RESPONDING TO OIL SPILLS IN ARCTIC ENVIRONMENTS

Cost: $100K Kicked off: 09/2011 COR=Guillermo Auad

A Contract between BOEM and,

- **The National Research Council of the National Academy of Sciences**

STUDY: Identification of OCS Renewable Energy Space-Use Conflicts and Analysis of Potential Mitigation Measures (2009-2012)

Applied Research: Need to Identify and Understand Marine Space-Use and Related Conflicts

- Energy Policy Act 2005

- BOEM INFORMATION NEED: Decisions on lease sales for renewable energy development must consider potential space-use conflicts on the OCS

Applied Research: Objectives of Study

- Identify marine space users on the Atlantic and Pacific Coasts – emphasis on fishing and shipping
- Identify traditional space-use conflicts between users
- Identify potential conflicts between users and alternative energy development (esp. wind)
- Identify techniques/methods/approaches to conflict mitigation, avoidance and resolution

Major Deliverables and Due Dates

- Literature Synthesis – Completed (Draft)
- Geo-database – 2/12 Final
- Project Report (synthesized report incorporating all findings)– 2/12 Draft, 6/12 Final
- Draft Journal Article – 4/12 Draft, 6/12 Final

Data Collection

- Open-ended discussions, large group meetings
- Literature review and collection of geo-spatial information (state and federal agencies, non-profits, fishing councils)

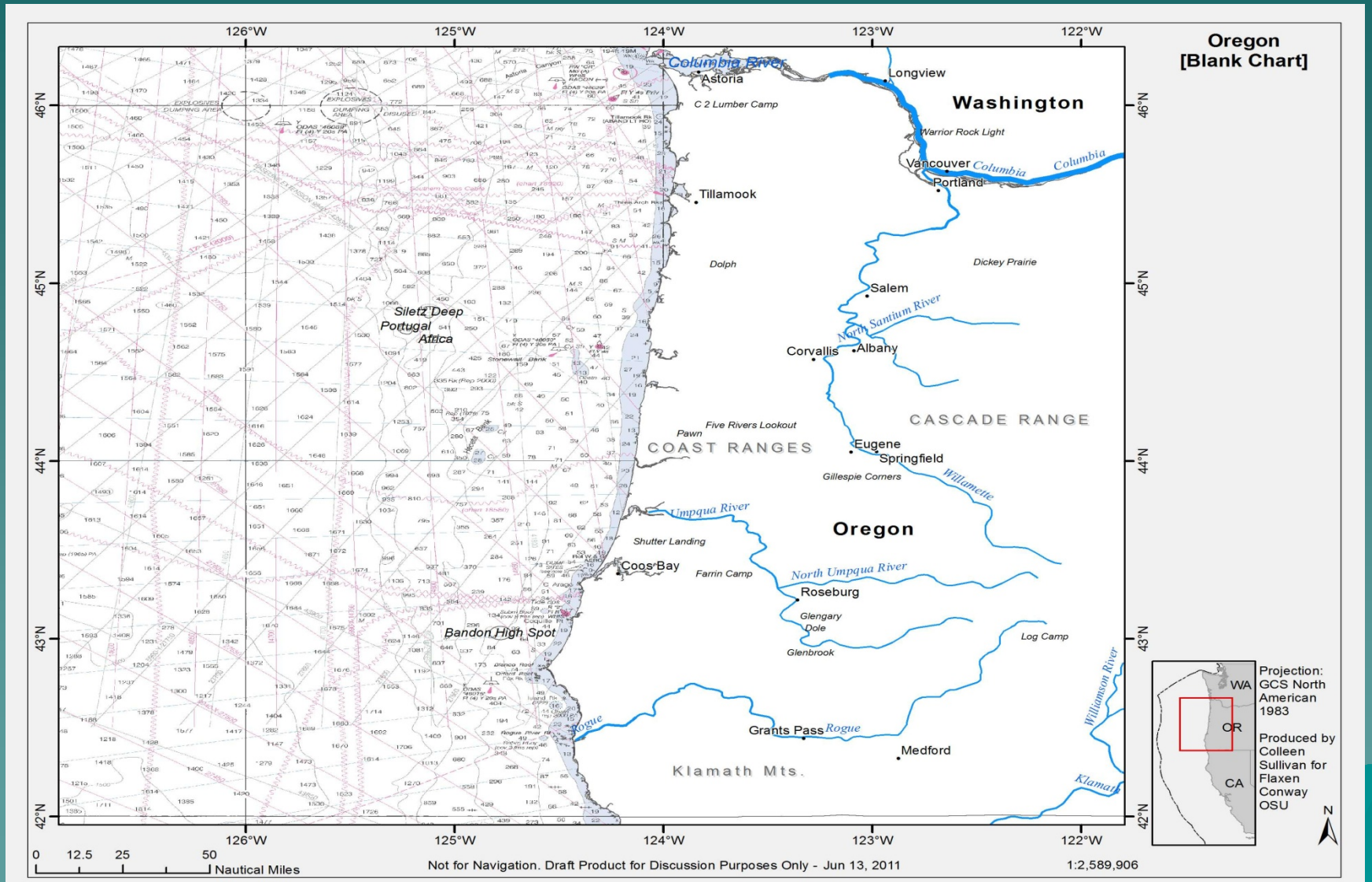
Preliminary Findings: Literature Review

- Underlying legal and institutional structures – heighten the potential for conflict
- CMSP appears to have done much to promote the resolution of space-use conflicts in European waters – conflict avoidance measure
- European “best practices” are transferable to U.S. state and federal waters; considerable adaptation of this material is required
- Attention to and investment in formal Environmental Dispute Resolution processes is needed for state and federal waters

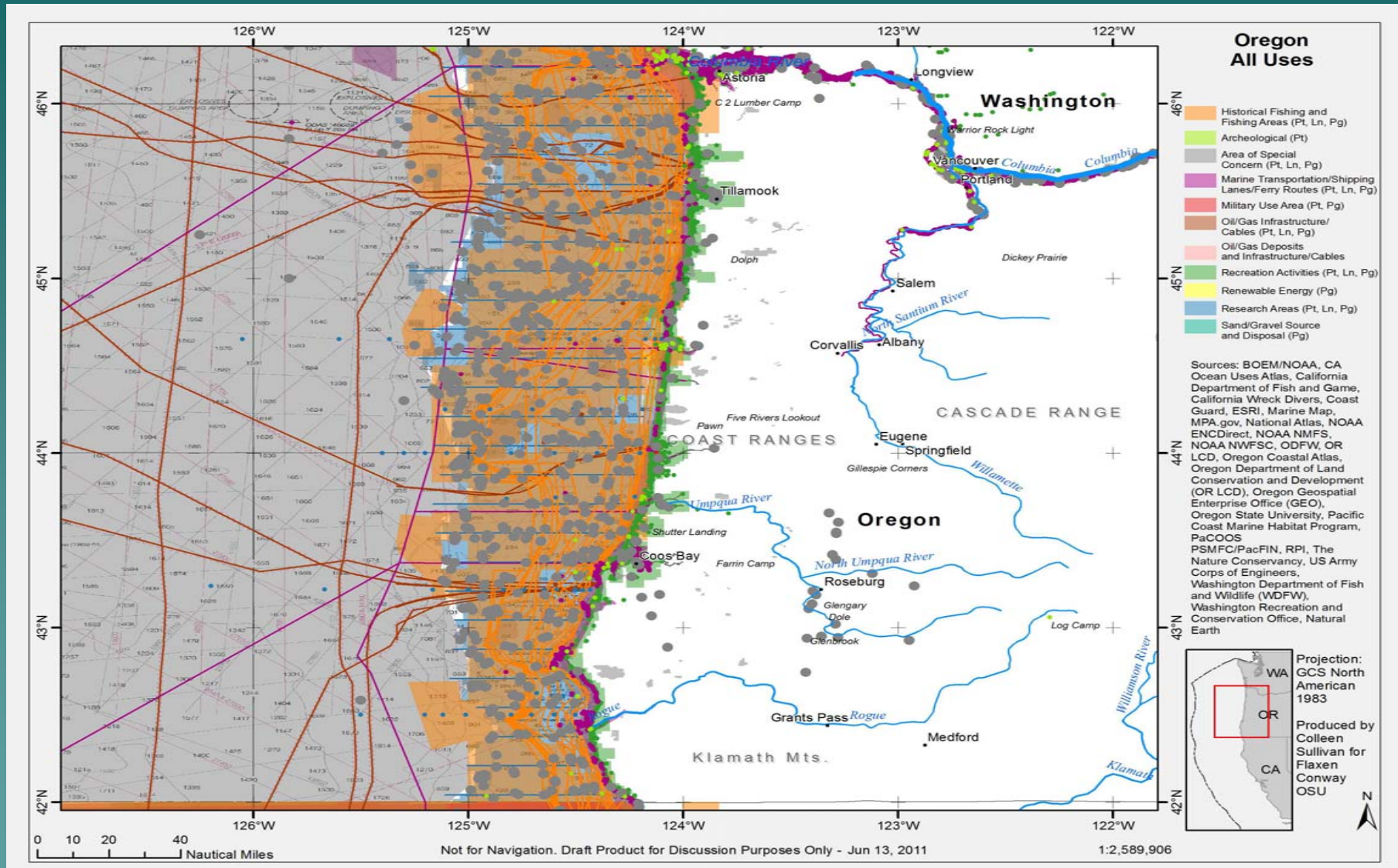
Preliminary Findings: Geo-Database

A GIS that enables the **clear visual representation of ocean users** and the **potential for space-use conflict with offshore renewable energy development** along the Atlantic and Pacific seaboards. This will **aid the environmental assessment process** by enhancing forecasting capabilities.

