



**FEDNAV**

DELIVERING A HIGHER STANDARD





## Arctic Shipping Best Practices Information Forum





## FEDNAV LIMITED – ARCTIC EXPERIENCE

- 60+ years of Arctic Trading
- More than 35 Million tonnes of cargo carried
- In excess of 850 voyages
- The vast majority of voyages using Category C (light or no ice class) vessels
- No environmental incidents





## EVOLUTION OF DATA





# EVOLUTION OF DATA

## *Milne Inlet*

239 **Milne Inlet** is entered between Ragged Island and Athole Point ( $72^{\circ}31'N.$ ,  $80^{\circ}32'W.$ ), 6.5 miles west.

240 **Dangers in approaches.** — An isolated rock with 3 feet (0.9 m) over it and a 3-fathom (5.5 m) patch, reported in 1956 (position approximate), are charted 4 miles NNE and 5.5 miles ENE, respectively, of the NE point of Ragged Island.

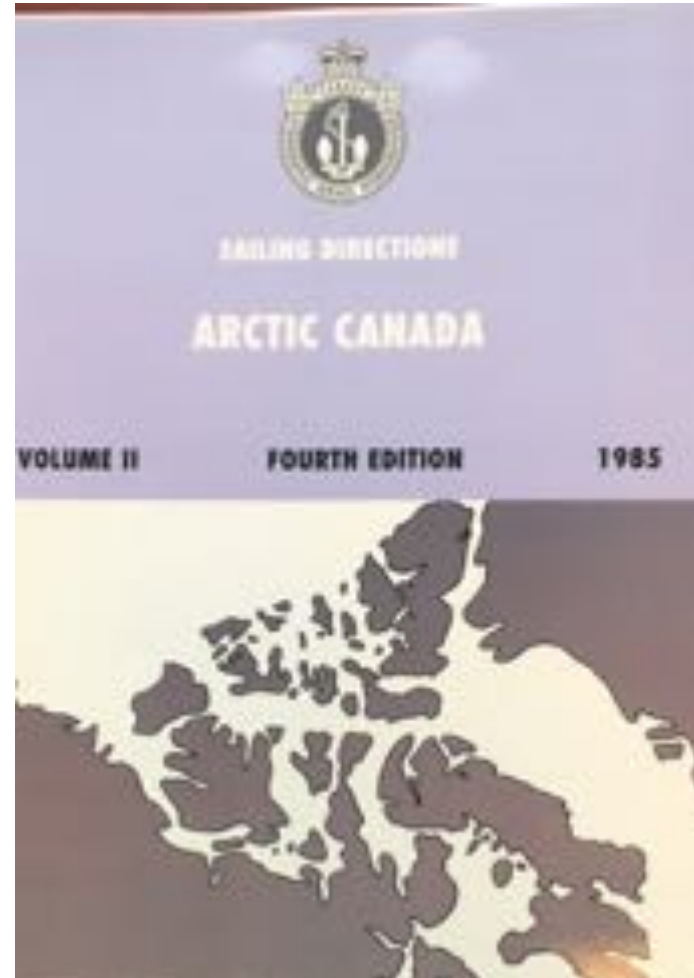
241 **Ragged Island** has cliffs on its east coast where it rises to over 1,500 feet (457 m) and a gravel beach at its south end. The larger of the islands off its NE coast has an elevation of 500 feet (152 m). Drying rocks are situated close west of the south end of the channel which runs between Ragged and Baffin Islands. **Anchorage** can be obtained in the bay on the west side of Ragged Island.

242 The outer part of **Eskimo Inlet** (*entrance*:  $72^{\circ}19'N.$ ,  $80^{\circ}12'W.$ ) runs between sedimentary walls rising to 2,500 feet (762 m) on the west and about 1,500 feet (457 m) on the east side. The shores of the inner 3 miles are lower and there is a 3-foot (0.9 m) shoal 1.8 miles from the head. **Angmagraluit Mountain**, on the west side of the inlet near the entrance, is over 1,400 feet (427 m) in elevation and is described as "rising like a tremendous wall over a low foreland."

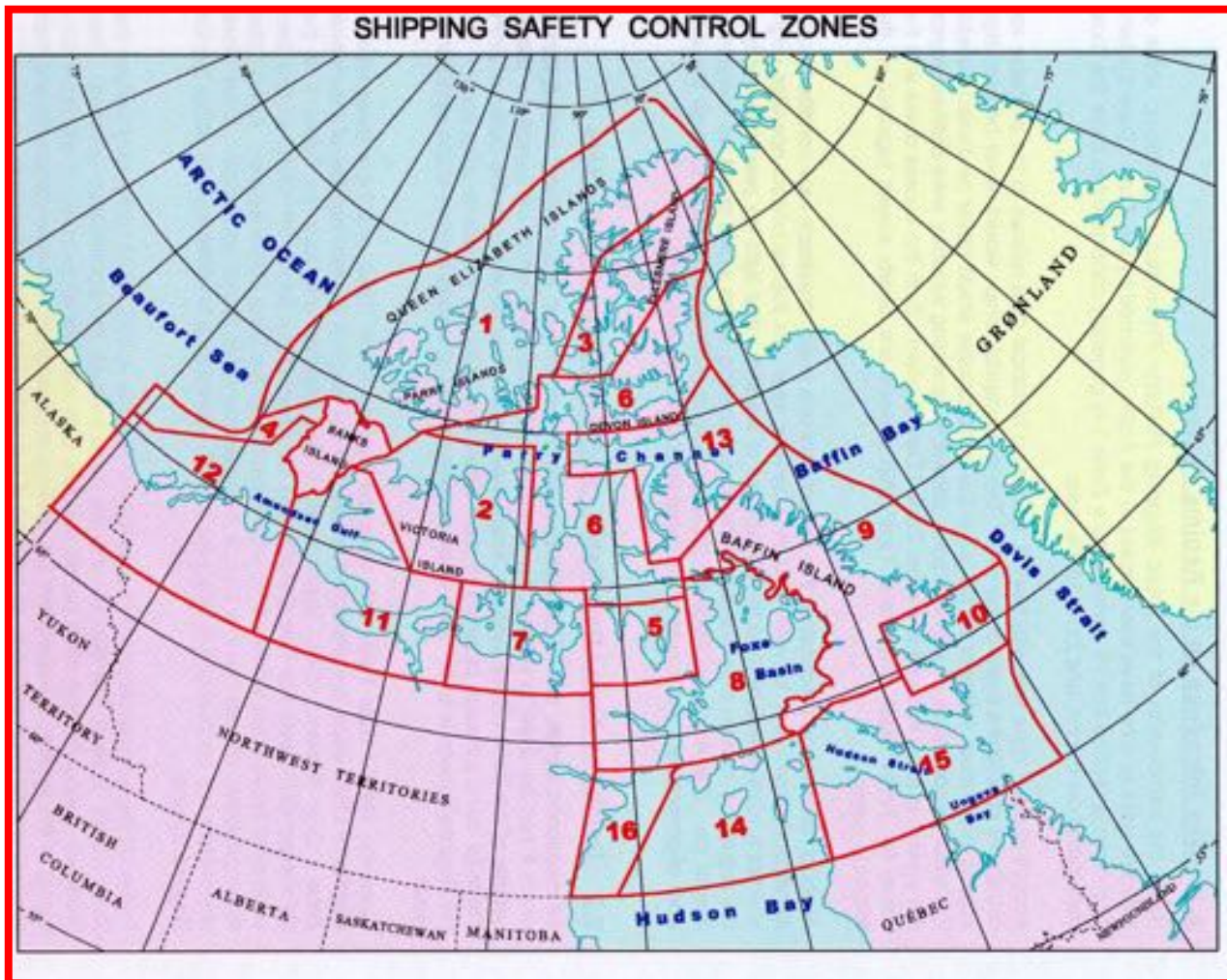
243 **Ipitalik Peninsula** lies 7 miles SSW of the entrance to Eskimo Inlet, and **Tikerakdjunk Mountain** rises 3 miles farther south. The bay on the east side of Ipitalik Peninsula is named **Deep Cove**; the one farther east, **Milky Bay**. A 1-fathom (1.8 m) shoal named **Lone Shoal** lies 1.2 miles WNW of Ipitalik Peninsula. **Anchorage** can be obtained NW of this shoal.

244 **Low Island** ( $72^{\circ}14'N.$ ,  $80^{\circ}38'W.$ ) has shoal water extending SSE from it; **Stephens Island** is steep-sided and rocky.

245 The west side of Milne Inlet, from Athole Point to **Fairweather Bay**, is formed by a wall of sediments rising to a fairly flat plateau with an elevation of 1,600 feet (488 m). The sharp point









# ARCTIC ICE REGIME SHIPPING SYSTEM

June, 1997 User Assistance Package

**Table of Ice Multipliers  
for the  
Arctic Ice Regime Shipping System (AIRSS)**

| AES / WMO<br>Ice Codes | Ice Types                          | Thickness | Ice Multipliers for each Ship Category |        |        |        |        |       |       |
|------------------------|------------------------------------|-----------|--|--------|--------|--------|--------|-------|-------|
|                        |                                    |           | Type E                                 | Type D | Type C | Type B | Type A | CAC 4 | CAC 3 |
| 7• or 9•               | Old / Multi-Year Ice               |           | -4                                     | -4     | -4     | -4     | -4     | -3    | -1    |
| 8•                     | Second-Year Ice                    |           | -4                                     | -4     | -4     | -4     | -3     | -2    | 1     |
| 6 or 4•                | Thick First-Year Ice               | > 120 cm  | -3                                     | -3     | -3     | -2     | -1     | 1     | 2     |
| 1•                     | Medium First-Year Ice              | 70-120 cm | -2                                     | -2     | -2     | -1     | 1      | 2     | 2     |
| 7                      | Thin First-Year Ice                | 30-70 cm  | -1                                     | -1     | -1     | 1      | 2      | 2     | 2     |
| 9                      | Thin First-Year Ice - 2nd Stage    | 50-70 cm  |  |        |        |        |        |       |       |
| 8                      | Thin First-Year Ice - 1st Stage    | 30-50 cm  | -1                                     | -1     | 1      | 1      | 2      | 2     | 2     |
| 3 or 5                 | Grey-White Ice                     | 15-30 cm  | -1                                     | 1      | 1      | 1      | 2      | 2     | 2     |
| 4                      | Grey Ice                           | 10-15 cm  | 1                                      | 2      | 2      | 2      | 2      | 2     | 2     |
| 2                      | Nilas, Ice Rind                    | < 10 cm   | 2                                      | 2      | 2      | 2      | 2      | 2     | 2     |
| 1                      | New Ice                            | < 10 cm   | *                                      | *      | *      | *      | *      | *     | *     |
|                        | Brash (ice fragments < 2 m across) |           | *                                      | *      | *      | *      | *      | *     | *     |
|                        | Bergy Water                        |           | *                                      | *      | *      | *      | *      | *     | *     |
|                        | Open Water                         |           | *                                      | *      | *      | *      | *      | *     | *     |

Decayed ice: For the following ice types: MY, SY, TFY, and MFY that are 'Decayed', add +1 to the Ice Multiplier.

Ridged ice: For ice floes that are over 3/10ths 'Ridged' and in an overall ice concentration that is greater than 6/10ths, subtract 1 from the Ice Multiplier.

\* Another version of this table can be found in TP 12259.





## NUNAVIK IN ICE HEADING INTO PRINCE OF WALES STRAIT





## Fednav Limited – Arctic Shipping Projects Through The Years



**Category B Vessels**





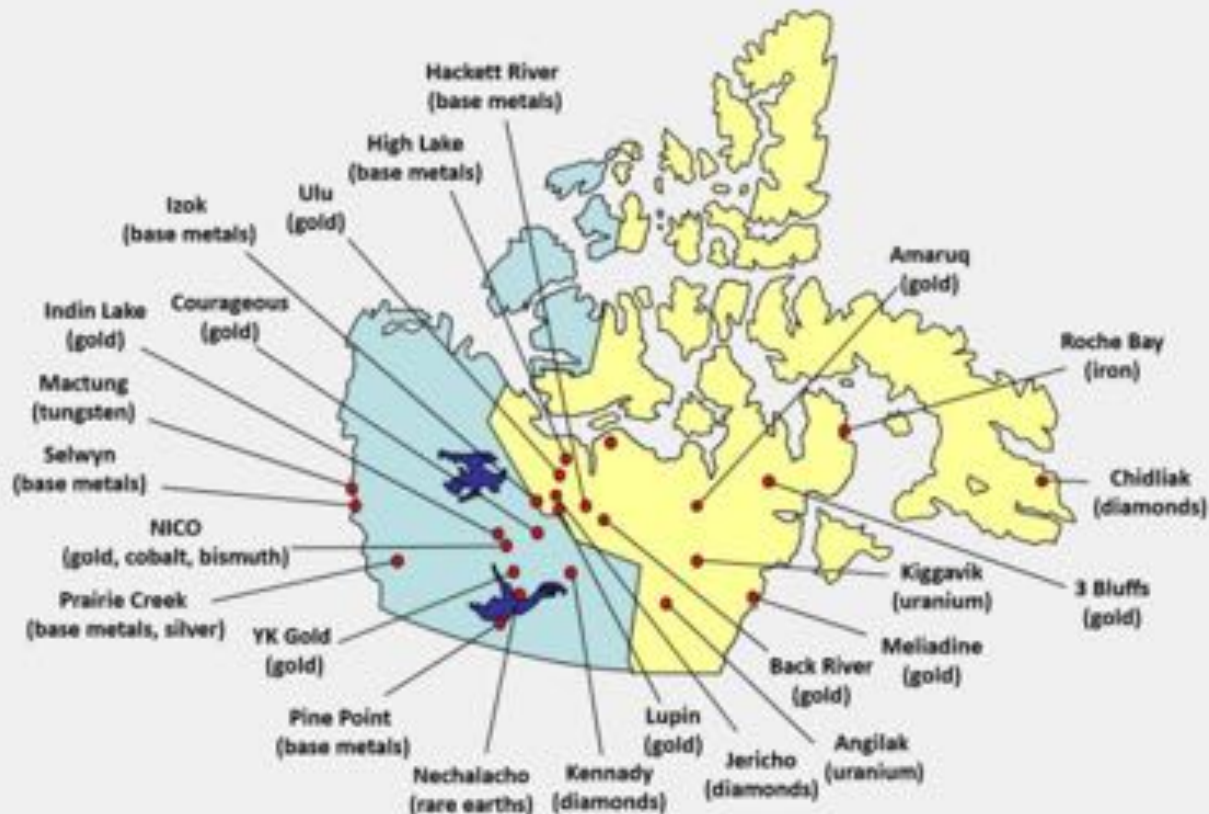


## NORTHERN RESOURCE WEALTH



# NORTHERN RESOURCE WEALTH

## *Advanced Projects = potential mines?*





## 'OPEN WATER' ONLY OPERATIONS





## BAFFINLAND IRON MINE

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# BAFFINLAND IRON ORE EXPORT PROJECT







