

BSED: Beaufort Sea Engineering Database

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National Research Council of Canada
Ocean, Coastal and River Engineering

NOGF, Oct. 12, 2017



NRC's Ocean, Coastal and River Engineering

PROGRAMS



Marine Vehicles



Arctic



Marine Infrastructure,
Energy and Water
Resources

Marine Infrastructure, Energy and Water Resources

Lead: Andrew Cornett andrew.cornett@nrc-cnrc.gc.ca

Research Thrusts:

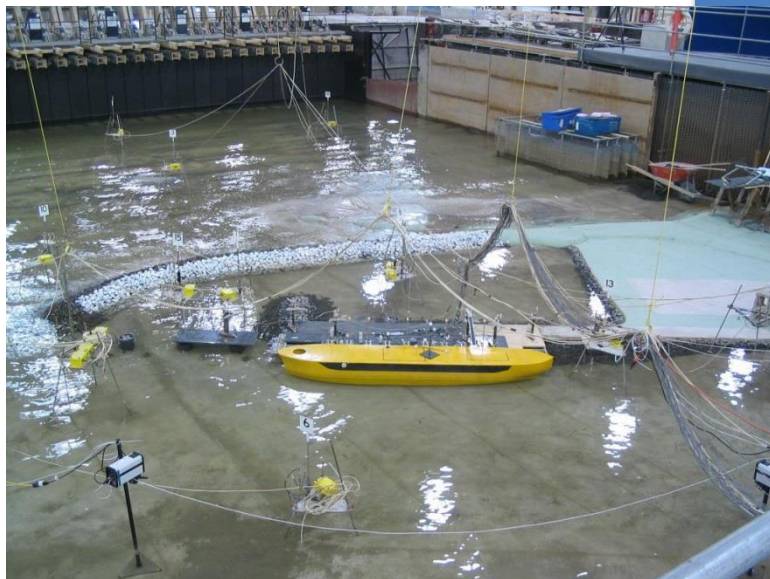
- **Marine infrastructure**
- **Renewable energy**
- **Water resources**

OBJECTIVES

Optimize the design of marine infrastructure

Improve the management of water resources

Accelerate the commercial viability of Canadian marine renewable energy technologies



Marine vehicles Program

Lead: Fraser Winsor fraser.winsor@nrc-cnrc.gc.ca

Research Thrusts:

- **Reduced cost of marine operations**
- **Safe and economic Arctic and offshore O&G operations**
- **Building a sustainable, competitive Canadian shipbuilding industry**

OBJECTIVES

Reduce fuel consumption
Reduce vessel design costs
Maximize the value of capital investment
Reduce risk



Arctic Program

Lead: Anne Barker anne.barker@nrc-cnrc.gc.ca

Research thrusts:

- **Resource development**
- **Northern transportation**
- **Marine safety technologies**
- **Community infrastructure**

OBJECTIVE

Ensure sustainable, low-impact development of the North while increasing the quality of life for Northerners



Arctic Program R&D Activities

Resource Development

- Ice loads on offshore structures
- Oil spill detection, forecasting and bioremediation
- Engineering datasets for offshore regulators and industry
- Ice characterization for design

Northern Transportation

- Shipping risk assessment system
- Pack ice forecasting for operations
- Ice- and winter-roads under climate change conditions

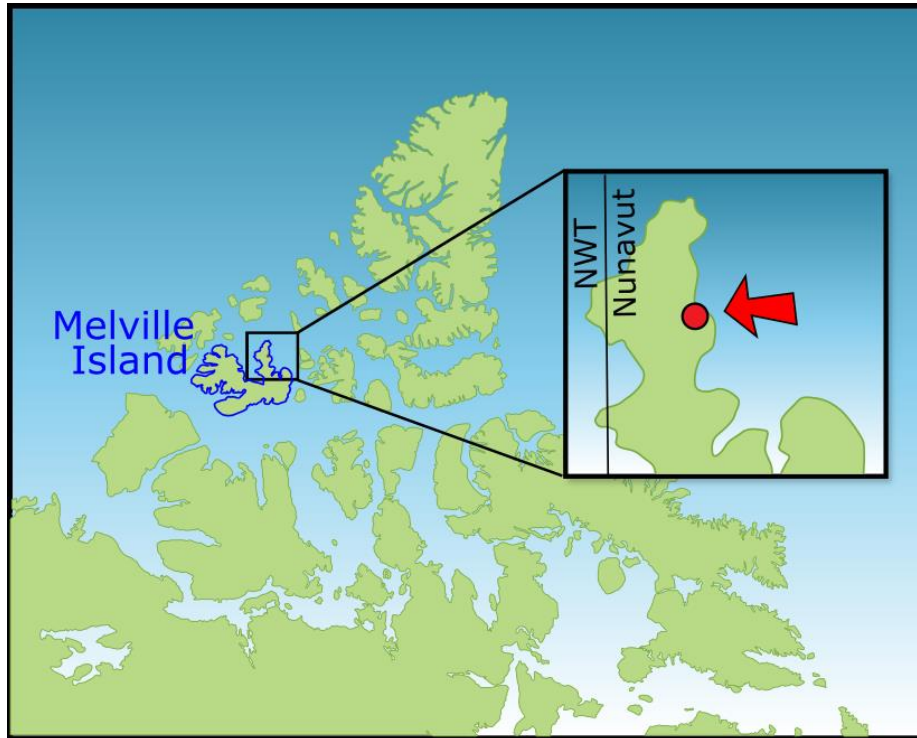
Marine Safety

- Next generation personal protective equipment
- Next generation life-saving appliances
- Operations to support evacuation and rescue

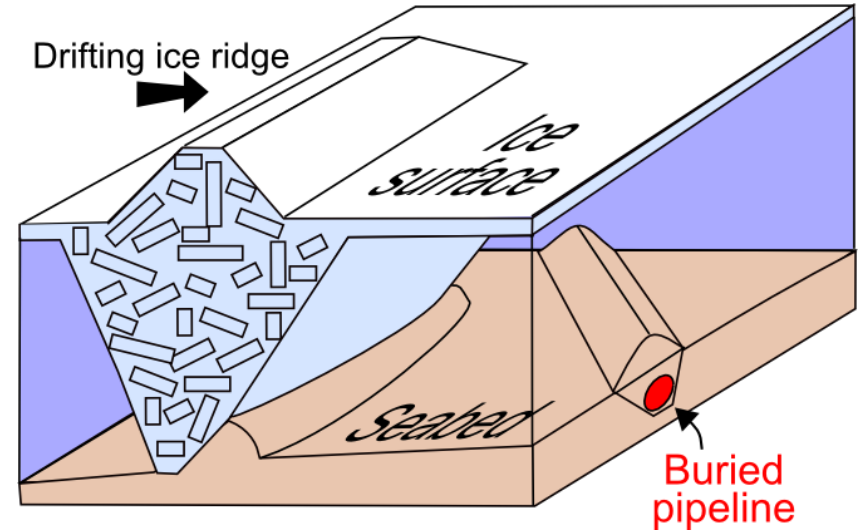
Community Infrastructure

- Northern building standards
- Water and wastewater technologies
- Building envelope, lighting and energy efficiency
- Foundations in permafrost
- In-situ bioremediation

Field Work: The Drake subsea pipeline



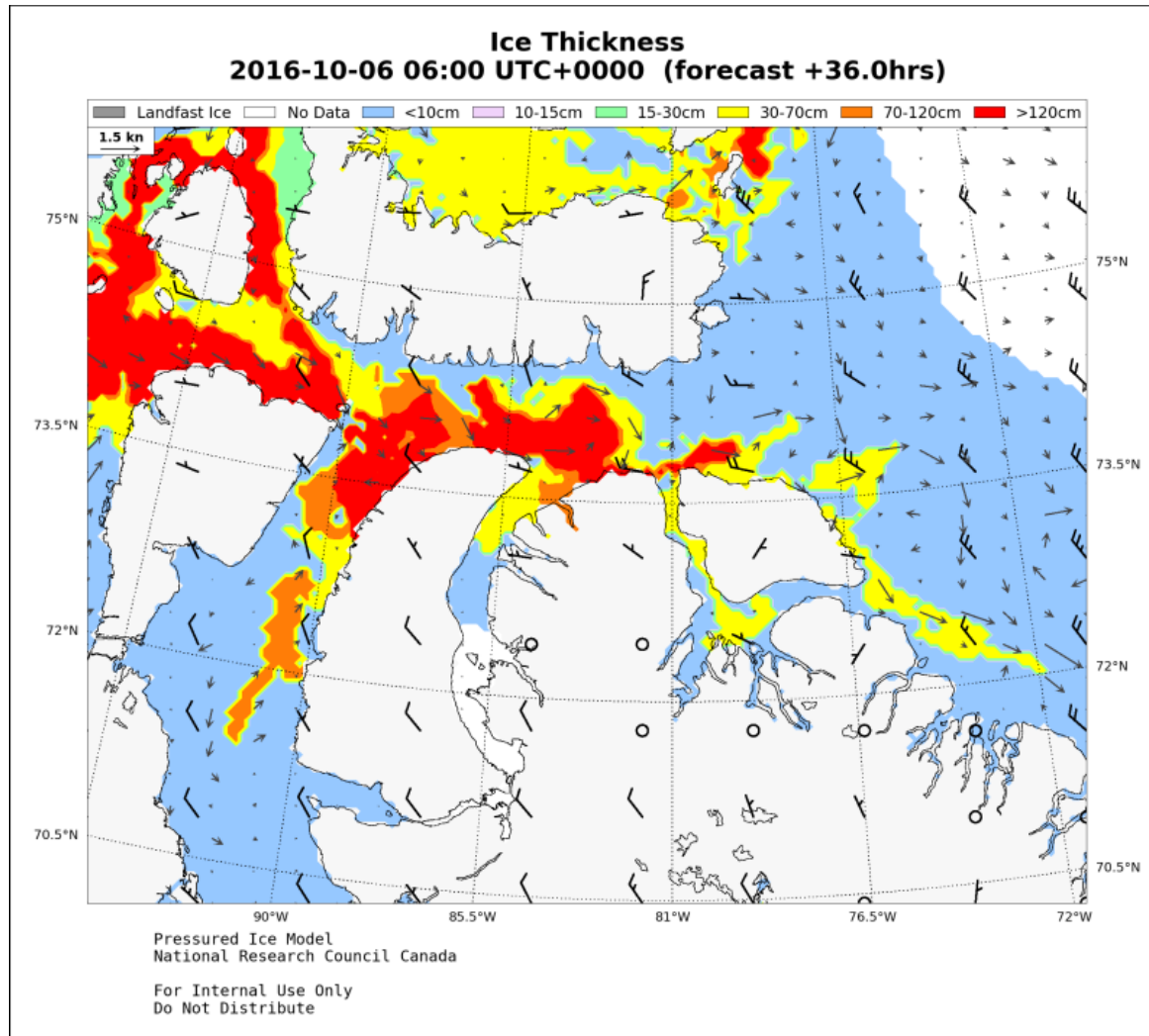
Field investigation (2020)
Outcome: To guide design
of future pipelines.



