# APPENDIX B

# INTERNATIONAL AND LOCAL LEGAL FRAMEWORK

**Table B-1 Legal Framework for Environmental Management in Greenland**

| Legal Framework | Details |
|---|---|
| Legislation | - Greenland Parliament Act No. 7 of 7 December 2009 on mineral resources and mineral resources activities (The Mineral Resources Act)<br>- Consolidated Act No. 1035 of 22 October 2004 on protection of the marine environment<br>- Consolidated Act No. 1048 of 26 October 2005 on the Greenland working environment<br>- Consolidated Act No. 882 of 25 August 2008 on maritime safety<br>- Greenland Parliament Act No. 12 of 29 October 1999 on catches and hunting<br>- Greenland Parliament Act No. 11 of 12 November 2001 amending the act on catches and hunting<br>- Greenland Parliament Act No. 9 of 15 April 2003 amending the act on catches and hunting<br>- Greenland Parliament Act No. 1 of 16 May 2008 amending the act on catches and hunting<br>- Greenland Home Rule Executive Order No. 8 of 2 March 2009 on protection and hunting of birds<br>- Greenland Government Executive Order No. 16 of 12 November 2010 on protection and hunting of seals with guidelines<br>- Greenland Home Rule Executive Order No. 20 of 27 October 2006 on protection and hunting of walrus<br>- Greenland Government Executive Order No. 7 of 29 March 2011 on protection and hunting of beluga whale and narwhale<br>- Greenland Government Executive Order No. 11 of 16 July 2010 on protection and hunting of big whales<br>- Greenland Home Rule Executive Order No. 21 of 22 September 2005 on protection and hunting of polar bears with guidelines<br>- Order No. 417 of 28 May 2009 on technical regulation on safety of navigation in Greenland waters<br>- Order No. 170 of 17 March 2003 on ship reporting systems in the waters off Greenland<br>- Technical Regulation No. 169 of 4 March 2009 on the use of ice searchlights during navigation in Greenland waters |
| Guidelines | - BMP guidelines for preparing an environmental report for activities related to hydrocarbon exploration and exploitation offshore Greenland; January 2011<br>- BMP guidelines for application, execution and reporting of offshore hydrocarbon exploration activities (excluding drilling) in Greenland, December 2011<br>- Guidelines to environmental impact assessment of seismic activities in Greenland waters, 3rd revised edition, DCE, December 2011<br>- Guidelines to environmental mitigation assessment of seismic activities in Greenland waters, 3rd revised edition, DCE, December 2011<br>- Manual for seabird and marine mammal survey on seismic vessels in Greenland, NERI and BMP, May 2011 |

**Table C-2 International Framework for Environmental Management in Greenland**

| Legal Framework | Details |
|---|---|
| International Conventions | - Convention on Environmental Impact Assessment in a Transboundary Context (Espoo), 1991<br>- Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal (Basel Convention) 1992<br>- United Nations Framework Convention on Climate Change (UNFCCC) 1992<br>- Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR) 1971<br>- Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) 1979<br>- Convention on Biological Diversity (CBD) 1992<br>- Convention for the Safety of Life at Sea (SOLAS) 1974<br>- United Nations Convention on the Law of the Sea (UNCLOS) 1982<br>- Guidelines for Ship Operating in Polar Waters 2010<br>- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (The London Convention) 1972<br>- MARPOL Convention (Prevention of Pollution from Ships) 1973/1978<br>- Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC 90)<br>- Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 |
| Transboundary Agreements | - Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB) between Greenland and Canada<br>- Agreement for cooperation relating to the marine environment between Denmark and Canada<br>- The Agreement between Denmark, Finland, Iceland, Norway and Sweden Concerning Cooperation in Measures to deal with Pollution of the Sea by Oil or other Harmful Substances (Copenhagen Agreement) |
| International Guidelines | - NORSOK standard G-001, latest edition<br>- Guidelines for Minimising Acoustic Disturbance to Marine Mammals from Seismic Surveys (UK Joint Nature Conservation Committee) 2010<br>- Arctic Council Protection of the Arctic Marine Environment Working Group: Arctic Offshore Oil and Gas Guidelines 2009<br>- OGP Guideline: Managing HSE in a geophysical contract (report No. 432) 2009<br>- Recommended Mitigation Measures for Cetaceans during Geophysical Operations (IAGC 2009)<br>- Oil and Gas UK: Guidelines for Fisheries Liaison 2008<br>- OGP Guidelines: Oil & gas exploration & production in arctic offshore regions: Guidelines for environmental protection 2002<br>- OGP Key Questions in Managing Social Issues in Oil and Gas Projects 2002<br>- Environmental Guidelines for World-wide Geophysical Operations (IAGC 2001)<br>- Arctic Environment Protection Strategy; Guidelines for Environmental Impact Assessment (EIA) in the Arctic 1997<br>- E&P Forum / UNEP: Environmental Management in Oil and Gas exploration and Production 1997<br>- Environmental Guidelines for Exploration Operations in Near-Shore and Sensitive Areas (UK Offshore Operators Association Ltd (UKOOA) 1995<br>- E&P Forum: Exploration and Production (E&P) Waste Management Guidelines 1993 |

# APPENDIX C

# PHYSICAL ENVIRONMENT APPENDIX

# 1 Introduction

This appendix contains supplementary information on physical environment related to the seismic survey that ConocoPhillips would like to perform in Qamut Block. This environment is described in Section 4.1 of the EIA. The majority of the supplementary information is regional in nature, and limited to the physical oceanography and ice climatology parts of this Section.

# 2 Section 4.1.4.1 on Bathymetry and Seabed

The following information is useful in a regional setting:

Scour depths vary from a few centimetres up to several metres, and could be as deep as 6 m in some locations. Depths up to 4 m have been measured in soft clays in the Beaufort Sea (K Been, pers. comm., 2012). The deepest scours are generally believed to occur in soft clay sediment. At locations where the seabed is stiff or hard, the depth of scouring is limited by the available forces to cut or incise the seabed, and by the strength of the ice (Croasdale et al, 2005). If the seabed is stronger than the ice in the keel, the bottom of the keel will fracture or break, instead of cutting through the soil.

A clay seabed subject to frequent ice scouring is likely to have a soft upper layer that is continually reworked by scours, overlying a stiffer, undisturbed seabed. This profile of a very soft reworked clay over stiff clays or sands is observed, for example, in many parts of the Beaufort Sea (K Been, pers. comm., 2012). While it is not certain this situation is caused by scouring alone, the reworking of surface sediments by this process, and the potential impact of reworked sediments on the benthic community (and on fish or mammals that prey on some of these species), cannot be overlooked. The large short-term impacts (massive or complete removal of benthic species and varying rates of recolonization or recovery) after widespread scouring by icebergs off Antarctica reported by Peck et al (1999) and Gutt and Starmans (2001), for example, are relevant in this regard.

In addition, frequent scouring of the seabed and in-filling afterwards, plus the extensive remoulding of surface sediment and other outcomes it can lead to over time on the shelf and upper slope in northeast Baffin Bay, will be important to consider during planning and placement of infrastructure (including pipelines, wellheads, and foundations for structures) on or below bottom in the future. There is some uncertainty about the actual types of sediments involved, but the main issues are the depth of scouring that occurs, how often this happens, the thickness of the remoulded or reworked layer, and the strength of the resulting seabed soils.

# 3 Section 4.1.4.2 on Circulation

The following information in useful in a regional and local setting:

To provide with a better spatial representation of the currents and their spatial variability, results from the Bedford Institute of Oceanography (BIO) operational model atlas (Wu and Tang 2011) were analyzed to provide a description of the general circulation. This was mentioned in the EIA. The summer mean current fields at the surface, 100 m deep, 500 m deep and at the bottom (average of the 10 m of water above seabed) are found in Figure 4.1-8.

This diagram shows that residual currents are weak overall, with maximums of the order of 0.1 m/s (or 10 cm/s) on the west and southwest side of the shallow bank in the central part of Qamut Block, exiting toward Smith Sound. The main flow is coming from the south on the east side of Baffin Bay and turns sharply westward, constrained by coastline and bathymetry. Over the license area, the flow is mainly east to west on the surface, turning to the northwest on the west side of the block. Another feature of this region in northeast Baffin Bay appears to a relatively strong southeast- to south-flowing counter-current along the slope. Seasonality is also apparent.

It should be noted that while the general patterns of the current field and order of magnitude of the currents provided by this numerical modeling work are believed to be reasonably good representation of the residual (or mean) circulation. Stronger and slower currents should be expected at times due to the action of the tides and the wind.

The general patterns of the current field and order of magnitude velocity for the currents from numerical modeling work should be regarded as a good representation of the residual (or mean) circulation only. Stronger and slower currents should be expected at times due to the action of the tide, and the surface wind field. Wind-driven surface currents generally have speeds of about 20 to 25° to the right of the wind and with a speed of about 2% of that of the wind (Forrester 1983). Storm-generated currents caused by wind stress can have velocities of up to 3% of that of the wind (ISO, 2005).

## 4 Section 4.1.4.4 on Water Mass Distribution and Structure

The following information is useful in a regional setting:

Horizontal and vertical gradients of temperature and salinity can be quite large (several degrees °C and tenths of psu, respectively). This is described by Tang et al. (2004), notably around the southern boundary (Davis Strait). Tang et al. (2004) also reported that mixed surface layer thickness can vary from about 100m in northeast Baffin Bay to about 300 m on its western side. These authors also noted a northward deepening of isopycnals in the upper 200 m, indicative of a west-setting current in northern Baffin Bay, and common features throughout Baffin Bay, including a temperature minimum (remnant of winter cooling) at about 100 m and a temperature maximum at 500 to 800 m.

The average distribution of temperature and salinity, created using the World Ocean Database 2009 (NOAA 2012), illustrates the intrusion of warmer and more saline surface water that is transported by the West Greenland Current on the east side of Davis Strait. This is shown in Figure 4.1-11.

There is a large amount of variability in the water mass distributions on short-term, seasonal and year-to-year time scales. The inter-annual variability of water masses has been analysed by Buch (1990 and 2002) and Tang et al. (2004) using long time-series data from Fylla Bank and Davis Strait, and is attributed to the West Greenland Current. Their results indicate a relatively small inter-annual temperature variation in summer (1.3°C to 0.8°C from surface to 400 m) with comparatively large salinity variations (0.6 to 0.1 psu from surface to 400 m). This suggests that the influence of run-off (drainage from land or the Inland Ice), and precipitation and/or melting of sea ice (possibly influenced or modulated by the West Greenland Current) is important (Tang et al. 2004).

The surface waters rapidly cool off during the fall, and the summer surface layer starts to vanish (Buch 1990, 2000), likely involving vertical convection and/or wind stress mixing. During early winter, sea ice starts to form, and as winter progresses, the strong vertical salinity gradient seen during summer (and fall, to a lesser extent) disappears. Buch (1990, 2000) attributed this increase of salinity in the surface layer largely to salt rejection during formation of sea ice. The temperature minimum located at about 100 m, which is a remnant of winter cooling, suggests that winter convection does not penetrate much deeper (Tang et al., 2004).

## 5 Section 4.1.4.6 on Sea Ice Melt and Upwelling

The following information is useful in a regional and local setting:

The clearing and melt of sea ice in a northeast Baffin Bay licence block typically occurs over a period of about 4 weeks. An estimate of the total amount of equivalent fresh water released by sea ice melting into the upper part of the ocean is based on the thickness of the sea ice of 1.75 m times 0.73 (i.e. the proportion of the sea ice that is below the ambient ocean water salinity of [30-8]/30) or the equivalent of 1.3 m of freshwater. The melt of sea ice in early summer amounts to a considerable freshening of the upper water column. Based on the equivalent thickness of 1.3 m of freshwater that melts during a period of approximately 4 weeks over the full continental shelf area of northeast Baffin Bay of 8.2 $\times 10^4$ km$^2$, the sea ice melt is equal to a freshwater equivalent volume of 1.1 $\times 10^{11}$ m$^3$. The reduced salinities in the uppermost ocean waters will range upwards from 8 psu. The horizontal distribution of the reduced salinities will vary with location since the melt of the larger keel features of the ice will take longer to melt by comparison to the thinner ice features. The horizontal scale of larger ice keels are typically 25 to 100 m with the result that localized horizontal gradients, or frontal features, can occur over distances of 10-100 m with salinity differences of up to roughly 20 psu. However, as natural mixing occurs due to wind, in both the horizontal and vertical domain, the magnitude of the gradients will be reduced with time and the reduction in salinities will decrease but extend over a greater depth in the upper water column.

