



# Beaufort Sea Engineering Database

Agenda Item 7.5

**Ivana Kubat**

***NRC – Ocean, Coastal and River Engineering  
Ottawa, Ontario***

***BREA Results Forum, February 21, 2013***



National Research  
Council Canada

Conseil national  
de recherches Canada

**Canada**

# Outline

- **Background**
- **Project Objective and Benefits**
- **Project team and partners**
- **Database description**
- **Database demonstration**
- **Work progress and future work**

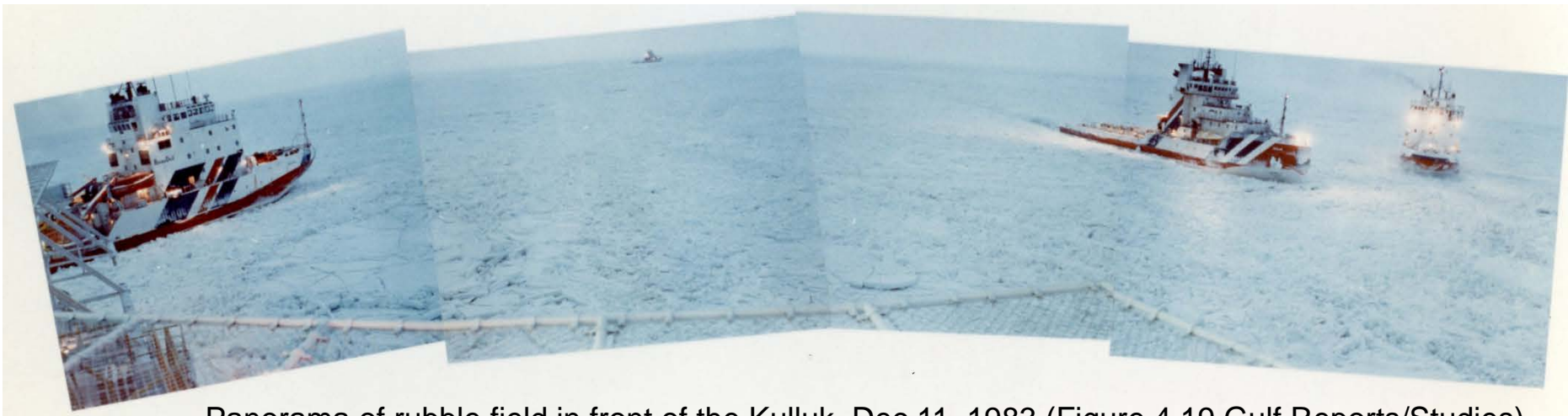


Beaufort Sea

Courtesy of Garry Timco

# Background

- **Renewed interest in Beaufort oil & gas**
- **Harsh and variable environment**
- **Lots of data exists but is widely scattered**
- **Good data informs good decisions**



Panorama of rubble field in front of the Kulluk, Dec.11, 1983 (Figure 4.19 Gulf Reports/Studies)

# Background – cont'd

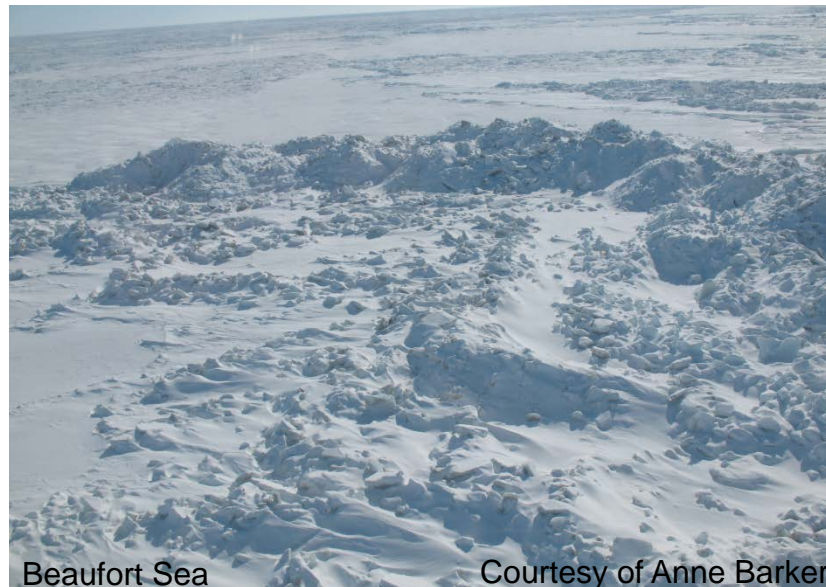
- **Using existing data sources is very time consuming**
  - **Different sources and file formats**
  - **Different software products and specialized knowledge required**
  - **No central repository, no standard process**



Panorama of rubble field in front of the Kulluk, Dec.11, 1983 (Figure 4.19 Gulf Reports/Studies)

# Project Overall Objective

- **An integrated database**
  - Storage, query and visualization
  - Include applications for determining the design ice loads
- **Common reference source for Industry and regulators**



Beaufort Sea

Courtesy of Anne Barker

# Benefits of Complete BSED

- Reference data source for current and historical data
- Quick and efficient
  - The best decisions can be made
- Input data for probabilistic models
  - Systematic, realistic parameter study
  - Identify gaps in important data and knowledge
- Many applications:
  - EER
  - vessel class needed
  - window for operation
  - ice forecasting
  - ice management

# BREA context and purpose

- **Produce regional information and results that simplify project level environmental assessments**
- **Strengthen assessment processes and integrated management**
- Engage Communities and advance their priorities for oil and gas preparedness

The project was largely funded by Industry, AADNC was a member representing Regulators. They all steered directions of the project to meet their community needs (NRC didn't directly engage with Communities)

# BREA priority areas

- **Sea Ice Types and Extreme Ice Features**
- **Worst-case Environmental Design Limits for Ice**
- **Geospatial Tool**
- **Coupled Ocean-ice-atmosphere Modeling and Forecasting**
- Baseline Fish Information
- Coastal and Marine Birds
- Offshore Geohazards and Coastal Processes
- Community Priorities – Polar Bears in Offshore and Coastal Monitoring



# **NRC team developing the BSED**

- **Mrs. Ivana Kubat**
- **Mr. Philippe Lamontagne**
- **Dr. Louis Poirier**
- **Ms. Denise Sudom**
- **Dr. Adrienne Tivy**
- **Mr. Dave Watson**

