Prepared by the North American Ice Service

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

02 June 2010

Seasonal Outlook

For North American Arctic Waters

Summer 2010

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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 1 and 2 imagery collected during the past winter and spring. NOAA and MODIS satellite imagery 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 years' ice conditions and, in conjunction with wind and temperatures forecasts for June, are applied to estimate the timing of breakup and the clearing of ice in the areas of interest. The Canadian Meteorological Centre forecasts the temperature regime for the period from June through August. Any variations from these forecast parameters will 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 twice monthly via the issue of a 30-day forecast to enable planning of shipping or other activities according to changing trends. These 30-day 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.

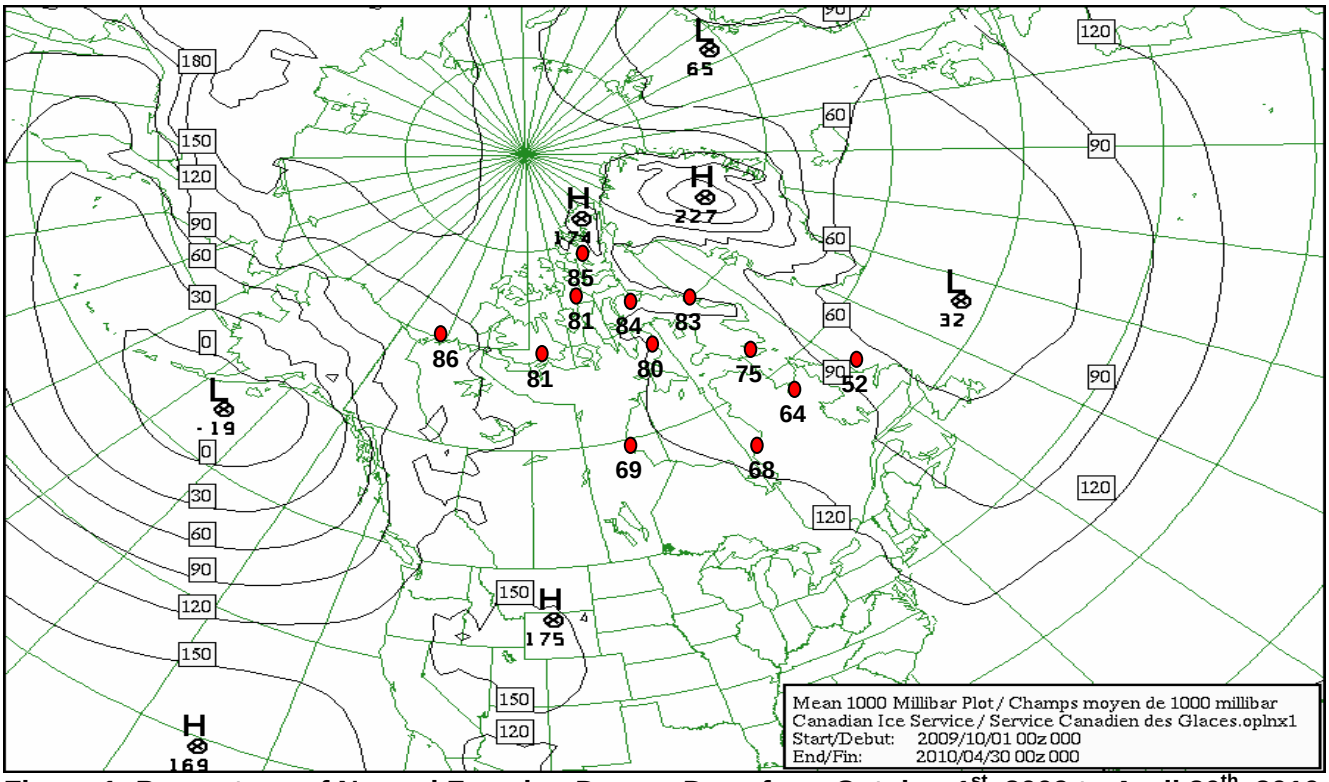

Figure 1: Percentage of Normal Freezing Degree Days from October 1st, 2009 to April 30th, 2010

