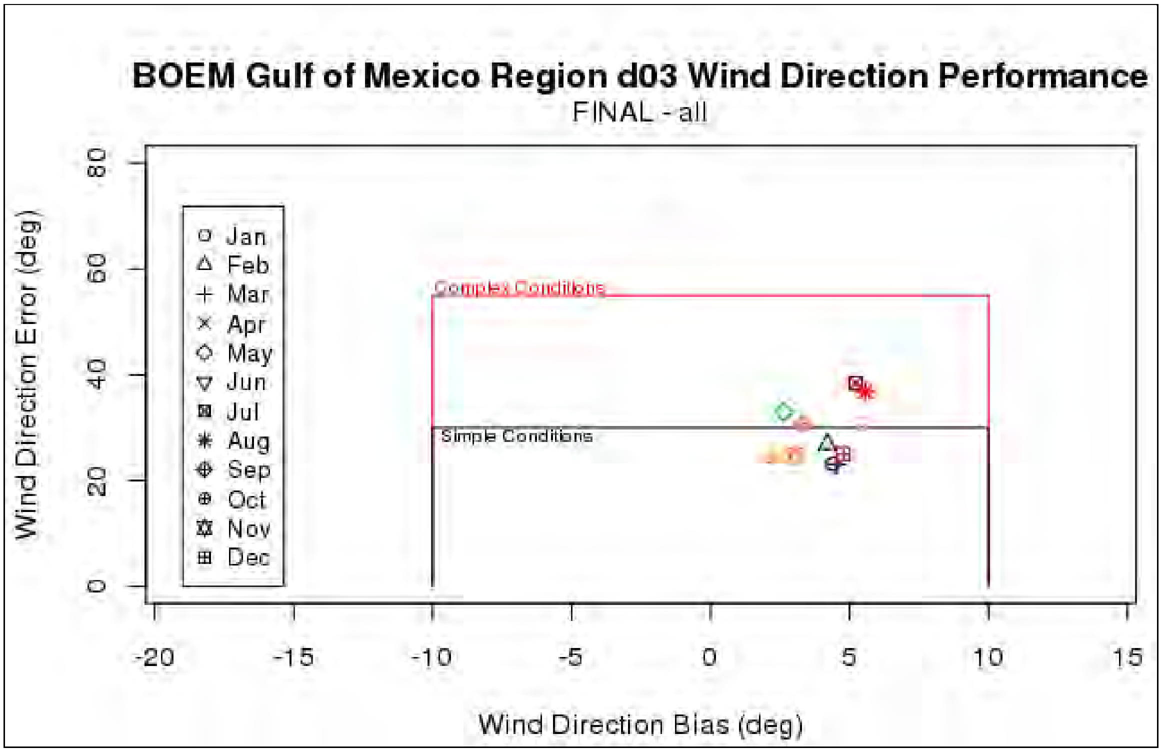


Figure B-13. BOEM Gulf of Mexico OCS Region WRF 4-km METSTAT Wind Direction Performance for 2012.

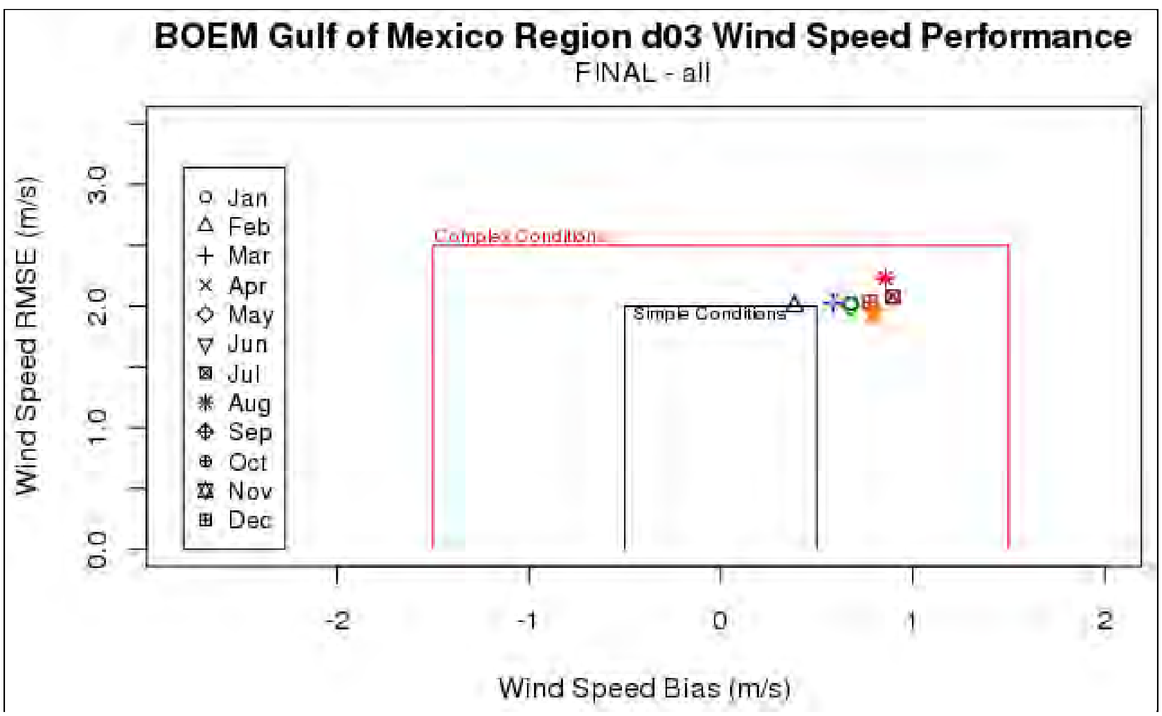


Figure B-14. BOEM Gulf of Mexico OCS Region WRF 4-km METSTAT Wind Speed Performance for 2012.

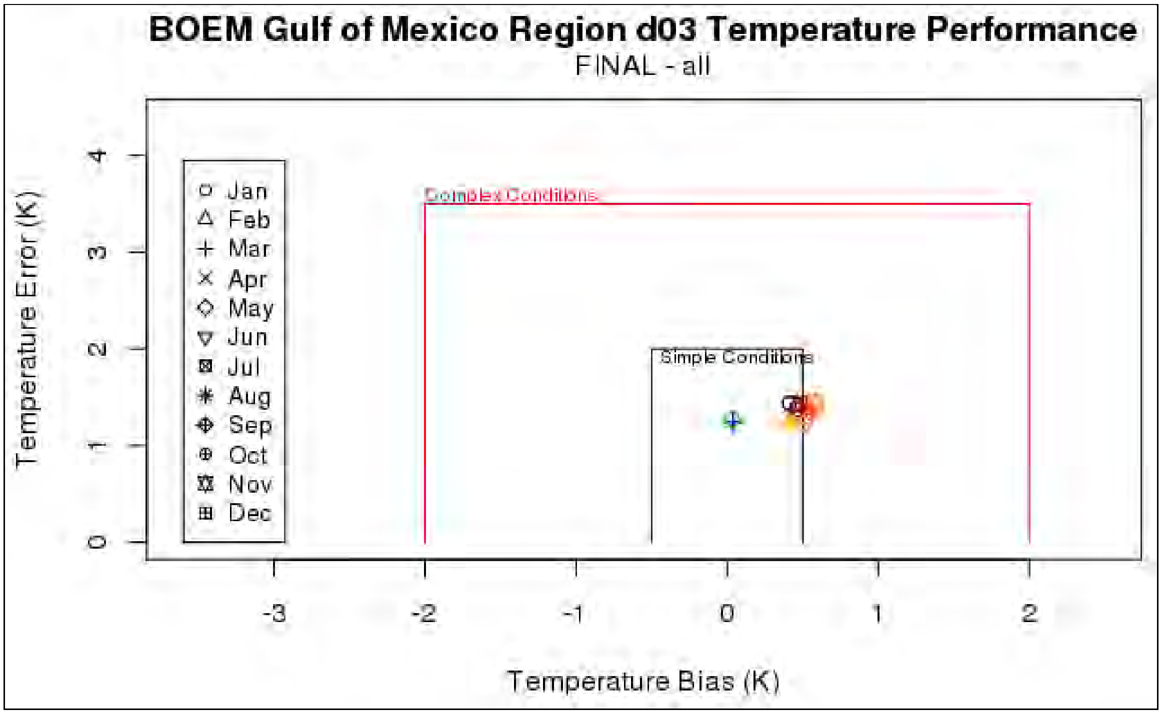


Figure B-15. BOEM Gulf of Mexico OCS Region WRF 4-km METSTAT Temperature Performance for 2012.

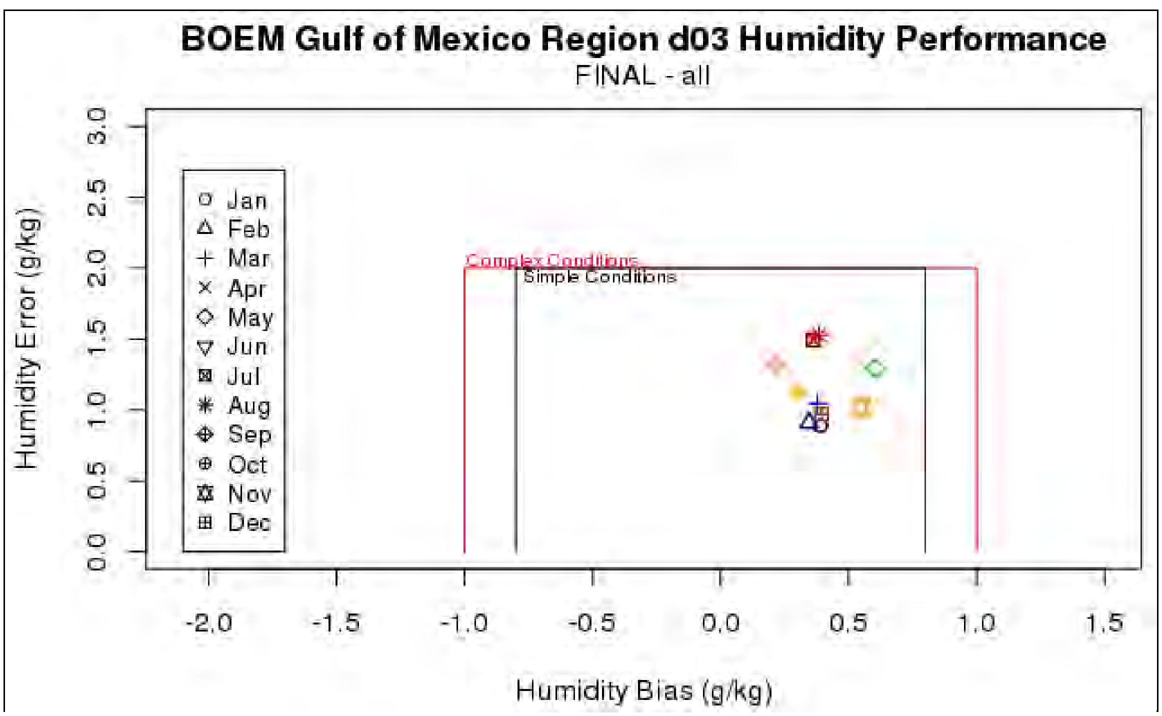


Figure B-16. BOEM Gulf of Mexico OCS Region WRF 4-km METSTAT Humidity Performance for 2012.

B.3.2 Qualitative Evaluation Using Wind Roses

The coastal sites of Gulfport, MS (KGPT); Naples, FL (NPSF); Port Isabel, TX (PTIT); and Calcasieu, LA (CAPL) were chosen to evaluate the frequency and intensity of onshore and offshore wind flow and WRF's performance at the land-sea interface. The locations of these sites are shown in **Figure B-17**. The 5-year comparisons of observed and modeled wind direction at each coastal site will be provided in the full WRF modeling report. Below, in **Figures B-17 through B-21**, the comparisons are made for only 2012. Wind direction observations were obtained from the DS3505 meteorological dataset, and modeled surface wind speed and wind direction were extracted from the 4-km WRF domain dataset using the Mesoscale Model Interface (MMIF) program (Brashers and Emery, 2015). Overall, WRF performs just satisfactorily at forecasting the frequency and intensity of onshore and offshore wind flow at the coastal sites. The WRF simulates the predominant NE wind direction at NPSF, as well as the strong SE winds at port PTIT and CAPL. However, WRF wind direction does not compare particularly well to KGPT in 2012 and does not replicate much of the NW wind at PTIT, or the SW wind at NPSF. The decline in apparent wind direction performance for 2012, compared to the 5-year analysis, is largely due to the shorter evaluation period.

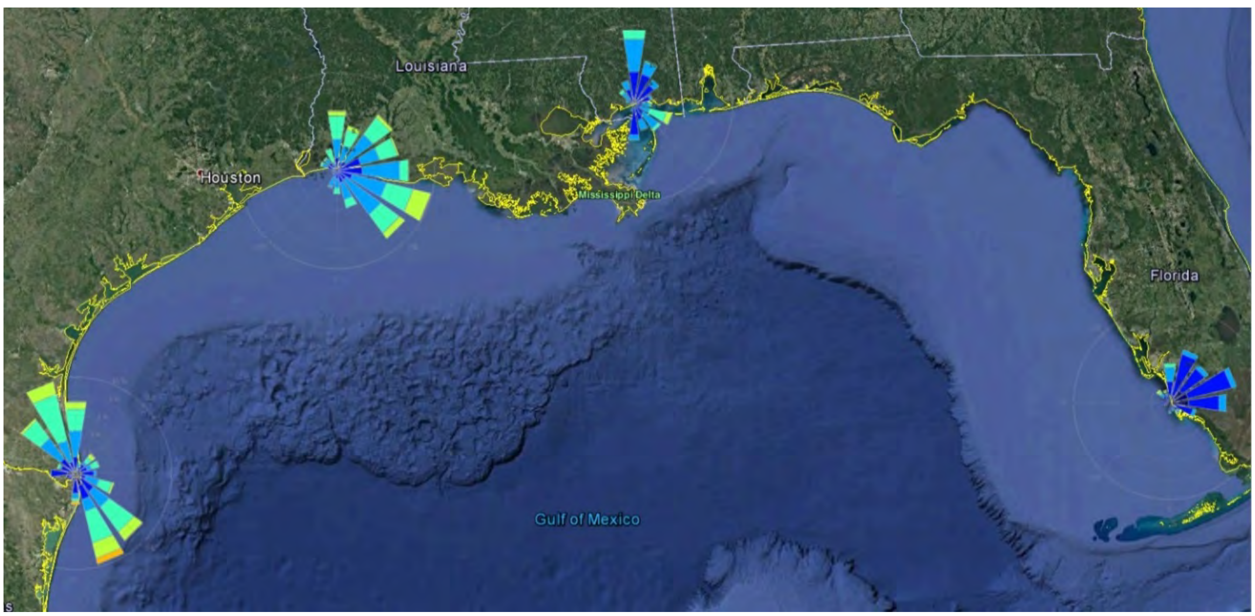


Figure B-17. Wind Rose Locations for Port Isabel, TX (PTIT), Calcasieu, LA (CAPL), Gulfport, MS (KGPT), and Naples, FL (NPSF).

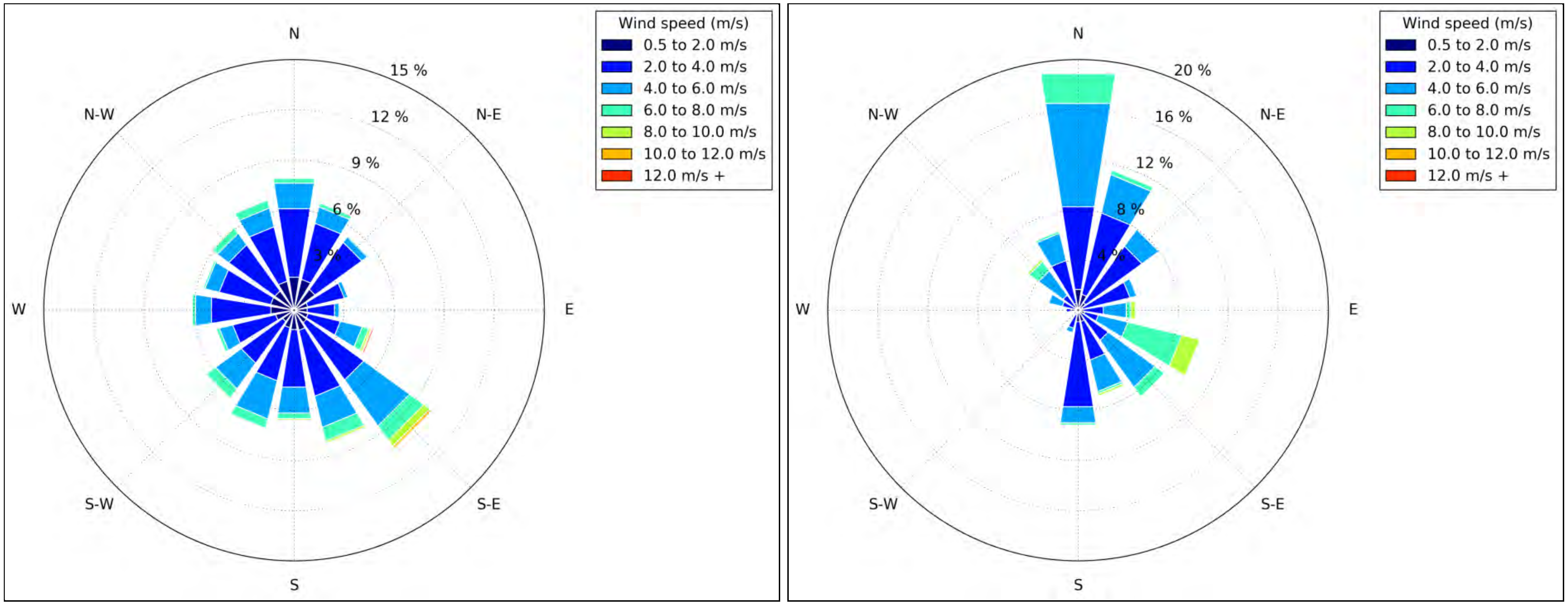


Figure B-18. 2012 WRF Wind Rose (left) Compared to 2012 Observation Wind Rose from Gulfport, MS (right) in 4-km Domain.

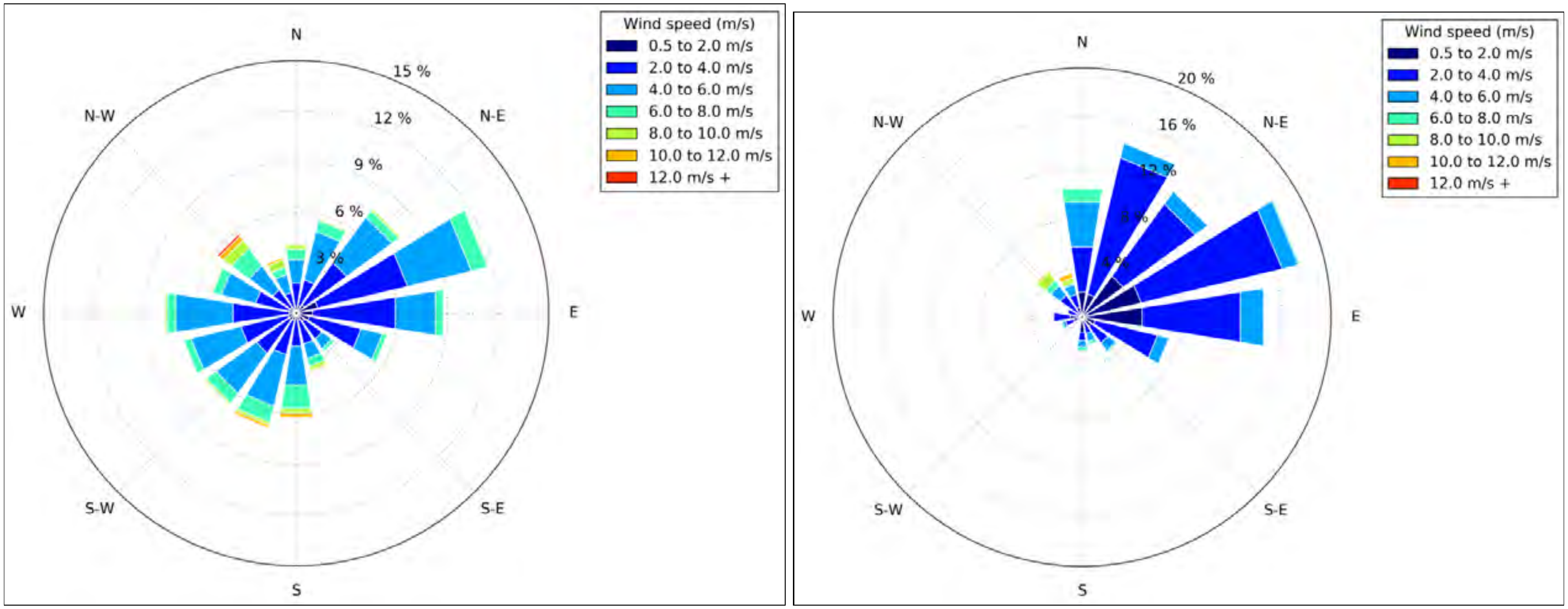


Figure B-19. 2012 WRF Wind Rose (left) Compared to 2012 Observation Wind Rose from Naples, FL (right) in 4-km Domain.

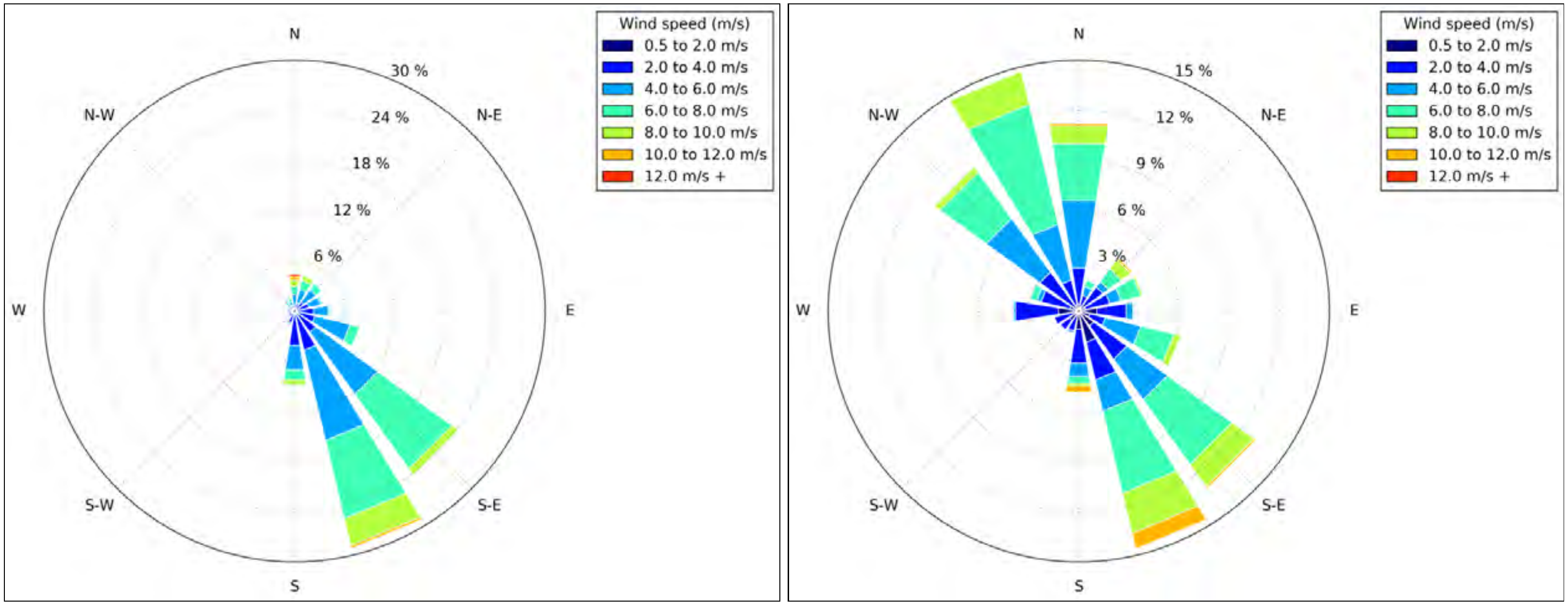


Figure B-20. 2012 WRF Wind Rose (left) Compared to 2012 Observation Wind Rose from Port Isabel, TX (right) in 4-km Domain.

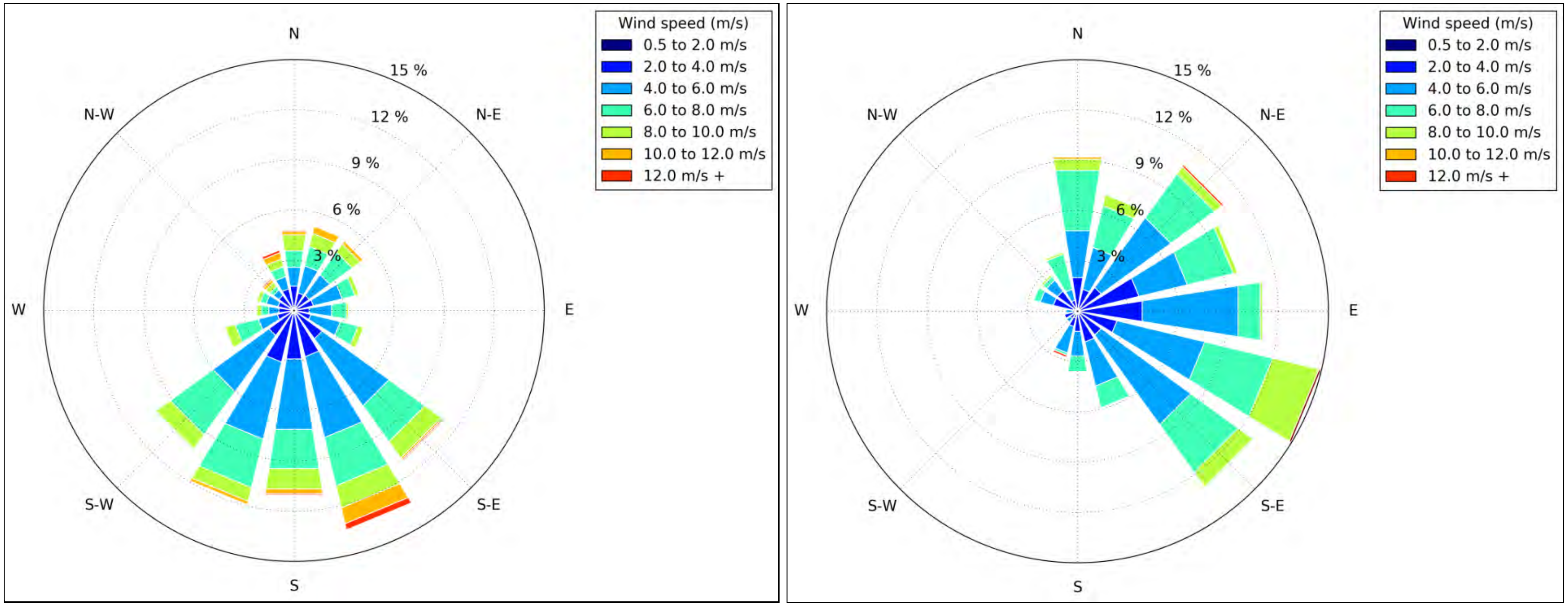


Figure B-21. 2012 WRF Wind Rose (left) Compared to 2012 Observation Wind Rose from Calcasieu, LA (right) in 4-km Domain.

B.3.3 Qualitative Evaluation Using Upper-Air Data

Plots of the sounding profiles of temperature and dew point for the vertical atmosphere were created using observational data from the Brownsville, TX (KBRO) and Key West, FL (KEYW) airports and the corresponding WRF data points. A random selection of upper air profiles was taken from the year-long dataset for a sampling of several different atmospheric situations. These are qualitatively compared, paying particular attention to how well the WRF model reproduces the observed near-surface inversion layers.

The KBRO and KEYW radiosonde datasets are collected by and maintained by the National Weather Service (NWS). Radiosondes are launched twice per day, at approximately 00 and 12 UTC. Radiosondes provide high-resolution vertical profiles of temperature, humidity, wind speed, and wind direction throughout the troposphere. The data are made publicly available by NOAA's Earth System Research Laboratory (USDOC, NOAA, ESRL, 2015). Ramboll Environ downloaded and stored the radiosonde data twice daily for 2012 for each upper air station in FSL format for use in WRF model dataset comparisons.

For the qualitative analysis, **Figure B-22** shows the vertical profiles of temperature and humidity from the observational and 4 km WRF datasets for Brownsville, TX and Key West, FL. The analysis focuses on how well the WRF model reproduces the vertical atmosphere structure using upper air observations from the selected sites within the 4-km domain, which have timeframes that overlap with the WRF model. The left panel in **Figure B-22** shows an evening sounding in August for Brownville, TX, which contains a weak elevated subsidence inversion. The WRF forecasts the base of the inversion well at around 900 meters. The right panel of **Figure B-22** shows observed and modeled vertical profiles for January in Key West, FL. The WRF forecasts the elevated subsidence inversion well, with a mixing height top at around 1,000 meters on the left panel. The dry air above the inversion is also represented well in the evening sounding at Key West, FL.

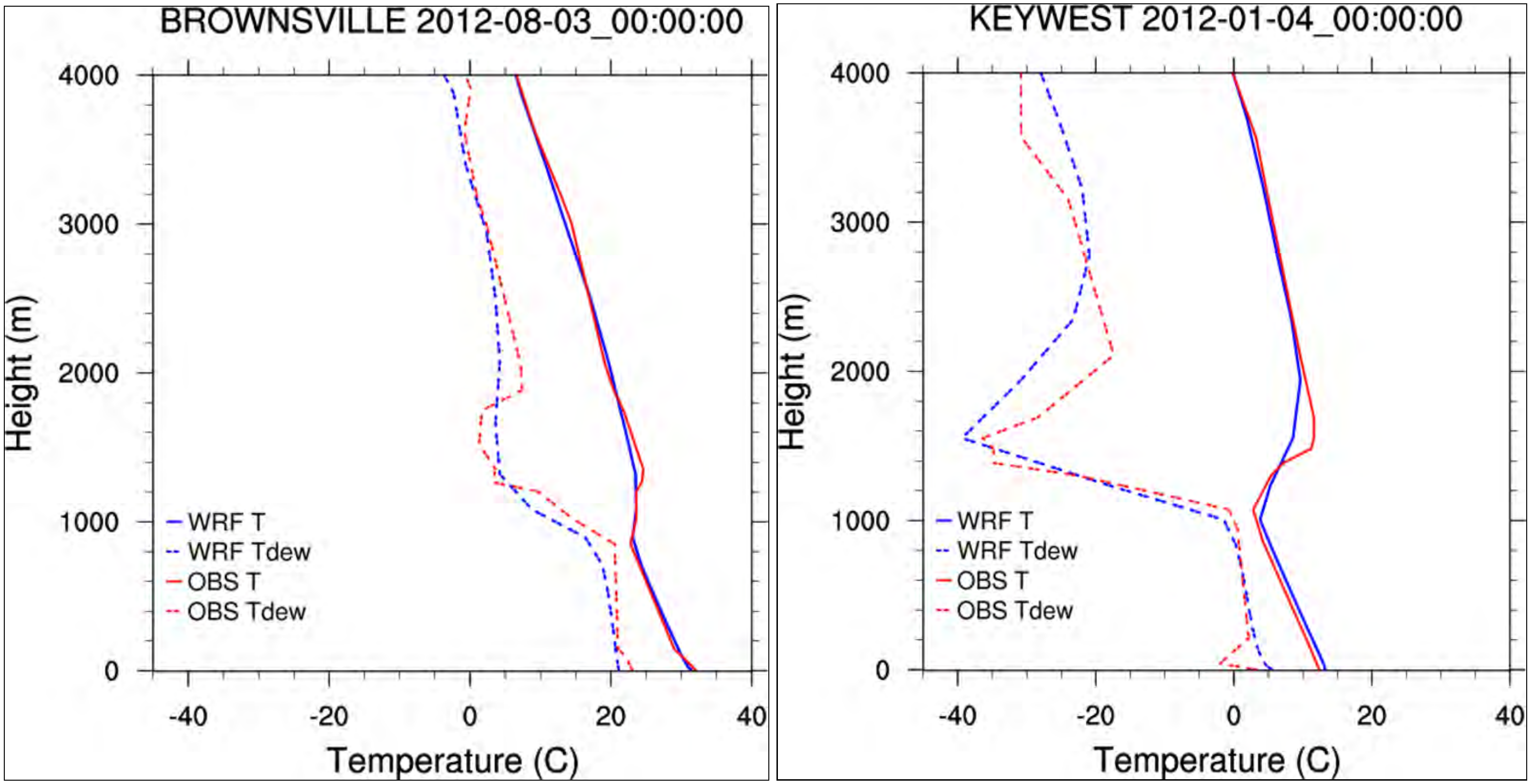


Figure B-22. Vertical Profile Soundings Comparing the 4-km WRF (blue lines) to Upper-Air Observations Data (red lines) for Brownsville, TX on August 3, 2012, and Key West, FL on January 4, 2012, at 00 UTC.

B.3.4 Qualitative Evaluation Using Precipitation

Precipitation removes chemicals and particulates from the air via wet deposition, and thus is an important parameter for high-quality dispersion modeling. Several precipitation datasets were evaluated for use in model comparisons. Ramboll Environ has used the Parameter-elevation Regressions on Independent Slopes Model (PRISM) dataset for rainfall extensively in the past, but it only covers the over-land portion of the modeling domain. Land-based RADAR retrievals of precipitation typically have larger uncertainty and are limited in geographic coverage to the area relatively near the coast and, as a result, were not chosen for this performance evaluation. Satellite-based retrievals are typically lower resolution and also feature larger uncertainty, but cover the entire Gulf of Mexico OCS region. Ramboll Environ performed comparisons between the BOEM Gulf of Mexico OCS Region WRF modeled precipitation output with the PRISM and Tropical Rainfall Measurements Mission (TRMM) satellite datasets.

The Oregon State University PRISM Climate Group gathers temperature and precipitation data from a range of monitoring networks, applies sophisticated quality control methods, and uses the data to produce spatial grids of climate parameters (Daly et al., 2008). The time series datasets are modeled using climatologically-aided interpolation (CAI), which uses the long-term average pattern as first-guess of the spatial pattern of climatic conditions. Both a daily product and a monthly product are available. The precipitation observations used in the daily PRISM product includes radar measurements, which the monthly product does not take into account. This may cause dramatic local differences between the two datasets in monthly totals.

TRMM was a joint mission being flown by the National Aeronautics and Space Administration (NASA, U.S.) and the Japan Aerospace Exploration Agency (JAXA, Japan) to improve our quantitative knowledge of the 3-dimensional distribution of precipitation in the tropics. TRMM had a passive microwave radiometer (TRMM Microwave Imager, TMI), the first active space-borne Precipitation Radar (PR), a Visible-Infrared Scanner (VIRS), and other instruments. Coordinated observations are intended to result in a "flying raingauge" capability. The TRMM dataset is coarser than the PRISM data (0.5 degrees, or about 55 km, vs. 4 km) but is available every 3 hours.

B.3.4.1 Evaluation Over Land Using PRISM Precipitation

High-resolution (4 km) PRISM datasets cover the contiguous U.S. in both monthly and daily output versions (Daly et al., 2008). Here WRF precipitation output is compared to the PRISM over-land portions of the Gulf of Mexico. Ramboll Environ re-projected and aggregated the PRISM data to the WRF projection’s grid cell locations, and the resulting gridded data was plotted and the gridded fields saved. This allows for consistent visual qualitative comparison.

The full WRF modeling report will display 5-year average (2010-2014) monthly precipitation plots constructed from BOEM Gulf of Mexico OCS Region WRF output, masked to only display over-land measurements, and compared to PRISM 5-year average (2010-2014) monthly plots for January through December in the 4-km domain. Below, WRF monthly precipitation totals are compared to corresponding PRISM totals for 2012 only. The results are mostly representative of the 5-year monthly averages and are briefly summarized in the following paragraph.

For the months of January through March, shown in **Figures B-23 through B-25**, WRF represents the spatial extent of the precipitation well, recreating the comparatively drier areas of central Texas and southern Florida. However, the model does under-estimate the total amount of average monthly rainfall across a small portion of southern Mississippi and south central Louisiana during this period. In April and May, **Figures B-26 and B-27**, the model shifts to overestimating rainfall in the same region, but otherwise depicts both the spatial distribution and amount of precipitation well over land, compared to PRISM. During the summer months of June through August, shown in **Figures B-28 through B-30**, WRF performs exceptionally well in re-creating the precipitation extent across the land portions of the domain, including the convergence zones across the east and west coasts of Florida. The model does slightly over-predict the amount of rainfall accumulations in the southern Georgia and southern Alabama areas. This is likely due to the higher humidity rates in the model during the summertime period. In September, shown in **Figure B-31**, WRF slightly under-predicts averaged precipitation rates over the land portion of the domain but over-forecasts the extent of rainfall over the northern Florida area. The WRF performed exceptionally well from October through December, shown in **Figures B-32 through B-34**, reproducing the extent and amount of rainfall very accurately, compared to PRISM totals. Overall, WRF performed very well in reproducing the spatial extent of precipitation over the land portions of Gulf of Mexico OCS region throughout 2012.

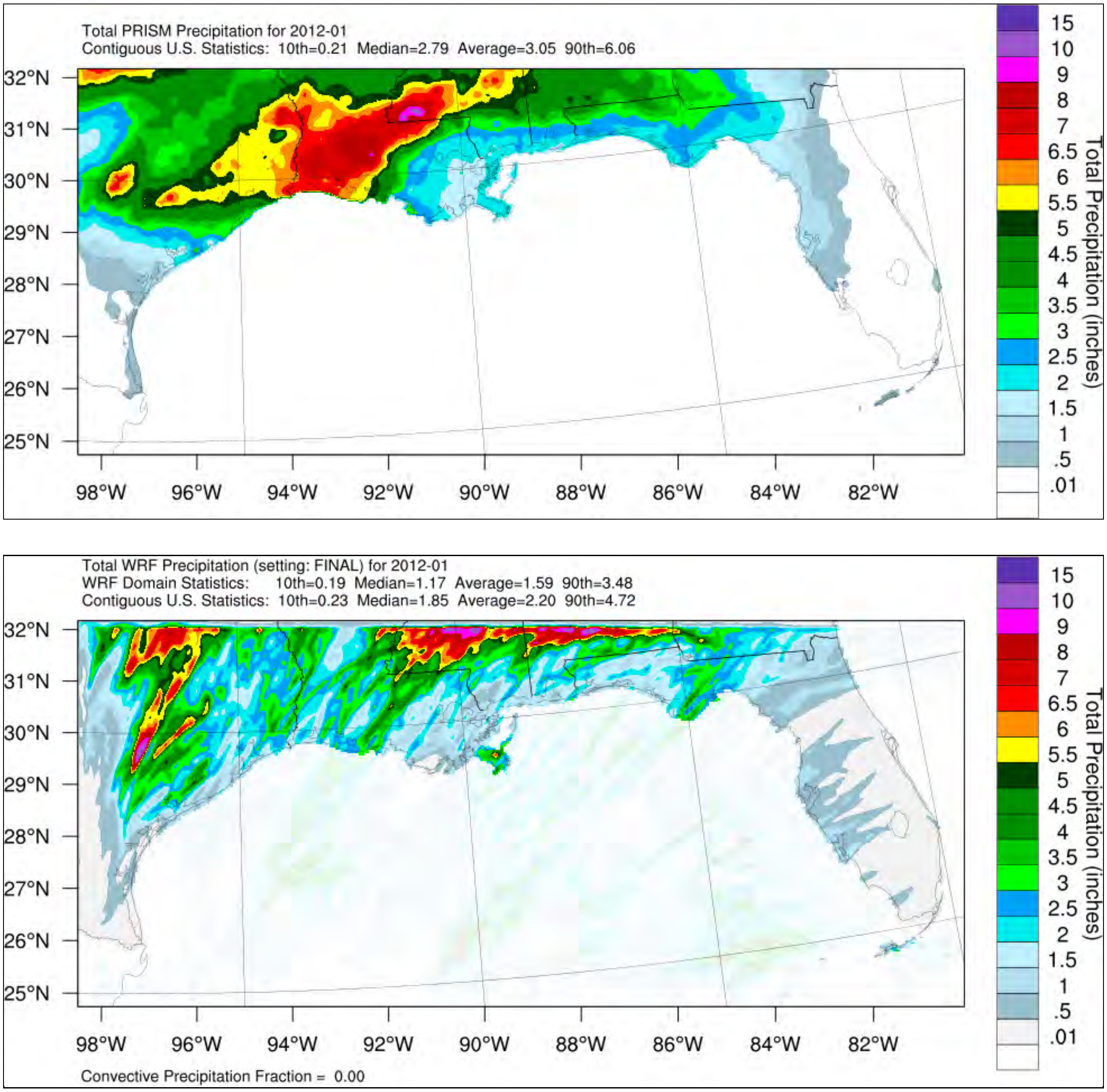


Figure B-23. January 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.

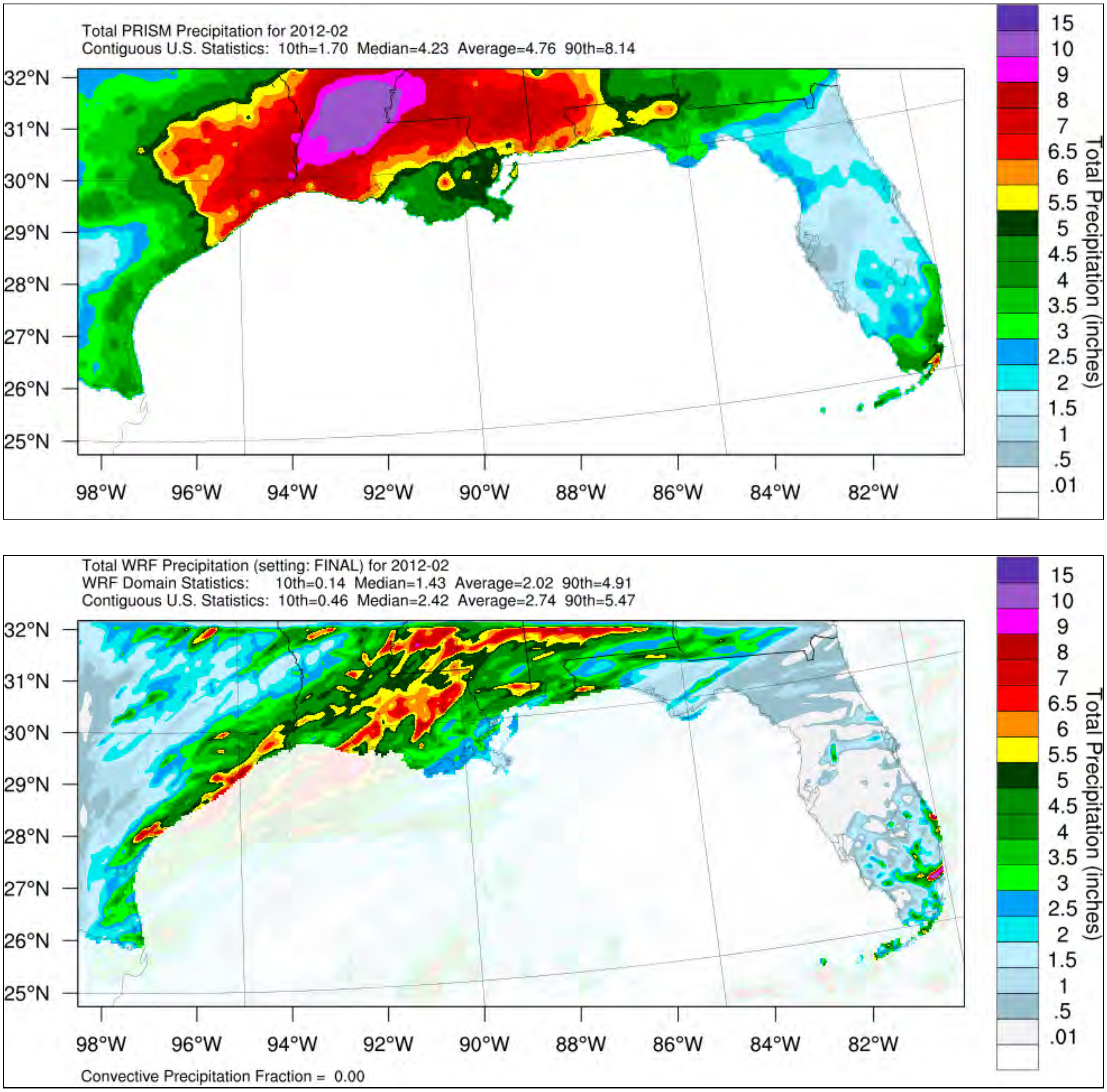


Figure B-24. February 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.

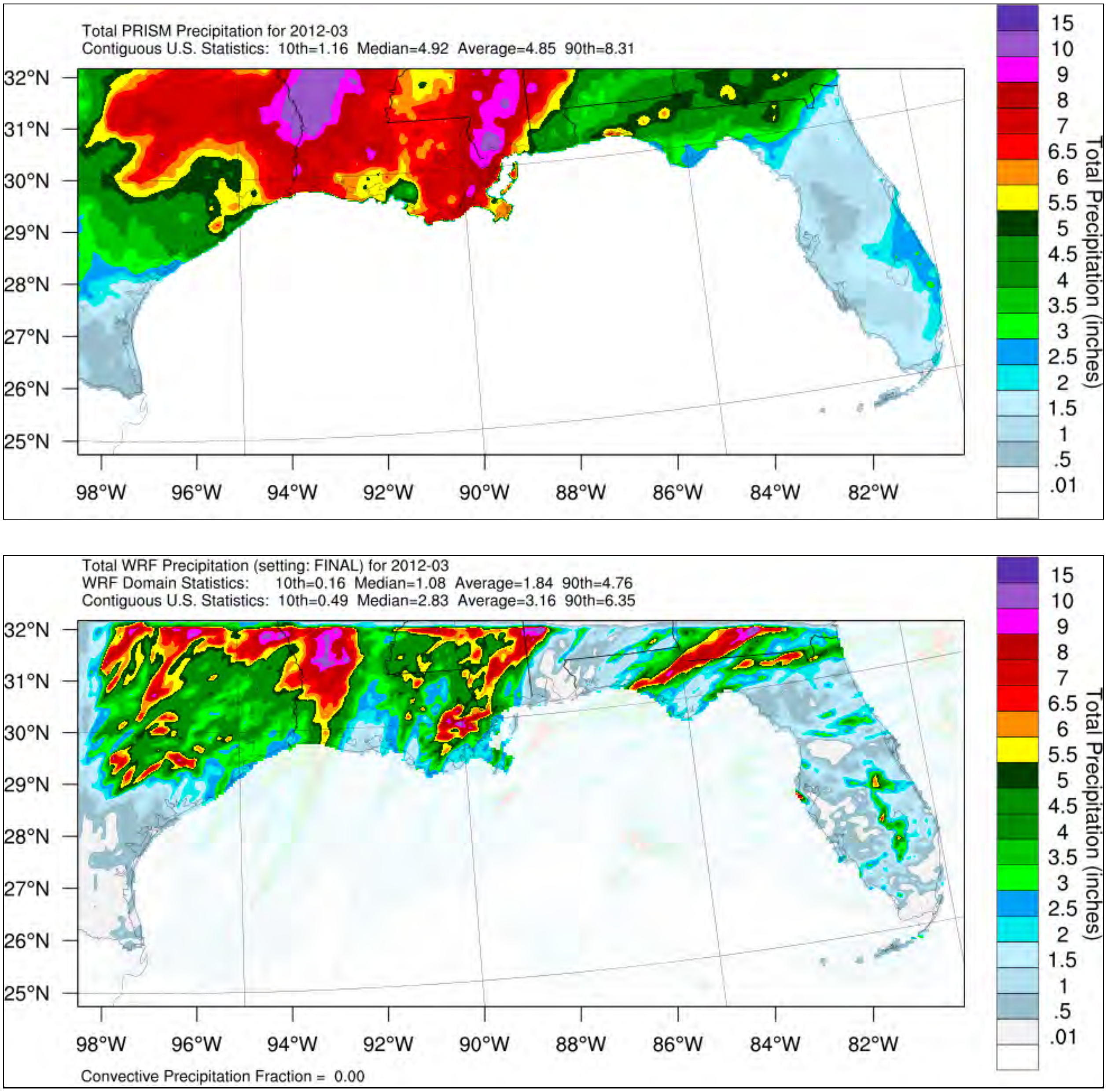
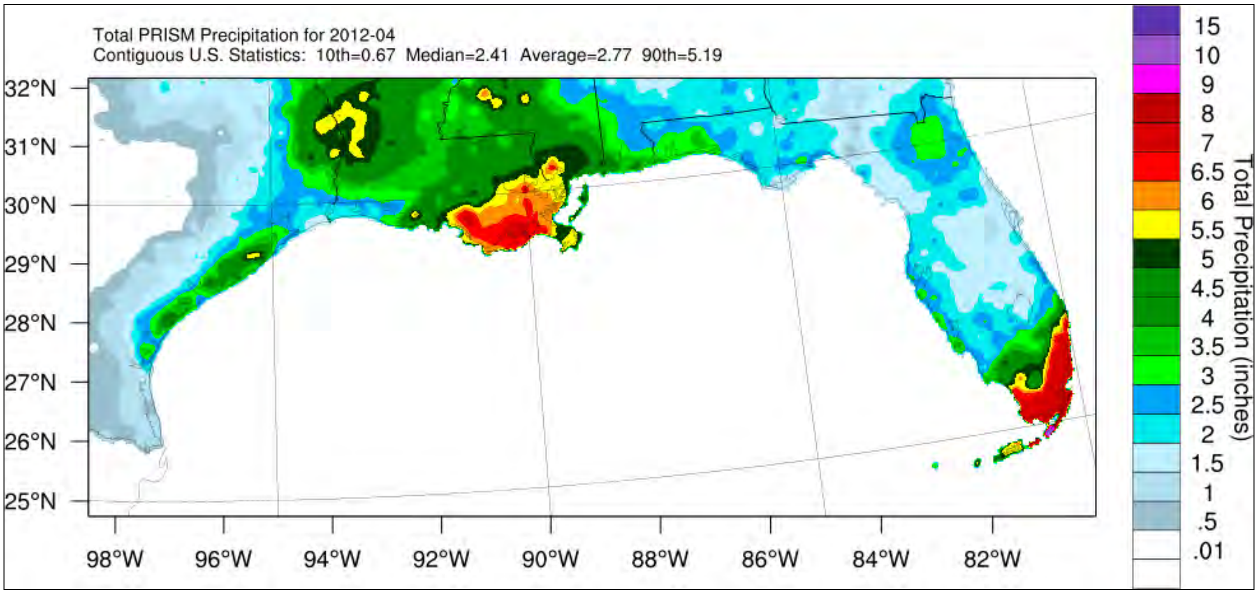


Figure B-25. March 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.



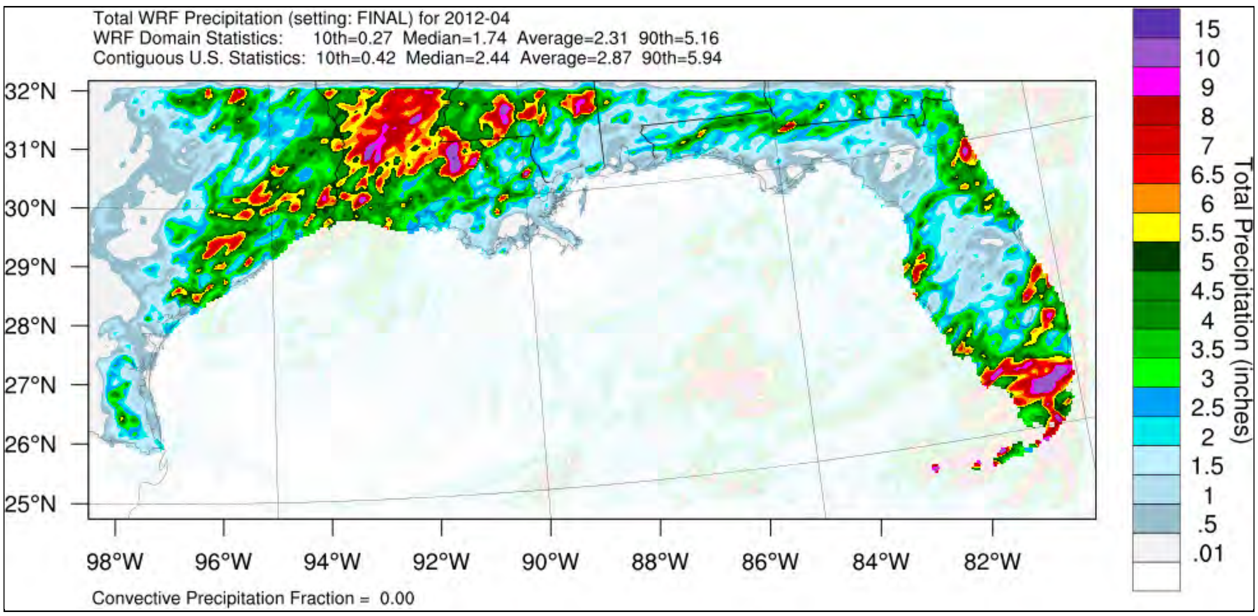
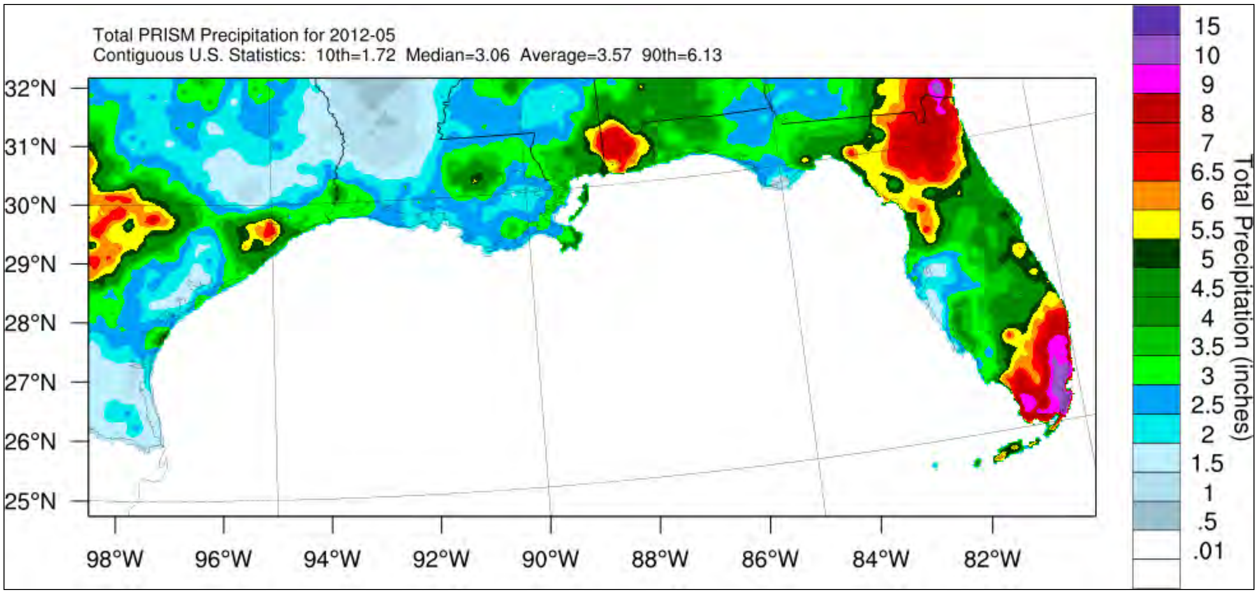


Figure B-26. April 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.



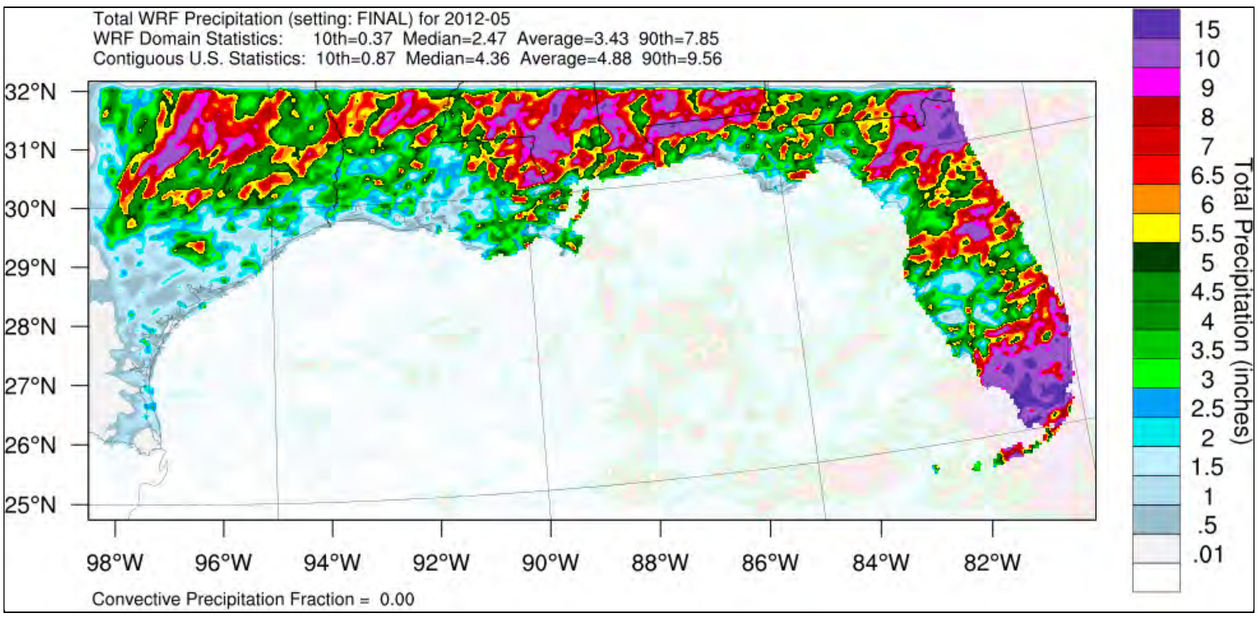


Figure B-27. May 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.

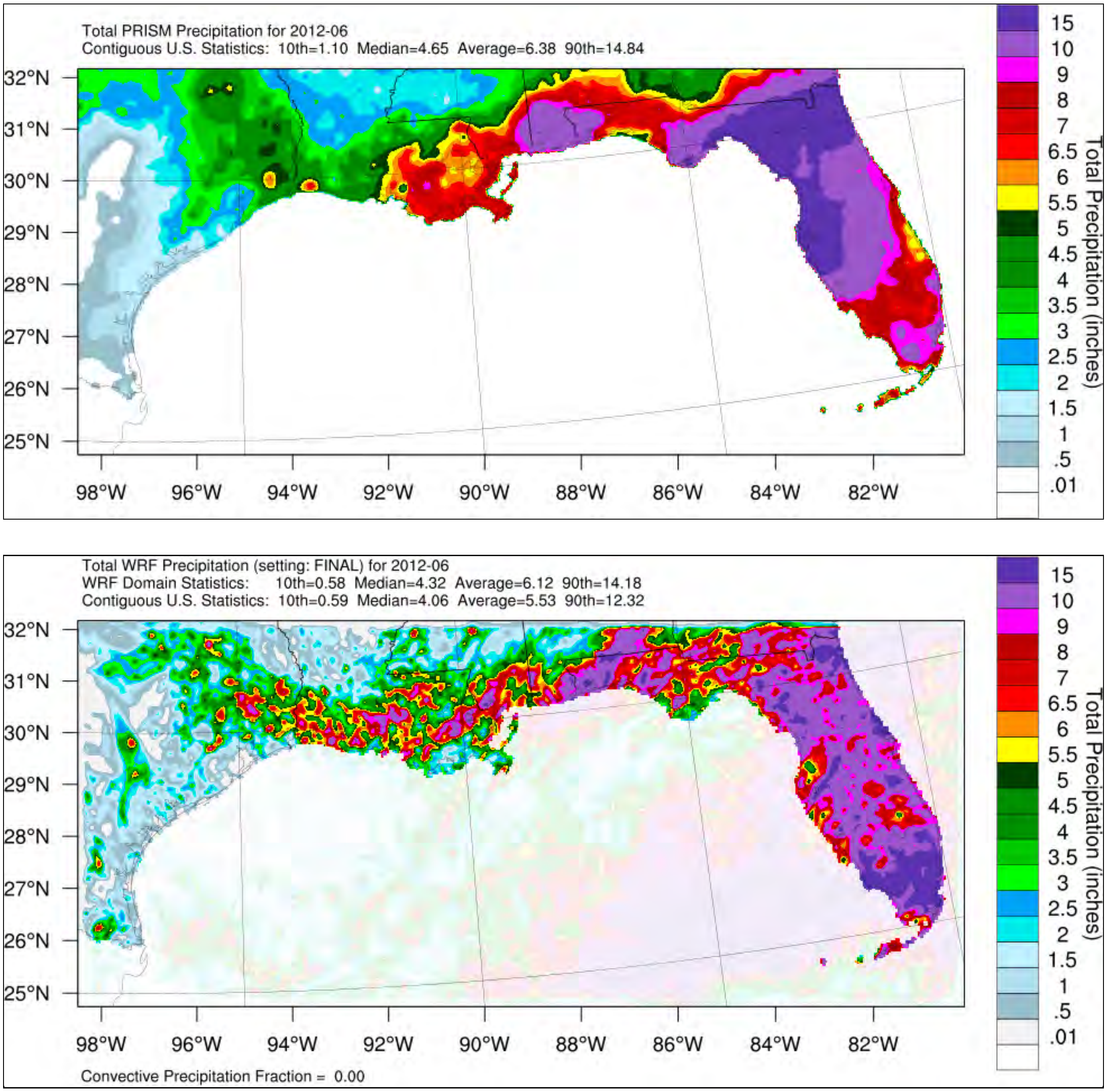


Figure B-28. June 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.

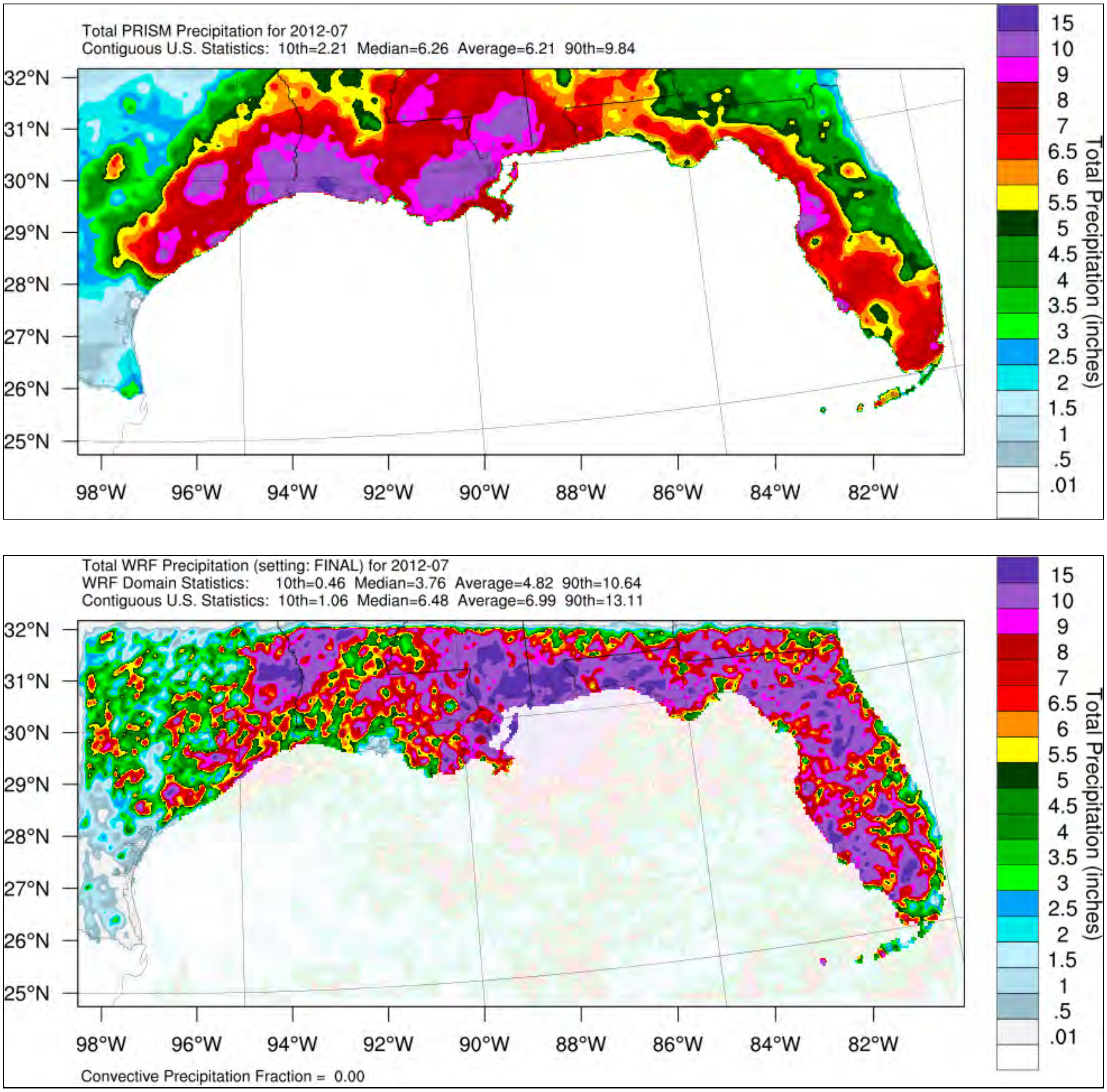


Figure B-29. July 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.

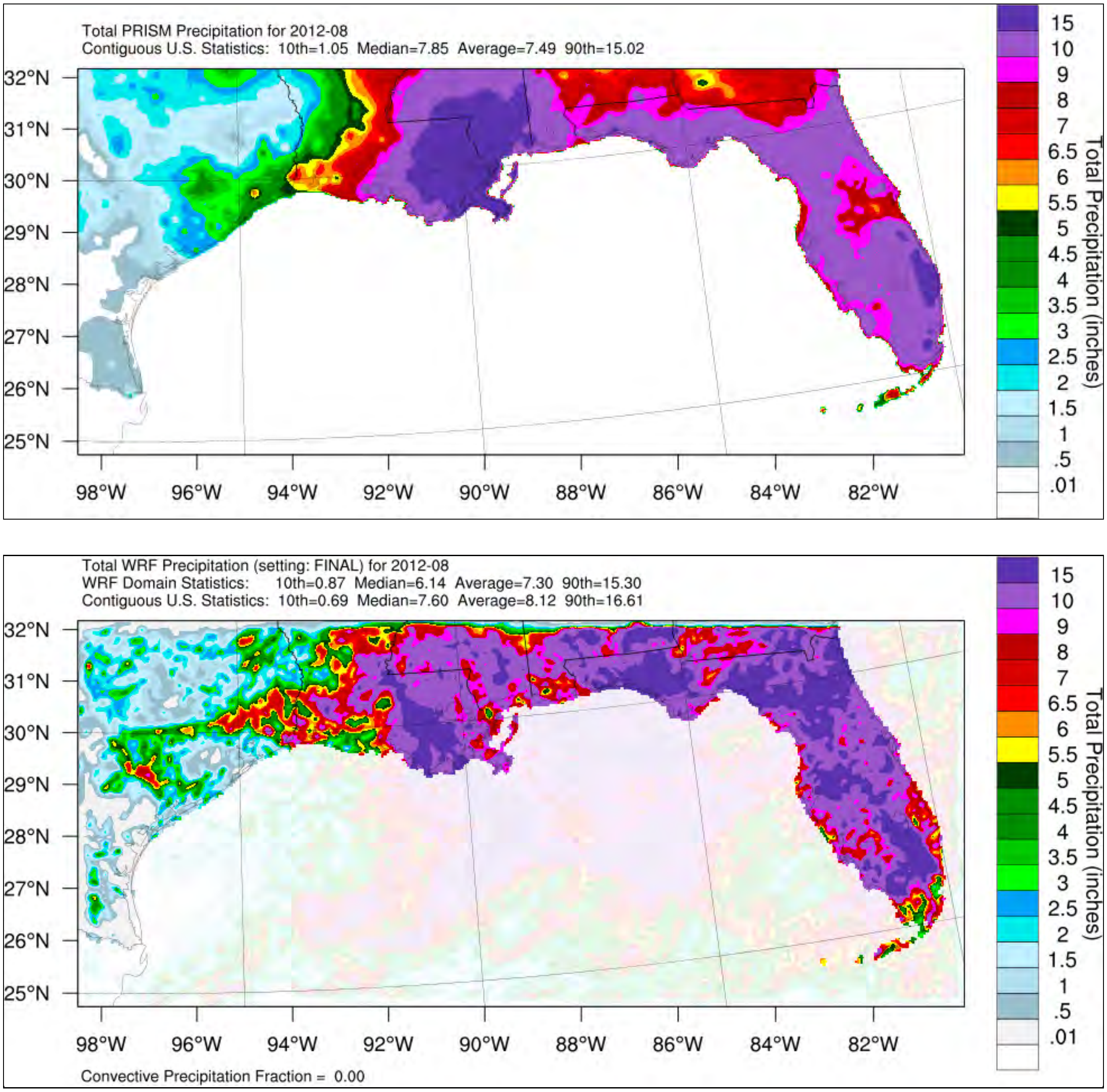
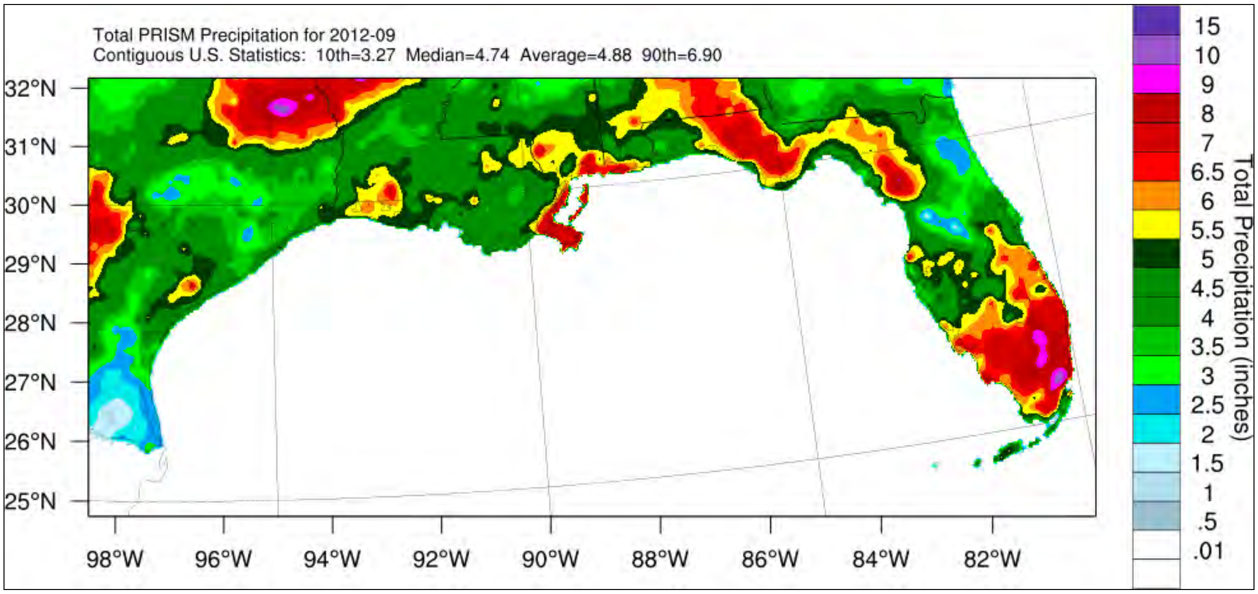


Figure B-30. August 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.



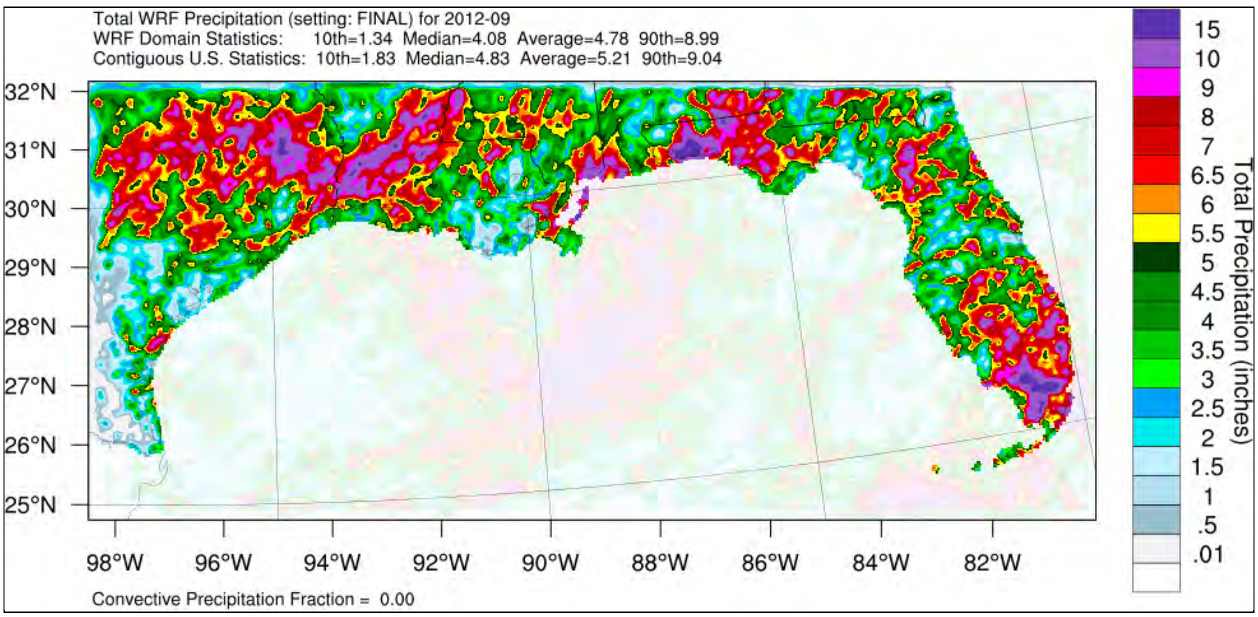
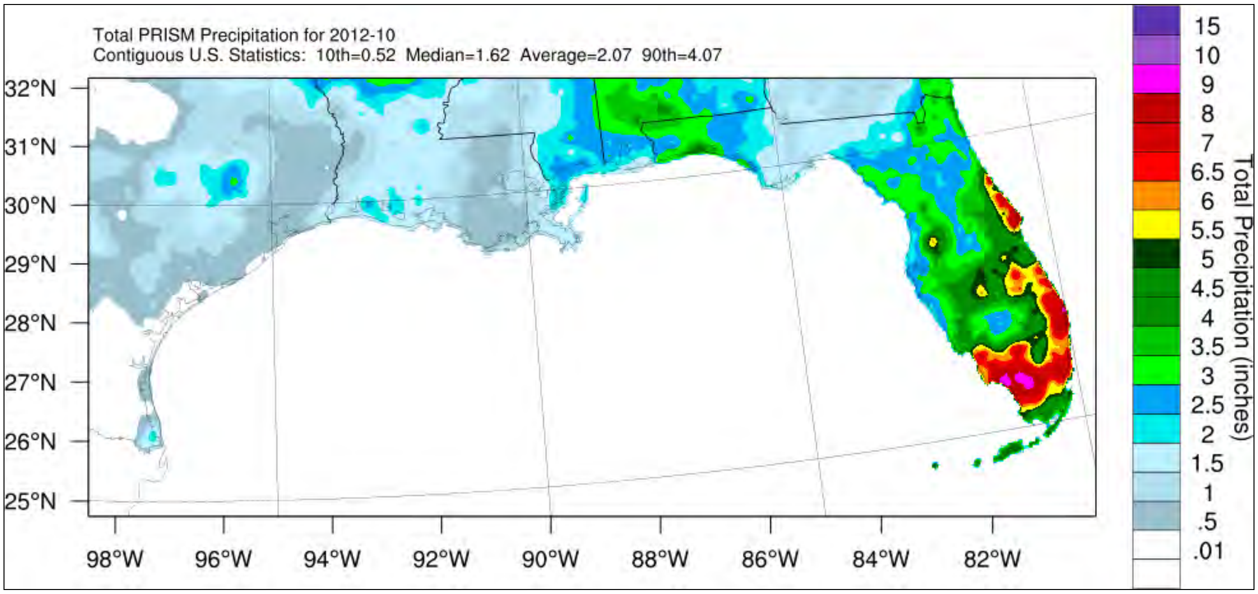


Figure B-31. September 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.



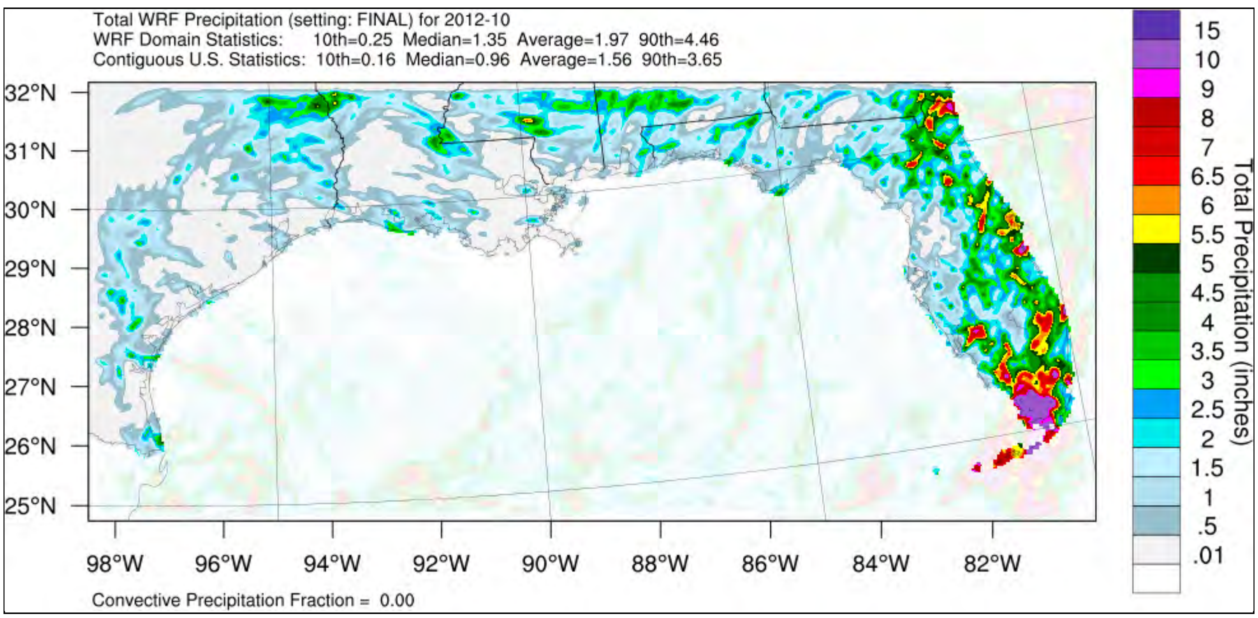


Figure B-32. October 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.

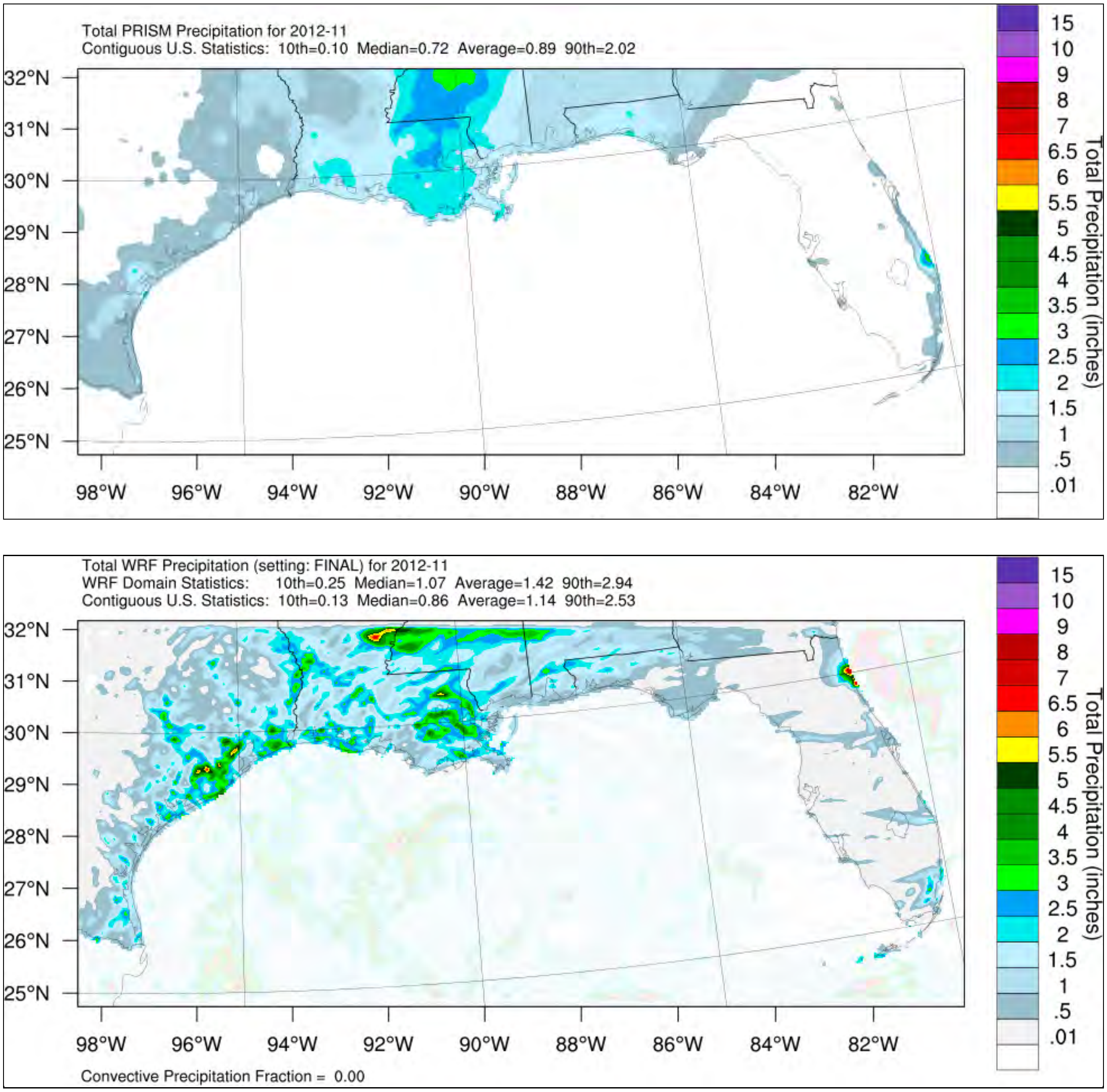
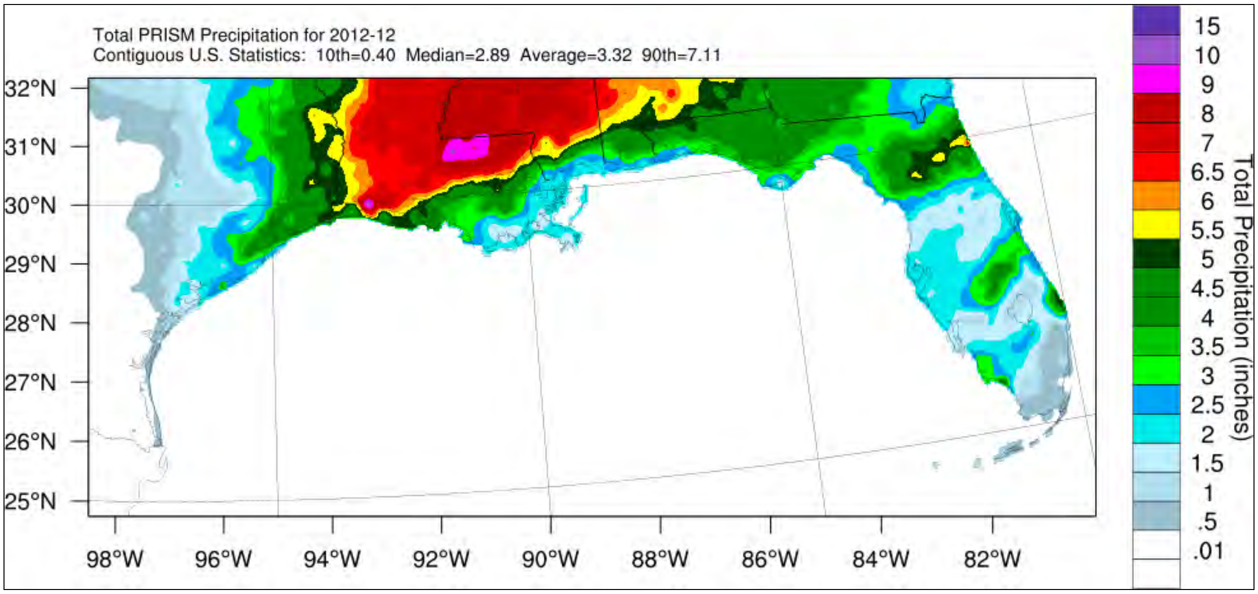


Figure B-33. November 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.



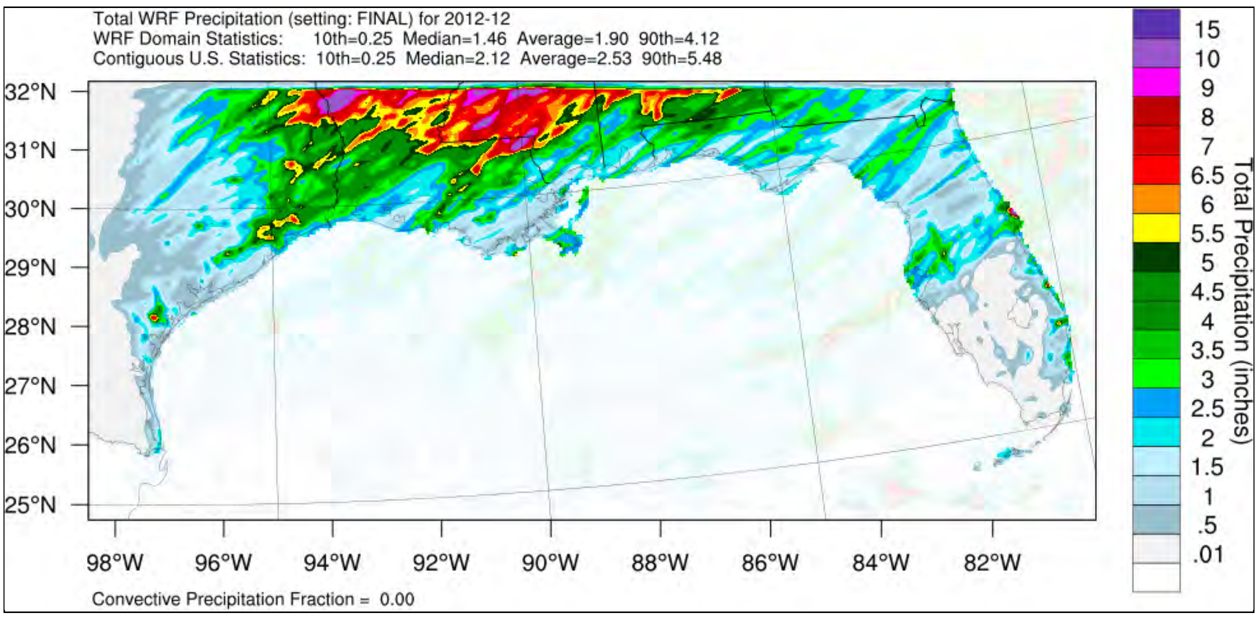


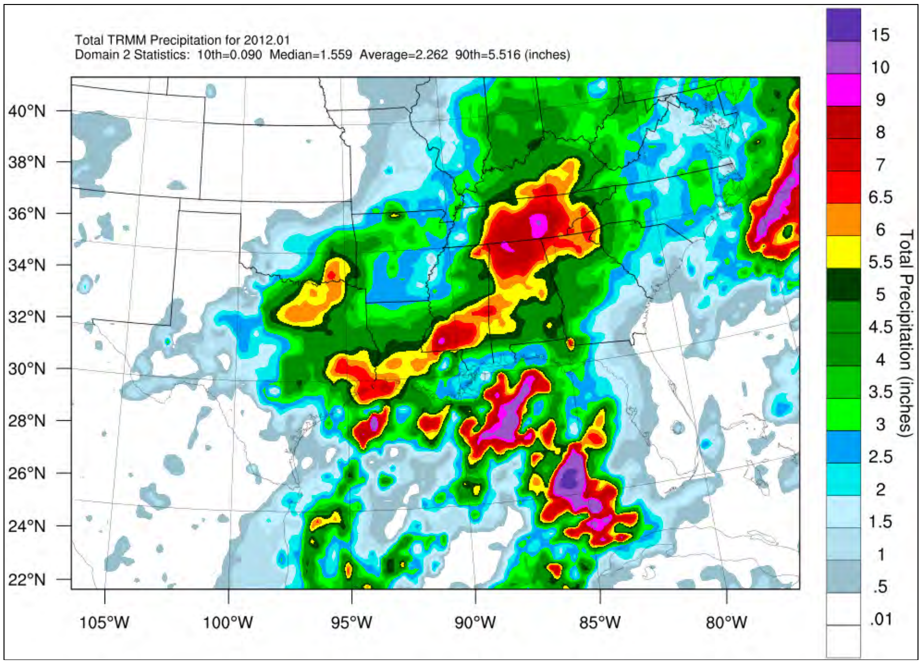
Figure B-34. December 2012 PRISM Precipitation (top) and WRF Precipitation (bottom), 4-km Domain.

B.3.4.2 Evaluation Over Water Using Satellite Precipitation

In this analysis, WRF precipitation data are also compared to TRMM satellite precipitation data to assess the accuracy of the WRF precipitation. Ramboll Environ re-projected and aggregated the TRMM data to the WRF projection's grid cell locations, and the resulting gridded data was plotted and the gridded fields saved. This allows for a consistent visual qualitative comparison, although the 0.5-degree (~55-km) TRMM dataset is at a lower resolution than the 4-km PRISM dataset and as a result, the satellite precipitation fields appear much coarser in the 4-km domain. Additionally, near the end of the WRF modeling period, the satellite hosting the TRMM sensor ran out of propellant. This caused its orbit to slowly decay, casting into doubt the validity of the derived rainfall quantities and is the reason only a qualitative comparison is presented below. Below, **Figures B-35 through B-46** show monthly WRF precipitation averages compared to TRMM precipitation averages throughout 2012 in the 12-km domain.

The WRF under-predicts precipitation over the offshore portions of the domain, compared to TRMM for the averaging months of January through May, as shown in **Figures B-35 through B-39**. From June through October, WRF performs well at predicting precipitation spatially and numerically, shown in **Figures B-40 through B-44**. The increased amount of rainfall over the southeast Gulf Coast States, stretching out over the coastlines, is well represented through the summertime months. The WRF slightly under-predicts the amount of rainfall in the offshore portions of the Gulf, compared to the TRMM precipitation averages for November and December, shown in **Figures B-45 and B-46**. Even with the coarse TRMM resolution, it appears the model has a slight dry bias in the over-water portions of the domain in the colder months.

Given the coarser resolution of the TRMM plots, WRF tends to under-forecast precipitation intensity overall in the offshore portions of the Gulf throughout the winter and spring months and does a satisfactory job at forecasting the amount of rainfall over water in the summer and fall months in the 4-km domain.



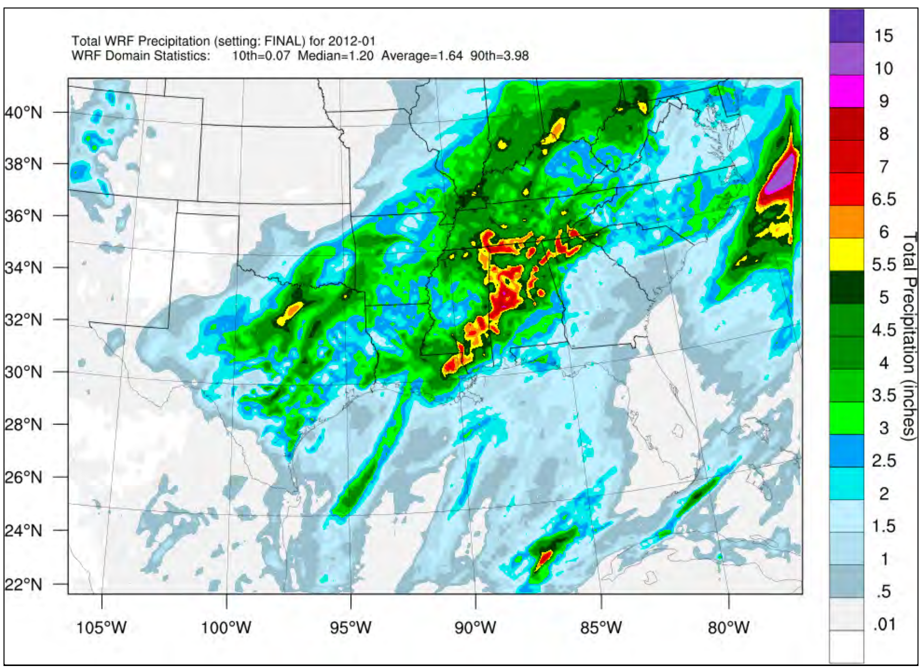


Figure B-35. January 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.

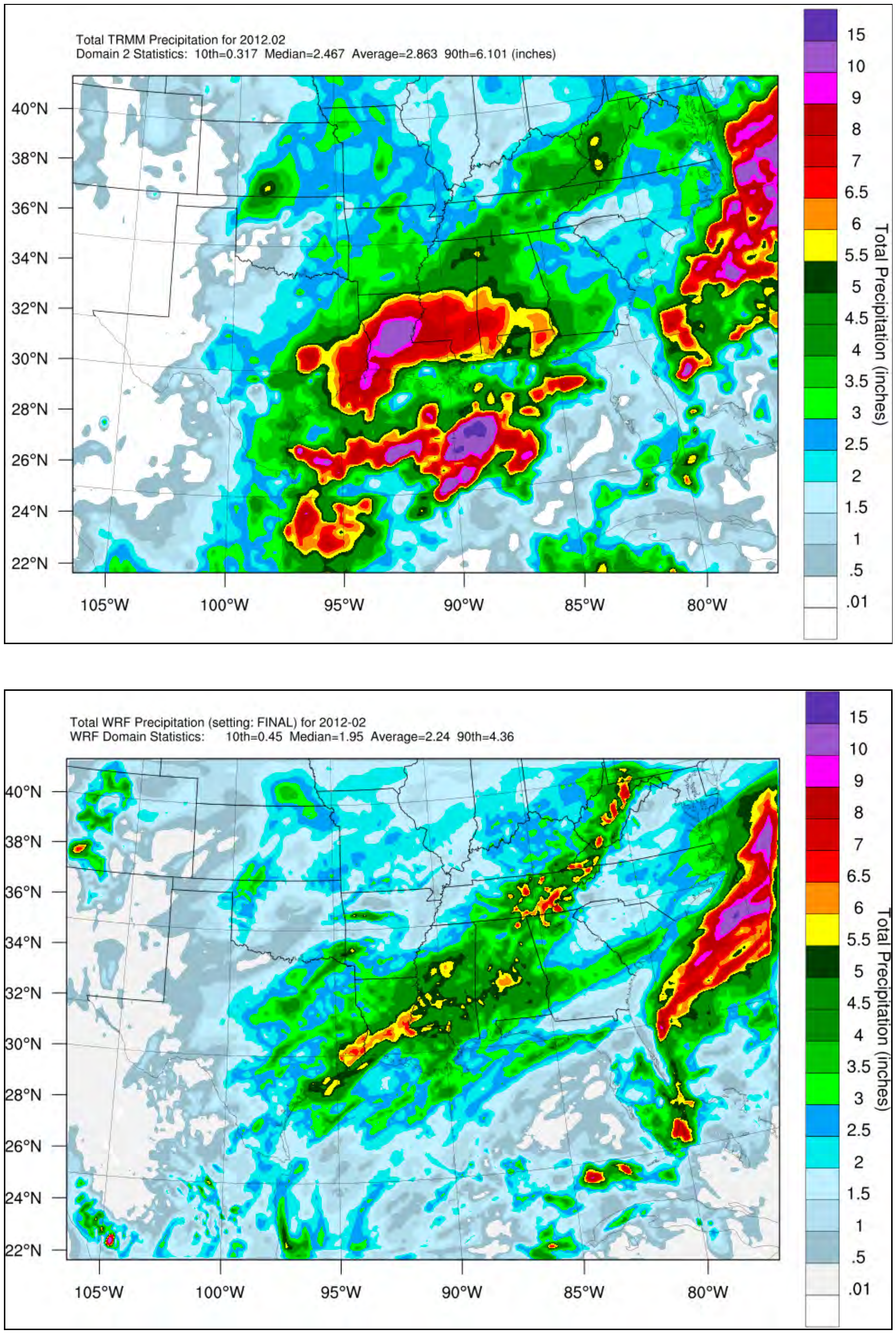
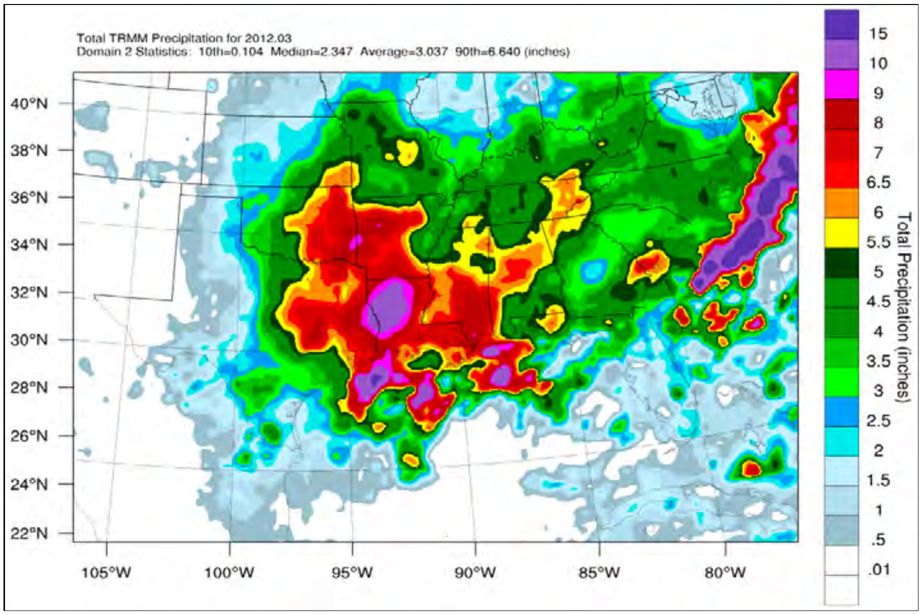


Figure B-36. February 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.



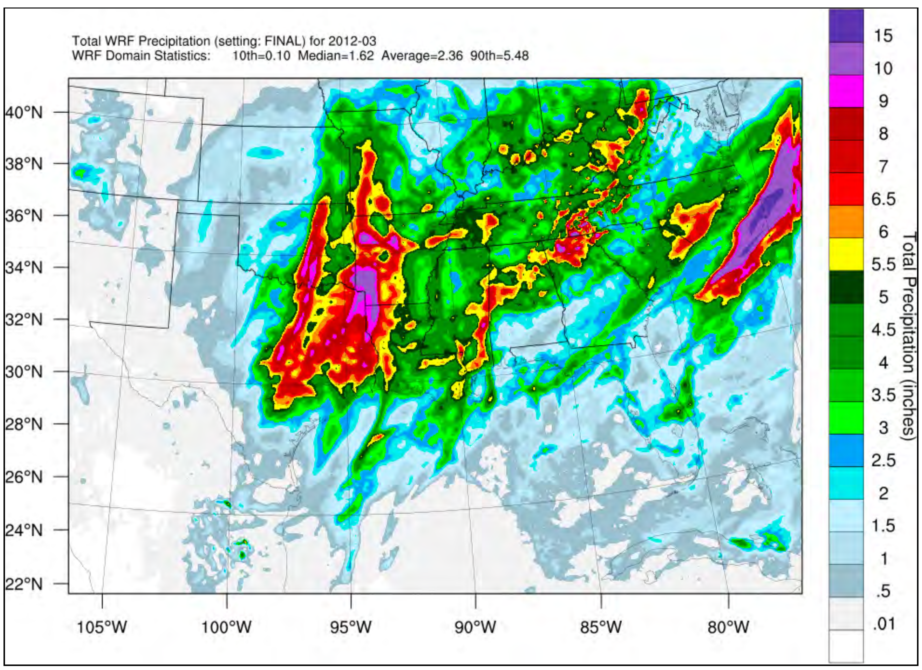
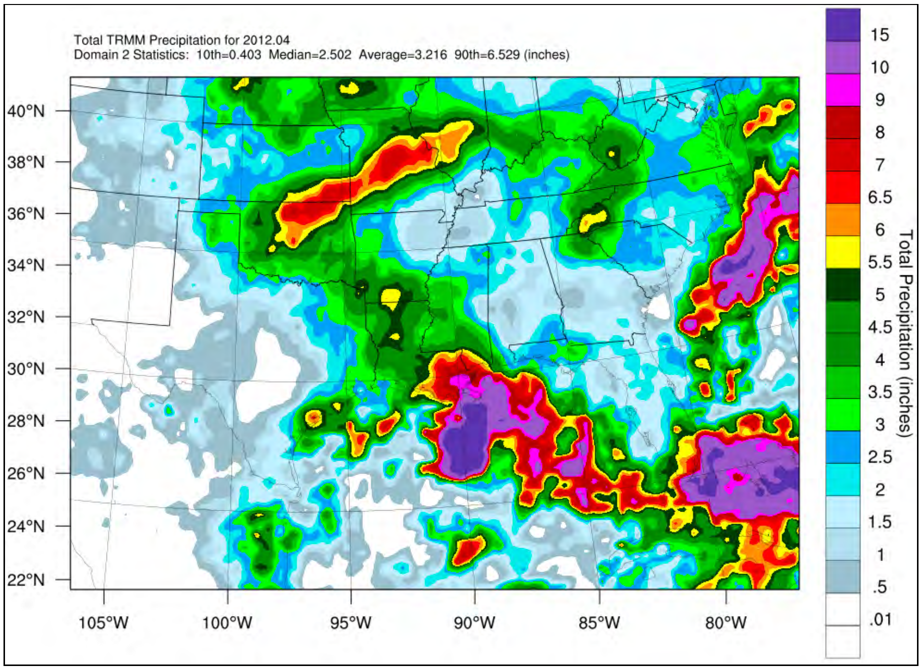


Figure B-37. March 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.



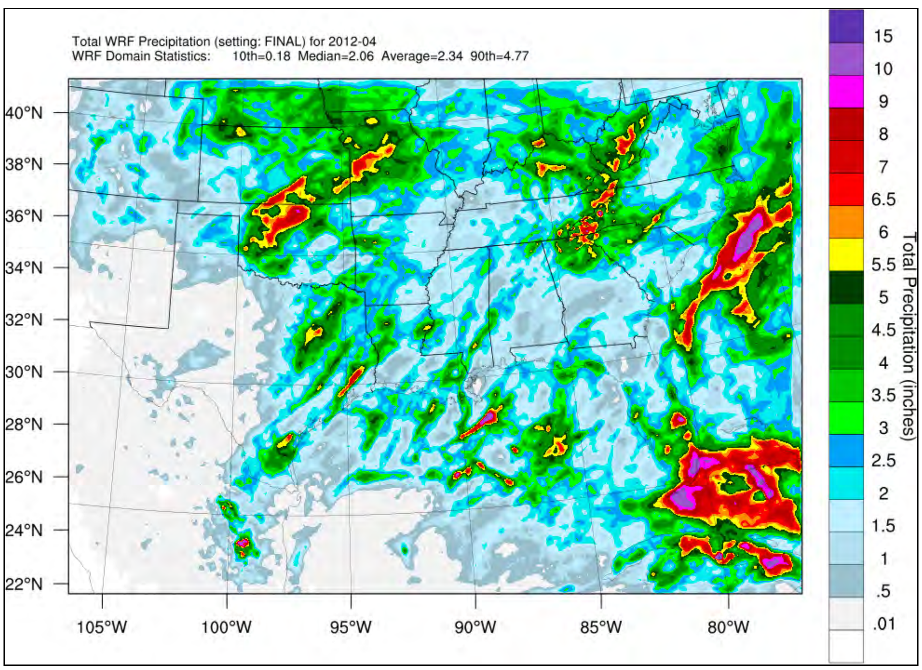
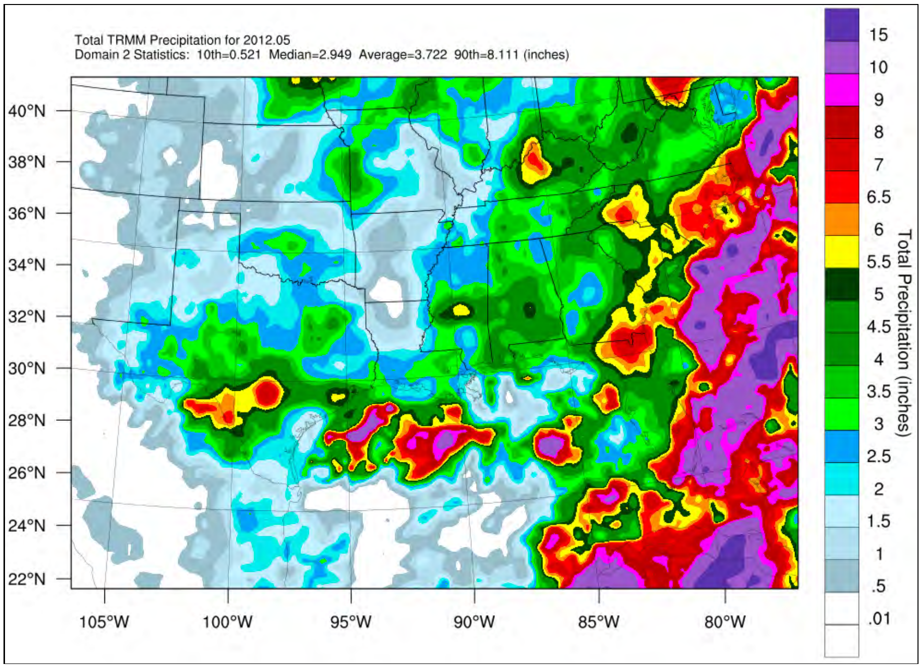


Figure B-38. April 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.



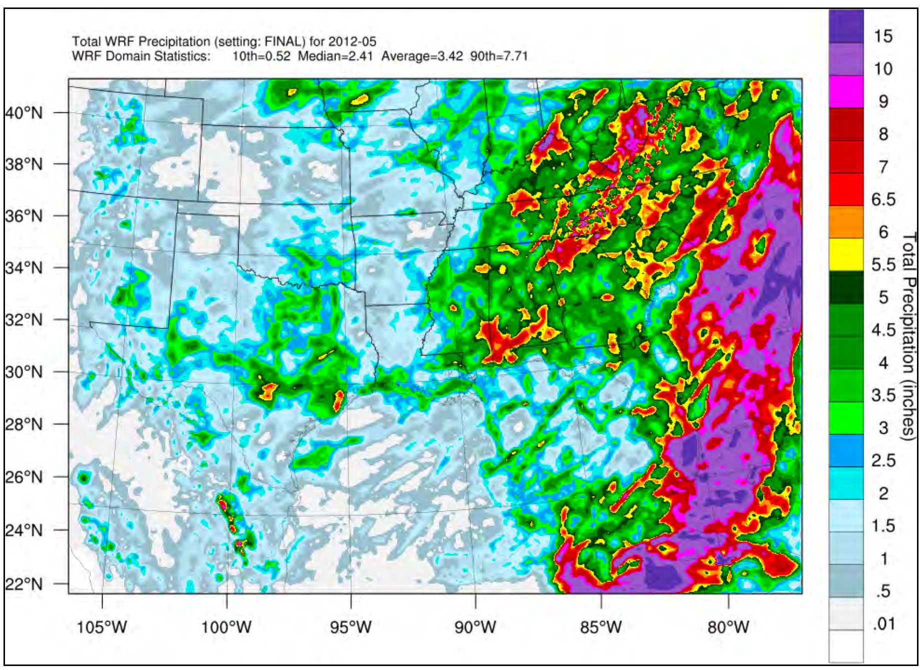
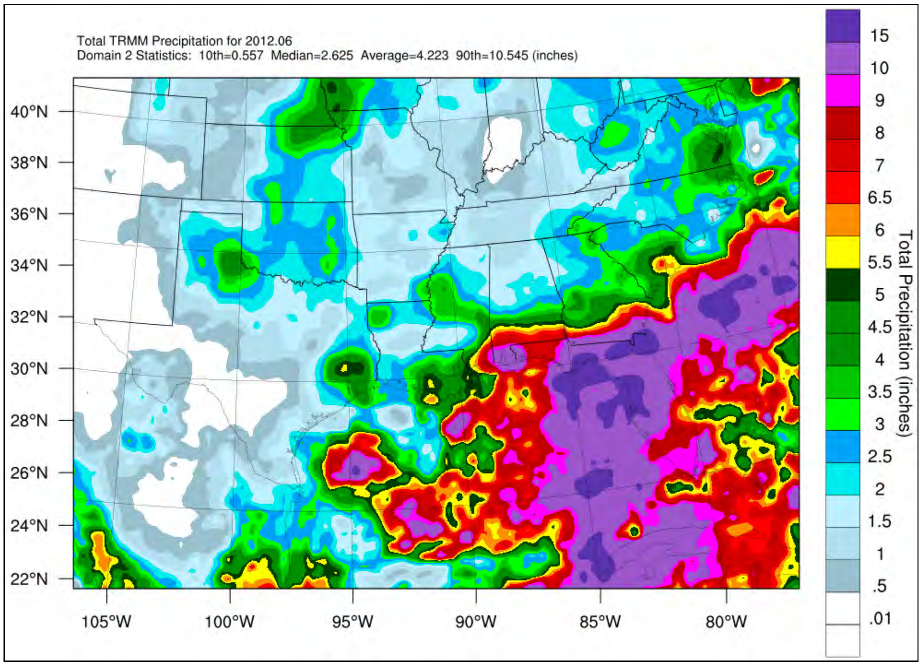


Figure B-39. May 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.



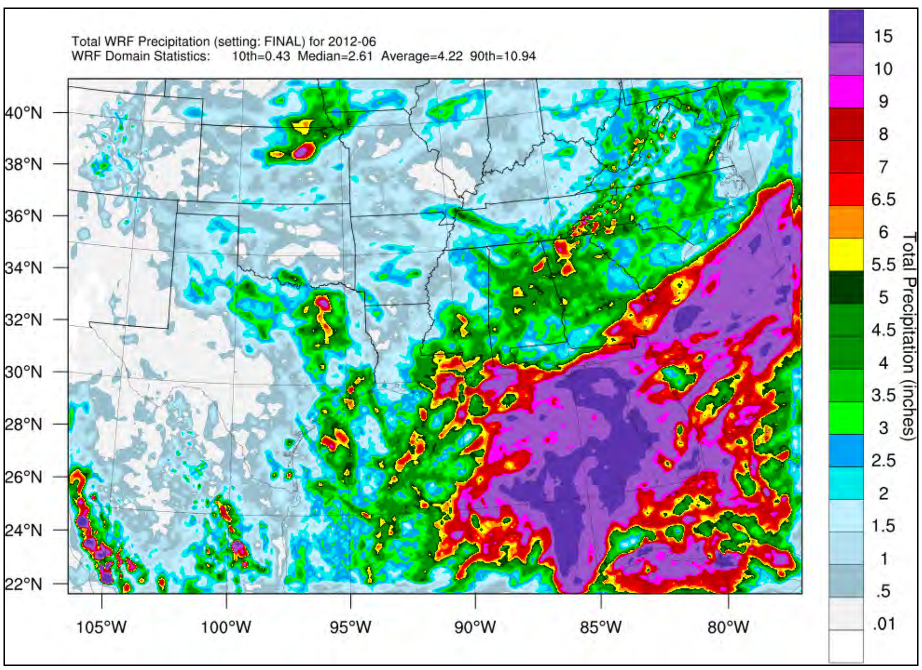
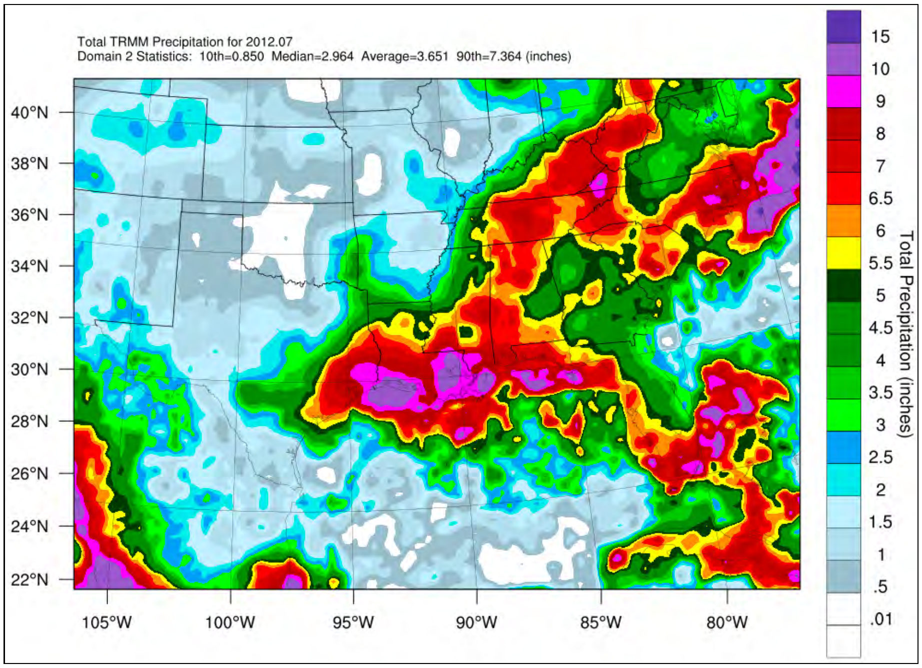


Figure B-40. June 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.



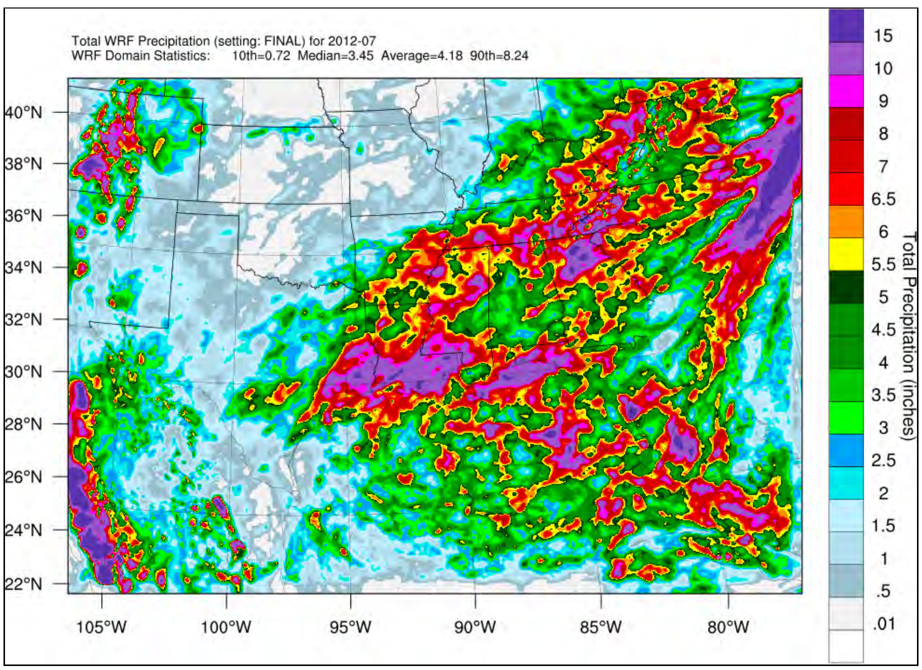


Figure B-41. July 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.

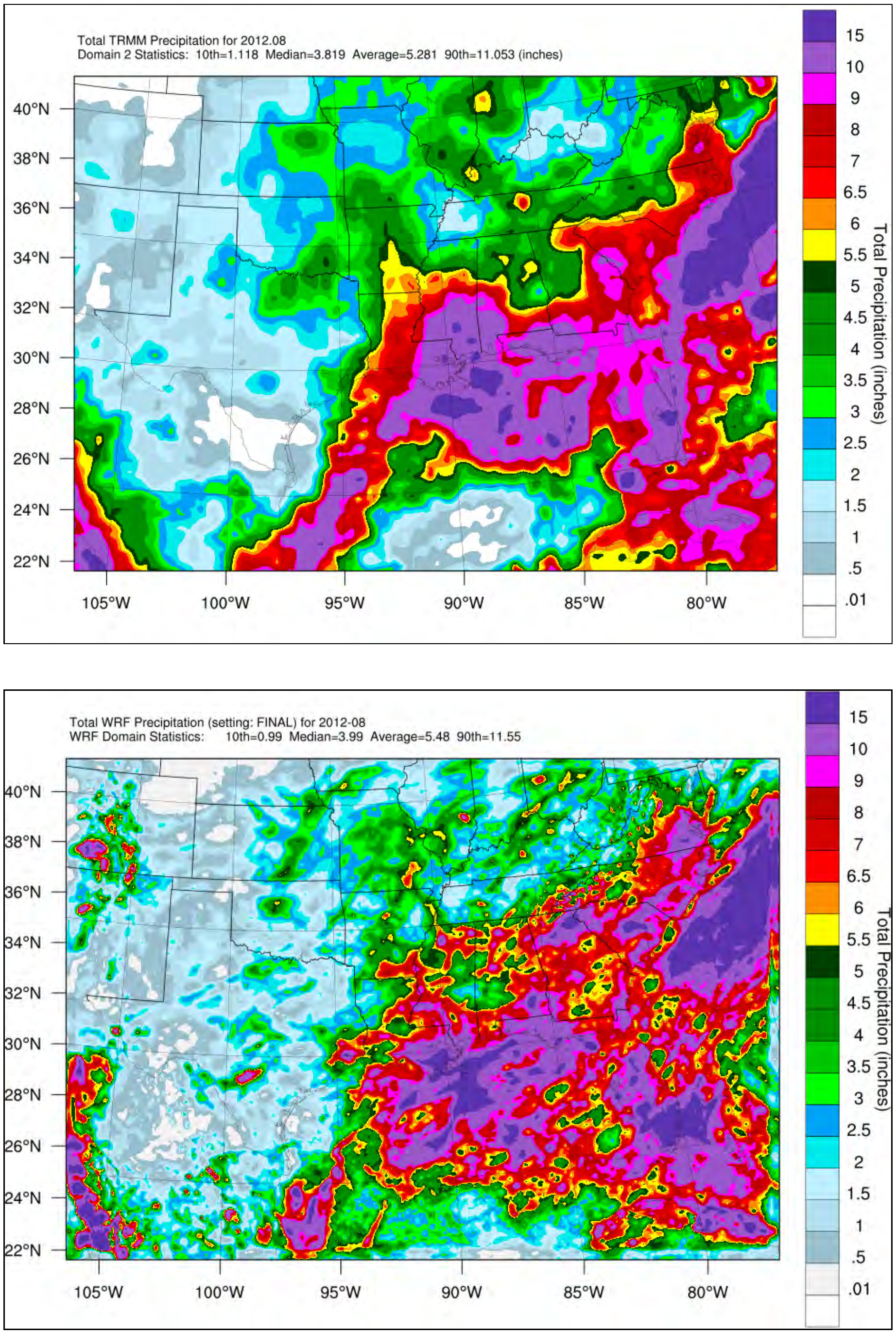


Figure B-42. August 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.

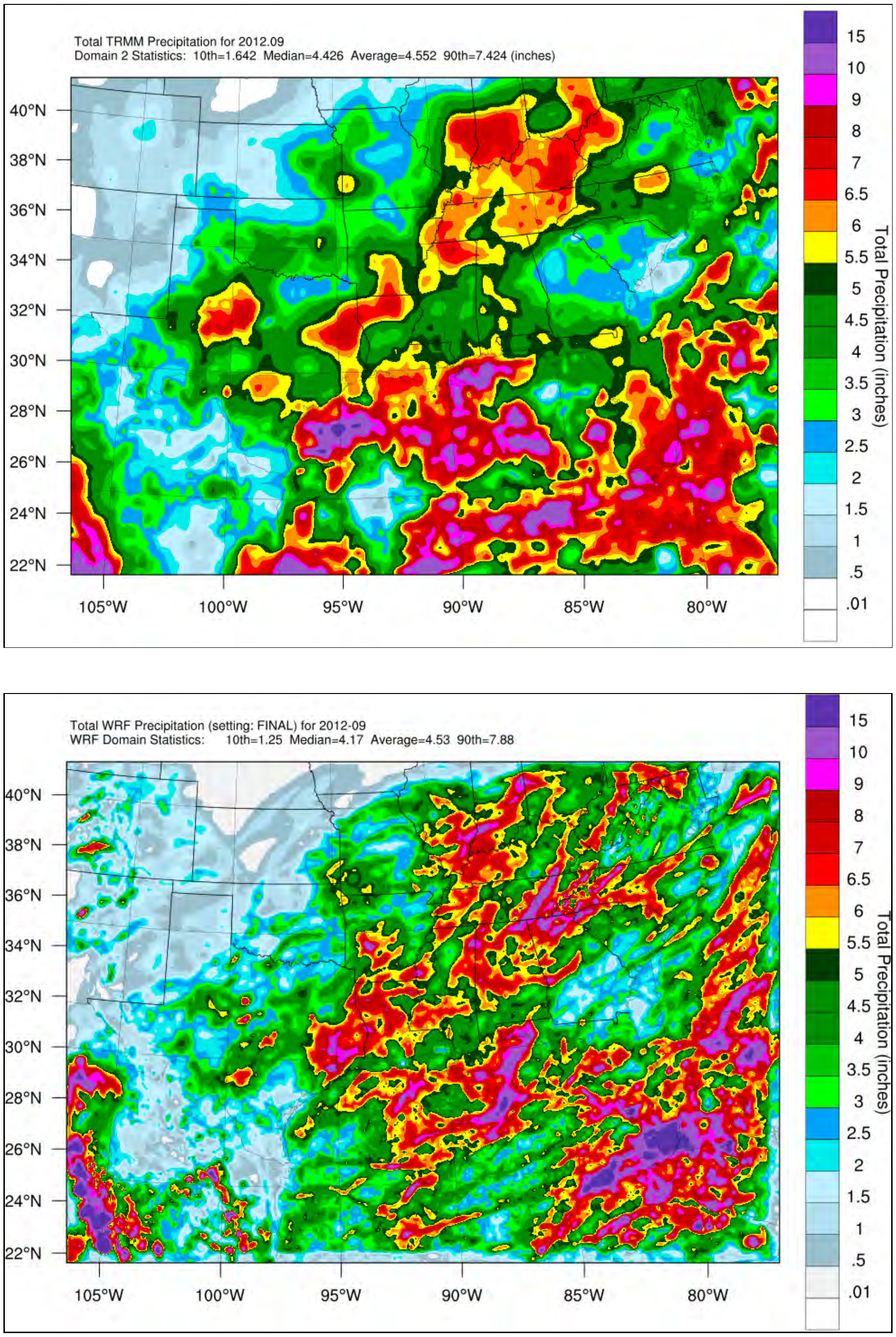
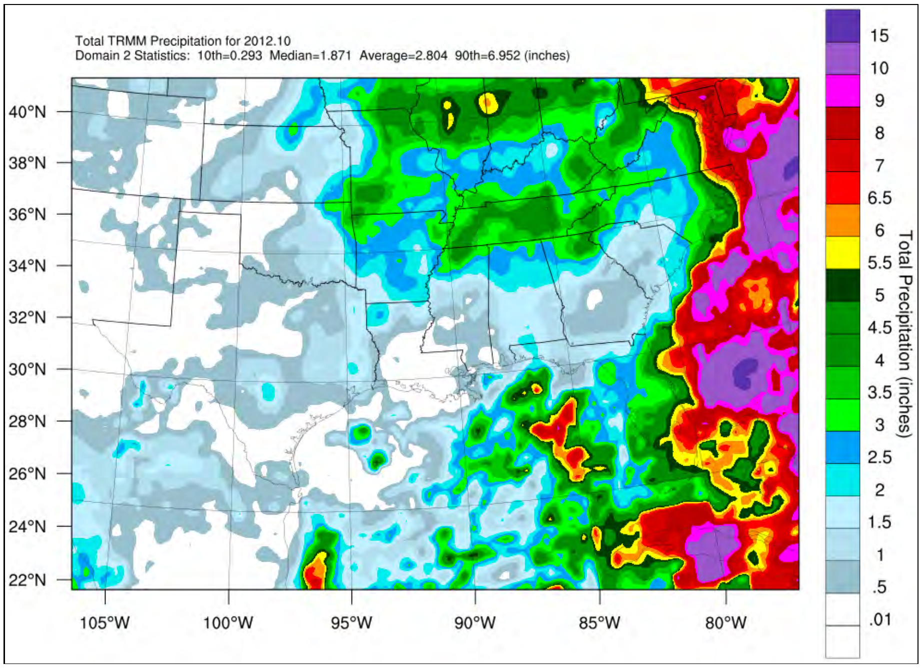


Figure B-43. September 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.



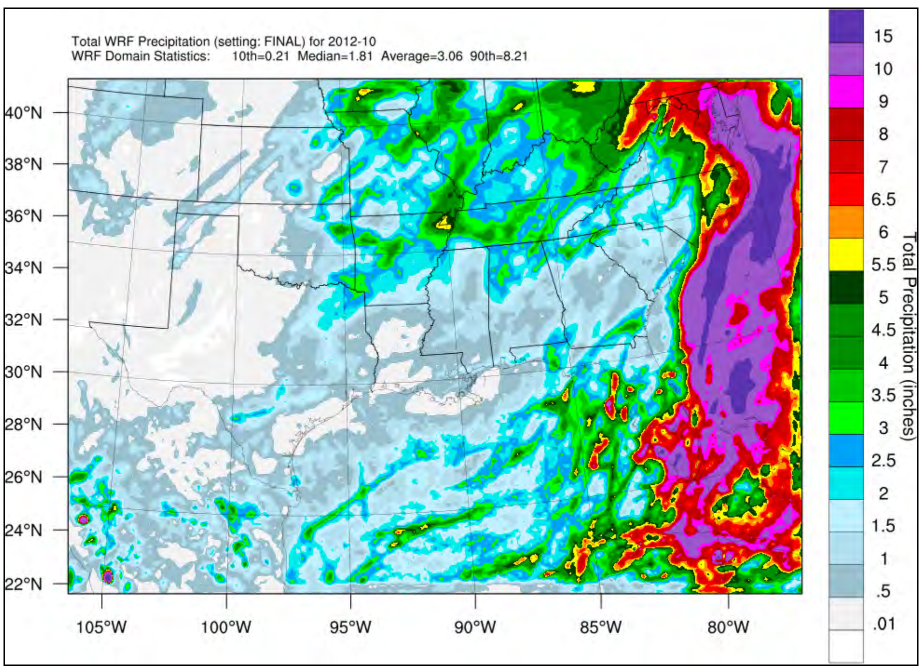


Figure B-44. October 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.