## **Advisors**

- **Dr. Robert Frederking**
- **Mr. Martin Serrer**
- **Dr. Garry Timco**

# Members of JIP

## (Technical Steering Committee)

- AANDC – Genevieve Carr
- BP – George Li / Richard Simpson
- ConocoPhillips – Karen Muggeridge
- Imperial Oil / Exxon Mobil – Jim Hawkins / Dmitri Matskevitch
- Statoil – Catherine Jahre-Nilsen
- CIS Participation (Canadian Ice Service)

# Terminology

- **Database** – Beaufort Sea Engineering Database (BSED)  
developed at NRC represents a collection of datasets.
- **Dataset** – Datasets or files linked to the BSED

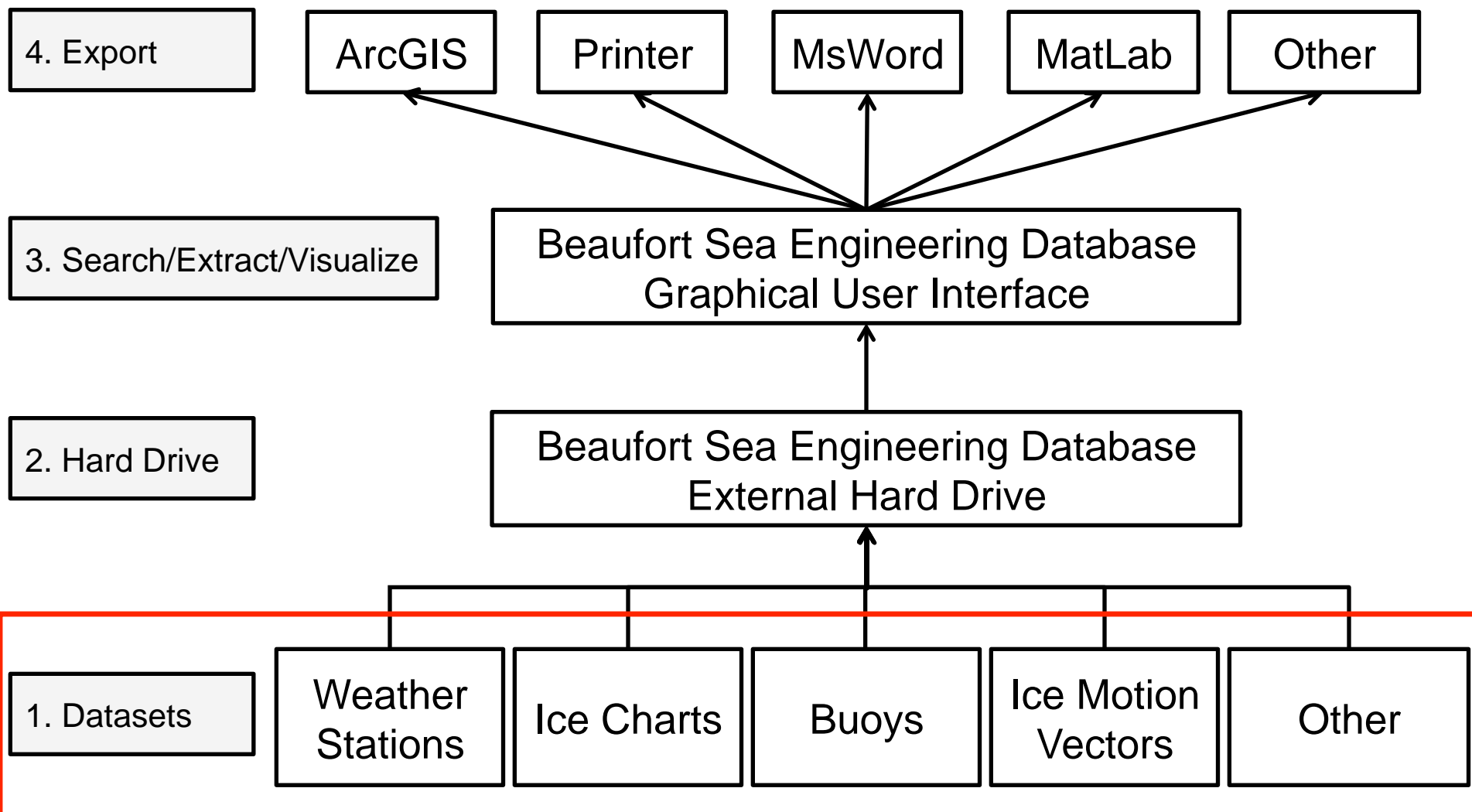
# Database Functionalities

- **Display Functions**
  - Addition or modification of base maps
  - Map customization
  - Latitude-Longitude or Polar Stereographic projection
  - Interactive zoom and pan functionalities
- **Query Functions**
  - Query multiple datasets simultaneously
  - Allows for user drawn search area (polygon)
- **Export Capabilities**
  - To printer, plus ASCII, Shapefile, CSV, Surfer grid

# Datasets formats

- **Different file formats**
  - **Binary, Grib, GeoTiff, CSV, Shapefile, Acsii, E00, etc...**
- **Different data types**
  - **Static raster** (eg. Bathymetric chart)
  - **Dynamic raster** (eg. Ice Concentration)
  - **Time series** (eg. Weather Stations)
  - **Points & Polygons** (eg. Well sites)

