Sea-Ice Information Services in the World

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NOTE

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FOREWORD

The WMO publication '*Sea Ice Information Services in the World*' (WMO No. 574) is intended to provide to mariners and other users the latest snapshot of the sea ice services available world-wide, effectively extending the WMO publication No. 9, Volume D – Information for Shipping. In March 2007, following finalization by the WMO Secretariat of the 3rd edition of the publication (as hardcopy edition), the Joint World Meteorological Organization/Intergovernmental Oceanographic Commission Technical Commission for Oceanography and Marine Meteorology (JCOMM) Expert Team on Sea Ice (ETSI) 3rd session agreed on further annual updates of the electronic version of the publication, using the following scheme (JCOMM Meeting report No.51):

- using content of the 3rd edition of the publication as a model;
- national ice services to submit corrections to the ETSI Chairperson and WMO Secretariat for appropriate paragraphs of Parts I-II and annexes, as needed and as appropriate;
- the ETSI Chairperson in collaboration with the WMO Secretariat to incorporate these corrections or amendments, update the contents of the electronic version (including the 'Table for noting supplements received') within a three month period and make the updated version officially available on the JCOMM website;
- the WMO Secretariat to inform the respective National Ice Services and sea ice community on the availability of the updated electronic version with the use of a mailing list and/or appropriate news sections and methods (similar to 'ArcticInfo');
- the WMO Secretariat Publishing Department to prepare updated or amended CD-ROM versions of the publication and/or supplements on an regular basis.

The ETSI-III session also agreed for the publication to start each section for a national ice service on an individual page, to use a single-column layout and to include the following additional annexes:

- list of abbreviations;
- hemispheric map showing max/min ice extent plus dots showing location of ice services;
- list of contact persons, which serve as editors for the electronic version of the publication.

By May 2009, updates for the first annual edition (Part-II and Annexes) were provided and included into the annual 2009 edition of the publication with other ETSI-III decisions also being introduced in the document: the list of abbreviations as a first and the 'Sea-ice products by areas of the World Ocean available via the Ice Logistics Portal' as a second new annex. Several amendments were also introduced to Part I GENERAL, section 'International cooperation' reflecting new regional alliances, development of a new transfer format for ice charts ('Ice Objects Catalogue') and development of a new mechanism of ice charts dissemination ('Ice Logistics Portal').

The ETSI-IV session (March 2010) approved the concept and layout of the annual 2009 edition and agreed that the similar JCOMM ETMSS "fast track" procedure should be used to further revisions of the publication with regular updates be published on the JCOMM website and announced by the WMO Secretariat.

FOREWORD to 3rd edition

Many ocean and sea areas of the world, in addition to the polar seas, are susceptible to sea ice (for example, the Baltic Sea and parts of the Yellow Sea). Sea ice occurs in a wide range of types and forms, and affects significantly and directly marine transport and navigation. Economic and social developments are engendering significant increases in international shipping, particularly in areas susceptible to sea ice. The specialized meteorological services, which evolved initially in support of local marine users, have since developed into a wide range of sea-ice information services designed to meet many user requirements. The Joint World Meteorological Organization/Intergovernmental Oceanographic Commission Technical Commission for Oceanography and Marine Meteorology (JCOMM) Expert Team on Sea Ice (ETSI) (before 2001 called the Subgroup on Sea Ice – SGSI, of the WMO Commission for Marine Meteorology – CMM) has been the focal point for promoting and coordinating international cooperation in the acquisition, exchange, archival and dissemination of sea-ice information.

The WMO publication *Sea-Ice Information Services in the World* (WMO-No. 574) was first published in 1981. Following a recommendation of the CMM-XII in 1997, the SGSI undertook a major review of this important publication. As a result, a second fully updated version was published in 2000. Fast progress in sea-ice information systems, as well as the need for comprehensive sea-ice information, predetermined the decision of the second session of the JCOMM ETSI in 2004 to start a regular update of the publication on the annual basis. This present revised third version was prepared in 2005–2006 by the ETSI with the support of the WMO Secretariat, and includes contributions from 20 countries from the Northern and Southern hemispheres involved in sea-ice activities.

I believe that this publication will continue to enhance the exchange of information relating to sea ice and sea-ice services for the benefit of many National Meteorological Services, in particular in conjunction with the International Polar Year 2007–2008. In addition, to facilitate provision of operational information to mariners, marine operations and controllers, it will also aid other National Meteorological Services, which are developing their own sea-ice services.

On behalf of the World Meteorological Organization, I would like to express my sincere appreciation to all members of the Expert Team on Sea Ice and other experts from the national ice services for their contributions to the preparation of this valuable publication.

(M. Jarraud)

Secretary-General

INTRODUCTION

Mariners have known of the existence and perils of sea ice since vessels first ventured into northern regions. The numerous polar expeditions of the nineteenth and twentieth centuries brought new understanding of the types and variability of conditions affecting these vast ocean areas. It was not until misfortune struck the SS Titanic, however, that thoughts of international cooperation in sea-ice information gained any strength. After 1918, increasing emphasis upon navigational safety and the need for agreed shipping routes led to contacts between nations who had established their own sea-ice observational information systems. Discussions about reporting methods, code forms and symbology (within the confines of the limited extent of observation at that time) continued steadily until 1959. Advances in communications, the advent of aircraft observations and routine reporting created the basis for the development of sea-ice information services by several nations by the mid-1950s. The first international sea-ice conferences were held and the Commission for Marine Meteorology (CMM) established a working group concerned with sea-ice affairs.

Since that time many further strides forward have been made both in observational and processing techniques, and information services are provided now as routine for all the commonly frequented sea-ice regions. The first edition of *Sea-Ice Information Services in the World* (WMO-No. 574) was prepared and published by 1981. Since then, due to advances in remote sensing, computational means and telecommunications, significant progress has been made in the number and complexity of sea-ice products. In addition changes in the number of sea-ice services and their regions of responsibility have occurred. Following recommendation of the CMM-XII in 1997, the Subgroup on Sea Ice (SGSI) undertook a review of the publication and a second fully updated version was issued in 2000.

Further progress in sea-ice information systems, the need for comprehensive information on sea-ice services and planning for the International Polar Year 2007–2008 predetermined the decision of the SGSI successor – the JCOMM Expert Team on Sea Ice (ETSI) – in 2004 to update the publication on an annual basis. The third edition was finalized by ETSI and published in hardcopy by the WMO Secretariat in March 2007.

Current annual edition is based on the latest amendments from the national services, follows the structure of the previous publications, and has been designed to describe sea-ice services as they are today, and to provide clear factual and updated details of the sources, background, preparation and presentation of these services. Special attention is given to (a) processing and presentation of various satellite imagery; (b) information products based on the results of numerical modeling of the sea-ice cover; and (c) using the Internet to relay sea-ice products to users.

The publication consists of two parts:

Part I – A general description of the nature of sea ice, methods of observation, and the basis of ice-information services.

Part II – A listing of the sea-ice information services available from 20 nations, given regionally, and in each case detailing:

(*a*) Organization;

(*b*) Data acquisition;

(*c*) Output products;

(*d*) Forecasts;

(*e*) Publications;

(*f*) Mailing and Internet addresses.

These details are supported by annexes containing sample charts and illustrating a wide selection of the products mentioned in Part II, including charts remotely sensed or with numerically modelled backgrounds, complexity, dissemination methods and national and international practices where relevant.

The extent to which sea-ice information services have now developed will be very evident to readers. It is hoped that this third review may in turn, through its users and those involved in related services, itself contribute further to future advances.

PART I

GENERAL

1. THE NATURE OF SEA ICE

Several forms of floating ice may be encountered at sea. The most common is that which results from the freezing of the sea surface, namely sea ice. The other forms are river ice and ice of land origin. River ice is encountered in harbours and estuaries where it is kept in motion by tidal streams and normally presents only a temporary hindrance to shipping. Ice of land origin in the form of icebergs is discussed separately below.

Both icebergs and sea ice can be dangerous to shipping and always have an effect on navigation. Sea ice also influences the normal processes of energy exchange between the sea and the air above it. The extent of sea-ice cover can vary significantly from year to year and has a great effect both on adjacent ocean areas and on the weather over large areas of the world. Its distribution is therefore of considerable interest to meteorologists and oceanographers.

1.1 FORMATION AND DEVELOPMENT OF SEA ICE

1.1.1 Ice less than 30 cm thick

The first indication of ice formation is the appearance of small ice spicules or plates in the top few centimeters of the water. These spicules, known as frazil ice, form in large quantities and give the sea an oily appearance. As cooling continues the frazil ice coalesces to form grease ice, which has a matt appearance. Under near-freezing, but as yet ice-free conditions, snow falling on the surface may result in the sea surface becoming covered by a layer of slush. These forms may be regrouped by the action of wind and waves to form shuga and all are classified as new ice.

With further cooling, sheets of ice rind or nilas are formed, depending on the rate of cooling and on the salinity of the water. Ice rind is formed when water of low salinity freezes into a thin layer of brittle ice which is almost free of salt. Ice rind may be up to 5 cm thick. When water of high salinity freezes, especially if the process is rapid and the wind is very light, the ice has an elastic property which is characteristic of nilas. Nilas is subdivided, according to its thickness, into dark and light nilas; the first one reach thickness of 5 cm, while the second, more advanced stage reaches a maximum thickness of 10 cm. Ice rind, dark and light nilas, may be referred to as nilas ice.

Pancake ice may be formed in the boundary between two water layers of different salinity – the lower layer with a high salinity has a temperature below the freezing point of the upper layer of lower salinity. Eventually the pancakes will surface due to buoyancy forces. "False" pancake ice may be formed by the breaking up of nilas, or ice rind, due to the action of wind and waves. It must be noted that the process of pancake ice formation is still poorly investigated due to the lack of observations.

Ice rind, nilas or pancake ice may thicken into grey ice and grey-white ice, the first being 10–15 cm thick and the latter attaining thicknesses of up to 30 cm. These forms of ice are referred to collectively as young ice. Rough weather may break this ice up into ice cakes, pancake ice or floes of varying size.

1.1.2 Ice 30 cm – 2 m thick

The next stage of development is known as first-year ice (FY) and is subdivided into thin, medium and thick categories. Thin first-year ice has a thickness of 30–70 cm and is subdivided according to its thickness into thin first-year ice first stage (30–50 cm) and thin firstyear ice second stage (50–70 cm). Medium first-year ice has a range of thickness from 70 to 120 cm while in polar areas thick first-year ice may attain a thickness of approximately 2 m by the end of the winter.

1.1.3 Old ice

Thick first-year ice may survive the summer melt season and is then classified as old ice (MY). This category is subdivided into second-year and multi-year ice depending on whether the floes have survived one or more summers. The thickness of old ice is normally in the range 1.2 to 5 m or more prior to the onset of the melt season. Old ice can often be recognized by a bluish surface colour in contrast to the greenish tinge of first-year ice.

1.2 DECAY OF SEA ICE

During the winter the ice usually becomes covered with snow of varying thicknesses. While this snow cover persists, almost 90 per cent of the incoming radiation is reflected back to space. Eventually, however, the snow begins to melt as air temperatures rise above 0°C in early summer and the resulting fresh water forms puddles on the surface. These puddles absorb (instead of reflect) around 90 per cent of the incoming radiation and rapidly enlarge as they melt the surrounding snow or ice. Eventually the puddles penetrate to the bottom surface of the floes and are known as thawholes. This decay process is characteristic of ice in the Arctic Ocean and seas where movement is restricted by the coastline or islands. Where ice is free to drift into warmer waters (e.g. the Antarctic and the Labrador Sea) puddling is less prevalent and decay is accelerated by wave erosion as well as warmer air and sea temperature.

1.3 MOVEMENT OF SEA ICE

Sea ice is divided into two main types according to its mobility. One type is drift ice, which is continually in motion under the action of wind and current stresses; the other is fast ice, attached to the coast or islands, which does not move.

Wind stress in the drift ice causes the floes to move approximately in a downwind direction. The rate of movement due to wind drift varies not only with the wind speed, but also with the concentration of the driftice and the extent of deformation (see below). In very open ice (1/10–3/10) and open ice (4/10–6/10) there is much more freedom to respond to the wind than in close ice or pack ice (7/10–8/10) and very close ice (9/10–10/10) where free space is very limited. No water is visible within the compact ice (10/10) or consolidated ice (10/10) where the floes are frozen together. Two per cent of the wind speed is a reasonable average for the rate of ice drift caused by the wind in close ice, but much higher rates of ice drift may be encountered in open ice. Since it is afloat, a force is exerted on drift ice by currents that are present in the upper layers of the water, whether these are tidal in nature or have a more consistent direction due to other forces. It is usually very difficult to differentiate between wind- and current-induced ice drift but in any case where both are present the resultant motion is always the vector sum of the two. Wind stress normally predominates the shortterm movements, particularly in offshore areas, whereas the average long-term transport is dominated by the prevailing surface currents.

1.4 DEFORMATION OF SEA ICE

Where the ice is subjected to pressure its surface becomes deformed. In new and young ice this may result in rafting as one ice floe overrides its neighbour; in thicker ice it leads to the formation of ridges and hummocks according to the pattern of the convergent forces causing the pressure. During the process of ridging and hummocking, when pieces of ice are piled up above the general ice level, large quantities of ice are also forced downward to support the weight of the ice in the ridge or hummock. The underwater parts may be termed respectively ice keel and bummock. The draught of a ridge can be three to five times as great as its height and these deformations are thus major impediments to navigation. Freshly-formed ridges are normally less difficult to navigate than older, weathered and consolidated ridges.

1.5 ICEBERGS

Icebergs are large masses of floating ice derived from glaciers. The underwater mass and draught of a berg, compared with its mass and height above water varies widely with different composition and shapes of bergs. The underwater mass of an Antarctic iceberg derived from a floating ice shelf is usually less than the underwater mass of icebergs derived from Greenland glaciers. A typical Antarctic tabular berg, of which the uppermost 10–20 m is composed of old snow, will show one part of its mass above the water to five parts below. The ratio for an Arctic berg, composed almost wholly of ice with much less snow is generally smaller, rather one to seven. However, because of their irregular shape the latter icebergs have a height-to-draught ratio averaging one to three.

Icebergs diminish in size in three different ways: by calving, melting and combined melting plus erosion caused by wave action. A berg is said to calve when a piece breaks off; this disturbs its equilibrium, so that it may float at a different angle or it may capsize. Large underwater projections, which may be difficult to observe, are a usual feature of icebergs in any state. In cold water, melting takes place mainly on the water line while in warm water a berg melts mainly from below and calves frequently. It is particularly dangerous to approach a berg in this state for it is unstable and may fragment or overturn at any time. There are likely to be many growlers and bergy bits around rapidly disintegrating icebergs, which form a particular hazard to navigation.

Weathered bergs are poor reflectors of radar pulses and cannot always be detected by such means. Their breakdown fragments – bergy bits and growlers – are even more difficult to detect with ships' radar for the background clutter from waves and swell often obscures them. These smaller fragments are especially dangerous to shipping for, despite their low profile they represent sufficient mass to damage a vessel, which comes into contact with them at normal cruising speed. Some growlers consisting of pure blue ice hardly break the sea surface and are extremely difficult to detect.

2. ICE OBSERVING METHODS

Although broad knowledge of the extent of sea-ice cover has been totally revolutionized by satellite imagery, observations from shore stations, ships and aircraft are still of great importance in establishing the "ground truth" of satellite observations. At present, observations of floating ice depend on instrumental and, to lesser extent, on visual observations. The instrumental observations are by conventional aircraft and coastal radar, visual and infra-red airborne and satellite imagery, and more recent techniques, such as passive microwave sensors, laser airborne profilometer, scatterometer, side-looking (airborne) radar (SLAR/SLR) or synthetic aperture radar (SAR, satellite or airborne).

The four most important features of sea ice, which affect marine operations, are:

(*a*) Its thickness (stage of development);

(*b*) The amount present – concentration, usually estimated according to the tenths or percentage of the sea surface covered by the ice;

(*c*) The form of the ice, whether it is fast or drift ice and the size of the constituent floes; and

(*d*) Any movement of the ice.

On a ship or at a coastal station it is obvious that a better view of the ice is obtained if the observation is made from a point as far above the sea as possible. From the bridge of a ship 10 m above the sea, the horizon is about 12 km away and good observations can cover a radius of only 7–8 km. From the top of a coastal lighthouse 100 m above the sea the visual range is almost 40 km and the observation may then cover a radius of 20 km.

Shore locations may provide an ice report several times a day as the ice changes in response to wind and current but the total area of ice being reported is very small. From a ship progressing through the ice, a summary report of the ice encountered during daytime progress may represent an area of the sea ice 15 km wide and 100 km long (assuming a ship's speed of approximately 5 kt). In some marine areas, such as the Baltic Sea, coastal settlements, lighthouses and ships may be present in sufficient numbers that a reasonable proportion of the ice cover can be reported each day by an organized surface network. In others such as the Gulf of St Lawrence, where the waterways are broad and the shores often unsettled, no shore reporting system can provide data on more than a very small percentage of the total ice cover. Although surface based reports can provide excellent detail about the ice, especially its thickness, it is generally recognized that for most areas, the surface reports are not really adequate to describe ice conditions fully.

Reports about the ice cover taken from the air, i.e. helicopters and fixed-wing aircraft, have the advantage of a much better viewing angle; the platform's flying speed allows a great deal more of the sea ice to be reported; and problems of remoteness from airports or other suitable landing sites can be overcome by using long-range aircraft. In several countries, ice observers are trained to recognize the various stages of development of sea ice, to estimate its amount, to note its deformation and the snow cover or stage of decay. All these data are provided by visual estimation and both training and experience are required to make the information reliable.

Comprehensive aerial reporting has its own particular requirements beginning with an accurate navigational system when out of sight of land. Inclement weather – fog, precipitation and low cloud – will restrict or interrupt the observations and the usual problems of flying limits at the aircraft base may also be a factor even if the weather over the ice is adequate for observing.

Recent advances in technology are now permitting more precise data to be obtained by aerial observations. SLAR and SAR can provide information, which documents precisely the distribution and nature of the ice in one or two belts along the flight path of the aircraft for distances of up to 100 km on each side. Unlike most other sensors, the radar has the capability of monitoring the ice under nearly all weather conditions. It responds mainly to the roughness of the ice surface but the dielectric properties of each ice floe also affect the response.

When no fog or low clouds are present a laser airborne profilometer can be used to measure the height and frequency of ridges on the ice, and under similar conditions an infra-red airborne scanning system can provide excellent information with regard to floe thickness in the ranges below 30 cm.

The advent of earth-orbiting meteorological satellites has added a third, and now the most important and predominant, mode of observing sea ice but again there are some restrictions. The spectral range of the sensors may be visible, infrared, passive or active microwave or a combination of these. Satellite coverage may be broad at low resolution or cover a narrow swathe at high resolution. In the latter case, data from a particular location may be obtained only at temporal intervals of several days. There is always the problem of rates of data transmission from space and the orbital altitude of the satellite, which affects the range of reception at each receiving station.

In general, most meteorological satellites provide 10–12 passes daily in the polar regions, i.e. complete coverage of polar regions once or twice a day. These satellites provide visible and infrared imagery with resolutions of 250 m–1 km (NOAA AVHRR, METEOR, MODIS, DMSP OLS); and passive microwave and scatterometer data at coarser resolutions of 6–70 km (AQUA AMSR, NOAA AMSU, DMSP SSM/I, SeaWinds QuikScat). Visible and infrared data do not have cloud-penetrating capability while microwave data are practically cloud independent. Active microwave SAR data (RADARSAT, ENVISAT) are characterized by improved ground resolution (approximately 10–100 m) but a reduced coverage due to narrow swathes and greater revisit time between exact repeat orbits. Ice services are also awaiting data from new satellites such as Cryosat (altimeter) in 2007 and ALOS (radiometer, SAR) in 2005.

Manual or visual interpretation of imagery from visible and infrared sensors requires a certain amount of skill, for example, a picture element composed of 50 per cent white ice and 50 per cent water will have the same greyness in the visible image as another element in which the whole surface is covered with thin (grey) ice. Snow cover on the ice and puddles on the floes are other complicating factors. Interpretation of SAR images may be even more difficult due to the ambiguities associated with SAR backscatter from sea-ice features that vary by season and geographic region. Therefore, in recent years automated digital processing techniques have been developed to aid in the interpretation of satellite data. Techniques are usually implemented within geographical information systems (GIS) and include automatic and/or interactive image georeference, enhancement and various types of image recognition and classification, which are based on data from a single sensor or combination from several ones.

Space-borne sensors can provide precise data on the location and type of ice boundary, concentration or concentration amounts (in tenths or percentages) and the presence or absence of leads, including their characteristics, if radar sensors are used. Less accurate information is provided on the stages of development of the sea ice including the FY/MY ratio, forms, with an indication of whether ice is land-fast or drifting, stages of ice melting and ice surface roughness. Floe motion over approximately 12–24-hour intervals can often be determined through the use of imagery from sequential orbits.

3. INTEGRATED O BSERVATIONAL SYSTEMS

Any well-designed ice services system must consist of three major components:

(*a*) A surface observation network consisting of *in situ* reports and remotely sensed data;

(*b*) A communication system to gather and distribute the ice information; and

(*c*) A digital data integration, analysis and production system.

Surface reports from shore stations, ships and drifting buoys provide accurate information on ice amount, thickness, motion and its deformation over rather small areas. When many vessels and fixed observing points are available accurate information can be provided in restricted waterways. Many areas of the Kattegat and Baltic Sea coastline fall into this category and landline facilities are available for the relay of these reports to national or regional centres.

When waterways are more open or more remote from populated areas, either satellite data or aerial observations must be integrated into the system. Aerial data are normally prepared by the observers in map format as they fly along the prescribed track. An airto-ship communication line is needed to pass the data directly to vessels in the area. This may be merely a voice channel, a radio facsimile broadcast or a digital network link, which enables radar data or the ice chart itself to be passed to the ships. In most cases, these data are also passed to the ice centre for integration into regional-scale analysis products.

Satellite data are typically passed in real-time (less than six hours) from satellite ground stations to the ice centres via high-speed communication links. Visible, infrared, passive microwave, SAR data are then digitally processed, integrated with meteorological guidance products and ice model output and then analysed by computer, typically using GIS. Image enhancement techniques and various other automated algorithms are often employed in the production of an ice analysis. Ice analyses are produced as charts at varying scales (typically ranging up to

1:2,500,000) depending on the size of the area and the level of detail required. The ice charts are made available as data coverages in GIS formats and/ or as simple electronic charts in such graphic formats as GIF or PNG, which can be viewed with almost any web browser or graphics viewer. Charts are typically labelled and coloured using the WMO international sea-ice symbology (WMO-No. 259) and *Ice Chart Colour Code Standard* (WMO-TD-No. 1214). Other ice analysis products include annotated satellite imagery, usually in JPEG and TIFF formats, text messages and electronic charts.

4. ICE INFORMATION SERVICES

Once the observational material from all sources has been combined into an ice chart which represents existing conditions the ice centre then has the task of relaying the chart to users while it is still timely. The ice data can also be combined with meteorological and oceanographic parameters in a prediction model to provide further guidance to vessels in or near the ice.

Relay of charts of existing ice conditions is mostly conducted by radio facsimile or in recent times via a digital network link. Time slots and schedules usually dictate the scale and number of charts provided by the broadcast station in the area of concern. Direct broadcast by the ice centre is obviously ideal but not always feasible.

Forecasts of ice conditions are difficult to prepare for, besides the drift caused by the wind, the floes are also affected both by residual and tidal currents. The results are complicated, and knowledge of the detail of oceanographic factors is not often available. In some cases the wind drift alone is specified and it is left to individual ships' captains to interpret this in relation to their own position. Recent advances in computer models for ice prediction are allowing more detailed data to be provided (as in the case of the gulfs of Bothnia and Finland – for example) but these require further facsimile or digital network transmission time, which may not be available.

Usually, ice forecasts are prepared once a day for a period of 24 to 144 hours because they are tied to the frequency of the data input. These are tactical forecasts, for scheduled radio broadcast to ships which may provide advice on difficult ice conditions forming or dissipating, the general motion of the pack, opening and closing of leads, etc. They are strongly influenced by meteorological prediction and should always be used in concert with the weather forecast.

Other longer-range predictions – those covering periods from 7–10 days to 30 days and seasonal predictions – are usually based on climatological and analogue methods. They are more commonly distributed by ground or electronic mail to shipping companies and agents rather than to individual ships.

After the ice data have been processed operationally and used in relation to the existing marine traffic, they can then be passed to a climatological unit of the ice service which compiles and analyses them in relation to averages, and which prepares atlases to be consulted by planners, marine architects and others who deal with longer-term aspects of the ice conditions and their effect on human activities.

5. INTERNATIONAL COOPERATION

In some areas of the world a regional approach to ice services is far more economical and efficient than one based solely on national facilities. For example, in North America, a joint service involving the USA and Canada has been adopted as the best method of supporting winter shipping in the Great Lakes. Starting in December 2004, the Canadian Ice Service and the US National Ice Center started jointly producing ice charts, ice hazard bulletins, 30-day forecasts and seasonal outlooks for the Great Lakes under the banner of the North American Ice Service (NAIS). The workload and the data sources for these products are shared between the stated two services. In the coming years, this practice will be extended to encompass all of the ice-covered waters of North America. The similar Baltic Sea Ice Services (BSIS) is under steady development and includes informational exchange between Denmark, Estonia, Germany, Finland, Latvia, Lithuania, the Netherlands, Norway, Poland, the Russian Federation and Sweden. A common numerical ice-reporting code (the Baltic Sea Ice Code), sea-ice charts (international sea-ice symbols), integrated data broadcasts in clear English and similar shipping control regulations are used. In Finland and Sweden icebreaker assistance is integrated in the Gulf of Bothnia. In special situations, such as when the Baltic Sea is totally ice covered, all icebreaker assistance in the Baltic Sea is integrated, with the common aim of supporting marine traffic. This is done under the development of BIM (Baltic Icebreaking Management), which is the cooperation body of the Baltic Sea icebreaking organizations. The Global Monitoring for Environment and Security (GMES), ICEMON and Northern View projects (http://earth.esa.int/gmes/) include partners from federal services as well as from research and industrial communities and are aimed at the implementation of a coherent operational oceanography system for the high latitudes, consisting of sea ice, meteorological and oceanographic services.

On a larger scale the WMO/IOC JCOMM Expert Team on Sea Ice (ETSI) has been instrumental in developing an internationally accepted terminology, formats to exchange operational and archived data on sea ice and other guidance material. To this effect the ETSI also collaborates with other international sea-ice groups – the International Ice Charting Working Group (IICWG) and the Baltic Sea Ice Meeting (BSIM). The international sea-ice terminology including an illustrated glossary and a set of chart symbols was developed and first published in 1971 in English, French, Russian and Spanish (***WMO Sea-Ice Nomenclature***, WMO-No. 259) with later additions and corrections introduced in 2004.

From November 2004 an electronic version of the nomenclature (predefined English, French, Russian and Spanish versions in alphabetic/subject order, equivalents, search/selection option), is available at (http://www.aari.nw.ru/gdsidb/XML/wmo_259.php). A set of formats was designed for the archive mode sea-ice information exchange (SIGRID, WMO 1989, SIGRID-2, WMO 1994).

In cooperation with IICWG, two JCOMM Technical Report Series documents – SIGRID-3: ***A Vector Archive Format for Sea-Ice Charts*** (WMO/TD-No. 1214) and ***Ice Chart Colour Code Standard*** (WMO/TD-No. 1214) were prepared and issued in 2004. Both documents are available as hard copy by request from the WMO Secretariat or in electronic form from the JCOMM publication web page http://www.wmo.int/pages/prog/amp/mmop/publications.html).

The ETSI in March 2007 adopted the "Ice Objects Catalogue Version 4.0" as the sea ice extension of the IHO S-57 format for the ENCs and agreed on a formal mechanism for its maintenance and development with JCOMM ETSI recognized as the competent international technical group on sea ice and icebergs by the WMO, IOC and IHO Committee on Hydrographic Requirements and Information Systems (CHRIS), the WMO Secretariat as Register Owner and Manager, Register Users as anyone interested in sea ice or iceberg MIOs, the Control Body as the ETSI ENC Ice Objects Task Group (TG ENCIO), the Submitting Organization as WMO and proposers as ETSI Members from Canada, Germany, Russian Federation and USA. In May 2008 the TG ENCIO finalized inclusion of the "Ice Objects Catalogue Version 4.0" into the IHO Register, so that presently the S-57 sea ice extensions are freely available within the Open Geospatial Consortium (OGS) Geospatial Data Abstraction Library (GDAL).

Until the 1980s, most ice services were directed towards shipping and offshore exploration. As a result, the needs were very specific but national or regional in nearly every case. With more interest and study being directed towards the world's climate in recent years, there is a growing need for international data exchange for use by meteorological and oceanographic researchers. This required the creation of data banks at a coarser scale than in operational services. Within the WMO project, Global Digital Sea Ice Data Bank (GDSIDB), which started in 1989, historical sea-ice information for the major part of the 20th century was archived in electronic form due to collaborative efforts of several ice services, institutions and data centres (from Argentina, China, Canada, Denmark, Finland, Japan, the Russian Federation, Sweden and the USA). Presently, the GDSIDB has two archiving centres, located at the Arctic and Antarctic Research Institute, St Petersburg, Russian Federation (http://www.aari.nw.ru/gdsidb) and the National Snow and Ice Data Center, Boulder, USA (http://nsidc.org/noaa/gdsidb) and holds 7- or 10-day-period mapped ice data for the Arctic starting from March 1950 and for the Antarctic from January 1973 and to near the present for both regions. From 1970s GDSIDB ice charts may serve as a ground-truth to SSM/I products or be the unique source of data on ice conditions and climate for before 1978. During 2002–2003 the first blending technique for Northern Hemisphere GDSIDB charts was developed and the resulting blended data set presently contains the greatest amount of ice data for 1950–1998. The product is scheduled to be extended as new data become available.

IICWG jointly with ETSI contributed to the development of the Ice Logistics Portal (http://ipy-ice-portal.com/) as a joint initiative with the European Space Agency through the EarthWatch GMES Service Element PolarView in support of the IPY 2007/2008. This Portal provides a single interactive website to operational sea ice information from National Ice Services for regions in the northern and southern hemispheres. The Portal has been active since May 2007 and utilizes a provider-flexible operative scheme resembling another WMO End-to-End Data Management project (E2EDM). It contributes to the Global Cryosphere Watch (GCW) and the MyOcean project, funded by the European Commission. In 2009-2010 the Ice Logistics Portal has been transferred from PolarView to the German Ice Service, Bundesamt fuer Seeschifffahrt und Hydrographie (BSH), http://www.bsis-ice.de/IcePortal, with two versions running in parallel mode at the current time.

PART II - REGIONAL AND NATIONAL PRACTICES

Northern Hemisphere

North and North-east Asia and North Europe

CHINA

1. Organization

The national ice service is provided by the National Marine Environment Forecast Centre (NMEFC), State Ocean Administration (SOA). Major users of the services are the China Offshore Oil Bohai Corporation (COOBC) and coastal and harbour activities. In the period from December to March, ice observation and forecasting services are provided for the Bohai Sea and the northern Yellow Sea. The ice services for local operations and specific tasks are provided by the Group of Sea Ice Management (GSIM) of the COOBC. An ice forecasting service is also provided by the Qingdao Marine Forecasting Observatory (QMFO) of SOA.

2. Data acquisition

Sea-ice type, thickness, concentration and temperature are operationally measured according to "The Specification for Offshore Observations" (GB/T 14914-94, SOA) at 11 coastal stations along the Bohai Sea and the northern Yellow Sea. Icebreakers are used by the Navy and COOBC for operational observations of sea-ice edge, thickness and type according to "The Specification for Oceanographic Survey" (GB/T 12763-91, SOA) and for special surveys. Ice condition reports are also provided by SOA patrol ships. The ice temperature, thickness and type are obtained from aerial remote sensing and the aerial survey of sea ice is provided as one of the operational observations during January to February.

The North Sea Branch (Qingdao) of SOA manages the operation of a dedicated aircraft equipped for ice reconnaissance missions in the Liaodong Gulf, Bohai Gulf, Laizhou Bay and in the shore of northern Yellow Sea. The helicopter reconnaissance flight is managed by the COOBC for special missions. Radar imagery from Bayuquan station of SOA and real-time ice data at the platform JZ-20-2 (40°27'N, 121°17'E) in the Liaodong Gulf are provided daily. The visible and infrared satellite imagery from NOAA (AVHRR) and the MODIS imagery from both satellites of the EOS series (TERRA and AQUA) are received by the NMEFC. The MODIS imagery has been applied in sea-ice operational monitoring and numerical seaice forecasting for the Bohai Sea since the winter of 2002; the precision of sea-ice monitoring has been improved with its high resolution.

3. Output products

(a) Chart output

A remote sensing image, showing sea-ice conditions in the Bohai Sea, is transmitted daily by e-mail or facsimile to each user (Figure II-1, Annex II). An analyzed chart of ice thickness, area and edge at the same scale is prepared daily and transmitted by the NMEFC (Figure II-2, Annex II). The fifth-day sea-ice thickness and concentration forecast charts (Figure II-3 and Figure II-4, Annex II), with the PIC ice model, and the forecast of ice drift (arrow) and thickness (isoline) by the operational ice mode (Figure II-5, Annex II), covering the Bohai Sea, are prepared daily by the NMEFC and transmitted by e-mail or facsimile to COOBC, shipping companies and other users.