## BAFFINLAND IRON MINE – LOCAL ECONOMIC DRIVER





## RED DOG MINE AND PORT, ALASKA

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Red Dog (Alaska) 67.34 N  
164.04 W loading  
operations during summer  
Open Water Vessels –  
Category C



25 plus seasons, over  
35,000,000 tonnes, nearly 600  
voyages



# RESOURCE DEVELOPMENT IN THE LOCAL ECONOMY

## RED DOG WAGES



|   |               |
|---|---------------|
| Annual average jobs (including on-site, year-round contractors)                 | 610 jobs      |
| Average Red Dog regular annual wage   | \$112,000     |
| Red Dog (Teck) employee wages (excluding benefits) to NANA shareholders         | \$31 million  |
| Red Dog (Teck) cumulative wages paid to NANA shareholders (1999-2013)           | \$303 million |
| Red Dog state and federal taxes (annual)  | \$100 million |
| Red Dog (Teck) cumulative wages paid to NWAB residents shareholders (1999-2013) | \$132 million |



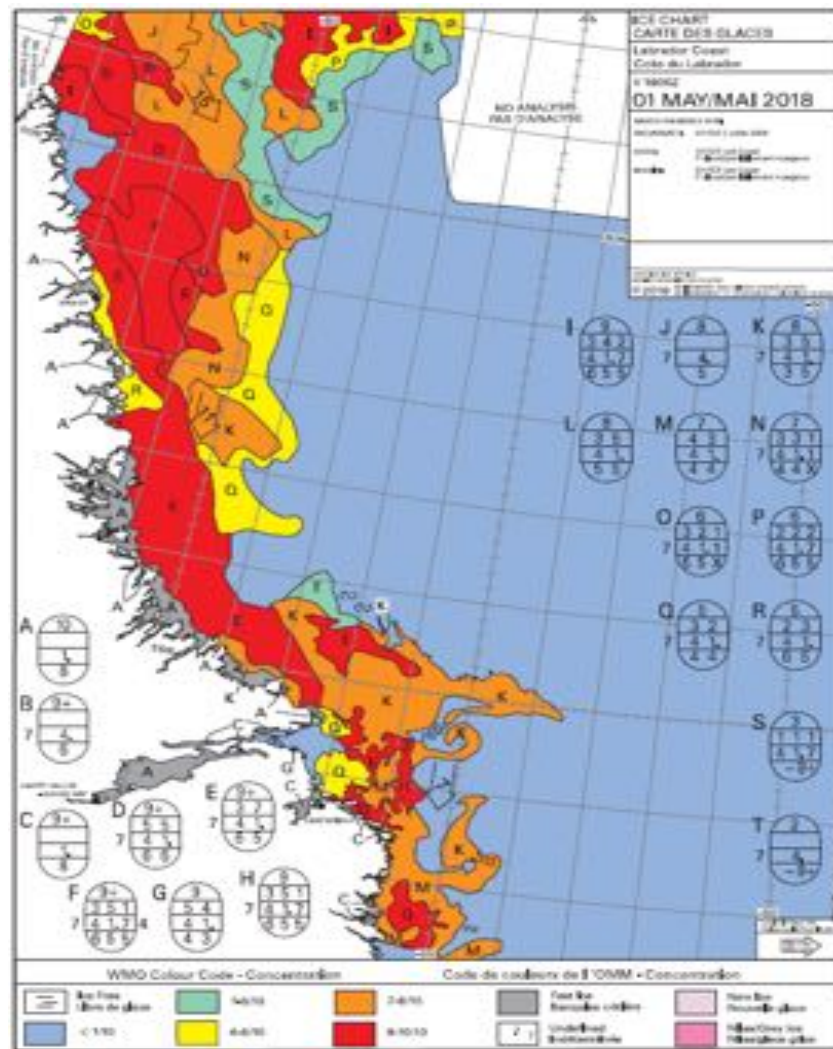
# EARLY SEPTEMBER, POLAR TEMPERATURES

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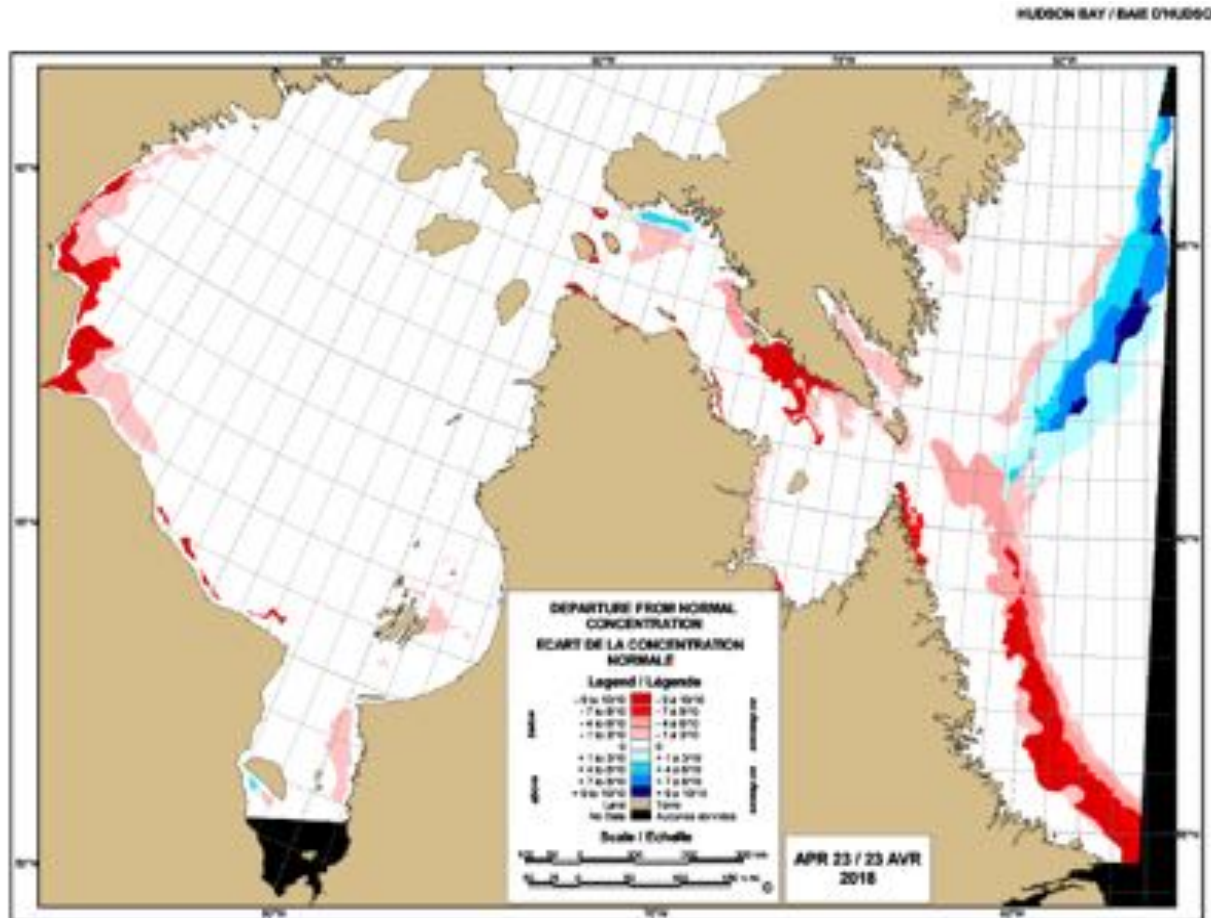


# CANADIAN ICE SERVICE





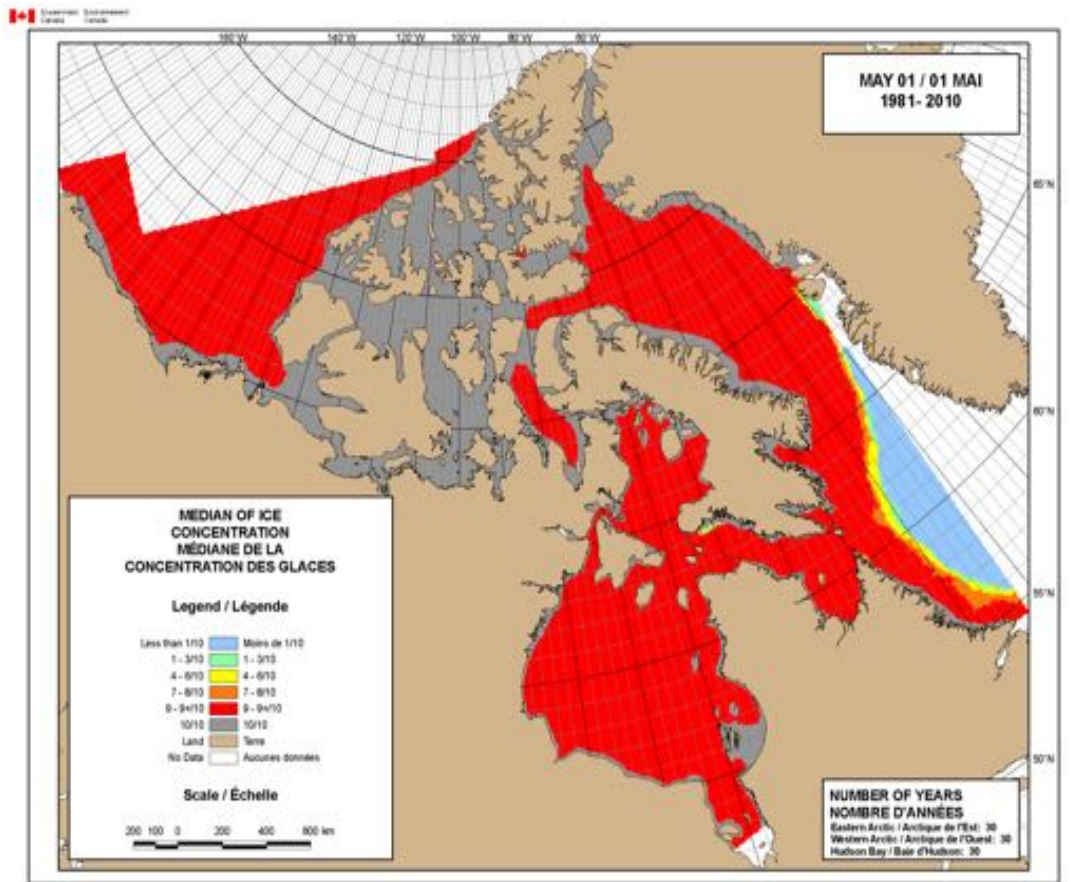
# CANADIAN ICE SERVICE



STATISTICS BASED UPON 1981-2010 (INTERPOLATED BETWEEN 01-APR AND 01-MAY)  
 LES STATISTIQUES S'AVÈRENT SUR 1981-2010 (INTERPOLÉES ENTRE LE 01-AVR ET LE 01-MAI)



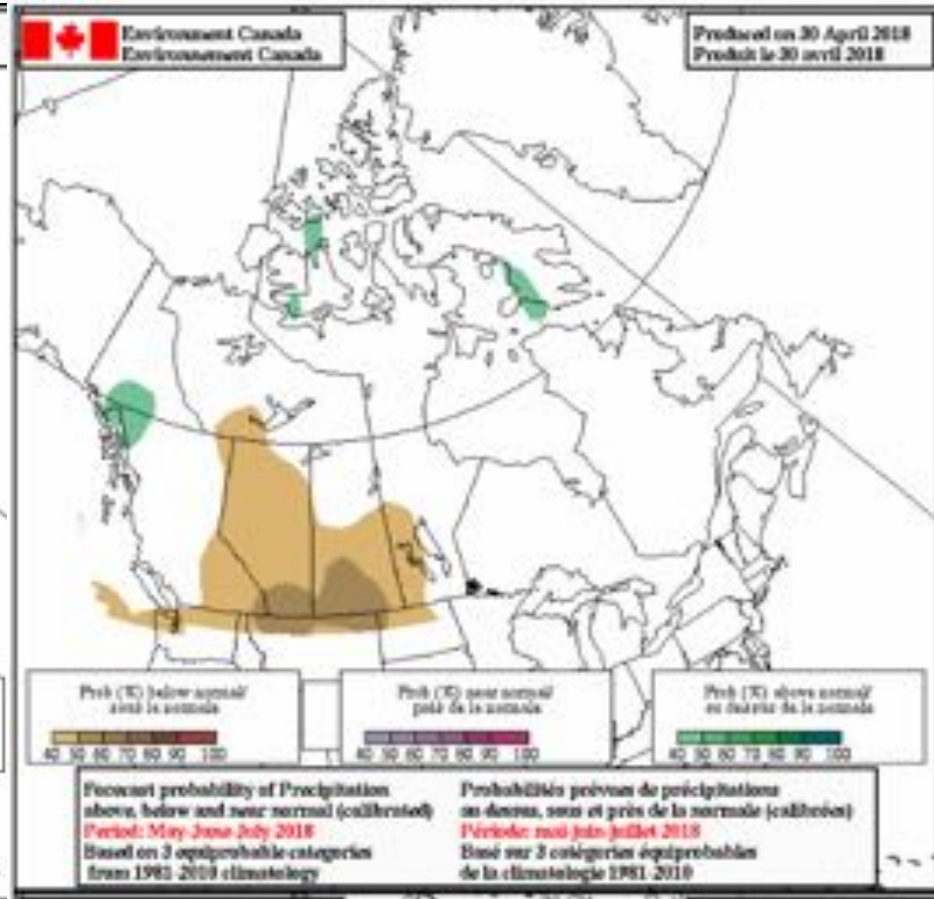
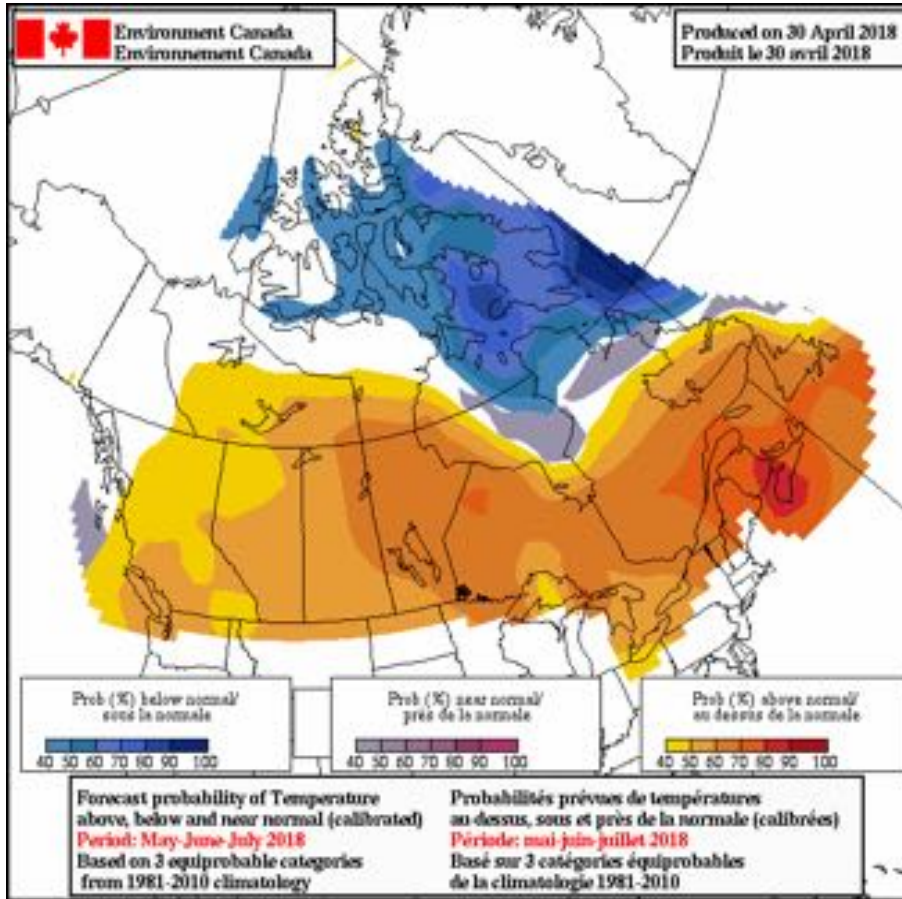
# CANADIAN ICE SERVICE







