Prepared by the North American Ice Service

A collaboration of the Canadian Ice Service and the National/Naval Ice Center

03 June 2009

Seasonal Outlook

For North American Arctic Waters

Summer 2009

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Introduction

This outlook is produced by the North American Ice Service, which is a joint co-operation of the Canadian Ice Service and the U.S. National Ice Center.

It will give an indication of the expected pattern of breakup and clearing of ice in the North American Arctic waters. It will identify areas and timings when breakup and clearing will likely occur with emphasis on those areas where there is ship navigation and other marine activities.

The outlook has been developed through the analysis of the meteorological and ice growth regimes. Thorough analyses have been done of extensive Radarsat/Envisat imagery collected during the past winter and spring. NOAA and MODIS satellite imageries were also used for the evaluation of the ice cover. All of this ice information was used in the preparation of regional ice analyses for the Arctic and Hudson Bay.

The results of the meteorological and ice analyses are then compared with previous year’s ice conditions and, in conjunction with the forecast for wind and temperatures for June, are applied to evaluate the breakup and the clearing of ice in the areas of interest. The Canadian Meteorological Centre provides the temperature regime for the period from the end of June to the end of August. Any variations from these forecast parameters have an impact on the forecast breakup pattern and timing.

Tables are included showing the forecast breakup or clearing dates along with median dates and last year's dates for each region. During the summer these events will be updated by a twice monthly issue of a 30-day forecast to enable planning of shipping or other activities according to changing trends. These forecasts will also include a prediction of the beginning of the freeze-up process throughout the regions.

Daily radio broadcasts of ice charts and forecasts will be made to support ongoing operations in the various areas where ice affects marine activities. Appendix A provides a link to the key to ice symbols showing the principle features of the International Ice symbols used on the ice charts. Appendix B contains links to these broadcast schedules as well as Aerial Reconnaissance Radio Facsimile Broadcast and NOAA Alaskan Marine Radio frequencies.

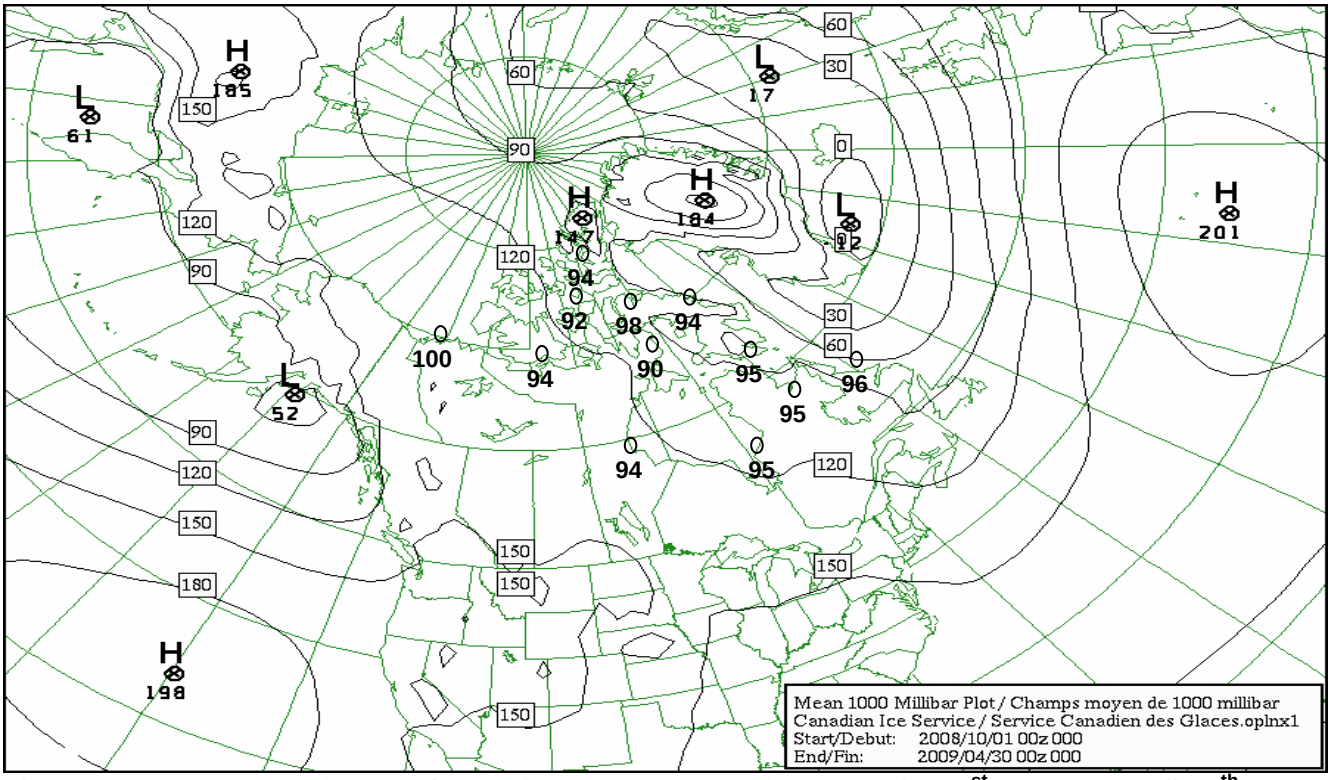

Figure 1: Percentage of Normal Freezing Degree Days from October 1st, 2008 to April 30th, 2009

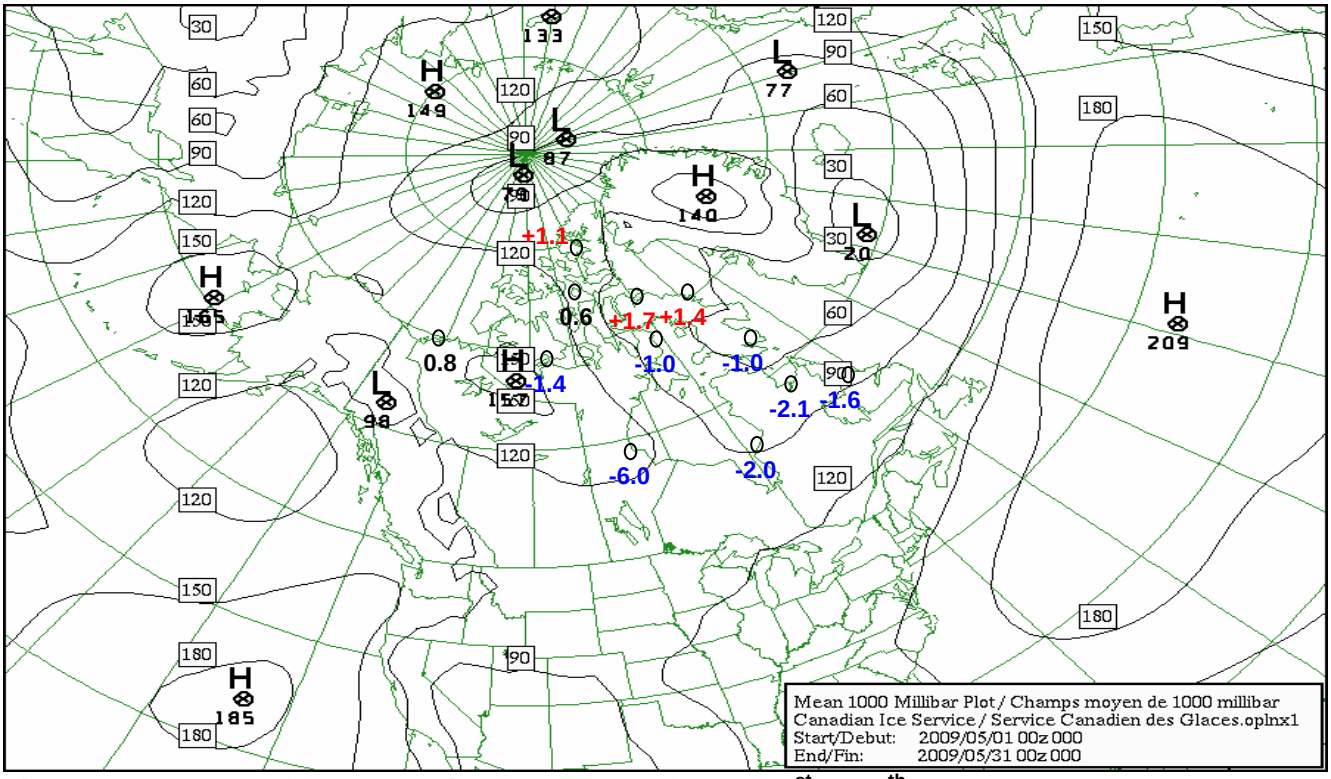

Figure 2: Departure from Normal Temperatures for May 1st to 30th, 2009

General Winter Conditions and Brief Outlook

The mean 1000 mb pressure pattern from October 01st, 2008 to April 30th, 2009 is represented in Figure 1. A low-pressure system persisted east of southern Greenland with a trough lying along the western shore of Greenland. A strong high-pressure area prevailed over Central Greenland with a weaker high-pressure region over northern Ellesmere Island. As a result, a light to moderate north to northwesterly flow prevailed along the Labrador Coast and in Davis Strait while a light and variable flow dominated elsewhere in the Arctic.