(b) Coded output

Forecasted fields of ice concentration, thickness and velocity at grid points in tenths of degrees of latitude and longitude, at 12-hour intervals up to 120-hour and analyzed fields are transmitted daily by computer network.

(c) Plain language

(i) Plain-language ice information with images and a 10-day outlook of ice conditions in the Bohai Sea and the northern Yellow Sea are prepared by the NMEFC and are disseminated by closed-circuit television and radio every 10 days during winter.

(ii) A long-range outlook for the next winter is prepared and mailed. It is also transmitted by facsimile in October from the NMEFC.

(iii) A 10-day forecast and an outlook up to one month are mailed and transmitted by facsimile for each 10-day and month period from the NMEFC and QMFO respectively.

(iv) A Sea-Ice Management Brief Report including sea-ice conditions, forecasts of ice and weather for the next week, information about sea-ice monitoring and forecasting, as well as suggestion to coastal and offshore operations is prepared by GSIM, and mailed and transmitted by facsimile weekly.

4. Forecasts

Numerical sea-ice forecasts for up to five days ahead for the Bohai Sea are prepared daily by the NMEFC using a PIC ice model with fine resolution and a thermodynamic- dynamic operational ice model at the same time. The forecast products contain fields of ice thickness, concentration and velocity, ice edge, parameters of ice ridge and local estimates of ice thickness and tracks of ice floes near drilling platforms.

The 10-day and the 30-day forecasts are prepared using statistical methods to determine ice edge, and mean and maximum of ice thickness in the Liaodong Gulf, Bohai Gulf, Laizhou Bay and northern Yellow Sea by the NMEFC and QMFO/SOA.

The long-range seasonal outlook is prepared using statistical methods to estimate the ice conditions of the Bohai Sea and the northern Yellow Sea the following winter.

5. Publications

The *China Ocean Annuals, China Marine Environment Annual Report* and *China Marine Disaster Bulletin* (all in Chinese) are annually prepared by SOA. These publications include sea-ice conditions, disasters and activities about sea ice for the year.

6. Mailing and Internet addresses

Mailing addresses

National Marine Environment Forecast Centre (NMEFC)
8 Dahuisi Rd
Haidian District
Beijing, 100081 China
Telephone: +86 010 62105750 Telefax: +86 010 62173620
E-mail: baishan@nmefc.gov.cn (Dr Shan Bai)

Qingdao Marine Forecasting Observatory of SOA
22 Fushun Road
Qingdao, 266033 China
Telephone: +86 0532 5611238 Telefax: +86 0532 5644944
E-mail: gmingke@public.qd.sd.cn (Dr Mingke Guo)

Group of Sea Ice Management
c/o General Dispatch Office
China Offshore Oil Bohai Corporation
P.O. Box 501 Tanggu
Tianjin, 300452 China
Telephone: +86 022 25800730 Telefax: +86 022 25807504
E-mail: wangwei3@cnooc.com.cn (Dr Wei Wang)
Internet addresses: NMEFC: http://www.nmefc.gov.cn

JAPAN

1. Organization

Sea-ice information services in Japan are provided by two governmental agencies: the Japan Meteorological Agency (JMA) and the Japan Coast Guard (JCG), mainly for fishing, shipping and coastal and harbour activities.

2. Data acquisition

Sea ice in the Sea of Okhotsk is formed in November and melts away and disappears in July. Sea ice is at its maximum extent from late February to early March.

Five weather stations of the JMA and seven coast guard stations of the JCG conduct daily visual observations of the amount and the condition of the sea ice. Patrol vessels of the JCG routinely report the sea-ice conditions, including types of sea ice, concentration, ice thickness and difficulties of navigation. The JMA and JCG exchange their sea-ice data by telefax and disseminate derived products to users.

Aerial observations are carried out around 10 times per year by the JMA in cooperation with the Japan Defense Agency (JDA) and about 10 times per year by JCG aerial observations. Both aerial observation data are used for sea-ice analysis at the JMA and JCG.

The JMA conducts satellite data analysis for sea-ice extent in the Sea of Okhotsk every day in winter using visible and infrared images of the MTSAT, NOAA-17 and NOAA-18 and microwave data of the Special Sensor Microwave/Imager (SSM/I) from the United States Defense Meteorological Satellite Program (DMSP) and the Advanced Microwave Scanning Radiometer (AMSR-E) from Aqua. Since March 2003, synthetic aperture radar (SAR) data from RADARSAT have also been used.

3. Output products

(*a*) Sea-ice condition charts (Figure VII-1, Annex VII) issued by the JMA are broadcast by meteorological radio facsimile on short wave (call sign: JMH) twice a week (on Tuesday and Friday) from December to May. The charts cover the Sea of Okhotsk, the northern part of the Sea of Japan including Peter the Great Bay, the northern part of the Yellow Sea, the Bo Hai, and the vicinity of Hokkaido, the Kuril Islands and the Kamchatka Peninsula. The charts show sea-ice edges, four classes of sea-ice concentration with a description of sea-ice conditions and one-week forecasts in both Japanese and English.

(*b*) Numerical sea-ice forecast charts, which show the distribution and concentration of sea ice for two and seven days ahead (Figure VII-2, Annex VII), are also broadcast by the JMH twice a week (on Wednesday and Saturday) when the southern edge of sea-ice extent in the Sea of Okhotsk is located south of 48°N. The forecast charts are objectively derived by a numerical sea-ice model, in which the physical processes of sea-ice formation/melting and drift of sea ice due to wind and ocean currents are considered.

(*c*) The Ice Information Center of the First Regional Coast Guard Headquarters of the JCG also disseminates the daily sea-ice charts around Hokkaido via the Internet (http://www1.kaiho.mlit.go.jp/KAN1/ice_center/ice_center-e.html) in Japanese, English and Russian.

4. Publications

(*a*) *The Results of Sea-Ice Observations*: an annual publication of the JMA, which contains the results of the daily visual observations by five weather stations of the JMA, the annual summary of sea-ice conditions with five-day sea-ice charts in the Sea of Okhotsk and five-day sea-ice charts in the polar regions; published on CD-ROM every October.

(*b*) *Kaiyou Gaihou – Kaihyou hen*: an annual publication of the First Regional Coast Guard Headquarters of the JCG, which contains the annual summary of observations by seven coast guard stations, patrol vessels and aircraft; published in printed matter (in Japanese).

5. Mailing and Internet addresses

Mailing address

Office of Marine Prediction

Global Environment and Marine Department
Japan Meteorological Agency (JMA)
1-3-4 Otemachi, Chiyoda-ku
Tokyo, 100-8122 Japan
Telephone: +81-3-3212-8341(ext. 5156) Telefax: +81-3-3211-3047
E-mail: seaice@climar.kishou.go.jp

Japan Coast Guard (JCG)
5-3 Minato-machi, Otaru-shi
Hokkaido, 047-8560 Japan
Telephone: +81-134-27-0118 Telefax: +81-134-27-6190
Telefax: +81 134-32-9301 (polling mode, Otaru)
Telefax: +81 1582-4-5689 (polling mode, Monbetsu)
E-mail: sodan1@jodc.go.jp

Internet addresses

JMA:

http://www.data.kishou.go.jp/db/seaice/information.html (in Japanese)

http://www.jma.go.jp/en/seawarn/1010.html (marine warnings for the Sea of Okhotsk)

JCG, Ice Information Center:

http://www1.kaiho.mlit.go.jp/KAN1/ice_center/ice_center-e.html (Japanese, English and Russian)

RUSSIAN FEDERATION

23 March 2009 Revision

1. Organization

Sea-ice information services in the Russian Federation are provided by the Centre for Ice Hydrometeorological Information at the Arctic and Antarctic Research Institute in St Petersburg (AARI), the Hydrometeorological Centre and the Scientific Research Center of Space Hydrometeorology "Planeta" in Moscow (Hydrometcentre) and local hydrometeorological offices in the Arctic, Far-Eastern Russia, Baltic, Black and Caspian seas; all belonging to the Russian Federal Hydrometeorological Service (Roshydromet).

AARI provides centralized services mainly for shipping and coastal and harbour activities within the Northen Sea Route, for the Central Arctic Basin and Arctic seas – Greenland, Kara, Laptevs, Eastern-Siberian, Chukha as well as for the seas with the seasonal ice cover – Baltic, White, Bering, Okhotsk, Caspian and also Antarctic seas.

2. Data acquisition

Coastal weather polar stations of Roshydromet make daily visual and instrumental ice observations on seaice concentration and stages of ice development, ice thickness, forms of ice, ice drift and other phenomena. Icebreakers routinely report the same mentioned main ice parameters plus parameters describing ice navigation.

Before 1994 aircraft ice reconnaissance flights were conducted in the Arctic usually on a monthly basis from November to April and on a 10-day internal during the summer navigation period. Since 1995 aircraft ice reconnaissance flights have been conducted only occasionally during tailored hydrometeorological support of applied and scientific activities. The scope of ice information collected during air-ice reconnaissance includes visual observations both on main ice parameters (mentioned above excluding thickness and ice drift) as well as discontinuities in sea-ice cover (leads, cracks, etc.) and various surface parameters (hummocks, ridges, snow, contamination, stages of melting, etc.). Collected data are fixed onboard by ice observers in log-books and in mapped form and further are used for sea-ice analysis onboard expeditionary vessels, at AARI and local meteorological offices.

The AARI satellite reception station provides visible and infrared satellite images for major part of the Arctic both from USA (NOAA HRPT, EOS TERRA) and Russian (METEOR, OKEAN) satellites. Information for other regions (e.g. Antarctic) or from other satellites (Envisat, Radarsat etc.) is provided to AARI via Internet from other Roshydromet reception stations (Moscow, Khabarovsk etc) or from commercial satellite data providers. All data are further processed within an ice information system, including ArcMap software and utilized for regional and pan-Arctic sea-ice analysis by AARI. Sample satellite products are available via the AARI and Planeta web pages.

AARI, Hydrometcentre, Planeta and the local meteorological offices of the Roshydromet exchange described seaice data by facsimile, telex, Inmarsat, Global Star, Iridium and the Internet and disseminate derived products to users. In cases where the AARI operational centre lacks initial data to compile an ice map for a specific area, the necessary information is requested and if available, is obtained within several hours via communicational relays.

For the Baltic Sea region observers of the Northwestern Department of the Hydrometeorological Service (NW Hydromet) at the coastal hydrometeorological stations are providing visual and instrumental daily observations on ice conditions by phone or telegraph.. From 1960s till 1991 daily aircraft ice reconnaissance flights for the Gulf of Finland and the Gulf of Riga were carried out. From 1992 NOAA satellite imagery from up to 15 passes a day is used in operative work. An additional source of the satellite information is TERRA/EQUA imagery received via the Internet. Data from stations and satellite images are by the Baltic Ice Group of the NW Hydromet, and on basis of these data a daily set of information is produced including: SEA telegram, icebreakers report and ice chart. The Baltic Group maintains a vast archive of daily ice chards (since 1927) and the stages of ice development (since 1920).

3. Output products

(a) Chart output

(i) General sea-ice conditions charts of the Arctic Ocean are prepared by AARI on weekly scale (every Wednesday) and available via the AARI web page for public use. Charts depict drifting and fast ice boundaries and five classes of sea-ice concentration in the summer period or stages

of development in the winter period and are available in graphic GIF format and in digital WMO SIGRID-3 format. A sample sea-ice conditions chart for the Arctic is presented in Figure X-1, Annex X.

(ii) Detailed sea-ice conditions charts are prepared by AARI twice a month (every 10-15 and 25-31 days of month) for the 3 Antarctic sectors (Atlantic-Weddell Sea, Indian - Cosmonavtov-Sodruzhestva Seas and Pacific -Ross Sea) to provide tailored support for national activities and general ice monitoring in the region. Sample charts are given in Figure X-2, Annex X.

(iii) Detailed regional sea-ice conditions charts and annotated imagery for the seas Greenland, Barents, Kara, Laptev, East-Siberian, Chukchi, Bering, Okhotsk and Baltic are prepared by AARI on weekly (every Wednesday) or shorter scales and on request and are disseminated via various telecommunication means to captains, shipping companies, local authorities, news media and other users requesting tailored support. Informational products are relayed to the users accordingly in graphic georeferenced GIF / JPEG formats, in WMO SIGRID-3, ARC/INFO e00 and S-57 formats. Detailed regional sea-ice charts in national coding are available via the AARI web site in GIF and SIGRID-3 formats. Sample detailed ice charts and annotated imagery for the Kara, Okhotsk and Caspian Seas are presented in Annex X, figures X-3, X-4 and X-5.

(b) Plain language information

(i) Coastal and open sea sea-ice and weather GMDSS and other plain language reports are prepared routinely on weekly, daily or shorter scales and on request by AARI and the local meteorological offices of Rosgydromet for METAREAs XX, XXI and XIII and are disseminated via various telecommunication means to the customers.

(ii) Synoptic bulletin on weather conditions in the Eurasian Arctic is prepared routinely on daily scale by AARI and is disseminated via various telecommunication means to the customers and published on AARI web-site.

(*c*) *Gulf of Finland sea-ice products*

Regular daily and longer term analysis and prognostic products for the Gulf of Finland are provided by the NW Hydromet Baltic Ice Group and include:

(i) Daily report for coastal points "SEA" / MORE" in KN-2 code.
(ii) Daily ice report for fairway containing review of Gulf of Finland ice conditions, the Baltic sea ice code telegram, information about icebreakers, navigation restrictions, point of convoy formation for the ships steering. Ice report for fairway is produced in English and Russian by 8:00 GMT.
(iii) Daily detailed ice chart produced by 10:00 GMT in international black-and-white and color coding (see Figure X-7, Annex X).
(iv) Ice bulletin produced twice a weak (Monday and Thursday). The bulletin consist s of ice chart, detailed review of ice condition of the Gulf of Finland and short ice review of Baltic sea, short-term forecast (next 3-4 days) of ice condition's development for the Gulf of Finland.
(v) Forecast of the ice condition along the fairway to the next month in English and Russian. It is made on last day of month for the 10-th, 20-th and 30(31)-th day of the next month. That forecast contains the probable ice thickness, concentration, hummocking, rafting for each part of fairway, probable position of fast ice boundary and ice edge location.
(vi) Long-term forecasts of the ice appearance, total freezing, fracturing of fast ice, total disappearance of ice at the points of Gulf of Finland in advance of 20- 45 days.
(vii) Preliminary forecast of maximum ice conditions for the Gulf of Finland for the coming ice season on July 31st with amendment on November 30th.

4. Forecasts and forecasts methods

(i) Daily diagnosis and forecast charts of mean daily and instantaneous ice drift, surface currents and level elevation in the Arctic Ocean for period 0d…+6d on the basis of dynamic AARI sea-ice model;

(ii) Weekly or shorter period diagnosis and forecast charts of the evolution of ice cover in Barents and Kara Seas including sea ice total concentration, thickness (stages of ice development), hummocks concentration and level of compacting for period 0d…+6d on the basis of the dynamic thermo-dynamic AARI model;

(iii) Daily diagnosis and forecast charts for winds, wave significant height and direction and ice accretion for open water areas in the Western and Eastern Eurasian Arctic Seas for period 00…+72h with 6-h interval on the basis of the AARI wave model;

(iv) Numerical forecast for water level at selected coastal points of Eurasian Arctic for period 0d…+6d;

(v) Seasonal forecasts of ice conditions in the Eurasian Arctic seas and big Siberian rivers estuaries based on AARI empirical-statistical techniques (textual bulletins);

(vi) Weekly-monthly forecasts of ice phenomena in the big Siberian rivers estuaries based on AARI empirical-statistical techniques (textual bulletins).

Sample numerical forecast charts are presented in figure X-6, Annex X.

5. Publications

The following publications are issued by AARI at different periods:

(a) The quarterly and yearly bulletin *Review of the hydrometeorological processes in the Arctic Ocean* (in Russian);

(b) The quarterly bulletin *State of the Antarctic Environment* (in Russian and English);

(*c*) Bulletin "Long-term forecast of the ice conditions in the Arctic seas": 3 bulletins are published per year in the end March, June and August (in Russian);

(d) *Trudi AANII* (AARI Transactions): irregular two to three volumes are published per year (in Russian);

(*e*) *Problemi Arktiki i Antarktiki* (Problems of the Arctic and Antarctic): two volumes are published per year (in Russian);

(f) Irregular express information, informational bulletins of the Russian Antarctic expedition, monographs etc.

6. Mailing and Internet addresses

Mailing addresses

Arctic and Antarctic Research Institute (AARI)
Bering Str., 38
199397, St Petersburg Russian Federation
Telephone: +7 (812) 352-1520 Telefax: +7 (812) 352-2688
E-mail: service@aari.nw.ru, aaricoop@aari.nw.ru

Hydrometeorological Research Centre of the Russian Federation (Hydrometcentre)
B. Predtechensky per., 11–13
123242, Moscow Russian Federation
Telephone: + 7 (095) 252-3448 Telefax: +7 (095) 255-1582
E-mail: vilfand@rhmc.mecom.ru

State Research Center "Planeta"
Bolshoy Predtechensky st. 7
123242, Moscow, Russian Federation
Telephone: +7 (499) 252-3717 (secretary) Telefax: +7 (499) 252-6610
E-mail: asmus@planet.iitp.ru

St Petersburg Center for Hydrometeorology and Environmental Monitoring. (NW Hydromet)
Hydrometeorological Center of St.-Petersburg
Baltic Russian Ice Service
199106, Vasilevsky Ostrov, 23 liniya, 2-a
St.-Petersburg, Russian Federation
Tel/Fax: +7(812)321-3018
E-mail: sea@meteo.nw.ru

Primorsky Directorate of Hydrometeorological Service (Primpogoda)
Mordovtseva Str., 3
690950, Vladivostok Russian Federation
Telephone: +7 (4232) 204974 Telefax: +7 (4232) 221750
E-mail: pkmeteo@primpogoda.ru

Far Eastern Regional Hydrometeorological Research Institute (FERHRI)
Fontannaya Str., 24
690600, Vladivostok Russian Federation
Telephone: +7 (4232) 26-97-88 Telefax: +7 (4232) 22-77-54
E-mail: hydromet@online.ru

Internet addresses

AARI:

http://www.aari.ru (main page)
http://www.aari.ru/projects/ecimo/modul.php?mod=d0015&in=1 (weekly ice charts)
http://www.aari.ru/projects/ecimo/ModuleLoad.php?mod=d0004&in=1 (weekly detailed ice charts)
http://www.aari.ru/projects/ecimo/index.php?im=101 (prognostic products)
http://www.aari.ru/projects/ecimo/ModuleLoad.php?mod=d0011&in=1 (synoptic bulletin)

Planeta:

http://planet.iitp.ru/english/products_eng.htm (Satellite data products)
http://planet.iitp.ru/Oper_pr/Oper_pr.html (Operational products)
See also direct links:
http://planeta.infospace.ru/prod-cgi/last.pl?product=67 (Ice charts – Black and Azov Seas)
http://planeta.infospace.ru/prod-cgi/last.pl?product=107 (Antarctic mosaic)

Hydrometcentre of Russia: http://hmc.hydromet.ru/
NW Hydromet: http://www.meteo.nw.ru
Primpogoda: http://www.primpogoda.ru
FERHRI: http://www.hydromet.com

North-East Atlantic and Baltic Sea areas

DENMARK

20 January 2009 Revision

Two governmental institutions in Denmark issue sea ice information:

(a) The Admiral Danish Fleet is responsible for the Danish Ice Breaking Service and ice information for the Danish Waters.

(b) The Danish Meteorological Institute is responsible for sea ice monitoring and information for the Greenland Waters.

DANISH ICE SERVICE

1. Organization

The Danish Ice Service consists of two parts; the ice reporting and the icebreaking services respectively. The Danish Ice Service is assisting navigation in Danish waters and harbours. The Danish Ice Service has four icebreakers and some icebreaking tugs at its disposal for icebreaking purpose. The Icebreaking Service collaborates closely with the German, Swedish and Finnish icebreaking services and all ships entering the area are subject to the same regulations concerning icebreaker assistance in all the countries. The Danish Ice reporting Service is distributing ice information daily (in English and Danish) by coastal radio station Lyngby. The information contains a short review of the ice and navigational conditions in Danish domestic waters.

2. Data acquisition

Visual surface observations are reported daily from approximately 140 ice observers, who report the ice conditions for about 260 different sections in Danish domestic waters. Visual surface observations are typically received from harbour authorities, some ferries and all the ships of the Danish Navy including the Danish icebreakers. Satellite images or dedicated flight reconnaissance are not being utilized. Observers are reporting daily information concerning ice concentration, thickness, type and navigational conditions to Admiral Danish Fleet HQ.

3. Output products

(a) *Ice charts*

Compiled ice charts (Annex III) are mailed as a weekly (or daily) annex to the Danish ice bulletin.

(b) *Coded information*

Coded sea ice information from 48 areas in Danish waters is issued once a day in the Baltic Ice Code and is distributed by coastal radio station Lyngby by radiotelephony and radiotelegraphy. Coded sea ice information is also issued to Estonia, Finland, Germany, Latvia, Lithuania, Netherlands, Norway, Poland, Russia and Sweden daily by TELEX or TELEFAX. The specific waterways are identified by an alphanumeric code, nine districts of six areas each. The ice information is also mailed to various agencies and ship owners.

(c) *Plain language information*

Sea ice reports – a description of the ice conditions at sea, operational areas for icebreakers - issued in Danish and English once a day are transmitted nation-wide through Denmark Radio and via coastal radio station Lyngby. The sea ice reports are also transmitted via TELEX or TELEFAX to the Baltic Sea countries once a day.

4. Forecasts

Forecasts are only given in qualitative form indicating, for example, that ice is likely to compact, grow or melt rapidly, drifting into the area or out of the area, etc. during the next 24 hours.

5. Statistics

No weekly or monthly summaries are issued. An annual publication indicating the number of frost days, freezing degree-days, etc. from selected stations and number of days with various ice types present at each reporting site is made. Further, the annual report may contain several statistics comparing various years.

6. Mailing address

Søværnets Operative Kommando
Istjenesten
Postboks 483
DK-8100 Århus C
DENMARK

Telephone:
+45 89 43 30 99,
+45 89 43 32 53 (Ice-Breaking Service and Ice-reporting Service)
Fax: +45 89 43 32 30
telephone answering unit: + 45 89 43 32 44.
Telex: 64527 SHIPPOS DK
Internet: http://www.sok.dk

THE DANISH METEOROLOGICAL INSTITUTE

1. Organization

The Ice Service at the Danish Meteorological Institute is responsible for sea ice monitoring and information for the Greenland Waters. The purpose of the sea ice mapping is to aid navigation and to provide strategic and tactical support in the Greenland waters. The main areas of concern are the waters around Cape Farewell. Furthermore, parts of East and West Greenland are mapped in selected periods, depending on navigational needs and the actual ice distribution.

DMI operates a two branch ice service. At Narsarsuaq Airfield in South Greenland, the DMI Ice Observation and Warning Service, 'Ice Patrol Narsarsuaq' positioned at 61°10' N, 45°25' W was established in 1959. A specially equipped AS 350 B2 Ecureuil helicopter is permanently chartered for the ice piloting and serves the ice reconnaissance of the South Greenland inshore routes and the inner parts of the Julianehåb Bay. Four ice observers are based at Ice Patrol Narsarsuaq and all are ships officers associated with the shipping company Royal Arctic Line and thus have several years of experience in navigating in Greenland waters. A twenty-four-hour watch duty is maintained to ensure that calls are answered and ice piloting can be provided at short notice. A fifth officer is stationed at DMI Ice Service in Copenhagen for periods of 2 years to ensure an optimal collaboration between DMI Ice Service and the Ship Officers.

The second branch is located at the Danish Meteorological Institute in Copenhagen, Denmark, employing 10 people with backgrounds in navigation, geophysics, oceanography, and geography. The launch of RADARSAT 1 with its ScanSar Wide capabilities marked the beginning of a new era and satellite data are now the main data source for the production of ice charts for all Greenland Waters. Mapping based on satellite data takes place at DMI in close co-operation with the office in Narsarsuaq. Currently RADARSAT-2, ENVISAT ASAR WIDE, NOAA-AVHRR, TERRA/AQUA MODIS and to some extent DMSP-SSM/I and AMSR-E are important data sources are used routinely in the Ice Service. Satellite data are always analyzed by experienced and specially trained ice analysts.

No ice breaking service is provided except for a few local arrangements. Ship piloting in ice covered waters is coordinated by Ice Patrol Narsarsuaq. Ships and shipping companies can order existing routine ice charting information free of charge, while special services (e.g. piloting or information requiring separate flights or additional acquisition of radar images) in principle are delivered against a marginal fee, unless there is an immediate safety risk. Special services for the offshore industry, among these are tactical and strategic support for seismic profiling, are always covered by fees.

2. Data acquisition

Visual observations from helicopter and visual/radar observations from aircraft. NOAA-AVHRR-, RADARSAT- and DMSP-SSM/I-imagery are resampled, geocoded and displayed by special dedicated

computers and software for sea ice mapping. The Ice Service at DMI has developed a state of the art ESRI ArcGIS-extension used in sea ice mapping named SIKU after the Greenlandic word for sea ice. Actual meteorological information (observations, model output) and observations by ships are utilized when analyzing the satellite data.

3. Output products

Ice charts for the Cape Farewell area are updated and issued 3-4 times a week when sea ice occurs. Outside the melt season ice charts are published once a week

Ice charts for other areas in Greenland, primarily based on RADARSAT and ENVISAT, are produced 1-6 times weekly depending on the actual ice situation and navigational requirements.

Ice conditions near or in shore ship routes in South Greenland are mapped 1-3 times weekly.

A weekly summary chart for all Greenland waters is published once a week. Ice charts follow international standards (Egg code) and are published by use of telefax, INMARSAT, and Internet. Further, ice information is broadcasted by radio, radiolinks, telex, telephone and mail.

Samples of output products are given in Annex III.

4. Forecasts

No forecasts are given.

5. Publications

No weekly or monthly summaries are prepared.

6. Mailing and Internet addresses

Danmarks Meteorologiske Institut
Centre for Ocean and Ice
Lyngbyvej 100
DK-2100 Copenhagen
Denmark
Internet: http://www.dmi.dk (DMI main page), http://ocean.dmi.dk (test site)
Email: iskort@dmi.dk

Ice Patrol Narsarsuaq
3923 Narsarsuaq
GREENLAND
Email: isc@greennet.gl

ESTONIA

1. Organization

The Estonian Meteorological and Hydrological Institute (EMHI) is responsible for the sea-ice information service in Estonia. The service is, in particular, intended to meet the needs of international and Estonian shipping services. Service is also given to all other activities, where sea-ice information is required: fisheries, coastal and harbour activities, meteorological forecasting and climatology.

The ice service in the Baltic begins at the end of October, when ice starts to form, and lasts until the end of May.

2. Data acquisition

Daily ice information is reported in Baltic Sea Ice Code, from 16 stations, which are situated along the Estonian coast.

In addition to the daily coded information, each station sends some information about the thickness of fast ice with the depth and density of snow cover on it. Most observations are visual.

All meteorological information, such as observations, weather charts, forecasts, are received from the weather service of the EMHI.

Ice information in Baltic Sea Ice Code is received daily via the Global Telecommunications System (GTS) from Finland, Germany, Norway, Poland, Sweden, Latvia, Lithuania and Russia. Ice charts are received by facsimile from Finland and by e-mail from Germany, Sweden, Poland and Russia.

3. Output products

(a) *Ice charts*

The ice bulletin/chart covers the Gulf of Finland, Gulf of Riga, the Irben Strait and the northern part of the Baltic proper. The actual chart contains ice information and sea-surface isotherms of wave height. The symbology used on actual charts is common for all countries around the Baltic Sea and is printed on the chart.

(b) *Coded information*

A complete listing of Estonian areas in Baltic Sea Ice Code is issued daily and sent by the GTS to Riga.

(c) Plain language information

(i) The sea-ice bulletin: a description of the ice situation at sea and restrictions to navigation is issued in Estonian and English and sent daily by fax to Sweden, Latvia, Lithuania and Russia;

(ii) Ice reports, ice charts and ice forecasts are distributed daily by fax or e-mail to users (approximately 20);

(iii) Similar sea-ice bulletins (as in item (i)) are issued in Estonian once a day by Estonian Radio.

A sample ice chart is in given in Annex IV.

4. Forecasts and forecast methods

An ice forecast is published daily in the printed sea-ice bulletin. The forecast describes in general terms the expected ice development such as ice drifting, opening of leads, areas with ice pressure, ice formation or melting.

An ice information forecast includes: date of ice formation, freeze-over, break-up and ice disappearance up to 30 days in advance. The predictions are produced by statistical methods.

5. Publications

Tables of sea-ice observations from shore stations are prepared as internal reports of EMHI, but not published.

6. Mailing address

Estonian Meteorological and Hydrological Institute (EMHI)
(Eesti Meteoroloogia ja Hьdroloogia Instituut)
Toompuiestee 24, 10149 Tallinn
Estonia
Telephone: +372 6660-914
Telefax: +372 6660-911
E-mail: mere@emhi.ee
Internet: http://www.emhi.ee/

FINLAND

8 March 2010 Revision

1. Organization

In January 1, 2009 physical oceanography in Finnish Institute of Marine Research (FIMR) was amalgamated with Finnish Meteorological Institute (FMI), and chemical and biological oceanography with Finnish Environmental Institute (SYKE). With these rearrangements Finnish Ice Service, responsible for the sea-ice information service in Finland, became a part of FMI.

The operational service in Finland started in already 1915. The service is intended to meet the needs of national and international shipping as well as other activities where sea-ice information is required, in particular fisheries, coastal and harbour activities, forecasting and climatology. The ice season in the Baltic normally begins at the end of October, when ice starts to form in the northernmost archipelagos of the Bay of Bothnia and lasts until the end of May or beginning of June. SST charts are published between mid-October and end of ice season.

2. Data acquisition

(a) Sea ice:

Ground truth input data: Finnish and Swedish icebreaker reports several times a day in plain language; daily and/or weekly coastal station rapports from 20-30 stations in plain language; ice charts over observation areas and ice and snow thickness profiles; daily or weekly reports from ships in plain language.

Space-borne: all NOAA AVHRR passes in 1.1 km resolution, all available MODIS data; 200-300 RADARSAT ScanSARWide screens per winter in 100 m resolution, and 200-300 ENVISAT ASAR WideSwath images.

(b) Sea surface temperatures:

Ground truth input data: twice a week measurements from about 10 coastal stations; automatic stations, icebreakers; 20-30 merchant vessels with hull thermometers measuring along track covering the Baltic Sea.

Air-borne input data: annually 10-20 reconnaissance flights by fixed-wind planes with infrared soundings along the track.

Space-borne input data: NOAA AVHRR, and Modis.

3. Output production

(a) Ice charts

Ice charts are issued daily during the ice season and available on Internet: in b/w and color: http://www.itameriportaali.fi/html/icef/jaakartta.pdf; http://www.itameriportaali.fi/html/icef/icemap_c.pdf. On Mondays and Thursdays also SSTs are included with 30-year averages. Charts are telefaxed (hard copies) or e-mailed (soft copies) to the users on daily basis, and on Mondays and Thursdays are also mailed.

Type of chart: (scale, areas, others): Mercator projection, and covering east of 9°00´E the Baltic Sea, Skagerrak and the Swedish Kattegat and Vanern and Malaren lakes. Simplified ice chart over the Baltic Sea is issued once a week and published on Internet (http://www.itameriportaali.fi/en/itamerinyt/en_GB/jaatilanne/).

(b) Plain language information:

The charts include position of icebreakers, Finnish and other Baltic Sea restrictions to navigation, and traffic control information. On Mondays and Thursdays 30-year average ice extent and mean ice thickness and 30-year mean SST.

(c) Bulletins on ice conditions:

Bulletins on ice conditions in the Baltic Sea including national restrictions to navigation, operational areas of icebreakers and traffic information are e-mailed, mailed, broadcasted, telefaxed on request, and it is also available at (http://www.itameriportaali.fi/html/icef/jaatiedotus.doc). Finnish Ice Report in plain language in Finnish, Swedish and English and in the Baltic Sea Ice Code is broadcasted, telefaxed, e-mailed, coastal radio stations on daily basis and mailed on weekdays only. Coded sea-ice information from 93 areas or fairways in the Baltic Sea Ice Code is included on bulletins.

(d) *Other information products*:

Digital satellite images (SAR and AVHRR) to Finnish and Swedish icebreakers. High-resolution (500m) ice thickness charts over the SAR images are available operationally at http://haavi.fimr.fi/polarview/index.php and http://www.baltice.org. Ice forecasts for 45h in 3h steps with seven parameters are provided on daily basis during the Baltic Sea ice season. Services are available to Finnish and Swedish icebreakers and on web at http://haavi.fimr.fi/polarview/index.php and http://www.baltice.com.

An example of daily ice chart is in given as fig. V-1, Annex V.

4. Forecasts and forecasting methods

(a) Forecast methods: ice drift model (Finnish-Chinese), thermodynamic model (Finnish-Chinese), HELMI (dynamic-thermodynamic);

(b) Forecasts are provided for: the Baltic Sea, 45 hours in advance for ice concentration, level ice thickness, total ice thickness, ridged ice density, ridged ice height, ice motion (direction and velocity), and areas of ice compression. Sample charts are given as fig. V-2 and V-3, Annex V. Ice forecasts with six parameters in 3hr time steps are available on daily basis at http://polarview.fimr.fi.