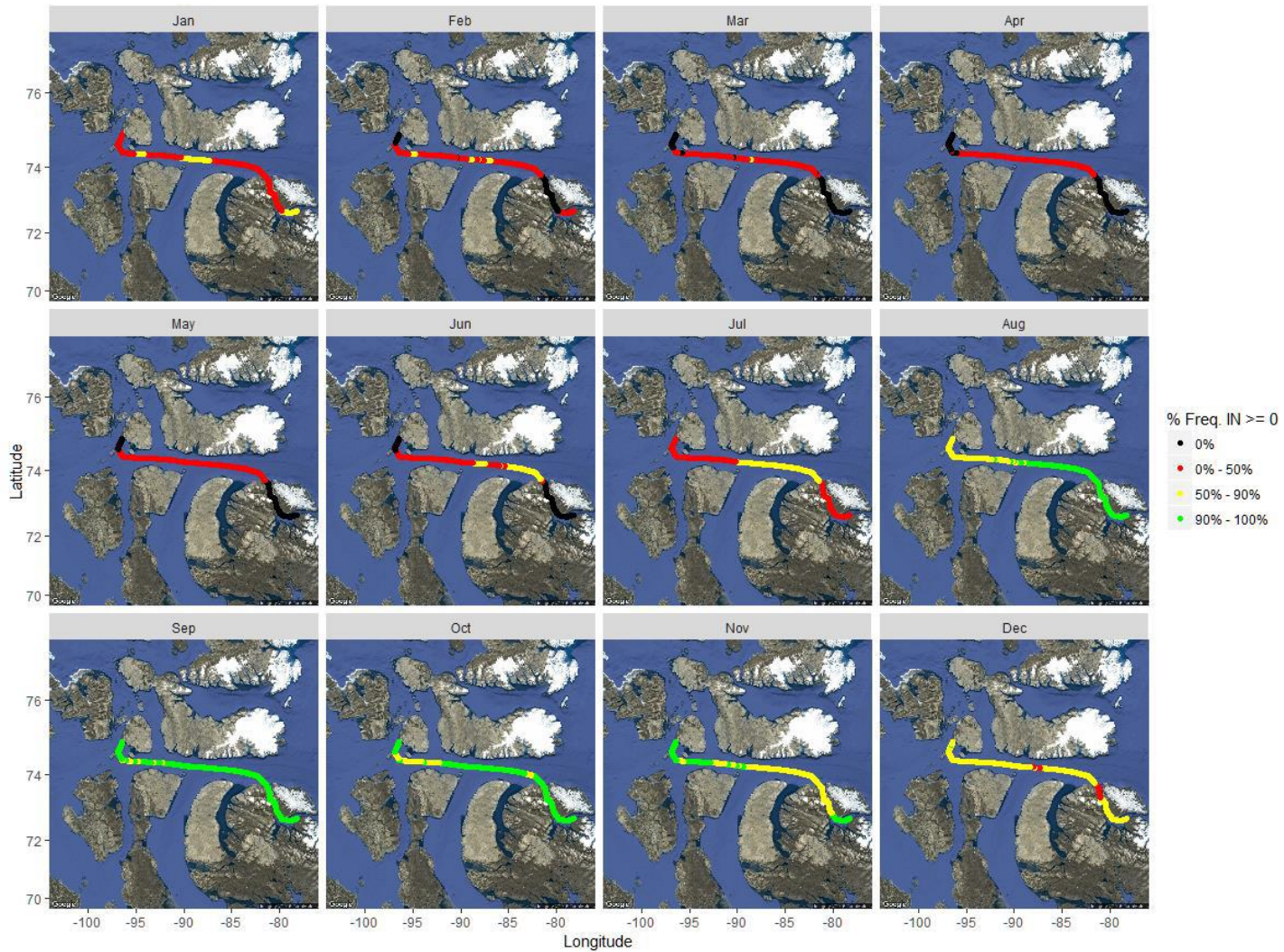
Cold Weather Laboratories: Safety at Sea



Numerical Models: Pack Ice Drift Forecasting

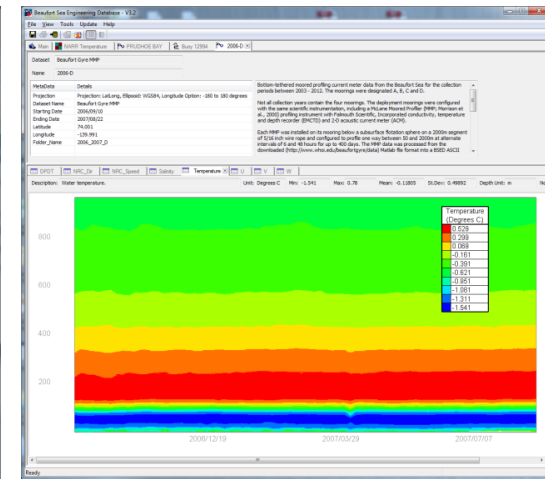
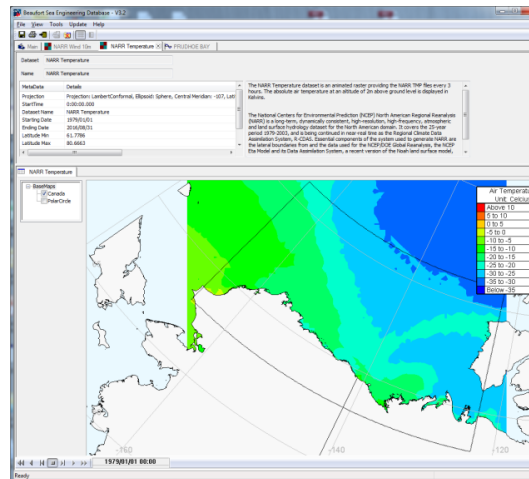
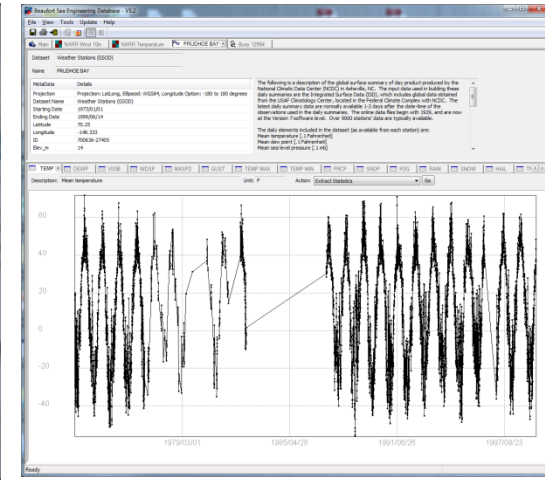
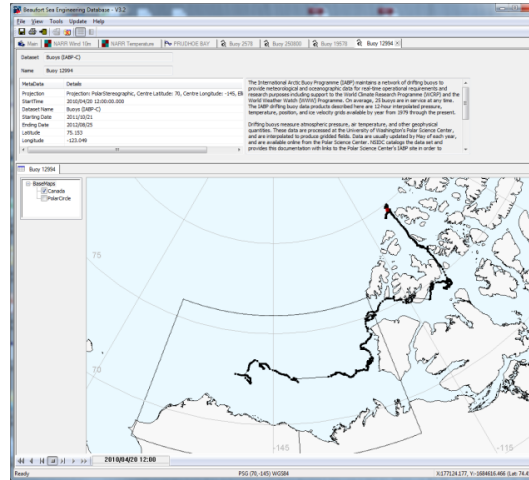