# CANADIAN ICE SERVICE





# CANADIAN ICE SERVICE

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Marine forecasts for Newfoundland issued by Environment Canada at 3:30 p.m. NDT Wednesday 2 May 2018 for tonight and Thursday. The next scheduled forecast will be issued at 8:00 p.m. NDT.

Fog implies visibility less than 1 mile.

#### Strait of Belle Isle.

Mind variable 10 to 15 knots except northeast 15 to 20 over eastern sections. Mind increasing to northeast 25 this evening then diminishing to northeast 15 to 20 near noon Thursday. Mind diminishing to variable 10 to 15 Thursday evening. Showers or flurries ending late overnight. Visibility 1 mile or less in precipitation. Temperatures minus 2 to plus 4.

#### Northeast Gulf

##### Gulf - Port au Port.

Mind southwest 15 to 20 knots increasing to northeast 30 this evening except variable 15 over southeastern sections tonight. Mind diminishing to northeast 15 to 20 Thursday afternoon. Showers changing to showers or flurries this evening and ending Thursday morning. Fog patches dissipating Thursday morning.

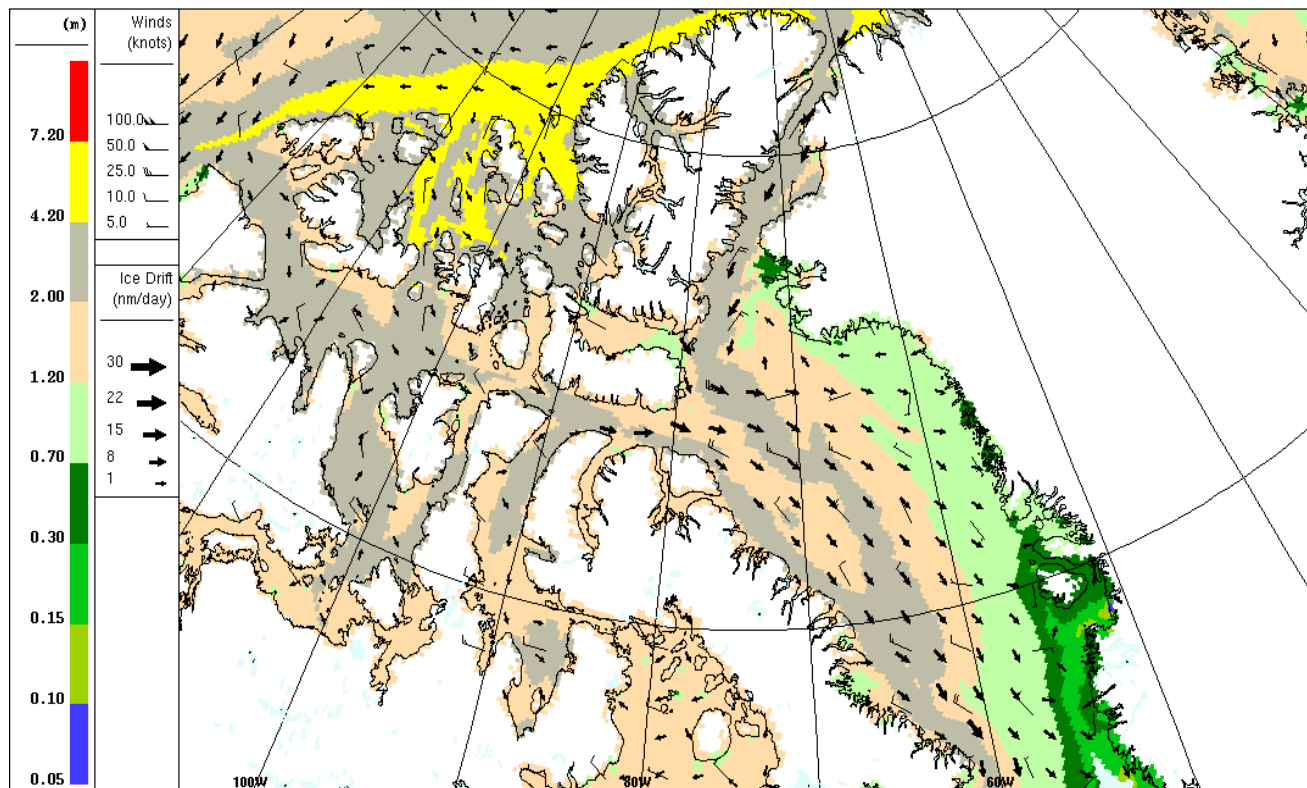
#### Southwest Coast.

Mind southwest 15 to 20 knots diminishing to variable 10 to 15 late overnight then increasing to northeast 15 to 20 near noon Thursday. A few showers changing to rain late overnight and ending Thursday afternoon. Fog banks dissipating Thursday afternoon.



# CANADIAN ICE SERVICE

GIOPS: Effective Ice thickness/épaisseur de la glace effective  
 Valid/Valide: 2018/04/24 03 UTC/UTC  
 2018042400\_003  
**Forecast/prevision**







# MODIS





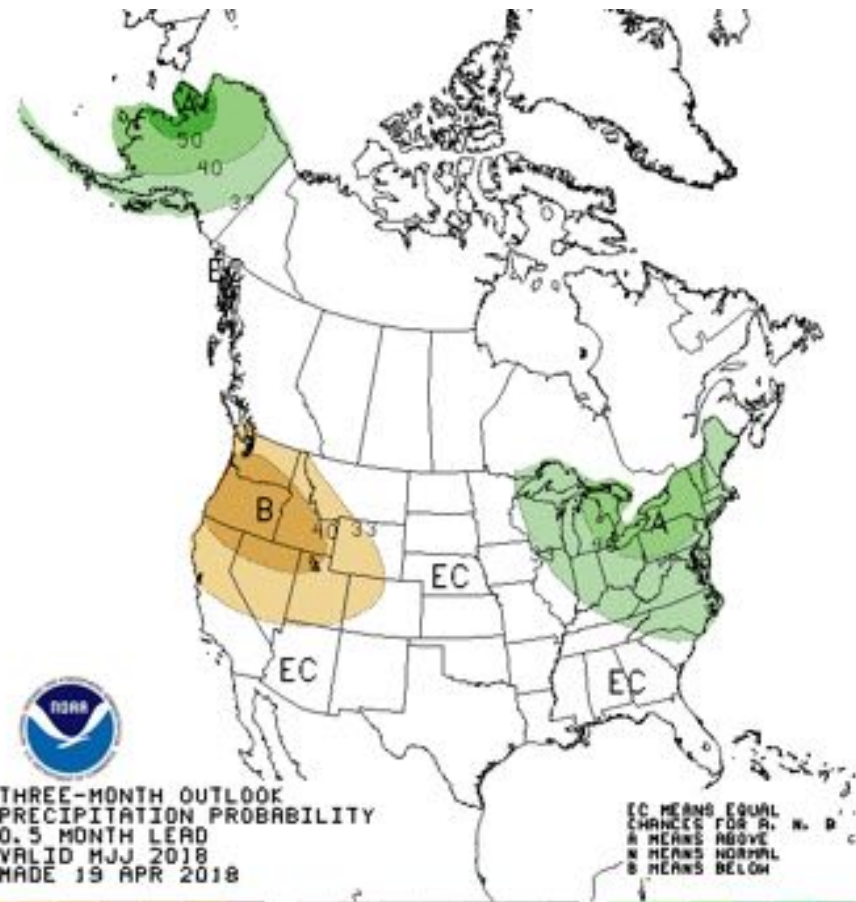
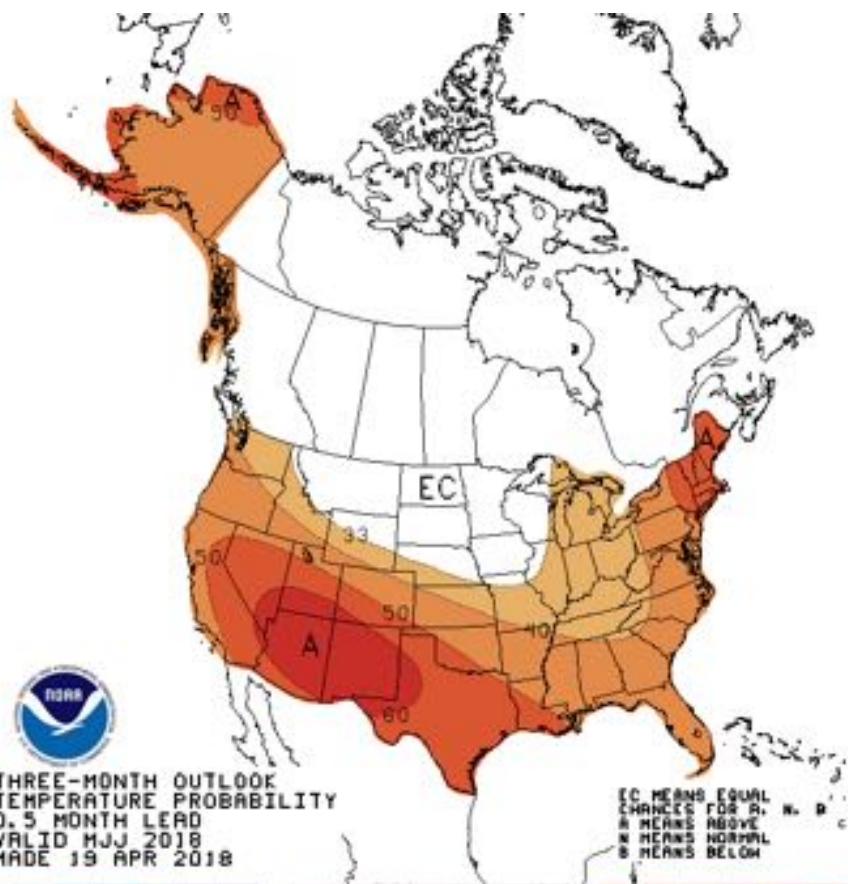
## TERRA SAR-X

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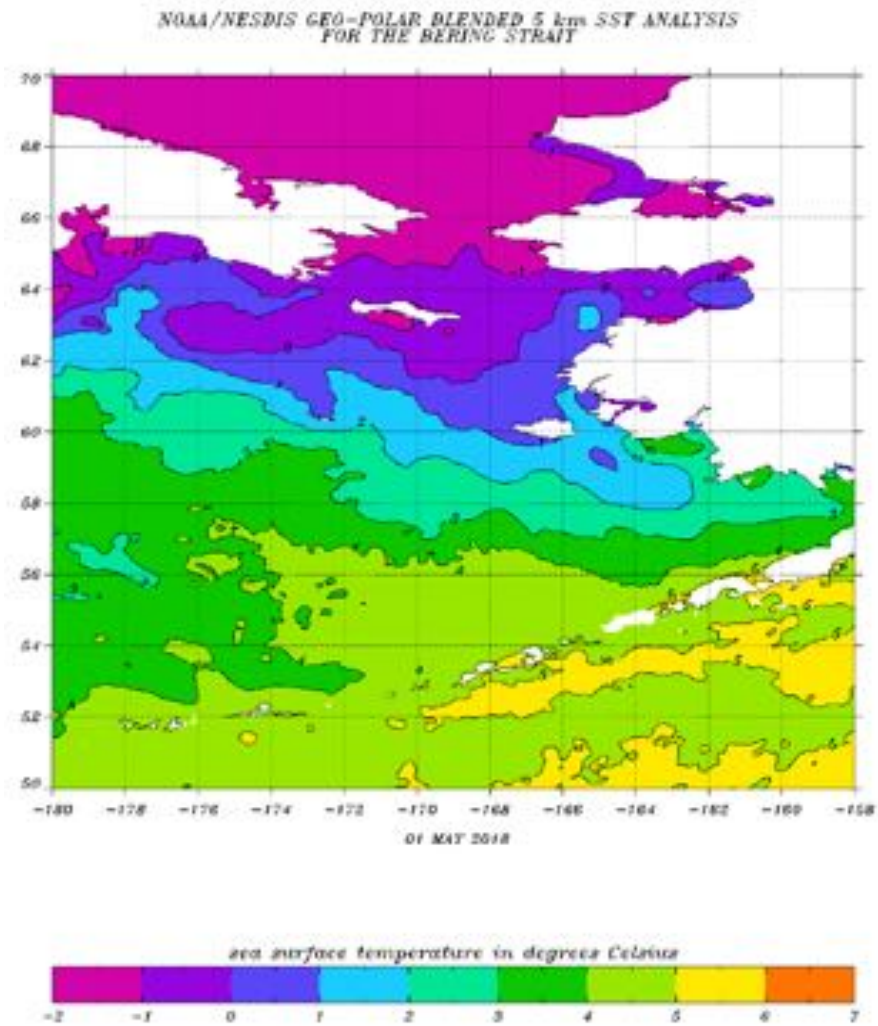