(c) Once a week 10-day ice thickness development forecasts are provided to Finnish Traffic Agency Twice a week 10-day forecasts for weather and ice conditions over the Baltic Sea are provided for companies, icebreakers and ships.

(d) The Finnish Ice Service responds to enquiries from users and provides a range of specialized forecasting, consultation and advisory services on a best-effort, cost-recovered basis.

5. Publication issued

(a) Regularity: in 5-year intervals;

(b) Irregularly.

6. Mailing and Internet addresses

Finnish Meteorological Institute (FMI)
Finnish Ice Service
PO Box 503, (Erik Palmenin aukio 1)
FI-00101 Helsinki
FINLAND

Telephone: +358-9-6857 659 (24h service during ice season), +358-9-1929 3969
Telefax: +358-9-1929 3413, +358-9-6857 638, +358-9-6857 639
E-mail: ice_info@ice.fmi.fi
Internet::
http://www.itameriportaali.fi/html/icef/jaakartta.pdf (b/w chart)
http://www.itameriportaali.fi/html/icef/icemap_c.pdf (colour chart)
http://haavi.fimr.fi/polarview/index.php
http://www.baltice.org
http://bsis.eisdienst.de/index.shtml

GERMANY

15 April 2009 Revision

1. Organization

The ice service provided by the Federal Maritime and Hydrographic Agency (BSH) covers the German Bight and the Baltic Sea west of Bornholm during the winter. The agency is separate from the Meteorological Service but both are part of the Federal Ministry of Transport, Building and Urban Affairs. Radio transmission of ice reports and a daily facsimile broadcast of ice charts are provided for fisheries, national and international shipping in the Baltic Sea and for harbour activities, maritime agencies and off-shore activities. An overall ice report for the whole Baltic Sea and the southeastern North Sea with relevant ice charts is offered to subscribers via mail, telefax, e-mail and the Internet. On request world-wide ice information is provided.

2. Data acquisition

Daily ice information is reported in Baltic Sea Ice Code from 134 areas or fairway sections along the coast of the southwestern Baltic Sea and the German Bight. A selection of these form 54 main areas or fairways grouped in 11 districts. Details are given in WMO No.9, Volume D – Information for Shipping. In addition to the coded information, a great many stations perform ice thickness measurements. The other data sources are observations from regular aerial reconnaissance, icebreakers and merchant ships, reported in plain language, from NOAA and MODIS satellite visual/infrared imagery and from AMSR microwave imagery. Reports, data and charts are also exchanged with foreign ice services via telefax and e-mail and via telex (GTS) transmission of plain language reports and coded data. Internet access to ice information products of foreign services is greatly used.

A joint web page for the Baltic Sea Ice Services (BSIS) has been developed and established as an independent domain at BSH (http://www.bsis-ice.de).

3. Output products

(a) *Ice charts*

(i) A printed ice chart (black/white and colour) of the ice conditions in the Baltic Sea using the international system of sea-ice symbols is mailed, telefaxed and e-mailed twice a week and presented on the Internet. Type of chart: Mercator projection, Baltic Sea north of 56°N and east of 16°E. If sea ice occurs farther south, charts cover the whole Baltic Sea area.

(ii) A printed ice chart (black/white and colour), showing ice conditions in the western Baltic and German Bight using the international system of sea-ice symbols is mailed, telefaxed and e-mailed three times a week when ice is present and shown on the Internet. Type of chart: Mercator projection, Baltic Sea between 52°30'N and 60°N, 7°E and 15°40'E.

(iii) A facsimile broadcast of the data in (ii) is made daily when ice is present; Mercator projection, Baltic Sea between 52°N and 60°N, 7°E and 16°E.

(iv) A daily facsimile broadcast is (re-)transmitting the iceberg charts for the North-West Atlantic provided by IIP (International Ice Patrol) and CIS (Canadian Ice Service), respectively (Figure I-2, Annex I, and Figure XII-I, Annex XII).

(v) A daily facsimile broadcast is done for the Swedish ice chart of the Baltic and the Norwegian ice chart of the European Arctic.

Note: charts (i)–(iii) are constructed with the digital ArcMap program. Larger scale (approximately 1:850,000) sub-regional charts are prepared as needed.

Sample ice charts are given in Annex VI.

(b) *Coded and plain language information*

(i) A bulletin describing ice conditions in the Baltic Sea using plain English and German and the Baltic Sea Ice Code is mailed, telefaxed, e-mailed and presented on the Internet Monday to Friday. An ice outlook for four to six days is included.

(ii) Similar bulletins covering the western Baltic and the German Bights are prepared daily in English and German for telex (GTS) and radio relays as well as for distribution via mail, telefax and e-mail and for presentation on the Internet.

4. Forecasts

Forecasts of the date of formation of new and young ice are provided for the western Baltic using thermodymanic methods. The analogue method is used for the decay of ice. An ice model simulates the formation, melting and drift of sea ice for the German Bight and western Baltic as well as for the other North Sea and Baltic Sea areas. The forecasts for the seas, computed by the operational ice model, cover 48 hours.

5. Publications

A publication on the ice season is presented regularly on the Internet and in special reports of the BSH. Other publications are prepared only at irregular intervals.

6. Mailing and Internet addresses

BSH – Eisdienst
Neptunallee 5
18057 Rostock Germany
Telephone: +49 (0) 381 4563 782 (and 787)
Telefax: +49 (0) 381 4563 949
E-mail: ice@bsh.de
Internet:
http://www.bsh.de/de/Meeresdaten/Beobachtungen/Eis/index.jsp (in German/English)
http://www.bsis-ice.de (a joint web page for the Baltic Sea Ice Services)

ICELAND

1. Organization

The Icelandic Meteorological Office provides all sea-ice information services in Iceland. The Icelandic sea-ice service covers Icelandic waters, defined by the ocean area inside the limit of the economic zone around Iceland.

2. Data acquisition

Sea ice in Icelandic waters is mainly encountered in the eastern side of the Greenland Strait (Denmark Strait) between Iceland and Greenland and in the Iceland Sea north of Iceland.

Visual observations are collected from lighthouses and coastal meteorological stations, and both visual and radar observations from ships at sea.

Aerial reports, both visual and radar, are made by Icelandic Coast Guard ice reconnaissance aircraft and ice is also reported by commercial aircraft.

Satellite imagery is also received and integrated into the charts. These are mainly NOAA visible and infrared images received many times a day at the forecast department of the Icelandic Meteorological Office. Additionally, sea-ice charts are received from abroad. Ice charts and satellite imagery on the Internet are also utilized.

3. Output products

Ship reports are prepared for display on the Internet, as well as Icelandic Coast Guard sea-ice charts giving ice edges and, when available, concentration and stage of development. The area covered is variable within 65–69°N and 11–28°W. Information on the position of ice edges is sent to ships by NAVTEX. Ice charts are sent to customers and other ice centres by fax. Information on sea ice in Icelandic waters is easily accessible through the web site of the Icelandic Meteorological Office.

4. Forecasts

Regular, formal ice forecasts are not prepared. However, probability statements on future sea-ice movements and changes in sea-ice extent are made available on request or made public through news media.

5. Publications

A monthly summary is prepared and included in a climatic bulletin issued by the Icelandic Meteorological Office. An annual report, Sea Ice off the Icelandic Coasts, is also issued in Icelandic and English.

6. Mailing and Internet addresses

Icelandic Meteorological Office
Bustadavegur 9
150 Reykjavik
Iceland
Telephone: +354 522 6000
Telefax: +354 522 6001
E-mail: office@vedur.is
Internet: http://www.vedur.is

LATVIA

7 May 2009 Revision

1. Organization

The Latvian Environment, Geology and Meteorology Agency (LEGMA) provides the national sea-ice service.

The collection, processing and dissemination of operational sea-ice information as well as further ice development forecasts are carried out for the Gulf of Riga and the Latvian economic zone in the Baltic Sea. The ice season in the region begins in November–December, when ice starts to form in the northern part of the Gulf of Riga and in the Bay of Pärnu. The season lasts until the complete decay of the ice in April–May.

The service collaborates with all ice services around the Baltic Sea through operational data exchange using the international Baltic Sea Ice Code.

The major users of sea-ice data are the Latvian Naval Fleet, coast guard, Maritime Rescue and Coordination Centre (MRCC), Maritime Administration, local port authorities, fishing industry and various private companies involved in operations at sea or in harbours.

2. Data acquisition

The principal data sources are visual observations from the coast and satellite data (visual and infrared imageries) from the LEGMA-operated HRPT station.

Visual sea-ice observations are carried out by nine LEGMA-operated coastal stations on the Baltic coast and in the Gulf of Riga daily at 0600 UTC during the ice season. The ice observation data (total concentration, stages of ice development, topography, thickness of fast ice and snow depth on it), accompanied by records of sea level, wind, wave, air and water temperatures are transmitted through telecommunication lines to the central office in Riga in coded form. In addition, some plain language information from vessels in the Gulf of Riga comes through the harbour master's services. Daily ice reports both coded and in plain language, are received from other Baltic Sea ice services using the GTS. Additionally, ice charts covering all the Baltic Sea regions from Sweden and Germany, regional ice charts from Estonia, and ice bulletins from German ice service are received as well.

All the data, mentioned above, are the principal sources of information for analyzing the ice conditions and producing output products.

3. Output products

(a) Coded and plain language information

(i) A daily Latvian Ice Report, both in the international Baltic Sea Ice Code and in plain language (English) are transmitted via the GTS circuit Riga-Norrköping. The data refer to the main fairways, harbour approaches and harbours in accordance with Latvia's area of responsibility as defined in the Baltic Sea Ice Code. It includes ice condition data in the harbours of Riga, Liepaja, Ventspils and approaches to them, ice information on the fairways Riga – Irben Strait – Lithuanian sea border.

(ii) A daily plain language (Latvian) ice condition description for the Gulf of Riga and the Latvian coastal area in the Baltic Sea.

(iii) A daily Ice Condition Report for the area around the Baltic Sea in plain English. Ice charts for the Gulf of Riga and adjacent to Latvia's Baltic Sea waters were not produced during the 2003–2004 ice season due to technical problems with the HRPT (High Resolution Picture Transmission) satellite image receiver.

(b) Ice charts

Ice charts for the Gulf of Riga and Latvia's Baltic Sea waters are produced once per week during ice season.

4. Forecasts

Expected ice development forecasts (in Latvian and English) for the following 10 days for the Gulf of Riga and the Latvian economic zone in the Baltic Sea are produced three times a month. Expected ice conditions on the main Latvian fairways are presented in forecasts as well.

5. Publications

Information in Latvian about monthly ice conditions can be found on http://www.meteo.lv/public/informativie_materiali.html

6. Mailing and Internet addresses

Latvian Hydrometeorological Agency
165, Maskavas Str.
LV- 1019 Riga
Latvia
Telephone: +371 7 032 600
Telefax: +371 7 145 154
E-mail: marine@lvgma.gov.lv
Internet: http://www.meteo.lv

LITHUANIA

1. Organization

At present there are two subdivisions of the Ministry of Environment involved in sea-ice information: the Centre of Marine Research (CMR) and the Klaipeda Department of the Lithuanian Hydrometeorological Service (LHMS). The CMR, besides other observation units in sea hydrology, includes three sea-ice observation posts. Daily observation data are promptly transmitted to the LHMS Klaipeda Department. From here data exchange is conducted with hydrometeorological services of foreign countries. Data on sea-ice observations are accumulated and archived as well as analysed in the CMR.

Referring to CMR data on sea ice and including extra information, the LHMS provides information and advises on sea-ice conditions as well as on navigation conditions in the Baltic Sea at users' requests.

2. Data acquisition

There are three sea-ice observation posts in the Lithuanian coastal area. Observations begin when ice appears and continue until full ice break. The state of the ice at the ice observation posts is observed daily at 0800 local time. When ice break occurs later in the day the observation time is changed to be closer to noon. Under circumstances of poor visibility, the observations are repeated once visibility has improved.

Basic drifting and fast sea-ice characteristics are determined during observations, including ice pollution, snow on ice, ice drift and ice thickness. The sea-ice state, determined from observations, is outlined in diagrams. The daily express information on sea ice from posts is sent by telegram to the LHMS Klaipeda Department.

To ensure safe navigation in the Baltic Sea the LHMS Klaipeda Department picks up the following information:

(a) CMR daily sea-ice observation data in the Lithuanian Baltic Sea coastal area;

(b) Daily sea-ice observation data in the Latvian Baltic Sea coastal area and Gulf of Riga from the Latvian Hydrometeorological Agency;

(c) The sea-ice report of the Estonian Hydrometeorological Institute in the Estonian coastal area Baltic Sea and Gulf of Riga;

(d) The sea-ice report of the Russian Hydrometeorological Service in the Gulf of Finland;

(e) The sea-ice report of the Hydrometeorological Service of Finland in the Bothnia Sea and Bothnian Bay and Gulf of Finland;

(f) Monthly sea-ice forecast from the Latvian Hydrometeorological Agency in the Irben Strait and Gulf of Riga;

(g) All available information on sea-ice distribution and development received from fishing-boats and merchant vessels entering Klaipeda seaport;

(h) Sea-ice map on ice situation in the Baltic Sea and the Belts from the Swedish Meteorological and Hydrological Institute broadcast through Germany;

(i) The sea-ice report taken during air surveys over the Lithuanian economic zone in severe winters.

3. Output products

The LHMS Klaipeda Department publishes information on sea ice in the Lithuanian coastal zone in a daily marine bulletin. At the request of ships' owners and masters, according to the information available, maps are provided on the sea-ice situation in the following parts of the Baltic:

(a) In the Gulf of Riga (sailing to Riga port);

(b) In the Gulf of Finland (sailing to St Petersburg);

(c) In the Belt Sea (sailing to the North Sea and Atlantic Ocean).

4. Forecasts and forecasts methods

In addition to the sea-ice observations and information on sea-ice distribution, the CMR and LHMS Klaipeda Department also carry out observations and forecast the ice situation in the Curonian Lagoon.

The Curonian Lagoon is a very closed freshwater basin connected by a narrow (600–800-m wide) strait with the Baltic. The main Lithuanian river, the Nemunas runs into this lagoon. The northern part of the Curonian Lagoon belongs to Lithuania. This part is significantly influenced by Baltic Sea waters during storms in the autumn and winter season, and the ice formed, often has the sea-ice properties.

There are three ice observation posts in the Lithuanian port of the Curonian Lagoon. Daily express information on the ice situation there is received by the LHMS Klaipeda Department. This department provides forecasts and warnings to shipping and fishing companies with the following details:

(a) Information on formation of new ice forms;

(b) Information on fast ice formation and total freezing of the lagoon;

(c) Information on ice break out;

(d) Information on total ice-break.

5. Mailing and Internet addresses

CMR
Taikos Str. 26
5802 Klaipeda
Lithuania
Telephone: + 3706 250324
Telefax: + 3706 250930
E-mail: CMR@klaipeda.omnitel.net

LHMS Klaipeda Department
Taikos Str. 26
5802 Klaipeda
Lithuania
Telephone: + 3706 252247
Telefax: + 3706 252247
E-mail: khmo@klaipeda.aiva.lt

NETHERLANDS

15 April 2009 Revision

1. Organization

Institution providing sea services: Rijkswaterstaat/Riza.

2. Data acquisition

Daily ice information reported in Baltic Sea Ice Code. Number of areas, regions, stations: 9 stations Nationwide, including Belgium Antwerp. Other sources of information: government ships, cargo ships, pilots. Data exchanged with foreign services daily by email. Ice charts are received from Sweden and Germany.

3. Output products

(a) *Ice information*

In ice season the ice situation is issued in code daily. The ice reports are sent to Germany and Sweden by e-mail. The coastguard sent the ice reports by navtex (518kHz) and VHF 23 or 83 to the ships.

(b) *Coded information*

Coded and/or plain language in Dutch and English.

4. Forecasts and forecast methods

For Netherlands coastal waters is no ice forecast

5. Publications

Regularly.

Irregularly: seasonally.

6. Mailing and Internet addresses

Rijkswaterstaat/Waterdienst
Information and Warning Centre (Infocentrum Binnenwateren)
Postbus 17
NL-8200 AA Lelystad
Netherlands
Telephone: +31 320 298-888
Telefax: +31 320 298-580
E-mail: infocentrum@rws.nl
Internet: http://www.infocentrum-binnenwateren.nl

NORWAY

1 September 2008 Revision

Two government institutions in Norway issue sea-ice information:

(a) The Ice Service of the Norwegian Meteorological Institute is responsible for ice monitoring within the Atlantic part of the Arctic with the emphasis on Svalbard.

(b) The Ice Service belonging to the Norwegian Coastal Administration is responsible for informing vessels about the ice situation in Norwegian waters in Skagerrak Strait from the Swedish border to Kristiansand.

I. NORWEGIAN METEOROLOGICAL INSTITUTE

1. Organization

The Norwegian Ice Service is located in Tromsø, and shares offices with the Forecasting Division for Northern Norway, which is in turn part of the Norwegian Meteorological Institute (met.no).

The Ice Service provides daily (working day, Monday-Friday) ice charts for the Atlantic part of the Arctic, covering the east coast of Greenland to the western coasts of Siberia, with the emphasis on Svalbard.

The main users of the Ice Service are fishing vessels, sailing close to the ice edge in northern and south-eastern parts of Spitsbergen throughout the year. The majority of these ships consist of non-ice class shrimp trawlers that are dependent on good ice information to be able to work and plan their activities in a safe and cost-efficient manner. Cargo and cruise ships are very active during summertime and reliable charting of the highly dynamic nature of sea ice within the fjords, narrow straits and sounds of the Svalbard archipelago is critical for their operations. Detailed and accurate ice information on the ice conditions is therefore important, and in high demand by the users.

The Ice Service analysts study the current conditions primarily via remotely sensed data and provide ice charts, ice-edge information and an overview of the sea surface temperatures.

High-resolution ice charts based on SAR are also produced daily (working day) on an operational basis. Due to the high demand for this product the Ice Service began delivering these products to users more frequently starting in 2005.

2. Data acquisition

Data received from satellites are the main source for analysts, augmented by visual observations and meteorological weather forecasts. The following informational products are used:

(a) The EUMETSAT O&SI SAF (Ocean and Sea Ice Satellite Application Facility) provides the data background for the analysts. These data are based on multi-sensor data, primarily from DMSP SSM/I and NOAA AVHRR products depicting ice concentration, ice type and ice edge on a 10-km grid.

(b) NOAA AVHRR imagery downloaded at met.no headquarters in Oslo.

(c) EOS Terra and Aqua MODIS images.

(d) Quickscat data showing ice edge on a 7-km grid.

(e) EOS Aqua AMSR data showing ice concentration.

(f) Radarsat ScanSAR Wide scenes covering the Svalbard area at 100 metre resolution.

(g) Envisat ASAR Global Mode and Wide Swath data, when available.

3. Output products

(a) Ice charts are issued daily (working day, Monday-Friday) throughout the year and are mailed and telefaxed to users. The position of the ice edge is also relayed to users by telex. The overview ice chart, "Norsk arktisk område fra 65 Nord", covers the European Arctic with a scale of 1:7,500,000. A sample chart is given in Figure VIII-1, Annex VIII.

(b) Formatted ice, sea surface temperature and snow data are prepared regularly for use in the HIRLAM weather prediction model.

(c) High-resolution ice charts are issued for the Svalbard area, when SAR data is available. A sample chart is given in Figure VIII-2, Annex VIII.

4. Forecasts and forecast methods

A forecast model is under development and is being tested on a pre-operational basis.

5. Publications

Publications are issued both on a regular and irregular basis.

6. Mailing and Internet addresses

Istjenesten
Vervarslinga for Nord-Norge
Postboks 6314
NO-9293 Tromsø
Norway

Telephone: +47 77 62 14 62
Telefax: +47 77 62 13 01
E-mail: istjenesten@met.no
Internet: http://www.met.no
http://retro.met.no/kyst_og_hav/iskart.html (regular ice charts)
http://retro.met.no/satellitt/index.html (satellite imagery, mainly NOAA)
http://retro.met.no/radar/index.html (real-time radar imagery for the Baltic Sea and Norwegian coastal waters)

II. NORWEGIAN COASTAL ADMINISTRATION

1. Organization

The main task of the Norwegian Coastal Administration Ice Service is to inform vessels about the ice situation in Norwegian waters from the Swedish border to Kristiansand including the Oslofjord.

The Norwegian Ice Service does not include assistance by icebreaker to and from ports. The larger ports have icebreaker service in the harbour and for assistance during approach and departure from the port. Please contact local port authorities for information.

2. Data acquisition

The coast is divided into observation areas that are identified by a code of letters and numbers according to "The Baltic Sea Ice Code".

3. Output production

Plain language ice reports and coded ice observations according to "The Baltic Sea Ice Code" are available and regularly updated: 1 December to 31 March on www.kystverket.no .

4. Mailing and Internet addresses

Kystverket Southeast, Ice Service
Serviceboks 625
N-4809 ARENDAL, NORGE
Telephone: +47-3701 9700/ -3701 9718 / -3701 9759
Cell phone: +47-4815 4142 / -9593 0261
Fax: +47-3701 9701/ -3702 7619
E-mail: ismelding@kystverket.no
Internet: http://www.kystverket.no

POLAND

31 October 2008 Revision

1. Organization

The Ice Service is provided by the Institute of Meteorology and Water Management, Maritime Branch (Instytut Meteorologii Gospodarki Wodnej, Oddzial Morski –IMGW OM), Hydrological Forecasting Office in Gdynia). It covers Polish waters. Ice services are provided for all marine activities (fisheries, navigation, drilling and harbours).

2. Data acquisition

Visual data are collected from 35 coastal stations and ships. Aerial reconnaissance is made only under very severe ice conditions. At present IMGW OM receives images from IMGW Krakow from satellites: NOAA – HRPT, Meteosat – HRI, MSG – HRIT and LRIT, FENG YUN – CHRPT. Details on 21 coastal stations are listed in publication WMO-No. 9, Volume D – Information for Shipping. Data are also exchanged with foreign ice services via the GTS, mail and fax.

3. Output products

(a) A coded ice report is broadcast daily by Witowo Radio on ice conditions in Polish waters. A plain language report is also provided in Polish and English.

(b) Ice charts (scale 1:4,400,000 in conic projection) of the whole Baltic Sea, the Kattegat and Skagerrak are prepared twice a week (Tuesday, Friday) in the ice season for distribution by messengers and mail (by fax on request). A sample chart is given in Figure IX-1, Annex IX.

(c) An ice bulletin in plain-language (Polish) giving ice conditions in Polish waters, twice a week (Tuesday, Friday) in the ice season, except very severe winter, when the ice bulletin is prepared daily from Monday to Friday for distribution by messenger and mail. It includes coded reports for the open Baltic Sea and coastal waters for all the Baltic countries as well as forecast for Polish coastal zone.

4. Forecasts and forecast methods

A 35-hour ice forecast for Polish waters is included in the ice bulletins. It uses subjective dynamical methods and a forecast of meteorological conditions. The freezing of sea ice is forecast by empirical model.

5. Publications

Descriptive summaries of sea-ice conditions are published by the Maritime Branch in Gdynia in the year-book, containing hydrological and oceanographic data.

6. Mailing and Internet addresses

Instytut Meteorologii i Gospodarki Wodnej (IMGW)
Oddzial Morski – Biuro Prognoz Hydrologicznych - Gdynia
Ul. Waszyngtona 42
PL 81-342 Gdynia
Poland
Telephone: +48 58 6288 146/+48 58 6288 100 (operator)
Telefax: +48 58 620 1641
E-mail: hydrologia.gdynia@imgw.pl
Internet: http://www.imgw.pl
http://www.imgw.pl/index.php?option=com_content&view=article&id=63&Itemid=143

SWEDEN

28 February 2010 Revision

1. Organization

The Swedish Meteorological and Hydrological Institute (SMHI) is responsible for the sea ice information service in Sweden since 1930. SMHI provides ice information for the Swedish icebreakers and international shipping through the National Maritime Administration, the Royal Swedish Navy and the general public and media.

Further, the Swedish Ice Service is, as the national expert authority on sea ice, often involved in marine accident investigations as well as other external inquiries. The Swedish Ice Service is operational seven days a week during the ice season, and produce daily ice charts and ice reports as well as client specific products such as ice formation forecasts. The ice season in the Baltic Sea normally begins in late November when ice starts to form in the northernmost archipelagos of the Bay of Bothnia, and lasts until end of May. The Swedish Ice Service is represented in IICWG and the JCOMM Expert Team on Sea Ice as well as in other international collaborative forums.

2. Data acquisition

(a) Ice observations – plain language

When at sea, icebreakers report on current ice conditions 3-4 times per day. Ice information is also provided in plain language by merchant vessels, either on their own initiative or upon request, and by a few coastal observation stations.

Ice observations - Baltic Sea Ice Code

Ice observations in Baltic Sea Ice Code are reported by Vessel Traffic Services centres (VTS) for ports and fairway sections along the Swedish coast. National ice reports in Baltic Sea Ice Code from Sweden, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Netherland, Poland and Russia are available via the WMO GTS network.

(b) Satellites

200 m resolution images from RADARSAT-2 (ScanSAR Wide) are used during ice season. These are received and processed by Norwegian KSAT and transferred to SMHI via the Finnish Ice Service. ENVISAT ASAR images at 200 m resolution are used when available, typically 1-2 times per week during ice season. NOAA AVHRR images (Visual/RGB and IR) at 1,1 km resolution are received at SMHI daily all year. OSISAF images are received daily and used in SST analysis.

(c) Sea surface temperature observations

Hourly or daily SST observation data is collected from buoys and automatic stations (both Swedish and international via ftp), coastal stations and some merchant and passenger vessels (mainly by Ferrybox).

(d) Meteorology forecasts

For meteorological forecasts the weather service at SMHI use a number of international meteorological models including SMHI's HIRLAM (High Resolution Limited Area Model) and the operational atmospheric model at European Centre for Medium-Range Weather Forecasts (ECMWF).

3. Output products

(a) Ice charts

Ice charts in Mercator projection are produced daily and cover the Baltic Sea including the Gulf of Finland and Gulf of Riga, Kattegat and Skagerrak, and the major Swedish lakes (Vänern and Mälaren). The scale at 60° N is 1:4 000 000. Charts display ice concentration, thickness and type using WMO international sea-ice symbols and colour code standard. Ice charts also include navigational restrictions for ports in the Baltic region and information on position of the operating icebreaker vessels. Twice weekly, the ice chart is complemented by a sea surface temperature (SST) chart for the same area.

All charts are uploaded on the SMHI webpage for public access. On request, vessels can receive the ice chart by email or fax. The Swedish ice charts are also transmitted on radio facsimile by the German stations Hamburg/Pinneberg.

(b) Ice bulletins / Ice reports

Daily bulletins, in Swedish and English, on current ice situations at sea, navigational restrictions and icebreaker information are distributed by NAVTEX, the GTS network and email, and are available for public access on the SMHI web page. The ice reports are also uploaded on the Baltic Icebreaker Management website. An abridged ice report is broadcasted daily on Swedish Public Radio.

(c) Baltic Sea Ice Code

Ice information for selected fairway sections is distributed in Baltic Sea Ice Code via WMO GTS network and is available on the SMHI web page. All Swedish and international Baltic Sea Ice Code data is stored in SMHI's Ice Database.

(d) Ice forecasts

SMHI produce ice forecasts for up to 15 days. The forecasting service is a commercial service available to clients, including the Swedish Maritime Administration, Swedish Navy and shipping companies. For more information on ice forecast methods see section 4.

(e) Other output products

Ice charts are converted to grid files which are used in data assimilation for SMHI's ocean circulation model HIROMB (see section 4). SMHI send daily wind, atmospheric pressure and water level forecast data to an external database for access and visualization onboard Swedish and Finnish icebreakers. SMHI is also the Baltic region's main provider of SIGRID-3 format ice charts to the Global Digital Sea Ice Database (GDSIDB).

4. Forecasts and forecast methods

Sea ice forecasts are prepared using SMHI's operational ocean circulation model HIROMB (High Resolution Operational Model for the Baltic Sea). HIROMB is a three dimensional baroclinic model, with a fully coupled ice model, which currently runs with horizontal resolutions of 3 and 1 nautical miles. The ice model in HIROMB is a viscous-viscoplastic model.

The forecast parameters are; ice concentration, thickness, drift, ridged ice, ridge density and ridge height. The ice model can produce forecasts up to 15 days and is forced with the HIRLAM model or the operational ECMWF meteorological model. Using HIRLAM as the forcing model, ice forecasts of up to 48 hours are produced in both 3 nm and 1 nm resolution. For longer forecasts (up to 15 days) the ECMWF model is used to force HIROMB at 3 nm resolution.

Long forecasts are produced both as deterministic prognoses, and as ensemble prognoses for ice concentration, thickness and ridging using a set of altered initial values and forcing the model with up to four consecutive ECMWF prognoses producing 20 ensembles. Currently, ensemble forecasts are run as 10 day forecasts, however trials on 14 day ensembles are currently underway.

Initial conditions are determined by data from observations and gridded ice- and SST charts and satellite data assimilated through the method of successive correlations (SCM). SMHI is currently working on new methods of data assimilation and trials are running using the OI (Optimal Interpolarization) method. The above described ice modelled forecasts are interpreted by analysts experienced in marine meteorology and thus used, along with weather information, as a basis for the commercial ice formation forecasts.

5. Publications

SMHI publish a monthly summary of meteorological, hydrological and oceanographical conditions in which ice conditions are presented during ice season.

Every year SMHI and the National Maritime Administration publish a joint report summarizing the past ice season. This report includes month by month description of ice development, statistical information on selected fairways, weather and SST summaries and a summary of icebreaking activities.

6. Mailing and Internet addresses

Swedish Meteorological and Hydrological Institute (SMHI)
Swedish Ice Service
601 76 Norrköping

Sweden
Telephone: +46 (0) 11 495 8533
Telefax: +46 (0) 11 495 8053
E-mail: ice@smhi.se
Internet:
http://www.smhi.se
http://www.smhi.se/iceservice (Ice products)
http://www.smhi.se/polarview (visual ice forecast)
http://www.baltice.org (icebreaker activities, ice reports)

UNITED KINGDOM

1. Organization

Since the first issue of the WMO publication Sea-Ice Information Services in the World (1981) the UK Met Office is not producing routine sea-ice analyses. No sea-ice information is available.

2. Mailing address

Meteorological Office
FitzRoy Road
Exeter
Devon EX1 3PB
United Kingdom
Telephone: +44 (0)1392 885680
Telefax: +44 (0)1392 885681
E-mail: enquiries@metoffice.gov.uk
Internet: http://www.metoffice.gov.uk

North America

CANADA

19 March 2010 Revision

1. Organization

The Canadian Ice Service, a division of the Meteorological Service of Canada in the Department of Environment, is a centre of expertise for ice related information for all of Canada and its surrounding waters. The Ice Service co-operates closely with the Canadian Coast Guard which operates Canada's fleet of icebreakers to assist marine transportation in Canadian waters.

The Canadian Ice Service promotes safe and efficient maritime operations and protects Canada's environment by providing reliable and timely information about ice conditions in Canadian waters. For example, the Ice Service provides timely warnings of icebergs and ice conditions that pose immediate threats to ships, ports and other marine operations; advises on ice conditions in shipping routes for navigators; provides information to help shipping, fishing and offshore operators plan their seasonal operations in a safe and efficient manner.

To meet its mission, the Canadian Ice Service collects and analyses data on ice conditions in all regions of the country affected by the annual cycle of pack ice growth and disintegration. In summer, the focus is on conditions in the Arctic and the Hudson Bay region. In winter and spring, attention shifts to the Labrador Coast and East Newfoundland waters, the Gulf of St. Lawrence, the Great Lakes and St. Lawrence Seaway.

Major users of Ice Service products and services are:

(a) the Canadian Coast Guard uses weather and ice information for marine safety, icebreaking operations and efficient marine transportation

(b) port authorities obtain site-specific information on current and long-term ice conditions in ports and shipping routes

(c) the commercial shipping industry uses ice information for strategic and tactical vessel passage planning

(d) fishing fleets obtain enroute and on-site ice conditions for ice-encumbered areas

(e) the offshore oil and gas companies use iceberg and sea ice information for exploration and production, both on-site and in transit

(f) the marine construction industry uses site-specific current and historical data for offshore and onshore projects, such as bridges and port facilities

(g) the tourism industry gets technical and general information for the operation of cruise ships and the enjoyment of passengers

(h) the marine insurance industry uses ice information for risk assessment for offshore operations affected by ice

(i) environmental consultants use ice data, analyses and expert advice for environmental impact assessments

(j) research scientists use ice information relating to research on transportation, construction, climate change, meteorology, oceanography, biology and socio-economic impacts.

The Canadian Ice Service operates a comprehensive ice information service, encompassing reconnaissance, analysis and forecasting, ice climatology, data archiving, informatics support and research and development. It has a staff of approximately 90 people working at the Ice Centre in Ottawa, aboard Coast Guard icebreakers and in field offices.