Databases: CASRAS



BSED 3.2 Datasets

- 84 datasets
- 11 dataset categories
- 211 GB
- Over 200 000 files
- 9 data types



Current BSED Datasets

Bathymetry	
1.1	Bathymetric Chart (IBCAO)
1.2	ArcticNet Basemaps
1.3	ArcticNet Beaufort Shelf
Buoy	
2.1	ArcticNet Beacons
2.2	SEDNA Buoys
2.3	Buoys (IABP-C)
Community and Infrastructure	
3.1	Arctic Infrastructure, Airports
3.2	Community Conservation Plans
3.3	Arctic Infrastructure, Ports

Hazardous Ice	
4.1	Extreme Ice Features
4.2	Extreme Ice Features, Historical
4.3	Historical Ice Islands
4.4	Ice Island Surveys: Southern Beaufort Sea
4.5	NRC Ice Ridges Dataset
4.6	NRC MY Ice Dataset
4.7	NRC Old Ice Borehole Strength
4.8	IceBridge topography
4.11	

Ice Charts	
5.1	CIS Ice Atlas [2]
-	
5.2	CIS Ice Atlas – Frequency of old ice
5.3	
5.4	CIS Ice Atlas – Frequency of old ice greater than 4 tenths
5.5	CIS Ice Atlas - Frequency of sea ice
5.6	CIS Ice Atlas - Median ice concentration
5.7	CIS Ice Atlas - Median ice concentration when ice is present
5.8	CIS Ice Atlas - Median old ice concentration
5.9	CIS Ice Atlas - Predominant Ice Type
5.10	CIS Daily Ice Charts
5.11	CIS Historical
5.12	CIS Regional Western Arctic
5.13	NIC Arctic
5.14	Polar Continental Shelf Project
5.14a	POLARIS: Polar Operational Limit Assessment Risk Indexing System

Current BSED Datasets

Ice Motion	
6.1	Moored Upward Looking Sonar - Ice Velocity
6.2	Ice Velocity (IABP-D)
6.3	Polar Pathfinder [4]
-	
6.6	
6.7	MEaSURES-06
6.8	GlobICE
Ice Properties	
7.1	ArcticNet HEMI
7.2	CIS Ice Thickness
7.3	Hourly Ice Observations (Molikpaq)
7.4	Ice Concentration MMAB
7.5	Ice Thickness - HEMI flight
7.6	Moored Upward Looking Sonar - Ice Draft
7.7	IceBridge
7.8	Ice Load Catalogue
7.9	Submarine Upward Looking Sonar - Ice Draft

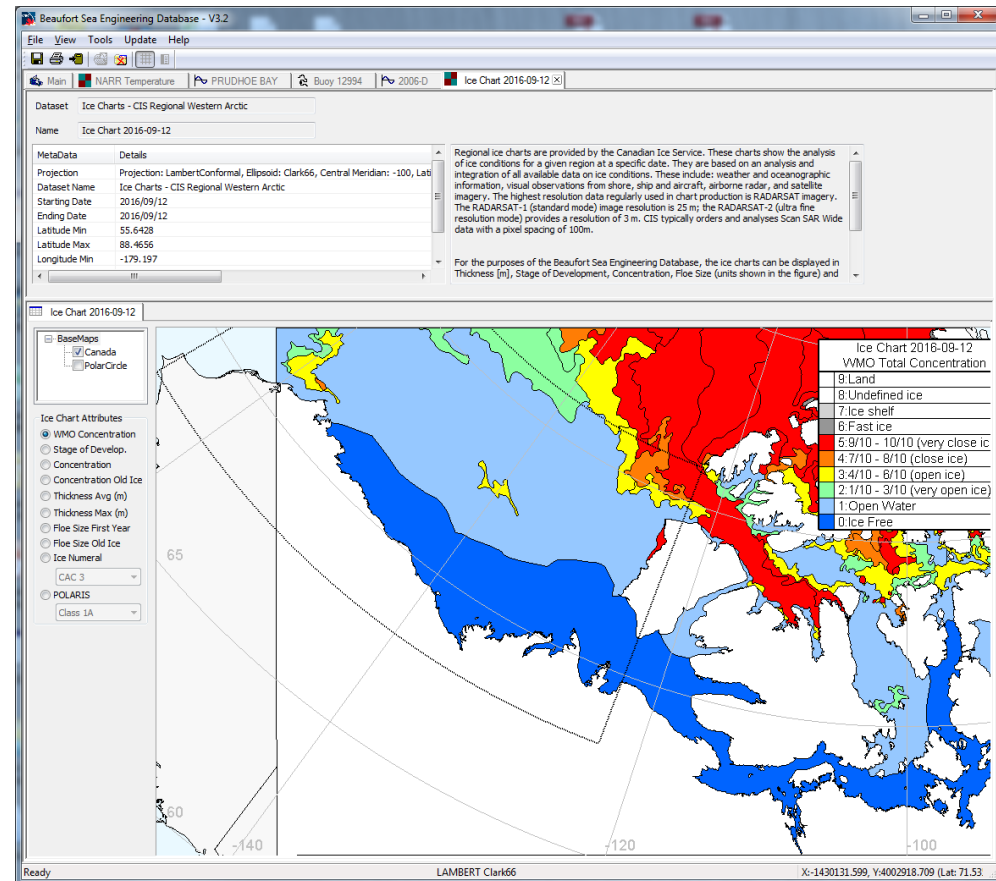
MetOcean	
8.1	Air Pressure (IABP-AB)
8.2	Beaufort Gyre MMP
8.3	CASES Mooring ADCP Sensor Data
8.4	CASES Mooring RCM Currents
8.5	MDLT: Mean Lowest Daily Low Temperature [3]
-	
8.7	
8.8	North American Regional Reanalysis [5]
-	
8.12	
8.13	Tide Stations
8.14	Weather Stations (CDCD)
8.15	Weather Stations [2]
-	
8.16	
8.17	Wind & Wave Hindcast

Navigation	
9.1	Shipping Safety Control Zones
9.2	Nautical Charts Canada
9.3	Nautical Charts USA
9.4	Arctic Data
Stakeholders	
10.1	Frontier Well Sites
10.2	Oil and Gas Rights

Subsurface	
11.1	Artificial Islands
11.2	Geotechnical Data (ESELog/ESEBase)
11.3	Geological Provinces of the World
11.4	Geological Map of the Arctic [3]
-	
11.6	
11.7	OCS Study Areas (Sub-Sea Data)
11.8	OCS Study Borings
11.9	OCS Study Boulder Patch
11.10	OCS Study Earthquakes
11.11	OCS Study Ice Gouge
11.12	OCS Study Strudel Scour
11.13	Soils Map

BSED - Current and Future

- 5 new datasets were added to the database this year
- 43 updateable datasets
- 2 more years are remaining in the current phase of the project



BSED interface

Beaufort Sea Engineering Database - V3.3

File View Tools Update Help

Main IBCAO_V3_500m_RR_ArcView.tif

Viewable Map Layers

- BaseMaps
 - Canada
 - PolarCircle
- Overlays
 - TownNames
- DataSets
 - Bathymetric Chart (IBCAO)
 - IBCAO_V3_500m_RR_ArcView.tif

Bring to Top Properties

Perform a Query

Select Datasets 1 Dataset Selected Search

Set Date Filter All Dates

Set Boundary Default Boundary Clear

Dataset Name: Bathymetric Chart (IBCAO) Description: An integrated map of bathymetric data north of 64 degrees (Arctic seabed)