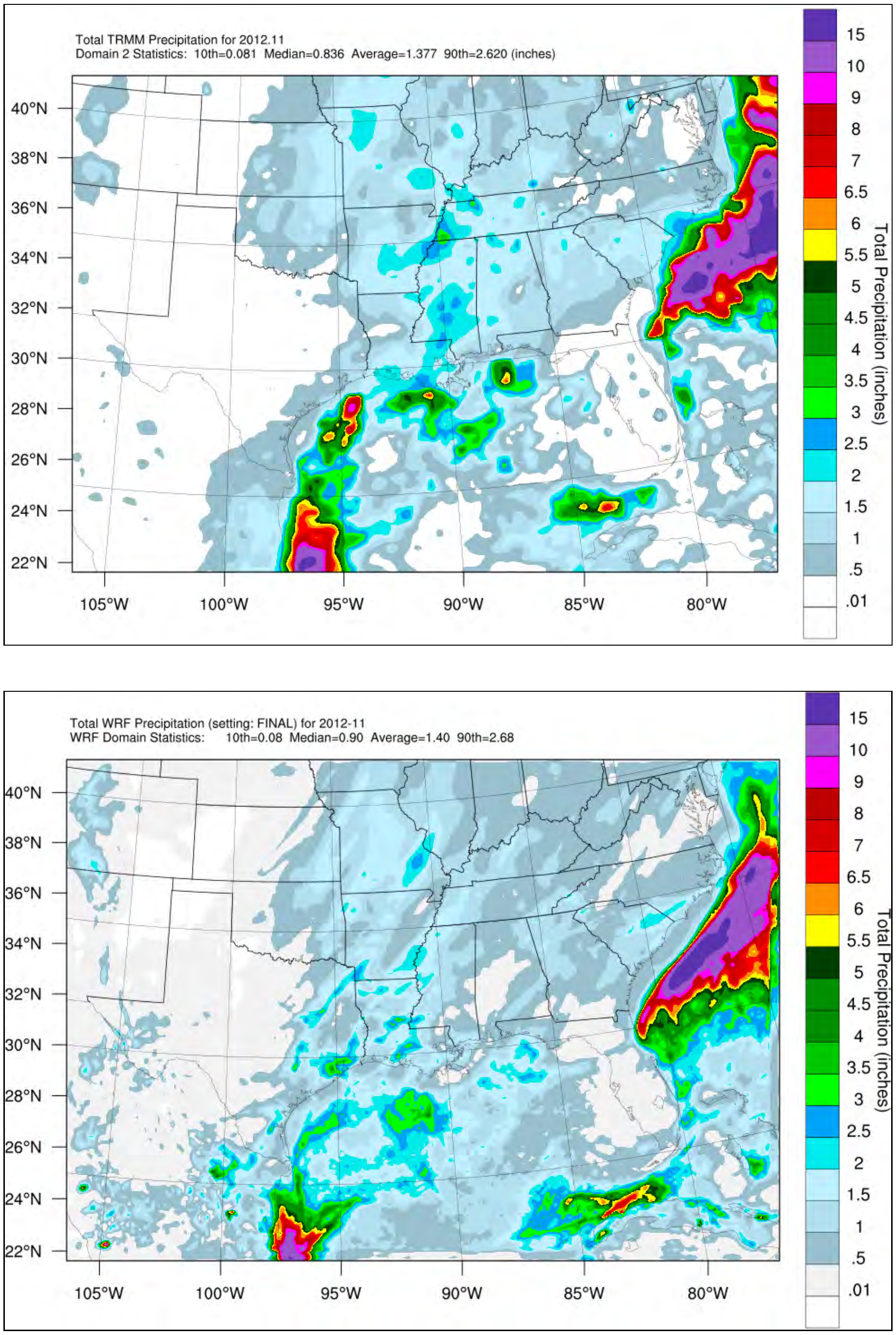
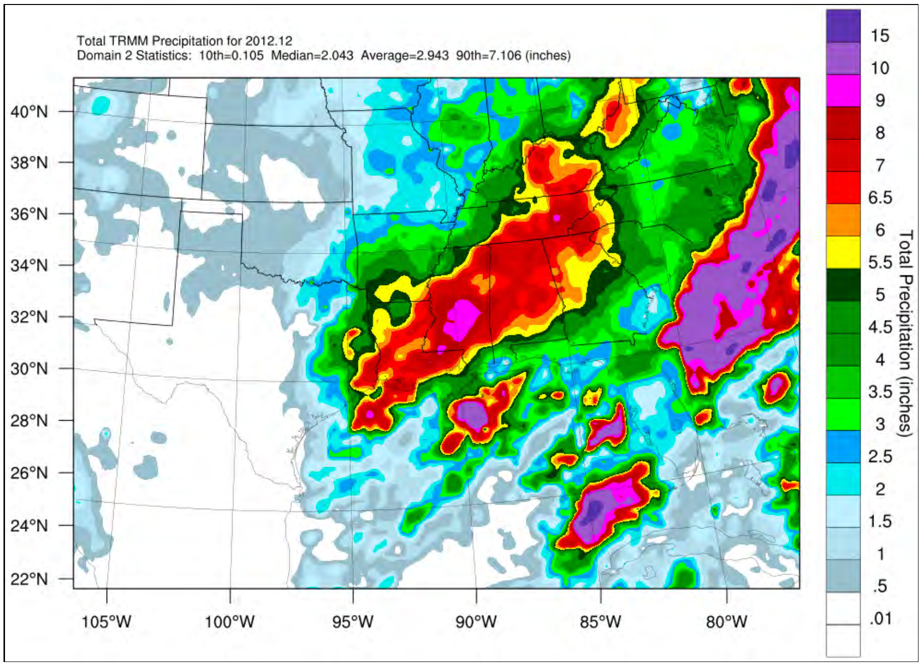


Figure B-45. November 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.



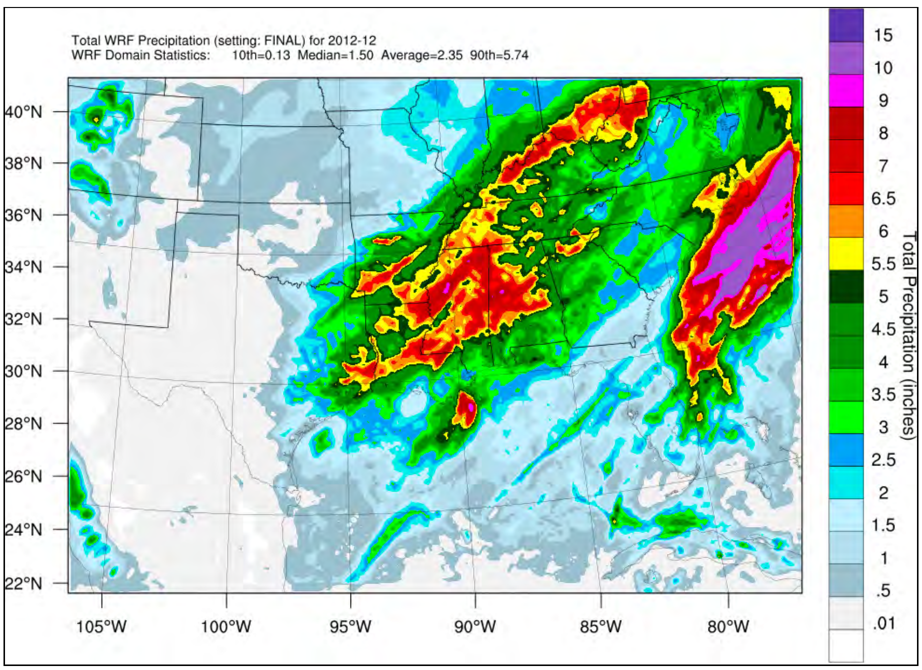


Figure B-46. December 2012 TRMM Precipitation Average (top) and Corresponding WRF Precipitation Average (bottom) in the 12-km Domain.

B.3.4.3 Evaluation Using Tropical Cyclone Precipitation Events

In order to evaluate the accuracy of the WRF model for precipitation performance, short-term rainfall events were also analyzed for local and regional scale impacts. Daily precipitation plots were created for every 24-hour period from the WRF, PRISM, and TRMM databases. Tropical cyclone events were chosen as each storm system typically produces a wide area of enhanced rainfall for both onshore and offshore areas.

A tropical cyclone is a warm-core, non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center (NHC, 2015). Increased rainfall events from two cyclones, Hurricane Isaac and Tropical Storm Debby, are presented in a qualitative comparison.

Hurricane Isaac made landfall along the coast of southern Louisiana on August 29, 2012, and moved northward, where it was downgraded to a tropical storm on August 30th. Daily precipitation plots from each dataset on August 30th are shown in **Figure B-47**. The WRF depicts the large cyclonic rotation and enhanced precipitation bands from Isaac over southeast Louisiana very well, compared to the PRISM dataset. Compared to TRMM, the model does appear to over-forecast the rainfall intensity for this 24-hour period.

Figure B-48 shows daily precipitation plots as Tropical Storm Debby's outer rain bands begin to impact Florida's west coast on June 25, 2012. The WRF performed very well in comparison to both PRISM and TRMM, forecasting the spatial extent of the large storm throughout the eastern Gulf of Mexico. The model did slightly under-predict the rainfall accumulations in this 24-hour period, compared to the observational and satellite databases.

Overall, WRF performed very well in recreating the daily precipitation events in these two scenarios. The daily precipitation plots from each WRF, PRISM, and TRMM dataset are available by request from Ramboll Environ.

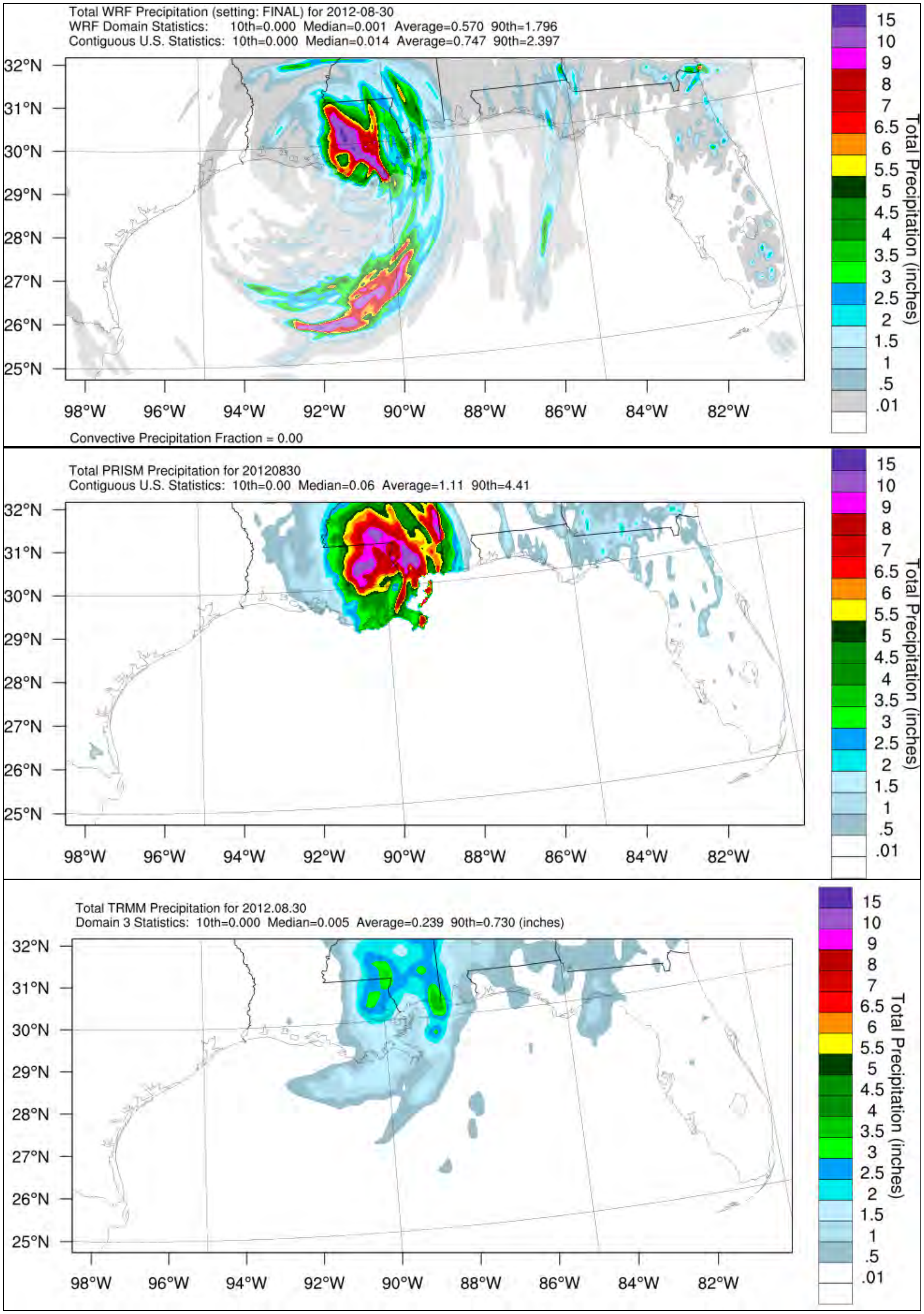


Figure B-47. Daily Precipitation Plots from WRF, PRISM, and TRMM on August 30, 2012.

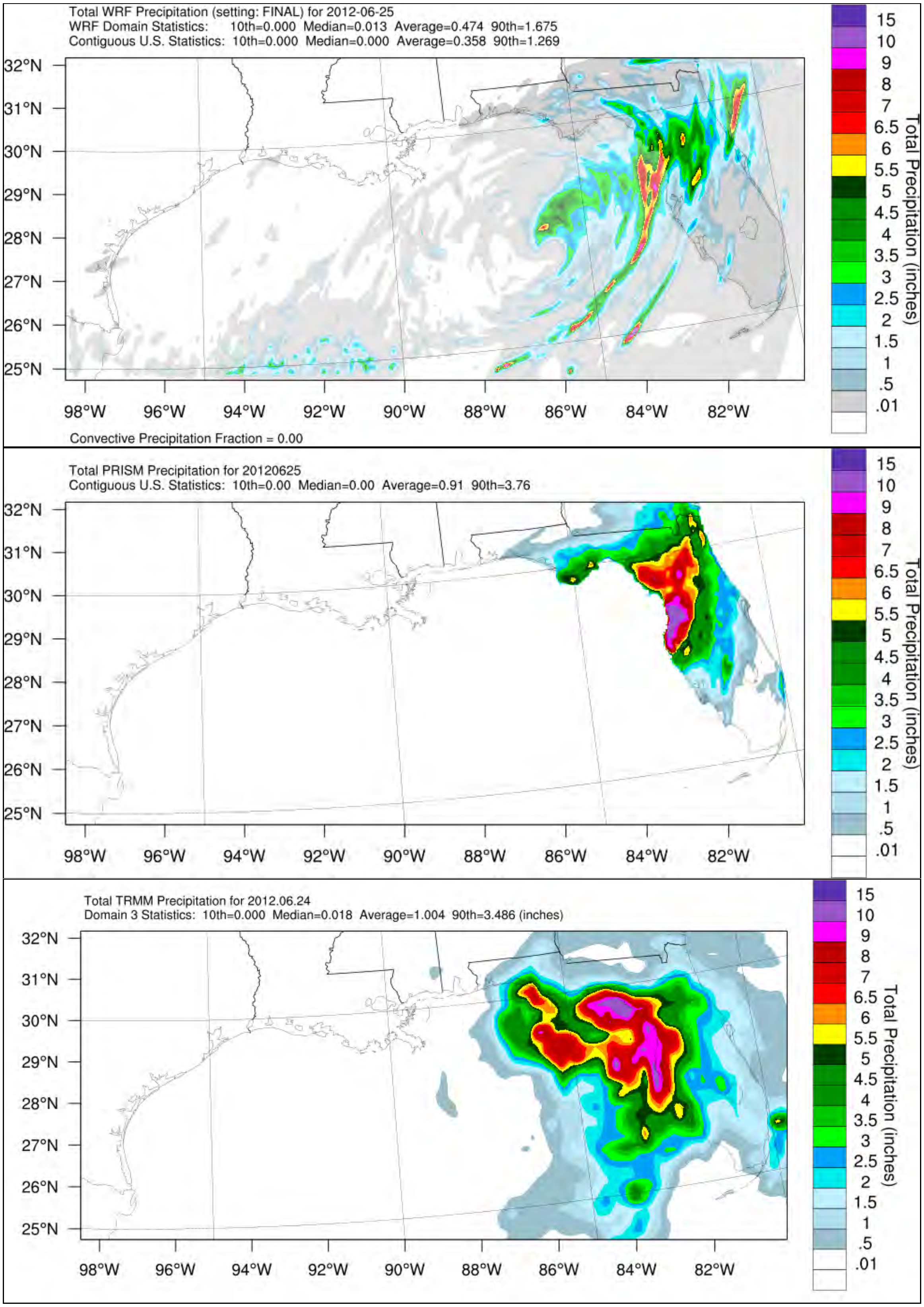


Figure B-48. Daily Precipitation Plots from WRF, PRISM, and TRMM Databases on June 25, 2012.

B.4 Summary and Conclusions

The BOEM Gulf of Mexico OCS Region WRF meteorological model simulation for January through December 2012 reproduced the observed surface and upper-air meteorological variables very well. The WRF performed exceptionally well in the onshore METSTAT analysis for the 36-km and 12-km domains and well in the onshore and offshore analysis for the 4-km domain, with a small bias in wind direction. This performance shows a very strong agreement overall between the model and surface observations.

Comparisons of selected wind roses along the Gulf Coast, which will be presented in the full WRF model evaluation, show WRF was able to forecast the offshore and onshore wind speed and wind direction very well in the 4-km domain. This suggests the model was able to accurately reproduce the land-sea breeze circulation.

Upper air performance in the 4-km (d03) domain for the two selected locations throughout the Gulf of Mexico reflects accurate predictions of the vertical atmosphere, as shown in comparisons between WRF and radiosonde data, especially in mixing layer heights and cases of surface-based temperature inversions.

The monthly precipitation analysis for the 4-km (d03) domain indicates there is a strong agreement between the model and observation-based precipitation measurements over land, including convergence zone and enhanced rainfall areas. The comparison with the 12-km (d02) WRF and satellite-based precipitation accumulations does indicate some understatement of precipitation over water, most notably in the winter months.

Based on our experience, the BOEM Gulf of Mexico OCS Region WRF modeling's superior performance throughout 2012 provides a substantial basis for developing meteorological inputs for air quality modeling in the Gulf of Mexico region.

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APPENDIX C

AIR QUALITY:
EMISSIONS FOR THE CUMULATIVE AND VISIBILITY IMPACTS

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ABBREVIATIONS AND ACRONYMS

μg/m^3	microgram(s) per cubic meter
2017-2022 GOM Multisale EIS	*Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022; Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261—Final Multisale Environmental Impact Statement*
AIS	Automatic Identification System
AL	Alabama
AQRV	air quality-related value(s)
BOEM	Bureau of Ocean Energy Management
CAAA	Clean Air Act Amendments
CAMD	Clean Air Markets Division (USEPA)
CAMx	Comprehensive Air quality Model with eXtensions
CO	carbon monoxide
CPA	Central Planning Area
EC	elemental carbon
ECA	Emission Control Area
ECA	North American Emission Control Area
EGUs	electric generating units
EIS	environmental impact statement
EPA	Eastern Planning Area
ERG	Eastern Research Group, Inc.
FINN	Fire INventory
FL	Florida
FLM	Federal Land Management
FOCA	Federal Office of Civil Aviation
GA	Georgia
GOMESA	Gulf of Mexico Energy Security Act
HC	hydrocarbon
HIS	Information Handling Service
hr	hour(s)
IC/BC	Initial Conditions/Boundary Conditions
ICAO	International Civil Aviation Organization
ICI	institutional/commercial/industrial
km	kilometer(s)
kW	kilowatt
kW-hr	kilowatt-hour
LA	Louisiana

LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
LTO	landing and takeoff
M	maintenance area
MARAD	Maritime Administration
MNEI	Mexico National Emissions Inventory
MS	Mississippi
MSW	municipal solid waste
MTSA	Maritime Transportation Security Act of 2002
NAA	nonattainment area
NAAQS	National Ambient Air Quality Standards
NAAQS	National Ambient Air Quality Standards
NAAs	nonattainment areas
NCAR	National Center for Atmospheric Research
NCAR	National Center for Atmospheric Research
NEI	National Emissions Inventory (USEPA)
NEPA	National Environmental Policy Act
NH_3	ammonia
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
OC	organic carbon
OCS	Outer Continental Shelf
OCSLA	OCS Lands Act
OGOR	Oil and Gas Operations Reports
OMSA	Offshore Marine Service Association
PAHs	polycyclic aromatic hydrocarbons
Pb	lead
PGM	Photochemical Grid Model
PM	particulate matter
PM_{10}	inhalable particulate matter (less than 10 microns in effective diameter)
$PM_{2.5}$	fine particulate matter (less than 2.5 microns in effective diameter)
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
QA/QC	quality assurance/quality control
Ramboll Environ	Ramboll Environ US Corporation
RHR	Regional Haze Rule

SIPs	State Implementation Plans
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	sulfur dioxide
tpy	tons per year
TRI	Toxics Release Inventory
TX	Texas
USDOI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WBD	windblown dust
WPA	Western Planning Area
WRF	Weather Research and Forecasting model
yr	year

C AIR QUALITY: EMISSIONS FOR THE CUMULATIVE AND VISIBILITY IMPACTS

C.1 INTRODUCTION

The U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM) is required under the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. § 1334(a)(8)) to comply with the National Ambient Air Quality Standards (NAAQS) to the extent that Outer Continental Shelf (OCS) offshore oil and gas exploration, development, and production sources do not significantly affect the air quality of any state. The Gulf of Mexico OCS Region's OCS area of possible influence includes the States of Texas, Louisiana, Mississippi, Alabama, and Florida. BOEM's Gulf of Mexico OCS Region manages the responsible development of oil, gas, and mineral resources for the 430 million acres in the Western, Central, and Eastern Planning Areas on the OCS comprising the Gulf of Mexico OCS Region, including the areas under moratoria (shown in **Figure C-1**). The Clean Air Act Amendments (CAAA) of 1990 designate air quality authorities in the Gulf of Mexico OCS Region, giving BOEM air quality jurisdiction westward of 87°30'W. longitude and the U.S. Environmental Protection Agency (USEPA) air quality jurisdiction eastward of 87°30'W. longitude. In 2006, oil and gas leasing operations within 125 miles (201 kilometers [km]) of the Florida coastline were banned until 2022 under the Gulf of Mexico Energy Security Act (GOMESA). The GOMESA moratoria area is depicted on **Figure C-1**.

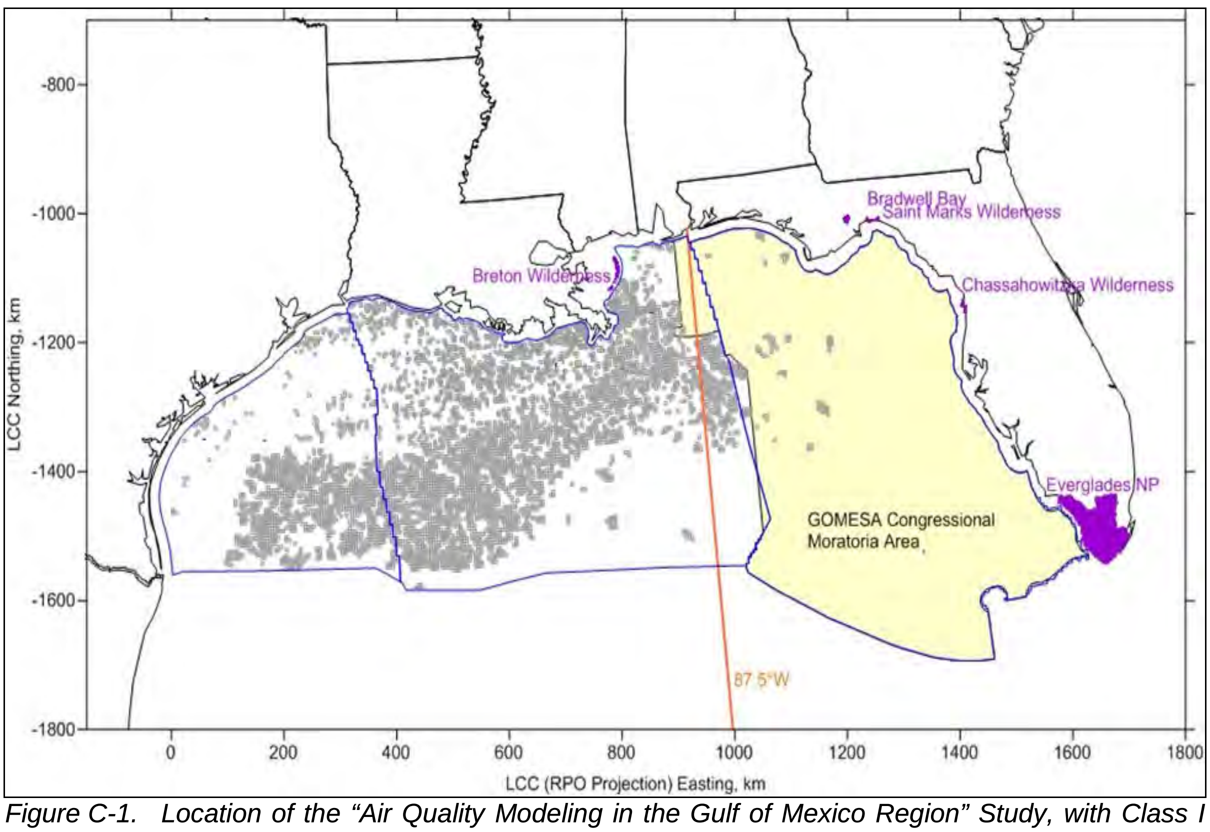

Figure C-1. Location of the "Air Quality Modeling in the Gulf of Mexico Region" Study, with Class I Areas (purple) and Platform Locations (gray dots).

The USEPA has set NAAQS for six regulated air quality pollutants: ozone; particulate matter with an aerodynamic diameter of 2.5 micrometers and smaller ($PM_{2.5}$); particulate matter with an aerodynamic diameter of 10 micrometers and smaller (PM_{10}); sulfur dioxide (SO_2); nitrogen dioxide (NO_2); carbon monoxide (CO); and lead (Pb). After promulgation of a NAAQS, the USEPA designates areas that fail to achieve the NAAQS as nonattainment areas (NAAs) and States are required to submit State Implementation Plans (SIPs) to the USEPA that contain emission control plans and a demonstration that the NAA will achieve the NAAQS by the required date. After an area comes into attainment of the NAAQS, the area can be redesignated as a maintenance area and must continue to demonstrate compliance with the NAAQS.

In 1997, the USEPA promulgated the first 8-hour ozone NAAQS with a threshold of 0.08 parts per million (ppm) (84 parts per billion [ppb]). On March 12, 2008, the USEPA promulgated a more stringent 0.075 ppm (75 ppb) 8-hour ozone NAAQS. **Figure C-2** presents the current ozone nonattainment areas in the southeastern U.S. On October 1, 2015, the USEPA strengthened the 8-hour NAAQS for ozone to 0.07 ppm (70 ppb). Under this more stringent ozone NAAQS, there may be more areas in the southeastern U.S. that will be in nonattainment. The USEPA plans to make attainment and nonattainment designations for the revised standards by late 2017, with the designations based on 2014-2016 air quality data.

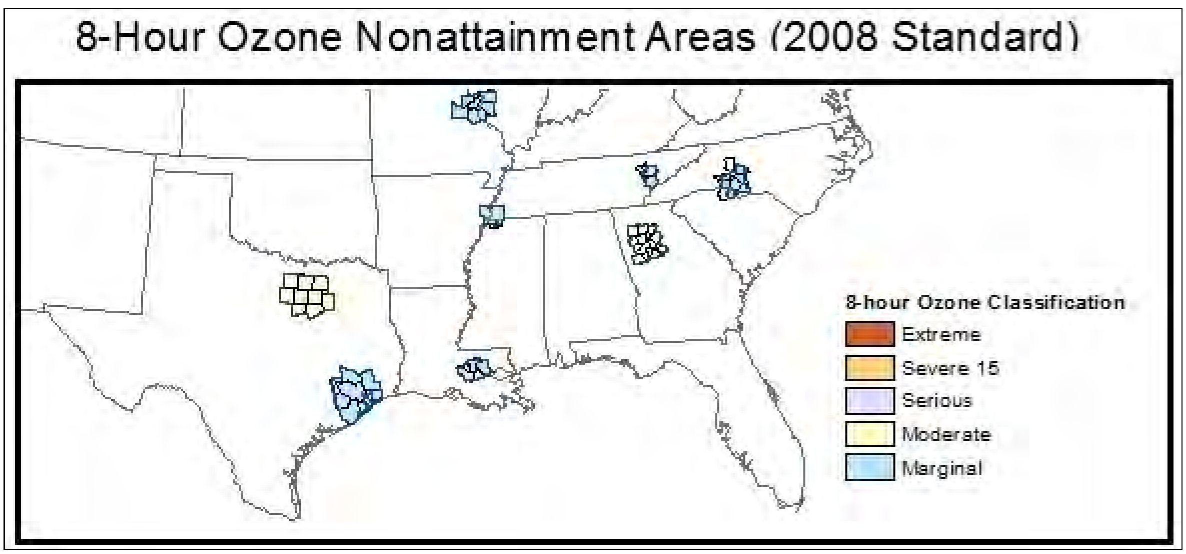

Figure C-2. Ozone Nonattainment Areas in the Southeastern U.S. (USEPA, 2016a).

On December 14, 2012, the USEPA revised the $PM_{2.5}$ primary NAAQS by lowering the annual $PM_{2.5}$ NAAQS threshold from 15.0 micrograms per cubic meter (μg/m^3) to 12.0 μg/m^3. The USEPA retained the 24-hour $PM_{2.5}$ primary NAAQS at 35 μg/m^3. The 24-hour coarse PM NAAQS (PM_{10}) was also retained at 150 μg/m^3.

In February 2010, the USEPA issued a new 1-hour NO_2 NAAQS with a threshold of 100 ppb (98th percentile daily maximum average over 3 years) and a new 1-hour SO_2 NAAQS was promulgated in June 2010 with a threshold of 75 ppb (99th percentile averaged over 3 years). The USEPA has not yet designated the nonattainment areas for the 1-hour NO_2 and 1 hour SO_2 NAAQS.

A new lead NAAQS was issued in 2008; NAAs for lead are associated with specific industrial sources. The NAAQS for carbon monoxide has remained essentially unchanged since it was originally promulgated in 1971. As of September 27, 2010, all NAAs for carbon monoxide have been redesignated as maintenance areas. **Table C-1** summarizes the nonattainment and maintenance areas in the southeastern U.S.

Table C-1. Nonattainment and Maintenance Areas in the Southeastern U.S.

State	Area	8-hr O_3 (1997)	8-hr O_3 (2008)	SO_2 (2010)	Lead (2008)
Alabama	Troy, AL				NAA[a]
Florida	Tampa, FL				NAA
	Hillsborough County, FL			NAA	
	Nassau County, FL			NAA	
Louisiana	Baton Rouge, LA	M[b]	NAA		
	St. Bernard Parish, LA			NAA	
Texas	Beaumont-Port Arthur, TX	M			
	Houston-Galveston-Brazoria, TX	NAA	NAA		
	Frisco, TX				NAA

[a] NAA = nonattainment area
[b] M = maintenance area
Blank cells indicate the area is in attainment of the NAAQS.

The CAAA designated 156 Class I areas consisting of National Parks and Wilderness Areas that are offered special protection for air quality and air quality-related values (AQRVs). The Class I areas, compared to Class II areas, have lower Prevention of Significant Deterioration (PSD) air quality increments that new sources may not exceed and are protected against excessive increases in several AQRVs including visibility impairment, acid (sulfur and nitrogen) deposition, and nitrogen eutrophication. The Regional Haze Rule (RHR) has a goal of natural visibility conditions by 2064 at Class I areas, and States must submit RHR SIPs that demonstrate progress towards that goal. **Figure C-1** displays the locations of the mandatory Class I areas (in purple) in the Gulf of Mexico OCS Region. In addition to Class I areas, Federal Land Management (FLM) agencies have designated certain other areas as sensitive Class II areas for tracking PSD increment consumption and AQRV impacts.

On August 26, 2014, BOEM contracted with Eastern Research Group, Inc. (ERG) and team members Ramboll Environ US Corporation (Ramboll Environ) and Alpine Geophysics, LLC to complete a comprehensive air quality modeling study in the Gulf of Mexico OCS Region. Under BOEM Contract Number M14PC00007, air quality photochemical grid modeling (PGM) will be conducted in the Gulf of Mexico OCS Region to assess the impacts to nearby States of OCS oil and gas exploration, development, and production as required under OCSLA. This assessment is used by BOEM in the cumulative and visibility impacts analyses of the National Environmental Policy Act (NEPA) environmental impact statements (EISs), which are the *Gulf of Mexico OCSOil and Gas Lease Sales: 2017-2022; Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261—Final Multisale Environmental Impact Statement* (2017-2022 GOM Multisale EIS) and this Supplemental EIS. These analyses address both current and proposed NAAQS.

Air quality modeling requires several input datasets, including meteorology, emissions inventories, and ambient pollutant concentrations. **Figure C-3** presents an overview of how these project datasets fit together for the "Air Quality Modeling in the Gulf of Mexico Region" study.

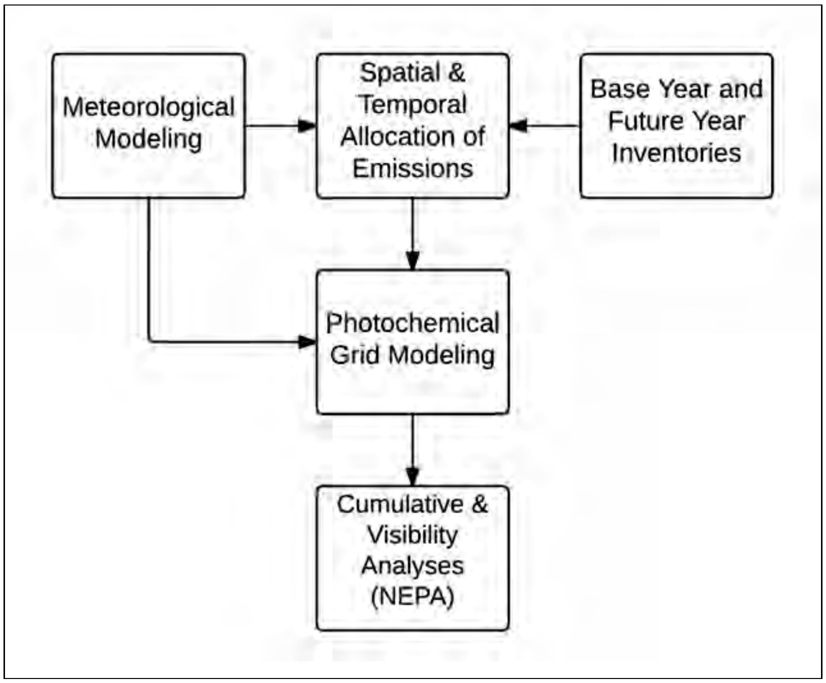

Figure C-3. Overview of the "Air Quality Modeling in the Gulf of Mexico Region" Study Tasks.

C.2 Development of Emission Inventories

A key step in performing the "Air Quality Modeling in the Gulf of Mexico Region" study in support of the subsequent cumulative and visibility impacts analyses is development of comprehensive air emission inventories that accurately depict the base case emissions within the study area, and emissions associated with the scenario (the future year) for the 2017-2022 GOM Multisale EIS and this Supplemental EIS.

The scope of the air pollutant emissions inventory development effort for the "Air Quality Modeling in the Gulf of Mexico Region" study includes selection of: pollutants, base case year, geographical domain, sources, spatial resolution, temporal resolution, speciation, and development of the base case and future year emission estimates. These elements are described below.

C.2.1 Pollutants

Pollutants for the "Air Quality Modeling in the Gulf of Mexico Region" study consist of criteria air pollutants as defined by CAA Title I: CO; lead; NO_x (stated as equivalent mass of nitrogen dioxide [NO_2]); $PM_{2.5}$; PM_{10}; and SO_2, as well as volatile organic compounds (VOCs, which are precursors to ozone formation) and ammonia (NH_3, a precursor to PM formation).

C.2.2 Base Case Year

In determining the base case year for the "Air Quality Modeling in the Gulf of Mexico Region" study emissions inventory, 2011 was initially selected based on data availability. Calendar year 2011 emissions data are readily available for most sources from the USEPA National Emissions Inventory (NEI) (USEPA, 2015a), and BOEM's *Year 2011 Gulfwide Emissions Inventory Study* (Wilson et al., 2014), hereby called the "2011 Gulfwide Inventory." However, 2011 was an unusually hot and dry year in the Gulf of Mexico OCS Region, particularly in Texas, which experienced record heat and dry conditions during the summer of 2011 and had a very high incidence of wildfires. Therefore, 2012 was selected as the base case year as more representative of "typical" conditions in the Gulf of Mexico OCS Region.

C.2.3 Geographical Domain

The domain of the "Air Quality Modeling in the Gulf of Mexico Region" study emissions inventory is the area depicted in **Figure C-4**, particularly the 4-kilometer (km) domain encompassing the Gulf of Mexico OCS. This area, which includes parts of Alabama, Georgia, Louisiana, Mississippi, and Texas; all of Florida; as well as the Western, Central, and Eastern Planning Areas in the Gulf of Mexico and part of the Atlantic Ocean, are the main focus of the emissions inventory efforts. Emissions data were also required for the 36- and 12-km expanded domains depicted in **Figure C-4**, which include parts of Mexico and Canada. The outermost domain with 36-km resolution includes the entire continental U.S. and parts of Canada and Mexico, and captures synoptic-scale (storm system-scale) structures in the atmosphere. The inner 12-km regional grid covers the southeastern U.S. and is used to ensure that large-scale meteorological patterns across the region are adequately represented and to provide boundary conditions to the 4-km domain.

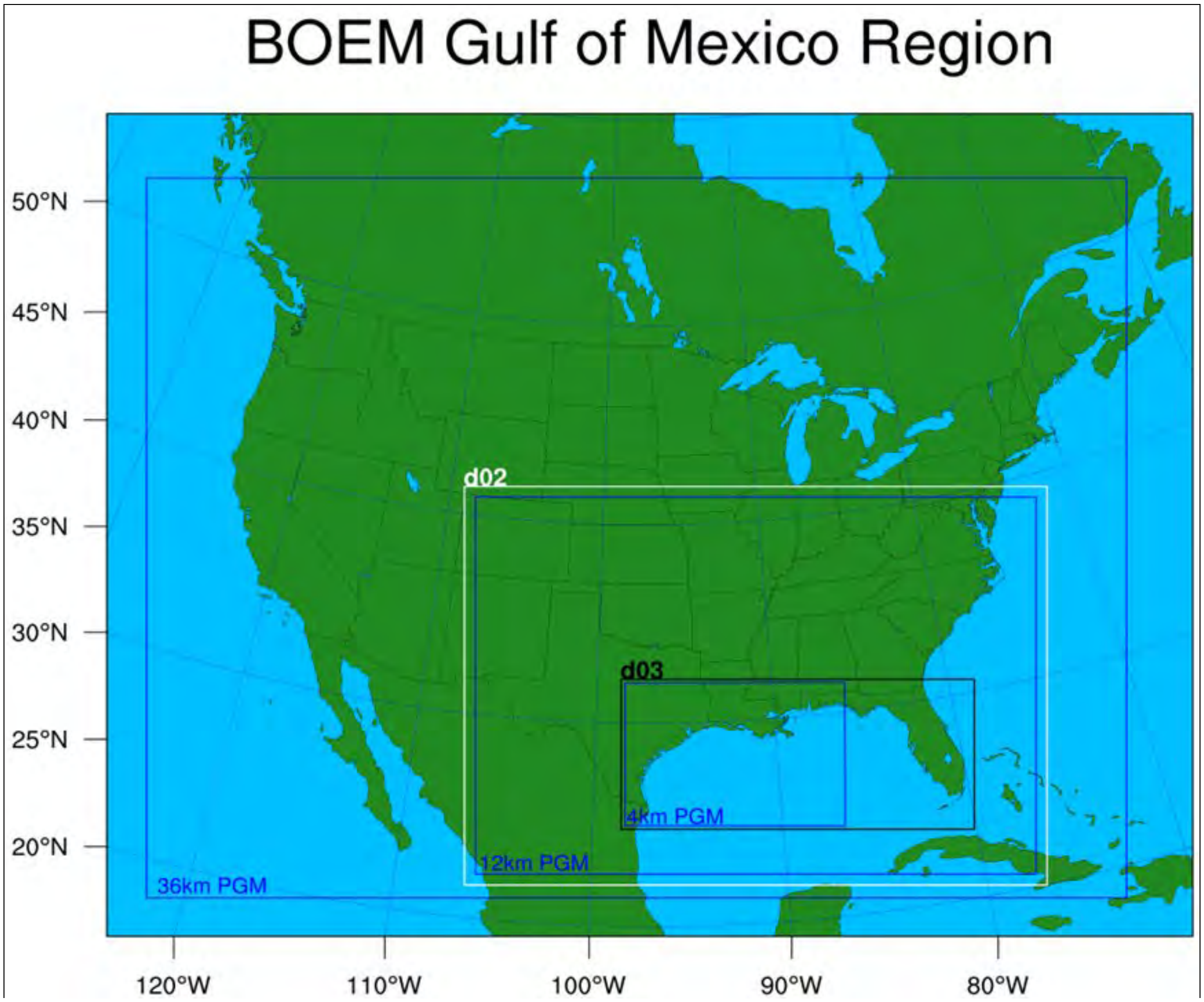

Figure C-4. WRF 36-km CONUS (d01), 12-km SE Regional (d02), and 4-km Gulf of Mexico Region (d03) Domains Along With the PGM Grids.

C.2.4 Inventory Sources

Emissions from anthropogenic (i.e., human caused) sources, including stationary point and nonpoint area sources located both onshore and offshore, onroad motor vehicles, nonroad equipment, locomotives, marine vessels and other offshore sources, and airports, were compiled for the "Air Quality Modeling in the Gulf of Mexico Region" study emissions inventory. **Table C-2** lists the source groups and categories included in the emissions inventory, along with the pollutants applicable to each source, and the spatial and temporal resolution. Note that emissions from non-anthropogenic sources (i.e., biogenic and geogenic sources) are also included as part of the "Air Quality Modeling in the Gulf of Mexico Region" study cumulative and visibility analyses.

Table C-2. Gulf of Mexico Air Quality Modeling Study Source Categories.

Group	Source Category	CO	NO_x	SO_2	VOC	Pb	$PM_{2.5}$	PM_{10}	NH_3	Spatial Resolution[a]
NEI Onshore Sources	Point Sources	✓	✓	✓	✓	✓	✓	✓	✓	P
	Nonpoint Area Sources	✓	✓	✓	✓	✓	✓	✓	✓	A
	Onroad Mobile Sources	✓	✓	✓	✓		✓	✓	✓	A
	Commercial Marine Vessels	✓	✓	✓	✓	✓	✓	✓	✓	P, A[b]
	Locomotives	✓	✓	✓	✓	✓	✓	✓	✓	P, A[c]
	Aircraft and Airports	✓	✓	✓	✓	✓	✓	✓	✓	P
	Other Nonroad Mobile Sources	✓	✓	✓	✓		✓	✓	✓	A
Offshore Oil & Gas Sources	Platforms in State Waters	✓	✓	✓	✓		✓	✓		P
	Platforms in Central and Western GOM OCS Planning Areas	✓	✓	✓	✓	✓	✓	✓	✓	P
	Drilling Rigs	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Pipe-Laying Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Support Helicopters	✓	✓	✓	✓		✓	✓		LB
	Support Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Survey Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
Non-oil and Gas Offshore Vessels and Activities	Commercial Fishing Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Commercial Marine Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Louisiana Offshore Oil Port	✓	✓	✓	✓	✓	✓	✓	✓	P
	Military Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Recreational Vessels	✓	✓	✓	✓		✓	✓	✓	LB
	Vessel Lightering	✓	✓	✓	✓	✓	✓	✓	✓	P
Biogenic and Geogenic Sources	Subsurface Oil Seeps				✓					LB
	Mud Volcanoes				✓					LB
	Onshore Vegetation		✓		✓					A
	Wildfires and Prescribed Burning	✓	✓	✓	✓		✓	✓	✓	P
	Windblown Dust						✓	✓		A
	Lightning		✓							A
	Sea Salt Emissions						✓	✓		A
Sources in Mexico and Canada	Point Sources	✓	✓	✓	✓	✓	✓	✓		P
	Nonpoint Area Sources	✓	✓	✓	✓		✓	✓		A
	Mobile Sources	✓	✓	✓	✓		✓	✓		A

[a] A = Area source (modeling grid cell, spatial surrogate); P = Point source (UTM coordinates, stack parameters); LB = Offshore lease block (modeling grid cell, spatial surrogate)
[b] Larger ports and shipping will be represented as shape files; smaller ports as point sources.
[c] Rail yards will be represented as point sources; railway segments as area sources.

C.2.5 Spatial Resolution

The spatial resolution of the emissions inventory is source-specific. For example, sources such as power plants are identified based on their geographic coordinates (i.e., latitude and longitude), while other sources such as nonroad mobile sources (e.g., construction equipment) are spatially distributed using surrogates within the county in which they are reported and that are typically related to the activity distribution of the category (e.g., construction sites).

The resolution of the geographical area covered by the emissions inventory is based on the grid cell size needed for photochemical modeling. Furthermore, the photochemical model grid resolution is dependent on the grid resolution of the WRF meteorological model output used.

C.2.6 Temporal Resolution

Emissions for all sources were estimated on an annual basis (i.e., emissions generated during 2012). For electric generating units (EGUs), emissions were allocated on a sub-annual basis to reflect variations in activity using data from the USEPA.

Emissions were allocated on an hourly, daily, and seasonal basis using default temporal allocation factors provided with the Sparse Matrix Operator Kernel Emissions (SMOKE) emissions model for some sources; other temporal allocations were source-specific, and profiles were developed and applied within the SMOKE model.

C.2.7 Speciation

When applying the PGM modeling, PM emissions were allocated to individual PM species as part of the SMOKE emissions processing using PM speciation factors obtained from the USEPA's SPECIATE database (USEPA, 2014a) for each source category (as defined by the Source Classification Code). This resulted in the PM mass being broken into the mass associated with elemental carbon (EC), organic carbon (OC), and other elements, and particle-bound VOCs, such as polycyclic aromatic hydrocarbons (PAHs). The model predictions of EC will undergo further analysis and will be discussed in the "Air Quality Modeling in the Gulf of Mexico Region" study final report.

SMOKE was also used to convert VOC emissions into the photochemical mechanism-specific (e.g., CB05 or CB6r2h) model species used in air quality models.

C.3 BASE CASE EMISSION ESTIMATES

This section presents an overview of the methodologies used to compile the base case 2012 emission estimates for all source categories in the emissions inventory.

C.3.1 Point Sources

Calendar year 2011 emissions data are available for onshore point sources from the USEPA NEI (USEPA, 2015a). In a separate modeling effort, the USEPA prepared a criteria pollutant calendar 2012 year emissions inventory for some sectors, including onshore point sources (USEPA, 2015b). The ERG obtained the USEPA 2012 point sources emissions inventory, conducted quality assurance/quality control (QA/QC) on the data, and supplemented and revised the criteria pollutant estimates, as needed. The USEPA prepared the 2012 point source emissions inventory as follows:

(1) 2012 data compiled by the USEPA from annual criteria pollutant reporting of Type A (large) sources that are submitted by responsible State and local air agencies;

(2) 2012 EGU emissions from the USEPA Clean Air Markets Division (CAMD) hourly emissions data;

(3) 2011 NEI data for other, smaller point sources that are not identified above; and

(4) 2011 airport and aircraft emission estimates developed by the USEPA updated to 2012 as needed.

Although the emissions data are likely complete for most point sources, ERG confirmed that offshore platforms within State boundaries are included in the NEI. Data from the USEPA's 2012 Toxics Release Inventory (TRI) for lead and ammonia were also used to supplement the inventory as needed (USEPA, 2015c).

C.3.2 Nonpoint Area Sources

The starting point for the 2012 nonpoint area source inventory was the data submitted by State and local agencies for the 2011 NEI. In addition, for completeness, the USEPA develops emission estimates for a number of nonpoint source categories (up to 165) for inclusion in the NEI if agencies do not provide estimates. The USEPA did not develop 2012 emission estimates for nonpoint area sources. The ERG prioritized key top-emitting source categories of NO_x, PM, SO_2, and VOCs in AL, FL, GA, LA, MS, and TX, and developed 2012 emission estimates using the USEPA nonpoint area source category tools (USEPA, 2014b). These categories are as follows: consumer products, architectural surface coatings, industrial maintenance coatings, open burning: municipal solid waste (MSW), residential and institutional/commercial/industrial (ICI) heating, upstream oil and gas, open burning, land clearing debris, paved and unpaved roads, and gasoline distribution Stage I. The ERG also conducted point source reconciliation for ICI heating, oil and gas, and gasoline distribution Stage I to verify that there are no gasoline distribution Stage II records in USEPA's nonpoint file (now reported with onroad mobile sources).

C.3.3 Mobile Sources

The onroad mobile source category includes exhaust and evaporative emissions from onroad motor vehicles (e.g., automobiles, light-duty trucks, heavy-duty trucks) and exhaust and evaporative emissions from nonroad mobile sources. The ERG team ran the MOVES2014 model for onroad sources (USEPA, 2014c), and the USEPA ran the NONROAD model for nonroad sources to develop 2012 emission estimates for these categories. Locomotive emissions in the 2011 NEI were not adjusted to represent 2012 activities because it was confirmed that the 2011 and 2012 fuel usage data from the Surface Transportation Board's R-1 Class 1 railroad annual reporting data (Surface Transportation Board, 2015) show only a slight (2%) reduction in 2012 levels from 2011 levels.

C.3.4 Offshore Helicopters

The Gulf of Mexico has more helicopter traffic than any other region of the U.S., primarily associated with offshore oil and gas support. Offshore support helicopter emission estimates were obtained from the 2011 Gulfwide inventory (Wilson et al., 2014). The estimates were supplemented with 2011 NEI helicopter data for onshore airports. The two datasets map out the full route between offshore platforms equipped with helipads and the closest onshore support facility; the NEI addresses emissions only at each airport and only for operations up to 3,000 feet of elevation (i.e., local mixing height). The two datasets were evaluated to ensure that the helicopter traffic data between the two are comparable and that there is no double counting of emissions.

C.3.5 Offshore Oil and Gas Production Sources—Western and Central/Eastern Planning Areas in the Gulf of Mexico

The starting point for offshore oil and gas production platforms in the Western and Central/Eastern Planning Areas (WPA and CPA/EPA) was the 2011 Gulfwide inventory. The ERG team supplemented the 2011 Gulfwide inventory with NH_3 and Pb emission estimates for all applicable emission sources using USEPA emission factors. The ERG team conducted research to determine if the 2011 emissions values for platform sources should be adjusted to be more representative of 2012 emissions values. Offshore oil and gas production values for 2011 and 2012 were obtained from the BOEM Part A Oil and Gas Operations Reports (OGOR) (USDOI, BOEM, 2015). The OGOR data are presented at the lease level. Production of both oil and gas (including deepwater production) decreased from 2011 to 2012; thus, the 2011 emission estimates were modeled without adjustment in order to be conservative. **Table C-3** presents the base case emission estimates for offshore oil and gas production sources in the WPA and CPA/EPA. **Figures C-5 through C-7** show the NO_x, VOC, and $PM_{2.5}$ emissions from platform sources. Platform sources include the following emission source types: amine units, boilers/heater/burners, diesel and gasoline engines, drilling equipment, combustion flares, fugitives, glycol dehydrators, losses from flashing, mud degassing, natural gas engines, natural gas turbines, pneumatic pumps, pressure/level controllers, storage tanks, and cold vents.

Table C-3. Base Case Offshore Oil and Gas Production Source Emissions Estimates for the GOM Western and Central/Eastern Planning Areas.

	NO_X (TPY)	SO_2 (TPY)	PM_{10} (TPY)	$PM_{2.5}$ (TPY)	VOC (TPY)	CO (TPY)	Pb (TPY)	NH_3 (TPY)
Platform Sources	84,128	3,197	838	835	54,724	70,339	<1	40
Non-platform Sources	232,765	22,977	8,632	8,225	7,937	41,880	701	70,139
Total	**316,893**	**26,174**	**9,470**	**9,060**	**62,661**	**112,219**	**701**	**70,179**

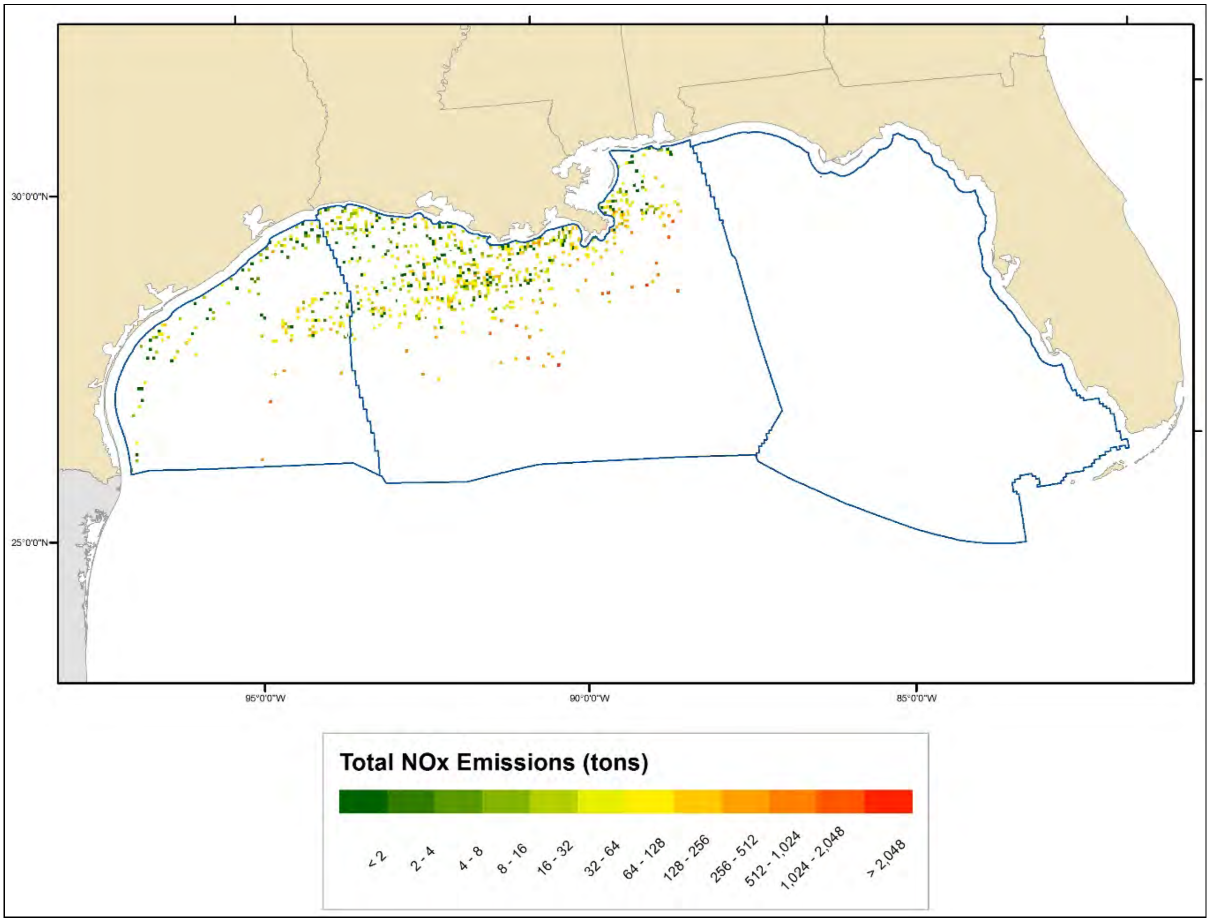

Figure C-5. 2012 Platform NO_x Emissions Aggregated by Lease Block. (Note: This figure does not indicate the platform source count, location, or emissions at the time of publication of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.)

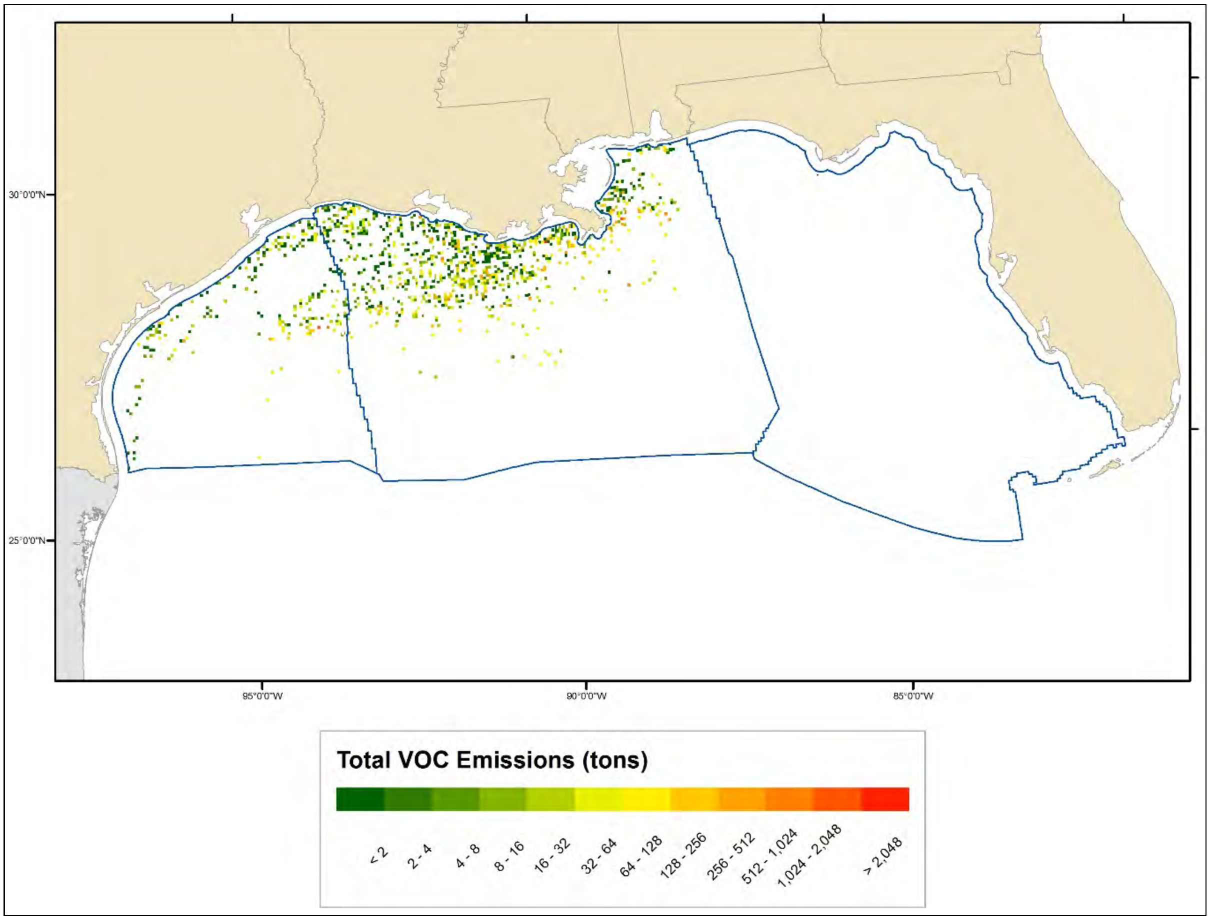

Figure C-6. 2012 Platform VOC Emissions Aggregated by Lease Block. (Note: This figure does not indicate the platform source count, location, or emissions at the time of publication of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.)

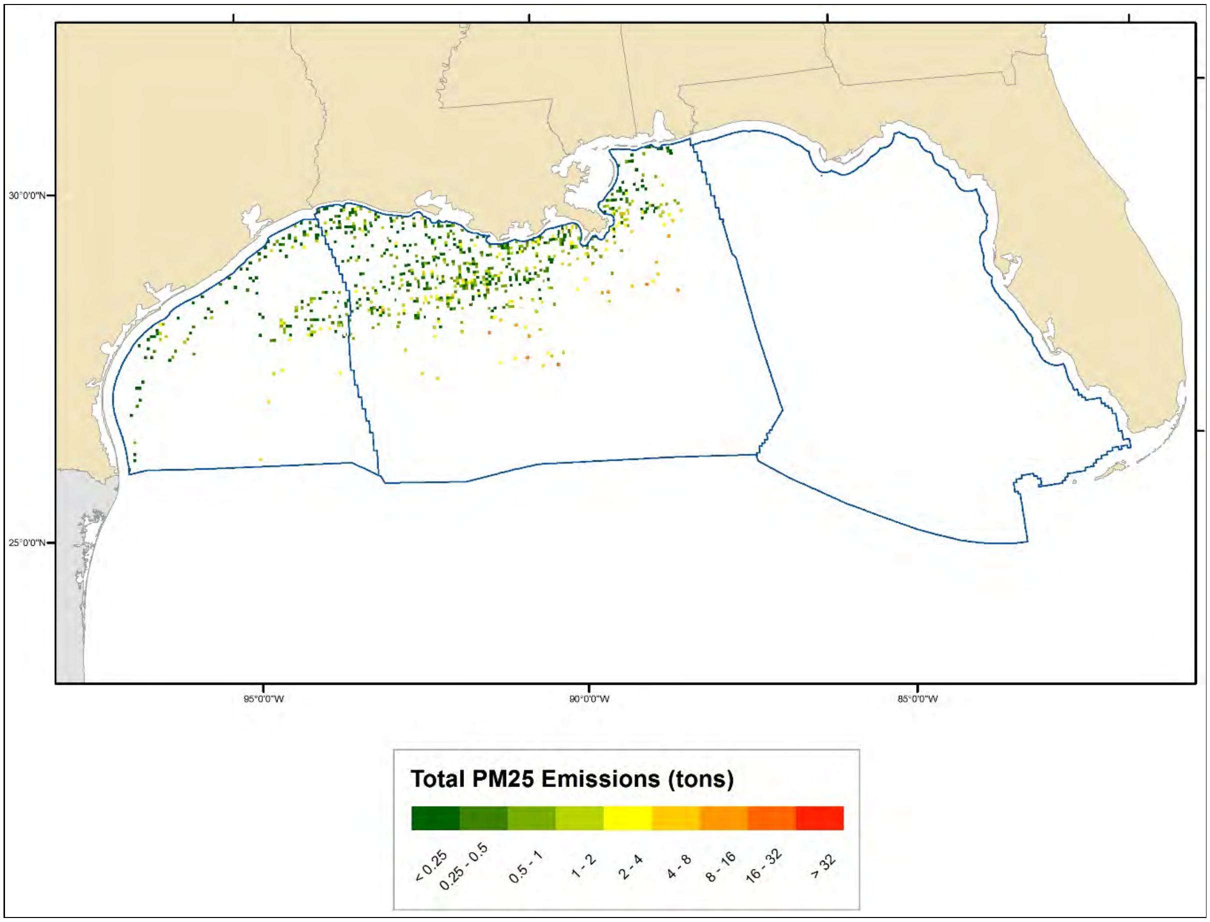

Figure C-7. 2012 Platform $PM_{2.5}$ Emissions Aggregated by Lease Block. (Note: This figure does not indicate the platform source count, location, or emissions at the time of publication of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.)

C.3.6 Offshore Vessels

Offshore vessels can be grouped into vessels that support the construction, operation, and decommissioning of oil and gas platforms; and vessels involved in other commercial, recreational, and military operations. All marine vessels included in this study operate using diesel engines. These include very large propulsion engines as well as smaller auxiliary diesel engines that provide power for electricity generation, winches, pumps, and other onboard equipment. Smaller engines tend to use distillate grade diesel fuel, while large engines are able to combust heavier residual blends.

40 CFR § 1043.109(b) created the North American Emission Control Area (ECA), which includes the Gulf of Mexico (USEPA, 2010). This regulation limits marine fuel sulfur content to 1% after August 1, 2012, for any vessel with a gross tonnage greater than 400. Vessels below this threshold tend to use distillate fuels, which are already at or below the 1% limit.

C.3.6.1 Oil and Gas Production Support Vessels

The offshore oil and gas production sector requires a wide variety of vessels to support the exploration, development, and extraction of oil and gas, including the following:

- seismic survey vessels;
- drilling vessels;
- pipe-laying vessels;
- crewboats; and
- supply vessels.

For the 2011 Gulfwide inventory, Automatic Identification System (AIS) data from PortVision were used to map spatial aspects of vessel movements (PortVision, 2012). The AIS is an automated tracking system that allows exchanges of location and contact data with other nearby ships, offshore platforms, satellites, and AIS base stations, enhancing navigation and reducing at-sea collisions.

On October 22, 2003, the U.S. harmonized the AIS mandates of the Safety of Life at Sea Convention with the Maritime Transportation Security Act of 2002 (MTSA), which requires the following vessels, including offshore support vessels, to participate in the AIS program:

(1) passenger vessels of 150 gross tonnage or more;

(2) tankers, regardless of tonnage; and

(3) vessels other than passenger vessels or tankers of 300 gross tonnage or more.

Vessels that do not meet these thresholds, such as crew boats and smaller support vessels, can still participate in AIS on a voluntary basis. The Offshore Marine Service Association (OMSA) is encouraging its membership to equip their vessels with AIS transponders, allowing for more efficient and safer ship movements in the highly congested central and western areas of the Gulf of Mexico.

The ERG team used the spatially distributed support vessel emission estimates from BOEM's 2011 Gulfwide inventory. While the USEPA 2011 NEI also includes marine vessel emission estimates for the Gulf of Mexico, the emission estimates were derived from national vessel activity data. During QA/QC of the 2011 BOEM Gulfwide estimates, ERG found and corrected an error in the vessel power rating for a number of smaller vessels.

As discussed above for offshore oil and gas production platforms, the 2011 emission estimates for these vessels were not adjusted to reflect 2012 production levels. SO_x and PM (associated with sulfates) were not adjusted to account for the introduction of low sulfur ECA compliant fuel in the last 5 months of 2012 because it was determined that most support vessels are

Category 1 or 2, which already use ECA compliant fuels. Emission estimates for NH_3 and Pb were also developed for vessels. **Table C-3** presents the base case emission estimates for drilling rigs, pipe-laying operations, support helicopters, support vessels, and survey vessels. **Figures C-8 through C-10** show the NO_x, VOC, and $PM_{2.5}$ emissions from non-platform sources.

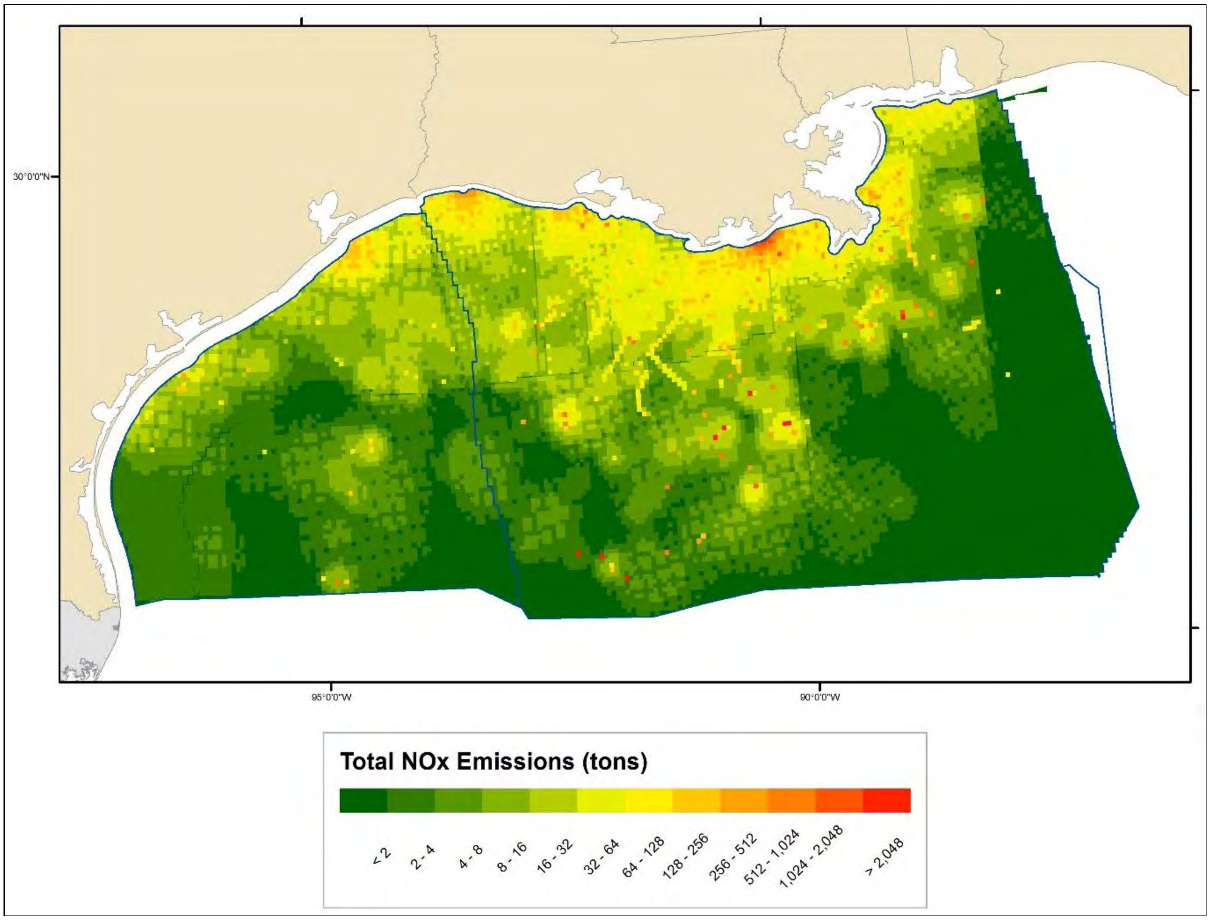

Figure C-8. 2012 Non-platform NO_x Emissions. (Note: This figure does not indicate the non-platform source count, location, or emissions at the time of publication of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.)

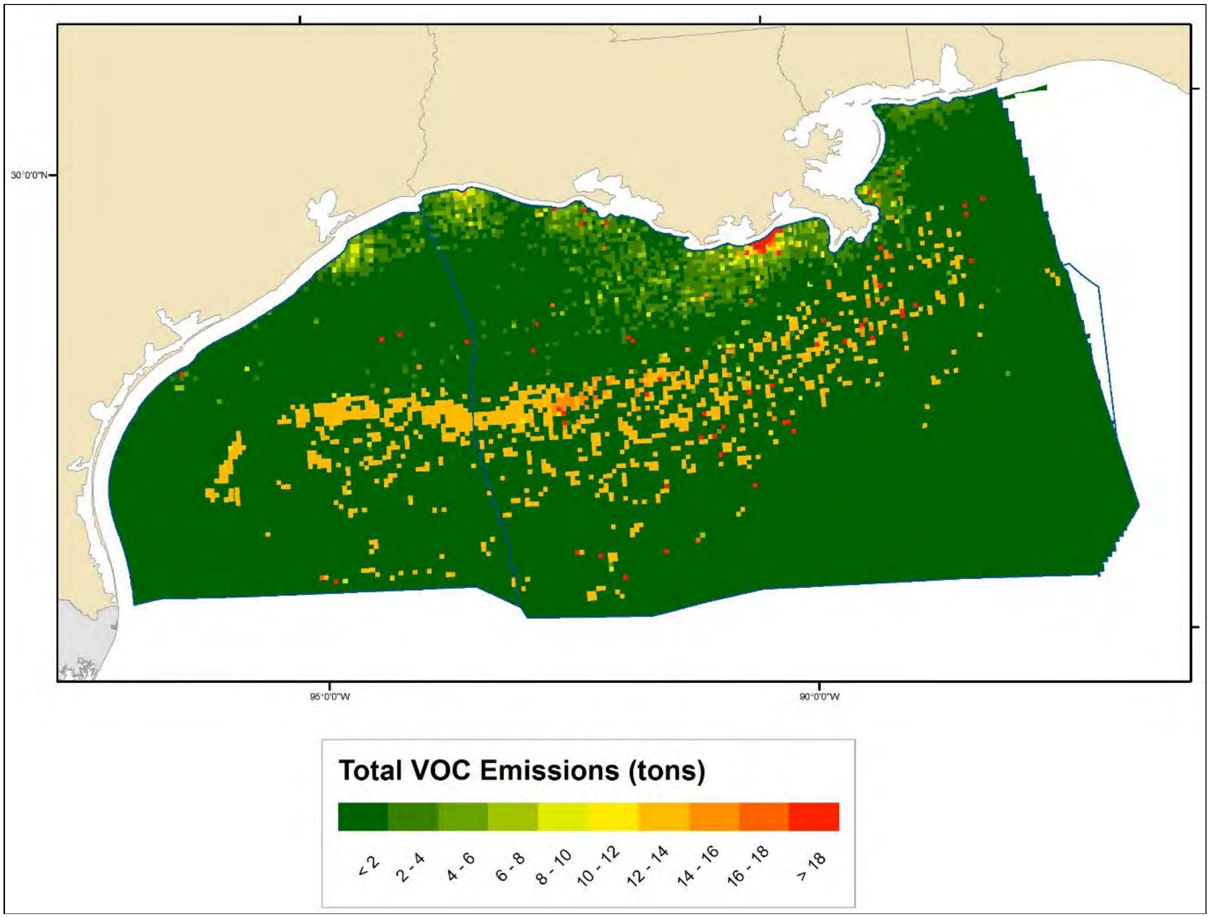

Figure C-9. 2012 Non-platform VOC Emissions. (Note: This figure does not indicate the non-platform source count, location, or emissions at the time of publication of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.)

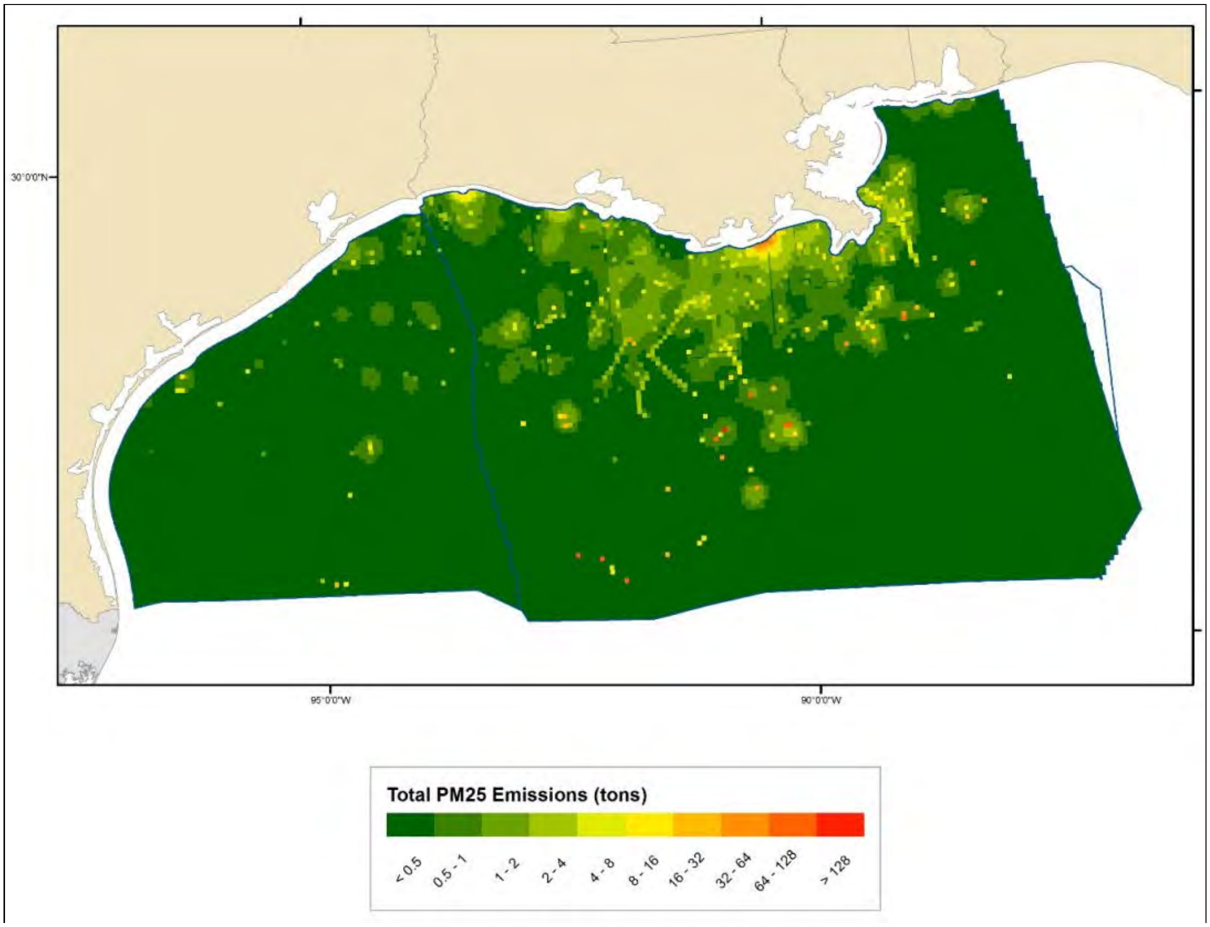

Figure C-10. 2012 Non-platform $PM_{2.5}$ Emissions. (Note: This figure does not indicate the non-platform source count, location, or emissions at the time of publication of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.)

The ERG team obtained drilling vessel data from BSEE to confirm that there was no drilling activity in the eastern Gulf of Mexico OCS region in 2012, and reviewed the permits granted by the USEPA for offshore platforms in the eastern Gulf of Mexico OCS region to confirm there were no active production platform activities in 2012.

C.3.6.2 Non-Oil and Gas Production Offshore Vessels

Vessels not directly associated with the offshore oil and gas activities include the following:

- commercial marine vessels;
- Louisiana Offshore Oil Port-associated vessels;
- commercial and recreational fishing vessels;
- ferries;
- research vessels;

- harbor craft; and
- military vessels.

Commercial marine vessels include large ships involved in international trade that visit coastal ports and operate in deep waters, as well as smaller general cargo ships and tugs that move barges along waterways and rivers. For the Federal waters of the central and western of the Gulf of Mexico, the ERG team used the commercial marine vessel data from the 2011 Gulfwide inventory. For completeness, for all other areas of the Gulf of Mexico, Atlantic Ocean, and State waters, the USEPA's NEI data were used (which were developed from national vessel activity data as noted above). These inventories cover different geographical areas than the BOEM inventory, as well as different vessel types. BOEM's data include large deepwater vessels as does the USEPA data beyond the Federal/State boundary, but they also include vessels such as ferries, dredging vessels, tugs, towboats, and harbor craft that tend to operate only in State waters.

The Louisiana Offshore Oil Port (LOOP) is a pumping platform for tankers to discharge imported crude oil to the mainland without having to maneuver through port traffic. Similarly, there are four offshore lightering zones in the Gulf of Mexico (i.e., Southtex, Gulfmex No. 2, Offshore Pascagoula No. 2, and South Sabine Point) where smaller shuttle tankers can move product from very large crude carriers, bringing the oil to port while the large tankers remain off the coast. Tankers that visit the LOOP or the lightering zones along with the shuttle tankers were identified in the 2011 Gulfwide inventory. The inventory also accounts for evaporative emissions from unloading and loading activities, and emissions from the operation of generators and pumps at the LOOP; adjustments were made to the 2011 LOOP emission estimates to reflect the 18% decline in crude imports in 2012.

Emissions from the operation of commercial and recreational fishing vessels are also included in the 2011 Gulfwide inventory for Federal waters. These were supplemented with the USEPA's 2011 NEI data for these fishing vessels for operations in the Eastern Planning Area in the Gulf of Mexico, Atlantic Ocean, and State waters. For military vessels, the ERG team used the 2011 Gulfwide inventory Navy and Coast Guard vessel emission estimates and the NEI's Coast Guard emission estimates for State waters, as well as Federal waters in the eastern part of the Gulf of Mexico and the Atlantic Coast. The ERG team conducted research to determine that activity levels from 2011 to 2012 were similar for the other non-oil and gas vessels (e.g., tankers, container ships, bulk, and general cargo). Based on the most recent International Maritime Organization data (IMO, 2015), fuel combustion is projected to remain constant from 2010 to 2015. Thus, no adjustments were needed to approximate activities in 2012.

The SO_2 and PM (associated with sulfates) emission estimates were adjusted for Category 3 vessels to account for the introduction of low sulfur ECA-compliant fuel in the last 5 months of 2012.

C.3.7 Biogenic and Geogenic Sources

For completeness, it is important to include non-anthropogenic emission sources in the inventory. The ERG team also estimated emissions for the sources listed below.

- Onshore vegetation (biogenic): MEGAN (version 2.1) biogenic emission model
- Wildfires, prescribed burns, and agricultural burning: USEPA's SMARTFIRE emissions inventory for the U.S.
- Windblown dust: Windblown dust (WBD) modeling using the WRF meteorological dataset
- Lightning: WRF data (preprocessor)
- Subsurface oil seeps: 2011 Gulfwide inventory
- Mud volcanoes: 2011 Gulfwide inventory
- Sea salt emissions: WRF data (preprocessor)

The ERG team used fire emission estimates from the National Center for Atmospheric Research (NCAR) Fire INventory (FINN) for Mexico and Canada.

C.3.8 Sources in Mexico

The ERG team developed the 2012 emission inventories for the portions of Mexico within the 36-km modeling inventory domain using the municipality-level emission files from the 2008 Mexico National Emissions Inventory (MNEI) (SEMARNAT, 2014) combined with projection factors for point, nonpoint area, and nonroad mobile sources. Mexico onroad motor vehicle emissions were generated using a version of the USEPA vehicle emissions model MOVES, updated to reflect conditions in Mexico. MOVES2014 was the most recent version of the model available at the time of the analysis and reflects USEPA's latest estimate of vehicle emissions and default U.S. activity data (USEPA, 2014c). The ERG also conducted research on the offshore oil production activities off the coast of Mexico. Based on a report published by the Congressional Research Service, it was determined that there was no offshore production within the 36-km modeling domain in 2012 (Seelke et al., 2015).

C.3.9 Sources in Canada

Emissions from the USEPA's most recent modeling platform (2010) were used for sources in Canada.

C.4 FUTURE YEAR MODELING SCENARIO EMISSION ESTIMATES

Emission estimates were also needed as inputs for additional modeling scenarios that will predict future impacts from implementation of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. For modeling the future year impacts, the ERG team forecast emissions estimates based on information provided by BOEM, combined with USEPA projected emission estimates and other data for onshore sources and marine vessels and other sources outside of the GOM region. The ERG team confirmed that offshore drilling in the EPA under USEPA air quality jurisdiction is included in BOEM's *2017-2022 Outer Continental Shelf Oil and Gas Leasing: Proposed Final Program* (Five-Year Program) spreadsheets. The ERG also reviewed the USEPA's offshore oil and gas production permits to confirm that no production platforms were permitted to be constructed prior to or during 2017. Projected emission estimates were developed for anticipated offshore drilling off the coast of Mexico.

C.4.1 Western, Central, and Eastern Planning Areas OCS Offshore Oil and Gas Production Sources

The ERG team developed annual emission estimates for all categories and pollutants for each year of activity for OCS offshore oil and gas production sources associated with the Five-Year Program using BOEM's spreadsheet-based data analyses tools. BOEM provided information on the predicted levels of activity, sources, and locations (by planning area and water depth) to depict offshore oil and gas activities in the future scenario. The emissions estimates are based on a mid-price oil case scenario and cover the WPA, CPA, and EPA, which are under BOEM's jurisdiction.

After completion of the OCS offshore oil and gas production source emission estimates, the resulting cumulative emissions for each pollutant were assessed to determine which emission estimates should be selected for PGM modeling to support the cumulative and visibility impacts analyses.

Based on information provided by BOEM, it was assumed that emissions for the following sources occur during the total period of proposed activity based on the 2017-2022 GOM Multisale EIS scenario (2017-2056)[1], from which this Supplemental EIS tiers:

- exploration and delineation well drilling activities (1,671 wells drilled);
- development and production well drilling activities (1,135 wells drilled);
- platform installation activities (535 platforms installed);
- FPSO installation (1 FPSO installed);
- FPSO operation (1 FPSO operating);
- FPSO removal (1 FPSO removed);
- pipeline installation excluding State waters (7,251 km of pipeline installed);

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[1] Excluding the Gulf of Mexico Energy Security Act (GOMESA) moratorium area.

- platform oil and gas production (535 platforms in operation);
- platform removal (535 platforms removed);
- support helicopters (642,000 round trips); and
- support vessels (1,062,000 operations).

The BOEM data analyses tools provide information on each of these anticipated activities by year, as well as water depth. The anticipated water depths by planning area were used to spatially allocate the emissions.

The ERG used this information to develop emission estimates for each source category based on emission estimation methods used in past Gulfwide emissions inventory studies and other data compiled for BOEM in order to determine which estimates should be selected for photochemical modeling to support the cumulative and visibility impacts analyses.

The following sections discuss the emission estimation methods that the ERG team used to estimate emissions for the BOEM oil and gas production sources in the future scenario.

C.4.1.1 Oil and Natural Gas Offshore Production Platforms

In order to develop reasonably foreseeable emission estimates for projected oil and natural gas production platforms, the emission factors presented in **Table C-4** were developed based on the 2011 Gulfwide inventory (Wilson et al., 2014). Because deepwater operations may significantly differ from conventional operations in shallower waters, are technologically more sophisticated, and produce at much higher rates, two sets of emission factors were developed and assigned to each projected platform based on water depth. Depths below 200 meters (656 feet) were assigned the shallow-water emission factors, and depths above were assigned deepwater emission factors.

Emission estimates for platform sources were developed based on platform installation and carried forward until the projected platform removal dates (provided by planning area and water depth).

Table C-4. Future Year Production Platform Emission Factors.

Pollutant	Shallow Water Emission Factors (<200 m) (tons/platform/yr)	Deepwater Emission Factors (>200 m) (tons/platform/yr)
CO	56	192
NO_x	46	582
PM_{10}-PRI	0.5	5.17
$PM_{2.5}$-PRI	0.50	5.15
SO_2	0.51	44
VOC	22	96
Pb	2.38E-05	3.79E-03
NH_3	0.0349	0.49

Source: Developed from the *Year 2011 Gulfwide Emissions Inventory* (Wilson et al., 2014).

C.4.1.2 Offshore Support Helicopters

The ERG team obtained helicopter emission factors from the Switzerland Federal Office of Civil Aviation (FOCA) Guidance on Determination of Helicopter Emissions (FOCA, 2009). However, the landing and takeoff (LTO) cycle used by FOCA was determined to be too short for typical trips taken in the Gulf of Mexico. The time-in-mode values were therefore adjusted based on the International Civil Aviation Organization (ICAO) test cycles, which are considered to be appropriate for offshore operations in the Gulf of Mexico. Because the future fleet mix is unknown, ERG weighted the emission factors using fleet profile data from the Helicopter Safety Advisory Conference (HSAC, 2015). The VOC emission factors were developed by converting the hydrocarbon (HC) emission factors using data from the USEPA's Procedures for Emission Inventory Preparation Volume IV: Mobile Sources (USEPA, 1992). The aggregated general aviation conversion factor of 1.0631 for turbine engines was used because the GOM support helicopter fleet is primarily equipped with turbine engines. The $PM_{2.5}$ emission factors were speciated from PM_{10} factors using USEPA aircraft speciation data, and the SO_2 emission factors were developed based on a typical jet fuel sulfur concentration of 0.05% (UNEP, 2012).

C.4.1.3 Oil and Gas Production Offshore Support Vessels

Four components are needed to estimate future offshore vessel emissions:

- vessel characteristics (engine power and speed);
- engine operating load (percent of maximum engine power);
- hours of operation (typically determined by the distance the vessel travels divided by the vessel speed); and
- appropriate emission factors (grams per kW-hr).

Because there is uncertainty about the location of future activities, it was assumed that a typical vessel trip is 200 nautical miles, which is the round-trip distance from shore to the mid-point of Federal waters.

In projecting future year activity, it is not always possible to identify specific vessels that will be used. Therefore, the use of larger vessels that represent the upper bound of each vessel type was assumed, such that actual future year emissions should be similar to or lower than emission estimates developed using this fleet profile. These vessels were identified based on data compiled from the Information Handling Service (IHS) Register of Ships (IHS, 2015). Vessels from the global fleet were used because these larger ships move internationally based on local demand. It should also be noted that these larger vessels tend to be involved in deepwater activities because they are designed for extended open-water operations. As trends to develop deeper water locations in the Gulf of Mexico continue into the future, it is likely that these larger or similar vessels will support future year activities.

The selected vessels and their characteristics are presented in **Table C-5**. In order to correctly match the vessel to the appropriate emission factors, the vessel engine category is required. The USEPA vessel category was determined by calculating the cylinder volume based on the stroke length and diameter of the cylinder. The USEPA categories are defined by the following cylinder volumes:

- Category 1: Cylinder displacement less than 5 liters;
- Category 2: Cylinder displacement from 5 to 30 liters; and
- Category 3: Cylinder displacement greater than 30 liters.

If a vessel's cylinder volume was unknown, it was assumed that the vessel was powered by a Category 3 propulsion engine. It should also be noted that all of the selected vessels are foreign flagged, but it is assumed that they refuel using U.S.-regulated marine fuels as they shift equipment and supplies from nearby U.S. ports.

Table C-5. Summary of Vessel Characteristics.

Vessel Type	Total Main Power (kW)	Vessel Name	Propulsion Engine Category	Speed (knots)
Drillship	48,666	Rowan Renaissance	3	12
Jackup	12,485	Bob Palmer	2	
(auxiliary)	Not self-propelled			
Platform Rig	8,100	Nabors Mods 087	2	
(auxiliary)	Not self-propelled			
Semisubmersible	22,371	ENSCO 7500	2	3.5
Submersible	3,691	Hercules 78	2	
(auxiliary)	Not self-propelled			
FPSO	14,110[1]	Terra Nova FPSO	2	12.0
FSO	51,519	Africa	3	16.5
Stimulation Vessel	15,840	Norshore Atlantic	2	14
Oil Tanker	13,369	SPT Explorer	3	15
Anchor Handling Vessel	27,000	KL Sandefjord	3	17
Crew Boat	11,520	R. J. Coco Mccall	3	23
Supply Vessel	18,000	Aleksey Chirikov	3	15
Tug Boat	19,990	Yury Topchev	3	15
Pipe-Laying Vessel	67,200	Castorone	3	14

[1] Only distillate oil main engine kW included (430 kW & 2 x 6840 kW). Topside emissions are included in the deepwater production platform estimates.

A vessel's engine power varies relative to the type of operation that is implemented. While cruising in open waters, the propulsion engine load is typically 84% of maximum load; during maneuvering, it can be 60% or lower; and when stationary,. it can be 10% or lower. **Table C-6** presents the aggregated load factors that will be used in this Study for propulsion and auxiliary engines.

Table C-6. Load Factors to be Used in the Future Year Projections.

Vessel Type	Load Factor
Propulsion Cruising	0.8-0.85
Propulsion Idle	0.1
Propulsion Crew/Supply Boat	0.45
Propulsion Drill Ship and Semi-Submersible	0.83
Propulsion Pipe-Laying Vessel	0.16
Propulsion Tug	0.68
Auxiliary Emergency Generator	0.75
Drilling Equipment	1

The future year emission factors were developed in terms of grams of pollutant emitted per load-adjusted engine kW-hours based on the emission factors used in the USEPA's 2014 NEI (**Table C-7**). The factors presented below are applicable for foreign-flagged vessels that are not required to comply with USEPA exhaust standards but that must comply with international Emission Control Area (ECA) standards. These future year factors account for the reduction in fuel sulfur level associated with the ECA. Because Category 2 foreign-flagged offshore support vessels will be refueling at U.S. ports, it was anticipated that these vessels will use low sulfur compliant U.S. fuels. Also, the NO_x emission factors were adjusted to account for the 2016 ECA Tier III standard that requires high efficiency, after-treatment technology, and is applicable for U.S. and foreign-flagged vessels. The Category 3 PM emission factors were not adjusted to account for reductions in PM as sulfate compounds because the USEPA's adjustment equation provided a PM factor lower than the PM emission factor for Category 2 powered vessels.

Table C-7. Marine Vessel Emission Factors (g/kW-hr).

Engine Category	NO_x	SO_2	PM_{10}	$PM_{2.5}$	VOC	CO	HC	NH_3	Pb
2	3.4	0.006	0.320	0.310	0.141	2.48	0.13	0.005	0.00003
3	3.4	0.362	0.450	0.437	0.632	1.40	0.60	0.003	0.00003

Source: USEPA, 2016b.

C.4.1.4 Future Year Emission Estimates and Selection of Future Modeling Year

The emission estimates developed for the future BOEM oil and gas production sources were reviewed to determine the most suitable future year emissions to model. The PGM modeling for the cumulative and visibility impacts analysis was conducted based on the emissions anticipated to have the greatest impact on the air quality of any state. This was determined based on the estimated annual emission trends. The future highest NO_x emission year for all activities in all planning areas coincided with the highest PM, CO, NH_3, and Pb emissions. These emissions are driven by support vessel activity for the most part. The future highest VOC emission year for all activities in all planning areas coincided with the highest SO_2 emissions and is driven by production platform emissions. **Table C-8** presents the resulting emission estimates, and **Figure C-11** presents a graphical depiction of the annual emission estimates for all pollutants. **Figures C-12 through C-14** present graphical depictions of the annual emission estimates for NO_x, VOC, and $PM_{2.5}$ by source category.

It was concluded that BOEM would model the activity data and resulting emission estimates for year 2033 for non-platform sources, and year 2036 activity data and resulting emission estimates for platform sources.

Table C-8. Emission Estimates for the Western, Central, and Eastern Planning Areas, All Depths, By Year and Pollutant.

Year	NO_x (TPY)	SO_2 (TPY)	PM_{10} (TPY)	$PM_{2.5}$ (TPY)	VOC (TPY)	CO (TPY)	Pb (TPY)	NH_3 (TPY)
2017	3,693	40	360	349	200	2,591	0.03	10
2018	19,328	118	1,813	1,759	1,213	14,058	0.17	80
2019	34,958	158	3,199	3,104	2,150	25,462	0.30	98
2020	46,119	268	4,124	4,001	3,042	33,293	0.39	111
2021	50,126	379	4,368	4,238	3,807	35,937	0.42	125
2022	54,328	446	4,605	4,469	4,535	38,906	0.45	139
2023	57,639	527	4,888	4,743	5,311	41,426	0.48	154
2024	59,979	484	5,030	4,881	5,872	43,637	0.49	170
2025	64,527	523	5,413	5,252	6,543	47,198	0.53	189
2026	70,601	598	5,870	5,696	7,510	51,762	0.57	209
2027	76,146	704	6,305	6,118	8,419	55,747	0.61	228
2028	79,863	742	6,609	6,414	9,125	58,701	0.64	244
2029	85,277	803	7,012	6,805	10,034	62,750	0.68	262
2030	90,332	876	7,381	7,163	11,010	66,523	0.72	280
2031	97,123	984	7,860	7,628	12,185	71,365	0.77	298
2032	100,564	1,022	8,057	7,820	13,228	74,107	0.79	315
2033	**108,447**[1]	1,199	**8,590**	**8,338**	14,709	**79,486**	**0.85**	**334**
2034	101,673	1,193	7,919	7,687	14,939	74,742	0.79	329
2035	102,443	1,253	7,923	7,691	15,484	75,167	0.79	327
2036	103,354	**1,395**	7,865	7,635	**15,940**	75,096	0.79	318
2037	96,715	1,343	7,274	7,062	15,254	70,088	0.74	298
2038	92,539	1,327	6,935	6,732	14,560	66,732	0.71	283
2039	84,787	1,280	6,269	6,087	13,443	60,725	0.65	247
2040	79,475	1,235	5,841	5,672	12,317	56,455	0.61	226
2041	77,705	1,294	5,652	5,488	11,544	54,267	0.60	209
2042	71,710	1,292	5,110	4,962	10,485	49,266	0.55	187

Table C-8. Emission Estimates for the Western, Central, and Eastern Planning Areas, All Depths, By Year and Pollutant. (continued).

Year	NO_x (TPY)	SO_2 (TPY)	PM_{10} (TPY)	$PM_{2.5}$ (TPY)	VOC (TPY)	CO (TPY)	Pb (TPY)	NH_3 (TPY)
2043	51,254	1,094	3,390	3,293	8,643	34,736	0.38	157
2044	46,692	1,077	3,018	2,932	7,842	31,076	0.35	143
2045	42,933	1,009	2,752	2,673	7,115	28,358	0.32	128
2046	39,227	974	2,433	2,364	6,492	25,503	0.29	117
2047	37,540	965	2,313	2,247	6,006	24,050	0.28	108
2048	34,738	954	2,083	2,024	5,495	21,808	0.26	98
2049	32,995	904	1,995	1,939	5,020	20,615	0.25	90
2050	28,873	849	1,688	1,640	4,403	17,665	0.22	82
2051	26,286	796	1,524	1,481	3,872	15,834	0.20	73
2052	24,303	747	1,406	1,367	3,475	14,510	0.18	67
2053	15,585	598	757	737	2,610	8,716	0.11	23
2054	13,131	592	542	527	2,333	6,838	0.09	17
2055	12,062	502	548	533	2,010	6,479	0.09	16
2056	10,119	453	434	422	1,615	5,185	0.07	12
2057	9,083	450	340	331	1,528	4,407	0.06	9
2058	8,519	405	344	335	1,321	4,185	0.06	8
2059	7,182	316	321	313	1,031	3,653	0.05	7
2060	6,052	314	215	209	984	2,829	0.04	5
2061	5,765	270	237	231	877	2,852	0.04	5
2062	5,075	268	180	176	760	2,305	0.04	4
2063	4,614	224	186	181	646	2,201	0.03	3
2064	3,524	136	183	178	433	1,872	0.03	2
2065	1,906	46	130	126	175	1,157	0.02	1
2066	1,392	46	81	79	153	782	0.01	1

[1] Bold numbers are the highest emissions per year per pollutant. These were the amounts modeled.

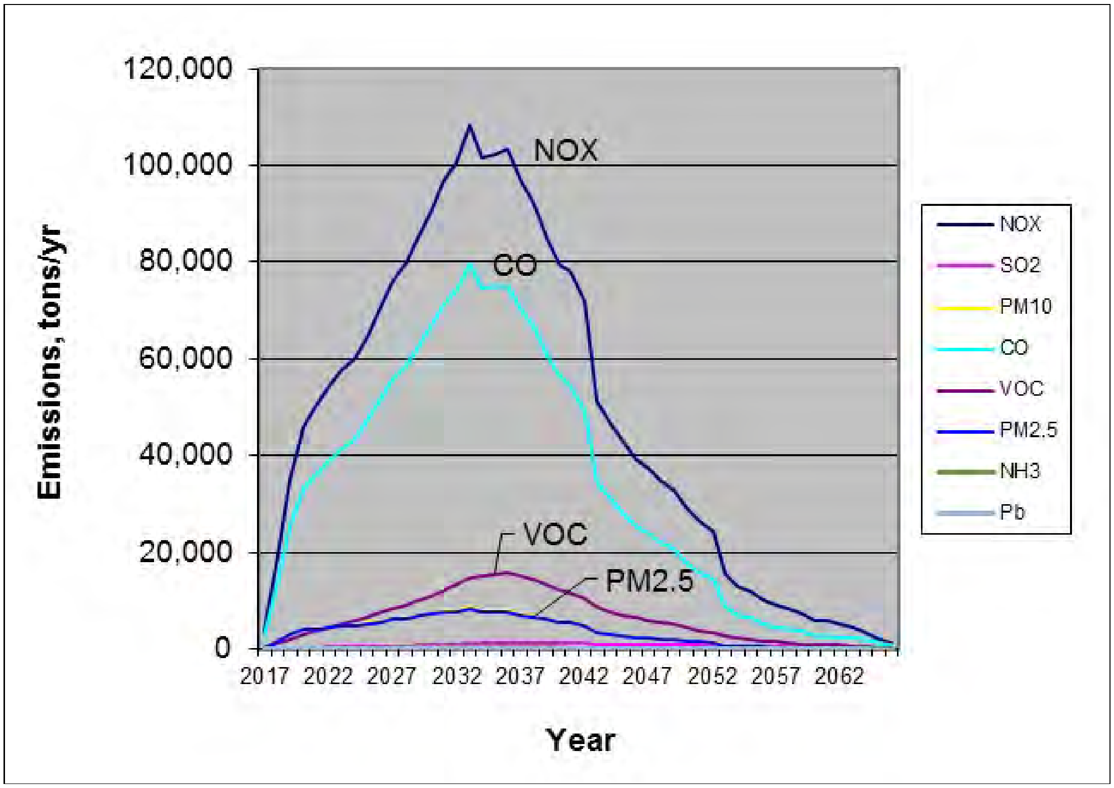

Figure C-11. Emission Estimates for all Planning Areas and Future Activities.

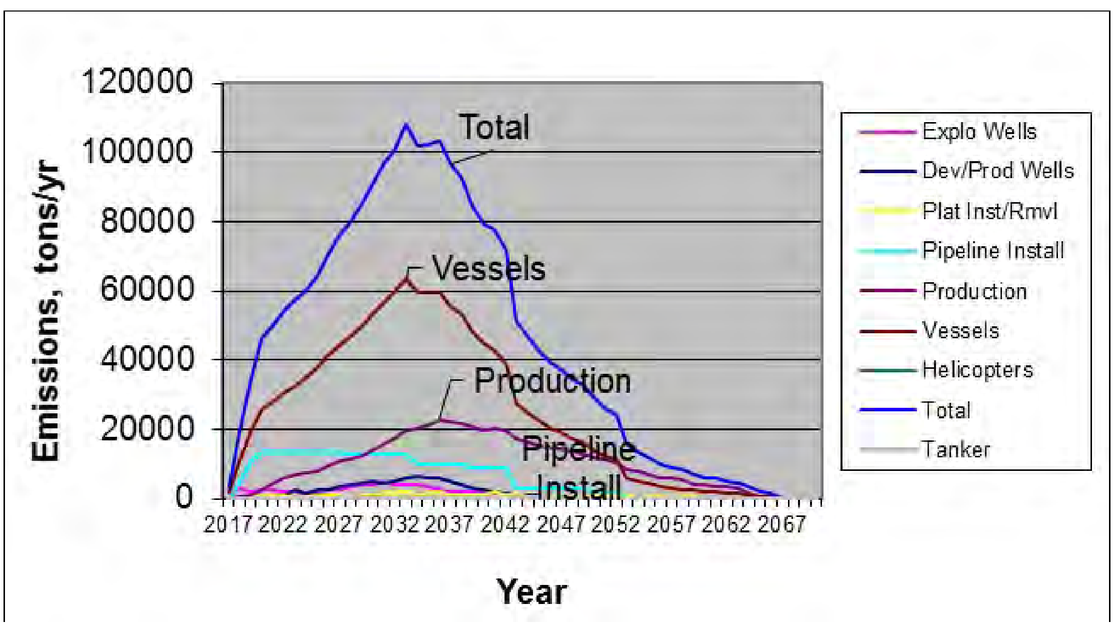

Figure C-12. Combined Annual NO_x Emissions.

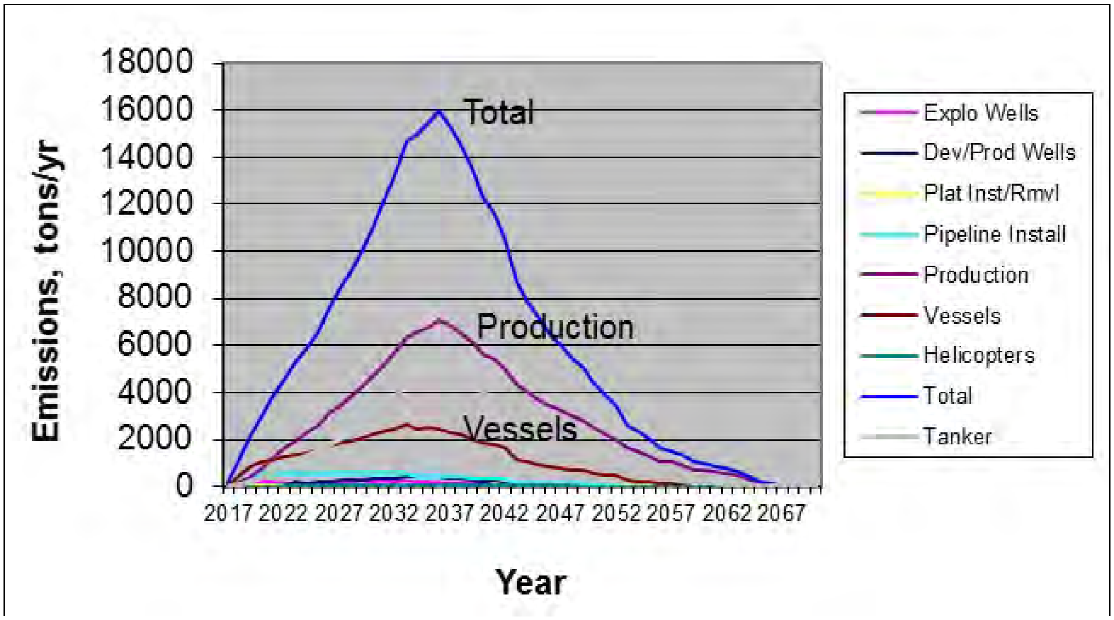

Figure C-13. Combined Annual VOC Emissions.

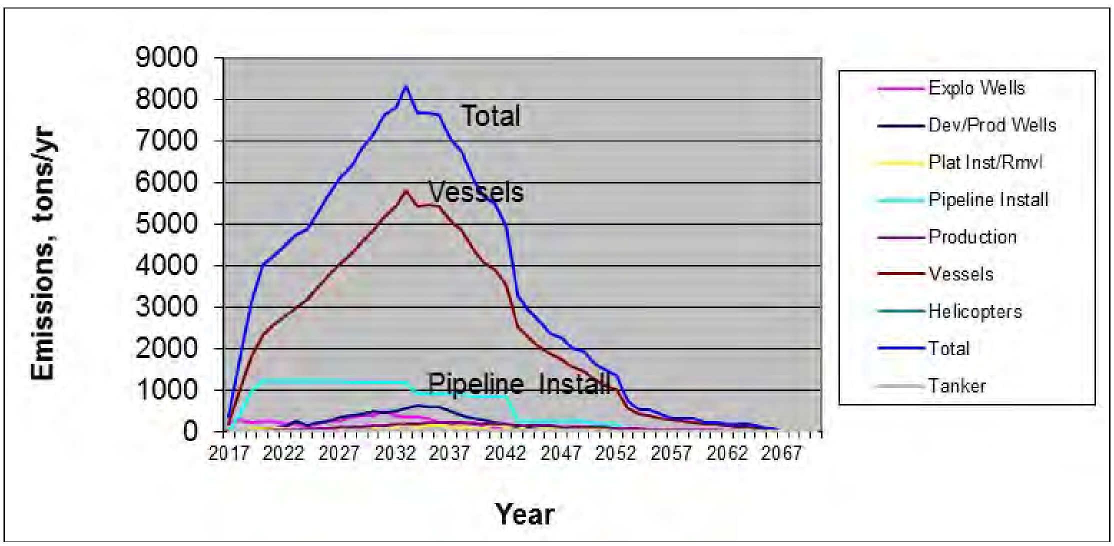

Figure C-14. Combined Annual $PM_{2.5}$ Emissions.

C.4.1.5 Spatial Allocation

The estimated emissions were allocated by planning area (WPA vs. CPA/EPA) and water depth (i.e., 0-60 m, 60-200 m, 200-800 m, 800-1,600 m, 1,600-2,400 m, and >2,400 m). **Figure C-15** depicts the planning area boundaries and water depth contours. (Note that the GOMESA Congressional Moratoria Area is not indicated in **Figure C-15**.) Emissions were not allocated to the GOMESA. The emission estimates were allocated spatially based on the anticipated future year activities provided by BOEM. Because helicopters, support vessels, and tankers transit multiple water depths, their emissions were allocated across multiple water depth contours based on assumed installed platform locations.

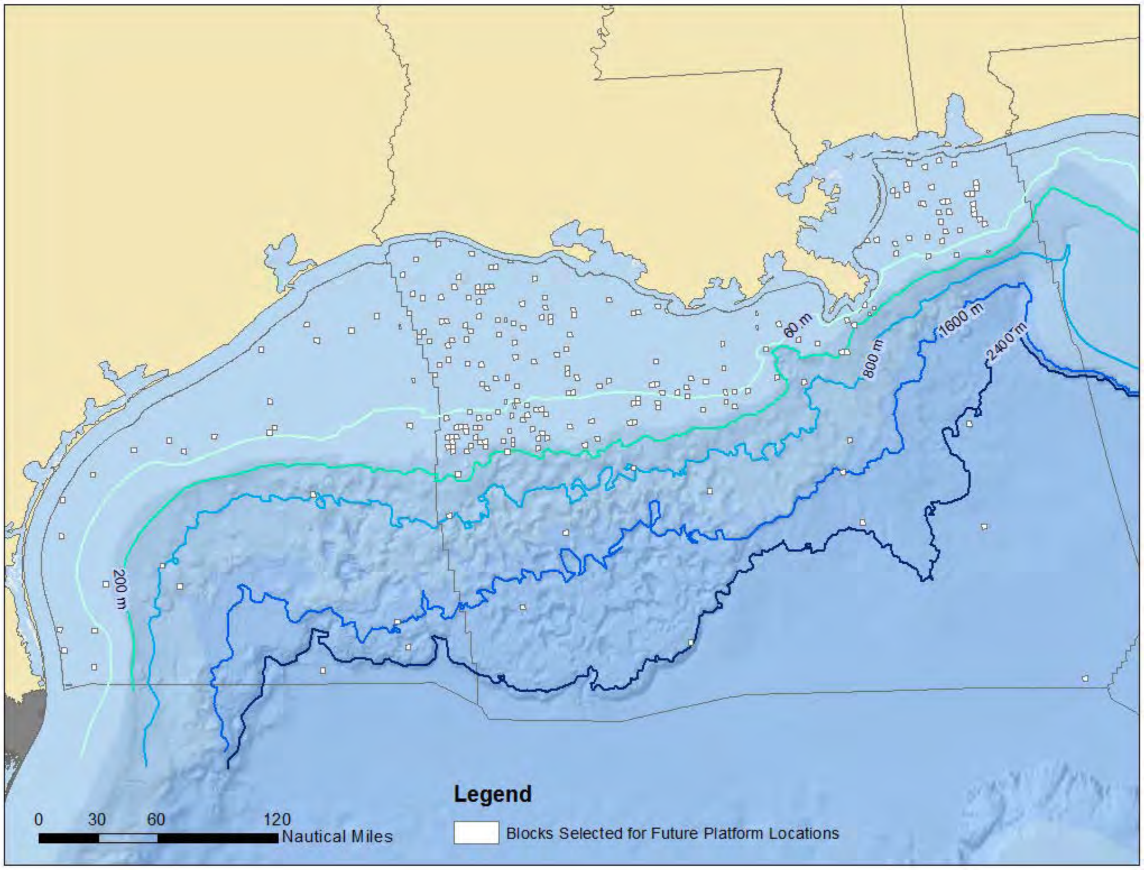

Figure C-15. BOEM OCS Planning Areas and Water Depths.

For some sources, emissions were assigned to unleased blocks in each area (i.e., WPA and CPA/EPA) relative to the water depth where the activity is anticipated to occur. These categories include the following:

- exploratory drilling vessels;
- development/production drilling vessels; and
- production platforms.

Production platforms were located as point sources with randomly selected locations. Using GIS, each lease block in the Gulf of Mexico was assigned to a water depth bin. Blocks with an active lease and that have contained a platform were then removed. Blocks that have had a platform suggest that they were leased at some point in time, and therefore are less desirable for future exploration. Once the inactive blocks with no history of production were identified, random blocks were selected throughout each water depth for each future platform as depicted in **Figure C-15**. Each platform was placed in a separate block at the centroid. Pipe-laying vessel activities were assigned to leased and unleased blocks as their operations were not limited to just the unleased blocks.

Emissions associated with BOEM's existing OCS oil and gas production sources were held constant at 2012 levels.

C.4.2 Onshore Sources and Marine Vessels

In support of the proposed ozone NAAQS revisions, the USEPA released the 2011 air quality modeling platform (2011v6.1), with projections to 2018 and 2025, for point, nonpoint area, and mobile sources in the United States (USEPA, 2014d). In addition, the USEPA released the 2011 air quality modeling platform (2011v6.2), with projections to 2017, to support ozone transport modeling for the 2008 NAAQS as well as the 2015 ozone NAAQS (USEPA, 2015d). In early October, 2015, the USEPA also released the 2011v6.2 calendar year 2025 projected inventory (USEPA, 2015d). The ERG team used the 2011v6.2 platform for calendar year 2017, primarily because the platform is based on the most recent version of the NEI (2011v.2). Calendar year 2017 data were selected rather than 2025 data because there is less uncertainty associated with the 2017 estimated emissions because most of the controls factored in by the USEPA are already "on the books" and not speculative. The *Technical Support Document (TSD) Preparation of Emissions Inventories for the Version 6.2, 2011 Emissions Modeling Platform* (USEPA, 2015d) provides details on the development of the 2011v6.2 future year modeling platforms.

C.4.3 Other Sources

For sources in Mexico, the USEPA air quality modeling platform 2011v6.2 includes projected 2018 emissions for onshore sources. The USEPA held emissions constant for sources in Canada.

For completeness, projected emissions estimates were also developed for platforms off the coast of Mexico; the ERG team researched the impacts of the restructuring of the energy sector in Mexico, which is predicted to include deepwater drilling within the modeling domain. Emissions were estimated based on projected deepwater production (PEMEX, 2012) and using production-based emission factors developed from the 2011 Gulfwide Inventory (Wilson et al., 2014).

For the LOOP and vessel lightering, emissions were held at 2012 levels because of uncertainties in future crude oil imports, which involve the very large crude carriers that visit the LOOP and lightering zones. The ERG team also investigated the need to include a liquefied natural gas (LNG) port to be located in Federal waters and originally expected to be operational in 2019. On September 18, 2015, however, the Maritime Administration (MARAD) and the U.S. Coast Guard stopped the permit application process, as Delphin LNG, LLC is amending the application. This potential source was not included in the future scenario given this uncertainty.

C.5 Source Apportionment

Source apportionment, as applied in PGM modeling, provides a means of assessing the contributions of specified sources or source groups to predicted ozone and PM concentrations under the air quality conditions being simulated. Source contributions can be calculated for ozone and for PM using ozone or PM source apportionment routines included in the CAMx PGM modeling. In this Study, the primary receptor locations of interest for examining source contributions lie both along the shoreline and the State seaward boundary, although the PGM source apportionment output is for the entire modeling domain. Source apportionment analyses with the PGM will be applied to the future year scenario in order to analyze the pre- and postlease OCS oil and gas impacts to short-term and annual NAAQS. This will afford BOEM the opportunity to discern which source groups have the largest impacts and potentially need to be examined for control strategies. BOEM selected the following source groups for source apportionment:

- fires (U.S., Canada, and Mexico);
- biogenic and other natural sources (e.g., lighting NO_x and sea salt);
- additional BOEM OCS oil and gas production platforms associated with the Five-Year Program;
- additional BOEM oil and gas production support vessels and helicopters associated with the Five-Year Program;
- BOEM OCS oil and gas production platforms, support vessels, and helicopters under No Action (base case) alternative;
- all other marine vessel activity in the Gulf of Mexico;
- other anthropogenic U.S. sources;
- Mexican and Canadian anthropogenic sources; and
- initial and boundary conditions (IC and BC).

These source groups aggregate similar sources based on jurisdiction (i.e., sources under BOEM control versus other Federal agencies) and sources beyond control (e.g., natural emission sources and foreign sources). This is helpful in showing whether BOEM's sources are significantly contributing to any modeled air quality issues onshore and at the State seaward boundary, or if a source category regulated by another Federal agency is the more likely the problem source.

Having the additional OCS oil and gas production platforms, support vessels, and helicopters associated with the scenarios for the 2017-2022 GOM Multisale EIS and this Supplemental EIS as separate source groups allows BOEM to quantify the impact of these sources on the onshore air quality and at the State seaward boundary.

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APPENDIX D

AIR QUALITY:
CUMULATIVE AND VISIBILITY IMPACTS

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ABBREVIATIONS AND ACRONYMS

ANC	acid neutralizing capacity
AQRV	air quality-related value(s)
BLM	Bureau of Land Management (U.S. Department of the Interior)
CAMx	Comprehensive Air quality Model with eXtensions
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
DAT	Deposition Analysis Threshold
dv	deciview
DVB	design value for base year
DVC	design value for current (base) year
DVF	design value for future year
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
GHG	greenhouse gas
HAP(s)	hazardous air pollutant(s)
hp	horsepower
hr	hour(s)
IMPROVE	Interagency Monitoring of Protected Visual Environments
kg/ha-yr	kilogram(s) per hectare - year
km	kilometer(s)
m	meter(s)
MATS	Modeled Attainment Test Software
mcf	Thousand cubic feet
MDA_8	Annual 4th highest daily maximum running 8-hour average (concentration)
Mm^{-1}	inverse megameters
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NO_2	nitrogen dioxide
NO_x	total oxides of nitrogen
O_3	ozone
$PM_{2.5}$	fine particulate matter (less than 2.5 microns in effective diameter)
PM_{10}	inhalable particulate matter (less than 10 microns in effective diameter)
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
RRF	Relative Reduction Factor
SO_2	sulfur dioxide
tpy	tons per year
UAA	Unmonitored Area Analysis

USDOI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
VOC	volatile organic compounds
WRF	Weather Research and Forecasting model
yr	year
μeq/l	microequivalent(s) per liter
$\mu g/m^3$	microgram(s) per cubic meter

D AIR QUALITY: CUMULATIVE AND VISIBILITY IMPACTS

D.1 INTRODUCTION

The U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM) is required under the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. § 1334(a)(8)) to comply with the National Ambient Air Quality Standards (NAAQS) to the extent that Outer Continental Shelf (OCS) offshore oil and gas exploration, development, and production sources do not significantly affect the air quality of any state. The Gulf of Mexico OCS Region's area of possible influence includes the States of Texas, Louisiana, Mississippi, Alabama, and Florida. BOEM's Gulf of Mexico OCS Region manages the responsible development of oil, gas, and mineral resources for the 430 million acres in the Western, Central, and Eastern Planning Areas (WPA, CPA, and EPA) on the OCS comprising the Gulf of Mexico region, including the areas under moratoria (shown in **Figure D-1**). The Clean Air Act Amendments (CAAA) of 1990 designate air quality authorities in the Gulf of Mexico OCS Region, giving BOEM air quality jurisdiction westward of 87°30'W. longitude and the U.S. Environmental Protection Agency (USEPA) air quality jurisdiction eastward of 87°30'W. longitude. In 2006, oil and gas leasing operations within 125 miles (201 kilometers [km]) off the Florida coastline were placed under moratoria until 2022 under the Gulf of Mexico Energy Security Act (GOMESA). The GOMESA moratoria area is depicted on **Figure D-1**.

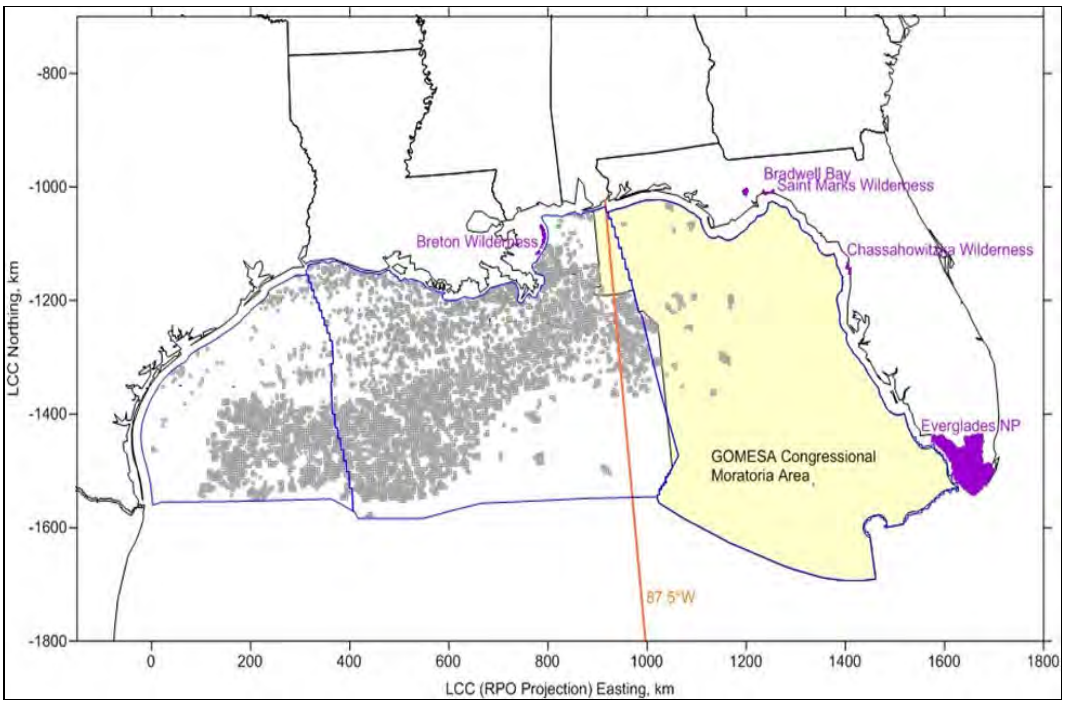

Figure D-1. Location of the "Air Quality Modeling in the Gulf of Mexico Region" Study, with Class I Areas (purple).

BOEM published the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022; Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261—Final Multisale Environmental Impact Statement* (2017-2022 GOM Multisale EIS) and has prepared the *Gulf of Mexico Outer Continental Shelf Lease Sale: Final Supplemental Environmental Impact Statement*

2018 (2018 GOM Supplemental EIS) for oil and gas resources under its jurisdiction within the Gulf of Mexico's WPA, CPA, and EPA (the Proposed Action).

On August 26, 2014, BOEM contracted with Eastern Research Group, Inc. (ERG) and team members Ramboll Environ US Corporation (Ramboll Environ) and Alpine Geophysics, LLC (Alpine) to complete a comprehensive air quality modeling study in the Gulf of Mexico OCS region. Under BOEM Contract Number M14PC00007, "Air Quality Modeling in the Gulf of Mexico Region," photochemical air quality modeling was conducted to assess impacts to nearby states of OCS oil and gas exploration, development, and production as required under OCSLA. This assessment was used by BOEM to disclose potential incremental and cumulative air quality impacts of a proposed action in the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. This Technical Support Document (TSD) provides a detailed description of the data, modeling procedures, and results of the Air Quality Impact Analysis (AQIA). BOEM used this information to complete its analysis of potential impacts of a proposed action on air quality in the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.

D.1.1 Background on Air Quality Impact Analyses and Thresholds

This analysis examines the potential impacts of the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers, with respect to the following:

- the NAAQS for the criteria pollutants ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), fine particulate matter with aerodynamic diameter less than 2.5 μm ($PM_{2.5}$) and fine plus coarse particulate matter with aerodynamic diameters less than 10 μm (PM_{10});
- air quality related values (AQRV), including visibility and acid deposition (sulfur and nitrogen) in nearby Class I and sensitive Class II areas (as defined below); and
- incremental impacts of Prevention of Significant Deterioration (PSD) pollutants (NO_2, PM_{10}, $PM_{2.5}$) with respect to PSD Class I and Class II increments.

Note that the PSD increments are provided here for information purposes, but this analysis does not constitute a regulatory PSD increment consumption analysis as would be required for major sources subject to the New Source Review (NSR) program requirements of the Clean Air Act.

Results of each impact analysis are compared with applicable "thresholds of concern," which have typically been used in air quality impact evaluations of other Federal actions, including onshore oil and gas leasing programs. The applicable comparison thresholds for criteria pollutant impacts are the corresponding NAAQS. For acid (i.e., sulfur and nitrogen) deposition impacts, thresholds are based on (a) incremental impacts considered sufficiently small as to have no consequential effect on the receiving ecosystems, i.e., Deposition Analysis Thresholds, and (b) critical load levels above which cumulative ecosystem effects are likely to or have been observed. For visibility impacts, thresholds are based on incremental changes in light extinction below the level at which they would be noticeable to the average human observer. Additional information about these various thresholds is provided in relevant sections in the remainder of this appendix.

D.1.1.1 Ambient Air Quality Standards

The USEPA has set NAAQS for six regulated air quality pollutants: ozone, particle pollution ($PM_{2.5}$ and PM_{10}), SO_2, NO_2, CO, and lead (Pb). After promulgation of a NAAQS, the USEPA designates areas that fail to achieve the NAAQS as nonattainment areas (NAAs), and States are required to submit State Implementation Plans (SIPs) to the USEPA that contain emission control plans and a demonstration that the NAA will achieve the NAAQS by the required date. After an area comes into attainment of the NAAQS, the area can be redesignated as a maintenance area and must continue to demonstrate compliance with the NAAQS.

In 1997, the USEPA promulgated the first 8-hour ozone NAAQS with a threshold of 0.08 parts per million (ppm) (84 parts per billion [ppb]). On March 12, 2008, the USEPA promulgated a more stringent 0.075 ppm (75 ppb) 8-hour ozone NAAQS. **Figure D-2** presents the current ozone nonattainment areas in the southeastern U.S. On October 1, 2015, the USEPA strengthened the 8-hour NAAQS for ozone to 0.07 ppm (70 ppb). Under this more stringent ozone NAAQS, there may be more areas in the southeastern U.S. that will be in nonattainment. The USEPA plans to make attainment and nonattainment designations for the revised standards by October 2017, with the designations based on 2014-2016 air quality data.

On December 14, 2012, the USEPA revised the $PM_{2.5}$ primary NAAQS by lowering the annual $PM_{2.5}$ NAAQS threshold from 15.0 micrograms per cubic meter ($\mu g/m^3$) to 12.0 $\mu g/m^3$. The USEPA retained the 24-hour $PM_{2.5}$ primary NAAQS at 35 $\mu g/m^3$. The 24-hour course PM NAAQS (PM_{10}) was also retained at 150 $\mu g/m^3$.

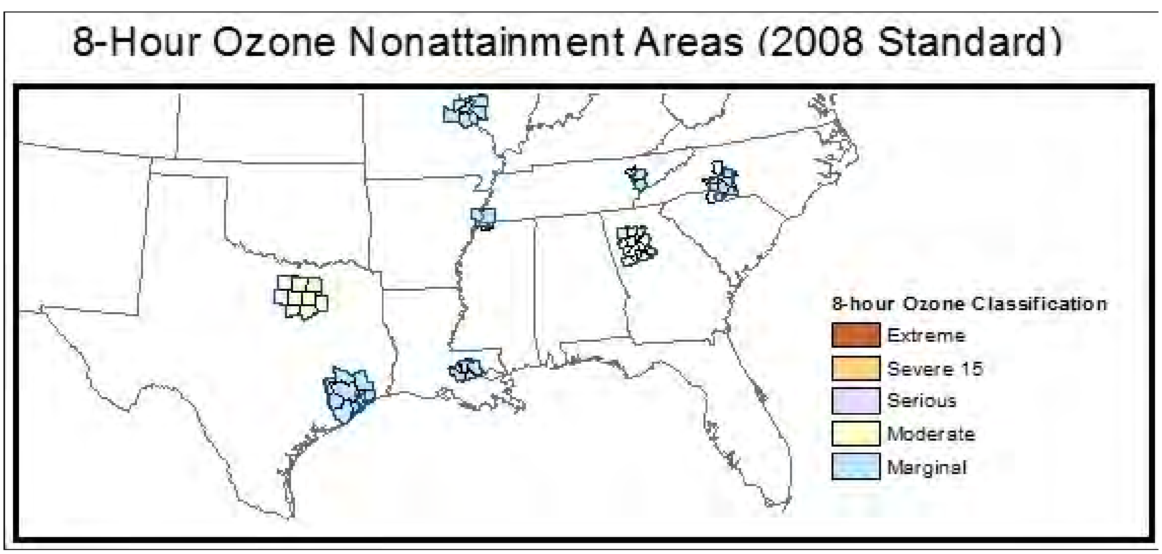

Figure D-2. Ozone Nonattainment Areas in the Southeastern U.S. (Source: USEPA, 2016; https://www3.epa.gov/airquality/greenbook/map8hr_2008.html).

In February 2010, the USEPA issued a new 1-hour NO_2 NAAQS with a threshold of 100 ppb (98^{th} percentile daily maximum 1-hour average averaged over 3 years) and a new 1-hour SO_2 NAAQS was promulgated in June 2010 with a threshold of 75 ppb (99^{th} percentile daily maximum 1-hour average averaged over 3 years). No areas are currently in nonattainment of either the annual or 1-hour NO_2 NAAQS. On July 25, 2013, the USEPA designated 29 areas in 16 states as nonattainment for the 1-hour SO_2 standard.[1] In June 2016, four additional areas were designated as nonattainment (Madison and Williamson Counties in southern Illinois, Anne Arundel-Baltimore Counties in Maryland and St. Clair County in Michigan).[2] The USEPA is currently in the process of gathering more information needed to complete designation of remaining unclassifiable areas with respect to the 1-hour SO_2 NAAQS.

A new lead NAAQS was issued in 2008; NAAs for lead are associated with specific industrial sources. As oil and gas sources in the Gulf of Mexico OCS region produce negligible amounts of lead emissions and to be consistent with onshore oil and gas analysis, which does not include lead, lead emissions were calculated but lead was not included in the air quality analysis. The NAAQS for carbon monoxide has remained essentially unchanged since it was originally promulgated in 1971. As of September 27, 2010, all NAAs for carbon monoxide have been redesignated as maintenance areas.

Table D-1 summarizes the nonattainment and maintenance areas in the southeastern U.S. SO_2 and lead NAAs are focused around specific large industrial sources of SO_2 or lead emissions, whereas ozone nonattainment areas are more regional in nature, reflecting the formation of ozone as a secondary pollutant from emissions of NO_x and VOC precursors from a wide range of sources.