During the winter season, from October 2008 to April 2009, mean air temperatures were above normal by 1 to 2 degree Celsius over most of the Arctic except near normal (0 to 1° C) along the east coast of Baffin Island and in the Hudson Bay regions. No part of the Arctic indicated a negative departure from mean temperatures. Freezing degree-day accumulations for the winter period reached normal values in the Tuktoyaktuk region but remained below normal values by 2 to 8 percent elsewhere in the Arctic, in the Hudson Bay region and along the Labrador Coast. These values are indicated in Figure 1.

The mean 1000 mb pressure pattern for May is shown in Figure 2. A low-pressure system located over the North Pole dominated the High Arctic with some high pressure areas located the Bering Sea, the southern portion of the central Arctic and over central Greenland. Light to moderate west wind prevailed over the High Arctic especially along the western coast of the Queen Elizabeth Islands. The Beaufort Sea winds were light and variable while the Central and Eastern Arctic regions as well as Hudson Bay were subjected to moderate northerly winds. Throughout the month of May, above normal temperatures ranging between +1.0 to 1.7 °C prevailed over the coastal regions of the Eastern Arctic. The mean temperatures over the Western and Central Arctic regions west of the Coronation Gulf remained near normal and below normal temperatures ranging from -1.0 to -6.0 °C dominated the southern Arctic, Hudson Bay and the Labrador Coast regions.

Throughout the summer period of June to August, near normal temperatures are forecast for most Arctic regions except for below normal temperatures over Hudson Bay and the eastern portion of the Eastern Arctic islands. Consequently, most events in the Western and Central Arctic regions will experience a near normal breakup pattern while most events over the Hudson Bay and the Eastern Arctic areas should expect near normal or slightly delayed breakup dates. This does not prevent local ice conditions to exhibit a different trend than the general forecast above.

Hudson Bay and Approaches

Freeze-up and Winter Ice Regime

Air temperatures were 1-4°C above normal for most of Hudson Bay during the month of November, except near normal for Hudson Strait and Frobisher Bay and 1-3°C below normal for Cumberland Sound. In early December, air temperatures were 2-6°C above normal in northeast Hudson Bay and Hudson Strait but 1-4°C below normal along the southwest shore of Hudson Bay and James Bay. Air temperatures were everywhere 2-5°C below normal during the last two weeks of December. As a result of the above normal November and early-December air temperatures, freeze-up was delayed almost everywhere by 1-2 weeks. Measured ice thicknesses at Coral Harbour were approximately 15cm below normal in early November, and predicted ice thicknesses were 7-8cm below normal. Both measured and predicted values recovered to near-normal values by mid-December.

Ice growth was slower-than-normal for almost all parts of Hudson Bay and its approaches, although ice formed slightly earlier than normal along the southwest coast of Southampton Island at the end of October and also along the southwest shore of Hudson Bay and along the Ungava Bay coast during the first two weeks of November. Ice growth also began early in Cumberland Sound. New ice started to form along the shores of Southampton Island, in Roes Welcome Sound and along the western shore of Hudson Bay during the last week in October. By mid-November, new ice also extended along the southern shore of Hudson Bay and had formed along the south and western shores of Ungava Bay and in Frobisher Bay. Grey-white ice dominated Roes Welcome Sound and grey ice extended south of Southampton Island. Cumberland Sound was completely covered with grey and grey-white ice and an area of grey and grey-white ice had formed in western Davis Strait along the Baffin Island coast. By the end of November, the ice to the south of Southampton Island had thickened to grey-white ice, and grey ice extended along the western shore of Hudson Bay and filled Frobisher Bay. New and grey ice extended along the south shore of Hudson Bay, along the west and south shores of James Bay, and along the southwest coast of Baffin Island. A tongue of new and grey ice also extended into the western part of Hudson Strait.

Ice growth was slower-than-normal at the beginning of December but accelerated during the middle and latter thirds of the month. By mid-December, Hudson Bay, Hudson Strait, Ungava Bay, and Davis Strait were completely ice-covered (2 weeks later than normal) and new ice had formed along the Labrador coast. By the end of December, ice concentrations had recovered to near-normal values everywhere. The grey-white ice covering Hudson Bay, Hudson Strait, and Davis Strait was thickening to first-year ice while the ice along the Labrador coast had thickened to a mixture of new, grey, and grey-white ice. Normally at the end of December, however, Hudson Bay would be entirely covered with first-year ice while grey-white ice would predominate along the Labrador coast.

By the end of January, medium first-year ice extended from Davis Strait towards the northern tip of Labrador and also prevailed in Hudson Bay (except for areas of thin first-year ice in western parts of the bay and in James Bay). Hudson Strait and Ungava Bay were primarily

covered in thin first-year ice. A tongue of thin first-year ice, flanked on the west by grey ice and on the east by grey-white ice, extended down the Labrador coast. An area of 3 tenths old ice lay just north of Caper Dyer and a trace of old ice extended down from this area to 61°N. The Petermann Ice Island, a large tabular iceberg that calved off the Petermann Glacier in northwest Greenland in summer 2008, lay just off Cape Dyer.

During February, the ice continued to grow and thick first-year ice appeared throughout the region except for the lower portions of Hudson Bay, which remained covered with medium first-year ice. Towards the end of the month, thick first-year ice was found over all areas except in James Bay. The ice edge gradually expanded eastward in the Davis Strait and Labrador Sea, exceeded slightly the normal ice distribution in those regions. The old ice remained along the north Labrador coast with a few areas containing 2 to 3 tenths of old ice between Cape Dyer and Cumberland Sound. Throughout February, the Petermann Ice Island moved shoreward and slowed down considerably to lie near the northern entrance to Cumberland Sound.

The first half of March was colder than normal almost everywhere and the ice continued to grow over all regions. Thick first-year ice concentrations increased in all places except for the James Bay region where medium first-year ice continued to prevail. With this intrusion of cold air, the Davis Strait ice edge continued to expand eastward although only grey and grey-white ice was found near the edge. Near the end of March, thick first-year ice prevailed in all regions saves the bottom half of James Bay. The ice edge in Davis Strait lies roughly 60 miles further east than normal down to 60°N then reverted to a normal position along the Labrador coast. The prevailing ice along the edge was grey-white although some grey ice and even thin first-year ice were also present in smaller concentrations. The trace of old ice now lied off the entrance to Goose Bay and several areas of 2-3 tenths old ice concentrations lied 60 to 100 miles off the Baffin Island coast from the entrance to Frobisher Bay northwards. During March, a trace of old ice moved into the entrance to Hudson Strait. The Peterman Ice Island moved into the entrance to Cumberland Sound and eventually flushed out to lie near 64°N.

During April, the mean temperatures remained above normal over the inland areas and stayed close to normal along the Baffin Island coast. The Labrador coast was the only region with a below-normal temperature regime. Several cracks opened up in the ice over eastern and western Hudson Bay as well as in Hudson Strait caused by storm systems moving through the area. Towards the end of April, the ice in central Frobisher Bay had already flush out leaving lower than normal ice concentration and thinner ice in the bay except for the coastal fast ice.

Over the Newfoundland waters, the melt season was up 2 weeks behind normal with abnormal ice conditions extended 120 miles further offshore than typical for the end of the month. A tongue of ice still prevailed along the northern edge of the Grand Banks.

Throughout May, the mean temperatures remained below normal over the entire region except for the Goose Bay area, which reported near normal temperatures. The ice conditions along the Labrador Coast gradually improved as the overall ice concentration decreased steadily and leads began to appear along the coast. Towards the end of the month, 7 to 9 tenths first-year ice including up to one tenths of old ice prevailed along the mid-Labrador coast as far south as 55°N. Some areas of very close pack first-year ice in Davis Strait also contained 1 to 2 tenths

of old ice. Elsewhere along the northern Labrador coast and over a small portion of the eastern entrance to Hudson Strait, only a trace of old ice was embedded within the first-year ice pack. Further west into Ungava Bay, Hudson Strait and in Hudson Bay, several coastal leads formed in the lee of the land and grew larger during the month. Although many leads remained ice-free after their formation, the northwest portion of Hudson Bay, which remained 4 to 5 °C below normal during the month, is the only region that grew some new ice. This new ice slowly thickened to grey ice during the third week of May and disappeared entirely towards the end of May. Based on this description, the break-up pattern in the east Newfoundland waters and Labrador Coast regions was more than two weeks late whereas the situation in some portions of the Hudson Bay and Hudson Strait already showed signs of an early break-up pattern by as much as two weeks.