Provider: International Bathymetric Chart of the Arctic

Web Site: <http://www.ngdc.noaa.gov/mgg/bathymetry>

File Format: Ascii

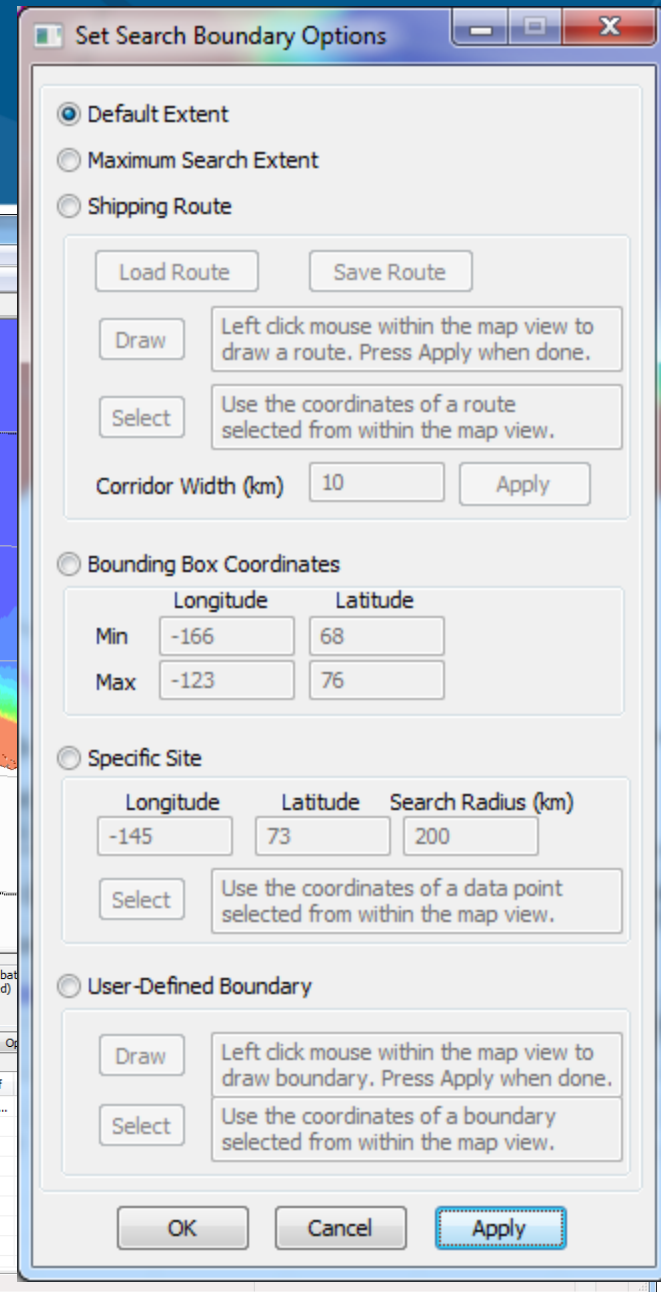
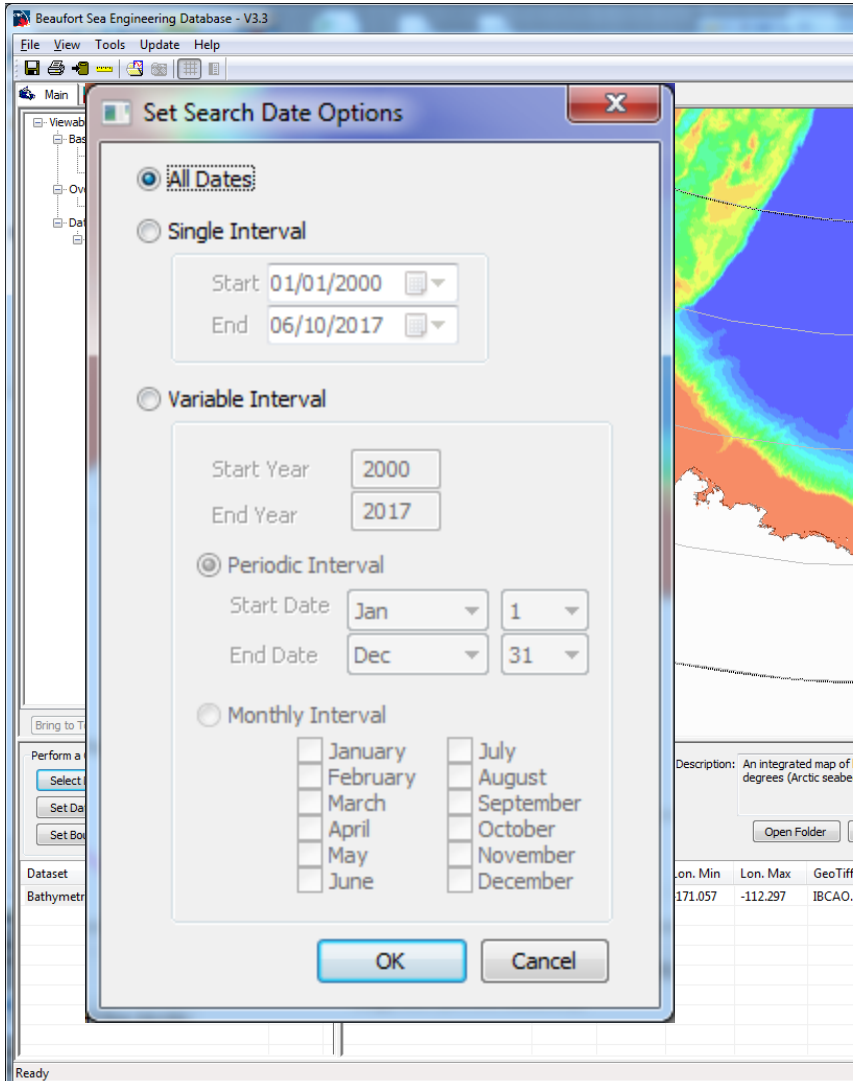
Open Folder Open Licence Documentation

Dataset	Count
Bathymetric Chart (IBCAO)	1

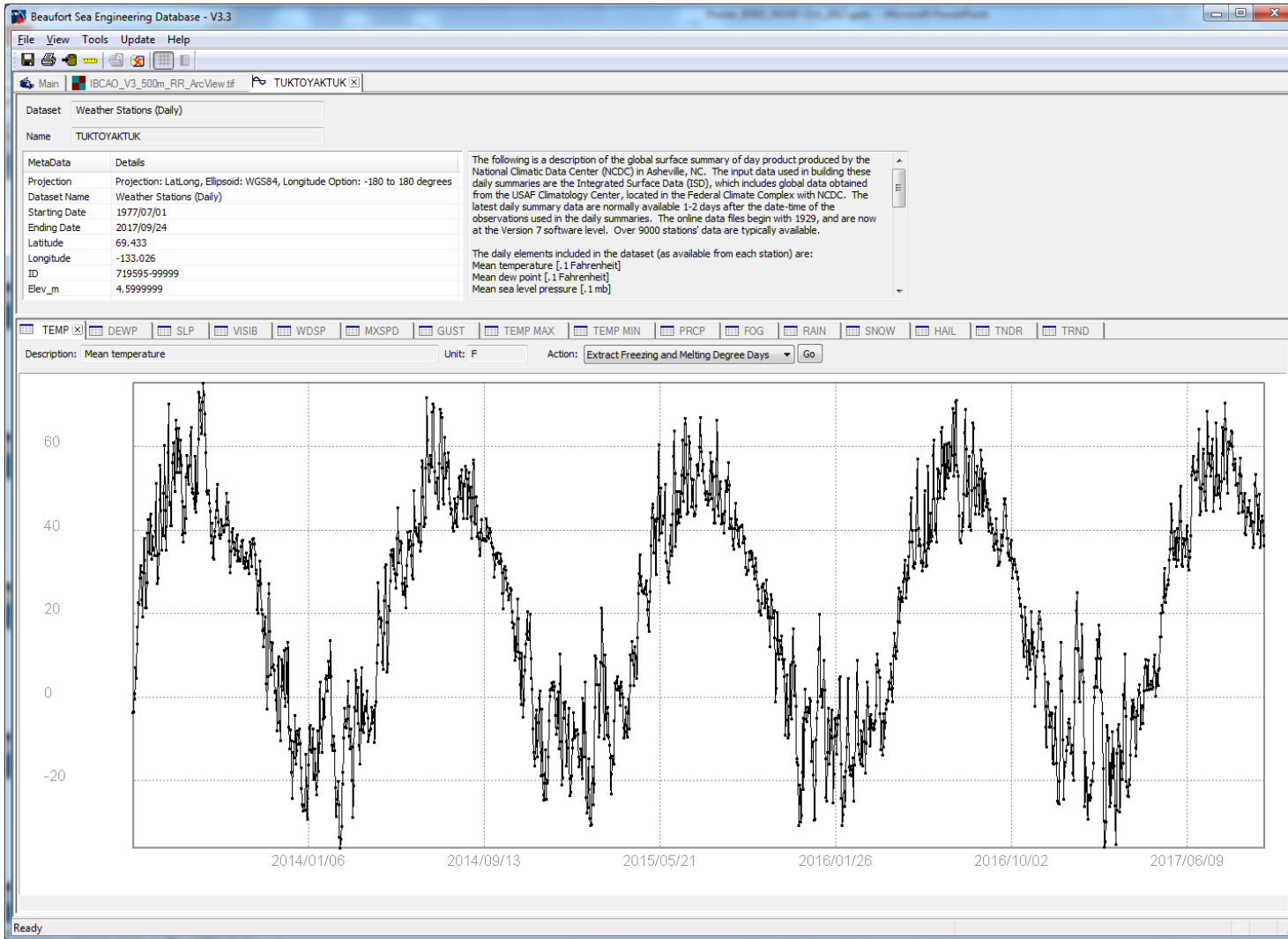
Name	Lat. Min	Lat. Max	Lon. Min	Lon. Max	GeoTiff
IBCAO_V3_500m_RR_ArcView.tif	61.9939	81.6359	-171.057	-112.297	IBCAO...