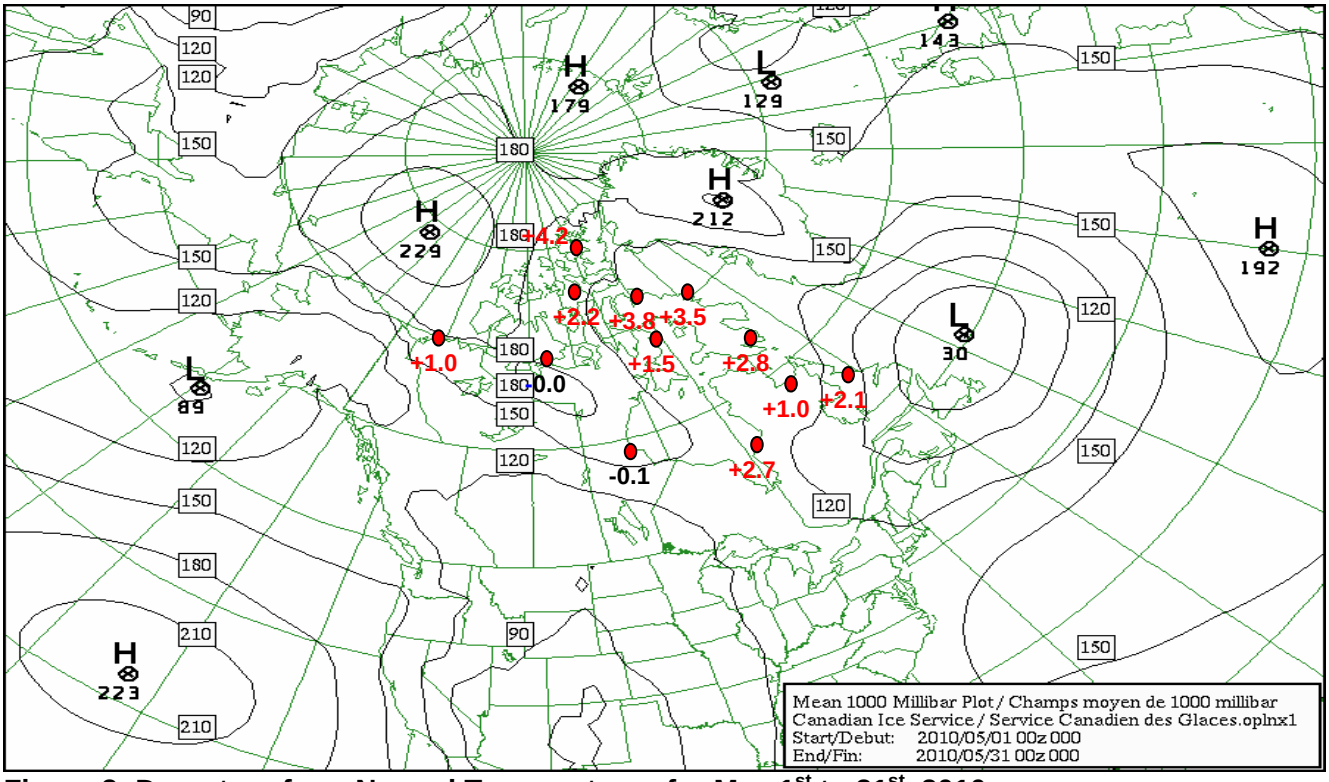

Figure 2: Departure from Normal Temperatures for May 1st to 31st, 2010

General Winter Conditions and Brief Outlook

The mean 1000 mb pressure pattern from October 01st, 2009 to April 30th, 2010 is represented in Figure 1. A low-pressure system persisted well south of 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 moderate northeasterly 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 2009 to April 2010, mean air temperatures were above normal by 2 to 4 degree Celsius over most of the Arctic except well above normal (6 to 8°C) over the southern Davis Strait regions. No part of the Arctic indicated colder than normal temperatures. Freezing degree-day (FDD) accumulations for the winter period only reached 80-85 % of normal values in Arctic regions setting minimum record values for many locations. These numbers were even more impressive in Hudson Bay and along the Labrador Coast where accumulated FDD only achieved 52-75% of normal values. These lower than normal percentages had a direct impact on ice thickness measurements taken at various places in the Arctic which were thinner by 20 cm (in the north) to 50 cm (in the south). Percentages of normal FDD accumulations are indicated in Figure 1.

The mean 1000 mb pressure pattern for May is shown in Figure 2. A high-pressure system located over Canada basin with a ridge line extending southeastward towards western Hudson Bay dominated the Arctic; another high pressure area was located over central Greenland. An inverted trough line over Baffin Bay and Davis Strait was associated with a low-pressure system east of Newfoundland and a weaker low pressure system also lay in the Gulf of Alaska. Light to moderate east wind prevailed over the Beaufort Sea. The winds were light elsewhere in the Central Arctic, the Eastern Arctic and Hudson Bay regions. Throughout May, above normal temperatures ranged between +1.0 to 4.2 °C over most Arctic regions; however, mean temperatures remained near normal over the south central portion of the Arctic near Coronation Gulf and over the western shore of Hudson Bay.

For the summer period of June through August, above normal temperatures are forecast for most Arctic regions. Consequently, all events monitored in the Arctic are forecast to occur on dates that are earlier than normal or near their normal (median) dates. This does not, however, prevent local ice conditions from exhibiting slight variations about the general forecast trend discussed above.