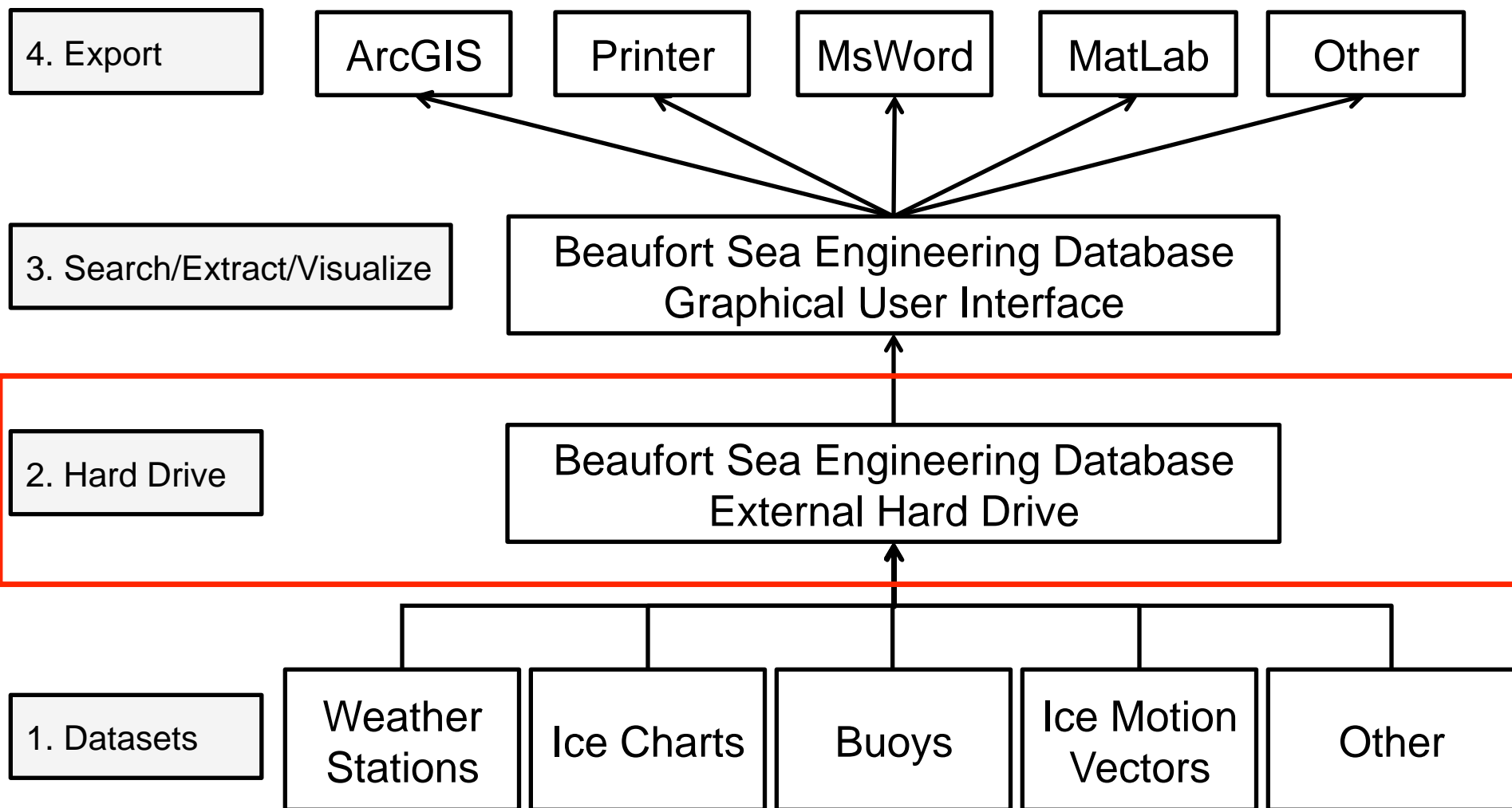
# Database Framework



# 64 Datasets included

- Bathymetry
  - ArcticNet Base maps
  - ArcticNet Beaufort Shelf
  - IBCAO
- Buoys
  - Buoys - IABP-C
  - Buoys - SEDNA
  - ArcticNet Beacons
- Hazardous Ice
  - NRC MY Ice Dataset
  - NRC Ice Ridges Dataset
  - Extreme Ice Features
  - Historical Ice Islands Drift
  - Ice Island Surveys
- Ice Charts
  - Ice Charts CIS – Western Arctic
  - Ice Charts CIS – Daily
  - Ice Charts CIS – Historical
  - Ice Charts CIS – PCSP
  - Ice Charts NIC
  - Ice Atlas 1980-2010
- Ice Motion
  - Ice Velocity (IABP-D)
  - Moored Upward Looking Sonar (Ice Velocity)
  - Polar PathFinder – Daily ice motion
  - Polar PathFinder – Weekly ice motion
  - Polar PathFinder – Monthly ice motion
  - Polar PathFinder – Yearly ice motion
- Ice Properties
  - ArcticNet HEMI
  - CIS Ice Thickness
  - Hourly Ice Observations (Molikpaq)
  - Ice Concentration derived from AMRS-E
  - Moored Upward Looking Sonar (Ice Draft)
  - Submarine Upward Looking Sonar (Ice Draft)
- MetOcean
  - Buoys Temperature and Pressure
  - Wind&Wave Hindcast
  - Tide Stations
  - Weather Stations CDCD
  - Weather Stations daily GSOD
  - Weather Stations hourly SDHG
  - NARR data (Wind, temperature, ...)
- Navigation
  - Shipping Safety Control Zones
  - Nautical Charts USA
  - Nautical Charts Canada
- Stakeholders
  - Community Conservation Plans
  - Frontier Well Sites
  - Oil and Gas Rights
- Subsurface
  - Soils Map
  - Geological map of the arctic
  - Artificial Islands
  - OCS Study