It was noted that localized “upwelling” can be created by icebergs as well. This involves the effect an iceberg was on the upper part of the water column when it is being moved by wind and surface currents through the ocean, including the momentum “wake” of glacial ice it creates. This wake of ice trails behind the iceberg when it is drifting. A vertical surface, or plane, in the water column is being penetrated by the keel as the iceberg moves through the ocean, which brings up water from deeper parts of the water column on an ongoing basis. The combination of nutrients brought up from depth by these processes and the decreased salinity of the meltwater surrounding the iceberg results in distinctly different water properties around the melting iceberg than the ambient oceanic water conditions including strong frontal features. Detailed measurements of localized water properties in the vicinity of icebergs, including nutrients and plankton concentrations, are not readily available for northeast Baffin Bay, compared to studies on southern polar (Antarctic) areas. However, it is expected that drifting icebergs will result in different water properties from ambient conditions that will often include enhanced settings for marine life, including plankton, fish and avifauna. The horizontal scales of the melt water and wake of the iceberg-influenced water properties are of the order of the horizontal and vertical scales of the icebergs, that is, typically 50 m to 1 km (horizontal) and 50 to 260 m (vertical).

## 6 Section 4.1.4.8 on Acoustic Conditions

The following information is useful in a regional setting:

Sound velocity and transmission or propagation of noise in Arctic regions, including northeast Baffin Bay, are influenced by temperature (the dominant factor), salinity, hydrostatic pressure (depth), sea state (upper water column only), sea ice (if present), and, to some extent, pH and other chemical properties of sea water. The sea ice effects are related to amount (concentration) of sea ice, type of sea ice (involving age, thickness, brine content, air content), cracks/fractures at small (mm) scale to larger (cm to m) scale, and bottom or underneath roughness at small scale (from uneven growth or finger rafting, for example) to larger scale (from ridging or rubble/hummock formation, for example). Acoustic conditions also vary from season to season, and may vary from year to year at the same location. Finally, they are influenced by bathymetry, bottom morphology, and geology at and below seabed. The various factors contributing to acoustic conditions in the Arctic are described in Col (2010), Menemenlis (2004), Mikhalevsky (2001), and Thode et al. (2010), among others.

It is noted that a site off the shelf, in a part of northeast Baffin Bay that has different temperature and salinity characteristics, compared to a site on the shelf or over the slope where the West Greenland Current is situated, would not necessarily have the same sound velocity profile at the same time of year. It is possible that sound will propagate differently at these locations because of the temperature and salinity differences. The amount of sea ice needs to be taken into account as well. When conditions are not completely ice-covered, but sea ice is present at intermediate concentrations (for example, open pack at 4:10 to 6:10 coverage), attenuation of surface-trapped sound by scattering will also influence sound transmission. These types of effects will vary in time and space, and can be influenced by the rate and direction of ice drift or movement as well.

## 7 Section 4.1.5.1 on Sea Ice Environment by Seasonal Period

The following information is useful in a regional setting:

The Canatec ICE06-derived ice regime entry maps were described in the EIA. They were produced for average ice conditions for various ice regimes in the region latitude 72 N to 76 N, longitude 55° W to 70 W, on a weekly basis for the period May to November. The charts are derived for the period 2001 to 2010 and depict ice conditions for typical ships having “open water” hulls not suited for contact with sea ice during operations in northeast Baffin Bay. They are found in Figure C-1 to C-31. Ship entry into an ocean area, or passage through an ocean area, based on the ice numerals mentioned in the maps, is related to ship safety and pollution prevention regulations that govern shipping in northern Canada, including the eastern Canadian Arctic. They are relevant to operations in northern Baffin Bay, given many similarities from a regional point of view. These maps can also be produced for ships with various ice classes, which was not done for the EIA.

Significant amount of regional sea ice information for Baffin Bay that is useful at local scale is available from the Canadian Ice Service and the Danish Meteorological Institute. The KANUMAS Met/Ice/Ocean Overview Report for Baffin Bay (DMI-DTU 2011), mentioned in various sections of Physical Baseline in the EIA, is an authoritative source of environmental information on this region.

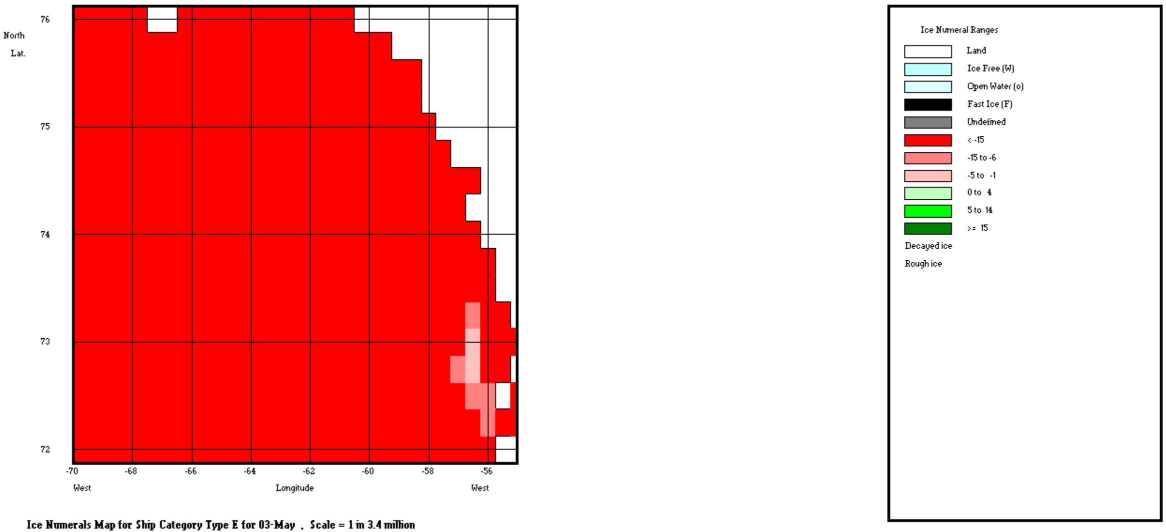
# 8 Section 4.1.5.6 on Iceberg Distribution and Mass

The following information is useful in a regional setting:

The drift of icebergs is highly variable, with speeds in northeast Baffin Bay usually less than 0.2 m/s, but reaching 0.35 m/s in other parts of Baffin Bay, which corresponds to 30 km/day. In winter, iceberg drift is almost entirely controlled by sea ice motion (Tang et al. 2004).

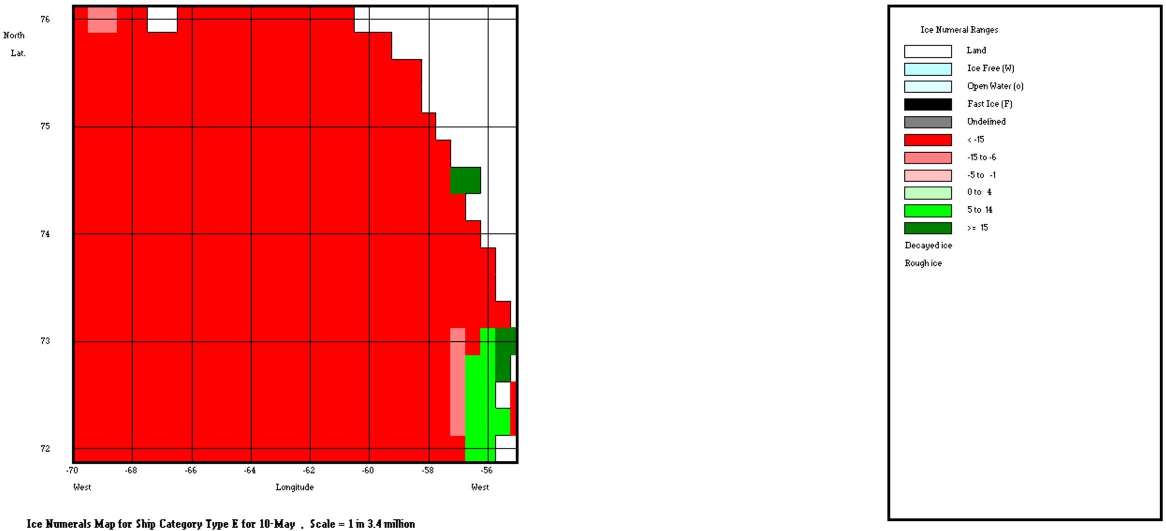
Most of the icebergs stay concentrated within 50 km of the West Greenland coast, with only the larger icebergs seen at greater distance offshore. Little deterioration of these icebergs takes place in the low winter water temperatures of Baffin Bay (Tang et al. 2004). Low air temperatures and the protective presence of surrounding sea ice contribute to this situation as well. Iceberg density generally correlates negatively with sea surface temperature (C-CORE 2011).

The locations of all icebergs documented in a northeast Baffin Bay iceberg survey in August-September 2011 (GEMS 2011a) are shown in Figure C-32.



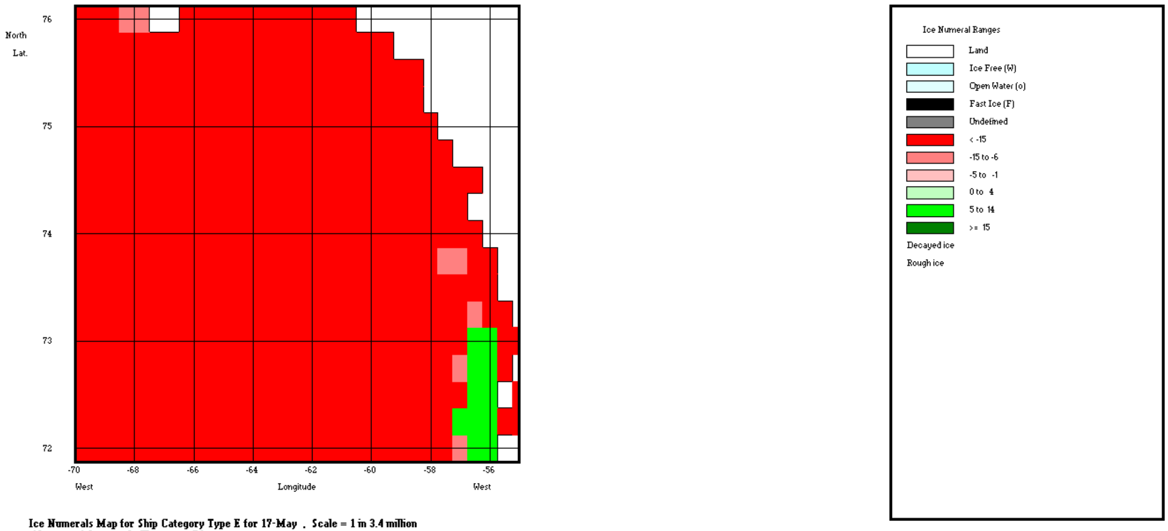
Ice Numerals Map for Ship Category Type E for 03-May . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-1** Average Ice Numerals for ice regimes in the region for an open water vessel, week of May 3, 2001-2010.