Ready

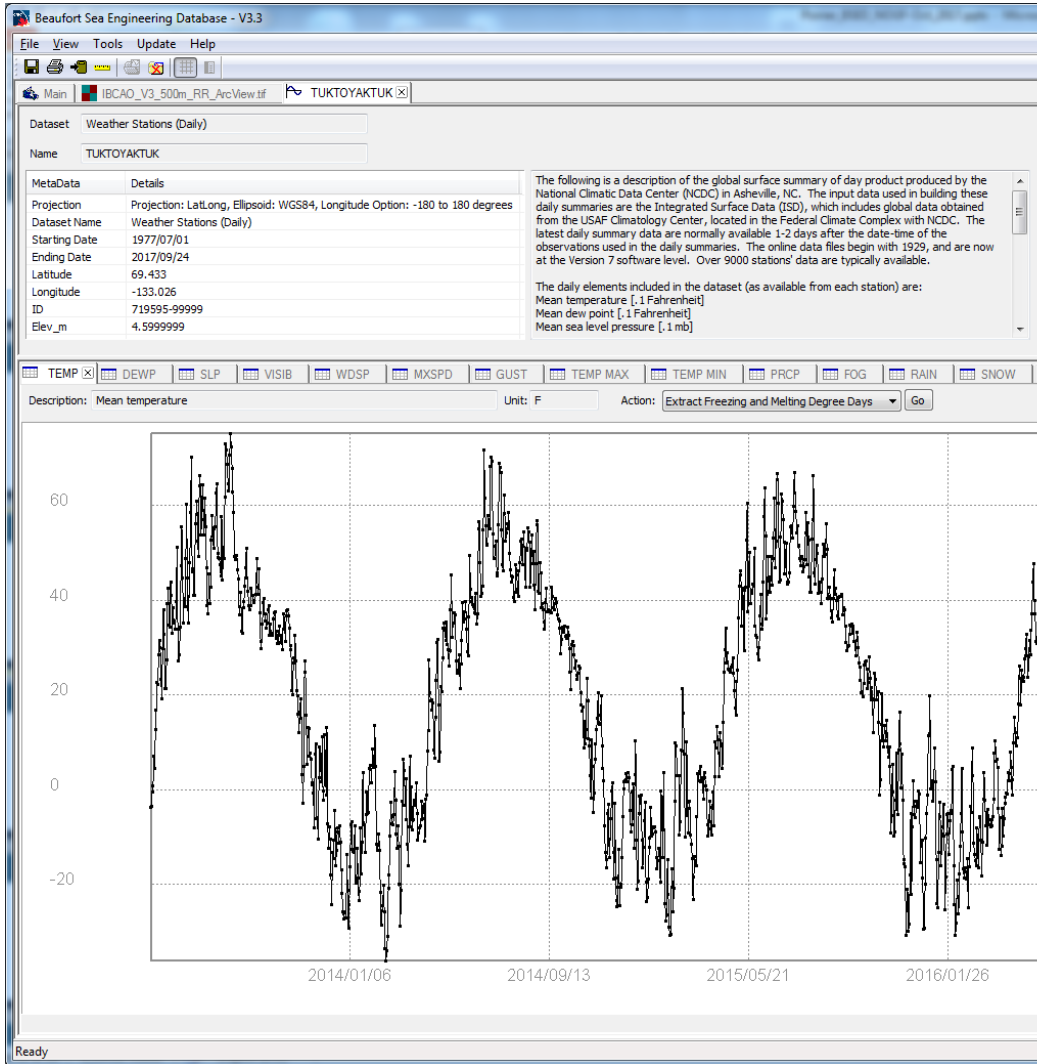
BSED: Querying Data



BSED: Weather Station Data



BSED: Tools (FDD)



Extract FDD and MDD

Freezing Degree Days

Month Day
 Start Date : 08 / 01
 End Date : 07 / 31
 Freezing Temperature : 0 Celsius

Melting Degree Days

Month Day
 Start Date : 04 / 01
 End Date : 09 / 01
 Melting Temperature : 0 Celsius

Estimating Ice Thickness from FDD

The maximum thickness of undisturbed level ice grown in a winter season can be inferred from accumulated FDD using the equation ISO 19906:2010 (A.6-3)

$$h = a * FDD^b$$

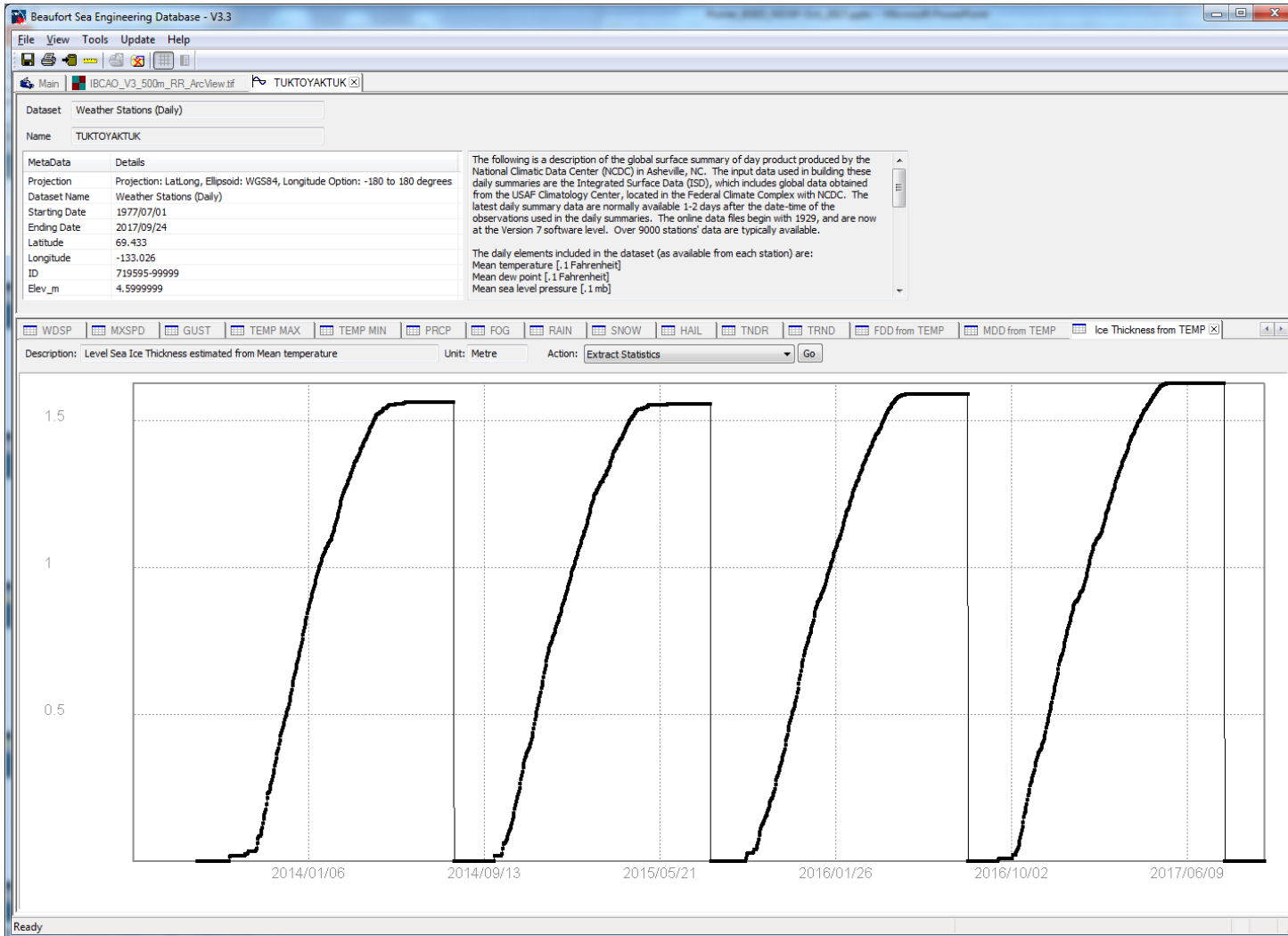
a - site-specific constant
 b - heat conduction coefficient
 Maximum level sea ice thickness Metre