Observed Ice Conditions

The regional ice chart in figure 3 was based on the analysis of Radarsat/Envisat and NOAA/MODIS imageries from around May 25th, 2009. This chart reveals some of the following features:

a) The ice edge along the Labrador Coast lies about 60 mile further east than normal while the edge along the southwestern portion of Davis Strait is near normal.

b) The bergy water lead along northern Hudson Strait and the open water lead over northwestern Hudson Bay usually appear by mid-June; this suggests the breakup pattern for those particular regions are at least 2 weeks ahead of normal right now.

c) Old ice with up to one-tenth concentration is embedded within the eastern edge pack ice. Smaller regions with higher amounts of old ice lie north of 65°N.

d) The northeastern portion of Hudson Bay shows evidence of a breakup pattern from 7 to 10 days ahead of normal.

e) The ice conditions over the remaining portions of Hudson Bay and James Bay are normal.

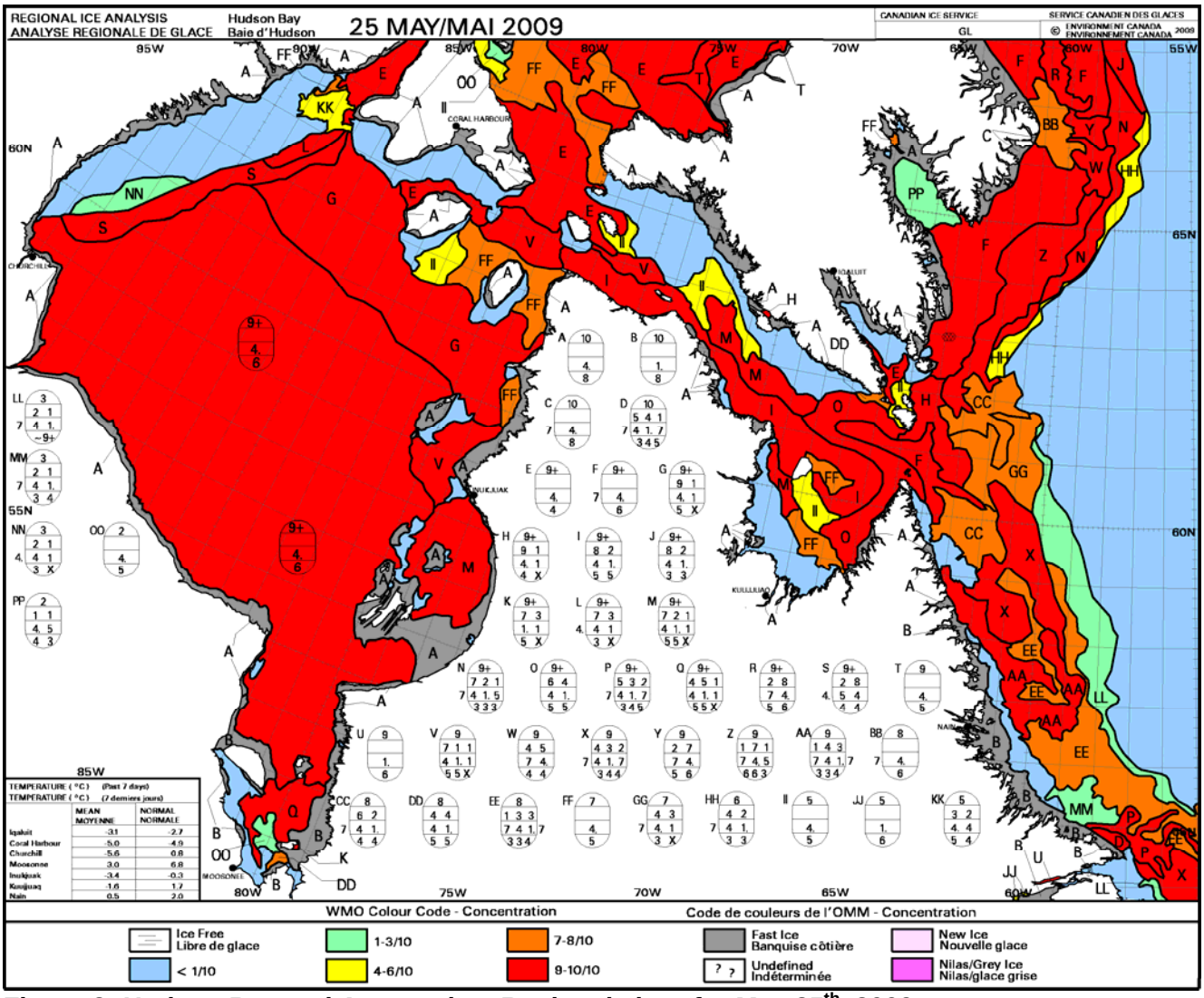

Figure 3: Hudson Bay and Approaches Regional chart for May 25th, 2009

Outlook for Hudson Bay and Approaches

The summer temperature outlook for June, July and August suggests colder than normal temperatures south of 62°N and near normal temperatures further north as well as along the mid-Labrador coast. Consequently, the clearing of the ice along the Labrador coast should occur normally, that is, during the first few days of August. The Hudson Strait region, which is already showing some signs of looser ice concentration and thinner than normal ice, will develop a bergy water route during the last week of July while the complete clearing of the ice will only occur in the second week of August. Similarly, Ungava Bay will follow suite with the clearing of the bay to occur towards the end of the first week of August. The ice in Hudson Bay will continue to loosen along the shores while maintaining higher ice concentrations in the central and southern regions. By the last week of July, much of the ice along the shores will have melted allowing for an open water route into Churchill. The last ice will clear from the south central region of the bay in early August. For James Bay, even though the southern half will clear up by mid-July, the entire clearing of the bay will not occur

until the end of July. In the Frobisher Bay area, the clearing is already ahead of normal however, the fast ice in the eastern portion of the bay is not expected to fracture significantly until early July. An open drift or less route is forecast for mid-July while the bergy water route will only develop during the second week of August.

The Petermann ice island remains the biggest unknown at this point. Its southward progression has greatly slowed down during May; it now lies just north of the entrance to Frobisher Bay. Should this special ice feature decide to move into Frobisher Bay and perhaps even into Hudson Strait or Ungava Bay instead of drifting towards the Labrador Coast, the normal access to some local ports could be severely affected.

Table 1: Hudson Bay and Approaches - Break-up Outlook Dates

	2008	Median	Outlook for 2009
Labrador Coast to Cape Chidley **- Clearing**	28 Jun	26 Jul	01-03 Aug
Frobisher Bay **- Open drift or less** **- Clearing**	26 Jul 04 Aug	19 Jul 06 Aug	14-16 Jul 10-12 Aug
Ungava Bay **- Clearing**	17 Jul	03 Aug	07-09 Aug
Bergy water route through Hudson Strait (eastern entrance to south of Nottingham Island)	26 Jul	27 Jul	25-27 Jul
Hudson Strait **- Clearing**	01 Aug	07 Aug	10-12 Aug
Bergy/open water route to Churchill (eastern entrance of Hudson Strait to Churchill)	26 Jul	28 Jul	25-27 Jul
Open water route through northern Hudson Bay (south of Nottingham Island to Churchill)	11 Jul	19 Jul	20-22 Jul
Hudson Bay **- Clearing**	26 Aug	16 Aug	01-03 Aug
James Bay **- Clearing**	22 Jul	29 Jul	29-31 Jul

Eastern Arctic

Freeze-up and Winter Ice Regime

Overall, air temperatures in the eastern Canadian Arctic averaged near-normal to 1-2°C above normal during the freeze-up period, except in November where temperatures were 3-5°C above normal north and west of Baffin Bay and 1-4°C below normal along the south-central Baffin Island coast. Freeze-up was delayed by at least 1 week in most areas, except at the leading edge of the ice pack in Baffin Bay which occasionally expanded rapidly forward to greater than normal extents. Another exception was Cumberland Sound on the south coast of Baffin Island, which froze over 1-2 weeks earlier than normal because of anomalous amounts of fresh water outflow from rivers feeding into the sound. This created a floating layer of fresh water, which could not mix with deeper, warmer, more-saline waters and allowed for the rapid freezing of surface waters. By the end of January, measured ice thicknesses in Resolute Bay and Eureka were ~5cm thinner-than-normal as a result of the warmer-than-normal air temperatures during freeze-up (although they were ~5cm thicker than calculated ice thicknesses, which predicted well-below-normal thicknesses in these areas). End-of-January measured ice thicknesses in Hall Beach were ~10cm less than normal, even though thicknesses at the beginning of the freeze-up period were near-normal in this area. End-of-January predicted ice thicknesses for Hall Beach were even less than observed, however (by an additional 15cm).

At the end of the summer of 2008, a large anomalous open-water lead existed along the northwest coasts of Ellesmere and Axel Heiberg Islands and into Sverdrup Channel, where high concentrations of old ice would normally be expected to prevail. Additionally, two of the remaining five ice shelves along the northwest coast of Ellesmere Island (composites of old ice and glacier ice) had experienced significant losses and a third ice shelf had disappeared entirely. No multi-year ice plug remained at the mouth of Nansen Sound. As a result of freer ice flow into the Canadian Arctic Archipelago, the old ice distribution was greater than normal in Nares Strait, Eureka Sound and in Belcher and Queens Channels. However, contrary to normal conditions, no traces of old ice remained in the Gulf of Boothia or Committee Bay.