# Database Framework

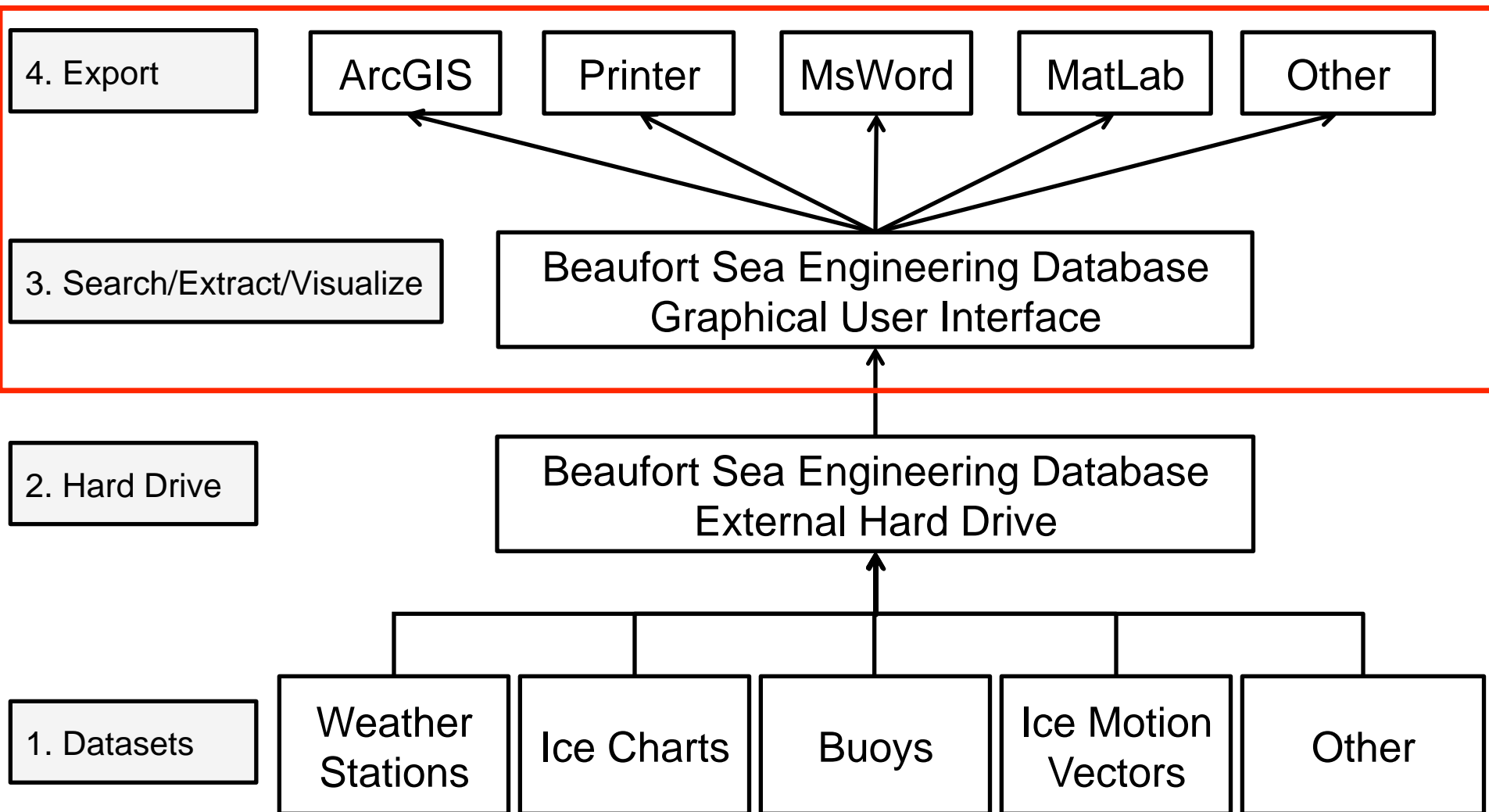




# Hard drive

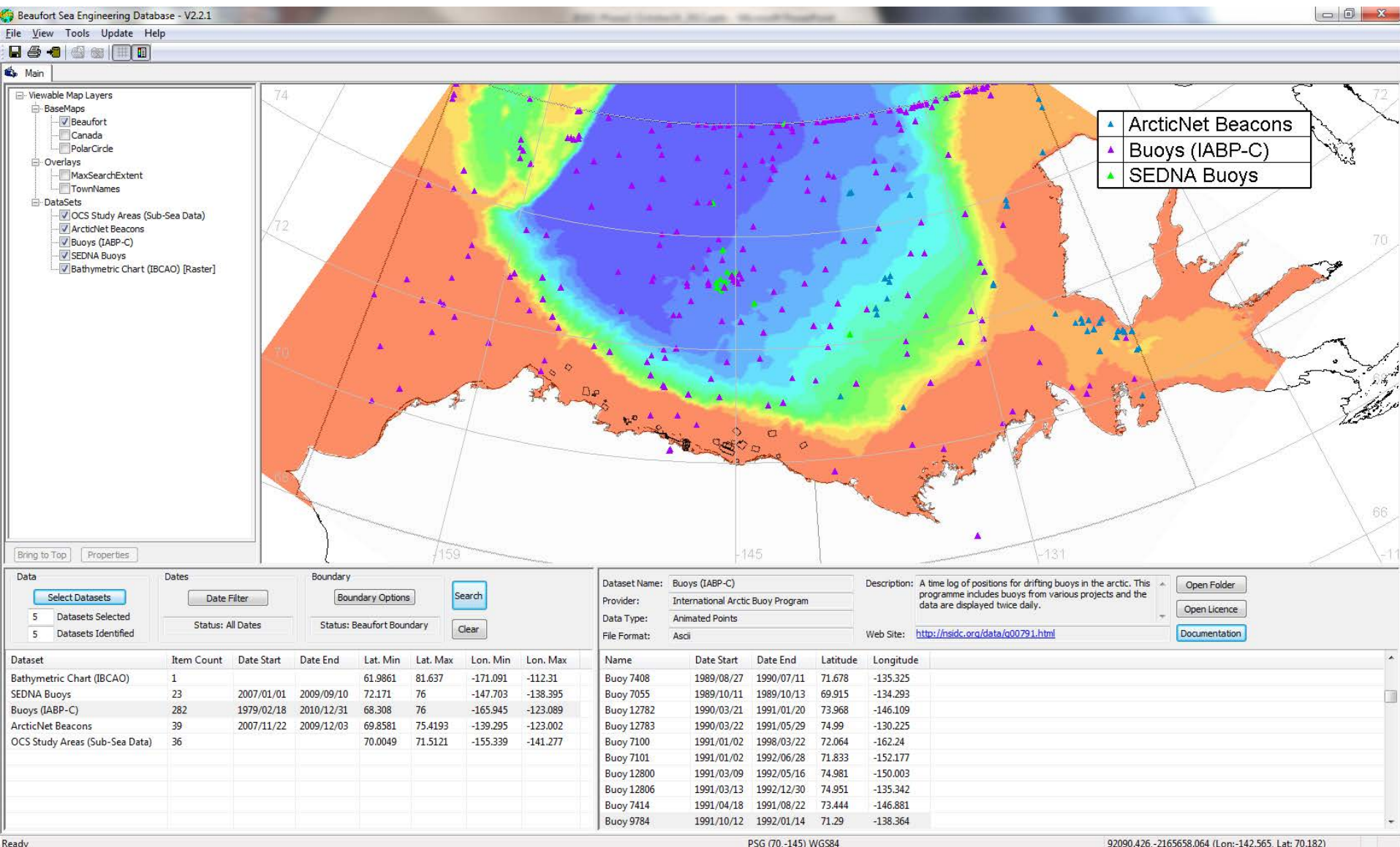
- It contains ~615,000 Files (152GB)
- BSD Software and User Manual
- 64 Datasets, each contains:
  - A short and long description, easily customizable and directly integrated into the software interface, that allows the user to quickly understand the content of the dataset.
  - The license attached to the dataset
  - A folder with raw data accessed by the software
  - A folder with additional data if required
  - A folder with additional documentation and reports