Table D-1. Nonattainment and Maintenance Areas in the Southeastern U.S.

State	Area	8-hr O_3 (1997)	8-hr O_3 (2008)	SO_2 (2010)	CO (1971)	Lead (2008)
Alabama	Troy, AL					NAA[a]
Florida	Tampa, FL					NAA
	Hillsborough County, FL			NAA		
	Nassau County, FL			NAA		
Louisiana	Baton Rouge, LA	M[b]	NAA			
	St. Bernard Parish, LA			NAA		
Texas	Beaumont-Port Arthur, TX	M				
	Houston-Galveston-Brazoria, TX	NAA	NAA			
	Frisco, TX					NAA

[a] NAA = nonattainment area.
[b] M = maintenance area.
Blank cells indicate the area is in attainment of the NAAQS.

[1] https://www.epa.gov/sites/production/files/2016-03/documents/20130725fs.pdf
[2] https://www.epa.gov/sites/production/files/2016-06/documents/so2d-r2-area-list.pdf

D.1.1.2 Air Quality-Related Values

The CAAA designated 156 Class I areas consisting of National Parks and Wilderness Areas that are offered special protection for air quality and AQRVs. The Class I areas, compared to Class II areas, have lower PSD increments that new sources may not exceed and are protected against excessive increases in several AQRVs including visibility impairment, acid (sulfur and nitrogen) deposition, and nitrogen eutrophication. The Regional Haze Rule (RHR) specifies a goal of achieving "natural" visibility conditions by 2064 in Class I areas, and States must submit RHR SIPs that demonstrate progress towards that goal. **Figure D-1** displays the locations of the mandatory Class I areas (in purple) in the Gulf of Mexico OCS region.

In addition to the Class I areas described above, Federal Land Management (FLM) agencies have designated certain other areas as Class II sensitive areas for tracking PSD increment consumption and AQRV impacts. Sensitive Class II areas in the southeastern U.S. study region are shown in **Figure D-3**.

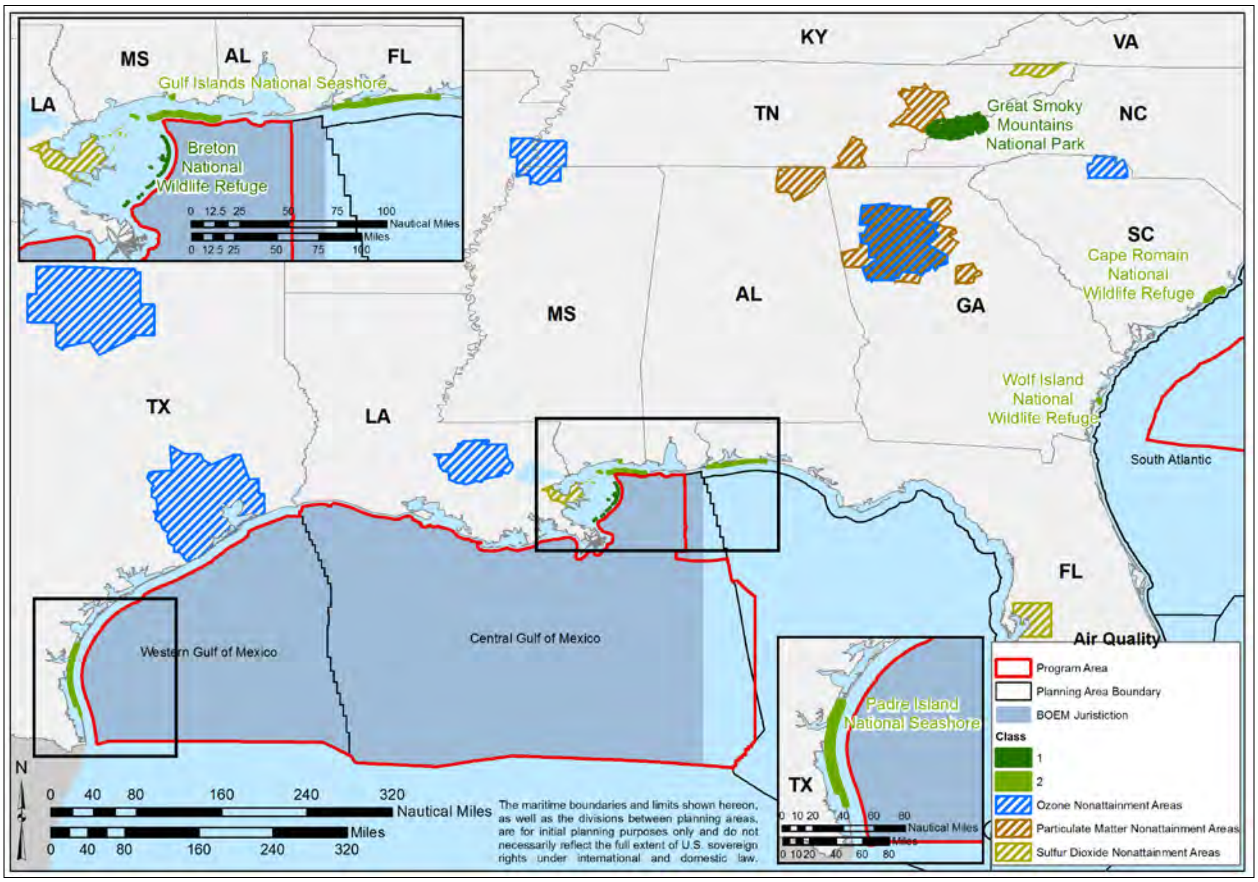

Figure D-3. Class I and Sensitive Class II Areas in the Study Region. (Note: The South Atlantic Planning Area was removed from the Five-Year Program.)

D.1.2 Overview of Approach

The Comprehensive Air-quality Model with extensions (CAMx; www.camx.com) and Community Multiscale Air Quality (CMAQ; https://www.cmascenter.org/cmaq/) Photochemical Grid Models (PGMs) were used to simulate the dispersion and chemical transformation of pollutants over the Study area. Similar to other air quality models, CAMx/CMAQ require several input datasets, including meteorology and an emissions inventory. **Figure D-4** presents an overview of how these project datasets fit together for the "Air Quality Modeling in the Gulf of Mexico OCS Region" study. Preparation of the required meteorological and emissions data is described briefly in this TSD, along with references to more detailed reports.

Photochemical modeling was conducted for two emission scenarios:

- a base case scenario using the 2012 base year (BY) emissions inventory described in **Section D.3** was used to evaluate model performance and to define current baseline air quality conditions; and
- a future year development scenario (FY) using an emissions inventory that includes potential new sources associated with the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers, and projections of emissions to 2017 for all other sources as described in **Section D.3** was used to estimate the cumulative and incremental air quality and AQRV impacts of the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers.

Note that both scenarios used the same meteorological dataset and the same photochemical model configuration.

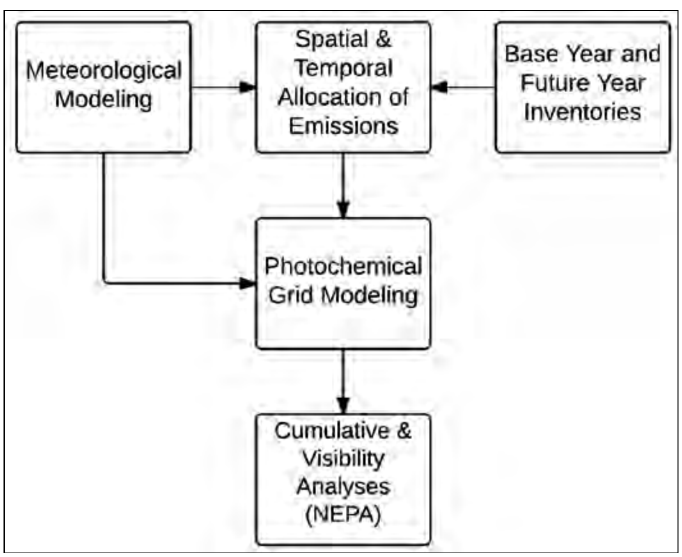

Figure D-4. Overview of the "Air Quality Modeling in the Gulf of Mexico Region" Study Tasks (note that the meteorological model takes meteorological observations as inputs).

D.2 METEOROLOGY

Meteorological datasets required to determine the rate that pollutants disperse and react in the atmosphere include spatially and temporally varying parameters such as wind speed, wind direction, air temperature, and humidity, among others. Sources of meteorological information include datasets of measurements gathered at various locations within the Gulf of Mexico OCS Region domain. However, the spatial coverage of measurements is insufficient to describe the three-dimensional structure of the atmosphere away from measurement locations. Using measurement data as inputs, gridded meteorological models capable of simulating the fluid dynamics of the atmospheric can be used to estimate meteorological conditions over a complete modeling domain—including regions far from measurement sites—in a physically consistent fashion. Results of these meteorological models provide the inputs needed to exercise the photochemical grid air quality dispersion models used in this Study. For this "Air Quality Modeling in the Gulf of Mexico Region" study, the Advanced Research version of the Weather and Research Forecasting (WRF) model (version 3.7) was applied over a system of nested modeling grids. **Figure D-5** shows the WRF modeling grids at horizontal resolutions of 36, 12, and 4 km. All WRF grids were defined on a Lambert Conformal Conic (LCC) projection centered at 40°N. latitude, 97°W. longitude with true latitudes at 33°N. and 45°N. (the "standard RPO" projection). The outermost domain (outer box) with 36-km resolution includes the entire continental U.S. and parts of Canada and Mexico, and captures synoptic-scale (storm system-scale) structures in the atmosphere. The inner 12-km regional grid (d02) covers the southeastern U.S. and is used to ensure that large-scale meteorological patterns across the region are adequately represented and to provide boundary conditions to the 4-km domain. The 4-km domain (d03) is centered on the coastal areas of the southeastern U.S. and over-water portions of the Gulf of Mexico.

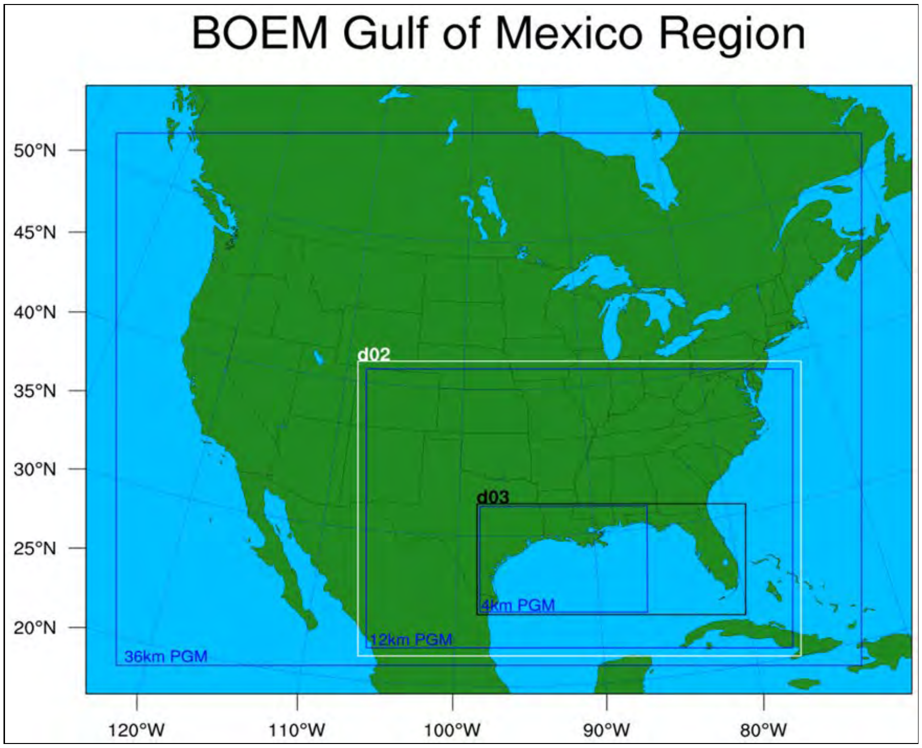

Figure D-5. Meteorological (WRF model) and PGM Modeling Domains Including the 36-km Horizontal Grid Resolution CONUS WRF Domain (outer box), 12-km Resolution Southeast Regional WRF (white) and PGM (blue) Domains (d02), and 4-km Resolution Gulf of Mexico OCS Region WRF (black) and PGM (blue) Domains (d03).

The WRF ran the 36-, 12- and 4-km grids simultaneously with one-way nesting, meaning that meteorological information flows down-scale via boundary conditions introduced from the respective coarser to finer grids without feedback from the finer to coarser grids. The WRF modeling domain was defined to be slightly larger than the CAMx/CMAQ PGM modeling domains to eliminate boundary artifacts in the meteorological fields. Such boundary artifacts occur for both numerical reason (the 3:1 grid spacing ratio) and because the imposed boundary conditions require some time/space to come into dynamic balance with WRF's atmospheric equations. All meteorological modeling domains, techniques, inputs, vertical resolution, parameters, nudging, physics options, and application strategy, along with quantitative and qualitative evaluation procedures and statistical benchmarks, are discussed in **Appendix B**.

D.3 Emissions

Analysis of the cumulative air quality impacts of the 2017-2022 GOM Multisale EIS scenario required development of both a contemporary base year emissions inventory for the base case analysis and a projected future year inventory that includes emissions from all cumulative sources, as well as additional emissions anticipated to occur under the 2017-2022 GOM OCS Multisale EIS alternatives in which additional exploratory drilling and construction of new shallow-water and deepwater platforms to support oil and gas production would occur. Both the base case and future year cumulative source inventories represent comprehensive compilations of pollutant emissions from all human activities, as well as emissions from biogenic and geogenic sources. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS and uses the scenario and alternatives analyzed in the 2017-2022 GOM Multisale EIS.

The scope of the air pollutant emissions inventory for the "Air Quality Modeling in the Gulf of Mexico Region" study is defined in terms of: pollutants, representative time periods for the base case and future year analysis, geographical domain, and sources to be included.

D.3.1 Pollutants

Pollutants included in the inventories were selected to support analysis of air quality impacts in terms of impacts on attainment of NAAQS and on AQRVs, including acid deposition and visibility. The selected pollutants are: CO, NO_x (which includes NO and NO_2 and is stated in terms of equivalent mass of NO_2), $PM_{2.5}$, fine plus coarse PM (PM_{10}), SO_2, volatile organic compounds (VOCs, which are precursors to formation of ozone and organic particulates), and ammonia (NH_3, a precursor to particulate matter formation). Note that lead emissions were calculated since lead is a criteria pollutant, but since oil and gas sources have negligible lead emissions, it was not modeled in the air quality analysis.

While the cumulative air quality impact analysis did not focus specifically on air toxics, compilation of VOC emissions by source type together with VOC speciation profiles by source type provides a mechanism for estimating emissions of individual air toxic species.

D.3.2 Base Year

In determining the base case (base year) for the "Air Quality Modeling in the Gulf of Mexico Region" study emissions inventory, 2011 was initially selected based on data availability. Calendar year 2011 emissions data are readily available for most sources from the USEPA's National Emissions Inventory (NEI) (USEPA, 2015a) and BOEM's *Year 2011 Gulfwide Emissions Inventory Study* (Wilson et al., 2014). However, 2011 was an unusually hot and dry year in the Gulf of Mexico OCS region, particularly in Texas, which experienced record heat and dry conditions during the summer of 2011 and had a very high incidence of wildfires. Therefore, 2012 was selected as the base year as more representative of "typical" conditions in the Gulf of Mexico OCS region.

D.3.3 Geographical Domain

Modeling domains used for the "Air Quality Modeling in the Gulf of Mexico Region" study emissions inventory are depicted in **Figure D-5**. Emissions were spatially allocated over the three PGM modeling domains: an outer 36-km horizontal grid resolution domain covering all of the U.S. and parts of Mexico and Canada; a regional 12-km resolution domain covering the southeastern U.S.; and an inner 4-km domain encompassing the CPA and WPA. The influences of global emissions on the study area are accounted for by the use of a global air quality model to specify domain boundary conditions.

D.3.4 Inventory Sources

A comprehensive inventory of emissions from anthropogenic (i.e., human caused) sources, including stationary point and nonpoint area sources located both onshore and offshore, on-road motor vehicles, nonroad equipment, locomotives, marine vessels and other offshore sources, and airports, were compiled for the “Air Quality Modeling in the Gulf of Mexico Region” study emissions inventory. **Table D-2** lists the source categories included in the emissions inventory, along with the pollutants applicable to each category, and the source type (area source, point source, offshore lease block). Note that emissions from non-anthropogenic sources (biogenic and geogenic sources) were developed in conjunction with the emissions modeling procedures described in **Section D.3.9**.

Table D-2. Gulf of Mexico OCS Region Air Quality Modeling Study Source Categories.

Group and Source Category		CO	NO_x	SO_2	VOC	Pb	$PM_{2.5}$	PM_{10}	NH_3	Source Type[a]
NEI Onshore Sources	Point Sources	✓	✓	✓	✓	✓	✓	✓	✓	P
	Nonpoint Area Sources	✓	✓	✓	✓	✓	✓	✓	✓	A
	Onroad Mobile Sources	✓	✓	✓	✓		✓	✓	✓	A
	Commercial Marine Vessels	✓	✓	✓	✓	✓	✓	✓	✓	P, A[b]
	Locomotives	✓	✓	✓	✓	✓	✓	✓	✓	P, A[c]
	Aircraft and Airports	✓	✓	✓	✓	✓	✓	✓	✓	P
	Other Nonroad Mobile Sources	✓	✓	✓	✓		✓	✓	✓	A
Offshore Oil and Gas Sources	Platforms in State Waters	✓	✓	✓	✓		✓	✓		P
	Platforms in the CPA and WPA	✓	✓	✓	✓	✓	✓	✓	✓	P
	Drilling Rigs	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Pipelaying Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Support Helicopters	✓	✓	✓	✓		✓	✓	✓	LB
	Support Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Survey Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
Non-oil and Gas Offshore Vessels and Activities	Commercial Fishing Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Commercial Marine Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Louisiana Offshore Oil Port	✓	✓	✓	✓	✓	✓	✓	✓	P
	Military Vessels	✓	✓	✓	✓	✓	✓	✓	✓	LB
	Recreational Vessels	✓	✓	✓	✓		✓	✓	✓	LB

Group and Source Category		CO	NO_x	SO_2	VOC	Pb	$PM_{2.5}$	PM_{10}	NH_3	Source Type[a]
	Vessel Lightering	✓	✓	✓	✓	✓	✓	✓	✓	P
Biogenic and Geogenic Sources	Subsurface Oil Seeps				✓					LB
	Mud Volcanoes				✓					LB
	Onshore Vegetation		✓		✓					A
	Wildfires and Prescribed Burning	✓	✓	✓	✓		✓	✓	✓	P
	Windblown Dust						✓	✓		A
	Lightning		✓							A
	Sea Salt Emissions						✓	✓		A
Sources in Mexico and Canada	Point Sources	✓	✓	✓	✓		✓	✓	✓	P
	Nonpoint Area Sources	✓	✓	✓	✓		✓	✓		A
	Mobile Sources	✓	✓	✓	✓		✓	✓		A

[a] A = area source (requires spatial surrogate); P = point source (requires UTM coordinates, stack parameters); LB = offshore lease block (requires GIS shape file).
[b] Larger ports and shipping represented as shape files; smaller ports as point sources.
[c] Rail yards represented as point sources; railway segments as area sources.

D.3.5 Spatial Resolution

The spatial resolution of the emissions inventory is source specific. For example, sources such as power plants are identified based on their geographic coordinates (i.e., latitude and longitude), while other sources such as nonroad mobile sources (e.g., construction equipment) are spatially distributed using surrogates within the county in which they are reported and that are typically related to the activity distribution of the category (e.g., construction sites).

The resolution of the geographical area covered by the emissions inventory is based on the grid cell size needed for photochemical and dispersion modeling. Furthermore, the photochemical model grid resolution is dependent on the grid resolution of the WRF meteorological model output used. This is described further in **Section D.3.9**.

D.3.6 Temporal Resolution

Emissions for all sources were estimated on an annual basis (i.e., emissions generated during 2012). For electric generating units (EGUs), emissions were allocated on a sub-annual basis to reflect variations in activity using data from the USEPA. Emissions were allocated on an hourly, daily, and seasonal basis during the emissions modeling process (**Section D.3.9**) using default temporal allocation factors provided with the Sparse Matrix Operator Kernel Emissions model (SMOKE) emissions model for some sources; other temporal allocations were source specific; and profiles were developed and applied within the SMOKE model.

D.3.7 Speciation

When applying the photochemical grid modeling, PM emissions were allocated to individual PM species as part of the SMOKE emissions processing using PM speciation factors obtained from the USEPA's SPECIATE database for each source category (as defined by the Source Classification Code). This resulted in the PM mass being broken into the mass associated with elemental carbon (EC), organic aerosol (OA), primary sulfate (SO_4) and nitrate (NO_3) and other elements, and particle-bound VOCs, such as polycyclic aromatic hydrocarbon (PAHs). The model predictions of EC will undergo for further analysis and discussed in the "Air Quality Modeling in the Gulf of Mexico Region" study final report.

SMOKE was also used to convert VOC emissions into the photochemical mechanism-specific (e.g., CB05 or CB6r2h) model species used in air quality models as described in **Section D.3.9**. The CB6r2h chemical mechanism used in CAMx also models excess methane (ECH_4) from local sources that is added to the background methane value (1.75 ppm) in the chemical mechanism. The excess methane species is calculated as part of the speciation of the VOC emissions that are first adjusted to total organic gases (TOG) before calculating the CB6 chemical species. Thus, the excess methane species only includes methane emissions from local VOC sources (e.g., oil and gas) and will not include methane emissions not associated with VOC sources.

D.3.8 Base Year and Future Year Emission Estimates

Details on the development of the base year and future year emission estimates are presented in **Appendix C**.

D.3.9 Emissions Processing for Preparation of Model-Ready Emissions

D.3.9.1 Smoke Processing

Anthropogenic emissions inventories discussed in the previous section and other data were used to prepare PGM model-ready emission files using the Sparse Matrix Operator Kernel Emissions (SMOKE) system version 3.6 and other methods as described below. The inventories were processed through SMOKE to develop hourly, gridded, and speciated emissions required for input to the PGM models at 36-, 12-, and 4-km grid resolutions. During emissions processing, annual emissions inventories were speciated to model species, temporally allocated to hourly emissions, and spatially allocated to grid cells.

The latest Carbon Bond 6 revision 2h (CB6r2h) photochemical mechanism with active local methane emissions and halogen chemistry was used for the CAMx modeling, whereas the Carbon Bond 5 (CB05) with updated toluene and chlorine chemistry photochemical mechanism was used for the CMAQ modeling, and emissions were processed accordingly. CMAQ versions 5.0 and later contain a thermodynamic equilibrium aerosol mechanism (ISORRPIA v2) that requires detailed speciation of $PM_{2.5}$. This involves splitting PMFINE into additional elemental components.

The SMOKE emissions model was used to perform the following tasks:

- Spatial Allocation: Spatial surrogates contained in the USEPA 2011v6.2 modeling platform[3] were used to spatially distribute emissions to modeling grid cells. Spatial surrogates are generated by overlaying the PGM modeling grid on maps of geospatial indicators appropriate to each source category (e.g., housing units). The Surrogate Tool[4], a component of USEPA's Spatial Allocator system, is used to calculate the fraction of geospatial indicator coverage in each model grid cell.

- Temporal Allocation: Air quality modeling systems, such as CMAQ and CAMx, require hourly emissions input data. With the exception of a few source types (i.e., Continuous Emissions Monitoring data, biogenic emissions, and some fire inventories), most inventory data are estimated in the form of annual or daily emissions. SMOKE was used to allocate annual emissions to months and across the diurnal cycle to account for seasonal, day-of-week and hour-of-day effects. Temporal profiles and SCC cross references from the 2011v6.2 modeling platform were used to incorporate seasonal and monthly variations into the development of the PGM model-ready emissions.

- Chemical Speciation: The emissions inventories for the "Air Quality Modeling in the Gulf of Mexico OCS Region" study included the following pollutants: CO, NO_x, VOC, NH_3, SO_2, PM_{10}, and $PM_{2.5}$. Ramboll Environ used SMOKE to convert inventoried VOC emissions into the CB6r2 photochemical mechanism model species. Chemical speciation profiles were assigned to inventory sources using cross-referencing data that match the profiles and inventory sources using country/state/county (FIPS) and source classification codes (SCCs). Ramboll Environ used NO_x, VOC, and PM speciation profiles from the 2011v6.2 platform for SMOKE processing. In the 2011v6.2 platform, USEPA-generated emissions for Carbon Bond version 6 revision 2 (CB6r2) chemical mechanism used by CAMx. In addition, this platform generates the $PM_{2.5}$ model species associated with the CMAQ Aerosol Module, version 6 (AE6). SMOKE also applied source-specific speciation profiles to convert inventoried NO_x emissions to NO, NO_2, and HONO components. After SMOKE processing, Ramboll Environ applied necessary species mapping to prepare CMAQ-ready emissions in CB05/AE6 terms and CAMx-ready emissions in CB6r2/CF terms. Note that CB6r2 chemistry also models local excess methane (ECH_4) above background concentrations. Sea salt and halogen emissions from the Gulf of Mexico and other ocean portions of the modeling domain were also generated for CAMx as described below.

[3] http://www.epa.gov/ttn/chief/emch/index.html#2011
[4] https://www.cmascenter.org/sa-tools/documentation/4.2/html/srgtool/SurrogateToolUserGuide_4_2.pdf

D.3.9.2 Biogenic Emissions

Biogenic emissions were generated using the MEGAN version 2.1 biogenics model developed at the National Center for Atmospheric Research (Guenther et al., 2012; Sakulyanontvittaya et al., 2008).

Biogenic emissions depend critically upon landuse/landcover input data. Biogenic VOC and NO emissions vary considerably on spatial scales ranging from a few meters to thousands of kilometers. The MEGAN model accounts for this variability with high-resolution estimates of vegetation type and quantity. The MEGAN landcover variables include total Leaf Area Index (LAI), tree fraction, and plant species composition. These variables are determined based primarily on satellite observations, such as 2003 1 km^2 Moderate Resolution Imaging Spectroradiometer (MODIS) and 30-m resolution LANDSAT data (Guenther et al., 2006; Sakulyanontvittaya et al., 2008). MEGAN driving variables include weather data, LAI, plant functional type (PFT) cover, and compound-specific emission factors that are based on plant species composition. All of these variables are available at various temporal scales and are provided in a geo-referenced gridded database in several formats (e.g., netcdf, ESRI GRID). The MEGAN database has global coverage at 30 sec (approximately 1 km) spatial resolution.

The MEGAN model was applied using the specific daily meteorology (e.g., temperature and solar radiation) extracted from the 2012 WRF model outputs to generate day-specific biogenic emissions for the 2012 calendar year in the 36-, 12-, and 4-km PGM modeling domains.

D.3.9.3 Fire Emissions

Forest fire emissions are highly episodic and very location specific. Using annual average fire emissions and temporally and spatially allocating these emissions using generic allocation schemes would result in significant inaccuracies. In this modeling study, Ramboll Environ used day-specific wild and prescribed fire (together called wildland fires [WLFs]) emission estimates developed by the USEPA for calendar year 2012.[5] The emission estimates are based on the SMARTFIRE2 (SF2) framework and the BlueSky models.[6] The USEPA fire inventory was processed through SMOKE in separate processing streams for CMAQ and CAMx. The CMAQ model-ready emissions were developed in “in-line” point format. The term “in-line” means that the plume rise calculations are done inside the CMAQ model instead of being computed by SMOKE. To prepare CAMx model-ready emissions using a plume rise algorithm that is consistent with the algorithms in CMAQ, plume rise calculation was done in SMOKE and 3-D emissions files were prepared that were converted into a CAMx “PTSOURCE” type file where each grid cell centroid represents one virtual stack. The cmaq2uam program was used to convert 3-D fire emissions from SMOKE into CAMx format. **Table D-3** shows total annual criteria air pollutant emissions by fire type for all U.S. wildland fires within each of BOEM’s PGM modeling domains.

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[5] ftp://ftp.epa.gov/EmisInventory/fires/
[6] http://www.airfire.org/smartfire/

Table D-3. 2012 Fire Criteria Air Pollutant Emissions Summary by Fire Type for BOEM's 36-, 12-, and 4-km Domains.

Fire Type (SCC)	Domain	CO (TPY)	NO_x (TPY)	PM_{10} (TPY)	$PM_{2.5}$ (TPY)	SO_2 (TPY)	VOC (TPY)
Wildfires (2810001000)	36 km	59,794	613	5,901	5,001	387	14,050
	12 km	6,568	74	654	554	44	1,545
	4 km	1,087	6	103	87	6	254
Prescribed fires (2810015000)	36 km	27,331	391	2,796	2,370	211	6,453
	12 km	20,126	308	2,077	1,760	161	4,757
	4 km	7,020	58	680	577	41	1,646
Total	36 km	87,125	1,003	8,698	7,371	598	20,503
	12 km	26,694	382	2,731	2,314	206	6,302
	4 km	8,107	64	783	664	47	1,900

As noted above, the USEPA wildland fires inventory is restricted to fire sources within the lower 48 states and thus does not cover the portions of Canada and Mexico lying within the 36-, 12-, and 4-km PGM domains. To fill this gap, we used 2012 day-specific Fire INventory from NCAR (FINN) for Canada and Mexico. The FINN provides daily, 1-km resolution, global estimates of the trace gas and particle emissions from open burning of biomass, which includes wildfire, agricultural fires, and prescribed burning exclusive of biofuel combustion and trash burning. Each fire record was treated as a point source and emissions were distributed vertically into multiple model layers to better represent each fire plume. The day-specific FINN fire emissions in Canada and Mexico were processed to develop elevated "point sources" of fire emissions using plume rise estimates as a function of fire size based on the Western Regional Air Partnership (WRAP) 2002 fire plume rise approach (Mavko and Morris, 2013). The chemical speciation profile for the MODIS fire emissions were derived from a study on biomass burning (Karl et al., 2007).

D.3.9.4 Sea Salt and Halogen Emissions

Ramboll Environ used an emissions processor that integrates published sea spray flux algorithms to estimate sea salt PM emissions for input to CAMx. The gridded data for input to the sea salt emissions model is a land-water mask file that identifies each modeling domain grid cell as open ocean, surf zone, or land. Additional details on the development and evaluation of the sea salt emissions processor that was used for the "Air Quality Modeling in the Gulf of Mexico Region" study are available in the WestJumpAQMS Sea Salt and Lightning memo (Morris et al., 2012). The CAMx sea salt emissions processor was used with the 2012 WRF data to generate sea salt emissions for the 36-, 12-, and 4-km modeling domains. The sea salt emissions processor has recently been updated to also generate emissions for halogen compounds from the ocean (Yarwood et al., 2014). Gridded chlorophyll data is obtained from satellite data is used as input and the processor generated gridded hourly emissions of chlorine, bromine, and iodine. Halogen chemistry over the ocean depletes ozone concentrations near the surface so is especially important in the Gulf of Mexico OCS region.

The CMAQ model includes inline calculation of sea-salt emissions from the open ocean and coastal surf zone so no pre-processing of sea salt emissions is needed. The CMAQ does not treat halogen chemistry except for chlorine.

D.3.9.5 Lightning NO_x Emissions

The NO_x is formed in lightning channels as the heat released by the electrical discharge causes the conversion of nitrogen (N_2) and oxygen (O_2) to NO. Modeling of lightning and its emissions is an area of active research. For example, the mechanism for the buildup of electric potential within clouds is not well understood, and modeling the production, transport, and fate of emissions from lighting is complicated by the fact that the cumulus towers where lightning occurs may be sub-grid scale depending on the resolution of the model. Given the importance of lightning NO_x in the tropospheric NO_x budget and in understanding its effect on upper tropospheric ozone and OH-, lightning NO_x is typically incorporated in global modeling (e.g., Tost et al., 2007; Sauvage et al., 2007; Emmons et al., 2010) and has also been integrated into many regional modeling studies (e.g., Allen et al., 2012; Koo et al., 2010).

For the CMAQ modeling, Ramboll Environ used in-line lightning NO_x emissions derived from the convective precipitation rate provided in the MCIP files. Since the CMAQ model includes inline calculation of lightening NO_x emissions, no pre-processing of lightening NO_x is needed. The CAMx model requires pre-calculated lightening emissions for input. To better facilitate comparisons with CMAQ, lightening NO_x emissions from the CMAQ modeling were output and converted into a format suitable for use in CAMx.

D.3.9.6 Windblown Dust

Windblown dust emissions are calculated in-line in the CMAQ model based on wind speed and soil moisture parameters passed to CMAQ from the WRF model. Spatially and temporally resolved CMAQ windblown dust emissions were output for use in CAMx.

D.3.9.7 QA/QC of Processed Emissions

Emissions were processed by major source category in several different processing "streams" to simplify the emissions modeling process and facilitate the QA/QC of results. SMOKE includes QA and reporting features to keep track of the adjustments at each step of emissions processing and to ensure that data integrity is not compromised. Ramboll Environ carefully reviewed the SMOKE log files for significant error messages and ensure that appropriate source profiles are being used. In addition, SMOKE output summary reports were reviewed and compared with input emission totals.

D.3.9.8 Development of Model-Ready Emissions

Since the "Air Quality Modeling in the Gulf of Mexico Region" study involved application of both the CAMx and CMAQ photochemical grid models, the emissions processing procedure included development of emissions ready for input to CMAQ, as well as for input to CAMx. Each

SMOKE processing stream generates a set of pre-merged model-ready emissions in CMAQ input format (netCDF). As specified in the chemical speciation section, species mapping was applied to convert SMOKE generated model species to the appropriate input for CMAQ. SMOKE modeling generated VOC model species for CB6 chemical mechanism, which were converted into CB05 model species for CMAQ. All pre-merged gridded emissions inputs were merged together to generate the final CMAQ-ready, two-dimensional gridded low-level (layer 1) and point source emissions inputs. Since CMAQ provides the option to specify point source emissions separately from the gridded emissions from other sources, only distributed sources (mobile sources, area sources, natural emissions) were merged in developing the CMAQ-ready emissions files.

The CAMx requires two types of emissions files, as described below, for every episode day; both of the emission files are UAM-based Fortran binary files.

(1) Surface-level 2D emissions: This file contains two-dimensional gridded fields of low-level (i.e., surface) emissions rates for all emitted species to be modeled.

(2) Elevated point source emissions: The elevated point source emissions file contains stack parameters and emissions rates for all elevated point sources and emitted species to be modeled.

The merged two-dimensional gridded anthropogenic emissions, which were originally output in CMAQ format, were converted into CAMx format using the CMAQ2CAMX program[7]. Ramboll Environ then merged natural source categories – sea salt, biogenic, fires, lightning and windblown dust with the surface-level emissions using the MRGUAM processor to develop CAMx model-ready emissions. Ramboll Environ first converted model species from CMAQ to CAMx compatible form and then converted CMAQ 2-D and in-line point emissions files to CAMx area-/point-source emissions files using the CMAQ2CAMx interface program. The point source emissions files in UAM-based binary format were merged together to develop the final CAMx-ready point-source emissions. The elevated point source file is independent of the modeling grid because it contains horizontal (X, Y) coordinates for each point source, and so one file includes all point sources in the 12- and 4-km BOEM modeling grids. In addition, CAMx requires separate emissions inputs for source groups being tracked in the source apportionment modeling performed for the future year scenario.

D.3.9.9 Summary of Processed Emissions

This section presents 2012 base case and future year scenario emissions summaries for the BOEM 12- and 4-km domains. The summary is organized by state and by source category.

Table D-4 summarizes NO_x, VOC, SO_2, and $PM_{2.5}$ air pollutant emissions in short tons per year for the states that border the Gulf of Mexico (i.e., Texas, Louisiana, Alabama, Mississippi, and

[7] http://www.camx.com/download/support-software.aspx

Florida). The summary data are based on 12-km SMOKE processing of 2012 base case and future year inventories as described above. With the exception of fugitive dust and biogenic sources, emissions are summarized from the SMOKE reports generated by the SMKMRG program. Fugitive dust emissions were adjusted after SMOKE processing to account for fugitive dust correction factors derived from the Biogenic Emission Landuse Database version 3 (BELD3). Application of these dust transport correction factors accounts for suppression of grid-scale dust emissions via deposition on proximate vegetation surfaces such as roadside trees and bushes. As noted above, biogenic emissions were generated using the MEGAN model outside of SMOKE and so are generated directly on the 36/12/4-km grids rather than by state/county. Across the 5-state region, NO_x emissions were projected to go down 4% but VOC emissions are expected to increase by 3%, with $PM_{2.5}$ emissions increasing by 10%. The largest change in emissions between the current and future year is for SO_2 that is projected to go down by 39%.

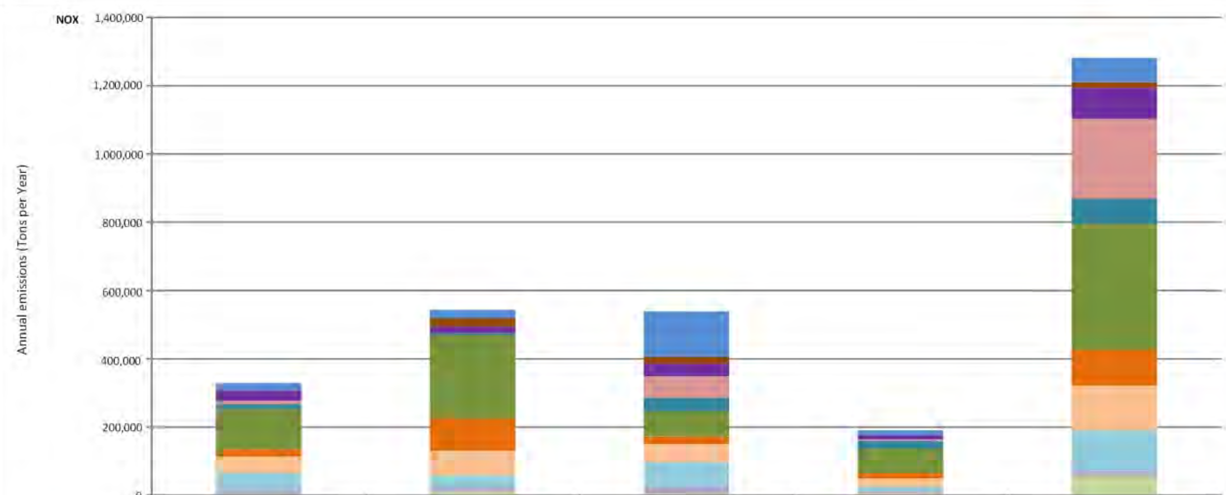
Table D-4. 2012 Base Case and Future Year Emissions Summary by State for BOEM'S 12-km Domain (only Gulf Coast States: Alabama, Florida, Louisiana, Mississippi, and Texas).

States	2012 Base Year				Future Year Scenario			
	NO_x (TPY)	$PM_{2.5}$ (TPY)	SO_2 (TPY)	VOC (TPY)	NO_X (TPY)	$PM_{2.5}$ (TPY)	SO_2 (TPY)	VOC (TPY)
Alabama	210,701	183,321	201,810	1,763,216	178,015	208,531	104,688	1,744,057
Florida	299,738	182,492	144,640	1,754,031	263,778	201,117	127,170	1,690,680
Louisiana	464,962	299,510	203,154	2,030,042	406,421	301,052	127,260	2,007,720
Mississippi	119,430	216,950	57,466	1,622,369	98,334	277,025	32,403	1,610,893
Texas	911,470	683,209	451,018	5,155,944	970,493	739,791	257,073	5,588,049

Figures D-6 through D-9 present stacked bar chart summaries for the 2012 base case emissions that show BOEM 12-km domain anthropogenic, fire, and biogenic emissions by source category and pollutants for Alabama, Florida, Louisiana, Mississippi, and Texas. Note that these emission summaries are only for the states (and State waters) that border the Gulf of Mexico. Similarly, **Figures D-10 through D-13** present stacked bar chart summaries for the future year scenario in short tons per year for the Gulf Coast States. Emission categories used in these summaries are defined below:

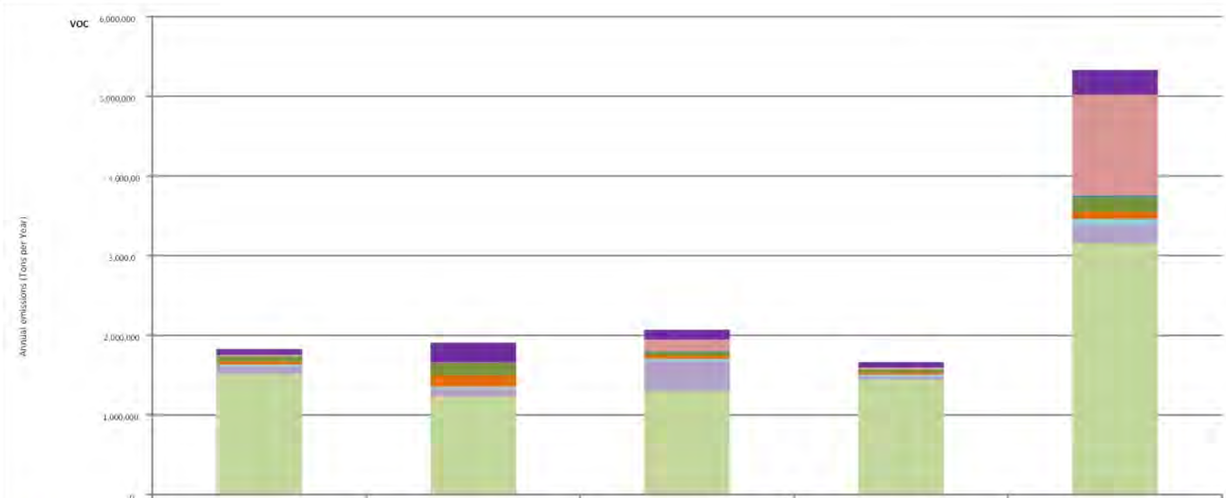
Source Category	Description
ALM	Aircraft, locomotive and smaller commercial marine vessels
Fugitive Dust	Anthropogenic fugitive dust from paved and unpaved roads, agricultural, construction, and mining sources
C3 CMV	Commercial marine vessels with Category 3 (C3) main engines
Nonpoint	Stationary non-point sources
Area Oil and Gas	Non-point oil and gas sector onshore sources
Point Oil and Gas	Point oil and gas sector onshore sources
Onroad	Motorized vehicles that are normally operated on public roadways (passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses
Nonroad	Off-road equipment included in USEPA's nonroad model
EGU Point	Electric Generating Unit point sources

Source Category	Description
NonEGU Point	NEI point sources that are not in the EGU or Point oil and gas sectors
Fires	Agricultural fires, wildfires and prescribed burning
Biogenic	Vegetation and soils throughout domain
BOEM OCS Support Vessel with Action (State waters only)	All BOEM OCS oil and gas support vessels and helicopter under the 2017-2022 GOM Multisale EIS's "Proposed Action" scenario, from which this Supplemental EIS tiers



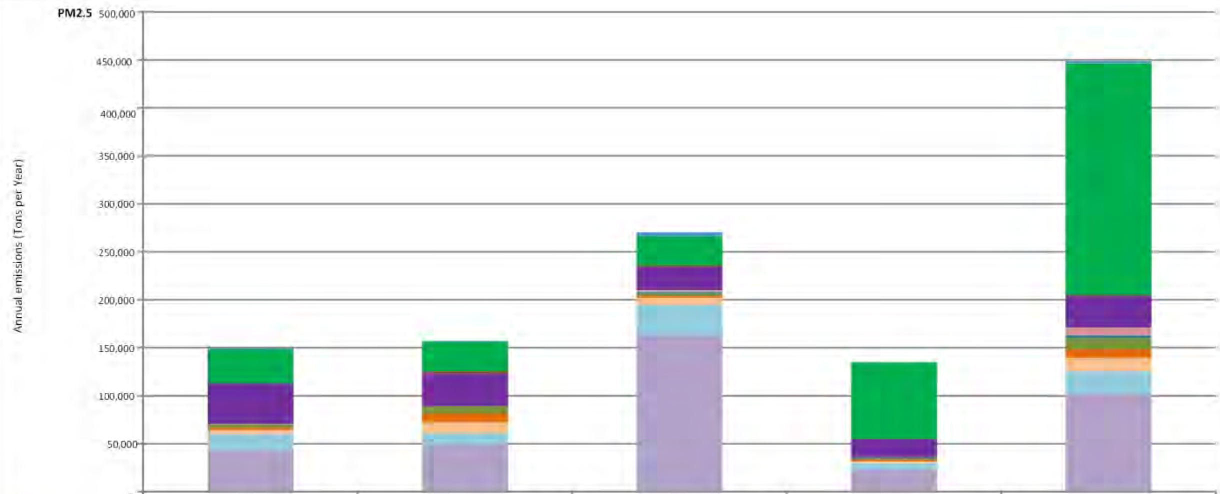
	Alabama	Florida	Louisiana	Mississippi	Texas
ALM	22,187	24,680	132,587	14,043	70,977
Fugitive Dust	-	-	-	-	-
C3 CMV	971	24,823	20,265	1,067	15,637
Nonpoint	29,583	19,810	37,279	12,713	91,593
Area O&G	10,207	75	63,115	3,126	234,192
Point O&G	13,338	5,303	39,071	23,337	73,067
Onroad	118,611	243,612	73,345	70,922	369,305
Nonroad	21,563	94,187	22,506	16,326	104,704
EGU Point	47,247	72,708	52,585	23,088	131,820
NonEGU Point	49,997	35,207	73,726	13,257	117,052
Fires	10,105	12,139	17,307	6,294	14,474
Biogenic	5,503	10,804	6,521	6,178	57,955

Figure D-6. BOEM's 12-km 2012 Base Case NO_x Emissions Summary in Tons per Year by Source Category and State (Alabama, Florida, Louisiana, Mississippi, and Texas).



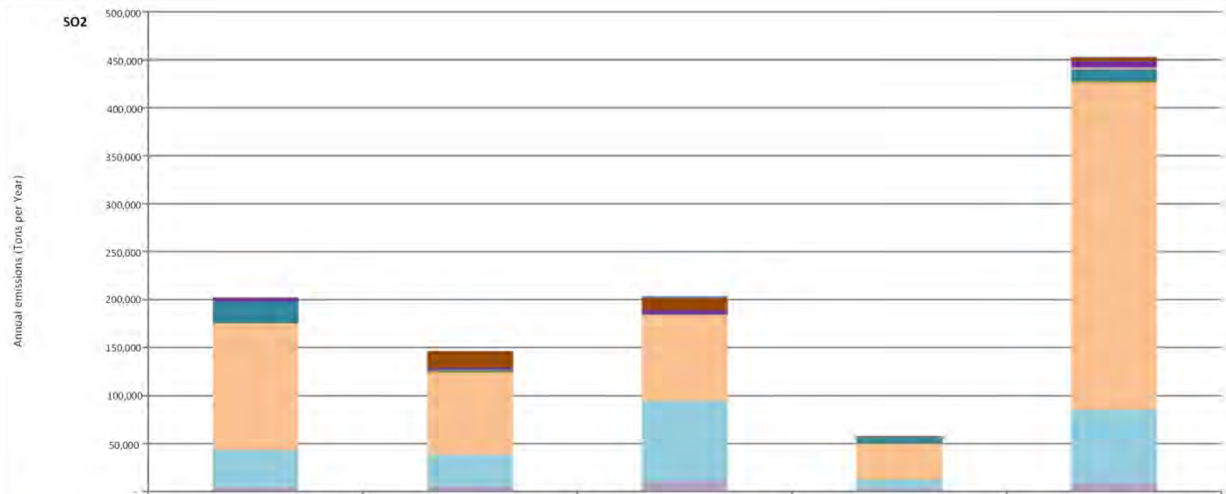
	Alabama	Florida	Louisiana	Mississippi	Texas
ALM	943	774	3,319	514	3,605
Fugitive Dust	-	-	-	-	-
C3 CMV	36	833	737	37	628
Nonpoint	66,912	248,371	119,530	65,800	309,395
Area O&G	22,960	2,726	147,466	21,091	1,268,897
Point O&G	1,866	558	11,263	3,366	22,395
Onroad	60,863	152,419	39,325	37,769	176,615
Nonroad	39,070	146,351	43,583	27,100	89,663
EGU Point	1,293	3,649	1,377	572	3,410
NonEGU Point	25,570	21,884	38,954	23,034	80,784
Fires	88,593	97,281	360,560	40,655	220,751
Biogenic	1,515,975	1,231,604	1,303,252	1,440,201	3,156,416

Figure D-7. BOEM 12-km 2012 Base Case VOC Emissions Summary in Tons per Year by Source Category and State (Alabama, Florida, Louisiana, Mississippi, and Texas).



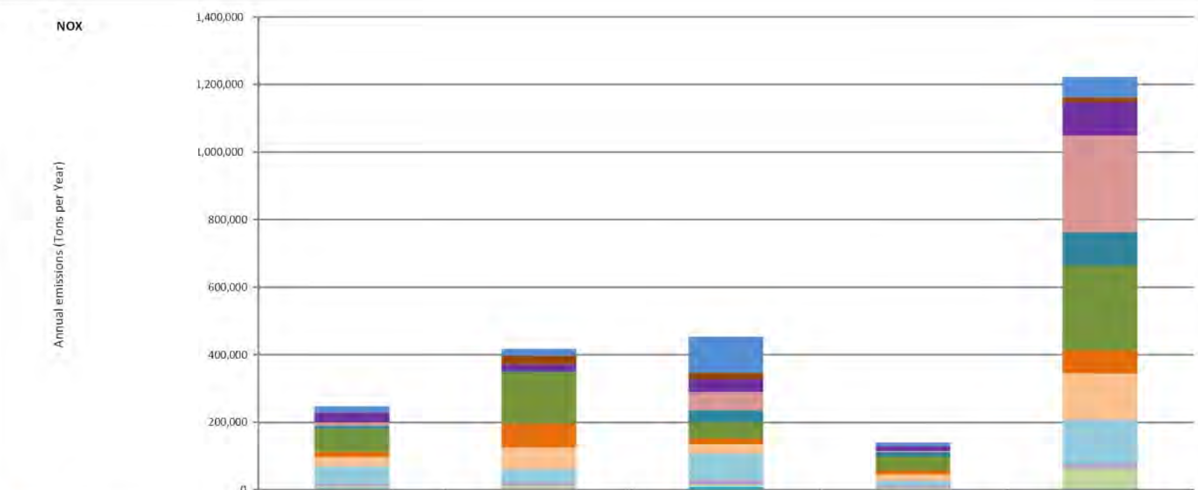
	Alabama	Florida	Louisiana	Mississippi	Texas
ALM	700	766	4,222	430	2,054
Fugitive Dust	35,334	31,200	30,530	79,263	241,756
C3 CMV	74	2,027	1,534	82	497
Nonpoint	42,167	33,881	23,829	19,757	33,391
Area O&G	260	2	1,982	88	7,855
Point O&G	338	108	1,715	364	2,931
Onroad	3,637	7,729	2,345	2,014	11,615
Nonroad	2,223	9,141	2,181	1,626	9,119
EGU Point	4,133	11,413	7,244	1,692	13,886
NonEGU Point	16,674	11,908	32,024	7,296	23,346
Fires	43,385	48,951	162,728	22,455	102,046
Biogenic	-	-	-	-	-

Figure D-8. BOEM 12-km 2012 Base Case $PM_{2.5}$ Emissions Summary in Tons per Year by Source Category and State (Alabama, Florida, Louisiana, Mississippi, and Texas).



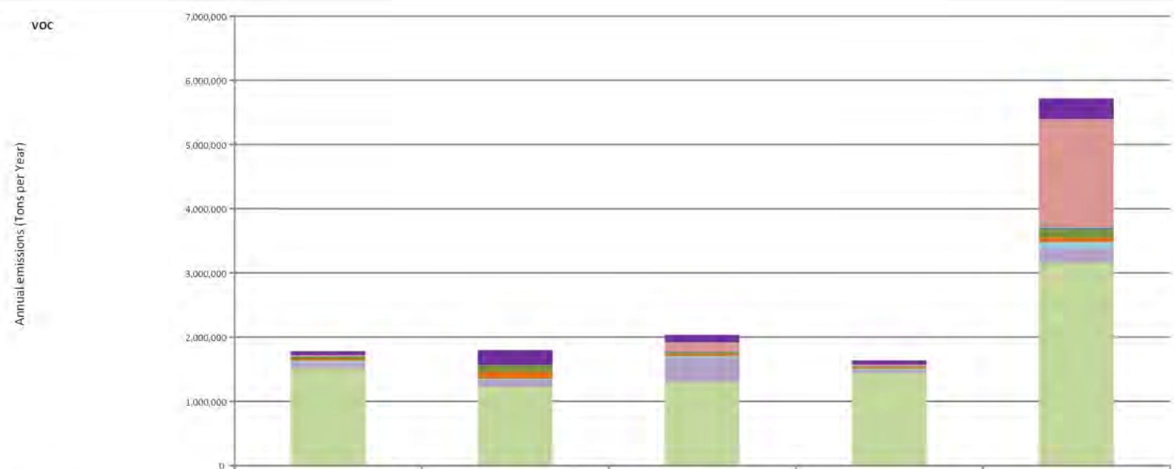
	Alabama	Florida	Louisiana	Mississippi	Texas
ALM	242	280	1,603	153	713
Fugitive Dust	-	-	-	-	-
C3 CMV	635	17,141	13,061	740	4,404
Nonpoint	3,643	2,388	4,302	894	6,240
Area O&G	46	2	173	31	2,304
Point O&G	21,967	943	488	5,825	11,304
Onroad	592	1,842	441	352	2,259
Nonroad	47	194	47	32	188
EGU Point	131,903	85,483	89,045	37,279	340,995
NonEGU Point	38,663	32,528	83,318	9,544	76,365
Fires	4,664	5,680	11,117	2,968	8,505
Biogenic	-	-	-	-	-

Figure D-9. BOEM 12-km 2012 Base Case SO_2 Emissions Summary in Tons per Year by Source Category and State (Alabama, Florida, Louisiana, Mississippi, and Texas).



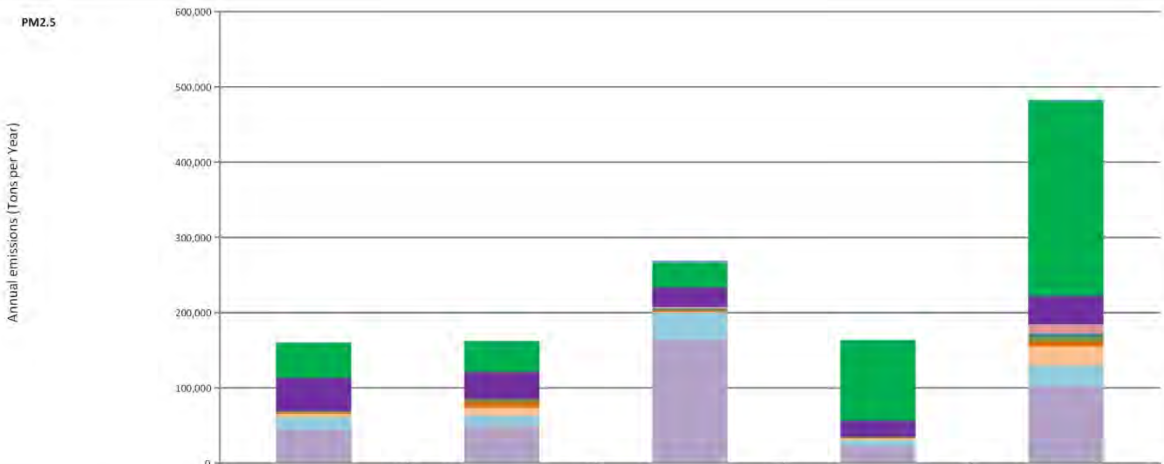
	Alabama	Florida	Louisiana	Mississippi	Texas
ALM	18,589	20,338	106,694	11,650	60,228
Fugitive Dust	-	-	-	-	-
C3 CMV	919	25,472	19,184	1,010	14,803
Nonpoint	28,479	20,023	38,619	13,162	98,650
Area O&G	9,791	54	52,941	2,460	286,144
Point O&G	7,941	2,619	36,784	13,217	98,642
Onroad	69,174	153,294	47,154	42,091	251,443
Nonroad	15,534	69,617	16,923	11,908	68,038
EGU Point	27,727	64,970	27,347	17,909	135,803
NonEGU Point	49,478	37,742	75,646	14,545	131,876
Fires	10,105	12,139	17,307	6,294	14,474
Biogenic	5,503	10,804	6,521	6,178	57,955
BOEM OCS Sup. Vessel w/Action	3,949	0	8,454	0	3,881

Figure D-10. BOEM 12-km Future Year NO_x Emissions Summary in Tons per Year by Source Category and State (Alabama, Florida, Louisiana, Mississippi, and Texas).



	Alabama	Florida	Louisiana	Mississippi	Texas
ALM	661	587	2,630	369	2,475
Fugitive Dust	-	-	-	-	-
C3 CMV	43	1,071	874	44	746
Nonpoint	62,324	227,349	113,678	61,502	319,263
Area O&G	20,611	2,264	143,332	21,786	1,691,300
Point O&G	1,394	435	11,250	3,475	27,984
Onroad	35,193	107,225	26,348	22,906	128,671
Nonroad	27,959	103,374	30,468	19,306	63,715
EGU Point	1,043	2,313	850	574	5,106
NonEGU Point	25,286	24,403	39,403	22,982	100,121
Fires	88,593	97,281	360,560	40,655	220,751
Biogenic	1,515,975	1,231,604	1,303,252	1,440,201	3,156,416
BOEM OCS Sup. Vessel w/Action	169	0	1,421	0	171

Figure D-11. BOEM 12-km Future Year VOC Emissions Summary in Tons per Year by Source Category and State (Alabama, Florida, Louisiana, Mississippi, and Texas).



	Alabama	Florida	Louisiana	Mississippi	Texas
ALM	508	555	3,011	311	1,501
Fugitive Dust	46,649	40,813	32,621	107,592	259,416
C3 CMV	13	386	271	14	88
Nonpoint	43,916	35,751	25,230	20,839	37,578
Area O&G	215	2	1,868	76	12,271
Point O&G	304	66	1,767	240	3,744
Onroad	2,001	4,592	1,395	1,170	7,128
Nonroad	1,618	6,841	1,544	1,140	6,155
EGU Point	4,613	10,062	1,395	2,097	25,048
NonEGU Point	16,623	14,396	36,271	7,899	27,414
Fires	43,385	48,951	162,728	22,455	102,046
Biogenic	-	-	-	-	-
BOEM OCS Sup. Vessel w/Action	360	0	777	0	354

Figure D-12. BOEM 12-km Future Year $PM_{2.5}$ Emissions Summary in Tons per Year by Source Category and State (Alabama, Florida, Louisiana, Mississippi, and Texas).

	Alabama	Florida	Louisiana	Mississippi	Texas
ALM	18	34	240	15	34
Fugitive Dust	-	-	-	-	-
C3 CMV	29	846	595	34	201
Nonpoint	2,004	1,510	1,492	873	2,924
Area O&G	23	2	214	37	5,125
Point O&G	20,298	853	576	5,513	11,291
Onroad	301	933	235	182	1,223
Nonroad	25	94	24	17	92
EGU Point	40,732	86,015	29,990	13,422	155,982
NonEGU Point	36,887	32,135	82,976	9,525	72,910
Fires	4,664	5,680	11,117	2,968	8,505
Biogenic	-	-	-	-	-
BOEM OCS Sup. Vessel w/Action	8	0	36	0	10

Figure D-13. BOEM 12-km Future Year SO_2 Emissions Summary in Tons per Year by Source Category and State (Alabama, Florida, Louisiana, Mississippi, and Texas).

Table D-5 summarizes NO_x, VOC, SO_2, and $PM_{2.5}$ emissions within the 4-km domain in short tons for the 2012 base year and the 2017 future year scenario, and **Table D-6** summarizes the changes in emissions between the base and future year scenarios by major source category.

Table D-5. 2012 Base Case and Future Year Emissions Summary by Source Category for BOEM's 4-km Domain.

Sectors	2012 Base Year (TPY)				Future Year Scenario (TPY)			
	NO_x	$PM_{2.5}$	SO_2	VOC	NO_x	$PM_{2.5}$	SO_2	VOC
Fugitive Dust	0	70,526	0	0	0	78,179	0	0
Agricultural	0	0	0	0	0	0	0	0
Fires	50,781	493,750	34,939	1,112,486	50,781	493,750	34,939	1,112,486
ALM	171,436	5,416	2,039	4,896	278,052	7,752	560	7,520
C3 CMV	68,857	3,650	36,339	2,466	108,654	2,666	25,892	4,769
Biogenic	19,015	0	0	3,140,424	19,015	0	0	3,140,424
Nonpoint	81,918	54,561	7,390	296,267	86,014	58,937	3,165	294,728
Nonroad	76,345	6,994	153	112,683	105,272	9,653	159	157,559
Area Oil and Gas	69,331	1,991	530	506,972	148,131	5,535	2,134	1,283,385
Onroad	270,364	8,467	1,731	145,061	183,305	7,124	940	106,904

Sectors	2012 Base Year (TPY)				Future Year Scenario (TPY)			
	NO_x	$PM_{2.5}$	SO_2	VOC	NO_x	$PM_{2.5}$	SO_2	VOC
Non-U.S. Fugitive Dust	0	0	0	0	0	0	0	0
Non-U.S. Area	38,832	4,361	719	15,208	35,625	4,429	502	16,787
BOEM Gulfwide	186,636	6,337	26,968	7,310	129,814	4,117	31,839	36,109
Non-U.S. Onroad	13,894	438	73	6,217	9,097	447	27	4,041
Non-U.S. Point (with GOM offshore platforms)	106,344	2,663	7,795	57,361	32,045	2,181	4,646	11,337
Point Oil and Gas	101,530	4,587	50,861	39,192	95,052	4,961	47,086	42,884
EGU Point	137,932	17,943	306,031	3,545	117,518	21,802	136,784	4,371
Non-EGU Point	319,924	105,264	271,961	208,773	344,080	120,826	269,191	240,212
BOEM OCS Platform No Action	0	0	0	0	84,351	837	3,205	54,449
BOEM OCS Platform w/Action	0	0	0	0	22,973	223	1,037	7,015
BOEM OCS Support Vessel No Action	0	0	0	0	234,796	8,296	23,089	8,093
BOEM OCS Support Vessel w/Action	0	0	0	0	106,163	9,749	396	10,238

Table D-6. Changes in Emissions between the 2012 Base Case and Future Year Emissions (short tons per year) by Source Category for BOEM's 4-km Domain.

Sector	Future Year - Base Year (TPY)				Future Year - Base Year (%)			
	NO_x	$PM_{2.5}$	SO_2	VOC	NO_x	$PM_{2.5}$	SO_2	VOC
Fugitive Dust	0	7,653	0	0	--	11%	--	--
Agricultural	0	0	0	0	--	--	--	--
Fires	0	0	0	0	0%	0%	0%	0%
ALM	106,616	2,336	(1,479)	2,624	62%	43%	-73%	54%
C3 CMV	39,797	(984)	(10,447)	2,303	58%	-27%	-29%	93%
Biogenic	0	0	0	0	0%	--	--	0%
Nonpoint	4,096	4,376	(4,225)	(1,539)	5%	8%	-57%	-1%
Nonroad	28,927	2,659	6	44,876	38%	38%	4%	40%
Area Oil and Gas	78,800	3,544	1,604	776,413	114%	178%	303%	153%
Onroad	(87,059)	(1,343)	(791)	(38,157)	-32%	-16%	-46%	-26%

Sector	Future Year - Base Year (TPY)				Future Year - Base Year (%)			
	NO_x	$PM_{2.5}$	SO_2	VOC	NO_x	$PM_{2.5}$	SO_2	VOC
Non-U.S. Fugitive Dust	0	0	0	0	--	--	--	--
Non-U.S. Area	(3,207)	68	(217)	1,579	-8%	2%	-30%	10%
BOEM Gulfwide	(56,822)	(2,220)	4,871	28,799	-30%	-35%	18%	394%
Non-U.S. Onroad	(4,797)	9	(46)	(2,176)	-35%	2%	-63%	-35%
Non-U.S. Point (with GOM offshore platforms)	(74,299)	(482)	(3,149)	(46,024)	-70%	-18%	-40%	-80%
Point Oil and Gas	(6,478)	374	(3,775)	3,692	-6%	8%	-7%	9%
EGU Point	(20,414)	3,859	(169,247)	826	-15%	22%	-55%	23%
Non-EGU Point	24,156	15,562	(2,770)	31,439	8%	15%	-1%	15%

Figure D-14 presents spatial plots of future year scenario NO_x, VOC, $PM_{2.5}$, and SO_2 emissions in short tons per year within the 4-km domain for the Bureau of Ocean Energy Management's OCS oil and gas production platforms under the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Note that the deepwater platforms have higher annual emissions than the shallow-water platforms. **Figure D-15** presents 4-km spatial plots for the same pollutants and future year scenario in short tons per year for BOEM's OCS oil and gas support vessels and helicopters under the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. **Figure D-16** shows emissions for the Bureau of Ocean Energy Management's OCS oil and gas platforms, support vessels, and helicopters under the No Action alternative, which are the existing sources. **Figure D-17** shows emissions for all other marine vessel activity in the Gulf of Mexico. **Figure D-18** shows emissions for all other anthropogenic U.S. sources.

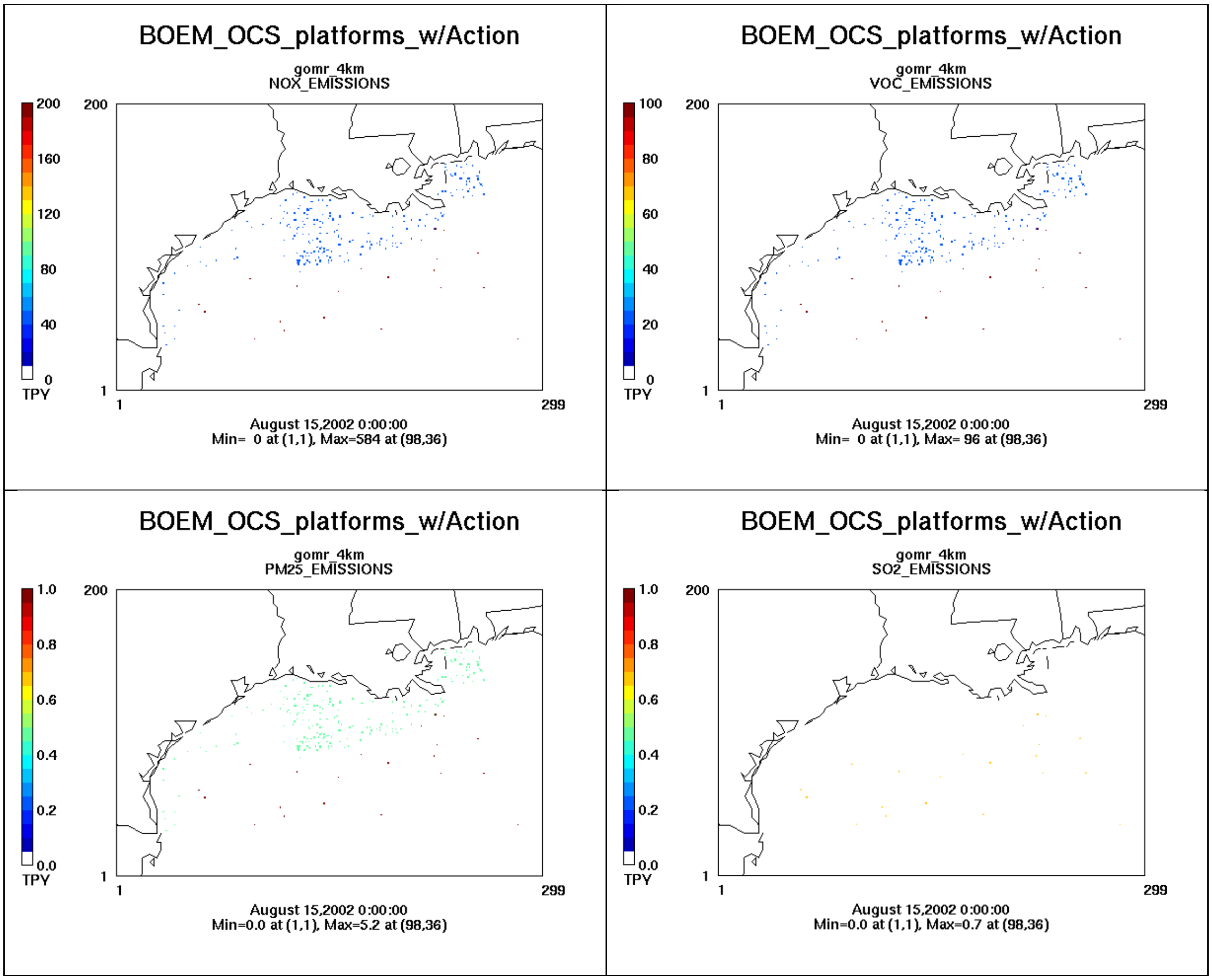


Figure D-14. Spatial Distribution of (clockwise starting from top left) NO_x, VOC, SO_2, and $PM_{2.5}$ Emissions (tons per year) from New OCS Oil and Gas Production Platforms under the Proposed Action.

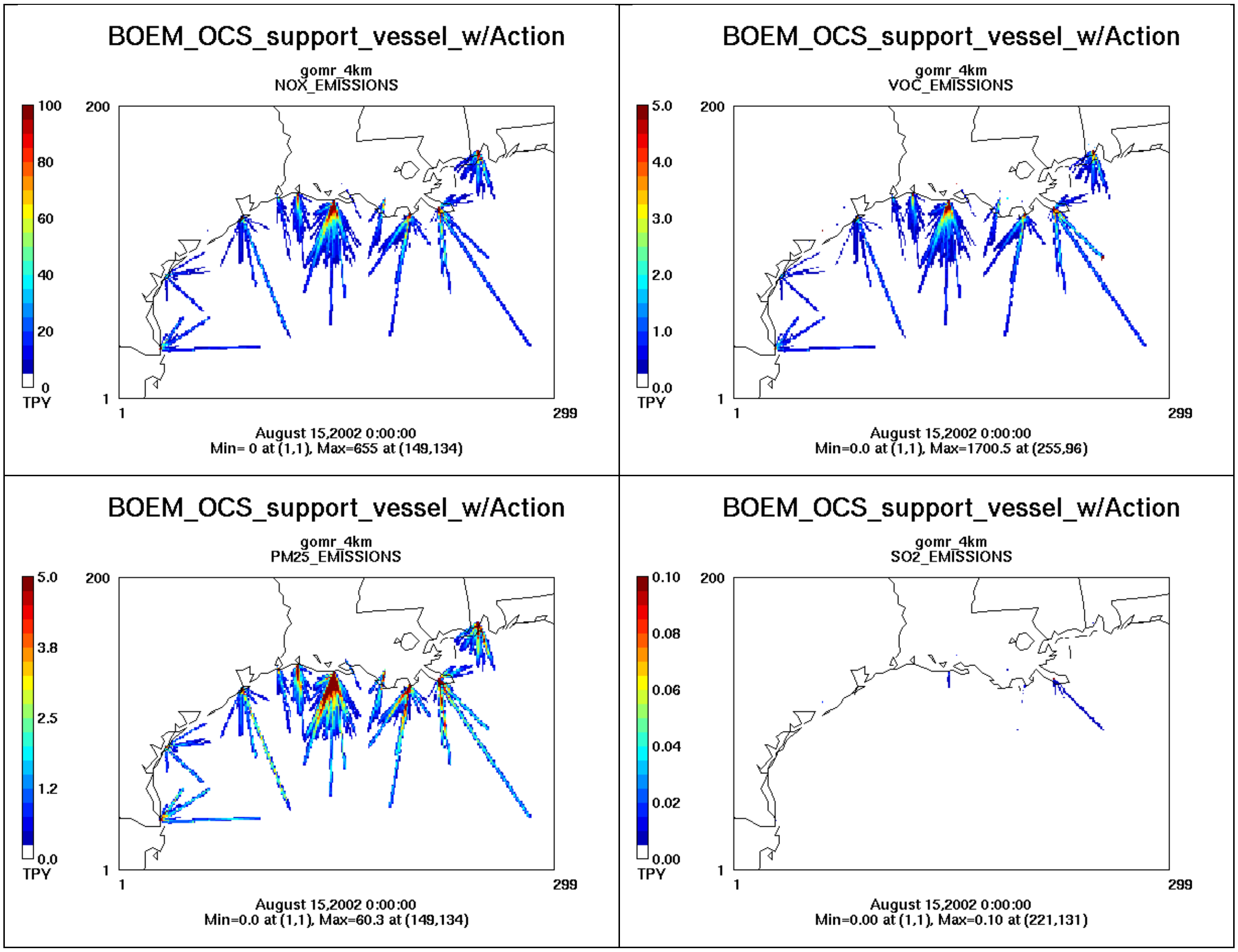


Figure D-15. Spatial Distribution of Emissions (tons per year) of (clockwise starting from top left) NO_x, VOC, SO_2, and $PM_{2.5}$ from BOEM's OCS Additional Oil and Gas Support Vessels and Helicopters under the Proposed Action Scenario.

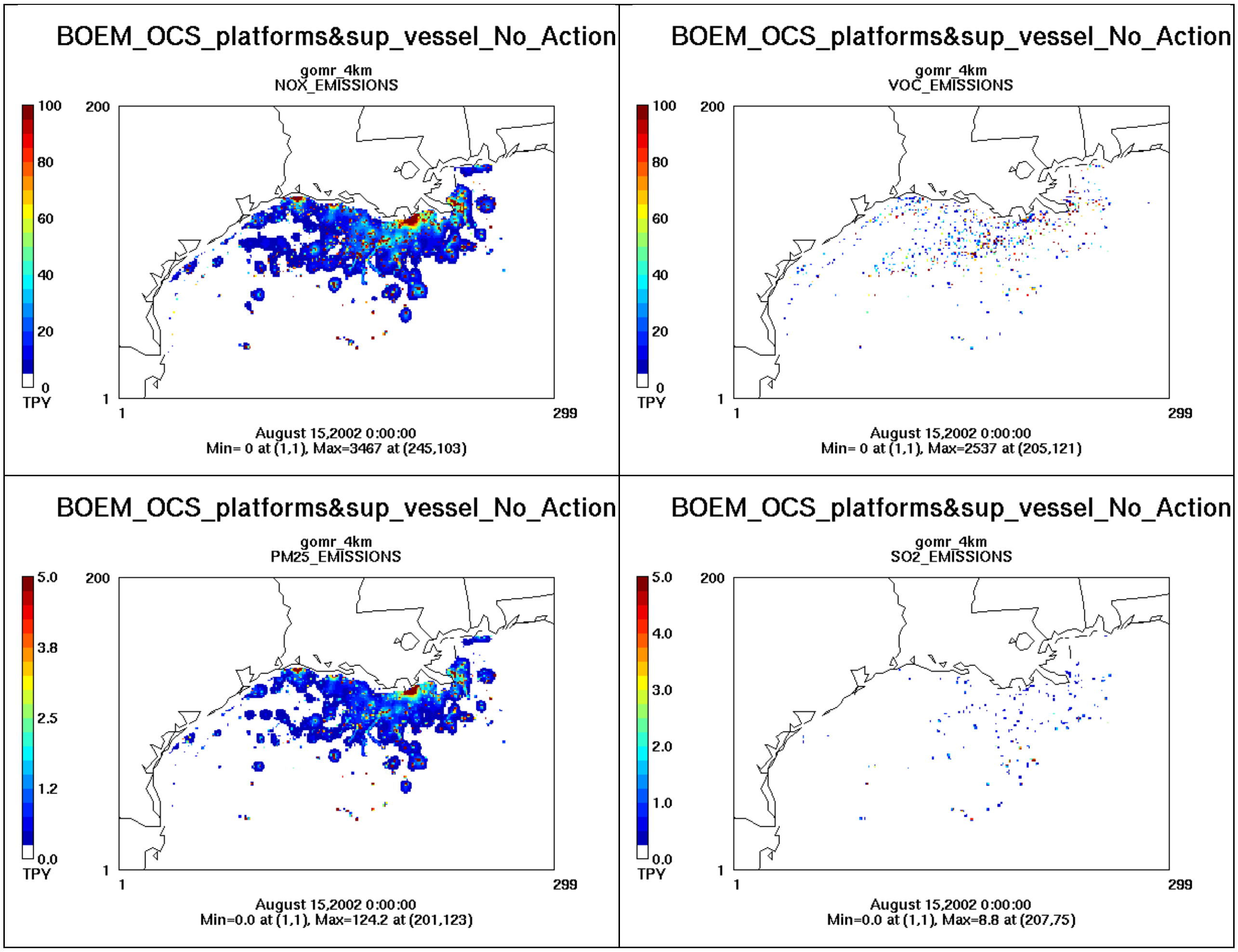


Figure D-16. Spatial Distribution of (clockwise starting from top left) NO_x, VOC, SO_2, and $PM_{2.5}$ Emissions (tons per year) from BOEM's OCS Oil and Gas Platforms, Support Vessels, and Helicopters under the No Action Alternative in BOEM's 4-km Domain.

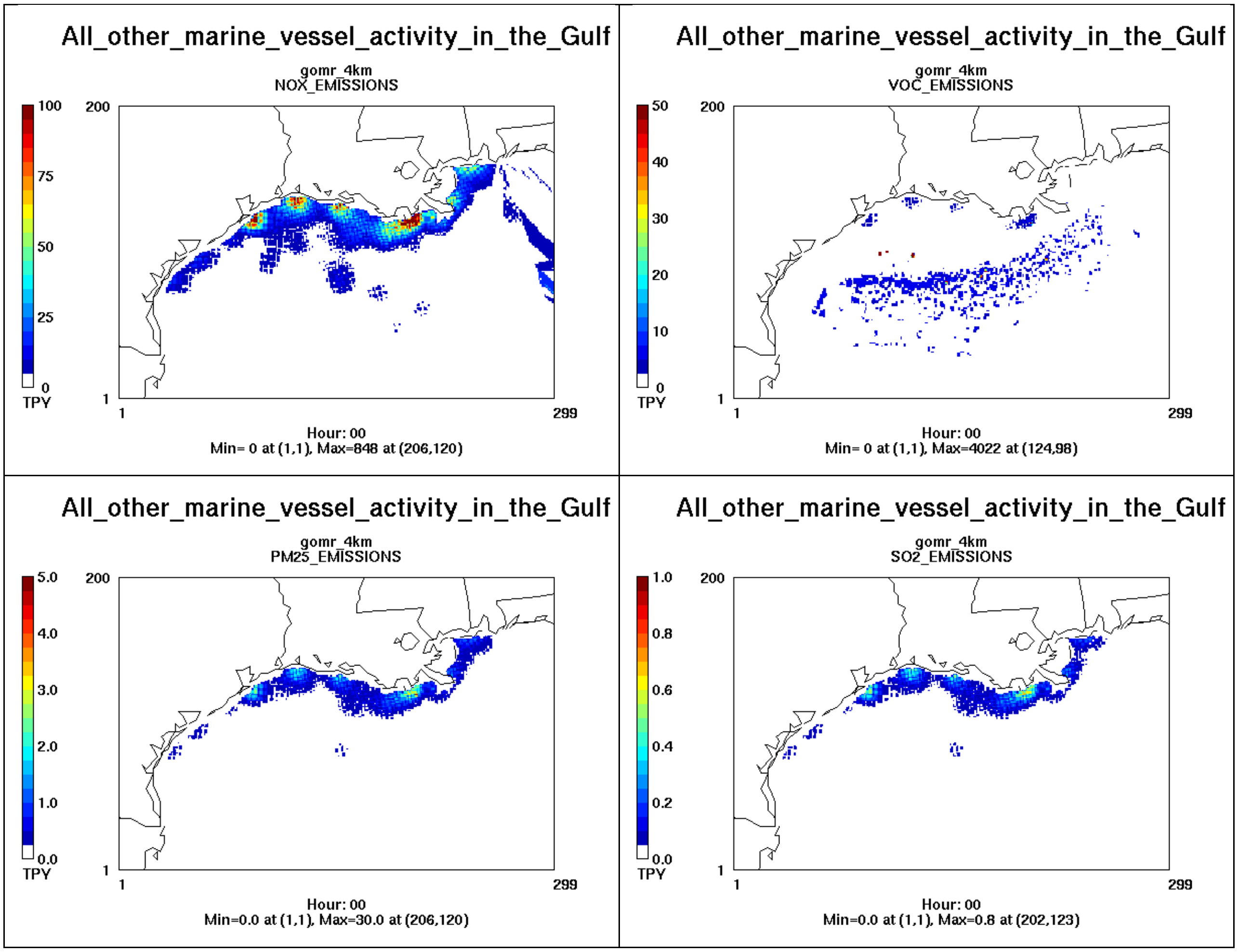


Figure D-17. Spatial Distribution of (clockwise starting from top left) NO_x, VOC, SO_2, and $PM_{2.5}$ Emissions (tons per year) from All Other Marine Vessel Activity in the Gulf of Mexico under the Future Year Scenario in BOEM's 4-km Domain.

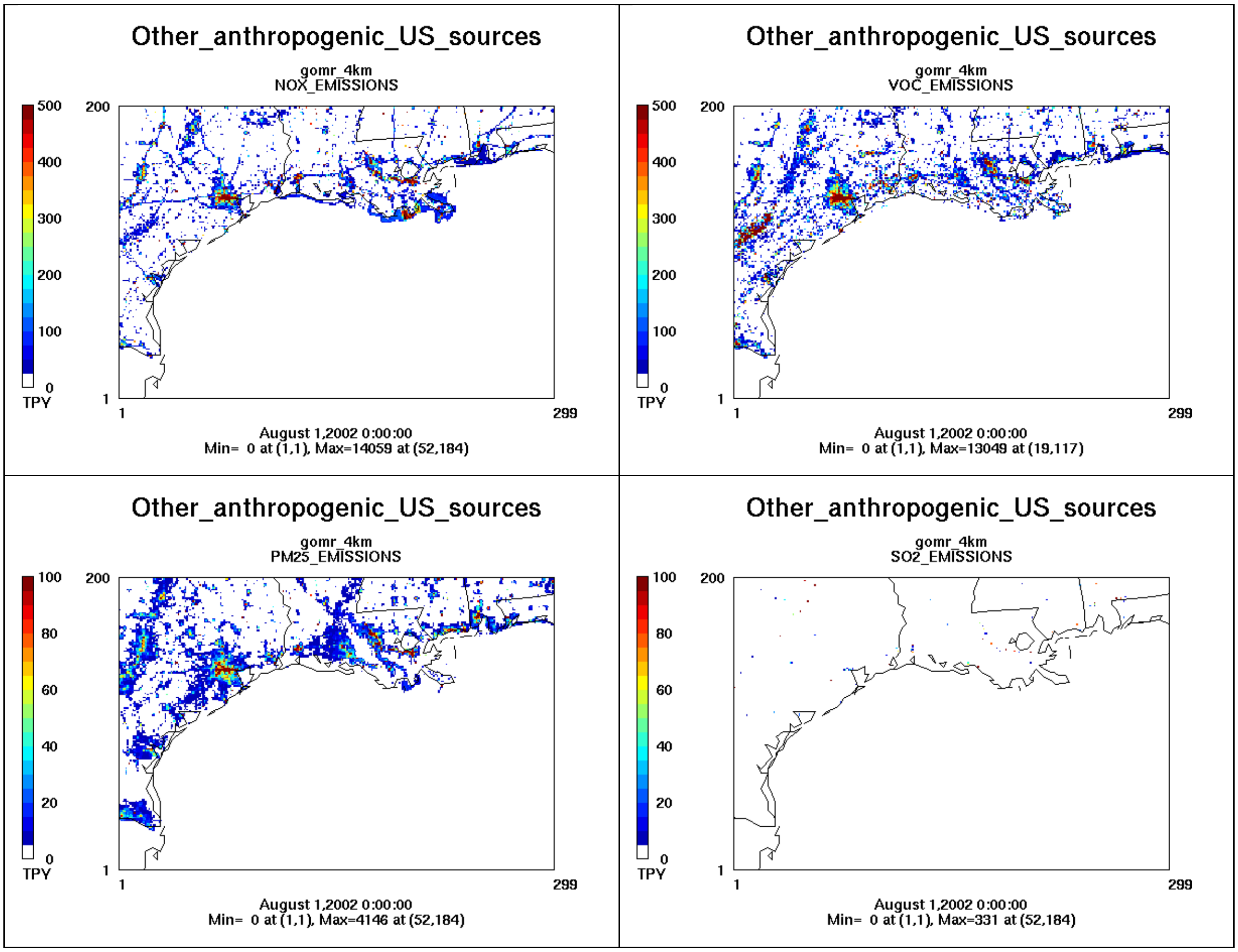


Figure D-18. Spatial Distribution of (clockwise starting from top left) NO_x, VOC, SO_2, and $PM_{2.5}$ Emissions (tons per year) from Other Anthropogenic U.S. Sources for the Future Year Scenario within BOEM's 4-km Domain.

D.3.10 Source Apportionment Design

Source apportionment, as applied in CAMx, provides a means of assessing the contributions of specified sources or categories of sources to predicted ozone and PM concentrations under the air quality conditions being simulated. Source contributions can be calculated for ozone and for PM using ozone or PM source apportionment routines included in CAMx. Source apportionment analyses were applied to the future year scenario in order to analyze the pre- and postlease OCS oil and gas impacts to short-term and annual NAAQS, AQRVs, and PSD increments. BOEM selected a set of nine source categories for source apportionment as listed in **Table D-7**.

Table D-7. Source Categories for Source Apportionment Calculations.

Category ID	Sources
SC1	Fires (U.S., Canada, and Mexico)
SC2	Biogenic and other natural sources (e.g., lighting NO_x and sea salt)
SC3	Additional BOEM OCS oil and gas production platforms associated with the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers (w/Action)
SC4	Additional BOEM oil and gas production support vessels and helicopters associated with the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers (w/Action)
SC5	BOEM's OCS oil and gas production platforms, support vessels, and helicopters under the base case (No Action) alternative
SC6	All other marine vessel activity in the Gulf of Mexico, not associated with OCS oil and gas activities
SC7	Other anthropogenic U.S. sources[8]
SC8	Mexican and Canadian anthropogenic sources[9]
SC9	Initial Conditions (IC)
SC10	Boundary Conditions (BC)

These source categories aggregate similar sources based on jurisdiction (i.e., sources under BOEM's jurisdiction versus other Federal agencies) and sources beyond direct domestic regulatory control (e.g., natural emission sources and foreign sources). Additional OCS oil and gas production platforms and additional support vessel and helicopter trips associated with the 2017-2022 GOM Multisale EIS are included as a separate source category, thus providing estimates of the impacts of these new sources, which are projected to occur under the future year scenario associated with the 2017-2022 GOM Multisale EIS. Platforms and support vessels and helicopters projected for the future year scenario under the base case (No Action) scenario are also included as a separate source apportionment category. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS and uses the scenario and alternatives analyzed in the 2017-2022 GOM Multisale EIS.

Isolating fires and biogenic emissions shows the component of the air quality concentrations that are typically beyond the control of Federal agencies and states. Similarly, the Mexican and Canadian anthropogenic emissions are beyond the control of U.S. regulators.

D.4 Base Case Photochemical Grid Modeling

D.4.1 Overview

The CAMx Photochemical Grid Model (PGM) was applied on a set of nested domains with horizontal resolutions of 36, 12 and 4 km centered on the Gulf of Mexico OCS Region (**Figure D-5**). For the 2012 base case analysis, CAMx was run with the 2012 base case emissions described in **Section D.3**. Meteorological fields required by CAMx were obtained from the WRF meteorological

[8] Includes onshore oil and gas production sources and oil and gas production sources in State waters.
[9] Also includes oil and gas production sources.

model results for 2012, which were developed as described in **Section D.2**. Modeling procedures were based on the USEPA's current and revised draft modeling guidance procedures (USEPA, 2007 and 2014). Additional features of the modeling approach are listed below.

- Anthropogenic and non-anthropogenic model-ready emissions for the 2012 base case were developed as described in the emission inventory TSD.
- Photochemical grid modeling was based on CAMx version 6.20 with the Carbon Bond 6 revision 2h (CB6r2h) photochemical mechanism, including active excess methane emissions and halogen chemistry.
- Day-specific boundary conditions (BCs) for the lateral boundaries of the 36-km modeling domain were based on 2012 GEOS-Chem global chemistry model (GCM) output.
- A model performance evaluation was conducted for the initial 2012 base case simulation using all available aerometric data within the modeling domain. Based on these initial results, a number of potential issues with model inputs were identified and appropriate modifications tested to confirm that the extent to which the modifications resolved the identified issues and resulted in improved model performance. These initial results and test results are described in **Section D.5**. Revised inputs were then used in the final model simulations and revised model performance metrics based on the final model runs were prepared. Results of the final model performance evaluation are also presented in **Section D.5**.

D.4.2 Model Grid Configuration

The PGM domain configuration is comprised of a system of nested grids with 36-, 12-, and 4-km horizontal resolution as shown in **Figure D-5**. **Table D-8** provides the modeling grid definitions for the WRF and CAMx simulations. Since a large portion of the eastern GOM is under Congressional moratoria (GOMESA), the 4-km PGM domain excluded this area to limit the grid dimension to allow for a more manageable size for computation efficiency.

Table D-8. Domain Grid Definitions for the WRF and CAMx/CMAQ Modeling.

Modeling Grid	WRF		CAMx	
	Origin[1] Coordinates (x, y) (km)	Grid Dimension (column × row)	Origin[1] Coordinates (x, y) (km)	Grid Dimension (column × row)
36-km grid	(-2592, -2304)	(164 × 128)	(-2736, -2088)	(148 × 112)
12-km grid	(-1008, -2016)	(264 × 186)	(-948, -1956)	(254 × 176)
4-km grid	(-156, -1704)	(480 × 210)	(-136, -1684)	(299 × 200)

[1] Southwest corner of each domain grid.

For CAMx, BCs for the 12-km domain were extracted from the 36-km simulation results, and the 12-and 4-km grids were modeled using 2-way nesting (allowing interactions between the two grids in both directions). Specification of the CAMx vertical domain structure depends on the definition of the WRF vertical layers structure. The WRF simulation was run with 33 vertical layer interfaces (which is equivalent to 32 vertical layers) from the surface up to 50 mbar (approximately 20 km above mean sea level [AMSL]). The WRF model employs a terrain following coordinate system called eta (η) coordinate, which is defined by relative pressure differences between layers. As shown in **Table D-9**, the WRF levels are more finely stratified near the surface in an attempt to improve simulation of the atmospheric boundary layer structure and processes. A layer collapsing scheme is adopted for the CAMx simulations whereby multiple WRF layers are combined into single CAMx layers to improve the PGM computational efficiency. **Table D-9** also shows the layer collapsing from the 32 WRF layers to 28 PGM layers. The mixing heights over the study domain are typically below 2 km. Therefore, the WRF modeling layers up to the 16th layer (approximately 2 km) are directly mapped to the PGM layers (no layer-collapsing) to better simulate the stable thermal stratification of the boundary layer and avoid errors potentially introduced by layer collapsing. Above the 20th WRF layer, two WRF layers were combined into a single PGM layer up to the 50 hPa region top.

Table D-9. Vertical Layer Interface Definition for WRF Simulations (left-most columns) and the Layer-collapsing Scheme for the CAMx/CMAQ Layers (right columns).

WRF					CAMx/CMAQ		
Layer Interface	Eta (η)	Pressure (mbar)	Height (m)	Thickness (m)	Layer	Layer Top Height (m)	Thickness (m)
33	0.0	50	19,594.2	2,090.8	24	19,594.2	3,972.6
32	0.027	76	17,503.4	1,881.8			
31	0.06	107	15,621.6	1,754.7	23	15,621.6	3,484.9
30	0.1	145	13,866.9	1,730.1			
29	0.15	193	12,136.7	1,412.6	22	12,136.7	2,614.2
28	0.2	240	10,724.1	1,201.6			
27	0.25	288	9,522.5	1,050.2	21	9,522.5	1,986.1
26	0.3	335	8,472.3	935.8			
25	0.35	383	7,536.4	846	20	7,536.4	1,693.2
24	0.4	430	6,690.5	847.3			
23	0.455	482	5,843.2	910.3	19	5,843.2	1,679.1
22	0.52	544	4,932.9	768.8			
21	0.58	601	4,164.1	711.8	18	4,164.1	1,375.4
20	0.64	658	3,452.2	663.5			
19	0.7	715	2,788.7	418.9	17	2,788.7	821.1
18	0.74	753	2,369.8	402.1			
17	0.78	791	1,967.6	386.8	16	1,967.6	386.8
16	0.82	829	1,580.8	280.8	15	1,580.8	280.7
15	0.85	858	1,300.1	273.3	14	1,300.1	273.4
14	0.88	886	1,026.7	178.3	13	1,026.7	178.2
13	0.9	905	848.5	131.7	12	848.5	131.8
12	0.915	919	716.7	130.1	11	716.7	130.1
11	0.93	934	586.6	85.8	10	586.6	85.8
10	0.94	943	500.8	85.1	9	500.8	85.1
9	0.95	953	415.7	84.5	8	415.7	84.5

WRF					CAMx/CMAQ		
Layer Interface	Eta (η)	Pressure (mbar)	Height (m)	Thickness (m)	Layer	Layer Top Height (m)	Thickness (m)
8	0.96	962	331.2	83.8	7	331.2	83.8
7	0.97	972	247.4	83.1	6	247.4	83.1
6	0.98	981	164.3	57.8	5	164.3	57.8
5	0.987	988	106.5	41.1	4	106.5	41.1
4	0.992	992	65.4	24.6	3	65.4	24.6
3	0.995	995	40.8	20.4	2	40.8	20.4
2	0.9975	998	20.4	20.4	1	20.4	20.4
1	1.0	1,000	0	--	--	--	--

D.4.3 Meteorology

Given the objectives of the air quality analysis and the availability of full annual WRF simulations for 2009 through 2013, the CAMx model was exercised for a full calendar year. The decision to model for an entire calendar year rather than just a single season is consistent with the need to address ozone, $PM_{2.5}$, visibility and annual deposition. Given the extremely hot, dry, and smoky conditions during 2011, the 2012 calendar year was selected for the base year, base case modeling.

Meteorological inputs for CAMx were generated by processing the WRF outputs using appropriate meteorological input preprocessors. The WRFCAMx Version 4.3 was used to translate WRF output meteorological fields to daily CAMx meteorological inputs. For a single day, 25 hours of meteorology must be present (midnight through midnight, inclusive) as these fields represent hourly instantaneous conditions and CAMx internally time-interpolates these fields to each model time step. Precipitation fields are not time-interpolated but rather time-accumulated, so cloud/precipitation files contain one less hour than other meteorological files (e.g., 24 hours of clouds/precipitation vs. 25 hours for other meteorology fields).

Several methodologies are available in WRFCAMx to derive vertical diffusivity (Kv) fields from WRF output. For this modeling, a method consistent with the Yonsei University (YSU) bulk boundary layer scheme (Hong and Noh, 2006; this is the default option in WRF) was used to generate the Kv profile. The lower bound Kv value is set based on the land-use type for each grid cell. Another issue is deep cumulus convection, which is difficult to simulate in a grid model because of the small horizontal spatial scale of the cumulus tower. Inadequate characterization of this convective mixing can cause ozone and precursor species to be overestimated in the boundary layer. To address this issue, a patch was developed that increases transport of air from the planetary boundary layer into the free troposphere and up to the cloud top within cloudy grid cells (ENVIRON, 2012). This patch was shown to improve surface layer ozone in a recent modeling study in Texas (Kemball-Cook et al., 2015), and thus was also employed in this modeling study.

The WRFCAMx provides an option to process sub-grid cloud data from WRF fields. Selecting the “DIAG” sub-grid cloud method diagnoses sub-grid cloud fields from WRF gridded thermodynamic fields. The DIAG option is generally selected for the 36- and 12-km WRF output extraction but not for grid spacing less than about 10 km. However, a recent modeling study showed that, without the sub-grid cloud, the 4-km grid produced too much ozone over the Houston area due to enhanced photochemistry (Nopmongcol et al., 2014). Therefore, the DIAG option was used for the 4-km grid as well as the 36- and 12-km grids.

D.4.4 Configuration of Model Input Parameters

Configuration of the CAMx model is summarized in **Table D-10**. Additional key configuration selections include the following:

Chemical Mechanism: Gas phase chemistry using the Carbon Bond 6 revision 2h (CB6r2h) photochemical mechanism including active local excess methane emissions and halogen chemistry. For particles, CAMx was configured to use the Coarse-Fine (CF) aerosol scheme in which primary species are modeled using two static modes (coarse and fine), while all secondary species are modeled as fine particles only.

Photolysis Rates: The CAMx requires a lookup table of photolysis rates as well as gridded albedo/haze/ozone/snow as input. Day-specific ozone column data are based on the Total Ozone Mapping Spectrometer (TOMS) data measured using the satellite-based Ozone Monitoring Instrument (OMI). Albedo is based on land use data, which includes enhanced albedo values when snow cover is present. For CAMx, there is an ancillary snow cover input that is based on WRF output that overrides the land use-based albedo input to use an enhanced snow cover albedo value. The Tropospheric Ultraviolet and Visible (TUV) Radiation Model photolysis rate processor was used. The CAMx is configured to use the in-line TUV to adjust for cloud cover and account for the effects aerosol loadings have on photolysis rates; this latter effect on photolysis may be especially important in adjusting the photolysis rates due to the occurrence of PM concentrations associated with emissions from fires. Note that the same photolysis rates are used in the 2012 base case and future year scenario model runs.

Landuse: Landuse fields were generated based on U.S. Geological Survey (USGS) Geographic Information Retrieval and Analysis System (GIRAS) data[10]. The WRF estimated snow cover data is used to override the USGS land cover categories when snow cover is present.

Meteorological Inputs: The WRF-derived meteorological fields were processed to generate CAMx meteorological inputs for the using the WRFCAMx processor.

Plume in Grid: The subgrid-scale Plum-in-Grid module was not used to avoid unacceptably long model run times and given the fact that most sources in the OCS are far upwind of the receptor sites of interest.

[10] http://pubs.usgs.gov/ds/2006/240/

Boundary Conditions: Boundary conditions (BCs) for the 36-km domain were derived from a GEOS-Chem global chemistry model run for 2012 as described bove. The BCs for the 12/4-km model runs were based on BCs extracted from the 36-km simulations.

Advection/Diffusion Methods: The piecewise parabolic method (PPM) advection solver was used for horizontal transport (Colella and Woodward, 1984), along with the spatially varying (Smagorinsky) horizontal diffusion approach. The CAMx used K-theory for vertical diffusion, using the CMAQ-like vertical diffusivities from WRFCAMx.

Initial Conditions: The 36-km simulation used default initial conditions (ICs) that represent clean remote conditions. A 10-day spin-up period was then used to eliminate any significant influence of the ICs. The ICs and BCs for the nested (12/4-km) grid simulations were extracted from the parent grid simulation outputs with a shorter (3 day) spin-up period.

Boundary Conditions: The lateral boundary conditions (BCs) for the 36-km grid were based on results from a GEOS-Chem GCM simulation for year 2012. The GEOS2CAMx processor was used to interpolate from the GEOS-Chem horizontal and vertical coordinate system to the CAMx coordinate system and to map the GEOS-Chem chemical species to the chemical mechanisms being used by CAMx. The use of an alternative global model (MOZART-4/GEOS5; available at http://www.acd.ucar.edu/wrf-chem/mozart.shtml) as a source for the BCs was explored via a test simulation on the 36-km domain with BCs derived from MOZART and subsequent comparison of model predictions with observations at rural monitoring sites. Results of this comparison indicated slightly worse model performance for ozone when using the MOZART BCs as compared to GEOS-Chem with mixed results for PM depending on species and monitoring network used for evaluation. Based on these results and the fact that, in contrast to GEOS-Chem, MOZART does not use day-specific values for dust emissions, resulted in the selection of BCs based on the GEOS-Chem model.

Table D-10. CAMx Model Configuration.

Science Options	Configuration	Notes
Model Codes	CAMx V6.20	
Horizontal Grid	36/12/4 km	Refer to **Section D.2**
36-km grid	148 x 112 cells	
12-km grid	254 x 176 cells	
4-km grid	299 x 200 cells	
Vertical Grid	19 vertical layers (layer-collapsed from 23 WRF layers)	
Grid Interaction	36/12 km one-way nesting 12/4 km two-way nesting	

Science Options	Configuration	Notes
Initial Conditions	Clean initial conditions	Use 10-day spin-up for the 36-km grid; 3-day spin-up for the nested (12/4 km) grids
Boundary Conditions	36 km from GCM simulation	GEOS-Chem GCM 2012 output data
Land-use Data	Land-use fields based on USGS GIRAS data	
Photolysis Rate Preprocessor	TUV V4.8	Clear-sky photolysis rates based on day-specific Total Ozone Mapping Spectrometer (TOMS) data
Chemistry		
Gas-phase	CB6r2h	Updated isoprene chemistry; heterogeneous hydrolysis of organic nitrates; active methane chemistry and ECH_4 tracer species (Hildebrandt Ruiz and Yarwood, 2013); halogen chemistry (Yarwood et al., 2014)
Aerosol-phase	CF	Coarse and fine mode aerosols
Meteorological Input Preprocessor	WRFCAMx V4.3	Compatible with CAMx V6.20
Diffusion Scheme		
Horizontal-grid	Explicit horizontal diffusion	Spatially varying horizontal diffusivities determined based on the methods of Smagorinsky (1963)
Vertical-grid	K-theory 1st-order closure	WRFCAMx-derived vertical diffusivities based on the Yonsei University (YSU) planetary boundary layer (PBL) scheme (Hong and Noh, 2006); land-use dependent minimum diffusivity (minimum Kv = 0.1 to 1.0 m^2/s) with a cloud Kv patch recently developed to address deep convective mixing (ENVIRON, 2012)
Deposition Scheme		
Dry deposition	ZHANG03	Dry deposition scheme by Zhang et al. (2001; 2003)
Wet deposition	CAMx-specific formulation	Scavenging model for gases and aerosols (Seinfeld and Pandis, 1998)
Numerical Solvers		
Gas-phase chemistry	Euler Backward Iterative (EBI) solver	Hertel et al., 1993
Horizontal advection	Piecewise Parabolic Method (PPM)	Colella and Woodward, 1984
Vertical advection	Implicit scheme w/ vertical velocity update	

D.5 MODEL PERFORMANCE EVALUATION

Results from the CAMx base case model runs were compared with available air quality observations within the 12/4-km domain to evaluate the ability of the model to accurately reproduce observed conditions. Evaluation of CAMx model performance focused on ozone and PM species as these predictions play the primary role in the air quality impact analysis. Evaluation of the CAMx 2012 base case simulation followed USEPA's current (USEPA, 2007) and new draft (USEPA, 2014) PGM modeling guidance. The model performance evaluation (MPE) used the Atmospheric Model

Evaluation Tool (AMET[11]), which is the evaluation tool discussed in USEPA's latest PGM guidance (USEPA, 2014). Note that AMET requires that a monitoring site have at least 75% valid data capture in order to be used in the MPE, which eliminated observed data from some sites for use in the MPE.

D.5.1 Implications of WRF Model Performance on PGM Simulations

The WRF model performance evaluation results are presented in **Appendix B**. The effects of the meteorological model performance on PGM modeled concentrations, visibility and deposition is difficult to predict given the multiple effects the meteorological model can have. As described in **Appendix B**, overall WRF model performance was found to be good and significant impediments to PGM model performance due to errors in meteorology are not anticipated.

D.5.2 Ambient Data Used In the Model Performance Evaluation

Ozone model performance was evaluated using observed hourly and daily maximum 8-hour (DMAX8) ozone concentrations from the USEPA's Air Qu ality System (AQS[12]) and the Clean Air Status and Trends Network (CASTNet[13]). **Figure D-19** displays the locations of the AQS and CASTNet ozone monitoring sites used in the ozone model performance evaluation. Historically, CASTNet ozone monitoring sites operated by the U.S. Dept. of the Interior's National Park Service (NPS) were included as part of AQS (i.e., ozone compliance monitors), while those operated by the USEPA were not. This has recently been changed and now all CASTNet ozone data are also reported in AQS. Thus, CASTNet ozone monitoring sites operated by the NPS are included in both the AQS and CASTNet monitoring databases. Apart from this overlap, most AQS monitoring sites tend to be more urban-oriented, while CASTNet sites tend to be more rural. Ramboll Environ therefore provides separate performance results for the AQS and CASTNet monitoring sites in order to provide insight into ozone performance at urban vs. rural sites.

[11] https://www.cmascenter.org/help/documentation.cfm?MODEL=amet&VERSION=1.1
[12] http://www.epa.gov/ttn/airs/airsaqs/aqsweb/
[13] http://java.epa.gov/castnet/

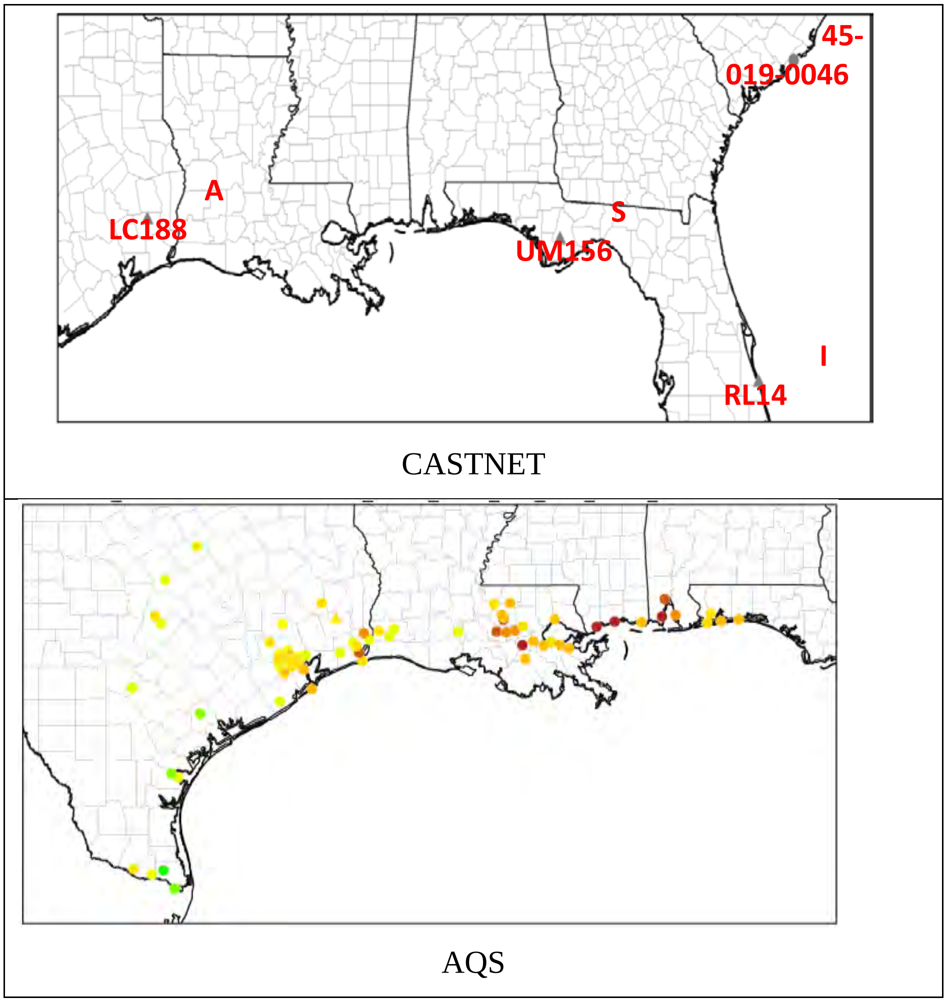


Figure D-19. Ozone Monitoring Sites Used in the Model Performance Evaluation: CASTNet Sites in the Southeastern U.S. (top) and AQS Sites within the 4-km Modeling Domain (bottom) (color coding of AQS monitor locations is arbitrary).

The $PM_{2.5}$ model performance was evaluated using observed speciated PM data from CSN, IMPROVE, and SEARCH monitoring sites in the southeastern U.S. as shown in **Figure D-20**. This was augmented by 24-hour integrated total $PM_{2.5}$ mass measurements using Federal Reference Method (FRM) or equivalent method monitoring sites reporting to the AQS. Most of these FRM sites collect samples on a 1-in-3 day schedule, although some collect data every day. The CSN data consist of 24-hour integrated particulate samples analyzed for SO_4, NO_3, NH_4, EC, OC, and elements using a 1:3 or 1:6 day sampling frequency. The Interagency Monitoring of Protected Visual Environments (IMPROVE[14]) network collects 24-hour average $PM_{2.5}$ and PM_{10} mass and speciated $PM_{2.5}$ concentrations (with the exception of ammonium) using a 1:3 day sampling frequency. The SEARCH network data consist of hourly and 24-hour $PM_{2.5}$ mass and speciated $PM_{2.5}$ data (including ammonia). The FRM and CSN monitoring sites tend to be more urban, whereas the IMPROVE sites are mostly located at national parks and wilderness areas and so are more rural.

There are additional monitoring sites within the modeling domain that collect hourly $PM_{2.5}$ and PM_{10} total mass. However, automated hourly PM measurements are in some cases subject to additional measurement artifacts and uncertainties relative to data collected on filters and do not include speciated PM measurements. Although MPE results were generated using hourly PM data, they are not shown here to maintain consistency with the 24-hour PM NAAQS and the speciated PM results, as well as for the sake of brevity. Some hourly PM data, including speciated PM data, are available at SEARCH network sites. Comparison of MPE results for model bias and error did not show large overall differences between the hourly and daily SEARCH network comparisons.

[14] http://vista.cira.colostate.edu/IMPROVE/

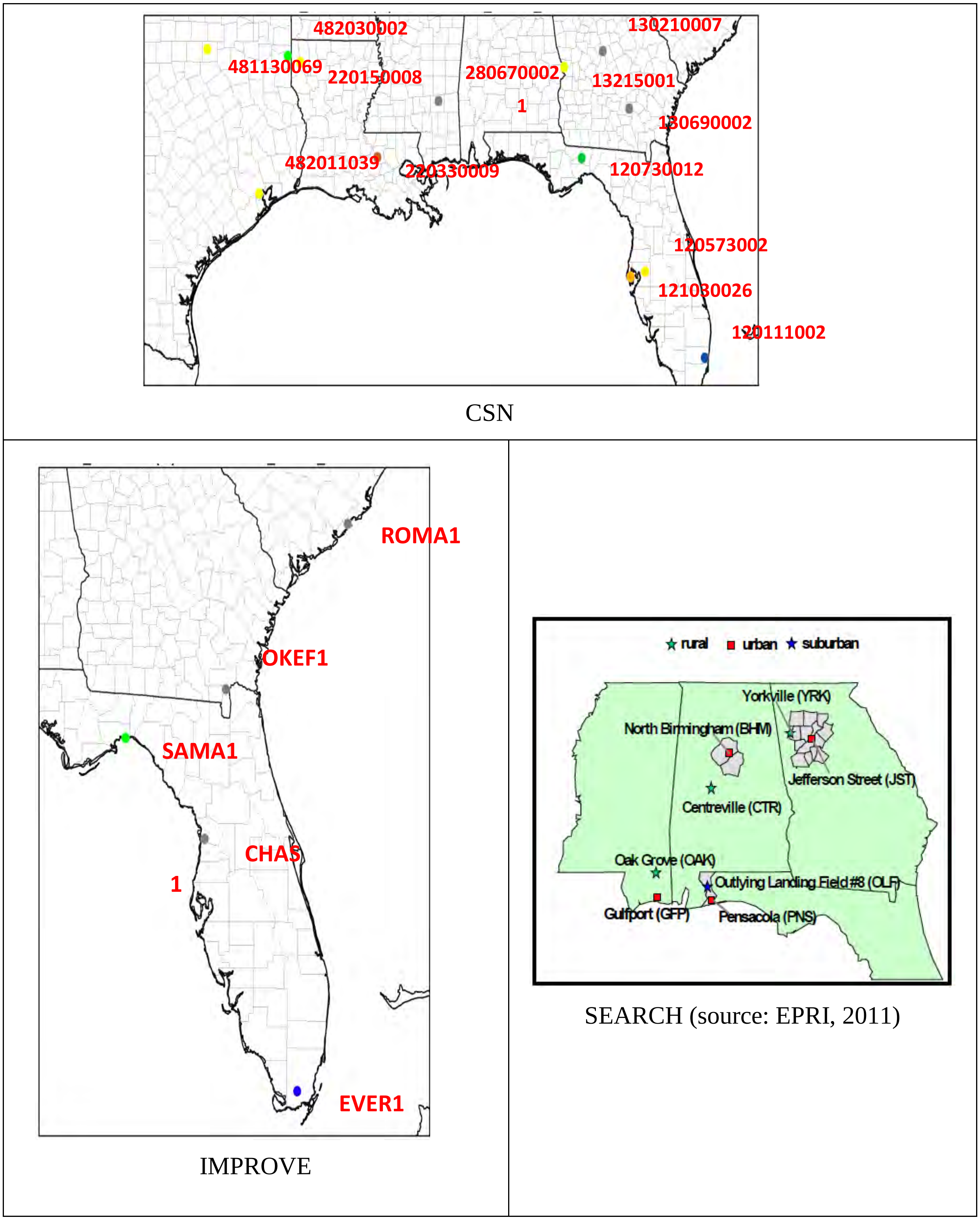


Figure D-20. Speciated PM Monitoring Sites Used in the Model Performance Evaluation: CSN Network (top), IMPROVE Network (bottom left), and SEARCH Network (bottom right).

D.5.3 Model Performance Statistics

Statistical performance measures applicable to air quality model evaluation are defined in **Table D-11**.

Table D-11. Definitions of Model Performance Evaluation Statistical Metrics.

Statistical Measure	Mathematical Expression	Notes
Ap: Accuracy of paired peak	$\frac{P - O_{peak}}{O_{peak}}$	Comparison of the peak observed value (Opeak) with the predicted value at same time and location
NME: Normalized Mean Error	$\frac{\sum_{i=1}^{N} \lvert P_i - O_i \rvert}{\sum_{i=1}^{N} O_i}$	Reported as %
RMSE: Root Mean Square Error	$\left[\frac{1}{N} \sum_{i=1}^{N} (P_i - O_i)^2 \right]^{1/2}$	Reported as %
FE: Fractional Gross Error	$\frac{2}{N} \sum_{i=1}^{N} \left\lvert \frac{P_i - O_i}{P_i + O_i} \right\rvert$	Reported as % and bounded by 0% to 200%
MAGE: Mean Absolute Gross Error	$\frac{1}{N} \sum_{i=1}^{N} \lvert P_i - O_i \rvert$	Reported as concentration (e.g., µg/m^3)
MNGE: Mean Normalized Gross Error	$\frac{1}{N} \sum_{i=1}^{N} \frac{\lvert P_i - O_i \rvert}{O_i}$	Reported as %
MB: Mean Bias	$\frac{1}{N} \sum_{i=1}^{N} (P_i - O_i)$	Reported as concentration (e.g., µg/m^3)
MNB: Mean Normalized Bias	$\frac{1}{N} \sum_{i=1}^{N} \frac{(P_i - O_i)}{O_i}$	Reported as %
FB: Mean Fractionalized Bias	$\frac{2}{N} \sum_{i=1}^{N} \left(\frac{P_i - O_i}{P_i + O_i} \right)$	Reported as %, bounded by -200% to +200%
NMB: Normalized Mean Bias	$\frac{\sum_{i=1}^{N} (P_i - O_i)}{\sum_{i=1}^{N} O_i}$	Reported as %

For over two decades, ozone model performance for bias and error has been compared against the USEPA's 1991 ozone modeling guidance model performance goals as follows (USEPA, 1991):

- Mean Normalized Bias (MNB) ≤ ±15%
- Mean Normalized Gross Error (MNGE) ≤ 35%

In the USEPA's 1991 ozone modeling guidance, these performance metrics were for hourly ozone concentrations that were consistent with the form of the ozone NAAQS in those days. The MNB performance statistic uses hourly predicted and observed ozone concentrations paired by time and location and is defined as the difference between the predicted and the observed hourly ozone divided by the observed hourly ozone concentrations averaged over all predicted/observed pairs within a given region and for a given time period (e.g., by day, month or modeling period). The MNGE is defined similarly only it uses the absolute value of the difference between the predicted and observed hourly ozone concentrations, so it is an unsigned metric. Note that, because the MNB and MNGE performance metrics divide by the observed ozone concentrations, they weigh performance for low ozone concentrations highly and can become unstable as the observed ozone approaches zero. Consequently, they are no longer recommended. Instead, the Fractional Bias and Error (FB/FE) and Normalized Mean Bias and Error (NMB/NME) are the preferred bias and error statistical performance measures.

For PM species, a separate set of model performance statistics and performance goals and criteria have been developed as part of the regional haze modeling performed by several Regional Planning Organizations (RPOs). The USEPA's modeling guidance notes that PM models might not be able to achieve the same level of model performance as ozone models. Indeed, $PM_{2.5}$ species definitions are defined by the measurement technology used to measure them, and different measurement technologies can produce very different $PM_{2.5}$ concentrations. Given this, several researchers have developed PM model performance goals and criteria that are less stringent than the ozone goals that are shown in **Table D-12** (Boylan, 2004; Boylan and Russell, 2006; Morris et al., 2009a and 2009b). However, unlike the 1991 ozone model performance goals that use the MNB and MNGE performance metrics, the Fractional Bias (FB) and Fractional Error (FE) are typically used for PM species with no observed concentration threshold screening. The FB/FE differs from the MNB/MNGE in that the difference in the predicted and observed concentrations are divided by the average of the predicted and observed values, rather than just the observed value as in the MNB/MNGE. This results in the FB being bounded by -200% to +200%, and the FE being bounded by 0% to +200%. There are additional statistical performance metrics that evaluate correlation, scatter, and normalized mean bias and error (NMB/NME), as shown in **Table D-12**.

Table D-12. Ozone and PM Model Performance Goals and Criteria.

Bias (FB/NMB)	Error (FE/NME)	Comment
≤±15%	≤35%	Ozone model performance goal that would be considered very good model performance for PM species
≤±30%	≤50%	PM model performance Goal, considered good PM performance
≤±60%	≤75%	PM model performance Criteria, considered average PM performance

More recently, the USEPA compiled and interpreted the model performance from 69 PGM modeling studies in the peer-reviewed literature between 2006 and March 2012 and developed recommendations on what should be reported in a model performance evaluation (Simon et al., 2012). Although these recommendations are not official USEPA guidance, their recommendations were integrated in this CAMx MPE.

- The PGM MPE studies should, at a minimum, report the Mean Bias (MB) and Error (ME or RMSE), and Normalized Mean Bias (NMB) and Error (NME) and/or Fractional Bias (FB) and Error (FE). Both the MNB and FB are symmetric around zero with the FB bounded by -200% to +200%.
- Use of the Mean Normalized Bias (MNB) and Gross Error (MNGE) is not encouraged because they are skewed toward low observed concentrations and can be misinterpreted due to the lack of symmetry around zero.
- The model evaluation statistics should be calculated for the highest resolution temporal resolution available (e.g., hourly ozone) and for important regulatory averaging times (e.g., daily maximum 8-hour ozone).
- It is important to report processing steps in the model evaluation and how the predicted and observed data were paired and whether data are spatially/temporally averaged before the statistics are calculated.
- Predicted values should be taken from the grid cell that contains the monitoring site, although bilinear interpolation to the monitoring site point can be used for higher resolution modeling (<12 km).
- The $PM_{2.5}$ should also be evaluated separately for each major component species (e.g., SO_4, NO_3, NH_4, EC, OA, and remainder other $PM_{2.5}$ [$OPM_{2.5}$]).
- Evaluation should be performed for subsets of the data, including high observed concentrations (e.g., ozone >60 ppb) by subregion and by season or month.
- Spatial displays should be used in the model evaluation to evaluate model predictions away from the monitoring sites. Time series of predicted and observed concentrations at a monitoring site should also be used.
- It is necessary to understand measurement artifacts in order to make meaningful interpretation of the model performance evaluation.

D.5.4 Approach

The PGM evaluation focused on ozone, both hourly and daily maximum 8-hour (DMAX8) ozone concentrations; total $PM_{2.5}$ mass and speciated $PM_{2.5}$ concentrations; gaseous NO_2, SO_2, and CO concentrations; and visibility. The evaluation was performed across all monitoring sites within either the southeastern U.S. as shown in the top panel of **Figure D-20** (in order to capture the regional CSN and IMPROVE network sites) or the 4-km modeling domain (**Figure D-5**), as well as at each individual site on an annual, seasonal (quarterly), and monthly basis. In addition to generating numerous statistical performance metrics (refer to **Table D-11**), graphical representation of model performance used three main types of displays.

- Soccer Plots of monthly bias and error that are compared against the ozone performance goals and the PM performance goals and criteria (refer to **Table D-11**). Monthly soccer plots allow the easy identification of when performance goals/criteria are achieved and an evaluation of performance across seasons.
- Spatial statistical performance maps that display bias/error on a map at the locations of the monitoring sites in order to better understand spatial attributes of model performance, along with tabular summaries of statistical performance metrics.
- Time series plots that compare predicted and observed concentrations at a monitoring site as a function of days.
- Scatter plots of predicted and observed concentrations.

All performance statistics and displays are performed matching the predicted and observed concentrations by time and location using the modeled prediction in the 12/4-km grid cell containing the monitoring site.

The CAMx model performance for PM was evaluated using total $PM_{2.5}$ mass and speciated $PM_{2.5}$ measurements compared against the PM performance goals and criteria given in **Table D-12**. Note that the PM goals and criteria are not as stringent as those for ozone because the measurements themselves, as well as the PM emissions, are much more uncertain and there are more processes involved in PM (e.g., dispersion, transformation and deposition of primary PM and formation of secondary PM from gaseous precursors). Each PM measurement technique has its own artifacts; different measurement technology could produce different observed $PM_{2.5}$ values that differ by as much as 30 percent. The USEPA's latest PGM modeling guidance includes a section on PM measurement artifacts for the monitoring technologies used in routine networks in the U.S. (USEPA, 2014). Thus, the PM model performance needs to recognize these measurement uncertainties and artifacts and take them into account in the interpretation of model performance, as even a "perfect" model may not achieve the PM performance goals and criteria.

The PM_{10} consists of particles with a mean aerodynamic diameter of 10 microns or less and consists of fine ($PM_{2.5}$, i.e., particles with a diameter of 2.5 microns or less) and coarse (PMC, i.e., particles with a diameter between 2.5 and 10 microns) modes. The $PM_{2.5}$ is composed of the following component species:

- sulfate (SO_4) that is typically in the form of ammonium sulfate;
- nitrate (NO_3) that is typically in the form of ammonium nitrate;
- ammonium (NH_4) that is associated with SO_4 and NO_3;
- elemental carbon (EC) that is also called black carbon (BC) and light-absorbing carbon (LAC);

- organic aerosol (OA) that includes primary (POA) and secondary organic aerosol (SOA) and is composed or organic carbon (OC) and other atoms (e.g., oxygen) that are adhered to the OC; and
- other $PM_{2.5}$ ($OPM_{2.5}$) that is primarily crustal in nature (SOIL) but can also include other compounds as well as measurement artifacts.

Model performance statistics were calculated for total PM mass using observations from the FRM, CSN, SEARCH, and IMPROVE networks and then evaluated for PM_{10} and $PM_{2.5}$ component species using data from the CSN, SEARCH, and IMPROVE sites.

D.5.5 Initial Model Performance Results

Results of initial CAMx runs for the 36- and 12-km domains configured as described in **Section D.4** were evaluated in terms of the MPE statistics described above to determine if any corrections or adjustments to model inputs were needed. In some cases, results from CAMx were compared with results from CMAQ to determine potential underlying causes of poor model performance. Results of these analyses indicated ozone and $PM_{2.5}$ over prediction biases, which were especially pronounced along the Gulf Coast. Evaluation of results for individual PM components showed that much of the $PM_{2.5}$ over prediction in coastal areas was associated with over prediction of sea salt emissions as evidenced by over prediction of sodium (Na) and consequently over prediction of nitrate PM as a result of nitrate substitution of chloride ions. This was confirmed by sensitivity tests in which sea salt emissions were reduced by a factor of five as suggested by regressions of predicted vs. observe Na at IMPROVE and CSN monitoring sites.

Consistent with results of other modeling studies in the southeastern U.S., the ozone over prediction bias was judged to likely be associated at least in part with known over prediction biases of ozone over the Gulf of Mexico in many different global models, including GEOS-Chem resulting in over estimates of boundary condition ozone and over prediction of isoprene by the MEGAN biogenic model (Johnson et al., 2015). A series of sensitivity tests based on CAMx performance over the 36-km domain with reduced ozone and ozone precursor BCs and reduced sea salt emissions confirmed that these modifications resulted in generally improved model performance. To this were added two additional modifications: the application of a commonly used adjustment to vertical diffusivity coefficients (Kv patch), which has been shown to improve model performance overnight and in urban areas (ibid); and a reduction in residential wood combustion (RWC) emissions following results of Adelman et al. (2014). A set of final 36-km and 12/4-km model runs were then completed with these modifications in place.

D.5.6 Final Model Performance Results

After making the model input and configuration revisions described in the previous section, CAMx was rerun on the 36-km grid and boundary conditions extracted for the 12/4-km, two-way nested grid run. Results of the MPE for the 12/4-km grid run are presented in this section.

D.5.6.1 Ozone

Model performance results for ozone are summarized in terms of monthly NMB and NME in soccer plots for AQS and CASTNet network monitors within the 4-km and 12-km domains in **Figure D-21**. Model performance for nearly all months is within the ±15% NMB and <35% NME ozone performance goals listed in **Table D-12** (which corresponds to the innermost "goal" box shown in the figure), with the principal exceptions being performance during July and August for sites in the 4-km domain (note only one CASTNet site – site ALC188, Alabama-Coushatta – is located within the 4-km domain).

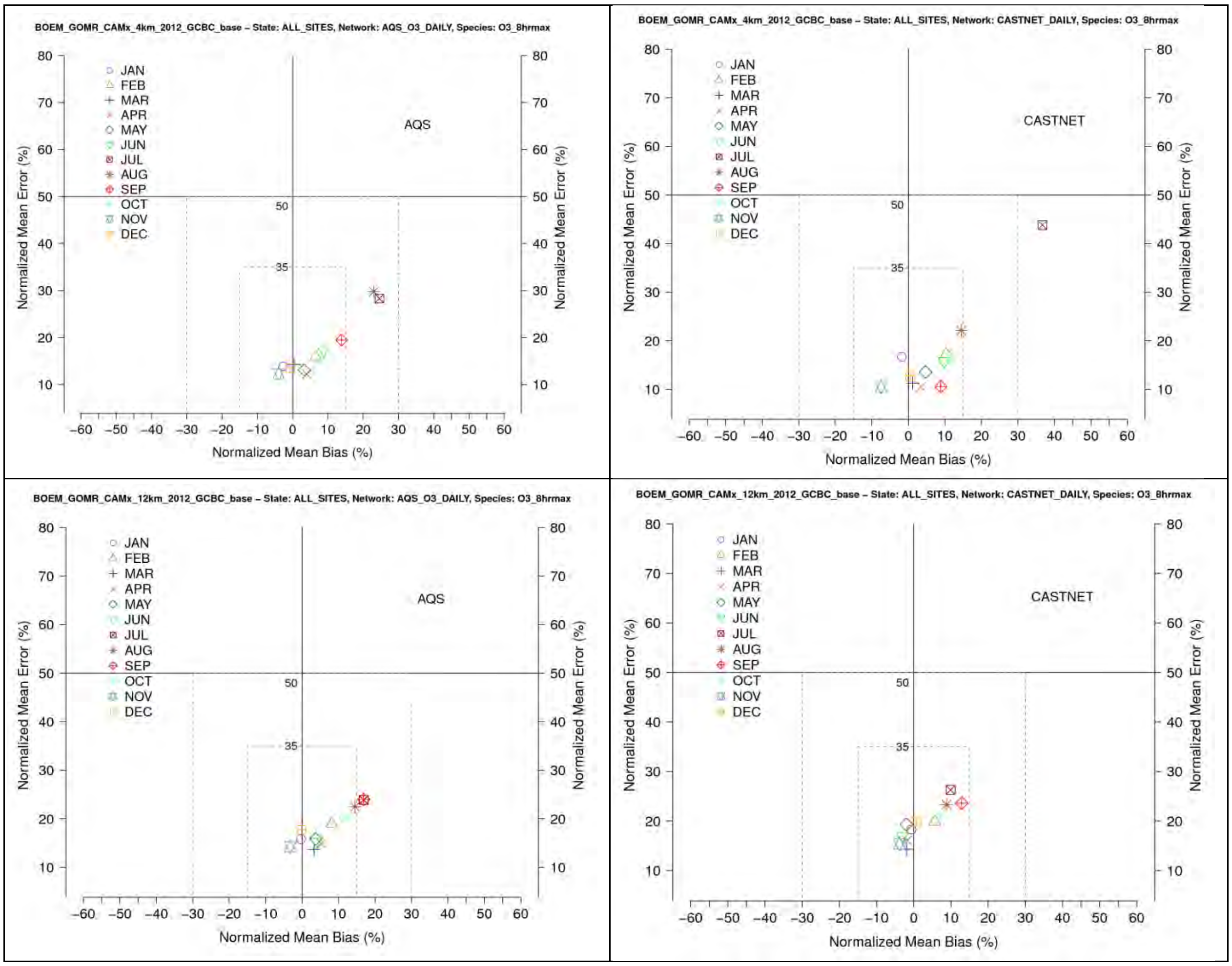


Figure D-21. Monthly Normalized Mean Bias and Normalized Mean Error for Daily Maximum 8-hour Average Ozone at AQS (left) and CASTNet (right) Monitoring Sites Located within the 4-km Modeling Domain (top) and the 12-km Domain (bottom).