# NOAA





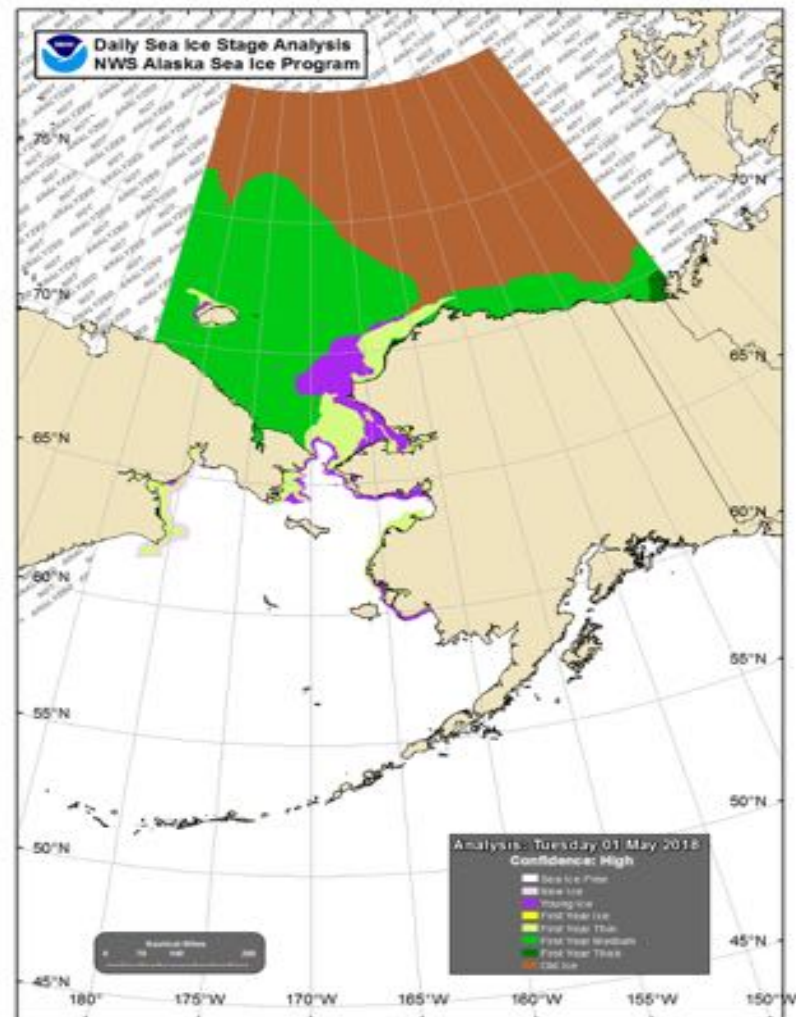
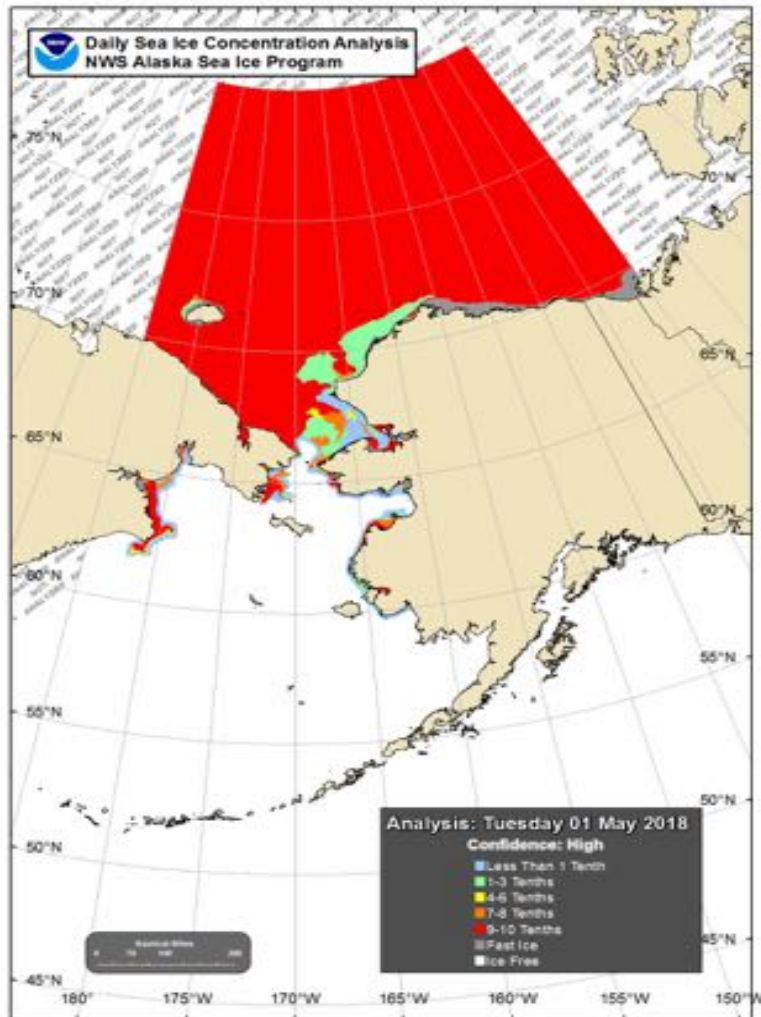
# NOAA