# Database Framework

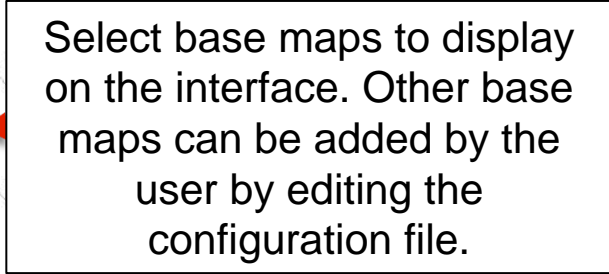


# Database demonstration

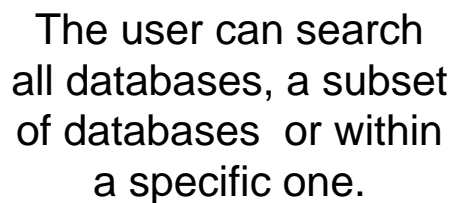
# BSED Interface











# Select Time Filter

- 4 Time Filters Available

**Set Search Date Options**

☒ All Dates

☐ Single Interval

Start: 01/01/2004  
End: 31/12/2008

☐ Variable Interval

Start Year: 2000  
End Year: 2011

☒ Periodic Interval

Start Date: Jan 1  
End Date: Jun 30

☐ Monthly Interval

<input type="checkbox"/> January	<input type="checkbox"/> July
<input type="checkbox"/> February	<input type="checkbox"/> August
<input checked="" type="checkbox"/> March	<input checked="" type="checkbox"/> September
<input type="checkbox"/> April	<input type="checkbox"/> October
<input type="checkbox"/> May	<input type="checkbox"/> November
<input type="checkbox"/> June	<input checked="" type="checkbox"/> December

Cancel OK

**Set Search Date Options**

☐ All Dates

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Start: 01/01/2004  
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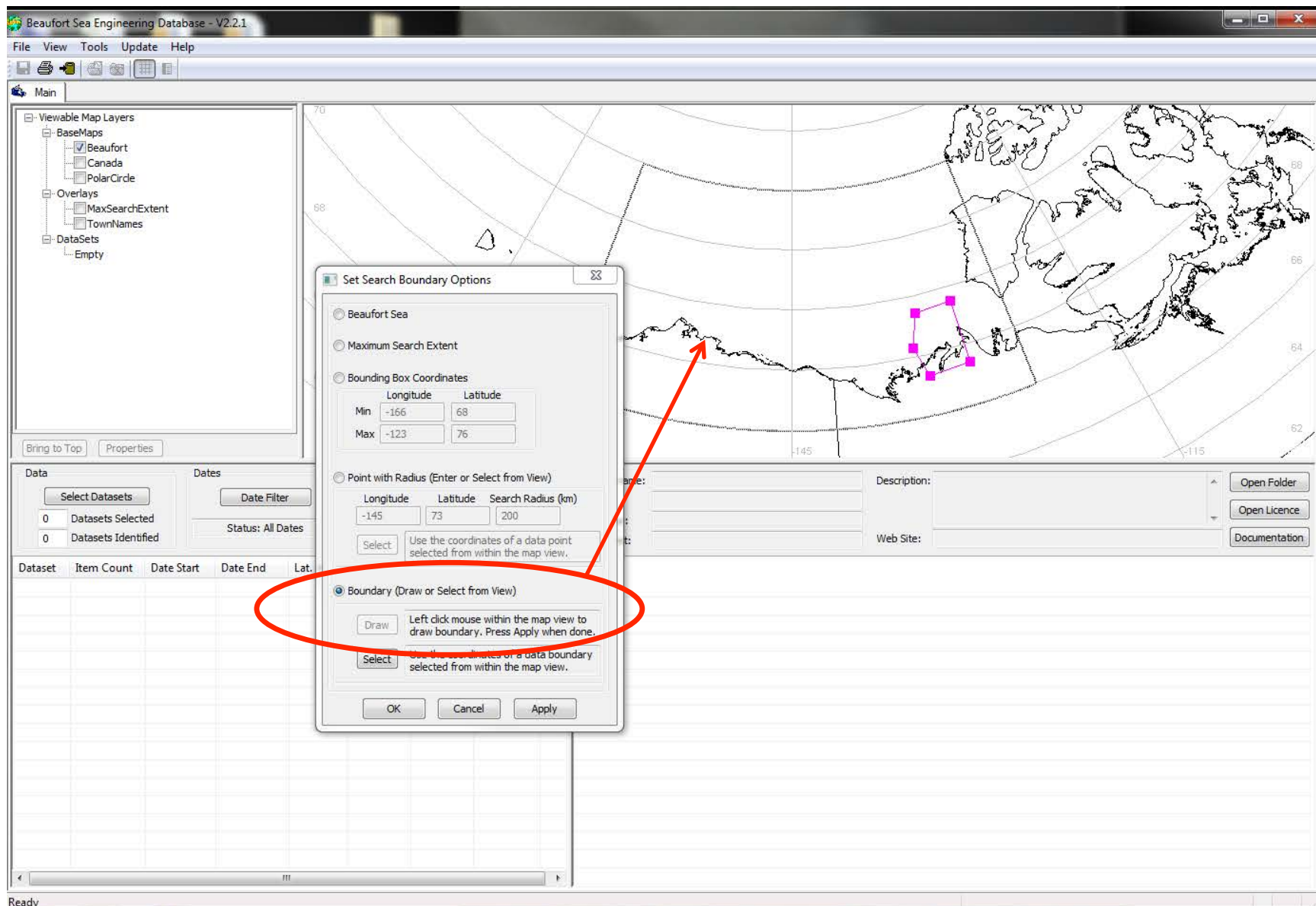
<input type="checkbox"/> January	<input type="checkbox"/> July
<input type="checkbox"/> February	<input checked="" type="checkbox"/> August
<input checked="" type="checkbox"/> March	<input checked="" type="checkbox"/> September
<input type="checkbox"/> April	<input type="checkbox"/> October
<input type="checkbox"/> May	<input type="checkbox"/> November
<input type="checkbox"/> June	<input checked="" type="checkbox"/> December