As illustrated by the threshold exceedance counts in **Figure D-22**, the ozone season in the far South generally follows a bimodal distribution with a pronounced ozone peak in spring and a secondary peak in late summer to early fall. There is a noticeable lack of high ozone events during July. This seasonal pattern is reproduced in the model results as shown in **Figure D-23**. Model performance statistics generated using the AMET tool are summarized by calendar quarter. We therefore focus further attention on ozone model performance results for Q2 (April-June) and Q3 (July-September), as these roughly coincide with the seasonal ozone peaks.

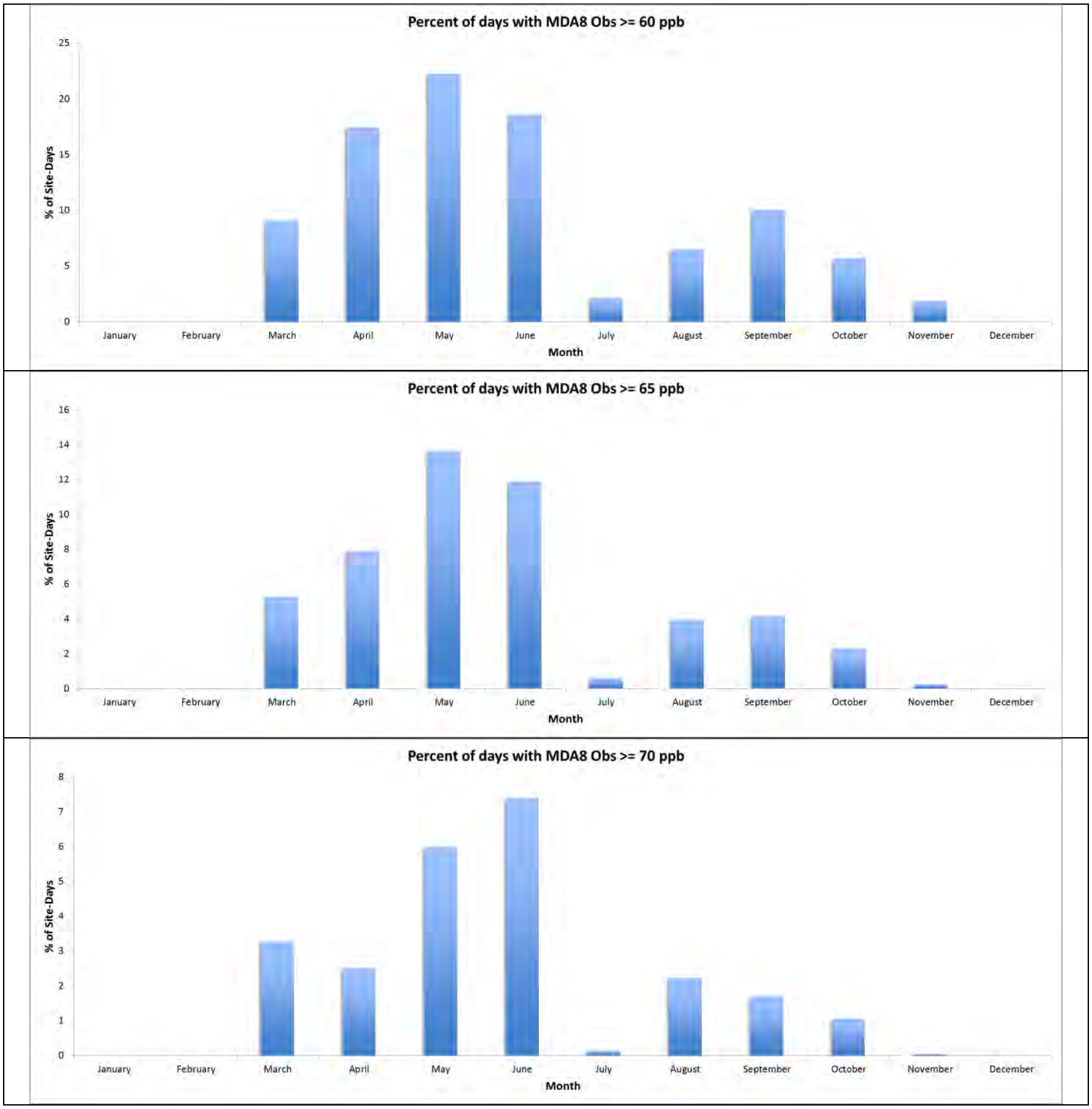


Figure D-22. Fraction of Site-days during Each Month of 2012 with Observed Daily Maximum 8-hour Ozone Exceeding 60 (top), 65 (middle), or 70 (bottom) ppb Over All Monitoring Sites in the 4-km Domain.

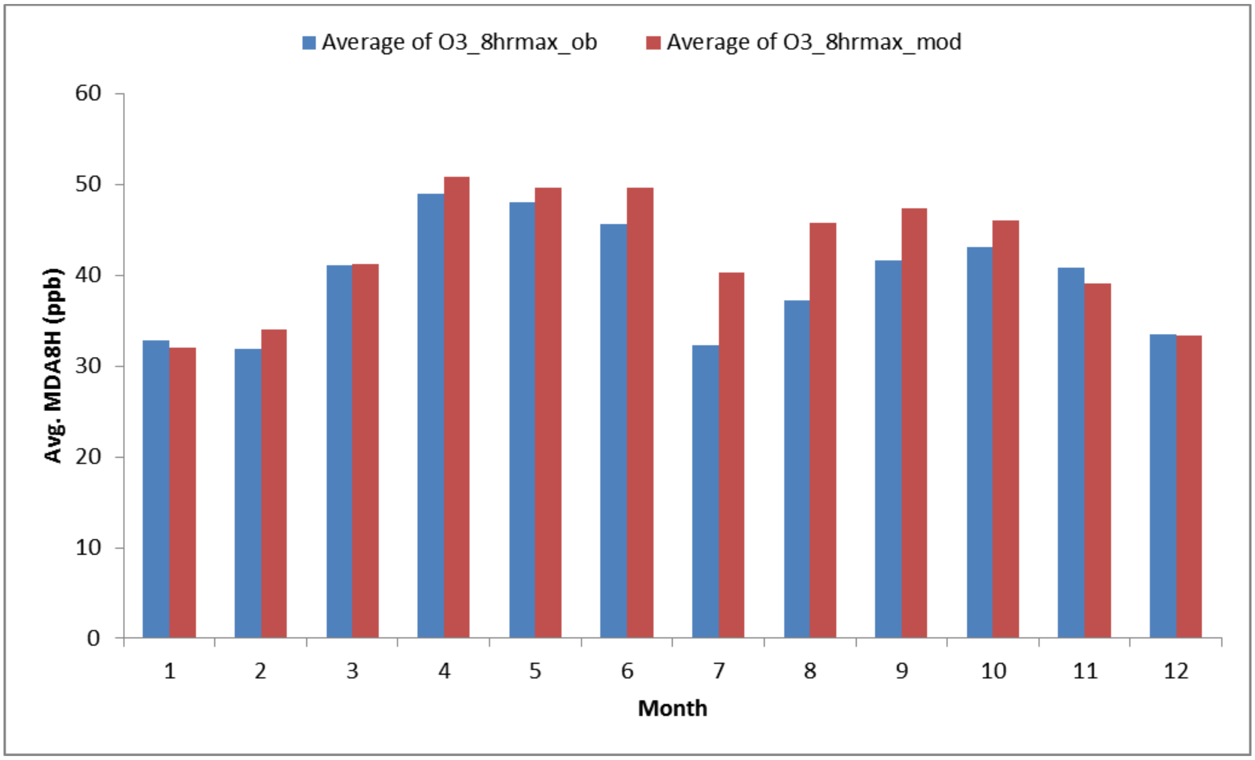


Figure D-23. Observed (blue) and Predicted (red) Monthly Mean Daily Maximum 8-hour Average Ozone Over All Sites in the 4-km Modeling Domain.

Ozone model performance for Q2 (April-May) and Q3 (July-September) over sites in the 4-km domain is illustrated by the scatter plots in **Figure D-24**. Standard scatter plots are shown in the left-hand column and corresponding scatter density plots are shown in the right-hand column. Colors in the scatter density plot indicate the fraction of data in each 2 ppb bin, thus revealing the data density variations that are otherwise obscured in regions with numerous overlapping points in the standard scatter plots. Model performance in Q2 is better than in Q3 primarily due to a lower bias (NMB of 5.2% in Q2 as compared to 20.1% in Q3). The scatter density plots show that the Q3 bias is primarily associated with over prediction of mid- and low-range values with less bias for values exceeding 60 ppb. Summaries of ozone performance statistics with a 60 ppb observed ozone cutoff applied are further discussed below.

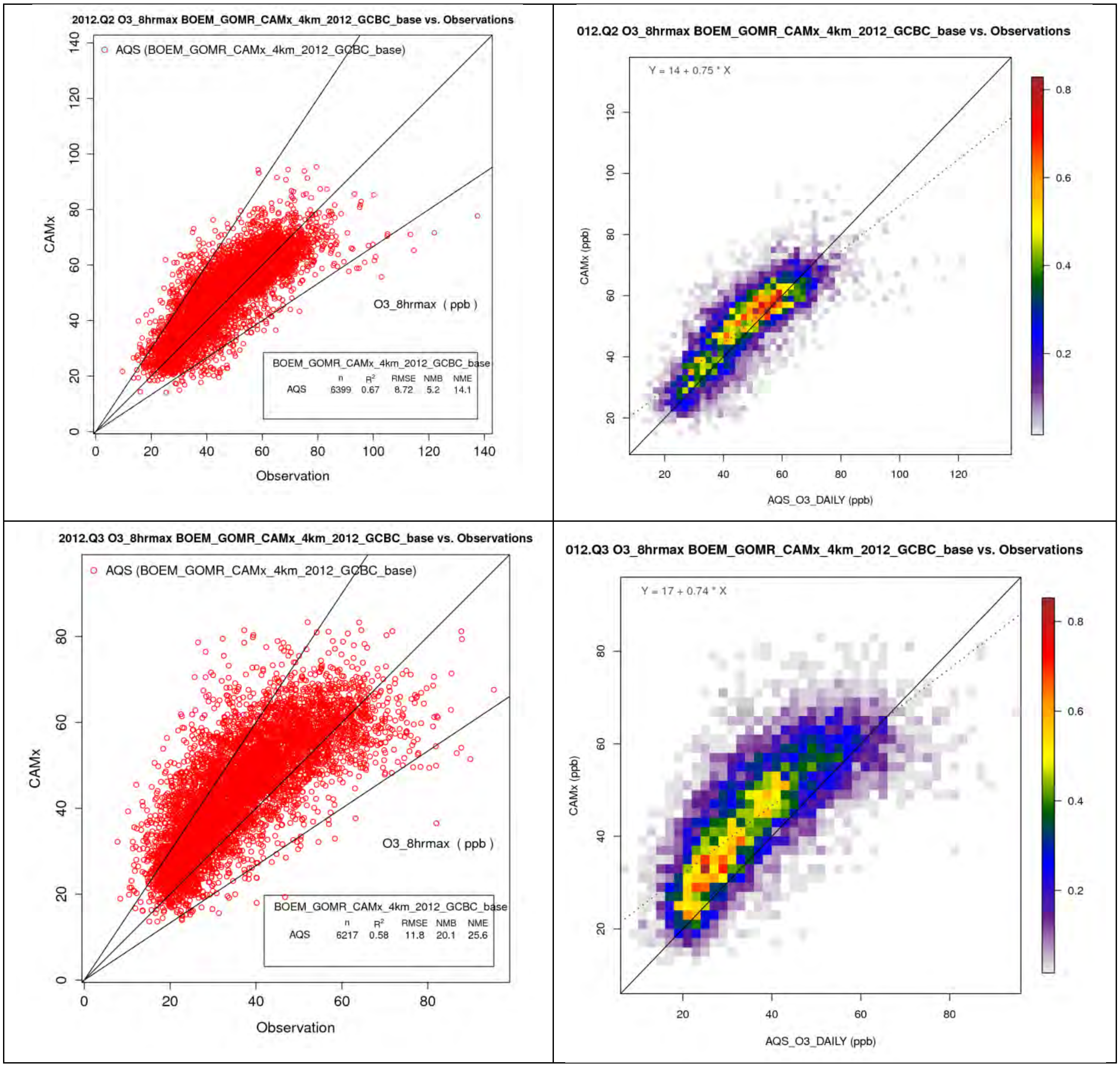
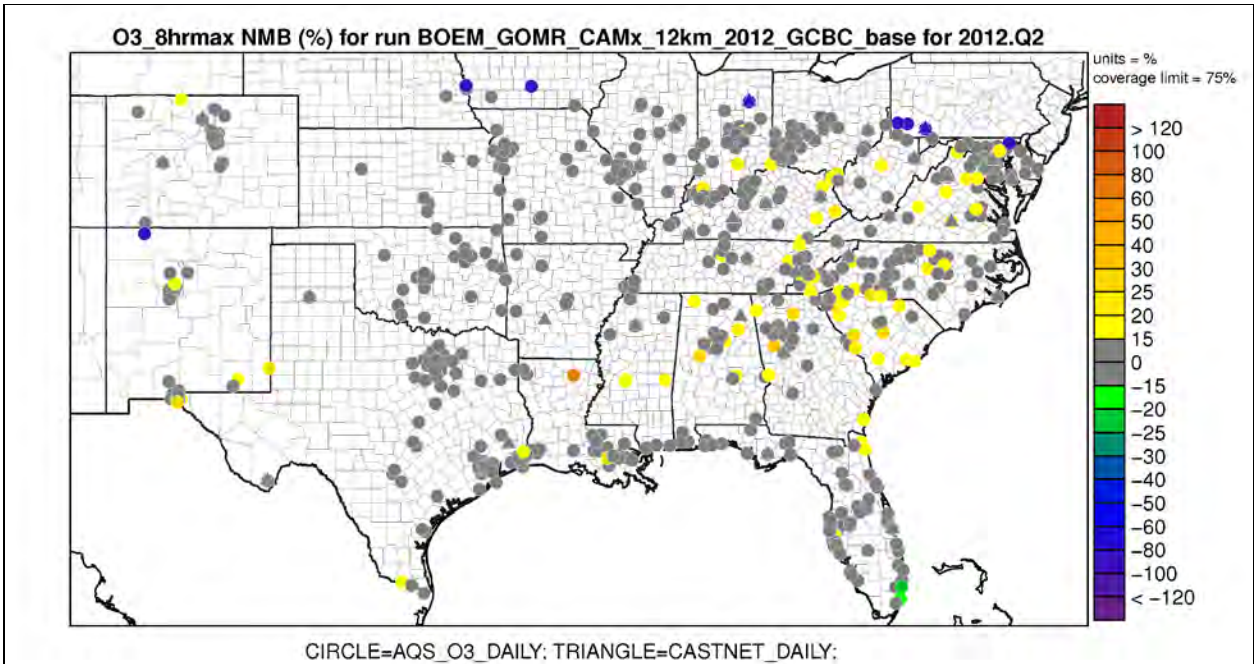


Figure D-24. Scatter (left) and Scatter Density (right) Plots for Observed vs. Predicted Daily Maximum 8-hour Ozone in Q2 (top) and Q3 (bottom) for All AQS Monitoring Sites in the 4-km Modeling Domain.

The spatial distribution of NMB over the full 12-km domain is shown in **Figure D-25**. Note that these results are based on the 12-km gridded model resolution for all sites shown. The NMB is within ±15% at most sites during Q2 but exceeds +15% at most sites along the Gulf Coast and throughout the southern tier and southeast Atlantic States in Q3.



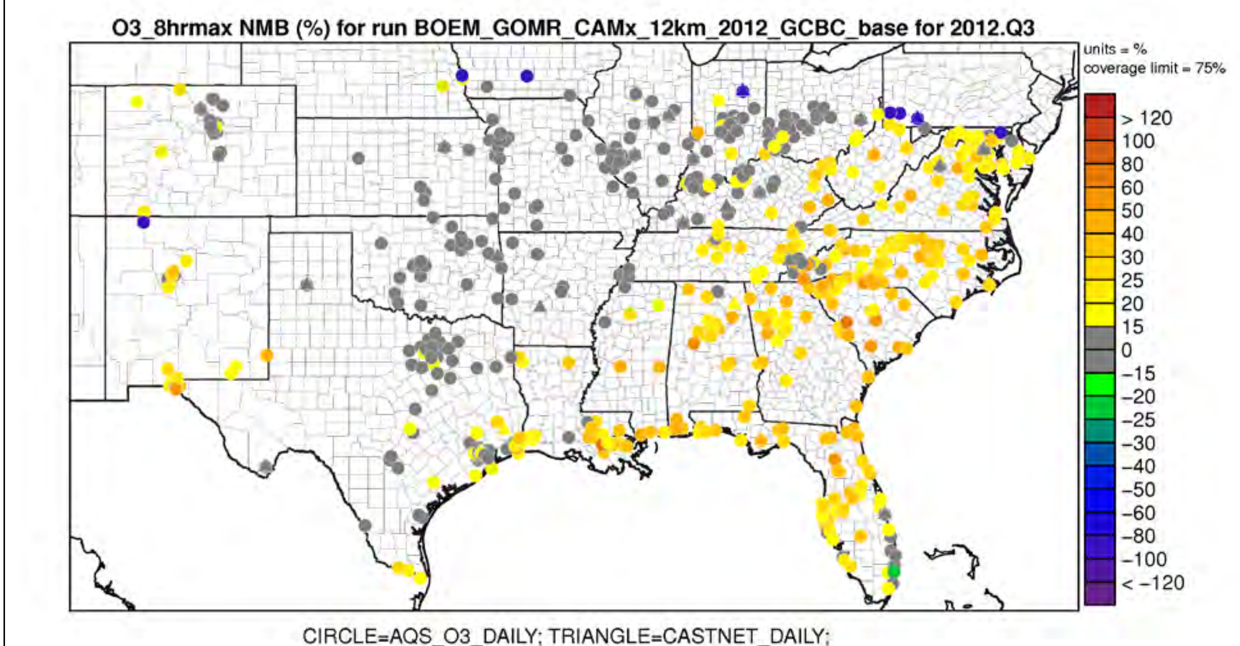


Figure D-25. Normalized Mean Bias (NMB) for Daily Maximum 8-hour Ozone for Q2 (top) and Q3 (bottom).

The USEPA recommends that ozone model performance statistics be calculated using a 60-ppb observed ozone concentration cut-off value (Simon et al., 2012; USEPA 2014). That is, the model performance statistics are calculated for all predicted and observed ozone pairs matched by time and location for which the observed value is 60 ppb or higher. **Table D-13** lists model performance summary statistics derived from the 4-km resolution model output for hourly and 8-hour daily maximum ozone with no concentration cut-off applied and with cut-offs of 40 or 60 ppb applied for Q2 and Q3. Values of NMB and NME exceeding USEPA's performance goals as listed in **Table D-12** are highlighted. Biases trend from positive to slightly negative as the threshold concentration increases but are always within the Performance Goal for Q2 and also under application of the 40- and 60-ppb thresholds in Q3. The NME is always within the USEPA Performance Goal except for hourly values in Q3 when no cut-off is applied.

Table D-13. Model Performance Statistics at Different Observed Ozone Concentration Screening Thresholds Based on All Monitoring Sites in the 4-km Domain (shaded cells indicate values exceeding USEPA performance goals).

Monitor Site	Q2 (April – June)			Q3 (July – September)		
	N	NMB (%)	NME (%)		NMB (%)	NME (%)
USEPA Performance Goal		≤±15%	≤35%		≤±15%	≤35%
Ozone Cut-Off Concentrations	DMAX8 Ozone					
0	6399	5.2	14.1	6217	20.1	25.6
40	4326	2.1	11.6	3218	7.9	15.9
60	1246	-5.7	9.9	375	-9.2	12.6
Ozone Cut-Off Concentrations	Hourly Ozone					
0	152327	10.9	30.5	149676	30.6	46.7
40	53213	-3.5	16.7	22751	1.5	19.6
60	11229	-10.6	14.7	3498	-13.9	17.8

Time series of observed and predicted daily maximum 8-hour ozone are plotted in **Figure D-26** for the monitoring site in each county in the Houston-Galveston-Brazoria ozone nonattainment area with the highest ozone design values during the 2010-2014 design value periods (2010-2012, 2011-2013, 2012-2014): Northwest Harris County site (AQS ID 48-201-0029)[15], Manvel Croix Park – Brazoria County (AQS ID 48-039-1004), and Galveston 99th St. – Galveston County (AQS ID 48-167-1034).

Time series of observed and predicted daily maximum 8-hour ozone are plotted in **Figure D-27** for two monitoring sites in the Baton Rouge ozone nonattainment area: LSU (AQS ID 22-033-0003) and Carville (AQS ID 22-047-0012). These sites typically had the highest ozone design values in the Baton Rouge area during the 2010-2014 design value periods.

The time series for the ALC188 (Alabama-Coushatta, Texas) CASTNet site (the only CASTNet site in the 4-km domain) are shown in **Figure D-28**.

Overall model performance as seen in these time series is good, especially in Q2 and especially in the Houston-Galveston area. There is a tendency towards over prediction in Q3 at Galveston and more noticeably at the Baton Rouge sites, consistent with the results for all sites presented above.

[15] This site recorded either the maximum or was within 1 ppb of the maximum ozone design value of all sites in Harris County during this period.

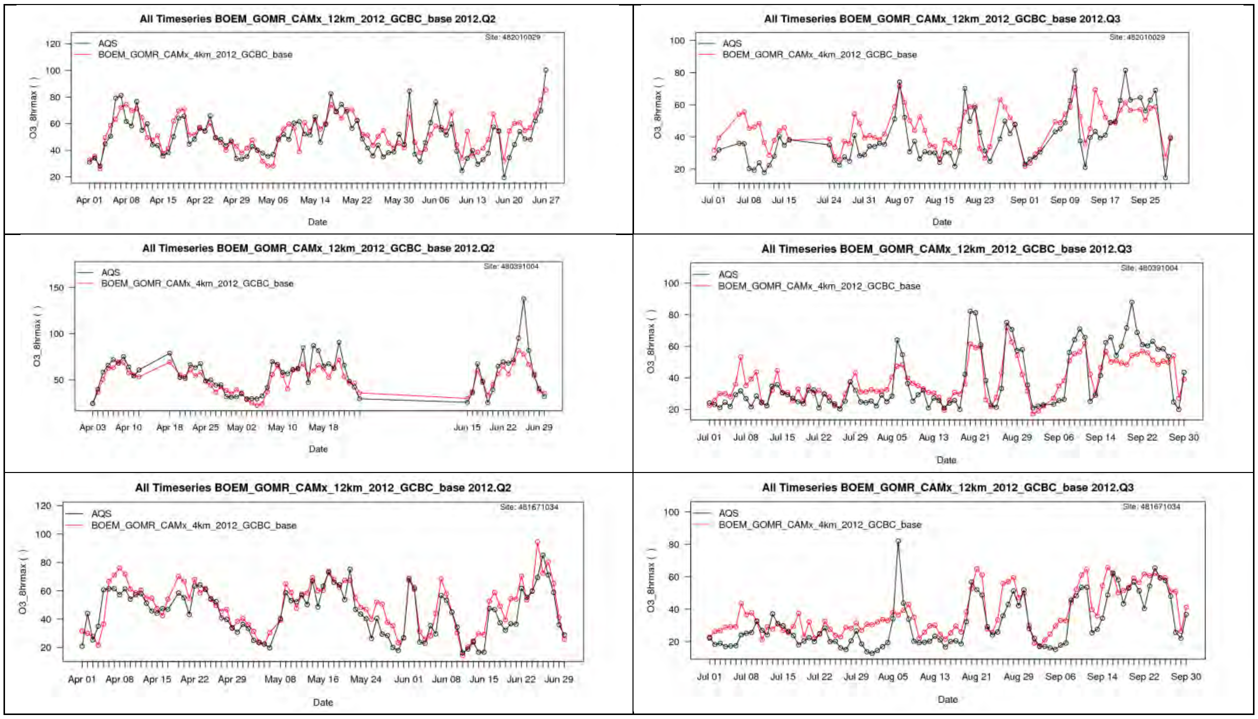


Figure D-26. Time Series of Daily Maximum 8-hour Ozone at Monitoring Sites with Highest Design Values in Harris (top), Brazoria (middle), and Galveston (bottom) Counties, Texas, for Q2 (left) and Q3 (right).

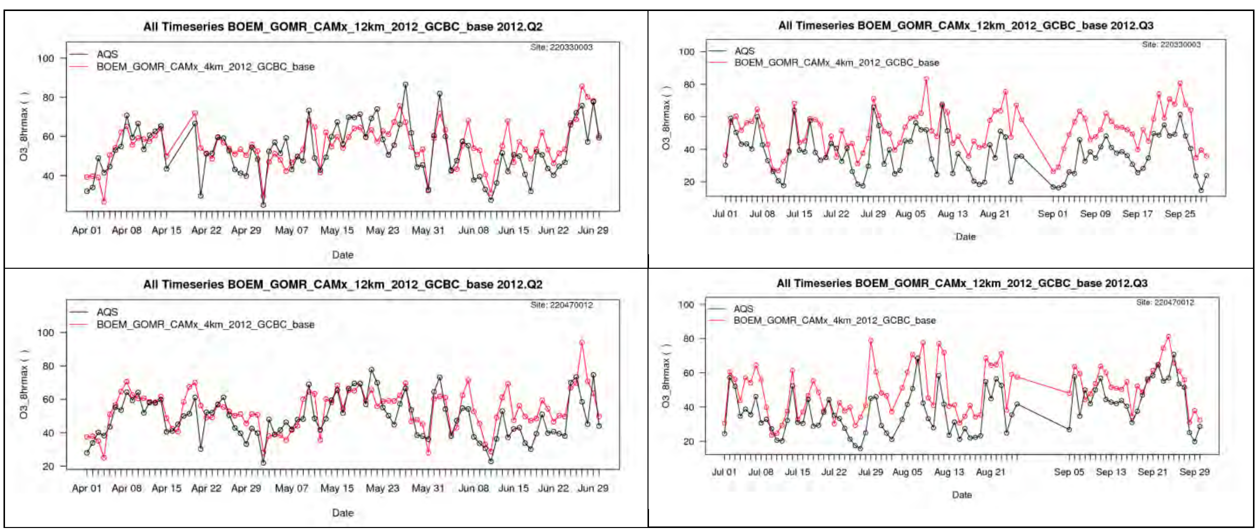


Figure D-27. Time Series of Daily Maximum 8-hour Ozone at Monitoring Sites in the Baton Rouge Nonattainment Area: LSU (top) and Carville (bottom) for Q2 (left) and Q3 (right).

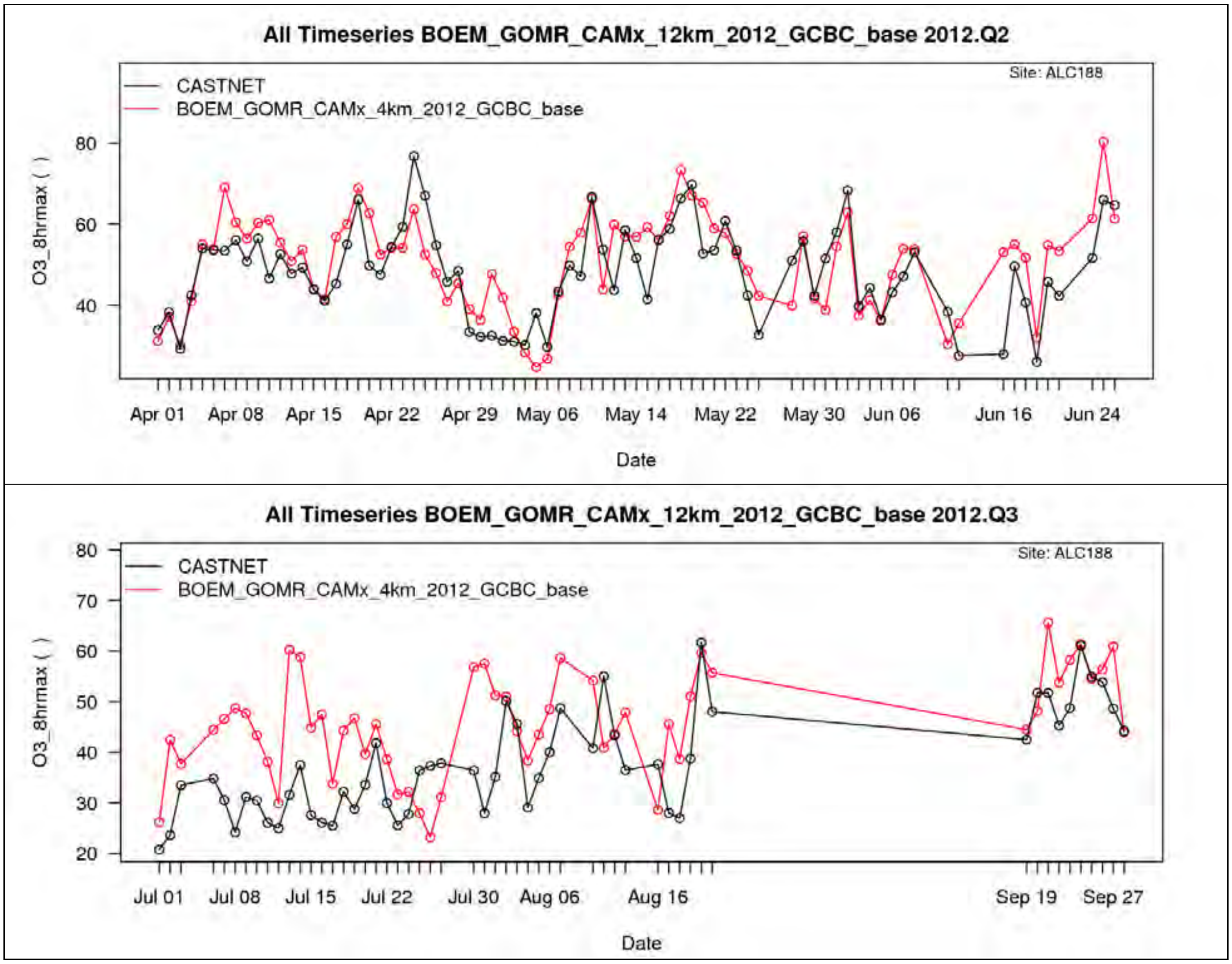


Figure D-28. Time Series of Daily Maximum 8-hour Ozone at the ALC188 (Alabama-Coushatta, Texas) CASTNet Monitoring Site for Q2 (top) and Q3 (bottom).

D.5.6.2 Particulate Matter

The CAMx model performance for particulate matter (PM) was evaluated for total $PM_{2.5}$ mass and speciated $PM_{2.5}$ measurements. The PM performance was compared against the performance goals and criteria given in **Table D-12**. Note that the PM goals and criteria are not as stringent as those for ozone because both PM measurements and PM emissions are subject to greater uncertainties and PM formation and transformation processes are more complex and difficult to model. Each PM measurement technique has its own artifacts; different measurement technologies can produce different observed $PM_{2.5}$ values that differ by as much as 30 percent. The USEPA’s latest PGM modeling guidance includes a section on PM measurement artifacts for the monitoring technologies used in routine networks in the U.S. (USEPA, 2014). The PM model performance results must be evaluated in light of these measurement uncertainties and artifacts as even a “perfect” model may not achieve the PM performance goals and criteria relative to the imperfect measurements.

The PM_{10} consists of particles with a mean aerodynamic diameter of 10 microns or less and consists of fine ($PM_{2.5}$, i.e., particles with a diameter of 2.5 microns or less) and coarse (PMC, i.e., particles with diameter between 2.5 and 10 microns) modes. The $PM_{2.5}$ is composed of the following component species:

- sulfate (SO_4) that is typically in the form of ammonium sulfate;
- nitrate (NO_3) that is typically in the form of ammonium nitrate;
- ammonium (NH_4) that is associated with SO_4 and NO_3;
- elemental carbon (EC) that is also called black carbon (BC) and light-absorbing carbon (LAC);
- organic aerosol (OA) that includes primary (POA) and secondary organic aerosol (SOA) and is composed or organic carbon (OC) and other atoms (e.g., oxygen) that are adhered to the OC; and
- other $PM_{2.5}$ ($OPM_{2.5}$) that is primarily crustal in nature (SOIL) but can also include other compounds such as sea salt and may include measurement artifacts as it is determined by subtraction of the sum of individual measured species from the measured total $PM_{2.5}$.

In the following subsections, we first evaluate the CAMx 2012 base case simulation for total $PM_{2.5}$ mass using observations from the FRM, CSN, and IMPROVE monitoring networks and then evaluate results for PM_{10} and $PM_{2.5}$ component species. There are also numerous hourly $PM_{2.5}$ and PM_{10} monitoring sites in the region that are also used in the MPE, but results for these are not presented here as they may suffer from additional measurement artifacts and uncertainties and are not directly comparable to the speciated PM data.

D.5.6.2.1 Total $PM_{2.5}$ Mass

Daily total $PM_{2.5}$ mass is measured at FRM, IMPROVE, and CSN network monitors, and hourly $PM_{2.5}$ is measured at FRM equivalent and non-FRM monitoring sites. Because only three CSN sites and no IMPROVE network sites are located within the 4-km CAMx modeling domain, some performance statistics are presented here for all monitors within the southeastern U.S. domain shown in **Figure D-29**.[16]

[16] This area corresponds to the high-resolution domain used for the meteorological (WRF) modeling described in **Section D.2**.

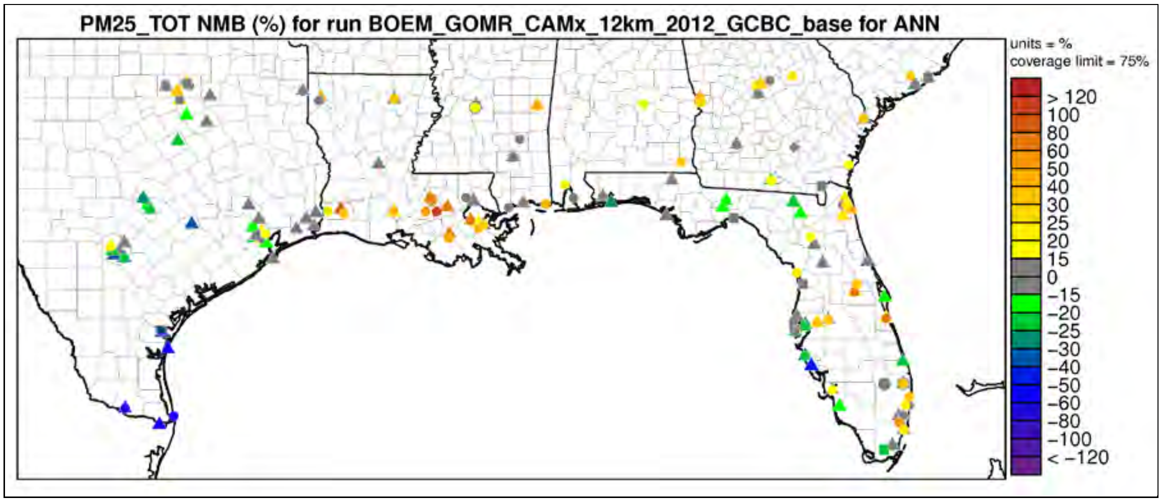


Figure D-29. PM Monitoring Sites in the Southeastern U.S. Domain (triangles – AQS hourly, square – IMPROVE, diamond – CSN, circles – AQS FRM daily).

Figure D-30 displays soccer plots of total $PM_{2.5}$ mass model performance across the FRM, CSN, and IMPROVE monitoring networks in the southeastern U.S. domain. Note that these results are based on 12-km resolution CAMx output. Also shown in the soccer plots are boxes that represent the performance goals for ozone (most inner) and PM (middle), and the PM performance criteria (most outer). Performance for the late fall and winter months (October-February) is characterized by larger positive NMB and higher NME in each network. This bias is somewhat more extreme in the FRM data. Performance results are within or nearly within the PM performance goals except for January and October-December for all networks and within the PM performance criteria for all months at all networks.

As illustrated in **Figure D-31**, over prediction in Q4 appears to be primarily associated with "other $PM_{2.5}$" ($OPM_{2.5}$). Measured OPM likely consists mostly of crustal material (dust) in addition to sea salt. Modeled $OPM_{2.5}$ is defined as the sum of unspeciated PM, crustal material, and sea salt.

Comparisons of particulate OC and EC performance statistics are presented in **Figure D-32**. The NMB and NME are within the PM performance goals with the exception of July and August EC predictions at CSN sites; the over prediction bias is smaller at SEARCH sites. Note that both the SEARCH and CSN networks use the Thermal Optical Reflectance (TOR) method to determine OC and EC.

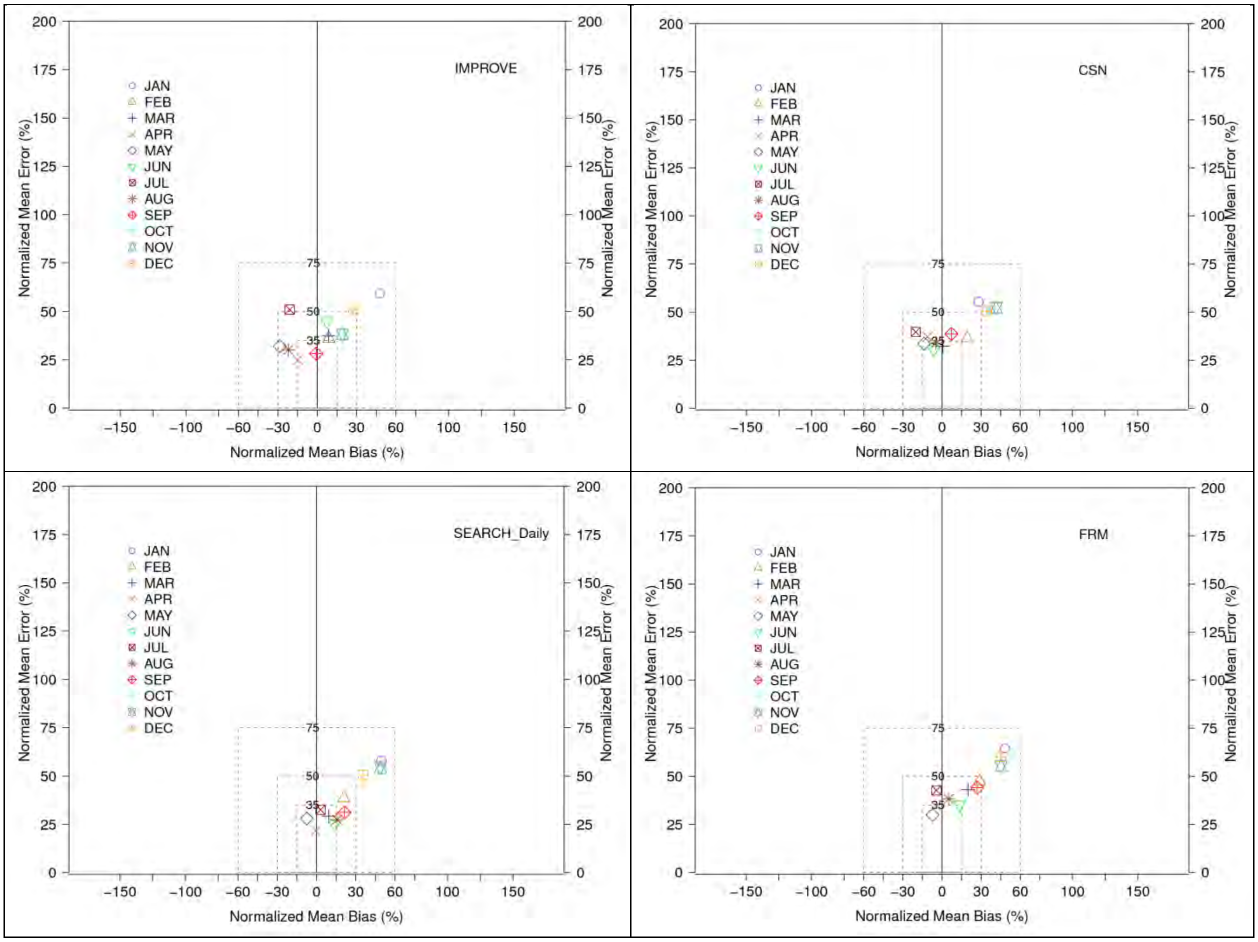


Figure D-30. Soccer Plots of Total $PM_{2.5}$ Mass Model Performance Across the IMPROVE (top left), CSN (top right), SEARCH (bottom left), and FRM Daily (bottom right) Monitoring Networks for Sites in the Southeastern U.S. Domain.

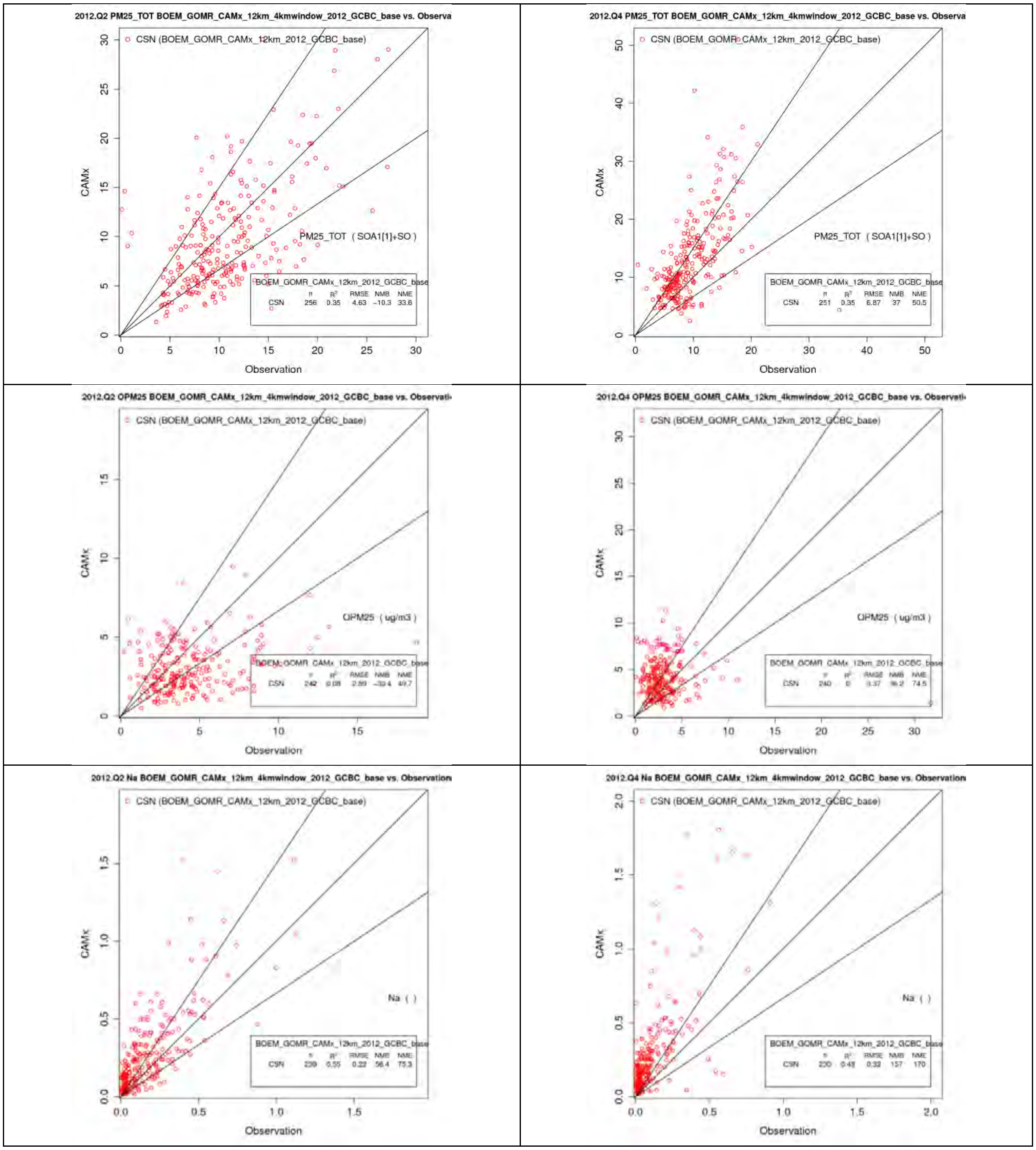


Figure D-31. Comparisons of Predicted with Observed Daily Average PM at CSN Network Sites in the Southeastern U.S. for Q2 (left) and Q4 (right) for Total $PM_{2.5}$ (top), Other $PM_{2.5}$ (middle), and Sodium (bottom).

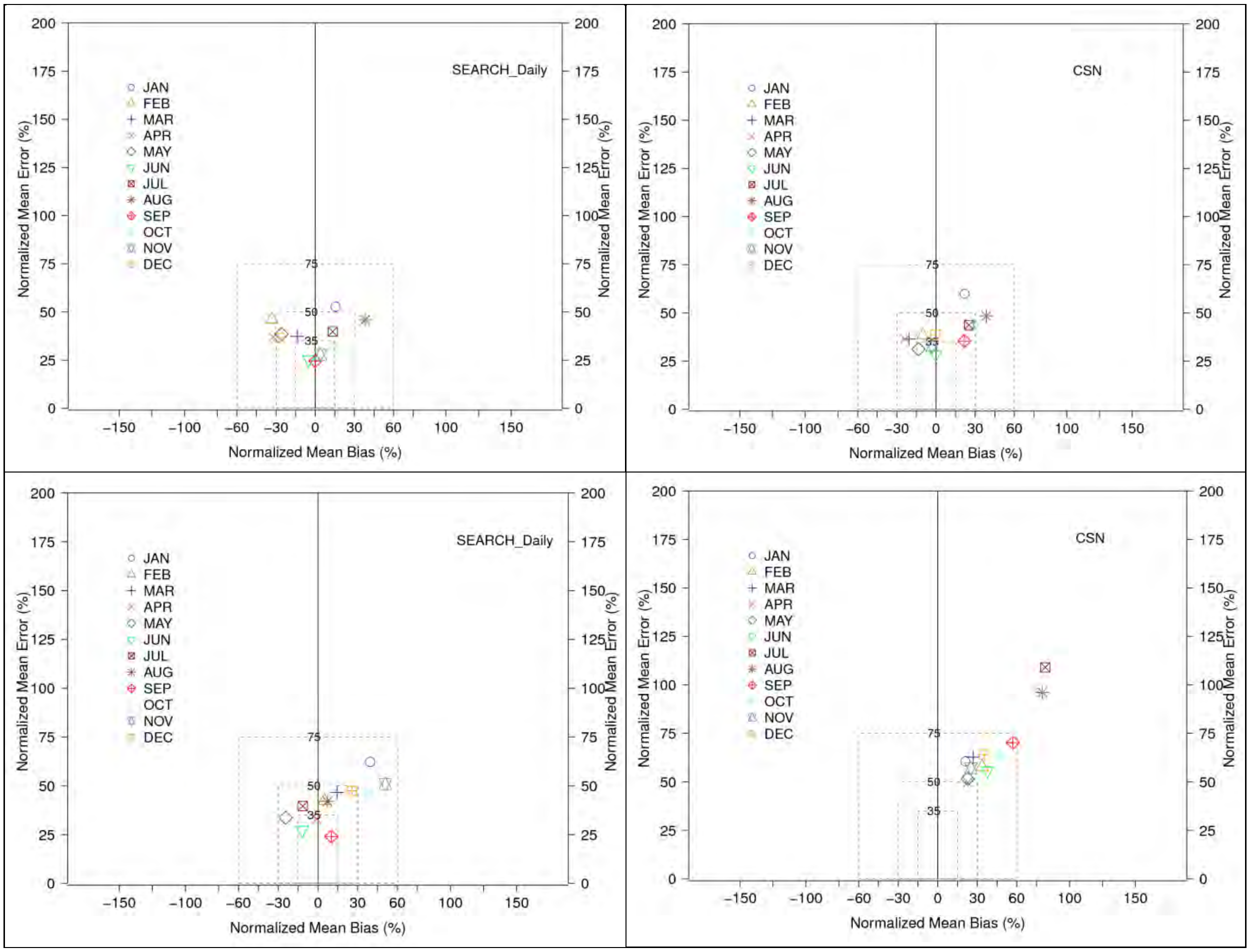


Figure D-32. Comparisons of Observed vs. redicted OC (top) and EC (bottom) at SEARCH (left) and CSN (right) Network Sites in the Southeastern U.S.

D.5.6.2.2 Nitrogen Species (NO_2, NOy, and NO_3)

Soccer plot summaries of NMB and NME for nitrogen species are shown in **Figures D-33 and D-34** for monitoring sites in the 4-km domain. The NO_2, NOy, and particulate NO_3 are over predicted, especially in the summer months. The NO_3 over prediction at coastal sites could be at least partially due to over prediction of sea salt emissions as a result of Cl- ion substitution. This is consistent with under prediction of particulate Cl at some sites despite over prediction of Na. Nitrate deposition biases fall within the performance criteria in all but one month, but errors are large indicating a lack of model precision. Measurement uncertainties may also be contributing to the large errors.

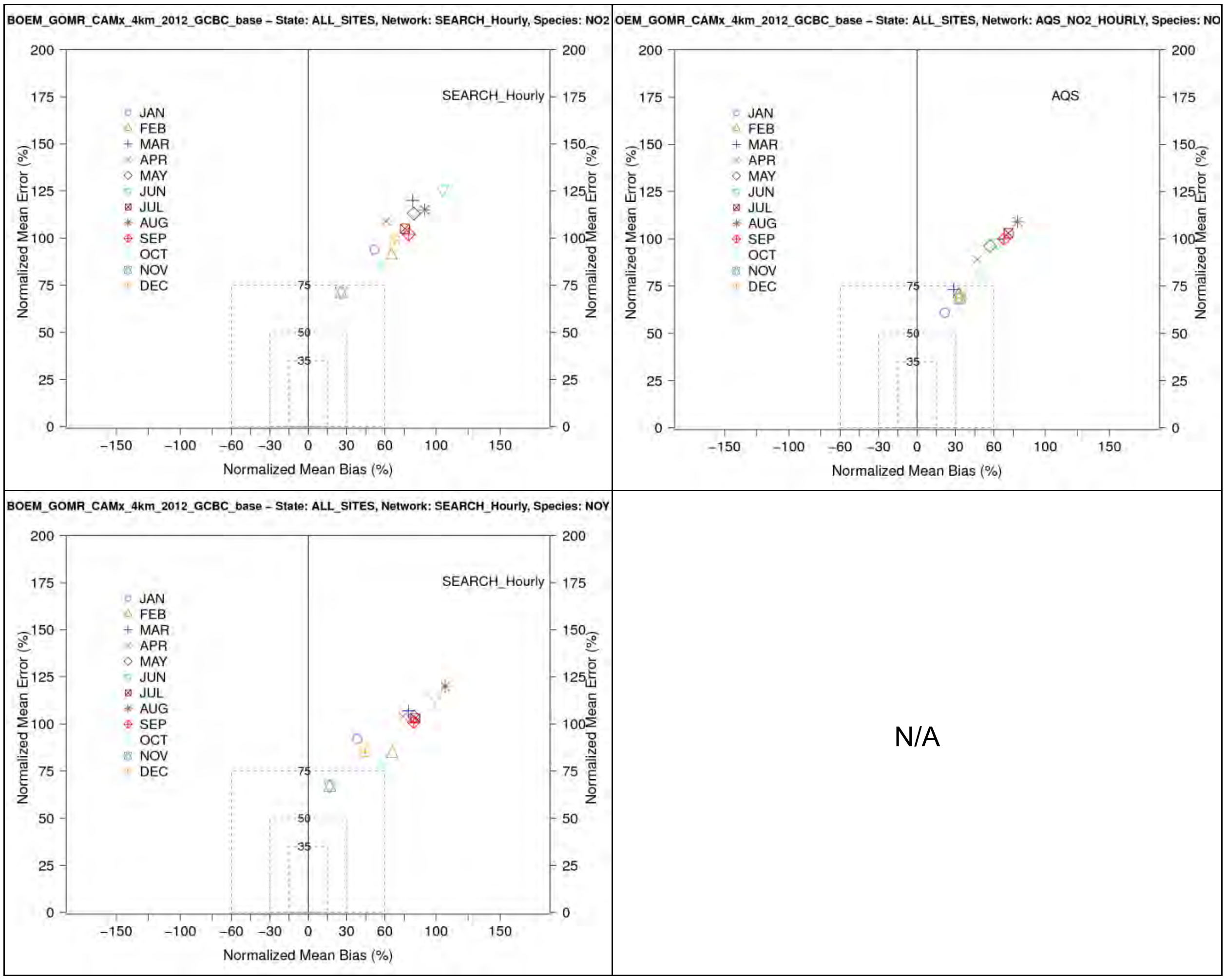


Figure D-33. Monthly Normalized Mean Bias and Normalized Mean Error for Hourly NO_2 (top) and Daily NOy (bottom) at SEARCH Network Sites (left) and AQS Sites (right) in the 4-km Domain.

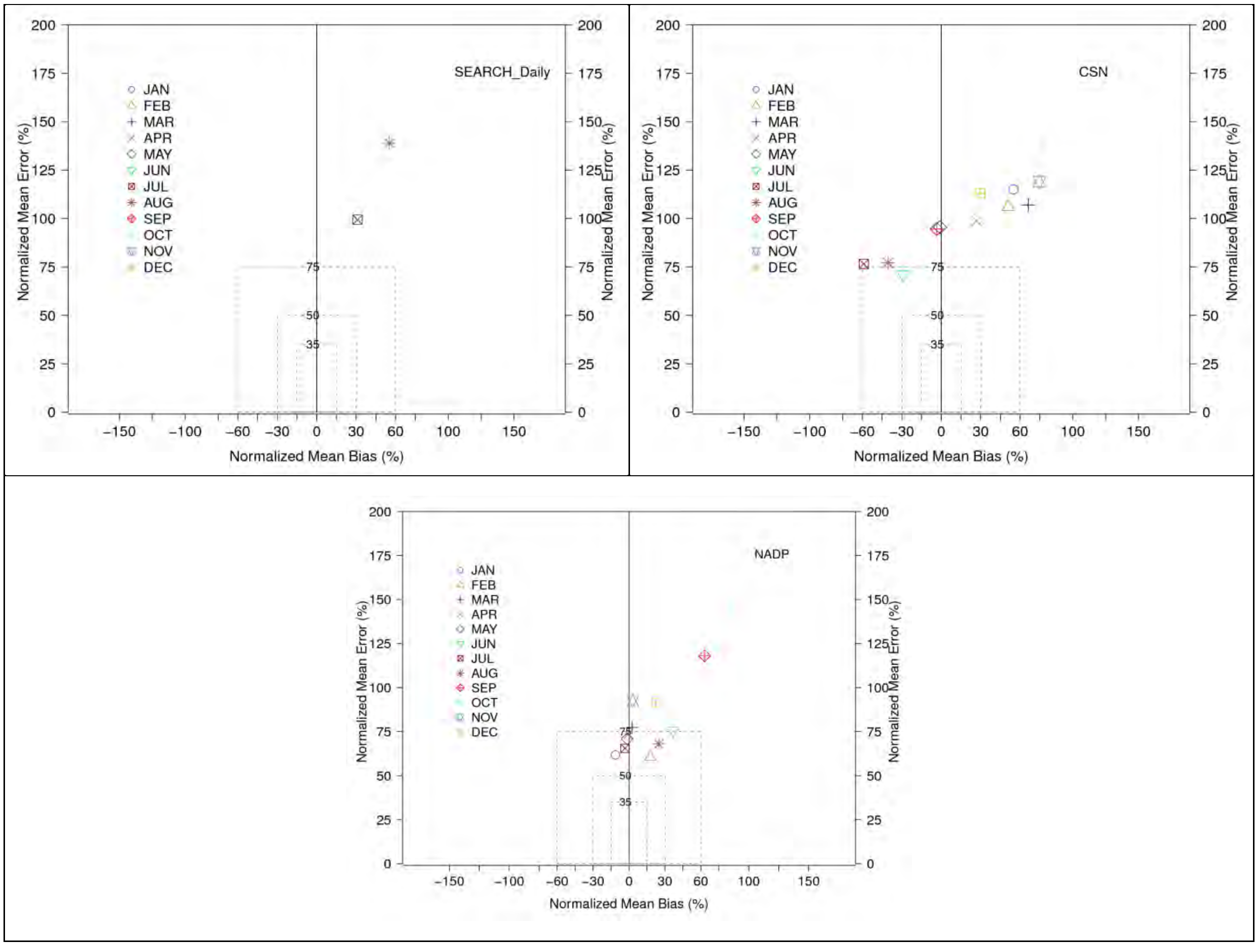


Figure D-34. Monthly Normalized Mean Bias and Normalized Mean Error for NO_3 at SEARCH Network Monitoring Sites (top left) and AQS Sites (top right) and NO_3 Deposition at NADP Sites (bottom) in the Southeastern U.S. (Note: Additional months for SEARCH NO_3 not shown as the NMB and NME exceed the upper axis limits.)

D.5.6.2.3 Sulfur Species (SO_2 and SO_4)

Model performance for hourly SO_2 within the 4-km domain is summarized in terms of monthly NME and NMB in **Figure D-35**. The AQS network SO_2 monitors are typically cited to represent the influence of major utility or industrial SO_2 sources and thus may measure short-term peaks associated with plume impacts from a discrete source. As a result, the timing, location, and magnitudes of peak SO_2 concentrations are not well represented within the 4-km grid modeling results. In addition, monitors near large ports may be influenced by discrete plumes from passing marine vessels, which could be sufficient to cause 1-hour peaks in the monitoring data. Since marine vessel emission inputs to the model are temporally averaged, these discrete events cannot be properly simulated by the model. Given these characteristics of the SO_2 monitoring data, we would expect large 1-hour SO_2 modeling errors as shown in **Figure D-35**, although we would not necessarily expect the positive normalized mean biases that occur in every month.

Over prediction bias of hourly SO_2 at SEARCH network sites seen in the top row of **Figure D-35** is in contrast to lower SO_4 bias shown in the next row. Good performance for SO_4 is also evident at CSN network sites. The SO_4 deposition is under predicted in most months. Reasons for the overall SO_2 over prediction bias at sites in the 4-km domain (top row of **Figure D-33**) are not immediately apparent. Examination of results over all sites in the 12-km domain (**Figure D-36**) shows wide variations in bias from site-to-site, including between sites in the 4-km domain, suggesting that the lower bias in the network average performance statistics in **Figure D-33** are partly the result of over- and under-predictions cancelling each other out.

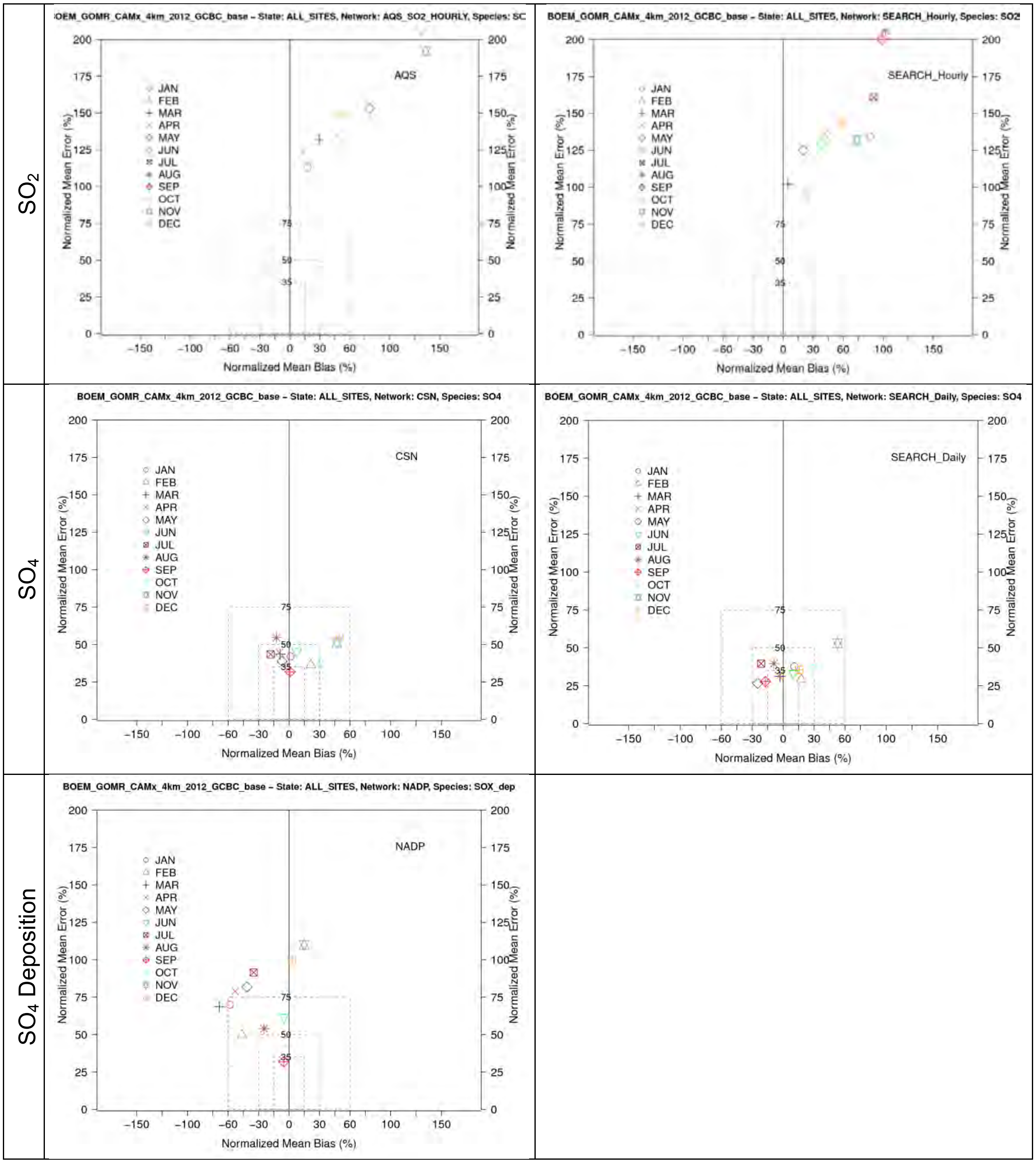


Figure D-35. Monthly Normalized Mean Bias and Normalized Mean Error at Monitoring Sites in the 4-km Domain for SO_2 (top row, AQS sites left panel, SEARCH sites right panel), SO_4 (middle row, CSN sites left panel, SEARCH sites right panel), and SO_4 Deposition Measured at NADP Sites (bottom row).

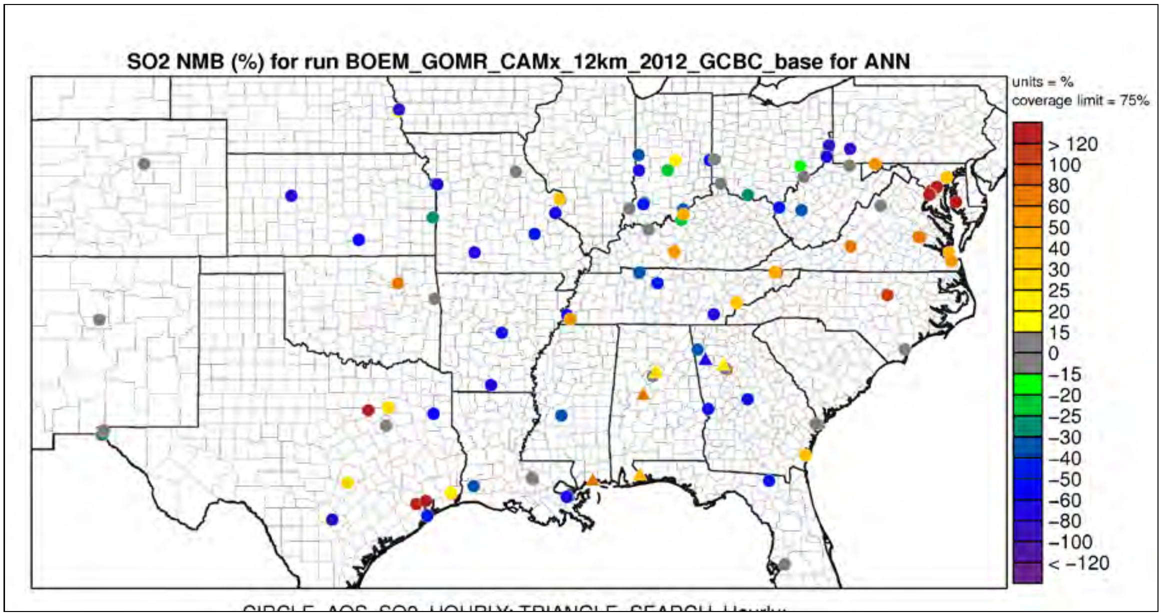


Figure D-36. Annual Normalized Mean Bias for Hourly SO_2 (based on 12-km resolution CAMx results).

D.5.6.2.4 Ammonium (NH_4)

Model performance for particulate ammonium at monitors within the 4-km domain is summarized in terms of monthly NME and NMB in **Figure D-37**. Performance at the two SEARCH network sites falls within the PM criteria bounds, but positive biases and large errors are seen at the three CSN sites. Note that results based on all sites in the southeastern U.S. domain (at 12-km resolution) are very similar. The NH_4 overestimation bias at the CSN sites is likely due to NO_3 over-prediction (**Figure D-34**), as SO_4 is showing biases closer to zero (**Figure D-35**). Examination of individual CSN site results shows acceptable performance at the Houston site (NMB=20%, NME=59%), but large positive biases and errors at the Baton Rouge, Louisiana, and Laurel, Mississippi, monitors.

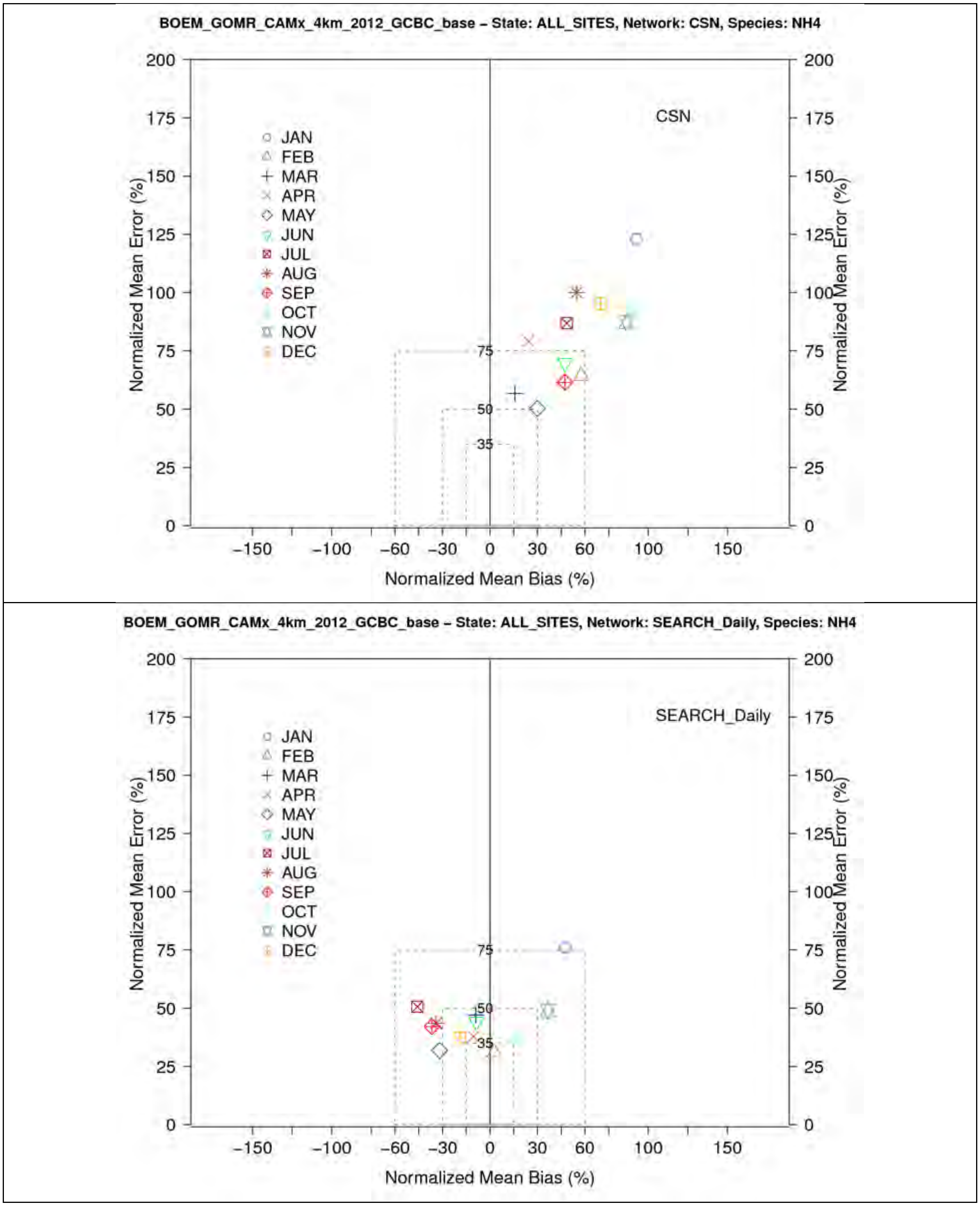


Figure D-37. Monthly Normalized Mean Bias and Normalized Mean Error for Daily Average NH_4 at CSN (top) and SEARCH (bottom) Network Sites in the 4-km Modeling Domain.

D.5.6.2.5 Carbon Monoxide (CO)

Model performance for hourly CO within the 4-km domain is summarized in terms of monthly NME and NMB in **Figure D-38**. Hourly CO is under predicted on average at AQS sites where the influenced of local mobile sources at sub-grid scales is not adequately resolved by the model's 4-km grid resolution; model performance is better at the SEARCH sites, several of which are in rural locations.

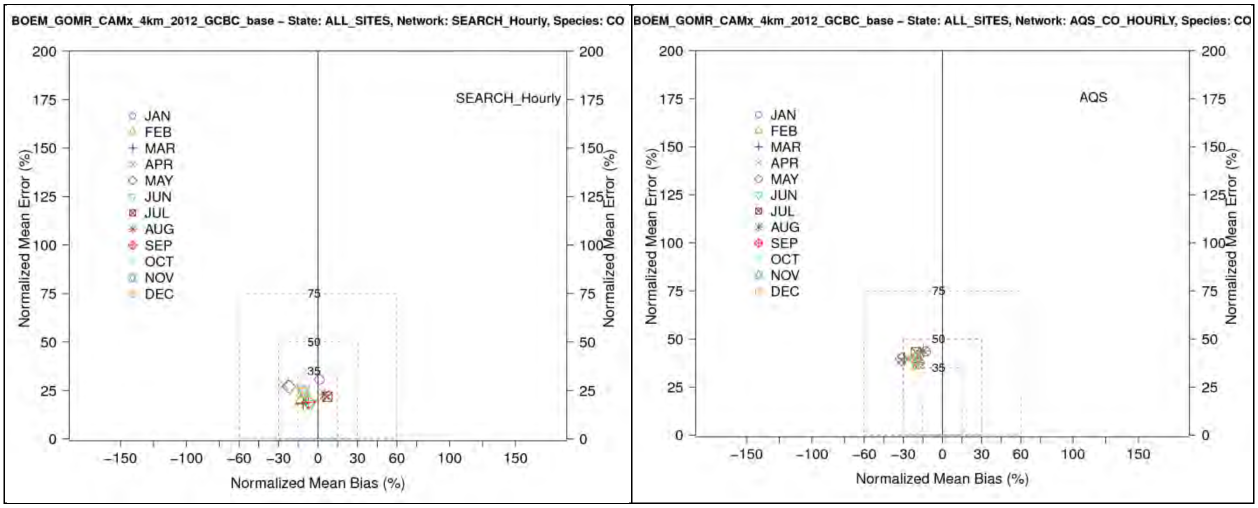


Figure D-38. Monthly Normalized Mean Bias and Normalized Mean Error for Hourly CO at SEARCH Network Sites (left) and AQS Sites (right).

D.6 AIR RESOURCE ASSESSMENT APPROACH

D.6.1 Future Year Modeling

The CAMx was run with the Future Year scenario emissions inventory, including emissions from the 2017-2022 GOM Multisale EIS sources described in **Appendix C**; this Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS. Model results were post-processed for analysis of air quality impacts with respect to the NAAQS and AQRVs; PSD increments were also calculated for information purposes. Source apportionment technology was used to provide estimates of source group impacts, including impacts of potential new sources associated with the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Details of the source apportionment and post-processing procedures are presented in this section.

D.6.1.1 Source Apportionment Design

The CAMx Ozone Source Apportionment Technology (OSAT) and Particulate Source Apportionment Technology (PSAT) tools were used to obtain the separate air quality, deposition, and visibility impacts associated with existing and new (2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers) OCS oil and gas development in the GOM, as well as from other emission sources in the GOM and several other source categories as described in **Appendix C**. The CAMx OSAT and PSAT source apportionment tools use reactive tracers that operate in parallel to the host PGM to provide air quality and deposition contributions due to user-selected source groups. The CAMx determines the contributions of emissions from each source category to the total CAMx model concentrations and depositions during the course of the simulation. A detailed description of the CAMx source apportionment tools is available in the CAMx user's guide (ENVIRON, 2014).

The Anthropogenic Precursor Culpability Assessment (APCA) version of the CAMx Ozone Source Apportionment Technology (OSAT) was used in the future year scenario modeling. The APCA differs from OSAT in that it distinguishes between natural and anthropogenic emissions; when ozone is formed due to the interaction of biogenic VOC and anthropogenic NO_x under VOC-limited conditions, a case OSAT would assign the ozone formed to the biogenic VOC, APCA recognizes that biogenic VOC is uncontrollable and re-directs the ozone formed to the anthropogenic NO_x. Thus, APCA only assigns ozone formed to natural emissions when it is due to natural VOC interacting with natural NO_x emissions. The APCA requires that the first source category is always natural emissions. Like OSAT, APCA uses four reactive tracers to track the ozone contributions of each source group: NO_x emissions (Ni); VOC emissions (Vi);and ozone formed under VOC-limited (O_3Vi) and NO_x-limited (O_3Ni) conditions.

For PM, three families of Particulate Source Apportionment Technology (PSAT) source apportionment tracers were used to track contributions of SO_4, NO_3/NH_4, and primary PM that require, respectively, 2, 7, and 6 reactive tracers for each family. Thus, combined APCA/PSAT source apportionment uses 19 reactive tracers to track the contribution of each source category. The Secondary Organic Aerosol (SOA) family of PSAT tracers was not used in the future year scenario source apportionment modeling because (1) only a few specific kinds of VOC species form SOA (i.e., isoprene, terpenes, sesquiterpenes, and aromatics), and these VOCs are mainly emitted by biogenic sources with some aromatic species (e.g., toluene and xylene) emitted by anthropogenic sources (e.g., gasoline combustion) (emissions from oil and gas exploration and production has negligible aromatic VOC emissions); and (2) the chemistry of SOA is quite complex, involving numerous gaseous, semi-volatile, and particulate species so that PSAT requires 21 tracers to track the SOA contributions of each source group (Morris et al., 2015). As a result, including SOA would more than double the number of reactive tracers, resulting in doubling of the computer time needed for the CAMx source apportionment run.

D.6.1.2 Future Year Source Apportionment Simulation

The CAMx 2017 source apportionment simulation was conducted for 1 January to 31 December calendar year over the 12-km southeastern U.S. modeling domain shown in **Figure D-5**. The boundary conditions (BCs) defining inflow concentrations around the lateral boundaries of the 12-km domain were obtained from a future year CAMx simulation of the 36-km continental U.S. (CONUS) domain shown in **Figure D-5**. Both the 36-km and 12-km simulations made use of the same 2012 WRF meteorology and model configuration used in the base case simulation.

D.6.2 Post-Processing of Future Year Source Apportionment Modeling Results

D.6.2.1 Overview

The CAMx future year scenario model and ozone and particulate matter source apportionment modeling outputs were post-processed for comparison against the NAAQS and PSD concentration increments listed in **Table D-14** and other thresholds of concern (TOC), as discussed below. For analyzing NAAQS and AQRV impacts at Class I and sensitive Class II areas, the Thresholds of Concern (TOCs) used were as defined by the Federal Land Manager (FLM) that manages each Class I/II area as prescribed in the June 23, 2011, Memorandum of Understanding (MOU) for evaluating onshore oil and gas AQ/AQRV impacts.[17]

The CAMx source apportionment results for individual source categories were used to evaluate the incremental impacts of each of a set of hierarchical source groups as defined in **Table D-15**. Note that Source Group B represents all new direct emissions associated with the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers, and Source Group C represents these sources in addition to all existing OCS platforms and associated support vessel and aircraft activity. Also note that Source Group E includes Source Groups A-D, along with all other anthropogenic sources, but excludes fires and other natural sources (biogenics, lightning NO_x, sea salt) and the contribution of boundary conditions.

Table D-14. NAAQS and PSD Increments.

Pollutant	Pollutant/Averaging Time	NAAQS	PSD Class I Increment[1]	PSD Class II Increment[1]
CO	1-hour[2]	35 ppm 40,000 μg/m^3	--	--
CO	8-hour[2]	9 ppm 10,000 μg/m^3	--	--
NO_2	1-hour[3]	100 ppb 188 μg/m^3	--	--
NO_2	Annual[4]	53 ppb 100 μg/m^3	2.5 μg/m^3	25 μg/m^3
O_3	8-hour[5]	0.070 ppm 137 μg/m^3	--	--
PM_{10}	24-hour[6]	150 μg/m^3	8 μg/m^3	^{3}0 μg/m^3
PM_{10}	Annual[7]	--	4 μg/m^3	17 μg/m^3
$PM_{2.5}$	24-hour[8]	35 μg/m^3	2 μg/m^3	9 μg/m^3
$PM_{2.5}$	Annual[9]	12 μg/m^3	1 μg/m^3	4 μg/m^3
SO_2	1-hour10	75 ppb 196 μg/m^3		
SO_2	3-hour[11]	0.5 ppm 1,300 μg/m^3	25 μg/m^3	512 μg/m^3
SO_2	24-hour	--	5 μg/m^3	91 μg/m^3
SO_2	Annual[4]	--	2 μg/m^3	20 μg/m^3

[17] http://www.epa.gov/compliance/resources/policies/nepa/air-quality-analyses-mou-2011.pdf

Pollutant	Pollutant/Averaging Time	NAAQS	PSD Class I Increment[1]	PSD Class II Increment[1]

[1] The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD increment consumption analysis.
[2] No more than one exceedance per calendar year.
[3] 98th percentile, averaged over 3 years.
[4] Annual mean not to be exceeded.
[5] Fourth-highest daily maximum 8-hour ozone concentrations in a year, averaged over 3 years, NAAQS promulgated December 28, 2015.
[6] Not to be exceeded more than once per calendar year on average over 3 years.
[7] 3-year average of the arithmetic means over a calendar year.
[8] 98th percentile, averaged over 3 years.
[9] Annual mean, averaged over 3 years, NAAQS promulgated December 14, 2012.
[10] 99th percentile of daily maximum 1-hour concentrations in a year, averaged over 3 years.
[11] No more than one exceedance per calendar year (secondary NAAQS).

Table D-15. Source Group for Incremental Impacts Analysis.

Source Group	Included Source Categories[a]	Comment
A	SC3	New oil and gas platform sources under the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers (w/Action)
B	SC3, SC4	Add support vessels and aircraft associated with new platform sources (w/Action)
C	SC3, SC4, SC5	Add oil and gas platforms and associated support vessels and aircraft under the No Action alternative (existing base case sources)
D	SC3, SC4, SC5, SC6	Add all other marine vessel activity in the GOM, not associated with OCS oil and gas activities
E	SC3, SC4, SC5, SC6, SC7, SC8	Add all other U.S. and non-U.S. anthropogenic sources
F	SC1, SC2, SC8, SC10	Natural and non-U.S. sources (including U.S. sources outside of the 12-km modeling domain)

[a] Refer to **Table D-6**.

D.6.2.2 Comparison against NAAQS

The CAMx future year scenario predicted total concentrations from all emission sources were post-processed for comparison to the applicable NAAQS, as listed in **Table D-14**, in two different ways. First, the CAMx predictions were compared directly against each NAAQS. This is referred to as the "absolute" prediction comparison. These absolute prediction comparisons may be misleading in cases in which the model exhibits significant prediction bias. In recognition of this, USEPA modeling guidance (USEPA, 2007 and 2014) recommends using the model in a relative sense when projecting future year ozone, $PM_{2.5}$, and regional haze levels; and the USEPA has developed the Modeled Attainment Test Software (MATS; Abt., 2014) for making such future year projections. This approach uses the ratio of future year to current year modeling results to develop Relative Response Factors (RRFs) that are applied to observed current year Design Values (abbreviated as either DVC or DVB) to make future year Design Value (DVF) projections (i.e., DVF = DVC x RRF). The MATS was applied to the prediction of both ozone and $PM_{2.5}$ DVFs. The MATS was also used for assessing the cumulative visibility impacts at IMPROVE monitoring sites in the 12-km domain, as discussed in more detail below.

D.6.2.3 Impacts at Class I and Sensitive Class II Areas

The incremental AQ/AQRV contributions associated with emissions from each source group listed in **Table D-15** were calculated at the Class I and sensitive Class II areas shown in **Figure D-39**. The selected areas include all Class I and sensitive Class II areas within the 4-km modeling domain plus additional Class I areas within the 12-km modeling domain.

Table D-16 lists those areas that are located in Gulf Coast or nearby states and thus are of greatest interest to this analysis. Refer to **Section D.7.3.1** for a complete list of all areas shown in **Figure D-39**, along with the results of the visibility analyses.

Receptors for each Class I and sensitive Class II area were defined based on the spatial extent of the Class I/II area defined using shapefiles obtained from the applicable Federal Land Management Agency. A GIS was used to determine the set of grid cells overlapping each area by at least 5%. Model results for the identified grid cells were then used to represent predicted ambient concentrations and deposition in each area.

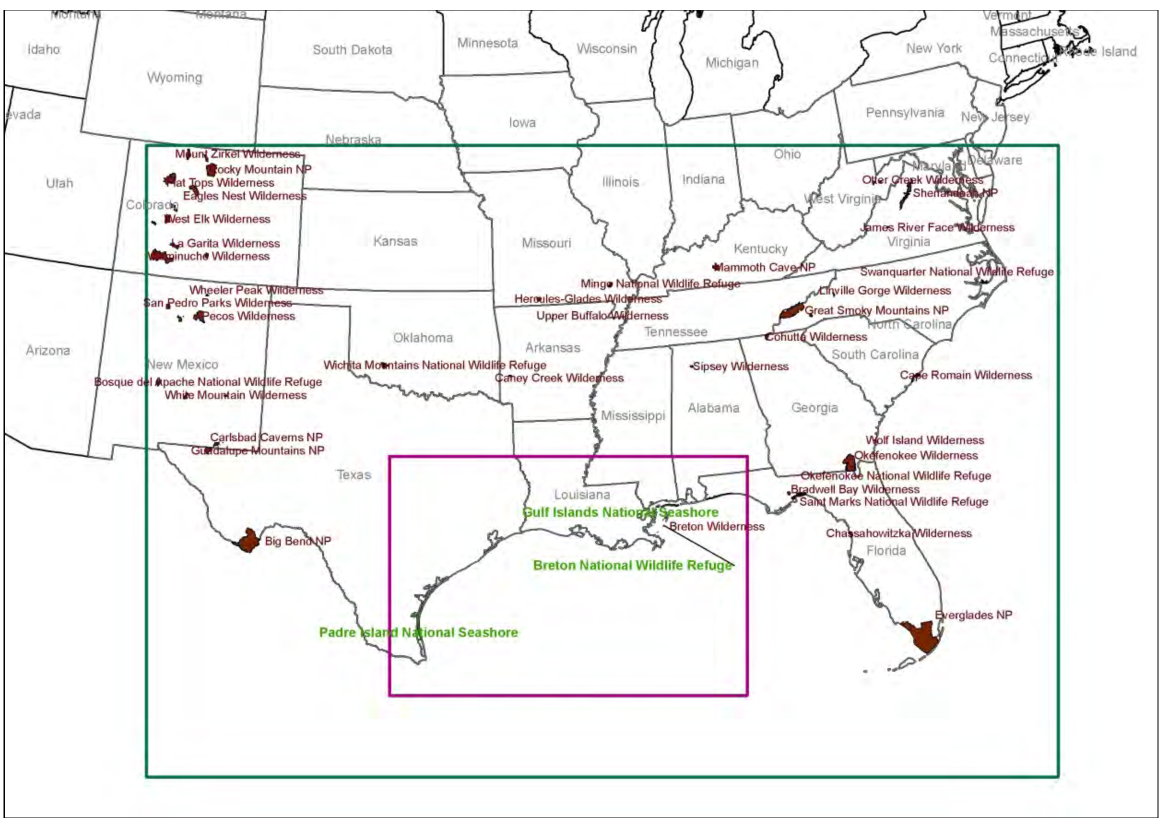


Figure D-39. Class I and Sensitive Class II Areas for Which Incremental AQ/AQRV Impacts Were Calculated.

Table D-16. Class I and Sensitive Class II Areas in Gulf Coast and Nearby States.

Type	Name	Agency[1]	State	Modeling Domain
Class I	Breton Wilderness	FWS	LA	4 km
Class II	Breton NWR	FWS	LA	4 km
Class II	Gulf Islands NS	NPS	MS, FL	4 km
Class II	Padre Island NS	NPS	TX	4 km
Class I	Bradwell Bay	FS	FL	12 km
Class I	St. Marks	FWS	FL	12 km
Class I	Chassahowitzka	FWS	FL	12 km
Class I	Everglades NP	NPS	FL	12 km
Class I	Okefenokee	FWS	GA	12 km
Class I	Wolf Island	FWS	GA	12 km
Class I	Cohutta	FS	GA	12 km
Class I	Sipsey	FS	AL	12 km
Class I	Guadalupe Mountains	NPS	TX	12 km
Class I	Big Bend	NPS	TX	12 km
Class I	Wichita Mountains	FWS	OK	12 km
Class I	Caney Creek	FS	AR	12 km
Class I	Upper Buffalo	FS	AR	12 km

[1] FWS = U.S. Dept. of the Interior, Fish and Wildlife Service; FS = U.S. Dept. of Agriculture, Forest Service; NPS = U.S. Dept. of the Interior, National Park Service; NS = National Seashore; NWR = National Wildlife Refuge.

D.6.2.3.1 Incremental Visibility Impacts

Visibility impacts were calculated for each source group using incremental concentrations as quantified by the CAMx PSAT tool. Changes in light extinction from CAMx model concentration increments due to emissions from each source group were calculated for each day at grid cells representing each Class I and sensitive Class II area. The FLAG (2010) procedures were used in the incremental visibility assessment analysis.

The visibility evaluation metric used in this analysis is based on the haze index (HI), which is measured in deciview (dv) units and is defined as follows:

$$HI = 10 \times \ln[b_{ext}/10]$$

Where b_{ext} is the atmospheric light extinction measured in inverse megameters (Mm^{-1}) and is calculated primarily from atmospheric concentrations of particulates.

A more intuitive measure of haze is visual range (VR), which is defined as the distance at which a large black object just disappears from view, and is measured in km. Visual range is related to b_{ext} by the formula $VR = 3912/b_{ext}$. The advantage of using the HI rather than VR is that a given change in HI is approximately associated with the same degree of perceived change in visibility regardless of the baseline conditions whereas small changes in VR are much more noticeable under clean conditions as compared to hazy conditions.

The incremental concentrations due to each source group were added to natural background extinction in the extinction equation (b_{ext}) and the difference between the haze index with the source group concentrations included and the haze index based solely on natural background concentrations is calculated. This quantity is the change in haze index, which is referred to as "delta deciview" (Δdv):

$$\Delta dv = 10 \times \ln[b_{ext(SC+background)}/10] - 10 \times \ln[b_{ext(background)}/10]$$
$$\Delta dv = 10 \times \ln[b_{ext(SC+background)}/b_{ext(background)}]$$

Here $b_{ext(SCi+background)}$ refers to atmospheric light extinction due to impacts from the source category plus background concentrations, and $b_{ext(background)}$ refers to atmospheric light extinction due to natural background concentrations only.

For each source group, the estimated visibility degradation at the Class I areas and sensitive Class II areas due to the source group are presented in terms of the number of days that exceed a threshold change in deciview (Δdv) relative to background conditions. The number of days with a deciview greater than 0.5 and 1.0 are reported.

IMPROVE Reconstructed Mass Extinction Equations

The FLAG (2010) procedures for evaluating visibility impacts at Class I areas use the revised IMPROVE reconstructed mass extinction equation to convert PM species in μg/m^3 to light extinction (b_{ext}) in inverse megameters (Mm^{-1}) as follows:

$$b_{ext} = b_{SO4} + b_{NO3} + b_{EC} + b_{OCM} + b_{Soil} + b_{PMC} + b_{SeaSalt} + b_{Rayleigh} + b_{NO2}$$

where

$b_{SO4} = 2.2 \times f_S(RH) \times$ [Small Sulfate] $+ 4.8 \times f_L(RH) \times$ [Large Sulfate]

$b_{NO3} = 2.4 \times f_S(RH) \times$ [Small Nitrate] $+ 5.1 \times f_L(RH) \times$ [Large Nitrate]

$b_{OCM} = 2.8 \times$ [Small Organic Mass] $+ 6.1 \times$ [Large Organic Mass]

$b_{EC} = 10 \times$ [Elemental Carbon]

$b_{Soil} = 1 \times$ [Fine Soil]

$b_{CM} = 0.6 \times$ [Coarse Mass]

$b_{SeaSalt} = 1.7 \times f_{SS}(RH) \times$ [Sea Salt]

$b_{Rayleigh}$ = Rayleigh Scattering (Site-specific)

$b_{NO2} = 0.33 \times [NO_2$ (ppb)] {or as: $0.1755 \times [NO_2$ (μg/m^3)]}.

f(RH) are relative humidity adjustment factors that account for the fact that sulfate, nitrate, and sea salt aerosols are hygroscopic and are more effective at scattering solar radiation at higher relative humidity. FLAG (2010) recommends using monthly average f(RH) values rather than the hourly averages recommended in the previous FLAG (2000) guidance document in order to moderate the effects of extreme weather events on the visibility results.

The revised IMPROVE equation treats "large sulfate" and "small sulfate" separately because large and small aerosols affect an incoming beam of light differently. However, the IMPROVE measurements do not separately measure large and small sulfate; they measure only the total $PM_{2.5}$ sulfate. Similarly, CAMx writes out a single concentration of particulate sulfate for each grid cell. Part of the definition of the new IMPROVE equation is a procedure for calculating the large and small sulfate contributions based on the magnitude of the model output sulfate concentrations; the procedure is documented in FLAG (2010).[18] The sulfate concentration magnitude is used as a surrogate for distinguishing between large and small sulfate concentrations. For a given grid cell, the large and small sulfate contributions are calculated from the model output sulfate (which is the "Total Sulfate" referred to in the FLAG [2010] guidance) as

For Total Sulfate $<20\ \mu g/m^3$:

$$[\text{Large Sulfate}] = ([\text{Total Sulfate}] / 20\ \mu g/m^3) \times [\text{Total Sulfate}]$$

For Total Sulfate $\geq 20\ \mu g/m^3$:

$$[\text{Large Sulfate}] = [\text{Total Sulfate}]$$

For all values of Total Sulfate:

$$[\text{Small Sulfate}] = [\text{Total Sulfate}] - [\text{Large Sulfate}]$$

The procedure is identical for nitrate and organic mass.

The PSAT source apportionment algorithm does not separately track NO_2 concentrations but instead tracks total reactive nitrogen (RGN) that consists of NO, NO_2, and other reactive nitrogen compounds (e.g., N_2O_5, HONO, etc.). Thus, for each hour and each grid cell representing a Class I/II area, a source group's incremental PSAT RGN contribution is converted to NO_2 by multiplying by the total (all emissions) CAMx model NO_2/RGN concentration ratio. Note that this same procedure is also used for contributions to NO_2 concentrations.

Although sodium and particulate chloride are treated in the CAMx core model, these species are not carried in the CAMx PSAT tool. This does not affect the calculations of visibility impacts from individual source groups other than impacts from the natural source category (SC2).

[18] http://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf

Predicted daily average modeled concentrations due to each source group for receptor grid cells containing Class I and sensitive Class II areas were processed using the revised IMPROVE reconstructed mass extinction equation FLAG (2010) to obtain changes in bext at each sensitive receptor area that are converted to deciview and reported.

Annual average natural conditions for each Class I area were obtained from Table 6 in FLAG (2010) and monthly relative humidity factors for each Class I area from Tables 7-9 in FLAG (2010). The Δdv was calculated for each grid cell that overlaps a Class I or sensitive Class II area by 5% or more for each day of the annual CAMx run. The highest Δdv across all grid cells overlapping a Class I or sensitive Class II area by at least 5% was selected to represent the daily value at that Class I/II area. Visibility impacts due to emissions from each source group that exceed the 0.5 and 1.0 Δdv thresholds are noted.

Cumulative Visibility Impacts

The cumulative visibility impacts of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers, were assessed following the recommendations from the U.S. Dept. of the Interior's Fish and Wildlife Service (FWS) and NPS (USDOI, FWS and USDOI, NPS, official communication, 2012). This approach is based on an abbreviated regional haze rule method that estimates the future year visibility at Class I and sensitive Class II areas for the average of the Worst 20% (W20%) and Best 20% (B20%) visibility days with and without the effects of the source group emissions on visibility impairment. The cumulative visibility impacts used CAMx model output from the 2012 Base Year and 2017 Future Year emissions scenarios in conjunction with monitoring data to produce cumulative visibility impacts at each Class I and sensitive Class II area. The USEPA's Modeled Attainment Test Software (MATS[19]) was used to make the 2017 visibility projections for the W20% and B20% days. The basic steps in the recommended cumulative visibility method are as follows (USDOI, FWS and USDOI, NPS, official communication, 2012):

(1) Calculate the observed average 2012 current year cumulative visibility impact using the haze index (HI, in deciviews) at each Class I area using representative IMPROVE measurement data to determine the 20% of days with the worst and 20% of days with the best visibility. The MATS is designed to use 5 years of monitoring data centered on the base case year, which for 2012 would include 2010-2014. However, MATS only includes IMPROVE monitoring data through 2012, so the 2008-2012 5-year period was used to define the visibility baseline conditions in the MATS visibility projections.

(2) Estimate the relative response factors (RRFs) for each component of $PM_{2.5}$ and for coarse mass (CM) corresponding to the new IMPROVE visibility algorithm using the CAMx 2012 and 2017 model output. The RRFs are based on the

[19] http://www.epa.gov/ttn/scram/modelingapps_mats.htm

average concentrations across a 3 x 3 array of 4-km grid cells centered on the IMPROVE monitoring site location.

(3) Using the RRFs and ambient data, calculate 2017 future year daily concentration data for the B20% and W20% days using the CAMx 2012 base case and 2017 standard model concentration estimates and PSAT source apportionment modeling results two ways:

(a) 2017 Total Emissions: Use total 2017 CAMx concentration results due to all emissions;

(b) 2017 No Cumulative Emissions: Use PSAT source apportionment results to eliminate contributions of PM concentrations associated with each source group.

(4) Use the information in Step 3 to calculate the average 2017 visibility for the 20% Best and 20% Worst visibility days and the 2017 emissions.

(5) Assess the average differences in cumulative visibility impacts for each source group and also compare with the future and current observed Baseline visibility conditions.

Because of the need for IMPROVE observations, monitoring data from nearby Class I areas were used to represent areas without any IMPROVE monitors.

D.6.2.3.2 Sulfur and Nitrogen Deposition

The CAMx-predicted wet and dry fluxes of sulfur- and nitrogen-containing species were processed to estimate total annual sulfur and nitrogen deposition values at each Class I and sensitive Class II area. The maximum annual sulfur and nitrogen deposition values from any grid cell that intersects a Class I receptor area was used to represent deposition for that area, in addition to the average annual deposition values of all grid cells that represent a Class I receptor area. Although the convention in the past has been to report just the maximum deposition in any receptor in a Class I/II area, since deposition relates to the total amount deposited across an entire watershed, the average metric may be considered a more relevant parameter for evaluating potential environmental effects. Maximum and average predicted sulfur and nitrogen deposition impacts are reported separately for each source group.

Nitrogen deposition impacts were calculated by taking the sum of the nitrogen contained in the fluxes of all nitrogen species modeled by the CAMx PSAT source apportionment tool. The CAMx species used in the nitrogen deposition flux calculation are reactive gaseous nitrate species, RGN (NO, NO_2, NO_3 radical, HONO, N_2O_5), TPN (PAN, PANX, PNA), organic nitrates (NTR), particulate nitrate formed from primary emissions plus secondarily formed particulate nitrate (NO_3), gaseous nitric acid (HNO_3), gaseous ammonia (NH_3), and particulate ammonium (NH_4). The CAMx species used in the sulfur deposition calculation are primarily sulfur dioxide emissions (SO_2) and particulate sulfate ion from primary emissions plus secondarily formed sulfate (SO_4).

FLAG (2010) recommends that applicable sources assess impacts of nitrogen and sulfur deposition at Class I areas. This guidance recognizes the importance of establishing critical deposition loading values ("critical loads") for each specific Class I area as these critical loads are completely dependent on local atmospheric, aquatic, and terrestrial conditions and chemistry. Critical load thresholds are essentially a level of atmospheric pollutant deposition below which negative ecosystem effects are not likely to occur. FLAG (2010) does not include any critical load levels for specific Class I areas and refers to site-specific critical load information on FLM websites for each area of concern. This guidance does, however recommend the use of deposition analysis thresholds (DATs [20]) developed by the NPS and FWS. The DATs represent screening level values for nitrogen and sulfur deposition for individual projects with deposition impacts below the DATS considered negligible. A DAT of 0.005 kilograms per hectare per year (kg/ha/yr) for both nitrogen and sulfur deposition has been established for both nitrogen and sulfur deposition in western Class I areas. A DAT of 0.01 kg/ha/yr has been established for both nitrogen and sulfur deposition for areas in the eastern U.S. As a screening analysis, results for Source Group B (new platforms and associated support vessels and aircraft associated with the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers) were compared to the DATs. Comparison of deposition impacts from cumulative sources to the DAT is not appropriate.

For the 2012 base case and the combined source groups and total 2012 and future year emissions, the annual nitrogen and sulfur deposition were compared against critical load values established by the Federal Land Management agencies. Published nitrogen critical load values for areas managed by the NPS[21] include minimum critical loads of 3 kg/ha/yr at the Gulf Islands National Seashore, as well as at Guadalupe Mountains and Big Bend, and 5 kg/ha/yr at Padre Island National Seashore and Everglades National Park. These values represent the minimum of the critical loads for each biological community type (i.e., forests, herbaceous plants, lichen, mycorrhizal fungi, and nitrate leaching). Nitrogen and sulfur critical load values for areas managed by the U.S. Dept. of Agriculture's Forest Service (USFS) include 5 kg/ha/yr at Bradwell Bay, Cohutta, Sipsey, Caney Creek and Upper Buffalo. The 5 kg/ha/yr critical load value for these areas applies separately to nitrogen and to sulfur deposition. As no separate critical load values for sulfur are available from the NPS areas, the sulfur critical loads were set equal to the values for nitrogen. No published critical load values were found for areas managed by the FWS; critical loads for these areas were set by reference to the NPS and USFS critical loads based on proximity and similarity of ecoregion types. Using this approach, both nitrogen and sulfur critical loads for the Breton Wilderness, Breton National Wildlife Refuge, St. Marks, Chassahowitzka, Okefenoke, and Wolf Island were set at 3 kg/ha/yr based on the Gulf Islands National Seashore value for Eastern Temperate Forests. The values for Wichita Mountains was set at 5 kg/ha/yr based on the NPS' Chickasaw National Recreation Area Great Plains ecoregion value.

[20] http://www.nature.nps.gov/air/Pubs/pdf/flag/nsDATGuidance.pdf
[21] http://www.nature.nps.gov/air/Studies/criticalloads/Ecoregions/index.cfm

D.6.2.4 PSD Increments

The maximum contribution of new oil and gas emissions in the Gulf of Mexico under the 2017-2022 GOM Multisale EIS scenario were reported for each Class I and sensitive Class II area and were compared against the PSD increments given in **Table D-14**. Under the Clean Air Act, a PSD increment consumption analysis requires major stationary sources subject to PSD review to demonstrate that emission increases from the proposed source, in conjunction with all other emissions increases or reductions in the impacted area (typically within 50 kilometers), will not cause or contribute to concentrations of air pollutants that exceed PSD increments. The PSD increments have been established for NO_x, SO_2, and PM in Class I and Class II areas. Actions to be authorized by BOEM under the 2017-2022 GOM Multisale EIS scenario do not typically constitute major stationary sources and do not typically trigger PSD permits or review. However, a comparison of ambient concentrations from an accumulation of new oil and gas sources within the entire study area to PSD increments at specific Class I and Class II areas is included in this analysis for information purposes. This information is presented to aid State agencies in tracking the potential minor source increment consumption and to aid Federal Land Managers or Tribal governments responsible for protecting air resources in Class I areas. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS and uses the scenario and alternatives analyzed in the 2017-2022 GOM Multisale EIS.

D.7 AIR RESOURCE ASSESSMENT RESULTS

D.7.1 NAAQS Impacts

Future year CAMx modeling results were used to examine future air quality relative to the NAAQS and the individual contributions of each source group relative to the NAAQS. For the ozone and $PM_{2.5}$ NAAQS, comparisons are presented both in terms of the “absolute” CAMx results and in terms of using the base case and future year CAMx results in a relative sense to scale the observed base (“current” or “base”) year design value (DVC or DVB) to obtain the projected future year design value (DVF) as recommended by the USEPA’s modeling guideline (USEPA, 2007 and 2014) and as described in **Section D.6.2.2.**

D.7.1.1 Ozone NAAQS Analysis using Relative Model Results

The USEPA’s Model Attainment Test Software (MATS) was used to make future year ozone DVF projections using the CAMx 2012 base case and future year scenario modeling results as described in **Section D.6.2.2.** The MATS was used to make DVF projections at the locations of ambient air monitoring sites as well as throughout the 4-km modeling domain using the MATS Unmonitored Area Analysis (UAA) procedures.

D.7.1.1.1 Monitored Ozone Design Value Projections using MATS

The MATS results for the future year ozone design values (DVFs) at individual ambient air monitoring sites in the 4-km domain are listed in **Tables D-17 and D-18**. Updated MATS data files containing ozone design values up through 2014 were obtained from the USEPA.[22] To make future year projections, MATS starts with a current year design value (DVC) that is based on an average of three ozone design values from the 5-year period centered on the base case modeling year, which was 2012 for this analysis. Thus, MATS DVCs are based on ozone design values from the 2010-2012, 2011-2013, and 2012-2014 periods. The MATS makes ozone DVF projections using the changes in daily maximum 8-hour ozone concentrations near (3 x 3 array of 4-km grid cells) a monitor using the ratio of future year to current year modeling results to scale the observed DVCs. These modeled derived scaling factors are called Relative Response Factors (RRFs; DVF = DVC x RRF). The RRFs are based on the 10 highest modeled ozone days above a threshold ozone concentration. A lower bound observed ozone threshold value of 50 ppb was used in MATS.

Of the 74 monitors with valid DVCs as calculated by MATS, 39 have DVCs exceeding the NAAQS (70 ppb). The DVFs are less than DVCs at all 74 sites. A total of 22 sites have predicted DVFs exceeding the MATS, all of which are among the sites with DVCs above the NAAQS.

Contributions of each source group to the DVFs were calculated as the difference between the DVF calculated from the CAMx results with all sources included and a revised DVF calculated after first subtracting out the individual hourly contributions of each source group in the future year model run. These source group contributions are tabulated in **Table D-18**. The maximum contribution from Source Group A (new platforms associated with the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers) is 0.5 ppb. The maximum contribution from Source Group B (new platforms and support vessels and helicopters associated with the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers) is 5.1 ppb.

Five sites in Texas and one in Louisiana were identified where the contribution of the new platforms and associated support vessels and aircraft under the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario (Source Group B) to the DVF was enough to push the DVF from just below the 70-ppb NAAQS (with Source Group B contributions removed) to just above the NAAQS when all sources were included (**Table D-19**). In each case, the “contribution” from Source Group B is less than 5 ppb. At each of these sites, the DVCs are all also greater than 70 ppb as noted above. At the Galveston, Texas, monitor, the 0.3-ppb contribution of Source Group A (new platforms) alone was sufficient to bump the future year design value from just below the NAAQS to just above the NAAQS (recall comparisons to the 70 ppb NAAQS are made after truncating design values to the nearest ppb).

For the ozone impacts assessment, please note that the states will not designate under the 2015 ozone standard of 70 ppb until 2017, with the earliest attainment date of March 2021 for marginal areas. For this impacts assessment, the non-OCS source emissions were based on the USEPA’s 2017 emission projections, with a future modeled year of 2017 and compared to the 70-ppb standard. This assessment is assuming the standard will be attained way before the actual

[22] https://www3.epa.gov/scram001/modelingapps_mats.htm

attainment date, but it wanted to give maximum OCS oil and gas impacts under the new 70 ppb ozone standard.

Table D-17. Current Year (DVC) and Future Year (DVF) Ozone Design Values at Ambient Air Monitoring Sites within the 4-km Modeling Domain from MATS.

Site ID	Site Name	State	County	DVC	DVF
10030010	FAIRHOPE HIGH SCHOOL, FAIRHOPE, ALABAMA	AL	Baldwin County	68	66.2
10970003	CHICKASAW, MOBILE CO., ALABAMA	AL	Mobile County	67.3	64.4
10972005	BAY RD. ,MOBILE AL.	AL	Mobile County	72	66.5
120330004	ELLYSON INDUSTRIAL PARK-COPTER ROAD	FL	Escambia County	67.7	65.1
120330018	NAS PENSACOLA	FL	Escambia County	70.7	68.1
120910002	720 Lovejoy Rd	FL	Okaloosa County	65	62.9
121130015	1500 WOODLAWN WAY	FL	Santa Rosa County	69.3	67.4
220050004	11153 Kling Road	LA	Ascension Parish	71.3	67.8
220190002	HIGHWAY 27 AND HIGHWAY 108	LA	Calcasieu Parish	70.7	68.9
220190008	2646 John Stine Road	LA	Calcasieu Parish	66.7	64.7
220190009	2284 Paul Bellow Road	LA	Calcasieu Parish	70	67.3
220330003	EAST END OF ASTER LANE	LA	East Baton Rouge Parish	75.3	71.3
220330009	1061-A Leesville Ave	LA	East Baton Rouge Parish	72.3	68.3
220330013	11245 Port Hudson-Pride Rd. Zachary, La	LA	East Baton Rouge Parish	69	65.1
220470009	65180 Belleview Road	LA	Iberville Parish	70.3	64.6
220470012	HIGHWAY 171, CARVILLE	LA	Iberville Parish	73.3	68.6
220511001	West Temple Pl	LA	Jefferson Parish	71.3	68.4
220550007	646 Cajundome	LA	Lafayette Parish	69.7	67.2
220570004	Nicholls University Farm Highway 1	LA	Lafourche Parish	71	65.7
220630002	Highway 16, French Settlement	LA	Livingston Parish	72.3	68.6
220710012	Corner of Florida Ave & Orleans Ave	LA	Orleans Parish	68.3	66.5
220770001	TED DAVIS RESIDENCE. HIGHWAY 415	LA	Pointe Coupee Parish	74	68.2
220870004	4101 Mistrot Dr. Meraux, LA 70075	LA	St. Bernard Parish	68	64.4
220890003	1 RIVER PARK DRIVE	LA	St. Charles Parish	67.7	65.2
220930002	ST. JAMES COURTHOUSE, HWY 44 @ CANAPELLA	LA	St. James Parish	66.3	62.7
220950002	Anthony F. Monica Street	LA	St. John the Baptist Parish	72	69.3
221030002	1421 Hwy 22 W, Madison Ville, LA 70447	LA	St. Tammany Parish	72.3	68.7
221210001	1005 Northwest Drive, Port Allen	LA	West Baton Rouge Parish	68	63.8
280450003	400 Baltic St	MS	Hancock County	66.3	63.4
280470008	47 Maple Street	MS	Harrison County	70.3	67
280590006	Hospital Road at Co. Health Dept.	MS	Jackson County	71.3	69.2
480271047	1605 Stone Tree Drive	TX	Bell County	73.7	71
				80.3	78

Site ID	Site Name	State	County	DVC	DVF
				68.7	66.3
480391004	4503 CROIX PKWY	TX	Brazoria County	85	81.9
480391016	109 B BRAZORIA HWY 332 WEST	TX	Brazoria County	69.3	66.8
480610006	344 PORTER DRIVE	TX	Cameron County	60.7	59.2
				69.3	66.6
481671034	9511 AVENUE V ½	TX	Galveston County	75.3	71.2
482010024	4510 1/2 ALDINE MAIL RD.	TX	Harris County	76.7	75.1
482010026	1405 SHELDON ROAD	TX	Harris County	73	71.2
482010029	16822 KITZMAN	TX	Harris County	80	76.3
482010046	7330 1/2 NORTH WAYSIDE	TX	Harris County	73.7	71.6
482010047	4401 1/2 LANG RD.	TX	Harris County	77	74.8
482010051	13826 1/2 CROQUET	TX	Harris County	78.7	76.3
482010055	6400 BISSONNET STREET	TX	Harris County	78.7	77.3
482010062	9726 1/2 MONROE	TX	Harris County	76.7	74.4
482010066	3333 1/2 HWY 6 SOUTH	TX	Harris County	77.7	75.2
482010070	5425 POLK AVE., SUITE H	TX	Harris County	75	73.5
482010416	7421 PARK PLACE BLVD	TX	Harris County	77.3	74.8
482011015	1001 B LYNCHBURG ROAD	TX	Harris County	71	68.5
482011034	1262 1/2 MAE DRIVE	TX	Harris County	78	76.1
482011035	9525 CLINTON DR	TX	Harris County	74.7	72.5
482011039	4514 1/2 DURANT ST.	TX	Harris County	78.3	75.5
482011050	4522 PARK RD.	TX	Harris County	76.3	74
482151048	325 Golf Course Road	TX	Hidalgo County	60	58.1
482450009	1086 Vermont Avenue	TX	Jefferson County	71.7	68.3
482450011	800 EL VISTA ROAD & 53RD STREET	TX	Jefferson County	74	70.5
482450022	12552 SECOND ST.	TX	Jefferson County	70.3	66.7
482450101	6019 MECHANIC	TX	Jefferson County	75	72.3
482450102	SETRPC 43 Jefferson Co Airport	TX	Jefferson County	67	64.4
482450628	UNAVAILABLE	TX	Jefferson County	69.3	66.4
482451035	Seattle Street	TX	Jefferson County	69.3	66.9
483091037	4472 MAZANEC RD	TX	McLennan County	71.7	69.1
483390078	9472 A HWY 1484	TX	Montgomery County	78	74.7
483491051	Corsicana Airport	TX	Navarro County	70	68.2
483550025	CORPUS CHRISTI STATE SCHOOL, AIRPORT RD	TX	Nueces County	69.3	68.2
483550026	9860 LA BRANCH	TX	Nueces County	68.3	66.2
483611001	2700 AUSTIN AVE	TX	Orange County	69.3	66.5
483611100	INTERSECTION OF TX HWYS 62 AND 12	TX	Orange County	68	65.4
484530014	3724 NORTH HILLS DR, AUSTIN, TX 78758	TX	Travis County	71.3	67.7
484530020	12200 LIME CREEK RD.	TX	Travis County	71.7	68.3
484690003	106 MOCKINGBIRD LANE	TX	Victoria County	66.3	64.2

Table D-18. Ozone Current (DVC) and Future Year (DVF) Design Values and Reduction in DVF with Contributions from Individual Source Groups Removed.

Site ID	State	County	DVC	DVF	Change in DVF with Source Group Removed				
					A	B	C	D	E
10030010	AL	Baldwin County	68	66.2	0.3	4.7	7.6	10.2	42.6
10970003	AL	Mobile County	67.3	64.4	0.1	2.3	4.2	5.4	40.4
10972005	AL	Mobile County	72	66.5	0.1	5.1	6.5	7.9	44.7
120330004	FL	Escambia County	67.7	65.1	0.3	1.7	5.5	7.4	35.3
120330018	FL	Escambia County	70.7	68.1	0.4	2.6	7.8	10.9	37.8
120910002	FL	Okaloosa County	65	62.9	0.3	1.9	6.8	9.5	33.6
121130015	FL	Santa Rosa County	69.3	67.4	0.5	2.6	9.3	12.7	37.5
220050004	LA	Ascension Parish	71.3	67.8	0.1	0.7	2.3	3.1	43.6
220190002	LA	Calcasieu Parish	70.7	68.9	0.3	2	5.6	8.3	40.2
220190008	LA	Calcasieu Parish	66.7	64.7	0.3	1.7	4.9	7.4	37.6
220190009	LA	Calcasieu Parish	70	67.3	0.2	1.5	4.2	6.1	39.7
220330003	LA	East Baton Rouge Parish	75.3	71.3	0.1	0.7	2.9	4	45.3
220330009	LA	East Baton Rouge Parish	72.3	68.3	0.1	0.7	2.6	3.7	43.3
220330013	LA	East Baton Rouge Parish	69	65.1	0.2	1	3.2	4.3	37.7
220470009	LA	Iberville Parish	70.3	64.6	0	0.2	0.7	1.1	41.2
220470012	LA	Iberville Parish	73.3	68.6	0	0.4	1.5	2.3	45.7
220511001	LA	Jefferson Parish	71.3	68.4	0.2	1.1	5.2	6.6	45
220550007	LA	Lafayette Parish	69.7	67.2	0.1	1.4	3.9	5.6	41.5
220570004	LA	Lafourche Parish	71	65.7	0.1	0.5	1.7	2.4	40.9
220630002	LA	Livingston Parish	72.3	68.6	0.2	1.1	4.4	5.9	44.3
220710012	LA	Orleans Parish	68.3	66.5	0.3	1.2	5.6	7.2	42
220770001	LA	Pointe Coupee Parish	74	68.2	0	0.5	2	3	43.7
220870004	LA	St. Bernard Parish	68	64.4	0.3	1.4	5.5	7.2	41.1
220890003	LA	St. Charles Parish	67.7	65.2	0.1	0.6	2.5	3.3	44.7
220930002	LA	St. James Parish	66.3	62.7	0.1	0.5	2.1	2.8	39.3
220950002	LA	St. John the Baptist Parish	72	69.3	0.2	0.9	3.5	4.6	45
221030002	LA	St. Tammany Parish	72.3	68.7	0.2	1.1	5	6.3	42.9
221210001	LA	West Baton Rouge Parish	68	63.8	0	0.5	2.1	2.9	40
280450003	MS	Hancock County	66.3	63.4	0.3	1.6	5.3	7.1	39.9
280470008	MS	Harrison County	70.3	67	0.3	1.7	5.4	7.3	42.8
280590006	MS	Jackson County	71.3	69.2	0.4	2.7	6	8.9	44.9
480271047	TX	Bell County	73.7	71	0	0.3	0.9	1.2	30.9
			80.3	78	0	0.3	0.9	1.3	37.4
			68.7	66.3	0.1	0.2	0.4	0.5	33.3
480391004	TX	Brazoria County	85	81.9	0.1	0.7	2.2	3.1	49.5
480391016	TX	Brazoria County	69.3	66.8	0.2	1.3	3.4	4.8	37.4
480610006	TX	Cameron County	60.7	59.2	0.2	1.3	2.4	3.3	29.2
			69.3	66.6	0.1	0.2	0.3	0.5	29.9
481671034	TX	Galveston County	75.3	71.2	0.3	3.6	9.8	16.6	46.6

Site ID	State	County	DVC	DVF	Change in DVF with Source Group Removed				
					A	B	C	D	E
482010024	TX	Harris County	76.7	75.1	0.2	1.5	4	5.8	44.1
482010026	TX	Harris County	73	71.2	0.2	1.6	4.1	5.9	42.1
482010029	TX	Harris County	80	76.3	0.2	1.1	3.3	4.8	48
482010046	TX	Harris County	73.7	71.6	0.2	1.3	3.4	4.9	41.8
482010047	TX	Harris County	77	74.8	0.2	1	3	4.4	46
482010051	TX	Harris County	78.7	76.3	0.1	0.6	1.8	2.6	47.5
482010055	TX	Harris County	78.7	77.3	0.1	0.8	2.4	3.3	46.9
482010062	TX	Harris County	76.7	74.4	0.2	1.1	3.1	4.5	45.3
482010066	TX	Harris County	77.7	75.2	0.1	0.7	2.2	3.1	46.6
482010070	TX	Harris County	75	73.5	0.2	1.3	3.4	5	41.6
482010416	TX	Harris County	77.3	74.8	0.1	1.2	3.1	4.6	44.4
482011015	TX	Harris County	71	68.5	0.2	1.3	3.7	5.3	39.1
482011034	TX	Harris County	78	76.1	0.3	1.7	4.1	5.9	44.3
482011035	TX	Harris County	74.7	72.5	0.2	1.3	3.3	5	41.7
482011039	TX	Harris County	78.3	75.5	0.2	1.3	3.4	5.1	42.8
482011050	TX	Harris County	76.3	74	0.3	2.2	5.8	9.1	43.5
					0.1	0.6	1.5	2.2	27.5
482151048	TX	Hidalgo County	60	58.1	0.1	0.6	1.4	2	24.3
482450009	TX	Jefferson County	71.7	68.3	0.1	0.7	2	2.9	42.2
482450011	TX	Jefferson County	74	70.5	0.2	1.9	4.9	7.2	43.9
482450022	TX	Jefferson County	70.3	66.7	0.1	0.8	2.4	3.5	40.3
482450101	TX	Jefferson County	75	72.3	0.3	3	8.2	12.4	45.9
482450102	TX	Jefferson County	67	64.4	0.2	1.3	4.1	6	40
482450628	TX	Jefferson County	69.3	66.4	0.2	2	5.3	7.8	41.8
482451035	TX	Jefferson County	69.3	66.9	0.2	1.5	4.5	6.7	41.9
483091037	TX	McLennan County	71.7	69.1	0	0.2	0.5	0.7	31.3
483390078	TX	Montgomery County	78	74.7	0.2	1	3.1	4.5	45.8
483491051	TX	Navarro County	70	68.2	0.1	0.2	0.6	0.8	33.5
483550025	TX	Nueces County	69.3	68.2	0.3	1.9	5.4	7.4	35
483550026	TX	Nueces County	68.3	66.2	0.3	1.3	3.6	4.9	32.7
483611001	TX	Orange County	69.3	66.5	0.1	1.4	4.8	6.9	41.3
483611100	TX	Orange County	68	65.4	0.1	1.5	4.6	6.9	40
484530014	TX	Travis County	71.3	67.7	0	0.2	0.9	1.3	37.5
484530020	TX	Travis County	71.7	68.3	0.1	0.3	1	1.4	35.8
484690003	TX	Victoria County	66.3	64.2	0.2	1	3	4.2	32.6

Table D-19. MATS Ozone Design Value Results for All Monitoring Sites Where Exclusion of Contributions from Source Group A or B is Sufficient to Reduce the Predicted Future Design Value (DVF) from Above the NAAQS to Below the NAAQS (all values in ppb).

Site ID	Location	State	DVC[1]	DVF[2]	DVF_A[3]	DVF – DVF_A	DVF_B[3]	DVF – DVF_B
220330003	East Baton Rouge Parish	LA	75.3	71.3	71.2	0.1	70.6	0.7
480271047	Bell County	TX	73.7	71.0	71.0	0.0	70.7	0.3
481671034	Galveston	TX	75.3	71.2	70.9	0.3	69.1	4.9
482010026	Houston	TX	73	71.2	71.0	0.2	69.6	1.6
482010046	Houston	TX	73.7	71.6	71.4	0.2	70.3	1.3
482450101	Port Arthur	TX	75	72.3	72.0	0.3	69.3	3.0

[1] The MATS base period ozone design value (ppb) representing combined contributions of all sources.
[2] The MATS future year ozone design value (ppb) representing combined contributions of all sources.
[3] The MATS future year ozone design value (ppb) calculated after removing source apportionment contributions of Source Group A or B.

Figure D-40 displays the MATS Unmonitored Area Analysis (UAA) results, which were generated using the observed ozone data in MATS and the base year and future year scenario CAMx results. The MATS UAA spatially interpolates the DVCs obtained from observations across the modeling domain and then calculates the DVF for each model grid cell by multiplying the interpolated DVC by the RRF value (i.e., the ratio of the modeled future year to base year design values) in each grid cell. Future year design values calculated using the MATS UAA procedure are lower than base year design values throughout most of the 4-km modeling domain with the exception of a maximum 1.6-ppb increase of less than 3 ppb off the Louisiana coast.

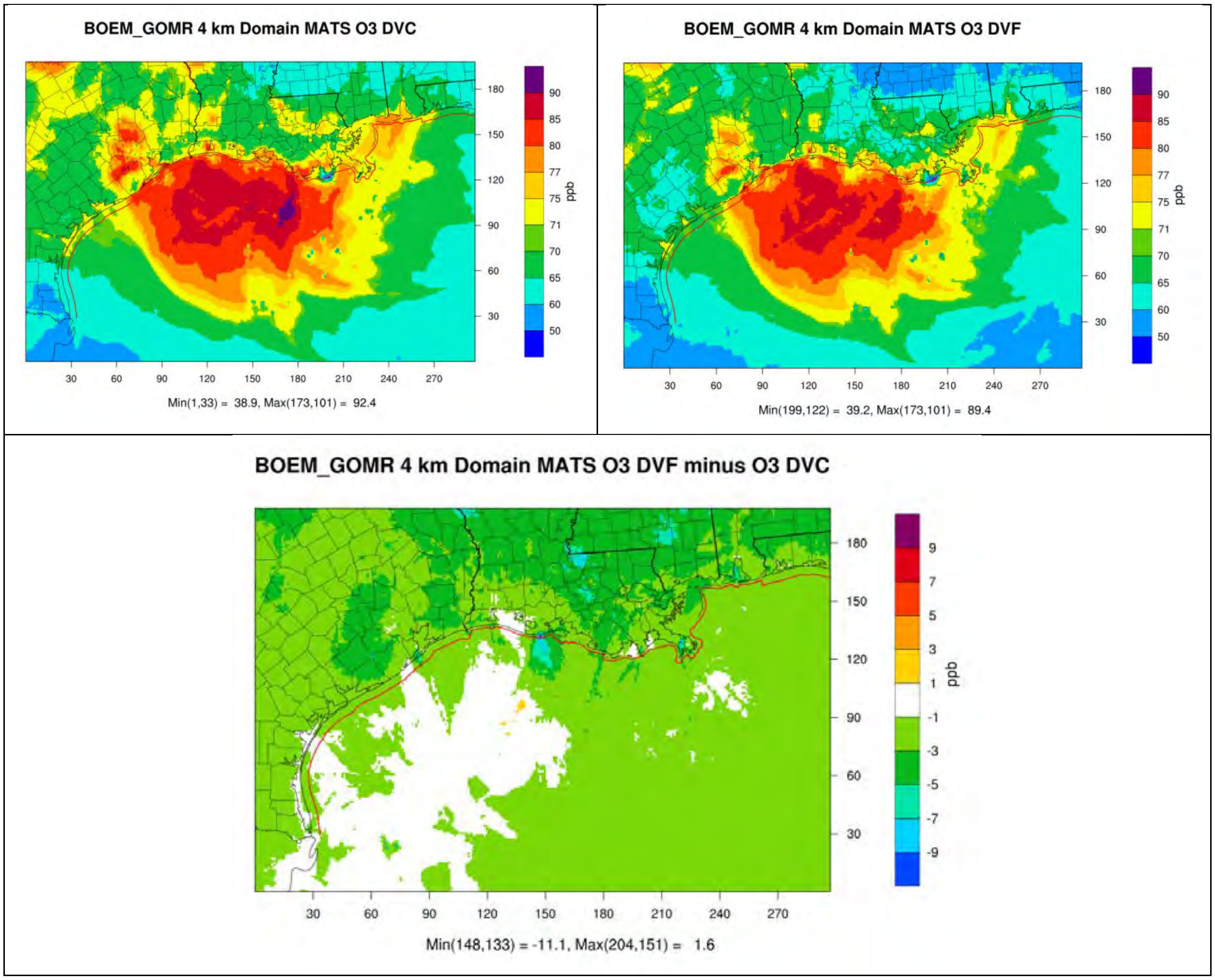
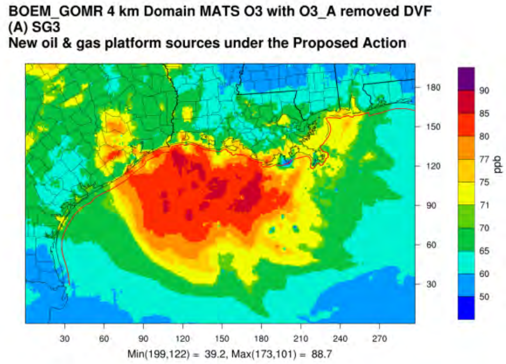
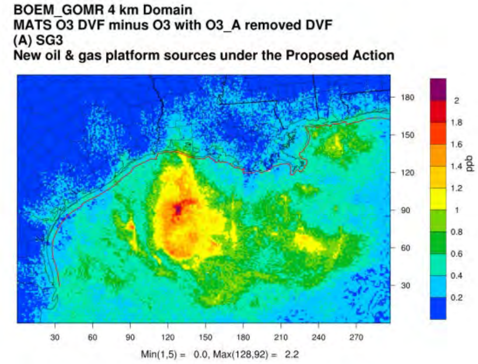


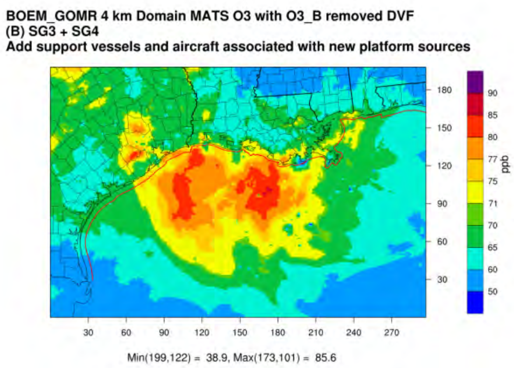
Figure D-40. Base Scenario Ozone Design Values (DVC, top left), Future Year Ozone Design Values (DVF, top right) and Their Differences (DVF – DVC; bottom) Calculated Using the MATS UAA Tool.

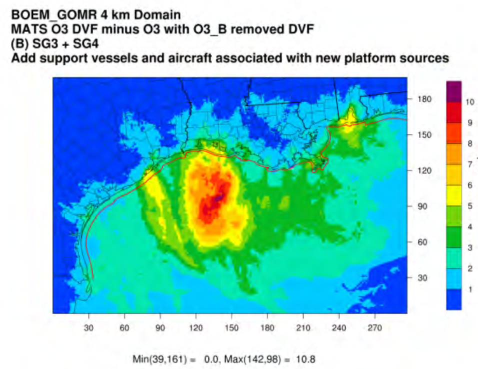
D.7.1.1.2 Ozone MATS Unmonitored Area Analysis

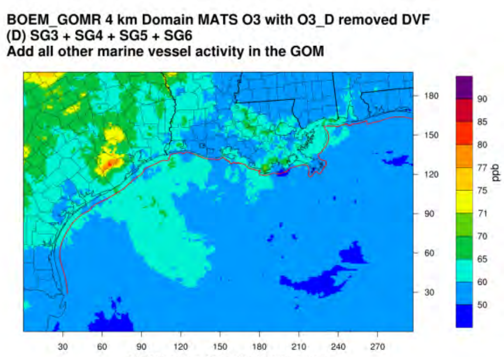
The MATS UAA DVF values calculated after first removing the hourly contributions from Source Groups A (new platforms), B (new platforms and associated support vessels and aircraft), and D (all Gulf of Mexico sources) are shown in the left column of **Figure D-41**. The contributions of Source Groups A, B, and D calculated as the difference between these DVF values and the DVF values from all sources (as shown in the upper right-hand corner of **Figure D-40**) are shown in the right column of **Figure D-41**. Source Group A contributions are centered in the Gulf of Mexico offshore of Louisiana, with a peak impact of 2.2 ppb; maximum impacts from the State seaward boundaries inland are in the 1- to 1.2-ppb range along the coast of Cameron Parish. For Source Group B, the maximum contribution (10.8 ppb) is in approximately the same location, but the support vessel and helicopter activities result in greater impacts landward of the State seaward boundary, with maximum contributions in the 6- to 7-ppb range.