By mid-September, new and grey ice had started forming in Nares Strait and Kane Basin, in Nansen and Eureka Sounds, and along the northwest coasts of Ellesmere and Axel Heiberg Islands. By the end of September, the old ice pack had moved back against the northwest Ellesmere coast, closing the wide lead that had formed during the melt season. Grey ice predominated in Nansen and Eureka Sounds and in Norwegian Bay (whereas normally grey-white ice would predominate at this time). Meihan Island was ringed with predominantly grey-white ice instead of the normal multi-year ice. New ice filled Kane Basin, Jones Sound, Queens Channel, eastern Barrow Strait and Prince Regent Inlet. Normally, however, most of these areas (except Jones Sound) would have been experiencing grey ice at this time and new ice would also have formed in Lancaster Sound, Admiralty Inlet and Eclipse Sound.

By mid-October, ice concentrations and thicknesses remained well below normal in Lancaster Sound which was covered with patchy new ice, while the Gulf of Boothia, Committee Bay and Eclipse Sound remained ice free. Ice in Jones Sound, Kane Basin and in Prince Regent Inlet had thickened to grey ice and Nansen and Eureka Sounds were covered in predominantly grey-white ice. By the end of October, the old ice from the Arctic Ocean had pushed into Peary Channel and surrounded Meihan Island. Thin first-year ice prevailed in Nansen and Eureka Sounds, in Kane Basin, around Amund Ringnes Island and to the north of Cornwallis Island. Nansen and Eureka Sounds consolidated around the third week of October – 2 weeks and 1 week later than normal, respectively. Grey-white ice prevailed in Norwegian Bay, Jones Sound, eastern Barrow Strait and Lancaster Sound, in Prince Regent and Admiralty Inlets and in the Gulf of Boothia. Grey ice covered the northwestern part of Baffin Bay, the extreme northern part of Foxe Basin and had formed in Eclipse Sound. Southern Committee Bay still remained ice free, however.

By mid-November, McDougall Sound, Admiralty Inlet (up to Nanisivik), and Navy Board Inlet had consolidated. Ice extents were near normal everywhere except slightly less than normal along the leading edge of the ice in mid-Baffin Bay. At this time, the ice growth in Davis Strait / Baffin Bay extended eastward to 60° W and southward from 75°N, along the western Greenland Coast, to 65°N near the entrance to Cumberland Sound. There was patchy two to four tenths of old ice in western Baffin Bay. Most of Foxe Basin was covered with grey-white ice and thin first-year ice had pushed into Committee Bay. By the end of November, Eclipse Sound, Pelly Bay, Fury and Hecla Strait, Wellington Channel, the eastern half of Kane Basin and most of Jones Sound had consolidated (2-4 weeks later than normal for some of these places). Medium first-year ice prevailed among the islands north of 75°N and thin first-year ice covered Foxe Basin and Baffin Bay. Grey-white ice covered western Davis Strait, west of 60°W and south of 65°N.

By the end of December, the ice among the islands north of 75°N was completely consolidated. Lancaster Sound and the Gulf of Boothia were covered in medium first-year ice. Baffin Bay was covered in thin first-year ice with areas of medium first-year ice and 3 to 5 tenths of old ice in western sections. The bergy water lead along the west Greenland Coast had closed down to near 73°N and contained strips of new and grey ice down to 70°N.

By the end of January, the ice extent was normal everywhere except slightly less than normal in places along the leading edge of the ice pack in Davis Strait. Barrow Strait west of Resolute Bay had become consolidated, but ice in Lancaster Sound and Prince Regent Inlet remained mobile. Ice in Nares Strait remained mobile as well, but an ice bridge had formed at the north end of Robeson Channel creating a polynia there, and blocking old ice from entering the strait from the Lincoln Sea and flowing into Baffin Bay. Nevertheless, greater than normal amounts of old ice already existed in a long stream extending from Nares Strait into Baffin Bay to approximately 68°N.

By the end of February, the ice had thickened to thick first-year almost everywhere except for the northern half of Nares Strait where thin first-year ice dominated and along the Davis Strait ice edge where young ice prevailed. Only two tenths of old ice was present in the mobile ice of Nares Strait. Areas of higher than normal concentration of old ice were

observed from Smith Sound southwards as well as off the Baffin Island coast all the way down to northern Davis Strait. The west coast of Greenland was now ice covered suggesting slightly more than normal ice concentration in this region for the period. The ice in Lancaster Sound and Prince Regent Inlet remained mobile with a trace of old ice prevailing almost everywhere. Although no old ice was seen in the southern half of the Gulf of Boothia, two small regions, each containing up to two tenths of old ice, were present in its northern portion. A thinner than normal ice region was also observed south and west of Thule. The ice conditions in Foxe Basin were normal but still very mobile in certain sectors. Several small areas of thinner ice type were present just off the fast ice edge along many island shores.

The mean temperatures in March were colder than normal in the High Arctic but warmer than normal in the southern regions albeit well below the freezing point. Ice growth continued throughout the month. By the end of March, thick first-year ice prevailed everywhere except for the northern part of Nares Strait where new and young ice dominated south of the Lincoln Sea ice bridge and along the Davis Strait ice edge. Ice concentration along the west coast of Greenland also started to diminish somewhat as far north as Disko Island but there was still no sign of bergy water in that region. The ice in Lancaster Sound failed to consolidate this winter as well as the eastern portion of Barrow Strait. In Foxe Basin, the ice situation resembled that of February except for the small regions of thinner ice type as well as weaker concentrations near the island shores.

During April, the mean temperatures were above normal for the areas south of 76°N and remained near normal for the extreme high arctic regions. Throughout the month, the ice concentration diminished steadily along the eastern ice edge and a bergy water region appeared along the western shore of the Greenland. As the month progressed, a lead developed and widened as far north as 70°N with looser ice concentration extending further north to 74°N. Meanwhile, the ice in Cumberland Sound and Lancaster Sound started to flush out. Since the ice in Lancaster Sound and eastern Barrow Strait never consolidated, the western edge of the ice in eastern Barrow Strait gradually opened up as it flushed out. With the temperature still well below the freezing point, the area refroze with thinner ice types. The Lincoln Sea ice bridge held up throughout April. Looser and thinner ice poured out of Nares Strait to create an ice situation never seen in history for this period. Much of the old ice typically found in Nares Strait was stretched in small areas of heavier concentration in the western half of Baffin Bay.

In May, the mean temperatures remained near normal throughout the High Arctic and over most Eastern Arctic regions except for Foxe Basin where they were below normal. Early in the month, slow ice growth continued in the areas recently opened and within regions of mobile ice except for the west Greenland coast where the bergy water lead widened. Towards the end of May, there were several large areas in the Eastern Arctic showing abnormally low ice concentrations; some of those include the eastern portion of Barrow Strait, Nares Strait, the North Open Water as well as an area in the northwestern portion of Foxe Basin. Actually, these areas typically exhibit these lower ice concentrations, but much later during the spring or early summer. This suggests that a few portions of the Eastern Arctic are already showing signs of an early breakup by 3 to 4 weeks. Elsewhere, the ice thicknesses and concentrations were normal.

Observed Ice Conditions

The regional ice chart in figure 4 was based on the analysis of Radarsat/Envisat and NOAA/MODIS imageries from around May 25th, 2009. This chart reveals some of the following features:

a) An ice bridge atop of the Lincoln Sea formed this year, but the ice in Nares Strait never consolidated during the winter months.

b) The ice condition in Nares Strait and Kane Basin is unprecedented at this time.

c) The lack of ice in the North Open Water region and along the west Greenland coast suggests a breakup pattern nearly one month ahead of normal for these regions.

d) More old ice than normal is present in the western portion of Baffin Bay and the northwestern potion of Davis Strait.

e) Opening of the ice in Penny Strait suggests an early breakup pattern by about 2 weeks for this region.

f) Early opening of the ice in Cumberland Sound and in the northwestern section of Foxe Basin is not unusual in the spring, but conditions depicted at the end of May normally occur 2 weeks later.

g) Many ice shelf fragments are showing just off the coast of the Queen Elizabeth Islands.