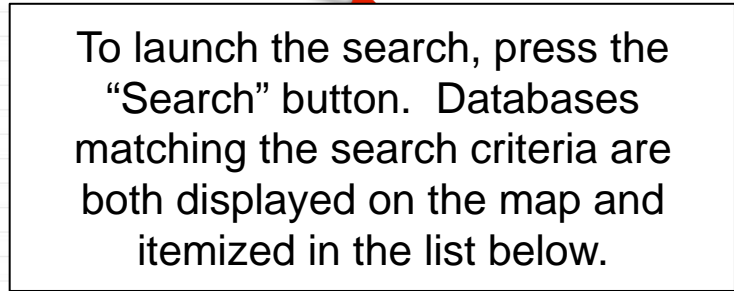
Cancel OK





# Select Spatial Filter - Boundary





# Select a retrieved database

Beaufort Sea Engineering Database - V2.2.1

File View Tools Update Help

Main

Viewable Map Layers

- BaseMaps
  - Beaufort
  - Canada
  - PolarCircle
- Overlays
  - MaxSearchExtent
  - TownNames
- DataSets
  - Weather Stations (CDOD)
  - Moored Upward Looking Sonar - Ice Veloc
  - Ice Charts - CIS Western Arctic
  - Frontier Well Sites
  - Community Conservation Plans
  - Extreme Ice Features

Bring to Top Properties

6 Datasets Selected  
6 Datasets Identified

Status: All Dates  
Status: Beaufort Boundary

Search

Dataset	Item Count	Date Start	Date End	Lat. Min	Lat. Max	Lon. Min	Lon. Max
Extreme Ice Fe...	5	2008/08/01	2008/08/01	75.6976	75.9425	-125.233	-124.386
Community C...	659			67.406	74.6378	-141.002	-115.025
Frontier Well ...	85			69.2778	70.7705	-140.243	-129.36
Ice Charts - CL...	1387	1968/08/02	2012/09/24	55.6428	88.4656	-179.197	178.629
Moored Upwa...	39	1990/03/31	2003/09/16	70.2896	74.1516	-133.828	-125.58
Weather Stati...	37	1896/01/01	2007/12/31	68.2167	72	-140.85	-124.083

Dataset Name: Description: Open Folder  
Provider: Open Licence  
Data Type: Documentation  
File Format: Web Site:

Select a specific database to show all items matching the search criteria within that database.



# Select items (example: Weather Station)

Slide #29

Beaufort Sea Engineering Database - V2.2.1

File View Tools Update Help

Main

Viewable Map Layers

- BaseMaps
  - Beaufort
  - Canada
  - PolarCircle
- Overlays
  - MaxSearchExtent
  - TownNames
- DataSets
  - Weather Stations (CDCD)
  - Moored Upward Looking Sonar - Ice Veloc
  - Ice Charts - CIS Western Arctic
  - Frontier Well Sites
  - Community Conservation Plans
  - Extreme Ice Features

Bring to Top Properties

Data

Select Datasets

6 Datasets Selected

6 Datasets Identified

Dates

Date Filter

Status: All Dates

Boundary

Boundary Options

Status: Beaufort Boundary

Search

Clear

Dataset Name: Weather Stations (CDCD)

Provider: Environment Canada

Data Type: Time Series

File Format: Binary

Description: Daily climate data from Environment Canada weather stations (1892-2007).

Open Folder

Open Licence

Documentation

Web Site: [http://www.climate.weatheroffice.gc.ca/prods\\_servs/index\\_e](http://www.climate.weatheroffice.gc.ca/prods_servs/index_e)

Dataset	Item Count	Date Start	Date End	Lat. Min	Lat. Max	Lon. Min	Lon. Max
Extreme Ice Fe...	5	2008/08/01	2008/08/01	75.6976	75.9425	-125.233	-124.386
Community C...	659			67.406	74.6378	-141.002	-115.025
Frontier Well ...	85			69.2778	70.7705	-140.243	-129.36
Ice Charts - CL...	1387	1968/08/02	2012/09/24	55.6428	88.4656	-179.197	178.629
Moored Upwa...	39	1990/03/31	2003/09/16	70.2896	74.1516	-133.828	-125.58
Weather Stati...	37	1896/01/01	2007/12/31	68.2167	72	-140.85	-124.083

Name	Date Start	Date End	Latitude	Longitude	CSN	Name	Airport	Province	District ID	District Name	Elevation	FirstYear	LastYear	StartRecNum
HERSCHEL ISLA...	1896/01/01	1918/12/31	69.5	-139.25	0635	HER...		Norther...	210	Yukon Territory	5	1896	1918	4336
HERSCHEL ISLA...	1974/01/01	2007/12/31	69.5667	-138.917	0636	HER...	WJN	Norther...	210	Yukon Territory	1	1974	2007	4386
IVVAVIK NAT. P...	1995/01/01	2007/12/31	69.1667	-140.15	0660	IVVA...	WOI	Norther...	210	Yukon Territory	244	1995	2007	4521
KOMAKUK BEA...	1994/01/01	2007/12/31	69.6167	-140.2	0682	KOM...	WKM	Norther...	210	Yukon Territory	13	1994	2007	5129
KOMAKUK BEA...	1958/01/01	1993/12/31	69.5833	-140.183	0685	KOM...	YAJ	Norther...	210	Yukon Territory	7	1958	1993	5214
MARGARET LAKE	1997/01/01	2006/12/31	68.8	-140.85	0697	MAR...	WZR	Norther...	210	Yukon Territory	543	1997	2006	5628
SAM LAKE	1974/01/01	1974/12/31	68.4167	-138.617	0945	SAM...		Norther...	210	Yukon Territory	457	1974	1974	8195
SHINGLE POINT A	1957/01/01	2007/12/31	68.95	-137.217	0950	SHIN...	YUA	Norther...	210	Yukon Territory	49	1957	2007	8372
STOKES POINT	1959/01/01	1993/12/31	69.35	-138.767	1050	STO...		Norther...	210	Yukon Territory	35	1959	1993	9411
AKLAVIK A	1926/01/01	2006/12/31	68.2167	-135	0100	AKL...	YKD	Norther...	220	Mackenzie	7	1926	2006	1
AKLAVIK RADIO...	1953/01/01	1960/12/31	68.2333	-135	0200	AKL...		Norther...	220	Mackenzie	9	1953	1960	354
ATKINSON POINT	1959/01/01	1963/12/31	69.9333	-131.4	0430	ATKI...		Norther...	220	Mackenzie	3	1959	1963	523
CAPE PARRY A	1957/01/01	2007/12/31	70.1667	-124.717	0675	CAP...	ZCP	Norther...	220	Mackenzie	87	1957	2007	591
FORT MCPHERS...	1974/01/01	1975/12/31	69.45	-134.833	1602	FOR...		Norther...	220	Mackenzie	31	1974	1975	2830
HORTON RIVER	1959/01/01	1963/12/31	70.0333	-126.967	2520	HOR...		Norther...	220	Mackenzie	164	1959	1963	6761