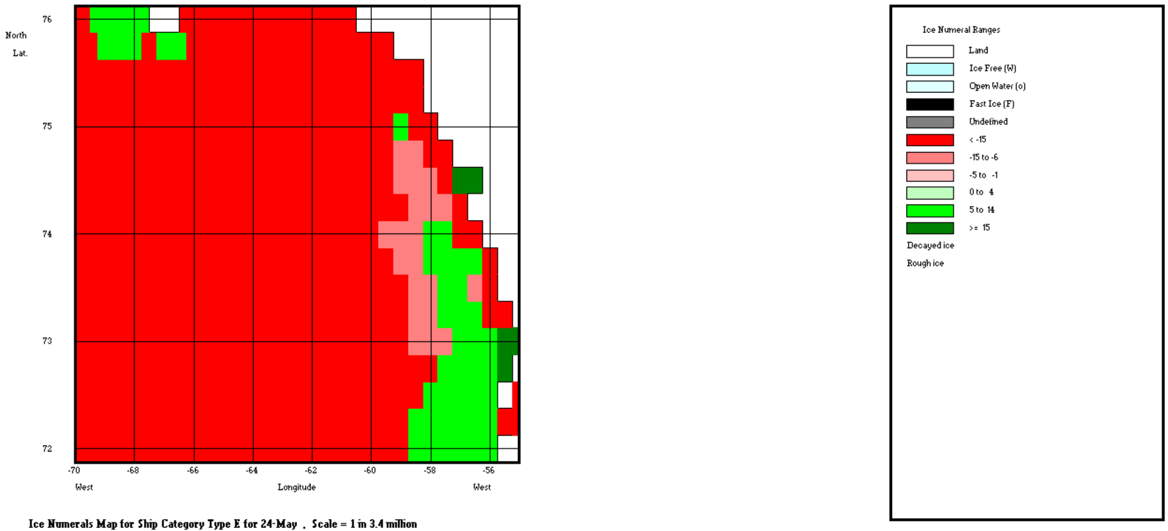
Ice Numerals Map for Ship Category Type E for 10-May . Scale = 1 in 3.4 million
4 years of data used. There are 2 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-2** Average Ice Numerals for ice regimes in the region for an open water vessel, week of May 10, 2001-2010.



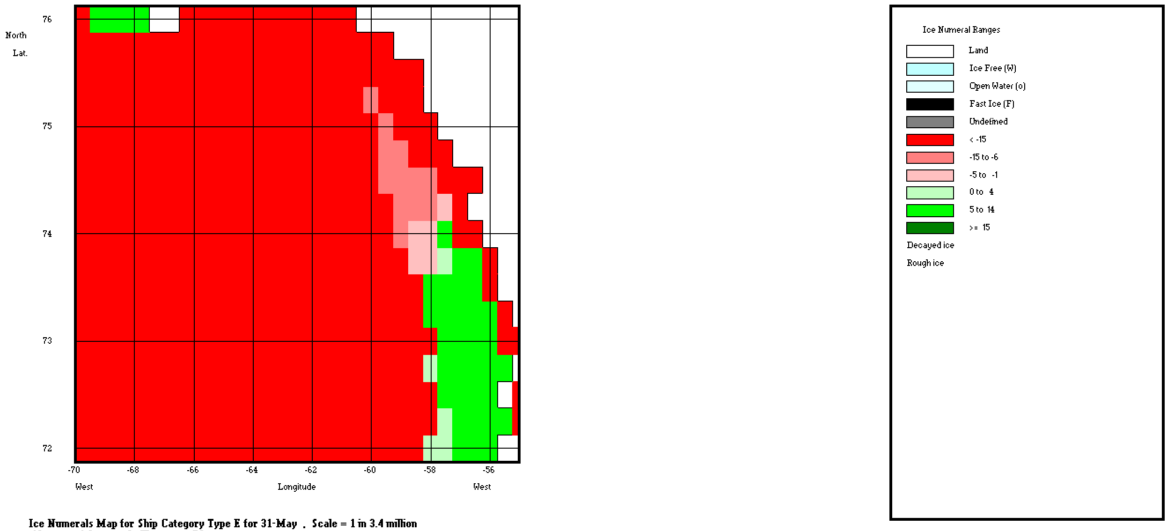
Ice Numerals Map for Ship Category Type E for 17-May . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-3** Average Ice Numerals for ice regimes in the region for an open water vessel, week of May 17, 2001-2010.



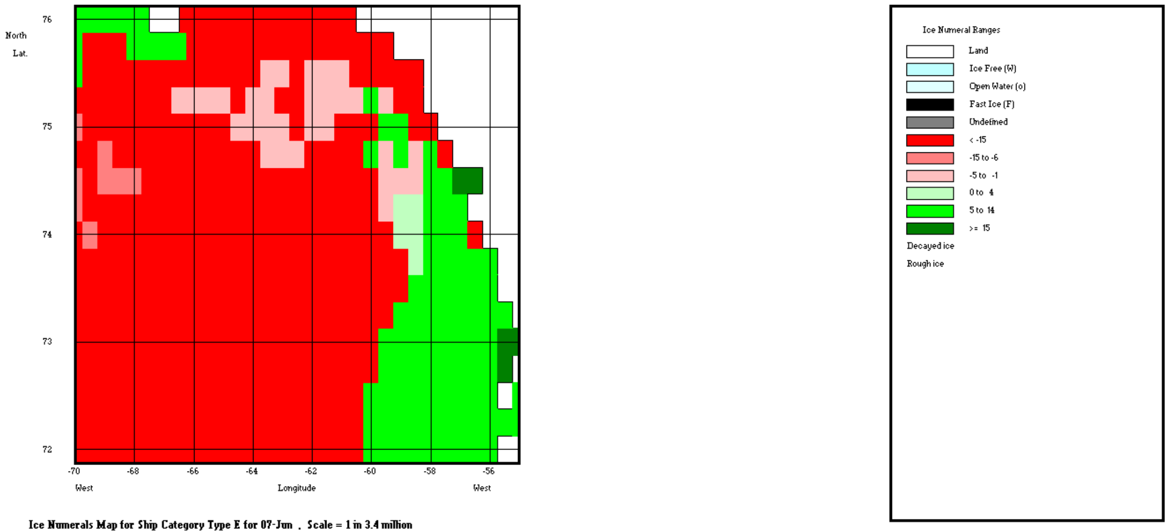
Ice Numerals Map for Ship Category Type E for 24-May . Scale = 1 in 3.4 million
4 years of data used. There are 2 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-4** Average Ice Numerals for ice regimes in the region for an open water vessel, week of May 24, 2001-2010.



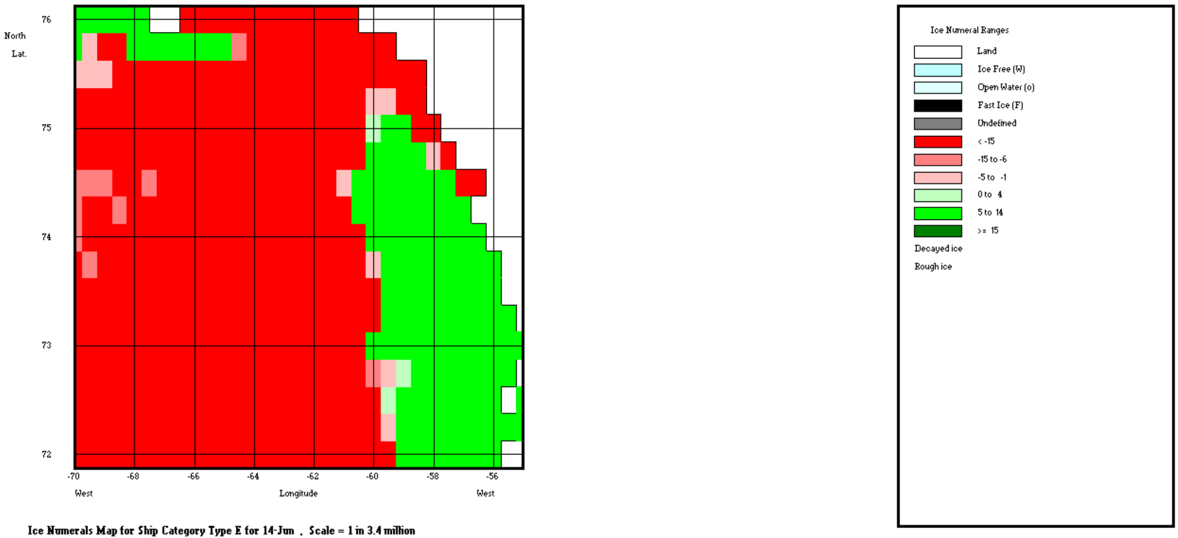
Ice Numerals Map for Ship Category Type E for 31-May . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-5** Average Ice Numerals for ice regimes in the region for an open water vessel, week of May 31, 2001-2010.



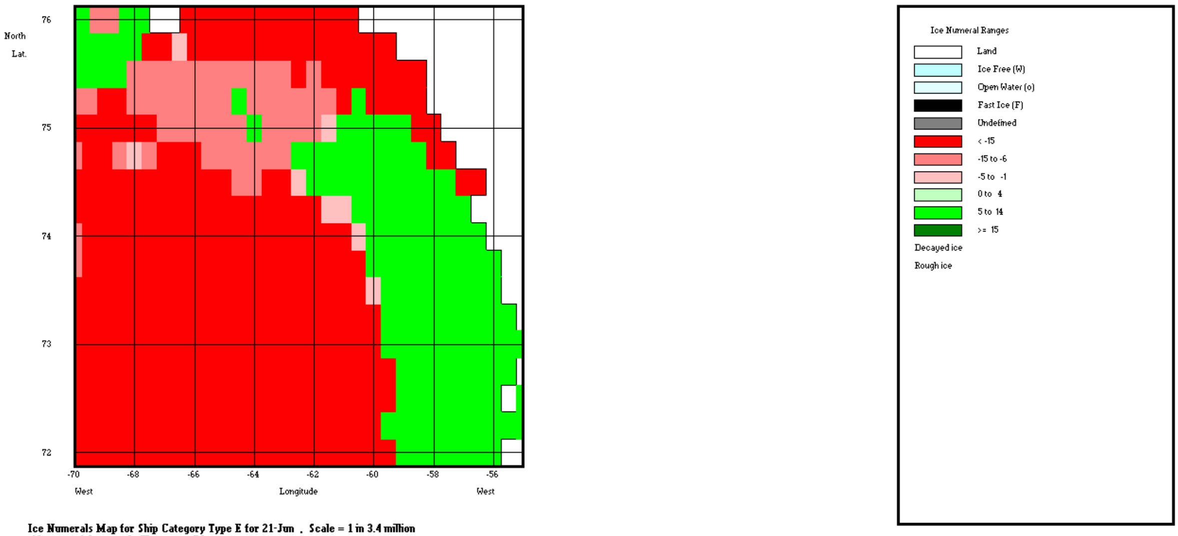
Ice Numerals Map for Ship Category Type E for 07-Jun . Scale = 1 in 3.4 million
5 years of data used. There are 3 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-6** Average Ice Numerals for ice regimes in the region for an open water vessel, week of June 7, 2001-2010.