2. Data acquisition

Radar imagery from satellites is the principle data source, augmented by visual observations from fixed-wing aircraft and helicopters. RADARSAT and ENVISAT synthetic aperture radar (SAR) data provides extensive and detailed (up to 30 metres resolution) coverage of ice conditions. The Ice Service uses approximately 7,000 SAR images covering over a billion square kilometres annually. Data are received in real-time by two Canadian satellite receiving stations, processed and delivered to the Canadian Ice Service and disseminated to marine users within hours.

Visual and infrared imagery from U.S. polar orbiting satellites is also used extensively in the ice analysis program. Passive microwave imagery is received daily to provide background information on the general ice distribution at low resolution.

Experienced ice observers are stationed on the major Coast Guard icebreakers and in regional ice offices. They conduct local visual reconnaissance by helicopter and transmit the observations to the Ice Centre immediately after the flight. These observed ice charts are posted on the Ice Service web site marine users immediately upon receipt.

The Canadian Ice Service is integrated with the national meteorological network and has access to the necessary meteorological and oceanographic inputs. Co-operation with research institutes, universities and other federal departments also provide other valuable data.

3. Output products and forecasts

The Canadian Ice Service provides its clients and the Canadian public with a variety of accurate and timely analyses and forecasts of ice conditions ranging from daily ice forecasts to seasonal outlooks. Information on ice conditions posing immediate threats, such as rapid closing of coastal leads, ice pressure or unusual ice conditions, are directly available from the Canadian Ice Service web site, the weather office web site of Environment Canada, and through weather and marine radio broadcasts.

Specialized products and services to meet the short-term tactical and longer-range planning needs of clients are also available. These products include detailed ice analysis charts, radar and satellite imagery, image analysis charts, and special forecasts covering days to months. These products are distributed in a variety of formats, including mail, e-mail, fax, and Internet.

The Ice Service provides a variety of field services, normally through the Coast Guard, for clients who need specialized ice information. Ice Service Specialists provide field support to clients on shore and aboard ships, including briefings on ice conditions, direct analysis of satellite images and special visual observations.

The Canadian Ice Service has expertise in ice modelling, remote sensing and climatological ice conditions in and around Canada. It supports research and development by scientists working in government, universities and the private sector. Drawing on the Canadian Ice Service national ice data archive, ice analysts work directly with clients to identify and analyze appropriate climatological ice information and provide advice on historical ice and iceberg conditions.

Ice information products and services are provided in those areas of Canada's waters where there is marine activity in the vicinity of sea ice. Arctic areas are active from June to November while southern areas, including the Gulf of St. Lawrence and the Great Lakes are active from December to May.

(a) Ice charts

Ice charts graphically illustrate ice or iceberg conditions at a particular time, presenting data by means of a standard international code. Charts may be used for strategic and tactical planning. Charts available from the Canadian Ice Service include:

(i) Regional Ice Chart (Figure I-1, Annex I);
(ii) Daily Iceberg Analysis Charts (Figure I-2, Annex I);
(iii) Daily Ice Analysis Charts (Figure I-3, Annex I);
(iv) Ice Reconnaissance Charts (Figure I-4, Annex I);
(v) Image Analysis Charts (Figure I-5, Annex I);

(b) Bulletins

Bulletins provide advice on present ice or iceberg conditions in simple text format. The following bulletins are available from the Canadian Ice Service:

(i) Daily Iceberg Bulletins
(ii) Daily St. Lawrence River Ice Bulletins
(iii) Seasonal Ice Summary
(iv) Forecasts

(c) Forecasts

Forecasts provide advice on present and forecast ice conditions in text format. The seasonal ice outlook provides a forecast of the ice season in graphical and chart format. The following bulletins are available from the Canadian Ice Service:

(i) Daily Ice Forecasts (Figure I-6, Annex I);

(ii) 30 Day Ice Forecasts

(iii) Seasonal Ice Outlook.

(d) Images

In preparing the charts and bulletins, the Canadian Ice Service uses an extensive array of satellite data. Raw images are available to users depending on their ability to receive image data:

(i) Visual / Infrared Satellite Imagery

(ii) SAR images from Radarsat and Envisat

(e) Weather maps

The Canadian Ice Service makes available the following weather maps produced by Environment Canada:

(i) Surface Analysis Weather Map

(ii) 500 HPA Height Analysis Map

(iii) Surface Prognostic Weather Map out to 120 hours

(iv) 500 HPA Prognostic Weather Map out to 120 hours

(v) Public and Marine Weather Forecast Bulletins

(vi) Significant weather depiction charts

(vii) Ocean wave analysis

(viii) 12-24-36 hour ocean wave prognosis

(.f) Special services

The Canadian Ice Service responds to enquiries from users and provides a range of specialized forecasting, consultation and advisory services on a best-effort, cost-recovered basis. If needs are substantial, the user is referred to the private sector when possible.

4. Publications

The Canadian Ice Service has a collection of reference material related to sea ice and icebergs. The following representative publications are available in printed format and on-line as indicated:

(a) Seasonal Summary for the Canadian Arctic since 2004 (available on-line).

(b) Seasonal Summary for the Great Lakes and Eastern Canadian Waters since 2004 (available on-line).

(c) MANICE - Manual of Standard Procedures for Observing and Reporting Ice Conditions. (available on-line).

(d) Ice Thickness Climatology (1961-1990)

(e) Melting and Freezing Degree Days (1961-1990)

(f) Sea Ice Climatic Atlas - Northern Canadian Waters 1971-2000 (also in CD) (available on-line).

(g) Sea Ice Climatic Atlas - East Coast of Canada 1971-2000 (available on-line).

(i) Lake Ice Climatic Atlas - Great Lakes 1973-2002 (available on-line).

(j) Annual Arctic Ice Atlas 1990 – present (available in paper format until 2003, then on CD or on-line)

5. Mailing and internet addresses

Canadian Ice Service – Environment Canada
373 Sussex Drive, Block E - 3rd floor
Ottawa, Ontario
Canada K1A 0H3
Telephone: +1 (877) 789-7733 Telefax: +1 (613) 947-9160
E-mail: cis-scg.client@ec.gc.ca
Internet: http://ice-glaces.ec.gc.ca

NORTH AMERICAN ICE SERVICE

19 March 2010 Revision

1. Organization

The North American Ice Service (NAIS) is a joint initiative of the U.S. National Ice Center (NIC), including the International Ice Patrol (IIP), and the Canadian Ice Service (CIS) that has grown out of the long-standing cooperation between the two organizations. The primary objective is to provide a better ice information service to users by reducing the potential for confusion caused by multiple, overlapping products coming from different sources. A secondary objective is to gain greater efficiency by reducing duplication of effort by the two services.

Since December 2004, the CIS and the NIC have jointly produced ice charts, ice forecasts, 30-day forecasts and seasonal outlooks for the Great Lakes under the banner of the North American Ice Service. The joint production of 30-day forecast and seasonal outlooks has been extended for the North American Arctic in summer 2005. The workload and the data sources for these products are shared between CIS and NIC. In 2008 and 2009 joint tactical support was given for ships operating in the Bering Strait and the western Arctic. In the coming years, this practice will be extended to encompass all of the ice-covered waters of North America. Common databases and production systems are being developed to facilitate this collaboration.

2. Output products

(a) Ice charts issued weekly for the Great Lakes. A sample chart is given in Figure XIII-1, Annex XIII.

(b) Ice hazard bulletins for the Great Lakes in plain language.

3. Forecasts and forecast methods

30-days forecasts and seasonal outlooks for the Great Lakes.

30-days forecasts and seasonal outlooks for waters surrounding North America in the Arctic.

4. Internet address

http://www.nais-sgan.org/

UNITED STATES

31 December 2008 Revision

1. Organizations

Ice products and services in the United States are provided by the National Ice Center located just outside of Washington, D.C., in Suitland, Maryland. Through the collective efforts of three Federal Government agencies: the National Oceanic and Atmospheric Administration (NOAA), the United States Navy (USN), and the United States Coast Guard (USCG), manpower and fiscal resources are contributed and used in the collaborative operation of the National Ice Center (NIC).

The mission of the NIC is to provide the highest quality, timely, accurate, and relevant snow and ice products and services to meet the strategic, operational, and tactical requirements of the United State's interests across a global area of responsibility.

The NIC's global area of responsibility includes:

(a) Arctic – All routinely ice covered Arctic Ocean waters, to include the Sea of Japan, Sea of Okhotsk, and the Yellow Sea.

(b) Antarctic – All routinely ice covered Antarctic waters.

(c) United States – Alaskan waters, Great Lakes, Chesapeake Bay, and the Delaware Bay.

(d) In addition to the global sea ice analyses and forecasts, the NIC produces a daily Northern Hemisphere Snow and Ice Cover Analysis Chart, and maintains an Antarctic Iceberg Database.

Internationally, the National Ice Center actively participates in the International Arctic Buoy Program (IAPB), International Ice Charting Working Group (IICWG), North American Ice Service (NAIS), and the World Meteorological Organization-Intergovernmental Oceanographic Commission's (WMO-IOC) Expert Team on Sea Ice.

The USCG's International Ice Patrol (IIP) monitors and distributes information on the southern limit of icebergs in the North Atlantic/Grand Banks region of Newfoundland during the iceberg season (February to July).

Sea ice analyses for Alaskan areas are also prepared by the NOAA National Weather Service (NWS) in Anchorage, Alaska.

2. Data acquisition

NIC ice products are produced primarily using radar, visible, and infrared imagery from a variety of sources. Satellite imagery constitutes over 95 per cent of the information received and integrated into NIC analysis products. Microwave and scatterometer data is also used in product production. In addition to imagery, drifting buoy data, ice model predictions, limited ship reports, and meteorological and oceanographic input is available to the analyst, as well as ice information provided by other international centers. The NIC has an extremely productive and active working relationship with the Canadian Ice Service (CIS) and receives some shared imagery from their center – and vice versa.

3. Output products and forecasts

NIC produces a variety of ice analyses and forecasts in support of operations and climate data covering both the northern and southern polar region. Routine NIC ice products include a daily ice edge analysis of the northern and southern hemispheres, marginal ice zone analysis in the northern hemisphere, a daily snow cover product, weekly or bi-weekly regional scale graphical ice analysis, alphanumeric text messages, and WMO Sea Ice in GRIDed (SIGRID) format. Geographical Information System (GIS) formats such as shape files, .e00 files, and coverage information is created either daily or weekly. Additionally, electronic charts in .pdf format, annotated imagery, and short term forecasts are available. All sea ice analysis, text messages and GIS products are available via the NIC website at http://www.natice.noaa.gov. Outlooks for the Ross Sea, Western Arctic, and Great Lakes are produced regularly and posted to the NIC website.

Special requests such as route recommendations, pre-sail ship briefs, ship rider support, legacy ice information (1972 to present), long term ice forecasts, location and orientation of exploitable openings or thin ice features in the ice pack, multi-year ice locations, estimated ice thickness based on ice stage of development, and tactical annotated imagery are available with some restrictions based on the requesting customer, (i.e., Department of Defense, research, academia, etc.).

Except for the Great Lakes analyses, which are produced in Lambert Conformal, all NIC ice products use polar stereographic projections, and WGS84 datum.

During the Great Lakes ice season, bi-weekly ice analyses, seasonal outlooks, 15 and 30 day forecasts, .e00 files, ASCII files, and an ice concentration product are provided as a service of the North American Ice Service (NAIS). The NIC and CIS alternate the twice weekly chart, providing a seamless, identical product available to customers. These products can currently be located on the NIC and CIS (http://ice-glaces.ec.gc.ca) website.

The USCG, also a founding member of the NAIS, has agreed to host a NAIS webpage that is currently under construction and will be available at http://www.nais-sgan.org.

The USCG's International Ice Patrol formally begins its seasonal ice observation service whenever icebergs threaten primary shipping routes between Europe and the U.S. and Canada. This usually occurs in the month of February and the threat extends through July. A list of products and broadcast times, in addition to reporting requirements, can be found at http://www.uscg-iip.org.

The Ice Desk of the NWS Anchorage, Alaska office produces sea ice advisories, sea ice analyses of Alaskan waters, including Cook Inlet, sea surface temperature analysis, and five day forecasts. These products can be accessed at http://pafc.arh.noaa.gov/ice .

4. Publications

(a) EWG Arctic Sea Ice Atlas - an Arctic compendium of sea-ice information. Information included on this CD-ROM is derived from unclassified and classified ice data (1972-1990). Statistics include: probability of occurrence of all ice, ice extent extremes (maximum, mean, minimum) and median ice concentration charts.

(b) The NIC Polar Science team regularly publishes papers and reports. The majority of these reports are available via the NIC website.

(c) Great Lakes climatology is available from the National Snow and Ice Data Center (NSIDC), Canadian Ice Service, and NOAA's Great Lakes Environmental Research Laboratory (GLERL).

(d) North Atlantic Iceberg Summary – the United States USCG's International Ice Patrol, publishes an annual report summarizing the ice, meteorological and oceanographic conditions during the North Atlantic iceberg season. The report can be located on the International Ice Patrol's website - http://www.uscg-iip.org/home.html.

5. Contact Information

National Ice Center
(a) Mailing address:
Director, National Ice Center
4251 Suitland Road
NSOF Washington, D.C., 20395
(b) Physical address:
4231 Suitland road
NSOF Suitland, MD 20746 USA
(c) Telephone:
Administration: (301)-394-3200
Operations Floor: (301)-394-3099
Operations Department Head: (301)-394-3020
Operations Technical Advisor: (301)-394-3028
Information Technology Department Head: (301)-394-3007
Science Department Head: (301)-394-3120
Chief Scientist: (301)-394-3105
(d) E-mail: liaison@natice.noaa.gov

International Ice Patrol

(a) Mailing address:
Commander, International Ice Patrol
1082 Shennecossett Road

Groton, CT 06340-6095 USA
(b) Telephone:
Administration: (860)-441-2626
(c) E-mail: iipcomms@usccg.mil

NWS Anchorage Alaska – Ice Desk

(a) Mailing address:
NWSFO Anchorage
222 West 7th Avenue
Building #23, Room 517
Anchorage, AK 99513-5113 USA
(b) Telephone: Ice Desk: (907)-226-5138
(c) E-mail: nws.ar.ice@noaa.gov

SOUTHERN HEMISPHERE

ARGENTINA

22 December 2008

1. Organization

Sea ice information services in Argentina are provided by the Argentine Navy Meteorological Service (SMARA) of the Naval Hydrographic Service, through the Glaciological Division at city of Buenos Aires. This information is also provided, upon request, when the ships sailing or operating in Antarctic waters (mainly in Weddell and Eastern Bellingshausen Seas or near the Antarctic Peninsula).

No sea ice charts or coded information are regularly prepared and transmitted, except for sea ice edge and icebergs locations (when available) included in Notice to Mariners for NAVAREA VI.

All ships may obtain sea ice information service provided that request is received in advance in Glaciological Division.

2. Data acquisition

Data sources are based on low (APT) and high resolution satellite images, sea ice observations from shore and ship stations (IILL & IISS codes after NIC U.S.A.), historical and reference operational data obtained from analysis prepared by NIC U.S.A.

Six Antarctic Argentine stations report sea ice and icebergs twice a week whilst the Argentine auxiliary ships report four daily sea ice observations when sailing or operating in Antarctic waters, and only if sea ice concentrations are equal or greater than 1/10 from 57°S.

3. Output products

The following information is available upon request for Weddell Sea zones, as well as those of adjacent waters of the Antarctic Peninsula, Eastern Bellingshausen Sea and sub-Antarctic waters of adjacent South Atlantic and Pacific Oceans:

Sea ice edge position and concentrations, openings, stages of development, sea ice fields under processes of pressure, and areas of weakness may be provided by the Glaciological Division in Buenos Aires for specific locations, in plain language coded messages

4. Forecasts

Sea ice forecasts, mostly constrained to specific locations, are prepared upon request in plain language by the Glaciological Division in Buenos Aires. The forecasts specially refer to sea ice edge movement, changes in concentrations, areas of pressure and zones of weakness.

5. Publications

There are no regular publications, however, two sea ice Atlases have been published for Antarctic waters between 0ºW and 90ºW; one covering the period 1972-1990 and the other for 1973-1982. Statistics on sea ice boundaries for nonstandard periods may be compiled, since 1972, and made available to users.

6. Mailing address

Servicio Meteorológico de la Armada Argentina. Glaciología.
Edificio Libertad
Comodoro Py 2055, 15-37
C1104BEA BUENOS AIRES
Argentina.
Telefax: +54 11 43172309
E-mail: hielo.marino@gmail.com

AUSTRALIA

1. Organization

During the Austral summer (approx November to March) the Antarctic Meteorological Centre at the Australian Station, Casey, Antarctica, provides on request sea-ice concentration analyses for any Antarctic coastal area between around 180°E and 20°E. These analyses are provided via e-mail.

NOAA satellite AVHRR imagery of the following coastal areas are routinely updated on the World Wide Web (currently provided to registered users, but subject to change): Terra Nova Bay area, Cape Adare, Dumont D'Urville area; Wilkes Coast area, Sabrina coast area, Casey area, Shackleton Ice Shelf area, West Ice Shelf area, Davis area, Mawson area, Enderby Land area, Ragnhild Coast area. These images include both infrared and visible AVHRR data during the Austral summer and infrared data only during the Austral winter. The images on the web are in GIF format.

As of 2004 the International Antarctic Weather Forecasting Handbook had been prepared under the auspices of a number of organizations, including the British Antarctic Survey (BAS), the Australian Bureau of Meteorology, the Scientific Committee on Antarctic Research (SCAR), the WMO International Commission on Polar Meteorology and the Council of Managers of National Antarctic Programmes (COMNAP), and is available in hardcopy version and in PDF format (at http://www.bom.gov.au/weather/ant/handbook/handbook.shtml).

2. Mailing and Internet addresses

Bureau of Meteorology Tasmania/Antarctica Region
GPO Box 727, Hobart
111 Macquarie Street
AUSTRALIA, 7001
Telephone: +61 3 6221 2021
Telefax: +61 3 6221 2080
Internet:
http://www.bom.gov.au/weather/ant/ (Antarctic and Southern Ocean Weather)
http://www.bom.gov.au/weather/tas/inside/amc/satindex.shtml (satellite imagery)

NEW ZEALAND

Since the first edition of the WMO publication Sea-Ice Information Services in the World (1981) the New Zealand meteorological service is not producing routine sea-ice analyses. No sea-ice information is available.

ANNEXES - SAMPLE CHARTS AND OUTPUT PRODUCTS OF NATIONAL SERVICES

ANNEX I - Canada

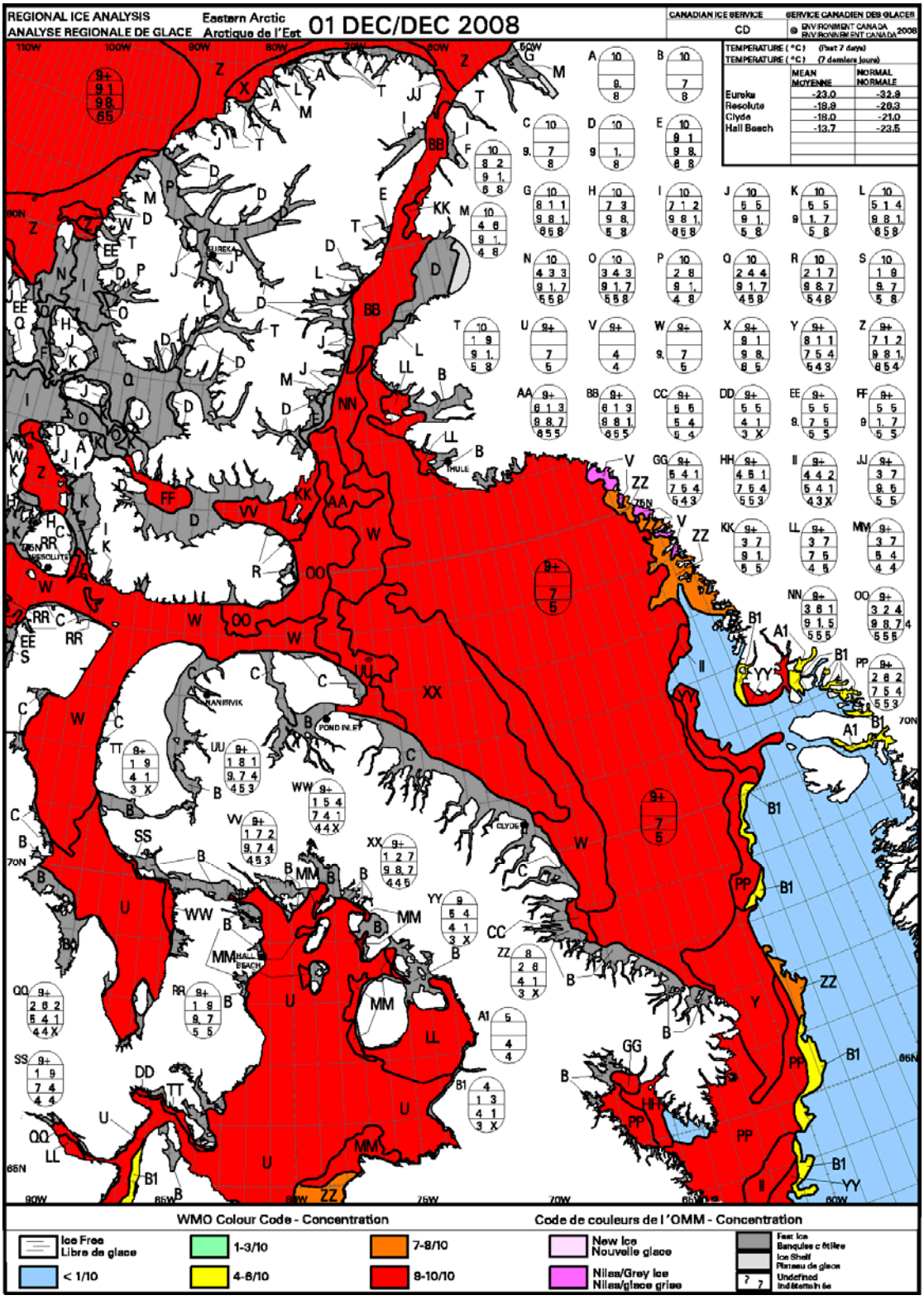


Figure I-1 – Regional Ice chart for the Eastern Arctic for 1 December 2008.

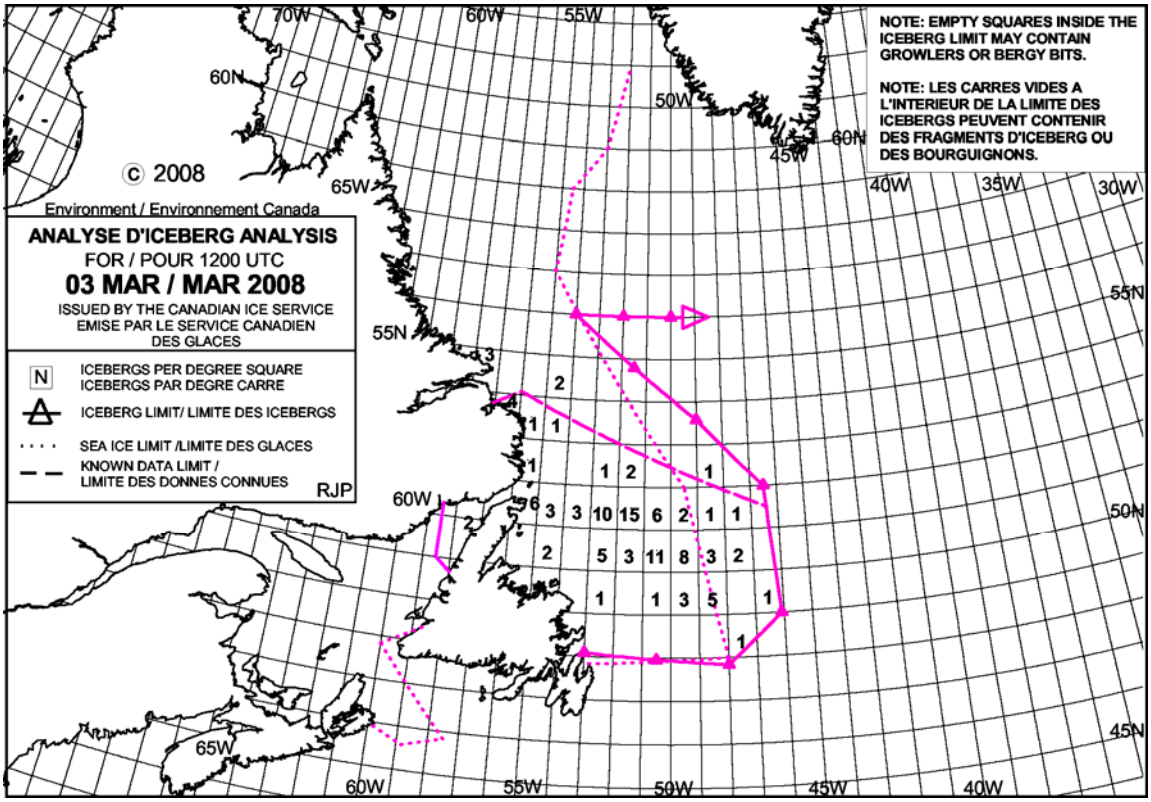


Figure I-2 – Daily Iceberg Analysis chart for the Canadian East Coast for 3 March 2008

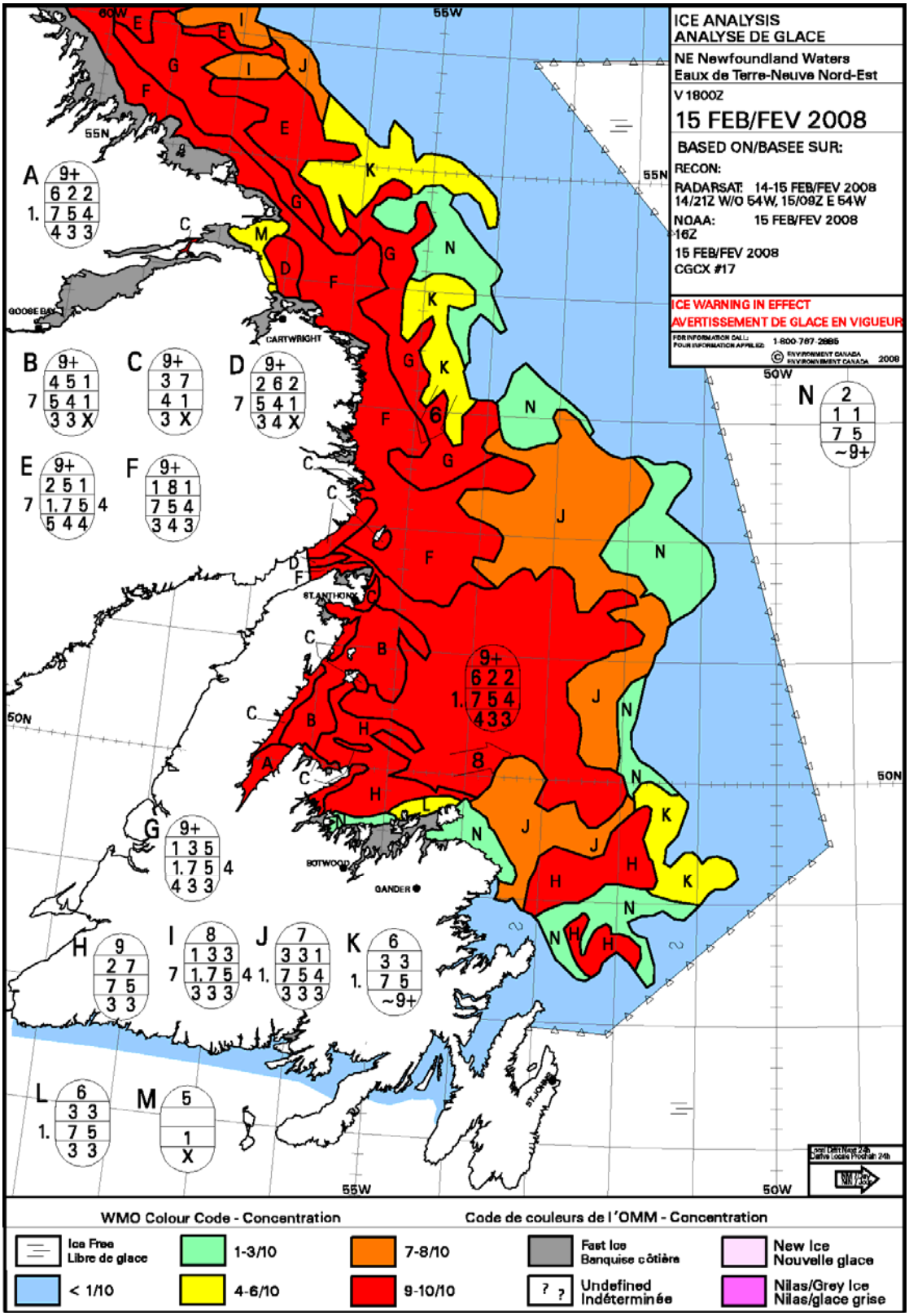


Figure I-3 – Daily Ice analysis chart for the Canadian East Coast for 15 February 2008.

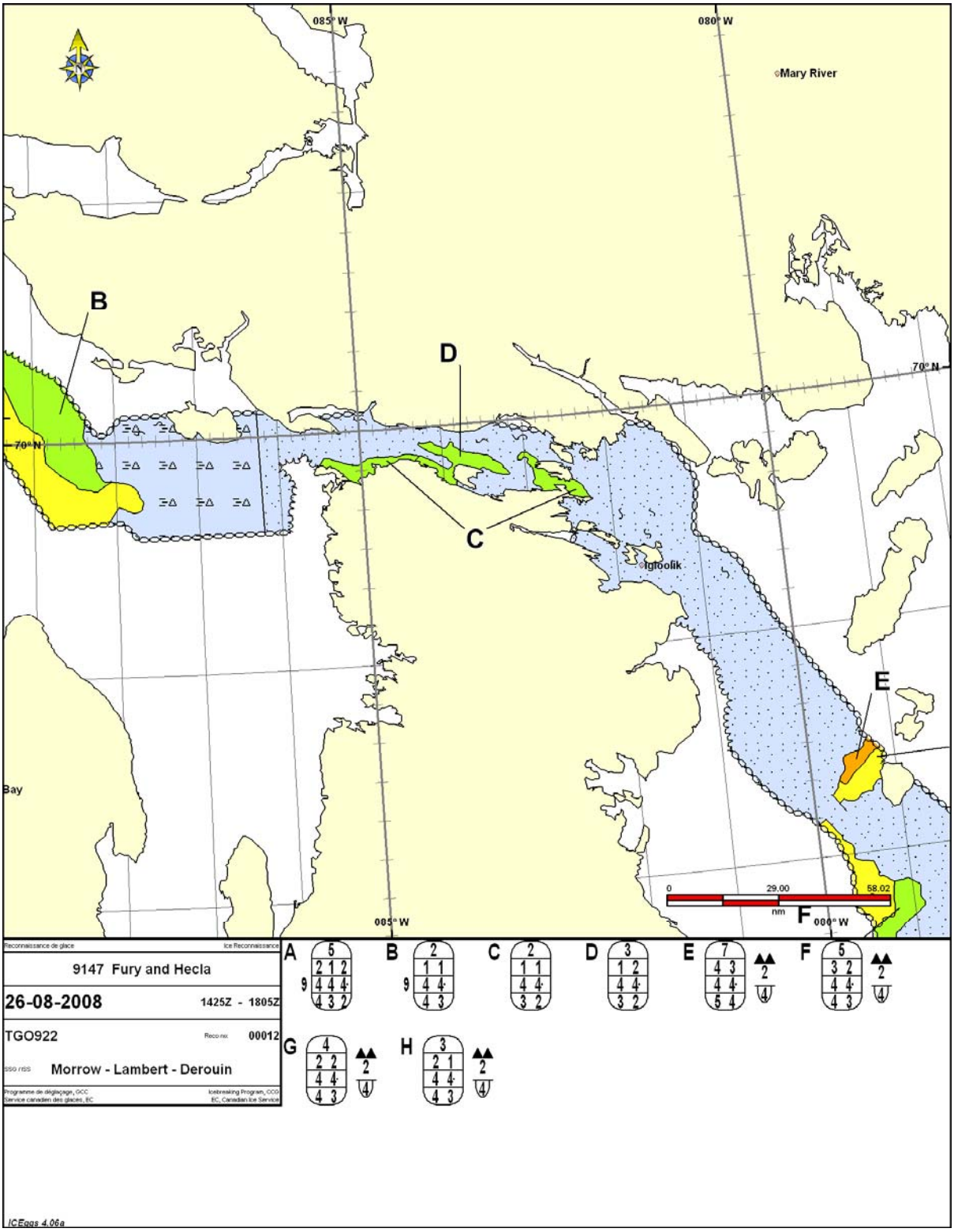


Figure I-4 – Ice Reconnaissance chart for Fury and Hecla for 26 August 2008.