Preliminary Findings: Geo-Database – Open Frontier?



Preliminary Findings: Geo-Database



Final Report: Content, Utility and Organization

- **A Synthesized Report** – incorporating information on CMSP, the European experience, mitigation/avoidance measures, conflict resolution techniques, suggestions for enhanced communication based on literature and primary data.

- **A Desktop Tool** – intended particularly for use by BOEM's environmental assessment personnel; will also be useful to a diversity of audiences – Academia, NGO's, other agencies (state and federal)

- **Format** – project overview, methods, findings organized by region and stakeholder group (fishing, shipping and non-commercial uses), synthesis and recommendations

Journal Article

- **Focus:** TBD; pending findings in the ‘Draft Final Report’

Ongoing Physical Sciences Studies in support of the Marine Minerals Program

Geoffrey Wikel
Oceanographer
Division of Environmental Assessment

BOEM
Bureau of Ocean Energy Management

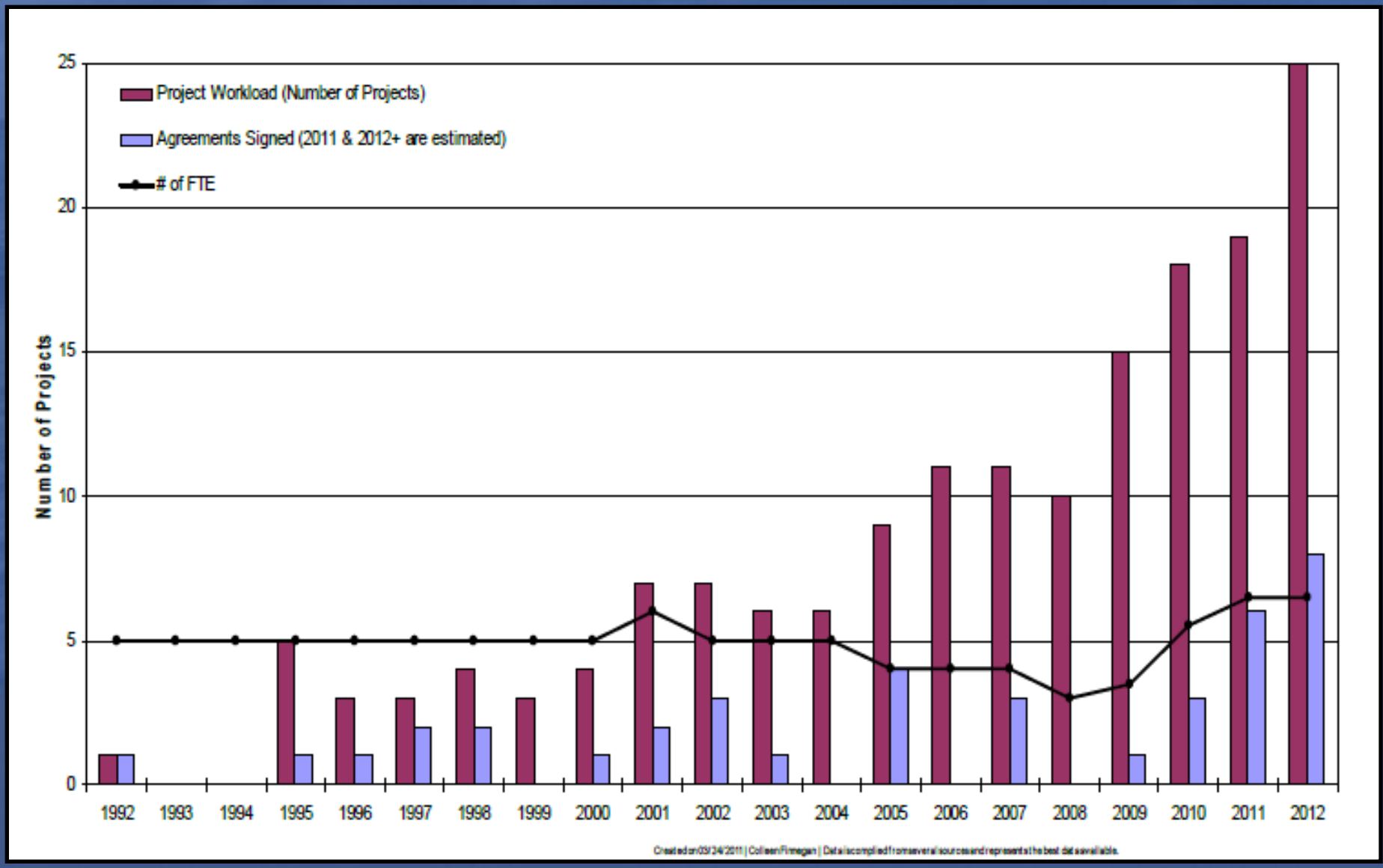
Marine Minerals Program (MMP)

- Noncompetitive leasing of OCS sand for use in shore protection, coastal restoration, qualifying construction projects
- Projects in New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Florida, and Louisiana
  - National defense and space program installations
  - Habitat restoration
  - Storm damage and infrastructure protection
  - Recreation improvement

MMP Accomplishments

- Over the past 20 years, the Program has…
  - Conveyed ~60 million cubic yards of OCS sand, replenishing/restoring ~175 miles of coastline
  - Prepared > 30 supporting NEPA documents and > 40 environmental studies (> $12 million)

Demand for OCS Sand Resources



Improving Emission Estimates and Understanding of Pollutant Dispersal

Objectives:

- define operational characteristics, activity profiles, loading factors, and emission factors for equipment by operational phase

- develop a tool to estimate emissions using accepted U.S. EPA methods –project emission estimates are adaptable for use with regional inventories

- characterize space and time scales of plume transport and dispersion

Improving Emission Estimates and Understanding of Pollutant Dispersal

- Research Team:
  - ENVIRON (air quality, meteorology, chemical engineering)
  - Woods Hole Group (coastal engineering, dredging practices)

- FY10 Award: ~$140,000

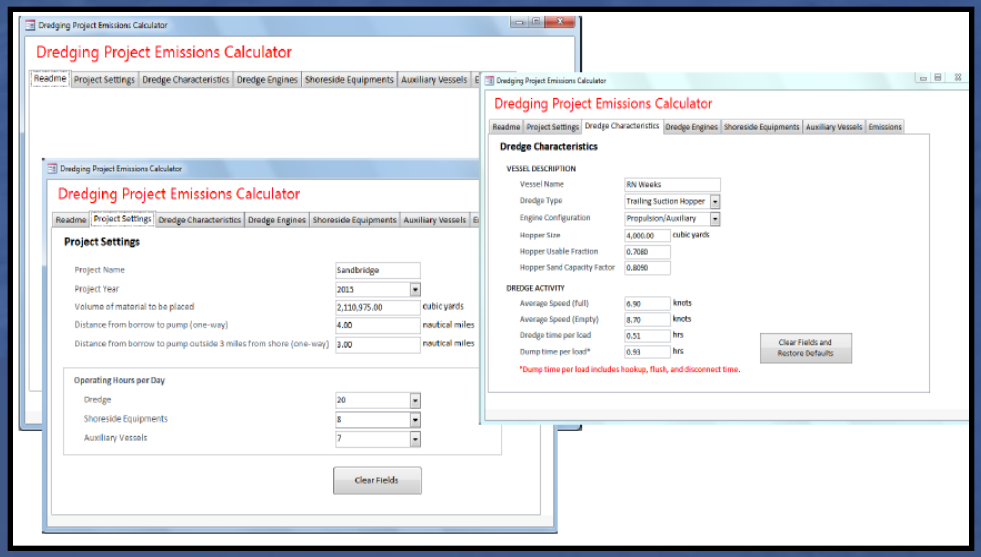
- Period of Performance: Oct. 2010 – Sept. 2012

Improving Emission Estimates and Understanding of Pollutant Dispersal

- Methods:
  - Collect operational data from U.S. dredge contractors. Analyze data to constrain operational characteristics, activity profiles, loading factors, and emission factors for dredge plants, support vessels, pumps, and land-based equipment
  - Program an Access I/O calculator to prepare emissions estimates
  - Model different project scenarios in the GOM/Atlantic with CalPUFF. Use existing met datasets representing seasonal variability. Estimate model uncertainty.