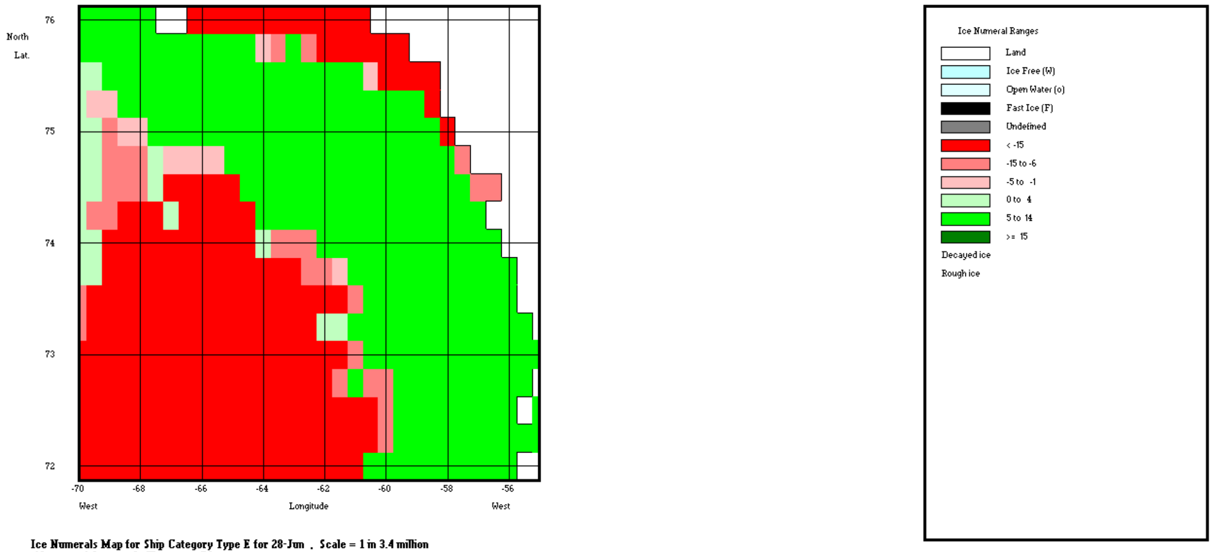
Ice Numerals Map for Ship Category Type E for 14-Jun . Scale = 1 in 3.4 million
9 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-7** **Average Ice Numerals for ice regimes in the region for an open water vessel, week of June 14, 2001-2010.**



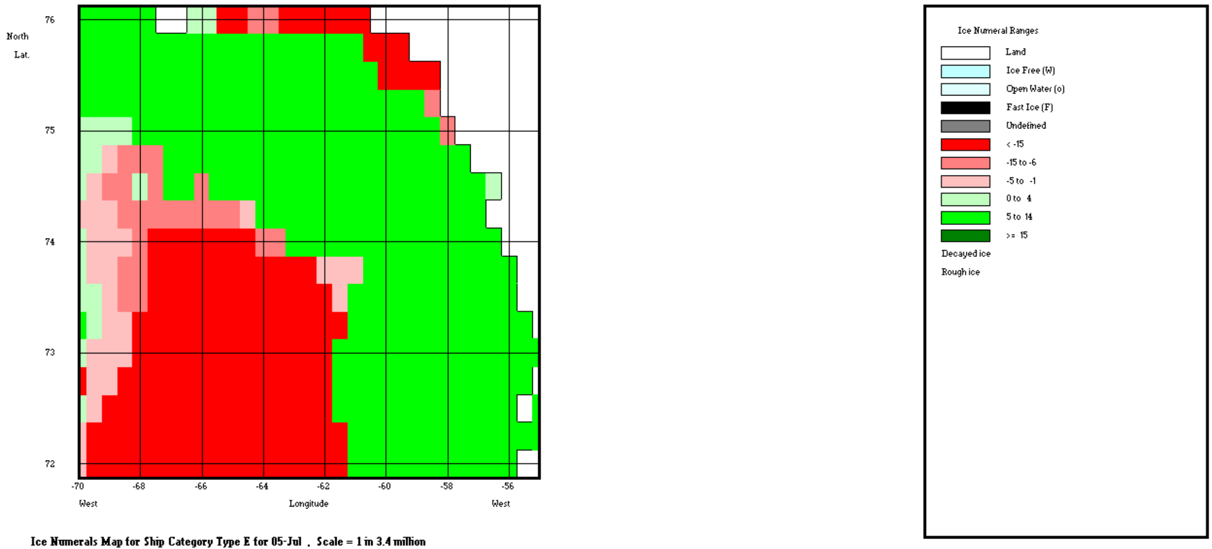
Ice Numerals Map for Ship Category Type E for 21-Jun . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-8** **Average Ice Numerals for ice regimes in the region for an open water vessel, week of June 21, 2001-2010.**



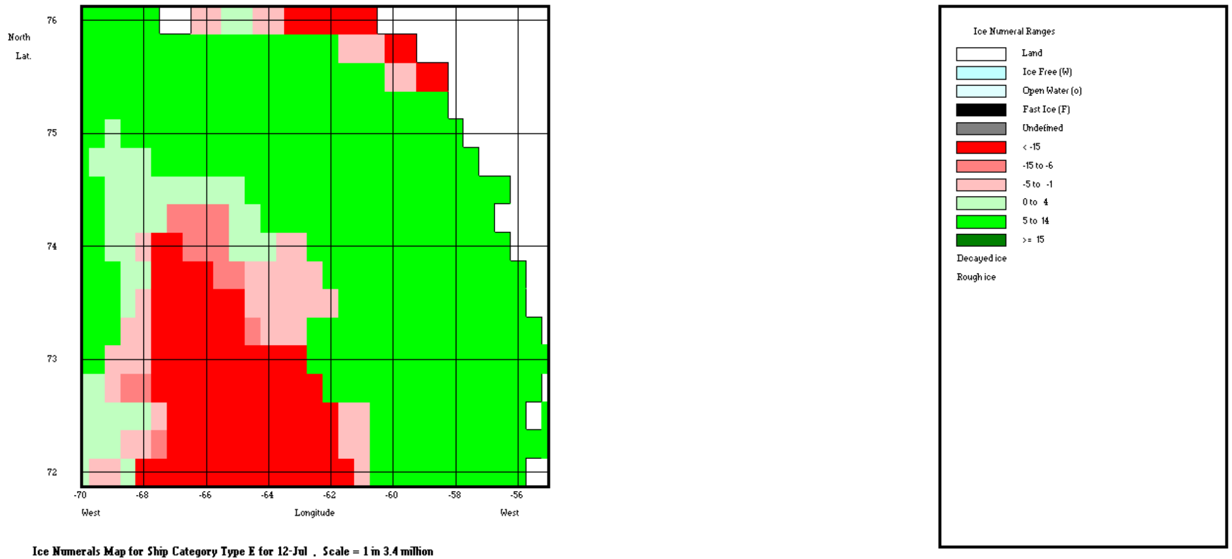
Ice Numerals Map for Ship Category Type E for 28-Jun . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-9** Average Ice Numerals for ice regimes in the region for an open water vessel, week of June 28, 2001-2010.



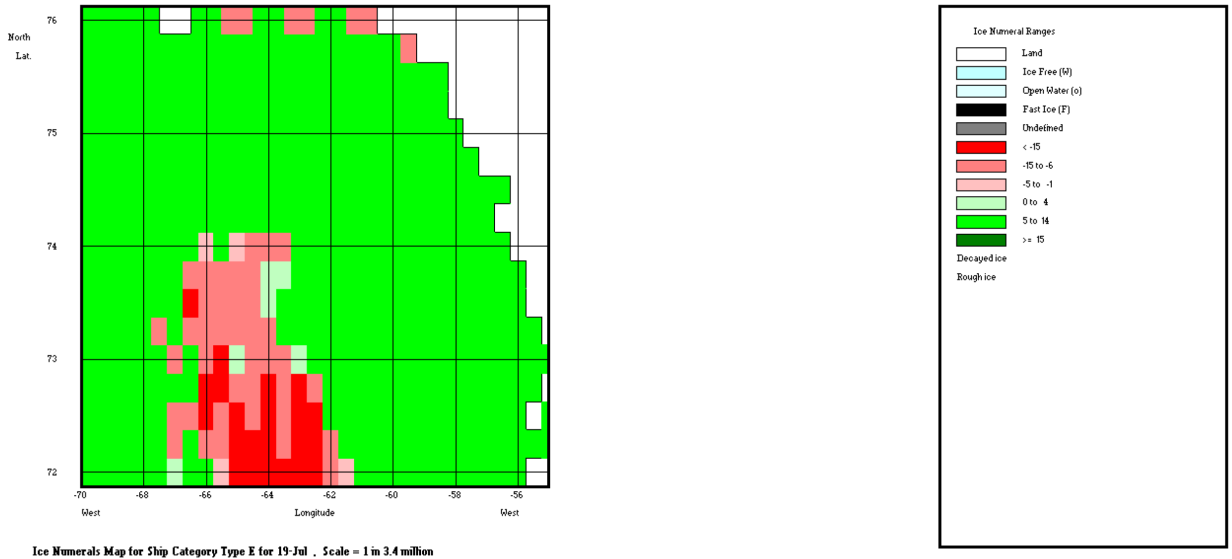
Ice Numerals Map for Ship Category Type E for 05-Jul . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-10** Average Ice Numerals for ice regimes in the region for an open water vessel, week of July 5, 2001-2010.



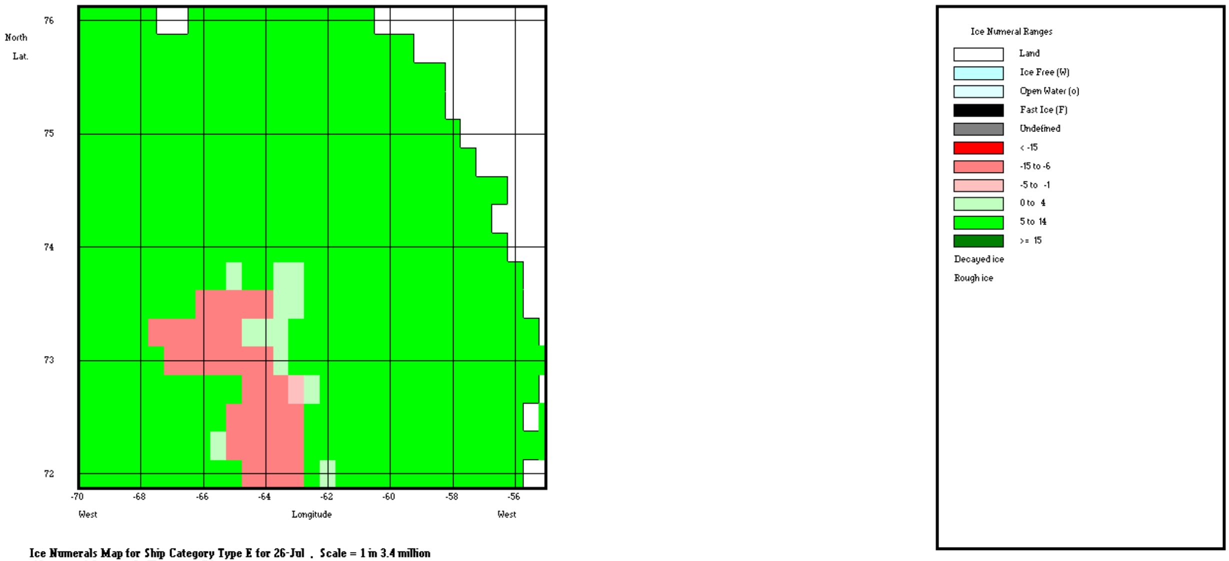
Ice Numerals Map for Ship Category Type E for 12-Jul . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-11** Average Ice Numerals for ice regimes in the region for an open water vessel, week of July 12, 2001-2010.