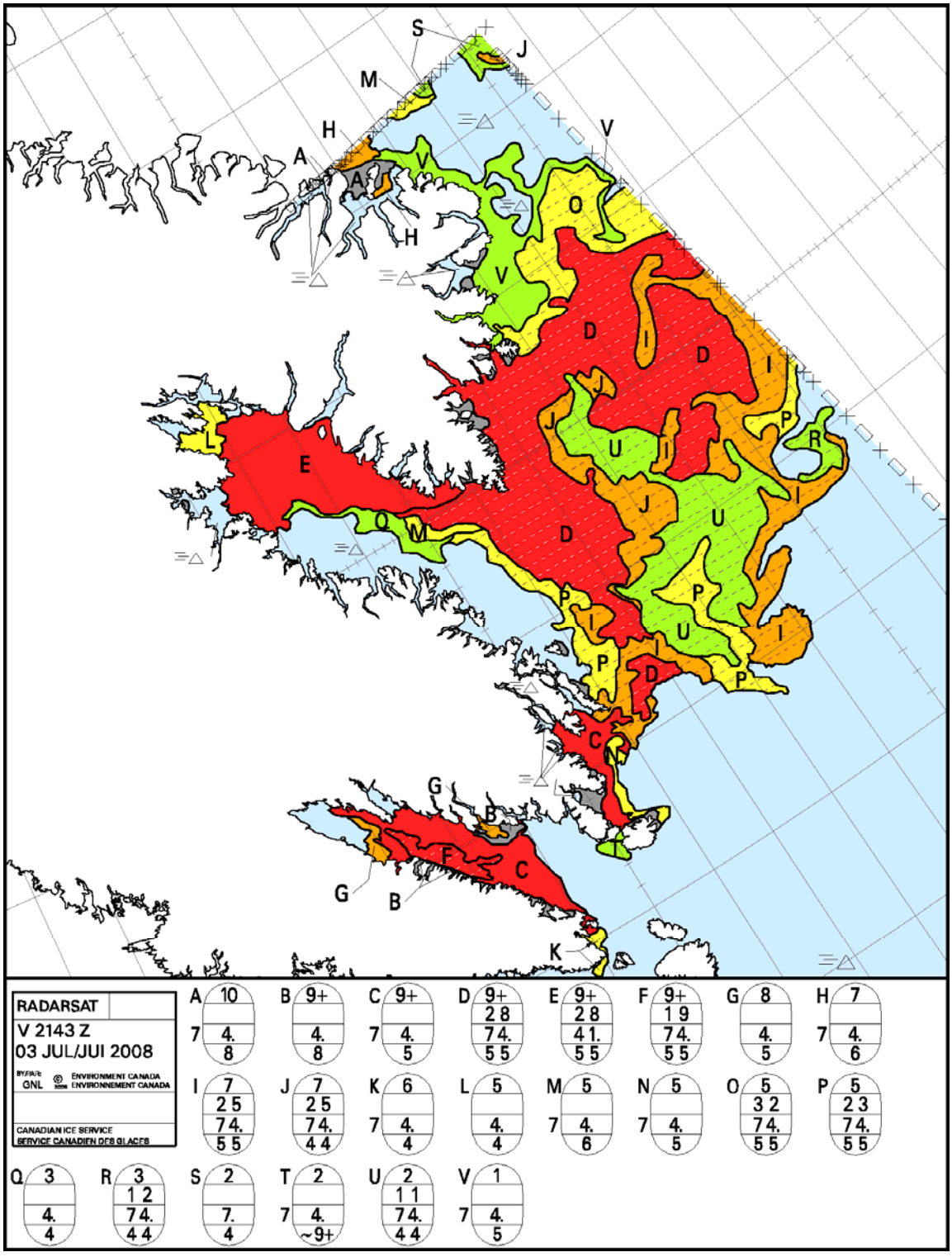


Figure I-5 – Image analysis chart for southern Davis Strait for 3 July 2008.

FICN14 CWIS 151400

Ice forecasts for the Western and Central Arctic issued by Environment Canada at 10:00 a.m. EDT Tuesday 15 July 2008 for today tonight and Wednesday. The next scheduled forecasts will be issued at 10:00 a.m. Wednesday.

Ice edge estimated from Nunavut near 6915N 11835W to 7030N 12015W to 7040N 12440W to 7220N 12645W to 7110N 12900W to 7105N 13315W then westwards. Sea ice north of the ice edge.

Baillie.

Open water except 1 tenth of old ice northeast of the ice edge.

Banks.

Open water except 1 tenth of old ice north and east of the ice edge.

Amundsen.

Open water except 1 tenth of first-year ice including a trace of old ice north of the ice edge.

Holman.

4 tenths of first-year ice including a trace of old ice.

Dolphin.

7 tenths of first-year ice including a trace of old ice.

Coronation.

9 tenths of first-year ice.

Dease.

9 plus tenths of first-year ice.

Maud.

10 tenths of first-year ice.

Larsen.

9 plus tenths of first-year ice including a trace of old ice.

Peel.

10 tenths of first-year ice including a trace of old ice.

Regent.

9 plus tenths of first-year ice including a trace of old ice.

Contact Nordreg Canada via marine radio for routing advice. Arctic ice analysis charts can be copied on VFA Inuvik at 0200 and 1630 UTC and on VFF Iqaluit at 0200, 0700, 1100 and 2200 UTC.

End

Figure I-6 – Daily Ice Forecast for Western and Central Arctic for 15 July 2008.

ANNEX II – China

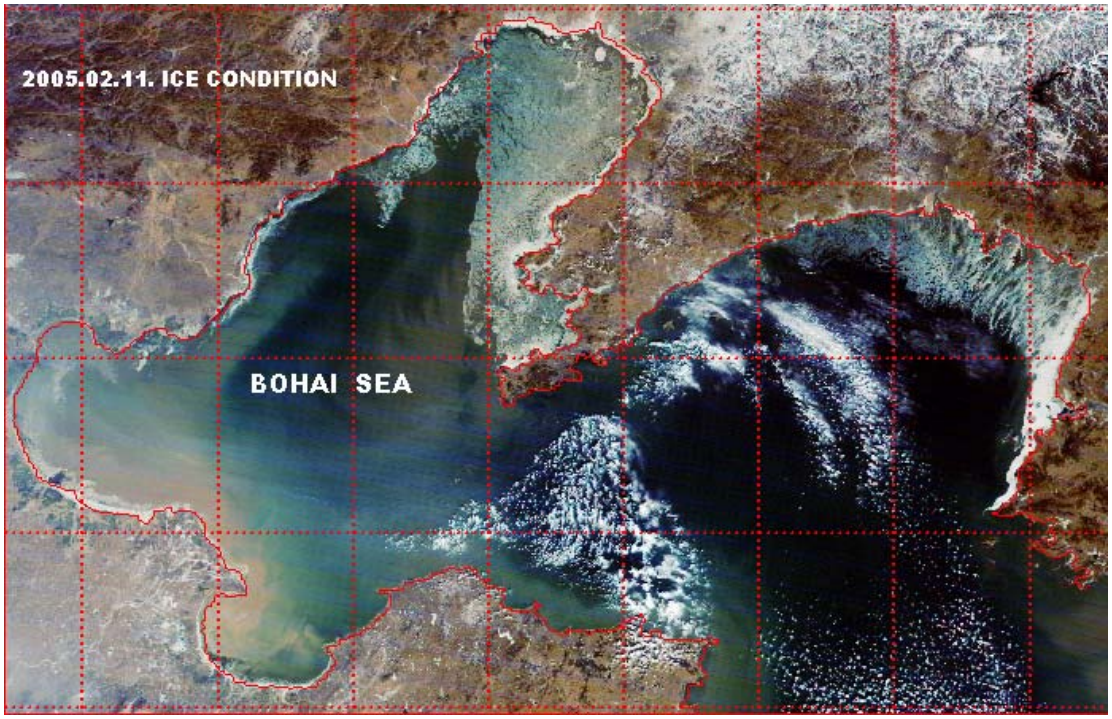


Figure II-1 – Sea Ice condition in the Bohai Sea on 11 February 2005 by the MODIS of the TERRA(EOS)

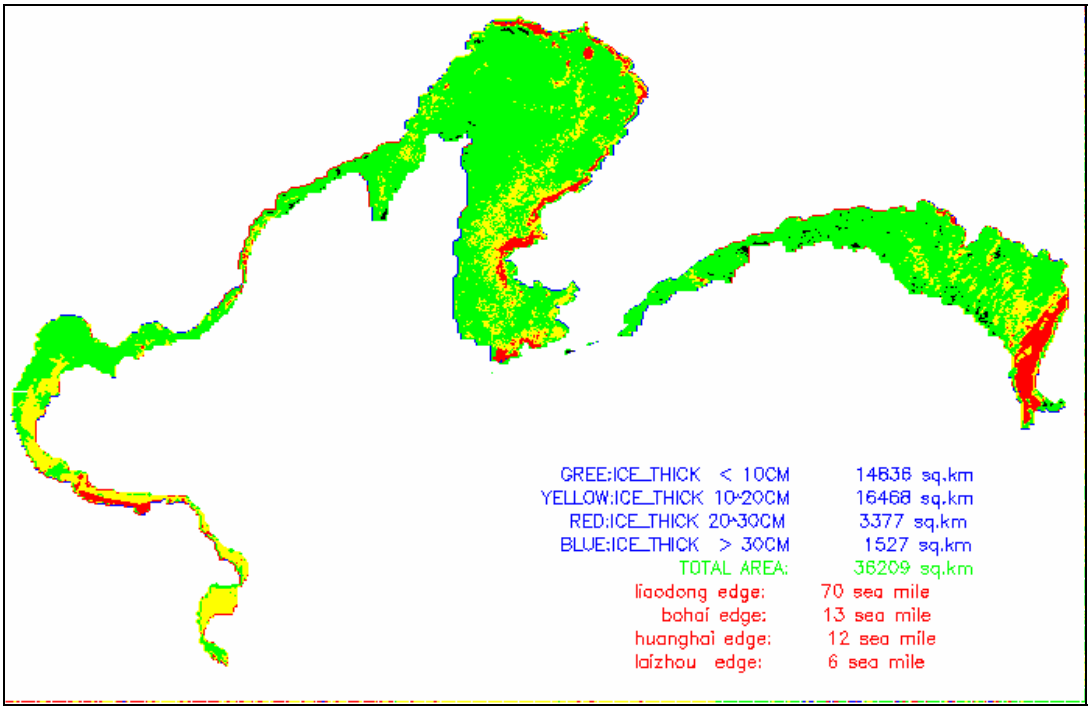


Figure II-2 – The analyzed chart of ice thickness and edge of the Bohai Sea on 11 February 2005

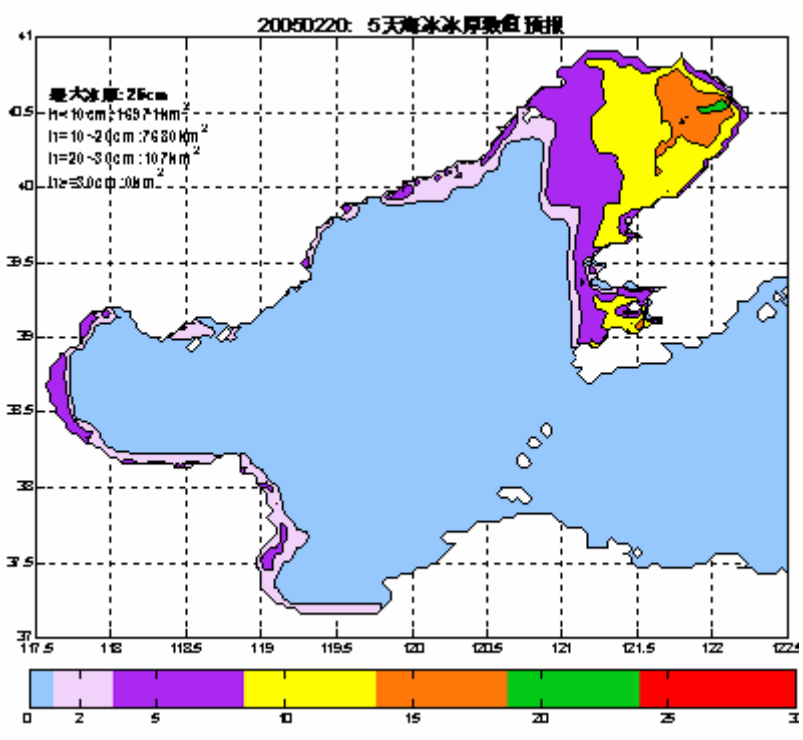


Figure II-3 – The 5th day forecast of ice thickness from 20 February 2005 in the Bohai Sea by the PIC ice model

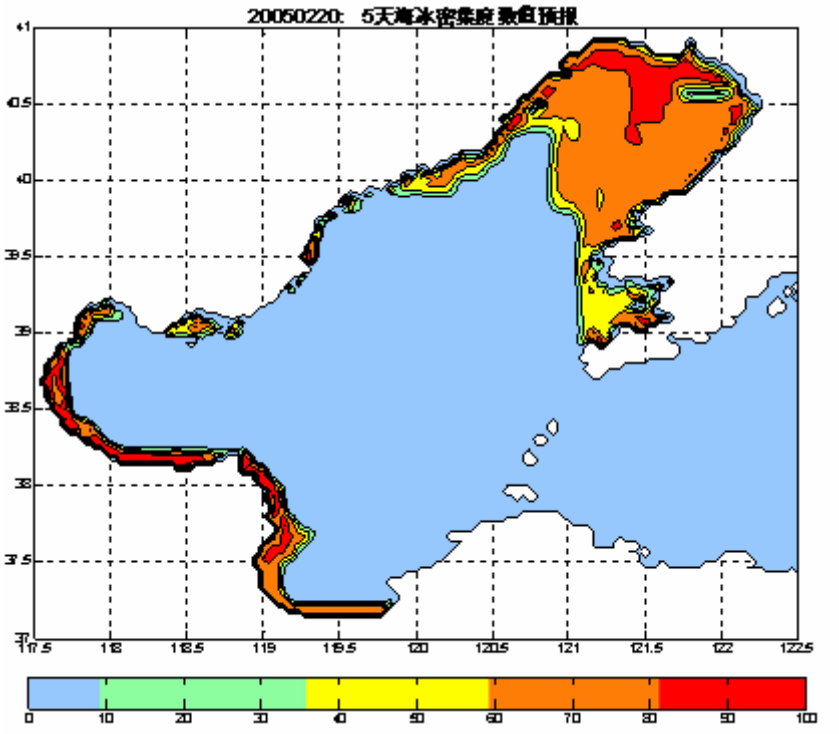


Figure II-4 – The 5th day forecast of ice concentration from 20 February 2005 in the Bohai Sea by the PIC ice model

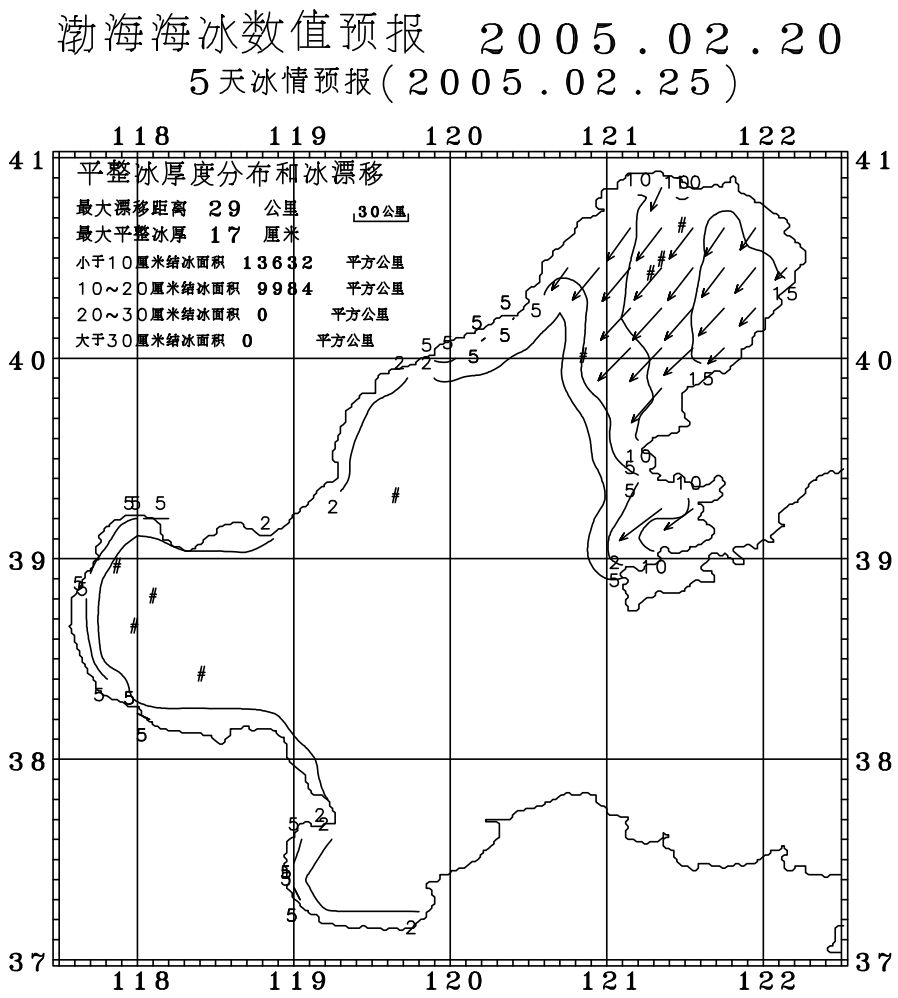


Figure II-5 – The 5th day forecast of ice drift (arrow) and thickness (isoline) from 20 February 2005 in the Bohai Sea with the operational ice model

ANNEX III – Denmark

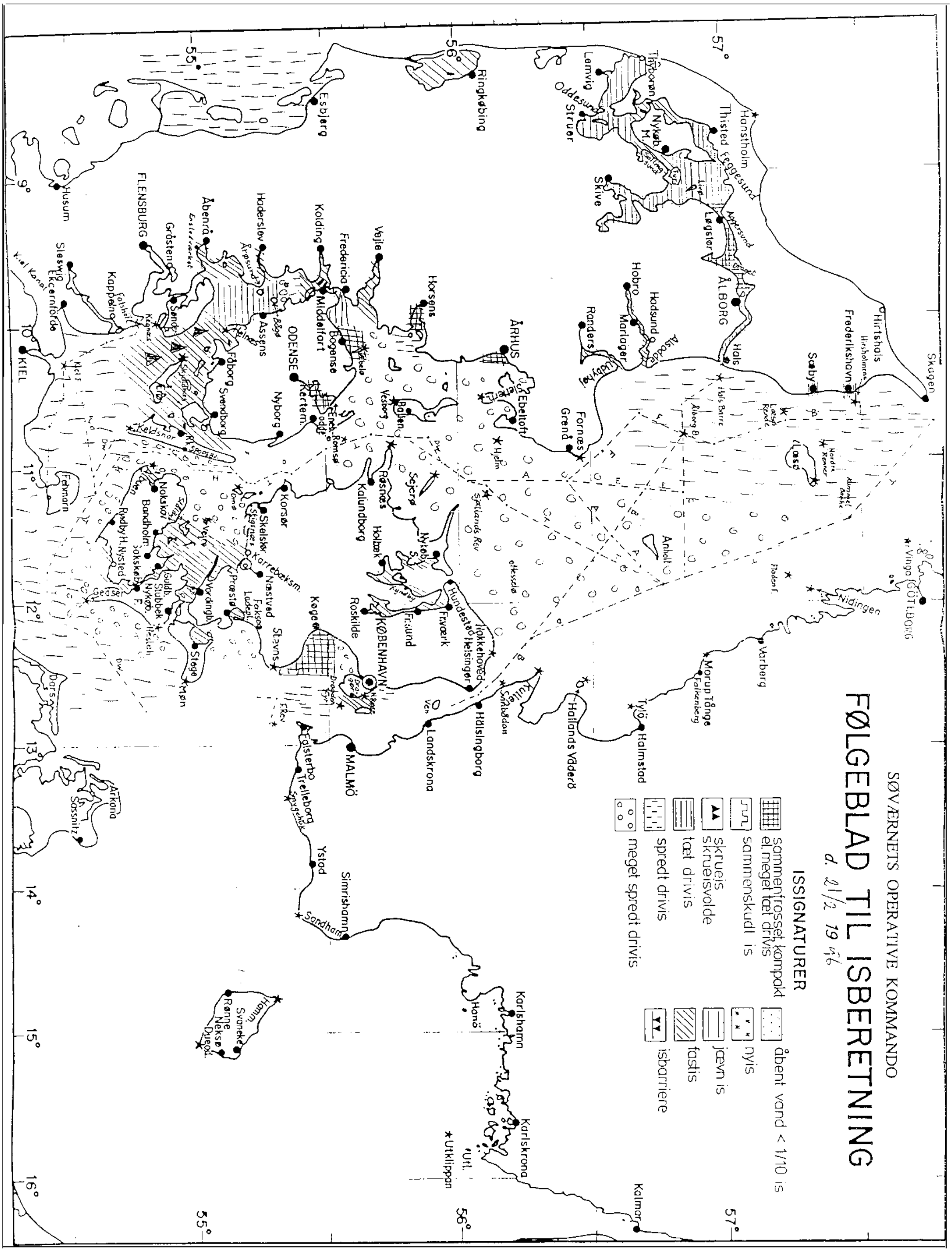


Figure III-1 – Ice chart for the Danish Waters.

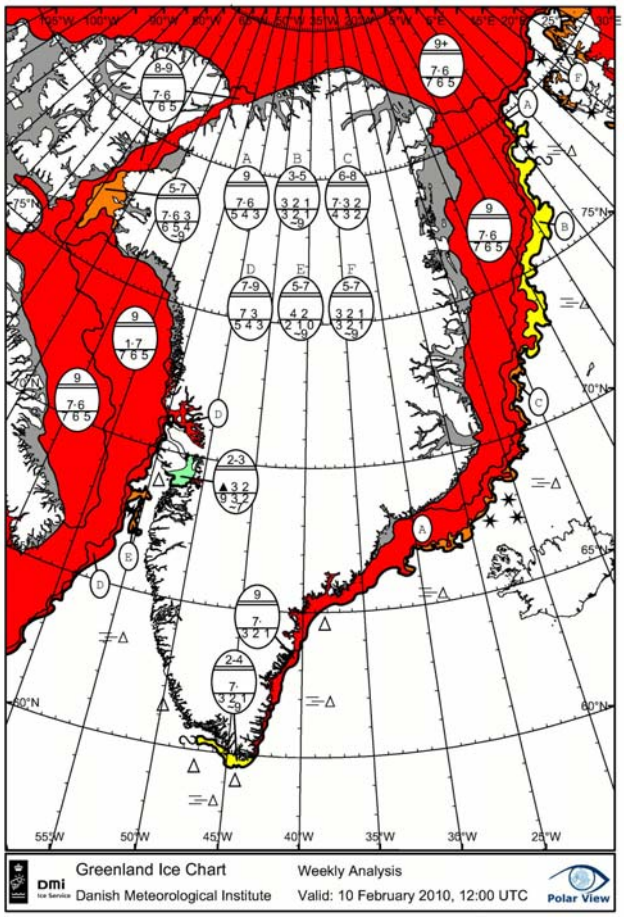


Figure III-2 – Weekly ice analysis for Greenland waters, 10 February 2010

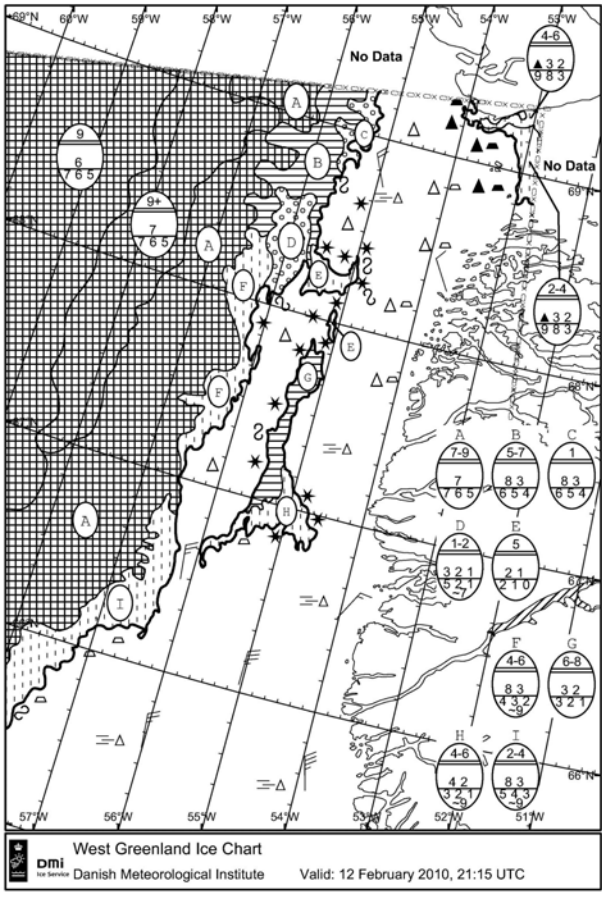


Figure III-3 – West Greenland ice chart for 12 February 2010 21:45

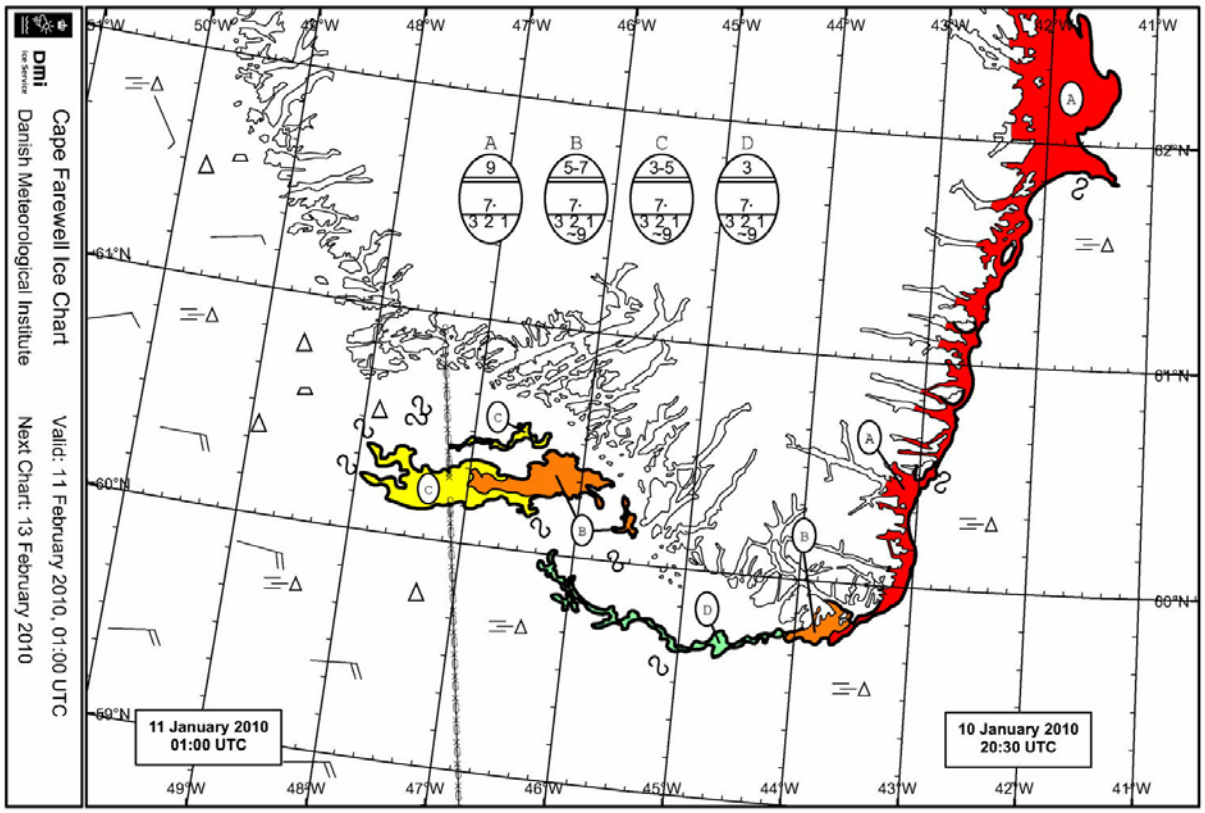


Figure III-4 – Cape Farewell ice chart for 11 February 01:00 2010.

ANNEX IV - Estonia

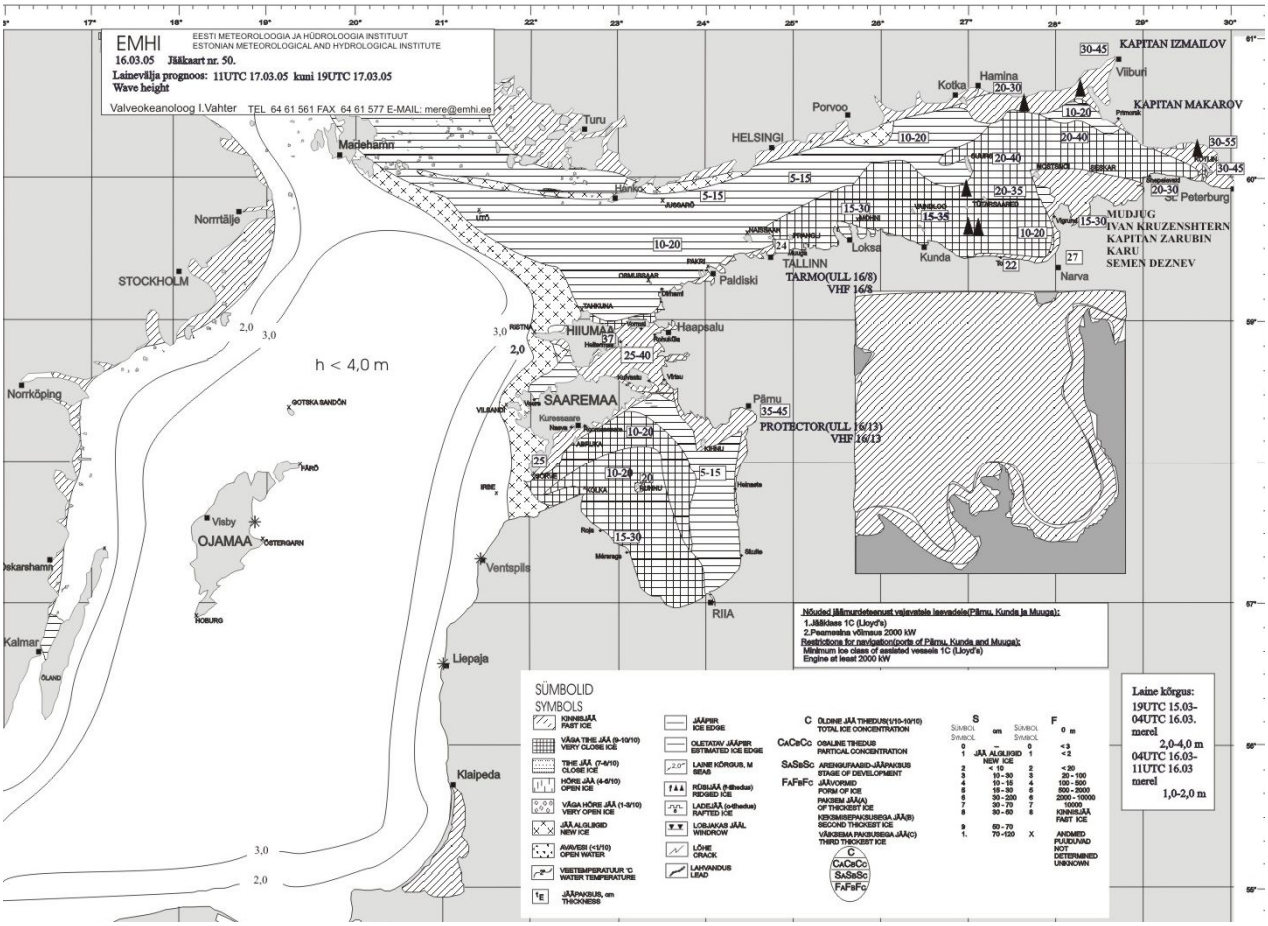


Figure IV-1 – Ice chart for the Baltic proper for 16 March 2005.