Improving Emission Estimates and Understanding of Pollutant Dispersal

- Status:
  - Compiled relevant data for four OCS projects (VA, SC, FL). Vetted information about operational characteristics, activity profiles, loading factors, and emission factors with dredge contractors and EPA
  - Completed initial programming, parameterization, and testing of the emissions inventory calculator



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National Oceanographic Partnership Program (NOPP)

a. Improving Wind Waves Prediction: Global to Regional Scales
b. Improving Tropical Cyclone Intensity Forecasting

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Improving Wind Wave Forecasting Systems (Models)

- Objectives:

  1. to develop new physics packages across a range of environments and conditions ;

  2. to develop a seamless transition from deep to shallow water;

  3. to embed new routine within the mission-specific prediction systems and produce hindcast data (WW III, STWAVE, WAN, SWAN, etc.).

Science Teams for Wind Wave Models

Wave dissipation Parameterization of wind wave and swell:

- **Fabrice Ardhuin (Ifremer, France)**
- **Mike Banner (UNSW, Australia)**

Input and Dissipation:

- **Alexander Babanin (Swinburne University of Technology, Australia)**

Nonlinear Interaction:

- **Will Perrie (Bedford Institute of Oceanography, Canada)**
- **Vladimir Zakharov (Waves and Solitons LLC, USA)**

Nearshore Processes:

- **Tim Janssen (San Francisco State University, USA)**
- **James Kaihatu (Texas A&M University) and Alexandru Sheremet (University of Florida)**
- **Gerbrant van Vledder (Delft University of Technology, with contributions from Shell)**

Teams from Government Laboratories

- NECP/NOAA (Hendrick Tolman and his team)
- USACE (Jane Smith and Jeff Hanson)
- NRL (Erick Rogers and David Wang)

Time Line and Progress
(Community Modeling Approach)

- Start proposed works and meet regularly
- Gathered a comprehensive set of validation data and archived at NCEP (test bed)
- Upgrade Physics of all systems
- Advance validation techniques
- Focus on test plan and exchange the results
- Develop unstructured grids on coast
- Set up subversion sever and wiki with full access to all NOPP members
- Generate 30 years hindcast wind and wave data

Outlook for the Program

- Cyclic development for NECP/NOAA path at 2014/2015 with:

  1. NOPP consensus physics available and implemented

  2. Coastal unstructured grids with fine resolution implemented and coupled with ADCIRC (NRL and USACE)

  3. Getting full ocean currents from operational global HYCOM model (NCEP/NOAA).

BOEM Information Needs
(Oil and Gas, Sand and Gravel, and Alternative Energy Programs)

- Wave dynamics and breaking statistics, coupling to the associated atmospheric and ocean circulation, and the fluxes across air-sea interface are needed for environmental and impact assessments.
- Modeling output and hindcast data are used in pollutant tracking and risk assessment, resource evaluation, site selection and safety operation.

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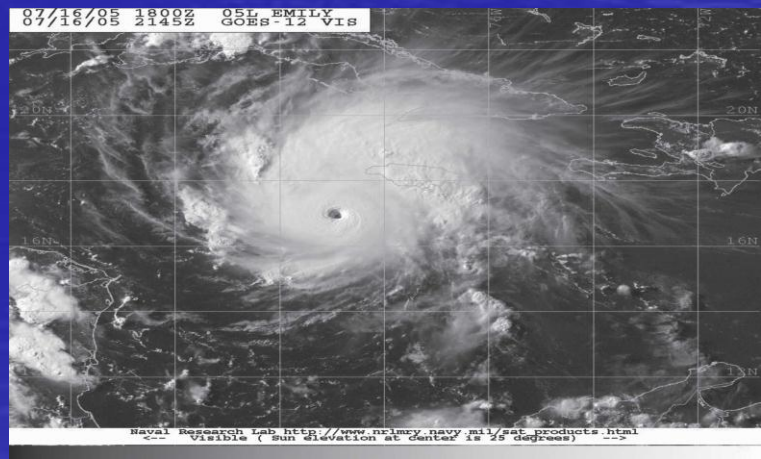
Improving Tropical Cyclone Intensity Forecasting

- Objectives:
  - Improved prediction capability in the atmosphere-wave-ocean-land interfaces;
  - Examine the new physics of tropical cyclone rapid intensification;
  - Prediction of mesoscale phenomena in the tropical cyclone system; and
  - Implement the module into NOAA's HWRF and Navy's COAMPS-TC coupled system.



Science Teams for Tropical Cyclone Intensification Program

Coupled Atmospheric-Wave-Ocean Models for TC Intensity:

- **Shuyi Chen/Rick Allard/Sue Chen of U Miami team**
- **Issac Ginis/Testu Hara of URI team.**

Theoretically based approach:

Wayne Schubert of CSU;
Yongsheng Chen of York U.

Data Assimilation:

Chris Velden of UWM;
Scott Tyo of UA
Michael Reeder of Monash U, Australian;
Takemesa Miyoshi of UM

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Teams from Government Laboratories

Navy:

- Naval Research Lab - West
- Naval Research Lab - South

NOAA:

- National Hurricane Center
- National Centers for Environmental Prediction

Time Line and Progress

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- To explore new physics in wind-wave-current coupling at the air-sea interface
- To develop new air-sea coupling parameterizations of the wind-wave-current interaction
- To develop and test the air-sea interface module in a multi-model
- To develop the statistical dynamical logistic growth equation model (LGEM) that include the relationship between surface and sub-surface ocean structure and tropical cyclone intensity change.
- To utilize the multiple satellite datasets in applications to TC structure/intensity prediction,
- To develop new data assimilation techniques to improve the performance of LETKF (Local Ensemble Transform Kalman Filter) and the WRF model.

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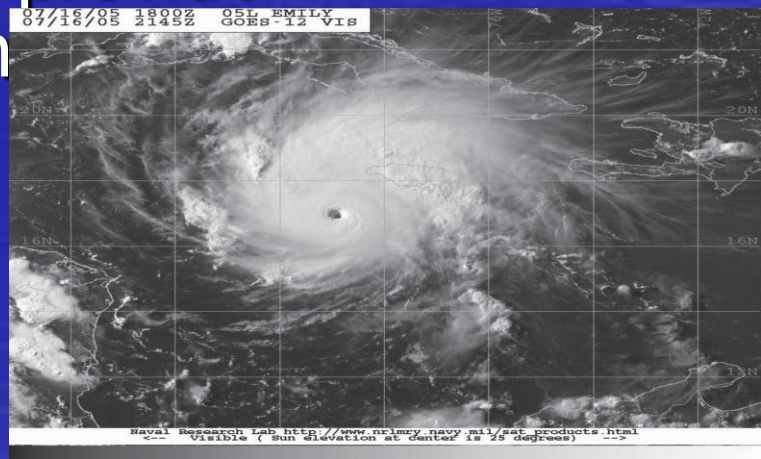
BOEM Information Needs

- Validated full coupled atmospheric-wave-ocean models in multi-model systems provides valuable tools to assess short and long terms environmental impacts;
- Modeling output shall be used to guide the development of control measures procedures to mitigate potential impact and provide information for safe operation in offshore environment.