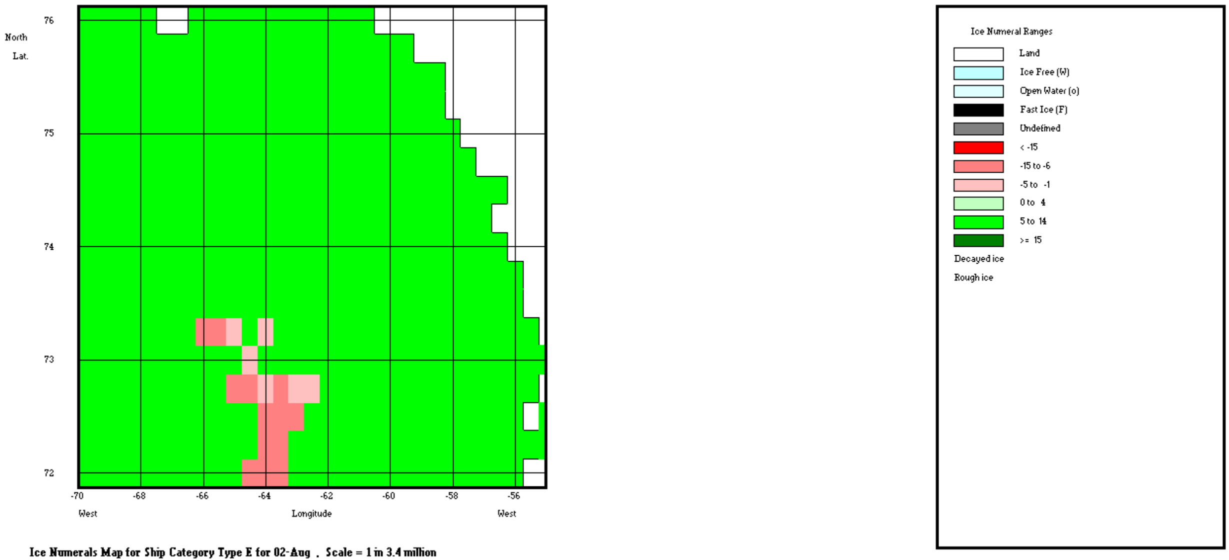
Ice Numerals Map for Ship Category Type E for 19-Jul . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-12** Average Ice Numerals for ice regimes in the region for an open water vessel, week of July 19, 2001-2010.



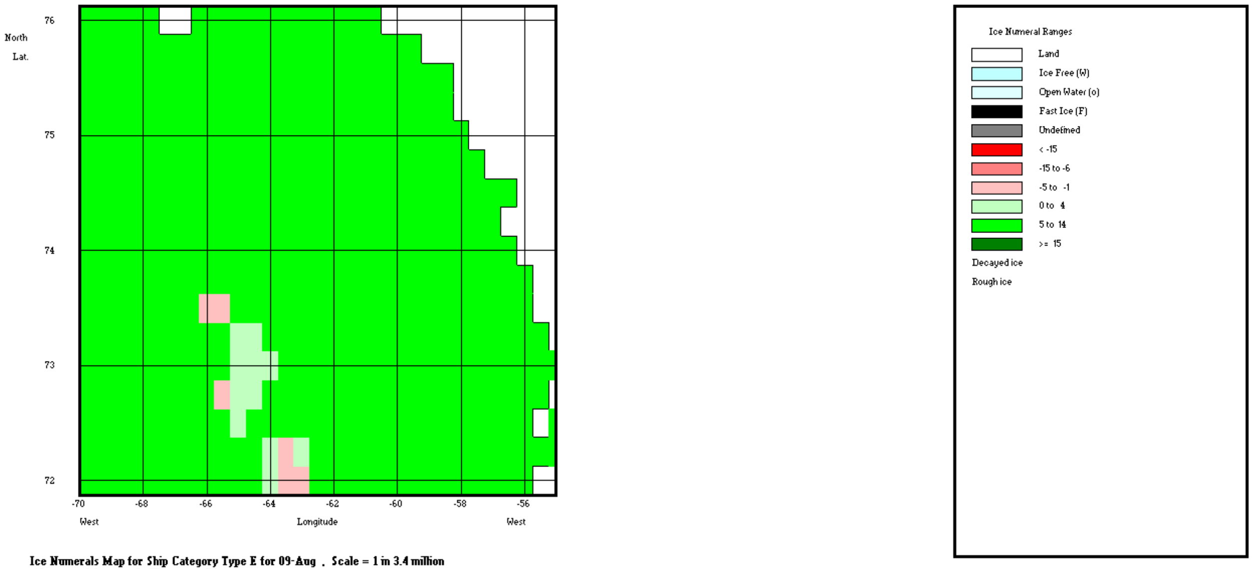
Ice Numerals Map for Ship Category Type E for 26-Jul . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-13** Average Ice Numerals for ice regimes in the region for an open water vessel, week of July 26, 2001-2010.



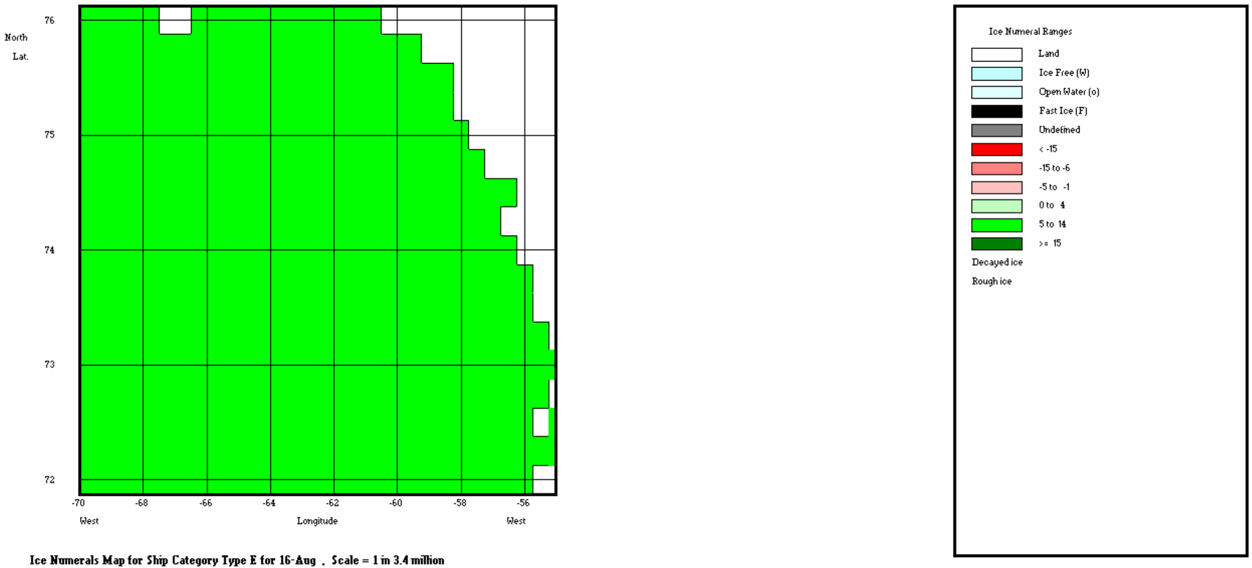
Ice Numerals Map for Ship Category Type E for 02-Aug . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-14** Average Ice Numerals for ice regimes in the region for an open water vessel, week of August 2, 2001-2010.



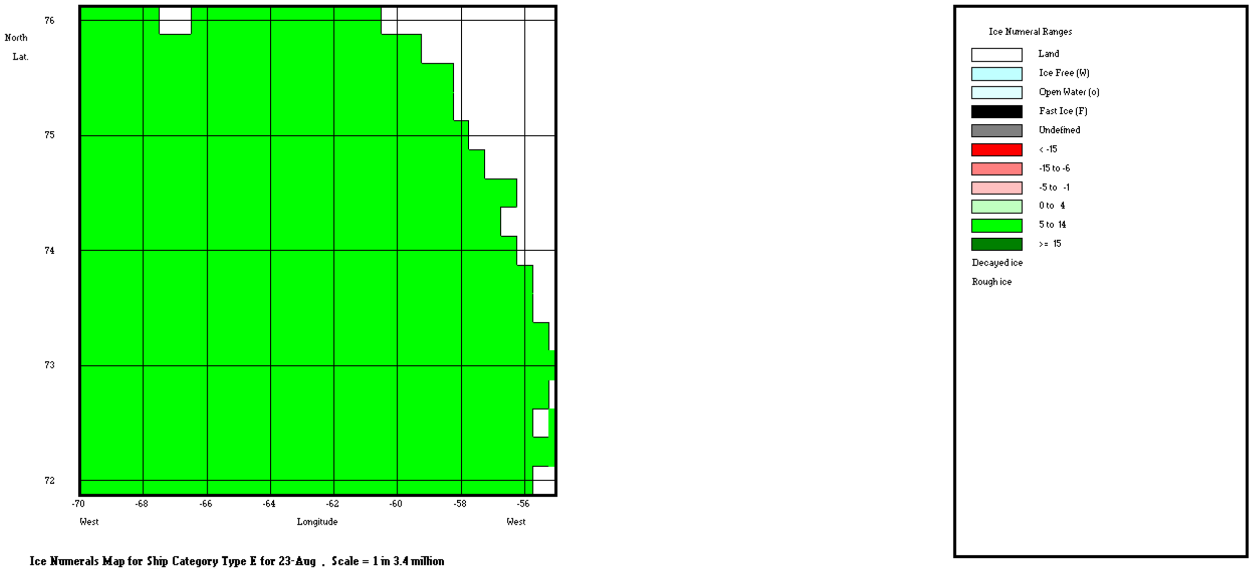
Ice Numerals Map for Ship Category Type E for 09-Aug . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-15** Average Ice Numerals for ice regimes in the region for an open water vessel, week of August 9, 2001-2010.



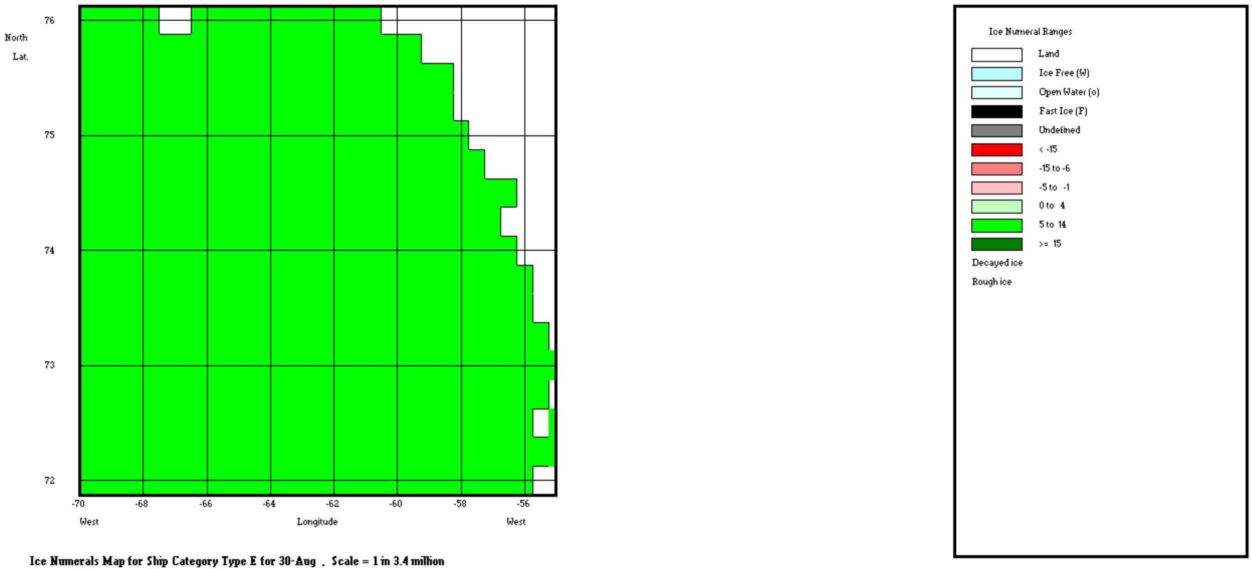
Ice Numerals Map for Ship Category Type E for 16-Aug . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-16** Average Ice Numerals for ice regimes in the region for an open water vessel, week of August 16, 2001-2010.