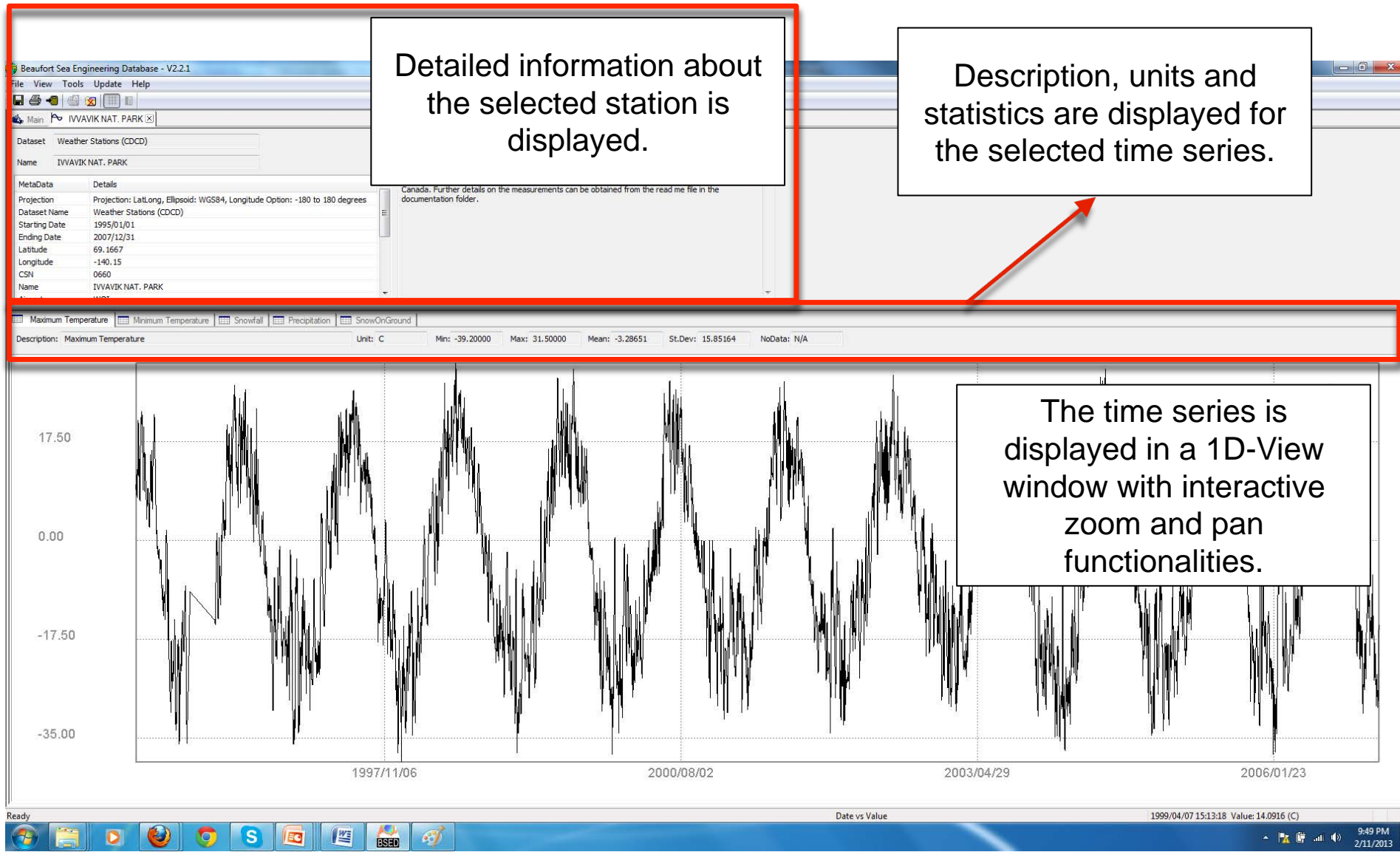
Ready

# Detailed Time Series (example: Weather Station)

Slide #30

Detailed information about the selected station is displayed.

Description, units and statistics are displayed for the selected time series.



# Retrieved Dataset

## (example: Community Conservation Plans)

Slide #31

Beaufort Sea Engineering Database - V2.2.1

File View Tools Update Help

Main

Viewable Map Layers

- BaseMaps
  - ☒ Beaufort
  - ☐ Canada
  - ☐ PolarCircle
- Overlays
  - ☐ MaxSearchExtent
  - ☒ TownNames
- DataSets
  - ☒ Community Conservation Plans

Bring to Top Properties

878901.480  
19313432560.268  
Spring Goose Harvesting Areas - Tuktoyaktuk

Data

Select Datasets

1 Datasets Selected  
1 Datasets Identified

Dates

Date Filter

Status: All Dates

Boundary

Boundary Options

Status: Beaufort Boundary

Search

Clear

Dataset Name: Community Conservation Plans  
Provider: Joint Secretariat  
Data Type: Polygons  
File Format: Shapefile

Description: Georeferenced data in the 6 community conservation plans from the Inuvialuit Settlement Region

Web Site: <http://www.jointsecretariat.ca/documents.html>

Open Folder  
Open Licence  
Documentation

Dataset	Item Count	Date Start	Date End	Lat. Min	Lat. Max	Lon. Min	Lon. Max	Name	Lat. Min	Lat. Max	Lon. Min	Lon. Max	SITE NO	TITLE
Comm...	659			67.406	74.6378	-141.002	-115.025	Spring Goose H...	68.6842	70.3046	-134.636	-128.235	304C	Spring Goose Harvesting Areas - Tuktoyaktuk
								Spring Goose H...	68.9394	69.7002	-136.076	-134.609	304C	Spring Goose Harvesting Areas - Tuktoyaktuk
								Spring Goose H...	68.8848	69.4444	-128.554	-128.079	304C	Spring Goose Harvesting Areas - Tuktoyaktuk
								Spring Goose H...	68.7106	68.9925	-132.045	-131.056	304C	Spring Goose Harvesting Areas - Tuktoyaktuk
								Spring Goose H...	68.4138	68.7736	-129.889	-129.289	304C	Spring Goose Harvesting Areas
								Spring Fishing A...	70.17	70.3017	-127.784	-127.457	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	69.9444	70.165	-128.467	-128.177	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	69.871	70.1225	-130.27	-129.509	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	69.9388	70.1366	-127.187	-126.621	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	69.811	69.9905	-129.218	-128.748	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	69.1243	69.7977	-134.221	-131.405	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	69.6063	69.7858	-131.036	-130.531	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	69.3031	69.5142	-135.333	-134.891	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	69.0369	69.4123	-131.38	-130.756	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	68.6927	69.194	-133.608	-132.375	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	68.7261	68.9921	-126.953	-126.544	305C	Spring Fishing Areas - Tuktoyaktuk
								Spring Fishing A...	68.6198	68.7171	-132.877	-132.553	305C	Spring Fishing Areas - Tuktoyaktuk