Walter Johnson

BOEM
Bureau of Ocean Energy Management

Oil Spill Risk Analysis

Walter Johnson, Ph.D.
Division of Environmental Sciences

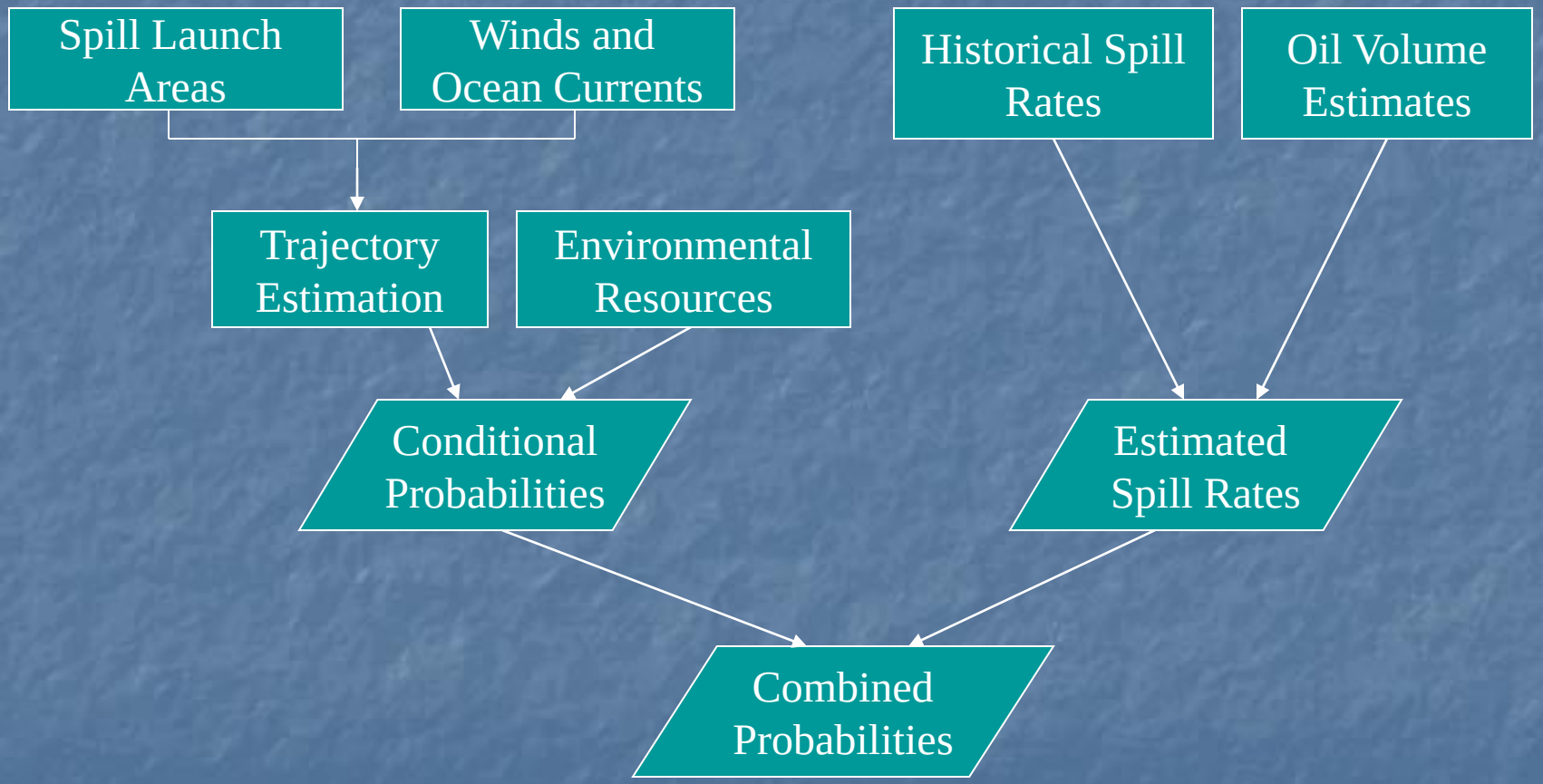
Oil Spill Research Program

- Physical Oceanography and Meteorology Studies
- Fate and Effects Studies of Oil Spills
- Ocean Circulation Modeling
- Remote Sensing of Ocean Properties

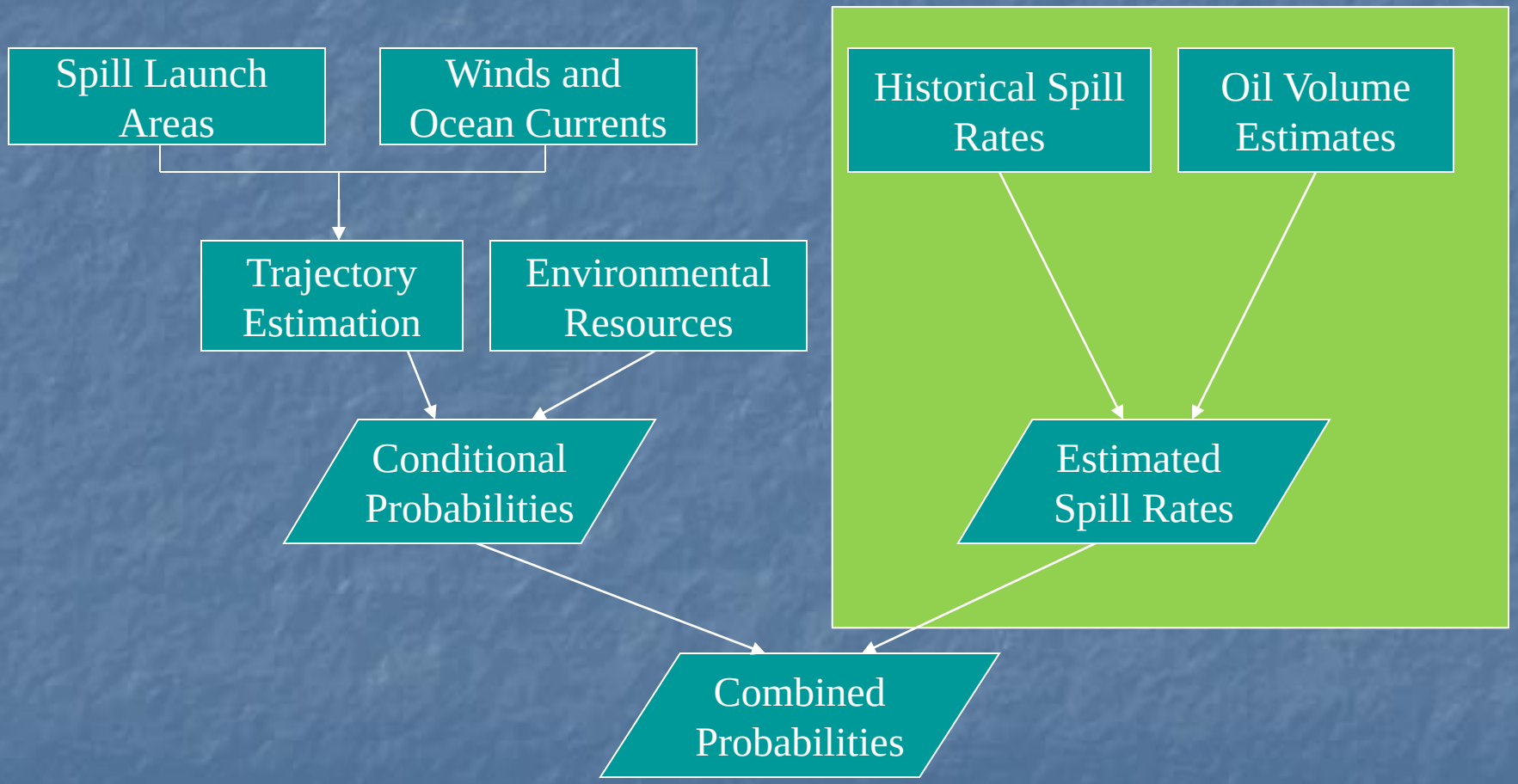
Oil Spill Modeling Program

- Bureau-wide Modeling of hypothetical Oil Spills: the OSRA model
- Uses the results of Physical Oceanography and Meteorology Studies and Ocean Circulation Modeling

OSRA Process



OSRA Process



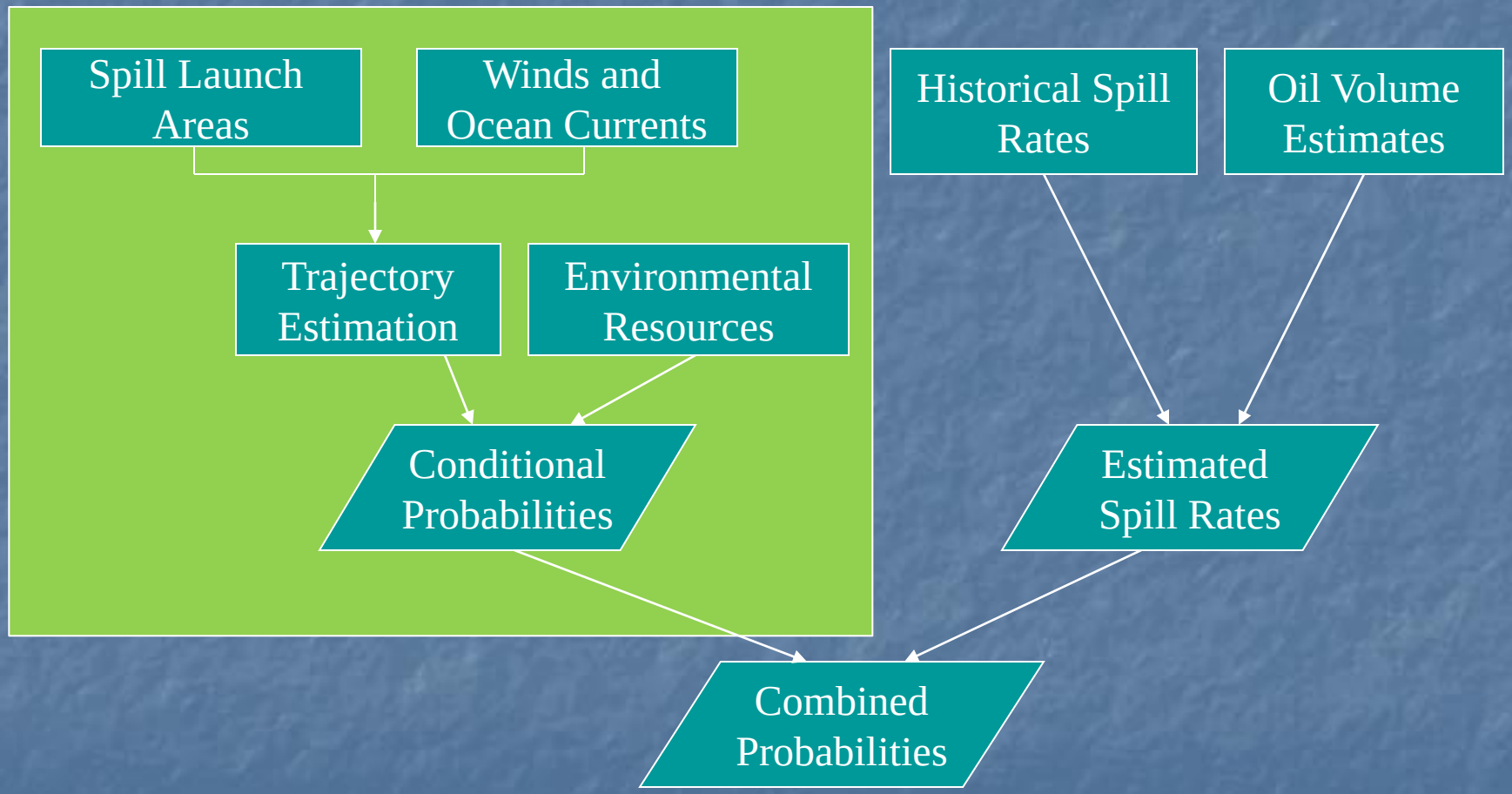
BOEMRE OSRA Oil Spill Occurrence Estimates