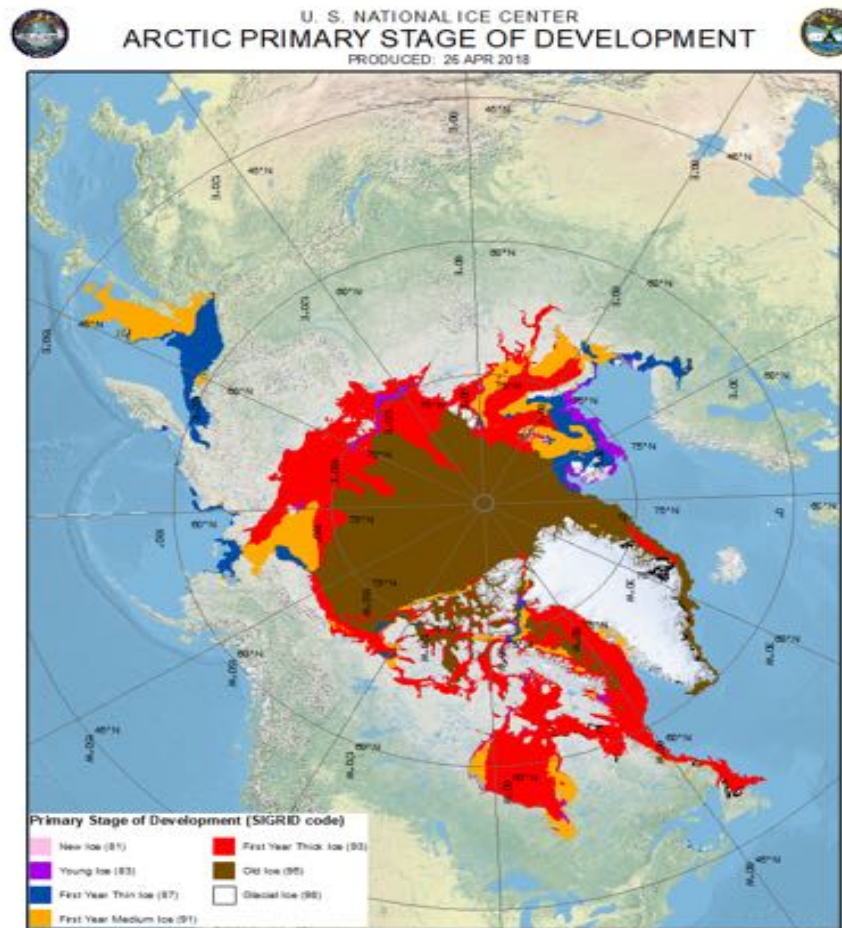


# NWS ALASKA SEA ICE PROGRAM



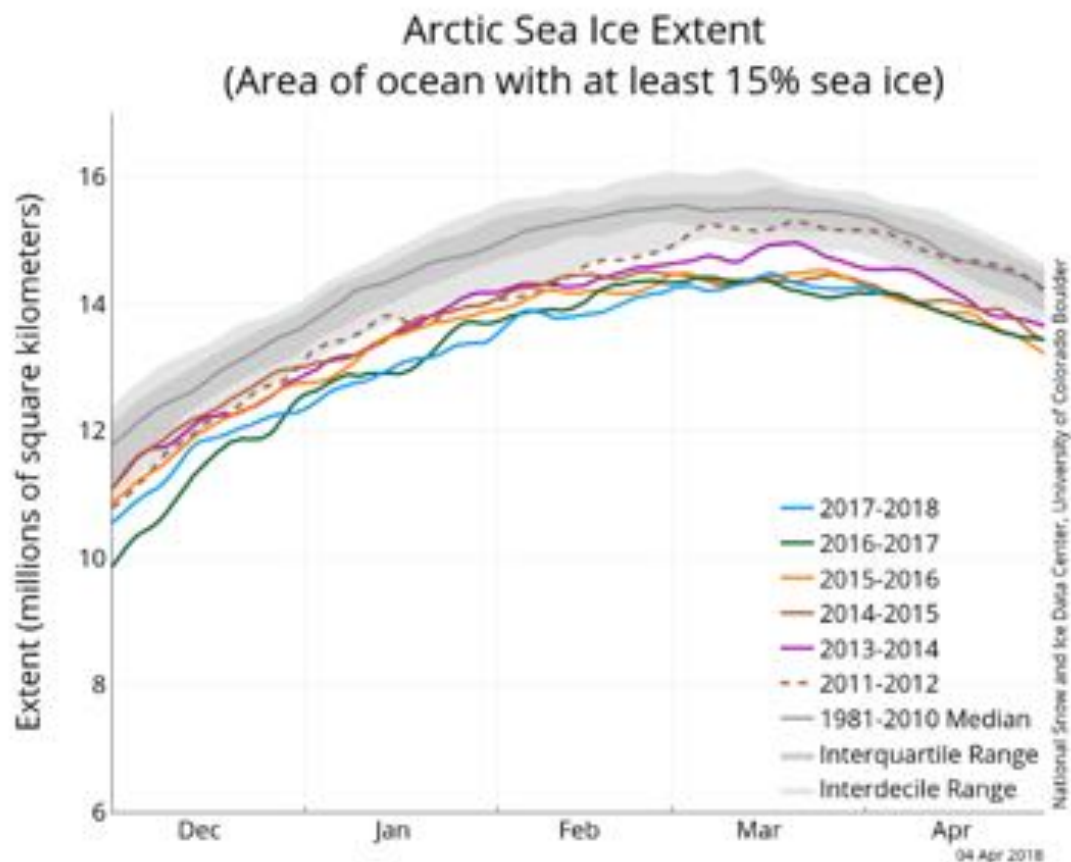


# U.S. NATIONAL ICE CENTRE



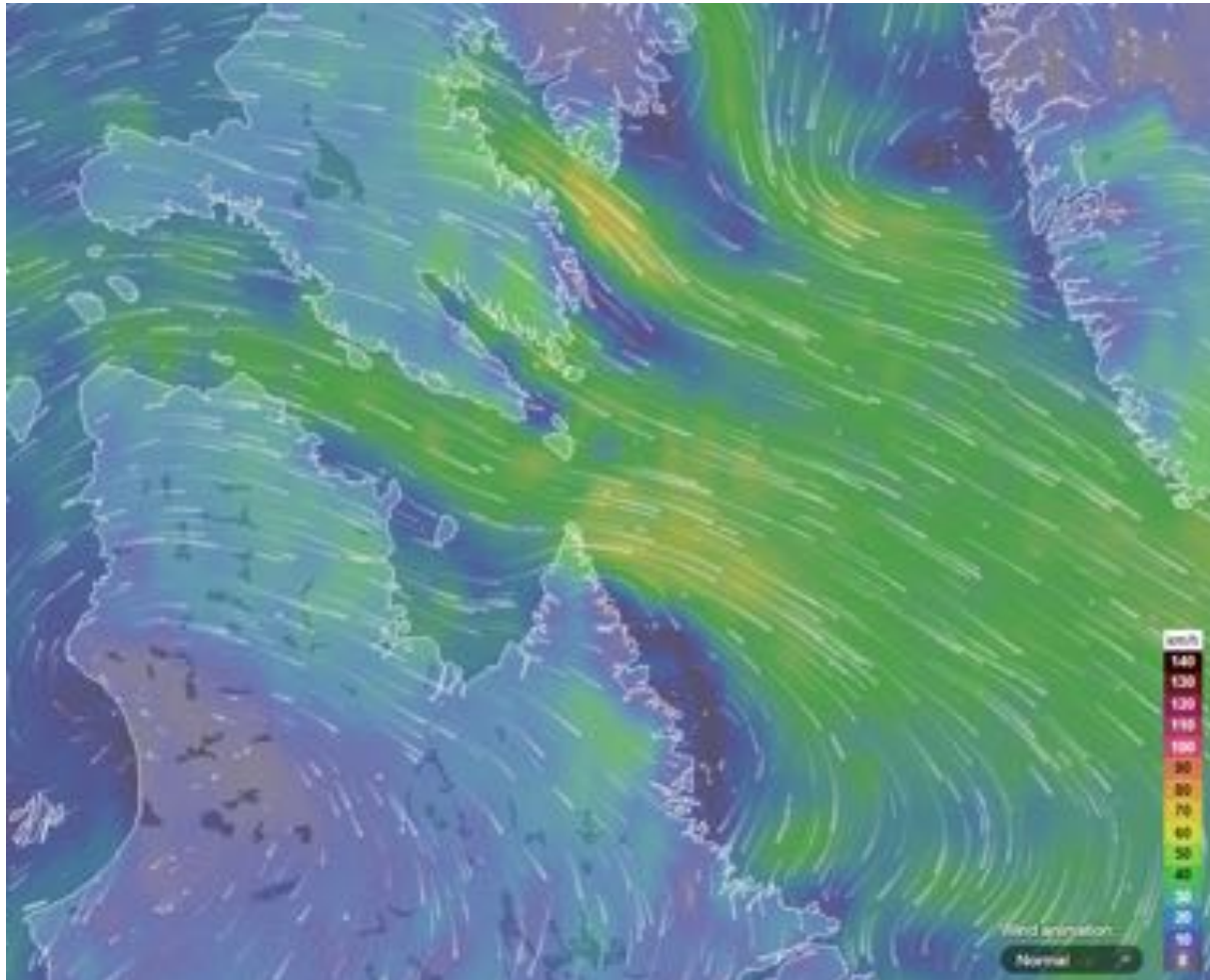


# NATIONAL SNOW AND ICE DATA CENTER

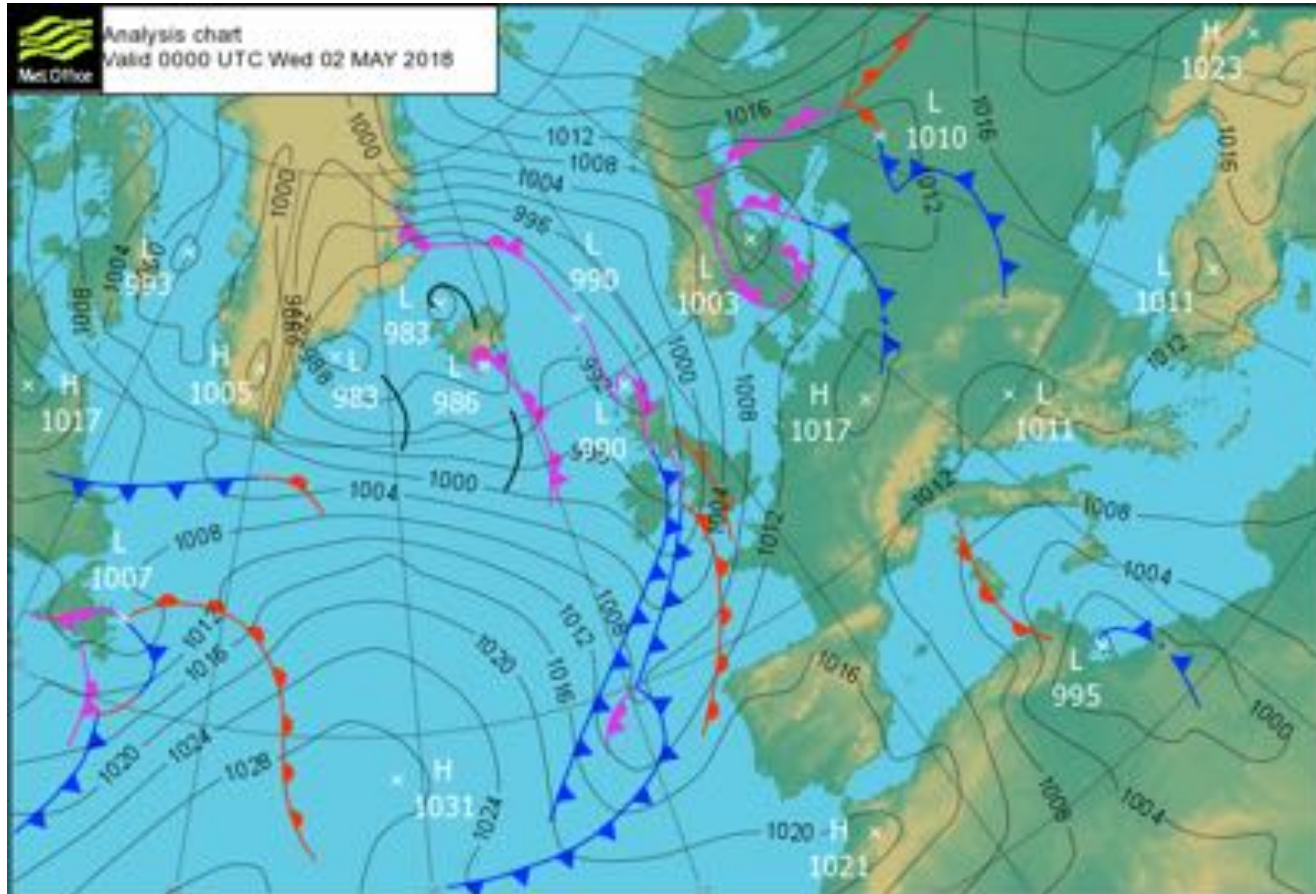




# VENTUSKY

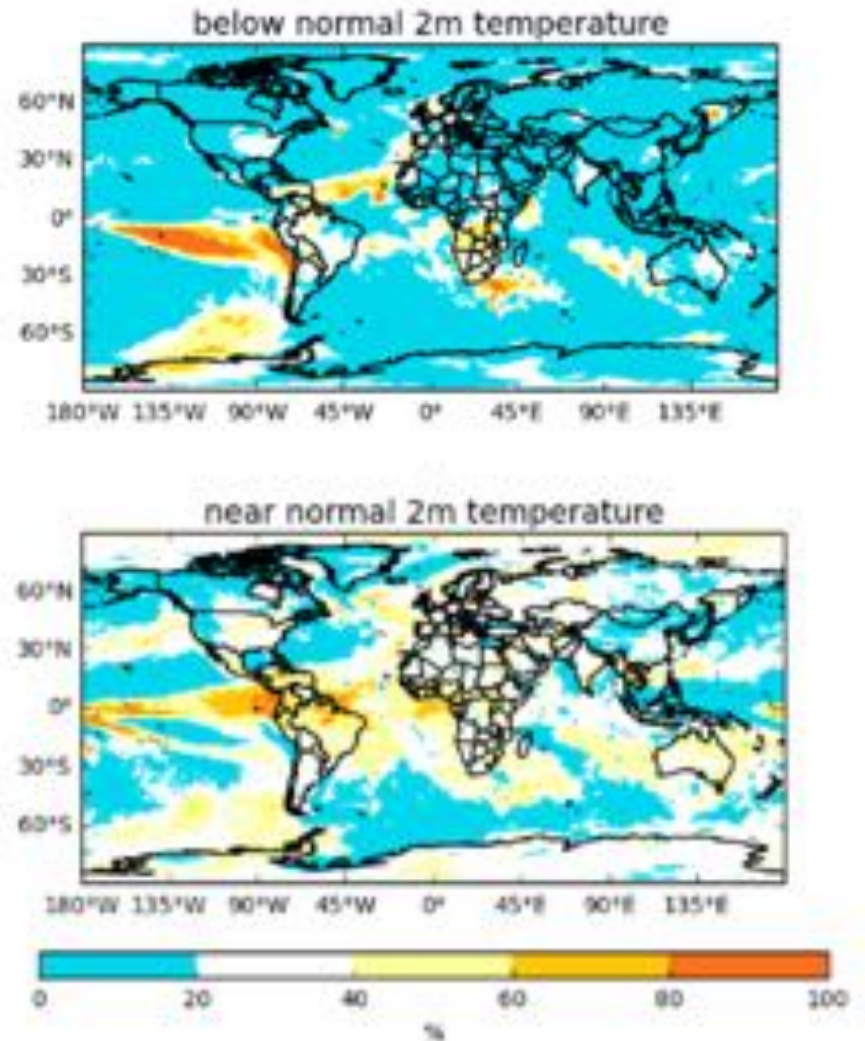
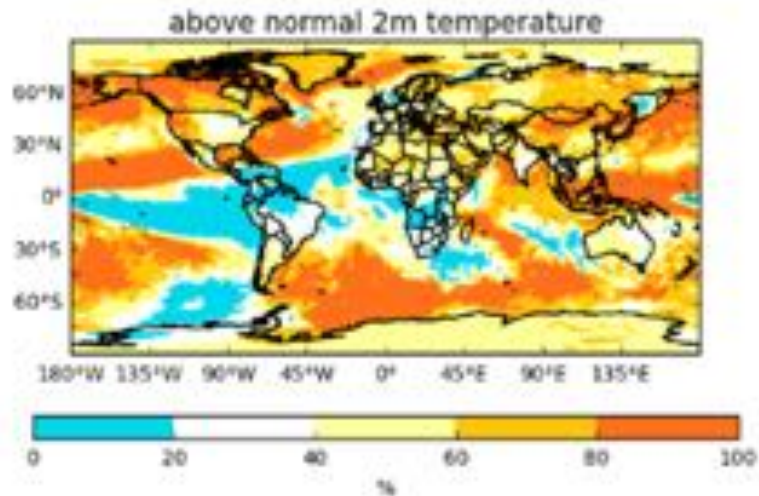


# BRITISH METEOROLOGICAL OFFICE



# BRITISH METEOROLOGICAL OFFICE

Probability of tercile categories May/Jun/Jul Issued April 2018

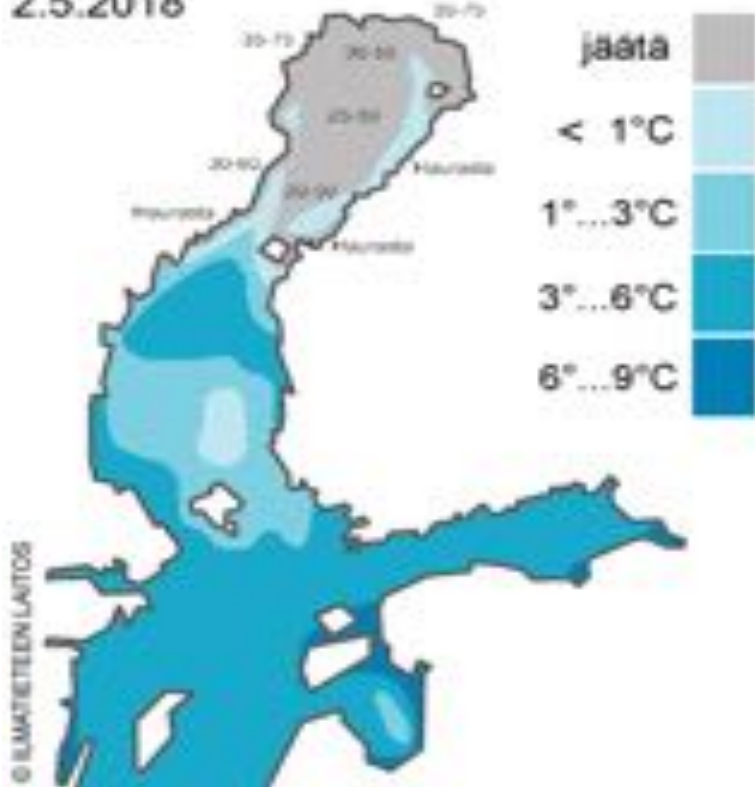




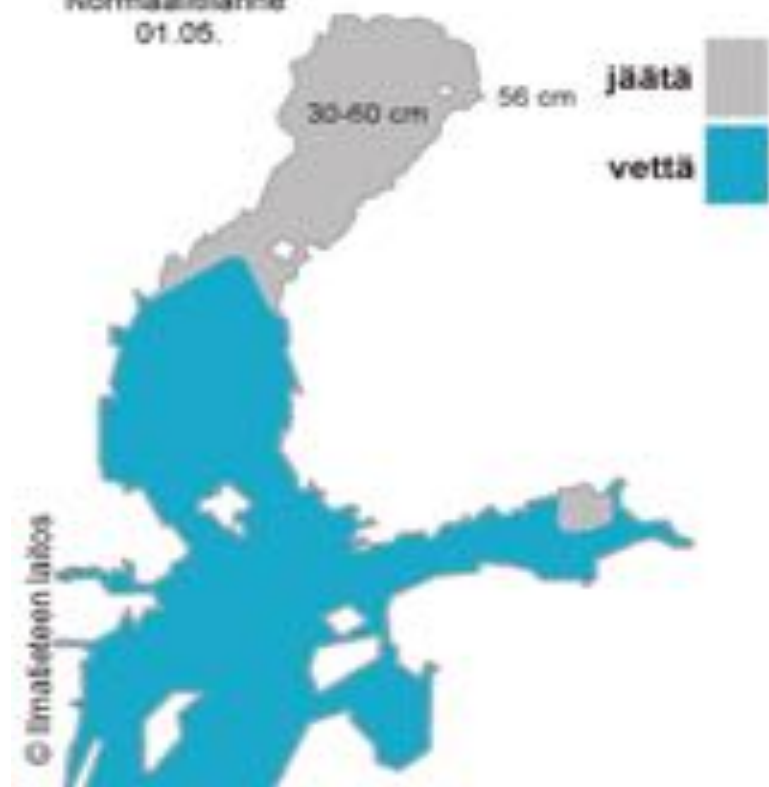


# FINNISH METEOROLOGICAL INSTITUTE

2.5.2018



Normaalitilanne  
01.05.