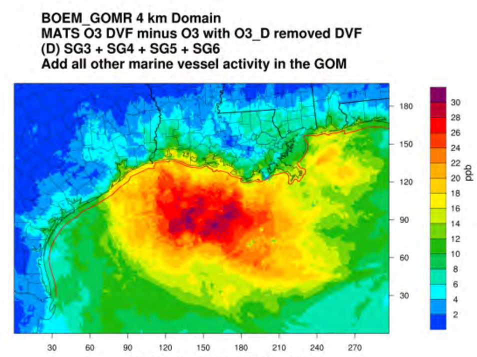
<table>
<tr><th>Source Group[1]</th><th>DVF with Source Group Contribution Removed</th><th>Source Group Contribution[2]</th></tr>
<tr><td>A</td><td>


</td><td>


</td></tr>
<tr><td>B</td><td>


</td><td>


</td></tr>
<tr><td>D</td><td>


</td><td>


</td></tr>
</table>

[1] As defined in **Table D-14**.

[2] Source group contributions are calculated by subtracting the DVF values calculated after removing the hourly source group contributions from the DVF values calculated when all sources are included.

*Figure D-41. MATS UAA Future Year Ozone Design Values (DFV) Calculated After First Removing the Hourly Contributions from a Source Group (left column) and the Corresponding Contributions of the Source Group to DVF (right column) Calculated by Subtracting the DVFs Shown in the Left-hand Column from the "All Sources" DVF Shown in the Top Right-hand Corner of **Figure D-40**. Top row – source group B; middle row – source group D.*

D.7.1.2 Ozone NAAQS Analysis Using Absolute Modeling Results

The CAMx source apportionment absolute modeling results from the future year scenario are analyzed and compared with the ozone NAAQS in this section. The ozone NAAQS is defined as the 3-year average of the 4th highest maximum daily average 8-hour (MDA_8) ozone concentration. Since only one calendar year of modeling results are available for the base year and future year scenarios, the future year 4th highest MDA_8 ozone concentration is used as a pseudo-NAAQS comparison metric.

Modeled 4th highest MDA_8 values in each model grid cell for the base and future year scenarios and the corresponding differences are shown in **Figure D-42**. Similar to the MATS results presented in **Figure D-40**, the 4th highest MDA_8 is lower under the future year scenario throughout most of the 4-km domain, with isolated areas of increases of less than 4 ppb located off the coasts of Louisiana and Texas and onshore in Cameron Parish, Louisiana.

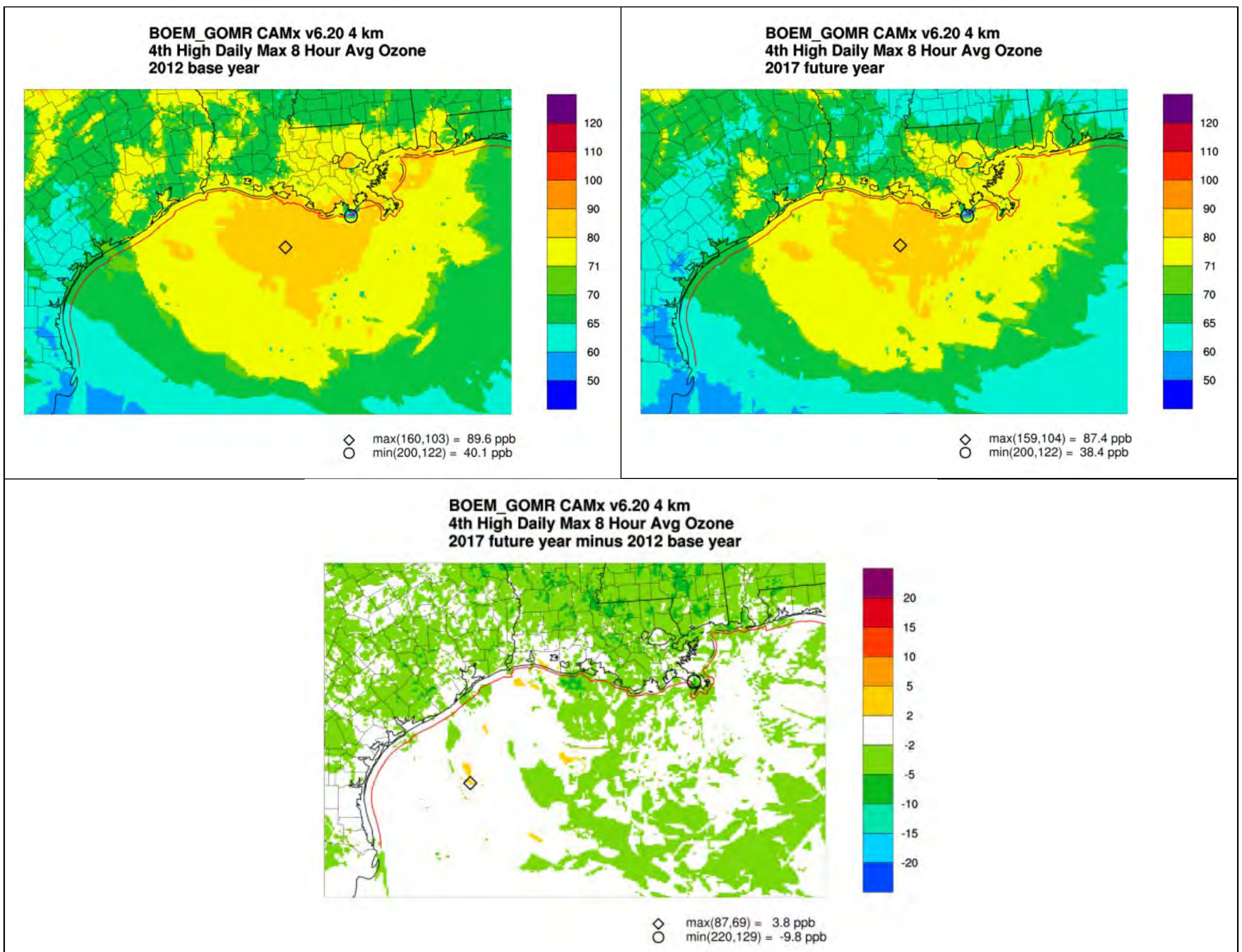


Figure D-42. Modeled 4th Highest MDA_8 Ozone for the Base Year (upper left) and Future Year (upper right) Scenarios and Their Differences (bottom center).

Contributions of each source group to the all sources future year 4th highest MDA_8 values shown in the upper right-hand panel of **Figure D-42** are shown in **Figures D-43 and D-44**. These contributions are matched in time to the all sources 4th highest MDA_8 values; contributions may be different during other periods with elevated MDA_8 values. As shown in **Figure D-43**, new platform sources under the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario (Source Group A) are estimated to contribute as much as 7.4 ppb to design values out over the Gulf of Mexico. Within the states out to the State Seaward Boundary (SSB), the contributions range from near zero to approximately 3 ppb, with the maximum contributions occurring along the coast of Cameron Parish, Louisiana. Contributions increase by about 10 ppb when contributions from support vessels and helicopters associated with the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers, are added in (Source Group B). Also, adding in all existing platforms and support vessels and helicopters (Source Group C) raises the maximum contribution out over the Gulf of Mexico to nearly 38 ppb. Contributions landward of the SSB are generally below 15 ppb but with some areas along the Louisiana coast reaching maximum contributions up to 35 ppb. Adding in all other marine vessel activity in the Gulf of Mexico (Source Group D) only increases the contributions by a few ppb. The addition of land-based and Mexican and Canadian anthropogenic sources (Source Group E) results in source contributions that are typically about 30 ppb higher than the contributions from Gulf of Mexico sources alone (Source Group D). Contributions over the land areas are higher than for Source Group D although the highest contributions remain out over the Gulf of Mexico where biogenic emissions have minimal influence. In other words, to the extent that elevated ozone levels are predicted over the Gulf of Mexico, they are nearly entirely attributable to anthropogenic sources.

Contributions from natural sources (including biogenics and fires) and non-U.S. emissions, including 12-km domain boundary conditions (Source Group F), are shown in the left panel of **Figure D-44**; contributions from just the boundary conditions (BCs) are shown in the right panel. These results show an area south of Galveston where ozone design values were almost entirely driven by U.S. or Mexican anthropogenic BCs; however, over the rest of the Gulf of Mexico, including the near coastal areas, contributions are generally between 20 and 30 ppb and are overwhelmingly attributable to the BCs. Higher contributions are seen inland where biogenic sources play a larger role in ozone formation.

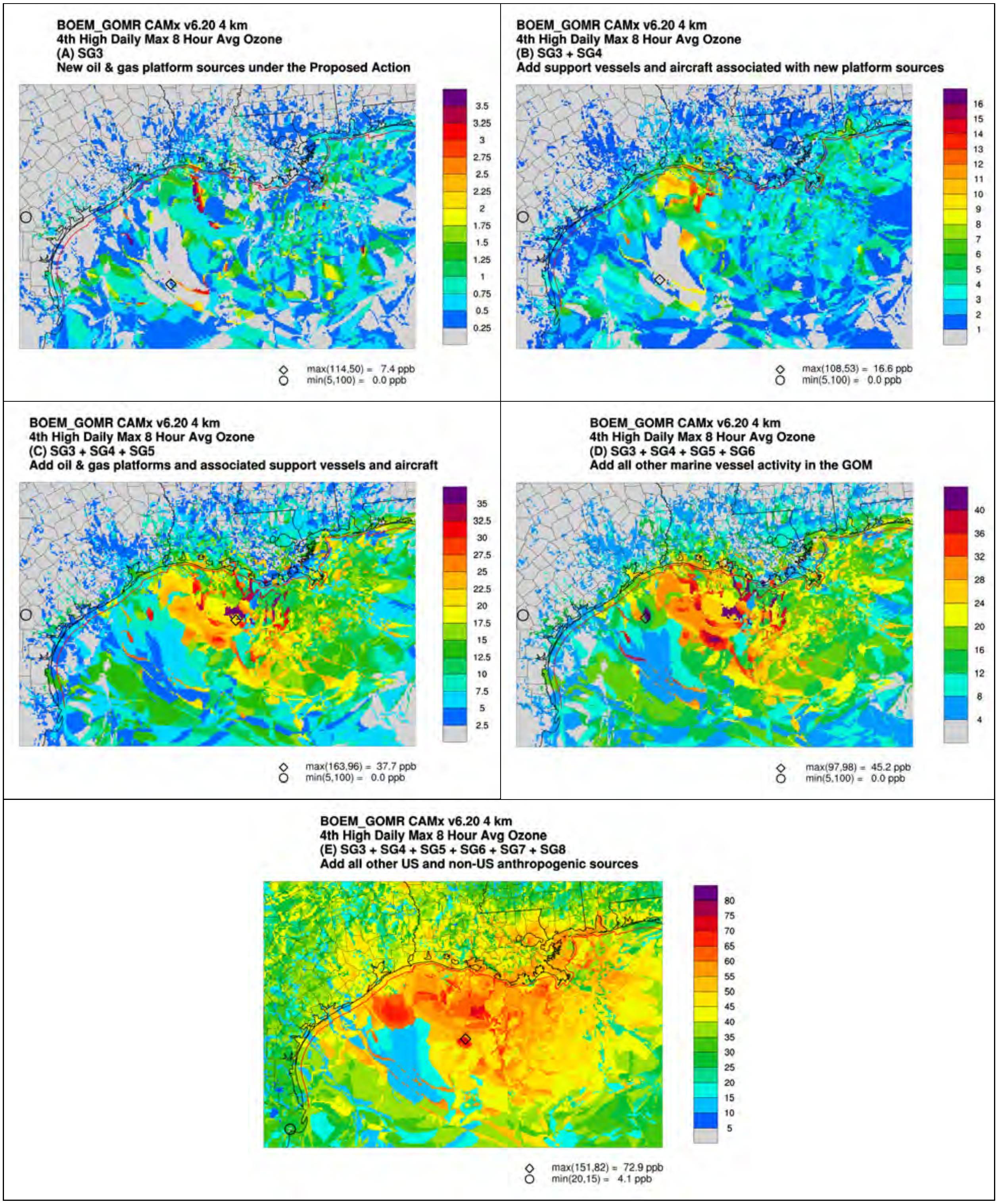


Figure D-43. Contributions of Source Groups A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to Future Year All-sources 4th Highest MDA_8 (note different color scales in each panel).

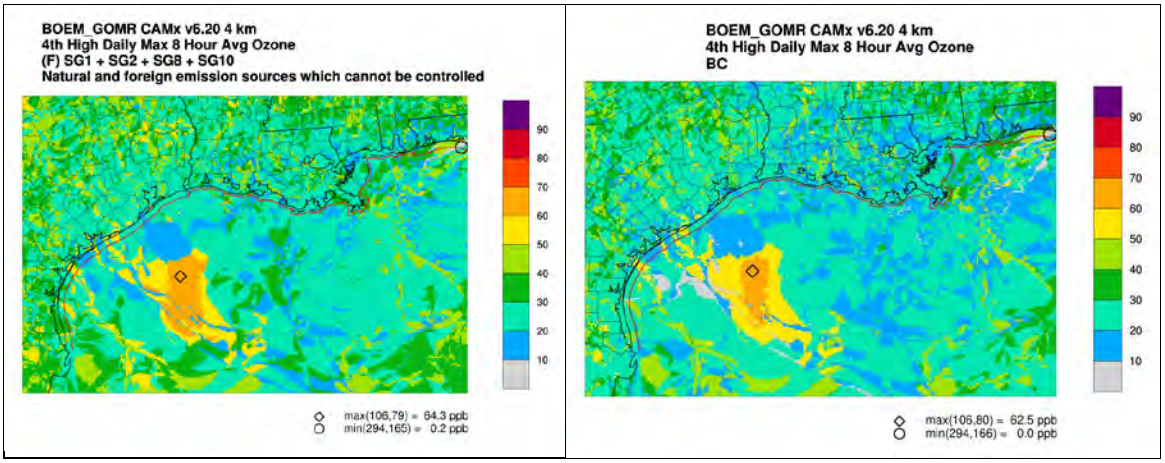


Figure D-44. Contributions from (left) Source Group F (natural and non-U.S. emission sources including boundary conditions) and (right) Boundary Conditions Only, to Future Year All-sources 4^{th} Highest MDA_8.

D.7.1.3 $PM_{2.5}$ NAAQS Analysis using Relative Model Results

There are two $PM_{2.5}$ NAAQS, one for 24-hour averaging time that is expressed as a 3-year average of the annual 98^{th} percentile in a year with a threshold of 35 μg/m^3 and an annual average over 3 years with a threshold of 12 μg/m^3. With 1 year of complete everyday modeling, the annual 98^{th} percentile will correspond to the 8^{th} highest 24-hour $PM_{2.5}$ concentration in a year.

Predictions of future year 24-hour and annual average $PM_{2.5}$ design values were made based on the use of model results in a relative sense as was done for ozone design values in **Section D.7.1.1**. The MATS software was used to generate predicted future year design values (DVFs) from current (base year) design values (DVB or DVC). The MATS was configured to use ambient measurements of total $PM_{2.5}$ for the period 2008-2012 to generate DVCs based on an average of three overlapping 3-year average DVs as recommended in the USEPA's guidance (USEPA, 2014) and speciated $PM_{2.5}$ monitoring data for the period 2010-2012 to generate the projected DVFs based on model predicted species RRFs.

D.7.1.3.1 24-Hour $PM_{2.5}$

As described for the ozone NAAQS analysis in **Section D.7.1.1**, the MATS was used to calculate DVFs for the 24-hour and annual $PM_{2.5}$ NAAQS. Observational data for use in the MATS were provided by the USEPA[23] for use in calculating the DVCs. For total $PM_{2.5}$, observational data covered the period 2008-2012; for the speciated $PM_{2.5}$ calculations, observational data covered the period 2010-2012.

Results of the MATS analysis are shown in **Table D-20**. All current and future year design values are below the 35 μg/m^3 NAAQS, and the future year design values are projected to be lower

[23] https://www3.epa.gov/scram001/modelingapps_mats.htm

than the current year design values at all sites. The reductions in the projected DVFs calculated after removing source contributions from each Source Group A, B, C, D, and E (i.e., DVF from **Table D-20** minus DVF calculated with hourly source group contributions removed) are listed in **Table D-21**. The largest of the Source Group A, B, C, or D contributions calculated in this manner occur at the Bay Rd. monitor in Mobile County, Alabama. New platforms and associated support vessels and helicopters (Source Group B) are calculated to contribute 1.2 μg/m^3 or 6.4% of the 18.9 μg/m^3 DVF at this location.

Table D-20. Current Year (DVC) and Future Year (DVF) 24-Hour $PM_{2.5}$ Design Values for Monitoring Sites in the 4-km Modeling Domain from MATS.

Site ID	Site Name	State	County	DVC	DVF
10030010	FAIRHOPE HIGH SCHOOL, FAIRHOPE, ALABAMA	AL	Baldwin County	19.5	17.7
10970003	CHICKASAW, MOBILE CO., ALABAMA	AL	Mobile County	19.1	17.2
10972005	BAY RD., MOBILE AL.	AL	Mobile County	20	18.9
120330004	ELLYSON INDUSTRIAL PARK-COPTER ROAD	FL	Escambia County	19.2	17.6
220190009	2284 Paul Bellow Road	LA	Calcasieu Parish	18.6	17
220190010	Common and East McNeese	LA	Calcasieu Parish	20.5	18.4
220330009	1061-A Leesville Ave	LA	East Baton Rouge Parish	21	19.2
220331001	Highway 964	LA	East Baton Rouge Parish	16.7	14.2
220470005	St Gabriel Agricultural Exp. Station	LA	Iberville Parish	21	19.9
220470009	65180 Belleview Road	LA	Iberville Parish	18.6	17.5
220511001	West Temple Pl	LA	Jefferson Parish	18.7	17.1
220512001	Patriot St. and Allo St.	LA	Jefferson Parish	18.5	16.6
220550006	121 East Point Des Mouton	LA	Lafayette Parish	18.8	17.5
220550007	646 Cajundome	LA	Lafayette Parish	20.2	18.1
220790002	8105 Tom Bowman Drive	LA	Rapides Parish	19.6	17.7
220870007	24 E. CHALMETTE CIRCLE	LA	St. Bernard Parish	20.2	17.4
221050001	21549 Old Hammond Hwy, Hammond, LA 70403	LA	Tangipahoa Parish	18.8	17.2
221090001	4047 Highway 24 North Gray	LA	Terrebonne Parish	17.6	16.2
221210001	1005 Northwest Drive, Port Allen	LA	West Baton Rouge Parish	21.7	20.2
280010004	Natchez Municipal Water Works, Brenham St.	MS	Adams County	20.3	17.7
280350004	205 Bay Street	MS	Forrest County	22.4	21
280450003	400 Baltic St.	MS	Hancock County	20	18.3
280470008	47 Maple Street	MS	Harrison County	18.3	16
280590006	Hospital Road at Co. Health Dept.	MS	Jackson County	20.8	19.6
280670002	26 Mason St.	MS	Jones County	23	21.7
480290059	14620 LAGUNA RD.	TX	Bexar County	21.4	20.9
480612004	LOT B 69 ½	TX	Cameron County	22.7	22.4

Site ID	Site Name	State	County	DVC	DVF
482010058	7210 1/2 BAYWAY DRIVE	TX	Harris County	20.8	20.2
482011035	9525 CLINTON DR	TX	Harris County	24	22.7
483550032	3810 HUISACHE STREET	TX	Nueces County	24.3	23.3
484530020	12200 LIME CREEK RD.	TX	Travis County	20.7	19.1
484530021	2600 B WEBBERVILLE RD.	TX	Travis County	21.8	20.5

Table D-21. 24-Hour $PM_{2.5}$ Current (DVC) and Future Year (DVF) Design Values and Reduction in DVF with Contributions from Individual Source Groups Removed.

Site ID	State	County	DVC	DVF	Change in DVF with Source Group Removed				
					A	B	C	D	E
10030010	AL	Baldwin County	19.5	17.7	0.0	0.2	0.3	0.4	8.8
10970003	AL	Mobile County	19.1	17.2	0.0	0.1	0.1	0.2	10.2
10972005	AL	Mobile County	20	18.9	0.0	1.2	1.2	1.3	12.0
120330004	FL	Escambia County	19.2	17.6	0.0	0.0	0.1	0.1	9.2
220190009	LA	Calcasieu Parish	18.6	17	0.0	0.1	0.2	0.5	9.9
220190010	LA	Calcasieu Parish	20.5	18.4	0.0	0.0	0.1	0.3	12.1
220330009	LA	East Baton Rouge Parish	21	19.2	0.0	0.1	0.2	0.3	12.3
220331001	LA	East Baton Rouge Parish	16.7	14.2	0.0	0.1	0.2	0.4	9.1
220470005	LA	Iberville Parish	21	19.9	0.0	0.0	0.2	0.4	14.2
220470009	LA	Iberville Parish	18.6	17.5	0.0	0.0	0.1	0.3	10.2
220511001	LA	Jefferson Parish	18.7	17.1	0.0	0.0	0.2	0.3	12.0
220512001	LA	Jefferson Parish	18.5	16.6	0.0	0.1	0.2	0.4	13.1
220550006	LA	Lafayette Parish	18.8	17.5	0.1	0.2	0.5	1.0	12.1
220550007	LA	Lafayette Parish	20.2	18.1	0.0	0.0	0.2	0.3	12.3
220790002	LA	Rapides Parish	19.6	17.7	0.0	0.0	0.2	0.4	8.1
220870007	LA	St. Bernard Parish	20.2	17.4	0.0	0.0	0.2	0.4	12.0
221050001	LA	Tangipahoa Parish	18.8	17.2	0.1	0.1	0.3	0.5	9.1
221090001	LA	Terrebonne Parish	17.6	16.2	0.0	0.1	0.3	0.4	10.8
221210001	LA	West Baton Rouge Parish	21.7	20.2	0.0	0.0	0.2	0.3	13.8
280010004	MS	Adams County	20.3	17.7	0.0	0.1	0.1	0.2	7.8
280350004	MS	Forrest County	22.4	21	0.0	0.1	0.1	0.2	11.4
280450003	MS	Hancock County	20	18.3	0.0	0.1	0.6	1.1	11.4
280470008	MS	Harrison County	18.3	16	0.0	0.0	0.3	0.4	8.8
280590006	MS	Jackson County	20.8	19.6	0.1	0.1	0.4	1.1	14.3
280670002	MS	Jones County	23	21.7	0.0	0.1	0.1	0.1	11.0
480290059	TX	Bexar County	21.4	20.9	0.0	0.0	0.0	0.0	11.8
480612004	TX	Cameron County	22.7	22.4	0.0	0.7	0.7	0.8	5.4
482010058	TX	Harris County	20.8	20.2	0.0	0.0	0.2	0.5	13.1
482011035	TX	Harris County	24	22.7	0.0	0.0	0.1	0.2	14.9
483550032	TX	Nueces County	24.3	23.3	0.0	0.1	0.1	0.2	12.3

Site ID	State	County	DVC	DVF	Change in DVF with Source Group Removed				
					A	B	C	D	E
484530020	TX	Travis County	20.7	19.1	0.0	0.0	0.0	0.1	9.4
484530021	TX	Travis County	21.8	20.5	0.0	0.0	0.0	0.1	12.1

D.7.1.3.2 Annual Average $PM_{2.5}$

The MATS projections of DVF for the annual average $PM_{2.5}$ design values are shown in **Table D-22**. The only design value exceeding the 12 μg/m^3 annual average NAAQS is the current year design value at the Clinton Dr. monitor in Houston, Texas. The projected future year design value at this location is below the NAAQS. Future year design values are projected to be less than the current year design values at all monitoring sites except for a 0.3 μg/m^3 increase at the Hidalgo County monitoring site just west of Brownsville, Texas.

Reductions in the projected annual average DVFs calculated after removing source contributions from each Source Group A, B, C, D, and E (i.e., DVF from **Table D-22** minus DVF calculated with hourly source group contributions removed) are shown in **Table D-23**. The largest of the Source Group A, B, C, or D contributions calculated in this manner occur at the Bay Rd. monitor in Mobile County, Alabama. New platforms and associated support vessels and helicopters (Source Group B) are calculated to contribute 0.7 μg/m^3 or 7.7% of the 9.1 μg/m^3 DVF at this location. Source Group B contributions at the Clinton Dr. monitor are calculated to be less than 0.05 μg/m^3. Source Group B contributions at the Hidalgo County monitoring site are calculated to be 0.1 μg/m^3.

Table D-22. Current (DVC) and Projected Future (DVF) Annual Average $PM_{2.5}$ Design Values for Monitoring Sites in the 4-km Modeling Domain (highlighted values exceed the 12 μg/m^3 NAAQS).

Site ID	Site Name	State	DVC	DVF
10030010	FAIRHOPE HIGH SCHOOL, FAIRHOPE, ALABAMA	AL	9.8	9.1
10970003	CHICKASAW, MOBILE CO., ALABAMA	AL	9.7	8.9
10972005	BAY RD., MOBILE AL.	AL	9.2	9.1
120330004	ELLYSON INDUSTRIAL PARK-COPTER ROAD	FL	8.9	8.3
220190009	2284 Paul Bellow Road	LA	8.6	7.9
220190010	Common and East McNeese	LA	9.1	8.5
220330009	1061-A Leesville Ave	LA	10.3	9.6
220331001	Highway 964	LA	9.3	8.3
220470005	St Gabriel Agricultural Exp. Station	LA	10.2	9.5
220470009	65180 Belleview Road	LA	8.9	8.1
220511001	West Temple Pl	LA	9	8.2
220512001	Patriot St. and Allo St.	LA	9.2	8.3
220550006	121 East Point Des Mouton	LA	8.9	8.2
220550007	646 Cajundome	LA	9.1	8.4
220790002	8105 Tom Bowman Drive	LA	8.8	8
220870007	24 E. CHALMETTE CIRCLE	LA	10.5	9.7
221050001	21549 Old Hammond Hwy, Hammond, LA 70403	LA	9	8.1

Site ID	Site Name	State	DVC	DVF
221090001	4047 Highway 24 North Gray	LA	8.5	7.8
221210001	1005 Northwest Drive, Port Allen	LA	10.8	10.1
280010004	Natchez Municipal Water Works Brenham St	MS	10.2	9.3
280350004	205 Bay Street	MS	11.7	10.9
280450003	400 Baltic St	MS	9.9	9.1
280470008	47 Maple Street	MS	9.6	8.7
280590006	Hospital Road at Co. Health Dept.	MS	9.5	9
280670002	26 Mason St.	MS	11.8	11.3
480290059	14620 LAGUNA RD.	TX	9	8.8
480612004	LOT B 69 ½	TX	11	10.9
482010058	7210 1/2 BAYWAY DRIVE	TX	11.1	10.9
482011035	9525 CLINTON DR	TX	12.4	11.6
482150043	2300 NORTH GLASSCOCK	TX	10.4	10.7
483550032	3810 HUISACHE STREET	TX	10.3	10
484530020	12200 LIME CREEK RD.	TX	8.4	7.9
484530021	2600 B WEBBERVILLE RD.	TX	10.2	9.8

Table D-23. Annual Average $PM_{2.5}$ Future Year Design Values (DVF) and Change in DVF with Contributions from Individual Source Groups Removed (highlighted values exceed the 12 µg/m^3 NAAQS).

Site ID	State	County	DVC	DVF	Change in DVF with Source Group Removed				
					A	B	C	D	E
10030010	AL	Baldwin County	9.8	9.1	0.0	0.1	0.2	0.3	5.5
10970003	AL	Mobile County	9.7	8.9	0.0	0.1	0.1	0.2	6.2
10972005	AL	Mobile County	9.2	9.1	0.0	0.7	0.8	0.9	6.1
120330004	FL	Escambia County	8.9	8.3	0.0	0.1	0.1	0.2	5.2
220190009	LA	Calcasieu Parish	8.6	7.9	0.0	0.1	0.2	0.4	5.0
220190010	LA	Calcasieu Parish	9.1	8.5	0.0	0.0	0.2	0.4	6.3
220330009	LA	East Baton Rouge Parish	10.3	9.6	0.0	0.1	0.2	0.3	7.2
220331001	LA	East Baton Rouge Parish	9.3	8.3	0.0	0.0	0.1	0.2	6.0
220470005	LA	Iberville Parish	10.2	9.5	0.0	0.0	0.1	0.2	7.4
220470009	LA	Iberville Parish	8.9	8.1	0.0	0.0	0.1	0.3	5.5
220511001	LA	Jefferson Parish	9	8.2	0.0	0.1	0.2	0.3	6.0
220512001	LA	Jefferson Parish	9.2	8.3	0.0	0.0	0.1	0.2	6.6
220550006	LA	Lafayette Parish	8.9	8.2	0.0	0.0	0.2	0.4	5.9
220550007	LA	Lafayette Parish	9.1	8.4	0.0	0.1	0.2	0.4	6.1
220790002	LA	Rapides Parish	8.8	8	0.0	0.0	0.1	0.2	4.7
220870007	LA	St. Bernard Parish	10.5	9.7	0.0	0.1	0.2	0.3	7.3
221050001	LA	Tangipahoa Parish	9	8.1	0.0	0.1	0.2	0.3	5.0
221090001	LA	Terrebonne Parish	8.5	7.8	0.0	0.0	0.2	0.4	5.5
221210001	LA	West Baton Rouge Parish	10.8	10.1	0.0	0.0	0.1	0.2	7.9

Site ID	State	County	DVC	DVF	Change in DVF with Source Group Removed				
					A	B	C	D	E
280010004	MS	Adams County	10.2	9.3	0.0	0.0	0.1	0.2	5.4
280350004	MS	Forrest County	11.7	10.9	0.0	0.0	0.1	0.2	7.2
280450003	MS	Hancock County	9.9	9.1	0.0	0.0	0.2	0.4	6.1
280470008	MS	Harrison County	9.6	8.7	0.0	0.0	0.2	0.3	5.6
280590006	MS	Jackson County	9.5	9	0.0	0.1	0.2	0.3	6.9
280670002	MS	Jones County	11.8	11.3	0.0	0.0	0.1	0.1	7.4
480290059	TX	Bexar County	9	8.8	0.0	0.0	0.1	0.1	5.0
480612004	TX	Cameron County	11	10.9	0.0	0.3	0.4	0.5	4.9
482010058	TX	Harris County	11.1	10.9	0.0	0.0	0.1	0.3	8.0
482011035	TX	Harris County	12.4	11.6	0.0	0.0	0.0	0.2	8.8
482150043	TX	Hidalgo County	10.4	10.7	0.0	0.1	0.1	0.1	6.4
483550032	TX	Nueces County	10.3	10	0.0	0.0	0.1	0.1	6.0
484530020	TX	Travis County	8.4	7.9	0.0	0.0	0.0	0.1	4.4
484530021	TX	Travis County	10.2	9.8	0.0	0.0	0.0	0.1	6.1

Figure D-45 displays the MATS UAA results for the annual average $PM_{2.5}$ DVC, DVF, and the difference, DVF - DVC.[24] Reductions in annual average $PM_{2.5}$ design values associated with emission reductions from all sources combined are projected throughout nearly the entire domain, with the exception of increases near the Freshwater Bayou Canal in Vermilion Parish, Louisiana, and Brownsville, Texas, in addition to a few additional areas in Texas and southern Louisiana. Some of the isolated areas of increases may represent artifacts of the MATS UAA spatial interpolation procedure and are not necessarily physically meaningful. Increases in the coastal ports are associated with new platforms and support vessel and helicopter traffic (Source Group B), as shown by the unmonitored area source group contributions in **Figure D-46**. Source Group B contributes as much as 1.8 $\mu g/m^3$ in these areas.

[24] The UAA analysis could only be performed for the annual average $PM_{2.5}$ NAAQS as the MATS software cannot calculate UAA results for the 24-hour average $PM_{2.5}$ NAAQS.

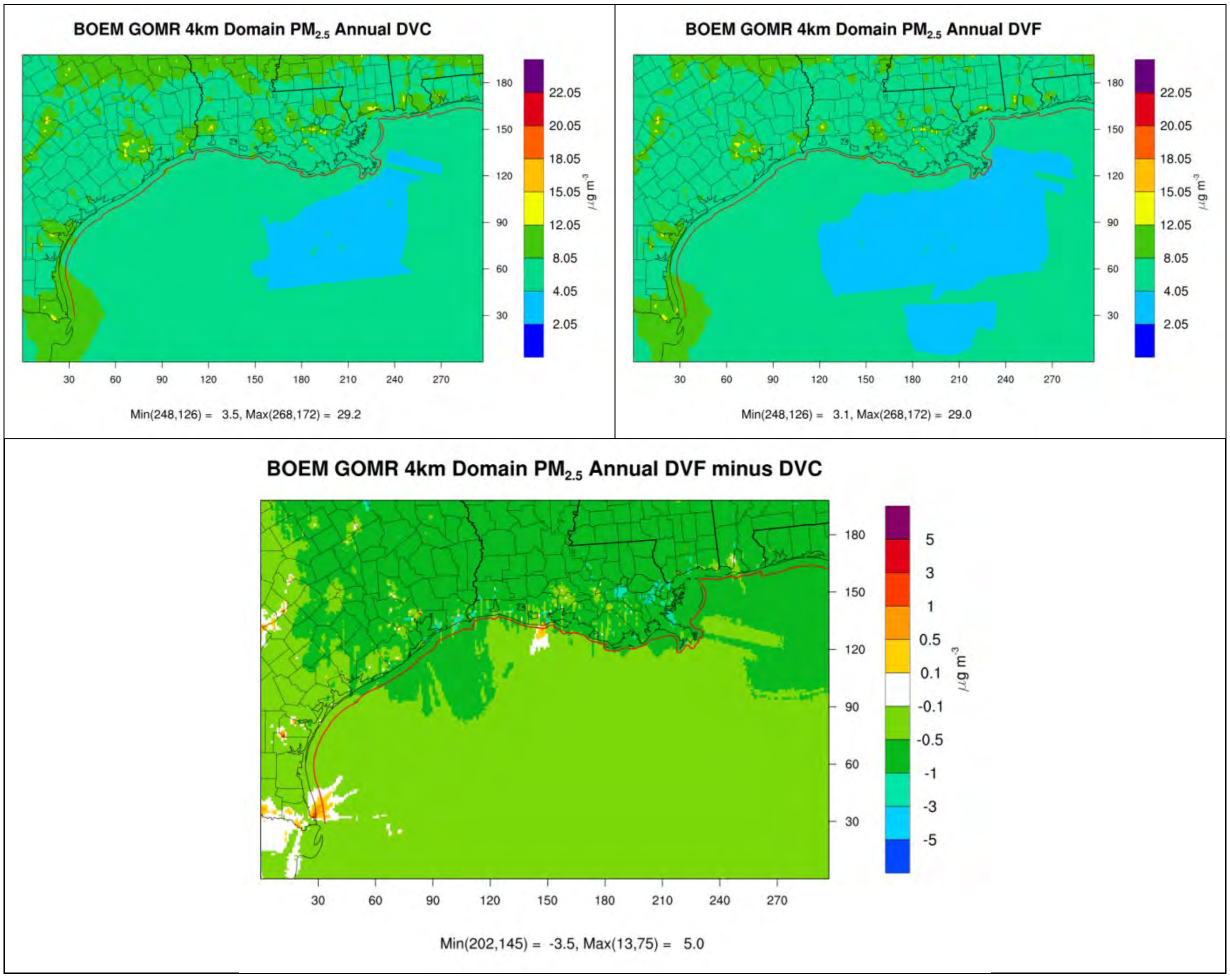


Figure D-45. Current Year (DVC) and Future Year (DVF) Annual Average $PM_{2.5}$ Design Values from the MATS Unmonitored Area Analysis (top left and top right, respectively) and the Difference, DVF – DVC (bottom).

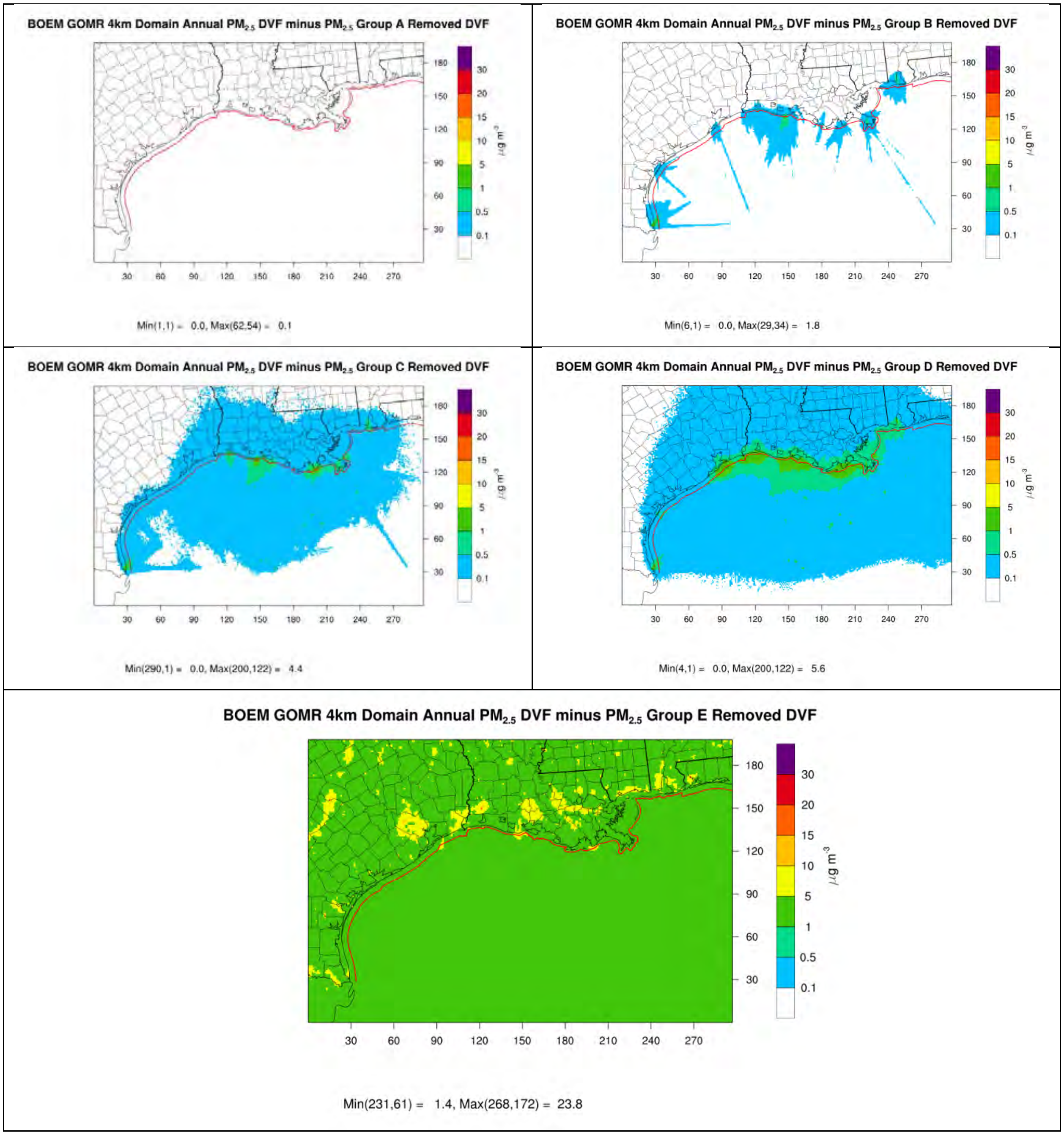


Figure D-46. Contributions of Source Groups A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to the Future Year All-sources Annual Average $PM_{2.5}$ Concentration Based on the MATS Unmonitored Area Analysis (note different color scales used in each panel).

D.7.1.4 $PM_{2.5}$ NAAQS Analysis using Absolute Model Predictions

The CAMx source apportionment absolute modeling results from the future year scenario are analyzed and compared with the $PM_{2.5}$ 24-hour and annual NAAQS in this section.

D.7.1.4.1 24-Hour $PM_{2.5}$

The 24-hour $PM_{2.5}$ NAAQS is defined as the three-year average of the annual 98th percentile daily average which corresponds to the 8th highest daily average in each year assuming complete data. Since only one calendar year of modeling results are available for the base year and future year scenarios, the future year 8th highest daily average $PM_{2.5}$ concentration is selected for comparison with the NAAQS.

Modeled 8th highest daily $PM_{2.5}$ concentrations in each model grid cell for the base and future year scenarios and the corresponding differences are shown in **Figure D-47**. Areas of high predicted $PM_{2.5}$ occur along the Alabama, Louisiana and east Texas Gulf coasts in both the base and future year scenarios. Although predicted 8th highest daily $PM_{2.5}$ concentrations in these areas exceed the 35 μg/m^3 NAAQS, both base-year monitored design values (DVCs) and projected future year design values (DVFs) are below the NAAQS at monitoring sites in these areas as noted in **Section D.7.1.3.1** above. A tendency towards over prediction of daily $PM_{2.5}$ noted in the model performance evaluation results presented in **Section D.5**. The difference plot at the bottom of **Figure D-47** shows $PM_{2.5}$ reductions in the majority of the domain with some areas of increases in $PM_{2.5}$ along portions of the immediate shoreline and offshore in the western Gulf where additional activities are anticipated under the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers. Where $PM_{2.5}$ increases are predicted, they are limited to less than 15 μg/m^3 for nearly all grid cells.

Source group contributions to the annual 8th highest daily average $PM_{2.5}$ concentrations under the future year scenario are shown in **Figure D-48**. These contributions are matched in time to the all sources 8th highest daily average $PM_{2.5}$ concentrations; contributions may be different during other periods with elevated daily average $PM_{2.5}$ values. Impacts of the new sources associated with the 2017-2022 GOM Multisale EIS scenario (Source Groups A and B) are largely focused on the area offshore of western Louisiana. Impacts from new platforms associated with the 2017-2022 GOM Multisale EIS scenario (Source Group A) are less than 1 μg/m^3; adding in support vessels and helicopters (Source Group B) increases the near-shore impacts up to a maximum of 7 μg/m^3 as compared to a combined maximum impact of all Gulf of Mexico sources (Source Group D) of 44 μg/m^3. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS and uses the scenario and alternatives analyzed in the 2017-2022 GOM Multisale EIS.

Contributions from Source Group E, which includes Source Group D plus all other U.S. and non-U.S. anthropogenic sources, shows the influence of inland urban areas on $PM_{2.5}$ levels, especially in Baton Rouge and Lake Charles, Louisiana.

Contributions from Source Group F (natural and non-U.S. emission sources including boundary conditions) shown in the left panel of **Figure D-49** are dominated by fire emissions near Beaumont, Texas, and in Vermilion and Lafourche Parishes, Louisiana. Boundary condition contributions are less than 4 μg/m^3 in the coastal areas as shown in the right panel of **Figure D-49**.

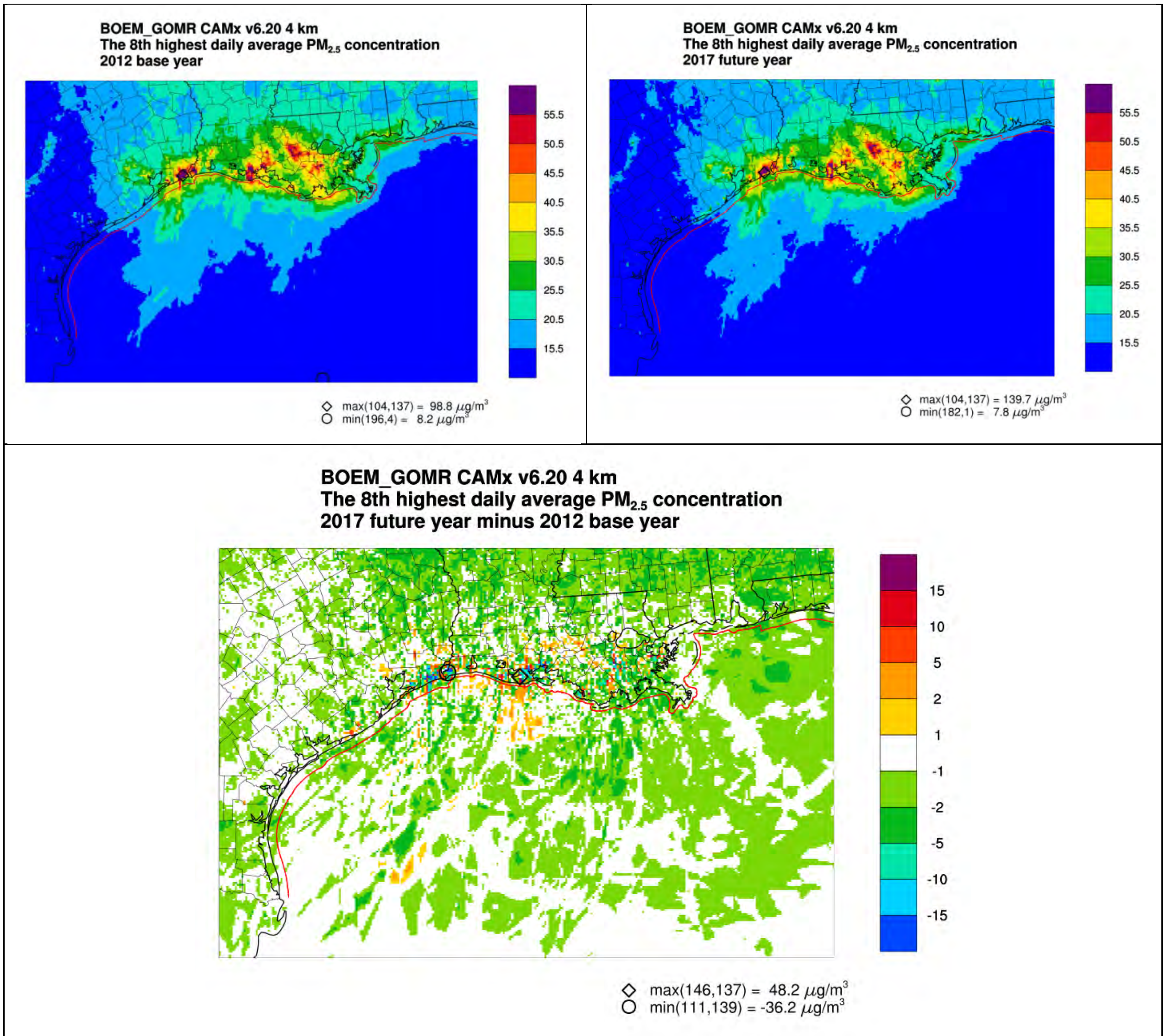


Figure D-47. Modeled 8th Highest Daily Average $PM_{2.5}$ Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

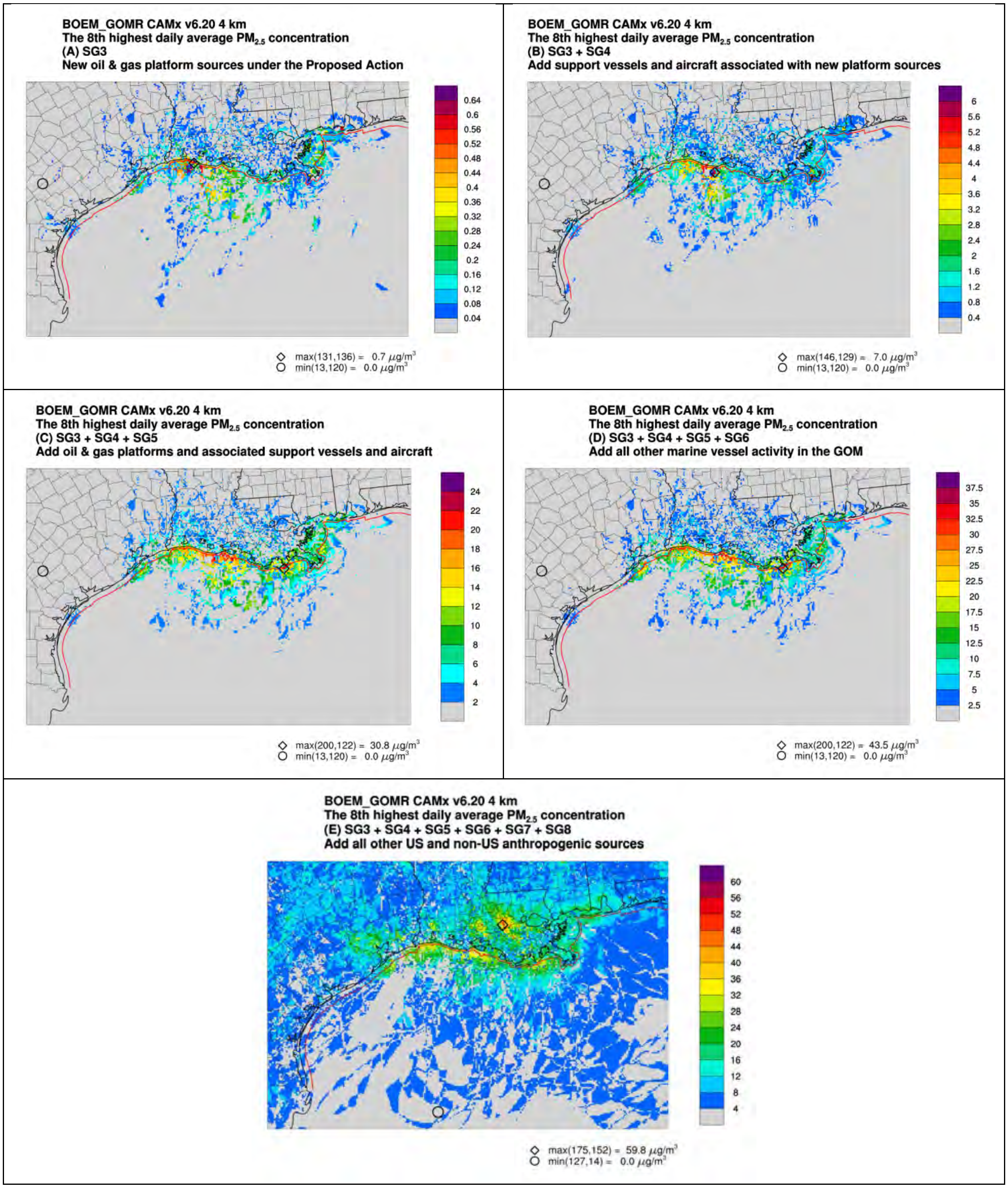


Figure D-48. Contributions of Source Groups A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to the Future Year All-sources 8th Highest Daily Average $PM_{2.5}$ Concentration (note different color scales used in each panel).

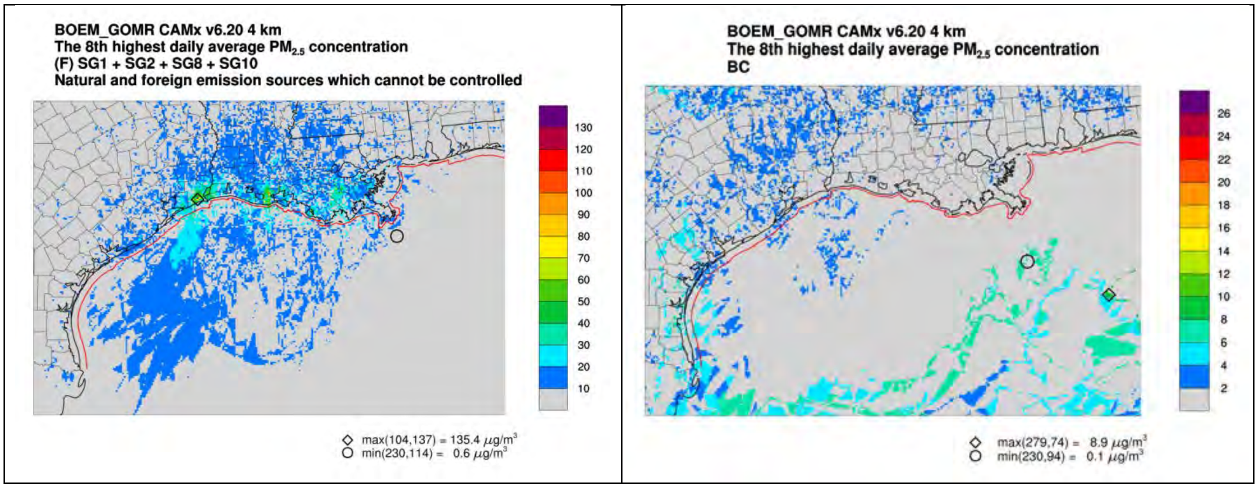


Figure D-49. Contributions from (left) Source Group F (natural and non-U.S. emission sources including boundary conditions) and (right) Boundary Conditions Only to Future Year All-sources 8^{th} Highest 24-hour $PM_{2.5}$ (note use of different color scale in each panel).

D.7.1.4.2 Annual Average $PM_{2.5}$

Modeled annual average $PM_{2.5}$ for the base year, future year, and the future – base differences are shown in **Figure D-50**. Average $PM_{2.5}$ concentrations decrease on most locations between the base and future year scenarios with changes over the western GOM between ± 0.5 μg/m^3. Increases of up to 2.5 μg/m^3 are calculated to occur in coastal Vermilion Parish, Louisiana.

Source group contributions to the annual average $PM_{2.5}$ concentrations under the future year scenario are shown in **Figure D-51**. Impacts of the new sources associated with the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario (Source Group B) are largely focused on the area offshore of western Louisiana with a maximum impact of 2.2 μg/m^3 as compared to a combined maximum impact of all GOM sources (Source Group D) of 9.3 μg/m^3. Source Group F contributions (natural and non-U.S. emission sources including boundary conditions) shown in the left panel of **Figure D-52** are dominated by fire emissions near Beaumont, Texas, and in Vermilion and Lafourche Parishes, Louisiana. Boundary condition contributions are less than 2 μg/m^3 in the coastal areas as shown in the right panel of **Figure D-52**.

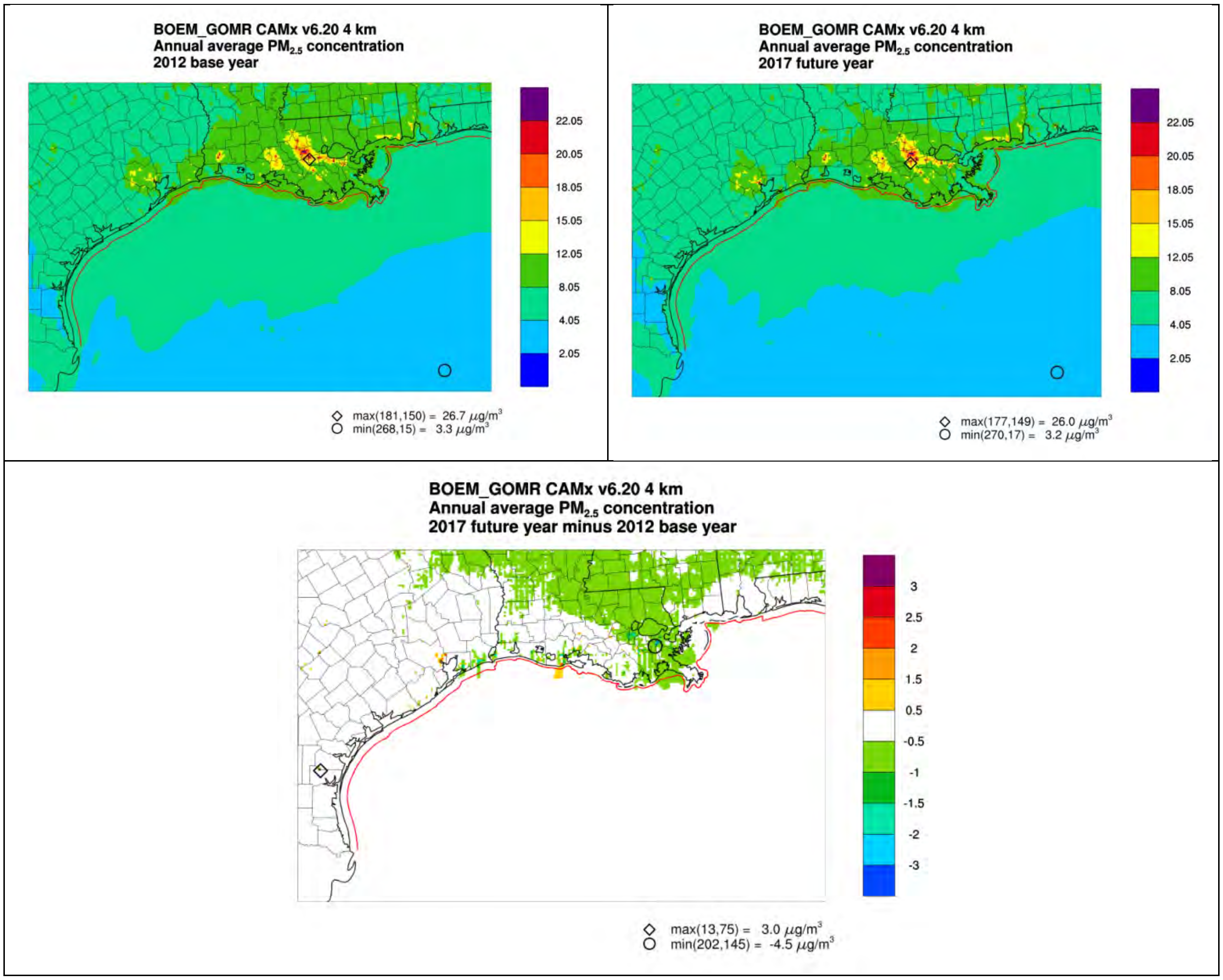


Figure D-50. Modeled Annual Average $PM_{2.5}$ Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

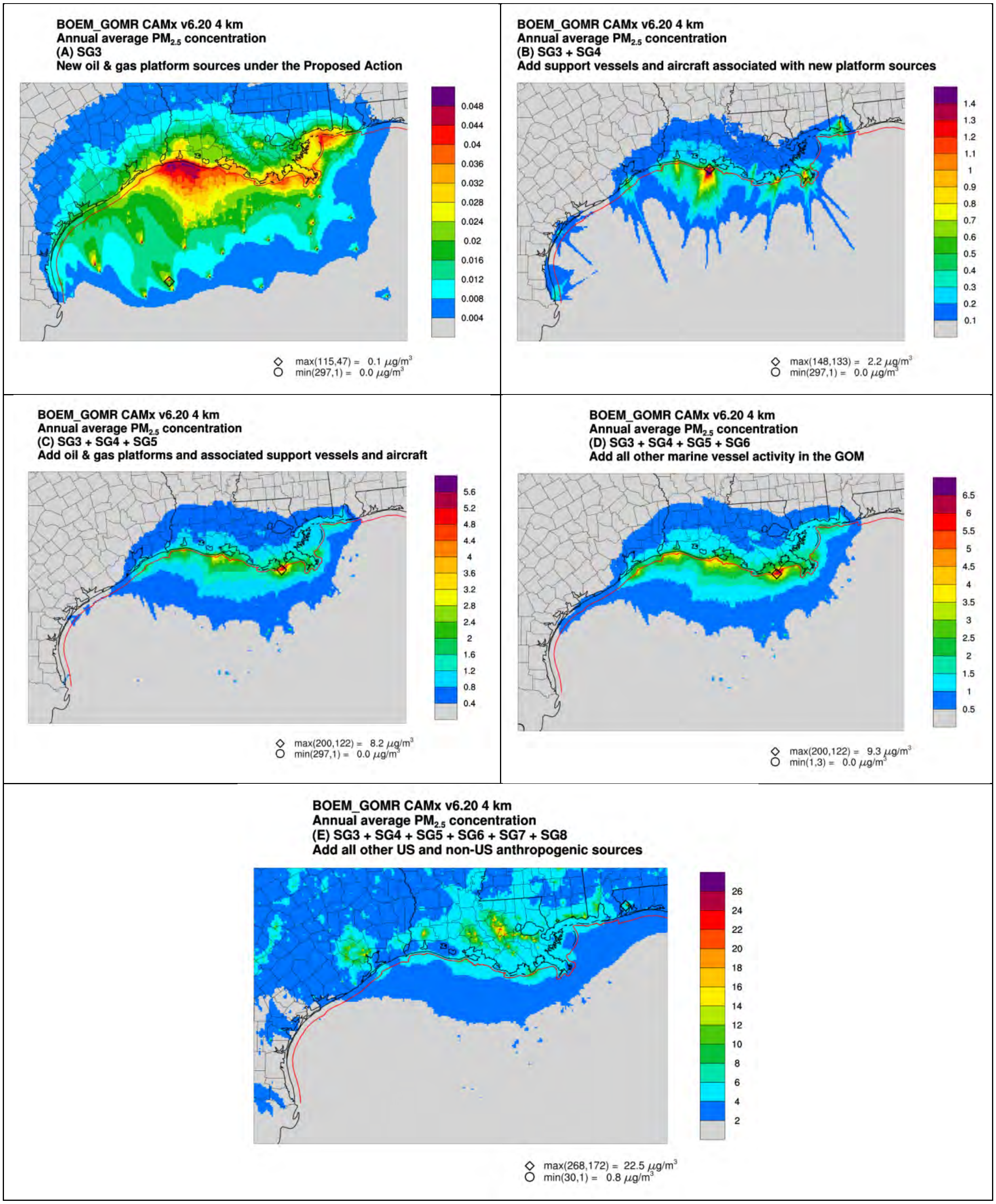


Figure D-51. Contributions of Source Group A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to the Future Year All-sources Annual Average $PM_{2.5}$ Concentration (note use of different color scales in each panel).

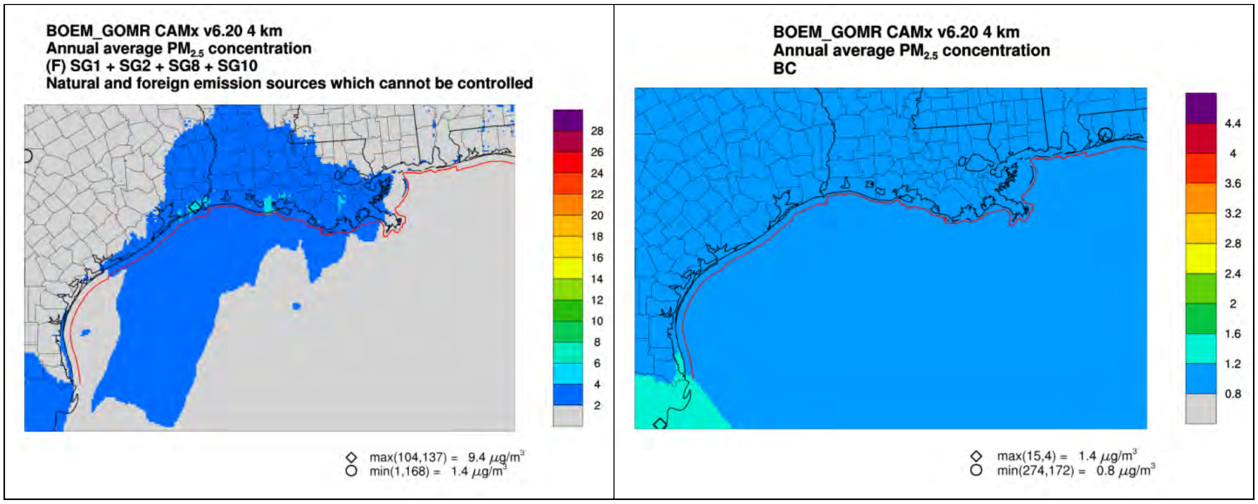


Figure D-52. Contributions from (left) Source Group F (natural and non-U.S. emission sources including boundary conditions) and (right) Boundary Conditions Only to Future Year All-sources Annual Average $PM_{2.5}$ (note use of different color scale in each panel).

D.7.1.5 NAAQS Analysis for other Criteria Air Pollutants

D.7.1.5.1 PM_{10}

Figure D-53 displays modeled 2nd highest daily average PM_{10} concentrations than can be compared with the 24-hour average PM_{10} NAAQS (150 μg/m^3) for the base and future scenarios and the base-future differences. Areas of elevated PM_{10} are evident in urban and port areas and in fire zones along the Gulf Coasts of Texas and Louisiana (impacts of fires on PM_{10} can be discerned from the left panel of **Figure D-55** described below). The PM_{10} decreases are modeled along the Louisiana coast with increases of between 2 and 5 μg/m^3 in waters farther offshore associated with new emissions from the 2017-2022 GOM Multisale EIS scenario sources, from which this Supplemental EIS tiers.

Source group contributions to the 2nd highest daily average PM_{10} concentrations are shown in **Figure D-54**. The maximum contribution of the new platforms and associated support vessels and aircraft under the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario (Source Group B) is predicted to be 10.7 μg/m^3 or 7% of the NAAQS. The maximum contribution of all oil and gas platforms and support vessels and helicopters (Source Group C) is 41 μg/m^3 (28% of the NAAQS). Fires dominate contributions from natural and non-U.S. sources (**Figure D-55**).

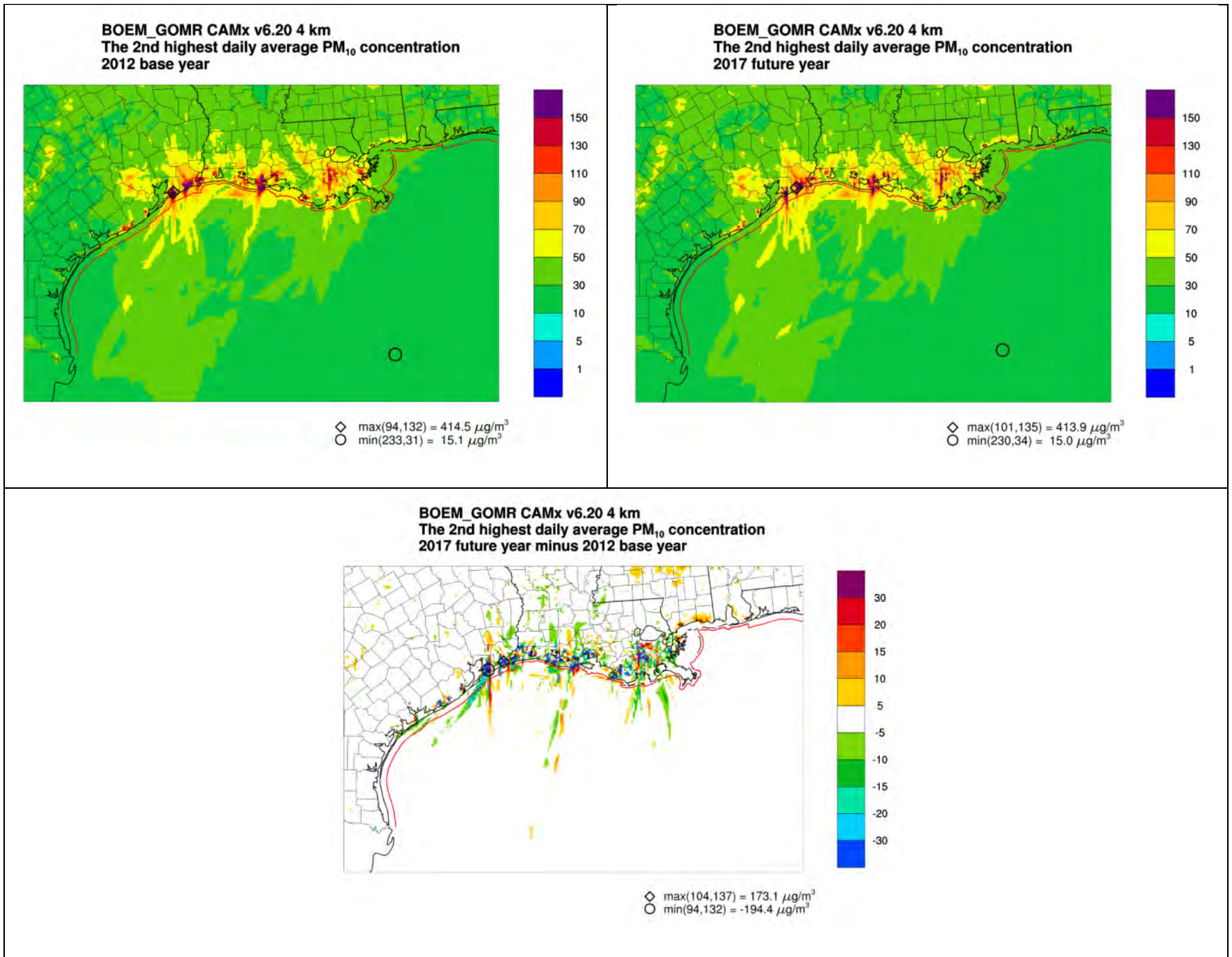


Figure D-53. Modeled 2nd Highest 24-hour Average PM_{10} Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

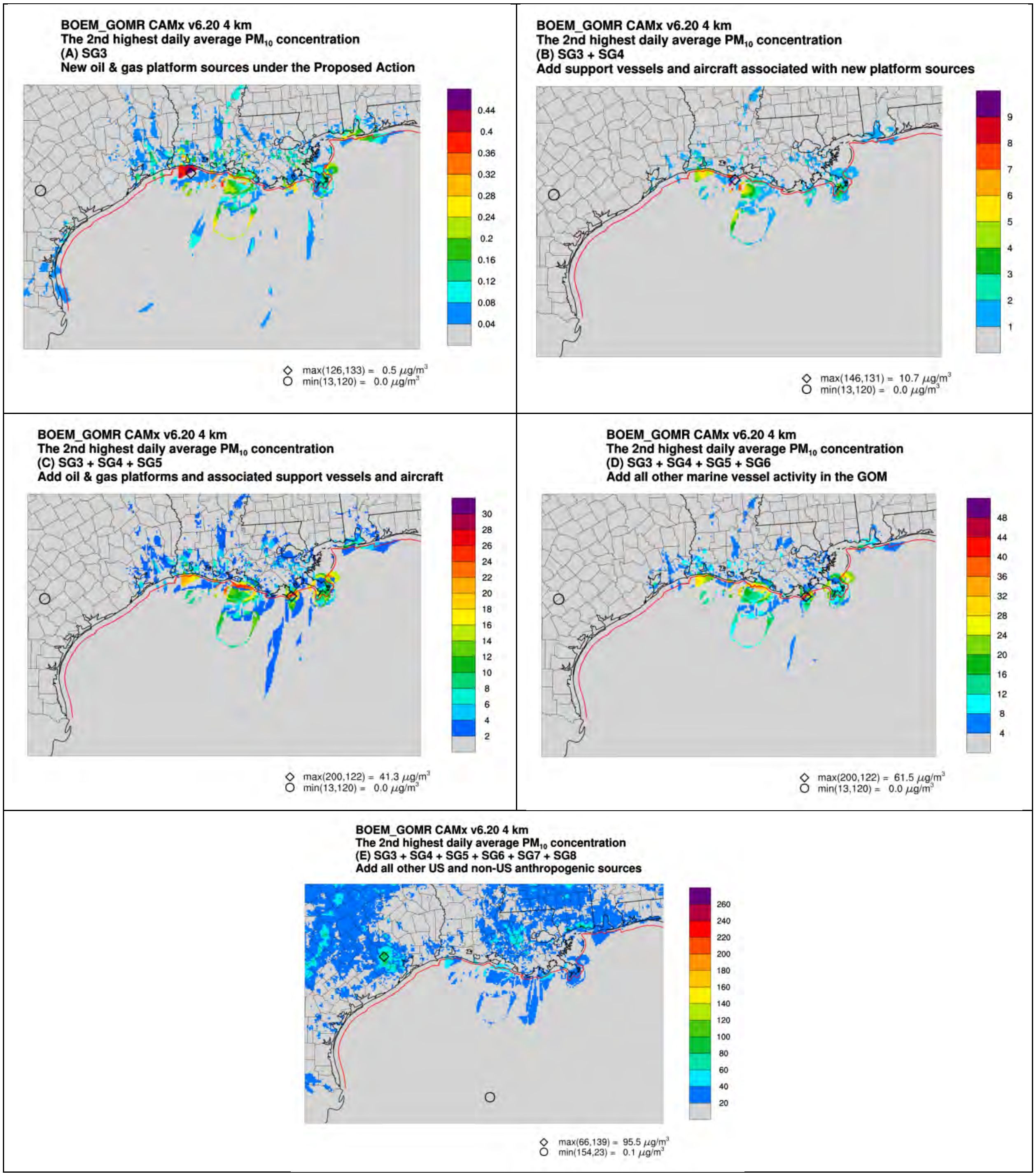


Figure D-54. Contributions of Source Groups A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to the Future Year All-sources 2nd Highest Daily Average PM_{10} Concentration (note use of different color scales in each panel).

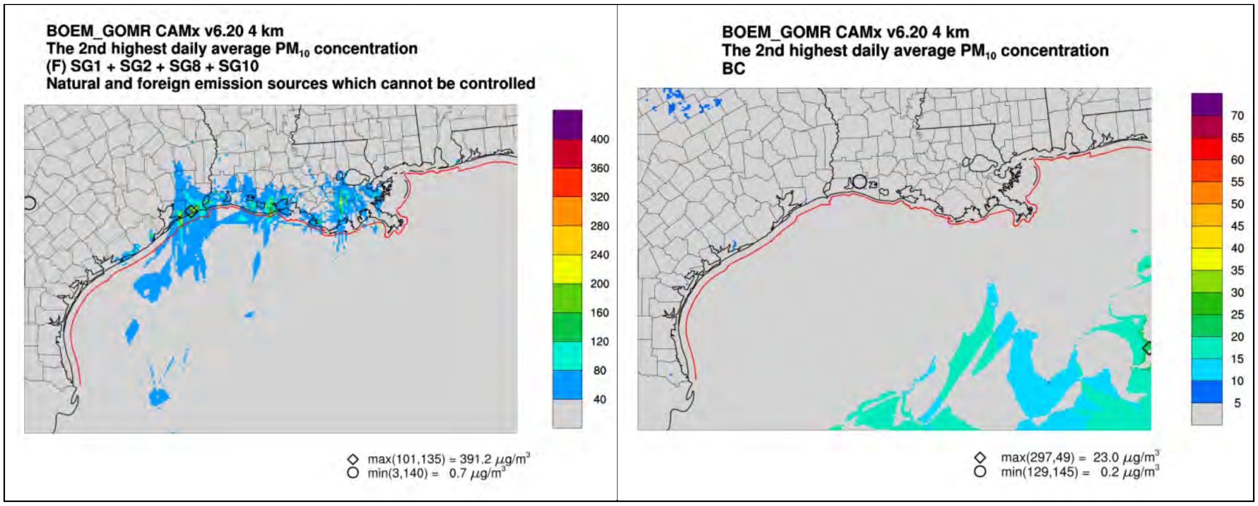


Figure D-55. Contributions from (left) Source Group F (natural and non-U.S. emission sources including boundary conditions) and (right) Boundary Conditions Only to Future Year All-sources 2nd Highest Daily Average PM_{10} Concentration (note use of different color scale in each panel).

D.7.1.5.2 NO_2

Results are presented here for both the 1-hour average NO_2 NAAQS (100 ppb) and the annual average NO_2 NAAQS (53 ppb). **Figures D-56 and D-57** display modeled 1-hour average NO_2 design values (based on the 8th highest daily average) for the base and future year scenarios along with source group contributions to the future year design values. All modeled 1-hour NO_2 concentrations are below the NAAQS (100 ppb); concentrations in the immediate vicinity of the Louisiana Offshore Oil Port (LOOP) peak at 98.5 ppb. Concentrations decrease between the base and future year scenarios at most locations except for of as much as a 32-ppb increase in coastal Vermilion Parish, Louisiana. Increases are also projected offshore of Texas and Alabama and in some interior portions of Texas.

Source Group contributions to the 8th highest daily average NO_2 concentrations are shown in **Figure D-57**. Contributions from new platforms and support vessels and helicopters associated with the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario (Source Group B) are dominated by vessel and possibly helicopter traffic in the port areas, most notably in Vermilion Parish, Louisiana, where the maximum contribution is 55.6 ppb. Combined contributions from new and existing platforms and support vessels and helicopters (Source Group C) are dominant in the area of the LOOP. Contributions from natural and foreign sources are less than 10 ppb (not shown).

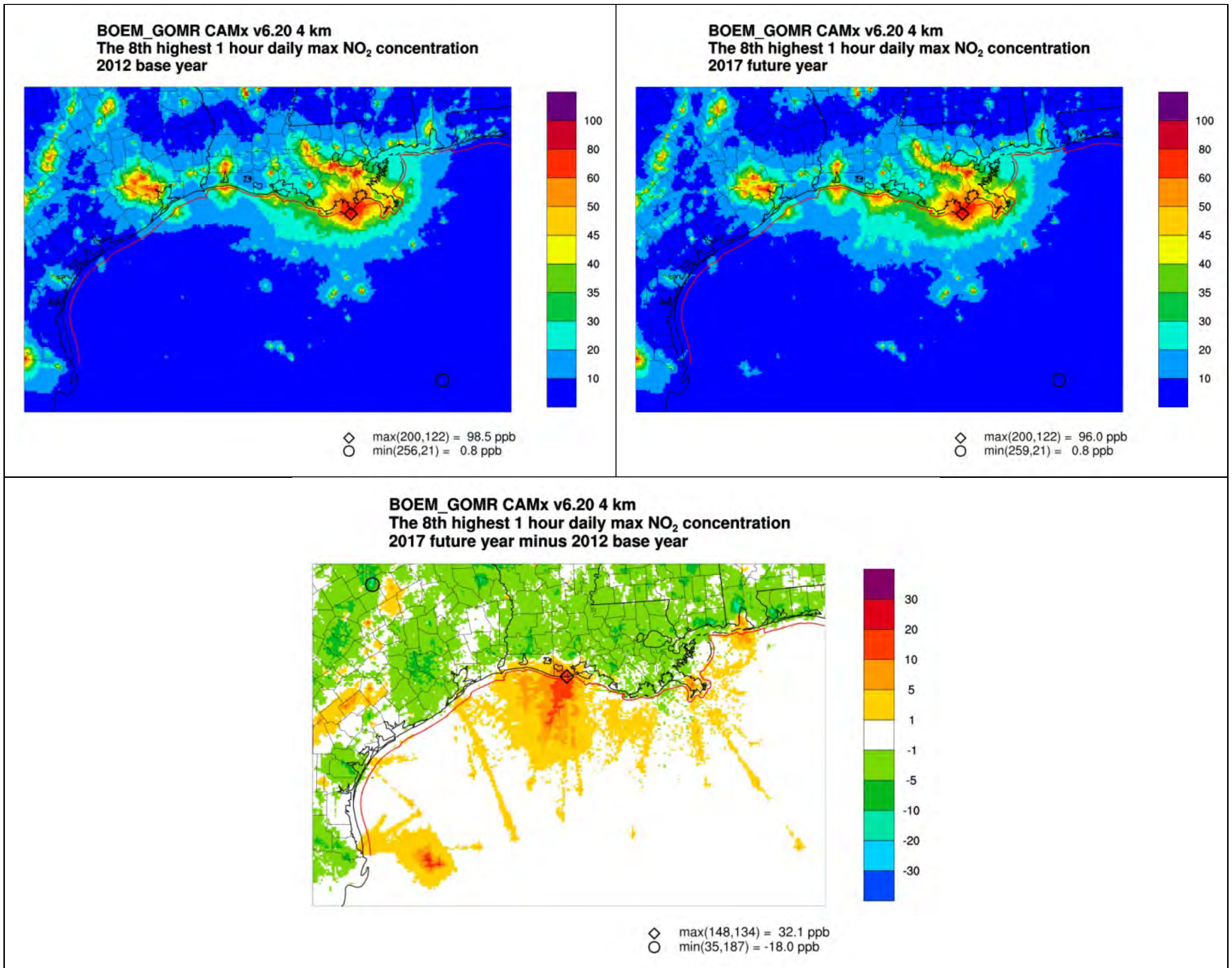


Figure D-56. Modeled 8th Highest 1-hour NO_2 Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

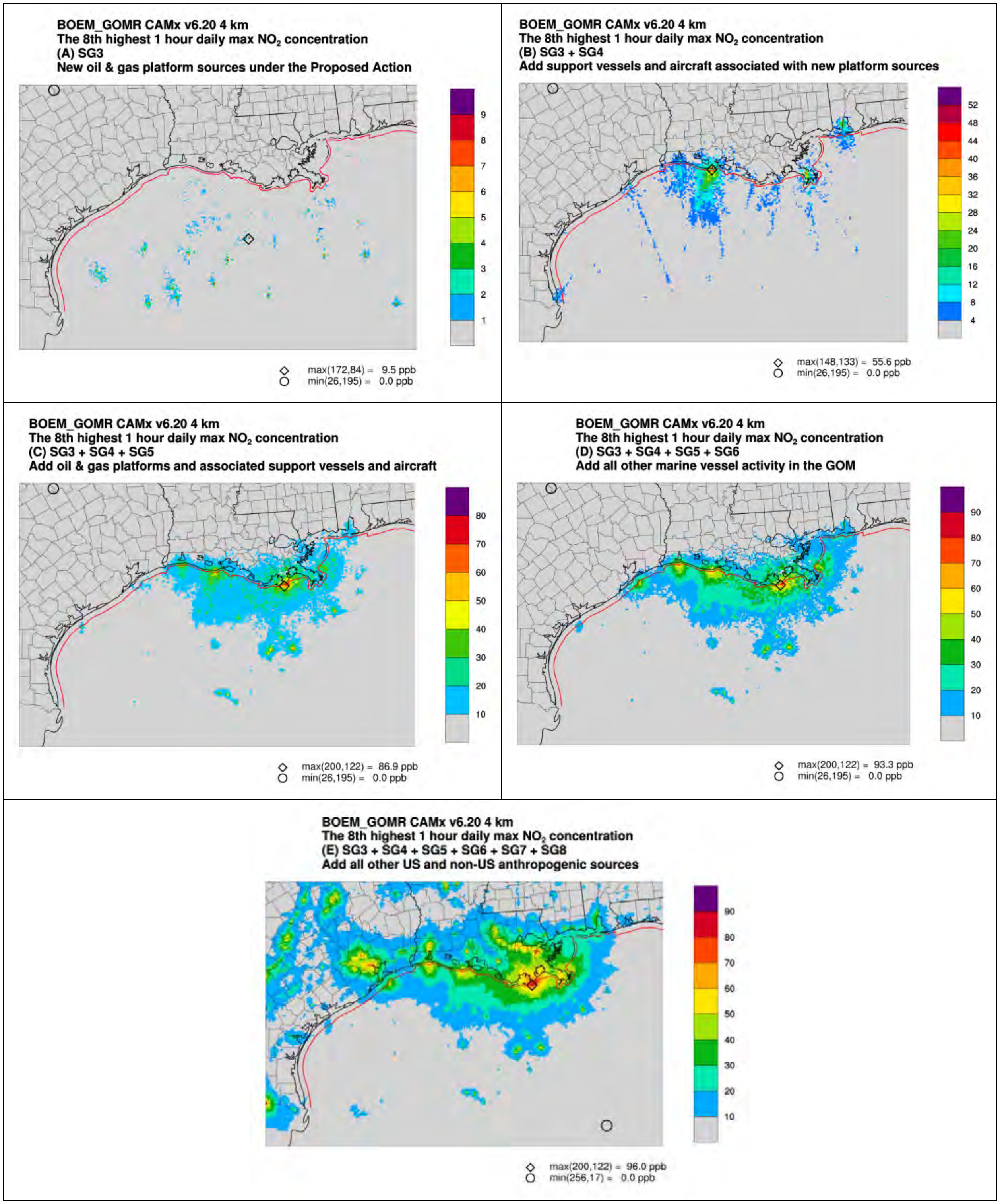


Figure D-57. Contributions of Source Group A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to the Future Year All-sources 8th Highest Daily Average NO_2 Concentrations (note use of different color scales in each panel).

Figures D-58 and D-59 display modeled annual average NO_2 concentrations for the base case and future year scenarios, along with source group contributions to the future year annual averages. All modeled concentrations are below the NAAQS. Increases between the base case and future year scenarios of as much as 8 ppb are modeled to occur near the entrance to the Freshwater Bayou Canal in Vermilion Parish, Louisiana. Somewhat larger increases are modeled in the Permian Basin of west Texas.

Contributions of Source Groups to the annual average NO_2 concentrations are shown in **Figure D-59**. These results are similar to those for 1-hour NO_2 shown above. Maximum impacts from new platforms and support vessels and helicopters associated with the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario are as much as 8.6 ppb (16% of the NAAQS).

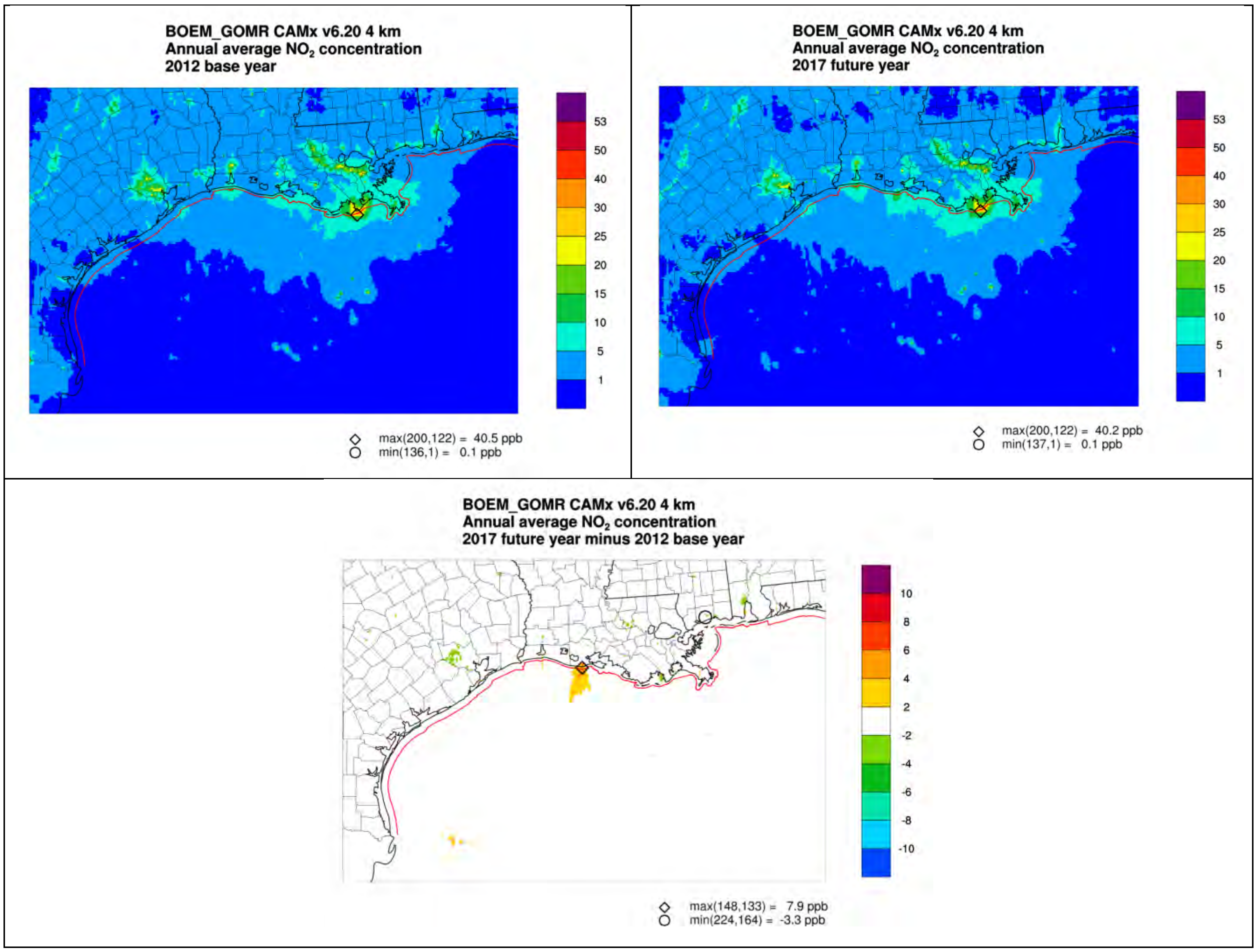


Figure D-58. Modeled Annual Average NO_2 Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

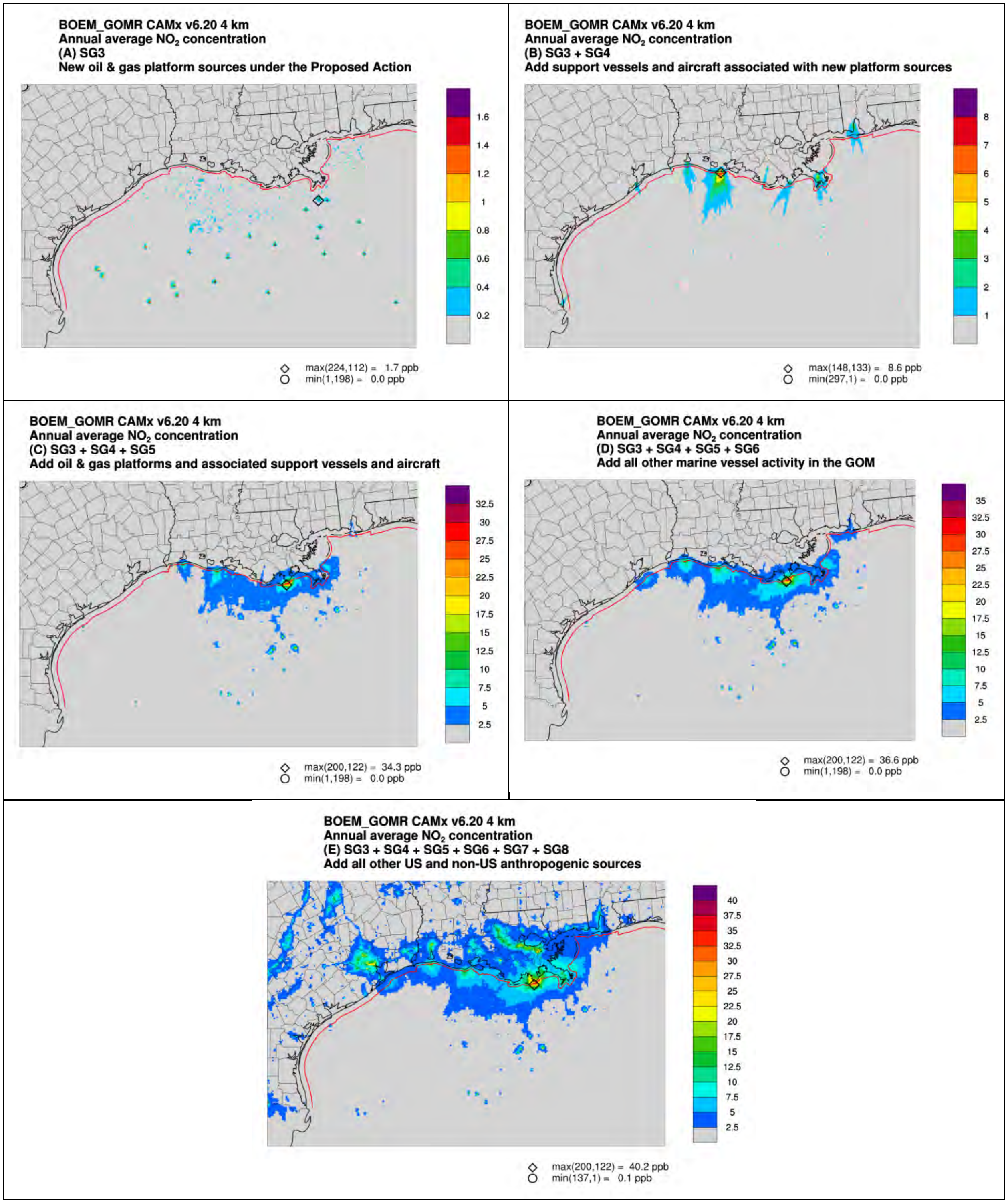


Figure D-59. Contributions of Source Groups A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to the Future Year All-sources Annual Average NO_2 Concentrations.

D.7.1.5.3 SO_2

Results are presented here for both the 1-hour average primary SO_2 NAAQS (75 ppb) and the 3-hour average secondary SO_2 NAAQS (0.5 ppm).

Figure D-60 displays modeled 1-hour SO_2 design values (based on the 4th highest daily maximum 1-hour average SO_2 concentration) for the base, future, and future-base scenarios. Modeled values for the base year are generally below the NAAQS except in the immediate vicinity of some major point sources. Sources in areas with deepwater platforms are evident with maximum values up to 50 ppb. Concentrations decrease in most locations in the future year scenario as sources are retired or apply control equipment with projected maximum impacts all below the NAAQS. No increases in excess of 5 ppb are modeled along the Gulf Coast or over the open ocean.

Contributions of source groups to the modeled 1-hour SO_2 concentrations are shown in **Figure D-61**. New sources associated with the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario (Source Group B) are modeled to contribute less than 1 ppb.

Figure D-62 displays modeled 3-hour SO_2 design values (based on the annual 2nd highest block, 3-hour average SO_2 concentration) for the base, future, and future-base scenarios. All modeled values are below the NAAQS (500 ppb). These results are similar to those for the 1-hour SO_2 described above.

Contributions of source groups to the modeled 3-hour SO_2 concentrations are shown in **Figure D-63**. Results are similar to those for the 1-hour SO_2 concentrations described above.

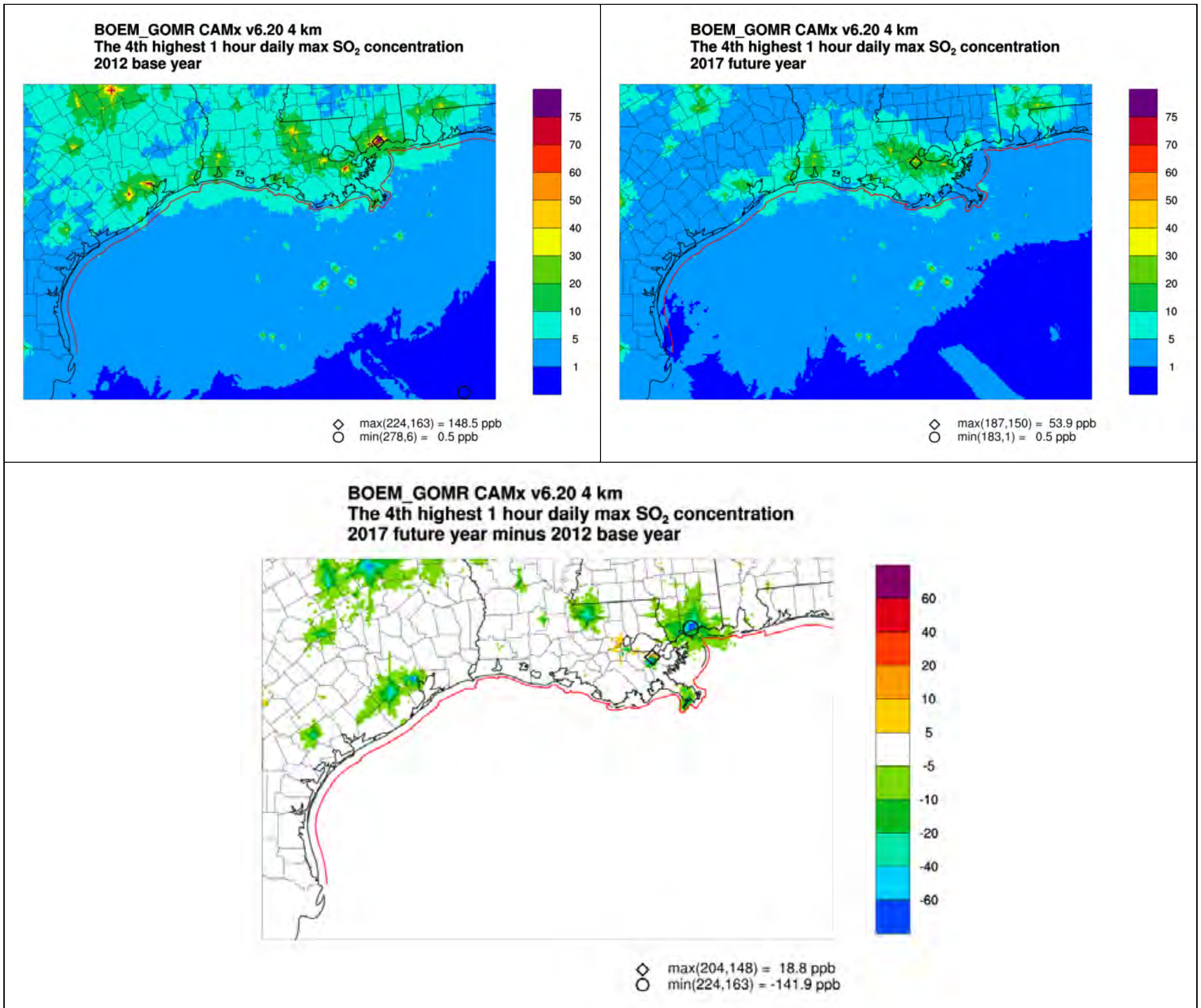


Figure D-60. Modeled 4th Highest Daily Maximum 1-hour SO_2 Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

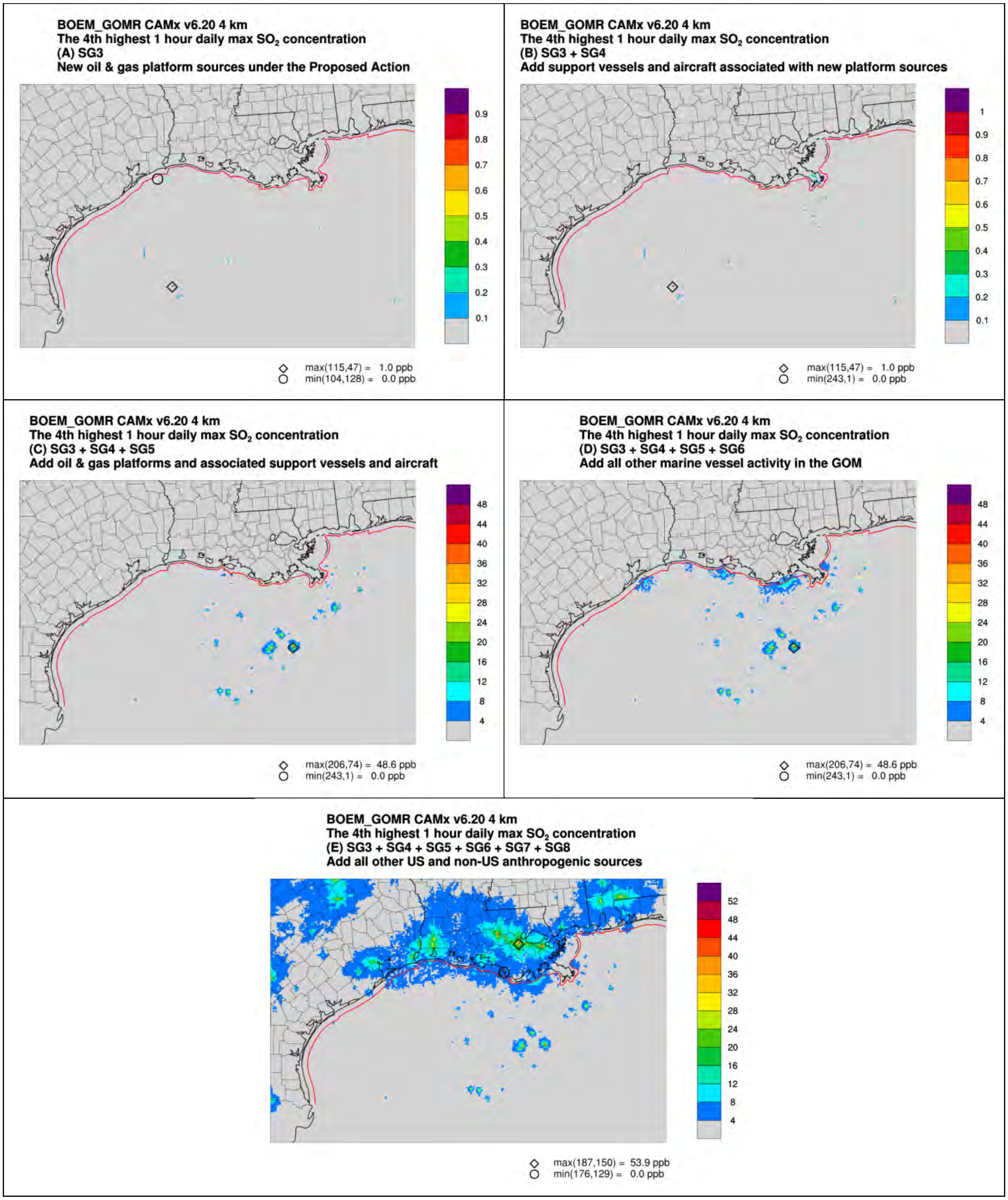


Figure D-61. Contributions of Source Group A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to the Future Year All-sources 4th Highest Daily Maximum 1-hour SO_2 Concentration (note different color scales used in each panel).

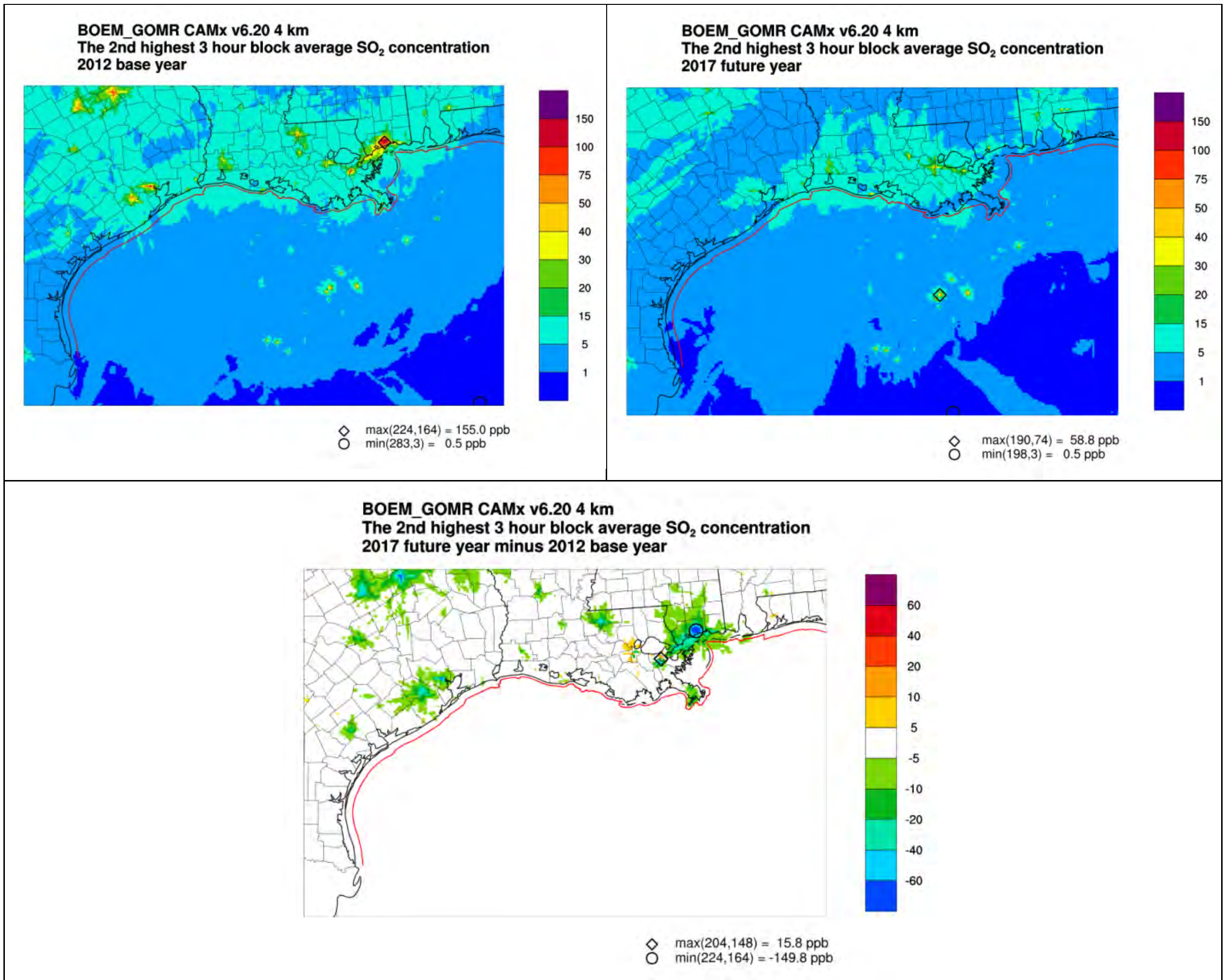


Figure D-62. Modeled Annual 2nd Highest Block 3-hour SO_2 Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

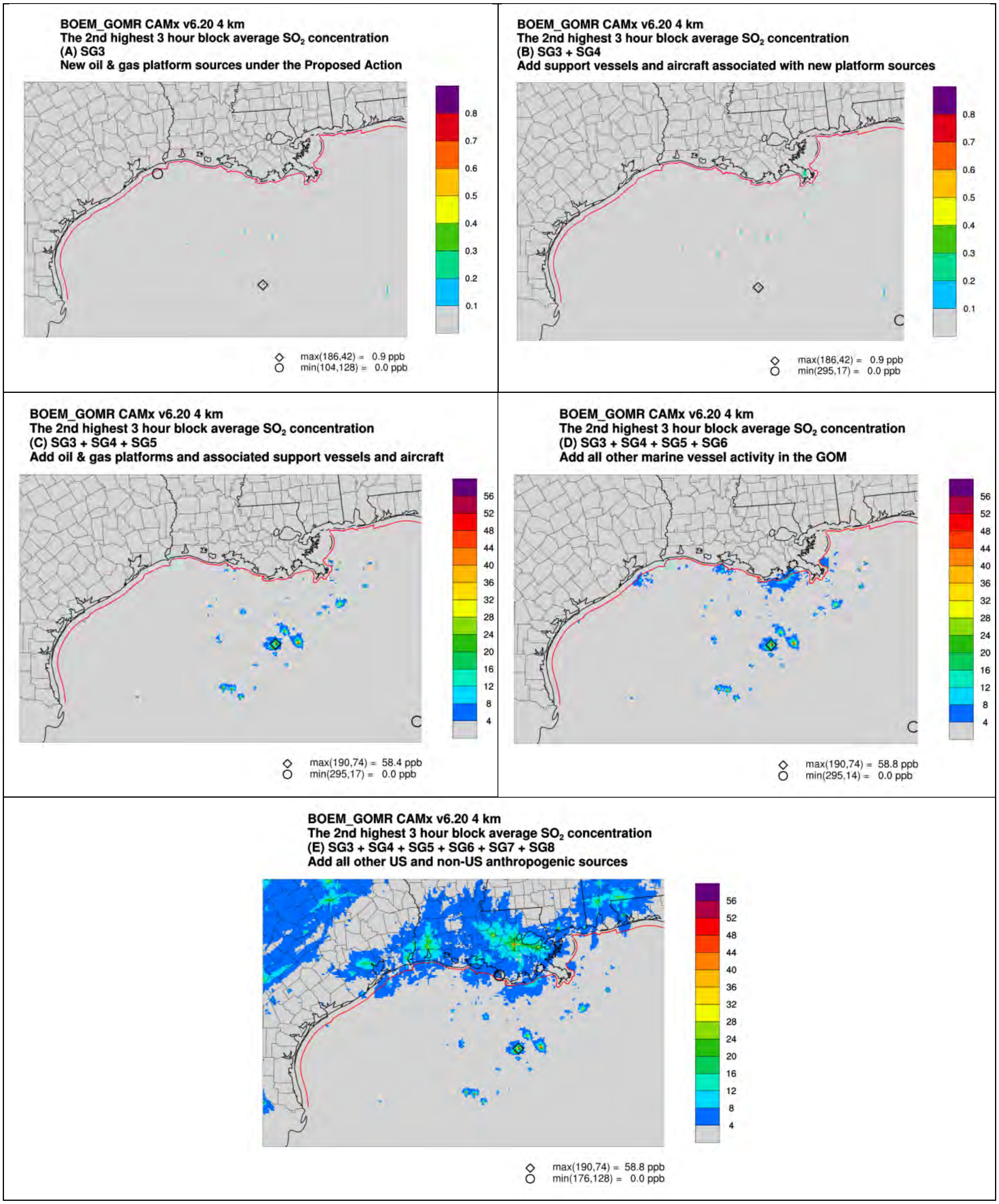


Figure D-63. Contributions of Source Group A (top left), B (top right), C (middle left), D (middle right), and E (bottom) to the Future Year All-sources 2nd Highest 3-hour Block Average SO_2 Concentration (note different color scales used in each panel).

D.7.1.5.4 CO

Results are presented here for both the 8-hour average (9 ppm) and 1-hour average (35 ppm) CO NAAQS.

Figure D-64 displays modeled 8-hour CO design values (based on the annual 2nd highest nonoverlapping running 8-hour average) for the base, future, and future-base scenarios. Similarly, **Figure D-65** displays modeled 1-hour CO design values (based on the annual 2nd highest daily maximum 1-hour average) for the base, future, and future-base scenarios. All values are below the NAAQS. The maximum predicted 8-hour design value in the future year is predicted to be 8.3 ppb at the entrance to the Freshwater Bayou Canal in Vermilion Parish, Louisiana. Differences between the base and future year scenarios are less than 3 ppm.

Individual source group contributions to CO design values were not calculated as the CAM_x source apportionment methods do not include tracers for CO.

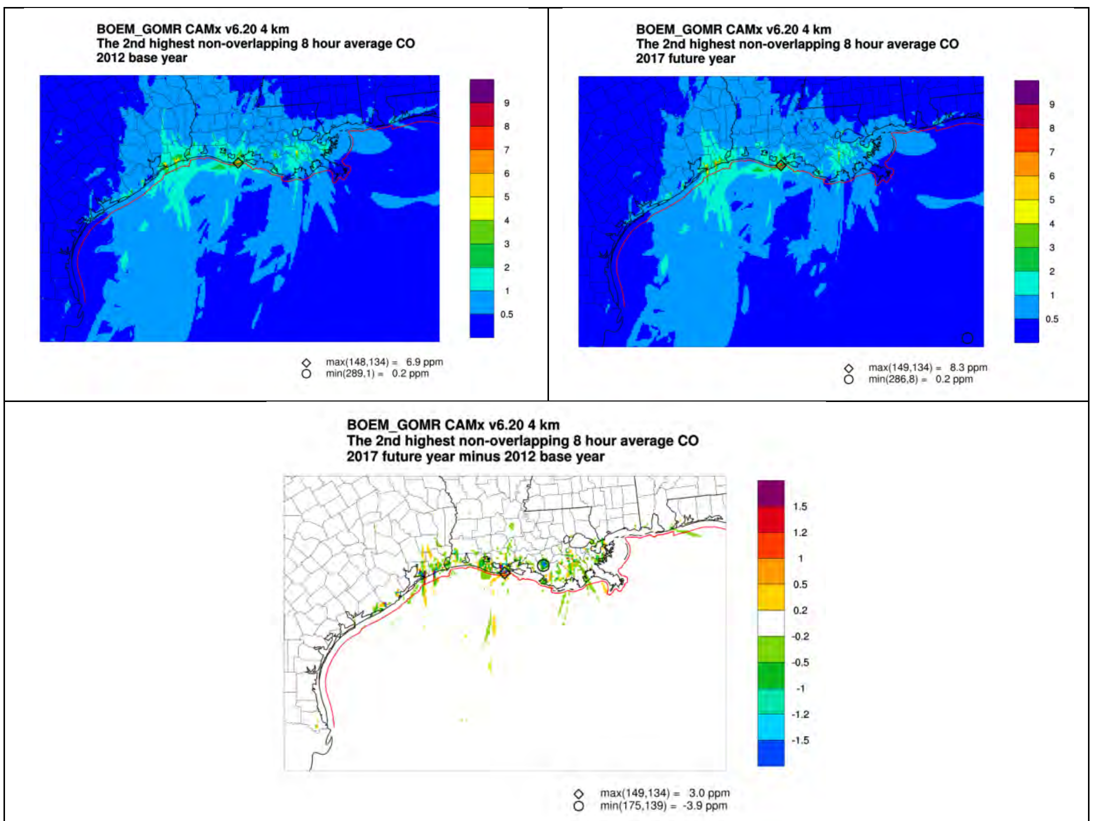


Figure D-64. Modeled Annual 2nd Highest Non-overlapping Running 8-hour Average CO Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

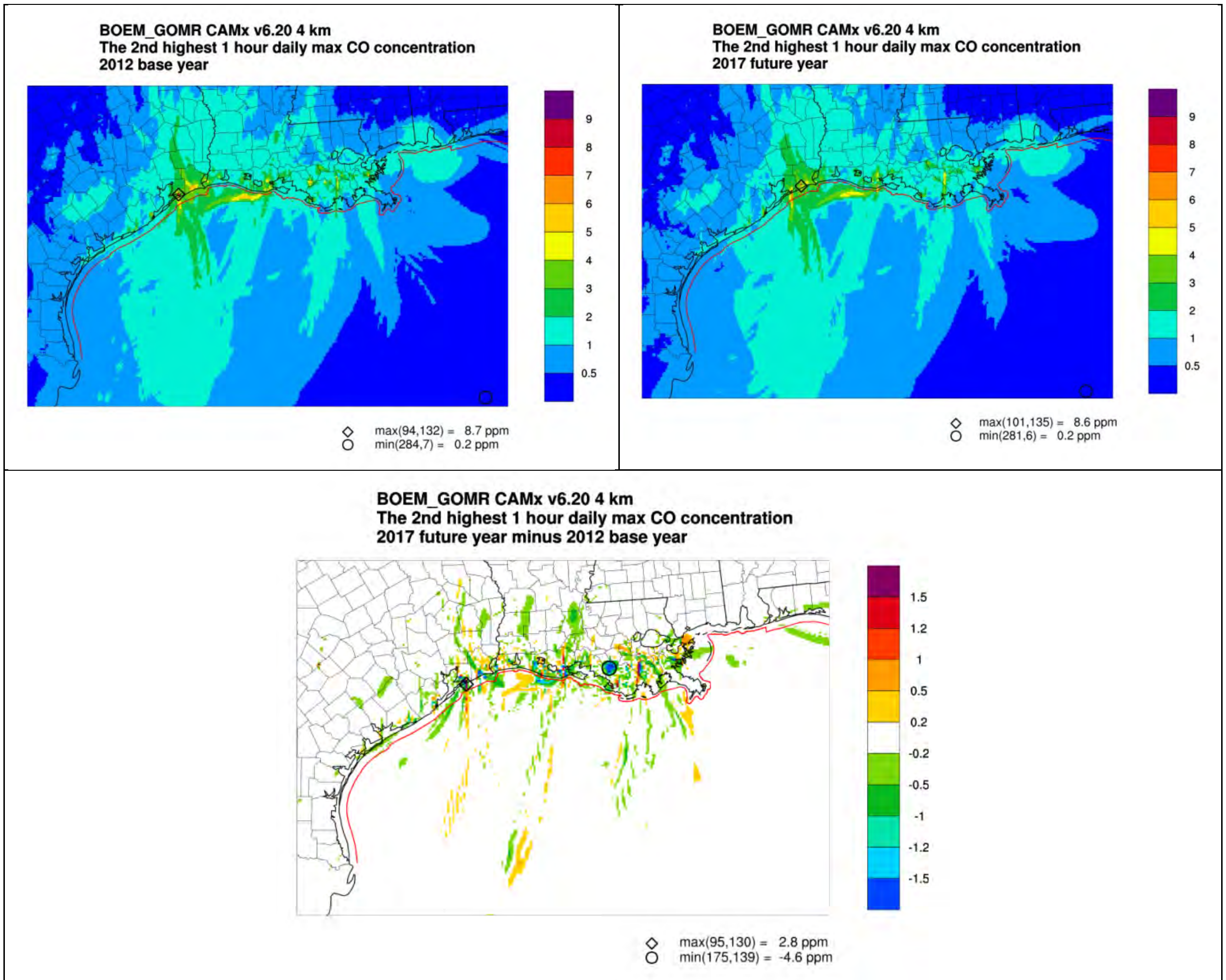


Figure D-65. Modeled Annual 2nd Highest 1-hour Average CO Concentrations for the Base Year (top left), Future Year (top right), and the Future – Base Difference (bottom).

D.7.2 PSD Increments

Incremental impacts of each source group at Class I and sensitive Class II areas were calculated for all pollutants for which PSD increments have been set (NO_2, SO_2, PM_{10}, $PM_{2.5}$). Increment consumption is based on the source group contribution calculated from the CAMx source contribution results. Increment consumption for 24-hour averages and the 3-hour average SO_2 are based on the annual second highest values. Comparisons of impacts from the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario with maximum allowed PSD increments are presented here as an evaluation of a “threshold of concern” for potentially significant adverse impacts, but they do not represent a regulatory PSD increment consumption analysis.

Results of the PSD increments analysis are summarized in **Table D-24** in terms of the maximum increment consumption over all Class I/II areas within the 4-km modeling domain. Maximum impacts occur at the Breton Wilderness Class I area for all PSD pollutants and averaging times. Concentration increments from Source Groups A and B are less than the maximum allowed

PSD increments for all pollutants and averaging times except for the 24-hour $PM_{2.5}$ increment from Source Group B at the Breton Wilderness Class I area where the maximum impact (2.19 μg/m^3) exceeds the Class I PSD increment (2 μg/m^3) by just under 10%. The maximum Source Group A 24-hour average $PM_{2.5}$ increment is 0.53 μg/m^3, indicating that support vessels or helicopter traffic associated with new offshore platforms, rather than emissions from the platforms themselves, are largely responsible for pushing the maximum impact above the Class I PSD increment at Breton Wilderness. The 24-hour $PM_{2.5}$ impact from Source Group B averaged over all grid cells covering the Breton Wilderness Class I area is 1.79 μg/m^3. Maximum impacts from Source Group C exceed the annual and 24-hour $PM_{2.5}$, the 24-hour PM_{10}, and the annual NO_2 Class I PSD increments at Breton Wilderness. A summary of impacts from Source Groups A, B, and C for all Class I/II areas is provided in **Table D-25**.

Table D-24. Maximum Source Group Contributions for PSD Pollutants at Class I and Sensitive Class II Areas in the 4-km Modeling Domain.

Group	Max @ Any Class I Area	Percent of PSD Class I Increment	Class I Area Where Max Occurred	Max @ Any Class II Area	Percent of PSD Class II Increment	Class II Area Where Max Occurred
PM_{10} Annual (Increment = 4 μg/m^3, 17 μg/m^3)						
A	0.04449	1.1%	Breton Wilderness	0.04196	0.2%	Gulf Islands NS
B	0.29475	7.4%	Breton Wilderness	0.35482	2.1%	Gulf Islands NS
C	1.44391	36.1%	Breton Wilderness	1.24095	7.3%	Gulf Islands NS
PM_{10} 24-Hour (Class I, II Increment = 8 μg/m^3, 30 μg/m^3)						
A	0.53529	6.7%	Breton Wilderness	0.61362	2.0%	Gulf Islands NS
B	2.19999	27.5%	Breton Wilderness	2.45061	8.2%	Gulf Islands NS
C	14.4191	180.2%	Breton Wilderness	13.9928	46.6%	Gulf Islands NS
$PM_{2.5}$ Annual (Class I, II Increment = 1 μg/m^3, 4 μg/m^3)						
A	0.04449	4.4%	Breton Wilderness	0.04196	1.0%	Gulf Islands NS
B	0.29152	29.2%	Breton Wilderness	0.34969	8.7%	Gulf Islands NS
C	1.43641	143.6%	Breton Wilderness	1.23711	30.9%	Gulf Islands NS
$PM_{2.5}$ 24-Hour (Class I, II Increment = 2 μg/m^3, 9 μg/m^3)						
A	0.53527	26.8%	Breton Wilderness	0.6136	6.8%	Gulf Islands NS
B	2.19194	109.6%	Breton Wilderness	2.44002	27.1%	Gulf Islands NS
C	14.3964	719.8%	Breton Wilderness	13.9795	155.3%	Gulf Islands NS
NO_2 Annual (Class I, II Increment = 2.5 μg/m^3, 25 μg/m^3)						
A	0.12789	5.1%	Breton Wilderness	0.14467	0.6%	Gulf Islands NS
B	0.65768	26.3%	Breton Wilderness	0.93535	3.7%	Gulf Islands NS
C	2.61628	104.7%	Breton Wilderness	1.95517	7.8%	Breton NWR
SO_2 Annual (Class I, II Increment = 2 μg/m^3, 20 μg/m^3)						
A	0.00113	0.1%	Breton Wilderness	0.00121	0.0%	Gulf Islands NS
B	0.00271	0.1%	Breton Wilderness	0.00178	0.0%	Gulf Islands NS
C	0.0684	3.4%	Breton Wilderness	0.05601	0.3%	Breton NWR
SO_2 24-Hour (Class I, II Increment = 5 μg/m^3, 91 μg/m^3)						
A	0.01009	0.2%	Breton Wilderness	0.01104	0.0%	Breton NWR
B	0.01891	0.4%	Breton Wilderness	0.0156	0.0%	Breton NWR
C	0.53913	10.8%	Breton Wilderness	0.41742	0.5%	Breton NWR

Group	Max @ Any Class I Area	Percent of PSD Class I Increment	Class I Area Where Max Occurred	Max @ Any Class II Area	Percent of PSD Class II Increment	Class II Area Where Max Occurred
SO_2 3-Hour (Class I, II Increment = 25 μg/m^3, 512 μg/m^3)						
A	0.02228	0.1%	Breton Wilderness	0.01655	0.0%	Breton NWR
B	0.03451	0.1%	Breton Wilderness	0.02296	0.0%	Breton NWR
C	1.17783	4.7%	Breton Wilderness	1.03688	0.2%	Breton NWR

NS = National Seashore; NWR = National Wildlife Refuge.

D.7.3 AQRV Impacts

D.7.3.1 Visibility

Incremental visibility impacts were calculated for each source group as well as the cumulative impact of all sources combined. The approach used the incremental concentrations as quantified by the CAMx PSAT source apportionment tool simulation for each source group. Changes in light extinction from CAMx model concentration increments due to emissions from each source group were calculated for each day at grid cells that intersect Class I and sensitive Class II areas within the 12-km modeling domain.

Calculation of incremental visibility impacts followed procedures recommended by the Federal Land Managers (FLAG, 2010) as described in **Section D.6.2.3.1**.

For each individual source group, the estimated visibility degradation at each Class I and sensitive Class II area in the 12-km modeling domain due to emissions from the source group are presented in terms of the number of days that exceed a threshold change in deciview (∆dv) relative to background conditions. The number of days with a ∆dv greater than 0.5 and 1.0 are reported.

Results of the FLAG (2010) incremental visibility impact assessment for Source Groups A and B are presented in **Tables D-26 and D-27**, respectively. For Source Group A, the annual 8th highest ∆dv exceed the 1.0 threshold at Breton Wilderness, Breton National Wildlife Refuge, and Gulf Islands National Seashore. Incremental impacts for Source Group B are larger and include days with the 8th highest ∆dv greater than 1.0 at Padre Island National Seashore in addition to the areas mentioned above, as well as values greater than 0.5 at Chassahowitzka Wilderness and St. Marks National Wildlife Refuge.

Table D-25. Source Group Contributions for PSD Pollutants at All Class I and Sensitive Class II Areas in the 4-km Modeling Domain.

Source Group A										
		Pollutant	NO_2 (µg/m^3)	PM_{10} (µg/m^3)		PM_{25} (µg/m^3)		SO_2 (µg/m^3)		
		Averaging Time	Annual[3]	24-hour[2]	Annual[3]	24-hour[4]	Annual[3]	3-hour[2]	24-hour[2]	Annual[3]
Class I	State	Owner	PSD Class I Increment[1]							
			2.5	8	4	2	1	25	5	2
Breton Wilderness	LA	FWS	0.128	0.535	0.044	0.535	0.044	0.022	0.010	0.001
Class II	State	Owner	PSD Class II Increment[1]							
			25	30	17	9	4	512	91	20
Breton NWR	LA	FWS	0.063	0.436	0.036	0.436	0.036	0.017	0.011	0.001
Gulf Islands NS	FL,MS	NPS	0.145	0.614	0.042	0.614	0.042	0.014	0.007	0.001
Padre Island NS	TX	NPS	0.014	0.169	0.014	0.169	0.014	0.006	0.002	0.000
Source Group B										
		Pollutant	NO_2 (µg/m^3)	PM_{10} (µg/m^3)		PM_{25} (µg/m^3)		SO_2 (µg/m^3)		
		Averaging Time	Annual[3]	24-hour[2]	Annual[3]	24-hour[4]	Annual[3]	3-hour[2]	24-hour[2]	Annual[3]
Class I	State	Owner	PSD Class I Increment[1]							
			2.5	8	4	2	1	25	5	2
Breton Wilderness	LA	FWS	0.658	2.200	0.295	2.192	0.292	0.035	0.019	0.003
Class II	State	Owner	PSD Class II Increment[1]							
			25	30	17	9	4	512	91	20
Breton NWR	LA	FWS	0.321	1.752	0.182	1.748	0.181	0.023	0.016	0.002
Gulf Islands NS	FL,MS	NPS	0.935	2.451	0.355	2.440	0.350	0.017	0.008	0.002
Padre Island NS	TX	NPS	0.181	1.013	0.166	1.012	0.165	0.006	0.003	0.001
Source Group C										
		Pollutant	NO_2 (µg/m^3)	PM_{10} (µg/m^3)		PM_{25} (µg/m^3)		SO_2 (µg/m^3)		
		Averaging Time	Annual[3]	24-hour[2]	Annual[3]	24-hour[4]	Annual[3]	3-hour[2]	24-hour[2]	Annual[3]
Class I	State	Owner	PSD Class I Increment[1]							
			2.5	8	4	2	1	25	5	2
Breton Wilderness	LA	FWS	2.616	14.419	1.444	14.396	1.436	1.178	0.539	0.068
Class II	State	Owner	PSD Class II Increment[1]							
			25	30	17	9	4	512	91	20
Breton NWR	LA	FWS	1.955	12.577	1.127	12.559	1.122	1.037	0.417	0.056
Gulf Islands NS	FL,MS	NPS	1.521	13.993	1.241	13.979	1.237	0.410	0.196	0.016
Padre Island NS	TX	NPS	0.198	2.031	0.225	2.030	0.224	0.044	0.022	0.002

NS = National Seashore; NWR = National Wildlife Refuge.

[1] The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD increment consumption analysis.

[2] Based on 2nd highest 24-hour average.

[3] Annual arithmetic mean.

[4] Based on 2nd highest 24-hour average.

Table D-26. Incremental Visibility Impacts Relative to Natural Background Conditions from Source Group A.

Area	Max Δdv	8^{th} High Δdv	No. of Days	
			>1.0	>0.5
Class I Areas				
Bandelier National Monument	0.00067	0.00016	0	0
Black Canyon of the Gunnison National Park	0.00002	0.00000	0	0
Bosque del Apache National Wildlife Refuge	0.00050	0.00018	0	0
Bosque del Apache (Chupadera Unit) Wilderness	0.00036	0.00013	0	0
Bosque del Apache (Indian Well Unit) Wilderness	0.00036	0.00014	0	0
Bosque del Apache (Little San Pascual Unit) Wilderness	0.00072	0.00023	0	0
Big Bend National Park	0.00746	0.00286	0	0
Bradwell Bay Wilderness	0.08487	0.05269	0	0
Breton Wilderness	2.65806	1.54415	22	57
Caney Creek Wilderness	0.21478	0.07569	0	0
Cape Romain Wilderness	0.08319	0.01800	0	0
Carlsbad Caverns National Park	0.00337	0.00163	0	0
Chassahowitzka Wilderness	0.26500	0.11299	0	0
Cohutta Wilderness	0.07214	0.02483	0	0
Dolly Sods Wilderness	0.01130	0.00424	0	0
Eagles Nest Wilderness	0.00009	0.00001	0	0
Everglades National Park	0.13374	0.04721	0	0
Flat Tops Wilderness	0.00002	0.00000	0	0
Great Sand Dunes National Monument	0.00020	0.00006	0	0
Great Smoky Mountains National Park	0.02866	0.01263	0	0
Guadalupe Mountains National Park	0.00283	0.00094	0	0
Hercules-Glades Wilderness	0.05899	0.02394	0	0
James River Face Wilderness	0.00768	0.00391	0	0
Joyce-Kilmer-Slickrock Wilderness	0.02655	0.00881	0	0
La Garita Wilderness	0.00013	0.00001	0	0
Linville Gorge Wilderness	0.01892	0.00436	0	0
Mammoth Cave National Park	0.04330	0.01815	0	0
Maroon Bells-Snowmass Wilderness	0.00007	0.00001	0	0
Mingo National Wildlife Refuge	0.07764	0.04615	0	0
Mount_Zirkel Wilderness	0.00002	0.00000	0	0
Okefenokee National Wildlife Refuge	0.06476	0.03510	0	0
Otter Creek Wilderness	0.01108	0.00356	0	0
Pecos Wilderness	0.00091	0.00023	0	0
Rawah Wilderness	0.00005	0.00001	0	0
Rocky Mountain National Park	0.00023	0.00003	0	0
Saint Marks National Wildlife Refuge	0.24139	0.19294	0	0
Salt Creek Wilderness	0.00278	0.00149	0	0
San Pedro Parks Wilderness	0.00038	0.00010	0	0
Shenandoah National Park	0.02361	0.00945	0	0
Shining Rock Wilderness	0.02231	0.01030	0	0
Sipsey Wilderness	0.09946	0.02484	0	0

Area	Max Δdv	8th High Δdv	No. of Days	
			>1.0	>0.5
Swanquarter National Wildlife Refuge	0.01852	0.00864	0	0
Upper Buffalo Wilderness	0.05460	0.02255	0	0
Weminuche Wilderness	0.00018	0.00002	0	0
West Elk Wilderness	0.00006	0.00001	0	0
Wheeler Peak Wilderness	0.00037	0.00012	0	0
White Mountain Wilderness	0.00085	0.00042	0	0
Wichita Mountains National Wildlife Refuge	0.02963	0.01625	0	0
Wichita Mountains (Charons Garden Unit) Wilderness	0.02932	0.01390	0	0
Wichita Mountains (North Mountain Unit) Wilderness	0.02983	0.01408	0	0
Wolf Island Wilderness	0.10444	0.02825	0	0
Class II Areas				
Breton National Wildlife Refuge	2.51391	1.44000	13	41
Gulf Islands National Seashore	3.59820	1.79194	26	64
Padre Island National Seashore	1.28497	0.44893	2	5

Table D-27. Incremental Visibility Impacts Relative to Natural Background Conditions from Source Group B.