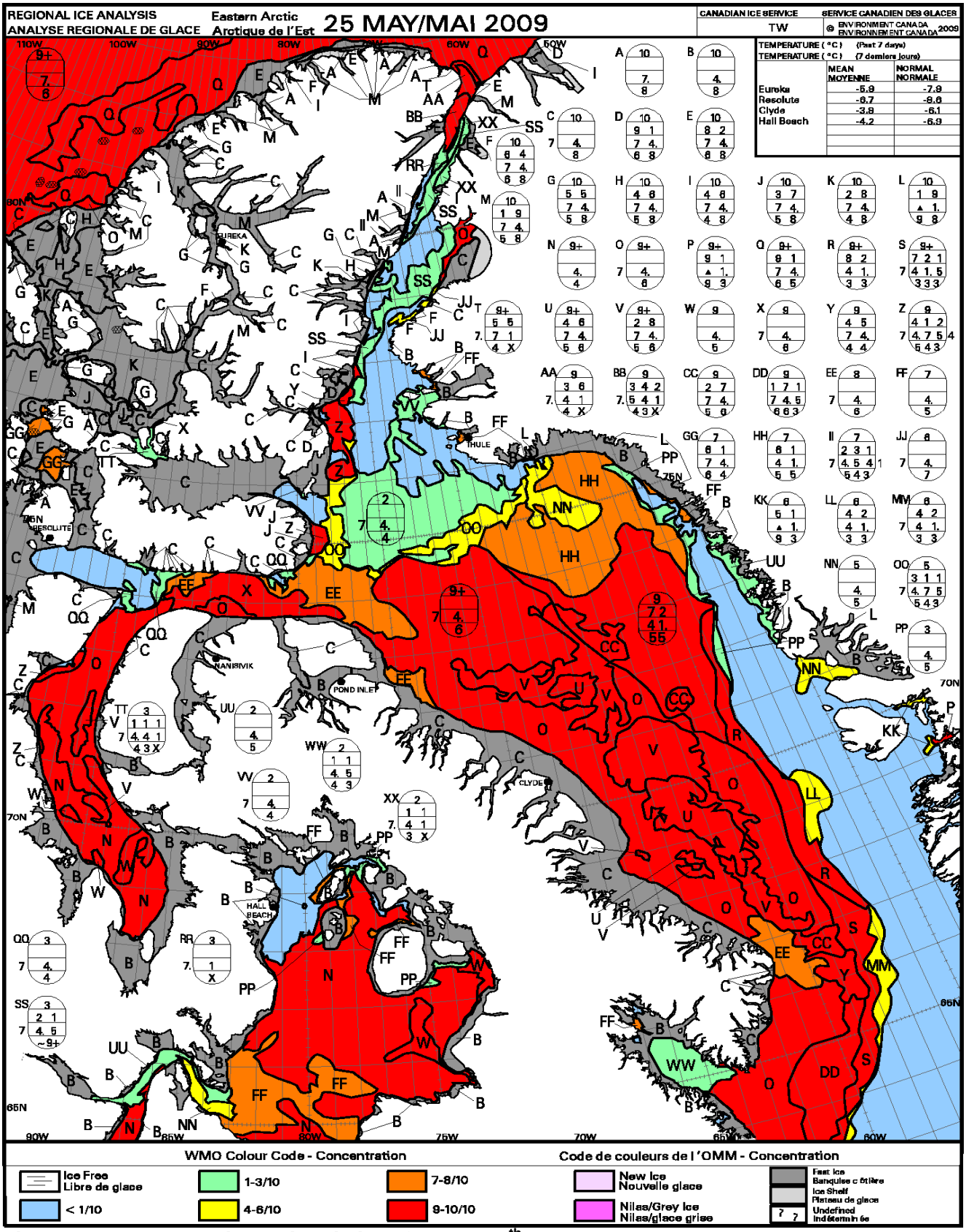

Figure 4: Eastern Arctic Regional chart for May 25th, 2009

Outlook for the Eastern Arctic

The summer temperature outlook for June through August is forecast to be near normal over the western regions while gradually cooling to below normal temperatures along the east shore of Baffin and Ellesmere Islands. The latest ice condition along the Greenland coast, suggests the open drift or less route into Thule will develop earlier than normal near mid-June while the route across northern Baffin Bay should develop earlier than normal during the first half of July. Elsewhere in the Eastern Arctic, all main fracture events will occur during the fourth week of July while the fracture of Eureka Sound will take place towards the end of July. For Pond Inlet, northern Admiralty Inlet and western Barrow Strait, this represents a normal breakup period, while for McDougall Sound, Jones Sound and Norwegian Bay, this is seven to 10 days earlier than normal. Most clearing events will be near their normal dates, which will range from the first week of August for Pond inlet and northern Admiralty Inlet to the last week of August for Davis Strait and Baffin Bay. The open drift or less routes into Home Bay will occur during the first week of August which is normal. The open drift or less route into Cape Dyer will happen during the second week of August, which is two weeks later than normal for this region. The presence of old ice in western Davis Strait will delay the event in this area. The open water route into Hall Beach should develop during the first week of September, but Foxe Basin is not expected to clear until the end of September.

Of concern this year, is the amount of old ice in Penny Strait. This old ice will undoubtedly flush out of Wellington Channel and into eastern Barrow Strait and Lancaster Sound during August. Some old ice floes might actually move into Prince Regent Inlet and finally come to rest in Committee Bay where no old ice has been seen for the last three years. The Lincoln Sea ice bridge and the lack of sea ice south of the bridge is a new feature never seen before; the consolidated ice in Nares Strait typically breaks around mid to late July. Once the bridge collapses, the old ice will pour down Nares Strait and might affect ship transit across the entrance to Lancaster Sound later in the summer.

Table 2: Eastern Arctic - Break-up Outlook Dates

	2008	Median	Outlook for 2009
Route across Northern Baffin Bay			
- Open drift or less	23 Jun	17 Jul	03-05 Jul
- Bergy water route	16 Jul	27 Jul	10-12 Jul
Baffin Bay			
- Clearing	29 Aug	08 Sep	26-28 Aug
Davis Strait			
- Clearing	20 Aug	02 Sep	26-28 Aug
Home Bay			
- Open drift or less	26 Jul	08 Aug	06-08 Aug
Cape Dyer			
- Open drift or less	28 Jun	27 Jul	13-15 Aug
Open water route			
to Hall Beach	06 Sep	04 Sep	05-07 Sep
Foxe Basin			
- Clearing	13 Oct	21 Sep	19-21 Sep
Pond Inlet			
- Fracture[1]	22 Jul	24 Jul	23-25 Jul
- Clearing	04 Aug	12 Aug	05-07 Aug
Admiralty Inlet northern half			
- Fracture[1]	18 Jul	21 Jul	23-25 Jul
- Bergy water	31 Aug	10 Aug	06-08 Aug
Lancaster Sound			
- Fracture[1]	Not consolidated	08 Jul	Not consolidated
Barrow Strait to Resolute			
- Fracture/eastern[1]	14 Jul	11 Jul	Not consolidated
- Fracture/western[1]	18 Jul	25 Jul	22-24 Jul
Wellington Channel			
- Fracture[1]	18 Jul	28 Jul	22-24 Jul
McDougall Sound			
- Fracture[1]	30 Jul	02 Aug	23-25 Jul
Kane Basin			
- Fracture[1]	06 Jun	23 Jul	Not Consolidated
Jones Sound			
- Fracture[1]	20 Jul	31 Jul	22-24 Jul
Norwegian Bay			
- Fracture/southern[1]	12 Jul	01 Aug	22-24 Jul
- Fracture/northern[1]	15 Jul	07 Aug	22-24 Jul
Eureka Sound			
- Fracture[1]	14 Jul	02 Aug	29-31 Jul
- Bergy water	Never cleared	18 Aug	Never clear
Pacer Goose route to Thule			
-Open drift or less	16 Jun	17 Jul	14-16 Jun
-Bergy water route	25 Jun	27 Jul	24-26 Jun

[1] Fracture indicates complete breakage of consolidated ice.

Western Arctic

Freeze-up and Winter Ice Regime

Air temperatures were generally above normal everywhere throughout the freeze-up period, averaging from 1-3°C warmer over the islands to 4-8°C warmer over the southwestern Beaufort Sea. As a result, freeze-up was delayed by a week in the southern Beaufort Sea and in Peel Sound. Freeze-up was delayed by two weeks from Amundsen Gulf to Larsen Sound. By the end of January, measured ice thicknesses were 10cm thinner than normal at Cambridge Bay (although 15cm thicker than calculated). Measured ice thicknesses were nearly 20cm thinner than normal and 35cm thinner than calculated at Inuvik at the end of December (although thicknesses were normal at the end of October / beginning of November). Ice thickness was not measured in Inuvik in January.

At the end of summer 2008 (at the beginning of freeze-up), the old ice extent was considerably less than normal in the Beaufort Sea, M'Clure Strait, Viscount Melville Sound, western Barrow Strait and M'Clintock Channel. Although pockets of greater than normal concentrations of old ice could be found in Prince of Wales Strait, in the bays along the north coast of Victoria Island, and in the straits and channels on the east and west sides of Cornwallis and Melville Islands, both the northern and southern routes of the Northwest Passage were navigable from end to end. One of the two fragments of the Ayles Ice Island had drifted south into Penny Strait / Queens Channel, where it fractured into 3 pieces, while the other fragment remained to the east of Amund Ringnes Island. Dozens of new ice islands from the fractured Ellesmere Island ice shelves were spreading southwestwards from the Ellesmere coast, some tracking along the north side of Meihan Island and some entering Sverdrup Channel. Ice-free water extended from Rae Strait, through southern Queen Maud Gulf, Coronation Gulf, southern Amundsen Gulf, along the Mackenzie Delta and into a large rectangle extending from the Alaska coast north to 75°N, between 145-155°W. Open water prevailed in a large swath along the west coast of Banks Island, in Larsen Sound, Peel Sound and in the northeast half of M'Clintock Channel. The bulk of the old ice pack in the Beaufort Sea was north of 75°N, except for a loosely-concentrated tongue extending down to 70°N primarily between 130-140°W.