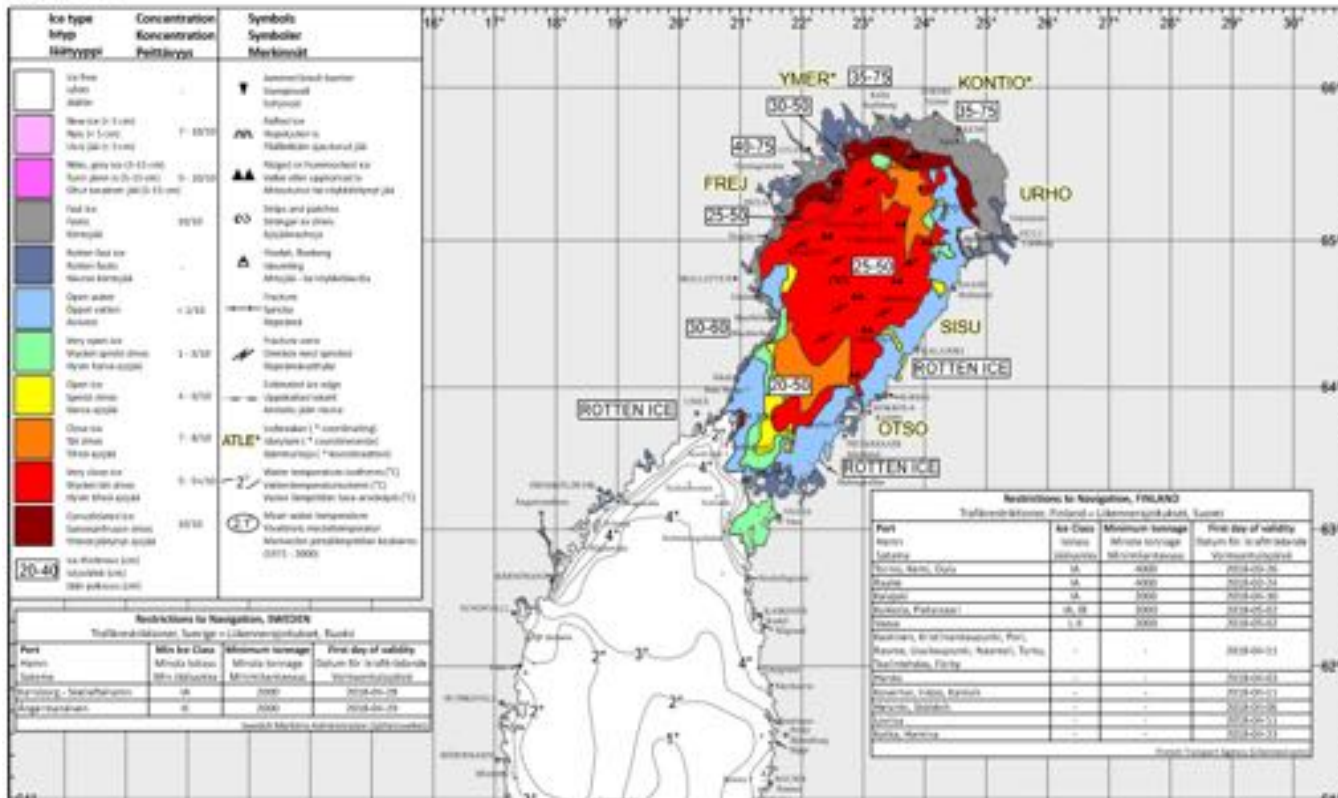


# FINNISH METEOROLOGICAL INSTITUTE



## ICE CHART Iskarta - Jääkartta

2018-05-02  
No. 154





# FINNISH METEOROLOGICAL INSTITUTE

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## FINNISH ICE REPORT 03.05.2018

*The ice condition is virtually unchanged.*

**In the northern Bay of Bothnia** there is 40-75 cm thick fast ice in the archipelago. At the fast ice edge 30-50 cm thick ridged consolidated ice to Kemi 2 and Oulu 4. Farther out a wide lead from Kemi 1 to Kokkola, but containing a few vast floes. Farther out 25-50 cm thick rafted and ridged, mainly very close ice. There are small leads and areas of open water in the ice field.

**In the southern Bay of Bothnia** rotten fast ice in the archipelago. Farther out first 5-15 nautical miles wide lead with wide ice floes in places. Then, 20-50 cm thick close and very close ridged ice.

**In the Quark** generally open water, in places strips and patches of drift ice. From Vaasa to Ensten very open ice. Farther out open water. In the Vaasa's northern archipelago rotten ice.

**Icebreakers:** Kontio, Urho and Sisu assist in the Bay of Bothnia. Otso assists in the Bay of Bothnia and in the Quark.

**Restrictions to navigation:** Minimum ice class and deadweight required of assisted vessels:

Tornio, Kemi, Oulu and Raahе, IA of more than 4000 tons.

Kalajokki, IA of more than 2000 tons.

Kokkola and Pietarsaari, IA or IB of more than 2000 tons.

Vaasa, I or II of more than 2000 tons.

Vessels bound for Gulf of Bothnia ports in which traffic restrictions apply shall, when passing the latitude 60°00'N, report their nationality, name, port of destination, ETA and speed to ICE INFO on VHF channel 78. This report can also be given directly by phone [+46 31 699 100](tel:+4631699100).



# SWEDISH ICE SERVICE

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## RESTRICTIONS

2018-05-03

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### RESTRICTIONS TO NAVIGATION

#### SWEDEN

##### Current traffic restrictions

##### Karlsborg - Skelleftehamn

Minimum ice class IA and minimum 2000 dwt

##### Angermanalven

Minimum ice class IC and minimum 2000 dwt

The traffic separation scheme in the Quark is temporarily suspended from 2018-01-25

#### FINLAND

##### Current traffic restrictions

##### Tornio - Raahе

Minimum ice class IA and minimum 4000 dwt

##### Kalajoki

Minimum ice class IA and minimum 2000 dwt

##### Kokkola - Pietarsaari

Minimum ice class IB and minimum 2000 dwt

##### Vaasa

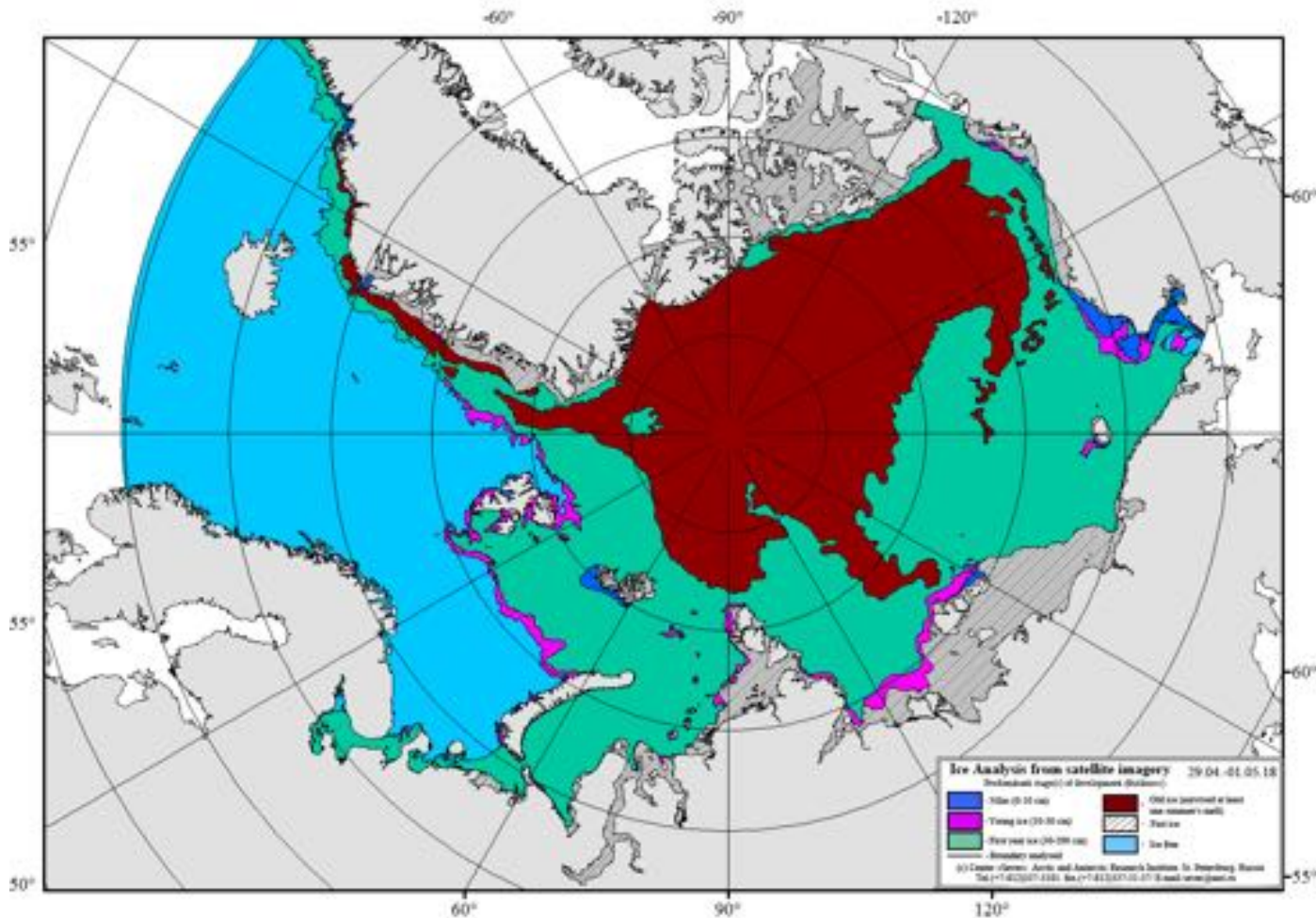
Minimum ice class II and minimum 2000 dwt

#### Icebreakers

FREJ, YMER, KONTIO, OTSO, SiSU and URHO assist in the Bay of Bothnia.

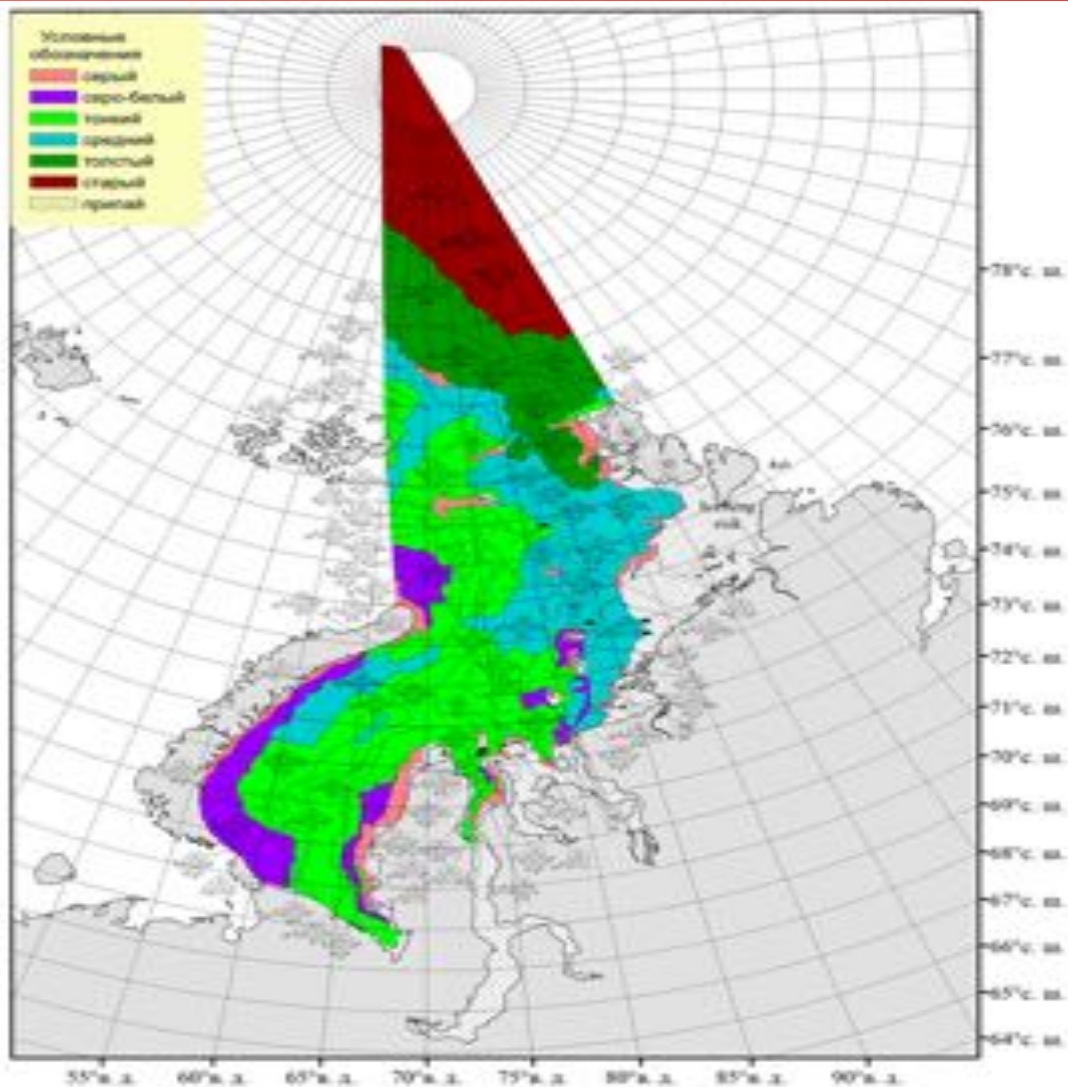


# ARCTIC AND ANTARCTIC RESEARCH INSTITUTE





# ARCTIC AND ANTARCTIC RESEARCH INSTITUTE





# INFORMATION SOURCES – IMAGERY AND WEATHER

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## Satellite Imagery :

Sentinel-1 (<https://www.polarview.ag/arctic>)

MODIS (<https://worldview.earthdata.nasa.gov/>)

TerraSAR-X (<https://www.intelligence-airbusds.com/en/5846-terrasar-x-image-products>)

Radarsat (<https://mdacorporation.com/geospatial/international/satellites/RADARSAT-2/services>)

Cosmo SkyMed (<http://www.e-geos.it/cosmo-skymed.html>)

VIIRS (<https://www.class.ncdc.noaa.gov/saa/products/welcome>)

## Weather:

Environment Canada, Analyses and Modeling

[https://weather.gc.ca/mainmenu/modelling\\_menu\\_e.html](https://weather.gc.ca/mainmenu/modelling_menu_e.html)

Environment Canada, Marine text bulletins

[https://weather.gc.ca/marine/marine\\_bulletins\\_e.html](https://weather.gc.ca/marine/marine_bulletins_e.html)

Environment Canada, Historical data

Search tool

[http://climate.weather.gc.ca/historical\\_data/search\\_historic\\_data\\_e.html](http://climate.weather.gc.ca/historical_data/search_historic_data_e.html)

Climate normals

[http://climate.weather.gc.ca/climate\\_normals/](http://climate.weather.gc.ca/climate_normals/)

Environment Canada, Weather forecasts

[https://weather.gc.ca/canada\\_e.html](https://weather.gc.ca/canada_e.html)

NOAA NWS Marine forecasts – radiofax charts for NW Atlantic

<http://tftp.nws.noaa.gov/fax/marsh.shtml>

NOAA surface temperature charts:

<http://www.ospo.noaa.gov/Products/ocean/sst/contour/>

British Met Office – global long-range model probability maps

<https://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/goc-outlooks/global-seas-prob>