Area	Max Δdv	8th High Δdv	No. of Days	
			>1.0	>0.5
Class I Areas				
Bandelier NM	0.00588	0.00225	0	0
Black Canyon of the Gunnison National Park	0.00027	0.00003	0	0
Bosque del Apache National Wildlife Refuge	0.00927	0.00254	0	0
Bosque del Apache (Chupadera Unit) Wilderness	0.00674	0.00173	0	0
Bosque del Apache (Indian Well Unit) Wilderness	0.00692	0.00183	0	0
Bosque del Apache (Little San Pascual Unit) Wilderness	0.01274	0.00311	0	0
Big Bend National Park	0.06000	0.03458	0	0
Bradwell Bay Wilderness	0.43077	0.29328	0	0
Breton Wilderness	7.77098	6.27094	155	256
Caney Creek Wilderness	1.37302	0.48258	1	7
Cape Romain Wilderness	0.31147	0.08130	0	0
Carlsbad Caverns National Park	0.03024	0.01639	0	0
Chassahowitzka Wilderness	1.35442	0.55791	3	9
Cohutta Wilderness	0.37888	0.12203	0	0
Dolly Sods Wilderness	0.06063	0.03063	0	0
Eagles Nest Wilderness	0.00128	0.00016	0	0
Everglades National Park	0.72032	0.18655	0	2
Flat Tops Wilderness	0.00022	0.00003	0	0
Great Sand Dunes National Monument	0.00329	0.00067	0	0
Great Smoky Mountains National Park	0.15002	0.07991	0	0
Guadalupe Mountains National Park	0.02529	0.01502	0	0
Hercules-Glades Wilderness	0.41027	0.16105	0	0
James River Face Wilderness	0.05739	0.02478	0	0

Joyce-Kilmer-Slickrock Wilderness	0.15156	0.07538	0	0
La Garita Wilderness	0.00252	0.00019	0	0
Linville Gorge Wilderness	0.10346	0.03554	0	0
Mammoth Cave National Park	0.23624	0.09683	0	0
Maroon Bells-Snowmass Wilderness	0.00103	0.00006	0	0
Mingo National Wildlife Refuge	0.44782	0.25368	0	0
Mount_Zirkel Wilderness	0.00019	0.00003	0	0
Okefenokee National Wildlife Refuge	0.40346	0.21507	0	0
Otter Creek Wilderness	0.06577	0.02996	0	0
Pecos Wilderness	0.00863	0.00303	0	0
Rawah Wilderness	0.00062	0.00016	0	0
Rocky Mountain National Park	0.00128	0.00028	0	0
Saint Marks National Wildlife Refuge	1.04546	0.79486	2	23
Salt Creek Wilderness	0.03543	0.01558	0	0
San Pedro Parks Wilderness	0.00562	0.00171	0	0
Shenandoah National Park	0.13636	0.05190	0	0
Shining Rock Wilderness	0.12422	0.06132	0	0
Sipsey Wilderness	0.47703	0.15148	0	0
Swanquarter National Wildlife Refuge	0.09369	0.04563	0	0
Upper Buffalo Wilderness	0.42865	0.16699	0	0
Weminuche Wilderness	0.00268	0.00031	0	0
West Elk Wilderness	0.00100	0.00006	0	0
Wheeler Peak Wilderness	0.00491	0.00148	0	0
White Mountain Wilderness	0.01424	0.00635	0	0
Wichita Mountains National Wildlife Refuge	0.19286	0.10693	0	0
Wichita Mountains (Charons Garden Unit) Wilderness	0.18960	0.08842	0	0
Wichita Mountains (North Mountain Unit) Wilderness	0.19390	0.09435	0	0
Wolf Island Wilderness	0.39934	0.13342	0	0
Class II Areas				
Breton National Wildlife Refuge	7.10912	4.34015	104	193
Gulf Islands National Seashore	10.54646	6.33562	198	311
Padre Island National Seashore	5.10452	3.05326	115	204

D.7.3.1.2 Cumulative Visibility Analysis

For the cumulative visibility impacts analysis, the MATS software was applied with observed PM species concentrations and monthly average relative humidity from IMPROVE monitoring sites to calculate daily visibility impairment at Class I areas from which the W20% and B20% visibility days metrics are determined as described in **Section D.7.2.3.1**. Since not all Class I areas have a co-located IMPROVE monitoring site, IMPROVE observations were mapped to nearby Class I areas that did not include an IMPROVE monitor. In **Table D-28**, the Class I area of interest is shown in the first column and the IMPROVE site used to represent observed visibility at the Class I area is shown in the third column. For example, the IMPROVE data from Dolly Sods Wilderness was used to represent observed visibility for both Dolly Sods Wilderness and Otter Creek Wilderness. The MATS includes mappings of IMPROVE site to Class I areas. However, MATS does not include a mapping for the Breton Wilderness or Bradwell Bay Class I areas and, therefore, cumulative visibility results for these areas are not included in this analysis.

Tables D-28 and D-29 resent results for the W20% visibility days, and **Tables D-30 and D-31** present results for the B20% visibility days. Visibility improvement between the base and future year scenarios (i.e., positive BY-FY results in **Tables D-29 and D-31**) are seen at most Class I areas, with eight areas experiencing reductions in visibility on the W20% days. All of these areas are in New Mexico and Colorado, and Gulf of Mexico sources (Source Group D) contribute less than 0.02 dv to visibility impairment in these areas. The maximum contribution from new platforms and support vessels and helicopters associated with the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) scenario (Source Group B) to any area on the W20% days is 0.04 dv at Caney Creek, Arkansas. Contributions from all Gulf of Mexico sources (Source Group D) are the greatest (0.34 dv) at St. Marks National Wildlife Refuge, Florida.

For the B20% visibility days, 11 areas experience reductions in visibility. All but one of these areas are located in New Mexico and Colorado; the lone exception is Big Bend National Park in Texas. Contributions from Gulf of Mexico sources to these 11 areas are all less than 0.01 dv. The maximum contribution from new platforms and support vessels and helicopters associated with the 2017-2022 GOM Multisale EIS (from which this Supplemental EIS tiers) (Source Group B) to any area on the B20% days is 0.01 dv, which occurs at several sites. Contributions from all Gulf of Mexico sources (Source Group D) are the greatest (0.08 dv) at St. Marks Wilderness in Florida.

Table D-28. Cumulative Visibility Results for 20% Worst Visibility Days (W20%) at Class I Areas for Base (2012) Year (BY) and Future Year (FY) Scenarios with All Sources Included and with Contributions from Each Source Group Removed.

					FY DV without Source Group				
Class I Name	State	IMPROVE Site	BY DV	FY DV	A	B	C	D	E
Bandelier NM	NM	BAND1	11.79	11.93	11.93	11.93	11.93	11.93	7.56
Big Bend NP	TX	BIBE1	16.40	16.11	16.11	16.11	16.10	16.09	11.13
Black Canyon of the Gunnison NM	CO	WEMI1	10.11	10.05	10.05	10.05	10.05	10.05	9.34
Bosque del Apache	NM	BOAP1	13.65	13.90	13.90	13.90	13.90	13.90	10.69
Caney Creek Wilderness	AR	CACR1	22.66	20.59	20.58	20.55	20.45	20.36	13.36
Carlsbad Caverns NP	TX	GUMO1	15.17	15.14	15.14	15.14	15.14	15.14	9.33
Chassahowitzka	FL	CHAS1	21.77	20.43	20.43	20.41	20.35	20.18	11.45
Cohutta Wilderness	GA	COHU1	23.94	21.11	21.11	21.11	21.09	21.06	12.89
Dolly Sods Wilderness	WV	DOSO1	23.45	19.52	19.52	19.52	19.52	19.51	14.64
Eagles Nest Wilderness	CO	WHRI1	8.81	8.72	8.72	8.72	8.72	8.72	7.84
Everglades NP	FL	EVER1	18.33	17.63	17.63	17.63	17.63	17.51	15.00
Flat Tops Wilderness	CO	WHRI1	8.81	8.72	8.72	8.72	8.72	8.72	7.84
Great Sand Dunes NM	CO	GRSA1	11.52	11.62	11.62	11.62	11.62	11.62	8.94
Great Smoky Mountains NP	TN	GRSM1	23.75	20.30	20.30	20.29	20.29	20.28	13.84
Guadalupe Mountains NP	TX	GUMO1	15.17	15.14	15.14	15.14	15.14	15.14	9.33
Hercules-Glades Wilderness	MO	HEGL1	23.50	21.48	21.47	21.46	21.42	21.37	13.21
James River Face Wilderness	VA	JARI1	23.50	20.75	20.75	20.74	20.74	20.73	16.07
Joyce-Kilmer-Slickrock Wilderness	TN	GRSM1	23.75	20.30	20.30	20.29	20.29	20.28	13.84
La Garita Wilderness	CO	WEMI1	10.11	10.05	10.05	10.05	10.05	10.05	9.34
Linville Gorge Wilderness	NC	LIGO1	22.61	19.38	19.38	19.37	19.37	19.36	13.29
Maroon Bells-Snowmass Wilderness	CO	WHRI1	8.81	8.72	8.72	8.72	8.72	8.72	7.84
Mammoth Cave NP	KY	MACA1	26.11	22.68	22.68	22.68	22.67	22.66	14.97
Mount Zirkel Wilderness	CO	MOZI1	9.33	9.20	9.20	9.20	9.20	9.20	7.25
Okefenokee	GA	OKEF1	23.31	21.99	21.99	21.98	21.93	21.87	12.62
Otter Creek Wilderness	WV	DOSO1	23.45	19.52	19.52	19.52	19.52	19.51	14.64
Pecos Wilderness	NM	WHPE1	10.04	10.10	10.10	10.10	10.10	10.10	6.73
Rawah Wilderness	CO	MOZI1	9.33	9.20	9.20	9.20	9.20	9.20	7.25
Cape Romain	SC	ROMA1	23.40	21.77	21.77	21.77	21.73	21.68	13.12
Rocky Mountain NP	CO	ROMO1	12.02	11.86	11.86	11.86	11.86	11.86	9.19

Table D-28. Cumulative Visibility Results for 20% Worst Visibility Days (W20%) at Class I Areas for Base (2012) Year (BY) and Future Year (FY) Scenarios with All Sources Included and with Contributions from Each Source Group Removed. (continued)

					FY DV without Source Group				
Class I Name	State	IMPROVE Site	BY DV	FY DV	A	B	C	D	E
Salt Creek	NM	SACR1	17.22	17.79	17.79	17.79	17.79	17.78	7.30
St. Marks	FL	SAMA1	23.01	21.18	21.18	21.16	21.06	20.84	13.43
San Pedro Parks Wilderness	NM	SAPE1	9.94	9.98	9.98	9.98	9.98	9.98	7.15
Shenandoah NP	VA	SHEN1	22.95	19.42	19.42	19.42	19.41	19.39	14.90
Shining Rock Wilderness	NC	SHRO1	21.90	18.78	18.78	18.77	18.77	18.76	12.25
Sipsey Wilderness	AL	SIPS1	23.98	21.48	21.48	21.47	21.46	21.44	13.01
Swanquarter	NC	SWAN1	22.29	20.39	20.39	20.39	20.38	20.37	13.42
Upper Buffalo Wilderness	AR	UPBU1	22.93	20.90	20.89	20.87	20.79	20.71	12.97
West Elk Wilderness	CO	WHRI1	8.81	8.72	8.72	8.72	8.72	8.72	7.84
Weminuche Wilderness	CO	WEMI1	10.11	10.05	10.05	10.05	10.05	10.05	9.34
White Mountain Wilderness	NM	WHIT1	14.24	14.60	14.60	14.60	14.59	14.59	8.15
Wheeler Peak Wilderness	NM	WHPE1	10.04	10.10	10.10	10.10	10.10	10.10	6.73
Wichita Mountains	OK	WIMO1	21.55	20.33	20.33	20.32	20.31	20.30	10.33
Wolf Island	GA	OKEF1	23.31	21.99	21.99	21.98	21.93	21.87	12.62

NM = National Monument; NP = National Park.

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Table D-29. Differences in Cumulative Visibility Results for 20% Worst Visibility Days (W20%) at Class I Areas Between the Future Year (FY) and Base Year (BY) Scenarios and Contributions of Each Source Group to the Future Year Scenario Visibility.

				FY DV without Source Group				
Class I Name	State	IMPROVE Site	BYFY DV	A	B	C	D	E
Bandelier NM	NM	BAND1	-0.14	0.00	0.00	0.00	0.00	4.37
Big Bend NP	TX	BIBE1	0.29	0.00	0.00	0.01	0.02	4.98
Black Canyon of the Gunnison NM	CO	WEMI1	0.06	0.00	0.00	0.00	0.00	0.71
Bosque del Apache	NM	BOAP1	-0.25	0.00	0.00	0.00	0.00	3.21
Caney Creek Wilderness	AR	CACR1	2.07	0.01	0.04	0.14	0.23	7.23
Carlsbad Caverns NP	TX	GUMO1	0.03	0.00	0.00	0.00	0.00	5.81
Chassahowitzka	FL	CHAS1	1.34	0.00	0.02	0.08	0.25	8.98
Cohutta Wilderness	GA	COHU1	2.83	0.00	0.00	0.02	0.05	8.22
Dolly Sods Wilderness	WV	DOSO1	3.93	0.00	0.00	0.00	0.01	4.88
Eagles Nest Wilderness	CO	WHRI1	0.09	0.00	0.00	0.00	0.00	0.88
Everglades NP	FL	EVER1	0.70	0.00	0.00	0.00	0.12	2.63
Flat Tops Wilderness	CO	WHRI1	0.09	0.00	0.00	0.00	0.00	0.88
Great Sand Dunes NM	CO	GRSA1	-0.10	0.00	0.00	0.00	0.00	2.68
Great Smoky Mountains NP	TN	GRSM1	3.45	0.00	0.01	0.01	0.02	6.46
Guadalupe Mountains NP	TX	GUMO1	0.03	0.00	0.00	0.00	0.00	5.81
Hercules-Glades Wilderness	MO	HEGL1	2.02	0.01	0.02	0.06	0.11	8.27
James River Face Wilderness	VA	JARI1	2.75	0.00	0.01	0.01	0.02	4.68
Joyce-Kilmer-Slickrock Wilderness	TN	GRSM1	3.45	0.00	0.01	0.01	0.02	6.46
La Garita Wilderness	CO	WEMI1	0.06	0.00	0.00	0.00	0.00	0.71
Linville Gorge Wilderness	NC	LIGO1	3.23	0.00	0.01	0.01	0.02	6.09
Maroon Bells-Snowmass Wilderness	CO	WHRI1	0.09	0.00	0.00	0.00	0.00	0.88
Mammoth Cave NP	KY	MACA1	3.43	0.00	0.00	0.01	0.02	7.71
Mount Zirkel Wilderness	CO	MOZI1	0.13	0.00	0.00	0.00	0.00	1.95
Okefenokee	GA	OKEF1	1.32	0.00	0.01	0.06	0.12	9.37
Otter Creek Wilderness	WV	DOSO1	3.93	0.00	0.00	0.00	0.01	4.88
Pecos Wilderness	NM	WHPE1	-0.06	0.00	0.00	0.00	0.00	3.37
Rawah Wilderness	CO	MOZI1	0.13	0.00	0.00	0.00	0.00	1.95
Cape Romain	SC	ROMA1	1.63	0.00	0.00	0.04	0.09	8.65
Rocky Mountain NP	CO	ROMO1	0.16	0.00	0.00	0.00	0.00	2.67

Table D-29. Differences in Cumulative Visibility Results for 20% Worst Visibility Days (W20%) at Class I Areas Between the Future Year (FY) and Base Year (BY) Scenarios and Contributions of Each Source Group to the Future Year Scenario Visibility (continued)

				FY DV without Source Group				
Class I Name	State	IMPROVE Site	BYFY DV	A	B	C	D	E
Salt Creek	NM	SACR1	-0.57	0.00	0.00	0.00	0.01	10.49
St. Marks	FL	SAMA1	1.83	0.00	0.02	0.12	0.34	7.75
San Pedro Parks Wilderness	NM	SAPE1	-0.04	0.00	0.00	0.00	0.00	2.83
Shenandoah NP	VA	SHEN1	3.53	0.00	0.00	0.01	0.03	4.52
Shining Rock Wilderness	NC	SHRO1	3.12	0.00	0.01	0.01	0.02	6.53
Sipsey Wilderness	AL	SIPS1	2.50	0.00	0.01	0.02	0.04	8.47
Swanquarter	NC	SWAN1	1.90	0.00	0.00	0.01	0.02	6.97
Upper Buffalo Wilderness	AR	UPBU1	2.03	0.01	0.03	0.11	0.19	7.93
West Elk Wilderness	CO	WHRI1	0.09	0.00	0.00	0.00	0.00	0.88
Weminuche Wilderness	CO	WEMI1	0.06	0.00	0.00	0.00	0.00	0.71
White Mountain Wilderness	NM	WHIT1	-0.36	0.00	0.00	0.01	0.01	6.45
Wheeler Peak Wilderness	NM	WHPE1	-0.06	0.00	0.00	0.00	0.00	3.37
Wichita Mountains	OK	WIMO1	1.22	0.00	0.01	0.02	0.03	10.00
Wolf Island	GA	OKEF1	1.32	0.00	0.01	0.06	0.12	9.37

NM = National Monument; NP = National Park.

Table D-30. Cumulative Visibility Results for 20% Best Visibility Days (B20%) at Class I Areas for Base (2012) Year (BY) and Future Year (FY) Scenarios with All Sources Included and with Contributions from Each Source Group Removed.

					FY DV without Source Group				
Class I Name	State	IMPROVE Site	BY DV	FY DV	A	B	C	D	E
Bandelier NM	NM	BAND1	3.81	3.96	3.96	3.96	3.96	3.96	1.51
Big Bend NP	TX	BIBE1	5.76	5.86	5.86	5.86	5.86	5.86	3.50
Black Canyon of the Gunnison NM	CO	WEMI1	2.04	2.18	2.18	2.18	2.18	2.18	1.55
Bosque del Apache	NM	BOAP1	5.57	5.60	5.60	5.60	5.60	5.60	3.60
Caney Creek Wilderness	AR	CACR1	9.82	9.25	9.25	9.24	9.22	9.20	5.15
Carlsbad Caverns NP	TX	GUMO1	5.08	5.03	5.03	5.03	5.03	5.03	2.39
Chassahowitzka	FL	CHAS1	14.05	13.55	13.55	13.54	13.52	13.34	8.22
Cohutta Wilderness	GA	COHU1	11.47	10.59	10.59	10.59	10.59	10.58	4.62
Dolly Sods Wilderness	WV	DOSO1	9.18	8.38	8.38	8.38	8.38	8.37	5.63
Eagles Nest Wilderness	CO	WHRI1	0.48	0.39	0.39	0.39	0.39	0.39	0.00
Everglades NP	FL	EVER1	11.29	11.08	11.08	11.07	11.06	10.99	8.01
Flat Tops Wilderness	CO	WHRI1	0.48	0.39	0.39	0.39	0.39	0.39	0.00
Great Sand Dunes NM	CO	GRSA1	3.57	3.56	3.56	3.56	3.56	3.56	2.20
Great Smoky Mountains NP	TN	GRSM1	11.10	9.78	9.78	9.78	9.78	9.77	4.22
Guadalupe Mountains NP	TX	GUMO1	5.08	5.03	5.03	5.03	5.03	5.03	2.39
Hercules-Glades Wilderness	MO	HEGL1	11.29	10.84	10.84	10.84	10.83	10.82	5.94
James River Face Wilderness	VA	JARI1	12.36	11.26	11.26	11.26	11.25	11.25	7.13
Joyce-Kilmer-Slickrock Wilderness	TN	GRSM1	11.10	9.78	9.78	9.78	9.78	9.77	4.22
La Garita Wilderness	CO	WEMI1	2.04	2.18	2.18	2.18	2.18	2.18	1.55
Linville Gorge Wilderness	NC	LIGO1	9.96	9.21	9.21	9.21	9.20	9.19	4.85
Maroon Bells-Snowmass Wilderness	CO	WHRI1	0.48	0.39	0.39	0.39	0.39	0.39	0.00
Mammoth Cave NP	KY	MACA1	14.20	13.04	13.04	13.04	13.03	13.02	7.41
Mount Zirkel Wilderness	CO	MOZI1	0.89	0.79	0.79	0.79	0.79	0.79	0.00
Okefenokee	GA	OKEF1	13.40	12.89	12.89	12.89	12.88	12.85	7.58
Otter Creek Wilderness	WV	DOSO1	9.18	8.38	8.38	8.38	8.38	8.37	5.63
Pecos Wilderness	NM	WHPE1	1.09	1.24	1.24	1.24	1.24	1.24	0.00
Rawah Wilderness	CO	MOZI1	0.89	0.79	0.79	0.79	0.79	0.79	0.00
Cape Romain	SC	ROMA1	13.79	13.09	13.09	13.09	13.09	13.08	8.48
Rocky Mountain NP	CO	ROMO1	1.64	1.62	1.62	1.62	1.62	1.62	0.53
Salt Creek	NM	SACR1	7.11	7.42	7.42	7.42	7.42	7.42	2.89
St. Marks	FL	SAMA1	13.73	13.00	12.99	12.99	12.92	12.75	8.31
San Pedro Parks Wilderness	NM	SAPE1	1.30	1.37	1.37	1.37	1.37	1.37	0.61

					FY DV without Source Group				
Class I Name	State	IMPROVE Site	BY DV	FY DV	A	B	C	D	E
Shenandoah NP	VA	SHEN1	8.68	7.66	7.66	7.66	7.65	7.65	4.56
Shining Rock Wilderness	NC	SHRO1	6.58	5.81	5.80	5.80	5.79	5.79	2.03
Sipsey Wilderness	AL	SIPS1	13.10	12.20	12.20	12.19	12.16	12.13	6.79
Swanquarter	NC	SWAN1	11.76	11.09	11.09	11.08	11.08	11.08	7.45
Upper Buffalo Wilderness	AR	UPBU1	10.35	9.80	9.80	9.79	9.77	9.76	5.03
West Elk Wilderness	CO	WHRI1	0.48	0.39	0.39	0.39	0.39	0.39	0.00
Weminuche Wilderness	CO	WEMI1	2.04	2.18	2.18	2.18	2.18	2.18	1.55
White Mountain Wilderness	NM	WHIT1	3.24	3.45	3.45	3.45	3.45	3.45	1.41
Wheeler Peak Wilderness	NM	WHPE1	1.09	1.24	1.24	1.24	1.24	1.24	0.00
Wichita Mountains	OK	WIMO1	9.53	9.24	9.24	9.24	9.24	9.24	5.36
Wolf Island	GA	OKEF1	13.40	12.89	12.89	12.89	12.88	12.85	7.58

NM = National Monument; NP = National Park.

Table D-31. Differences in Cumulative Visibility Results for 20% Best Visibility Days (B20%) at Class I Areas Between the Future Year (FY) and Base Year (BY) Scenarios and Contributions of Each Source Group to the Future Year Scenario Visibility.

				Source Group Contribution to FY DV				
Class I Name	State	IMPROVE Site	BY - FY DV	A	B	C	D	E
Bandelier NM	NM	BAND1	-0.15	0.00	0.00	0.00	0.00	2.45
Big Bend NP	TX	BIBE1	-0.10	0.00	0.00	0.00	0.00	2.36
Black Canyon of the Gunnison NM	CO	WEMI1	-0.14	0.00	0.00	0.00	0.00	0.63
Bosque del Apache	NM	BOAP1	-0.03	0.00	0.00	0.00	0.00	2.00
Caney Creek Wilderness	AR	CACR1	0.57	0.00	0.01	0.03	0.05	4.10
Carlsbad Caverns NP	TX	GUMO1	0.05	0.00	0.00	0.00	0.00	2.64
Chassahowitzka	FL	CHAS1	0.50	0.00	0.01	0.03	0.21	5.33
Cohutta Wilderness	GA	COHU1	0.88	0.00	0.00	0.00	0.01	5.97
Dolly Sods Wilderness	WV	DOSO1	0.80	0.00	0.00	0.00	0.01	2.75
Eagles Nest Wilderness	CO	WHRI1	0.09	0.00	0.00	0.00	0.00	0.39
Everglades NP	FL	EVER1	0.21	0.00	0.01	0.02	0.09	3.07
Flat Tops Wilderness	CO	WHRI1	0.09	0.00	0.00	0.00	0.00	0.39
Great Sand Dunes NM	CO	GRSA1	0.01	0.00	0.00	0.00	0.00	1.36
Great Smoky Mountains NP	TN	GRSM1	1.32	0.00	0.00	0.00	0.01	5.56
Guadalupe Mountains NP	TX	GUMO1	0.05	0.00	0.00	0.00	0.00	2.64
Hercules-Glades Wilderness	MO	HEGL1	0.45	0.00	0.00	0.01	0.02	4.90
James River Face Wilderness	VA	JARI1	1.10	0.00	0.00	0.01	0.01	4.13
Joyce-Kilmer-Slickrock Wilderness	TN	GRSM1	1.32	0.00	0.00	0.00	0.01	5.56

				Source Group Contribution to FY DV				
Class I Name	State	IMPROVE Site	BY - FY DV	A	B	C	D	E
La Garita Wilderness	CO	WEMI1	-0.14	0.00	0.00	0.00	0.00	0.63
Linville Gorge Wilderness	NC	LIGO1	0.75	0.00	0.00	0.01	0.02	4.36
Maroon Bells-Snowmass Wilderness	CO	WHRI1	0.09	0.00	0.00	0.00	0.00	0.39
Mammoth Cave NP	KY	MACA1	1.16	0.00	0.00	0.01	0.02	5.63
Mount Zirkel Wilderness	CO	MOZI1	0.10	0.00	0.00	0.00	0.00	0.79
Okefenokee	GA	OKEF1	0.51	0.00	0.00	0.01	0.04	5.31
Otter Creek Wilderness	WV	DOSO1	0.80	0.00	0.00	0.00	0.01	2.75
Pecos Wilderness	NM	WHPE1	-0.15	0.00	0.00	0.00	0.00	1.24
Rawah Wilderness	CO	MOZI1	0.10	0.00	0.00	0.00	0.00	0.79
Cape Romain	SC	ROMA1	0.70	0.00	0.00	0.00	0.01	4.61
Rocky Mountain NP	CO	ROMO1	0.02	0.00	0.00	0.00	0.00	1.09
Salt Creek	NM	SACR1	-0.31	0.00	0.00	0.00	0.00	4.53
St. Marks	FL	SAMA1	0.73	0.01	0.01	0.08	0.25	4.69
San Pedro Parks Wilderness	NM	SAPE1	-0.07	0.00	0.00	0.00	0.00	0.76
Shenandoah NP	VA	SHEN1	1.02	0.00	0.00	0.01	0.01	3.10
Shining Rock Wilderness	NC	SHRO1	0.77	0.01	0.01	0.02	0.02	3.78
Sipsey Wilderness	AL	SIPS1	0.90	0.00	0.01	0.04	0.07	5.41
Swanquarter	NC	SWAN1	0.67	0.00	0.01	0.01	0.01	3.64
Upper Buffalo Wilderness	AR	UPBU1	0.55	0.00	0.01	0.03	0.04	4.77
West Elk Wilderness	CO	WHRI1	0.09	0.00	0.00	0.00	0.00	0.39
Weminuche Wilderness	CO	WEMI1	-0.14	0.00	0.00	0.00	0.00	0.63
White Mountain Wilderness	NM	WHIT1	-0.21	0.00	0.00	0.00	0.00	2.04
Wheeler Peak Wilderness	NM	WHPE1	-0.15	0.00	0.00	0.00	0.00	1.24
Wichita Mountains	OK	WIMO1	0.29	0.00	0.00	0.00	0.00	3.88
Wolf Island	GA	OKEF1	0.51	0.00	0.00	0.01	0.04	5.31

NM = National Monument; NP = National Park.

D.7.3.2 Acid Deposition

The CAMx-predicted wet and dry fluxes of sulfur- and nitrogen-containing species were processed to estimate total annual sulfur and nitrogen deposition values at each Class I and sensitive Class II area in the 12/4-km modeling domain. As described in **Section D.6.2.3.2**, the maximum annual sulfur and nitrogen deposition values from any grid cell that intersects a Class I or sensitive Class II receptor area was used to represent deposition for that area, in addition to the average annual deposition values of all grid cells that intersect a Class I or sensitive Class II receptor area. Maximum and average predicted sulfur and nitrogen deposition impacts were estimated separately for each source group and together across all source groups.

As a screening analysis, incremental deposition values in Class I/II areas for combined Source Groups A (new platforms associated with the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers) and B (new platforms and associated support vessels and helicopters associated with the 2017-2022 GOM Multisale EIS scenario, from which this Supplemental EIS tiers) were compared to the eastern and western U.S. Deposition Analysis Thresholds (DATs) listed in **Table D-32**. These DATs are specified in the FLAG guidance[25] and are further described in **Section D.6.2.3.2** above. Results of the incremental deposition analysis are summarized in **Table D-33** for Class I/II areas in the 4-km modeling domain. Deposition results were also obtained for all other sensitive areas throughout the 12 km-modeling domain, but the highest deposition values all occurred within the 4-km domain. The dividing line between the eastern and western DATs specified in the FLAG guidance is the Mississippi River, which makes sense for most locations in the U.S. but it is not necessarily clear which DAT would be most appropriate for coastal locations along the Gulf of Mexico so results are compared here against both DATs. Note that comparisons of deposition impacts from cumulative sources as represented by Source Groups C, D, E, and F to the DAT are not appropriate. Incremental nitrogen deposition exceeds the western and eastern DATs at all three locations. Incremental sulfur deposition is below the DATs in all cases except the sulfur deposition from Source Group B at Breton Wilderness and Gulf Islands National Seashore, which exceeds the western DAT but not the eastern DAT.

Table D-32. Deposition Analysis Threshold Values (kg/ha/yr) as Defined in the Federal Land Manager Guidance (FLAG, 2010).

	Nitrogen	Sulfur
East	0.010	0.010
West	0.005	0.005

Table D-33. Incremental Deposition Impacts from Source Groups A and B at Class I and Sensitive Class II Areas in the 4-km Domain.

<table>
<tr><th rowspan="3">Area</th><th rowspan="3"></th><th colspan="4">Source Group A</th><th colspan="4">Source Group B</th></tr>
<tr><th colspan="2">Nitrogen</th><th colspan="2">Sulfur</th><th colspan="2">Nitrogen</th><th colspan="2">Sulfur</th></tr>
<tr><th>Max</th><th>Avg</th><th>Max</th><th>Avg</th><th>Max</th><th>Avg</th><th>Max</th><th>Avg</th></tr>
<tr><td rowspan="3">Breton Wilderness</td><td>Annual Deposition</td><td>0.0589</td><td>0.0501</td><td>0.0045</td><td>0.0039</td><td>0.3496</td><td>0.2701</td><td>0.0079</td><td>0.0061</td></tr>
<tr><td>Exceeds Eastern DAT?</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>Exceeds Western DAT?</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td rowspan="3">Gulf Islands National Seashore</td><td>Annual Deposition</td><td>0.0909</td><td>0.0383</td><td>0.0046</td><td>0.0025</td><td>0.4560</td><td>0.2151</td><td>0.0064</td><td>0.0039</td></tr>
<tr><td>Exceeds Eastern DAT?</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>Exceeds Western DAT?</td><td>Yes</td><td>Yes</td><td>No</td><td>No</td><td>Yes</td><td>Yes</td><td>Yes</td><td>No</td></tr>
</table>

[25] *Guidance on Nitrogen and Sulfur Deposition Analysis Thresholds* (http://www.nature.nps.gov/air/Pubs/pdf/flag/nsDATGuidance.pdf).

Area		Source Group A				Source Group B			
		Nitrogen		Sulfur		Nitrogen		Sulfur	
		Max	Avg	Max	Avg	Max	Avg	Max	Avg
Padre Island National Seashore	Annual Deposition	0.0458	0.0190	0.0012	0.0010	0.2410	0.1044	0.0019	0.0015
	Exceeds Eastern DAT?	Yes	Yes	No	No	Yes	Yes	No	No
	Exceeds Western DAT?	Yes	Yes	No	No	Yes	Yes	No	No

Cumulative deposition from all sources combined for the base case and future year scenarios were compared against applicable critical load levels in each Class I/II area for which critical loads were identified as described in **Section D.6.2.3.2**. Results are summarized in **Table D-34**. Cumulative nitrogen deposition is projected to decrease in all areas between the 2012 base case and the 2017 future year, consistent with an overall reduction in NO_x emissions. Nevertheless, maximum nitrogen deposition is modeled to continue exceeding the critical load thresholds under the future year scenario for all areas except the Padre Island National Seashore. Sulfur deposition values are lower, and larger sulfur emission reductions help to reduce sulfur deposition from above the critical load to below the critical load at Breton Wilderness, Breton National Wildlife Refuge, and Cohutta Wilderness (based on maximum grid cell values). Nevertheless, the maximum grid cell sulfur deposition still exceeds the critical load at the Gulf Islands National Seashore by a small margin.

Table D-34. Cumulative Nitrogen (N) and Sulfur (S) Deposition Impacts (kg/ha/yr) under the Base and Future Year Scenarios (shading indicates values exceeding the Critical Load threshold).

Class I/II Area	Critical Load Threshold	2012 Base Case				2017 Future Year			
		N-Max	N-Avg	S-Max	S-Avg	N-Max	N-Avg	S-Max	S-Avg
Big Bend National Park	3	3.6	2.5	2.3	1.1	3.6	2.5	2.2	1.0
Breton Wilderness	3	7.8	7.1	4.1	3.6	7.7	6.9	2.8	2.5
Breton National Wildlife Refuge	3	7.2	6.9	3.7	3.5	7.0	6.7	2.6	2.4
Gulf Islands National Seashore	3	13.8	7.0	5.3	4.4	13.0	6.7	3.6	2.9
Padre Island National Seashore	5	4.5	2.2	1.5	1.2	4.6	2.2	1.1	0.9
Bradwell Bay Wilderness	5	6.5	6.2	2.5	2.3	6.0	5.8	1.8	1.7
Saint Marks National Wildlife Refuge	3	6.8	5.2	2.5	2.0	6.2	4.7	1.8	1.5
Saint Marks Wilderness	3	6.1	4.9	2.0	1.9	5.6	4.5	1.5	1.4
Chassahowitzka Wilderness	3	6.8	6.1	2.5	2.5	6.0	5.4	1.9	1.9
Everglades National Park	5	7.5	4.7	3.9	2.2	6.9	4.5	2.4	1.7
Okefenokee National Wildlife Refuge	3	6.0	5.7	2.3	2.1	5.6	5.3	1.8	1.7
Okefenokee Wilderness	3	6.5	5.5	2.6	2.1	6.1	5.1	2.1	1.7
Wolf Island Wilderness	3	3.3	3.1	2.1	2.0	3.0	2.8	1.5	1.4

Class I/II Area	Critical Load Threshold	2012 Base Case				2017 Future Year			
		N-Max	N-Avg	S-Max	S-Avg	N-Max	N-Avg	S-Max	S-Avg
Cohutta Wilderness	5	11.5	10.2	5.4	4.3	10.6	9.3	3.6	2.9
Sipsey Wilderness	5	9.4	9.0	3.2	3.2	9.1	8.6	2.1	2.1
Guadalupe Mountains National Park	3	3.3	2.6	1.1	0.7	3.2	2.5	0.9	0.6
Wichita Mountains (Charons Garden Unit) Wilderness	5	5.6	5.6	1.7	1.7	5.4	5.4	1.5	1.5
Wichita Mountains (North Mountain Unit) Wilderness	5	6.3	6.3	1.8	1.8	6.1	6.1	1.5	1.5
Wichita Mountains National Wildlife Refuge	5	6.5	6.0	1.8	1.7	6.2	5.8	1.5	1.5
Caney Creek Wilderness	5	9.3	9.2	3.7	3.6	9.1	9.0	2.3	2.3
Upper Buffalo Wilderness	5	7.4	7.4	2.5	2.5	7.1	7.1	1.7	1.7

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APPENDIX E

RESPONSES TO PUBLIC COMMENTS ON THE DRAFT SUPPLEMENTAL EIS

E RESPONSES TO PUBLIC COMMENTS ON THE DRAFT SUPPLEMENTAL EIS

All comments (i.e., letters, public meeting transcripts, electronic submissions, etc.) were analyzed to identify all substantive issues raised by the public. Each substantive issue within an individual's comment was assigned a unique identifier. For example, the first substantive comment from the United States Environmental Protection Agency was assigned USEPA-1. Comments were then grouped by similar issues into nine major categories, and responses are provided for each issue. The comments were reproduced verbatim as they were received. When similar issues were raised by several commenters, a single response has been provided for multiple comments. The comments and responses are presented in a matrix (**Table E-1**) and are organized by the following nine topics: Topic 1–NEPA Process and Public Involvement; Topic 2–NEPA Analysis; Topic 3–Alternatives; Topic 4–Environmental Issues and Concerns; Topic 5–Cumulative Analysis; Topic 6–Oil Spills; Topic 7–Mitigation; Topic 8–Regulations and Safety; and Topic 9–Other. Some topics include subtopics to further group similar comments. Topic 3 includes a subtopic on stated preference for those commenters who stated a preference for a particular alternative. Topic 4 has 15 subtopics (i.e., Climate Change, Greenhouse Gases, Well Stimulation, Renewable Energy and Alternative Uses of the OCS, Natural Stressors, Air Quality, Water Quality, Coastal Habitats, Deepwater Benthic Communities, *Sargassum* and Associated Communities, Marine Mammals, Commercial Fisheries, Land Use and Coastal Infrastructure, Economic Factors, and Social Factors [Including Environmental Justice]) to separate the various environmental issues and concerns raised by commenters.

An index of comments, which is organized by topic and commenter, can be found below. An individual or group can search by name to more quickly find BOEM's response.

Topic 1 – NEPA Process and Public Involvement

- American Petroleum Institute: API-1
- Louisiana Mid-Continent Oil and Gas Association: LMOGA-1
- National Ocean Industries Association: NOIA-1
- Offshore Operators Committee: OOC-1
- Maggi Roberts: MaRo-1
- Jackie Antalan: JA-1, JA-8, JA-5
- M. Fleming: MF-5, MF-4
- Barbara Brewster: BB-2, BB-1
- Lorie Chinn: LC-1, LC-2

Topic 2 – NEPA Analysis

- Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade: CBD,SC,GRN,LBB-1; CBD,SC,GRN,LBB-3; CBD,SC,GRN,LBB-4; CBD,SC,GRN,LBB-5; CBD,SC,GRN,LBB-6
- David Quist: DQ-13
- Sierra Club: SC-3, SC-2
- John Warden: JW-2
- Joint Trades: JT-28
- Alicia Cooke: AC-7
- Gulf Restoration Network: GRN-11
- Allison Kalnik: AK-3
- M. Fleming: MF-3
- Peter Shrock: PS-8
- Mobile Environmental Justice Action Coalition: MEJAC-4
- Dyan Gibson: DyGi-1
- Jodi Koszarek: JK-1
- June Charles: JC-3
- Rebecca King: RK-9
- 350 Louisiana - New Orleans: 350LANO-2
- Renate Heurich: RH-2
- United States Environmental Protection Agency: USEPA-3
- United States Fish and Wildlife Service: USFWS-1

Topic 3 – Alternatives

- Peter Shrock: PS-7, PS-10, PS-9
- Gulf Restoration Network: GRN-4
- Allison Kalnik: AK-2
- Eli Lamb: EL-1
- Alicia Cooke: AC-1

Stated Preference

- Consumer Energy Alliance: CEA-1, CEA-4
- Beth Everage, Consumer Energy Alliance: BECEA-1
- Florida Department of Environmental Protection: FDEP-1
- Alicia Cooke: AC-6
- Amy Merrill: AmMe-1
- Bill Clarke: BC-1
- Carole Tebay: CT-1
- David Quist: DQ-1
- Jean Publeee: JP-1
- June Charles: JC-4
- Sierra Club: SC-1
- Lisa Rogers: LR-1
- Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade: CBD,SC,GRN,LBB-14; CBD,SC,GRN,LBB-2
- Nicholas Gault: NG-1
- Peter Shrock: PS-13
- Mobile Environmental Justice Action Coalition: MEJAC-9
- Rebecca King: RK-10
- Ryan Bowman: RB-1
- Sarah Danner: SD-1
- Kevin Holm: KH-1
- Sarah Howard: SH-1
- Valerie Longa: VL-2
- Carol “Cay” Burton: CB-1, CB-3
- Jackie Hartstein: JH-3
- Care2: Care2-1
- Bob Smith: BoSm-1
- Carol A. “Cay” Burton: CAB-1, CAB-3

- Kathleen McBride: KM-1
- Lorie Chinn: LC-3
- Bonnie Aylward: BA-4
- Pam Scaggs, South Baldwin Democrats: PSSBD-2
- Donna Baker: DB-1
- Francine Slack: FS-1
- Deborah Jiminez: DJ-1
- Brian A. Mayhew: BAM-1
- Daryl Frahn: DaFr-1
- Mobile Environmental Justice Action Coalition: MEJAC-1, MEJAC-8
- Janice Overstreet: JO-1
- James Sorrells: JaSo-1
- Daniel Gillis: DaGi-1
- Dennis Rentschler: DR-1
- Gary Stephens: GS-1
- Ron Masters: RM-1
- David Gorchov: DaGo-1, DaGo-5
- Jensie Madden: JM-1

Topic 4 – Environmental Issues and Concerns

Climate Change

- Allison Kalnik: AK-1
- Peter Shrock: PS-11
- Rebecca King: RK-11, RK-7
- David Quist: DQ-3, DQ-6
- David Gorchov: DaGo-4
- Gulf Restoration Network: GRN-12, GRN-13
- Wendy King: WK-1, WK-2

- Jodi Koszarek: JK-2
- Amanda Munson: AmMu-1

Greenhouse Gases

- Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade: CBD,SC,GRN,LBB-7; CBD,SC,GRN,LBB-8; CBD,SC,GRN,LBB-9
- Renate Heurich: RH-3, RH-1
- Michael Robertshaw: MiRo-1
- Eli Lamb: EL-2
- Rebecca King: RK-8
- 350 Louisiana - New Orleans: 350LANO-1; 350LANO-5

Well Stimulation

- Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade: CBD,SC,GRN,LBB-10
- Peter Shrock: PS-4
- Maggi Roberts: MaRo-3
- Rebecca King: RK-6
- 350 Louisiana - New Orleans: 350LANO-4
- William Myers: WM-1
- June Charles: JC-2

Renewable Energy and Alternative Uses of the OCS

- Alicia Cooke: AC-2, AC-5
- Ryan Bowman: RB-2
- Valerie Longa: VL-1, VL-3
- Jackie Hartstein: JH-4
- Kathryn R. Smith: KS-1
- Lorie Chinn: LC-6
- M. Fleming: MF-1, MF-6
- Pam Scaggs, South Baldwin Democrats: PSSBD-3

- Carol A. “Cay” Burton: CAB-5
- Carol “Cay” Burton: CB-5
- David Gorchov: DaGo-3
- John Warden: JW-3

Natural Stressors

- Jean Publeee: JP-3
- Carol “Cay” Burton: CB-4
- Carol A. “Cay” Burton: CAB-4

Air Quality

- Consumer Energy Alliance: CEA-3
- David Quist: DQ-4
- Maggi Roberts: MaRo-2
- United States Environmental Protection Agency: USEPA-1, USEPA-4, USEPA-5, USEPA-6, USEPA-7, USEPA-8, USEPA-9, USEPA-10, USEPA-11, USEPA-12, USEPA-13, USEPA-14, USEPA-15, USEPA-16, USEPA-17, USEPA-18, USEPA-19, USEPA-20, USEPA-21, USEPA-22, USEPA-23, USEPA-24, USEPA-25, USEPA-26, USEPA-27, USEPA-28, USEPA-29, USEPA-30, USEPA-31, USEPA-32, USEPA-33, USEPA-34, USEPA-35, USEPA-36, USEPA-37, USEPA-38, USEPA-39, USEPA-40, USEPA-41, USEPA-42, USEPA-43, USEPA-44, USEPA-45, USEPA-46, USEPA-47
- Joint Trades: JT-1, JT-2, JT-3, JT-4, JT-5, JT-6, JT-7, JT-8, JT-9, JT-10, JT-11, JT-12, JT-13, JT-14, JT-15, JT-16, JT-17, JT-18, JT-19, JT-20, JT-21, JT-22, JT-23, JT-24, JT-25, JT-26, JT-27, JT-30, JT-31

Water Quality

- David Quist: DQ-5

Coastal Habitats

- Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade : CBD,SC,GRN,LBB-11
- Joint Trades: JT-29
- Chelsea Gray: CG-1

- United States Environmental Protection Agency: USEPA-2
- National Park Service: NPS-1

Deepwater Benthic Communities

- Chelsea Gray: CG-2
- David Quist: DQ-9

Sargassum *and Associated Communities*

- David Quist: DQ-10
- Gulf Restoration Network: GRN-8

Marine Mammals

- Chelsea Gray: CG-4
- Rebecca King: RK-2
- Gulf Restoration Network: GRN-9, GRN-10
- David Quist: DQ-12

Commercial Fisheries

- Chelsea Gray: CG-5, CG-7

Land Use and Coastal Infrastructure

- Alicia Cooke: AC-3
- Gulf Restoration Network: GRN-2
- Chris Werle: CW-1
- June Charles: JC-1
- Penny Dipuma: PD-1
- Carol “Cay” Burton: CB-2
- Carol A. “Cay” Burton: CAB-2

Economic Factors

- Chelsea Gray: CG-6
- Jackie Antalan: JA-2
- Mobile Environmental Justice Action Coalition: MEJAC-5
- Jean Publeee: JP-2, JP-4

Social Factors (Including Environmental Justice)

- Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade: CBD,SC,GRN,LBB-13
- Peter Shrock: PS-6
- Mobile Environmental Justice Action Coalition: MEJAC-2
- Sierra Club: SC-5
- Gulf Restoration Network: GRN-14

Topic 5 – Cumulative Analysis

- Chelsea Gray: CG-3
- David Quist: DQ-2
- Lorie Chinn: LC-5
- Peter Shrock: PS-12

Topic 6 – Oil Spills

- David Quist: DQ-8
- Maggi Roberts: MaRo-4
- Gulf Restoration Network: GRN-1, GRN-3, GRN-6, GRN-5, GRN-7
- Sierra Club: SC-4
- Rebecca King: RK-1, RK-3, RK-4, RK-5
- Eli Lamb: EL-3
- Susan Prerost: SP-1
- Lorie Chinn: LC-4
- Bill McBride: BM-1
- Alan Ackerman: AA-1

- Judith Shields: JuSh-1
- Anonymous: ANON-1
- Ryan Bowman: RB-4
- Peter Shrock: PS-1, PS-2
- 350 Louisiana - New Orleans: 350LANO-3
- Bonnie Aylward: BA-1
- Pam Scaggs, South Baldwin Democrats: PSSBD-1
- Jackie Hartstein: JH-1

Topic 7 – Mitigation

- David Quist: DQ-11
- Peter Shrock: PS-5
- Alabama Department of Environmental Management: ADEM-1
- Mobile Environmental Justice Action Coalition: MEJAC-7
- Charles Frey: CF-1

Topic 8 – Regulations and Safety

- Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade: CBD,SC,GRN,LBB-12
- Peter Shrock: PS-3
- Jackie Antalan: JA-4
- Bill McBride: BM-2
- M. Fleming: MF-2
- Jodi Koszarek: JK-3
- Jackie Hartstein: JH-2
- Judy Fisher: JF-1, JF-2, JF-3, JF-4, JF-5, JF-6, JF-7, JF-8
- Bud See: BuSe-1
- John Warden: JW-1

Topic 9 – Other

- David Quist: DQ-7
- Maggi Roberts: MaRo-5, MaRo-6
- David Gorchov: DaGo-2
- Mobile Environmental Justice Action Coalition: MEJAC-6, MEJAC-3
- Bill McBride: BM-3
- Alicia Cooke: AC-4
- Ryan Bowman: RB-3
- Consumer Energy Alliance: CEA-2
- Beth Everage, Consumer Energy Alliance: BECEA-2
- Jackie Antalan: JA-3, JA-6, JA-7
- Bonnie Aylward: BA-2, BA-3
- Denise Folley: DeFo-1

Table E-1. Public Comments and BOEM's Response Matrix.

Commenter	Comment ID	Comment	Response
Topic 1 – NEPA Process and Public Involvement			
American Petroleum Institute	API-1	On March 31, 2017 the Bureau of Ocean Energy Management (BOEM) provided a notice of availability of the Gulf of Mexico Outer Continental Shelf Lease Sale Draft Supplemental Environmental Impact Statement 2018 (Draft Supplemental EIS). The Draft Supplemental EIS is expected to be used to inform decisions on each of two lease sales scheduled in 2018. The American Petroleum Institute (API) requests that BOEM extend the comment period for the Draft Supplemental EIS by an additional 30 days (providing a 75-day comment period). The Draft Supplemental EIS includes information on an air quality analysis that was completed for the Final 2017-2022 GOM Multisale EIS but which was not previously made available for public review. This new air quality information is extensive and complex, and additional time to review the air quality modeling inputs, methodologies and results would allow for more substantive and meaningful stakeholder comment. BOEM specifically notes in Chapter 4 of the Draft Supplemental EIS that it "looks forward to receiving relevant comments on the methods used in air quality modeling and the resulting analyses". We appreciate your consideration of this request.	On March 31, 2017, BOEM published a Notice of Availability for the Draft 2018 GOM Supplemental EIS. The National Environmental Policy Act (NEPA) requires a 45-day comment period on Draft EISs, which is a period that may be extended at the discretion of the agency issuing the document. In the case of the Draft 2018 GOM Supplemental EIS, BOEM determined that an additional 30-day review would be granted to the five parties that specifically requested an extension to provide comments on the air quality analysis. An email was sent to the five parties that requested the extension, indicating that BOEM would accept comments on the air quality analysis in the Draft 2018 GOM Supplemental EIS until June 14, 2017. Comments on the rest of the Draft 2018 GOM Supplemental EIS, however, were to be submitted by the end of the 45-day comment period, which was May 15, 2015. No additional comments were received on the air quality analysis during the extension period.
Louisiana Mid-Continent Oil and Gas Association	LMOGA-1	The Louisiana Mid-Continent Oil & Gas Association respectfully requests that the Bureau of Ocean Energy Management (BOEM) extend the 45-day comment period on the proposed Gulf of Mexico Outer Continental Shelf Lease Sale Draft Supplemental Environmental Impact Statement 2018 (the "Draft SEIS") to 75 days (an additional 30 days). LMOGA recognizes the Bureau's need to issue the	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Draft SEIS in order to provide business critical services supporting oil and natural gas development; however, we would appreciate more time to review the document in order to provide informed, substantive feedback. An extension of the comment period is justified given that BOEM has included substantial new information in the Air Quality section of the document. In fact, BOEM has stated in the Draft SEIS that, "...since this air quality analysis was completed for the Final 2017-2002 GOM Multisale EIS and did not have the benefit of public review, the complete analysis is included in this Supplemental EIS for public review and comment. BOEM looks forward to receiving relevant comments on the methods used in air quality modeling and the resulting analyses." Given the complexity of the air quality information included in the Draft SEIS, and the fact that this is the first opportunity for the public to review and comment on the air quality analysis, we believe additional time is warranted to generate relevant comments to benefit BOEM's final SEIS. The Louisiana Mid-Continent Oil & Gas Association (LMOGA) is Louisiana's longest standing trade association, exclusively representing all aspects of the oil and gas industry onshore and offshore, including exploration, production, mid-stream activities, pipeline, refining and marketing. Louisiana is a significant supporter of OCS activity in the Gulf, which accounts for more than 17 percent of the Nation's oil production and about five percent of natural gas production. Comments submitted on behalf of LMOGA are submitted without prejudice to any member's right to have or express different or opposing views. We	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		appreciate your consideration of this request for an extension.	
National Ocean Industries Association	NOIA-1	The National Ocean Industries Association (NOIA) respectfully requests that the Bureau of Ocean Energy Management (BOEM) extend the 45-day comment period on the proposed Gulf of Mexico Outer Continental Shelf Lease Sale Draft Supplemental Environmental Impact Statement 2018 (the "Draft SEIS") to 75 days (an additional 30 days). NOIA is the only trade association representing all segments of the offshore industry and has nearly 300 member companies with an interest in the exploration and production of both traditional and renewable energy resources. NOIA's mission is to secure reliable access and a fair regulatory and economic environment for the companies that develop the nation's valuable offshore energy resources in an environmentally responsible manner. NOIA recognizes the Bureau's need to issue the Draft SEIS in order to provide business critical services supporting oil and natural gas development: however, we would appreciate more time to review the document in order to provide informed, substantive feedback. An extension of the comment period is justified given that BOEM has included substantial new information in the Air Quality section of the document. In fact, BOEM has stated in the draft SEIS that, "…since this air quality analysis was completed for the Final 2017-2022 GOM Multisale EIS and did not have the benefit of public review, the complete analysis is included in this Supplemental EIS for public review and comment. BOEM looks forward to receiving relevant comments on the methods used in air quality modeling and the resulting analyses." Given	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		the complexity of the air quality information included in the Draft SEIS, and the fact that this is the first opportunity for the public to review and comment on the air quality analysis, we believe additional time is warranted to generate relevant comments to benefit BOEM's final SEIS. We appreciate your consideration of this request for an extension.	
Offshore Operators Committee	OOC-1	The Offshore Operators Committee (OOC) respectfully requests that the Bureau of Ocean Energy Management (BOEM) extend the 45-day comment period on the proposed Gulf of Mexico Outer Continental Shelf Lease Sale Draft Supplemental Environmental Impact Statement 2018 (the "Draft SEIS") to 75 days (an additional 30 days). OOC recognizes the Bureau's need to issue the Draft SEIS in order to provide business critical services supporting oil and natural gas development; however, we would appreciate more time to review the document in order to provide informed, substantive feedback. An extension of the comment period is justified given that BOEM has included substantial new information in the Air Quality section of the document. In fact, BOEM has stated in the Draft SEIS that, "...since this air quality analysis was completed for the Final 2017-2002 GOM Multisale EIS and did not have the benefit of public review, the complete analysis is included in this Supplemental EIS for public review and comment. BOEM looks forward to receiving relevant comments on the methods used in air quality modeling and the resulting analyses."[1] Given the complexity of the air quality information included in the Draft SEIS, and the fact that this is the first opportunity for the public to review and comment on the air quality analysis, we believe additional time is	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		warranted to generate relevant comments to benefit BOEM's final SEIS. The OOC is an organization of 47 producing companies and 61 service providers to the offshore oil and natural gas industry who conduct essentially all of the Outer Continental Shelf (OCS) oil and gas exploration and production activities in the Gulf of Mexico (GOM). Comments submitted on behalf of the OOC are submitted without prejudice to any member's right to have or express different or opposing views. We appreciate your consideration of this request for an extension.	
Maggi Roberts	MaRo-1	Given the complexity of the air quality information included in the Draft SEIS, and the fact that this is the first opportunity for the public to review and comment on the air quality analysis, additional time is needed to gather appropriate information and make it available to the public.	
Jackie Antalan	JA-1	BOEM continues to fail in their methodology of conducting meaningful community engagement. We appreciate the outreach being extended to later hours, but it still continues to create barriers to people who reside in the southern coastal communities that are directly impacted by the lease sales.	Thank you for your comment. BOEM did its best to consider work hours and locations that were easily accessible for the public. BOEM has also held public meetings at locations in southern coastal communities, such as Larose, Louisiana, but did not have any attendees. BOEM will continue to consider work hours and locations when planning future public participation opportunities. BOEM welcomes suggestions for public meeting locations.
M. Fleming	MF-5	Hosting this meeting in Metairie – a location that many people who feel strongly on this matter find difficult to reach – also demonstrates a lack of actual interest in hearing and acknowledging points counter to the one it seems that this agency is most interested in.	
Jackie Antalan	JA-8	This public hearing was conducted with the fear factor where the public servant, NOAA and BOEM were under strict security. I was escorted to the	Thank you for your comment. BOEM has provided security at the open-house meetings to ensure the safety of the public attending the meetings, as well as

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		recorder under security, private security. This fear factor is one of the major reasons why the community is not fully engaged. This increased security is going to further divide the communities who are fearful and uninformed about what is happening in the community, and it does not serve the mission or the best interest of the United States of America and its citizens.	the safety of BOEM's employees. Security presence is not meant to intimidate attendees but to make them feel safe. BOEM will consider this factor when planning future public meetings.
Barbara Brewster	BB-2	And I would like to say that I was very happy with how I was treated by the people here today and feel like I am much better informed and would like to say that I would like to see an end to offshore oil production.	Thank you for your comment. BOEM is continually looking for ways to improve public involvement. BOEM's open-house meeting format is designed to create a better atmosphere for open and honest dialogue to not only provide information to the public but also to help with the solicitation of meaningful comments to improve the NEPA review.
Lorie Chinn	LC-1	This EIS information was very useful in my research. It was the alternatives maps that showed all of the leases in each area that was the most impactful to me.	
M. Fleming	MF-4	The information handed to me gave a lot of time and attention to the benefits of leasing, how safe it will be, etc., and I would feel much more trusting of a government agency if equal information was provided that more thoroughly accounted for the risks and described the benefits of not leasing the Gulf.	Thank you for your comment. The purpose of the public meeting was to obtain comments on the Draft 2018 GOM Supplemental EIS. Through the open-house format, BOEM worked diligently to inform the public of our mission and the potential impacts of a proposed regionwide lease sale. More details on the impacts associated with a proposed regionwide lease sale can be found in this Supplemental EIS.
Jackie Antalan	JA-5	BOEM should undergo a comprehensive review and implement new outreach and meaningful community engagement consistent with its 2016 and pending 2017 strategic framework.	BOEM's mission is to "manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way." BOEM accomplishes this through responsible stewardship, science-informed decisions, and integrity and ethics. BOEM's Strategic Framework can be found on BOEM's website at https://www.boem.gov/Strategic-Framework/. As part of the NEPA process, BOEM collects and considers public comments at the scoping and public comment stages of the preparation of an EIS. Please

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			refer to 40 CFR § 1506.6 for detailed information of public participation in the NEPA process. BOEM has recently changed our scoping and public comment meetings to an open-house format to increase public outreach and interaction. **Chapter 5** of this Supplemental EIS details the number of comments received and number of participants that attended each meeting.
Barbara Brewster	BB-1	My name is Barbara Brewster, and I'm here today as a concerned citizen. I was tragically affected by the BP oil spill. We have a very good friend who was a charter boat owner who committed suicide over the impact of the BP oil spill, and I would like to do better at being informed with oil leases and what the impact will be on the Gulf of Mexico and the coastal areas.	Thank you for your comment. BOEM acknowledges the potential harmful impacts to sea life, seafood industry, and tourism industry as a result of an oil spill. These negative consequences are analyzed for each resource chapter in **Chapter 4** and in the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a). BOEM appreciates that you came to our open-house meeting for the public comment period on the Draft 2018 GOM Supplemental EIS. We restructured the public meetings to an open-house format in hopes of providing more open dialogue with individual members of the public to create more understanding and solicit better comments about the potential impacts of offshore oil and gas leases.
Lorie Chinn	LC-2	I've learned that the federal lease areas is farther out into the Gulf than the state. This information was not disclosed in the advertisement / announcement about the meeting.	Thank you for your comment. BOEM will clarify in future newspaper ads that the proposed regionwide lease sales are in Federal waters.
Topic 2 – NEPA Analysis			
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana	CBD,SC,GRN, LBB-1	The Bureau's proposal fails to comply with clear requirements of the Outer Continental Shelf Lands Act ("OCSLA") and the National Environmental Policy Act ("NEPA") to precisely define areas available for leasing and conduct environmental analyses on a finer geographic scale. The Draft SEIS provides little to no meaningful analysis of the site-specific environmental impacts of the proposed	The Outer Continental Shelf Lands Act (OCSLA) provides the Congressional mandate for BOEM to make "available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs" the land of the Federal OCS. The Secretary of the Interior oversees the OCS Oil and Gas Program and is required to

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Bucket Brigade		lease sale.	balance orderly resource development with protection of the human, marine, and coastal environments while
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-3	In addition, NEPA regulations recognize that "tiering" from one environmental analysis to another may sometimes be appropriate where a broad environmental analysis has been conducted and the agency wishes to refer back to that assessment at a subsequent stage to avoid repetition. However, the process cannot be used to evade the thorough review required by NEPA. Indeed, "it is not better documents but better decisions that count. NEPA's purpose is not to generate paperwork — even excellent paperwork — but to foster excellent action." The Bureau cannot continue to use tiering to avoid the requisite in-depth analysis required by NEPA. The Draft SEIS fails to cure the deficiencies from the 2017-2022 programmatic EIS and the Gulf of Mexico multi-lease sale EIS, and lacks adequate analysis of the issues raised in our scoping comments for Lease Sales 250 and 251.	simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained. It is during this national-level review that the location (GOM regionwide leasing) and timing of lease sales (number of lease sales per year) is set in the schedule of proposed lease sales. The OCSLA requires a staged decisionmaking process beginning with the Five-Year Program, continuing through individual lease sales under the Five-Year Program, and ultimately to individual postlease activities requiring a permit or approval. As stated in **Chapters 1 and 2**, the 2017-2022 GOM Multisale EIS (USDOI, BOEM, 2017b) discusses all 10 Federal actions, i.e., 10 proposed regionwide oil and gas lease sales, as scheduled under the 2017-2022 Five-Year Program, and this Supplemental EIS
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-4	The area-wide lease sale alternative violates OCSLA and NEPA by failing to precisely define the location and provide a hard look at the site-specific environmental impacts. As courts have made clear, OCSLA's procedures for authorizing oil and gas activities on the OCS "are pyramidic in structure, proceeding from broad-based planning to an increasingly narrower focus as actual development grows more imminent." Thus, the lease sale stage must have a fine scale analysis and full disclosure of the environmental impacts of its action. But rather than "precisely" defining the location of the lease sale, the Bureau's proposed action takes an area-wide approach that designates the entire Gulf of Mexico as the area eligible for the lease sale. This area-wide lease sale approach is incompatible with OCSLA. Indeed, under this approach, the Bureau	updates the analyses of a single proposed regionwide lease sale in the 2017-2022 Five-Year Program. The multisale EIS approach is intended to focus the NEPA/EIS process on the staged OCSLA process for decisionmaking, including the proposed regionwide lease sales and any new issues and information identified since a prior stage. It also lessens duplication and saves resources when BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) conduct postlease reviews. Additionally, the issuance of leases does not conclude the environmental analysis of planned OCS oil- and gas-related activities. Each plan throughout the exploration, production, and decommissioning processes receives a site-specific environmental analysis pursuant to NEPA and the OCSLA's pyramidal structure, going from large scale to site

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		allows the oil industry to determine which areas are explored and developed, thereby abdicating the agency's responsibility under OCSLA to direct oil activities and assure that they do not cause environmental harm. The area-wide lease sale approach undermines the ability of the Bureau to take a "hard look" at the environmental impacts of its proposal as required by NEPA. An agency must take a "hard look" at the environmental impacts of an agency's decision before an agency acts, and include a discussion of the need for the proposal, alternatives to the proposal, and the environmental impacts of the proposal and the alternatives. "The hallmarks of a 'hard look' are thorough investigation into environmental impacts and forthright acknowledgment of potential environmental harms." The Draft SEIS lacks a site-specific environmental analysis of the offshore drilling leases and subsequent activities. Offshore leasing is carried out in stages, with each step triggering a more detailed and site-specific NEPA environmental review. Instead, at the five year plan, multi-lease sale, and lease sale NEPA review the geographic scope and detail of the impacts has remained the same. But according to Marble Mountain Audubon Society Rice, unless the programmatic documents address site-specific impacts, they must be addressed in later individual NEPA documents. The Bureau's area-wide lease sale approach is particularly troubling considering that this approach was cited as one of the problems in the offshore oil regime that led to the Deepwater Horizon oil spill. In response to the spill, President Obama established the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling	specific. For more information on BOEM's postlease processes, please refer to Appendix A of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Because of these multiple and tiered programmatic documents, along with future site-specific reviews that tier to these programmatic and discretionary documents, BOEM takes a hard look at the potential for environmental consequences at each phase of the decisionmaking process that considers a proposed action in the GOM. At each phase, BOEM has identified numerous environmental safeguards to minimize the impacts, i.e., through the consideration of EISs and programmatic mitigation at the Five-Year Program level, consideration of alternatives to limit impacts to sensitive topographic features in this Supplemental EIS, and commonly applied mitigation measures. Further, the 2017-2022 Five-Year Program EIS analyzes the environmental impacts of the entire 10 lease sale program in the Gulf of Mexico. The regional-level NEPA analysis covered in this Supplemental EIS provides a regional-level analysis of the environmental impacts of a single proposed regionwide lease sale in the 2017-2022 Five-Year Program. In addition, BOEM analyzes Alternatives B, C, and D, which would scale back the regionwide leasing to planning area (Western Planning Area [WPA] or Central Planning Area/Eastern Planning Area [CPA/EPA]) leasing, similar to leasing in the 2012-2017 Five-Year Program. Therefore, the analysis in this Supplemental EIS evaluates several smaller actions consistent with the OCSLA's pyramidal structure.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		("Commission") as an independent, nonpartisan entity charged with providing a thorough analysis of the causes of the disaster and recommending reforms for making offshore drilling safer. The Commission issued its final report in January 2011, in which it highlighted the need for a fundamentally different approach to management of offshore drilling. The Commission noted that the area-wide approach favored industry at the cost of meaningful environmental analysis. According to the Commission: OCS lease sales cover such large geographic areas that meaningful NEPA review is difficult. A decision to dramatically increase the size of lease sales—known as area-wide leasing—was made over 20 years ago at the request of industry; it has necessitated environmental analyses of very large areas at the lease sale stage. For example, the Final Environmental Impact Statement for the 2007–2012 multilease sales in the Gulf of Mexico covered more than 87 million acres, while the Final Environmental Impact Statement for Chukchi Sea Lease Sale 193 covered about 34 million acres. Given that 2008 lease sales in the Central Gulf of Mexico and the Chukchi Sea attracted almost $3.7 billion and almost $2.7 billion in high bids, respectively, it is appropriate to conduct environmental reviews on a finer geographic scale before private-sector commitments of this magnitude are made to purchase leases. However, the Bureau's current proposal does just the opposite. In fact, it backslides from prior programs with respect to the lease sale in the Gulf of Mexico. Previous lease sales were based on the three separate planning areas—the Western Gulf, the Central Gulf and the Eastern Gulf—compared to the proposed action of offering all unleased portions of	Pursuant to NEPA, this Supplemental EIS analyzes a range of alternatives, but NEPA does not require carrying all of the alternatives considered through a full analysis of impacts. BOEM has ensured that a reasonable range of alternatives to a proposed action, within the framework of the 2017-2022 Five Year Program, was considered in the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Chapter 2.2.3 of the 2017-2022 GOM Multisale EIS discusses additional alternatives that were considered but eliminated based on the best available information currently available. All of the alternatives considered were not analyzed in detail because they were either outside the scope of the lease sale decision, were speculative, were not warranted, did not meet the purpose of and need for the oil and gas leasing program, or current data did not support the alternative. As noted in **Chapter 1.0**, any individual lease sale could still be scaled back during the prelease sale process to offer a smaller area should circumstances warrant. Examples of smaller lease areas include the WPA and CPA/EPA planning area alternatives, which were analyzed throughout this Supplemental EIS. In reference to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, as suggested in the Commission's final report, BOEM (along with BSEE) has implemented many fundamental changes to improve the management of offshore leasing and drilling. Some of the changes made since 2010 include the following: an Investigations and Review Unit was instituted to root out problems within the regulatory agencies and target companies that aim to game the system; BOEM created multiple Implementation Teams, tasked with analyzing various aspects of BOEM's regulatory structure and helping to implement the reform agenda;

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		the "Gulf of Mexico." But the Gulf of Mexico contains nearly 160 million acres, more than 75 million of which are currently unleased and available for lease under the Bureau's proposal. The Gulf also contains a great diversity of environmental and socioeconomic characteristics. For example, as the Bureau has repeatedly admitted, the separate regions in the Gulf of Mexico have distinct ecological features. According to the Bureau the Gulf of Mexico is "subject to an array of environmental conditions, resulting in a large number of ecological community types" ranging from highly productive coral reefs to less diverse benthic habitats. Coastal areas are biologically important for calving coastal bottlenose dolphins, and dolphins in Barataria Bay are especially vulnerable because of their site fidelity and continuing harm from the Deepwater Horizon oil spill. Bryde's whales have an incredibly limited range, and they have been documented only in the eastern Gulf of Mexico—specifically their habitat is focused in the De Soto canyon. Like Bryde's whales Cuvier's beaked whales also have high site fidelity and would be more vulnerable to noise impacts from airguns and oil development than in other Gulf locations. Also, new science shows that there is chronically elevated noise in important marine habitats with airgun surveys dominating the acoustic environment. These differences illustrate how a meaningful environmental analysis would disclose specific locations or populations of wildlife that may be affected by the proposed action. The area-wide environmental review covers a massive geographic range and fails to disclose the environmental impacts on these special areas or provide a meaningful analysis to inform a decision about which areas would be the preferred environmental alternative.	BOEM implemented a recusal policy for employees to deal with real and perceived conflicts of interest; and Secretary Salazar and Director Bromwich launched a full review of the use of NEPA and categorical exclusions for the approval of proposed deepwater drilling projects. BOEM places a significant emphasis on public input and scientific analysis, which are critical to safe exploration and development of offshore resources. Public comment is solicited in our environmental review programs for both oil and gas and renewable energy proposals. Plans submitted by industry are subject to rigorous scientific review to ensure that environmental safeguards are the foundation of all offshore energy development. A brief summary of the reforms within BOEM and BSEE since the *Deepwater Horizon* explosion, oil spill, and response can be found on BOEM's website at https://www.boem.gov/Regulatory-Reform/. BOEM and BSEE will remain vigilant in instituting reform efforts and lessons learned since the *Deepwater Horizon* explosion, oil spill, and response. Mitigating measures are an integral part of BOEM's program to ensure that postlease operations are conducted in an environmentally sound manner (with an emphasis on minimizing any adverse impact of routine activities on the environment). BOEM assigns site-specific mitigation by imposing conditions of approval on a plan, permit, or authorization. Appendix A of the 2017-2022 GOM Multisale EIS discusses BOEM's rigorous postlease process, and Appendix B of the 2017-2022 GOM Multisale EIS describes over 120 standard mitigations that may be required by BOEM or BSEE as a result of the plan and

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		This new area-wide leasing approach also directly contradicts the Commission's express recommendations that the Bureau conduct environmental reviews on a finer geographic scale.	permit review processes for the Gulf of Mexico OCS Region.
David Quist	DQ-13	In short, the EIS does not adequately assess the full range, and the significance, of impacts associated with offshore energy exploration, drilling, and production in the Gulf. If does not adequately address impacts on specific areas, and given its generic nature and broad geographic coverage, cannot adequately assess impacts within the demands of the law. Thank you for the opportunity to comment.	
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-5	The Bureau's purpose and need statement fails to comply with NEPA. NEPA's implementing regulations provide that an EIS should "specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action." This purpose and need inquiry is crucial for a sufficient environmental analysis because "[t]he stated goal of a project necessarily dictates the range of 'reasonable' alternatives." Thus, "an agency cannot define its objectives in unreasonably narrow terms" without violating NEPA. The Bureau's stated purpose and need for its proposal is "to offer for lease those areas that may contain economically recoverable oil and gas resources" to manage the development of oil and gas resources on the OCS. This purpose and need is too narrow and thus inadequate because the agency considered an unreasonably narrow range of alternatives. By framing its statement as needing to auction off areas of the OCS that might contain recoverable oil and gas, the Bureau necessarily	Per Section 18 of the OCSLA, BOEM is required to develop a schedule of oil and gas lease sales on the OCS for 5-year periods. Thus, the OCSLA is the implementing legislation driving the purpose, and it is the law requiring the Secretary of the Interior to propose an action. The need is founded in the sources of energy consumption in the United States, which were detailed in the 2017-2022 GOM Multisale EIS and summarized in this Supplemental EIS. The proposed action under NEPA is the proposed regionwide lease sales identified in the 2012-2022 Five-Year Program, and this Supplemental EIS determined possible environmental impacts of a proposed action in comparative form to other lease sale alternatives allowable under Section 18 of the OCSLA, including the No Action alternative (i.e., no lease sale). Thus, the Secretary of the Interior has the ability to choose any of the alternatives, including the No Action alternative, after weighing possible benefits and adverse environmental impacts. The alternatives in this Supplemental EIS provide a

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		makes auctioning off all of the Gulf of Mexico not under moratorium, i.e., the proposed alternative, the only way to meet such a need. But OCSLA charges the Bureau with ensuring that "environmental safeguards" are in place for offshore oil development and ensuring the "balance [of] orderly energy resource development with protection of the human, marine, and coastal environments" and "national needs." Accordingly, the agency should have focused its purpose and need inquiry on objectives that comport with these statutory duties. The narrowly framed purpose and need fails to establish and justify a national need for developing these areas given that there is already adequate oil and gas resources under lease or in development coupled with significant growth of renewable and cleaner fuels and a commitment to reduce greenhouse gas pollution. The Bureau has already leased more than 15 million acres of the Gulf of Mexico to oil companies, 70 percent of those leased acres are not currently in production. Consequently, the Bureau overlooks alternatives that use renewable energy or conservation to reduce energy development. Additionally, the purpose and need of leasing everything is not limited to meeting our regional and national energy needs, as required by OCSLA, and instead could carelessly lease areas for export or waste. Nationally, our needs are to shift away from oil and gas reliance. Moreover, NEPA evaluation must take place "before decisions are made." Such an approach ensures that agencies will take the requisite "hard look" at environmental consequences before approving any major federal action. But the Bureau's purpose and need statement indicates that it did just the opposite and predetermined the result of its decision-making process. In other words, the statement	reasonable range of alternatives that provide environmental safeguards, including alternatives and mitigations that can be included at the site-specific decision level. BOEM has also considered alternatives and deferrals in addition to Alternatives A-E to ensure that all reasonable alternatives have been considered in this Supplemental EIS. However, not all of the alternatives considered were analyzed in detail because they were either outside the scope of the lease sale decision, were speculative, were not warranted, did not meet the purpose of and need for the oil and gas leasing program, or current data did not support the alternative. For a summary of the alternatives and deferrals considered but not analyzed in detail, refer to **Chapter 2.2.2** of this Supplemental EIS and Chapter 2.2.3 of the 2017-2022 GOM Multisale EIS for a detailed analysis of each eliminated alternative. As required by the 2017-2022 Five-Year Program, 10 individual phased decisions on whether or how to proceed with each proposed regionwide lease sale will be made. So while the obligation to fully comply with NEPA does not mature until leases are issued (Center for Biological Diversity v. U.S. Department of the Interior, 2009; Center for Sustainable Economy v. Sally Jewell, 2015), BOEM has chosen to prepare an EIS at this stage to analyze the potential environmental impacts that could result if exploration, development, production, and decommissioning activities eventually occur in order to provide the context and setting of future proposed actions and to better understand the potential impacts associated with these types of activities, as well as the cumulative impacts on GOM resources. The approach to this Supplemental EIS allows more time to include more

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		demonstrates that the Bureau already made the decision to hold offshore oil and gas leases across all of the Gulf of Mexico and that its entire analysis was framed in a way to support that pre-determined outcome. This backward approach reflects a fundamental misunderstanding of its legal obligations and an apparent desire to appease the oil industry at the expense of our ocean environment and climate.	public involvement, evaluate potential impacts, and provide for a more informed decision, which in turn allows site-specific reviews to tier from this Supplemental EIS and be more streamlined. Because of these multiple and tiered programmatic documents, along with future site-specific reviews that tier to these programmatic and discretionary documents, BOEM has taken a hard look at the potential for environmental consequences at each phase of the decisionmaking process that considers a proposed action in the GOM. At each phase, BOEM has identified numerous environmental safeguards to minimize the impacts, i.e., through the consideration of EISs and programmatic mitigation at the Five-Year Program level, consideration of alternatives to limit impacts to sensitive topographic features in this Supplemental EIS, and commonly applied mitigation measures.
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-6	The Draft SEIS fails to properly define baseline conditions. NEPA requires the agency to "describe the environment of the areas to be affected or created by the alternatives under consideration." Thus, the establishment of the baseline conditions of the affected environment is a fundamental requirement of the NEPA process. "Without establishing the baseline conditions which exist in the vicinity. . . there is simply no way to determine what effect the proposed [project] will have on the environment and, consequently, no way to comply with NEPA." The primary deficiency with the Draft EIS' baseline is that it fails to address new key information gaps and new information that the Gulf's wildlife, habitat, and human environment continue to be adversely affected by the Deepwater Horizon oil spill. The Bureau concedes that it lacks critical information	Thank you for your comment. BOEM acknowledges that there is some lingering uncertainty regarding the impacts of the *Deepwater Horizon* oil spill. However, this uncertainty has diminished as new data and studies have become available. BOEM has incorporated this additional information as appropriate and has complied with NEPA procedures for dealing with incomplete or unavailable information. Current baselines are described for all resources under their respective "Description of the Affected Environment" chapters in the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Specific to the Natural Resource Damage Assessment Trustees' (Trustees) *Deepwater Horizon Oil Spill: Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (PDARP/PEIS) (Deepwater Horizon Natural Resource Damage Assessment Trustees,

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		regarding the effects of the Deepwater Horizon oil spill on the Gulf of Mexico, and yet declines to consider the latest new information in its baseline description. The Deepwater Horizon disaster resulted in the deaths of 11 workers and caused a spill of approximately 206 million gallons of oil over the course of at least 87 days. More than 1,000 miles of shoreline were contaminated with oil; 88,522 square miles of ocean—totaling one-third of the Gulf of Mexico—were closed to commercial and recreational fishing; millions of animals were killed or harmed; and local residents were sickened. Seven years later, the Gulf is still reeling from the effects of the spill. Recent studies demonstrate severe lung disease in dolphins; near-record lows of critically endangered Kemp's Ridley sea turtle nesting; oil dispersants toxic to corals and jellyfish; and a "bathtub ring" of oil on the seafloor. Another recent study published in April 2016 indicates that the spill impacted 19% more coastline than originally believed, finding that oil washed up on 1,313 miles of coastline along the Gulf of Mexico. In addition, the 50,000 people involved in cleanup efforts suffer from an increased risk of physical and psychological injury. Gulf residents are still suffering from increased symptoms of depression, anxiety, mental illness, and posttraumatic stress. However, there is new information about the spill and longer-term impacts are still being studied. The agency notes the availability of the Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement, but declines to use the information for its baseline. The Draft SEIS arbitrarily and capriciously states that the injuries assessed in the Deepwater Horizon oil spill Natural Damage Resource	2016), the altered baseline in this Supplemental EIS already includes individual protected species directly affected by this unexpected, unique catastrophic event. The injuries assessed within the PDARP/PEIS do not necessarily equate the baseline as defined in NEPA, but they were considered when determining the baseline for our impact determinations. BOEM understands that each oil-spill event is unique and that its outcome depends on several factors, including time of year and location of the release relative to winds, currents, land, and sensitive resources, as well as specifics of the well and response effort. BOEM also understands that the severity of impacts from an oil spill cannot be predicated on volume alone. BOEM has analyzed a low-probability catastrophic event (USDOI, BOEM, 2017a) in conjunction with its analysis of potential effects, as requested by the Council on Environmental Quality (CEQ) pursuant to its regulation at 40 CFR § 1502.22. A low-probability catastrophic spill is, by definition, not reasonably certain to occur. The return period of a catastrophic oil spill in OCS areas is estimated to be 165 years, with a 95% confidence interval between 41 years and more than 500 years (Ji et al., 2014). Regarding marine mammals, sea turtles, and fish, although the Natural Resource Damage Assessment studies are ongoing, the Trustees' PDARP/PEIS has been released and BOEM has analyzed it for relevant information. The injuries assessed within the PDARP/PEIS do not necessarily equate the baseline as defined in NEPA, but they were considered when determining the baseline for our impact determinations. With the release of the Trustees' PDARP/PEIS, our understanding of the environmental impacts of the *Deepwater Horizon* explosion, oil spill,

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		Assessment don't equate with NEPA baseline. The assessment concluded that the recovery of marine mammals and sea turtles could take decades and significant restoration efforts. Moreover, the Bureau has repeatedly admitted in other environmental review documents that there are data gaps regarding numerous resources in the Gulf of Mexico, including wetlands, coastal water quality, offshore water quality, air quality, commercial and recreational fishing and environmental justice, and that the impacts of the Deepwater Horizon oil spill on such resources may have changed baseline conditions. The Bureau must analyze significant new information about the effects of the Deepwater Horizon oil spill and especially its significant impacts on protected species that the agency failed to incorporate into its Draft SEIS. For example, the Bureau failed to consider an important new special issue in Endangered Species Research dedicated to the impacts of the Deepwater Horizon oil spill on threatened and endangered species. The scientific articles in the journal describe a wide range of damaging impacts on protected species. The oil spill caused significant harm to sea turtles and marine mammals including death and injuries, reproductive failure, organ damage and massive stranding events. New research quantifies impacts of the oil spill on sea turtles, marine mammals, and fish. For example, the science shows the oil spill caused Florida loggerhead nest densities to decline 43.7 percent from expected nesting rates in 2010. More than half of Kemp's Ridley sea turtles were exposed to oil and scientists suspect a link to slowed population growth rates. Other research estimates mortality of sea turtles based on oiling, models sea turtle oiling and confirms effects from the oil spill. For marine	and response has greatly increased; however, there are many ongoing, long-term and monitoring studies that are not complete. Therefore, our understanding of the lasting effects or long-term recovery of the system is still incomplete and has data gaps, but the information is not essential to a reasoned choice among alternatives and has been analyzed as required by regulation at 40 CFR § 1502.22. Where gaps remained, BOEM's subject-matter experts exercised their best professional judgment to extrapolate baseline conditions and impact analyses using accepted methodologies based on credible information. BOEM's subject-matter experts have applied other scientifically credible information using accepted theoretical approaches and research methods, such as information on related or surrogate species. Moreover, BOEM will continue to monitor these resources for effects caused by the *Deepwater Horizon* explosion, oil spill, and response, and will ensure that future BOEM environmental reviews take into account any new information that may emerge. In reference to the Section 7 Consultation, BOEM and BSEE have submitted Biological Assessments to the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (FWS), and are actively engaged with them in consultation concerning all of our past and reasonably foreseeable future activities. Until the NMFS' formal consultation is complete, BOEM is under an interim consultation agreement with NMFS. The NMFS and FWS understand the types and levels of activities that BOEM is engaged in and have not raised concerns with our ongoing activities. They are fully informed of the potential impacts identified in this Supplemental EIS, as well as those in the Biological Assessments. The Protected Species Stipulation, if applied, would require already existing terms and conditions and mitigations

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		mammals, the new science documents numerous species of cetaceans observed in the oil footprint and the oil spill's lasting impacts. Researchers found marine mammal reproductive failure, impaired stress response and death caused by the oil spill. The estimated time to recovery for the Barataria Bay dolphins has been estimated at 39 years. The location of the Deepwater Horizon oil spill was in core sperm whale habitat. The Mississippi Canyon provides year-round sperm whale habitat. It is well established, on the basis of historic whaling records, mark-recapture data, and extensive surveys including by GulfCet II and the Sperm Whale Seismic Study, that this area constitutes important habitat for the Gulf's small, biologically distinct population of sperm whales, most likely due to the input of a nutrient-rich, freshwater plume from the Mississippi Delta. Nearly all sightings of females and mother-calf groups have occurred in the Mississippi Canyon area, strongly suggesting it functions as a nursery ground. Reports to the Gulf of Mexico Research conference in 2016 and 2017 indicated that the animals are no longer feeding in a large area around the Deepwater Horizon wellhead. Acoustic monitoring also shows that this area constitutes the area with the vast majority of social activity. Surveys also show that the sperm whales are present here throughout the year. New information that the Bureau must consider includes the unusually high number of four reported stranded sperm whale calves in the Gulf in 2016. New scientific studies of the impacts of the Deepwater Horizon oil spill on fish shows that not only did the oil spill cause up to $1.2 billion in	implemented to protect species at the lease sale stage. As the stipulation notes, BOEM and BSEE can condition approval of any postlease authorization or permit on compliance with the most current mitigations or requirements to protected listed species or habitats at the time. The staged OCSLA decisionmaking and approval process ensures that BOEM and BSEE can require additional protected species protections after leases are issued. Refer to **Chapter 5.8** of this Supplemental EIS for more information on the Endangered Species Act (ESA) consultations. In addition, refer to the response to Comment USFWS-1, which indicates that FWS is developing a Biological Opinion for BOEM on the effects of oil and gas leasing, exploration, development, production, decommissioning, and all related activities in the Gulf of Mexico OCS within existing lease areas and those proposed for future leasing in the WPA, CPA, and EPA through the year 2022.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		damage to the Gulf's commercial fisheries, but also significantly harmed fish habitat. For example, the oil spill affected about five percent of the spawning habitat during the peak spawning time for Atlantic bluefin tuna—an imperiled, overfished species. Researchers are concerned that because the oil has been linked to deformation and death of eggs and larval fish that there could be continuing population-level impacts. Additionally, new science shows that the phenanthrene, a polycyclic aromatic hydrocarbon (PAH), released from the oil caused the heart malfunctions in fish affected by the oil spill. The scientists note that there are also human health concerns associated with this finding because similar effects can occur in humans. The Draft SEIS section on protected species is wholly inadequate, not only for not incorporating this new information, but also because it doesn't take a hard look at the impacts from the leasing. Compounding this problem, the Bureau reinitiated Section 7 consultation under the ESA following the Deepwater Horizon oil spill in 2010, but the agency has yet to complete that consultation seven years later. Accordingly, the Bureau does not have an accurate picture of the effects that authorizing more offshore oil and gas drilling (including in the very same area where the Deepwater Horizon spill occurred) could have on already imperiled species.	
Sierra Club	SC-3	BOEM has repeatedly admitted that it lacks critical information regarding the effects of the Deepwater Horizon oil spill on the Gulf of Mexico. It has also repeatedly admitted that there are data gaps regarding numerous resources in the Gulf, including wetlands, coastal water quality, offshore water quality, air quality, commercial and recreational fishing and environmental justice, and that the impacts of the Deepwater Horizon oil spill on such	BOEM acknowledges that there is some lingering uncertainty regarding the impacts of the *Deepwater Horizon* oil spill. However, this uncertainty has diminished as new data and studies have become available. BOEM continues to analyze the *Deepwater Horizon* explosion, oil spill, and response as information becomes available, and it was evaluated as part of the baseline for resources in this Supplemental EIS. In addition, in each resource

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		resources may have changed baseline conditions. BOEM cannot properly define the environmental baseline, and cannot conduct a proper NEPA analysis unless and until these significant data gaps are filled.	chapter, BOEM has complied with NEPA procedures, as described in the regulation at 40 CFR § 1502.22, for dealing with incomplete or unavailable information. BOEM has made some changes to this Supplemental EIS in order to clarify the nature of the incomplete or unavailable information related to the impacts of the *Deepwater Horizon* oil spill on the baseline conditions of various resources. BOEM has revisited the baseline description and cumulative impacts analysis in the Final 2017-2022 GOM Multisale EIS and has added clarifications and additional information where appropriate (i.e., in the land use and social factors chapters). That information is incorporated into this Supplemental EIS by reference.
John Warden	JW-2	BOEM has repeatedly admitted that it lacks critical information regarding the effects of the Deepwater Horizon oil spill on the Gulf of Mexico. BOEM cannot properly define the environmental baseline, and cannot conduct a proper NEPA analysis unless and until significant data gaps are filled.	
Joint Trades	JT-28	In comments on the Draft Multisale EIS dated June 6, 2016, API noted the confusion concerning BOEM's use of the acronym "EIA" to describe one thing in the DSEIS (economic impact area) and another in the 5-Year Program Programmatic EIS (environmentally important area). This confusion persists in the Draft SEIS.	In this Supplemental EIS, the term EIA (i.e., economic impact area) represents regions of important environmental value where there is potential for conflict between ecologically important or sensitive habitats; maintenance of social, cultural, and economic resources; and possible oil and gas development. As far as the use of the term "areas of concern" versus "environmentally important areas" in the 2017-2022 Five-Year Program EIS, the use of environmentally important areas is broader than areas of concern and therefore more appropriate in this context. The acronym "EIA" has been used in the Bureau of Ocean Energy Management's NEPA documents for economic impact areas since the 2007-2012 WPA/CPA Supplemental EIS (USDOI, MMS, 2007a). No CEQ regulations or guidance exist for the use of acronyms. However, style guides recommend, when you introduce new or unfamiliar acronyms, spelling out

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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			the component words first and then placing the acronym in parentheses. As is common with most technical and government documents, BOEM also includes a list of abbreviations and acronyms for each NEPA document.
Sierra Club	SC-2	BOEM has already leased over 23 million acres of the Gulf to oil companies, and nearly three million acres of the Alaskan Arctic. Many of the leases in the Gulf of Mexico are relatively new leases, meaning that, by BOEM's own admission, production under these leases will last up to 70 years. BOEM's analysis fails to consider why the OCS areas already under lease are not sufficient to supply the nation's energy needs while we transition away from dirty fossil fuels and toward clean, sustainable energy.	BOEM is responsible for administering the leasing program for oil and gas resources on the OCS and for developing a 5-year schedule of proposed lease sales designed to "best meet national energy needs for the five-year period following [the schedule's] approval . . ." (Section 18 of the OCSLA [43 U.S.C. § 1344]). The 2017-2022 Five-Year Program is an important component of President Trump's America First Energy Plan, which calls for energy policies that stimulate our economy, ensure our security, and protect our health. For more information, please refer to The White House's website (The White House, 2017). As stated in Chapter 1.2 of the 2017-2022 Five-Year Program EIS (USDOI, BOEM, 2016a), "Offshore oil and gas production represents approximately 11% of the total national oil and gas production. Domestic oil and natural gas supplies contribute to meeting domestic demand and enhance national economic security. The development of an OCS oil and gas lease sale schedule for 2017-2022 will facilitate domestic oil and gas production to meet this need." This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS, which tiers from the 2017-2022 Five-Year Program EIS, which provides an analysis of existing and future leases and their sufficiency to supply the Nation's energy needs. For the GOM's regionwide single lease sale analysis, all areas currently under lease are taken into consideration throughout the environmental analyses (i.e., cumulative impacts). The cumulative impacts analysis considers all of BOEM's past, present, and reasonably foreseeable future actions, as well as
Alicia Cooke	AC-7	The scientific credentials of the BOEM staff, and the conversations I have had with them in public meetings, leave me with no doubt that they understand the severity of the climate crisis and a need to not only scale back on existing oil production but to halt any new development of fossil fuel infrastructure. In keeping with the Bureau's mission of developing resources in an "environmentally and economically responsible way," I see no path forward that both opens the Gulf to new drilling and still abides by the Paris Agreement.	
Gulf Restoration Network	GRN-11	BOEM cannot permit more drilling when the threat of drilling to national security hasn't been evaluated.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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			other non-OCS oil- and gas-related activities. Further, commenters should be aware that any past or present commitments made by the U.S. concerning a reduction of greenhouse gas (GHG) emissions (e.g., Paris Agreement) do not broaden the scope of the Bureau of Ocean Energy Management's NEPA analysis at the lease sale stage or require BOEM to venture into analyzing the potential worldwide effect of GHG emissions that could result from a lease sale.
Allison Kalnik	AK-3	If the GoM OCS Lease Sale is to genuinely analyze greenhouse gas emissions generated by the project, renewable energy must be included as an alternative to offshore oil production. This would render the current No Action Alternative null and void, which states that "If a lease sale were to be cancelled, the resulting development of oil and gas would most likely be postponed to a future lease sale; therefore, the overall level of OCS oil- and gas-related activity would only be reduced by a small percentage, if any." Furthermore, it is arbitrary and capricious to assert that no alternative to fossil fuel production exists when a neighboring state, Texas, has become an industry leader in both wind and solar energy production.	Per Section 18 of the OCSLA, BOEM is required to develop a schedule of oil and gas lease sales on the OCS for 5-year periods. Thus, the OCSLA is the implementing legislation driving the purpose, and it is the law requiring the Secretary of the Interior to propose an action. The need is founded in the sources of energy consumption in the United States, which were detailed in the 2017-2022 GOM Multisale EIS and summarized in this Supplemental EIS. The proposed action under NEPA is the proposed regionwide lease sales identified in the 2012-2022 Five-Year Program, and this Supplemental EIS determined possible environmental impacts of a proposed action in comparative form to other lease sale alternatives allowable under Section 18 of the OCSLA, including the No Action alternative (i.e., no lease sale). Thus, the Secretary of the Interior has the ability to choose any of the alternatives, including the No Action alternative, after weighing possible benefits and adverse environmental impacts. BOEM has also considered alternatives and deferrals in addition to Alternatives A-E to ensure that all reasonable alternatives have been considered in this Supplemental EIS. However, not all of the alternatives considered were analyzed in detail because they were either outside the scope of the lease sale decision, were speculative, were not
M. Fleming	MF-3	If the same amount of attention and money were directed at developing renewable energy sources as are currently being given the oil industry, we would already be well on our way to seeing a Gulf Coast that wouldn't need to be evacuated within the next foreseeable chunk of time due to pipeline-related erosion, rising water related to an increasing greenhouse effect, and environmental disasters like the BP spill.	
Peter Shrock	PS-8	In general, the EIS is not comprehensive enough regarding alternatives. As the BOEM currently manages renewable resources, it is reasonable for them to consider using the OCS land for projects	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		other than fossil fuel extraction.	warranted, did not meet the purpose of and need for the oil and gas leasing program, or current data did not support the alternative. For a summary of the alternatives and deferrals considered but not analyzed in detail, refer to **Chapter 2.2.2** of this Supplemental EIS and Chapter 2.2.3 of the 2017-2022 GOM Multisale EIS for a detailed analysis of each eliminated alternative. BOEM determined that an analysis of the potential for alternative energy is outside the scope of this Supplemental EIS for a proposed action. Alternative energy is not a reasonable alternative to achieve the purpose of and need for the proposed action because the development of renewable energy resources in the foreseeable future does not fully or partially satisfy the purpose of and need for the proposed action at this time. The objective of this Supplemental EIS is to provide an analysis of the environmental impacts of oil and gas leasing. However, BOEM does recognize the need to investigate the potential for alternative energy on the Federal OCS. BOEM's Office of Renewable Energy is responsible for developing an offshore renewable energy program in the Gulf of Mexico. Information on BOEM's renewable energy program, OCS leases, and renewable energy projects (34 proposed or currently in development) is available at on BOEM's website at http://www.boem.gov/Renewable-Energy/. In response to comments on alternate use of platforms, BOEM has analyzed the alternate use of facilities on the OCS in the *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf: Final*
Mobile Environmental Justice Action Coalition	MEJAC-4	BOEM's pending offshore renewables study offers yet another compelling reason to accept Alternative E for 2018. Much of the available literature on renewable use in Europe suggests in comparison that the Gulf of Mexico is not only windier and sunnier but that it also has very good tidal energy potential, as well. The fact that there is such a dearth of parity in renewable energy and fossil fuel exploitation in the Gulf is itself a glaringly compelling reason to do more renewables and less OCS drilling.	
Dyan Gibson	DyGi-1	Our inevitable fate is a planet run on sustainable and clean energy, either now to preserve our fragile ecosystems and curb the effects of climate change, or later because all our reserves are dried up and we have descended into the dystopian future of a man-made mass extinction event, where the ravaging of our planet has led to famine and wars over dwindling resources. Offshore drilling is a a shortsighted and environmentally disastrous tactic. Exxon, Chevron, Shell, and others - it is time to embrace the green energy movement and be the heros of our future. Refit your platforms for offshore wind and wave energy, and refit your drills for asteroid mining - send us into an amazing future of clean air and water and healthy ecosystems - please!	
Jodi Koszarek	JK-1	It is time for America to concentrate her efforts on renewable sustainable energy with an eye on the future. We can no longer afford to fall behind the rest of the world in this regard. A focus on the future embraces clean, renewable energy that supports health and maintains our future national security.	
June Charles	JC-3	Fossil fuel has become obsolete and completely dangerous to our water, land and air. Our children's children will be the recipients of your ignorance and greed. We the people say NO to continued use of	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		fossil fuel and YES to increased funding and attention by the government to renewables. WE are ready. They are ready.	*Environmental Impact Statement*" (USDOI, MMS, 2007b). In response to specific questions about the impacts of wind energy on resources in the Gulf of Mexico, because analysis of the potential for alternative energy is outside the scope of this Supplemental EIS, these types of questions are not answered in this Supplemental EIS. However, several renewable energy studies have already been conducted in the Atlantic and Pacific regions (https://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Renewable-Energy/Renewable-Energy.aspx), and renewable energy feasibility studies have begun in the Gulf of Mexico region (https://www.boem.gov/SDP-2017-2019/).
Rebecca King	RK-9	How is BOEM working to implement sustainable energy in the Gulf in order to address climate change?	
350 Louisiana - New Orleans	350LANO-2	- With what urgency does BOEM work towards a shift to renewable sources of energy in the Gulf of Mexico? What are timelines for key steps to make this shift? - According to a Stanford study by Marc Jacobson (thesolutionsproject.org) offshore wind energy could provide for 60% of all energy needs for Louisiana (electricity, transportation, heating/ cooling, industry). To what extend is BOEM aware of this study? - BOEM is promoting offshore wind development on the Atlantic and Pacific coast and in Hawaii. How does BOEM plan to encourage development of offshore wind energy in the GOM? - What are key challenges to developing wind energy resources in the GOM? - What steps has BOEM undertaken so far to explore the potential for wind energy in the GOM? - What is the level of interest of the offshore wind industry in leases in the GOM? - What is the level of interest on part of the governor's office in Texas, Louisiana, Alabama, or Florida? Have any attempts been made to establish an intergovernmental task force with any of them? - Have there been any studies evaluating the economic impact of developing an offshore wind industry in the GOM? - To what extent can existing oil/gas infrastructure in the GOM be utilized to facilitate development of renewable sources of energy in the GOM? - What effect would wind farms in the GOM have on migrating birds? Has BOEM initiated any avian	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		studies in the GOM related to offshore wind farms? - What effect would wind farms in the GOM have on fisheries? Would it be comparable to oil rigs minus the pollution associated with the fossil fuel industry? Has BOEM initiated any fisheries studies in the GOM related to offshore wind farms? - What would be the economic impact of an offshore wind industry in Gulf Coast states? Have there been any studies evaluating the economic impact of developing wind industry in the GOM? If yes, what are the results? If no, when will such studies be initiated? - Given the fact that the platforms for the wind farm in Rhode Island were constructed in Houma, LA, how does BOEM evaluate the unique position of Louisiana's workforce in constructing wind farms in the GOM? - How does the environmental impact of offshore wind energy compare to the environmental impact of oil and gas production in the GOM?	
Renate Heurich	RH-2	Offshore wind is a viable source of renewable energy in the Gulf of Mexico. What are BOEM's estimates as far as delaying the development of renewable energy from the GOM by promoting more fossil fuel infrastructure at this point?	
United States Environmental Protection Agency	USEPA-3	EPA recommends that BOEM include in the DSEIS discussions regarding the direct, indirect, and cumulative impacts of Tribes or Tribal land within the parameter of the specific Lease Sale Blocks for the single Oil and Gas lease sales 250 and 251.	Impacts to onshore lands are included in the analysis where BOEM discusses direct, indirect, and cumulative impacts to land use/coastal infrastructure in **Chapter 4.14.1**. Impacts to populations, including Tribal populations, are considered in the social factors' analysis in **Chapter 4.14.3**, where impacts to environmental justice communities have their own analysis in **Chapter 4.14.3.1**. There is no discussion of impacts to Tribal lands or their artifacts "within the parameter of the specific Lease Sale Blocks for the single Oil and Gas lease sales 250 and 251" because these leases are 3 miles (mi) (5 kilometers [km]) or more offshore. Therefore, there are no Tribal – or

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			other – populations living within or along the boundaries of the proposed lease sale blocks.
United States Fish and Wildlife Service	USFWS-1	In order to properly address federally threatened and endangered species under the jurisdiction of the U.S. Fish and Wildlife Service, the Service is developing a Biological Opinion for BOEM on the effects of oil and gas leasing, exploration, development, production, decommissioning, and all related activities in the Gulf of Mexico OCS within existing lease areas and those proposed for future leasing in the Western Planning Area, Central Planning Area, and Eastern Planning Area through the year 2022.	BOEM and BSEE have submitted Biological Assessments to both NMFS and FWS, and are actively engaged with them in consultation concerning all of our past and reasonably foreseeable future activities. Until the above-mentioned formal consultation with NMFS is completed, BOEM is under an interim consultation agreement with NMFS. The NMFS and FWS understand the types and levels of activities that BOEM is engaged in and have not raised concerns with our ongoing activities. They are fully informed of the potential impacts identified in this Supplemental EIS, as well as in the Biological Assessments. Copies of the interim concurrence letters can be found in Appendix K of the 2017-2022 GOM Multisale EIS.
Topic 3 – Alternatives			
Peter Shrock	PS-7	The National Environmental Policy Act (NEPA) requires a "detailed statement" of "alternatives to the proposed action," which is considered "the heart of the environmental impact statement." But BOEM's alternatives analysis is seriously lacking. For example, BOEM failed to consider an alternative that would prohibit drilling in certain biologically sensitive areas, such as critical habitat for imperiled loggerhead sea turtles; an alternative that would restrict the number of wells to be drilled; or an alternative that would end all new offshore oil and gas leasing pending a plan to limit warming to 1.5 or 2C.	Thank you for your comment. Per Section 18 of the OCSLA, BOEM is required to develop a schedule of oil and gas lease sales on the OCS for 5-year periods. Thus, the OCSLA is the implementing legislation driving the purpose, and it is the law requiring the Secretary of the Interior to propose an action. The need is founded in the sources of energy consumption in the United States that were presented in the 2017-2022 GOM Multisale EIS and summarized in this Supplemental EIS. The proposed action under NEPA is a proposed regionwide lease sale identified in the 2017-2022 Five-Year Program, and this Supplemental EIS determined possible environmental impacts of a proposed action in comparative form to other lease sale alternatives allowable under Section 18 of the OCSLA, including the No Action alternative (i.e., no lease sale). Thus, the Secretary of the Interior has the ability to choose any of the alternatives, including the No Action alternative, after weighing possible benefits
Peter Shrock	PS-10	Lastly, BOEM failed to look outside their jurisdiction for alternatives for the lease sale.	
Gulf Restoration Network	GRN-4	BOEM must develop alternatives to avoid these thousands of accidents.	
Allison Kalnik	AK-2	In particular, the Draft EIS alternatives analysis	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		provides a narrow range of alternatives that deal only with excluding certain sections of the Proposed Lease Sale Area. CEQ clearly states that the alternatives analysis must include "reasonable alternatives not within the jurisdiction of the lead agency." All of the proposed alternatives are within the jurisdiction of the lead agency.	and adverse environmental impacts. BOEM has ensured that a reasonable range of alternatives to the proposed action, within the framework of the 2017-2022 Five-Year Program, has been considered in this Supplemental EIS. BOEM has considered alternatives and deferrals in addition to Alternatives A-E to ensure that all reasonable alternatives have been considered in this Supplemental EIS. However, not all of the alternatives considered were analyzed in detail because they were either outside the scope of the lease sale decision, were speculative, were not warranted, did not meet the purpose and need for the oil and gas leasing program, or current data did not support the alternative. For a summary of the alternatives and deferrals considered but not analyzed in detail, refer to **Chapter 2.2.2** of this Supplemental EIS and Chapter 2.2.3 of the 2017-2022 GOM Multisale EIS for a detailed analysis of each eliminated alternative. In those chapters, there are discussions on the alternatives excluding loggerhead sea turtle critical habitat. A summary analysis can be found in **Chapter 4.9.2** of this Supplemental EIS, and a full analysis of sea turtles, including loggerhead sea turtles, can be found in Chapter 4.9.2 of the 2017-2022 GOM Multisale EIS. Further, any alternative to delay activities is analyzed in this Supplemental EIS as Alternative E. The No Action alternative is the cancellation of a single proposed regionwide lease sale, and a new decision will be made for the next proposed regionwide lease sale in the 2017-2022 Five-Year Program. BOEM has addressed the alternative to stop issuing
Eli Lamb	EL-1	I feel, as a landowner and community member in a region which is literally the most vulnerable to both climate change-induced disaster and localized destruction (land loss, subsidence, fishery damage, etc.) directly caused by oil production and distribution, that insufficient scholarly rigor has been applied to analyzing the differences between the 5 "Alternatives" included in the EIS.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			leases in the Gulf of Mexico in Chapters 2.4, "Reduced Proposed Action (Alternative C)," and 2.5, "No Action (Alternative D)" of the 2017-2022 Five-Year Program EIS. These alternatives evaluated the environmental effects of having reduced areas of leasing or no new lease sales during the 2017-2022 Five-Year Program. The impacts of these alternatives are discussed in Chapters 4.4.3.4, "C(4): Exclusion of the Gulf of Mexico Program Area," and 4.4.4, "Alternative D – The No Action Alternative," of the 2017-2022 Five-Year Program EIS. However, it should be noted that oil -and gas-related activities stemming from previous programs would continue, and only activity resulting from proposed lease sales in the new Five-Year Program would be halted.
Peter Shrock	PS-9	The required "no-action" alternative is not rigorous; to suggest that "no-action" on one particular lease sale will have the same effect as some foreseeable future sale fails to consider that the "no-action" alternative will be selected in the future, and also fails to appraise the reduction of cumulative and indirect effects as required by NEPA.	The OCSLA requires a staged decisionmaking process, beginning with the Five-Year Program, continuing through individual lease sales under the Five-Year Program, and ultimately to individual postlease activities requiring a permit or approval. At the lease sale stage of the OCSLA process, BOEM typically evaluates all individual lease sale decisions in one or more GOM planning areas under the Five-Year Program in an EIS. This EIS approach is intended to focus the NEPA/EIS process on the staged OCSLA process for decisionmaking, including the proposed regionwide lease sales, and any new issues and information identified since a prior stage. The impact analyses in this Supplemental EIS specifically address resource impacts associated with holding one proposed regionwide lease sale. Therefore, the No Action alternative associated with the analyzed Federal proposed action is the cancellation or delay of a single proposed regionwide lease sale. If a single proposed regionwide lease sale would be cancelled, under the OCSLA, BOEM would be required to consider any proposed regionwide lease
Alicia Cooke	AC-1	I appreciate the opportunity to sumbit a public comment on the BOEM Draft Supplemental EIS for the proposed 2018 lease sales in the Gulf of Mexico. In dismissing the environmental and economic benefit to a no-action scenario (Alternative E), the EIS states: "If a lease sale were to be cancelled, the resulting development of oil and gas would most likely be postponed to a future lease sale; therefore, the overall level of OCS oil- and gas-related activity would only be reduced by a small percentage, if any." This reasoning fails to consider that the "no-action" alternative will be selected in the future, and also fails to appraise the reduction of cumulative and indirect effects (both environmental and economic) as required by NEPA.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			sales remaining in the current Five-Year Program, if applicable, or proposed as part of a future Five-Year Program. Therefore, a decision to cancel a single proposed regionwide lease sale will not alter future decisions for proposed regionwide lease sales in the GOM, as required by the OCSLA. The decision point is at the individual proposed action or lease sale stage. By selecting the No Action alternative and avoiding those activities associated with a proposed regionwide lease sale, those potential impacts related to a single proposed regionwide lease sale would be avoided; however, please be advised that a decision to cancel a single proposed regionwide lease sale would not preclude activity related to past lease sales or decisions on future lease sales. There are a number of currently leased blocks within the proposed regionwide lease sale area with proposed plans, and BOEM anticipates another decision point for the proposed regionwide lease sale, which is proposed as part of the 2017-2022 Five-Year Program. Should the No Action alternative be selected, in the interim, industry may explore and develop their existing portfolio of leaseholds subject to the terms of those leases and any conditions of approval for plans or permits. An individual decision or a series of decisions on proposed regionwide lease sales in a given planning area may influence industry's decisionmaking or strategy to develop existing leases. In this context, the No Action alternative does not explicitly presume an identical proposal or one that is only delayed into the future. As noted above, under the OCSLA, BOEM would be required to consider any proposed regionwide lease sales remaining in the current Five-Year Program, if applicable, or proposed as part of a future Five-Year Program. As such, each proposed regionwide lease sale will have its own

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			decision point. Analyzing a permanent no lease option is outside the scope of this Supplemental EIS. Cancellation of all 10 proposed regionwide lease sales in the 2017-2022 Five-Year Program was analyzed in the 2017-2022 Five-Year Program EIS (USDOI, BOEM, 2016a), from which the 2017-2022 GOM Multisale EIS and this Supplemental EIS are tiered.
Stated Preference for an Alternative			
Consumer Energy Alliance	CEA-1	As the Voice of the Energy Consumer, Consumer Energy Alliance (CEA) is a nationwide association of energy consumers who advocate for balanced policies that support access to affordable, reliable energy. In addition to our nearly 300 company and association members that represent nearly every sector of the U.S. economy, CEA's membership includes more than 450,000 individual citizens across the country, including over 90,000 in the Gulf Coast region. From everyday citizens to truckers, manufacturers, farmers, and beyond, our members and the American public at large depend on access to affordable, reliable energy – and the products it produces -- in order to meet daily needs, sustain and create jobs, and power the economy. In recent years, the domestic energy revolution has provided a major boost to the American economy and consumer pocketbooks, while fundamentally transforming the global geopolitical landscape to the benefit of U.S. national security. At the same time, thanks to continuing improvements in technology, practices, and oversight, the United States has demonstrated that offshore energy development and environmental stewardship can and do coexist. CEA understands that, to meet our long-term energy	Thank you for your comment. We note that your preferred alternative is Alternative A. The Secretary of the Interior oversees the OCS Oil and Gas Program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained. The decision on whether and how to proceed with each proposed regionwide lease sale is under the authority of the Assistant Secretary for Land and Minerals Management and will be disclosed in the Record of Decision following publication of this Final Supplemental EIS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		needs, we will need access to all of our resources, including oil and natural gas, nuclear, solar, wind, and beyond. We also understand that oil and natural gas will continue to be a critical and dominant part of that mix for decades to come. The federal government understands this as well, as underscored by the Energy Information Administration's forecast that oil and natural gas will contribute just as much if not more to our nation's energy portfolio in 2040 than it did in 2016. In addition, the Interior Department has concluded that not holding Gulf of Mexico lease sales could cause billions of dollars in environmental and social costs, with imports having to replace the vast majority of foregone production. As Interior Secretary Ryan Zinke recently stated, "American energy production benefits the economy, the environment, and national security," and "it is better to develop our energy here under reasonable regulations…rather than have it produced overseas under little or no regulations." CEA agrees. Indeed, industry and regulators alike have taken a number of actions in recent years that have further strengthened the safety of offshore operations in U.S. waters, including what the Obama administration termed "the most aggressive and comprehensive reforms to offshore oil and gas regulation and oversight in U.S. history." In short, contrary to assertions by a small but vocal group of anti-energy groups, whose unproven and unrealistic "just say no to fossil fuels" strategy threatens the most vulnerable among us -- low-income and fixed-income families -- we can protect our environment AND meet our energy needs. This fact is highlighted by a recent Interior Department conclusion that Gulf lease sales have beneficial impacts for commercial and recreational fishing and	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		recreational resources. More broadly, it is highlighted by human experience around the world, which shows that modern day energy enables people to live healthier and more prosperous lives with dignity, all the while contributing to a reduced environmental footprint, while societies that don't have access to modern energy experience greater incidences of poverty and increased health and environmental risks. For all these reasons, CEA supports the proposed action to hold region-wide lease sales in the Gulf of Mexico in 2018, and opposes any alternative that would cancel them or further reduce or restrict the areas available in those lease sales.	
Consumer Energy Alliance	CEA-4	On behalf of energy consumers across the Gulf Coast region and the entire nation, CEA encourages the Interior Department to ensure that all Americans are able to affordably air condition and heat their homes and feed their children. An "all of the above" approach to energy policy is the only sensible solution, and that must include the Gulf of Mexico. That is why CEA urges the Interior Department to include valuable offshore opportunities in the Gulf of Mexico, and reject any demands to take actions that would in any way delay, restrict, or prohibit Lease Sales 250 and 251, by finalizing a Supplemental EIS that allows these lease sales to proceed without any further exclusions or restrictions.	
Beth Everage, Consumer Energy Alliance	BECEA-1	Good afternoon. My name is Beth Everage, and I'm speaking today on behalf of Consumer Energy Alliance (CEA). CEA represents producers and consumers of energy from every sector of the economy, with more than 450,000 individual supporters across the United States, including over 90,000 in the Gulf Coast region. From everyday citizens to truckers, manufacturers, farmers, and	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		beyond, our members and the American public at large depend on access to affordable, reliable energy - and the products it produces -- in order to meet daily needs, sustain and create jobs, and power the economy. In recent years, the domestic energy revolution has provided a major boost to the American economy and consumer pocketbooks, while fundamentally transforming the global geopolitical landscape to the benefit of U.s. national security. At the same time, thanks to continuing improvements in technology, practices, and oversight, the United States has demonstrated that offshore energy development and environmental stewardship can and do coexist. CEA understands that, to meet our long-term energy needs, we will need access to all of our resources, including oil and natural gas, nuclear, solar, wind, and beyond. We also understand that oil and natural gas will continue to be a critical and dominant part of that mix for decades to come. The federal government understands this as well, as underscored by the Energy Information Administration's forecast that oil and natural gas will contribute just as much if not more to our nation's energy portfolio in 2040 than it did in 2016. In addition, the Interior Department has concluded that not holding Gulf of Mexico lease sales could cause billions of dollars in environmental and social costs, with imports having to replace the vast majority of foregone production. In the wake of the most aggressive and comprehensive reforms to offshore oil and gas regulation and oversight in U.S. history, it is clearer than ever before that offshore energy development and a healthy environment can and do exist.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		In short, contrary to assertions by a small but vocal group of anti-energy groups, whose unproven and unrealistic "just say no to fossil fuels" strategy threatens the most vulnerable among us -- low-income and fixed-income families -- we can protect our environment AND meet our energy needs. This is borne out not only by government conclusions that Gulf lease sales have beneficial impacts for commercial and recreational fishing and recreational resources, but more broadly by human experience around the world, which shows that modern day energy enables people to live healthier and more prosperous lives with dignity, all the while contributing to a reduced environmental footprint, while societies that don't have access to modern energy are relegated experience greater poverty and increased health and environmental risks. For all these reasons, while CEA will have additional comments on the draft supplemental EIS in its formal comment letter, we support the proposed action to hold regionwide lease sales in the Gulf of Mexico in 2018, and oppose any alternative that would cancel Gulf of Mexico lease sales 250 or 251, or further reduce or restrict the areas available in those lease sales. On behalf of energy consumers across Texas, the Gulf Coast region, and the entire nation, CEA urges the Interior Department to ensure that all Americans are able to affordably air condition and heat their homes and feed their children. An "all of the above" approach to energy policy is the only sensible solution, and that must include the Gulf of Mexico. That is why CEA urges the Interior Department to include valuable offshore opportunities in the Gulf of	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Mexico, and reject any demands to take actions that would in any way delay, restrict, or prohibit Lease Sales 250 and 251, by finalizing a Supplemental EIS that allows these lease sales to proceed without any further exclusions or restrictions.	
Florida Department of Environmental Protection	FDEP-1	Florida State Clearinghouse staff has reviewed the proposal under the following authorities: Presidential Executive Order 12372; § 403.061(42), Florida Statutes; the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended; and the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347, as amended. Based on the information submitted and minimal project impacts, the state has no objections to the subject project and, therefore, it is consistent with the Florida Coastal Management Program (FCMP). Thank you for the opportunity to review the proposed plan.	Thank you for your comment. The States' coordination with BOEM is an important part of the lease sale process.
Alicia Cooke	AC-6	The two main alternatives appear to be: 1) Take no action/cancel lease sale (Alternative E): Exceed the world's carbon budget in all PROBABILITY via future drilling and other avenues of fossil fuel exploitation, but with a small path forward toward meeting the Paris Agreement as the price of oil continues to rise and global public pressure leads to reforms such as improved renewable technology and carbon pricing initiatives; 2) Continue drilling (Alternatives A-D): Exceed the world's carbon budget in all CERTAINTY, albeit perhaps less quickly than in a "no action" alternative. This is not an attractive choice, but as it is what we are faced with and it leaves "No Action" as the only remotely responsible choice.	Thank you for your comment. We note that your preferred alternative is Alternative E. The Secretary of the Interior oversees the OCS Oil and Gas Program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained. The decision on whether and how to proceed with each proposed regionwide lease sale is under the authority of the Assistant Secretary for Land and Minerals Management and will be disclosed in the Record of Decision following publication of this Final Supplemental EIS. BOEM determined that an analysis of alternative energy and alternative uses of the OCS is outside the scope of this Supplemental EIS. BOEM also
Amy Merrill	AmMe-1	The gulf coast has been hit by the BP oil spill and Hurricane Katrina and is STILL trying to recover.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Please, for pity's sake, do NOT allow a perfect storm of another leaking oil well plus a hurricane completely devastate this part of the world! Not much can be done about hurricanes, but oil wells DO NOT HAVE TO BE THERE.	determined that alternative energy is not a reasonable alternative to achieve the purpose of and need for the proposed action because the development of renewable energy resources in the foreseeable future does not fully or partially satisfy the purpose of and need for the proposed action at this time. However, BOEM does recognize the need to investigate the potential for alternative energy on the Federal OCS, and this is addressed in the 2017-2022 Five-Year Program EIS (Chapters 1.4.6.1 and 2.7.4) from which the 2017-2022 GOM Multisale EIS tiers, and this Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS. BOEM's Office of Renewable Energy is responsible for developing an offshore renewable energy program in the Gulf of Mexico. Information on BOEM's renewable energy program, OCS leases, and renewable energy projects (34 proposed or currently in development) is available at on BOEM's website at http://www.boem.gov/Renewable-Energy/. In reference to fishing, the economy, and tourism, BOEM analyzes the impacts of oil and gas production on a number of important habitats, resources, and socioeconomic entities. For specific information on commercial fisheries, recreational fishing, and tourism, refer to **Chapters 4.10, 4.11, and 4.12**, respectively. In reference to climate change, BOEM analyzes and considers many facets of the potential effects of climate change in its decisionmaking with respect to oil and gas leasing, whether in the Five-Year Program or lease sale analyses. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS, which tiers from the 2017-2022 Five-Year Program EIS. It incorporates by reference a summary of the greenhouse gas and downstream emissions information that may result from a Gulf of Mexico oil and gas lease sale discussed in Chapter 4.0 of the
Bill Clarke	BC-1	Drilling in the Gulf of Mexico for gas and/or oil is extremely hazardous and has the potential for severe environmental damage, similar to that which has happened in the past. Therefore, I am strongly opposed to ANY drilling in the Gulf of Mexico.	
Carole Tebay	CT-1	I am in opposition to the sale of new leases for oil and gas in the Gulf because of the...... -oil and gas disasters that have already occurred in the Gulf and their effect on wildlife, health, tourism and fishing. -contribution to ocean acidification -contribution to climate change -halting oil and gas leases in the Gulf of Mexico will keep tons of carbon in the ground	
David Quist	DQ-1	I provide these comments both as to the wisdom of further leasing in the Gulf, and specifically with regard to the proposed EIS for the Gulf of Mexico Outer Continental Shelf Lease Sale. The Gulf has been abused for far too long and additional lease sales make no sense. The environmental risks are too great, it frustrates efforts to modernize our energy sources and respond to the realities of climate change, and damages critical resources.	
Jean Publeee	JP-1	THE UNITED STATES SHOULD STOP GIVING LEASES FOR OIL DRILLING IN THE GULF OF MEXICO. THIS GULF IS ALREADY POLLUTED WHERE NOTING CAN LIVE AND THIS IS JUST FURTHER DESTRUCTION OF AMERICA.	
June Charles	JC-4	FOSSIL FUEL MUST GO. FOSSIL FUEL MUST STAY IN THE GROUND. Do we determine right now never to enjoy the fish in the ocean and the leisure of beachfront play. You are the government;	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		you protect us. DO YOUR JOBS - SAY NO TO BIG OIL.	2017-2022 GOM Multisale EIS. Further, commenters should be aware that any past or present commitments made by the U.S. concerning a reduction of GHG emissions (e.g., Paris Agreement) do not broaden the scope of the Bureau of Ocean Energy Management's NEPA analysis at the lease sale stage or require BOEM to venture into analyzing the potential worldwide effect of GHG emissions that could result from a lease sale. In reference to comments within the Sierra Club form letter (SC-1), please refer to the responses to Comments SC-2, SC-3, SC-4, and SC-5. In addition, the petition submitted by Care2 has been sent to BOEM Headquarters for consideration in the new proposed Five-Year Program. The individual comments within the petition were focused at the program level rather than comments on this Supplemental EIS.
Sierra Club	SC-1	3,679 Sierra Club members and supporters have submitted comments objecting to the expansion of offshore Gulf oil drilling. Please find two spreadsheets with all of the 3,679 signatures attached. More than 205 people have taken the time to write a personalized comment and 3474 have signed to the following text: Seven years ago, an explosion on BP's Deepwater Horizon oil rig took 11 lives and led to the largest offshore oil spill in US history: 210 million gallons of oil flowed out for 87 days. Damages are still being felt by local communities and wildlife. Gulf communities cannot afford the risk that comes with new oil and gas leases. I urge you to consider the following and reject plans for new oil and gas leases in the Gulf: BOEM's proposal to lease over 70 million acres of the Gulf of Mexico so that oil and gas companies can drill up to 9.5 billion barrels of oil equivalent over the next 70 years will deepen the climate crisis. Climate change, driven primarily by the combustion of fossil fuels, poses a severe and immediate threat to the health, welfare, ecosystems and economy of the United States and the world. Halting new oil and gas leases off our coasts would keep up to 62 billion tons of carbon emissions in the ground the pollution equivalent of more than 16,000 coal-fired power plants. BOEM has already leased over 23 million acres of the Gulf to oil companies, and nearly three million	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		acres of the Alaskan Arctic. Many of the leases in the Gulf of Mexico are relatively new leases, meaning that, by BOEM's own admission, production under these leases will last up to 70 years. BOEM's analysis fails to consider why the OCS areas already under lease are not sufficient to supply the nation's energy needs while we transition away from dirty fossil fuels and toward clean, sustainable energy. BOEM has repeatedly admitted that it lacks critical information regarding the effects of the Deepwater Horizon oil spill on the Gulf of Mexico. It has also repeatedly admitted that there are data gaps regarding numerous resources in the Gulf, including wetlands, coastal water quality, offshore water quality, air quality, commercial and recreational fishing and environmental justice, and that the impacts of the Deepwater Horizon oil spill on such resources may have changed baseline conditions. BOEM cannot properly define the environmental baseline, and cannot conduct a proper NEPA analysis unless and until these significant data gaps are filled. Similarly, BOEM must analyze the impacts of another catastrophic oil spill. Oil spills and air pollution from offshore drilling and industrial facilities like refineries that support the industry make people sick and disproportionately harm low-income neighborhoods and communities of color. But BOEM fails to adequately analyze the environmental justice impacts of its proposal. I urge you to halt all new oil and gas lease sales in federal waters and keep these dirty fossil fuels in the ground.	
Lisa Rogers	LR-1	As a Florida resident, my husband and I do NOT want any more oil leases sold this year, or any year.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Thank you in advance for listening to our concerns.	
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-14	In conclusion, the Bureau's leasing proposal would cause a wide variety of serious harms to the environment, including greenhouse gas emissions that will exacerbate climate change, oil spills, and further impacts to already imperiled wildlife and local communities, many of which are still suffering the effects of the Deepwater Horizon oil spill six years later. Accordingly, we urge the Bureau to adopt the no-action alternative, end new offshore oil and gas leasing, and keep dirty fossil fuels in the ground. If the Bureau nevertheless decides to proceed with its proposal, it must first address and remedy the numerous deficiencies within the Draft SEIS and should circulate a revised Draft SEIS with a robust site-specific analysis for public comment.	
Nicholas Gault	NG-1	Please continue to protect our ocean wildlife and continue to disallow new leases and drilling in US coastal waters.	
Peter Shrock	PS-13	For these reasons I advocate strongly delaying or perhaps even stopping the Gulf of Mexico OCS Lease Sale.	
Mobile Environmental Justice Action Coalition	MEJAC-9	I hope BOEM and its leadership within the Department of Interior take these and the concerns of others seriously enough to understand the very positive encouragement available from among impacted communities all along our Gulf for a concerted effort to thoroughly reconsider Gulf of Mexico OCS drilling priorities that adopting Alternative E of the 2018 Gulf of Mexico OCS Lease Sale Draft SEIS could represent.	
Rebecca King	RK-10	In conclusion, I recommend no new drilling leases.	
Ryan Bowman	RB-1	We cannot risk another Deep Water Horizon incident. Please do not allow any new offshore drilling in the Gulf of Mexico.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Sarah Danner	SD-1	As a lifelong resident of the Gulf Coast, we retired to the Florida Panhandle in '03. After checking out coastal Texas we decided on Florida because of its clean beaches and clear water. The rest of the Gulf area aside from Florida was too dirty and polluted from extensive oil and gas exploration. I am sensitive to fossil fuel pollution. It triggers my asthma causing asthmatic bronchitis. Please do not extend the leases closer to Florida. We depend on tourist dollars for the economy well-being of the state. Deepwater Horizon was an example of both environmental and economic devastation wrought by drilling disasters. It also proved that leaks and mistakes happen, are not fool-proof, often with catastrophic results. Please protect Florida and keep one area of the Gulf clean and less polluted. Both people and wildlife depend on it.	
Kevin Holm	KH-1	As a Florida resident, this is important to me. Our economy is based on tourism. And tourism revolves around our beaches. Oil and our beaches do not go well together. And besides Floridas special issues, climate science alone should be enough for any reasonable person to fight against oil. We need to focus on renewables, not filth.	
Sarah Howard	SH-1	I support ALTERNATIVE E - No new leases in the Gulf of Mexico!	
Valerie Longa	VL-2	The responsibility that we have in Alabama to care for this precious environment is great. Alabama is number one in aquatic biodiversity, and the Mobile Tensaw Delta was recently placed as one of the most endangered river systems in the country. The resources that we have here need our care, including the gulf. My stance on the environmental impact statement from BOEM is the no-action option. I believe that the no-action option reduces the possibility for greater wells to be explored and greater infrastructure and expansion of the oil and gas industry in the gulf.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Carol "Cay" Burton	CB-1	I believe that leasing in the Gulf should cease.	
Jackie Hartstein	JH-3	But I vote for Alternative E.	
Care2	Care2-1	For Earth Day, Donald Trump is trying to open up 95 million acres of the Gulf of Mexico to new oil drilling. He's also working on overturning efforts by President Obama to protect the Arctic and the Atlantic. It's been exactly seven years since we watched BP's Deepwater Horizon offshore drilling disaster threaten the Gulf coast and its communities. We watched the oil wash into the nation's most productive fishing grounds, and heard from fisherfolk who didn't know how they would provide for their families. We also saw one of the largest oil companies on the planet screw up every step of the way as they tried to clean up and contain their pollution. Sick workers, toxic and ineffective cleanup techniques, oiled turtles and dead sperm whales, government agencies incapable and unwilling to hold BP accountable to their own clean up plan. It was a disgrace. Offshore drilling is a dirty and dangerous business, and we should not allow it on any more of our sensitive coastlines. Petition signed by more than 89,000+ Care2 members Signed and sent via this Care2 petition: http://www.care2.com/go/z/BOEM	
Bob Smith	BoSm-1	As a retired middle school science teacher, I understand the importance of preserving our natural resources. Our beaches and Gulf waters are vital to	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		our economy and our future health and prosperity. No oil leases should be granted!! I am opposed to any new leases.	
Carol A. "Cay" Burton	CAB-1	I believe that leasing in the Gulf should cease.	
Kathleen McBride	KM-1	After the disaster with the Deepwater Horizon, I don't think any drilling in the Gulf should be done. It is not safe. This spill has impacted our lives and there is still oil off the shore of Pensacola.	
Lorie Chinn	LC-3	There has been a great amount of leases sold already. I think that (No Action) or the cancellation of the proposed lease sale should be the main focus at this time.	
Bonnie Aylward	BA-4	I encourage no more leasing or drilling in the Gulf of Mexico.	
Pam Scaggs, South Baldwin Democrats	PSSBD-2	To issue permits for more drilling offshore is insane. Our oceans are our life. Without them being healthy and productive, we will perish. Without plankton, all forms of life will die.	
Carol "Cay" Burton	CB-3	While Florida waters are not included at this time, Florida waters have been and will be affected by spills in nearby states west. Fish, plants and people must not be exposed to further chemical pollution from predictable spills and their cleanup chemicals.	
Carol A. "Cay" Burton	CAB-3	While Florida waters are not included at this time, Florida waters have been and will be affected by spills in nearby states west. Fish, plants, and people must not be exposed to further chemical pollution from predictable spills and their clean-up chemicals.	
Donna Baker	DB-1	Like millions of baby boomers, I moved to SW Florida for the beaches and beautiful waterways. The tourist and fishing industry are huge here. We do not want oil rigs offshore. Another spill would be disastrous to the wildlife, the economy of Florida, and devastate our property values. People come here to boat and to fish and vacation on the beach. An oil spill would devastate the economy here once again.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Please respect Florida's unique beauty and ecosystems and the people who live and work here, and the tourist industry. Florida has nothing else. Oil rigs employ few people compared to the fishing/tourism industry here. Canadians and Europeans love to vacation here. Why risk ruining it all? Please don't allow offshore drilling in the gulf of Mexico!	
Francine Slack	FS-1	Florida, the land of sunshine, needs more solar power investment, not a search for dirty, destructive oil. Additionally, since our economy rests on tourism, as well as seafood harvests, it would be suicidal to risk fouling our environment with oil exploration and the attendant support industries and personnel. Please refuse any proposals for oil exploration in the Gulf of Mexico.	
Deborah Jiminez	DJ-1	Along with opposing offshore drilling in the Gulf I urge you to stop the proposals and Congressional bills for fracking in Florida. The state is a beautiful state to live in as well as many tourists from around the world to visit. Let's keep our waters and our state as pristine as possible for future generations to come. Let's focus on clean sustainable energy alternatives.	
Brian A. Mayhew	BAM-1	Florida's Gulf coast communities cannot afford the economic risk that comes with new oil and gas leases in the eastern part of the Gulf. Tar balls and oil spills like they have in Louisiana and on Texas beaches will ruin our state's beautiful waters, beaches, and will ruin our very important tourism industry. There are plenty of areas in the Gulf that have been leased and not yet developed. Please reject	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		BOEM?s proposal to lease more acreage in the eastern Gulf. Thank you for considering my comments.	
Daryl Frahn	DaFr-1	The economy of the cities and small towns on the Gulf of Mexico rely on tourism. The impact of a spill would be catastrophic to businesses and residents.	
Mobile Environmental Justice Action Coalition	MEJAC-1	There are many compelling reasons why Alternative E of the 2018 Gulf of Mexico OCS Lease Sale Draft SEIS is the only reasonable action for the Department of the Interior to take. Taken together with respect to the lack of critical data corresponding to lingering human and environmental health stressors from OCS petrochemical mineral extraction, transport, and refining, risk management best practice would suggest implementation of the precautionary principle as exercised in Alternative E is the socially responsible course of action among all available alternatives, although not necessarily for the reasons cited by BOEM staff.	
Mobile Environmental Justice Action Coalition	MEJAC-8	These points taken in consideration with outstanding concerns surrounding the Bureau of Safety and Environmental Enforcement's implementation and oversight protocols by the Government Accounting Office paint a picture of Alternative E that isn't just attractive to sloganeering activists, but suggests sound policy consideration and defensible precautionary principle bona fides.	
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket	CBD,SC,GRN, LBB-2	We urge the Bureau to adopt the no action alternative and cancel this lease sale because of its detrimental impacts on wildlife and coastal communities in the Gulf of Mexico. Offshore oil and gas activities damage the Gulf's vulnerable ecosystems, erode its coastlines, and deepen our climate crisis.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Brigade			
Janice Overstreet	JO-1	I strongly object to the proposal to lease addition acres of the Gulf of MExico to oil companies! This would lead to increased risk of accidents which will harm the gulf, echosystems, and beaches as well as Florida economy.	
James Sorrells	JaSo-1	The statistics highlight the path we are already on. Our inaction will ultimately lead to the demise of other species and eventually the human race. How we respond in this moment will determine the future for our children. ?Americans are already feeling the effects of climate change -- and it's bound to get worse, according to the National Climate Assessment released this week. Among the report's findings: Sea level at many of America's largest coastal cities could rise 4 feet or more by 2100, average temperatures could rise by 10 degrees, hurricanes will become stronger, yields of major U.S. crops could decline by 2050, more wildlife will go extinct, and biodiversity will be altered so much in some places "that their mix of plant and animal life will become almost unrecognizable." ~biodiversity.com	
Daniel Gillis	DaGi-1	Enough is enough! Another Deep water Horizon would devastate the the economy as well as the ecology of the Gulf states. It is time to back off drilling until the ecology heals. The livelihood of millions are put at risk to profit the few.	
Dennis Rentschler	DR-1	SEVERAL OF THE SO CALLED 'THIRD WORLD' COUNTRIES ARE NOW AHEAD OF US IN CLEAN ENERGY PRODUCTION AND MANUFACTURING. WHY ARE WE MOVING BACKWARDS INTO THIRD WORLD STATUS???? FOSSIL FUELS ARE A DYING ENERGY SOURCE AND YOU CAN'T STOP IT. IT'S WHAT THE PEOPLE WANT. IT'S WHAT THE ENERGY COMPANIES ARE MOVING TOWARD. IT'S WHAT THE PLANET NEEDS TO	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		SURVIVE IN THE LONG RUN. FOSSIL FUELS WILL NOT 'MAKE AMERICA GREAT AGAIN'. THEY WILL MAKE AMERICA DIRTY AGAIN WITH POLLUTION, HEALTH ISSUES, LOST REVENUES, A LOSS OF GLOBAL TRUST TO CARRY OUT A PROMISE, ETC., ETC. IT'S A DYING FUEL SOURCE. LET IT R.I.P.	
Gary Stephens	GS-1	I believe that we have enough evidence from a variety of sources that the last thing we need to be doing now is encouraging more drilling. We need to give this a break for a few years, while we see what will change in the energy market. The last thing we want is a bunch of drilling that gets abandoned if the push for renewable energy makes the progress we hope it will.	
Ron Masters	RM-1	To meet the whole world's COP21 goal of limiting warming to 2øC, humanity can afford to emit no more than 1 trillion tons of additional CO_2 over the next several millennia. That's equivalent to the proven reserves of oil; i.e., assets on company books. Proven reserves of natural gas would contribute almost as much; of coal, three times more. Exploration for fossil fuels is a crime against humanity. Stop leasing!	
David Gorchov	DaGo-1	Off-shore drilling necessarily involves risks of spills, blowouts, and other accidents, some of which have extensive impacts on marine and coastal life and on livelihoods, especially in tourism and fishing. I live 15 miles from the Gulf of Mexico, and strongly expose any new offshore drilling.	
David Gorchov	DaGo-5	I urge you to reject plans for new oil and gas leases in the Gulf of Mexico:	
Jensie Madden	JM-1	Please do not allow any new leases for oil and gas exploration in the Gulf. For generations my family has lived in Texas, enjoying excursions to Gulf beaches for decades of	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		summers. In my own lifetime I have seen the change in the beach, especially Padre Island, from pristine to almost constant "tar" in the sand and in the water. The disadvantages of continued oil and gas exploration are numerous: degradation of the ocean and the beach, the possibility of another Deepwater Horizon-type oil spill, and the continued use of fossil fuels to the detriment of our future climate. Resist the short-term advantages and consider the long-lasting consequences for our children and grandchildren. Please say no to all new oil and gas leases in federal waters.	
Topic 4 – Environmental Issues and Concerns			
Climate Change			
Allison Kalnik	AK-1	The Gulf of Mexico OCS Lease Sale Draft Supplemental Environmental Impact Statement 2018 does not adequately comply with NEP and fails to genuinely address climate change concerns already mentioned in previous comments submitted to BOEM, namely that: New leases are not compatible with U.S. commitment to reduce greenhouse gas emissions and remain under 2 degrees Celsius of global warming (which requires that 80% of known fossil fuel reserves remain in the ground).	BOEM considers many facets of the potential effects of climate change in its decisionmaking with respect to oil and gas leasing, whether in a Five-Year Program or lease sale analysis. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS, which tiers from the 2017-2022 Five-Year Program EIS. It incorporates by reference a summary of the greenhouse gas and downstream emissions information that may result from a Gulf of Mexico oil and gas lease sale discussed in Chapter 4.0 of the 2017-2022 GOM Multisale EIS. The effects that a proposed action could have on climate change or the effects that climate change could have on the proposed action are incorporated by reference into this Supplemental EIS. BOEM decided to qualitatively address climate change impacts since it acknowledges that methods for quantifying greenhouse gas and potential social costs of such emissions are still subject to continual improvement.
Peter Shrock	PS-11	The EIS does not adequately consider any (indirect, direct, cumulative etc) climate change impacts. This is especially serious as climate change is the gravest threat that the United States and even the world faces at present.	
Rebecca King	RK-11	I feel that this EIS is so compartmentalized that it misses the big picture of climate change and how all of these ecosystems are connected. Just looking at what is in close proximty to the proposed leases is not acceptable.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
David Quist	DQ-3	Finally, it makes no effort to consider the climatic impact of further exploration, drilling, and production of additional fossil fuels.	Further, commenters should be aware that any past or present commitments made by the U.S. concerning a reduction of GHG emissions (e.g., Paris Agreement) do not broaden the scope of the Bureau of Ocean Energy Management's NEPA analysis at the lease sale stage or require BOEM to venture into analyzing the potential worldwide effect of GHG emissions that could result from a lease sale.
David Gorchov	DaGo-4	BOEM?s proposal to lease over 70 million acres of the Gulf of Mexico so that oil and gas companies can drill up to 9.5 billion barrels of oil equivalent over the next 70 years will worsen our nation's emissions of greenhouse gases, and make it more difficult to mitigate emissions enough to reduce the risk of rapid climate change.	
Rebecca King	RK-7	How were the affects of climate change and the loss of Louisiana wetlands due to climate change and oil and gas activity analysed?	Louisiana's land loss has been acknowledged in this Supplemental EIS, but the contribution from the oil and gas industry has been more from inshore activities such as the dredging of location canals through marshes as opposed to OCS oil- and gas-related activity. Separating the causes of such land loss is difficult, but one study estimated that the total of direct and indirect impacts from OCS oil- and gas-related activities from 1955 to 1978 accounted for 21,863-49,884 hectares (ha) (54,024-123,266 acres [ac]), or 8-17% of Louisiana's total wetland loss (Baumann and Turner, 1990; Turner and Cahoon, 1987). BOEM summarizes estimates of the impact of OCS oil- and gas-related activity on coastal wetlands and beaches in this Supplemental EIS and elaborates in greater detail in the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers, based on currently available information. Coastal storms, hurricanes, and sea-level rise are addressed in the land use/coastal infrastructure and social factors chapters based on existing peer-reviewed research. BOEM analyzes and considers many facets of the
Gulf Restoration Network	GRN-12	BOEM must assess the degree to which production projected in this SEIS and Multi-year plan contributes to the increased annual flood damages outlined by the Louisiana Coastal Plan. Climate Change will increase Louisiana's flood damages by $3 billion annually buy 2040 and $12 billion annually by 2060. BOEM must determine what component of that $3 Billion or $12 Billion is due to carbon emissions from these leases and the leases in the multi-year EIS Carbon emissions must be accounted for quantitatively.	
David Quist	DQ-6	Loss of hundreds of acres of wetlands, in the context of ongoing damage over decades, rising sea levels, climate change, and increased storm intensity, is significant and more than moderate, taken in context. Wetland acreage needs to grow, not shrink, in order to retain the viability of both the Gulf and shoreline areas.	
Wendy King	WK-1	Contrary to what the oil industry's supporters say, this is about our long-term environmental survival, and about the survival of fence-line communities near oil refineries and petrochemical plants. Oil industry supporters talk about the importance of their jobs to the wetlands, and how they hunt and fish	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		there. These same industries put the canals and pipelines through the marshes and wetlands that are buffers and protective barriers during tropical storms and hurricanes. Those marshes and wetlands are now disappearing, because of the saltwater introduced by the dredging for those canals and pipelines.	potential effects of climate change in its decisionmaking with respect to oil and gas leasing, whether in the Five-Year Program or lease sale analyses. The Five-Year Program EIS includes a full analysis of the impact of greenhouse gas emissions on different resources, including coastal wetlands, and an analysis quantifying the lifecycle GHG emissions associated with all 10 GOM lease sales in the 2017-2022 Five-Year Program. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS, which tiers from the 2017-2022 Five-Year Program EIS, and both EISs incorporate the greenhouse gas analysis of the Five-Year Program EIS by reference.
Gulf Restoration Network	GRN-13	The draft supplement also fails to evaluate the social impact of the lease sale. Communities within the Gulf of Mexico are at the front lines of climate change; tribes like isle de Jean Charles band of Biloxi, Chitimacha, and Choctaw have left their homes due to the effects of climate change. The sale of these leases will only exacerbate an impending social and economic catastrophe.	Impacts of coastal storms, hurricanes, sea-level rise and subsidence are addressed in the cumulative portion of the land use/coastal infrastructure chapter (**Chapter 4.14.1**), the social factors chapter (**Chapter 4.14.3**), and **Chapter 3.3.2** based on existing peer-reviewed research. An environmental justice determination can be found in **Chapter 4.14.3.1**. The impacts of climate change are addressed in the 2017-2022 Five-Year Program and are incorporated by reference into this Supplemental EIS. For more information on this analysis, please refer to the responses to Comments RK-7, GRN-12, DQ-6, and WK-1.
Jodi Koszarek	JK-2	Climate change is real and it's time we stop contributing to it. Coastal communities are the most vulnerable to climate change consequences.	
Amanda Munson	AmMu-1	BOEM?s proposal to lease over 70 million acres of the Gulf of Mexico so that oil and gas companies can drill up to 9.5 billion barrels of oil equivalent over the next 70 years will create problems for local communities. It has been proven that offshore drilling contributes to coastal erosion--a problem that is ever worsening along the Gulf Coast. Louisiana loses roughly a football field of coast every day. The loss of the coast means that storms coming from the Gulf are able to reach further inland where people live, and they devastate the areas with torrential rains and fierce winds. These storms cause flash floods that lead to loss of life and millions of dollars worth of property damage. Our communities cannot afford to	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		pay this price, and we should not have to. Our nation's energy resources should not be obtained at the expense of our communities. Please reject BOEM's proposal.	
Wendy King	WK-2	Coastal communities, particularly Native American communities like Isle de Jean Charles and Pointe-Au-Chien, are now moving inland, to higher ground, and away from their home territories, due to sea-level rise, which is worsened by the 70+ years of oil and gas extraction and the canals and pipelines constructed to make it easier to move oil and gas from the offshore drilling platforms to our state's onshore distribution grid.	
Greenhouse Gas			
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-7	The Bureau's analysis of lifecycle greenhouse gas emissions resulting from the FPP concludes that adding 3.7 billion barrels of oil to the world would make no difference for GHG emissions, and would even reduce emissions compared to the No Action Alternative of no new leasing: "America's GHG emissions will be little affected by leasing decisions under the Bureau's 2017– 2022 OCS Oil and Gas Leasing Program and could, in fact, increase slightly in the absence of new OCS leasing." The Bureau explains this contradictory conclusion with the argument that, in the No Action Alternative, "foreign sources of oil will substitute for reduced OCS supply, and the production and transport of that foreign oil would emit more GHGs." The Bureau's conclusion that the No Action Alternative will lead to higher, rather than lower, GHGs compared to the lease scenario is deeply flawed in several key aspects. First, the Bureau reaches this conclusion by failing to conduct a full accounting of the GHG emissions that would result from the No Action Alternative. The Bureau concedes up front that its GHG analysis is limited in	BOEM considers many facets of the potential effects of climate change in its decisionmaking with respect to oil and gas leasing, whether in the Five-Year Program or lease sale analyses. In the 2017-2022 Five-Year Program EIS, BOEM compares greenhouse gas emissions from direct OCS emissions to those that could occur from energy substitutes that would presumably replace OCS production in the absence of a new OCS Program and comparable demand levels. Downstream greenhouse gases have been quantified for both the OCS Program and energy substitutes required to replace foregone production in the absence of leasing. Please refer to the 2017-2022 Five-Year Program EIS for additional information about how BOEM evaluates greenhouse gas emissions and climate change. That analysis concludes that reducing OCS oil and gas consumption in the U.S. and the associated emissions from limiting OCS leasing would largely be offset by substitutes from other energy sources, either within the United States or elsewhere. BOEM has considered a No Action alternative (i.e., cancellation of a proposed regionwide lease sale); however, that does not necessarily equate to zero downstream greenhouse