Missing Data Points

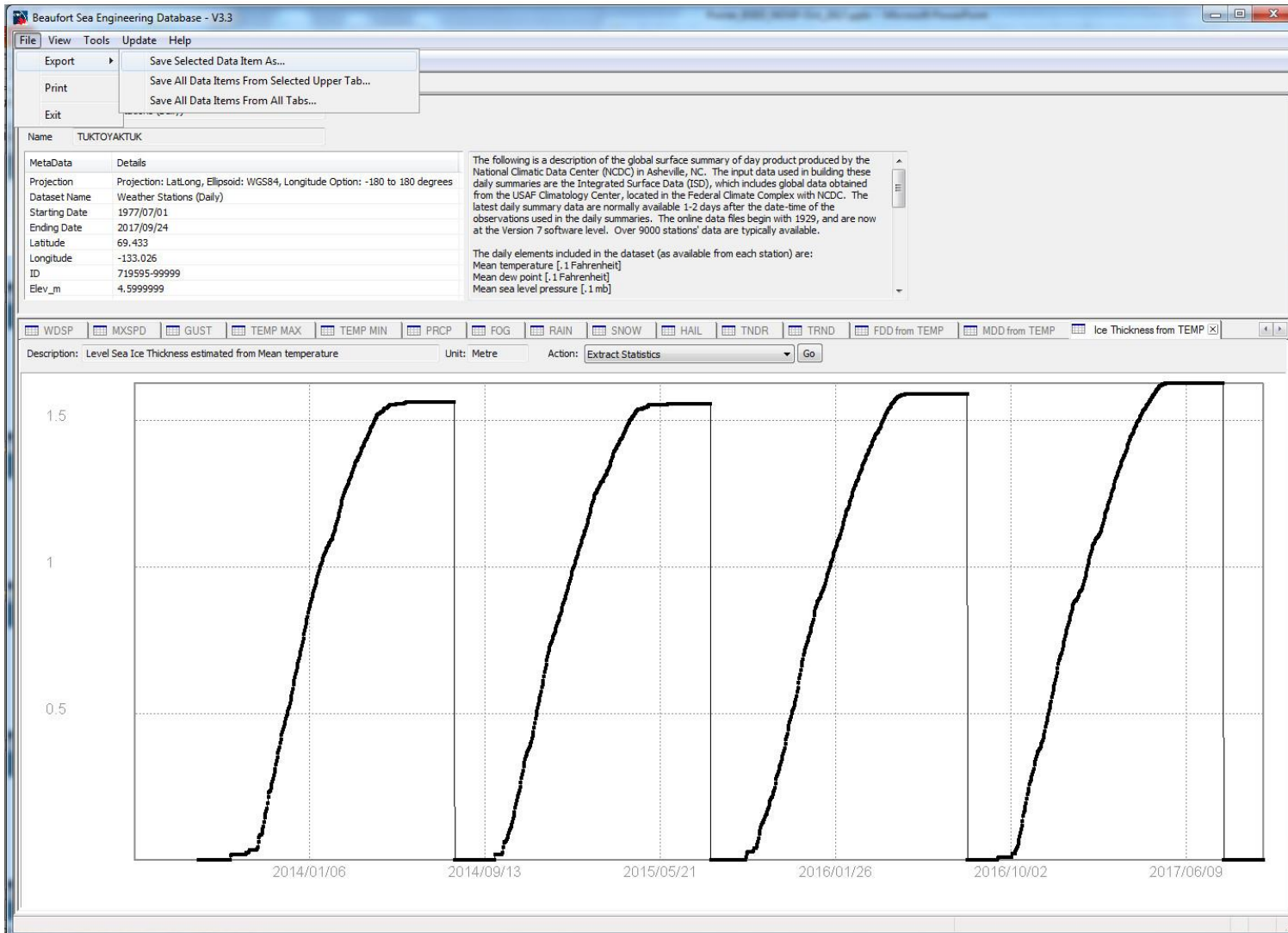
Acceptable Missing Days :

Any sequence of missing days up to and including the 'Acceptable Missing Day' count will be replaced using linear interpolation. If this day count sequence is exceeded, the remaining time period will be set to NoData.

BSED: Analyzing Data



BSED: Extracting Data



BSED: Extracting temporal data from Ice Charts

The screenshot shows the Beaufort Sea Engineering Database - V3.3 interface. The main window displays a map of the Arctic region with a grid. A dialog box titled "Extract Temporal Data From Ice Charts" is open, showing the following settings:

- Ice Chart Dataset: Ice Charts - CIS Regional Western Arctic
- Radio button selected: Extract time series for each ice chart attribute at a single location
- Latitude (dec. degrees): 73.0
- Longitude (dec. degrees): -133.296
- Sampling resolution (km): 20

A progress window titled "Extracting Time Series [12%]" is overlaid on the dialog, showing the following text:

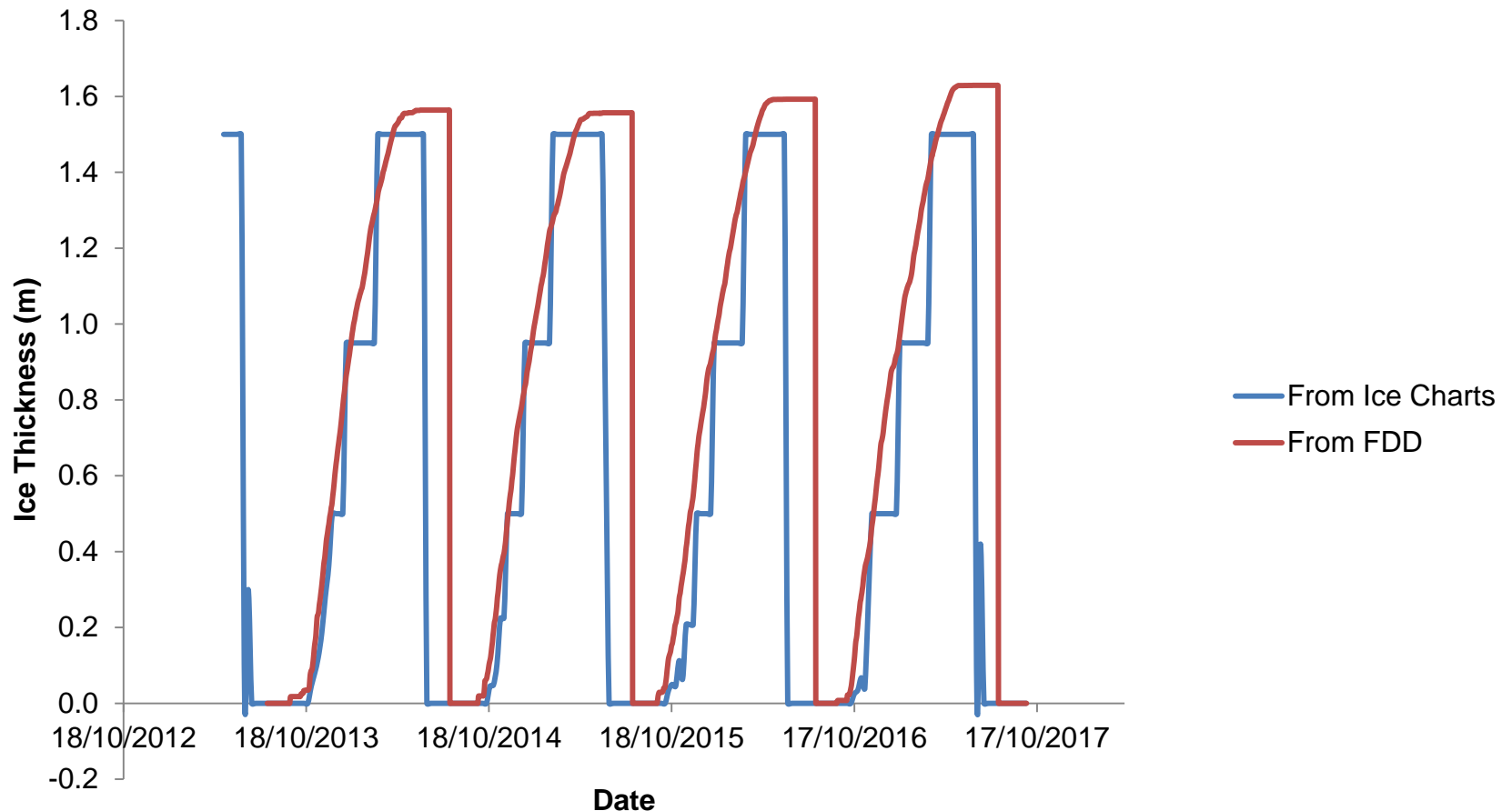
Extracting Time Series
 Dataset : Ice Charts - CIS Regional Western Arctic
 Processing Ice Chart 2013-11-04 (27/230)

At the bottom of the main window, a table displays the following data:

Name	Start Date	End Date	Latitude	Longitude	Count	Other
TRAIL VALLEY	1979/01/31	1981/04/17	69.45	-133	7..	18
TUKTOYAKTUK	1977/07/01	2017/09/24	69.433	-133.026	7..	4.5999...
TUKTOYAKTUK	1973/01/01	1977/06/30	69.45	-133	7..	18
TUKTOYAKTUK	1964/01/01	1972/12/31	69.45	-133.017	9..	5
TUKTOYAKTUK &	1973/02/24	1977/06/30	69.433	-133.033	7..	1
TUKTOYAKTUK NWT	1994/09/01	2017/09/24	69.433	-133.017	7..	5
UGNU-KUPARUK AIRPORT	1981/02/20	2007/12/31	70.317	-149.583	7..	20
UGNU-KUPARUK AIRPORT	2006/01/01	2017/09/24	70.317	-149.583	7..	20