British Met Office – Surface Pressure Charts

<https://www.metoffice.gov.uk/public/weather/surface-pressure/#?tab=surfacePressureColour&fcTime=1525885200>

Swedish Meteorological and Hydrological Institute – Baltic Sea and Gulf of Bothnia Forecast

<https://www.smhi.se/en/weather/sweden-weather/sea-weather-forecast>

Finish Meteorological Institute – Baltic Sea and Gulf of Bothnia Forecast

<http://en.ilmatieteenlaitos.fi/weather-forecast-for-shipping>

Norwegian Meteorological Institute – Weather around Baltic Sea and Gulf of Bothnia

<https://www.vr.no/>

Accuweather- world weather forecasts - <https://www.accuweather.com/en/ru/>

Windy - [www.windy.com](http://www.windy.com) - Ventusky - [www.ventusky.com](http://www.ventusky.com)



## INFORMATION SOURCES – ICE DATA

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### Ice services:

Canadian Ice Service

<http://www.ec.gc.ca/glaces-ice/?lang=En>

US National Ice Center (US NIC)

<http://www.natice.noaa.gov/>

Alaska Ocean Observing System (AOOS) Arctic Portal

<https://portal.aos.org/arctic/#map?lg=a5b58402-a9c1-11e3-a3fe-00215b95678&p=proj3572&k=bluemarble07>

NWS Alaska Sea Ice Program

<https://www.weather.gov/af/ice>

Finnish Meteorological Institute

<http://en.ilmatieteennlaitos.fi/ice-conditions>

Swedish Meteorological and Hydrographic Institute – Ice Service

<https://www.smhi.se/en/services/professional-services/shipping/swedish-ice-service-1.8715>

Norwegian Ice Service

<http://isolanview.met.no/>

Arctic and Antarctic Research Institute (AARI) – Russian Ice Service

<http://www.aari.ru/main.php?lg=1>



## IMPORTANCE OF LOCAL INPUT

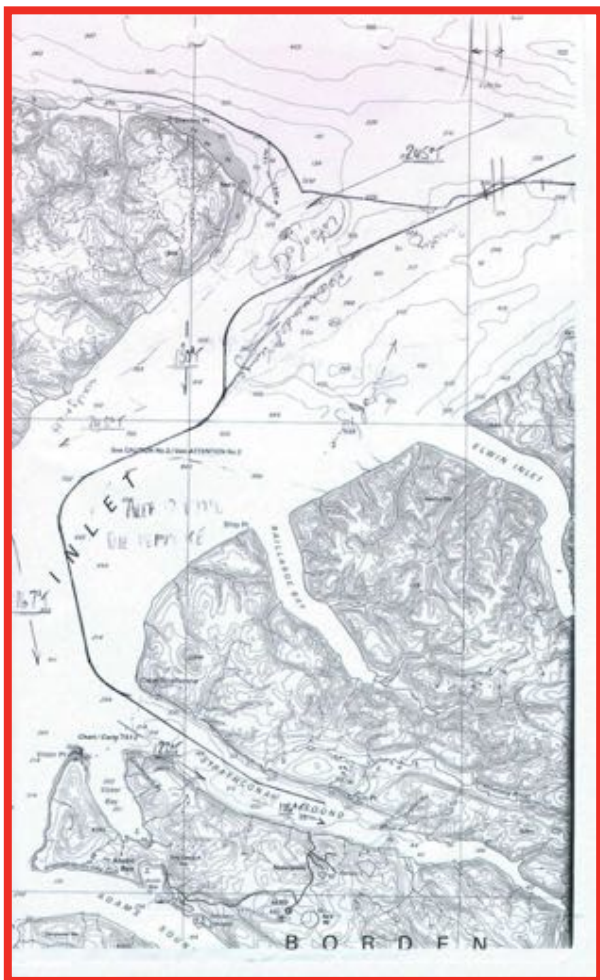






## IMPORTANCE OF LOCAL INPUT

Modified Track of MV Arctic - Admiralty Inlet



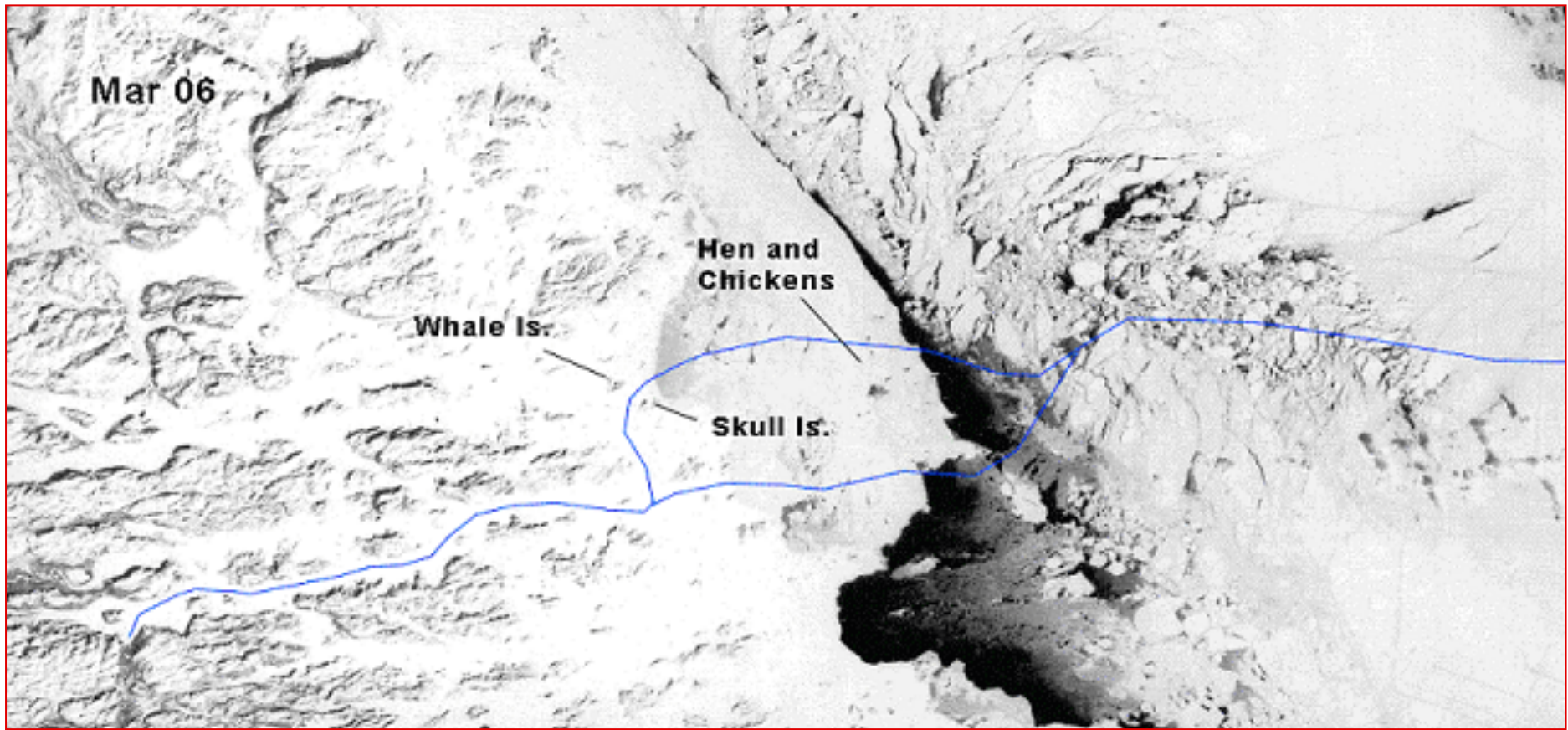
Community consultation & cooperation





## Community Engagement







# BEST PRACTICES IN TRAINING AND CREW RETENTION

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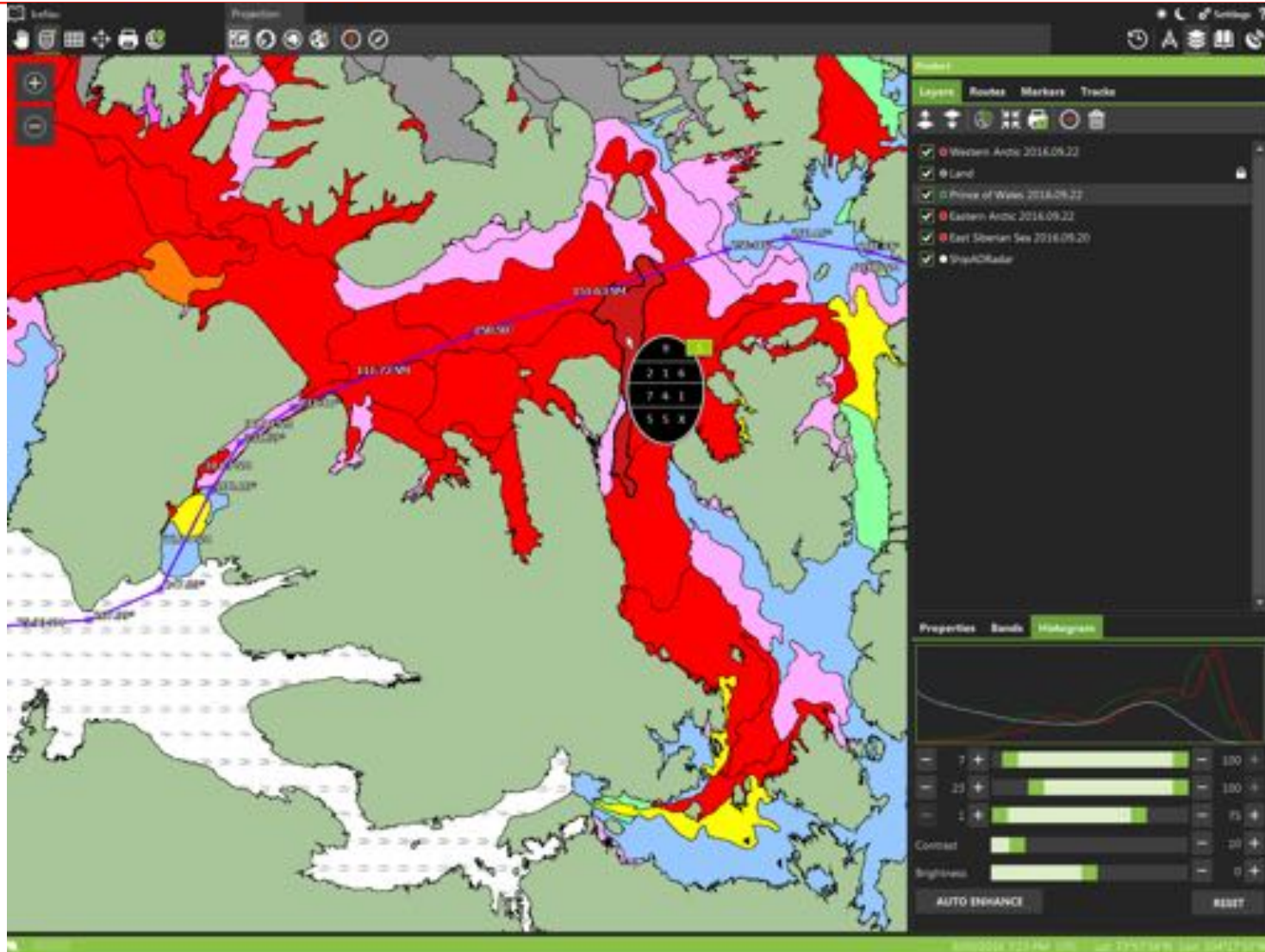


## BEST PRACTICES – DATA ACCESS AND USAGE





# CARTOGRAPHIC INTERFACE





# RADAR INTERFACE

**IceNav Radar**

Range: **4.8NM** (+)

HEADING UP

CENTER

55°37'31"N | 59°03'01"W

5.35 NM

Heading: **113.70** Speed: **08.60** kt

55°42'45" N 59°1'19" W

CMG 00.00

SMG 00.00

2016/08/26 14:54:50

Tools Radar Image Control

Measure

Measure | CLEAR ALL

Total Distance: 0.00 NM

Latitude Longitude

Target

Target | CLEAR ALL

|                     |  |
|---------------------|--|
| Name                |  |
| Latitude            |  |
| Longitude           |  |
| Speed (KT)          |  |
| Mean Speed (KT)     |  |
| Heading             |  |
| Track Distance (NM) |  |
| Track Time          |  |