ANNEX V - Finland

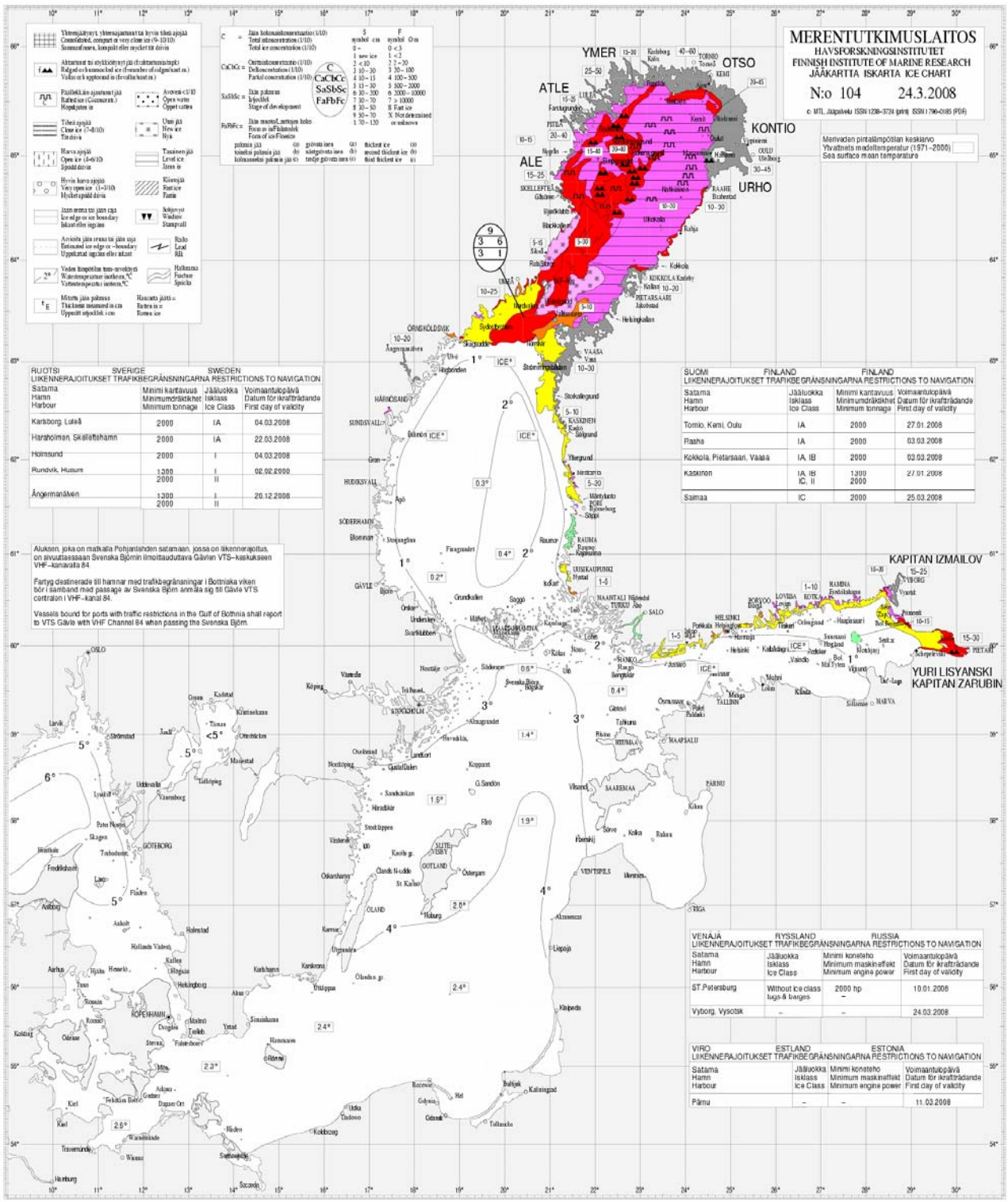


Figure V-1 – Example of Finnish ice chart on 24 March 2008.

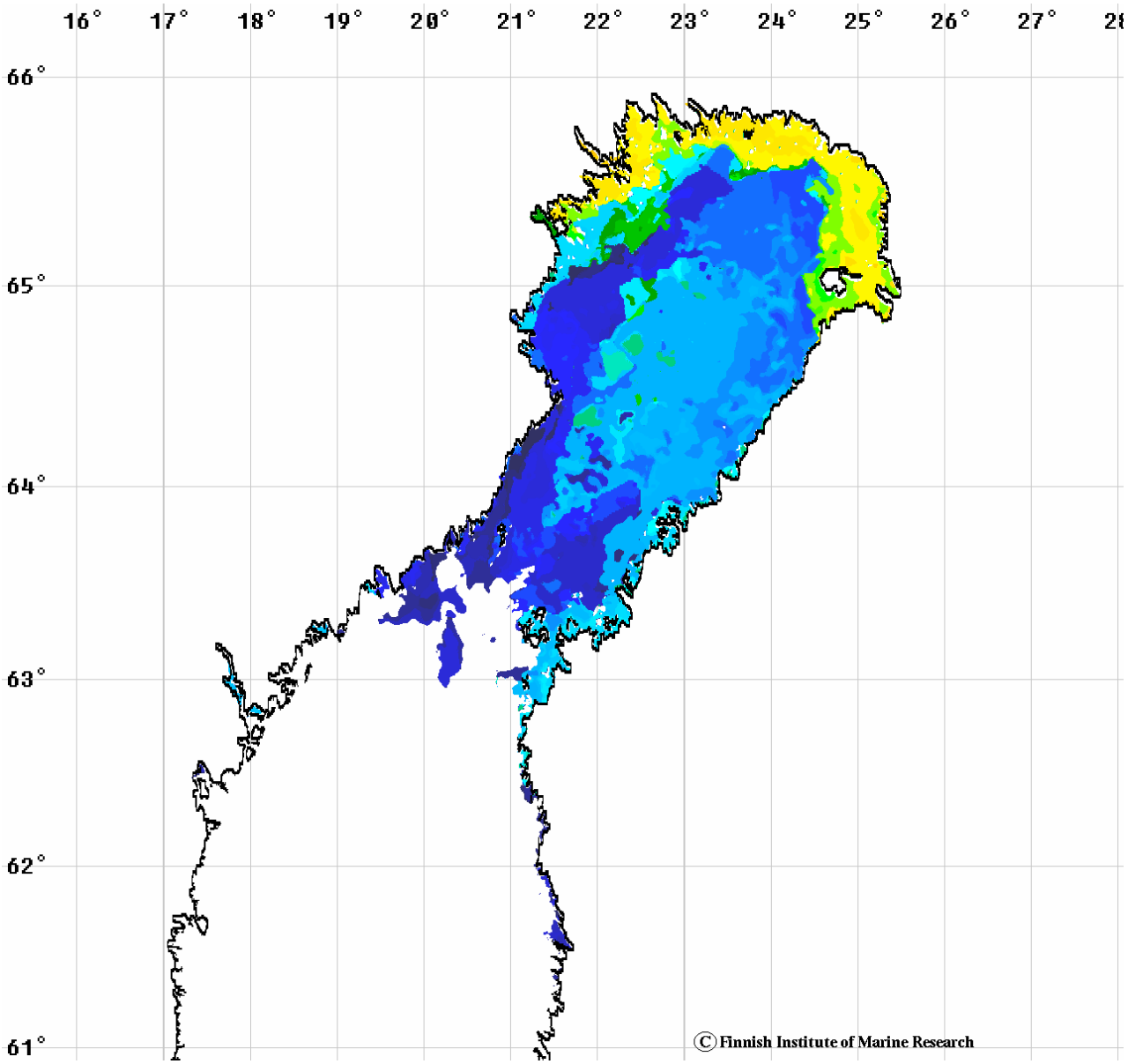


Figure V-2 – Example of high-resolution ice thickness map on 23 March 2008.

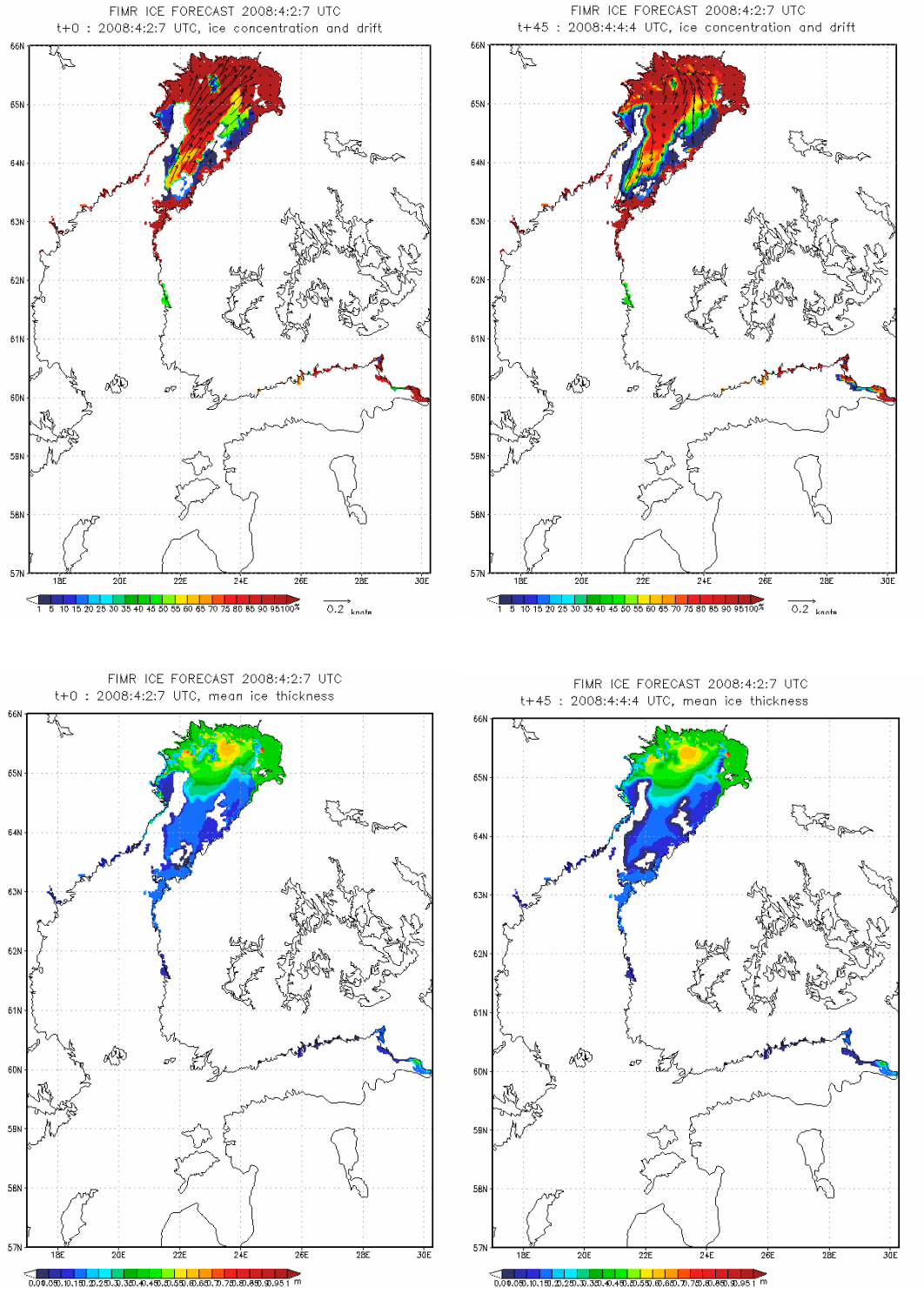


Figure V-3 – Examples of Finnish ice forecasts (0h and +45h)

ANNEX VI – Germany

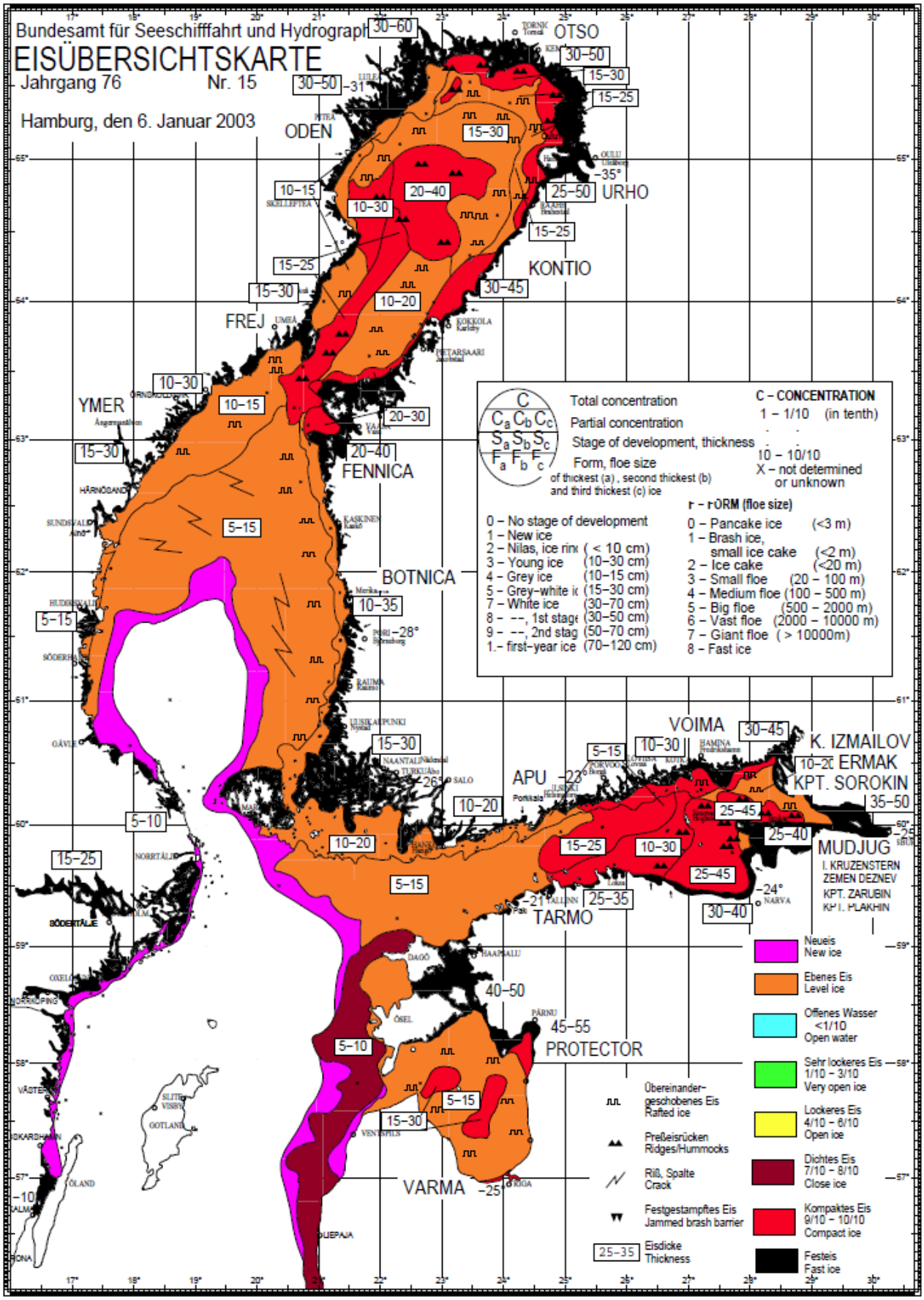


Figure VI-1 – Ice chart for the Baltic proper northward of 56ºN, 6 January 2003.

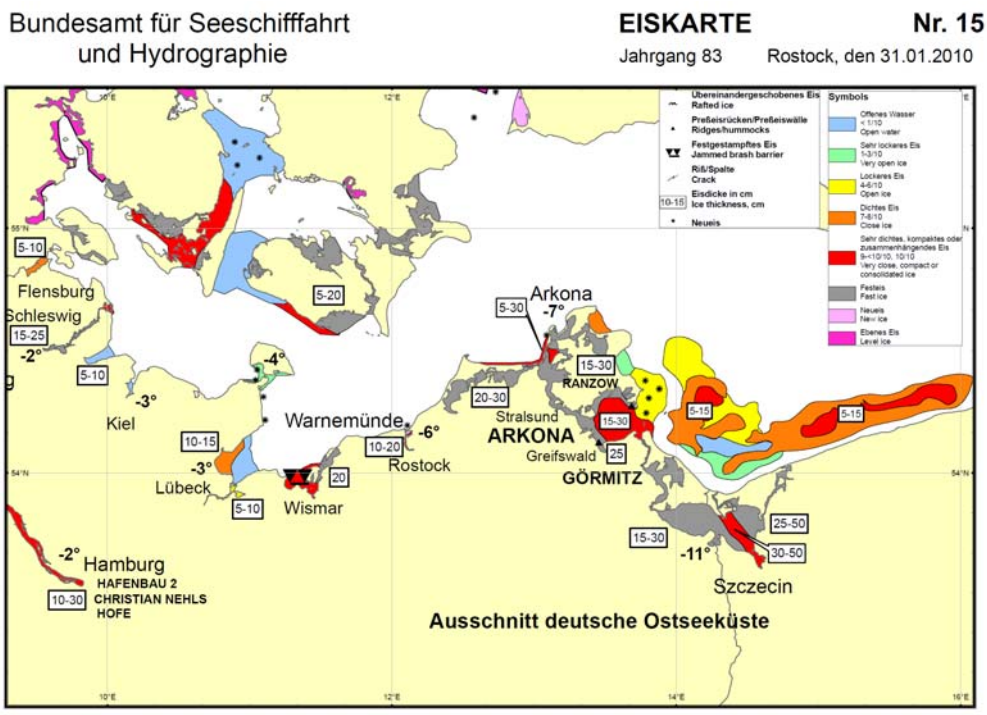


Figure VI-2 – German Baltic Sea coast chart, 31 January 2010.

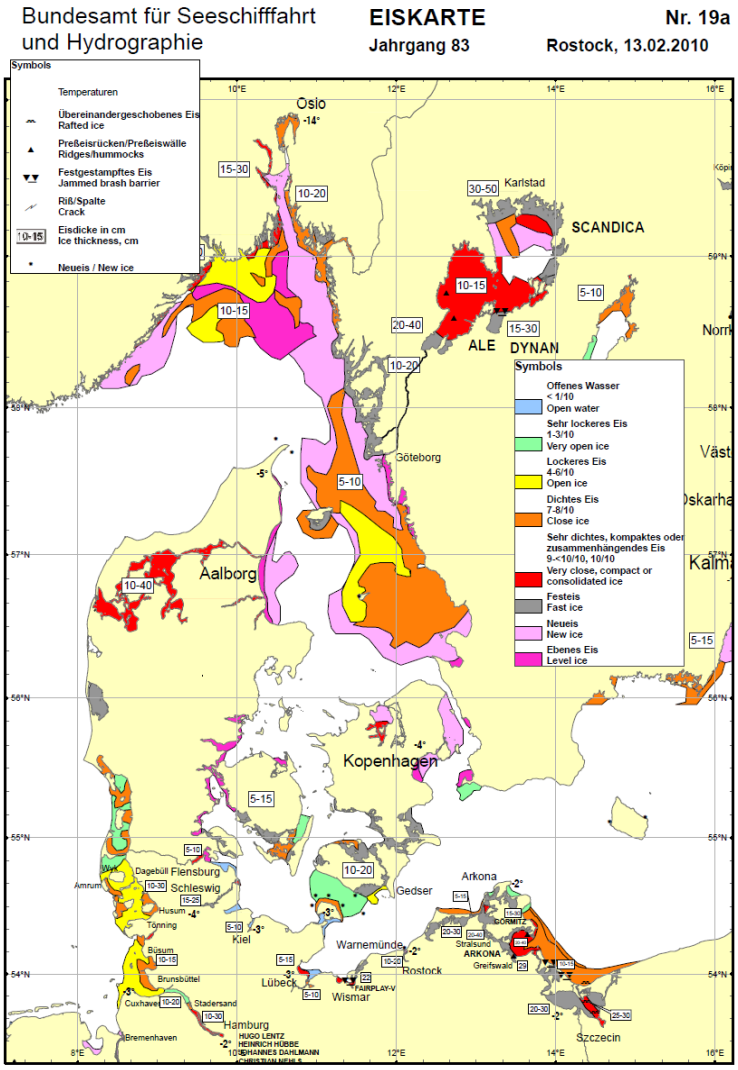


Figure VI-3 – Western Baltic Sea area and North Sea coast ice chart for 13 February 2010.

ANNEX VII – Japan

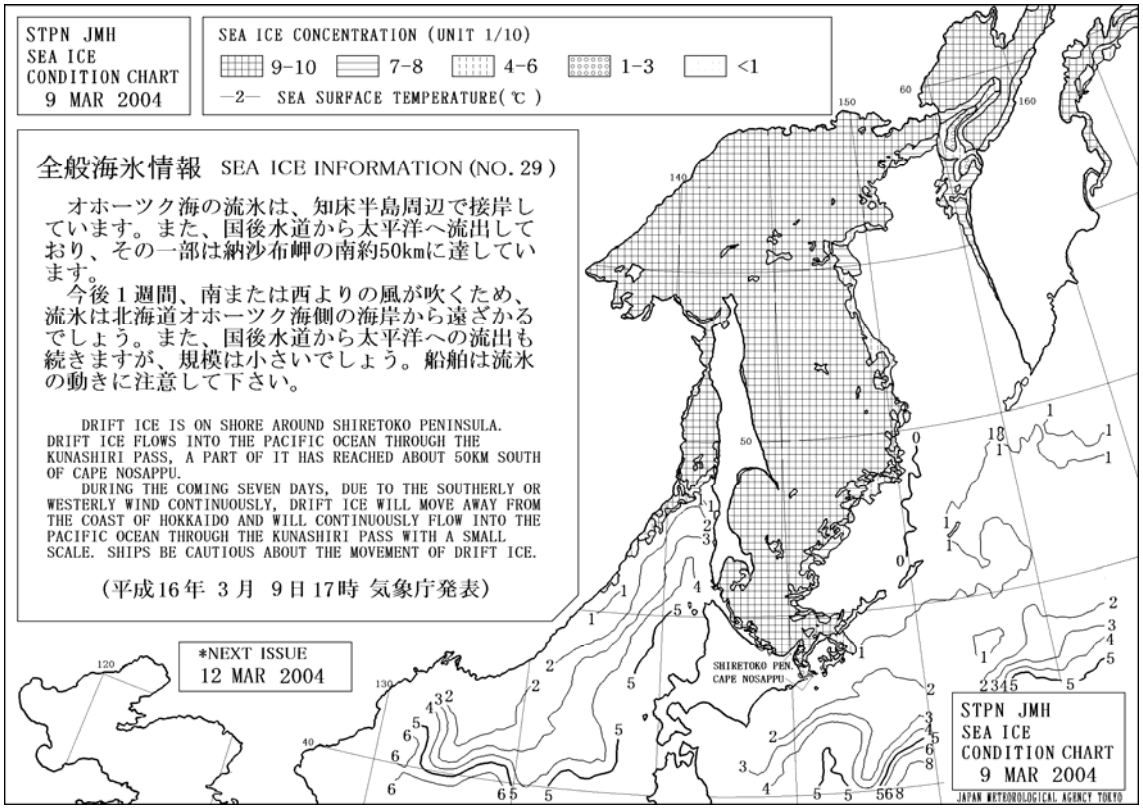


Figure VII-1 — Ice chart for the Sea of Japan and Sea of Okhotsk for 9 March 2004.

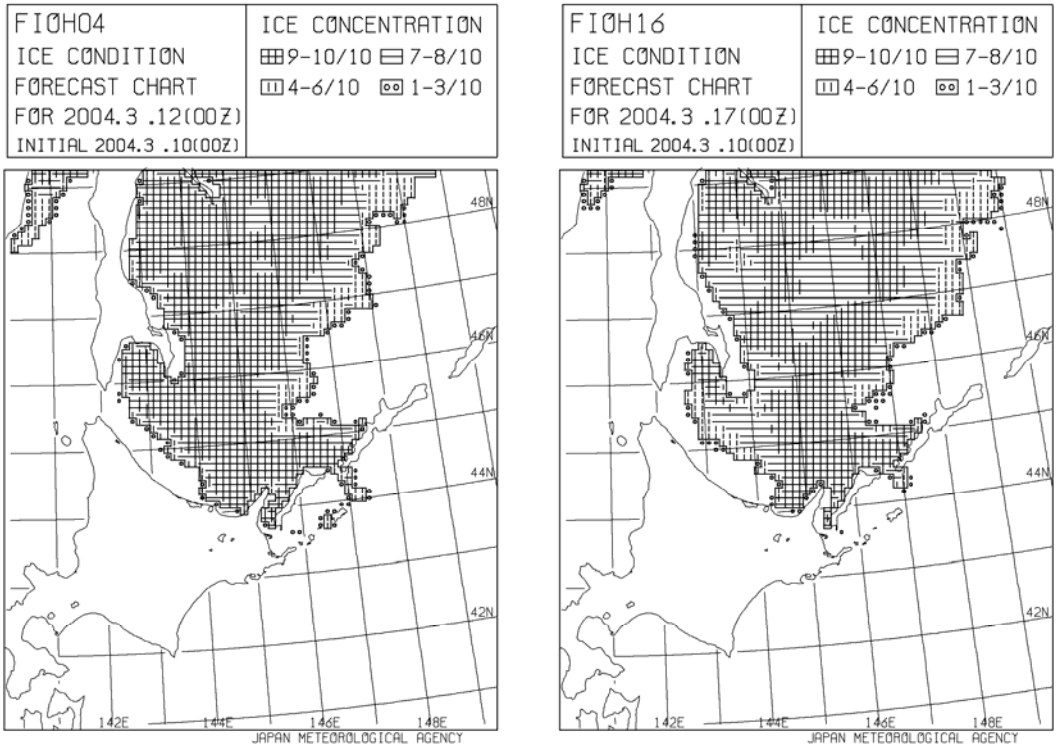


Figure VII-2 — Ice condition forecast charts for 12 and 17 March 2004 for the southern part of the Sea of Okhotsk(initial conditions from 10 March 2004).

ANNEX VIII – Norway

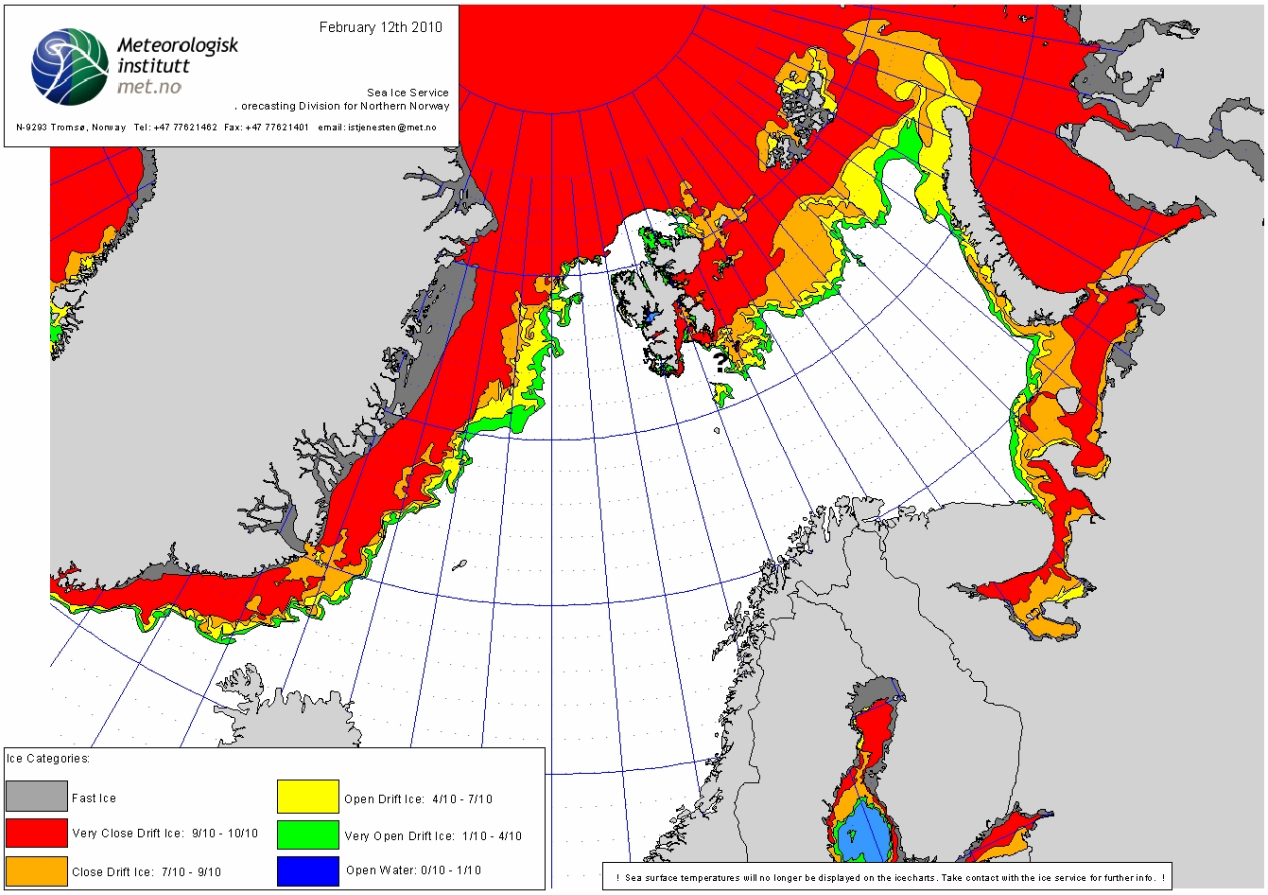


Figure VIII-1 – Daily ice chart for the Atlantic sector of the Arctic for 12 February 2010.

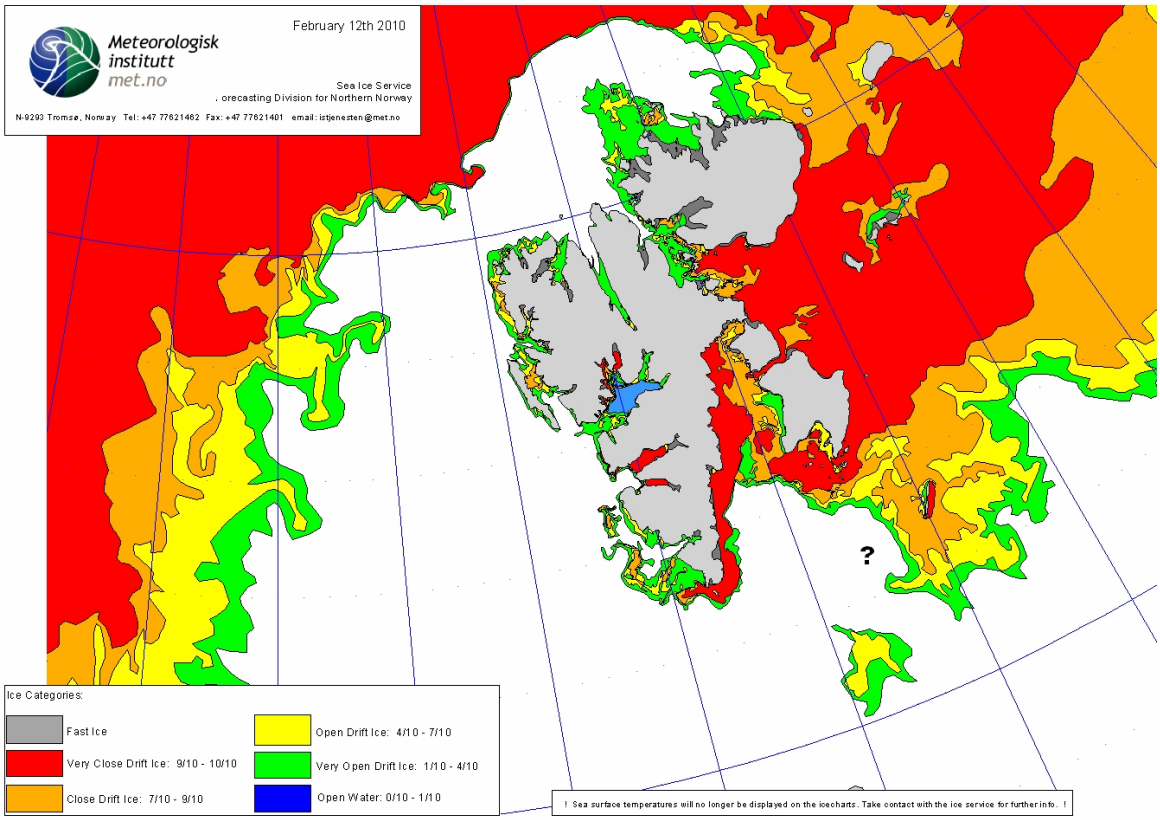


Figure VIII-2 – High-resolution ice chart for the Svalbard area for 12 February 2010.