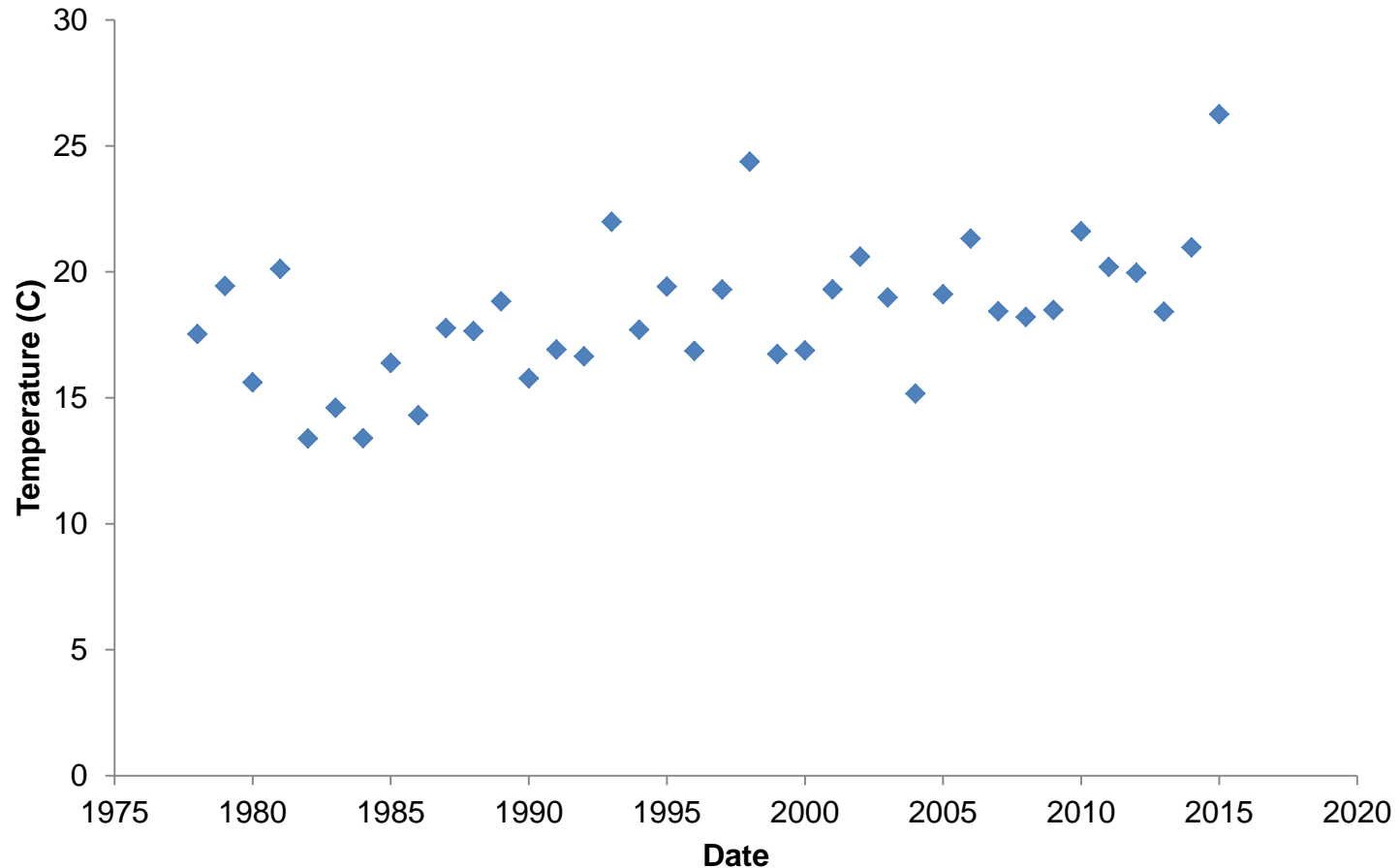
BSED: Comparing ice thickness from Ice Charts to FDD

Comparison of Ice Thickness off Tuktoyaktuk using CIS Regional Ice Chart data and FDD calculation tool in BSED



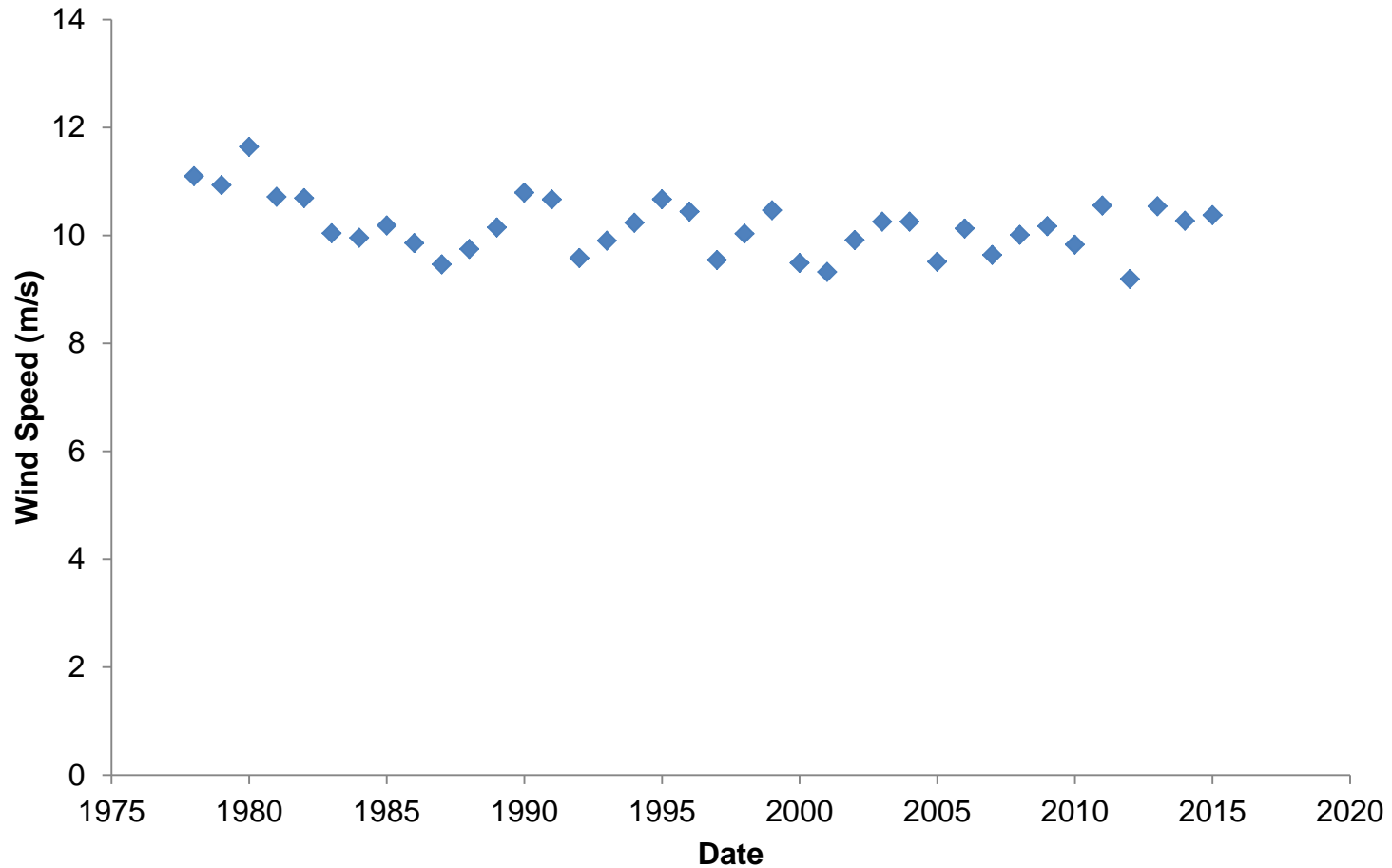
BSED: Verifying for Climate Change Impacts

Annual Average of the Daily Average Temperature in Inuvik



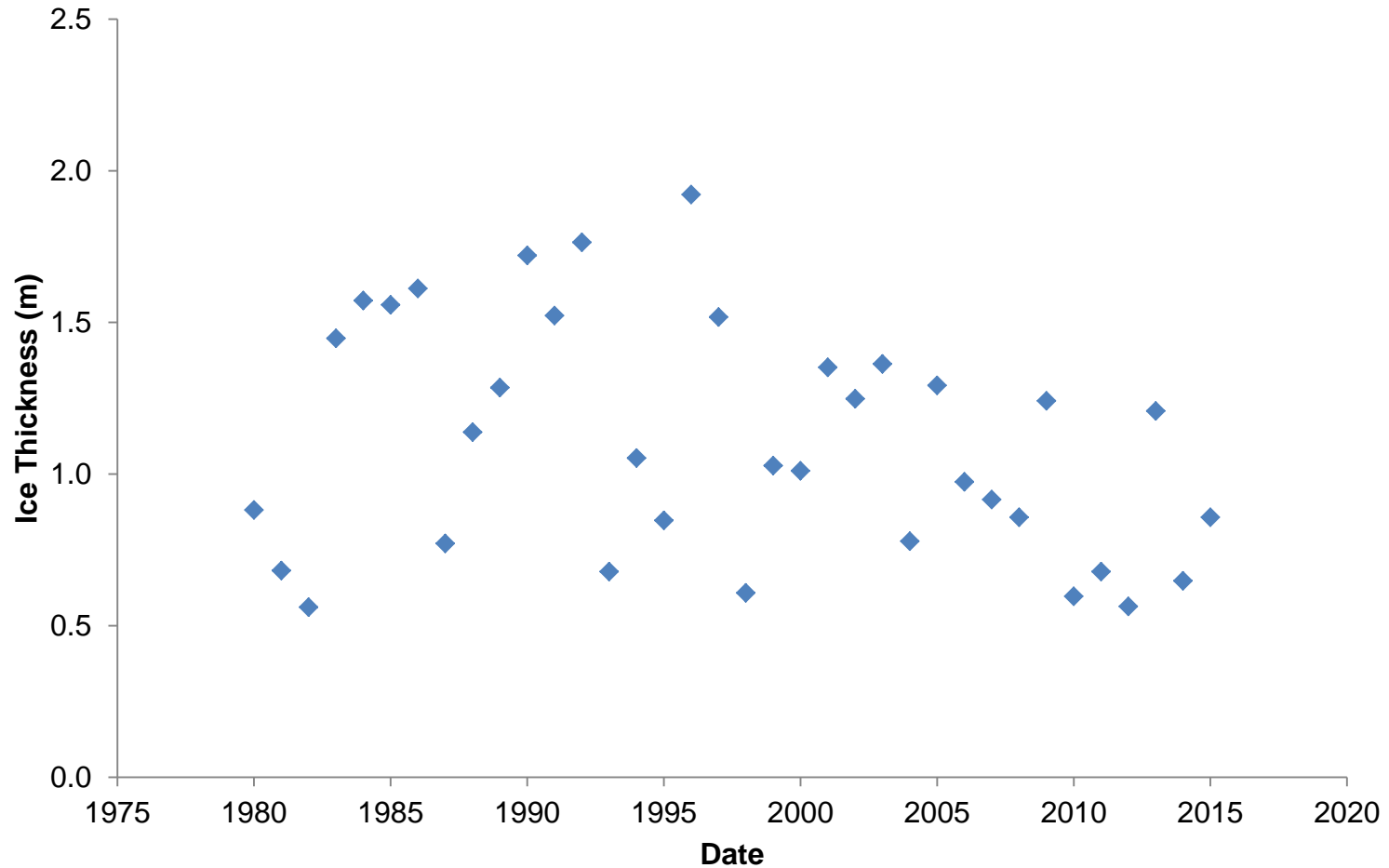
BSED: Verifying for Climate Change Impacts