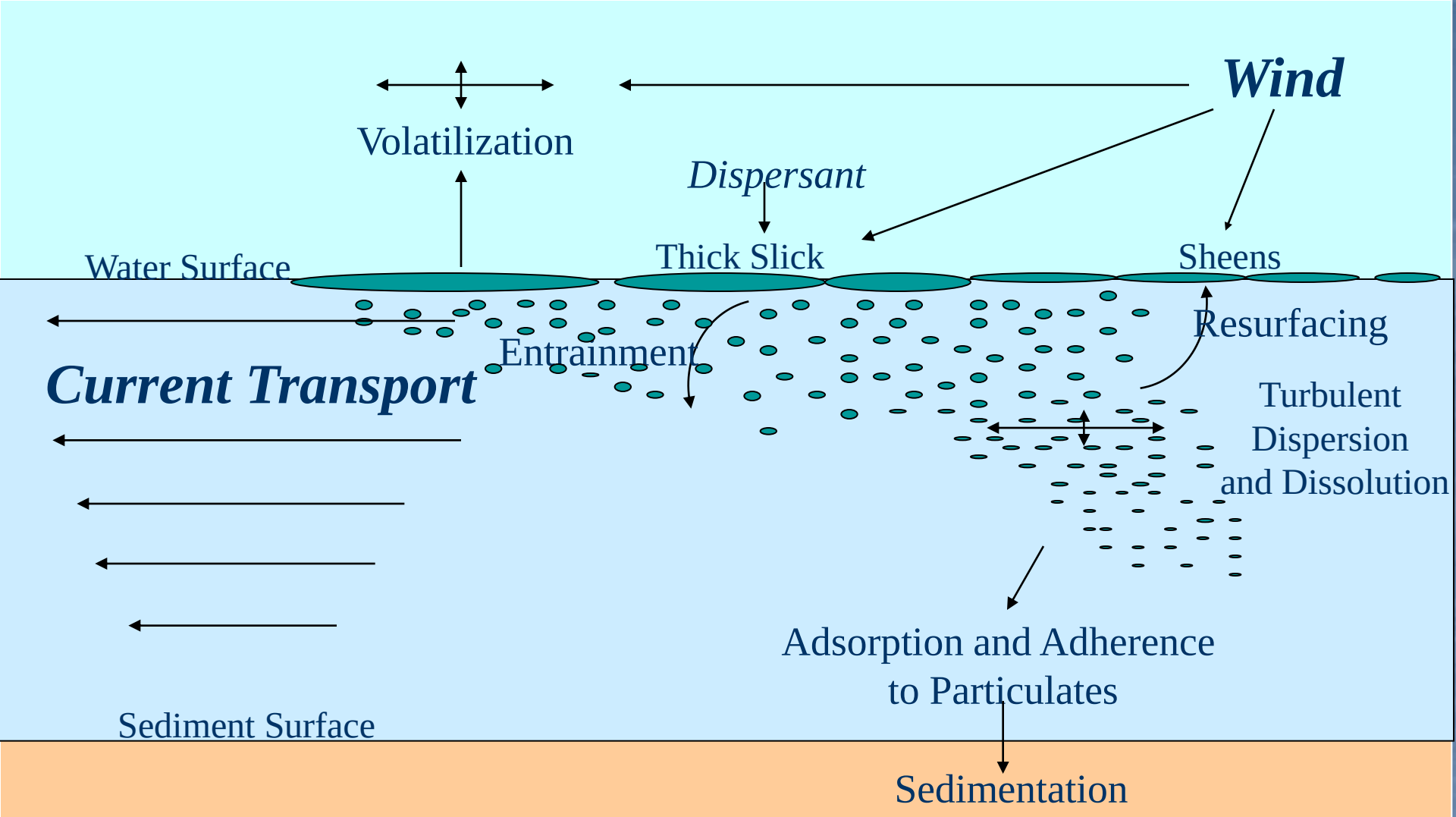
- Based on accident history
- For the Lease Sale estimated oil volume
- Scenario includes
  - Production locations (areas)
  - Transportation routes
- OSRA Report and Environmental Documents

Spill Rates: Spills per Bbbl Produced

	1964 - 1999 Anderson and LaBelle (2000)	1964 - 2010 Anderson (2011, in process)	1996 - 2010 Anderson (2011, in process)
Petroleum Spills ≥ 1,000 bbl			
U.S. OCS Platforms/Rigs	0.32*	0.32*	0.25
U.S. OCS Pipelines	1.33	0.99#	0.88
Petroleum Spills ≥ 10,000 bbl			
U.S. OCS Platforms/Rigs	0.12^	0.06*	0.13
U.S. OCS Pipelines	0.33	0.2^	0.18^