RINGS

COMPASS

EBL1 0.00°

EBL2 0.00°

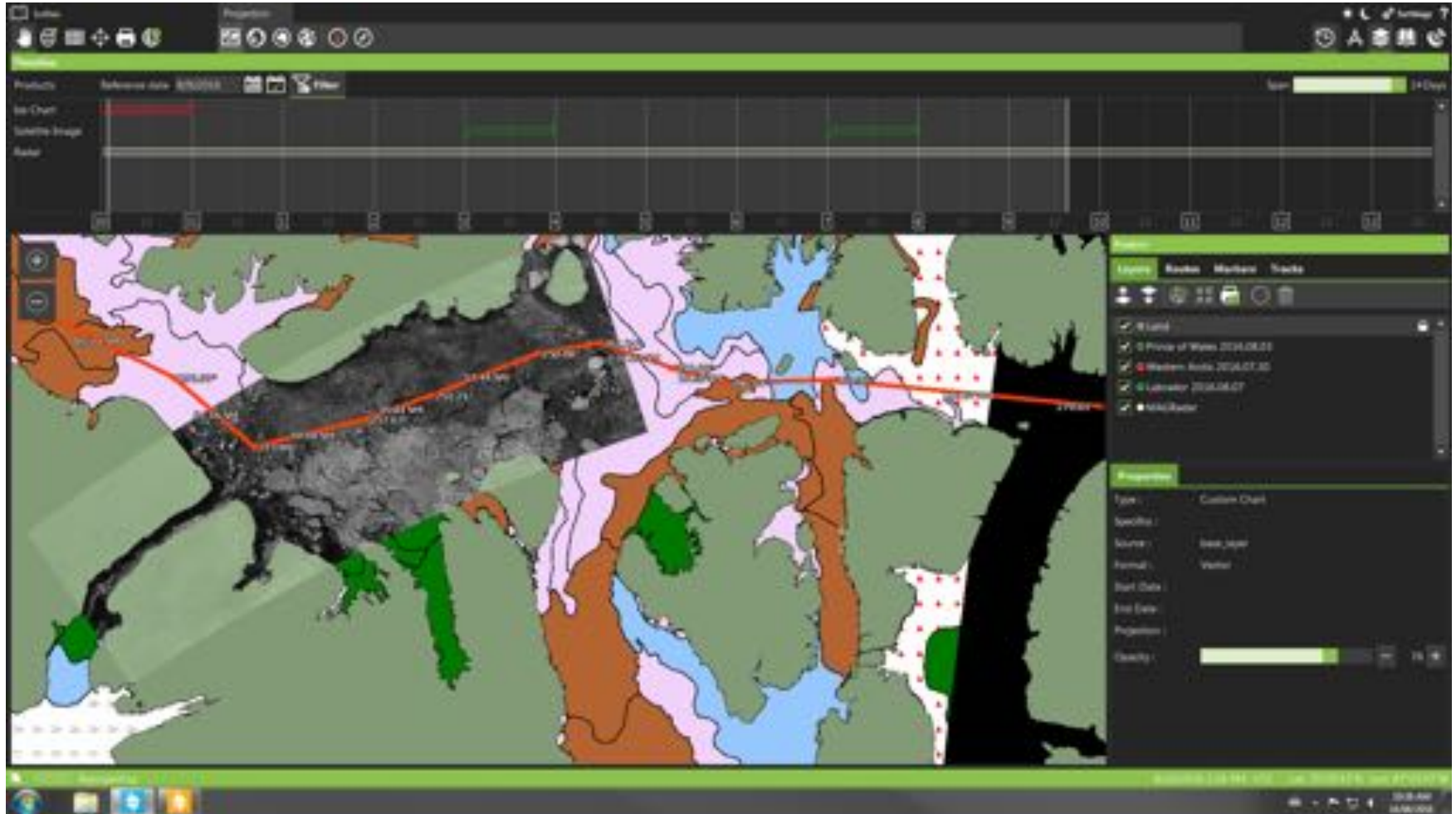
HEADING

VRM1 1.00 NM

VRM2 1.00 NM



## SATELLITE IMAGE OVERLAY

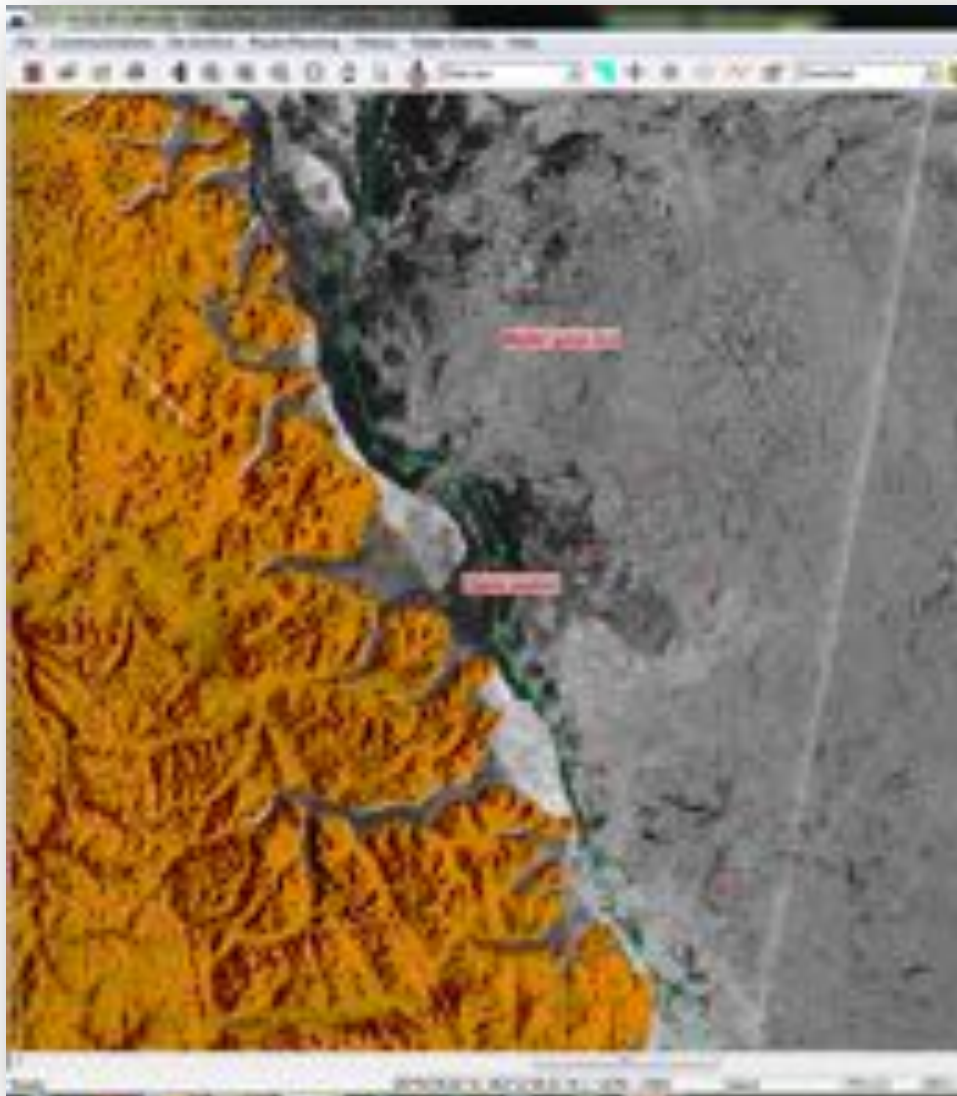








## PLANNING ROUTES



With the help of the latest ice information, IceNav can be used to plan routes based on the ice conditions.



# CANADIAN ARCTIC RISK ASSESSMENT SYSTEM (CASRAS)

## Datasets Included in CASRAS as of May 2018

### Bathymetry Information

- ArcticNet Basemaps
- ArcticNet Beaufort Shelf
- International Bathymetric Chart of the Arctic Ocean

### Drifting Buoys

- International Arctic Buoy Program

### Navigation Chart (CHS) Indexes

- Berthing ENC & Paper (2k)
- Harbour ENC & Paper (2k-20k)
- Approach ENC & Paper (20k-50k)
- Coastal ENC & Paper (50k-150k)
- General ENC & Paper (150k-500k)
- Overview ENC & Paper (500k)

### Community and Infrastructure

- Inuvialuit Community Conservation Plans
- Nunavut Land Use Plan, Community tour
- Nunavut Land Use Plan, Direction to Regulators
- Nunavut Land Use Plan, Land Use Designations
- Airports
- Ports

### Emergency Management

- NRC Personnel Exposure Time
- NRC Places of Refuge

### Ice Charts and Atlas

- CS Ice Atlas (1980-2010)
  - Break up, Freeze up, frequency of old ice, frequency of old ice greater 4 tenths, frequency of sea ice, Median ice concentration, Median old ice concentration, Predominant ice type
- CS Daily Ice Charts
- CS Regional Ice Charts (since 1968)
- NC Ice Charts (north hemisphere)

### Ice Motion

- Moored Upward Looking Sonar
- Polar Pathfinder Ice Motion (Daily, weekly, Monthly and Yearly average)

### Ice Properties

- Ice Thickness from HEMI flights

- CS Ice Thickness measurements
- Moored Upward Looking Sonar – Ice Draft
- Submarine Upward Looking Sonar – Ice Draft

### Marine Mammals

- WWF Cetacean Calving
- WWF Cetacean Summer Distribution
- WWF Walrus Haulouts

### Marine Protected Areas

- Canada
- USA
- Greenland

### Mariner Knowledge

- NRC Marine Knowledge

### MetOcean

- MDLT (Mean Daily Low Temperature, 10 20 and 30 years)
- Hourly Weather Stations
- Daily Weather Stations
- Wind and Wave Hindcast
- Tide Stations
- Reanalysis modelled data
  - Wind
  - Air Temperature
  - Sea Surface Temperature
  - Visibility
  - Water Current
  - Wave
  - Precipitation

### Navigation

- Nautical Charts – Canada (BSB compatible)\*
- Nautical Charts – USA (BSB compatible)\*
- Shipping Safety Control Zones
- Marine Forecast Areas
- NORDREG Zone

\*The end user has to license and obtain the charts from CHS. The CASRAS is set-up to load the charts.

### Other

- Frontier Well Sites
- Beaufort Sea Artificial Islands



# CASRAS

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Designed to provide a library of critical information to facilitate voyage planning

- Hydrographic information and aids to navigation available;
- Current information on the extent and type of ice and icebergs in the vicinity of the intended route;
- Statistical information on ice and temperatures from former years;
- Places of refuge;
- Current information and measures to be taken when marine mammals are encountered relating to known areas with densities of marine mammals, including seasonal migration areas;
- Current information on relevant ships' routing systems, speed recommendations and vessel traffic services relating to known areas with densities of marine mammals, including seasonal migration areas;
- National and international designated protected areas along the route



## CASRAS UPDATES (CANADIAN ARCTIC SHIPPING RISK ASSESSMENT SYSTEM)

CASRAS will be used and tested onboard both the CCGS Amundsen and CCGS Pierre Radisson and in the CCG ROC Ice Office in Montreal.

CASRAS was licensed to the Marine Institute as a training tool - Polar Code and Ice Navigation training program at the Centre for Marine Simulations

### Customizing CASRAS based on users feedback:

- New functionalities will be implemented
- New reports will be designed and generated
- New data/datasets will be included
- The system can be integrated with other tools and systems (e.g. NRC Pressured Ice/ Pack Ice Drift Forecasting Model)

CASRAS onboard a vessel in summer 2017



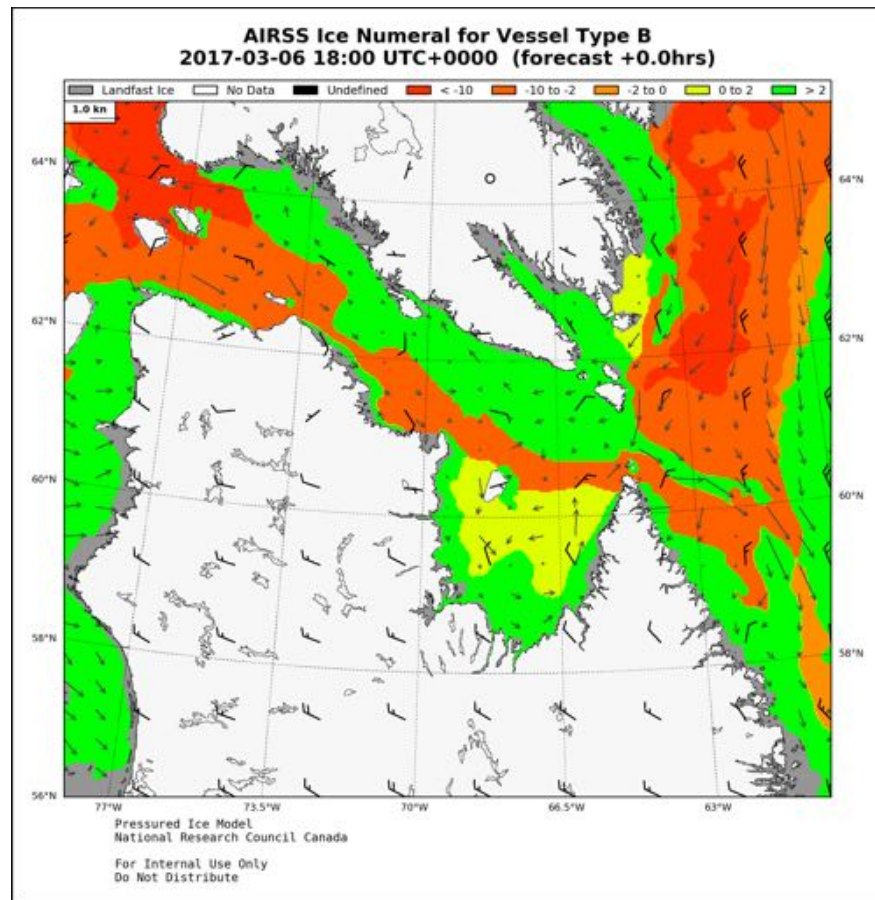
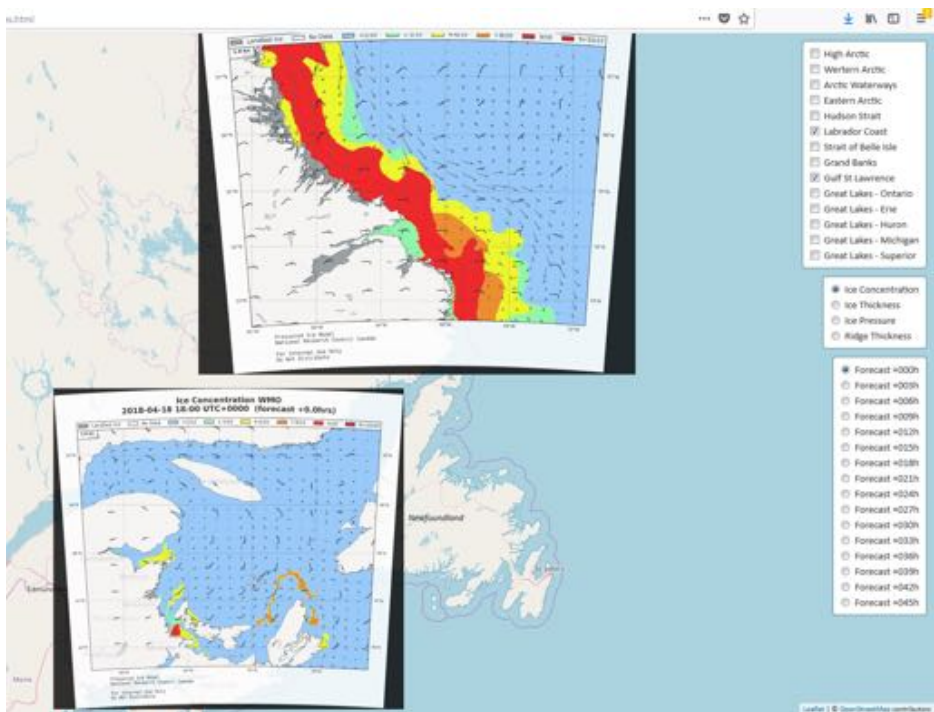


# NRC Pressured Ice Model Updates

COURTESY IVANA KUBAT, NRC

NRC Pressured Ice model maps accessible through a web interface

Ice Numeral calculation forecast





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