Hudson Bay and Approaches

Freeze-up and Winter Ice Regime

In spite of a 2-week earlier-than-normal freeze-up along the western shores of Hudson Bay in the second half of October, freeze-up was delayed almost everywhere else by 3-4 weeks as a result of the above normal November and December air temperatures. Air temperatures during the first half of November were near normal everywhere. In the second half of November, air temperatures were 4-6°C above normal for most of Hudson Bay and Hudson Strait except 7-10°C above normal for northwestern Hudson Bay. They were 1-3°C above normal for Frobisher Bay but 1-3°C below normal over the Cumberland Peninsula. In December, air temperatures averaged 10°C and greater above normal in northeast Hudson Bay, Hudson Strait and southern Baffin Island. Air temperatures were 4-8°C above normal over the rest of Hudson Bay except only 1-4°C above normal along the southwest shore of Hudson Bay and James Bay. By the first week of January, measured ice thickness values lagged normal ice thicknesses by 12cm. At the end of January, measured ice thicknesses lagged normal thicknesses by 17cm.

October/November:

Ice growth was slower-than-normal for almost all parts of Hudson Bay and its approaches, with the following exceptions: 1) in the second half of October, near-shore ice formed 2-3 weeks earlier than normal along the southwest coast of Southampton Island and along the western shore of Hudson Bay; and 2) in late October - early November, near-shore ice formed 2-3 weeks earlier-than-normal along the northeast coast of Hudson Bay, the west coast of Ungava Bay and at the head of Frobisher Bay. New ice started to form along the shore near Churchill, Manitoba, in the second week of October. New ice started to form along the shores of Southampton Island, along the western shore of Hudson Bay and at the head of Frobisher Bay during the third week of October. By mid-November, grey and grey-white ice surrounded Southampton Island, filled Roes Welcome Sound and extended along the west coast of Hudson Bay. Grey and new ice had spread along the southwest shore and parts of the northeast shore of Hudson Bay and also along the southwest coast of Ungava Bay. New ice had developed along the coast in James Bay. New and grey ice had developed along the east coast of Baffin Island and now extended around Cape Dyer to the mouth of Cumberland Sound. New ice had developed along most of the south coast of Baffin Island, including the north shore of Hudson Strait and in Frobisher Bay and Cumberland Sound. By the end of November, conditions in Hudson Bay had changed very little. In the approaches, however, new ice now covered much of the western half of Hudson Strait and filled Frobisher Bay. Thin first-year ice descended along the east coast of Baffin Island to Cape Dyer and grey-white ice extended towards the mouth of Cumberland Sound. Cumberland Sound was predominantly covered in grey ice.

December:

Ice growth was slower-than-normal throughout December. By mid-December, areas of open water still remained in eastern Hudson Bay and James Bay while central Ungava Bay was still primarily bergy water. Grey-white ice extended from the first-year pack to the mouth

of Frobisher Bay and around Resolution Island. New ice filled central Hudson Bay and grey ice now covered Hudson Strait west of Ungava Bay. Frobisher Bay and Cumberland Sound were covered in grey and grey-white ice and patches of new ice were developing along the Labrador Coast. By the end of December, ice concentrations had recovered to near-normal values everywhere except at the eastern entrance to Hudson Strait, along the leading edge of the ice pack in Davis Strait and along the Labrador Coast. Furthermore, ice thicknesses lagged normal values almost everywhere in Hudson Bay, Hudson Strait and along the Labrador Coast. While a tongue of thin first-year ice extended from the southwest Southampton Island into central Hudson Bay, the remainder of Hudson Bay, including James Bay, remained covered in grey-white ice which thinned to grey ice along many parts of its shores. Hudson Strait and Ungava Bay were primarily covered in grey-white ice except for eastern sections, which remained covered in grey ice. First-year ice rounded Cape Dyer and filled Cumberland Sound and Frobisher Bay, areas of coastal fast ice had yet to develop in Frobisher Bay. New ice predominated in a thin band along the Labrador Coast.

January:

By the end of January, medium first-year ice covered most of central and northeastern Hudson Bay, western Hudson Strait, and extended around Cape Dyer across the mouth of Cumberland Sound to the entrance of Frobisher Bay. Medium first-year ice also filled Roes Welcome Sound and the heads of Frobisher Bay and Cumberland Sound. Thin first-year ice prevailed to the east of the Belcher Islands in Hudson Bay, in James Bay and in the western parts of Hudson Bay (except for a band of grey-white ice along the northwestern shore). The area to the east of the Belcher Islands, which is normally consolidated by this time, remained mobile. Thin first-year ice also filled the eastern sections of Hudson Strait, Ungava Bay and the bulk of Frobisher Bay and Cumberland Sound although areas of grey and grey-white ice could be found along the southern coasts of Ellesmere Island and the western shores of Ungava Bay. Grey-white ice, extending from the outer edge of the first-year pack ice in Davis and Hudson Straits, extended southwards along the Labrador Coast, where normally first-year ice would prevail at this time of year. South of ~57°N, a lead containing primarily new ice prevailed between this grey-white ice pack and the coastal fast ice (mostly thin first-year ice). An area of 2 tenths old ice was just rounding Caper Dyer and a trace of old ice extended down from this area to 59°N.