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		"not fully capturing global market and GHG implications." In a section on "critical assumptions" that affect its GHG estimates, the Bureau states that foreign consumption of oil and gas will be significantly reduced under the No Action Alternative, but that the GHG savings from this reduction "is not taken into account" in its analysis. The Bureau states that its MarketSim model estimates a reduction in foreign oil consumption under the No Action Alternative of "approximately 1, 4, and 6 billion barrels of oil for the low-, mid-, and high-price scenarios, respectively, over the duration of the 2017–2022 Program." However, the GHG benefits of this reduction of oil consumption are not included in the calculation of the GHG emissions that would result from the No Action Alternative. The Bureau justifies this decision not to include these significant GHG savings from the No Action Alternative by stating that "[o]il consumption in each country is different, and the Bureau does not have information related to which countries would consume less oil." The Bureau also does not include the GHG benefits from the reduction in the foreign consumption in natural gas under the No Action Alternative because MarketSim does not model natural gas fluctuations in the global market. However, as pointed out in an analysis by experts at the Stockholm Environment Institute, despite this lack of information, the Bureau is able to estimate the GHG savings resulting from the reduced foreign consumption of 1, 4, and 6 billion barrels of oil under the different price scenarios. Using standard energy contents (from the U.S. Department of Energy) and carbon contents (from the U.S. Environmental Protection Agency), and discounting the oil used in products and not combusted (International Energy	gas emissions from oil and gas unless energy demand or supply changes drastically or cost-competitive clean energy sources are substituted. This Supplemental EIS tiers from the 2017-2022 Five-Year Program EIS, and **Chapter 4.1** of this Supplemental EIS includes a summary of the greenhouse gas and downstream emissions information that may result from a Gulf of Mexico oil and gas lease sale. The determination of the U.S. energy needs is based on the U.S. Dept. of Energy's Energy Information Administration's 2016 demand projections and is discussed in detail in the 2017-2022 Five-Year Program EIS. The Energy Information Administration is the principal Federal agency responsible for collecting, analyzing, and disseminating energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. The Energy Information Administration forecasts future energy demand and supply based on current laws and regulations. BOEM relies on special runs performed by the Energy Information Administration's National Energy Modeling System (NEMS) to feed its MarketSim model that, in turn, is used to determine changes in energy demand and energy substitutes under the No Action alternative. The energy demand analysis from the 2017-2022 Five-Year Program EIS is incorporated into this Supplemental EIS through the tiering process. This Supplemental EIS analyzes environmental and economic impacts and benefits for the alternatives, including the proposed action and No Action alternative (i.e., no new leasing).

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Agency), SEI estimated that the reduction in global oil consumption would result in a savings of 2.3 billion tonnes CO_2 in high-price scenarios for oil, 1.6 billion in mid-price scenarios, and 0.4 billion in the low-price scenarios. As the SEI analysis points out, the decreases in rest-of-world GHG emissions under the No Action Alternative are enormous: These decreases in rest-of-world emissions dwarf the official estimated increases in U.S. emissions that the Bureau's official Programmatic Environmental Impact Statement reports for its No Action Alternative (relative to the Proposed Program), which instead amount to just 0.13 billion, 0.12 billion and 0.013 billion tonnes CO_2 for the high, mid, and low-price scenarios, respectively. Those calculations exclude the far larger emissions attributable to the global market effect. In short, if the Bureau were to account for the effects of reducing production on international oil consumption, the global GHG impact of the No Action Alternative over the life of the 2017-2022 Program would be a decrease of up to 2.3 billion tonnes of CO_2 which is greater than a year's worth of emissions from the entire U.S. transportation section (i.e.,1.7 billion tonnes CO_2). The failure of the Bureau to account for the GHG benefits of reduced foreign oil consumption illustrates a problematic inconsistency in how it accounts for GHGs occurring outside the US. Under the No Action Alternative, the Bureau includes the higher GHG emissions associated with importing more foreign oil and gas to the US, even though these emissions occur primarily outside US borders. However, under the No Action Alternative, the Bureau does not include the much larger reductions	Further, commenters should be aware that any past or present commitments made by the U.S. concerning a reduction of GHG emissions (e.g., Paris Agreement) do not broaden the scope of the Bureau of Ocean Energy Management's NEPA analysis at the lease sale stage or require BOEM to venture into analyzing the potential worldwide effect of GHG emissions that could result from a lease sale.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		in GHG emissions occurring outside US borders that result from lower foreign consumption of oil and gas. The Bureau should also be more transparent in acknowledging and accounting for the effects of the global market on oil and gas consumption. As noted by the Bureau, MarketSim models oil as a "global market." The Bureau briefly acknowledges that, in the No Action Alternative, decreased oil and gas production reduces demand through reduced energy consumption. The Bureau should also directly acknowledge that in the case of increased oil and gas production under the FPP, global markets will respond by decreasing prices that lead to increased global consumption. As summarized by SEI: "the oil market is also highly global, with oil readily traded among countries, and substantial infrastructure in place to do so. The U.S. both imports and exports oil, and world and domestic oil prices very closely track each other (U.S. EIA 2016). For this reason, we expect that changes in U.S. oil production would affect an integrated global oil market, an assumption also made by many other analysts that have looked at changes in U.S. oil supply (Bordoff and Houser 2015; Rajagopal and Plevin 2013; Allaire and Brown 2012; Metcalf 2007; IEc 2012). Though in the past the oil market could be strongly influenced by cartel behavior among a small number of producers, many analysts now see the market as more likely to behave competitively (The Economist 2016; U.S. EIA 2016), meaning that increases or decreases in supply do translate into shifts in prices and, in turn, consumption." A recent, comprehensive analysis of the emissions consequences of the US ceasing to issue new leases for oil extraction on federal waters and lands,	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		and avoiding renewal of existing leases for resources that are not yet producing, found that ceasing new leasing led to a large GHG emissions benefit. Like the Bureau's analysis, this study accounted for the effects of substitution of other fuels for the oil that was foregone by ceasing leasing. The analysis estimated that cutting federal oil leasing reduces global CO_2 emissions in 2030 from oil consumption by 54 Mt CO_2, and leads to an increase in CO_2 emissions from other fuels of 23 Mt CO_2, for a net emissions benefit of 31 Mt CO_2. The study recommended that "policy-makers should give greater attention to measures that slow the expansion of fossil fuel supplies." Another problematic element of the Bureau's analysis is that the agency makes several "critical assumptions" that are not well-founded and help contribute to the flawed conclusion that GHG emissions resulting from the No Action Alternative will exceed the emissions from extracting and consuming billions of barrels of oil. For example, one critical assumption is that "near constant demand is assumed over the next 40-70 years for oil and gas" and that "oil and gas will remain a primary energy source" over the next 70 years. The Bureau states that it uses the EIA's 2016 AEO reference case projection of near constant demand in oil and gas, which "does not assume any future changes in laws or policies other than what is incorporated in existing laws and policies." However, the AEO reference case makes projections only for the next 23 years through 2040, whereas the Bureau is making the assumption of no change in oil and gas demand over the much longer time span of the next 40 to 70 years. The assumption that oil and gas demand will not change during the next 40 to 70 years is simply not realistic in light of national and	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		international GHG reduction commitments and the rapidly expanding capacity and price competitiveness of solar and wind energy that can substitute for fossil fuels. As acknowledged by the Bureau, the US has committed to GHG targets that require the US to steadily decrease GHG emissions. Under the Paris Agreement, which the US signed on April 22, 2016 as a legally binding instrument through executive agreement, the United States has committed to holding the long-term global average temperature "to well below 2°C above preindustrial levels and to pursue efforts to limit the temperature increase to 1.5°C above preindustrial levels." The Agreement requires a "well below 2°C" climate target because 2°C of warming is no longer considered a safe guardrail for avoiding catastrophic climate impacts and runaway climate change. Under the Agreement, the US Nationally Determined Contribution (NDC) is to reduce net GHG emissions by 26–28% below 2005 by 2025. Independent of the Paris Agreement, the US set a long-term goal of reducing emissions by 83% below 2005 levels by 2050. US GHG commitments are not compatible with continuing fossil fuel extraction from federal waters and lands. The lifecycle GHG emissions from the FPP would consume a substantial portion of the remaining US carbon budget for staying below 2°C, and an even greater portion of the budget for staying "well below 2°C" or below 1.5°C. As the Bureau acknowledges, for a reasonable chance of constraining global temperature rise to 2°C, "full lifecycle GHG emissions from past OCS oil and gas leasing and the 2017-2022 Program could represent as much as one half percent of the remaining global carbon budget and potentially could represent up to	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		9 percent of the remaining carbon budget for the United States." These percentages of the US carbon budget, though high, are actually underestimates because they are calculated for a 2°C target, rather than the more ambitious targets required under the Paris Agreement, and they do not account for the substantial portion of the carbon budget that was consumed between 2011 and 2015. According to the IPCC, total cumulative anthropogenic emissions of CO_2 must remain below about 1,000 gigatonnes (GtCO2) from 2011 onward for a 66 percent probability of limiting warming to 2°C above pre-industrial levels, and to 400 $GtCO_2$ from 2011 onward for a 66 percent probability of limiting warming to 1.5°C. These carbon budgets have been reduced to 850 $GtCO_2$ and 240 $GtCO_2$, respectively, from 2015 onward. Using these updated carbon budgets, FPP emissions would consume a greater portion of global and US carbon budgets than reflected in Table 8-10. The Bureau should also acknowledge the large body of scientific research that concludes that vast majority of global and US fossil fuels must stay in the ground in order to hold temperature rise to well below 2°C.[90] Scientific studies have estimated that 68 to 80 percent of global fossil fuel reserves must not be extracted and consumed to limit temperature rise to 2°C based on a 1,000 $GtCO_2$ carbon budget. An estimated 85 percent of known fossil fuel reserves must stay in the ground for a 50 percent chance of limiting temperature rise to 1.5°C. Effectively, to limit temperature rise to 2°C, fossil fuel emissions must be phased out globally by mid-century. In addition, a 2016 analysis found that carbon emissions from developed reserves in currently	

Commenter	Comment ID	Comment	Response
		operating oil and gas fields and mines would lead to global temperature rise beyond 2°C. Excluding coal, currently operating oil and gas fields alone would take the world beyond 1.5°C. To stay well below 2°C, the study recommends that no new fossil fuel extraction or transportation infrastructure should be built, and governments should grant no new permits for new fossil fuel extraction and infrastructure. Moreover, some fields and mines, primarily in rich countries, must closed before fully exploiting their resources. The analysis concludes that, because "existing fossil fuel reserves considerably exceed both the 2°C and 1.5°C carbon budgets[, i]t follows that exploration for new fossil fuel reserves is at best a waste of money and at worst very dangerous." Finally, according to a US-focused analysis, the United States alone has enough recoverable fossil fuels, split about evenly between federal and non-federal resources, that if extracted and burned, would exceed the global carbon budget for a 1.5°C limit, and would consume nearly the entire global budget for a 2°C limit. Specifically, the analysis found: • Potential greenhouse gas emissions of federal fossil fuels (leased and unleased) if developed would release up to 492 gigatons (Gt) of carbon dioxide equivalent pollution (CO_2e), representing 46 percent to 50 percent of potential emissions from all remaining U.S. fossil fuels. • Of that amount, up to 450 Gt CO_2e have not yet been leased to private industry for extraction; • Releasing those 450 Gt CO_2e (the equivalent annual pollution of more than 118,000 coalfired power plants) would be greater than any proposed	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		U.S. share of global carbon limits that would keep emissions well below 2°C. Specifically for the OCS, recent analyses also show that the potential emissions from unleased OCS areas alone would consume between 11.6% and 13.8% of that global 450 Gt CO_2e budget. A report issued in August 2016 report finds that burning oil and gas under unleased federal waters in the Gulf of Mexico would release between 27.79 to 32. Gt CO_2e into the atmosphere—the pollution equivalent of running 9,500 coal-fired power plants for a year. The report also notes that developing the entire Gulf of Mexico oil and gas resources would nearly double the greenhouse gas pollution of all fossil fuels currently under federal leases; and that the combined consumption of fossil fuels from the Gulf of Mexico with other leased areas would result in the United States monopolizing 27 percent of the scientifically advised global carbon budget needed to limit global warming to 1.5°C.[101] Any reasonable path towards meeting that goal does not comport with continued area-wide lease sales in the OCS. In sum, the urgent need to prevent the worst impacts of climate change means that the US cannot afford to invest in new offshore oil and gas leasing that locks in carbon intensive production for years into the future. Investment in offshore oil infrastructure is particularly susceptible to carbon lock-in. Offshore oil and gas production requires investments in capital-intensive, high-carbon fuel infrastructure that resists being shut down and locks in long-term fuel supplies, making it more difficult and expensive to later shift to a low-carbon pathway and reach greenhouse gas targets.	
Renate Heurich	RH-3	New fossil fuel leasing in the Gulf of Mexico could ultimately contribute nearly 33 billion tons of carbon	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		dioxide equivalent to global warming as much greenhouse gas pollution as 9,500 coal-fired power plants operating for a year. To what extent will the lease sales deepen our climate crisis?	
Michael Robertshaw	MiRo-1	BOEM's analysis states that more drilling won't have an impact on fossil fuel emissions because if no drilling takes place in expanded areas, it will take place in other areas to make up for it. Is this scenario realistic given the Paris Agreement, global pressure to promote renewable alternatives and the continuously rising price of oil	
Renate Heurich	RH-1	BOEM's analysis states that more drilling won't have an impact on fossil fuel emissions because if no drilling takes place in expanded areas, it will take place in other areas to make up for it. How realistic is this scenario given the Paris Agreement and strong global efforts to promote renewable alternatives?	
Eli Lamb	EL-2	Chief among these is the assertion that "No Action" would automatically produce more GHG than the other alternatives mentioned. It is an abject failure of the imagination to suggest that the only result of the denial of this lease sale would be a postponed, inevitable later lease sale; this failure is made all the more absurd when one considers that BOEM itself manages a diverse portfolio of renewable energy.	
Rebecca King	RK-8	Since climate scientists recommend that 80% of the remaining fossil fuels must remain in the ground to prevent passing the critical 2 degree point, how does it make any sense to lease for new drilling?	
350 Louisiana - New Orleans	350LANO-1	Climate scientist tell us that a majority of all known fossil have to stay in the ground if we want to have a 50/50 chance avoid catastrophic climate change (McGlade, Ekins, Nature, 1/8/2015). The U.S. has signed the Paris Climate Agreement, pledging to cut emissions between 26 and 28% compared with 2005 levels by 2025.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

<table>
<tr><th>Commenter</th><th>Comment ID</th><th>Comment</th><th>Response</th></tr>
<tr><td></td><td></td><td>- Does BOEM agree that climate change is presenting a significant danger to our society and societies globally?</td><td></td></tr>
<tr><td>Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade</td><td>CBD,SC,GRN, LBB-8</td><td>In calculating the warming impact of methane produced by offshore production, the Bureau uses an outdated, incorrect global warming potential (GWP) for methane which substantially underestimates its climate impact. The Bureau uses a GWP for methane of 25 over a 100-year time period. However the 2013 IPCC Fifth Assessment Report clearly establishes a GWP of 36 for fossil fuel sources of methane over a 100-year time period. Importantly, the GWP of methane over a 20-year period is even higher at 87, meaning that methane is 87 times stronger in trapping heat than CO_2 over a 20-year period. It is critical that the Bureau's quantitative assessment account for methane's short-term (20-year) warming impact using the latest peer reviewed science to ensure that potentially significant impacts are not underestimated or ignored. These estimates are essential given the importance of near-term action to ameliorate climate change focused on preventing the emission of short-lived but potent GHGs like methane that can drive the crossing of climate tipping points.</td><td rowspan="2">Thank you for your comment. BOEM used the Global Warming Potential (GWP) as cited by USEPA. The USEPA's conversion factors are used (USEPA, 2015) and are as follows:

<table><tr><th>Greenhouse Gas</th><th>Global Warming Potential (CO_{2e})</th></tr><tr><td>CO_2</td><td>1</td></tr><tr><td>CH_4</td><td>25</td></tr><tr><td>N_2O</td><td>298</td></tr></table>Source: USEPA, 2015.

BOEM used the U.S. Environmental Protection Agency's GWPs from the 2014 Emissions Inventory study, which is a calendar year 2014 inventory, and the most recent emissions inventory. These data can be found in the U.S. Environmental Protection Agency's Emission Factors for Greenhouse Gas Inventories (USEPA, 2015) and at the following website: https://www.epa.gov/sites/production/files/2015-12/documents/emission-factors_nov_2015.pdf. If there are updated GWPs at the time that BOEM conducts future inventory efforts, the updated GWPs will be evaluated for use in BOEM's future inventory efforts.

In addition, BOEM used the 20-year warming impacts from USEPA's website: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials#Learn why.

The U.S. primarily uses the 100-year GWP as a measure of the relative impact of different GHGs.</td></tr>
<tr><td>350 Louisiana - New Orleans</td><td>350LANO-5</td><td>What is the estimated amount of methane spilled/ leaked into the GOM annually associated with gas production?</td></tr>
</table>

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			However, the scientific community has developed a number of other metrics that could be used for comparing one GHG to another. These metrics may differ based on timeframe, climate endpoint measured, or method of calculation. Estimated methane releases are beyond the scope of this Supplemental EIS because BOEM's postlease plan approvals assess emissions and require air quality dispersion modeling to assess VOCs and GOADS (Gulfwide Offshore Activity Data System) reports to compare data to review for compliance by BSEE.
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC, GRN,LBB-9	The Draft SEIS's finding that GHG emissions would be lower with a lease sale than in the absence of a lease sale is arbitrary and capricious because it also assumes that the regulatory structure to reduce greenhouse gas emissions in place in 2016 under President Obama would continue through the lifespan of the lease sale. The Trump administration, however, has reversed course on pollution controls, especially for the fossil fuel industry. Specifically, Trump lifted the permanent ban on offshore leasing in the Arctic and other areas, froze pending climate and energy regulations, cancelled a reporting requirement for onshore oil and gas methane emissions, lifted a freeze on new coal leases on public lands, withdrew the NEPA greenhouse gas guidance, opened reviews of important climate rules including fuel-efficiency standards, the Clean Power Plan, limits on methane emissions at oil and gas drilling sites, and the nationwide five-year offshore oil and gas leasing plan. These rollbacks and potential revisions will impact the greenhouse gas analysis in two key ways. These climate rollbacks invalidate the models used to prepare the lifecycle greenhouse gas analysis because emissions from downstream oil and gas use will increase. They also bring into	BOEM is aware of changing regulations under a new administration. However, the analyses conducted for a proposed 2018 lease sale are valid in that it is a proposed regionwide lease sale conducted under the current 2017-2022 Five-Year Program. The information used to conduct these analyses was the best available information at that time. During preparation of this Supplemental EIS, BOEM was working under President Obama's The All-of-the-Above Energy Strategy as a Path to Sustainable Economic Growth (The White House, 2014), which has three main goals: to support economic growth and job creation; to enhance energy security; and to deploy low-carbon energy technologies and lay the foundation for a clean energy future. According to that plan, oil and natural gas supplies are integral to meeting national energy demand. This plan also aligns with President Trump's America First Energy Plan, which calls for energy policies that stimulate our economy, ensure our security, and protect our health. For more information, please refer to The White House's website (The White House, 2017).

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		question the underlying assumption that foreign fossil fuels have a higher carbon footprint in the absence of robust greenhouse gas pollution controls in the US. In sum, the Draft EIS needs to be revised to fix the error in its substitution effects greenhouse gas analysis and meaningfully disclose the impacts of its action on climate change.	Further, commenters should be aware that any past or present commitments made by the U.S. concerning a reduction of GHG emissions (e.g., Paris Agreement) do not broaden the scope of the Bureau of Ocean Energy Management's NEPA analysis at the lease sale stage or require BOEM to venture into analyzing the potential worldwide effect of GHG emissions that could result from a lease sale.
Well Stimulation			
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-10	The Bureau must consider new information revealing the scope of inherently dangerous offshore fracking permitted in the Gulf of Mexico. New information reveals that the Bureau permitted oil companies to frack offshore wells in the Gulf of Mexico more than 1,200 times between 2010 and 2014 alone. The fracks occurred in at least 630 different wells off the coasts of Texas, Louisiana, Mississippi, and Alabama; and many took place in critical habitat for imperiled loggerhead sea turtles. New information also reveals that at least one of the wells connected to the flow line involved in a nearly 90,000-gallon oil spill in the Gulf of Mexico discovered on May 12, 2016 was fracked. Offshore fracking has several significant harmful impacts beyond that of conventional offshore oil and gas development. For example, oil companies are allowed to dump their wastewater — including fracking chemicals — into the Gulf of Mexico, which may harm the Gulf's sensitive wildlife. Many fracking chemicals are known to be toxic to people and marine animals. Forty percent of the chemicals added to fracking fluids have ecological effects, meaning they can harm aquatic and other wildlife. An analysis of the chemicals used during offshore fracking events in California found that many of the chemicals could kill or harm a broad variety of marine organisms,	Thank you for your comments. Chapter 3.1.3.1 ("Development and Production Drilling") of the 2017-2022 GOM Multisale EIS provides detailed information on hydraulic fracturing on the OCS in the Gulf of Mexico, how it is accomplished, and how it differs from onshore fracking. Onshore and offshore fracking are two very different processes with different potential environmental impacts, even though they are commonly referred to by the same term, "fracking." Chapter 3.1.5.1 ("Operational Wastes and Discharges Generated by OCS Oil- and Gas- Related Facilities") of the 2017-2022 GOM Multisale EIS details information on discharges and regulations on OCS oil and gas discharges. Chapter 4.2 ("Water Quality") of the 2017-2022 GOM Multisale EIS has detailed language on operational discharges and wastes, including those from hydraulic fracturing. The language in the above-mentioned chapters was added to the Final 2017-2022 GOM Multisale EIS based on a similar comment from CBD and its joint commenters during the 2017-2022 GOM Multisale EIS comment period. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS and incorporates the language by reference. The primary impact-producing factor of concern related to well stimulation activities in the Gulf of Mexico OCS would be discharges of well treatment,

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		including sea otters, fish, and invertebrates. Indeed, scientists list some of the chemicals frequently used in offshore fracking as among the most toxic in the world with respect to aquatic life. Numerous scientists and reports have linked fracking to water contamination, air contamination, spills, earthquakes and birth defects. The Bureau's supplemental EIS must properly account for the added harms and risks caused by offshore fracking in the Gulf. The Draft SEIS, and the documents to which it tiers, fail to analyze the environmental impacts of offshore fracking and discharge of produced waters, including fracking chemicals. There is one vague reference to a "frac pack" in describing development and production operations, without any analysis of the environmental impacts of offshore fracking, in the Draft SEIS. The Bureau's failure to meaningfully analyze the impacts of fracking violates NEPA's requirement to take a hard look and to disclose those impacts to the public. To the extent that the Bureau relies on the Environmental Protection Agency's water pollution permit to account for these impacts, such reliance is invalid. Mere reliance on a pollution control permit does not excuse an agency from its duties to disclose the impacts under NEPA. The Draft SEIS doesn't discuss fracking chemicals in the analysis of water quality issues from produced water. Nor does it consider the fact that water quality testing is infrequent and can be taken at-will when such chemicals would not be detected. Additionally, it appears that the brief section of the Draft SEIS describing produced water contradicts federal records on the amount of wastewater being discharged into the Gulf. The Bureau states that all offshore oil and gas platforms in the Gulf of Mexico discharged roughly 16.7 billion gallons of produced	completion, and workover fluids, which are discussed in **Table 3-9** of this Supplemental EIS and in detail in Chapters 3.1.3.1, 3.1.5.1, and 4.2 of the 2017-2022 GOM Multisale EIS. Based on this information, it is estimated that 63-70% of development wells may be completed for production. A typical completion process may include the use of a "frac pack/sand proppant pack." The use of stimulation treatments are permitted by BSEE, and the production discharges are permitted by USEPA under the National Pollutant Discharge Elimination System (NPDES) permit. The potential effects of produced waters (including well treatment, completion, and workover fluids) on other resources, such as deepwater benthic communities (**Chapter 4.4**), live bottom habitats (**Chapter 4.6**), and protected species (**Chapter 4.9**), have also been analyzed and are expected to be negligible due to the assumed compliance with all permitting requirements and existing regulations. Environmental issues associated with offshore oil and gas operations in Federal waters are governed by BSEE's regulations at 30 CFR § 250.107, Safety and Environmental Management Systems' (SEMS) regulations at 30 CFR § 250.1910, and the National Pollutant Discharge Elimination System (NPDES) at 40 CFR part 122. Generally, however, under these regulations, oil and gas wastes are not considered hazardous. Produced water, the largest waste stream from offshore oil and gas operations, may be discharged to the Gulf of Mexico in accordance with USEPA Regions 4 and 6 NPDES permits. Spent chemicals used in well treatment, completion, and workover fluids may be commingled and discharged with produced water. Because chemicals used in well completions are discharged with produced water, it is

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		water in 2014. However, a review of records obtained from the Environmental Protection Agency pursuant to a request under the Freedom of Information Act reveals that offshore oil and gas platforms under the jurisdiction of Region 6— federal waters in the Western Planning Area and the Central Planning Area off the coasts of Texas and Louisiana—discharged more than 75 billion gallons of produced waters in 2014. This is a significant discrepancy that must be remedied, particularly considering that produced water contains toxic pollutants released during the drilling process. For example, produced water can contain harmful substances like benzene, arsenic, lead, hexavalent chromium, barium, chloride, sodium, sulfates, and boron, and it also can be radioactive. Produced water itself is potentially harmful to humans, aquatic life, and ecosystems—in fact, a study sponsored by the U.S. Department of Energy demonstrated that oil production yields "environmentally hazardous" produced water. The Bureau must significantly revise its Draft SEIS to provide a meaningful analysis of the scope and environmental impacts of offshore fracking and other unconventional well stimulation practices, or prohibit the use of these practices entirely to mitigate the potentially hazardous impacts of fracking.	difficult to obtain the volume of produced water that is fracking fluid. However, the volume of fracking fluid in produced waters is not necessary for this NEPA analysis because BOEM accounts for the fracking fluid in its analysis of impacts from produced water as a whole. BOEM considers the potential impacts from the offshore discharge of all produced water to be negligible beyond 1,000 meters (m) (3,281 feet [ft]) from the discharge point due to rapid dilution of produced waters from the discharge point to moderate within 1,000 m (3,281 ft) of the discharge. In addition, produced-water discharge must meet regulations set forth in the U.S. Environmental Protection Agency's NPDES permit. The effects of these discharges are considered in the water quality analysis in **Chapter 4.2**. For a full water quality analysis, refer to Chapter 4.2 of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. In reference to the USEPA's data on produced water, BOEM's produced-water data are collected from the Office of Natural Resources Revenue (ONRR). The ONRR's "Oil and Gas Operations Report" (OGOR) collects produced-water data, which can be found on ONRR's website at http://www.onrr.gov/ReportPay/production-reporting.htm. The OGOR-B report includes a disposition code to indicate how the produced water is disposed of (i.e., injected on lease, injected or transferred off lease, or disposed of). BOEM does not manage USEPA's data. It is likely that data collected in different databases will be different due to differences in definitions, time periods, and data management practices. Despite the difference, BOEM considers the potential impacts from the offshore discharge of produced water to be negligible beyond 1,000 m (3,281 ft) from the discharge point to moderate within 1,000 m (3,281 ft). The conclusions reached in this Supplemental EIS
Peter Shrock	PS-4	Another issue is that BOEM fails to adequately disclose the amount of hydraulic fracturing and other unconventional well stimulation will take place under the lease sale, and it entirely fails to evaluate the impact of discharging wastewater, including toxic fracking chemicals, into the Gulf of Mexico.	
Maggi Roberts	MaRo-3	Toxic waters from fracking are being dumped into our Gulf waters with no oversight.	
Rebecca King	RK-6	A BOEM scientist I spoke with at the public meeting said he was concerned about the fracking waste	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		dumped into the Gulf currently. It is the EPA's job to regulate that. In light of Trump's rollback of the EPA has BOEM considered that new wells will be dumping more and less regulated fracking waste?	remain the same, regardless of which estimate is used in an impact analysis, based on the rapid dilution of discharge from the source.
350 Louisiana - New Orleans	350LANO-4	What is the estimated amount of fracking fluid spilled/ leaked into the GOM annually associated with oil and gas production?	
William Myers	WM-1	Hundreds of billions of gallons of TOXIC oil fracking waste water are currently being released into the world's oceans. Environmental concerns are contrary to oil drilling profits. Environmental standards will always sink to the lowest allowed by law. There are no laws regarding the release of toxic fracking waste water into the ocean from drilling platforms. Oil companies' motives are no different than tobacco companies' motives: Profits at all costs. Governmental leaders act as Pontius Pilot while God's most precious gift in the known universe is being fouled. It's already too late. The Anthropocene Era of mass extinctions is upon us. We must limit strictly limit fracking.	
June Charles	JC-2	Oh, and what about the increased earthquakes?	To BOEM's knowledge, there have been no reported or documented seismic events linked to OCS well stimulation activities in the GOM. Onshore and offshore fracking are two very different processes with different potential environmental impacts, even though they are commonly referred to by the same term, "fracking." The onshore operations associated with the occurrence of increased seismic activity tend to use much higher volumes of water and proppants and create much more expansive fractures in the formation to stimulate the flow of natural gas or oil. For a description of the difference between onshore fracking and offshore hydraulic fracturing, please refer to Chapter 3.1.3.1 of the 2017-2022 GOM Multisale EIS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Renewable Energy and Alternative Uses of the OCS			
Alicia Cooke	AC-2	Without considering the current global understanding of the gravity of the climate crisis and political and economic measures being subsequently taken (the arrogance of the current U.S. administration on this issue notwithstanding), this analysis therefore relies upon an outdated assumption of the continuing value of oil and impracticality of renewable energy. This is a dangerous assumption both from a climate standpoint and economic one.	This Supplemental EIS provides an analysis of the environmental impacts of oil and gas leasing. Per Section 18 of the OCSLA, BOEM is required to develop a schedule of oil and gas lease sales on the OCS for 5-year periods. Thus, the OCSLA is the implementing legislation driving the purpose, and it is the law requiring the Secretary of the Interior to propose an action. The proposed action under NEPA is a proposed regionwide lease sale identified in the 2017-2022 Five-Year Program, and this Supplemental EIS determined possible environmental impacts of a proposed action in comparative form to other lease sale alternatives allowable under Section 18 of the OCSLA, including the No Action alternative (i.e., no lease sale). BOEM has also considered alternatives and deferrals other than Alternatives A-E to ensure that all reasonable alternatives have been considered in this Supplemental EIS. However, not all of the alternatives considered were analyzed in detail because they were either outside the scope of the lease sale decision, were speculative, were not warranted, did not meet the purpose of and need for the oil and gas leasing program, or current data did not support the alternative. For a summary of the alternatives and deferrals considered but not analyzed in detail, refer to **Chapter 2.2.2** of this Supplemental EIS and Chapter 2.2.3 of the 2017-2022 GOM Multisale EIS for a detailed analysis of each eliminated alternative. BOEM does recognize the need to investigate the potential for alternative energy on the Federal OCS and has considered this alternative in the 2017-2022 Five-Year Program EIS. However, BOEM did not
Alicia Cooke	AC-5	In light of the previous administration's recognition of the collective, global need to limit global temperature rise to 1.5 degrees C above pre-industrial levels in order to avoid catastrophic climate change, the Secretary of the Interior (or other responsible figure) should have mandated that BOEM examine a further alternative, which is the use of the planning areas under its jurisdiction exclusively for the development of renewable energy technology. Without seriously considering and analyzing such an alternative (even if this would necessitate a rulemaking change in BOEM leasing protocol), how can the Department of Interior/Bureau of Ocean Energy Management possibly claim a true understanding of the global climate crisis and commitment to meaningful action to abide by the Paris Agreements?	
Ryan Bowman	RB-2	The energy industry worldwide is shifting to renewable sources.	
Valerie Longa	VL-1	I have been a resident of Mobile County for 13 years now, and I live in Alabama because of the beautiful environment that we have here. I personally experienced the BP oil spill and was a part of the clean-up efforts. We would go out at night and clean up the massive mats of oil that would coat the beaches. I also worked with sea turtles and ensuring that the baby sea turtles were released in the Atlantic side of Florida for a start to a safe life. Because of	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		those experiences and others in my local community, such as an oil pipeline being put through our drinking water, a pipeline being put through a historic African American community, elementary school, and other oil and gas-related projects, I feel very strongly about the pursuit of sustainable green energy. It is my desire for our government to focus its plans and policies on the production of renewable, clean and green energy.	perform a detailed analysis of this alternative at the 2017-2022 Five-Year Program stage because it was not a reasonable alternative to achieve the purpose of and need for the proposed action because the development of renewable energy resources in the foreseeable future does not fully or partially satisfy the purpose of and need for the proposed action at this time. BOEM's Office of Renewable Energy is responsible for developing an offshore renewable energy program in the Gulf of Mexico. Information on BOEM's renewable energy program, OCS leases, and renewable energy projects (34 proposed or currently in development) is available at on BOEM's website at http://www.boem.gov/Renewable-Energy/. Further, commenters should be aware that any past or present commitments made by the U.S. concerning a reduction of GHG emissions (e.g., Paris Agreement) do not broaden the scope of the Bureau of Ocean Energy Management's NEPA analysis at the lease sale stage or require BOEM to venture into analyzing the potential worldwide effect of GHG emissions that could result from a lease sale.
Valerie Longa	VL-3	I would like to see a divestment from fossil fuels and a greater focus on renewables. The focus on renewables allows us to be a leader in this energy sector. It allows us to create new jobs, expansion of job opportunity, and it allows for creativity. The time is now for us to step up and to take greater care of our natural resources. It is a fact that the health of our environment and ecosystems directly equates to the greatness of quality of life for people. Therefore, it is in our best interest to divest from fossil fuels and to make serious plans on how we can begin to utilize renewable energy and in greater ways.	
Jackie Hartstein	JH-4	Just skip us or give us a turbine and our windmill thing. If you were here yesterday, we had plenty of wind to disperse. And we can do solar panels. If you drive down East Bay Boulevard to State Road 87, there's acres of solar panels there. We are the Sunshine State. We should not be the surrender state. That's what I think.	
Kathryn R. Smith	KS-1	My name is Kathryn R. Smith. I've lived in NW Florida since June, 1977. I moved here from Dayton, Ohio, and the pollution I experienced in Dayton, Ohio confirms my strong desire to resist any and all oil leases in any portion of Florida. Not only is pollution a personal concern, but our economy depends on clean, beautiful beaches. Not is not an option once leases are approved. Leave our beaches for the tourist, who support our economy, and the residents to enjoy. I vote!! Keep oil out of Florida! Use solar	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		and wind energy!	
Lorie Chinn	LC-6	Please focus on renewable energy and stop the drilling.	
M. Fleming	MF-1	Please do not lease the Gulf for non-renewable energy ventures. While I'm not able to substantiate my request with the volume of data available regarding the negative impact continuing to use natural resources to extract non-renewable fuel, hopefully y'all are in direct contact with organizations like the Gulf Restoration Network, and the Louisiana Bucket Brigade. They have done expensive research as to the incredible environmental and social costs of keeping the oil industry in Louisiana.	
M. Fleming	MF-6	Regardless, hopefully your consciences in addition to general public outcry will at least put a pause in the leasing plans until a better source of renewable energy can be utilized.	
Pam Scaggs, South Baldwin Democrats	PSSBD-3	As the Bureau of Ocean ENERGY Management, my emphases on Energy, why don't you think about turbo wind power? Clean, renewable and there is always a wind in the Gulf. Let's try being realistic and responsible here. Doing the same thing over and over and getting the same results is a sign of ????	
Carol A. "Cay" Burton	CAB-5	This country needs to use energy reduction of use techniques and invest in alternative renewable fuels, not lease the Gulf for further drilling and exploration.	
Carol "Cay" Burton	CB-5	This country needs to use energy reduction of use techniques and invest in alternative renewable fuels, not lease the Gulf for further drilling and exploration. An example could be that this room that we're using today is about 40 degrees. We're wasting energy constantly, and it needs to stop.	
David Gorchov	DaGo-3	We have an expansion of wind and other renewable sources of electricity, at prices competitive with fossil fuels. We can improve fuel efficiency of vehicles and expand mass transit, reducing the need for	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		petroleum-based fuels.	
John Warden	JW-3	My family has made its living in the oil bidness for a generation. We recognize the opportunities and the need to pursue superior alternatives to further exploitation of the Gulf of Mexico. I urge you to halt all new oil and gas lease sales in federal waters and keep these dirty fossil fuels in the ground.	
		Natural Stressors	
Jean Publeee	JP-3	THE GULF IS ALREADY HALF DEVOID OF OXYGEN FOR ANY FISH OR OCEAN MAMMAL TO STAY ALIVE. THE DEAD ZONE KEEPS GROWING CONTINUALLY. CRAP AND GARBAGE OF ALL KINDS IS ALLOWED TO FLOW INTO THIS GULF.	The hypoxic zone in the Gulf of Mexico is described in Chapter 3.3.2.12 of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Chapter 4.2 of the 2017-2022 GOM Multisale EIS describes how hypoxia occurs in the Gulf of Mexico, i.e., from upland river runoff with excessive nutrients and not oil and gas activities. The resource chapters in **Chapter 4** considered this seasonal occurrence in the analysis of potential impacts. Refer to **Chapters 4.2, 4.5, 4.6.1, 4.6.2, and 4.9.1**.
Carol "Cay" Burton	CB-4	Also, oxygen in the water is rapidly shrinking from pollution.	
Carol A. "Cay" Burton	CAB-4	Also, oxygen in the water is rapidly shrinking from pollution.	
		Air Quality	
Consumer Energy Alliance	CEA-3	At the same time, CEA is concerned about the draft Supplemental EIS' reliance on preliminary results from an ongoing study to make conclusions about air quality impacts, and use of the draft Supplemental EIS to solicit public review and comment on the yet-to-be finalized study. Making conclusions based on incomplete, inaccurate, or unavailable information -- and seeking input through non-transparent means -- erodes public trust and confidence in government and can negatively impact families, citizens, and businesses across the country. To ensure sound, science-based decision-making, CEA urges the Interior Department to exclude the interim study and any related conclusions from the final Supplemental EIS and to provide adequate opportunities for engagement on the study prior to its finalization.	Thank you for your comment. The air quality analysis in this Supplemental EIS is centered on the best available and credible scientific information. BOEM is committed to using the best available scientific information in all of its EISs, consistent with the information requirements under NEPA. Even though it has already been included in the 2017-2022 GOM Multisale EIS, the air quality analysis was specifically published in the Draft 2018 GOM Supplemental EIS in order to obtain public review and comment. BOEM is in the process of updating the air quality modeling based on public comments, and the results of the final air quality modeling will be included in a future NEPA analysis that will be available for public review and comment. The revised air quality model run will not be completed before the publication of this Final Supplemental EIS. The results of the initial air

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			quality model are therefore the best available information we have, and they are included in this Supplemental EIS as a reference for NEPA analysis. The air quality modeling results currently available allow consideration of anticipated air quality impacts without those impacts being underestimated. No activities beyond certain ancillary activities are actually authorized by the lease; therefore, there are few environmental impacts, including on air quality, reasonably expected from a proposed lease sale itself (refer to **Chapter 1.3.1**). Should there be any air quality impacts suggested from the updated air quality modeling, regulations governing postlease plan approvals allow for mitigations to address these impacts. During its review of any plan submitted postlease, BOEM conducts an air quality review to determine if additional controls are necessary. At this postlease stage, BOEM has the authority to disapprove or require additional mitigation to reduce impacts from site-specific activities as additional information related to the revised air quality modeling becomes available. It is anticipated that new air quality modeling results will be available for consideration before any plan is submitted on a block leased as a result of proposed Lease Sale 250. Therefore, while additional air quality data would be useful in consideration of this lease sale, it is not necessary for a decision on this lease sale. Any concerns raised by the modeling study will be further refined by the time plans are submitted, and/or additional plan-specific modeling may be required consistent with BOEM's regulations when the plan is submitted for approval.
David Quist	DQ-4	As to particular classes of impacts identified in the EIS: Air Quality -	Thank you for your comment. The air quality analysis in this Supplemental EIS is centered on the best available and credible scientific information. BOEM is committed to using the best available scientific

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		- how can air quality impacts be assessed if the necessary air modeling studies won't be completed until the fall of 2017? - the EIS must consider the impact of the lease sale, not just the incremental impact in the context of existing leases. Focusing on the latter effectively underestimates the impacts on those areas not currently leased, but which will be after lease sale 250 - a moderate effect on coastal non-attainment areas for certain pollutants is itself significant, and can't be minimized simply because the cumulative impacts do not, on their own, cause an exceedence	information in all of its EISs, consistent with the information requirements under NEPA. The air quality analysis was specifically published in the Draft 2018 GOM Supplemental EIS in order to obtain public review and comment. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. This Supplemental EIS considers both the incremental impact of a single proposed regionwide lease sale and the cumulative impacts of the OCS Oil and Gas Program. Refer to **Chapter 4.1** for a full analysis of air quality. In reference to the coastal nonattainment areas, BOEM is currently in the process of updating the air quality modeling based on public comments and will publish the results when the analysis is complete.
Maggi Roberts	MaRo-2	The full impact of drilling in the Gulf on our air quality as well as the impact of pollution to our ocean waters needs full consideration.	Thank you for your comment. BOEM has analyzed the impacts to air quality and water quality in **Chapters 4.1 and 4.2** of this Supplemental EIS. For a detailed water quality analysis, refer to Chapter 4.2 of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.
Joint Trades	JT-1	Our members recognize that offshore operations must be conducted safely and in a manner that protects the environment. We also recognize that policy decisions that impact the offshore oil and gas industry must be based on sound science, transparency, consultation and adequate review. The Draft SEIS raises serious concerns regarding these important criteria. Specifically, BOEM has elected to include new, substantive, yet still incomplete, information from the ongoing Gulf of Mexico (GOM) Air Quality Modeling study in the Draft SEIS. Even more concerning, BOEM is choosing to	Thank you for your comment. The air quality analysis in this Supplemental EIS is centered on the best available and credible scientific information. BOEM is committed to using the best available scientific information in all of its EISs, consistent with the information requirements under NEPA. The air quality analysis was specifically published in the Draft 2018 GOM Supplemental EIS in order to obtain public review and comment. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		use preliminary, incomplete results from this study to make National Environmental Policy Act (NEPA) environmental impact determinations. Use of an incomplete, ongoing work product as a basis for drawing conclusions on possible environmental impacts is neither prudent nor transparent, and does not present an accurate depiction of offshore operations to the public and interested stakeholders. The Joint Trades believe it is imperative that BOEM not utilize the preliminary results from the ongoing study as a basis for impact determinations. We recommend that the preliminary results only be used for analysis and review, but conclusions regarding any potential impacts to onshore air quality should not be based on an unfinished study. These concerns are not new. In an earlier letter dated January 18, 2017, API objected to BOEM's conclusion in the Final Programmatic Environmental Impact Statement for the 2017-2022 Five-year Program (5-year Program FPEIS) that offshore oil and natural gas activity will lead to moderate onshore air quality impacts based on an interim deliverable from an ongoing BOEM study. To our knowledge, the interim deliverable was not publicly released for review. API raised similar concerns again in a letter to BOEM on April 10, 2017 regarding the inclusion of the preliminary air modeling results in the Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022; Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261; Final Multisale Environmental Impact Statement (Multisale EIS). Also, the Joint Trades submitted comments on June 20, 2016 on BOEM's proposed Air Quality, Reporting and Compliance Rule (Docket ID: BOEM-2013-0081) recommending that agency decisions should not proceed until there is a	Supplemental EIS. BOEM has not discounted industry's concern on this issue and has actively engaged in communications with industry to discuss the air quality modeling. In addition, BOEM has examined incorporating industry's comments into the new air quality modeling and analysis. The results of the final air quality modeling will be included in a future NEPA analysis that will be available for public review and comment.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		demonstration that OCS sources significantly affect onshore air quality and jeopardize compliance with the NAAQS. It appears that BOEM continues to discount industry's concerns regarding use of preliminary data from the incomplete GOM Air Quality Modeling study. We cannot emphasize this point enough – the study must be completed and made available for public comment and input before the results and conclusions are used for policy-making, agency decisions, or future rulemaking. We recommend that BOEM change the process for review of the GOM Air Modeling study moving forward to one that allows for substantial input from a multi-stakeholder group. By establishing such a group, model inputs, assumptions and results could be improved and the overall process would become more transparent. Such an approach would likely be more cost effective for BOEM as well, since re-running year-long photochemical models with updated assumptions can be time consuming and expensive.	
Joint Trades	JT-2	The air quality information included in the Draft SEIS is incomplete. BOEM has not provided sufficient documentation on the assumptions that were made related to the models, the assumptions and basis for the data used as model inputs, and what type of adjustments were made as the result of sensitivity analysis. Some examples of critical information that has not been included in the Draft SEIS are: • Model input data from the 2011 GOM Emissions Inventory (GOADS), including how the emissions estimates in the 2011 emissions inventory were adjusted prior to use in the modeling study. • The methodology for developing the default	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. Based on the revised air quality modeling, BOEM will consider including in future NEPA analyses more documentation for (1) model input data from the Gulfwide Offshore Activity Data System (GOADS) adjustments, (2) development of the default emissions factors for shallow-water and deepwater platforms (and perhaps other water-depth groups) used to project future emissions, and (3) development of emissions factors for ammonia and lead. Final

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		emission factors for Shallow and Deepwater platforms used to project future emissions. • Information on how emission factors for ammonia and lead were developed; this information is important since the 2011 GOM Emissions Inventory did not contain emissions estimates for ammonia and lead. In short, the public has received an unfinished work-in-progress document that does not include relevant information required for the public and interested stakeholders to make well-informed, constructive comments.	modeling results will also be included in these future NEPA documents that will be available for public review and comment.
Joint Trades	JT-3	Since not all supporting information has been made available and the GOM air study is still underway, the public has no means to determine whether the information presented in the Draft SEIS represents "the best available data" for NEPA decision-making. Of greater concern is the fact that BOEM has chosen to utilize an unfinished, work-in-progress study as the one of the bases for important decisions regarding further development of resources in the GOM.	The air quality analysis in this Supplemental EIS is centered on the best available and credible scientific information. BOEM is committed to using the best available scientific information in all of its EISs, consistent with the information requirements under NEPA. The air quality analysis was specifically published in the Draft 2018 GOM Supplemental EIS in order to obtain public review and comment. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.
Joint Trades	JT-4	In numerous instances, information is referenced that has been omitted from the Draft SEIS, or the Draft SEIS makes contradictory conclusions. Some examples include: • Section 4.1.2.1, Drilling and Production Associated Vessel Support, page 4-29 BOEM references Section 3.1.4.4 for a discussion of support vessels for OCS oil and gas related activities; however, there no such section in the Draft SEIS document. In addition, other sub-sections in Section 3.1 "Routine Activities" do not provide a discussion of support	BOEM has updated the information in **Chapter 4.1.2.1**, under the "Drilling and Production Associated Vessel Support" section, to reflect the correct reference of Chapter 3.1.4.3, "Service Vessels," of the 2017-2022 GOM Multisale EIS. In reference to assumptions in the air quality modeling, all emissions within the GOM geographical area were included in the model. BOEM is now in the process of updating the air quality model based on public comments. The results of the final air quality modeling will be included in a future NEPA analysis

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		vessels. The conclusion paragraph stating that the impacts of support vessels are minor offers no substantiated basis for this conclusion; it only references impacts "as shown in the model" – a model, as discussed above, that has not been completed and made available for comment. In addition, it is unclear how emissions from support vessels were assessed in the model. As referenced in BOEM guidance, operators are required to assess support vessel emissions when the vessel is within 25 miles of a facility. For consistency and future comparison of the model results to actual OCS emissions, we recommend that BOEM include similar assumptions in the modeling. • Section 4.1.2.2, Accidental Events, page 4-31 The Draft SEIS states that air emissions from accidental events are discussed in Section 3.2.3. However, Section 3.2.3 discusses accidental events response, but offers no discussion of air emissions from accidental events.	that will be available for public review and comment. BOEM has updated the information in **Chapter 4.1.2.2**, "Accidental Events" to reflect the information described in **Chapter 3.2.3**."
Joint Trades	JT-5	• The existing OCS oil and gas platform and support vessel emissions were developed from the 2011 Gulfwide inventory based on activity data from GOADS. The existing GOM oil and gas emissions were held constant for future year projects at the 2011 level, even though these emissions would likely decrease over time as existing assets reach the end of their productive life and are removed from service. For these future year projections, the new emissions from new oil and gas platform and support vessels from the upcoming lease sale were taken as the maximum emissions from any future year in the lease period. The total emissions from these new platforms and support vessels were estimated to be the highest in 2033 for NOx, CO, PM_{10}, $PM_{2.5}$, lead,	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. New air quality modeling will contemplate including improved projections of activities by removing platforms that reached the end of their productive life. Decommissioning data from the existing base year to 2016 will be considered to assist with this effort, along with using the cumulative scenario data to further decommission existing sources past 2017.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		and ammonia and in 2036 for SO_2 and VOC emissions. By 2033 and 2036, the emissions from the existing GOM oil & gas related sources would likely be much lower due to asset retirement, and emissions from unrelated onshore sources would likely be less as well due to control technology installation, calling into question specific changes in design values at regulatory monitors that are discussed in multiple sections of the Draft SEIS.	
Joint Trades	JT-6	• There appears to be quite a bit of overprediction throughout the modeling process, such as the number of platforms forecasted for future years in the GOM, the direction of onshore flow winds used in the WRF model, and the development of worst case emissions based on a combination of two different forecasted emission years (2033 and 2036), yet the uncertainty due to these overpredictions does not seem to be addressed in the impact section. If BOEM is going to issue qualitative conclusions, then the uncertainty due to model overpredictions must also be addressed. The Draft SEIS makes statements about OCS sources contributing to exceedances, but those contributions might not be impacting NAAQS compliance status considering the overpredictions. The Draft SEIS does not discuss the uncertainty caveats in the summaries/conclusions.	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM will address the Joint Trades' comments in future NEPA documents as follows: BOEM's Office of Resource Evaluation will provide updated scenario data that will be reviewed for future-year emissions inventory development in the new air quality modeling run. The WRF model is the state-of-the-art atmospheric simulation system, commonly used to drive air quality models on the regional level. Winds are critically important since they drive pollutant dispersion. BOEM will therefore consider evaluating and documenting the evaluation of winds on significant impact events, if any, suggested by the new modeling. BOEM will examine using reasonably foreseeable high year for future-year emissions inventory development in the new modeling. BOEM will contemplate adding an uncertainty analysis.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Joint Trades	JT-7	• Figure C-15 in the Draft SEIS appears to overpredict the future number of platforms in shallower water depths, particularly platforms in less than 60 m of water. A review of Figure C-15 reveals that BOEM's future predictions show 137 new platforms (60% of the future total) in less than 60 m water depth. However, Figure C-15 does not account for historical trends nor ongoing platform removals. Using data from BSEE's Online Data Center, the Joint Trades have determined that for each year from 1990 to 2016, platform removals exceed platform installations in water depths less than 60 m (see chart below). Therefore, GOM activity in areas of less than 60 m water are centered on structure removal not installation. Any future projections must account for this type of historical trend.	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM's Office of Resource Evaluation will provide more reasonable shallow-water, future-year development with the updated scenario, and caisson emissions factors will be considered for single well structures in shallow water depths less than 60-m (197-ft) in the new modeling. Documentation, including final modeling results, will be provided in a future NEPA document.
Joint Trades	JT-8	Similarly, the number of wells drilled annually since 1990 has dramatically declined in shallower water depths (less than 200 meters). As the chart below demonstrates, activity as measured by the number of wells drilled is shifting from shallower water depths to deeper waters. Any future projections on platform locations used in the GOM Air Quality Modeling study and Draft SEIS should account for these trends to realistically represent future GOM projections.	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM's Office of Resource Evaluation will provide updated data that will be considered to be used for future projections on platform locations in the new modeling. Documentation will be provided in a future NEPA document, including final modeling results.
Joint Trades	JT-9	• The underlying assumption used in the CAMx future year projections is that any currently unleased blocks in GOM are equally likely to be developed as part of the upcoming lease sale. This assumption ends up placing a substantial number of exploration and delineation wells (Figure 3-3 on page 3-16) and	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		development wells (Figure 3-4 on page 3-18) in the areas closest to shore, where emissions are most likely to have an impact on on-shore receptors. Given that the placement of support vessel emissions is a function of the location of placement in the model, this decision compounds the overestimation of near-shore emissions and further overstates the on-shore impact. It also contradicts the general trends in development in the GOM region, which is increasingly moving to deepwater leases, which due to their distance from shore would likely have a lesser impact on onshore air quality. For example, BOEM data on bids received for lease sales in 2015 for the Western and Central GOM were 94% and 70%, respectively at a depth of 400 m (~1320 ft) greater[2].	BOEM's Office of Resource Evaluation will provide a more realistic account of where future-year activity "might" occur, which will be reviewed to aid in spatial allocation of future-year estimated emissions in the new modeling. Documentation, including final modeling results, will be provided in a future NEPA document.
Joint Trades	JT-10	• In Appendix B which discusses the WRF modeling, every wind rose plot presented shows the model overpredicted onshore flow at every site in 2012. This impacts any results that show an onshore impact from offshore sources. It doesn't appear that the overprediction was considered in the uncertainties for the results. Data from 2012 is particularly important since it was the meteorology used in the CAMx model.	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM will examine providing a robust model evaluation for winds in a future NEPA document.
Joint Trades	JT-11	• It appears that a limited number of sites were selected for the wind rose plot evaluation used in the WRF model. For example, no wind data were selected for Galveston, TX. Since it seems to be important in the future year design value comparison, and since Galveston is one of the few nonattainment areas along the Gulf Coast, it would be beneficial to have the meteorological evaluation for Galveston in the WRF model.	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM will contemplate providing more wind rose analysis for 2012, including Galveston, Texas, and will include a discussion of those wind rose plots in an uncertainty analysis in a future NEPA document.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Joint Trades	JT-12	• The upper air qualitative evaluation presented in Appendix B is very limited and as such raises several questions. Evaluation results are presented for just two sites and for just one sounding at each site. Using such limited data to represent the upper air modeling performance for the entire year is incomplete and inadequate. How did the rest of the year look for these two sites? Why were only two sites evaluated when there are nearly ten sounding sites along the Gulf Coast? What do the soundings look like at times of high ozone and/or PM? We recommend that further evaluation be completed and presented for multiple sounding sites and during times of elevated ozone and/or PM.	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM will consider including more upper air sites along the Gulf Coast. Documentation, including final modeling results, will be provided in a future NEPA document.
Joint Trades	JT-13	• Actual monitoring data show that the attainment/nonattainment areas along the Gulf Coast tend to have their cleanest days when there is a consistent onshore flow. The times where there are elevated levels of ozone with onshore flow, for example, is when there is recirculation of onshore emissions and not an impact of offshore emissions. The modeling does not appear to match actual monitoring conditions. The Joint Trades offer the following technical references as additional information regarding onshore ozone concentrations: o Background ozone concentrations in southeast Texas average about 50 ppb, with higher concentrations observed when winds originate from the continental U.S., and much lower concentrations observed when winds originate directly from the Gulf of Mexico (Nielsen-Gammon et al., 2005a). o Days that are dominated by a stationary anticyclone (the Bermuda High, for example) tend to have lower ozone, in part because this	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. A more comprehensive data analysis (including dominant patterns of wind circulation and pollutant concentration at sensitive areas) will be examined in a future NEPA document.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		circulatory pattern brings steady southeast winds from the Gulf of Mexico (Davis et al., 1998). o Sullivan et al (2009) performed cluster analysis on daily 72-hour HYSPLIT back trajectories for 2000 to 2007 to determine which transport patterns were associated with high ozone in the HoustonGalveston-Brazoria area. The lowest concentrations were observed for the trajectory cluster with a long fetch from the Gulf of Mexico (Sullivan et. al 2009). o Higher ozone levels were generally associated with backward trajectories over land compared with backward trajectories over the Gulf of Mexico (Hendler, 2012).	
Joint Trades	JT-14	• Assumptions regarding support vessel emissions are overly conservative and do not represent actual GOM operations. It is likely that support vessel emissions associated with existing platforms would decrease as older platforms are decommissioned, and would not be constant at 2012 levels in future year predictions. If nearer shore blocks were to be developed, they would likely be serviced by some of the same support vessels as existing facilities and may not have as high of incremental emissions as a result. In addition, there are potentially future year emission reductions for support vessels that would be realized based on new requirements for emission performance for vessels (MARPOL Annex 6), specifically near port locations. Also, the support vessel data presented in the Draft SEIS appears to show that most support vessel activity is originating in Vermilion Parish, Louisiana. However, industry operational experience would lead to the conclusion that most support vessel activity is originating from lower Lafourche Parish, Louisiana. We recommend that BOEM specifically examine these assumptions	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM's Office of Resource Evaluation will provide updated scenario data that will be considered to characterize more reasonably foreseeable support vessel activity. Documentation, including final modeling results, will be provided in a future NEPA document.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		in the GOM Air Quality Modeling study and the Draft SEIS to ensure support vessel activity is characterized correctly.	
Joint Trades	JT-15	• The Draft SEIS states that fugitive emissions can occur during all phases of OCS oil- and gas-related activity (Section 4.1.2, Page 4-28). However, production activities are the main source of fugitive emissions. There may be small fugitive emissions from diesel components on vessels and rigs, but production fugitive emissions are the primary source of fugitive emissions from OCS oil and gas activities. The 2011 GOADS report states, "Evaporative losses are insignificant in diesel engines due to the low volatility of diesel fuels (USEPA 2010)." Fugitive emissions are not calculated for diesel components on vessels and rigs as part of GOADS. In addition, BOEM has previously indicated that fugitive emissions may be overestimated by current emission factors. But the Draft SEIS contains no discussion of if or how adjustments to fugitive emissions data were made during the calculation of the platform emission factor used for projected future platforms.	BOEM is now in the process of updating the air quality modeling based on public comments. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM will contemplate discussing an uncertainty analysis in a future NEPA document. Documentation will include final modeling results.
Joint Trades	JT-16	One of the Joint Trades' primary concerns is that the Draft SEIS does not contain a complete data set that describes the GOM Air Quality Modeling study and that the study is not complete. BOEM has elected to use the NEPA process and this, as well as subsequent SEISs to publish the results of the GOM Air Quality Modeling study for public review. Using the NEPA process for this purpose is inappropriate and decreases the transparency of how the modeling study was developed and executed. The use of incomplete information presents conclusions about the impacts on air quality from offshore operations that are not accurate – ultimately, resulting in providing incorrect information to the public. In addition, by utilizing preliminary, work-in-progress information in this (and possibly future) SEIS	Thank you for your comment. The air quality analysis in this Supplemental EIS is centered on the best available and credible scientific information. BOEM is committed to using the best available scientific information in all of its EISs, consistent with the information requirements under NEPA. The air quality analysis was specifically published in the Draft 2018 GOM Supplemental EIS in order to obtain public review and comment. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM used the initial results of the "Air Quality Modeling in the Gulf of Mexico Region" study, which

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		documents, the agency is arriving at conclusions and making decisions based on information that may significantly change once the study is complete. This is not a credible definition of "best available data." To maximize transparency and ensure that the best available information is made available to the public, BOEM must establish a collaborative, multi-stakeholder input process to review the study inputs, methods, assumptions and results, complete the study, and make the complete study report available for public comment. Preliminary study results should not be used in NEPA decisions or future rule-making as this is inconsistent with sound science practices and could mislead the public.	was the best available science at this time in order to draw impact conclusions on air quality. BOEM is currently revising the air quality modeling and is taking comments from Federal agencies, industry, and the general public into consideration in the model run, which will be available for review in a future NEPA document. BOEM is examining correcting the initial air quality model for sea-salt estimates, along with caisson emissions, decommissioned structures, and locations of platforms. In addition, BOEM is considering tagging the model for a single lease sale, which was not done in the initial model run. However, because the revised air quality modeling will not be completed before the publication of this Final Supplemental EIS, the results of the initial air quality model are still included in this Supplemental EIS as a reference for NEPA analysis. The air quality modeling results currently available allow consideration of anticipated air quality impacts without those impacts being underestimated. In order to address data gaps and current impacts for this analysis, BOEM used the initial air quality modeling results, emissions inventory data, available studies of OCS oil- and gas-related activities, postlease exploration and development plan information, and current proposed lease sale scenario data, as well as previous proposed action scenario data, to reach the impact conclusions. This approach was adequate because it assessed a combination of pollutants from OCS oil- and gas-related activities, non-OCS oil- and gas-related activities, and non-oil and gas activities. BOEM is now in the process of updating the air quality model based on public comments. BOEM has collaborated with USEPA, as well as industry, on the review and discussions of the air quality model. In

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			addition, BOEM has examined and considered incorporating industry's comments into the new air quality modeling and analysis. The results of the final air quality modeling will be included in a future NEPA analysis that will be available for public review and comment.
Joint Trades	JT-17	BOEM's air quality authority set forth in OCSLA and the Clean Air Act is limited to onshore impacts to the NAAQS from offshore development and production. Although it may be appropriate for BOEM to consider and analyze other pollutants and activities in addition to the NAAQS when developing an EIS, only potential impacts to the NAAQS should be considered when determining future mitigations. For example, the Draft SEIS contains extensive discussion of greenhouse gases (GHGs). GHGs are not NAAQS pollutants, and any future mitigations prescribed by BOEM should not be based on potential GHG impacts. Specifically, in the Draft SEIS: • Section 4.1.2, Greenhouse Gases Including Downstream Gas, Page 4-26 - The entire discussion from the beginning of this section on page 4-25 centers on GHGs, pollutants that BOEM does not have authority to regulate because there is no NAAQS for these pollutants. However, on page 4-26, BOEM mentions N_2O and black carbon as a by-product of flaring. The next sentence states that "This practice is rare on the OCS". Is BOEM referring to flaring as being rare, or the conversion of flared gas into N_2O and black carbon as being rare? This distinction is key because in the next paragraph, BOEM states that they have used the $PM_{2.5}$ concentration to estimate the maximum amount of black carbon released because black carbon is a specific type of $PM_{2.5}$. BOEM justifies this assumption in the final sentence of the second	This Supplemental EIS is a disclosure document. Although BOEM does not regulate greenhouse gas (GHG), BOEM has taken a step toward complete disclosure to the public of the contribution of BOEM-permitted OCS oil and gas leasing and development activities to national GHG emissions in accordance with NEPA. Because BOEM must consider impacts of offshore OCS oil- and gas-related activities from all sources, BOEM has discussed GHG and black carbon in this Supplemental EIS. Black carbon is mentioned as a method of managing natural gas removed from wells. However, the practice of releasing N_2O and black carbon via flaring is rare on the Gulf of Mexico OCS. BOEM states that $PM_{2.5}$ can be used to estimate the amount of black carbon released. Since BOEM has regulatory authority over National Ambient Air Quality Standards (NAAQS) pollutants, and $PM_{2.5}$ is a NAAQS pollutant, BOEM has regulatory authority over $PM_{2.5}$. However, because BOEM does not have the authority to regulate GHG, BOEM is not proposing to mitigate GHG or black carbon in this Supplemental EIS. In reference to the discussion of black carbon in **Chapter 4.1.2**, under the "Greenhouse Gases Including Downstream Gas" section, BOEM has clarified that the practice of releasing N_2O and black carbon via flaring is rare on the Gulf of Mexico OCS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		paragraph stating "BOEM has regulatory authority over $PM_{2.5}$". Section II.A of the Joint Trades comments on the proposed air rule (dated June 20, 2016) discusses BOEM's lack of authority to regulate pollutants that do not have a corresponding NAAQS, including precursors that have not been explicitly defined as such by EPA. Although ozone modeling considers CO emissions from a facility, EPA has not defined it as a regulated precursor for ozone. We also note that BOEM should not regulate black carbon separately, to the extent it seeks to regulate precursors, as it lacks authority to regulate precursor elements absent a supporting EPA regulatory record, which is the agency with the expertise to make such a finding. It is unclear what BOEM is seeking to accomplish with this discussion of GHGs and black carbon in the Draft SEIS. The Joint Trades recommends that the entire discussion of GHGs be removed from the Draft SEIS, especially since BOEM lacks the proper regulatory authority to impose mitigations for black carbon. Black carbon is not a NAAQS pollutant.	
Joint Trades	JT-18	Similarly, BOEM's authority over certain activities in the GOM is limited, especially as that authority relates to offshore support vessels. Like GHGs, information contained in the Draft SEIS regarding support vessels should not be used to justify future mitigations. Specifically, • Section 4.1.1, Emissions Inventories, Page 4-21 - BOEM states that production sources include survey vessels, pipe-laying operations, support vessels and helicopters, yet does not mention that BOEM does	It is appropriate for NEPA analyses to include direct and indirect impacts; therefore, support vessel emissions were included in this NEPA analysis.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		not have the authority to regulate air pollution emissions from vessels and helicopters. See section III.A of the Joint Trades comments on the proposed air rule (dated June 20, 2016) inserted below: OCSLA limits BOEM's authority over offshore facilities to "artificial islands[] and [] installations . . . permanently or temporarily attached to the seabed, which may be erected thereon for the purpose of exploring for, developing, or producing resources therefrom."[45] MSCs, aircraft, and onshore facilities are clearly not "artificial islands . . . permanently or temporarily attached to the seabed" that are "exploring for, developing, or producing" oil and gas. The Supreme Court has made clear that "the purpose of [OCSLA] was to define a body of law applicable to the seabed, the subsoil, and the fixed structures . . .on the Outer Continental Shelf." The Supreme Court has noted that Congress' approach under OCSLA "was deliberately taken in lieu of treating the structures as vessels, to which admiralty law supplemented by the law of the jurisdiction of the vessel's owner would apply."	
Joint Trades	JT-19	The Draft SEIS makes several conclusions that appear to be overly conservative and do not appear to meet the impact definitions described Section 4.1, page 4-15. The impact definitions shown on page 4-15 are as follows: • Negligible – No measurable impact(s). • Minor – Most impacts on the affected resource could be avoided with proper mitigation; if impacts occur, the affected resource would recover completely without mitigation once the impacting stressor is eliminated. • Moderate – Impacts on the affected resource are unavoidable. The viability of the affected resource is	The conclusions developed by BOEM's subject-matter experts regarding the potential effects of a proposed regionwide lease sale for most resources are necessarily qualitative in nature; however, they are based on the science-based judgment of the highly trained subject-matter experts. Staff approach this effort utilizing credible scientific information and apply it to the subject resources using accepted methodologies.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		not threatened although some impacts may be irreversible, or the affected resource would recover completely if proper mitigation is applied or proper remedial action is taken once the impacting stressor is eliminated. • Major – Impacts on the affected resource are unavoidable. The viability of the affected resource may be threatened although some impacts may be irreversible, and the affected resource would not fully recover even if proper mitigation is applied or remedial action is implemented once the impacting stressor is eliminated.	
Joint Trades	JT-20	• Section 4.1.2.1, Flaring and Venting, page 4-31 - The conclusion paragraph stating that the impacts of flaring and venting are minor offers no substantiated basis for this conclusion, and in fact, states that any such release would likely dissipate before reaching coastal areas. The justification presented supports a conclusion of "Negligible" not "Minor."	BOEM selected the conclusion of "minor" because flaring and venting include a wide range of scenarios. The processes of flaring and venting can be sorted into two processes: continuous or intermittent, which can include subcategories (i.e., planned, unplanned, and safety situations). The location, volume, and duration, as well as the sulfur content and resultant SO_x content for flares, may vary as well. "Minor" was selected because not every possible scenario would be "negligible." It is possible for flaring and venting events to be below the NAAQS but still be above the Significant Impact Levels (SILs) established by USEPA for the protection of human health and welfare in offshore areas near the flare. "Minor" allows for some situations of extended duration closer to shore. This impact conclusion definition does not include accidental flaring. BOEM used the initial results of the "Air Quality Modeling in the Gulf of Mexico Region" study, which was the best available science at this time in order to draw impact conclusions on air quality. BOEM is currently revising the air quality modeling and taking comments from Federal agencies, industry, and the general public into consideration in the model run, which will be available for review in a future NEPA

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			document. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.
Joint Trades	JT-21	• Section 4.1.2.1, Decommissioning, page 4-31 - BOEM is again drawing a conclusion that the air quality impacts from decommissioning activities, specifically from vessels which are not under BOEM's jurisdiction for air quality purposes, are "Minor" without offering any substantiated basis for this conclusion. What is the justification for labeling this activity as "Minor" instead of "Negligible" in this section, as well as in Table 4-1?	BOEM selected the conclusion of "minor" because decommissioning includes a wide range of scenarios. Decommissioning projects will vary because different projects require different types of equipment due to water depth and platform size and weight. Decommissioning may require a large amount of engines with a broad range of engine sizes, and application of engine use varies as the uses occur both onshore and offshore. Therefore, the potential for air pollution emissions is large as well. While potential impacts to air quality from decommissioning some projects may be very low, the process of removing other facilities has the potential to cause adverse impacts to air quality. "Minor "was selected because not every possible scenario would be "negligible." BOEM used the initial results of the "Air Quality Modeling in the Gulf of Mexico Region" study, which was the best available science at this time in order to draw impact conclusions on air quality. BOEM is currently revising the air quality modeling and taking comments from Federal agencies, industry, and the general public into consideration in the model run, which will be available for review in a future NEPA document. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.
Joint Trades	JT-22	• Section 4.1.2.3.1, Impacts Assessment, PM_{10}, page 4-42 – The Draft SEIS states, "The impacts to air quality from PM_{10} are minor because, while there are concentrations increases in water farther offshore, no overall standards were exceeded." The	BOEM selected the conclusion of "minor" because, while no overall standards were exceeded, it does not mean there will be no impacts to air quality. It is possible for the concentrations to be below the NAAQS but still be above the SILs established by

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		conclusion that no overall standards were exceeded should justify an impact classification of "Negligible."	USEPA for the protection of human health and welfare in offshore areas. A "minor" conclusion allows for such instances. BOEM used the initial results of the "Air Quality Modeling in the Gulf of Mexico Region" study, which was the best available science at this time in order to draw impact conclusions on air quality. BOEM is currently revising the air quality modeling and taking comments from Federal agencies, industry, and the general public into consideration in the model run, which will be available for review in a future NEPA document. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.
Joint Trades	JT-23	Section 4.1.2.3.1, Impacts Assessment, Nitrogen Dioxide (NO_2), page 4-42 – The Draft SEIS states, "The impacts to air quality from 1-hour NO_2 and annual NO_2 are minor because overall, concentrations decrease between the base and future year scenarios at most locations." A decrease in projected emissions appears to indicate that air quality may be improving in projected future years. Therefore, the impact conclusion must be "Negligible."	BOEM selected the conclusion of "minor" because, while overall concentrations decreased between the base- and future-year scenarios, it does not mean there will be no impacts to air quality. It is possible for the concentrations to be below the NAAQS but still be above the SILs established by USEPA for the protection of human health and welfare. A "minor" conclusion allows for such instances. BOEM used the initial results of the "Air Quality Modeling in the Gulf of Mexico Region" study, which was the best available science at this time in order to draw impact conclusions on air quality. BOEM is currently revising the air quality modeling and taking comments from Federal agencies, industry, and the general public into consideration in the model run, which will be available for review in a future NEPA document. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Joint Trades	JT-24	• Section 4.1.2.3.1, Impacts Assessment, Sulfur Dioxide (SO2), page 4-43 – The Draft SEIS states, "The impacts to air quality from 1-hour SO_2 and 3-hour SO_2 are minor because overall, concentrations decrease between the base and future year scenarios at most locations as sources retire or apply control equipment." A decrease in projected onshore concentrations appears to indicate that air quality may be improving in projected future years. Therefore, the impact conclusion must be "Negligible."	BOEM selected the conclusion of "minor" because, while overall concentrations decreased between the base- and future-year scenarios, it does not mean there will be no impacts to air quality. It is possible for the concentrations to be below the NAAQS but still be above the SILs established by USEPA for the protection of human health and welfare. A "minor" conclusion allows for such instances. BOEM used the initial results of the "Air Quality Modeling in the Gulf of Mexico Region" study, which was the best available science at this time in order to draw impact conclusions on air quality. BOEM is currently revising the air quality modeling and taking comments from Federal agencies, industry, and the general public into consideration in the model run, which will be available for review in a future NEPA document. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.
Joint Trades	JT-25	• Section 4.1.2.3.1, Impacts Assessment, Carbon Monoxide (CO), page 4-43 – The Draft SEIS states, "The impacts to air quality from 1-hour CO and 8-hour CO are minor because overall, concentrations decrease between the base and future year scenarios at all locations." A decrease in projected onshore concentrations appears to indicate that air quality may be improving in projected future years. Therefore, the impact conclusion must be "Negligible."	BOEM selected the conclusion of "minor" because, while no overall concentrations decreased between the base- and future-year scenarios, it does not mean there will be no impacts to air quality. It is possible for the concentrations to be below the NAAQS but still be above the SILs established by USEPA for the protection of human health and welfare. A "minor" conclusion allows for such instances. BOEM used the initial results of the "Air Quality Modeling in the Gulf of Mexico Region" study, which was the best available science at this time in order to draw impact conclusions on air quality. BOEM is currently revising the air quality modeling and taking comments from Federal agencies, industry, and the general public into consideration in the model run, which will be available for review in a future NEPA

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			document. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.
Joint Trades	JT-26	• Characterization in Table 4-1 does not match text section discussions for Accidental Events (Emergency Flaring and Venting and Oil Spills) - Emergency Flaring and Venting, and Oil Spills are identified in Table 4-1 as having a "Minor" impact on air quality, however, the second paragraph on page 4-32 in the "Emergency Flaring and Venting" section, and the first paragraph on page 4-33 in the "Oil Spills" section states "…potential impacts as a result of the much smaller reasonably foreseeable accidental gas release (Emergency Flaring and Venting) spills (Oil Spills) analyzed in this Supplemental EIS would be localized and short term, and would have no impact on coastal areas….". The concluding sentence of these paragraphs draws the unsubstantiated conclusion that "the accidental event's impact on air quality over the OCS and adjacent onshore areas on oil spills is therefore expected to be minor." If there is no impact to the coastal areas, Table 4-1 should reflect a "negligible" impact for Emergency Flaring and Venting and Oil Spills. The OCS is not subject to the NAAQS. As explained in the Joint Trades written comments on the Proposed Air Quality Rules (June 20, 2016), "First, as discussed, under section 5(a)(8) the Secretary's authority is limited to promulgating regulations for "compliance with the [NAAQS] pursuant to the [CAA] to the extent that activities authorized under [OCSLA] significantly affect the air quality of any State." Under the relevant state implementation plans, the border of the air quality control regions appears to extend only to the shoreline and not to the respective	BOEM selected the conclusion of "minor" because the location, volume, and duration (as well as the sulfur content and resultant SO_x content for flares) may vary for flaring and venting and oil-spill events. "Minor" was selected because not every possible scenario would be "negligible." It is possible for flaring and venting and oil-spill events to be below the NAAQS but still be above the SILs established by USEPA for the protection of human health and welfare in offshore areas near the flare. "Minor" allows for such instances. BOEM used the initial results of the "Air Quality Modeling in the Gulf of Mexico Region" study, which was the best available science at this time in order to draw impact conclusions on air quality. BOEM is currently revising the air quality modeling and taking comments from Federal agencies, industry, and the general public into consideration in the model run, which will be available for review in a future NEPA document. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		states' territorial waters. As such, NAAQS do not apply in the territorial waters." Since the NAAQS do not apply to OCS, and BOEM has concluded that emergency flaring and venting and oil spills will have no impact on coastal areas air quality, Table 4-1 must be changed to document a "Negligible" impact from Emergency Flaring and Venting and Oil Spills, as opposed to "Minor".	
Joint Trades	JT-27	Many of the issues discussed above such as overprediction of future platforms and overly-conservative assumptions regarding onshore wind flows do not have a singular effect on the conclusions of the Draft SEIS. Overly conservative assumptions utilized in multiple ways in the GOM Air Modeling study and the Draft SEIS have a compound effect upon the final results. Inappropriate and inaccurate assumptions and model inputs, taken cumulatively, greatly exaggerate the potential impacts and conclusions presented in the Draft SEIS. Therefore, it is critical that assumptions and model inputs are realistic and appropriate. Because of this compounding effect, the Joint Trades' recommendation of establishing a collaborative, multi-stakeholder work group to provide input to the GOM Air Quality Modeling study becomes imperative. By establishing a more collaborative, transparent process, where input from stakeholders is considered and utilized, the impact of overpredictions can be minimized and, ultimately, the model results are improved.	BOEM is now in the process of updating the air quality modeling based on public comments and will publish the results when the analysis is complete. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM has collaborated with USEPA, as well as industry, on the review and discussions of the air quality model. In addition, BOEM has considered addressing and incorporating industry's comments into the new air quality model and analysis.
Joint Trades	JT-30	The Joint Trades appreciate the opportunity to provide these written comments on the air quality data that has been made available in the Draft SEIS. However, as discussed in this letter, overall, we remain extremely concerned that BOEM is utilizing	BOEM is now in the process of updating the air quality model based on public comments and will publish the results when the analysis is complete. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		an inappropriate process for public review of the GOM Air Quality Modeling study. In addition, we have even greater concern that BOEM is using a yet-unfinished study to justify conclusions regarding potential environmental impacts and to present those conclusions to the public as "best available science." This is clearly not a prudent, sound and common sense approach to policy making.	run and the use of the initial air quality analysis in this Supplemental EIS. BOEM has collaborated with USEPA, as well as industry, on the review and discussions of the air quality model. In addition, BOEM has considered addressing and incorporating industry's comments into the new air quality model and analysis. Once the air quality model is complete, the public will have an opportunity to comment on the model and analysis.
Joint Trades	JT-31	In addition, the Joint Trades were notified on May 15, 2017 that BOEM extended the comment period until June 14, 2017 to allow for additional review of air quality information in the Draft SEIS. At the time notification of the comment period extension was received, the comments contained in this letter had been finalized. However, the Joint Trades will utilize the additional time granted to continue our review of the Draft SEIS air quality information, and we reserve the right to submit additional comments before the extended deadline of June 14, 2017.	Thank you for your comments. We accepted air quality comments until June 14, 2017.
United States Environmental Protection Agency	USEPA-1	Since the air quality analysis and supporting appendices for the Gulf of Mexico Outer Continental Shelf (OCS) Lease Sale 2018 are identical to the Gulf of Mexico OCS Oil and Gas 2017-2022 Final Multisale EIS, the EPA refers BOEM to our previous air quality comments in our letter dated April 10, 2017. The EPA appreciates BOEM's continued interagency coordination with respect to the air quality study that supports these lease sales.	Thank you for your comment. BOEM will continue to coordinate with USEPA on the new air quality modeling. Responses to individual comments from the April 10, 2017, letter follow in the responses to Comments USEPA-4 through USEPA-47.
United States Environmental Protection Agency	USEPA-4	**General Comments** <u>Model Receptors</u> EPA fully supports BOEM's consideration of Outer Continental Shelf (OCS) impacts at the State seaward boundary in BOEM's air quality modelling study and impacts analysis. Such analysis is necessary to ensure that the National Ambient Air	Thank you for your comment. Your comment is noted.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Quality Standards (NAAQS) are protected and that States can meet their State Implementation Plan and Coastal Zone Management Act (CZMA) responsibilities, as well as, to ensure that the air quality within this nearshore area is not adversely impacted by OCS activity.	
United States Environmental Protection Agency	USEPA-5	<u>Impact Level Determinations</u> According to Table 1 in the Executive Summary and Chapter 4 Table 4.1, overall impacts on air quality have been concluded to be minor for Alternatives A-D. This conclusion is not fully supported by other statements of the Executive Summary, as well as the detailed analyses in Section 4.1 (Air Quality) of the EIS. For instance, page XIX of the Executive Summary refers to potential impacts to Breton Wilderness Area as moderate. Additionally, page XX of the Executive Summary refers to impacts from the cumulative lease sales as moderate to both Breton Wilderness Area and the Gulf Islands National Seashore and "...would most likely have a moderate effect on coastal nonattainment areas for certain pollutants." Page XX refers to the cumulative impacts having a minor effect "...because most impacts on the affected resources could be avoided with proper mitigation." However, there is no detailed discussion of what constitutes proper mitigation for the specific impacts nor analysis (modelled or otherwise) of how it will alleviate or counteract air quality impacts. EPA suggests that quantitative analysis of assumed emissions reductions using emission factors associated with control technologies or mitigation is a valuable tool for determining if specific mitigation measures would reduce impacts to minor levels. In addition, current offshore operations employ very little targeted mitigation, and if they did, these reductions would likely be accounted for in the emissions reported by operators and used as the basis for the inventory	As discussed in the **Executive Summary**, the *incremental contribution* of a proposed lease sale to the cumulative impacts would most likely have a ***minor*** effect on coastal nonattainment areas because most impacts on the affected resource could be avoided with proper mitigation. Portions of the Gulf Coast onshore areas have ozone levels that exceed the Federal air quality standard, but the incremental contribution from a proposed lease sale would be very small and would not on their own cause an exceedance. Any minor to moderate impact conclusions were for cumulative impacts for the OCS Oil and Gas Program, not for an individual lease sale. BOEM is now in the process of updating the air quality model based on public comments. The revised air quality model run will not be completed before the publication of this Final Supplemental EIS; therefore, the results of the initial air quality model are still included in this Supplemental EIS as a reference for NEPA analysis. The air quality modeling results currently available allow consideration of anticipated air quality impacts without those impacts being underestimated. Should the results of the revised model change the impact conclusions, the impact table will be revised. In reference to the request for detailed air quality mitigation information, refer to Appendix B of the 2017-2022 GOM Multisale EIS, "Commonly Applied Mitigating Measures," for full descriptions of the air quality mitigations.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		that resulted in the adverse impacts of the current study. Additional inconsistencies were found in Section 4.1 regarding the conclusion of minor versus moderate impacts of this EIS. For example, according to page 4-39 of this Section, "[t]he impacts to air quality from ozone (03) for all proposed and existing oil and gas emissions from Gulf of Mexico OCS sources and their support vessels/aircraft (Source Group C) are moderate because future year design values were above the current year design value (which was already above the [national ambient air quality standards] NAAQS)." The EIS identifies Galveston, Texas, as a current nonattainment area, which is the location of the maximum impacts from Source Group C (new and existing) emissions. The paragraph further concludes that the impacts from Source Group B (new emissions) are minor, since design values in the future are lower than the current year design values. However, since the current year design values are already above the NAAQSs and the area is designated nonattainment (Galveston, TX), it cannot be concluded that Source Group B will not continue to contribute to the existing violations of the NAAQS and, therefore, have just minor impacts, as "minor" is defined in the EIS. Based on our review of the analysis contained in the FEIS, and supporting documentation, EPA concurs with the text of the analysis that the air quality impacts range from minor to moderate. EPA recommends that any such impact summary tables in the record of decision (ROD) and future EIS documents reflect BOEM's conclusions of minor to moderate impacts, unless otherwise supported by revised impact analyses.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
United States Environmental Protection Agency	USEPA-6	c) Monitoring and Mitigation EPA continues to recommend that BOEM develop measures to monitor and mitigate NAAQS pollutants, such as NO_x, and $PM_{2.5}$, as well as, regulated toxic and greenhouse gas pollutants, and to include recommendations for these measures in the ROD. EPA suggests that reasonable mitigation measures that should be considered include the use of low sulfur fuels, including liquefied natural gas, inherently lower polluting and high efficiency engine designs, use of required tier certified non-road and marine engines (rather than engines certified for US export), flaring (rather than cold venting), and electrification of cranes and support equipment. EPA also encourages BOEM to include provisions for periodic or continuous emissions monitoring for large emission units to ensure that emissions are maintained below the exemption thresholds, and hence, ensure compliance with the NAAQS and CZMA. EPA supports BOEM's inclusion of these recommended measures in BOEMs table of mitigation.	BOEM will consider the use of reasonable mitigation measures suggested by USEPA in future NEPA documents. During the postlease stage, stack testing is required when operator emissions factors are lower than default emission factors (e.g., lower than USEPA tier standards). Additionally, when actual or historical fuel usage is used, a fuel usage mitigation that requires submission of monthly fuel records is applied to operators. Likewise, BSEE completed a study, "Analysis of Potential Opportunities to Reduce Venting and Flaring on the OCS", intended to support the advancement of knowledge about venting and flaring practices in offshore operations and to foster improvements in the oversight and regulation of venting and flaring activities.
United States Environmental Protection Agency	USEPA-7	**Section 3.1 Impact Producing Factors** Section 3.1.8, Air Emissions, page 3-92: EPA recommends that the line that begins, "the Clean Air Act Amendments" require the USEPA to set the NAAQS ..., should be revised to state, "the Clean Air Act," as EPA was required to establish the NAAQS prior to the 1980 Amendments.	Chapters 3.1 and 3.3 of the 2017-2022 GOM Multisale EIS describe in detail the routine and accidental impact-producing factors and activity scenarios associated with Alternatives A-D that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico. In this Supplemental EIS, a summary of the impact-producing factors and scenario incorporated from the 2017-2022 GOM Multisale EIS are included in Chapter 3.1.2. BOEM will make this requested language change in the next EIS that uses this language. All air quality comments from USEPA were submitted for the Final 2017-2022 GOM Multisale EIS, but they were re-referenced in the comment letter from USEPA for the Draft 2018 GOM Supplemental EIS. Because the

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			text referenced in this comment was not reproduced in this Supplemental EIS, the change could not be made to this Supplemental EIS. However, the change will be made in the next NEPA document that uses this language.
United States Environmental Protection Agency	USEPA-8	EPA recommends that Section 3.1.8.l and 3.1.8.3 be revised to include VOCs as combustion gases. In addition to being non-combustion sources of emission, fuel carbon not converted to $C0_2$, results in CH_4, CO, and/or VOC emissions due to incomplete combustion.	Refer to the response to Comment USEPA-7 above.
United States Environmental Protection Agency	USEPA-9	**Section 4.2 Air Quality** Appropriateness of Reference Measures According to Page 4-13 of this section, the air quality impacts of the oil and gas related activities planned as part of this multisale lease activity are being compared to several reference measures, such as the NAAQS, significant impact levels (SILs), and other air quality related values (AQRVs), including visibility and acid deposition. As outlined in Table 4-2, the NAAQS take many different forms with varying averaging times for several of the pollutants. Page 4-37 of this section provides an overview of the modeling results compared to these reference measures, beginning with the NAAQS. While there are several NAAQS that may be appropriate for comparison (e.g., long-term, annual standards), EPA believes the use of actual emissions (instead of allowable maximum hourly emissions), the nature of photochemical grid-based modeling and the uncertainties associated with the future year (2033 and 2036) emissions inventories, as well as the unknown location and number of future platforms and vessel activity, makes comparison of the future year emission impacts to short-term (1-hour and 3-hour) NAAQSs far too uncertain and potentially	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. The results of the initial air quality model are the best available information we have, and they are included in this Supplemental EIS as a reference for NEPA analysis. The air quality modeling results currently available allow consideration of anticipated air quality impacts without those impacts being underestimated. Including comparisons to the short-term (e.g., 1-hour) NAAQS were included in the analysis for disclosure. Caveats were included in the analysis regarding uncertainties as suggested by USEPA. While cumulative impacts relative to short-term (e.g., 1-hour) NAAQS are disclosed in this Supplemental EIS, readers should be aware that these impact estimates are subject to greater uncertainties than impacts relative to longer term (e.g., annual average) NAAQS since they will typically occur very close to a specific source and are therefore more sensitive to the exact characteristics and locations of individual sources; this information is not generally available at this point in the planning process. Also worth noting is that this analysis did include temporal profiles that are source

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		misleading to the public. Additionally, in order to perform a PSD increment analysis, one would have to ascertain which emission units/facilities are increment consuming and expanding, since all existing emission units/facilities do not consume PSD increments and decreases in emissions from PSD affecting sources expand PSD increments. Further, the pollutant's minor source baseline date, which determines PSD increment affecting emission sources, is location dependent. This kind of location specific information was not included as part of the increment analysis described on Pages 4-43 to 4-45 of this section. Because of this, photochemical grid-based modeling is not conducive to the assessment of PSD increments. The EIS did acknowledge that the analysis done "…did not constitute a regulatory PSD increment analysis." However, since the analysis that was performed shows several exceedances of the PSD increment, EPA believes it is misleading to present the results in the EIS document. The assessment of PSD increments are more appropriately part of an individual receptor-based impact modeling assessment using air quality dispersion modeling. EPA recommends that short-term NAAQSs and PSD increments cannot be properly assessed with the available emission inventory information and air quality modeling technique used for the EIS. Therefore, it is recommended that these ambient air quality standards be removed from future EIS documents for multisale lease activity. EPA believes a better comparison to determine the air quality impacts of the future lease sale activities would be to compare only the future platform and support vessel emissions (i.e., Group B emissions) impacts to the	category specific based on previous Gulfwide emissions inventories; therefore, some emissions adjustments were made with respect to time, and not all of the emissions are based the same hourly emissions. No regulatory Prevention of Significant Deterioration (PSD) analysis was included in the analysis; instead, impacts from new sources associated with the proposed action (Source Group B) at Class I and sensitive Class II areas were compared against the PSD increments *for informational purposes only*. The PSD increments are merely adopted as a set of convenient benchmarks. This has become common practice in air quality impact disclosures for upstream oil and gas NEPA documents. BOEM has chosen to disclose impacts relative to the PSD increments in Class I and sensitive Class II areas in light of the fact that this has become common practice in NEPA documents for upstream oil and gas projects; full disclosure of all impacts with appropriate caveats noted is more appropriate. In keeping with this approach, impacts at Class I/II areas from Source Groups A, B, and C are presented in this Supplemental EIS, and it is noted that Source Group C includes sources that are not exclusively associated with the proposed action. The SILs are designed to represent *de minimus* levels below which it is presumed that impacts of an individual source will not "cause or contribute to the violation of a NAAQS" or the exceedance of a PSD increment, thus obviating the need to perform detailed modeling of cumulative impacts (for NAAQS) or a full regulatory PSD analysis. The source contribution analysis presented in Appendix H of the 2017-2022 GOM Multisale EIS (**Appendix D** of this Supplemental EIS) gives estimates of the combined impacts of all

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

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		SILs. This would allow a more applicable analysis of the effects of the new OCS activities being proposed as part of the EIS. In addition, impacts from the emissions associated with the lease sales that are less than the SIL would not be considered significant enough to cause or contribute to ambient standard violations.	new sources associated with the proposed action as a group (Source Group B) and does not focus on any individual new source. Each of the individual new sources within Group B will be subject to further regulatory review before being approved. Thus, comparing Group B impacts to the SILs is inappropriate. Furthermore, there is no value in examining impacts relative to the SILs since the regional-scale photochemical modeling already provides estimates of cumulative impacts and compares them to the NAAQS.
United States Environmental Protection Agency	USEPA-10	**Section 4.1.1: Description of the Affected Environment** The EIS (Page 4-16) included the following Class I areas in the analysis: Breton Wilderness Area, Bradwell Bay Wilderness Area, Chassahowitzka National Wilderness Area, Everglades National Park, and St. Marks Wilderness Area. It is unclear why only these particular Class I areas were included in the analysis. EPA recommends that the EIS include a description of the criteria used to determine which Class I areas were of concern (e.g., distance from shoreline, etc.).	Under BOEM Contract Number M14PC00007, "Air Quality Modeling in the Gulf of Mexico Region" study, photochemical air quality modeling was conducted to assess impacts to nearby states of OCS oil and gas exploration, development, and production as required under the OCSLA. Since the Gulf of Mexico OCS Region manages the WPA, CPA, and EPA on the OCS, the area of possible influence includes the States of Texas, Louisiana, Mississippi, Alabama, and Florida. In addition, the NEPA analysis included the Class I areas located in the coastal waters of these states adjacent to the OCS because they fall within BOEM's Gulf of Mexico OCS Region's area of responsibility.
United States Environmental Protection Agency	USEPA-11	**Section 4.1.1: Gulf of Mexico OCS Region Attainment Status** This section describes the NAAQS and attainment status of the criteria pollutants. However, this section no longer discusses the NAAQS or attainment status for particulate matter (i.e. the paragraph that was in the draft was removed). Since particulate matter is a pollutant of concern for health effects, Class I area visibility, and regional haze, and is directly emitted by OCS facilities, EPA recommends including a description of the particulate matter standards in the EIS, as was included in the draft.	The previously removed language has been reinserted in this Supplemental EIS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
United States Environmental Protection Agency	USEPA-12	**Section 4.1.1: Emissions Inventories** It is our understanding that the emission inventory used for the base year (2012) analysis is actually a compilation of several different emission inventories as described in various areas of the EIS, as well as the appendices. These inventories include: 1) EPA's 2011 National Emissions Inventory (NEI), 2) BOEM's 2011 Gulf-wide Emissions Inventory (GWEI) study, 3) EPA's Clean Air Markets Division (CAMD) data from 2012 and 4) onshore mobile source emissions from 2012 used in EPA's MOVES model. However, the discussion in Section 4.1.1 regarding emissions inventories only describes the GWEI from BOEM. Section 4.1.2.3 (Page 4-34) briefly mentions the EPA NEI as well as the use of 2012 meteorological datasets. EPA strongly recommends the emissions inventory discussion in Section 4.1 include at least a brief description of all the emission inventories used in the base year analysis, as well as references to additional information in the appropriate appendices.	This Supplemental EIS has been updated to include the different emission inventories used in the base case analysis, as well as reference to additional information in the appropriate appendices.
United States Environmental Protection Agency	USEPA-13	This section, page 4-20, indicates that emission estimates were provided for directly emitted pollutants, and indicates that only four of the common air pollutants, for which there are NAAQS (i.e. CO, Pb, NO_2 and SO_2), are emitted directly. EPA recommends that this statement be revised to include particulate matter ($PM_{2.5}$ and PM_{10}) as common air pollutants that are emitted directly from OCS facilities and for which there are NAAQS.	The chapter has been updated to include $PM_{2.5}$ and PM_{10}.
United States Environmental Protection Agency	USEPA-14	**Section 4.1.2.1: Routine Activities-Drilling and Production with Associated Vessel Support** This section, pages 4-28 and 4-29, discusses the contributions of drilling and vessel support, and describes vessel support as emitting NOx, CO and CO_2. EPA recommends including $PM_{2.5}$ and PM10 in the list on page 4-29. In addition, EPA recommends that the EIS clarify, that for the purpose of the emissions inventory, BOEM considers drillships and	This chapter has been updated to include (1) $PM_{2.5}$ and PM_{10}, (2) drillships and well stimulation vessels considered as non-platform sources, and (3) clarification of the scenario and how the results align with the Source Categories/Source Groups.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		well stimulation vessels to be non-platform sources of emissions. This helps to provide perspective on the emission rates for the non-platform/support vessel contribution. Finally, the concluding statement, "because the projected activities in this scenario for a proposed lease sale are less than the current 2011 GWEI activities, the impacts would be minor," seems out of place and is not well supported by the prior statements. A "scenario" as not been described prior to this statement, nor is it clear how this result aligns with SC3-SC6 categories discussed in the context of the modelling results.	
United States Environmental Protection Agency	USEPA-15	**Section 4.1.2.3.1: Impacts Assessment** In this section, the EIS describes many of the future year pollutant impacts as having decreased concentrations from those estimated for the base year. The EIS makes several statements that the future year design values and/or concentrations are lower than current year values. For example, Page 4-39 describes the future year design values based on Group B emissions for Ozone as lower than current year values. A similar statement is made on Page 4-41 that $PM_{2.5}$ design values decrease in the future without reference to which Source Group was used to make this assessment. Additionally, on page 4-41, the conclusion is made that impacts to the 1-hour nitrogen dioxide (NO_2) and annual NO_2 standards are minor because overall concentrations decrease between base and future year scenarios at most locations. No reference is made to whether this analysis is based on Source Group B or C emissions. EPA recommends that the basis should be provided as part of the EIS. In addition, EPA recommends that the reason(s) for the decreases in future year impacts and/or design values, considering the addition of new OCS activities associated with these lease sales and possible increased land based development, be described in	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. In future NEPA documents, BOEM will consider adding a detailed description of the reason impacts decreased in future years, including supporting documentation and analyses, as well as quantitative summary tables comparing the modeled concentrations to NAAQS or other reference measures. This comment suggests that there is some misinterpretation of BOEM's air quality analysis. BOEM acknowledges that this section of **Chapter 4** did not include a full explanation of the air quality modeling results because detailed explanation of the results are included in **Appendices B, C, and D**, and are incorporated by reference into the analysis in this Supplemental EIS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		detail in the EIS documents and that supporting documentation or analyses should be included, as needed, in order for the reader to understand the conclusions made by BOEM with regard to the impact assessments. In general, this particular section is difficult to understand and to draw reasonable conclusions from. EPA recommends that this section contained quantitative summary tables comparing the modeled concentrations to NAAQS or other reference measures.	
United States Environmental Protection Agency	USEPA-16	**Section 4.1.2.3.1: Comparison at the Class I and Sensitive Class II Areas** The notes to this section in italics (page 4-44) indicate: "Actions to be authorized by BOEM under this Multisale EIS do not typically constitute major stationary sources and do not typically trigger PSD permits or review… This information is presented to aid State agencies in tracking potential minor source increment consumption." While it is true that sources under this BOEM action are generally not subject to PSD permitting, EPA believes these statements could be misinterpreted to mean that the sources covered by this action have emissions that are generally below EPA's PSD major source thresholds. The vast majority of the sources covered by this EIS are located in the area of the Gulf under BOEM jurisdiction and are not subject to PSD requirements, despite having emission above the PSD "trigger" thresholds. All of the sources under EPA jurisdiction have had emissions above the PSD thresholds and have received PSD permits.	This chapter has been updated to reflect that these sources fall under BOEM's jurisdiction. Sources that fall under BOEM's air quality jurisdiction do not require PSD permits or review. The information provided in that chapter is presented here as an evaluation of a "threshold of concern" for potentially significant adverse impacts, but they do not represent a regulatory PSD increment consumption analysis.
United States Environmental Protection Agency	USEPA-17	**Section 4.1.2.3.1: Non-OCS Oil and Gas Related Impacts** This section includes a discussion of intercontinental dust transport from Central America and North Africa on the Gulf of Mexico air quality and Texas, in particular. While EPA concurs that such transport may contribute to cumulative visibility impairment,	The suggested revision has been included in this Supplemental EIS.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		EPA is concerned that the referenced material does not directly support the EIS conclusion that "an increase in visibility impairment in Texas is likely due to transport of dust rather than OCS oil and gas emissions sources," given that multiple factors, including increased port emissions, increased wildfires, etc. contribute to visibility impairment. EPA recommends that this conclusion be revised to indicate the intercontinental transport likely contributes to visibility impairment.	
United States Environmental Protection Agency	USEPA-18	**Section 4.1.2.4: Incomplete or Unavailable Information** In this section, the EIS acknowledges that the Air Quality Modeling in the Gulf of Mexico Region study is not complete and the analyses relied upon preliminary data. However, the section does not discuss how the final study results will be used in future lease sale activities. Since, the current Final Multisale EIS will be used for all Gulf of Mexico lease sales in 2017-2022, EPA recommends that the ROD address how any final study results will be used in future lease sale activities (i.e. through Supplemental EIS documents, etc.)	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. BOEM acknowledged USEPA's comment by including language in the Record of Decision (ROD) for Lease Sale 249 discussing how any final study results will be used in future lease sale activities. The Lease Sale 249 ROD included language that BOEM does conduct further air quality review during the postlease plan process, and BOEM will consider requiring controls should results of the updated modeling suggest controls are necessary to protect the NAAQS of any state. The language in the Lease Sale 249 ROD follows: "In reviewing the initial results [of the air quality model run] and after considering several modeling assumptions used in the study, BOEM has decided to conduct further refined modeling in coordination with the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. National Park Service. It is anticipated that any new results would be provided in a supplemental EIS, and furthermore, the results will be available and considered before any plan is submitted on a block leased as a result of Lease Sale 249. Therefore, while additional air quality data would be useful in consideration of this lease sale, it is not necessary for

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			my decision on this lease sale. Any concerns raised by the modeling study will be further refined by the time plans are submitted and/or additional plan specific modeling may be required consistent with BOEM regulations when the plan is submitted for approval. During its review of any submitted plan, BOEM conducts an air quality review to determine if additional controls would be necessary."
United States Environmental Protection Agency	USEPA-19	**Inconsistencies** The definition of Source Categories (SCs) as used in Section 4.1 and in Appendix H should are not consistent. Section 4.1 Source Categories only go from SC3 to SC6 (Table 4-4) and their descriptions are not exactly the same as provided in Appendix H. The appendix has added SC1-SC2 and SC7-SC10 (see Table H-7). EPA recommends that the EIS and future documents based on the Appendices, explain the differences and/or revise these definitions to be more consistent throughout the NEPA document.	The suggested clarification has been included in this Supplemental EIS.
United States Environmental Protection Agency	USEPA-20	Similar to our comment regarding the source category definitions above, the source groups in Section 4.1 are only provided and defined for Source Groups A-D and appear to be the same definitions as those provided in Appendix H. However, the appendix also includes Source Groups D-F with their definitions (see Table H-15). EPA recommends providing a definition for each of the source groups and source categories used in the EIS analyses sooner in the documents and consistently when describing "Source Groups/Source Categories" as a whole.	In this Supplemental EIS, "Source Categories" were only used to discuss the source apportionment assessment. However, the modeling results and impacts assessment reference the "Source Groups." **Table 4-5**, which showcases "Source Groups" in relation to "Source Categories," as well as providing a definition of the corresponding source, has been moved up in this Supplemental EIS for better explanation for the reader.
United States Environmental Protection Agency	USEPA-21	**Appendix F - Specific Comments** Overall, BOEM's 2012 Weather Research & Forecasting (WRF) dataset model performance results based on METSTAT appears reasonable; however, EPA suggests that BOEM consider including EPA's Atmospheric Model Evaluation Tool for some meteorological parameters in future WRF	The WRF modeling has been finalized for this Supplemental EIS analysis and refined modeling efforts. The METSTAT tool will continue to be used for this modeling since it is recognized and historically used as the meteorological modeling evaluation tool. However, BOEM will consider including other model evaluation tools in future WRF performance

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		performance evaluations.	evaluations.
United States Environmental Protection Agency	USEPA-22	EPA recommends, per *Appendix W's Section 9.0 Regulatory Application of Models-9.1 Discussion*, that BOEM extend its WRF datasets to 3 years. The 3-year WRF datasets do not necessarily have to be consecutive years as long as an adequate performance evaluation (see comment 1) of the 3-year WRF dataset is performed.	Only 1 year of WRF data is used in this analysis, which is typical for regional scale photochemical modeling. Also, given current limitations in computer processing power, it is not technically feasible to prepare photochemical modeling results of the type presented in this Supplemental EIS for a 3-year period. The WRF modeling is finalized for this Supplemental EIS analysis and refined modeling efforts. However, BOEM will consider running 3-year WRF datasets for future photochemical modeling efforts if sufficient time and computing power become available.
United States Environmental Protection Agency	USEPA-23	**Appendix G - Specific Comments** Section G.2.1, page G-5, describes the selection of 2012 as the base case year due to an unusually hot and dry year in the region during 2011. Since the selection of time specific meteorology and emission inventories are the basis on which all modeling impacts are assessed, EPA recommends that the report provide more quantitative information to support the decision to choose 2012 as the base year.	BOEM will consider including more quantitative information in support of the selection of 2012 as a base year over 2011 in BOEM's final study report and NEPA analysis.
United States Environmental Protection Agency	USEPA-24	Section G.3.3, page G-9, indicates that the ERG team ran the MOVES2014 model for onroad sources to develop 2012 emission estimates. However, no further discussion was provided explaining what assumptions or procedures were employed when generating these emission estimates. EPA recommends that this technical report provide additional documentation for this approach.	Onroad emissions were generated using the SMOKE-MOVES integration tool. This SMOKE-MOVES processing approach has been used in various regulatory applications by USEPA. The SMOKE-MOVES uses emission rate lookup tables generated by the MOVES mobile source emissions model. The MOVES generates emissions by process (i.e., running, start, vapor venting, etc.), vehicle type, road type, ambient temperature, vehicle speed, hour of day, and other factors. To generate the MOVES emission rates that could be applied across the U.S., USEPA uses an automated process to run MOVES to produce emission factors by temperature and speed

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			for a series of "representative counties," to which every other county is mapped. Representative counties are used because it is impractical to generate a full suite of emission factors for each of the more than 3,000 counties in the U.S. Representative counties are selected according to the state in which they are located, elevation, fuel characteristics, vehicle age distribution, ramp fraction, and inspection and maintenance programs. Each county is then mapped to a representative county based on its similarity with the representative county with respect to these attributes. In this modeling study, the SMOKE-MOVES system was used with the WRF gridded hourly meteorological data, MOVES2014 emission factor lookup table for the 2012 calendar year, and 2011 NEI version 2 (2011NEIv2) vehicular activity data to generate gridded, day-specific, hourly onroad mobile source emissions. Further documentation on assumptions used for MOVES2014 is expected to be included in BOEM's final study report and NEPA analysis.
United States Environmental Protection Agency	USEPA-25	EPA recommends that the caption of Figures G-1 and F-1 be revised to more accurately indicate that the gray dots are active leases or *potential* platform locations, rather than defining the gray dots as platform locations. As defined, when the reader compares Figures G-5 through G-7 with Figure G-1, it is confusing, as it would appear that many existing platforms west of the 87.5-degree line that are missing if the reader is not aware that the gray dots actually represent active lease blocks.	BOEM is now in the process of updating the air quality model based on public comments and will publish the results when the analysis is complete. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this NEPA document. Based on the results of the analyses, BOEM will consider changing the titles of Figures G-1 and F-1 of the 2017-2022 GOM Multisale EIS (**Figures C-1 and B-1** of this Supplemental EIS) to "Location of the "Air Quality Modeling in the Gulf of Mexico Region" Study, with Class I areas (purple) and existing wells (gray dots)" in BOEM's future NEPA documents.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
United States Environmental Protection Agency	USEPA-26	In Section G.3.7, on page G-19, BOEM lists the biogenic and geogenic sources. Onshore biogenic (vegetation) emissions are included in the modeling; however, this Section does not seem to include offshore biogenic emissions such as dimethysulfide (DMS), which are a significant source of atmospheric sulfur compounds. EPA recommends including DMS or providing an explanation in the report for the exclusion of this category of biogenic emission sources.	BOEM's *Year 2011 Gulfwide Emissions Inventory* (Wilson et al., 2014) was reviewed to uncover emissions estimates from biogenic sources in the GOM. The only available emissions data seemed to be on VOC subsurface seeps of oil and N_2O from bacterial processes, which were included in the inventory and in this modeling study. The DMS emissions and DMS chemistry is included in the GEOS-Chem global model used to generate boundary conditions (BCs) for the CAMx modeling used in this study. The DMS from GEOS-Chem is added to the CAMx CB6r2h SO_2 BC, and MSA (methylsulfonic acid) from GEOS-Chem is added to the CAMx CB6r2h PSO4 BC. While DMS emissions within the CAMx domain are not modeled, their main effect would be to increase natural (background) sulfate, which is not likely to have any significant effect on predictions of new oil and gas source emission impacts on PM species.
United States Environmental Protection Agency	USEPA-27	In Section G.4.1, on page G-20, when describing future year modeling scenario estimates off the coast of Mexico, the analsyis includes just one sentence: "Projected emission estimates were developed for anticipated offshore drilling off the coast of Mexico." EPA recommends that the report include additional detail of what sources and assumptions were used to estimate these emissions, as well as the magnitude of these emissions, or include a specific reference in this section to the developed emissions inventory for this area.	The ERG developed projected emissions estimates for platforms off the coast of Mexico. The ERG researched the impacts of the restructuring of the energy sector in Mexico, which is predicted to include deepwater production within the modeling domain. The ERG estimated emissions based on projected deepwater production (PEMEX, 2012) and using the production-based emission factors developed from the *Year 2011 Gulfwide Emissions Inventory* (Wilson et al., 2014). These estimates were developed using the *Year 2011 Gulfwide Emissions Inventory* estimates for major platforms (excluding caissons, living quarters, and wellhead protectors), combined with production data from BOEM's Part A Oil and Gas Operations Reports (OGOR) (USDOI, BOEM, 2015). BOEM will consider including additional documentation on Mexico's future-year offshore oil

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			and gas emissions estimates in BOEM's final study report and NEPA analysis.
United States Environmental Protection Agency	USEPA-28	Section G.4.1, on page G-20, describes how the ERG team developed annual emission estimates for each year of activity for OCS offshore oil and gas production sources using BOEM's "spreadsheet-based data analyses tools." EPA recommends that the report provide a brief description of these data analysis tools and a description of how these emission factors may vary by source and year.	BOEM used past Gulfwide emissions inventory studies to compute an average emissions factor for each equipment type by water depth. A similar approach was used for vessels and helicopters; engine power ratings and load factors were taken from past Gulfwide emissions inventory studies and combined with the most up-to-date USEPA emission factors. The spreadsheet-based data analyses tool then calculates annual emissions using these emission factors and proposed activity scenario. The resulting annual emissions estimates vary by year depending on the proposed activity scenario. BOEM will consider explaining BOEM's Excel "spreadsheet-based data analyses tool" that BOEM also updated recently to use GOADS emissions to generate typical emissions per source in BOEM's final study report and NEPA analysis.
United States Environmental Protection Agency	USEPA-29	Section G.4.1, page G-20, states that the emissions estimates are based on mid-price oil case scenarios. Further elaboration on the assumptions and details of this scenario would be helpful to determine the impact on potential emission estimates. EPA recommends including a link to the references that were used to develop these scenarios. Further, EPA recommends looking at a range of oil price cases in addition to the mid-price case and performing sensitivity analyses to estimate how the emissions could vary depending on a range of oil price scenarios. If these types of analyses were conducted, they should be included in the EIS reference documents.	BOEM uses a series of spreadsheet-based data analyses tools to develop the forecasts of oil and gas exploration, development, and production activity scenario for each action alternative presented in the 2017-2022 GOM Multisale EIS and this Supplemental EIS. A more detailed description of the assumptions and details of how BOEM develops the oil and gas activity scenarios can be found in **Chapter 3.1.2**. Based on previous analyses by BOEM (USDOI, MMS, 2007c), the actual activity falls generally below the level of activity forecasted in its NEPA documents, and the majority of time the actual activity was at or near the low end of the forecasted range. The analysis of potential environmental and socioeconomic impacts presented in this Supplemental EIS is therefore considered conservative. The air quality model aggregates the highest year contribution for all scenario activities into

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			a single year to create an estimated high year. BOEM used the mid-price exploration and development activity scenarios (50th percentile level of activity) in the air quality model because this activity level would be most reasonably foreseeable to occur, especially in light of developing an estimated high year of emissions for the air quality modeling input. The use of the mid-case scenario to develop the estimated high emissions year would result in an estimation of emissions in a hypothetical future year that BOEM feels would be high but reasonably foreseeable. In reference to the request for links to references that were used to develop the scenario, no direct links to references are available at this time because much of the data used to develop the scenarios is proprietary.
United States Environmental Protection Agency	USEPA-30	Section G.4.1.1, page G-21, projects future oil and gas production platforms based on two different emission factors distinguished by shallow water (<200 m) *vs.* deepwater (>200m). EPA recommends that the report provide the specific reasoning as to why this is the delineated depth cut-off. Since emissions are significantly higher for the deepwater depth, EPA suggests generating more emission depth bins, similar to the ocean depth bins used during the platform location distribution performed for the future year estimates. This will provide a more accurate representation of future year emissions.	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this NEPA document. The updated modeling and final report could possibly include more than two emission depth bins. BOEM will consider looking into generating emissions factors for different water-depth bins (more than just two conducted in the original modeling), including a shallow-water "caisson" emission factor, for the final study report and NEPA analysis.
United States Environmental Protection Agency	USEPA-31	Section G.4.1.3, page G-22, discusses the approach of estimating emissions from oil and gas production offshore support vessels. BOEM used an estimated vessel trip of 200 nautical miles, which is the round-trip distance from shore to the mid-point of Federal waters. Since the platforms were randomly placed in lease blocks and modeled as point sources from these set locations, EPA suggests that BOEM use the actual modeled platform distances, which could	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this NEPA document. BOEM will consider generating vessel emissions based on the placement of future year platforms, including the helicopter sources with BOEM's Office of Resource Evaluation's assistance for the final study

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		vary significantly from the mid-point assumption.	effort and NEPA analysis and to make clear the vessel and helicopter spatial allocation through documentation.
United States Environmental Protection Agency	USEPA-32	Section G.4.1.5, page G-29, indicates that the production platforms were located as point sources with randomly assigned locations. The location of these sources may significantly alter the modeling impacts. EPA suggests that the report provide further detail into the assumptions and reasoning of the random assignment. If not part of the analysis, EPA suggests using a probabilistic function applied to this random distribution, such as the likelihood (probability) for new platforms to set up in shallow water *vs* deep water, etc. Additionally, EPA recommends investigating multiple scenarios to support a sensitivity analysis (*i.e.,* more deepwater development *vs* more shallow water scenarios).	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this NEPA document. The number of future-year platforms was not random, as this is determined by BOEM's lease sale scenario. However, the locations of these platforms were random within the water depth and planning area for unleased blocks given in the scenario. BOEM's air quality personnel will work with BOEM's Office of Resource Evaluation, who developed the scenario to have improved spatial allocation based on where the future oil and gas resources are located for the refined modeling effort.
United States Environmental Protection Agency	USEPA-33	Section G.4.1.5, page G-29, describes how the emissions were spatially allocated. Only one sentence was used to detail allocation for helicopters and support vessels: "Because helicopters, support vessels, and tankers transit multiple water depths, their emissions were allocated across multiple water depth contours based on assumed installed platform locations." EPA recommends that the report provide more information explaining in further detail how these emissions are spatially represented in the modeling, or provide such information in a technical support document to be released with the final report.	Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this NEPA document. BOEM anticipates including in the final study report and NEPA analysis more explanation detailing how vessel and helicopter emissions were spatially represented in the modeling. BOEM anticipates including well stimulation vessels and floating and production storage and offloading vessels (FPSOs).
United States Environmental Protection Agency	USEPA-34	Section G.4.2, page G-30, describes how the 2017 projections were selected for onshore sources and marine vessels over projected 2025 inventory data. The reasoning provided was that there is less uncertainty associated with the 2017 estimated emissions. Although this may be true, it is also possible that 2025 projections may match more	The USEPA's modeling platform emissions projections for 2017 are more conservative (i.e., higher) than USEPA's 2025 emissions projections for all pollutants except for ammonia and PM_{10}. For additional details on USEPA's modeling platforms, please refer to their website at https://www.epa.gov/

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		closely with the future year emissions of the OCS offshore oil and gas production sources in years 2033 and 2036. EPA suggests that it would be helpful to describe how the onshore and marine vessel emission projections differ from the 2017 and 2025 projections and to discuss which data set is more conservative and why.	air-emissions-modeling/2011-version-62-platform. Overall, the projections to calendar years 2017 and 2025 are based on anticipated point source closures, implementation of future regulatory control programs, and predictions of future activity levels. The year 2017 was selected because it represents the starting point for the 5-year lease sale program and is believed to be more realistic of future onshore and marine activities. BOEM anticipates discussing the reasoning behind the choice of 2017 as the future year instead of 2025, with perhaps some quantitative discussion of which is more conservative in BOEM's final study report and NEPA analysis.
United States Environmental Protection Agency	USEPA-35	Section G.4.3, page G-30, discusses projected emissions for platform development off the coast of Mexico, which is predicted to include deepwater drilling within the modeling domain. Emissions were estimated based on projected deepwater production in which BOEM includes a citation to a report from Petróleos Mexicanos (PEMEX). EPA suggests that BOEM elaborate more on the scope and magnitude of these included projected emissions.	The ERG developed projected emissions estimates for platforms off the coast of Mexico. The ERG researched the impacts of the restructuring of the energy sector in Mexico, which is predicted to include deepwater drilling within the modeling domain. The ERG estimated emissions based on projected deepwater production (PEMEX, 2012) using the production-based emission factors developed from the *Year 2011 Gulfwide Emissions Inventory* (Wilson et al., 2014). These estimates were developed using the *Year 2011 Gulfwide Emissions Inventory* estimates for major platforms (excluding caissons, living quarters, and wellhead protectors), combined with production data from BOEM's Part A Oil and Gas Operations Reports (OGOR) (BOEM, 2015). BOEM anticipates elaborating on the scope and magnitude of Mexico's offshore deepwater drilling emissions in BOEM's final study report and NEPA analysis.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
United States Environmental Protection Agency	USEPA-36	**Appendix H - Specific Comments** Throughout Appendix H, Congestion Mitigation and Air Quality (CMAQ) modeling inputs and procedures are discussed and referenced; however, there is very little to no discussion of the CMAQ modeling results and how they were applied in this study. EPA recommends that the report provide further elaboration on how the CMAQ modeling was used, including how it compared with the Comprehensive Air Quality Model with Extensions (CAMx) results and overall model performance.	The Community Multisale Air Quality model (CMAQ) was run for comparison with CAMx and also to generate wind-blown dust and lightning NO_x emissions for use in CAMx. The rational for basing the future-year air quality impacts analysis on CAMx is described in **Appendix D**. BOEM anticipates including discussion of the comparison of CMAQ to CAMx in BOEM's final study report and NEPA analysis. Upon completion, this report and NEPA analysis will be made available for public review and comment.
United States Environmental Protection Agency	USEPA-37	Section H.3.9.9 on Page H-27 summarizes the pre-processed emissions in Table H-5. EPA suggests that BOEM also describe the BOEM OCS Action and No Action alternatives and other sources that were not already described in Table H-4.	BOEM acknowledges that this table is confusing and will clarify it in future NEPA documents.
United States Environmental Protection Agency	USEPA-38	Section H.3.9.9, page H-27, in Table H-5 there are zero (0) emissions listed under the base year (2012) for 2 categories (platform and support vessel) of BOEM OCS activity for both the **No Action** and **Action** scenarios. It is unclear why there are no emissions listed in the no action scenarios for the base year, since it is our understanding that the base year no action emissions represent existing OCS activity. Additionally, it is unclear why the future year platform and support vessel No Action scenarios have higher emissions than the corresponding action scenario for several pollutants. EPA recommends that the study report provide information on the basis for these assumptions and results.	We recognize that Table H-5 of the 2017-2022 GOM Multisale EIS (**Table D-5** of this Supplemental EIS) is confusing. In addition, we recently identified some errors that were made when this table was originally prepared. However, these errors only pertain to the table and not the actual emissions that were modeled; the modeled emissions are correct. The corrected Table H-5 of the 2017-2022 GOM Multisale EIS (**Table D-5** of this Supplemental EIS) is at the end of this comment response section. Emissions in the "BOEM OCS Platform No Action" and "BOEM OCS Sup. Vessel No Action" categories represent only emissions included in the future-year scenario. Existing platform emissions in the 2012 base case were included in the "Non-US Point (with GOM offshore platforms)" category and 2012 base case support vessel emissions were included in the "BOEM Gulfwide" category.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			In addition, all of the emission categories in Table H-5 of the 2017-2022 GOM Multisale EIS (**Table D-5** of this Supplemental EIS) are mutually exclusive. In particular, the "BOEM OCS Platform w/Action" and "BOEM OCS Sup. Vessel w/Action" categories represent just the additional emissions from new sources associated with the proposed action.
United States Environmental Protection Agency	USEPA-39	EPA recommends that Section H.3.9.9 on page H-28, in Table H-6, provide additional information to explain why emissions in the BOEM Gulfwide Sector are not increasing due to the OCS offshore projected activity. EPA suggests this table also include information about both scenarios (action and no action) and include further description of the sources categories for clarity.	Comments from Federal agencies, industry, and the general public obtained during the public comment period and from meetings concerning the initial air quality model are being taken into consideration as BOEM revises the initial air quality model. Please refer to BOEM's response to Comment CEA-3 for information detailing BOEM's update of the air quality modeling run and the use of the initial air quality analysis in this Supplemental EIS. The decrease in NO_x and $PM_{2.5}$ in the BOEM Gulfwide category is misleading because some sources are included in other row categories, but all sources were included in the analyses and our impacts results from this initial modeling will not change. For future documentation, BOEM will present all data more clearly.
United States Environmental Protection Agency	USEPA-40	In Section H.3.9.9 on pages H-29 through H-31, for Figures H-14 through H-16, EPA suggests it may be beneficial to show difference plots between the two scenarios to explore the incremental changes in the magnitude and spatial representation of the emissions. In addition, EPA suggests BOEM break up the "No Action" plots in a similar manner to the "With Action" plots (*i.e.,* platform emissions vs. support vessel emissions). In addition, it is unclear why the time stamps on the spatial plots read "August, 15 2002" in these Figures. EPA recommends that the report provide an explanation for this past date or correct the time stamp, as necessary.	BOEM acknowledges USEPA's comment and will take it into consideration when we include the updated air quality modeling in a future NEPA analysis. BOEM anticipates addressing the time stamp on these figures and looking into breaking up the "No Action" and the "With Action" plots in BOEM's final study report and NEPA analysis. Upon completion, this report and NEPA analysis will be made available for public review and comment.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
United States Environmental Protection Agency	USEPA-41	Section H.3.10, page H-33, discusses the source categories for the source apportionment modeling performed. Among these is the base case "No Action" scenario where platforms and support vessels and helicopters were projected for the future year scenario. It was not clear to EPA how these emission projections were calculated; EPA recommends the report provide additional information to support these results.	Emissions estimates are provided in Appendix G of the 2017-2022 GOM Multisale EIS (**Appendix C** of this Supplemental EIS). The "No Action" scenario emissions are the existing emissions. For the preliminary modeling, base case platforms and support vessels and helicopters remained static for the future-year modeling run. BOEM will clarify this in the final study report and NEPA analysis. Upon completion, this report and NEPA analysis will be made available for public review and comment.
United States Environmental Protection Agency	USEPA-42	Section H.4.2, page H-35, describes the model grid configuration. Florida is largely excluded from the smallest, highest resolution, 4-km grid. EPA recommends including additional information on the impacts to Florida. If the impacts are expected to be insignificant, EPA recommends providing a more detailed explanation supporting this conclusion.	Florida is included in the 12-km domain, and impacts were assessed in Florida through the 12-km domain. However, the analysis was not detailed in the Draft Supplemental EIS because the 4-km domain includes the potential areas of interest. The limited domain does not suggest the impacts to Florida are insignificant; however, Florida was outside of the area of interest for this Supplemental EIS. BOEM can provide clarification of this point in BOEM's final study report and NEPA analysis.
United States Environmental Protection Agency	USEPA-43	The title of Table H-18 (page H-84) is unclear; "…with Source Groups Removed." It appears that this table provides the contribution from each source group, less F, to the design year future (DVF) value. Summing the A-E Source Groups values does not equal the provided DVF value. It appears that to obtain the DVF value provided, Source Group E should have been included. EPA recommends that the source of the values in the Table be clarified.	Table H-19 of the 2017-2022 GOM Multisale EIS (**Table D-19** of this Supplemental EIS) provides MATS results at air quality monitoring sites for ozone design values. These MATS results are only available for ozone and $PM_{2.5}$ at locations of ozone and $PM_{2.5}$ air quality monitors. Analysis of impacts at Class I/II areas is presented in Section H.7.2 of the 2017-2022 GOM Multisale EIS (**Section D.7.2** of this Supplemental EIS).
United States Environmental Protection Agency	USEPA-44	Table H-19 (page H-86) provides important information concerning anticipated impacts from oil/gas OCS activities associated with the lease sales. Similar tables addressing other pollutants of interest at PSD Class I and sensitive PSD Class II areas would be valuable in the final report, and for reference in future EIS documents.	Table H-19 of the 2017-2022 GOM Multisale EIS (**Table D-19** of this Supplemental EIS) provides MATS results at air quality monitoring sites for ozone design values. These MATS results are only available for ozone and $PM_{2.5}$ at locations of ozone and $PM_{2.5}$ air quality monitors. Analysis of impacts at Class I/II areas is presented in Section H.7.2 of the 2017-2022 GOM Multisale EIS (**Section D.7.2** of this Supplemental EIS).