In early September, new ice growth started among the old ice floes in the Beaufort Sea north of 75°N. By mid-September, new ice was forming in Viscount Melville Sound, amongst the islands north of 76°N and in the tongue of old ice to the west of Banks Island. Grey ice prevailed amongst the old ice floes in the Beaufort Sea north of 75°N. By the end of September, the area of old ice north of 75°N had narrowed to a thin band barely extending west of 130°W. Grey ice filled M'Clure Strait, western Barrow Strait and the southwest half of M'Clintock Channel. Grey ice filled Norwegian Bay and also the spaces between the old ice floes to the west of Banks Island. Grey-white ice prevailed between and to the west of the old ice floes in the Beaufort Sea north of 75°N and out to 135°W, and also around Meihan Island. A large swath of ice-free water still extended from Amundsen Gulf, along the Mackenzie Delta all the way to Point Barrow. Open water remained over large parts of the

southern Beaufort Sea, in Coronation and Queen Maud Gulfs, in Rae Strait and in Larsen Sound.

In mid-October, as ice was expanding out of M'Clintock Channel into Larsen Sound, a patch of 4 tenths multi-year ice and 1 tenth second-year ice drifted out of M'Clintock Channel into central Larsen Sound. New ice extending southwards from the main ice pack in the Beaufort Sea had nearly closed the gap with new ice forming along the Alaskan and Yukon coasts. By the end of October, thin first-year ice had formed within the multi-year ice pack in the Beaufort Sea north of 75°N, in M'Clure Strait, in western Barrow Strait and in the western half of Peel Sound. Grey-white ice extended southwestwards from the mixed first-year / multi-year ice pack in the Beaufort Sea, merging into an extensive area of thinner-than-normal grey ice all along the coast between Point Barrow and Cape Parry. Grey-white ice prevailed in Viscount Melville Sound, M'Clintock Channel and Larsen Sound. New and grey ice, where normally grey-white ice would be expected, filled Rae Strait, Queen Maud Gulf, Dease Strait, Prince of Wales Strait and the area along the west coast of Banks Island. Ice concentrations were everywhere near normal except between Amundsen and Coronation Gulfs, where anomalous areas of open water still prevailed, While fast ice had formed around most of the islands north of 75°N, the inter-island areas had not yet consolidated as would normally be expected. Only parts of the Tuktoyaktuk Peninsula and the Alaskan coast west to Point Barrow had become consolidated.

By mid-November, the anomalous area of open water between Amundsen and Coronation Gulfs had filled in with grey and grey-white ice. Thin first-year ice covered the bulk of the Beaufort Sea south and west of the multi-year ice pack, extended from M'Clure Strait to Larsen Sound and had formed to the south of King William Island. A tongue of 2 tenths multi-year ice extended northwards from the patch in Larsen Sound into Peel Sound. By the end of November, thin first-year ice prevailed in all areas south of 75°N not predominantly covered in multi-year ice, while medium first-year ice prevailed north of 75°N. Ice had consolidated around and between most of the islands north of Parry Channel, however an anomalous unconsolidated channel still extended between Prince Gustaf Adolf Sea and Byam Martin Channel. Penny Strait / Queens Channel also remained unconsolidated. Ice had consolidated between Rae Strait and parts of Coronation Gulf, however M'Clure Strait, Viscount Melville Sound, M'Clintock Channel and Larsen Sound had not yet consolidated. One of the fragments of the Ayles Ice Island had become trapped in the fast ice to the east of Amund Ringnes Island, while the largest piece of the now-fractured second fragment remained mobile in Penny Strait.

By mid-December, ice had finally consolidated in Prince Gustaf Adolf Sea (6 weeks later than normal), Byam Martin Channel (4 weeks later than normal), and between Viscount Melville Sound and Larsen Sound (2-3 weeks later than normal). Penny Strait and Queens Channel consolidated normally. By the end of December, thin first-year ice prevailed throughout the western Arctic except within approximately 100 nm of the coast from Amundsen Gulf and westwards. M'Clure Strait remained unconsolidated when normally it would have consolidated by the beginning of December. The bulk of the Beaufort Sea remained anomalously depleted of multi-year ice.

By the end of January, all consolidated ice within the archipelago had thickened to thick first-year ice, except in Dolphin and Union Strait where the fast ice was predominantly medium first-year. Elsewhere, except for the old ice pack itself, the ice cover was primarily composed of medium first year ice except in parts of Barrow Strait where thin first-year ice prevailed. Patches with concentrations of 5 tenths old ice now trailed westwards between 70-74°N, from the tongue of old ice to the west of Banks Island to Point Barrow and beyond, creating a narrow zone of slightly greater than normal old ice concentrations in an area otherwise depleted of old ice.

During February, the ice growth continued at a normal rate and all remaining medium first-year ice thickened to thick first-year ice except for the extreme southern regions of the Beaufort Sea. The old ice in the southern Beaufort Sea continued its westward motion during the first half of the month but its southern edge moved northward towards the end of February. This was certainly the case along the Alaskan Coast where the old ice edge drifted to its more normal position. The thin first-year ice in Amundsen Gulf appeared to consolidate early in the month but gradually became mobile again over much of the gulf region towards the end of February.

March was colder than normal almost everywhere which also featured two specific ice events. The first occurred around mid-March where the old ice accelerated southward along the west coast of Banks Island as well as westward along the southern Beaufort Sea coast. This acceleration yielded long linear tear fractures in the main Beaufort Sea ice pack. The fracture patterns were similar to last winter's patterns except for its short duration; the fractures closed back by the end of March and the new ice thickened rapidly in the leads. The second event happened when the acceleration of the pack ice caused two regions to become depleted of ice for a very brief period; one of the two regions was off the fast ice area in the Mackenzie Delta while the other was west of Point Barrow. With the cold temperatures prevailing during the month, the ice grew rapidly in these two regions but the area west of Point Barrow remained more prone to the thinner ice types as the ice kept moving offshore.

During April, the mean temperatures were above normal along the southern Beaufort Sea and most of the southern archipelago region while below normal temperatures prevailed north of 73°N. At the beginning of the month, the ice in eastern Barrow Strait slowly flushed eastward. New leads quickly refroze and young ice thickened as it spread eastward. Elsewhere within the archipelago, fast ice conditions prevailed; Amundsen Gulf finally consolidated near mid-April. In the Beaufort Sea, the main ice pack continued to move in a clockwise direction throughout the month. Some old ice approached within 30 miles of the coast along the Tuktoyaktuk Peninsula, which is rather unusual. The entire southern edge of the old ice pack was roughly 30 miles closer to the coast than normal along the Alaskan coast but as much as 100 miles further south than usual in Canadian waters west of Cape Parry.

In May, the mean temperatures were near normal west of Coronation Gulf, but colder than normal from Cambridge Bay eastward. The Central Arctic ice situation did not change much from the one described in April since the ice remained consolidated; the only exception is in the eastern Barrow Strait region where thinner ice stopped growing during the third week

of May and open water conditions prevailed towards the end of the month. In the Beaufort Sea, a slow clockwise motion of the pack ice persisted throughout the month. During the last week of May, the ice accelerated westward along the Alaskan coast and headed almost due north in the regions west of Point Barrow.

Observed Ice Conditions

The regional ice charts in figures 5 and 6 were based on the analysis of Radarsat/Envisat and NOAA/MODIS imageries from around May 25th, 2009. These charts reveal some of the following features:

a) An early clearing of the ice in the eastern Barrow Strait region.

b) Opening of the ice in Penny Strait suggests an early breakup pattern by about 2 weeks for this region.

c) Up to six tenths of old ice is depicted in Franklin Strait, yet only a trace of old ice is present in Victoria Strait; the reverse situation would be normal.

d) The southern old ice extent in the Beaufort Sea is 60 to 90 miles further south than normal in the Canadian waters west of Cape Parry, but diminished to only 20-30 miles further south than normal along the Alaska coast.

e) The amount of old ice in the Canada Basin west of 130°W is significantly less than normal, but as we get closer to the Queen Elizabeth Islands coast, the amount old ice nears normal.

f) M'Clure Strait has very little amount of old ice and the northern sections of Viscount Melville Sound only contains a trace of old ice while the southern section shows 6 tenths of old ice; this represents significantly less old ice than normal for these regions.

g) No significant leads are apparent between Cape Lisburne and Point Barrow, but huge opening are noticeable along the Russian coast of the southern Chukchi Sea.