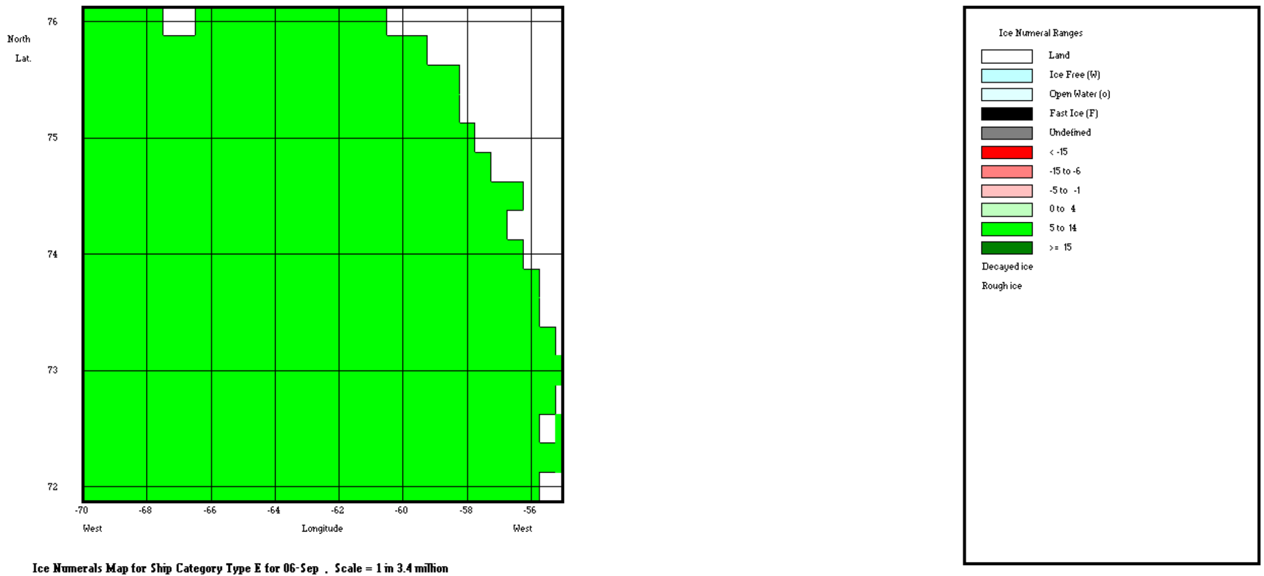
**Ice Numerals Map for Ship Category Type E for 23-Aug . Scale = 1 in 3.4 million**
**10 years of data used. There are 5 better years**
**For ice Numerals**
**If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.**

**Figure C-17 Average Ice Numerals for ice regimes in the region for an open water vessel, week of August 23, 2001-2010.**



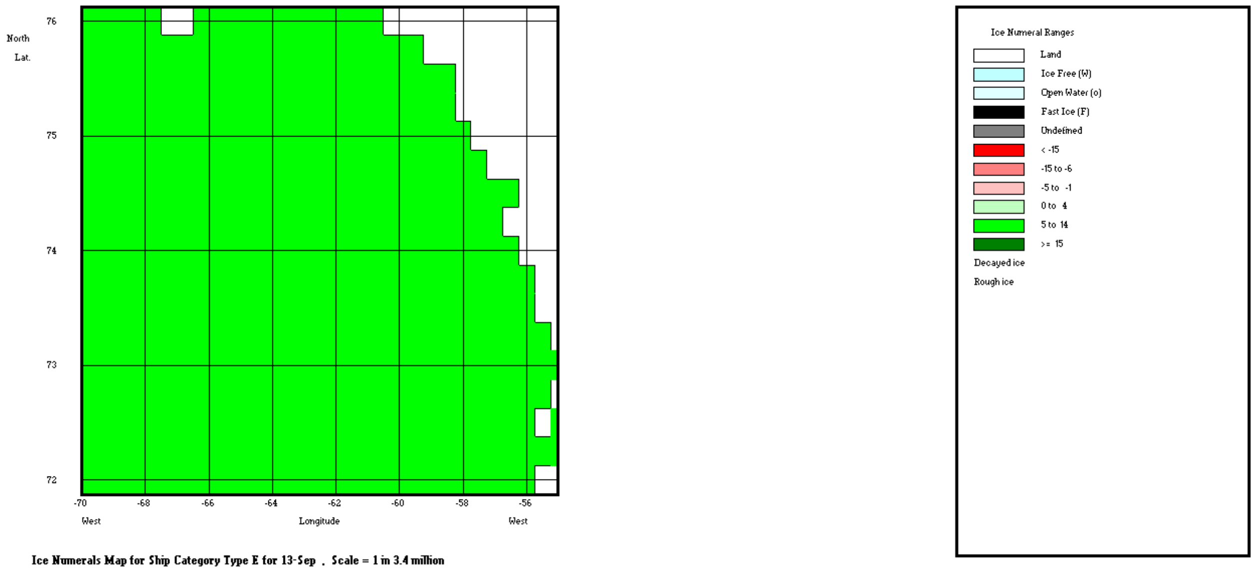
**Ice Numerals Map for Ship Category Type E for 30-Aug . Scale = 1 in 3.4 million**
**10 years of data used. There are 5 better years**
**For ice Numerals**
**If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.**

**Figure C-18 Average Ice Numerals for ice regimes in the region for an open water vessel, week of August 30, 2001-2010.**



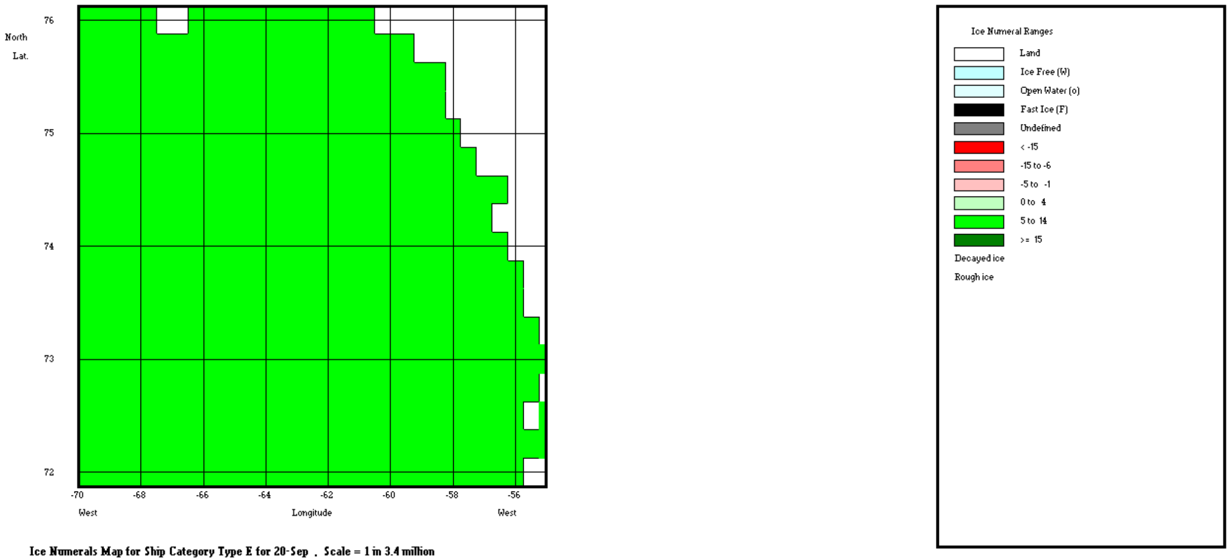
**Ice Numerals Map for Ship Category Type E for 06-Sep . Scale = 1 in 3.4 million**
**10 years of data used. There are 5 better years**
**For ice Numerals**
**If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.**

**Figure C-19** **Average Ice Numerals for ice regimes in the region for an open water vessel, week of September 6, 2001-2010.**



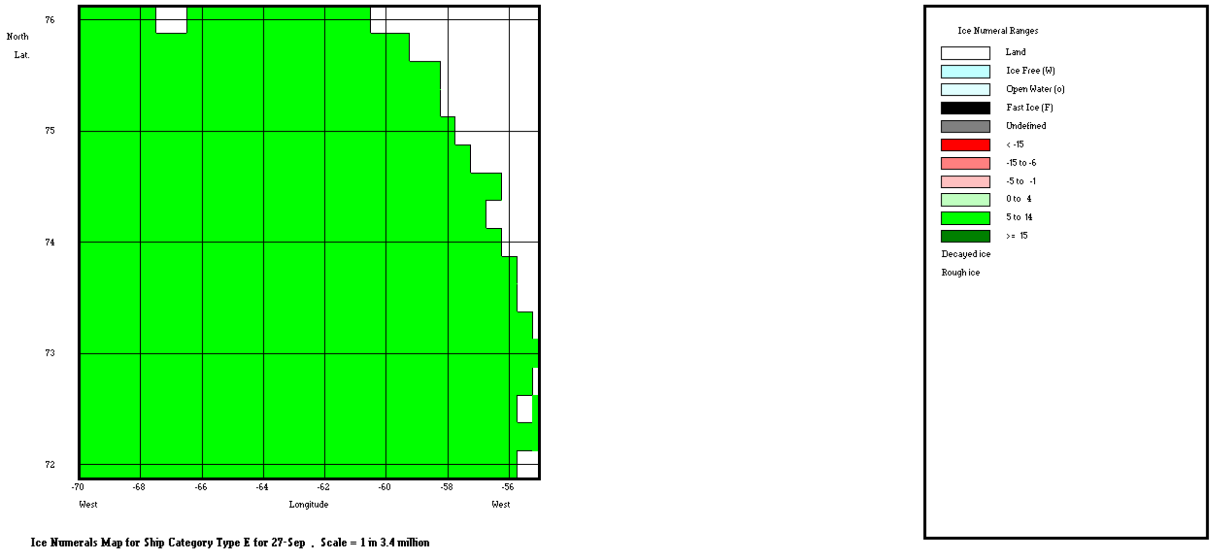
**Ice Numerals Map for Ship Category Type E for 13-Sep . Scale = 1 in 3.4 million**
**10 years of data used. There are 5 better years**
**For ice Numerals**
**If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.**

**Figure C-20** **Average Ice Numerals for ice regimes in the region for an open water vessel, week of September 13, 2001-2010.**



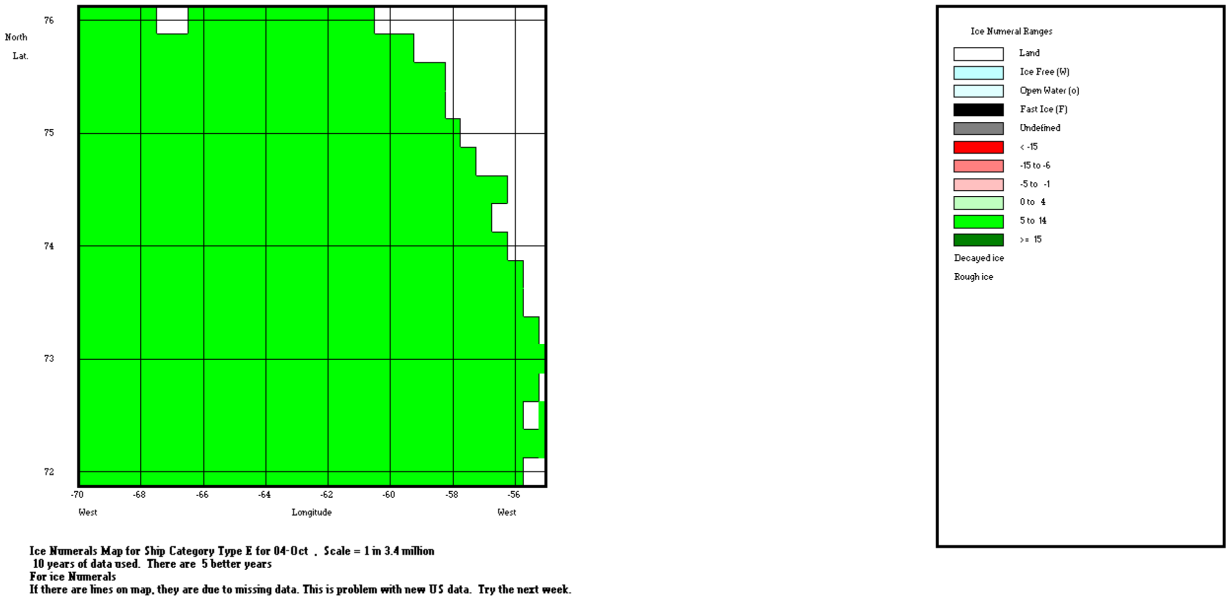
Ice Numerals Map for Ship Category Type E for 20-Sep . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-21** Average Ice Numerals for ice regimes in the region for an open water vessel, week of September 20, 2001-2010.