Ready

PSG (70,-145) WGS84

1440843.969,-2087672.691 (Lon:-110.388, Lat: 66.890)

# **Additional BSED demonstration**

- **10:10 – 10:30 during BREAK (CanICE and BSED)**
- **4:45 – 6:00 additional opportunities to demo databases**



# Work progress

## Meeting/ training in October 2012

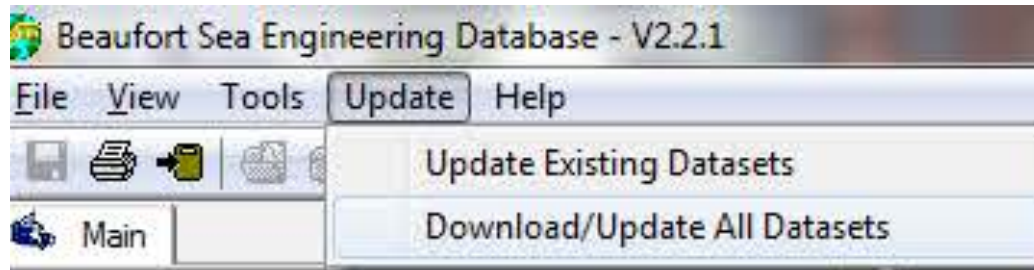
- **BSED *draft version* on external hard drive distributed to JIP partners**
- **Draft of End-user Manual**

## Remaining

- **Populating datasets**
- **Final End-user Manual**
- **Synchronize clients' BSED with the most updated NRC version (Master Database)**

# Update Mechanism

- The update mechanism is built-in the interface



- Synchronize the client database with the master database hosted on NRC's FTP server
  - Uploads only files that have been modified since the last update.
  - Does not affect or upload proprietary data stored in the client database.

# Future Work

- Continued Database maintenance

1	Buoys IABP-C (logged positions)
2	Ice Velocity IABP-D
3	Air Pressure IABP-AB
4	Ice Charts - CIS daily
5	Ice Charts - CIS Western Arctic
6	Ice Charts - NIC Arctic
7	<u>ArcticNet Basemaps</u>
8	<u>ArcticNet Beaufort shelf</u>
9	CIS Ice thickness
10	Weather stations, Daily (GSOD)
11	Weather stations, Hourly (SDHG)
12	Oil and Gas Rights
13	NARR Precipitation
14	NARR Pressure
15	NARR Temperature
16	NARR Wind 10m
17	Ice Concentration (MMAB)
18	Wind and Wave <u>Hindcast</u>

# Future Work – cont'd

- **Include new datasets**
  - **Primary focus would be on geotechnical data such as permafrost data, scour maps, etc.; other data should include breakup patterns of the landfast ice, extent and degradation of landfast ice, seismic lines, etc.**
    - Traditional and local knowledge could be used to validate or augment site specific information such as ice conditions, breakup patterns of landfast ice, etc.

# Potential Use of BSED

- **The complete comprehensive integrated database will ensure that engineering decisions are made with the best available regional information.**
- **It becomes a primary point of reference for regional environmental information for Regulators responsible for reviewing project applications in the Beaufort Sea.**
- **The database will collect diverse existing historical datasets before the data is lost , evaluate the quality and quantity of available data and make them available for future projects in Beaufort Sea region.**
- **The database and analysis can be used to identify gaps in important data and knowledge. Once identified, these gaps can be used to select the most beneficial and cost effective research required to close the gaps or for mitigation.**

# Potential Use of BSED – cont'd

- **It can be used for many other engineering applications and operations in the Beaufort Sea:**
  - **The information on ice conditions will be a major driving factor for decisions related to the types of emergency evacuation systems that must be in place on the platform;**
  - **Analysis of BSED data provides direct input on the shipping regulations and severity of ice conditions throughout the year in the Beaufort Sea. This information can be used to evaluate required vessel class, windows of operation for both platform supplies, and offloading of the hydrocarbons (if done using a tanker), routes for tankers and supply vessels, etc;**

# Potential Use of BSED – cont'd

- Historical information on winds, waves, ice movement, etc. can be used as background (default) information for ice forecasting models and ice movement severity at any location in the Beaufort Sea.
- Information on seabed scour and seabed properties could be used to evaluate suitable pipeline routes;
- Defining historic windows of opportunity for seismic vessels;

**The use of BSED will lead to safe and efficient operations in the Beaufort Sea ensuring that needs of Communities are met**

AANDC – Aboriginal Affairs and Northern Development Canada  
AMRS-E – Advanced Microwave Scanning Radiometer - Earth Observing System  
ASCII - American Standard Code for Information Interchange  
BP – British Petroleum  
BREA – Beaufort Regional Environmental Assessment  
BSED – Beaufort Sea Engineering Database  
CDCD – Canadian Daily Climate Data  
CIS – Canadian Ice Service  
EER – Escape, Evacuation and Rescue  
FTP – File Transfer Protocol  
GSOD - Global Surface Summary of Day  
HEMI - Helicopter Electro-Magnetic Induction  
IABP – International Arctic Buoy Program  
IBCAO – International Bathymetric Chart of the Arctic Ocean  
NAAR – North American Regional Reanalysis  
NIC - National Ice Centre  
NRC – National Research Council  
MY – Multi-year Ice  
OCS - Outer Continental Shelf  
PCSP – Polar Continental Shelf Project  
SDHG – Surface Data Hourly Global  
SEDNA - Sea ice Experiment: Dynamic Nature of the Arctic



# Thank you

## Questions?

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