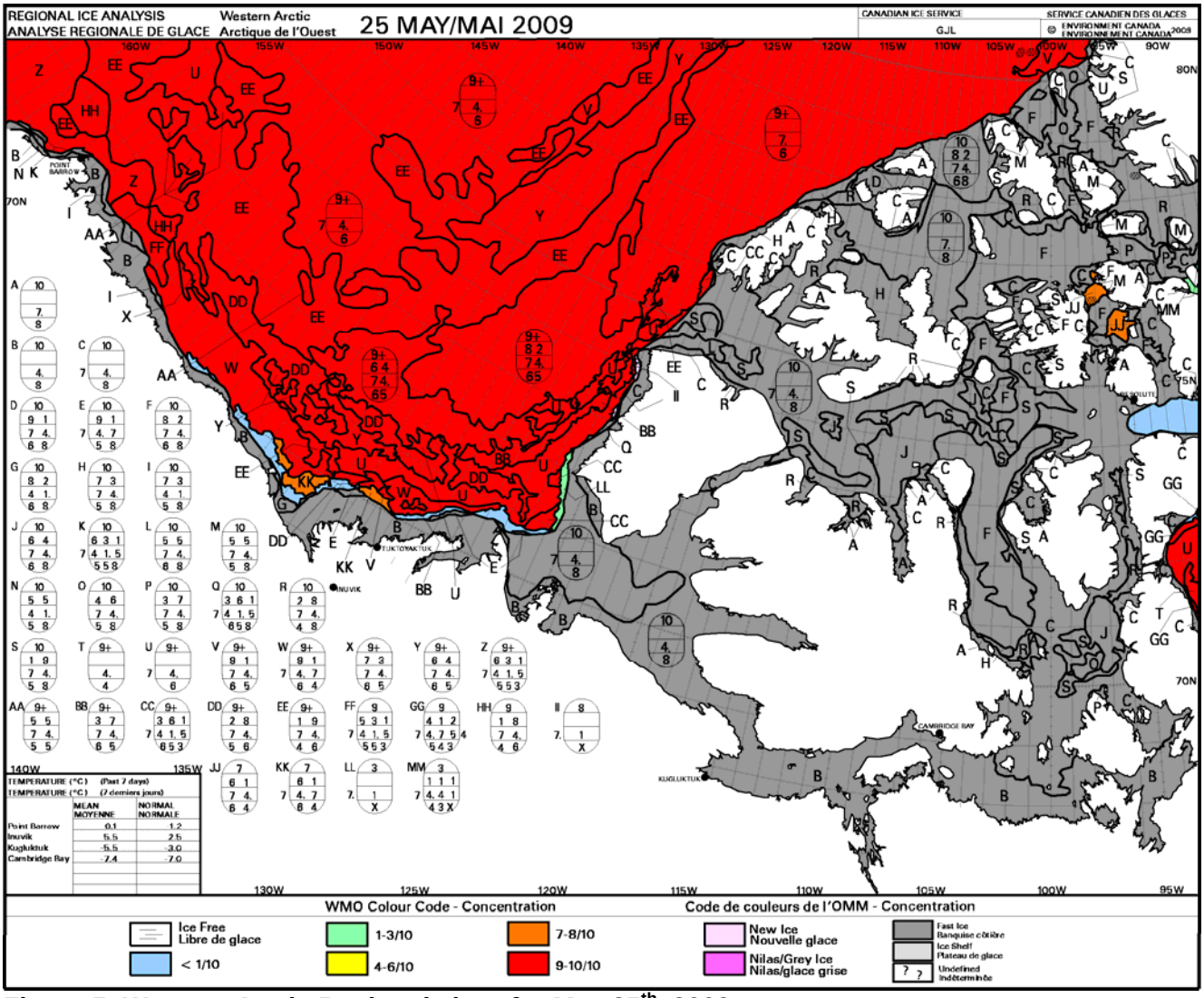

Figure 5: Western Arctic Regional chart for May 25th, 2009

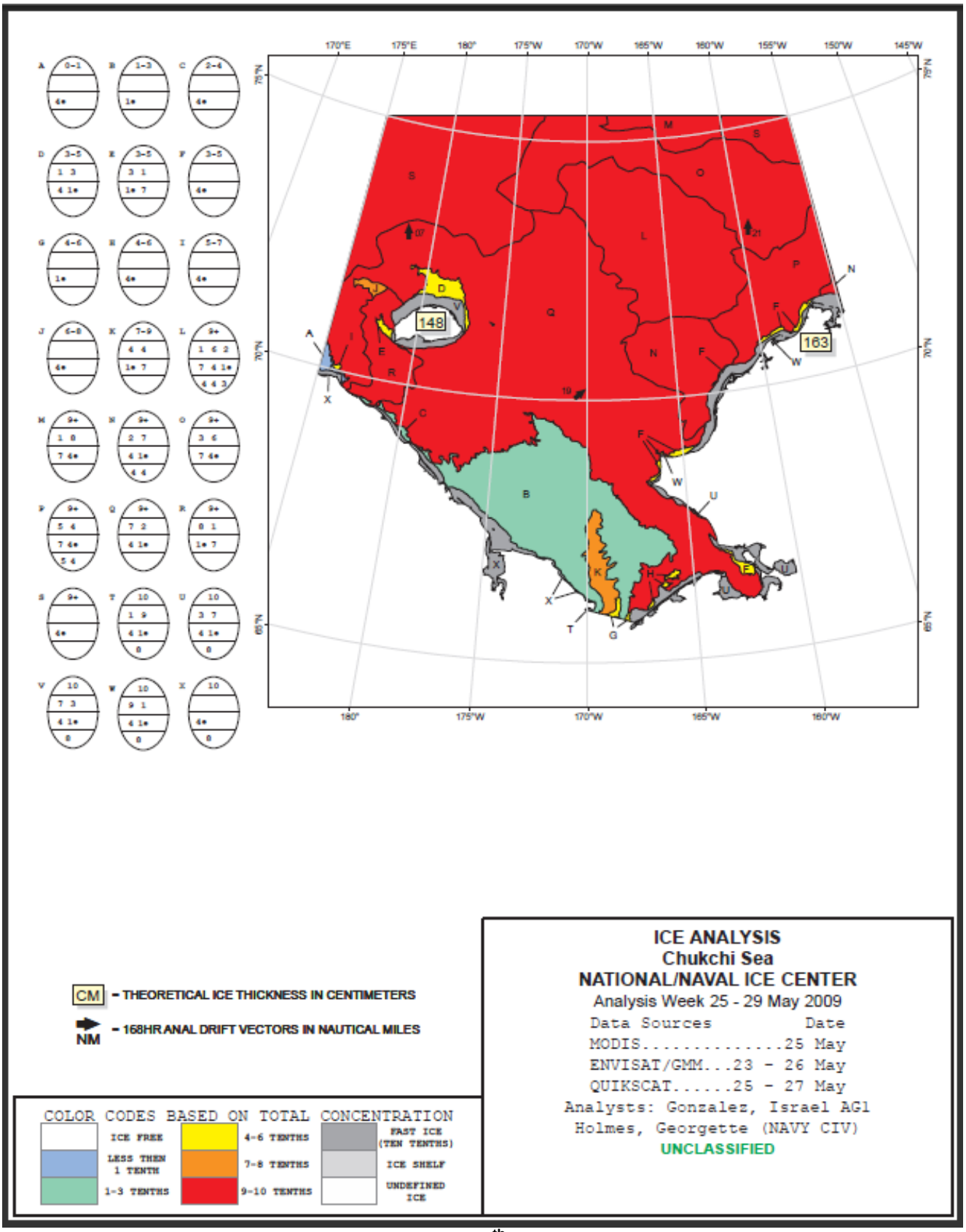

Figure 6: Chukchi Sea Regional chart for May 25th, 2009

Outlook for the Western Arctic

Through the months of June, July and August, the mean temperatures are forecasted to be warmer than normal along the coastal sections of Alaska, Yukon and the Northwest Territories. Further east in the central Arctic region, the temperature regime is expected to be near normal. Consequently, most events monitored through the summer period are expected to occur around their respective normal dates. Mackenzie Bay will fracture around the mid-June period followed by the clearing of Kugmallit Bay one week later. The Tuktoyaktuk Peninsula and Amundsen Gulf will fracture during the second week of July while the fracture events in Coronation Gulf, Queen-Maud Gulf as well as Larsen and Peel Sound will take place during the fourth week of July. At the same time, the open water route from Mackenzie Bay to Cape Bathurst should develop. The clearing event for Coronation Gulf and the open water route to Taloyoak are expected during the second week of August while Amundsen Gulf is not expected to clear until the third week of August. As for the Alaskan coast events, the open drift or less route from Cape Lisburne to Point Barrow and the open water route for the same region are expected to develop 7 to 10 days earlier than normal; these will respectively occur towards the last week of July and the second week of August. Meanwhile, the open drift or less routes east of Point Barrow to Prudhoe Bay and to Mackenzie Bay are not expected to develop until the mid-August period.

Of concern for the western Arctic region for this summer, is the unusual amount of old ice described earlier in Franklin Strait and M'Clintock Channel. This will most certainly prevent the clearing of the Northwest Passage for a fourth consecutive year and affect transit through the Victoria Strait region during late August and early September period.