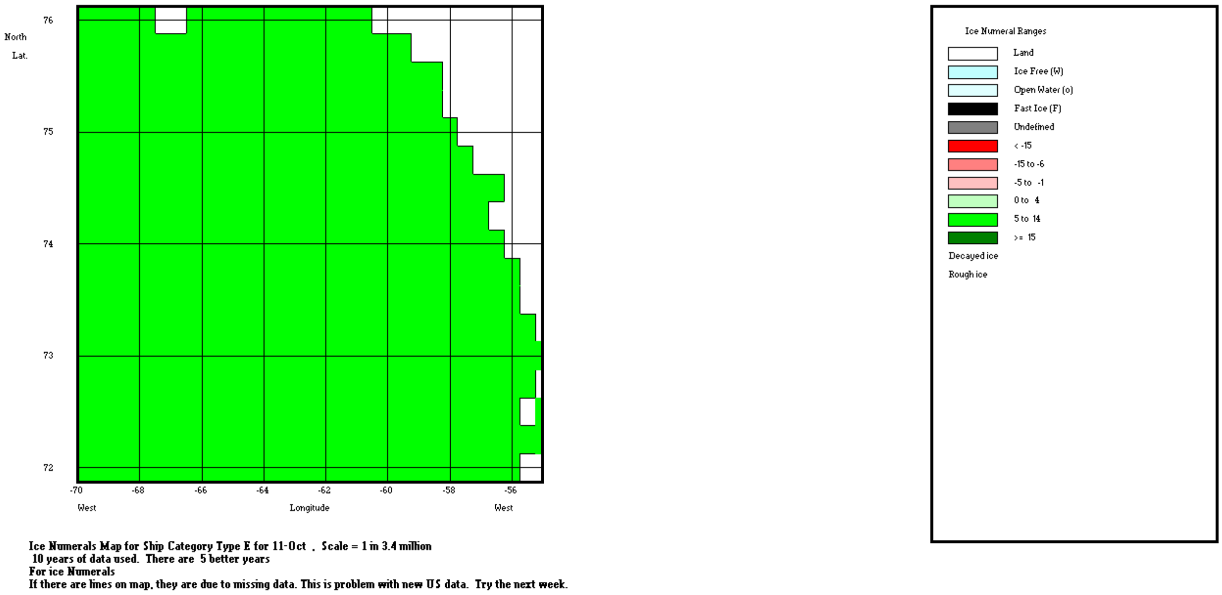
Ice Numerals Map for Ship Category Type E for 27-Sep . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-22** Average Ice Numerals for ice regimes in the region for an open water vessel, week of September 27, 2001-2010.



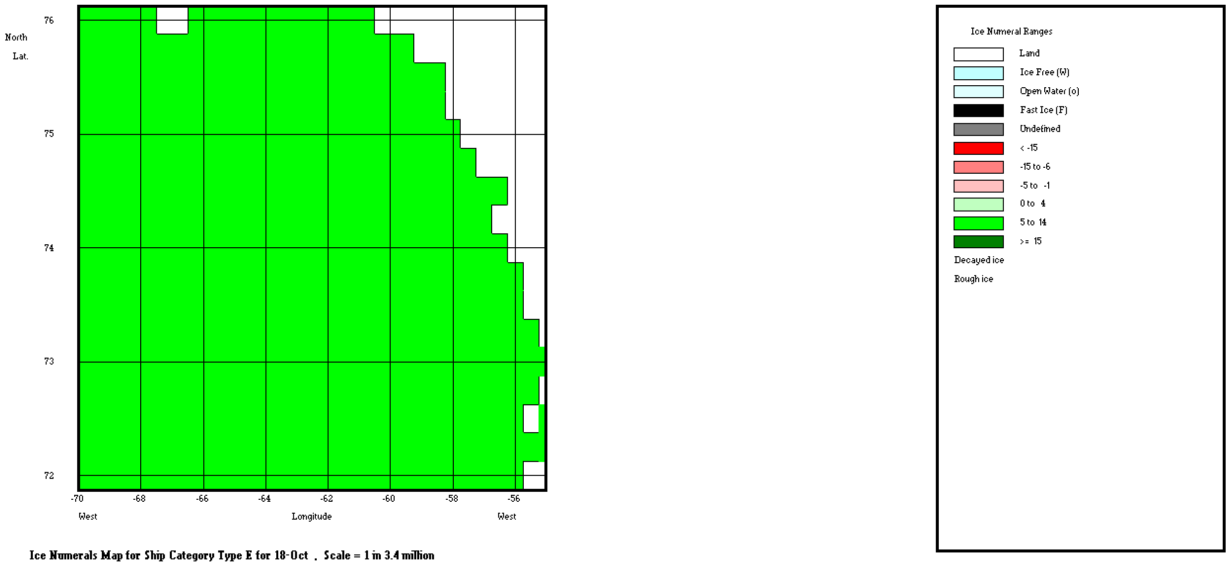
Ice Numerals Map for Ship Category Type E for 04-Oct . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-23** **Average Ice Numerals for ice regimes in the region for an open water vessel, week of October 4, 2001-2010.**



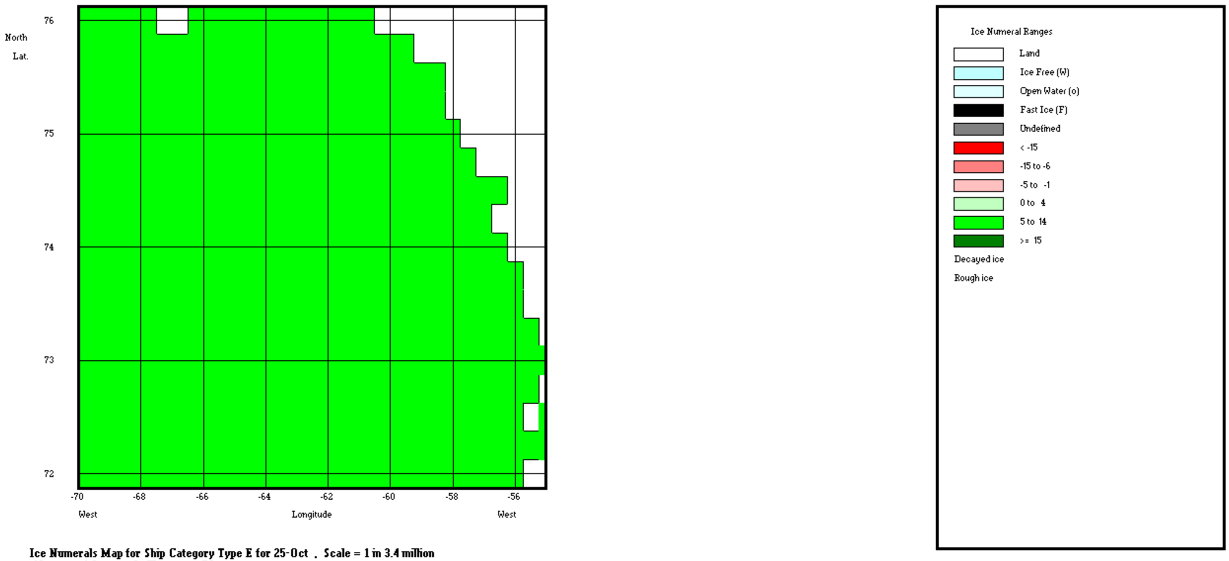
Ice Numerals Map for Ship Category Type E for 11-Oct . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-24** **Average Ice Numerals for ice regimes in the region for an open water vessel, week of October 11, 2001-2010.**



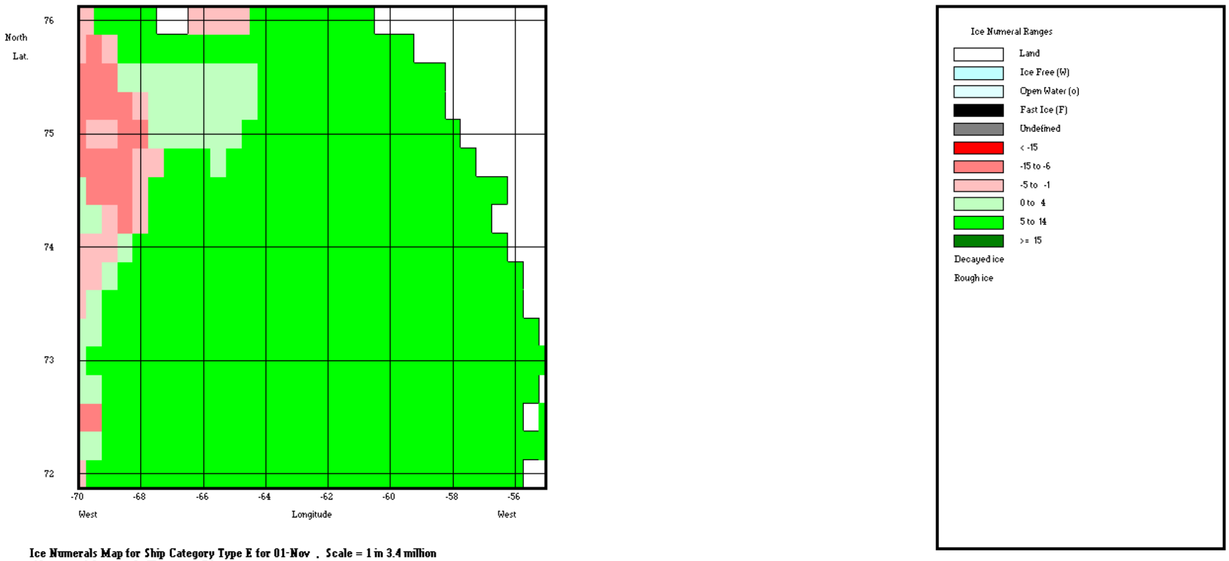
Ice Numerals Map for Ship Category Type E for 18-Oct . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-25** Average Ice Numerals for ice regimes in the region for an open water vessel, week of October 18, 2001-2010.



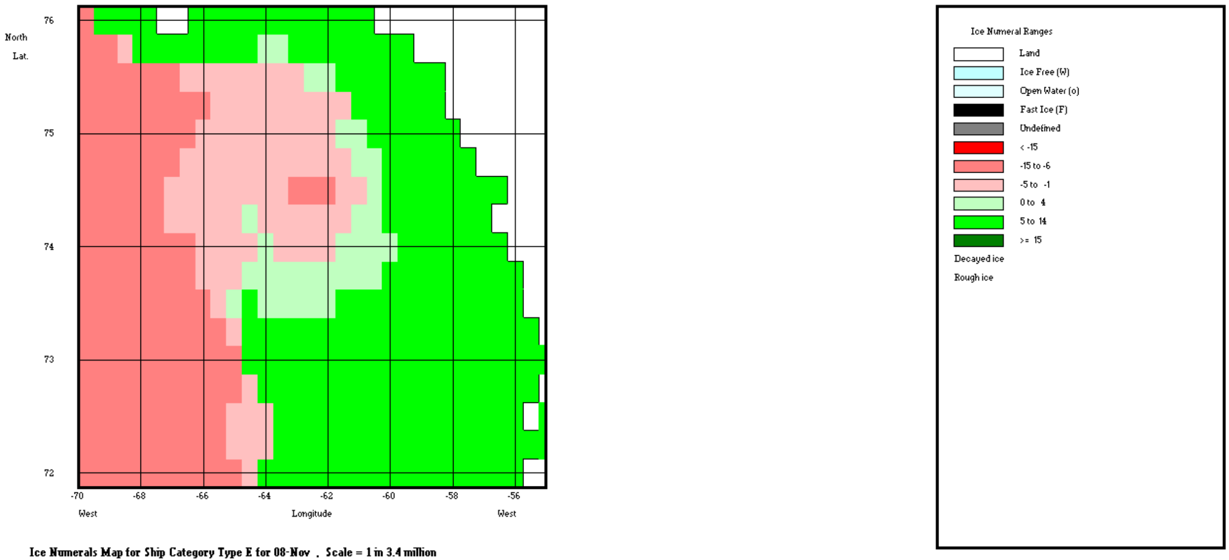
Ice Numerals Map for Ship Category Type E for 25-Oct . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-26** Average Ice Numerals for ice regimes in the region for an open water vessel, week of October 25, 2001-2010.