Annual Average of the Daily Maximum Wind Speed in Inuvik



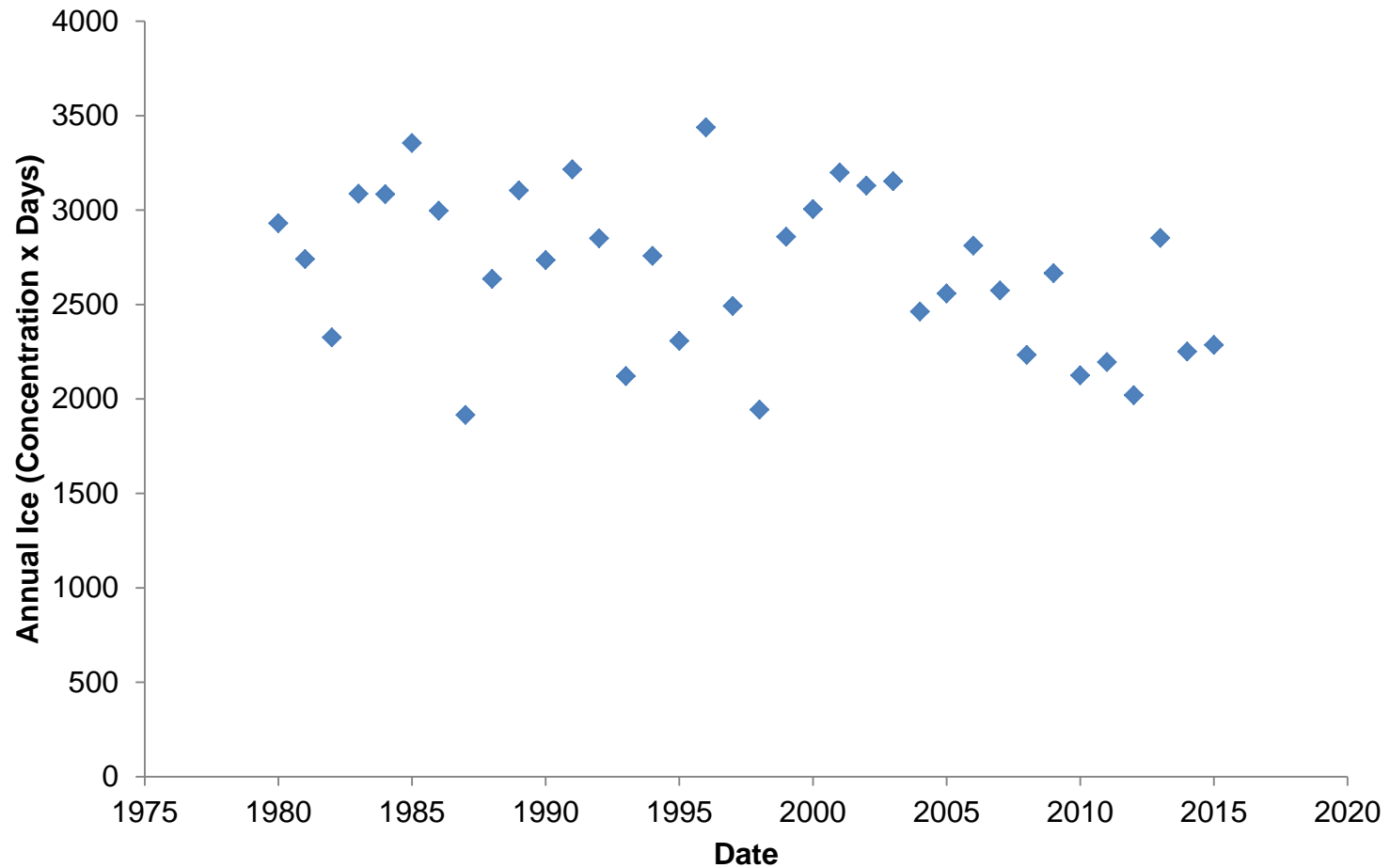
BSED: Verifying for Climate Change Impacts

Average Ice Thickness in the Pokak Exploration Licence Area from the CIS Regional Ice Charts



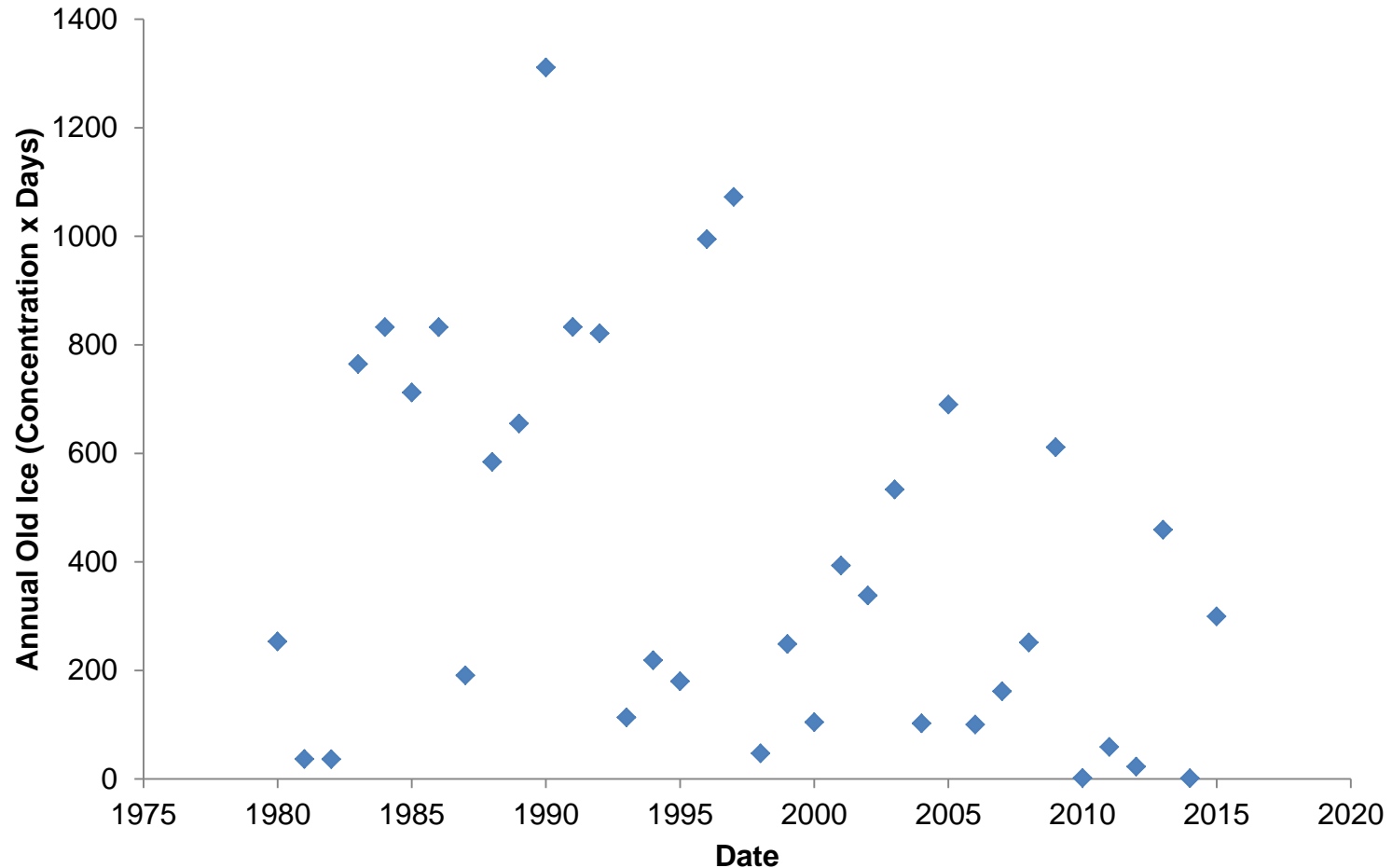
BSED: Verifying for Climate Change Impacts

Persistence of Ice at the Pokak Exploration Licence Area



BSED: Verifying for Climate Change Impacts

Persistence of Old Ice at the Pokak Exploration Licence Area



Thank you

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