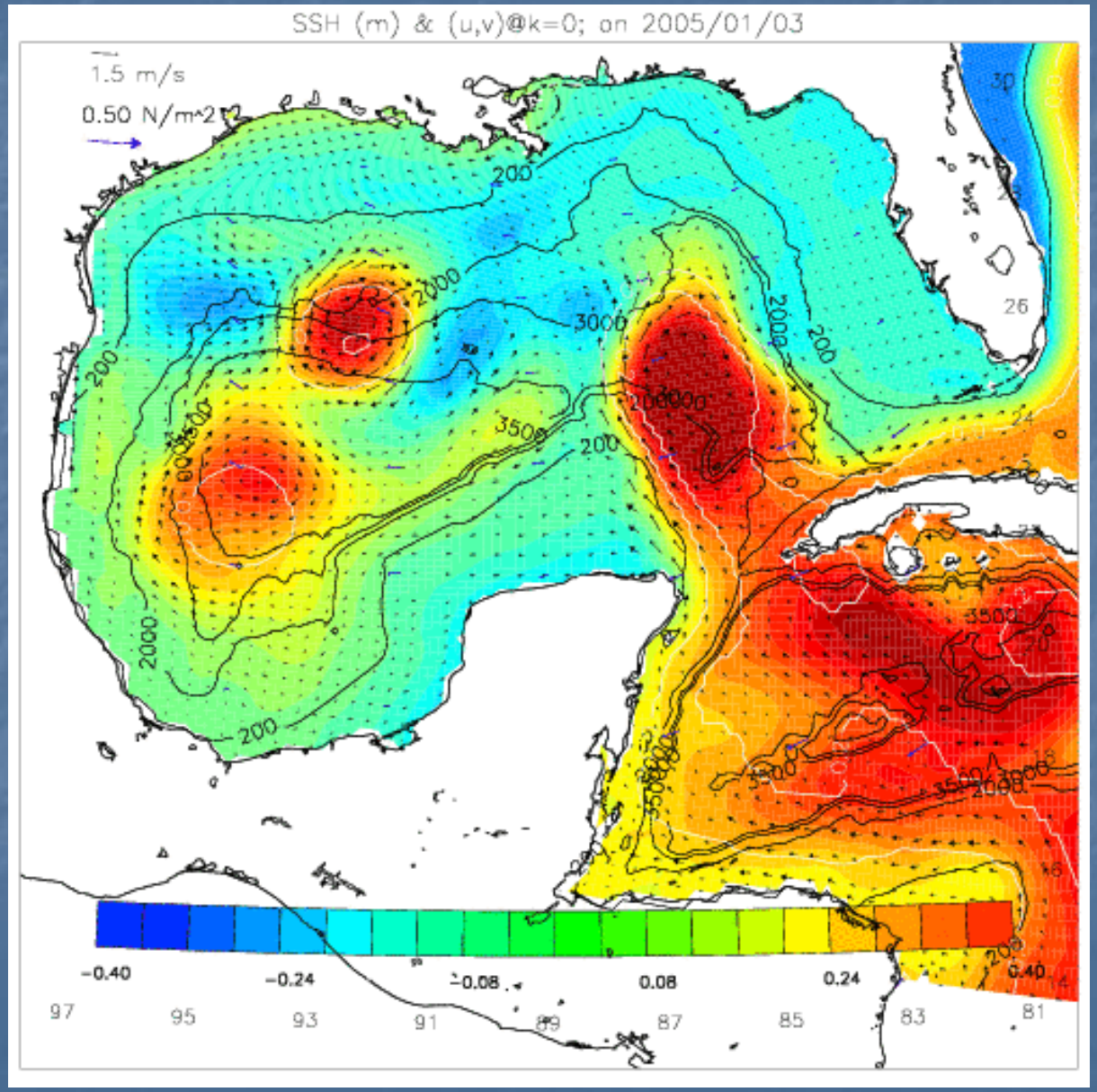
OSRA Process



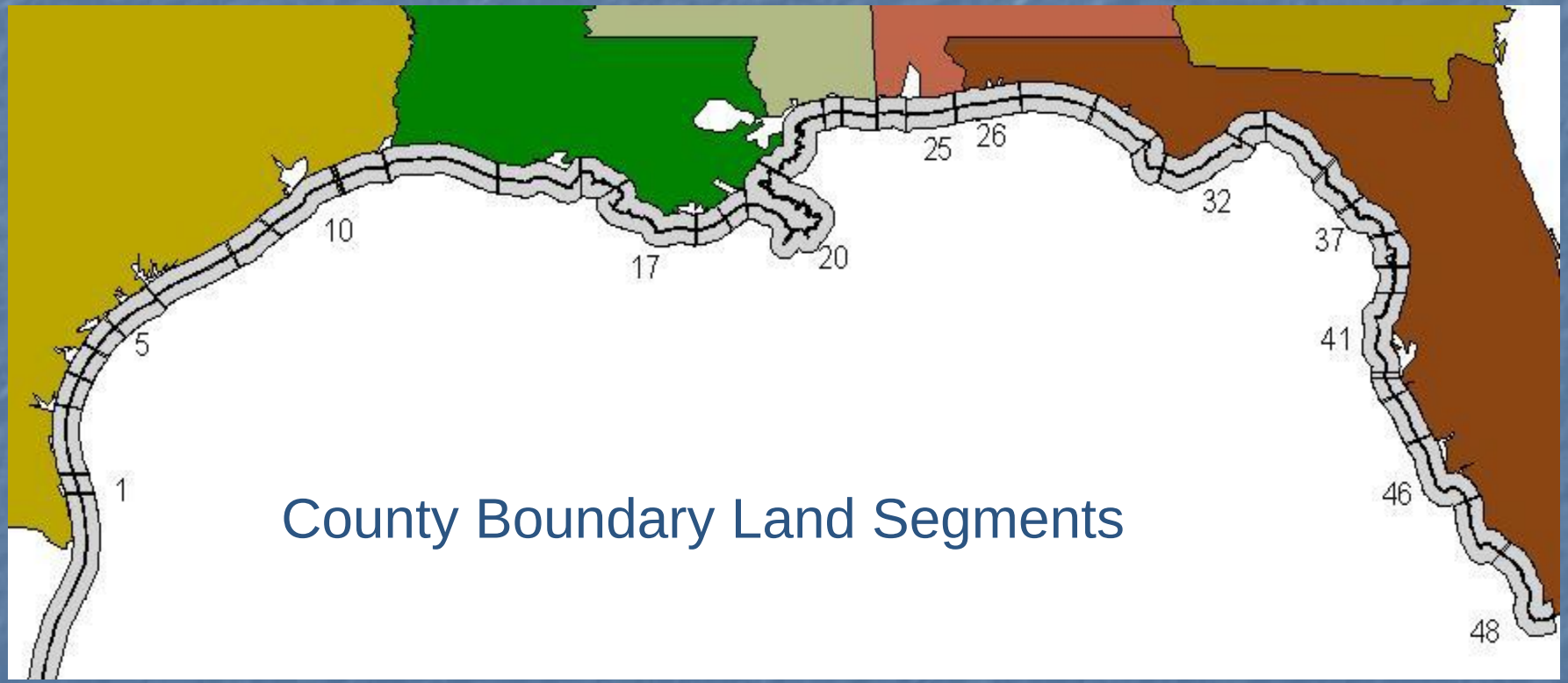


Oils and Floating Chemicals

Princeton Ocean Model sub-domain

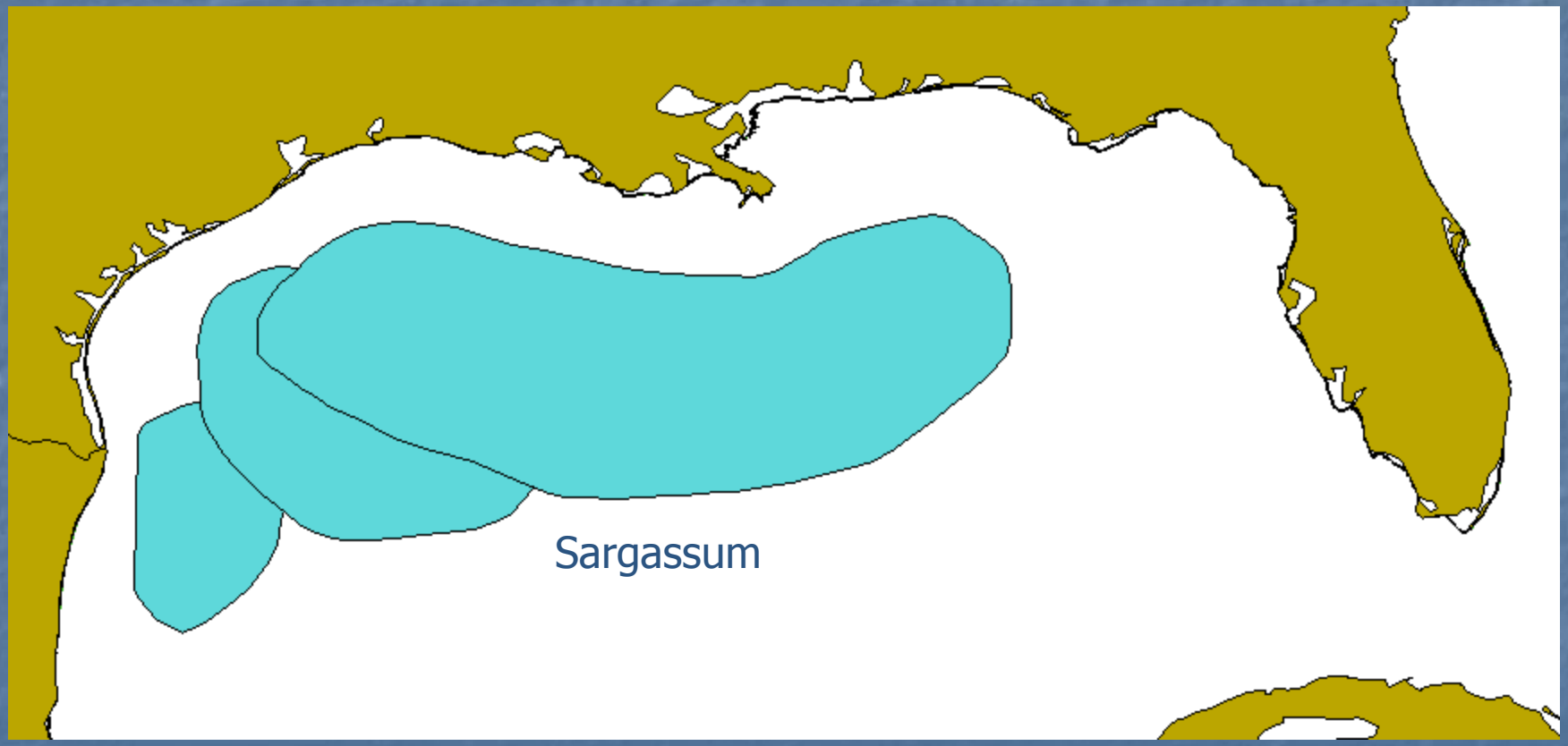


Gulf of Mexico
County Land Segments



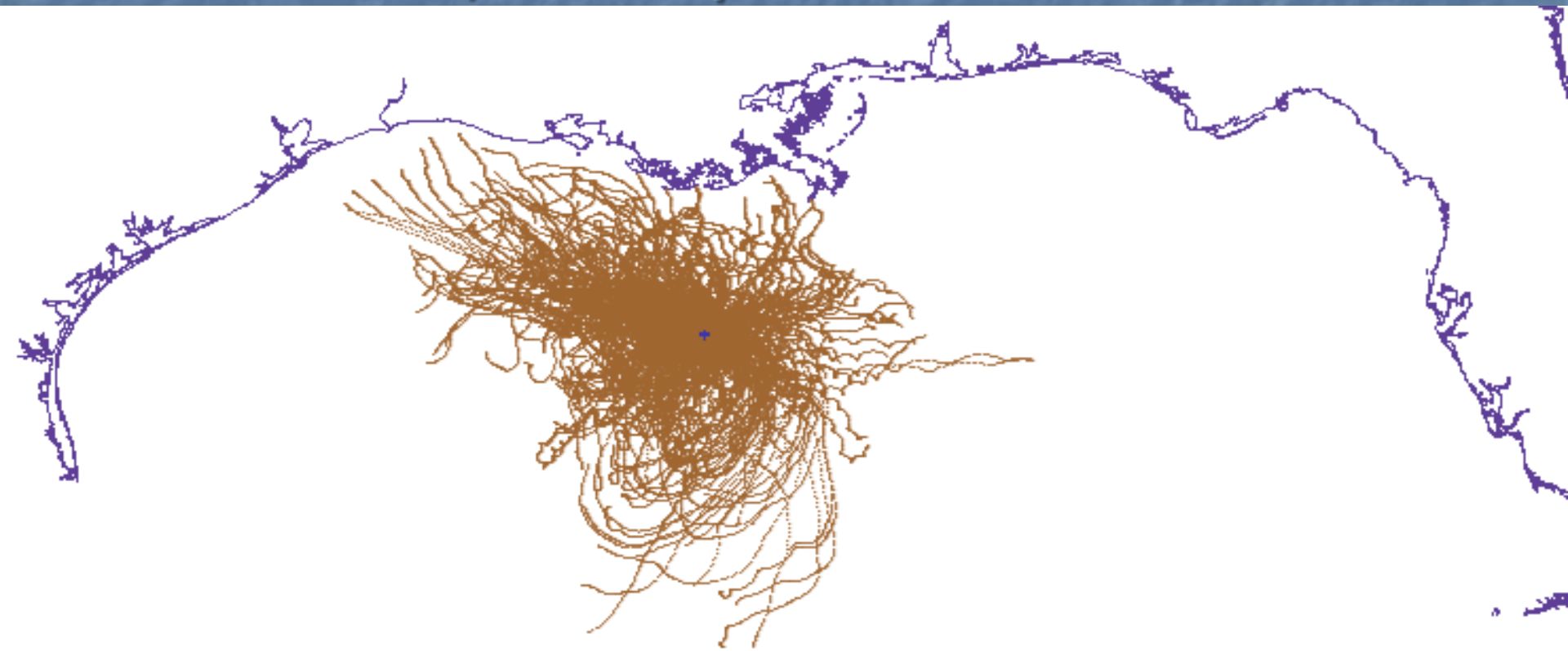
Gulf of Mexico Environmental Resources

Gulf of Mexico Environmental Resources



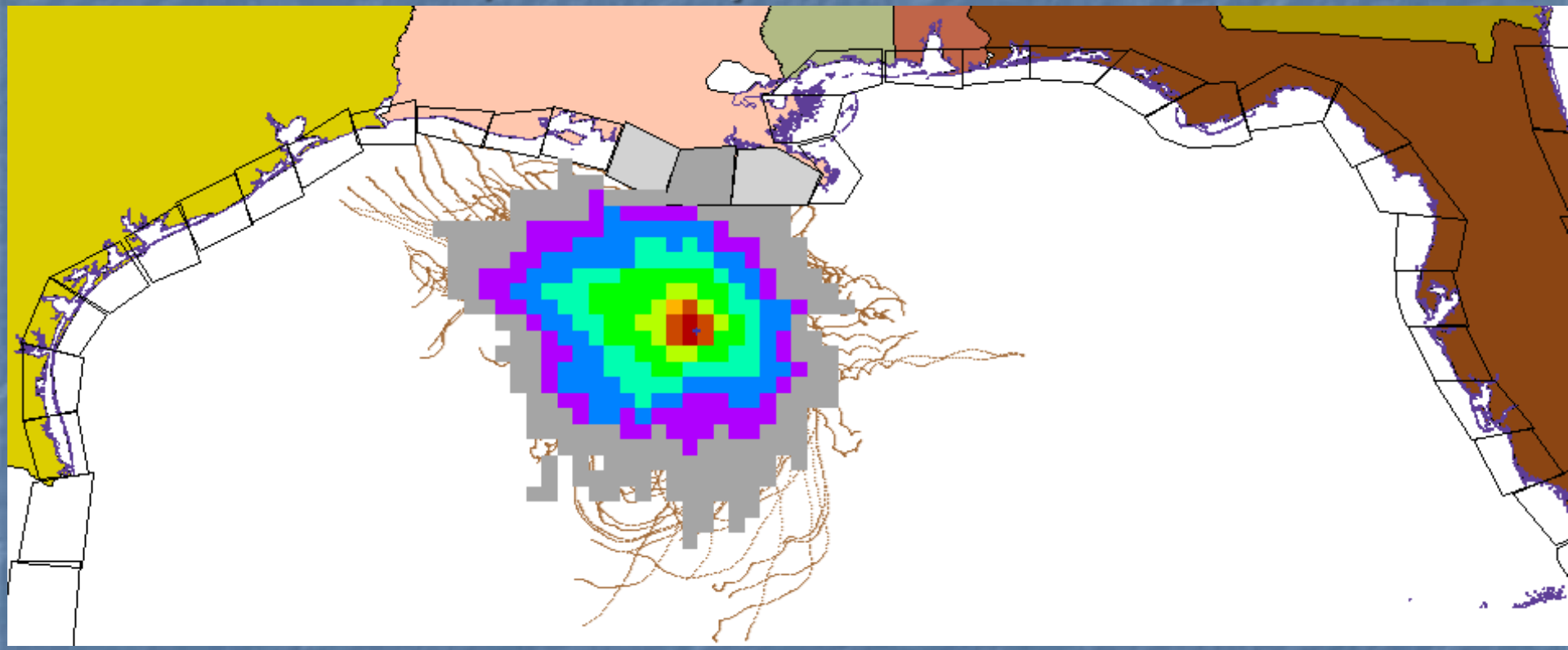
OSRA Trajectories

1993, 10 days travel time

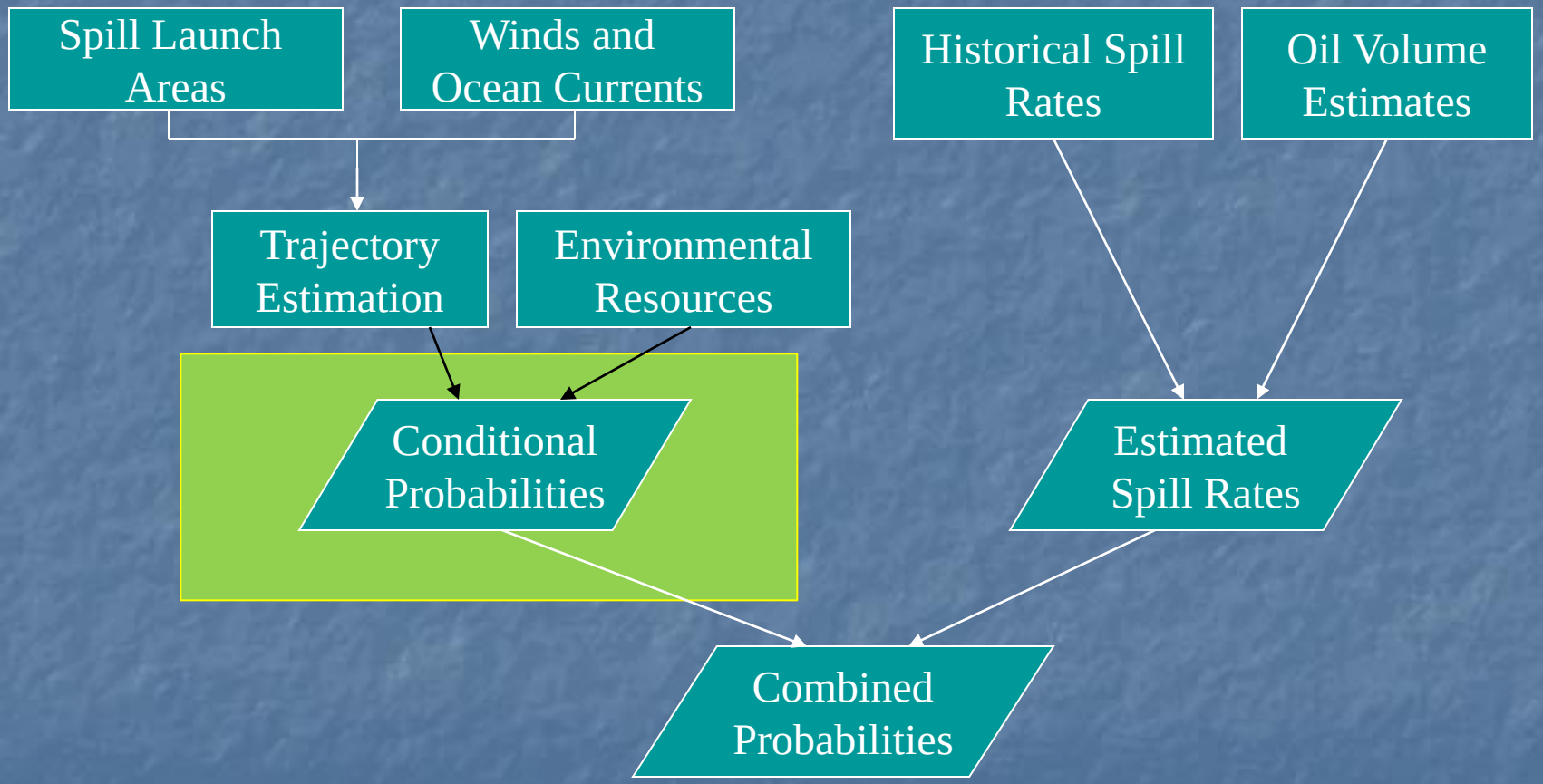


OSRA Trajectory Probabilities

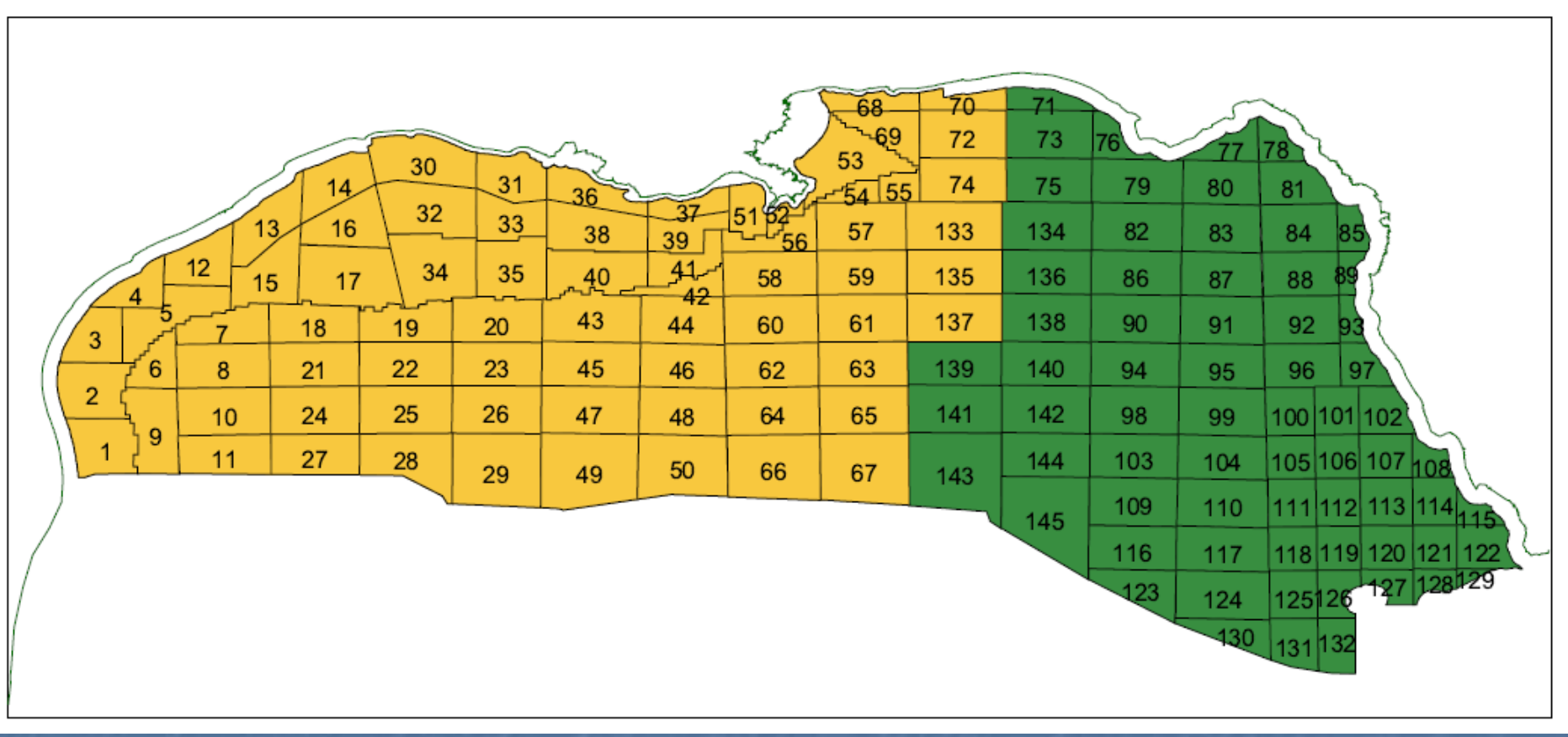
1993, 10 day travel time



OSRA Process

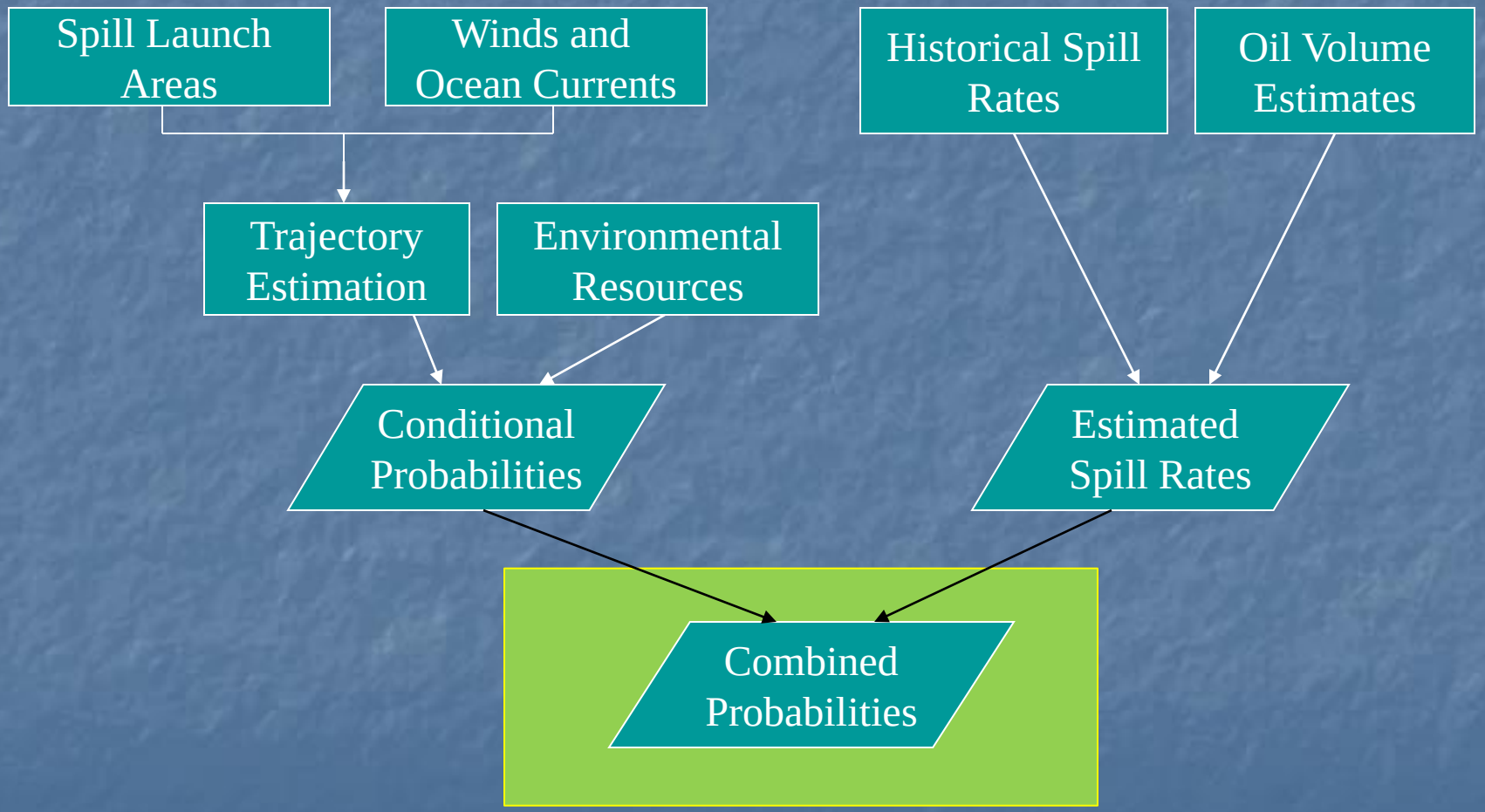


OSRP Conditional Probability Areas



MMS OSRA Report, 2004-026

OSRA Process



Environmental Studies Program

Overview

- BOEM information needs
- Objectives
- Methods
- Status
- Next steps

BOEM information needs

The ability to respond to oil spills under Arctic conditions is a continuing public concern associated with oil development in the Chukchi and Beaufort Seas. The Deepwater Horizon spill, and the time it took to stop the oil flow, has raised more questions about preparedness and the limits of clean-up technologies. This NRC study will provide an up-to-date, unbiased analysis of current capabilities that will support BOEM's environmental reviews, help focus research priorities, and assist with development of mitigation approaches.

Objectives

1. Assess the current state of the science regarding oil spill response in Arctic environments;
2. Develop a decision tool for use of various spill response technologies under the types of conditions and spill scenarios encountered at high latitudes;
3. Review new and ongoing research;
4. Describe promising new concepts and technologies for improving response to oil spills in Arctic environments; and
5. Recommend strategies for advancing research and addressing information gaps.

Methods

- Appointment of best available experts for each discipline
- Literature review
- Interviews
- Four meetings with top experts from the US, Canada, Norway and the UK.

Status

- Contract awarded Sept. 2011
- Currently awaiting for funding from other federal agencies (e.g., USCG, etc) to kickoff.