Table 3: Western Arctic - Break-up Outlook Dates

	2008	Median	Outlook for 2009
Mackenzie Bay			
- Clearing	22 Jun	19 Jun	14-16 Jun
Kugmallit Bay			
- Clearing	24 Jun	26 Jun	21-23 Jun
Tuktoyaktuk Peninsula			
- Fracture[1]	24 Jun	02 Jul	07-09 Jul
Mackenzie Bay to Cape Bathurst			
- Open water route	02 Jul	26 Jul	19-21 Jul
Coastal waterway Mackenzie Bay to Prudhoe Bay			
- Open drift or less	10 Jul	14 Aug	17-19 Aug
Coastal waterway Prudhoe Bay to Point Barrow			
- Open drift or less	19 Jul	11 Aug	12-14 Aug
- Close pack (refreeze)	10 Oct	08 Oct	08-10 Oct
Cape Lisburne to Point Barrow			
- Open drift or less	25 Jul	03 Aug	23-25 Jul
- Open water route	15 Aug	17 Aug	11-13 Aug
Wainwright			
- Open drift or less	23 Jun	29 Jun	28-30 Jun
Coastal waterway Prudhoe Bay to Barter Island			
- Open drift or less	12 Jul	01 Aug	17-19 Aug
Open water route to Taloyoak	09 Aug	16 Aug	08-10 Aug
Amundsen Gulf			
- Fracture[1]	Not consolidated	07 Jul	06-08 Jul
- Clearing	08 Aug	15 Aug	14-16 Aug
Coronation Gulf			
- Fracture[1]	18 Jul	16 Jul	22-24 Jul
- Clearing	04 Aug	01 Aug	07-09 Aug
Queen Maud Gulf			
- Fracture[1]	28 Jul	23 Jul	22-24 Jul
Larsen Sound			
- Fracture[1]	27 Jul	31 Jul	23-25 Jul
Peel Sound			
- Fracture[1]	22 Jul	31 Jul	23-25 Jul

[1] Fracture indicates complete breakage of consolidated ice.

Table 4: Selected Sea Ice Data and Severity Index for the north coast of Alaska (1953-2008)

		1	2	3	4	5	6	7	8	9		
RANK	YEAR	10 Aug	15 Sep	10 Aug	15 Sep	date	date	#days	#days	# days	Obs Index	Fcst Index
1	2007	150	397	183	515	16-Jul	08-Oct	63	84	77	1136	221
2	2008	0	318	213	318	07-Jul	10-Oct	66	91	86	879	170
3	2004	13	238	70	260	16-Jul	08-Oct	71	68	77	637	602
4	1958	50	150	50	210	19-Jul	25-Oct	92	99	74	624	446
5	1968	25	165	30	200	19-Jul	18-Oct	86	91	74	615	495
6	1998	15	105	20	240	15-Jul	21-Oct	72	100	78	584	486
7	2005	70	130	85	250	23-Jul	03-Oct	63	70	70	580	381
8	2003	18	167	27	185	21-Jul	20-Oct	52	92	72	568	481
9	1993	0	130	5	185	18-Jul	07-Nov	64	112	75	565	388
10	2002	0	135	18	225	13-Aug	14-Oct	32	64	49	504	293
11	1962	25	150	30	150	19-Jul	30-Sep	49	68	74	490	406
12	1973	5	80	5	190	31-Jul	20-Oct	73	82	62	486	344
13	1954	20	115	20	210	01-Aug	30-Sep	38	61	61	484	552
14	1997	28	150	40	150	08-Aug	10-Oct	47	63	54	463	297
15	1963	5	130	5	130	13-Aug	18-Oct	67	67	49	442	351
16	1990	0	90	40	90	23-Jul	12-Oct	75	105	70	429	173
17	1961	15	105	15	135	25-Jul	24-Sep	49	62	68	418	414
18	1996	10	65	70	155	16-Jul	25-Sep	37	71	77	405	446
19	1979	0	125	0	125	04-Aug	08-Oct	31	56	58	394	178
20	1989	10	70	55	110	19-Jul	22-Oct	34	95	74	383	284
21	1974	10	100	10	100	06-Aug	05-Oct	35	61	56	351	372
22	1978	5	70	30	95	25-Jul	09-Oct	35	76	68	343	492
23	1986	10	80	10	110	29-Jul	21-Oct	30	58	64	342	517
24	1999	15	45	45	105	30-Jul	08-Oct	56	70	63	338	98
25	1977	5	55	25	85	02-Aug	15-Oct	63	74	60	336	381
26	1959	20	65	20	65	19-Jul	06-Oct	42	86	74	331	271
27	1995	30	30	50	50	15-Jul	17-Oct	70	94	78	329	477
28	1972	0	60	30	90	31-Jul	01-Oct	45	63	62	320	251
29	1982	0	85	0	95	03-Aug	10-Oct	21	69	59	318	271
30	2006	17	18	17	69	04-Aug	13-Oct	60	70	58	275	-462
31	1994	10	35	10	60	05-Aug	24-Sep	44	55	57	251	334
32	1957	5	45	70	60	01-Aug	06-Oct	18	67	61	250	300
33	1987	0	10	0	85	05-Aug	30-Oct	35	59	57	250	299
34	1981	0	0	35	100	26-Jul	01-Oct	0	66	67	232	521
35	2000	10	70	10	75	31-Jul	02-Oct	19	33	62	228	274
36	1985	0	35	0	55	01-Aug	15-Oct	22	52	61	224	245
37	1967	15	0	30	50	25-Jul	12-Oct		68	68	213	212
38	1984	0	25	0	50	11-Aug	15-Oct	21	42	51	209	219
39	1966	5	0	5	45	01-Aug	22-Oct	24	65	61	194	296
40	1992	15	0	15	75	09-Aug	19-Sep	24	37	53	188	560
41	1965	0	10	0	70	25-Aug	25-Sep	25	32	37	173	182
42	2001	0	25	15	25	17-Aug	08-Oct	26	52	45	172	262

		1	2	3	4	5	6	7	8	9		
RANK	YEAR	10 Aug	15 Sep	10 Aug	15 Sep	date	date	#days	#days	# days	Obs Index	Fcst Index
43	1980	15	25	15	25	05-Aug	30-Sep	11	42	57	159	426
44	1953	0	0	5	35	27-Jul	16-Sep	5	52	66	157	213
45	1976	0	15	0	15	15-Aug	07-Oct	21	53	47	150	106
46	1971	0	0	0	30	23-Aug	01-Nov	8	71	39	147	166
47	1991	0	0	0	20	16-Aug	02-Oct	0	46	46	111	199
48	1960	0	0	20	20	05-Aug	07-Sep	0	34	57	110	231
49	1988	0	0	0	25	09-Aug	20-Sep	0	32	53	110	354
50	1964	0	0	0	5	13-Aug	20-Sep	0	39	49	95	536
51	1983	0	10	0	10	08-Aug	16-Sep	0	21	54	92	41
52	1970	0	0	5	0	06-Aug	14-Sep	0	32	56	87	251
53	1956	0	0	0	40	07-Sep	30-Sep	0	24	24	87	93
54	1969	0	0	0	30	07-Sep	18-Sep	5	12	24	70	157
55	1955	0	0	5	15	13-Sep	24-Sep	0	12	18	44	44
56	1975	5	0	5	0	NEVER	NEVER	0	0	0	0	8

1 - Distance from Point Barrow northward to ice edge (10 Aug)

2 - Distance from Point Barrow northward to ice edge (15 Sept)

3 - Distance from Point Barrow northward to boundary of five tenths ice concentration (10 Aug)

4 - Distance from Point Barrow northward to boundary of five tenths ice concentration (15 Sep)

5 - Initial date the entire sea route to Prudhoe Bay is less than or equal to five tenths ice concentration.

6 - Date that combined ice concentration and thickness dictate end of prudent navigation.

7 - Number of days the entire sea route to Prudhoe Bay is ice free.

8 - Number of days entire sea route to Prudhoe Bay less than/equal to five tenths ice concentration.

9 - Number of days between initial opening date and 01 Oct.

Appendix A : Key To Canadian Ice Service Sea Ice Symbols

For more information on this section, please refer to the following web link on the Canadian Ice Service web site:

http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?Lang=eng&lnid=76&ScndLvl=no&ID=11030

or on the National Ice Center web site:

http://www.natice.noaa.gov/egg_code/index.html

Appendix B : Broadcast Schedules For Arctic Ice and Marine Conditions

For more information on this section, please refer to the following web links:

Canadian Coast Guard (Radio Aids to Marine Navigation):

http://www.ccg-gcc.gc.ca/eng/CCG/MCTS_Radio_Aids

Alaska Marine VHF Voice:

http://www.nws.noaa.gov/om/marine/akvhfv.htm

NOAA MF/HF Voice – 4125 kHz:

http://www.nws.noaa.gov/om/marine/noaahfv.htm

NOAA Weather Radio at U.S. Coast Guard Sites in Alaska:

http://www.nws.noaa.gov/om/marine/aknwr.htm

For further information, please contact Canadian Ice Service by:

Phone: 1-877-789-7733
Fax: 1-613-947-9160
E-Mail: ECWeather-Meteo@ec.gc.ca

Or National Ice Center by:

Phone: 1-301-394-3099
E-Mail: liaison@natice.noaa.gov