ANNEX IX - Poland

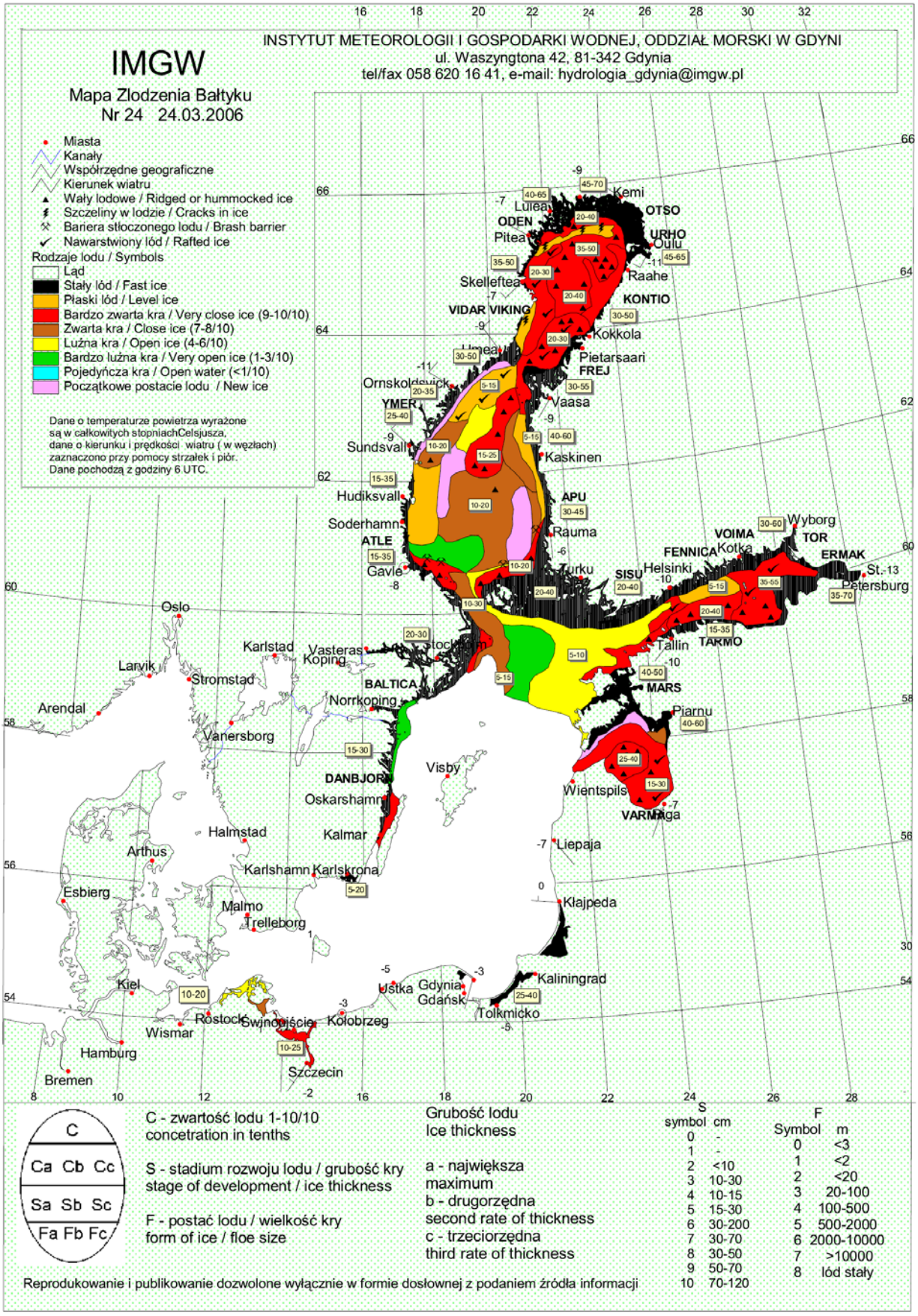


Figure IX-1 – Ice chart for the Baltic Sea on 24 March 2006.

ANNEX X – Russian Federation

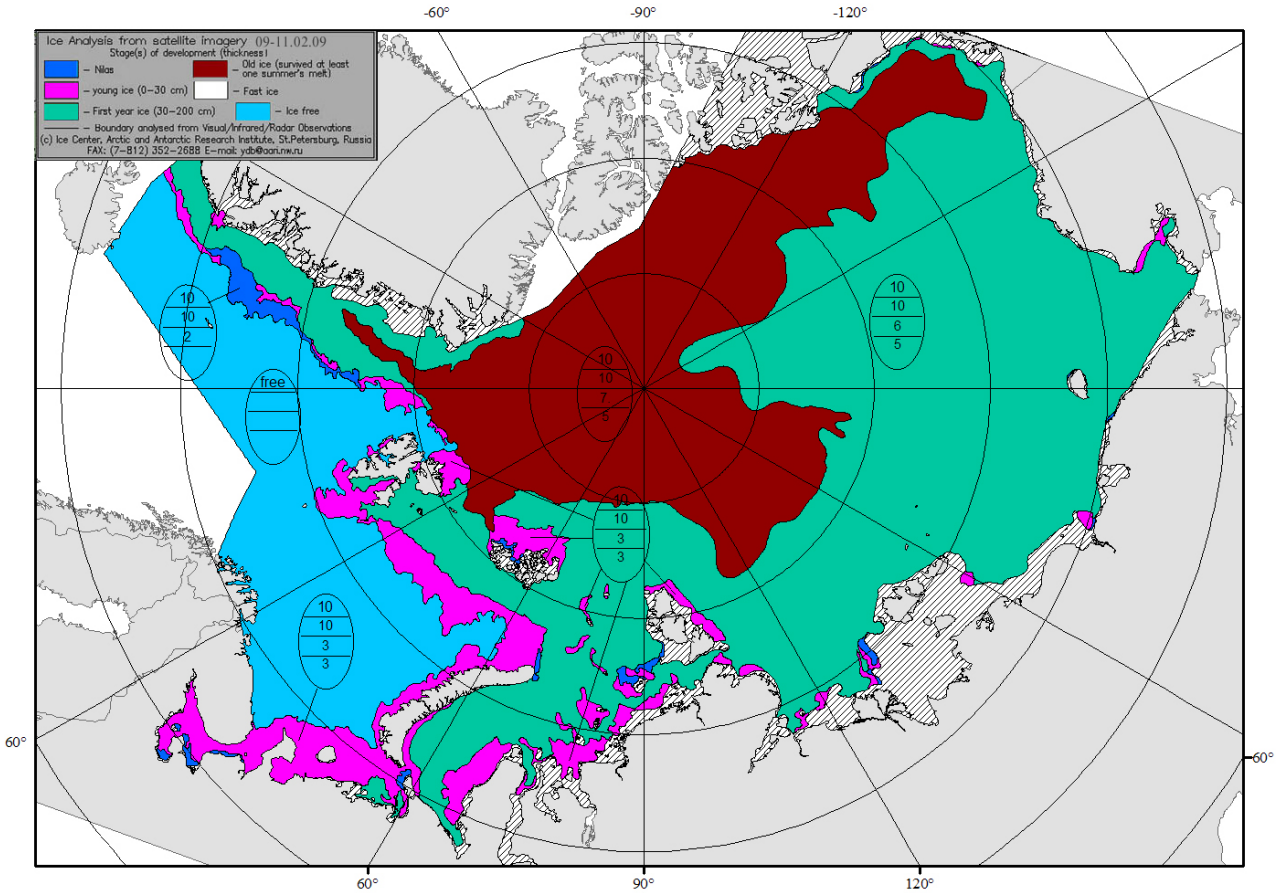


Figure X-1 – Common usage ice chart for the Arctic Ocean on 9 February 2009.

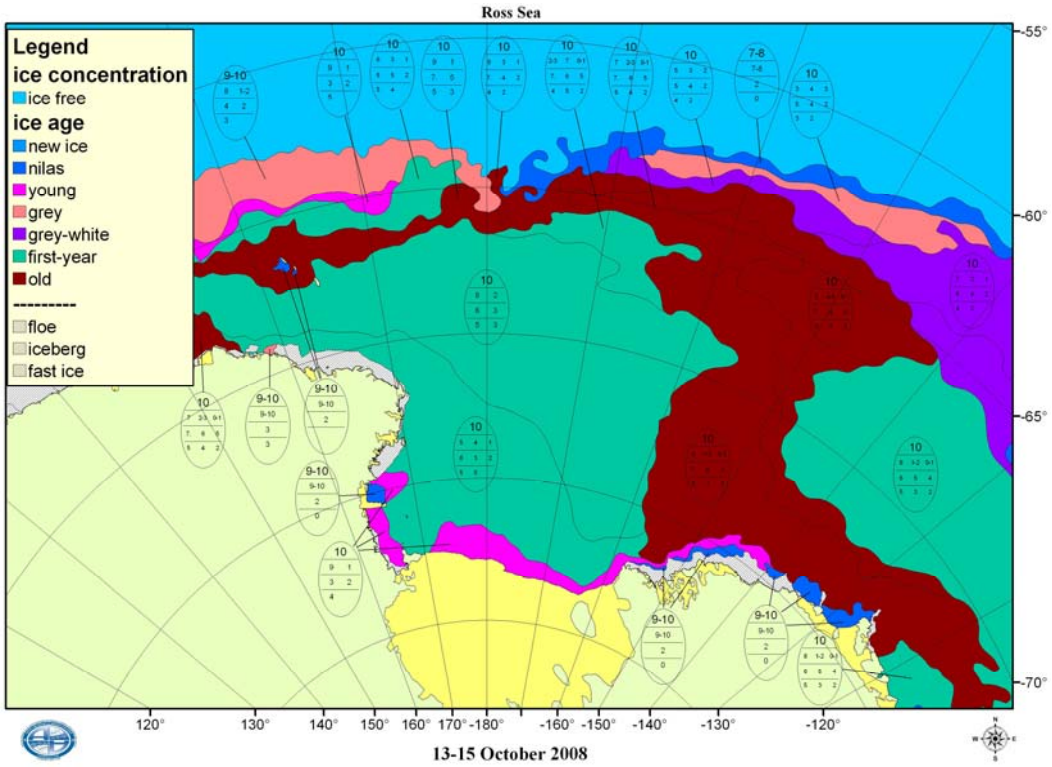


Figure X-2 – Antarctic sea ice analysis: Pacific sector (Ross Sea) for 13-15 October 2008.

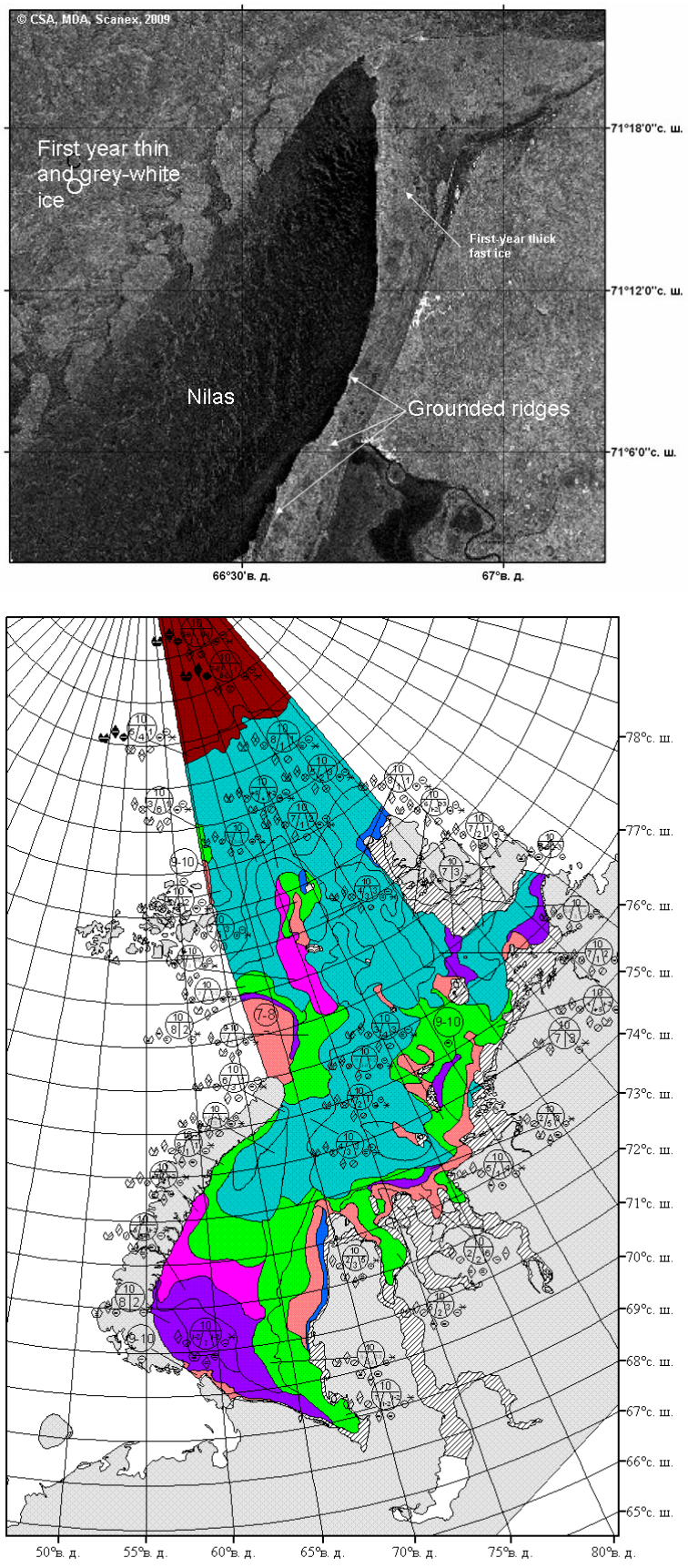


Figure X-3 – Background Radarsat-1 fine beam imagery for 5 February 2009 12:54 for the area near Yamal peninsula and detailed ice chart in Russian national symbology for the Kara Sea, 2-4 February 2009.

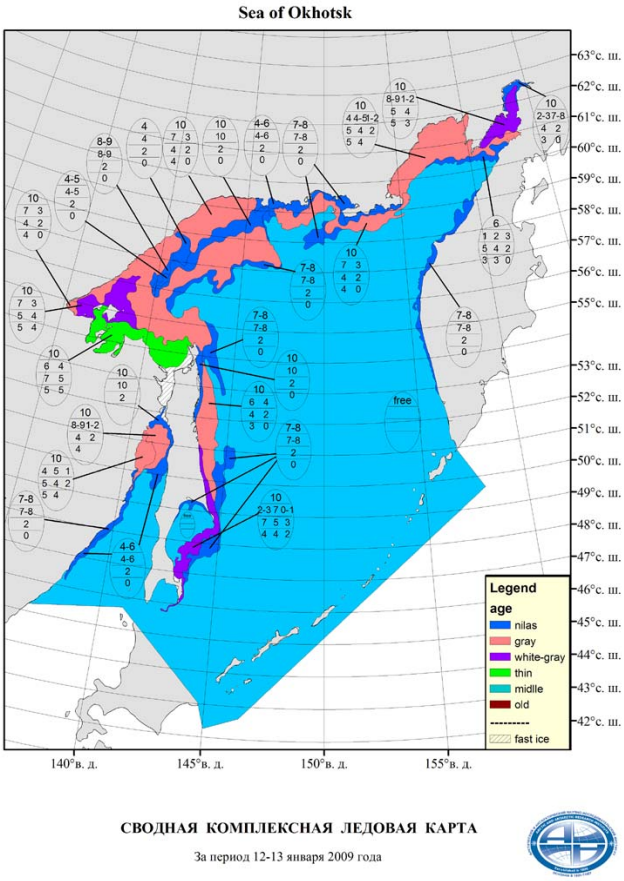


Figure X-4 –Detailed ice chart for the Sea of Okhotsk and Tatar Strait for 12-13 January 2009.

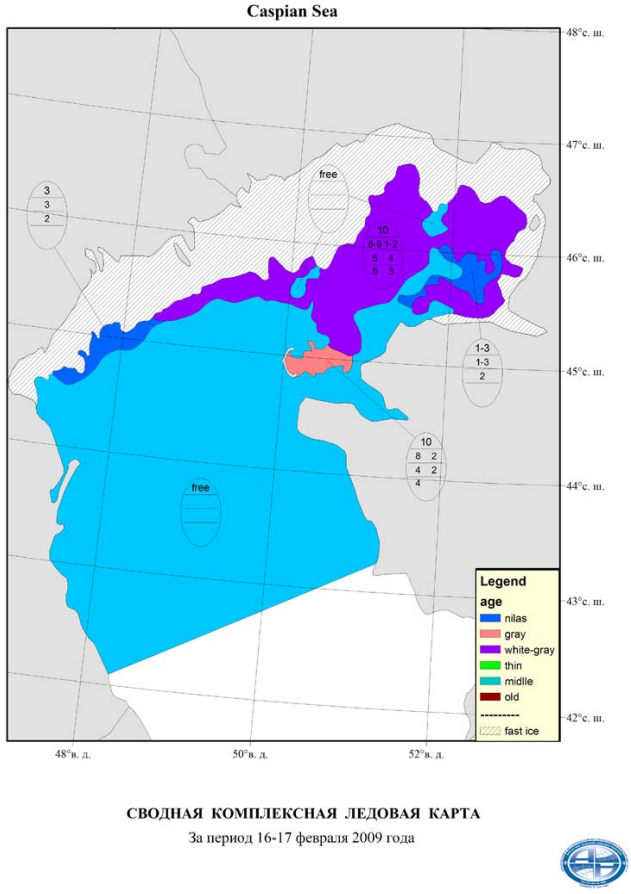
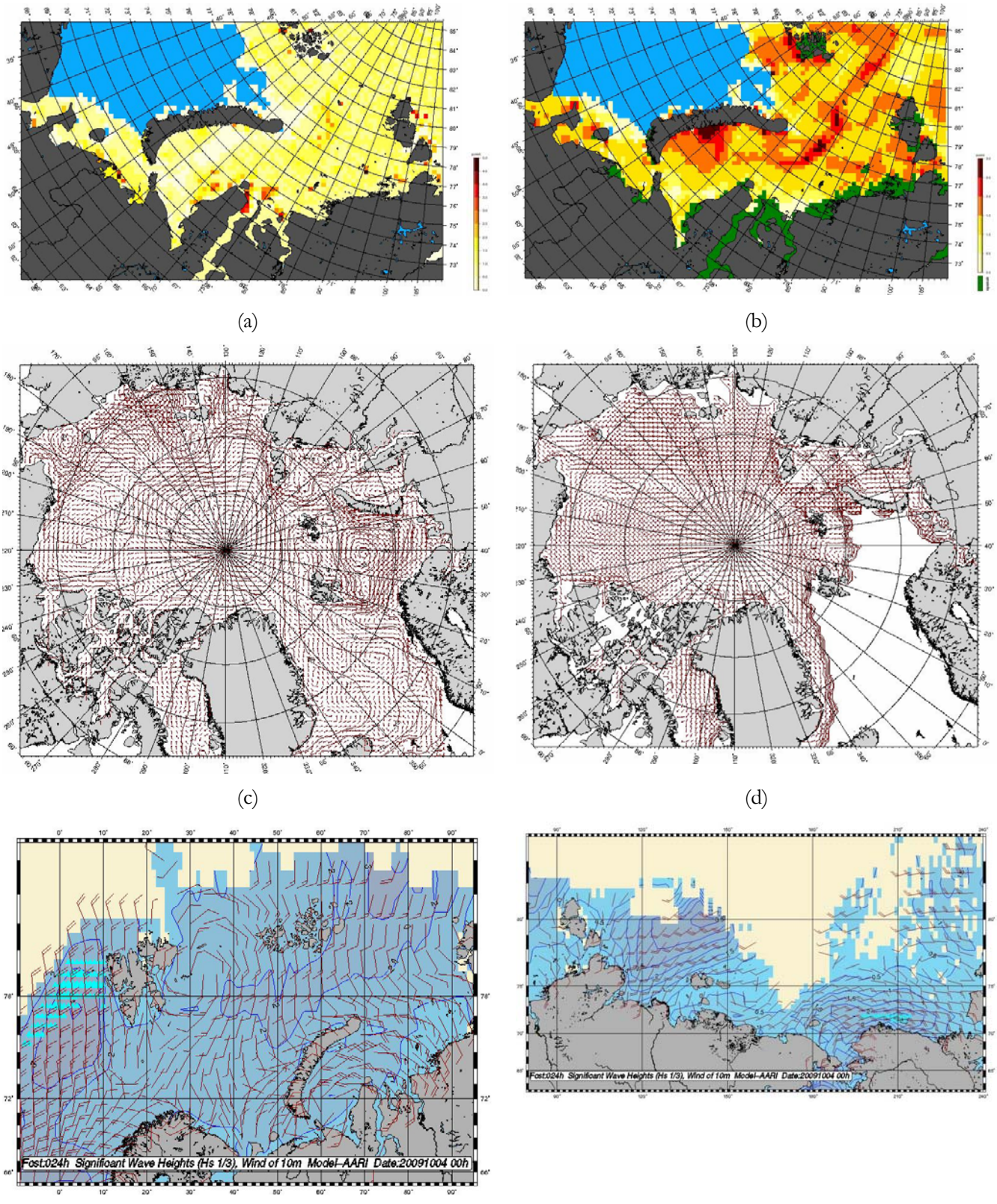


Figure X-5 –Detailed ice chart for the Caspian Sea for 16-17 February 2009.



(a) (b)

(c) (d)

(e) (f)

Figure X-6 – Short-term prognostic charts: 2010-02-05 +024h for the Barents-Kara Seas: hummocks concentration (a) and level of ice compacting (b); 2010-02-05 +024h for the Arctic Ocean: surface currents and level elevation (c) and mean daily ice drift (d); 2009-10-03 +024h significant (3%) waves height, level of ice accretion and surface widn vectors for the Western Eurasian (e) and Eastern Eurasian (f) Arctic seas.

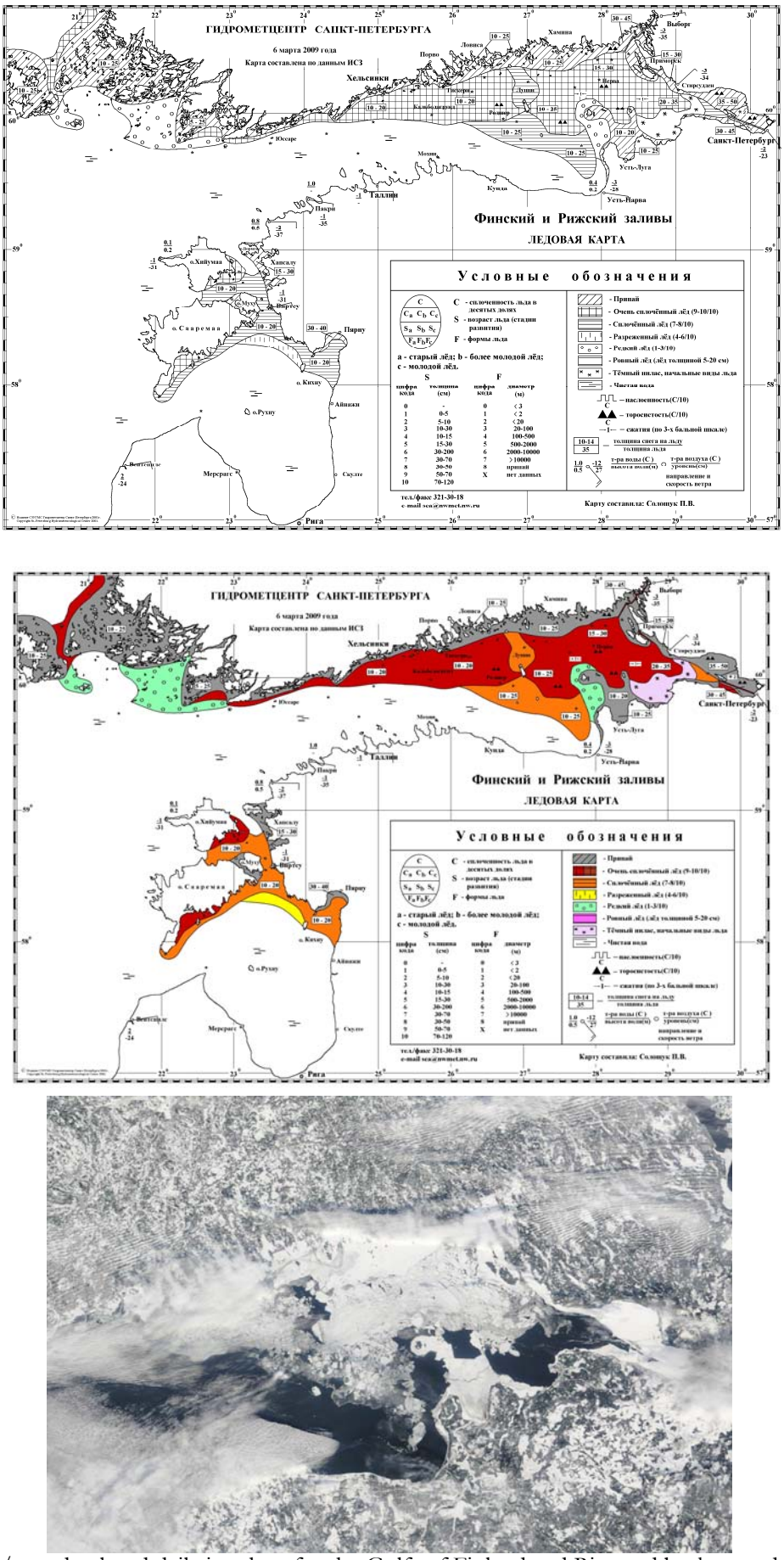


Figure X-7 – B/w and colored daily ice chart for the Gulfs of Finland and Riga and background NOAA visible imagery on 6 March 2009.

ANNEX XI – Sweden

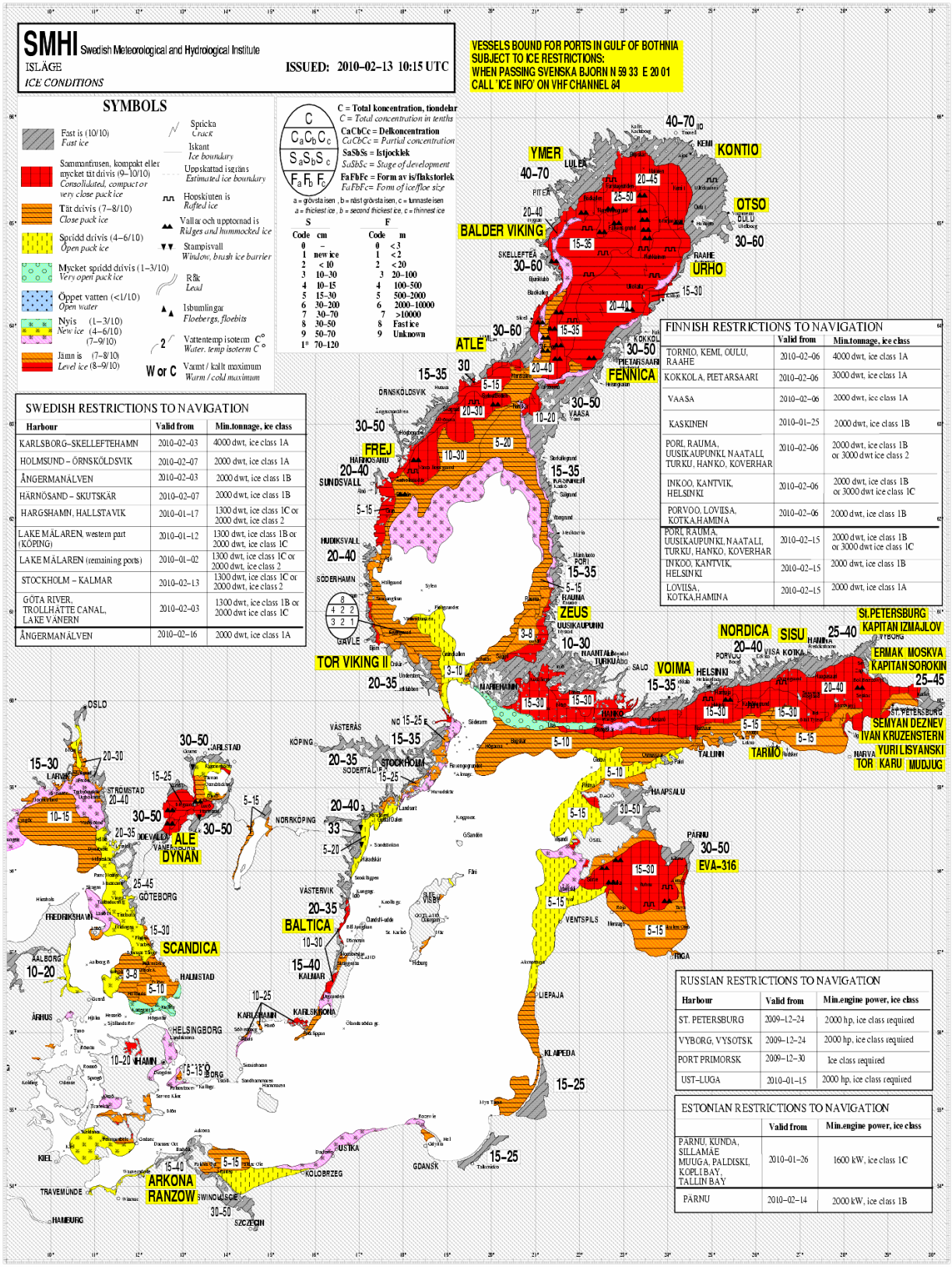


Figure XI -1 – Daily ice chart for the Baltic Sea, 13 February 2010, 10:15

ANNEX XII - United States

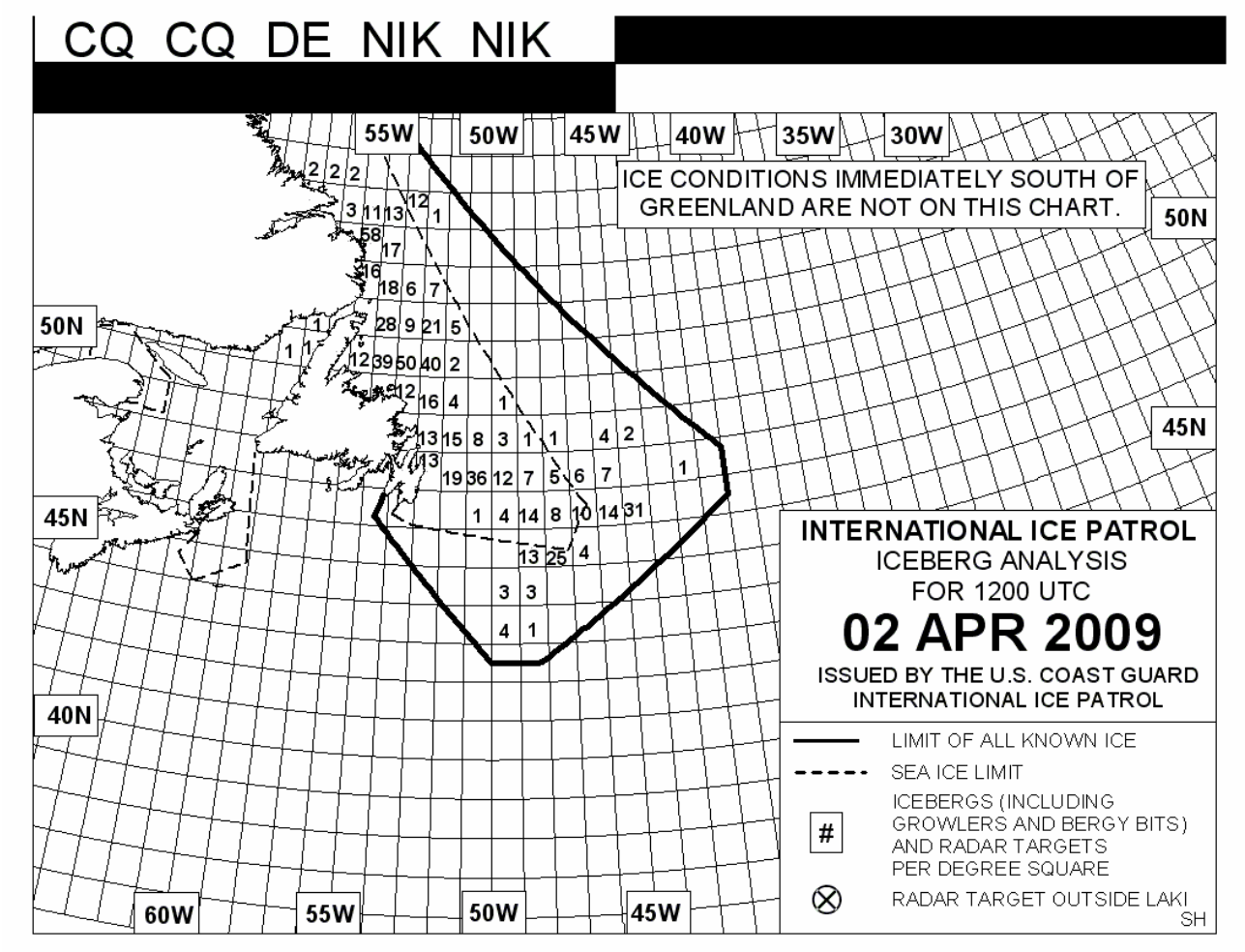


Figure XII-1 – Iceberg chart produced by the US Coast Guard International Ice Patrol for 2 April 2009.