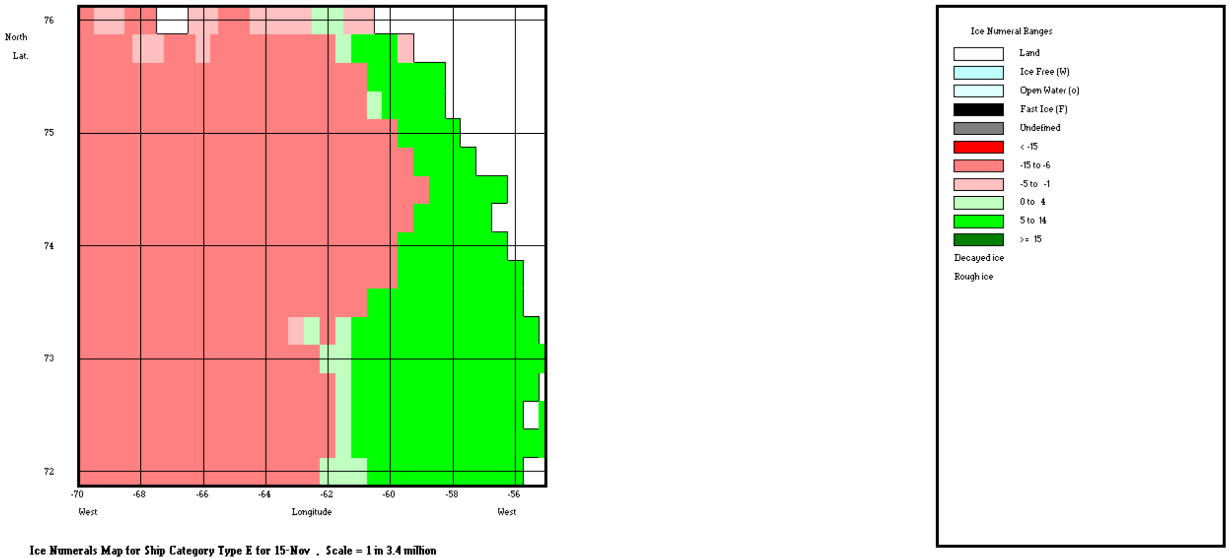
Ice Numerals Map for Ship Category Type E for 01-Nov . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-27** Average Ice Numerals for ice regimes in the region for an open water vessel, week of November 1, 2001-2010.



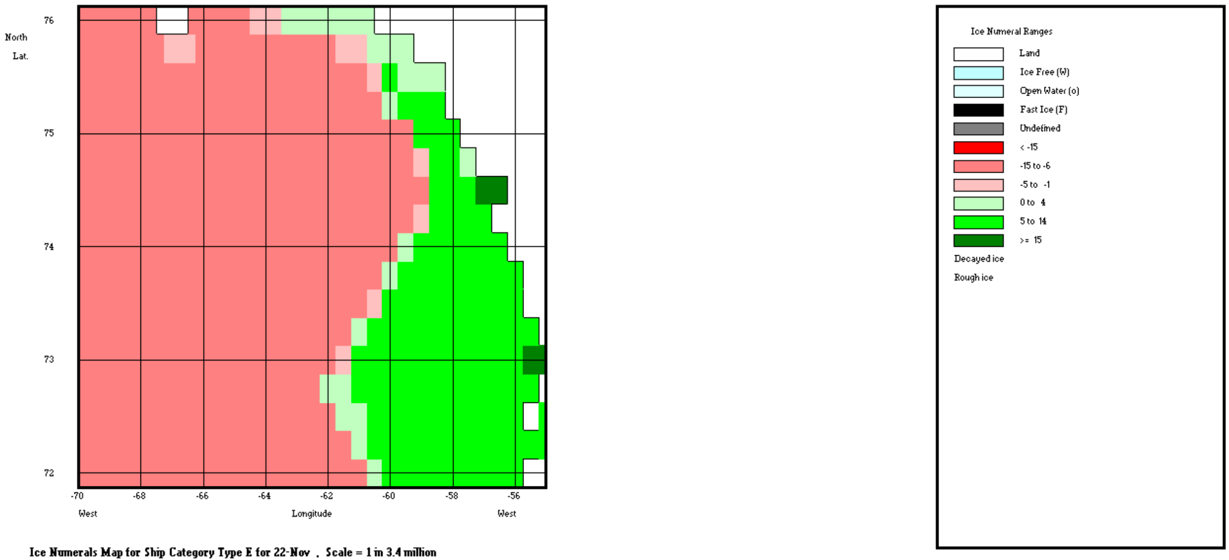
Ice Numerals Map for Ship Category Type E for 08-Nov . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-28** Average Ice Numerals for ice regimes in the region for an open water vessel, week of November 8, 2001-2010.



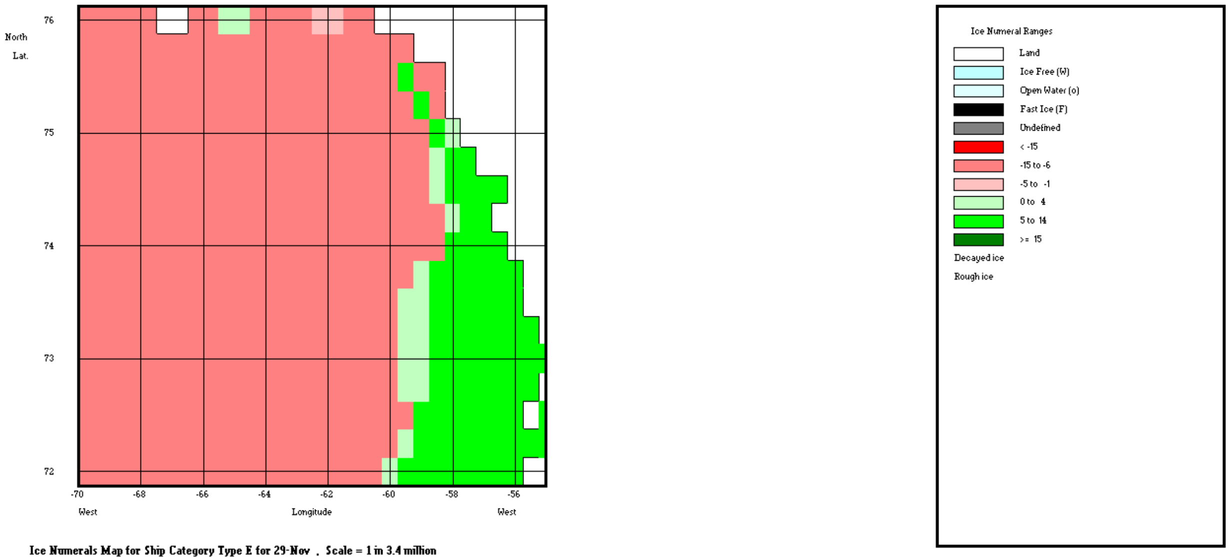
Ice Numerals Map for Ship Category Type E for 15-Nov . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-29** Average Ice Numerals for ice regimes in the region for an open water vessel, week of November 15, 2001-2010.



Ice Numerals Map for Ship Category Type E for 22-Nov . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-30** Average Ice Numerals for ice regimes in the region for an open water vessel, week of November 22, 2001-2010.



Ice Numerals Map for Ship Category Type E for 29-Nov . Scale = 1 in 3.4 million
10 years of data used. There are 5 better years
For ice Numerals
If there are lines on map, they are due to missing data. This is problem with new US data. Try the next week.

**Figure C-31** Average Ice Numerals for ice regimes in the region for an open water vessel, week of November 29, 2001-2010.

## Physical Baseline Appendix for Maersk

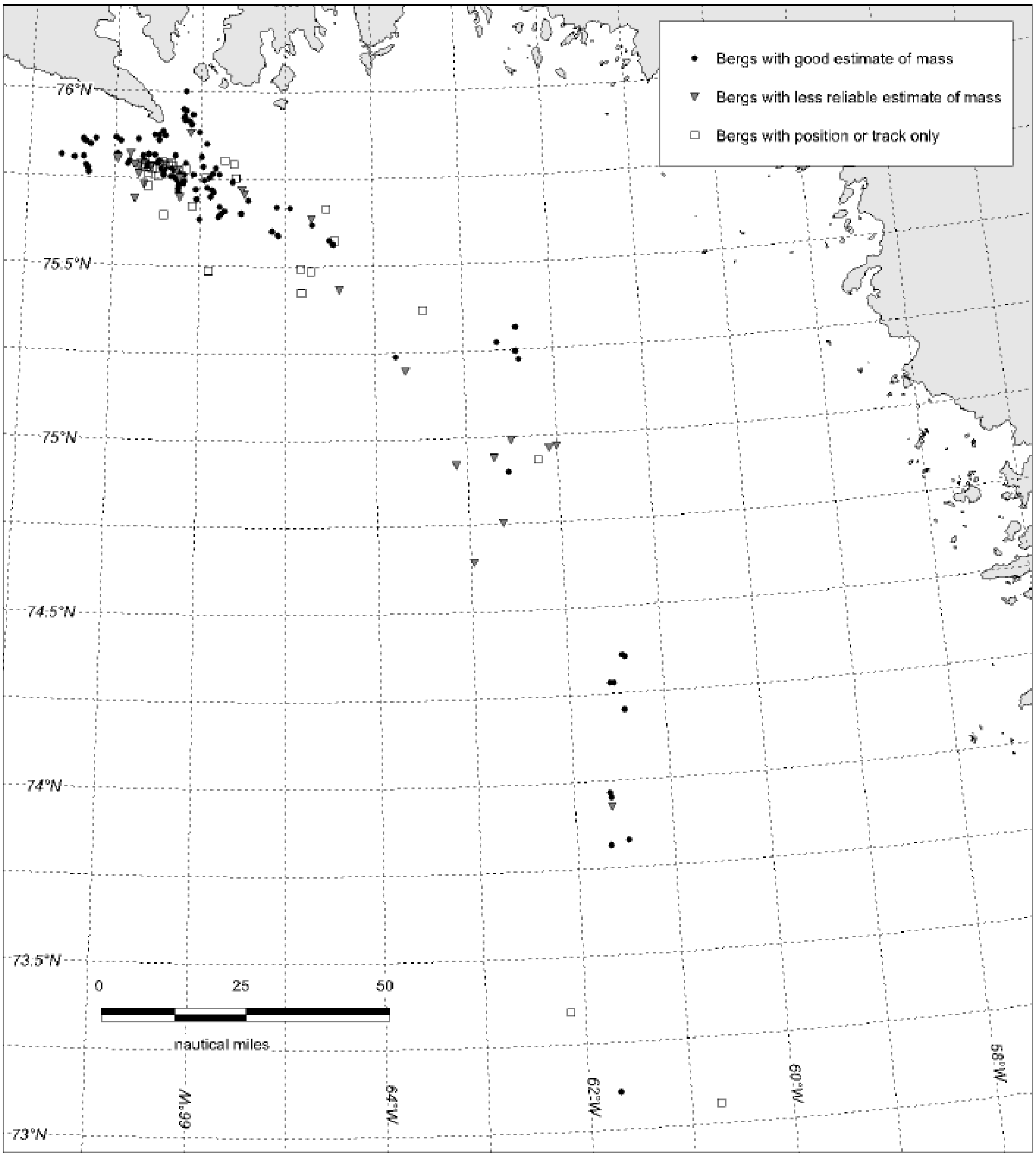


**Figure C-32** **The locations of all icebergs documented August 13 - September 15, 2011 (GEMS 2011a).**