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
United States Environmental Protection Agency	USEPA-45	The footnote in Figure H-41 (page H-88) referring to Table H-14 (page H-71) for definitions of Source Groups is not correct. Table H-14 provides values for NAAQS and PSD Increments. EPA suggest that this should be corrected in future documents associated with this EIS.	BOEM is now in the process of updating the air quality modeling based on public comments and will publish the results when the analysis is complete. Revisions to associated documents will be made as necessary. However, correcting the footnote would not change BOEM's impact determinations.
United States Environmental Protection Agency	USEPA-46	The NAAQS comparison used two methods; direct comparison of modeled results (absolute) and use of the relative response factors to obtain modeled concentrations (Model Attainment Test Software (MATS)). The inclusion of both the MATS and the absolute O_3 NAAQS (Section H.7.1.2, beginning on Page H-87) and explanation is somewhat confusing and may be misinterpreted. EPA suggests that only the O_3 NAAQS assessment method deemed most appropriate (*i.e.,* MATS) be provided, with a brief explanation or footnote on other methods considered.	It is customary to include both the MATS results (both at monitoring sites and, when appropriate, the MATS unmonitored area analysis) and the absolute model results in an air quality impact assessment conducted for inclusion in an EIS. Characteristics of both approaches are compared in Section H.6.2.2 of the 2017-2022 GOM Multisale EIS (**Section D.6.2.2** of this Supplemental EIS). While MATS is USEPA's recommended approach for calculating future-year O_3 and $PM_{2.5}$ design values at monitoring sites, the MATS unmonitored area analysis can produce misleading results in areas with limited monitoring data, in which case the absolute model predictions provide the best available estimate. The discussion of the two different methods in Section H.6.2.2 of the 2017-2022 GOM Multisale EIS (**Section D.6.2.2** of this Supplemental EIS) can be expanded to clarify the relative advantages and disadvantages of each approach. BOEM may also decide to include results from only the MATS method in future EISs.
United States Environmental Protection Agency	USEPA-47	The footnote on page H-97 indicates that the MATS software cannot perform the unmonitored area analysis (UAA) for the 24-hour average $PM_{2.5}$ NAAQS. EPA recommends that the effect of this limitation on the provided 24-hour estimates be provided in the final report.	The provided future-year, 24-hour $PM_{2.5}$ design values are based on the absolute model predictions. The characteristics of this approach vs. the MATS approach are described in Section H.6.2.2 of the 2017-2022 GOM Multisale EIS (**Section D.6.2.2** of this Supplemental EIS) (refer to the response to Comment USEPA-46).

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Water Quality			
David Quist	DQ-5	Water Quality - just because the Gulf, or portions of it, has become a sacrifice zone in many respects does not mean that additional incremental impacts pushing it even further over the edge are acceptable. Such impacts are significant - impact of spills are catastrophic, and routine operations are NOT "negligible" or "moderate" even by the description in the executive summary portion of the EIS.	Thank you for your comment. A summary of the impacts of a proposed action on water quality can be found in **Chapter 4.2**, and a full analysis of these impacts can be found in Chapter 4.2 of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. BOEM's conclusion that a proposed action will have a negligible incremental contribution to water quality is based on the analysis of an incremental contribution of a single proposed regionwide lease sale to all cumulative impacts in the Gulf of Mexico. The USEPA's regulations on waste streams generated from offshore oil- and gas-related activities help to mitigate routine oil and gas activity impacts. Reasonably foreseeable oil spills are anticipated to have moderate impacts on water quality, as discussed in **Chapter 4.2**. A catastrophic oil spill is not part of a proposed action nor is it considered likely to occur. BOEM, nevertheless, provides an analysis of such a spill in the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a).
Coastal Habitats			
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-11	The Draft SEIS inadequately addresses this lease sale's impact on coastal habitat. The Draft SEIS incorrectly states there is no new information on coastal impacts and concludes that the proposed action's impacts will be moderate without any analysis of the site-specific and species specific damage to expect. This falls short of NEPA's requisite hard look analysis. The Gulf Coast will lose significant coastal wetlands as a result of the proposed action. The Bureau concedes that the reasonably foreseeable impacts of offshore oil and gas activities on coastal habitats are major, meaning	Thank you for your comment. Please refer to **Chapters 4.3.1 and 4.3.2** for a summary of the analysis of oil and gas development impacts on wetlands and coastal barrier beaches and associated dunes. Detailed analyses of these resources can be found in Chapters 4.3.1 and 4.3.2 of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Please note that this Supplemental EIS indicates that no new information was discovered that would alter the impact conclusion for estuarine systems presented in the 2017-2022 GOM Multisale EIS, not that there was no new information on coastal

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		there will be longstanding and extensive "widespread, permanent loss of habitat; changes in species composition and abundance and/or altered ecological function well beyond that of normal variability." The area's coastal wetlands are experiencing a "death-by-a-thousand-cuts." The largest category of damage is from the large crude oil pipelines that are the foreseeable consequence of OCS development. The maintenance of old crude oil pipelines, such as Shell's Ship Shoal Pipeline, as well as construction of new oil transport pipelines like Energy Transfer Partners' Bayou Bridge Pipeline have impacted an average of over 700 acres of wetlands per year in the New Orleans District of the Corps alone. The Bureau's analysis here improperly accounts for the appreciable damage that this lease sale adds to the overall degraded condition of wetland forest and coastal habitats. To fully inform the decision-maker about the impacts of the proposed action, the Bureau must identify which areas, habitats, species, and communities will be directly and indirectly harmed and to what extent by the lease sale. This is necessary to guide the decision on which alternative to select and mitigation. From 1932 to 2010, coastal Louisiana lost about 1.2 million acres, equating to coastal wetlands disappearing at a rate of about a football field per hour. The oil and gas industry admits that it is responsible for at least 36% of the total loss of this area, though the Department of the Interior has stated that the industry could be responsible for as much as 59% of the loss. And scientists say that at current rates, coastal erosion and sea level rise will lead to nearly all of Southeast Louisiana to be under water by 2100. Models estimate a loss up to 1,739 square miles over the next 50 years. A large amount of remaining	impacts. BOEM has analyzed both the impacts of a single proposed regionwide lease sale and the cumulative impacts of the OCS Oil and Gas Program in this Supplemental EIS. BOEM classifies the incremental contribution of a proposed action (an individual proposed regionwide lease sale) to the cumulative impacts on estuarine systems to be minor to moderate, depending on the selected alternative. In addition, BOEM classifies the incremental contribution of a proposed action (an individual proposed regionwide lease sale) to the cumulative impacts on coastal barrier beaches and associated dunes to be minor. There are two "major" impact determinations, which are different from the possible impacts of a single proposed regionwide lease sale. One is the impact determination of the entire cumulative Oil and Gas Program (i.e., routine activities projected to occur and accidental events that could occur) from past, proposed, and future lease sales. The other is the non-OCS oil- and gas-related impacts, which include past, present, and reasonably foreseeable future activities occurring within the same geographic range and within the same timeframes as the proposed action; however, they are not related to the OCS Oil and Gas Program. Louisiana's land loss has been acknowledged in this Supplemental EIS, but the contribution from the oil and gas industry has been more from inshore activities, such as the dredging of location canals through marshes, as opposed to OCS oil- and gas-related activity. Separating the causes of such land loss is difficult, but one study estimated that the total of direct and indirect impacts from OCS oil- and gas-related activities from 1955 to 1978 accounted for

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Louisiana's wetlands will not keep pace with sea level rise. A new model shows that coastal damage from disasters, like an oil spill, produces "acute, chronic, and cumulative stress in humans" because the loss of ecosystem services harms people's livelihoods and health. The Bureau must specify the additional, site-specific coastal impacts by the proposed lease sale, including areas where habitat will be lost, impacts to wildlife, and human health.	21,863-49,884 ha (54,024-123,266 ac), or 8-17% of Louisiana's total wetland loss (Turner and Cahoon, 1987). There is only 0-1 pipeline landfall projected to result from a proposed action. About 12-20 ac (5-8 ha) of land loss for the projected 1.2 mi (2 km) of pipeline (based on historic loss rates) are expected from the proposed action. This represents approximately 0.19% of the total land loss estimated to occur along the Louisiana coast in 1 year (Couvillion et al., 2011). This estimate does not take into account mitigating measures from the present regulatory programs of Federal or State agencies, modern installation techniques, and the Federal "no net loss" policy, which would reduce land loss associated with OCS oil- and gas-related activity. In reference to the request for site-specific coastal impacts of a proposed regionwide lease sale, the following paragraphs apply. The OCSLA requires a staged decisionmaking process beginning with the Five-Year Program, continuing through individual lease sales under the Five-Year Program, and ultimately to individual postlease activities requiring a permit or approval. As stated in **Chapters 1 and 2** of this Supplemental EIS, the 2017-2022 GOM Multisale EIS discusses all 10 Federal actions, i.e., 10 proposed regionwide oil and gas lease sales, as scheduled under the 2017-2022 Five-Year Program, and this Supplemental EIS analyzes a single proposed regionwide lease sale in the 2017-2022 Five-Year Program. This Supplemental EIS approach is intended to focus the NEPA/EIS process on the staged OCSLA process for decisionmaking, including the proposed regionwide lease sales and any new issues and information identified since a prior stage. It also lessens duplication and saves resources when BOEM and BSEE conduct postlease reviews.
Joint Trades	JT-29	Our review shows that there were no changes between the impact determination table (Table 4-9, p. 4- 62) in the Draft SEIS and the Multisale EIS. However, for estuarine systems the cumulative impact for both OCS oil and natural gas and non-OCS oil and natural gas is shown as "major". This is not what is reflected in the text on page 4-63 which describes only minor to moderate impacts.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			Additionally, the issuance of leases does not conclude the environmental analysis of planned OCS oil- and gas-related activities. Each plan throughout the exploration, development, production, and decommissioning processes receives a site-specific environmental analysis pursuant to NEPA and the OCSLA's pyramidal structure going from large scale to site specific. For more information on BOEM's postlease processes, refer to Appendix A of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Because of these multiple and tiered programmatic documents, along with future site-specific reviews that tier to these programmatic and discretionary documents, BOEM takes a hard look at the potential for environmental consequences at each phase of the decisionmaking process that considers a proposed action in the GOM. At each phase, BOEM has identified numerous environmental safeguards to minimize the impacts, i.e., through the consideration of EISs and programmatic mitigation at the Five-Year Program level, consideration of alternatives to limit impacts to sensitive topographic features in this Supplemental EIS, and commonly applied mitigating measures.
Chelsea Gray	CG-1	I do not believe that EIS supplied is sufficient, and therefore leases should not be sold. Statements like this are a serious cause for concern: "Due to the distance of deep water from shore, the possibility of a spill from a deepwater blowout reaching coastal wetlands with the toxicity to significantly impact the coastal wetlands is low because of the response procedures implemented during a catastrophic spill". There is nothing in the report to indicate that this is 100% achievable, and sufficient consideration is not given to how foul weather will effect the	Catastrophic spills, such as a deepwater blowout, are not analyzed in this Supplemental EIS, but they are analyzed in a separate white paper. For a detailed analysis of reasonably foreseeable impacts associated with a low-probability catastrophic spill, such as the *Deepwater Horizon* explosion and oil spill, refer to the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a). BOEM determined that, because a catastrophic event like the *Deepwater Horizon* explosion, oil spill, and

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		environmental impacts, spread of oil, and clean up efforts in the event of a spill.	response is not considered reasonably foreseeable as a result of a proposed action, the analysis should not be included in this Supplemental EIS to avoid confusion over whether it is or is not part of a proposed action. This is allowed under CEQ's regulations, which removed the requirement to analyze worst-case scenarios. However, in accordance with CEQ guidance and to inform the public of the potential impacts in the unlikely event of such a spill (though not reasonably foreseeable), BOEM has made this information available to the public through its website. BOEM also acknowledges that one of the key ways of managing the risk of such an event is to implement a rigorous regulatory regime to ensure that postlease drilling activities are conducted in a safe manner. Additionally, BOEM is concerned about the potential impacts of oil spills on the environment. In this Supplemental EIS, impacts of smaller, reasonably foreseeable OCS oil- and gas-related oil spills are analyzed in the "Accidental Events" section of **Chapter 4.3.1**, and other spills (e.g., in State waters or from other sources on the OCS) are analyzed in the "Cumulative Impacts" section of **Chapter 4.3.1**. In reference to the impacts of foul weather on oil spills and cleanup, BOEM has incorporated BOEM's Oil Spill Risk Analysis (OSRA) estimates to determine the risk of oil-spill contact to sensitive offshore and onshore environmental resources and socioeconomic features. Included in this analysis are trajectory simulations based on historical surface ocean currents and winds, which incorporate periods of hurricane conditions. In addition, BSEE provides a robust set of regulations relating to hurricane preparedness that help lower the risk of oil spills occurring and help prevent any loss of life. The effects of hurricanes on

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			coastal areas and oil and gas structures are discussed in Chapters 3.1.6.1 and 3.2.1.1 of the 2017-2022 GOM Multisale EIS and in relevant resource sections in Chapter 4 of the 2017-2022 GOM Multisale EIS. In addition, finalization of the Well Control Rule on April 29, 2016, resulted in reforms, such as increased regulation of blowout preventers, that are expected to decrease the probability of deepwater blowouts and the extent of oil spills from such blowouts.
United States Environmental Protection Agency	USEPA-2	It is noted that several impact levels have changed since the DSEIS was prepared. Section 4.31 identifies routine impacts ranging from negligible to minor for pipeline construction and maintenance, navigation channel maintenance and vessel operations, and use of coastal support infrastructure. It is still unclear how impacts are deemed negligible or minor when a routine activity estimates a wetland loss to occur. The Final EIS estimates 12-20 acres of wetlands impacts from 0-1 pipeline, 70-860 acres of impacts from navigation channel maintenance and vessel operations, and notes that large coastal infrastructure projects such as the projected 0-1 new gas plants and 0-1 new pipeline landfall is likely to impact some wetland acreage. In the locations where wetland loss is projected, the losses are anticipated to be long term or permanent, and therefore should be considered moderate based upon the impact level definitions being utilized. The DSEIS should farther clarify how impacts are deemed either negligible or minor.	Thank you for your comment. **Chapter 4.3.1** describes the impacts to estuarine systems from routine activities associated with a proposed action. This Supplemental EIS has been updated to indicate that potential impacts from routine activities could be negligible to moderate. Impacts from pipeline construction and maintenance, navigation channel maintenance dredging, and construction and use of coastal support infrastructure would range from negligible to minor, while vessel operations (support use of navigation channels) would range from minor to moderate. Refer to **Chapter 4.3.1** for details on the impacts of each routine activity. To address the comment on the permanence of wetland loss, the impact level definition for "minor" has been updated to say "Minor – Noticeable but short-term or localized impacts." In order to clarify the basis for pipeline impacts, BOEM projects that the majority of new pipelines constructed as a result of a proposed action would connect to the existing pipeline infrastructure offshore; therefore, there would be no coastal or wetland impacts from pipeline landfalls. In the rare instance that a new pipeline to shore would need to be constructed, it would likely be because there are no existing pipelines reasonably close and because constructing a pipeline

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			to shore is considered more cost effective, although it is highly unlikely for an operator to choose this contingency (Dismukes, official communication, 2011). BOEM anticipates that pipelines from most of the new offshore production facilities would tie into the existing pipeline infrastructure offshore or in State waters, which would result in few new pipeline landfalls (page 3-42 of the 2017-2022 GOM Multisale EIS). Impacts from pipeline construction and maintenance are deemed negligible due primarily to the fact that only 0-1 pipeline landfalls are projected with a proposed action. In addition, the 12- to 20-ac (5- to 8-ha) estimate represents the impact that could occur without mitigation. In practice, it would likely be an overestimate, given current regulatory policies of the Corps of Engineers and Gulf Coast States.
National Park Service	NPS-1	Thank you for the opportunity to comment on the Bureau of Ocean Energy Management' s (BOEM's) Final 2018 Supplemental Environmental Impact Statement (SEIS) for offshore lease sales in the Gulf of Mexico (GOM), specifically the "Coastal Barrier Beaches and Associated Dunes" and "Recreational Resources" sections of the SEIS. In addition, the 2017-2022 GOM Multisale Environmental Impact Statement (EIS) was referenced. The proposed Outer Continental Shelf Oil and Gas Leasing Program: 2017-2022 will include regionwide lease sales including areas near or with associated activities within close proximity to Gulf Islands National Seashore (GUIS) in Mississippi and Florida. The SEIS section on "Coastal Barrier Beaches and Associated Dunes" concludes that navigation channel maintenance dredging associated with the proposed lease sales will have minor environmental impacts. While the EIS appears to adequately cover the benefits as well as the detrimental impacts caused by dredging and dredge disposal methods	Thank you for your comment. Dredging is discussed in Chapter 4.3.2.2.1 of the 2017-2022 GOM Multisale EIS, which is incorporated by reference into this Supplemental EIS. The 2017-2022 GOM Multisale EIS states that "Periodic maintenance dredging is expected in existing navigation channels through barrier passes and associated bar channels. Maintenance dredging of barrier inlets and bar channels removes sediment from the system, contributing to beach erosion. Materials from maintenance dredging of bar and pass channels are typically discharged to nearby ocean dumping sites in the GOM (Chapter 3.3.2.8.5) or they are used for marsh creation or beach nourishment projects as part of mitigation . . . . These dredging activities are permitted, regulated, and coordinated by the U.S. Army Corps of Engineers (USACE) with the appropriate State and Federal resource agencies. Effects from maintenance dredging related to a proposed action on coastal barrier beaches and associated dunes are expected to be **minor** due to the small contribution from a proposed action to total

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		that may occur at navigational channels, it is unclear if the mitigation measures will be required or incorporated into the individual leases. The EIS states that the US Army Corp of Engineers (USACE) uses dredge material beneficially if the material is suitable and funds are available. It also states that the applicant would need funds to cover the excess cost over the least cost environmentally acceptable alternative since open water disposal is permitted and completed often. GUIS has several navigational channels adjacent or within close proximity to coastal barrier beaches within park boundaries. It has been our experience that the USACE will generally place dredged material in deep water outside the littoral zone because it is more cost effective to do so. USACE staff have studied swash zone deposition and have acknowledged the benefits as keeping the maximum amount of sand near or on the beach where the surf can move the sand around naturally, increasing beach habitat for use by animals (e.g., sea turtles, beach mice), birds, and humans. However, cheaper and easier options are most often implemented which require less monitoring (e.g. of archeological resources and protected species) and it can be done using a boat rather than setting up a relatively complicated pipeline system on the beach. The resulting impact s are a sand starved and eroding beach downdrift of the navigational channel. Swash zone placement of dredge material from navigational channels should not be funding dependent. If and when the leases occur a commitment or mitigation requirement that includes the additional costs should be included during subsequent compliance/permitting phases. Leases should include a long-term strategy which would	channel use and the offsetting effects of beach nourishment." In reference to NPS asking if BOEM is requiring mitigating measures for dredge and dredge disposal methods, BOEM is unable to require mitigation on another agency's (Corps of Engineers [COE]) activity (dredging). In addition, BOEM is unable to collect costs for swash zone placement of dredge material as part of the leasing process because another agency (COE), not BOEM, is the lead agency for the dredging of navigation channels. As discussed in Chapter 3.3.2.8.5 of the 2017-2022 GOM Multisale EIS, which is incorporated by reference into this Supplemental EIS, the Corps of Engineers is the lead agency for maintenance and construction dredging and is also in charge of dredge material disposal and the beneficial use of dredge material, such as marsh creation or beach nourishment. In addition, dredge material must meet certain physical characteristics to be used in a beneficial use program. BOEM, however, does indicate in this Supplemental EIS that mitigation of dredging activity (marsh creation or beach nourishment) implemented by COE on their own action would additionally mitigate impacts to barrier beaches from usage of the navigation channels by OCS oil- and gas-related vessels. Currently, as the lead agency for dredging projects, COE has implemented a monitoring and adaptive management program through the Mississippi Coastal Improvement Program (MsCIP) to evaluate placement of dredge material from the Pascagoula Federal Navigation Channel in the littoral zone at Horn Island Pass, in Mississippi. Monitoring of dredge material will occur before, during, and after the placement of dredge material. Monitoring will enable COE to assess short- and long-term effects of the restoration

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		facilitate and fund the "swash zone" or nearshore placement of suitable dredge materials along coastal barrier islands by the US Army Corp of Engineers (USACE). Otherwise the barrier islands will continue to erode and diminish just as has occurred in the Mississippi islands downdrift of the Pascagoula shipping channel.	process and provide necessary information for adaptive management for other coastal resources (U.S. Dept. of the Army, COE, 2016). Even though BOEM is unable to require lessees to fund another agency's activities, BOEM is part of the MsCIP ongoing effort. BOEM was a Cooperating Agency on the COE's 2016 Supplemental EIS for Mississippi barrier island restoration and has a Memorandum of Agreement with COE's Mobile District to make OCS sand available for barrier island restoration in support of the MsCIP (USDOI, BOEM, 2016d).
Deepwater Benthic Communities			
Chelsea Gray	CG-2	An effective EIS should not only rely on "best case" scenarios, and yet it does throughout. "Studies indicate that periods as long as hundreds of years are required to reestablish a seep community once it has disappeared (depending on the community type) (Powell, 1995; Fisher, 1995). There is evidence that substantial impacts on these communities could permanently prevent reestablishment (Fisher, 1995), particularly if hard substrate required for recolonization is buried by resuspended sediments from a loss of well control. Because widely scattered, high-density chemosynthetic communities would typically be located at more than 2,000 ft (610 m) away from a loss of well control event due to mitigating measures, potential accidental impacts from the CPA proposed action are expected to cause little damage to ecological or biological function of these communities." I see nothing in the report to indicate that 2,000 ft is a magically safe distance for such delicate communities. This is once again a "best case" scenario, even wishful thinking.	Protective measures have been developed over time based on the nature and sensitivity of various benthic habitats and their associated communities, as understood from decades of BOEM-funded and other environmental studies. One such study (CSA, 2006) indicated a separation distance of 2,000 ft (610 m) between sensitive deepwater benthic communities and drilling activity to be sufficient to protect those communities from disturbance. NTL 2009-G40, "Deepwater Benthic Communities," provides operators with relevant information and consolidates guidance for the avoidance and protection of the various types of potentially suitable habitat for chemosynthetic organisms and deepwater coral. As detailed in NTL 2009-G40, all plans submitted for permitted deepwater (300 m [984 ft] or greater) activities are reviewed for the presence of deepwater benthic communities that may be impacted by the proposed activity. Conditions of approval are applied at that time. Specifically, for deepwater benthic communities, the general types of protective measures are identified and summarized in the section titled "Historical Protections for Deepwater Benthic Communities." Commonly applied mitigating measures during the postlease process are described

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			in Appendix B of the 2017-2022 GOM Multisale EIS.
David Quist	DQ-9	- Benthic - no consideration of the impact of catastrophic spills or events, the risk of which is not negligible and which, if they are occur, are drastic and wide-ranging	Catastrophic spills, such as a deepwater blowout, are not analyzed in this Supplemental EIS, but they are analyzed in a separate white paper. For a detailed analysis of reasonably foreseeable impacts associated with a low-probability catastrophic spill, such as the *Deepwater Horizon* explosion and oil spill, refer to the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a). BOEM determined that, because a catastrophic event like the *Deepwater Horizon* explosion, oil spill, and response is not considered reasonably foreseeable as a result of a proposed action, the analysis should be removed from this Supplemental EIS to avoid confusion over whether it is or is not part of a proposed action. This is allowed under CEQ's regulations, which removed the requirement to analyze worst-case scenarios. However, in accordance with CEQ guidance and to inform the public of the potential impacts in the unlikely event of such a spill (though not reasonably foreseeable), BOEM has made this information available to the public through its website. BOEM also acknowledges that one of the key ways of managing the risk of such an event is to implement a rigorous regulatory regime to ensure that postlease drilling activities are conducted in a safe manner. Additionally, in this Supplemental EIS, impacts of reasonably foreseeable OCS oil- and gas-related oil spills are summarized in **Chapter 4.4**, "Deepwater Benthic Communities."
Sargassum and Associated Communities			
David Quist	DQ-10	- Saragassum the EIS uses a population-level impact analysis - the issue is also ecosystem impact in a specific location.	Thank you for your comment. *Sargassum* is summarized in **Chapter 4.5** of this Supplemental EIS and described in full detail in Chapter 4.5 of the

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		The approach taken in the EIS grossly, and artificially, underestimates impact	2017-2022 GOM Multisale EIS. As indicated in the "Impact-Level Definitions" in **Chapter 4.5**, impacts are analyzed from the immediate area of impact on a plant up through population-level changes in species composition. An in-depth analysis of potential impact-producing factors determined that, although many may occur within the GOM, few occur at an extent that could cause impacts to the population of *Sargassum* as a whole. This is because localized impacts may occur to a small percentage of a population, but *Sargassum* has a yearly cycle that promotes quick recovery from impacts where new plants rapidly replace impacted plants. The unique and transient characteristics of the life history of *Sargassum* and globally widespread nature of the plants and animals that use the plant matrix buffer against impacts that could occur at any given location. In fact, *Sargassum* has proliferated in recent years to the point that huge amounts of it are found washing up on Caribbean island shorelines, fouling beaches and affecting tourism (Louime et al., 2017). In addition, the issuance of leases does not conclude the environmental analysis of planned OCS oil- and gas-related activities. Each plan throughout the exploration, development, production, and decommissioning processes receives a site-specific environmental analysis pursuant to NEPA and the OCSLA's pyramidal structure going from large scale to site specific. For more information on BOEM's postlease processes, refer to Appendix A of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.
Gulf Restoration Network	GRN-8	Because Sargassum passes through the Mississippi Canyon area, it is likely that the Taylor leak oils some Sargassum. The impact of Taylor on Sargassum must be evaluated. Oiled Sargassum could also affect juvenile sea turtles and other finfishes that use	The cumulative oil-spill analysis in this Supplemental EIS takes the Taylor leak into account. The impacts of oil spills on *Sargassum* and its associated communities are summarized in **Chapter 4.5** of this Supplemental EIS and discussed in detail in Chapter

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		Sargassum for habitat.	4.5.2.2 ("Accidental Events") of the 2017-2022 GOM Multisale EIS. The analyses included in these chapters discuss impacts of oil on *Sargassum* and associated communities, which would be similar to those that could occur from a spill, such as the Taylor platform leak. In addition, oil impacts on sea turtles and finfish are summarized in **Chapters 4.9.2 and 4.7** of this Supplemental EIS and discussed in detail in Chapters 4.9.2.2.2 and 4.7.2.2 of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers.
Marine Mammals			
Chelsea Gray	CG-4	And also a discussion of chronic issues, especially as many large marine mammals are still recovering from the BP oil spill.	Thank you for your comment. BOEM acknowledges the potential harmful impacts to marine mammals as a result of an oil spill. These negative consequences are summarized for marine mammals in **Chapter 4.9.1** of this Supplemental EIS and discussed in detailed in Chapter 4.9.1.2.2 ("Accidental Events") of the 2017-2022 GOM Multisale EIS. Impacts of a catastrophic spill are analyzed in the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a). As impacts from the *Deepwater Horizon* explosion, oil spill, and response continue to be assessed, additional analyses will be completed at the site-specific approval stage and in future Supplemental EISs.
Rebecca King	RK-2	Has BOEM considered that baby dolphins are still dying at an abnormally high rate since the spill?.	
Gulf Restoration Network	GRN-9	BOEM cannot permit more drilling when 2 juvenile sperm whales were stranded last year. This is unprecedented in the history of the Gulf. Sperm Whales have endemic populations in the Gulf--what if these children were from those endemic populations? Loss of such a keystone predator is devastating for the whole system, and BOEM does not know the cause. All new activity must cease, in order to comply with the ESA plan for this species.	BOEM and BSEE are actively engaged in ESA consultation with NMFS and FWS concerning all of our past and reasonably foreseeable future activities. Until the above-mentioned NMFS' formal consultation is complete, BOEM is under an interim consultation agreement with NMFS. The NMFS and FWS are informed of the types, levels, and potential impacts that may result from proposed oil- and gas-related activities and will provide Biological Opinions as part of the formal consultation process. The Protected Species Stipulation, if applied, would require already existing terms and conditions and mitigations implemented to protect species from postlease

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			activities. As the stipulation notes, BOEM and BSEE add the most current mitigations or requirements about protected species or critical habitats to the conditions for approval of any postlease authorization or permit. The staged OCSLA decisionmaking and approval process ensures that BOEM and BSEE can require additional protected species protections after leases are issued. Refer to **Chapter 5.2** for more information on the ESA consultations.
Gulf Restoration Network	GRN-10	Whale tracking studies have shown that the animals have stopped eating in an area around the DWH site. We urgently need information on Sperm Whale diet and how its diet is changing after the BP DWH disaster.	BOEM has an ongoing study to obtain more information on sperm whale prey and is currently waiting for the final study report. More information on this study can be found on BOEM's website at https://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/SDP-2008-2010-pdf.aspx. Additionally, BOEM is actively involved in the scientific community and uses the most current and best available science for a more informed decisionmaking process. As noted in the Protected Species Stipulation, should new information become available, BOEM and BSEE will add that information to postlease site-specific NEPA documents for the decisionmaker and can add mitigation or other requirements as part of the conditions of approvals.
David Quist	DQ-12	Wildlife - proceeding with the lease sale will involve additional exploration which would not occur under the no-action alternative. Those activities, particularly seismic exploration tools/airguns, have significant to catastrophic impact upon marine life, particularly protected marine mammals. The fact that populations may be experiencing other environmental stressors does not change the fact	By selecting the No Action alternative and avoiding those activities associated with a proposed regionwide lease sale, those potential impacts related to a single proposed regionwide lease sale would be avoided; however, please be advised that a decision to cancel a single proposed regionwide lease sale would not preclude activity related to past lease sales or decisions on future lease sales. There are a number of currently leased blocks within the proposed regionwide lease sale area with proposed plans, and

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		adding yet more stressors make a bad situation worse, and could lead to the death of individuals, the decline or elimination of populations, and the collapse of ecosystems.	BOEM anticipates another decision point for the proposed regionwide lease sale, which is proposed as part of the 2017-2022 Five-Year Program. Should the No Action alternative be selected, in the interim, industry may explore and develop their existing portfolio of leaseholds subject to the terms of those leases and any conditions of approval for plans or permits. A full discussion of impacts associated with geological and geophysical (G&G) activities is outside the scope of this Supplemental EIS because these activities are permitted outside of the leasing process and would continue regardless of the alternative selected here. However, Chapter 4.9.1 ("Marine Mammals") of the 2017-2022 GOM Multisale EIS includes a summary of G&G operations and potential impacts to marine mammal species that may result from G&G activities. For a full analysis of the impacts of G&G activities in the Gulf of Mexico, refer to the *Gulf of Mexico OCS Proposed Geological and Geophysical Activities: Western, Central, and Eastern Planning Areas—Final Programmatic Environmental Impact Statement* (USDOI, BOEM, 2017c).
Commercial Fisheries			
Chelsea Gray	CG-5	Furthermore, there is little real discussion of the serious economic consequences of oil spills. Fisheries can be destroyed, not only through the loss of fish, but also because consumers fear purchasing fish after an oil spill (even if the fish is not from the affected area). The economic consequences of an oil spill are more far reaching then the EIS implies.	Thank you for your comment. BOEM analyzes the impacts of oil and gas production on a number of important habitats, resources, and socioeconomic entities. For specific information on commercial fisheries, recreational fishing, and tourism, refer to **Chapters 4.10, 4.11, and 4.12**, respectively. BOEM determined that, because a catastrophic event like the *Deepwater Horizon* explosion, oil spill, and response is not considered reasonably foreseeable as a result of a proposed action, the analysis should be removed from this Supplemental EIS to avoid confusion over whether it is or is not part of a
Chelsea Gray	CG-7	It is irresponsible to continue to give out any more oil leases, when they do not benefit the nation as a whole and put a profitable industry (fisheries) at great risk.	

Commenter	Comment ID	Comment	Response
			proposed action. This is allowed under CEQ's regulations, which removed the requirement to analyze worst-case scenarios. However, in accordance with CEQ guidance and to inform the public of the potential impacts in the unlikely event of such a spill (though not reasonably foreseeable), BOEM has made this information available to the public through its website. BOEM also acknowledges that one of the key ways of managing the risk of such an event is to implement a rigorous regulatory regime to ensure that postlease drilling activities are conducted in a safe manner. For a detailed analysis of reasonably foreseeable impacts associated with a low-probability catastrophic spill, such as the *Deepwater Horizon* explosion and oil spill, refer to the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a).
Land Use and Coastal Infrastructure			
Alicia Cooke	AC-3	As oil infrastructure ages, the costs of maintenance and development rises. Suncor, for example, currently has obligations for debts and decommissioning approaching $30 billion (http://oilprice.com/Energy/Energy-General/A-Sobering-Look-At-The-Future-Of-Oil.html).	Thank you for your comment. For more information on well workovers and abandonment, refer to **Chapter 3.1.3** of this Supplemental EIS and Chapter 3.1.3.5 of the 2017-2022 GOM Multisale EIS. For more information on pipelines and pipeline age, refer to Chapters 3.1.3.3.1 and 3.1.6.1 of the 2017-2022 GOM Multisale EIS. For more information on decommissioning and removal, refer to **Chapter 3.1.3** of this Supplemental EIS and Chapter 3.1.6 of the 2017-2022 GOM Multisale EIS.
Gulf Restoration Network	GRN-2	The draft supplement inadequately addresses the risks associated with the aging infrastructure of over 3,400 offshore rigs in the Gulf of Mexico, and the inevitable risk of oil spills resulting from the lease.	BOEM has also modeled oil spills and analyzed trends in reported spill volumes and numbers (Chapter 3.2.1.1.1 of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers) and reported the total number and volume of oil spills reported to the U.S. Coast Guard (USCG) from various sources, including barges, tankers, pipelines, and platforms. The analysis reported in Etkin (2009) reinforces the fact that hurricanes are the most common cause of

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			spills from both platforms and pipelines, but it also reports that structural failures (e.g., corrosion) account for a significant percentage of the total volume of spilled oil from offshore pipelines. Preventative measures are taken, including inspecting pipelines at routine intervals and using corrosion resistant or corrosion-inert materials. In addition, when pipelines are protected by rectifiers or anodes for which the initial cathodic protection system either cannot be calculated or calculations indicate a life expectancy of less than 20 years, the pipelines are inspected annually. For more information, refer to Chapters 3.1.6.1 ("Structure Age and Idle Iron") and 3.2.4 ("Pipeline Failures") of the 2017-2022 GOM Multisale EIS, which is where BOEM addresses potential environmental hazards and impacts relating to pipelines.
Chris Werle	CW-1	Given the past disasters with oil spills in the gulf, and the thousands that are currently *known* to be leaking, paired with the coming cuts or elimination of the EPA, I believe that expanded drilling operations presents a clear and present risk to coast communities and all those who depend on the gulf ecosystem.	The issues discussed in the following response are independent of the leaking wells from the Taylor Energy platform that was lost during Hurricane Ivan and which is located in Mississippi Canyon Block 20. For more information on the response to the Taylor Energy platform leak and BOEM's analysis of this leak in this Supplemental EIS, please refer to the response to Comment GRN-7. Refer to Chapters 3.1.3.3 and 3.1.6.1 of the 2017-2022 GOM Multisale EIS for more information on infrastructure (platforms and pipelines) and infrastructure age. BOEM is currently unaware of any issues related to the decommissioning of offshore wells, including plugging, sealing, and abandonment. A review of spill data reported to both USCG and BSEE provides no information showing that abandoned wells are currently leaking. BOEM's analysis in this Supplemental EIS acknowledges the risks of accidental spills and
June Charles	JC-1	Every day there is another pipeline that leaks, a platform that leaks oil and poisoning of our water by chemicals used in fracking.	
Penny Dipuma	PD-1	There is still oil leaking in the gulf. The oil companies need to fix those leaks.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			events, even in light of the rigorous safety regulations in place. Accidental events are identified and described in **Chapter 3.2**. Potential impacts from these activities are analyzed in each resource chapter of **Chapter 4**. Nevertheless, BOEM acknowledges that, even with the stringent standards, risk is not wholly eliminated. For example, Table 3-17 of the 2017-2022 GOM Multisale EIS acknowledges that, even with application of these standards, certain small spills (≥1,000 barrels [bbl]) may be reasonably foreseeable. BOEM and BSEE are constantly evaluating and responding to potential risks through strengthening enforcement and inspection, and continually updating regulatory requirements.
Carol "Cay" Burton	CB-2	We had multiple leaks going unpublished and unaddressed according to Coast Guard data and statistics.	Operators are required to immediately report to BSEE all spills of oil or other liquid pollutants that are known or suspected to be 1 bbl in volume or greater, per 30 CFR § 250.187 and 30 CFR § 254.46(a). This requirement is in addition to, but does not substitute for, the National Response Center's reporting requirements. Per 30 CFR § 254.46(b)(2), spills >50 bbl in volume require more detailed reporting and monitoring, and such spills trigger greater investigative response by BSEE, which may require the operator to submit additional information about the response.
Carol A. "Cay" Burton	CAB-2	We have multiple leaks going unpublished and unaddressed, according to Coast Guard data and statistics.	
Economic Factors			
Chelsea Gray	CG-6	Finally, the economic benefit of yet another oil lease is simply not worth the potential impacts. Oil does not bring in enough jobs, and frequently private sector jobs are cut in order to make room for tax cuts for oil rigs (resulting in a net loss of jobs overall).	Thank you for your comment. BOEM presents data regarding the beneficial impacts of the alternatives in **Chapter 4.14.2**. BOEM is responsible for administering the leasing program for oil and gas resources on the OCS and for developing a 5-year schedule of proposed lease sales designed to "best meet national energy needs for the five-year period following [the schedule's]
Jackie Antalan	JA-2	We also feel that there is no need for an additional 75 million acres to be leased in that it is unjustified economically and socially.	
Mobile	MEJAC-5	While OCS drilling activities contributes significantly	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Environmental Justice Action Coalition		to the federal revenue stream, it's true that recent lease sales haven't proven to be huge contributors. Taking Alternative E would not significantly diminish federal revenue.	approval . . ." (Section 18 of the OCSLA [43 U.S.C. § 1344]). The 2017-2022 Five-Year Program is an important component of the President's comprehensive energy strategy to allow for safe and responsible domestic oil and natural gas production as a means to support economic growth and job creation, and enhance energy security. In addition, the OCSLA grants the Secretary of the Interior the authority to issue leases on the OCS. Section 18(a)(4) of the OCSLA states that "Leasing activities shall be conducted to assure receipt of fair market value for the lands leased and the rights conveyed by the Federal Government." Lessees pay bonuses, rentals, and royalties reflecting the value of the rights to explore and potentially develop and produce OCS oil and gas resources. BOEM sets minimum bid levels, rental rates, and royalty rates by individual lease sale based on its assessment of market and resource conditions as the proposed regionwide lease sale approaches. A description of the revenue generated from offshore oil- and gas-related activities is described in Chapter 4.14.2.1 of the 2017-2022 GOM Multisale EIS. When the lease is acquired, a bonus bid is paid. The bonus bid is the winning highest dollar amount paid at the time of the lease sale. This acquisition cost reflects the opportunity cost of exploring and producing those mineral resources. During the initial term of a lease and before royalty on production is paid, the lessee pays annual rentals in an amount prescribed in the Final Notice of Sale. Rentals reflect the holding cost of the lease during the initial term prior to production in paying quantities. In recent lease sales, BOEM has imposed rentals that escalate over time to encourage faster exploration and development of leases. The Government receives a royalty payment once
Jean Publeee	JP-2	THE AMERICAN TAXPAYERS GET ZERO MONEY FROM THESE LEASES AND IT IS ALL SUCKED AWAY BY OUIR FAT CAT SWAMP BUREAUCRATS SO THEY GIVE THE AMERICAN TAXPAYERS NO HELP SO THERE IS NO REASON TO CONTINUALLY DESTROY THE GULF OF MEXICO.	
Jean Publeee	JP-4	THIS PLOT TO ALLOW RICH WHITE MEN PALS OF OUR CORRUPT GOVT TO MAKE BIG MONEY THROUGH THIS ENDLESS DESTRUCTION OF THIS LAND IN THE OCEAN WHICH BELONGS TO 325 MILLION PEOPLE IS SAD AND SHOWS A US GOVT WHICH CAN BE BOUGHT. ALL OF THE PEOPLE IN THIS COUNTRY ARE CLAMORING TO STOP THE TOTAL DESTRUCTION OF LANDS OWNED BY ALL OF THEM - THOSE 325 MILLION PEOPLS AND THE CORRUPT GANG IN WSHINGTON DC KEEPS DESTROYING THE PUBLIC LAND. THE LAW CALLED THE POUBLIC TRUST IS EXTREMELY IGNORED AND BULLIED BY THIS CORRUPT GANG IN WASHINGTON DC. WE WANT THIS DESRUCTION OF THE GULF TO STOP. NOW. THIS PLAN SUCKS.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			production starts. The royalty rate is a percentage of production. The royalty rate is used to calculate the royalty payment, i.e., the dollar amount paid based on the value of the amount of production. Under certain conditions, the royalty payment might be temporarily waived. Known as royalty relief, this generally occurs when an economic incentive is needed to spur additional production, such as in a frontier area or deeper water depth. Price thresholds or triggers suspend royalty payments if market prices are low but do not suspend royalty payments if market prices are high. Price thresholds provide an incentive when production might not otherwise occur. Additionally, they provide protection when market prices are high and the incentive is no longer needed. Revenues from OCS leases consist of bonuses, royalties, and rentals and are collected by the Office of Natural Resources Revenue. These revenues are shared with coastal states, as directed by statute, and the remaining funds are deposited in the U.S. Treasury. The OCS revenues provide annual deposits of nearly $900 million to the Land and Water Conservation Fund and $150 million to the Historical Preservation Fund. By statute, coastal states share a portion of the revenues from OCS leasing and production under three programs: (1) the OCSLA's Section 8(g) revenue sharing program, which provides that states with offshore Federal leases located within the first 3 mi (5 km) of the State's seaward boundary receive 27% of the revenue generated from those leases; (2) the Coastal Impact Assistance Program (CIAP) for Alaska, Alabama, California, Louisiana, Mississippi, and Texas; and (3) the Gulf of Mexico Energy Security Act (GOMESA) for Alabama, Louisiana, Mississippi, and Texas. For more information on OCS oil and gas leasing,

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			refer to BOEM's leasing fact sheet (USDOI, BOEM, 2016c).
Social Factors (Including Environmental Justice)			
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-13	The Bureau's determination that lease sales do not disproportionately impact communities of color is premised on a flawed assumption that there's no appreciable difference because there's so much cumulative harm from oil and gas activities in the Gulf. Specifically, the Bureau said the harmful impacts of the lease sale on environmental justice "is like a blip on a radar screen" for Gulf communities already inundated by prior oil and gas activities, infrastructure, and pollution. The industry is dangerous for workers and the welfare of people of color. The risk of fatality for offshore oil workers is seven times higher than the national average. And the industry harms public health with pollution and neighborhood blight from onshore oil infrastructure, including refineries. Refineries and other petroleum facilities in Alabama, Louisiana, Mississippi, and Texas reported 422.98 million pounds of toxic chemical releases between 2004 and 2014, the majority of that was air pollution followed by water discharges. Some of the most commonly released hazardous chemicals included xylene, cyanide, and toluene that are toxic to humans and harm the human nervous system, among other effects. Toxic pollution from these refineries and petrochemical facilities disproportionately impact low income neighborhoods, indigenous and communities of color. For example, Port Arthur, Texas is home to two facilities that refine more than 900,000 barrels of crude per day. The Environmental Protection Agency's Toxics Release Inventory places Jefferson County, where Port Arthur is located, among the worst in the nation for emissions of chemicals known to cause cancer, birth	The proposed Federal action being analyzed in this Supplemental EIS is to offer for lease those areas that may contain economically recoverable oil and gas resources in accordance with the OCSLA, which specifically states that these resources "should be made available for expeditious and orderly development, subject to environmental safeguards" (OCSLA, 43 U.S.C. §§ 1331 *et seq*.). The purpose of this Supplemental EIS is to evaluate the direct and indirect effects of a proposed action (i.e., a proposed regionwide lease sale) as well as the incremental contribution of a proposed regionwide lease sale to the cumulative effects. A low-probability catastrophic oil spill is not reasonably foreseeable, not part of the proposed action, and therefore is not included in this analysis. A detailed analysis of reasonably foreseeable impacts associated with a low-probability catastrophic spill is available in the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a). BOEM acknowledges that there could be impacts from onshore infrastructure supporting oil and gas activities on the OCS, whether through development and production or through refining onshore. Refer to **Chapters 4.14.1 and 4.14.3** for a discussion of indirect impacts to land use and coastal infrastructure and social factors (including discussion of environmental justice communities and an environmental justice determination). Refer to **Chapter 4.1** for the air quality analysis. Oil and gas from the OCS represent only a fraction of what is transported or refined onshore, and BOEM does not have the authority to regulate or permit onshore infrastructure, facilities, or activities that contribute to

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		defects, and reproductive disorders. Data collected by the Texas Cancer Registry indicates that cancer rates among African Americans in Jefferson County are roughly 15% higher than they are for the average Texan, and the mortality rate from cancer is more than 40% higher.	pollution. Employment in OCS-related industries is complex and variable. BOEM recognizes this complexity; refer to **Chapter 4.14.3** of this Supplemental EIS for a summary of this topic and Chapter 4.14.3 of the 2017-2022 GOM Multisale EIS for a full discussion of this topic.
Peter Shrock	PS-6	BOEM improperly dismisses air pollution that resulting from the proposed lease on Gulf communities because there is already significant Outer Continental Shelf (OCS) – related infrastructure in Gulf States. This approach undercuts the entire purpose of a cumulative impacts analysis and efforts to inform and engage environmental justice communities, in violation of NEPA.	
Mobile Environmental Justice Action Coalition	MEJAC-2	What Gulf residents deserve is a sober quantification of the potential impacts from the refining of OCS minerals in Gulf refineries. An analysis of this nature should include particulate matter, heavy metals, and polycyclic aromatic hydrocarbons quantification in addition to photochemical smog components. It is impossible to even being to properly consider the environmental justice and human health impacts without this elementary data. Also included in this data should be the amount of hazardous vapors released in routine storage and transport of product with an OCS origin.	
Sierra Club	SC-5	Oil spills and air pollution from offshore drilling and industrial facilities like refineries that support the industry make people sick and disproportionately harm low-income neighborhoods and communities of color. But BOEM fails to adequately analyze the environmental justice impacts of its proposal.	
Gulf Restoration Network	GRN-14	Climate change negatively impacts all of us, but communities on the front line of fossil fuel development in the Gulf of Mexico - most often people of color - have had to shoulder that burden	BOEM analyzes and considers many facets of the potential effects of climate change in its decisionmaking with respect to oil and gas leasing, whether in the Five-Year Program or lease sale

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		disproportionately. Each step of fossil fuel development - extraction, transportation, refining, and burning - directly threatens the health and well-being of communities across the Gulf. It is time to stop treating the Gulf as a sacrifice zone for the fossil fuel industry, and halt new offshore drilling.	analyses. This Supplemental EIS tiers from the 2017-2022 GOM Multisale EIS, which tiers from the 2017-2022 Five-Year Program EIS. Chapter 4.0 of the 2017-2022 GOM Multisale EIS has a summary of the greenhouse gas and downstream emissions information that may result from a Gulf of Mexico oil and gas lease sale. BOEM acknowledges that methods for quantifying greenhouse gas and potential social costs of such emissions are subject to continual improvement. BOEM continues to consider different ways to quantitatively address and disclose downstream greenhouse gas emissions and effects, and will update its analysis as warranted.
Topic 5 – Cumulative Analysis			
Chelsea Gray	CG-3	The EIS also seems to ignore the cumulative effects of multiple oil drills/spills in a region, and acts as if the area in question in isolated. There should be a discussion on what happens if multiple spills happen in the gulf at the same time, both minor and major.	**Chapter 4** of this Supplemental EIS summarizes the effects of oil spills to each of the identified resources. Refer to Chapter 4 of the 2017-2022 GOM Multisale EIS for detailed analyses on the effects of oil spills to each of the identified resources. In addition, **Chapter 3.2** of this Supplemental EIS summarizes oil spills, while Chapter 3.2 of the 2017-2022 GOM Multisale EIS provides a full analysis of past trends in reported spill volumes and numbers, showing that the majority of offshore spills are <1 bbl and result in only negligible and minor impacts to resources. While the occurrence of multiple spills of significance is low, the ability to respond to those spills is supported by the multiple staging areas for oil-spill response equipment across the GOM. For a discussion of the spill-response requirements, as well as the variety of methods employed, refer to Chapter 3.2.8 of the 2017-2022 GOM Multisale EIS.
David Quist	DQ-2	The proposed EIS erroneously focuses on incremental impacts rather than cumulative impact,	Thank you for your comment. This Supplemental EIS includes analysis of both the incremental impact of a

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		fails to acknowledge localized impacts, and fails to provide an impact assessment recognizing local as well as regional impacts.	single proposed regionwide lease sale and the cumulative impacts of the OCS Oil and Gas Program, as well as the cumulative impacts of non-OCS oil- and gas-related activities in the Gulf of Mexico. Refer to each resource summary in **Chapter 4** of this Supplemental EIS for impact analyses. For a full analysis on each resource, refer to Chapter 4 of the 2017-2022 GOM Multisale EIS. The geographic scale of analysis varies depending on the stage of the leasing process. The OCSLA requires a staged decisionmaking process beginning with the Five-Year Program, continuing through individual proposed regionwide lease sales under the Five-Year Program, and ultimately to individual postlease activities requiring a permit or approval. As stated in **Chapters 1 and 2**, this Supplemental EIS discusses a single proposed oil and gas lease sale, as scheduled under the 2017-2022 Five-Year Program. This approach is intended to focus the NEPA/EIS process on the staged OCSLA process for decisionmaking, including the proposed regionwide lease sales and any new issues and information identified since a prior stage. It also lessens duplication and saves resources when BOEM and BSEE conduct postlease reviews. Additionally, the issuance of leases does not conclude the environmental analysis of planned OCS oil- and gas-related activities. Each plan throughout the exploration, production, and decommissioning processes receives a site-specific environmental analysis pursuant to NEPA and the OCSLA's pyramidal structure going from large scale to site specific. For more information on BOEM's postlease processes, refer to Appendix A of the 2017-2022 GOM Multisale EIS.
Lorie Chinn	LC-5	The study shows that one lease won't effect much, but multiple leases has a major effect.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Peter Shrock	PS-12	The EIS does not consider connected, cumulative or similar actions and their indirect or cumulative impacts; the suggestion that these only need to be considered every 5 years is a violation of NEPA.	Thank you for your comment. As part of the cumulative analysis, BOEM considers both connected and similar actions. Cumulative impacts of the OCS Oil and Gas Program, as well as the cumulative impacts of non-OCS oil and gas activities in the Gulf of Mexico, are considered. Refer to each resource summary in **Chapter 4** of this Supplemental EIS for impact analyses. For a full analysis on each resource, refer to Chapter 4 of the 2017-2022 GOM Multisale EIS. The OCSLA provides the Congressional mandate for BOEM to make "available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs" the land of the Federal OCS. The Secretary of the Interior oversees the OCS Oil and Gas Program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained. It is during this national-level review that the location (GOM regionwide leasing) and timing of lease sales (number of lease sales per year) is set in the schedule of proposed regionwide lease sales. The 2017-2022 Five-Year Program EIS analyzes the environmental impacts of the entire 10 lease sale program in the Gulf of Mexico. The regional-level NEPA analysis covered in the 2017-2022 GOM Multisale EIS and this Supplemental EIS provide a regional-level analysis of the environmental impacts of a single proposed regionwide lease sale in the 2017-2022 Five-Year Program. A NEPA analysis must be conducted for each proposed regionwide lease sale in the Five-Year Program. This

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			Supplemental EIS tiers from the 2017-2022 Five-Year Program EIS and 2017-2022 GOM Multisale EIS, and incorporates the analyses (including connected and cumulative analyses) into this Supplemental EIS by reference. The decision on whether or how to proceed with each proposed regionwide lease sale is under the authority of the Assistant Secretary for Land and Minerals Management and will be disclosed in the Record of Decision following the NEPA analysis for each proposed regionwide lease sale.
Topic 6 – Oil Spills			
David Quist	DQ-8	- increased drilling = increased risk of spills. If Deepwater Horizon taught anything, it's that the impacts on water quality, shoreline, beaches, dunes, estuarine ecosystems, and marine ecology and wildlife are severe. The Gulf still hasn't recovered from that one spill event.	BOEM is concerned about the potential impacts of oil spills on the environment. In this Supplemental EIS, OCS oil- and gas-related oil spills are analyzed under "Accidental Events," and other spills (e.g., in State waters or from other sources on the OCS) are analyzed under "Cumulative Impacts" for all relevant resources. As impacts from the *Deepwater Horizon* explosion, oil spill, and response continue to be assessed, additional analyses will be completed at the site-specific approval stage and in future NEPA documents. BOEM understands that the *Deepwater Horizon* explosion, oil spill, and response had impacts on the Gulf of Mexico. However, the *Deepwater Horizon* explosion and oil spill was a catastrophic event, and a catastrophic oil spill is not part of a proposed action nor is it considered likely to occur. The return period of a catastrophic oil spill on OCS areas is estimated to be 165 years, with a 95% confidence interval between 41 years and more than 500 years (Ji et al., 2014). BOEM determined that, because a catastrophic event like the *Deepwater Horizon* explosion, oil spill, and response is not considered reasonably foreseeable as a result of a proposed action, the analysis should not be overly emphasized in this Supplemental EIS to avoid confusion over whether it is or is not part of a
Maggi Roberts	MaRo-4	We are still recovering from the Oil Spill that devastated the Fishing and Tourist Industries on the Gulf Coast. We all know the impact and consequences of drilling in the Gulf that the Deep Horizon incident had.	
Gulf Restoration Network	GRN-1	Seven years after the Deepwater Horizon spill, hundreds of miles of coastal habitat, sea turtles, sea birds, dolphins, and other wildlife in the Gulf of Mexico are still suffering. Key fishing grounds have still not recovered.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			proposed action. This is allowed under CEQ's regulations that removed the requirement to analyze worst-case scenarios. For a detailed analysis of reasonably foreseeable impacts associated with a low-probability catastrophic spill, such as the *Deepwater Horizon* explosion and oil spill, refer to the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a). The Natural Resource Damage Assessment studies are ongoing, but the Trustees' PDARP/PEIS has been released and analyzed for relevant information. With the release of the Trustees' PDARP/PEIS, our understanding of the environmental impacts of the *Deepwater Horizon* explosion, oil spill, and response has greatly increased; however, there are many ongoing long-term and monitoring studies that are not complete. Therefore, our understanding of the lasting effects or long-term recovery of the system is still incomplete and has data gaps, but the information is not essential to a reasoned choice among alternatives. Current baselines are described for all resources under their respective "Description of the Affected Environment" chapters in the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. Specific to the Trustees' PDARP/PEIS (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016), the altered baseline in this Supplemental EIS already includes individual protected species directly affected by this unexpected unique catastrophic event. The injuries assessed within the PDARP/PEIS do not necessarily equate the baseline as defined in NEPA, but they were considered when determining the baseline for our impact determinations.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			Where gaps remained, BOEM's subject-matter experts exercised their best professional judgment to extrapolate baseline conditions and impact analyses using accepted methodologies based on credible information. BOEM's subject-matter experts have applied other scientifically credible information using accepted theoretical approaches and research methods, such as information on related or surrogate species. Moreover, BOEM will continue to monitor these resources for effects caused by the *Deepwater Horizon* explosion, oil spill, and response, and will ensure that future BOEM environmental reviews take into account any new information that may emerge. BOEM considers a key to managing risk is through implementing a rigorous regulatory regime to ensure that postlease drilling activities are conducted in a safe manner. Refer to Appendix A of the 2017-2022 GOM Multisale EIS for information on BOEM's and BSEE's rigorous postlease processes. Safety measures and technologies have increased since the *Deepwater Horizon* oil spill. A fact sheet on research and regulatory reforms can be found on BOEM's website at http://www.boem.gov/2017-2022-GOM-Multisale-Public-Meeting-Handouts-Visuals/.
Sierra Club	SC-4	Similarly, BOEM must analyze the impacts of another catastrophic oil spill.	BOEM has analyzed the impacts of a catastrophic oil spill. BOEM determined that, because a catastrophic event like the *Deepwater Horizon* explosion, oil spill, and response is not considered reasonably foreseeable as a result of a proposed action, the analysis should not be overly emphasized in this Supplemental EIS to avoid confusion over whether it is or is not part of a proposed action. This is allowed under CEQ's regulations that removed the requirement to analyze worst-case scenarios. For a detailed analysis of reasonably foreseeable impacts
Rebecca King	RK-1	I would like to know how BOEM addressed the catastrophic BP spill. This EIS is based on smaller more common spills, however it only takes one spill like the Deepwater Horizon to cause damage that lasts for years or possibly decades.	
Eli Lamb	EL-3	Additionally, the recent (and still not fully ameliorated) BP oil spill still demonstrates that an agency responsible for management (BOEM) must consider outlying negative outcomes even more	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		seriously than the statistically certain ones. Otherwise its role is obsolete, and we could trust to the "common sense" propaganda of the oil companies themselves. Remember, if you align your motives too closely with those you are supposed to oversee, they will eventually decide you are an unnecessary burden to their bottom line – and they will be correct.	associated with a low-probability catastrophic spill, such as the *Deepwater Horizon* explosion and oil spill, refer to the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a).
Susan Prerost	SP-1	I ask BOEM to reconsider implementation of 250. The incredibly detailed analysis is limited re: future catastrophic events such as the BP oil spill. There is no way to know how devastating – to our already fragile ecosystem – another unstoppable surge would be to our estuary. The analysis is finite as is our estuary, culture, biodiversity.	
Lorie Chinn	LC-4	The impact of a major catastrophe happening again out in this Gulf would have an even greater lasting effect on the environment.	
Rebecca King	RK-3	Has BOEM considered that people in Grand Isle are still getting cancer at much higher rates since the spill?	The proposed action in this Supplemental EIS is to hold a regionwide lease sale in the GOM according to the schedule of proposed regionwide lease sales set forth by the 2017-2022 Five-Year Program. The purpose of the proposed regionwide lease sale analyzed in this Supplemental EIS is to offer for lease those areas in the Gulf of Mexico (GOM) that may contain economically recoverable oil and gas resources in accordance with the OCSLA, subject to environmental safeguards in order to further the orderly development of OCS oil and gas resources. BOEM acknowledges that there could be impacts from the proposed action on coastal communities (as discussed in **Chapter 4.14.3**), but a low-probability catastrophic oil spill is not reasonably foreseeable, not part of the proposed action, and therefore is not included in this analysis. BOEM acknowledges that a low-probability catastrophic spill, such as the *Deepwater Horizon*

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			explosion and oil spill, may cause impacts to coastal communities, including health impacts. A detailed analysis of reasonably foreseeable impacts associated with a low-probability catastrophic spill is available in the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a). BOEM has revisited the baseline description for the social factors chapter and does not agree that enough evidence exists yet to conclusively determine that the *Deepwater Horizon* explosion, oil spill, and response has changed the baseline conditions for evaluating the impact of a lease sale. BOEM has identified unavailable information that is relevant to people and communities regarding the impacts of the *Deepwater Horizon* explosion, oil spill, and response. This information cannot be obtained because long-term health impact studies, subsistence studies, and the Natural Resource Damage Assessment restoration process are ongoing and because data from these efforts would be unavailable and unobtainable for some time. In order to fill this data gap, BOEM has used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis, including information that has been released after the *Deepwater Horizon* explosion, oil spill, and response and studies of past oil spills, which indicate that a low-probability, catastrophic oil spill, which is not part of a proposed lease sale and not likely or expected to occur, may have adverse impacts on residents in GOM coastal communities. Research into possible long-term health impacts of the *Deepwater Horizon* explosion, oil spill, and response continues (National Institute of Environmental Health Science, 2014; National Center for Disease Preparedness, 2013 and 2014; Substance Abuse and Mental Health Services Administration and Centers for Disease Control and

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			Prevention, 2013). Because long-term health impacts to coastal populations are unknown, this information may be relevant to the evaluation of impacts from the *Deepwater Horizon* explosion, oil spill, and response; therefore, BOEM continues to seek additional information as it becomes available and bases the previous analysis on the best information currently available. Although long-term health impacts to people and communities may be relevant to this analysis, BOEM has determined that the unavailable information is not essential to a reasoned choice among alternatives based on the information discussed above. Some additional clarifying language and references are provided in the social factors chapter of the 2017-2022 GOM Multisale EIS's baseline descriptions and cumulative impacts analysis. Because health studies and other research are ongoing, BOEM is monitoring the results and will revise the analysis if warranted.
Rebecca King	RK-4	Has this EIS considered BP oil just showed up in sparrows this past year so it in the food chain.	This Supplemental EIS has been updated to include this new information. Refer to **Chapter 4.8** for this information.
Rebecca King	RK-5	Much of the oil is still on the bottom of the Gulf.	Thank you for your comment. Current baselines are summarized in this Supplemental EIS and described in detail for all resources under their respective "Description of the Affected Environment" chapters in the 2017-2022 GOM Multisale EIS. BOEM has included information from the Trustees' PDARP/PEIS (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016) for the altered baseline affected by this unexpected, unique catastrophic event. BOEM acknowledges that there is some lingering uncertainty regarding the impacts of the *Deepwater Horizon* oil spill. However, this uncertainty has diminished as time passes and as new data and studies have become available. In addition, BOEM has complied with NEPA procedures for dealing with
Bill McBride	BM-1	There exists a case study in why there should be no drilling in the Gulf of Mexico, the 2010 Deepwater Horizon blowout that killed 11 people and countless wildlife in the Gulf ecosystem. From all reports the bottom of the Gulf remains blanketed in oil.	
Alan Ackerman	AA-1	NOW THEY FINDING 10 MILLION GALLON TAR MAT ON GULF BOTTOM ???	
Judith Shields	JuSh-1	An enormous mat of oil still lies in the Gulf. Big Oil wants to risk that again. http://www.cbsnews.com/news/oil-2-inches-thick-found-on-gulf-sea-floor/	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			incomplete or unavailable information.
Anonymous	ANON-1	I was born and raised in Pensacola, Florida and have now retired back to the area. I enjoyed the beaches and local waters growing up in Northwest Florida. That is one of the primary reasons for returning here in retirement. Over the years, I have been disappointed to see the Gulf of Mexico become an "oil field" with platforms dotting the once clear waters. I recognize the need for energy as well as other products that come from oil such is synthetic materials. However, my major concern is the human factor in farther development in the Gulf (actually, any offshore drilling). Please consider the following accidents: 1) The Exxon Valdez oil spill occurred in Prince William Sound, Alaska, March 24, 1989, when Exxon Valdez, an oil tanker owned by Exxon Shipping Company, bound for Long Beach, California, struck Prince William Sound's Bligh Reef at 12:04 am local time and spilled approximately 10.8 million US gallons of crude oil over the next few days. 2) Ixtoc I was an exploratory oil well being drilled by the semi-submersible drilling rig Sedco 135-F in the Bay of Campeche of the Gulf of Mexico, about 62 miles northwest of Ciudad del Carmen, Campeche in waters 160 ft deep. On 3 June 1979, the well suffered a blowout resulting in one of the largest oil spills, in history (to that date). 3) The Deepwater Horizon oil spill (aka BP oil spill, BP oil disaster, the Gulf of Mexico oil spill, and the Macondo blowout) began on April 20, 2010, in the Gulf of Mexico on the BP-operated Macondo Prospect. Eleven people went missing and were never found and it is considered the largest accidental marine oil spill in the history of the	The Six Sigma approach to managing quality is not used to evaluate oil- and gas-related incident rates; however, BSEE monitors incident statistics including, but not limited to, injuries, losses of well control, and fires and explosions, which can be found on BSEE's website at https://www.bsee.gov/stats-facts/offshore-incident-statistics. The BSEE uses the results of incident investigations and data analysis to identify incident causes and trends. Appropriate actions are then identified to prevent the recurrence of these incidents and to enhance safety and environmental protection on the OCS. These actions may include publishing Safety Alerts, initiating technical research, developing new/revised regulations or standards, changing inspection strategies, holding safety workshops, etc. Incident data are also used to calculate performance indicators. On April 17, 2006, MMS published a Final Rule (*Federal Register*, 2006) that revised the agency's incident reporting requirements. The new Incident Reporting Rule more clearly defines which incidents must be reported, broadens the scope to include incidents that have the potential to be serious, and requires the reporting of standard information for both oral and written reports. This has resulted in more consistent incident reporting and the collection of more reliable incident information. Prevention of future undesirable incidents on the OCS is a paramount goal of both industry and MMS. For more information on incident reporting, refer to BSEE's website at https://www.bsee.gov/resources-tools/incident-reporting. This information is considered in the "Accidental Events" section in **Chapter 3.2**. In addition, a BOEM/BSEE-sponsored study entitled

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

<table>
<tr><th>Commenter</th><th>Comment ID</th><th>Comment</th><th>Response</th></tr>
<tr><td></td><td></td><td>petroleum industry, an estimated 8% to 31% larger in volume than the previously largest, the Ixtoc I oil spill. The US Government estimated the total discharge at 210 million US gallons. After several failed efforts to contain the flow, the well was declared sealed on September 19, 2010. Reports in early 2012 indicated the well site was still leaking.

Please ask your engineers to provide calculations for mean time between failures and other failure rate data before making a decision that could affect the environment of the Gulf of Mexico for future generations. Please consider this from the Six Sigma approach to managing quality. The scale shows how well a vital feature performs compared to its requirements. The higher the sigma score, the more efficient the feature is:

<table>
<tr><th>Sigma Level</th><th>Defects per Million Opportunities (DPMO)</th><th>Percent of Defects (%)</th><th>Percent of Successes (Yield %)</th><th>Capability (CP)</th></tr>
<tr><td>1</td><td>691,462</td><td>69</td><td>31</td><td>0.33</td></tr>
<tr><td>2</td><td>308,538</td><td>31</td><td>69</td><td>0.67</td></tr>
<tr><td>3</td><td>66,807</td><td>6.7</td><td>93.3</td><td>1.00</td></tr>
<tr><td>4</td><td>6,210</td><td>0.62</td><td>99.38</td><td>1.33</td></tr>
<tr><td>5</td><td>233</td><td>0.023</td><td>99.977</td><td>1.67</td></tr>
<tr><td>6</td><td>3.4</td><td>0.00034</td><td>99.99966</td><td>2.00</td></tr>
</table>

Human error is inevitable, so even if the developer achieves Six Sigma Level 6 (the highest level) there is still a predictable error rate that could result in another disaster. Please refrain from permitting additional offshore production platforms.</td><td rowspan="2">"2016 Update of Occurrence Rates for Offshore Oil Spills," recently updated the previous work presented in Anderson et al. (2012). While this update includes oil spills reported through 2015, it also examines causal factors associated with each individual spill. The information in Anderson et al. (2012) can be found in the 2017-2022 GOM Multisale EIS and is incorporated by reference into this Supplemental EIS, which tiers from the 2017-2022 GOM Multisale EIS. While there will always be incomplete or unavailable information regarding offshore spills that could conceivably result in potential future shifts in baseline conditions and affect BOEM's decisionmaking, BOEM has determined that it can make an informed decision on a proposed regionwide lease sale using the most recent spill information provided by ABS Consulting, Inc. (2016). Through the tiered NEPA process for oil and gas leasing, future BOEM environmental reviews can take into account any new information that may emerge.</td></tr>
<tr><td>Ryan Bowman</td><td>RB-4</td><td>Having more offshore drilling sites increases the probability of another catastrophic oil spill. The risk of such a catastrophe far outweighs the potential temporary benefits of opening new sites.</td></tr>
</table>

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Peter Shrock	PS-1	The Bureau of Ocean Energy Management's (BOEM) analysis of threats to the environment is inadequate. BOEM's oil spill analysis, for example, vastly understates the damage to the environment and wildlife and risk of oil spills. It ignores the reality that transporting oil and gas is inherently dangerous and spills occur routinely in offshore oil and gas operations from both tankers and pipelines.	BOEM's analysis of oil-spill risk, which is summarized in **Chapter 3.2** of this Supplemental EIS and discussed in detail in Chapter 3.2.1 of the 2017-2022 GOM Multisale EIS, includes detailed discussions of offshore spills <1,000 bbl and ≥1,000 bbl, and coastal spills. As described in Chapter 3.2.1.4.2 ("Trajectory Modeling for Offshore Spills ≥1,000 bbl") of the 2017-2022 GOM Multisale EIS, the Bureau of Ocean Energy Management's OSRA model simulates the trajectory of thousands of spills throughout the Gulf of Mexico OCS and calculates the probability of these spills being transported and contacting specified geographic areas and features. Using these assumptions, BOEM's subject-matter experts then evaluated the potential impacts to resources in the Gulf of Mexico. While there is always some professional judgment that must be used when developing forecasts for a scenario and the potential resulting impacts, BOEM believes this is a reasonable approach and that it would tend to be conservative and to probably overestimate impacts rather than underestimate them. BOEM has summarized oil and gas transport, safety requirements, and accidents from both tankers and pipelines in **Chapter 3.2.4** of this Supplemental EIS. Pipeline failures are discussed in detail in Chapter 3.2.4 of the 2017-2022 GOM Multisale EIS. Oil tankers and their safety requirements are discussed in detail in Chapter 3.1.4.2 of the 2017-2022 GOM Multisale EIS, and vessel collisions are discussed in Chapter 3.2.5 of the 2017-2022 GOM Multisale EIS.
350 Louisiana - New Orleans	350LANO-3	What is the estimated amount of oil spilled/ leaked into the GOM annually associated with oil production?	**Chapter 3.2** of this Supplemental EIS summarizes and Chapter 3.2.1.1.1 ("Trends in Reported Spill Volumes and Numbers") of the 2017-2022 GOM Multisale EIS reports the total number and volume of oil spills reported to USCG from various sources, including barges, tankers, pipelines, and platforms.
Gulf Restoration Network	GRN-3	BOEM cannot permit more drilling when it does not know the rolling sheen size of the thousands of spills that routinely cover the Gulf.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			Historical data on oil spills from 2001 through 2015, including the number of spills and volume of spills each year, is shown in Table 3-11 of the 2017-2022 GOM Multisale EIS. **Tables 3-10**, **3-11, and 3-12** of this Supplemental EIS show estimated spill data for an individual lease sale and the cumulative OCS Oil and Gas Program. The analysis reported in Etkin (2009) reinforces the fact that hurricanes are the most common cause of spills from both platforms and pipelines; it also reports that structural failures (e.g., corrosion) account for a significant percentage of the total volume of spilled oil from offshore pipelines. Preventative measures are taken, including inspecting pipelines at routine intervals and using corrosion resistant or corrosion-inert materials. In addition, when pipelines are protected by rectifiers or anodes for which the initial cathodic protection system either cannot be calculated or calculations indicate a life expectancy of less than 20 years, the pipelines are inspected annually. Also, refer to Chapter 3.1.6.1 ("Structure Age and Idle Iron") and Chapter 3.2.4 ("Pipeline Failures") of the 2017-2022 GOM Multisale EIS, which is where BOEM addresses potential environmental hazards and impacts relating to pipelines. In addition, natural oil seeps are geographically common and have likely been active throughout history. Natural seeps have been estimated to account for approximately 47% of the crude oil entering the marine environment (Kvenvolden and Cooper, 2003). For more information on seeps in comparison to other petroleum inputs to Gulf of Mexico waters, refer to **Table 3-29 and Chapter 3.3.2.9.2** of the 2017-2022 GOM Multisale EIS. The impacts of oil spills are summarized for each resource in **Chapter 4** of this Supplemental EIS and

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			analyzed in detail in Chapter 4 of the 2017-2022 GOM Multisale EIS.
Gulf Restoration Network	GRN-6	These spills represent much more oil than natural seeps, and represent a different chemistry than natural seeps. BOEM cannot claim that the ecosystem has adapted to cope with accidental spills because of the differences in density and chemistry between natural seeps and crude oil spills.	As discussed in the 2017-2022 GOM Multisale EIS, natural oil and gas seeps do occur in the Gulf of Mexico and there are some bacteria and deepwater benthic communities that inhabit areas with seeps. Natural oil seeps are geographically common and have likely been active throughout history. Natural seeps have been estimated to account for approximately 47% of the crude oil entering the marine environment (Kvenvolden and Cooper, 2003). For more information on seeps in comparison to other petroleum inputs to Gulf of Mexico waters, refer to Table 3-29 and Chapter 3.3.2.9.2 of the 2017-2022 GOM Multisale EIS. Chemosynthetic organisms are naturally adapted to handle the limited amounts of hydrocarbons that are typical at slow-flowing seeps. While they have not been as well studied as deepwater corals, there have been no documented impacts from the *Deepwater Horizon* oil spill to chemosynthetic communities (USDOI, BOEM, 2012; Shedd, official communication, 2015). It is possible that some deepwater coral species also have limited capabilities to endure oil exposure. Results from DeLeo et al. (2015) suggested that *Callogorgia delta*, a soft coral often associated with natural hydrocarbon seeps, may have some natural adaptation to short-term oil exposure. Al-Dahash and Mahmoud (2013) suggest that a possible mechanism for this is coral harboring of symbiotic oil-degrading bacteria.
Gulf Restoration Network	GRN-5	BOEM cannot move forward until companies are required to report oil spills according to NOAA or USCG standards.	Operators are required to immediately report to BSEE all spills of oil or other liquid pollutants that are known or suspected to be 1 bbl in volume or greater, per 30 CFR § 250.187 and 30 CFR § 254.46(a). This requirement is in addition to, but does not substitute for, the National Response Center's reporting requirements. Per 30 CFR § 254.46(b)(2), spills >50 bbl in volume require more detailed reporting and

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			monitoring, and such spills trigger greater investigative response by BSEE, who may require the operator to submit additional information about the response. The National Oceanic and Atmospheric Administrations' (NOAA's) Office of Response and Restoration is charged with responding to oil spills, chemical accidents, and other emergencies in coastal areas. Under the National Contingency Plan, NOAA is responsible for providing scientific support to the Federal On-Scene Coordinator for oil and hazardous material spills. To support this mandate, the Office of Response and Restoration provides 24-hour, 7-day-a-week response to spills (USDOC, NOAA, Office of Response and Restoration, 2016). A Federal On-Scene Coordinator is a representative of a Federal agency such as USCG or USEPA. The Federal On-Scene Coordinator oversees the oil-spill response effort and determines if the efforts were conducted in accordance with the National Contingency Plan (USDHS, CG, 2016).
Gulf Restoration Network	GRN-7	Ongoing leaks like the Taylor platform have not been evaluated for environmental impact. It is ludicrous to say that oil from Taylor does not impact some proportion of spawning for Bluefin Tuna, Cobia, and other highly migratory species that spawn in the Gulf. The sheen has been emitted from the well site year round since 2004. The oil slick increases in size during the summer, and seems to be getting longer, according to NRC reports. The site may be used for dumping by other parties, since it is well known that there are no consequences for dumping oil into waters of the United States at this site.	Information regarding the Taylor Energy platform that was lost during Hurricane Ivan and that was located in Mississippi Canyon Block 20 is discussed in Chapter 3.2.1.1.3 of the 2017-2022 GOM Multisale EIS and is incorporated by reference into this Supplemental EIS. The BSEE and BOEM have worked with USCG under a Unified Command to monitor and respond to discharges from Taylor Energy's Mississippi Canyon Block 20 site since the oil production platform and 25 of the 28 connected wells were impacted and damaged during Hurricane Ivan in 2004. The multi-agency effort has worked continuously to prevent and control oil discharge, improve the effectiveness of containment around the source of the oil discharge, and mitigate environmental impacts. The Unified Command's collaborative efforts have resulted in the

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			removal of the platform deck, removal of subsea debris, decommissioning of the oil pipeline, and intervention of 9 of the 25 impacted wells. Taylor Energy, as the responsible party, has a continuing legal obligation and responsibility to pay for oil-spill recovery and response costs under the Oil Pollution Act of 1990. The Taylor Energy leak has been included in the oil-spill analysis that is summarized in **Chapter 3** of this Supplemental EIS and discussed in detail in the 2017-2022 GOM Multisale EIS. Although analysis of the impacts of the Taylor Energy platform is out of the scope for this Supplemental EIS, impacts to fish from oil spills are summarized in **Chapter 4.7** of this Supplemental EIS and analyzed in detail in Chapter 4.7 of the 2017-2022 GOM Multisale EIS.
Bonnie Aylward	BA-1	I am a resident of Venice, FL and was there for the Deepwater Horizon event. We were never compensated and are unable to sell out house. We have lost a lot of money and know the housing market has gone down, but think there is a relationship with the Deepwater Horizon event and that there were impacts to the housing market.	Thank you for your comment. BOEM has no authority to provide compensation for changes in the housing market. However, the Federal Government has provided funding through other means in recognition of these ongoing impacts. The Coastal Impact Assistance Program (CIAP) was established by The Energy Policy Act of 2005 (Public Law 109-58). The CIAP authorizes funds from OCS oil and gas revenues to be distributed to OCS oil- and gas-producing states for the conservation, protection, and preservation of coastal areas, including wetlands. In recent years, Louisiana has received over $1 billion in offshore 8(g) revenues, over $500 million dollars in CIAP funds, and stands to receive more offshore revenue shares in coming years from the Gulf of Mexico Energy Security Act of 2006 (Public Law 109-432).
Pam Scaggs, South Baldwin Democrats	PSSBD-1	We signed a contract to buy our house April 19, 2010. The BP oil rig blew the next day. We were devastated. We did go through with buying our house, only because we believed what BP said about how the spill was not that bad and was under control and we believed them. After we settled our contact and bought the house, all the truth came out and how bad it was. It really took a toll on us. We put our retirement money into buying our last home to spend our final days here on the Gulf. Our whole community suffered greatly from the spill. Everything went downhill. Housing prices dropped, restaurants closed, condos on the beach just stopped building. Our fishery suffered and not sure to this day how	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		safe it is. It has taken years for our community to get back to stability.	
Peter Shrock	PS-2	In particular, the Environmental Impact Statement (EIS) is not comprehensive in its risk analysis of catastrophic oil spills, which increase in probability as drilling is forced into deeper reserves, and which are subject to climate change effects (e.g. fiercer storms, rising sea levels) that increase the risk of damage to infrastructure and catastrophic spills.	BOEM acknowledges that each oil-spill event is unique; its outcome depends on several factors, including time of year and location, atmospheric and oceanographic conditions (e.g., winds, currents, coastal type, and sensitive resources), specifics of the well (i.e., flow rates, hydrocarbon characteristics, and infrastructure damage), and response effort (i.e., speed and effectiveness). For this reason, the severity of impacts from an oil spill cannot be predicted based on volume alone, although a minimum volume of oil must be spilled to reach catastrophic impacts. BOEM's resource assessment studies show a higher probability of large oil reservoirs being discovered and produced in deep water as compared with shallow water (DeCort, official communication, 2012). BOEM provides an analysis of a catastrophic oil spill in the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a) because a spill of that magnitude is not reasonably foreseeable and not part of a proposed action (Ji et al., 2014). While it is possible that, as a result of climate change, both the number and severity of hurricanes may increase, the Bureau of Ocean Energy Management's OSRA includes data collected during hurricane conditions. In addition, BSEE provides a robust set of regulations related to hurricane preparedness that help lower the risk of oil spills occurring and that help prevent any loss of life. Severe weather, including hurricanes, are addressed in Chapters 3.2.1.1, 3.2.4, and 3.3.2.9.3 of the 2017-2022 GOM Multisale EIS. In addition, severe weather is addressed in Chapter 1.2.2.8 of the *Catastrophic Spill Event Analysis* white paper (USDOI, BOEM, 2017a). Rising sea levels are addressed in Chapter 3.3.2.8.1 of the 2017-2022 GOM Multisale EIS.
Jackie Hartstein	JH-1	Well, anyways, I'm here because I was hoping that I could say something in terms of the depth if the leases are sold. I think the more depth to the drilling increases the risk, and I just really don't think we deserve any more risk after 2010. It hasn't been a very long time and we all remember it very well.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Topic 7 – Mitigation			
David Quist	DQ-11	Topographic Features - - if the impacts are being assessed assuming that the Topographic Features Stipulation are in place, those Stipulations should be a required part of the leases under any alternative, rather than simply a possible mitigation strategy	The Topographic Features and Live Bottom (Pinnacle Trend) Stipulations have been applied as programmatic mitigation in the 2017-2022 Five Year Program EIS (USDOI, BOEM, 201a); therefore, these stipulations would apply to all leases issued under the 2017-2022 Five-Year Program in designated lease blocks. In **Chapter 2.2.3.1**, BOEM defines all prelease mitigating measures (stipulations) analyzed in this Supplemental EIS and identifies which stipulations are applicable to which alternative in **Table 2-1**. Appendix B of the 2017-2022 GOM Multisale EIS provides definitions of all commonly applied postlease mitigating measures.
Peter Shrock	PS-5	BOEM's proposal lacks meaningful mitigation of the harms that it discloses such as coastal erosion, harms to birds, and noise impacts on marine mammals.	In **Chapter 2.2.3.1**, BOEM defines all prelease mitigating measures (stipulations) analyzed in this Supplemental EIS and identifies which stipulations are applicable to which alternative in **Table 2-1**. Appendix B of the 2017-2022 GOM Multisale EIS provides definitions of all commonly applied postlease mitigating measures. Where applicable, the mitigating measures applied for each resource are identified in that resource analysis in **Chapter 4**. The Topographic Features and Live Bottom (Pinnacle Trend) Stipulations have been applied as programmatic mitigation in the Five-Year Program EIS (USDOI, BOEM, 2016a); therefore, these stipulations would apply to all leases issued under the 2017-2022 Five-Year Program in designated lease blocks. The analysis of the other eight stipulations for any particular alternative does not ensure that the Assistant Secretary for Land and Minerals Management will make a decision to apply the
Mobile Environmental Justice Action Coalition	MEJAC-7	There are additionally many unanswered questions about the effectiveness of industry's preferred Gulf of Mexico marine mammal impact mitigation techniques. Thorough vetting and duplication of these policies and procedures to reduce impacts from such activities like ultrasound mapping has yet to be undertaken appropriately.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			stipulations to leases that may result from any proposed regionwide lease sale nor does it preclude minor modifications in wording during subsequent steps in the prelease process if comments indicate changes are necessary or if conditions change. Any prelease mitigating measures are disclosed in the Record of Decision for that particular lease sale. Those stipulations become enforceable provisions of the lease and are enforced by BSEE through their rigorous enforcement programs. Postlease mitigating measures are implemented on a case-by-case basis throughout the postlease process through site-specific plan and/or permit reviews and cannot be speculated on at this point in the program. Appendix A of the 2017-2022 GOM Multisale EIS provides detailed information on BOEM's and BSEE's postlease permitting and approval processes. Noise impacts to marine mammals are primarily from G&G activities. A full discussion of impacts associated with G&G activities is outside the scope of this Supplemental EIS because these activities are permitted outside of the leasing process and would continue regardless of the alternative selected here. A summary of G&G operations can be found in **Chapter 4.9.1** ("Marine Mammals") of this Supplemental EIS, and a more detailed discussion can be found in Chapter 4.9.1 of the 2017-2022 GOM Multisale EIS. This chapter includes the potential impacts to marine mammal species that may result from G&G activities and the information that is currently available. In addition, ancillary activities or G&G exploration and development activities may be conducted on a lease. For more detail on these activities and the mitigations and stipulations associated with those activities, refer to Appendix A ("Postlease Processes") of the 2017-2022 GOM

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			Multisale EIS. Mitigating measures for seismic surveys are described in NTL 2016-BOEM-G02. The Protected Species Stipulation is one of BOEM's prelease stipulations that may be disclosed in the Record of Decision for that particular lease sale. It will then become an enforceable provision of the lease and is enforced by BSEE through their rigorous inspection program. The Protected Species Stipulation has been applied to all blocks leased in the GOM since December 2001. This stipulation was developed in consultation with the U.S. Department of Commerce's National Oceanic and Atmospheric Administration's NMFS and the U.S. Department of the Interior's FWS in accordance with Section 7 of the Endangered Species Act, and it is designed to minimize or avoid potential adverse impacts to federally protected species. In addition, NMFS, BOEM, and BSEE collaborated to publish National Standards for a Protected Species Observer Program, which provides guidance on how to reduce impacts to protected species from G&G activities by standardizing the variation in and improving the management of the program (Baker et al., 2013), although this guidance is not mandatory. More detailed information on Gulf of Mexico G&G activities can be found in the *Gulf of Mexico Geological and Geophysical Activities: Western, Central, and Eastern Planning Areas—Final Programmatic Environmental Impact Statement* (USDOI, BOEM, 2017c), which BOEM prepared with BSEE and the National Oceanic and Atmospheric Administration's NMFS as cooperating agencies, to evaluate the potential environmental impacts of multiple G&G activities within Federal waters of the Gulf of Mexico's OCS and adjacent State waters.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
Alabama Department of Environmental Management	ADEM-1	On behalf of the Alabama Coastal Area Management Program (ACAMP, the Alabama Department of Environmental Management (ADEM) reviewed BOEM's draft Supplemental EIS 2018 for the referenced proposed five-year lease sale for activities in the Gulf of Mexico. This five-year plan includes Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261. The ADEM supports the leasing of any unleased blocks in the Gulf of Mexico except those blocks which are within 15 miles of the Baldwin County coastline. Alabama's Governors have consistently opposed the sale of those leases. In addition, the ADEM requests BOEM require adequate protection for the live bottom areas, pinnacle reefs, chemosynthetic communities, and other sensitive environments in the OCS off Alabama's coast.	As noted in the Alabama Department of Environmental Management's letter, the Governors of Alabama have historically indicated opposition to new leasing south and within 15 mi (24 km) of Baldwin County; however, they have requested that, if the area is offered for lease, a lease stipulation to reduce the potential for visual impacts be applied to all new leases in this area. Protective measures are in place to mitigate the potential impacts to the areas south of Baldwin County and to the biologically significant bottom-founded marine communities and archaeological resources. Coordination requirements are described in the Blocks South of Baldwin County, Alabama and Topographic Features Stipulations (which can be found in Appendix D of the 2017-2022 GOM Multisale EIS), and in the resource analyses in **Chapter 4**. In addition, during postlease reviews, BOEM and BSEE have a suite of mitigations that are included as conditions of approval, as the site-specific conditions warrant. Examples of such relevant postlease mitigations might include, but is not limited to, prohibiting discharges near sensitive live bottom habitats (e.g., chemosynthetic communities), anchoring restrictions, distancing requirements, and remotely operated vehicle surveys. Appendix B of the 2017-2022 GOM Multisale EIS provides more detail on the suite of applicable mitigations that could be applied to protect the areas of concern presented in your comment.
Charles Frey	CF-1	PRESERVE THE MILITY TRAING AREA IN THE EASTERN GULF.	The Military Areas Stipulation is discussed in Chapter 2.2.4.1 and outlined in Figure 2-8 of the 2017-2022 GOM Multisale EIS, from which this Supplemental EIS tiers. The Military Areas Stipulation has been applied to all blocks leased in military areas since 1977 and reduces potential impacts, particularly in regards to safety, but it does not reduce or eliminate the actual

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			physical presence of OCS oil- and gas-related operations in areas where military operations are conducted. The stipulation contains a "hold harmless" clause (holding the U.S. Government harmless in case of an accident involving military operations) and requires lessees to coordinate their activities with appropriate local military contacts. The Assistant Secretary for Land and Minerals Management will make a decision to apply stipulations to leases, and those prelease mitigating measures are disclosed in the Record of Decision for that particular lease sale. Those stipulations become enforceable provisions of the lease and are enforced by BSEE through their rigorous inspection program.
Topic 8 – Regulations and Safety			
Center for Biological Diversity, Sierra Club, Gulf Restoration Network, Louisiana Bucket Brigade	CBD,SC,GRN, LBB-12	The Draft SEIS fails to consider the failure of the Bureau to reform safety and environmental oversight of offshore oil and gas development in the Gulf of Mexico. On one hand, numerous recommendations to improve regulation of the industry have never been implemented. On the other hand, voluntary measures to promote a culture of safety have been ineffective. First, in 2017, the Government Accountability Office (GAO) expanded the high risk status of management of federal oil and gas resources to include the failure to institute needed safety and environmental reforms providing oversight of offshore oil and gas activities. The GAO investigation concluded that the safety and enforcement agency, the Bureau of Safety and Environmental Enforcement, had failed to make progress in improving its regulatory oversight—as needed after Deepwater Horizon oil spill. It found many problems including that the Bureau was still using deficient pre-Deepwater Horizon policies and procedures and that the environmental compliance	Thank you for your comment. In response to the *Deepwater Horizon* explosion and oil spill in the Gulf of Mexico in 2010, DOI launched the most aggressive and comprehensive reforms to offshore oil and gas regulation and oversight in U.S. history (USDOI, BSEE, 2016). The DOI has implemented a suite of regulatory changes following the *Deepwater Horizon* explosion, oil spill, and response. These changes are discussed in detail in Chapter 3.2 and Appendix A of the 2017-2022 GOM Multisale EIS. In addition, safety measures and technologies have improved since the *Deepwater Horizon* oil spill. A fact sheet on research and regulatory reforms can be found on BOEM's website at http://www.bsee.gov/About-BSEE/BSEE-History/Reforms/Reforms/. BOEM and BSEE will remain vigilant in instituting reform efforts and lessons learned since the *Deepwater Horizon* explosion, oil spill, and response. The findings in the Government Account Office's report concerning BSEE's operations are outside the scope of this Supplemental EIS because BSEE's

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		program had reversed course on actions taken to improve its oversight. The GAO made numerous recommendations that seek to address the Bureau's insufficient regulatory oversight of the offshore oil and gas industry. This new information must be disclosed and evaluated in the SEIS. Moreover, new research found that people would pay $17.2 billion in taxes for regulatory programs that would avoid an oil spill in the Gulf of Mexico. Second, past practice indicates that the industry lacks follow-through on environmental and safety programs. For example, the Bureau of Safety and Environmental Enforcement reports that its effort to improve safety through voluntary industry self-reporting of near-miss incidents has failed. It noted a lack of industry interest in the program and found that the only reports were those that were made mandatory. Another example is the chronic problem of companies failing to decommission old platforms, a problem that prompted a 2016 increase in financial assurances for decommissioning via NTL No. 2016-N01 – a notice repealed by President Trump. Third, President Trump issued an Executive Order that seeks to expand leasing and rollback regulatory oversight of offshore oil and gas. The Order directs the Secretary of Interior to review the blowout preventer rule, the financial assurance bonding rule, and a rule addressing air pollution. These actions could increase the environmental impacts of offshore oil and gas development as well as increase the risk of a catastrophic oil spill, which must be analyzed here. Fourth, reliance on mitigation to reduce environmental impacts on protected species is misplaced because expert protected species	operations are outside of the leasing process. However, BOEM acknowledges your concerns and recommends that you contact BSEE directly regarding your concerns. In response to the third comment, BOEM is aware of changing regulations under a new administration. However, the analysis conducted for the 2018 lease sale was performed under the current 2017-2022 Five-Year Program. The information used to conduct these analyses was the best available information at that time. In reference to the fourth comment concerning protected species, BOEM and BSEE have submitted Biological Assessments to NMFS and FWS, and are actively engaged with them in consultation concerning all of our past and reasonably foreseeable future activities. Until the above-mentioned NMFS' formal consultation is complete, BOEM is under an interim consultation agreement with NMFS with all terms and conditions being followed. The determinations within this Supplemental EIS are required under NEPA to help inform the decisionmaker at the lease sale stage and are not necessarily for the determinations under the ESA or Marine Mammal Protection Act. The NMFS and FWS understand the types and levels of activities that BOEM is engaged in and have not raised concerns with our ongoing activities. They are fully informed of the potential impacts identified in this Supplemental EIS as well as in the Biological Assessments. Furthermore, the Protected Species Stipulation, if applied, would require already existing terms and conditions and mitigations implemented to protect species at the lease sale stage. As the stipulation notes, BOEM and BSEE can condition approval of any postlease authorization or permit on compliance with the most current mitigations or

Table E-1.   Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		evaluations have yet to be completed to prescribe and recommend necessary mitigation. The biological opinion on the impact of offshore oil and gas activities in the Gulf of Mexico is woefully outdated since consultation took place before the Deepwater Horizon oil spill caused an enormous toll on the Gulf's wildlife and habitat. Recognizing that it had a duty to reinitiate consultation, the Bureau did so more than seven years ago in 2010. Section 7 consultation is required for "any action [that] may affect listed species or critical habitat." Once the action agency has initiated formal consultation, the Service is required to complete a biological opinion on the impacts of that proposed action. If the Service determines the agency action is likely to jeopardize the continued existence of a listed species or result in adverse modification, the biological opinion must suggest "reasonable and prudent alternatives" which would reduce action-related impacts such that the agency action may avoid jeopardizing listed species. Absent the completion of such consultation, the Bureau's Draft EIS is invalid with respect to its conclusions on threatened and endangered species. Similarly, the industry takes marine mammals in violation of the Marine Mammal Protection Act. Only by going through the requisite process for compliance can the Bureau rely on mitigation to reduce and avoid impacts to marine mammals. In issuing an "incidental take" authorization, the Service must prescribe methods and means of affecting the "least practicable adverse impact" on the species or stock and its habitat. According to the courts, the least practical adverse impact requirement is a stringent standard. The least practicable adverse impact mandate is "an independent threshold statutory requirement" that must be met in addition to the requirements that "take" authorizations have only a	requirements to protected listed species or habitats at the time. The staged OCSLA decisionmaking and approval process ensures that BOEM and BSEE can require additional protected species protections after leases are issued. Refer to **Chapter 5.8** for more information on the ESA consultations. In addition, refer to the response to Comment USFWS-1, which indicates that FWS is developing a Biological Opinion for BOEM on the effects of oil and gas leasing, exploration, development, production, decommissioning, and all related activities in the Gulf of Mexico OCS within existing lease areas and those proposed for future leasing in the WPA, CPA, and EPA through the year 2022.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		negligible impact and be only for small numbers of marine mammals. Additionally, post-Deepwater Horizon research shows that oil spill response for marine mammal stranding was insufficiently prepared, and that there was a significant lack of people with adequate training.	
Peter Shrock	PS-3	Additionally, the feds have failed to adopt reforms that address the safety and environmental risks since the Deepwater Horizon oil spill. A 2016 General Accounting Office report found that the Bureau of Safety and Environmental Enforcement (BSEE) "has not fully addressed deficiencies in its investigative, environmental compliance, and enforcement capabilities identified by investigations after the Deepwater Horizon incident" and that BSEE is still using "pre-Deepwater Horizon policies and procedures." Among other things, this means that our environment and offshore workers are still facing significant, unacceptable dangers.	Thank you for your comment. The findings in the Government Account Office's report concerning BSEE's operations are outside the scope of this Supplemental EIS because BSEE's operations are outside of the leasing process. However, BOEM acknowledges your concerns and recommends that you contact BSEE directly regarding your concerns.
Jackie Antalan	JA-4	This lease sale should be canceled until such time as BOEM will adequately analyze the impacts of offshore drilling, including safety requirements for public safety and public health. Further, the lease sale should be canceled based on the GAO report that found that BSEE has not fully addressed the deficiencies of the BP oil spill and further leasing put coastal rural underserved communities at risk for public safety which includes air and water pollution.	
Bill McBride	BM-2	We cannot trust profit-driven oil companies to drill safely. BP cut corners to save money.	The BSEE promotes compliance with safety and environmental standards through regular inspections and other monitoring activities, timely notice to operators of detected violations, clear direction for coming into compliance, and a reasonable opportunity for improvement. The BSEE's intent is to prevent incidents; however, should they occur, BSEE has a duty to investigate, to determine the causal elements/factors, and to take the appropriate
M. Fleming	MF-2	No amount of safety measures could be put in place to make these leases a good idea.	
Jodi Koszarek	JK-3	Please do not further erode the health of our Gulf of Mexico! After suffering through the BP disaster, it is difficult to express my dismay at the prospect of millions of more acres of the gulf falling victim to an industry who does not regulate itself especially with	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		today's deregulation atmosphere in DC. The people who live along the shores of the Gulf of Mexico deserve better not to mention the myriad wildlife that live in the sea and along the shore that this industry has a history of decimating.	corrective actions. Refer to Appendix A.4 of the 2017-2022 GOM Multisale EIS for more information on BSEE's inspection and enforcement responsibilities, as authorized by the OCSLA.
Jackie Hartstein	JH-2	We're also losing ground with the EPA and -- what is it? -- the National Ocean Atmospheric -- BOEM Representative: Administration. MS. HARTSTEIN: -- Administration is taking a hit. So who's going to help us when there is a problem? And I don't like to call them accidents, because, to me, my puppy has accidents. An oil spill is not an accident. It's a big deal. And there's nobody to really police them, even though I heard about BES and I'm great -- it's a great thing, but day by day, a rich company does not do things to protect the environment. Time is money. If they don't want to do a safety precaution or a maintenance job, they're not going to do it. And I don't think the State of Florida can go into litigation with BP and win. I don't think we have the money to do that. But our state rep -- well, our representative to Washington, D.C., wants to do away with the EPA. So he wants like the State of Florida to give guidelines and protect us. Well, that's just more politics, and politics is part of what causes the accidents in my book, because we don't have enough people to really police these guys. And it's nobody's fault. Certainly not you all's fault.	In addition, after the *Deepwater Horizon* explosion and oil spill in the Gulf of Mexico in 2010, DOI launched the most aggressive and comprehensive reforms to offshore oil and gas regulation and oversight in U.S. history (USDOI, BSEE, 2016). The DOI has implemented a suite of regulatory changes following the *Deepwater Horizon* explosion, oil spill, and response. These changes are discussed in detail in Chapter 3.2 and Appendix A of the 2017-2022 GOM Multisale EIS. In addition, safety measures and technologies have increased since the *Deepwater Horizon* oil spill. A fact sheet on research and regulatory reforms can be found on BOEM's website at http://www.bsee.gov/About-BSEE/BSEE-History/Reforms/Reforms/. BOEM and BSEE will remain vigilant in instituting reform efforts and lessons learned since the *Deepwater Horizon* explosion, oil spill, and response.
Judy Fisher	JF-1	As a business person I was shocked and horrified by the Deep Horizon/Macondo Well blowout in April of 2010 that claimed 10 lives and destroyed the environment around it. I couldn't wrap my mind around the fact that neither industry or government had a clue or plan in place in how to react to the catastrophe.	As a result of the Oil Pollution Act of 1990 and the reorganization of the Bureau of Ocean Energy Management, Regulation and Enforcement into BOEM and BSEE, BSEE was tasked with a number of oil-spill response duties and planning requirements. Within BSEE, the Oil Spill Preparedness Division addresses all aspects of offshore oil-spill planning, preparedness, and response. Additional information
Judy Fisher	JF-2	It really hasn't been explained to the public how the	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		"reaction" would be different if another "accident" were to occur.	about the Oil Spill Preparedness Division can be found on BSEE's website at http://www.bsee.gov/About-BSEE/Divisions/OSPD/index/. Refer to Chapter 3.2.8.1 of the 2017-2022 GOM Multisale EIS for a more detailed discussion of BSEE's spill-response requirements and initiatives. The responsible party for covered offshore facilities must demonstrate oil-spill financial responsibility, as required by 30 CFR part 553. These regulations implement the oil-spill financial responsibility requirements of Title I of the Oil Pollution Act of 1990, as amended. Penalties for noncompliance with these requirements are covered at 30 CFR § 553.51 and in NTL 2008-N05, "Guidelines for Oil Spill Financial Responsibility for Covered Facilities." A covered offshore facility, as defined in 30 CFR § 553.3, is any structure and all of its components (including wells completed at the structure and the associated pipelines), equipment, pipeline, or device (other than a vessel or other than a pipeline or deepwater port licensed under the Deepwater Port Act of 1974) used for exploring, drilling, or producing oil, or for transporting oil from such facilities. The BSEE ensures that each responsible party has sufficient funds for removal costs and damages resulting from the accidental release of liquid hydrocarbons into the environment for which the responsible party is liable. More information on oil-spill response plan regulations and processes can be found in Appendix A.5 of the 2017-2022 GOM Multisale EIS. In response to the *Deepwater Horizon* explosion and oil spill in the Gulf of Mexico in 2010, DOI launched the most aggressive and comprehensive reforms to offshore oil and gas regulation and oversight in U.S. history (USDOI, BSEE, 2016). The DOI has implemented a suite of regulatory changes following
Judy Fisher	JF-3	Does the oil exploration industry and the federal government know for certain that another disaster would not occur and if it did that any entity would know how to respond.	
Judy Fisher	JF-4	Why do we need to try mitigate a disaster when we should have knowledgeable people who can implement regulations that will prevent a disaster?	
Judy Fisher	JF-5	The fact that permits were issued for the exploration of this well without adequate emergency plans in place should be an embarrassment for the industry and for our regulatory agencies.	
Judy Fisher	JF-6	The other issue is that industry was relied upon to solve the problem (after the fact) that they created with their negligence but really it is the regulators who were negligent in not anticipating such a disaster could occur and require the proper mechanisms are in place to prevent unprecedented loss of life and damage and death to the environment.	
Judy Fisher	JF-7	We are learning that a clean environment is invaluable and that we do not have the technology mitigate a disaster and bring our environment back to a clean state in a human life span.	
Judy Fisher	JF-8	I ask the BOEM to provide to the general population the information that explains how we can now trust that these types of disasters will be prevented in the future before more auctions are held and more permits are issued.	
Bud See	BuSe-1	But I am just an ordinary citizen with no money, so government officials ignore me and cater to the millionaires and the big corporations. Now, my state government requires me to have liability insurance before I can drive my car. We know that several offshore oil wells have had problems, and millions of gallons of crude oil have leaked into the oceans and	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		the Gulf of Mexico. If the federal government insists on allowing companies to drill for offshore oil, it should require the oil company to post a multimillion-dollar bond that is great enough to cover the following costs: Repair the break, Scoop up the spilled crude, Rescue as many whales, dolphins, turtles, fish, shrimp, and birds as possible. Yes, this would make the offshore oil drilling too expensive for a small, mom-and-pop company to pursue--but we SHOULD NOT have small companies drilling for offshore oil!!!! The Deepwater Horizon oil spill demonstrated to us what a great danger is involved in offshore oil drilling. Before any company embarks on such a risky business venture, that company should guarantee that it will pay the cost of repairing the damage that it might inflict upon our coast. The oil company stands to make millions of dollars in profits from the offshore oil, so it should be willing to guarantee that it will pay the cost of repairing its possible damage.	the *Deepwater Horizon* explosion, oil spill, and response. These changes are discussed in detail in Chapter 3.2 and Appendix A of the 2017-2022 GOM Multisale EIS. In addition, safety measures and technologies have increased since the *Deepwater Horizon* oil spill. A fact sheet on research and regulatory reforms can be found on BOEM's website at http://www.bsee.gov/About-BSEE/BSEE-History/Reforms/Reforms/. BOEM and BSEE will remain vigilant in instituting reform efforts and lessons learned since the *Deepwater Horizon* explosion, oil spill, and response.
John Warden	JW-1	Risk management practices within the offshore drilling and production industries have proven to be inadequate. Cost-benefit analyses cannot adequately account for the complexity of environmental, economic and societal costs of a major spill which is a certainty -- not an If, only a When.	
Topic 9 – Other			
David Quist	DQ-7	US gas production is booming - it is not credible, under current market conditions, to expect increased imports under alternative E.	Oil from the Gulf of Mexico OCS contributes to meeting domestic demand and enhances national economic security. Although peak OCS production may not occur until some point in the future, oil and gas production is still necessary to bridge to a balanced, or even different, energy future. Over the
Maggi Roberts	MaRo-5	There are ample reserves that oil and gas companies can tap into from previous oil and gas leases so allowing this activity to continue is	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		unnecessary in 2018.	next 20 years, the U.S. Dept. of Energy's Energy Information Administration expects the U.S. to rely on more oil and natural gas to meet its energy demands, even as alternative sources of energy provide an increasing share of U.S. energy needs. Since the U.S. is expected to continue to rely on oil and natural gas to meet its energy needs, a proposed action would contribute to meeting domestic demand. The OCS is a major long-term supplier of crude oil and natural gas, and the Gulf of Mexico OCS region has the greatest resource potential of the four OCS regions in the United States. The determination of the U.S. energy needs is based on the U.S. Dept. of Energy's Energy Information Administration's 2016 demand projections and is discussed in detail in the 2017-2022 Five-Year Program. The Energy Information Administration is the principal Federal agency responsible for collecting, analyzing, and disseminating energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. The Energy Information Administration forecasts future energy demand and supply based on current laws and regulations. BOEM relies on special runs performed by the Energy Information Administration's National Energy Modeling System (NEMS) to feed its MarketSim model that, in turn, is used to determine changes in energy demand and energy substitutes under the No Action alternative. The energy demand analysis from the 2017-2022 Five-Year Program EIS is incorporated into this Supplemental EIS through the tiering process. This Supplemental EIS analyzes environmental and economic impacts and benefits for the alternatives, including the proposed action and No Action
David Gorchov	DaGo-2	The risks are not worth it. We have a glut of oil and gas from hydraulic fracturing on inland sites.	
Mobile Environmental Justice Action Coalition	MEJAC-6	Also, given the glut oil market we are in where petrochemical export options are being actively explored, Alternative E would not significantly deprive the market of a supply to meet its short-term demands.	
Bill McBride	BM-3	With huge reserves elsewhere, why take this terrible risk! No Leases.	
Alicia Cooke	AC-4	BP predicts a peak oil demand in the 2040's with assets likely to be stranded after that point (https://resourcegovernance.org/blog/oil-companies-face-stranded-assets-producercountries-have-it-worse).	
Ryan Bowman	RB-3	It does not make sense to open new offshore oil sites when the oil industry will begin to wane in the near future.	
Mobile Environmental Justice Action Coalition	MEJAC-3	Data related to the amount of petrochemical mineral stock processed at Gulf refiners or stored at Gulf transport facilities from OCS leased properties should be tracked not just to monitor environmental justice and human health impacts but also account for how much, if any, product is being exported abroad.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

<table>
<tr><th>Commenter</th><th>Comment ID</th><th>Comment</th><th>Response</th></tr>
<tr><td></td><td></td><td></td><td>alternative (i.e., no new leasing).</td></tr>
<tr><td>Consumer Energy Alliance</td><td>CEA-2</td><td>CEA understands that, to meet our long-term energy needs, we will need access to all of our resources, including oil and natural gas, nuclear, solar, wind, and beyond. We also understand that oil and natural gas will continue to be a critical and dominant part of that mix for decades to come. The federal government understands this as well, as underscored by the Energy Information Administration's forecast that oil and natural gas will contribute just as much if not more to our nation's energy portfolio in 2040 than it did in 2016. In addition, the Interior Department has concluded that not holding Gulf of Mexico lease sales could cause billions of dollars in environmental and social costs, with imports having to replace the vast majority of foregone production.</td><td rowspan="3">Thank you for your comment. BOEM is working under President Trump's America First Energy Plan, which calls for energy policies that stimulate our economy, ensure our security, and protect our health. For more information, refer to The White House's website (The White House, 2017).

The decision on whether and how to proceed with each proposed regionwide lease sale is under the authority of the Assistant Secretary for Land and Minerals Management and will be disclosed in the Record of Decision following publication of this Final Supplemental EIS.

Further, commenters should be aware that any past or present commitments made by the U.S. concerning a reduction of GHG emissions (e.g., Paris Agreement) do not broaden the scope of the Bureau of Ocean Energy Management's NEPA analysis at the lease sale stage or require BOEM to venture into analyzing the potential worldwide effect of GHG emissions that could result from a lease sale.</td></tr>
<tr><td>Beth Everage, Consumer Energy Alliance</td><td>BECEA-2</td><td>CEA understands that, to meet our long-term energy needs, we will need access to all of our resources, including oil and natural gas, nuclear, solar, wind, and beyond. We also understand that oil and natural gas will continue to be a critical and dominant part of that mix for decades to come. The federal government understands this as well, as underscored by the Energy Information Administration's forecast that oil and natural gas will contribute just as much if not more to our nation's energy portfolio in 2040 than it did in 2016. In addition, the Interior Department has concluded that not holding Gulf of Mexico lease sales could cause billions of dollars in environmental and social costs, with imports having to replace the vast majority of foregone production.</td></tr>
<tr><td>350 Louisiana - New Orleans</td><td>350LANO-1</td><td>Climate scientist tell us that a majority of all known fossil have to stay in the ground if we want to have a 50/50 chance avoid catastrophic climate change (McGlade, Ekins, Nature, 1/8/2015). The U.S. has signed the Paris Climate Agreement, pledging to cut</td></tr>
</table>

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
		emissions between 26 and 28% compared with 2005 levels by 2025. - Does BOEM agree that climate change is presenting a significant danger to our society and societies globally?	
Maggi Roberts	MaRo-6	We need to assess what gas and oil companies are doing to preserve and protect the ocean waters and how they contribute to stop the pollution of the Gulf of Mexico.	It is outside the scope of this Supplemental EIS to assess preservation activities conducted by industry. However, BOEM's mission is to "manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way." BOEM accomplishes this through responsible stewardship, science-informed decisions, and integrity and ethics. The Secretary of the Interior oversees the OCS Oil and Gas Program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained.
Jackie Antalan	JA-3	BOEM's supplemental EIS does not fully or clearly comply with the law. BOEM still continues to forget that its mission is to protect the public and the interests of the United States as opposed to private foreign corporations.	The OCSLA provides the Congressional mandate for BOEM to make "available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs" the land of the Federal OCS. The Secretary of the Interior oversees the OCS Oil and Gas Program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained. BOEM places a significant emphasis on public input and scientific analysis, which are critical to safe exploration and development of offshore resources. Public comment is solicited in our environmental review programs for both oil and gas and renewable
Jackie Antalan	JA-6	It is BOEM's responsibility, again, to protect the public, to keep the public fully informed of the risks and the benefits of oil and gas leases. In as much, there are limited benefits and numerous risks, these lease sales should be canceled.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			energy proposals. Plans submitted by industry are subject to rigorous scientific review to ensure that environmental safeguards are the foundation of all offshore energy development. Mitigating measures are an integral part of BOEM's program to ensure that postlease operations are conducted in an environmentally sound manner (with an emphasis on minimizing any adverse impact of routine activities on the environment). BOEM assigns site-specific mitigation by imposing conditions of approval on a plan, permit, or authorization. Appendix A of the 2017-2022 GOM Multisale EIS discusses BOEM's rigorous postlease process, and Appendix B of the 2017-2022 GOM Multisale EIS describes over 120 standard mitigations that may be required by BOEM or BSEE as a result of the plan and permit review processes for the Gulf of Mexico OCS Region.
Jackie Antalan	JA-7	Please consider these comments, ensure that all department heads all the way up to the secretary receives this information. I appreciate this opportunity to comment.	BOEM considers all comments received during the public comment period and addresses those comments in the Final EIS. BOEM follows/implements a transparent NEPA process to ensure that all stakeholders (i.e., Federal and State agencies [comments and consultations], Tribes, nongovernment organizations, industry, and public comments/ concerns) are aware of and are a part of the process. There are numerous opportunities for stakeholder involvement throughout the Bureau of Ocean Energy Management's NEPA process. The NEPA documents and analyses incorporate all relevant and important input from all stakeholders that was received during scoping and public comment periods. While BOEM considers and evaluates all substantive relevant comments from the public, this remains a BOEM document meant to inform the decisionmaker and the public of reasonably foreseeable impacts from

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			a proposed action and its alternatives. BOEM employs a team of highly trained technical staff of subject-matter experts who develop the analyses based on rigorous scientific reviews, consultations with other Federal and State agencies, expert opinions, and all relevant and important stakeholder considerations. The Secretary of the Interior oversees the OCS Oil and Gas Program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained. The decision on whether or how to proceed with each proposed regionwide lease sale is under the authority of the Assistant Secretary for Land and Minerals Management and will be disclosed in the Record of Decision following publication of this Supplemental EIS.
Bonnie Aylward	BA-2	I am worried about the waters in the Gulf of Mexico. I don't know if there is a connection between red tide and drilling.	There are many different species of harmful phytoplankton and many different types of harmful algal blooms, and to speculate as to which types would be enhanced or suppressed in the GOM due to oil and gas activity is unduly speculative and not possible at this time.
Bonnie Aylward	BA-3	The debris on our shoreline is terrible.	NTL 2015-BSEE-G03, "Marine Trash and Debris Awareness and Elimination," presents BSEE's policy regarding marine debris prevention. "The discharge of garbage and debris has been the subject of strict laws, such as MARPOL-Annex V and the Marine Debris Act, 33 U.S.C. §§ 1951 *et seq.*, and regulations imposed by various agencies including the United States Coast Guard and the Environmental Protection Agency. Since oil and gas operations in the Gulf of Mexico may contribute to this problem,
Denise Folley	DeFo-1	I'm a longtime resident of the Gulf coast and would like to see an end to drilling in the Gulf. Not only because of potential spills and the pollution but because of all the trash that washes up on our beaches from the rigs and the boats serving them.	

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Commenter	Comment ID	Comment	Response
			30 CFR §§ 250.300(a) and (b)(6) prohibit you from discharging containers and other materials into the marine environment, and 30 CFR §§ 250.300(c) and (d) require you to make durable identification markings on skid-mounted equipment, portable containers, spools or reels, and drums, and to record and report such items when lost overboard to the District Manager through facility daily operations reports." However, BOEM acknowledges the fact that debris from OCS oil- and gas-related activities contributes to the debris found on coastal beaches. For example, this Supplemental EIS states that the offshore oil and gas industry was shown to contribute 13% of the debris found at the Padre Island National Seashore (Miller et al., 1995). However, this debris does not alter beach profiles, species composition and abundance, or ecological function beyond a minor extent.

Table E-1. Public Comments and BOEM's Response Matrix. (continued).

Corrected Version of Table H-5 of the 2017-2022 GOM Multisale EIS (**Table D-5** of this Supplemental EIS) for Comment USEPA-39

Simplified Sector	2012 Base Year (TPY)				Future Year Scenario (TPY)			
	NO_x	$PM_{2.5}$	SO_2	VOC	NO_x	$PM_{2.5}$	SO_2	VOC
Fugitive Dust	0	70,526	0	0	0	78,179	0	0
Agricultural	0	0	0	0	0	0	0	0
Fires	27,335	250,850	17,852	559,643	27,335	250,850	17,852	559,643
ALM	171,436	5,416	2,039	4,896	139,026	3,876	280	3,760
C3 CMV	68,857	3,650	36,339	2,466	72,701	2,280	25,033	3,059
Biogenic	19,015	0	0	3,140,424	19,015	0	0	3,140,424
Nonpoint	81,464	50,730	7,334	291,650	85,532	55,032	3,106	290,118
Nonroad	76,345	6,994	153	112,683	52,636	4,826	79	78,780
Area O&G	69,331	1,991	530	506,972	74,065	2,768	1,067	641,692
Onroad	270,364	8,467	1,731	145,061	183,305	7,124	940	106,904
Non-U.S. Fugitive Dust	0	0	0	0	0	0	0	0
Non-U.S. Area	38,832	4,361	719	15,208	35,625	4,429	502	16,787
BOEM Gulfwide	363,607	12,453	57,060	44,924	126,566	4,013	31,039	36,825
Non-U.S. Onroad	13,894	438	73	6,217	9,097	447	27	4,041
Non-U.S. Point (with GOM offshore platforms)	106,344	2,663	7,795	57,361	32,045	2,181	4,646	11,337
Point O&G	50,765	2,294	25,431	19,596	47,526	2,480	23,543	21,442
EGU Point	137,932	17,943	306,031	3,545	117,518	21,802	136,784	4,371
Non-EGU Point	159,962	52,632	135,981	104,387	172,040	60,413	134,595	120,106
BOEM OCS Platform No Action	0	0	0	0	84,351	837	3,205	54,449
BOEM OCS Platform w/Action	0	0	0	0	22,973	223	1,037	7,015
BOEM OCS Sup. Vessel No Action	0	0	0	0	232,765	8,224	22,977	7,936
BOEM OCS Sup. Vessel w/Action	0	0	0	0	88,637	8,144	341	8,345

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The Department of the Interior Mission

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The Bureau of Ocean Energy Management Mission

The Bureau of Ocean Energy Management (BOEM) is responsible for managing development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.