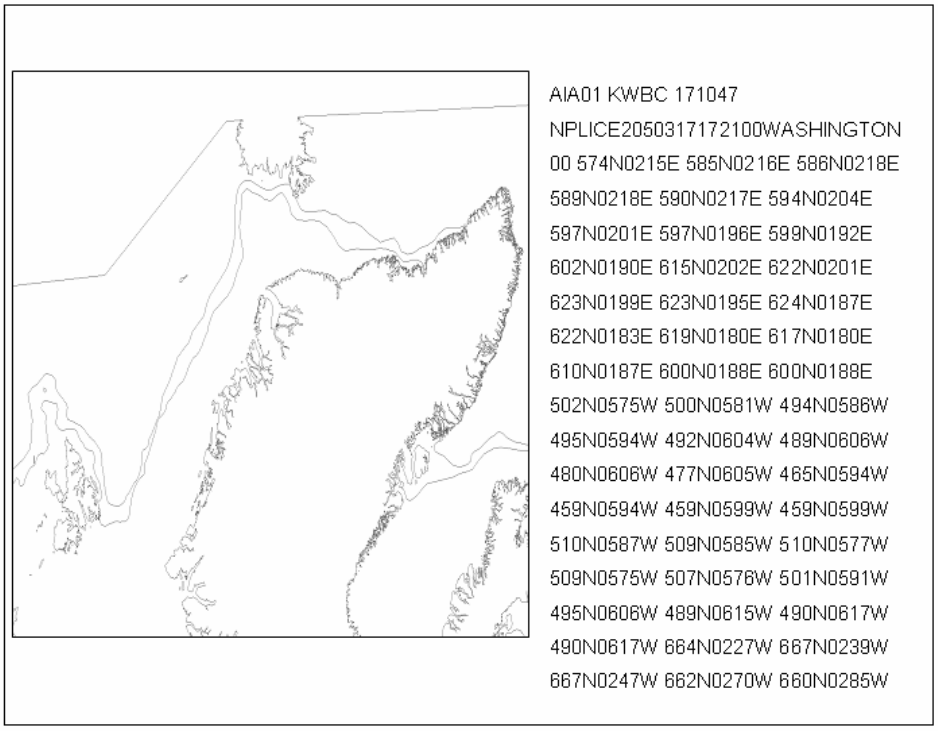


Figure XII-2 – Alphanumerical text message and corresponding graphical output for the ice edge position (Daily Ice Edge (DIE)) from 17 March 2005

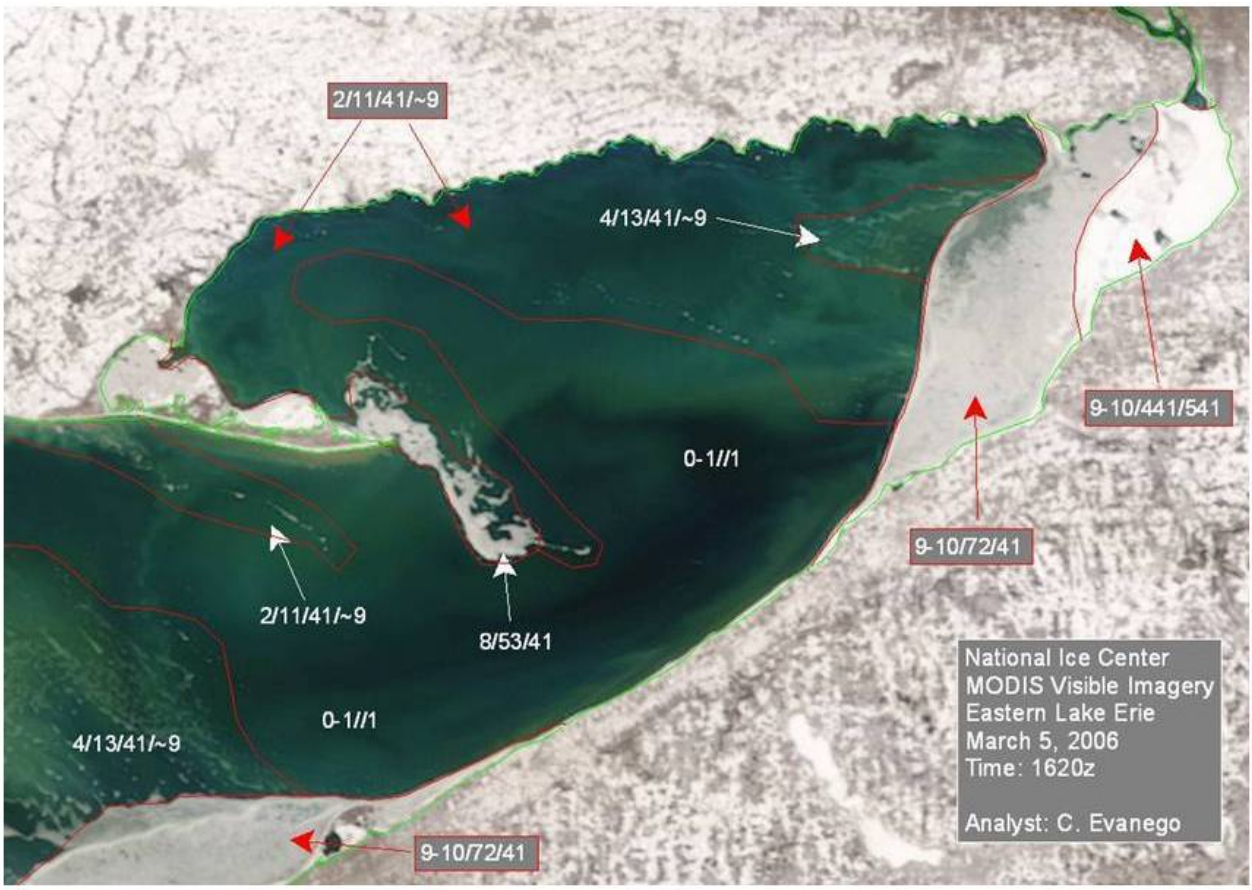


Figure XII-3 – Annotated MODIS visible imagery for Great Lakes for 5 March 2006.

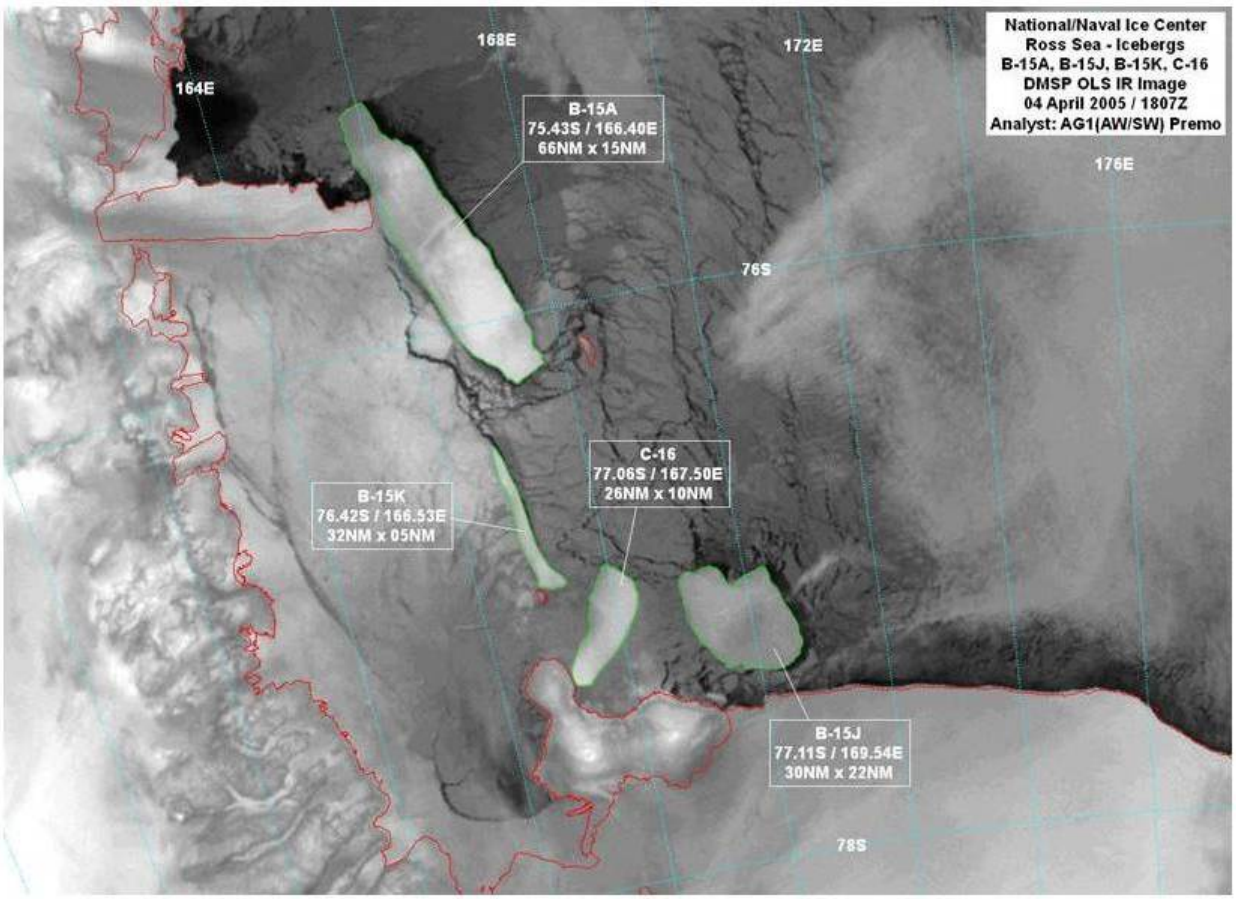


Figure XII-4 – Annotated DMSP OLS visible imagery for Ross Sea for 4 April 2005.

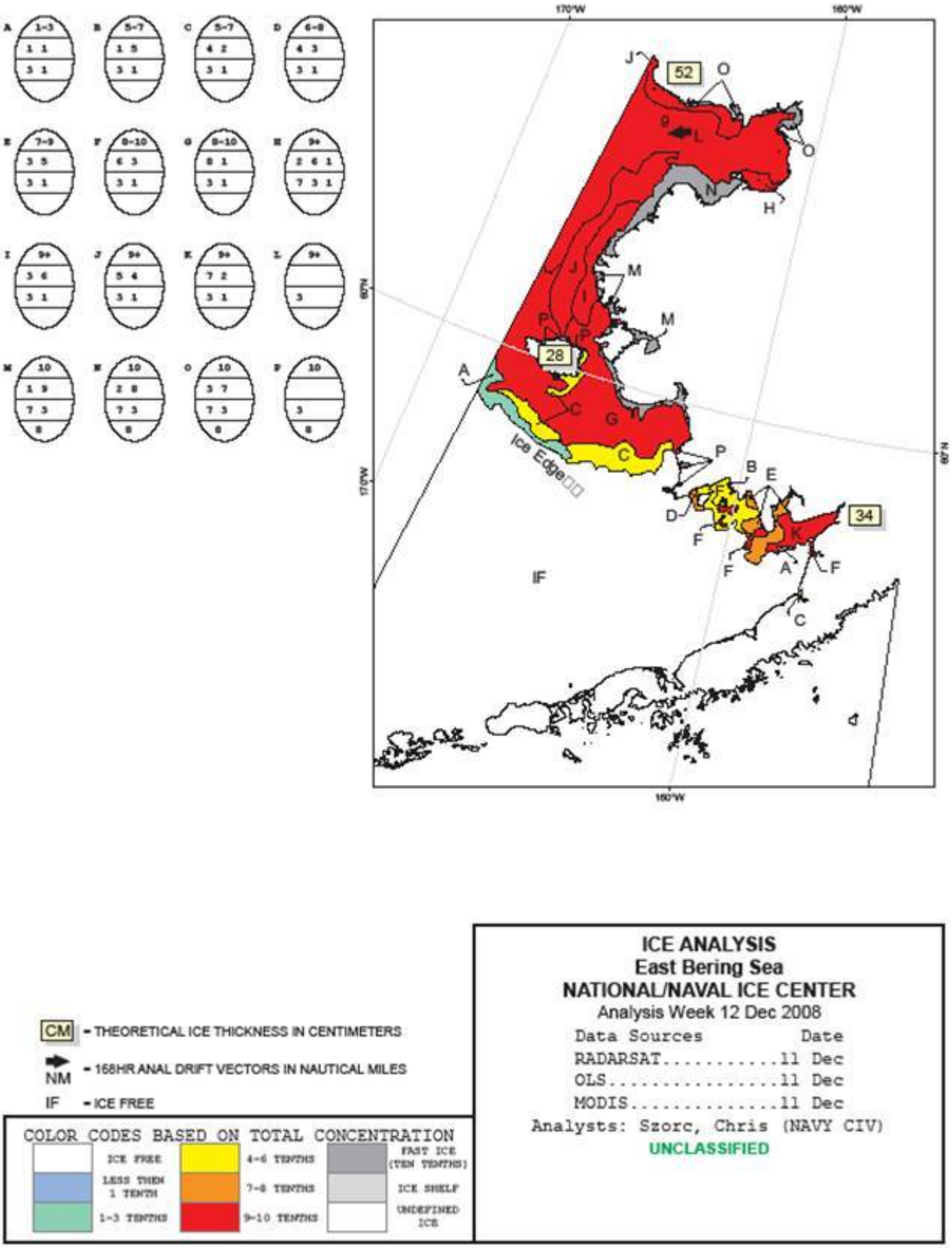


Figure XII-5 – Ice chart for the Eastern Bering Sea for 12 December 2008.

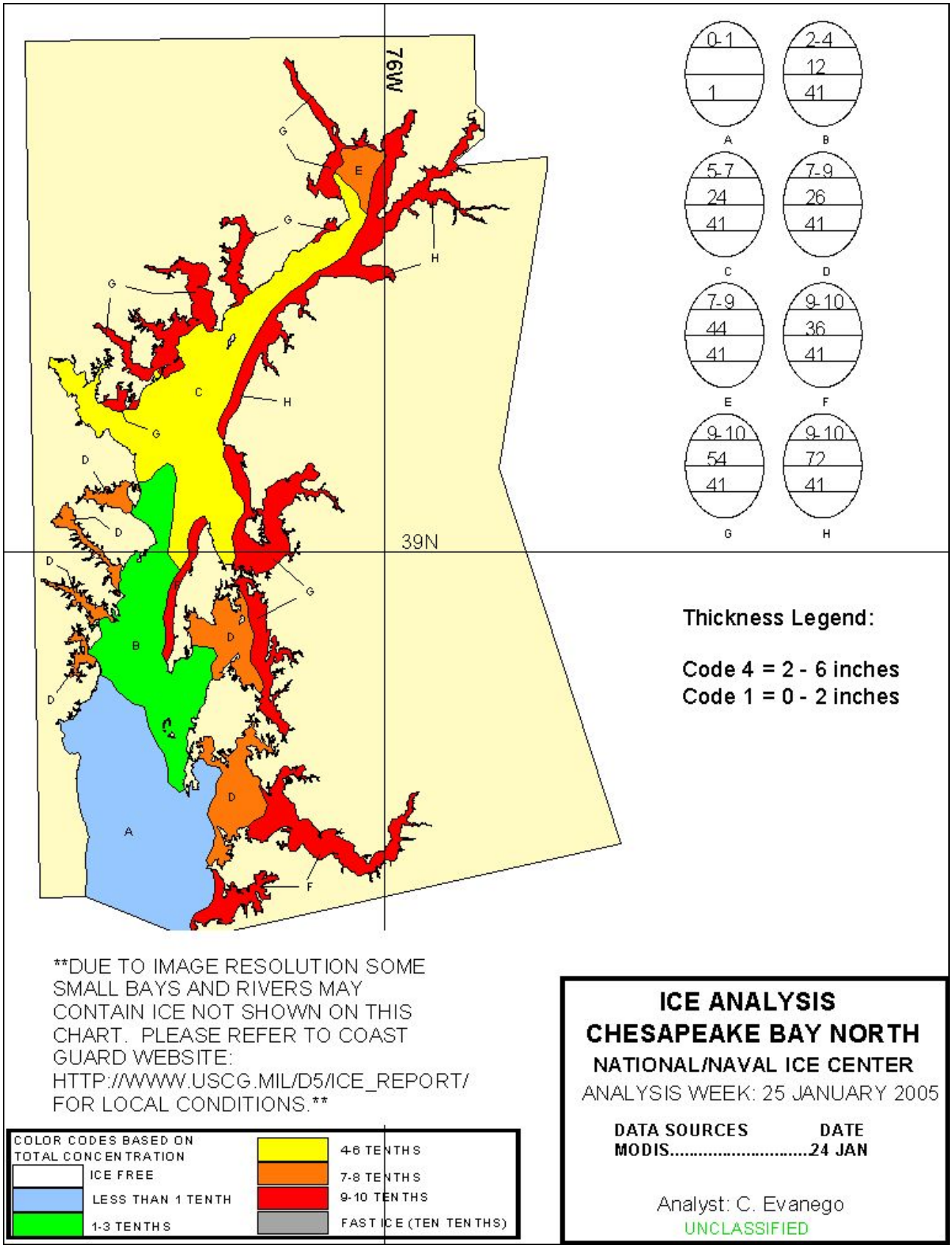


Figure XII-6 – Ice chart for the Northern Chesapeake Bay for 25 January 2005.

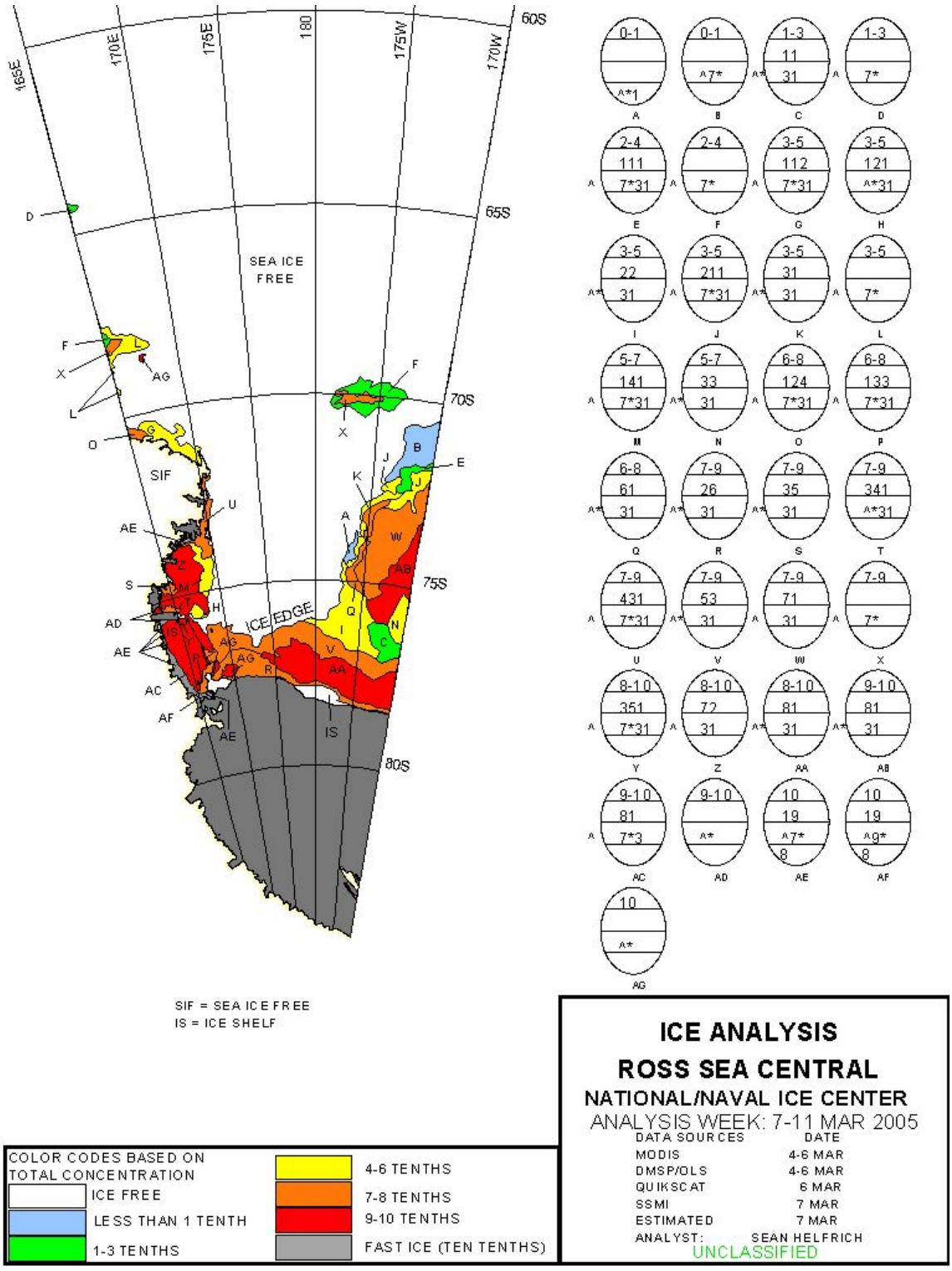


Figure XII-7 – Ice chart for the Central Ross Sea for 7 – 11 March 2005.

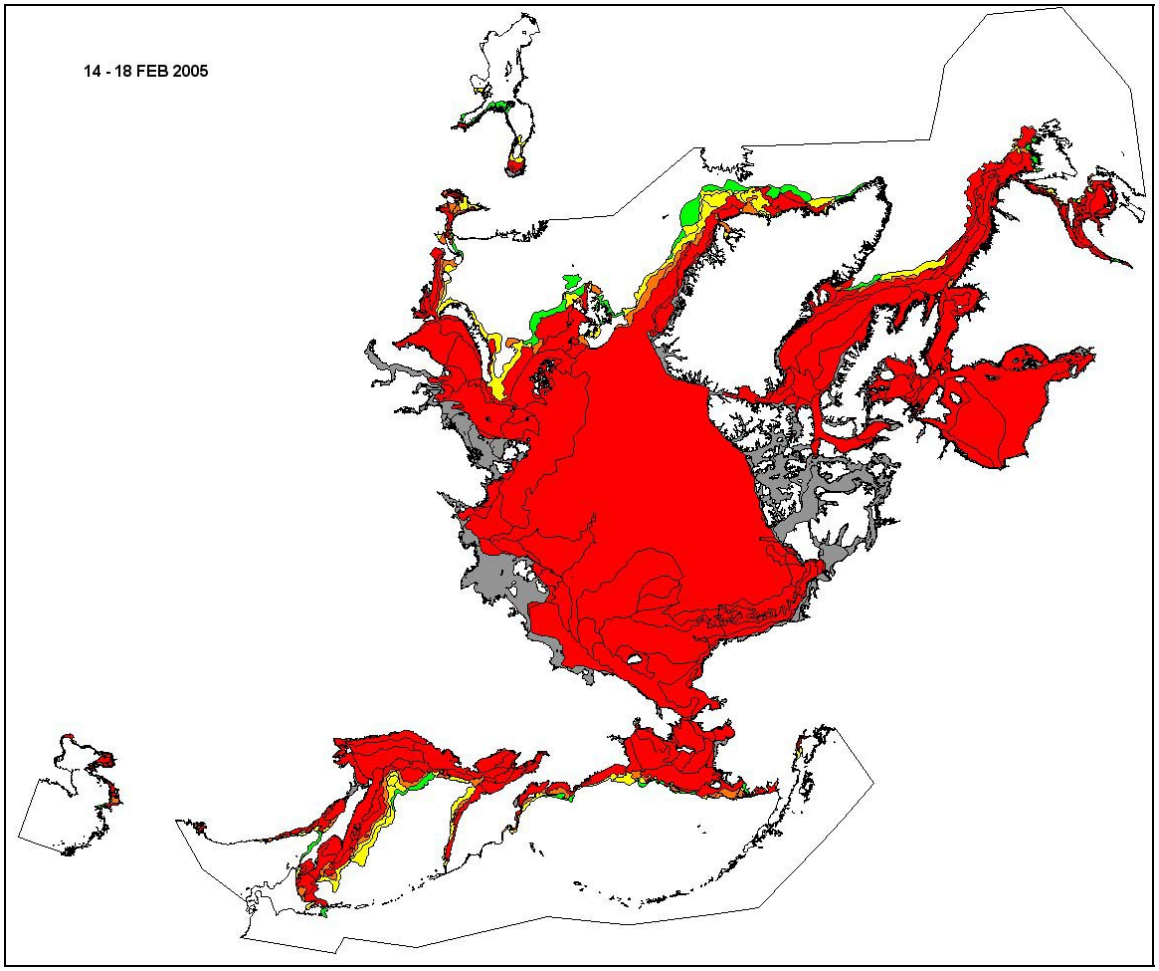


Fig.XII-8. Northern Hemisphere Sea Ice Analysis from ESRI ArcView for 14 – 18 February 2005.

ANNEX XIII – North American Ice Service

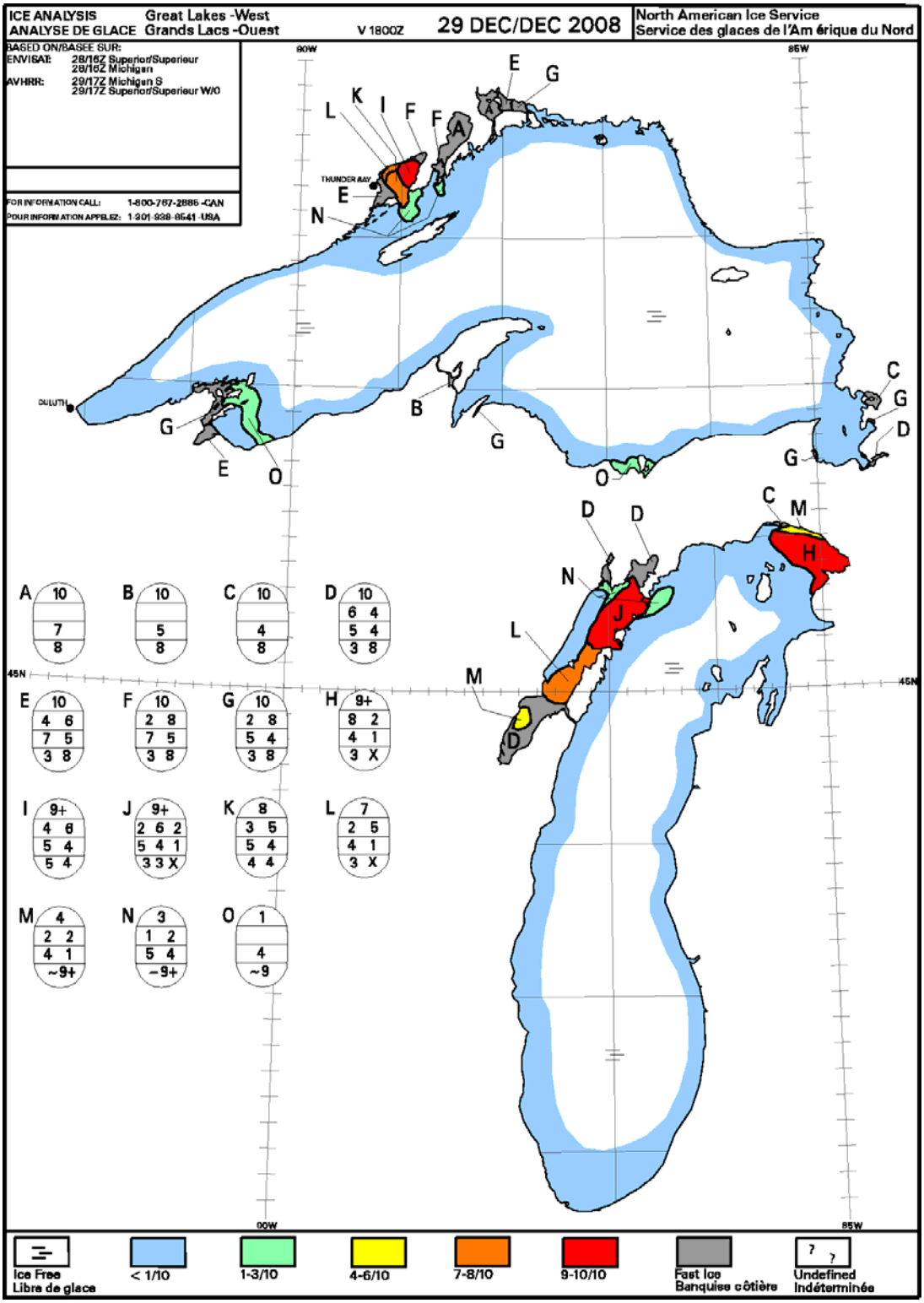


Figure XIII-1 Weekly ice chart for Great Lakes, 29 December 2008.

List of acronyms and other abbreviations

AARI	Arctic and Antarctic Research Institute
ACSYS	Arctic Climate System Study
AIRSS	Arctic Sea Ice Regime Shipping System
AMSR	Advanced Microwave Scanning Radiometer
APT	Automatic Picture Transmission
ATF	Antarctic Task Force (Argentina)
AVHRR	Advanced Very High Resolution Radiometer
BIM	Baltic Icebreaking Management
BSH	Bundesamt für Seeschiffahrt und Hydrographie (Germany)
BSIM	Baltic Sea Ice Meeting
BSIS	Baltic Sea Ice Services
CAA	Chinese Antarctic and Arctic Administration
CEADO	Argentine Centre of Oceanographic Data
CCG	Canadian Coast Guard
CDA	Command Data Acquisition (satellite communications)
CDC	Climate Data Centre
CIS	Canadian Ice Service
CliC	Climate and Cryosphere project
CLIVAR	Climate Variability and Predictability (WCRP)
CMM	former WMO Commission for Marine Meteorology
COADS	Comprehensive Ocean Atmosphere Data Set
COTS	Commercial Off-the-Shelf
COOBC	China Offshore Oil Bohai Corporation
DCRS	Danish Center for Remote Sensing
DMSP	Defense Meteorological Satellite Program (USA)
DMI	Danish Meteorological Institute
DNMI	Norwegian Meteorological Institute
EC	Executive Council
ECDIS	Electronic Chart Display Information System
ECMWF	European Centre for Medium-Range Weather Forecasting
EIS	European Ice Service
EMHI	Estonian Meteorological and Hydrological Institute
ENVISAT	Environmental Satellite
ERS	European Remote-Sensing Satellite
ESA	European Space Agency
ESDIM	Environmental Services, Data, and Information Management Programme
ETSI	JCOMM Expert Team on Sea Ice
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FIMR	former Finnish Institute of Marine Research (now part of FMI)
FMI	Finnish Meteorological Institute
GCC-EWG	Gore-Chernomyrdin Commission Environmental Working Group
GCOS	Global Climate Observing System
GDSIDB	Global Digital Sea Ice Data Bank
GIS	Geographic Information System
GLERL	Great Lakes Environmental Research Laboratory (USA)
GMDSS	Global Maritime Distress and Safety System
GMES	Global Monitoring of Environment and Security Programme
GTS	WMO WWW Global Telecommunications System
HRPT	Higher Resolution Picture Transmission
IABP	International Arctic Buoy Programme
IHO	International Hydrographic Organization
IICWG	International Ice Charting Working Group
IIP	International Ice Patrol
IMGW	Institute of Meteorology and Water Management (Poland)
IMO	Icelandic Meteorological Office

IMO International Maritime Organization
IOC Intergovernmental Oceanographic Commission (of UNESCO)
IPAB International Programme for Antarctic Buoys
IST Information Society Technology
IWICOS Weather, Sea ice and Ocean Service System
IUGG International Union of Geodesy and Geophysics
JCOMM Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JCG Japan Coast Guard
JDA Japan Defense Agency
JIWG Joint USA/Canada Ice Working Group
JMA Japan Meteorological Agency
HELMI forecast dynamic-thermodynamic numeric model for sea ice used at FIMR
LAC Local Area Coverage
LEGMA Latvian Environment, Geology and Meteorology Agency
LHMS Lithuanian Hydrometeorological Service
MANICE Manual of Standard Procedures for Observing and Reporting Ice Conditions (CIS)
MetOffice UK Meteorological Office
MODIS Moderate Resolution Imaging Spectrometer
NAIS North American Ice Service
NASA National Aeronautics and Space Administration (USA)
NAVOCEANO Naval Oceanographic Office (USA)
NAVTEX International system for reception of marine safety information
NCEP National Center for Environmental Prediction (USA)
NESDIS NOAA National Environmental Satellite Data Information Service
NGDC NOAA National Geophysical Data Center
NIC National Ice Center (USA)
NMEFC National Marine Environment Forecast Centre (China)
NOAA National Oceanographic and Atmospheric Administration (USA)
NPOESS National Polar Orbiting Environmental Satellite (USA)
NSIDC National Snow and Ice Center (USA)
OLS Operational Linescale System
ONR Office of Naval Research (USA)
OTSR Optimum Track Ship Routing
PIPS Polar Ice Prediction System (USA)
PRIC Polar Research Institute of China
PSC University of Washington Polar Science Center
QC Quality Control
QMFO Qingdao Marine Forecasting Observatory
RADARSAT Satellite from Canada
RIZA Institute for Inland Water Management and Waste Water Treatment (the Netherlands)
SAR Synthetic Aperture Radar
SCC CLiC Science and Coordination Committee
SCG JCOMM Services Programme Area Coordination Group
SG Steering Group
SGSI former CMM Subgroup on Sea Ice
SIGRID Format for the archival and exchange of sea-ice data in digital form
SHN Naval Hydrographic Service (Argentina)
SIMS Sea Ice Mapping System
SMARA Argentine Navy Meteorological Service
SMHI Swedish Meteorological and Hydrological Institute
SMN Argentine National Meteorological Service
SOA State Ocean Administration (China)
SPA JCOMM Services Programme Area
SSM/I Special Sensor microwave Imager
SST Sea Surface Temperature
SYKE former Finnish Environmental Institute (now part of FMI)
TD Technical Document
UN United Nations
UNESCO United Nations Educational, Scientific and Cultural Organization
USN U.S. Navy

USCG	U.S. Coast Guard
WCP	World Climate Programme
WCRP	World Climate Research Programme
WDC	World Data Centre
WMO	World Meteorological Organization
WWW	World Weather Watch of WMO
XML	Extensible Markup Language

Sea-ice products by areas of the World Ocean available via the Ice Logistics Portal

High connection speed:

http://www.bsis-ice.de/IcePortal/displayNorthernMap90E.html

http://ipy-ice-portal.com/highRes/displayNorthernMap90E.jsp

Low connection speed: http://ipy-ice-portal.com/lowRes/index.jsp

High connection speed:

http://www.bsis-ice.de/IcePortal/displaySouthernMap.html

http://ipy-ice-portal.com/highRes/displaySouthernMap.jsp

Low connection speed: http://ipy-ice-portal.com/lowRes/displaySouthern.jsp