February:

Ice growth during the month was slower than normal due to well above normal temperature over the entire region. Monthly temperature anomalies ranged from 5 degrees above normal near Churchill and increased gradually northeastward to peak at 16 degrees above normal over the southern portion of Davis Strait. The eastern ice edge was driven shoreward during the first half of the month. By mid-month, medium first-year ice dominated western Davis Strait, Hudson Bay and Hudson Strait although many areas along the shore of Hudson Bay and Hudson Strait remained very mobile with up to four tenths of young ice. In Davis Strait, areas containing 1 to 2 tenths of old ice had reached as far south as 65°N while trace amounts of old ice extended into the eastern entrance to Hudson Strait and along the mid-Labrador Coast. Thin first-year ice prevailed along the Labrador Coast and along the ice edge in Davis Strait albeit mixed with young ice. By the end of the month, the ice thicknesses had not increased significantly and remained below normal values. The eastern ice edge

rebounded slightly seaward, but remained 30 to 50 miles further west than normal for this time of year.

March:

Ice growth continued to be slower than normal during March as well above normal temperatures persisted over the whole region. Air temperature anomalies remained similar to February's (4 to 10 degrees above normal), but the pattern had shifted somewhat; warmer anomalies were located over Hudson Bay and Davis Strait while the mid-Labrador Coast had the cooler values. Warmer temperatures helped the ice to remain more mobile than it usually is at this time. This was reflected in several regions still showing 2 to 4 tenths of young ice amongst the prevailing medium first-year ice while many narrow coastal regions only showed grey and grey-white ice types. By mid-month, medium first-year ice dominated most regions while thick first-year ice was only seen in the northern most regions of Davis Strait. Areas containing 1 to 2 tenths concentration of old ice continued to move southward in Davis Strait while trace amounts were reported at the eastern entrance to Hudson Strait and further east near the ice edge and along the Labrador Coast. No old ice was observed inside Frobisher Bay. A narrow region containing trace amount of old ice was also showing in the southern region of Foxe Basin northeast of Southampton Island. At the end of March, Medium first-year ice prevailed over the entire region but was mixed with up to 4 tenths of thick first-year ice north of 60°N. Areas located within 60-100 miles of the eastern Hudson Bay shore, in James Bay and in Hudson Strait still contained 1 tenth of grey-white ice while the western shore of Hudson Bay had up to 4 to 6 tenths of new and young ice mixed with 3 to 5 tenths of thin first-year ice. The trace of old ice in southern Foxe Basin had moved into the Foxe channel. Along the Labrador Coast, the ice extent was near normal but the ice pack was mostly composed of thin and medium first-year ice with a trace of old ice. As we moved north of 60°N, the ice extent lay 90-120 miles further west than normal and the pack ice was mostly medium and thick first-year ice with a trace of old ice. The area containing 1 to 2 tenths of old ice reached 62°N.

April:

Mean temperatures during the entire month remained above normal by 5 degrees in the southern sectors and by up to 8 degrees in the northern half. Although ice growth was still possible (albeit slow) in the north, the above normal temperatures observed during the past 5 months rendered the ice increasingly mobile for this time of the year. Meanwhile in the southern areas, the melt season started 1-2 weeks ahead of normal. At the end of April, the breakup pattern was already 4 to 6 weeks ahead of normal. In Hudson Bay and Hudson Strait, many regions only showed 7 to 8 tenths ice concentrations of prevailing medium first-year ice; open water leads were also seen off the coastal fast ice regions. In the Davis Strait region, bands of medium and thick first-year ice containing up to 2 tenths of old ice were embedded in western sections and extended as far south as 60°N. A trace of old ice prevailed elsewhere including in Hudson Strait as far west as 70°W. The eastern ice edge was 40 to 60 miles further west than normal in Davis Strait, but only by 20 to 30 miles along the Labrador Coast.

Over the Newfoundland waters, the total accumulated ice coverage for April was the second lowest since the winter of 1968/69. At the end of the month, the only ice left was found along the Great Northern Peninsula coast and over parts of the Strait of Belle Isle.

May:

The temperature anomaly pattern during the first three weeks of May was significantly different from that of the previous months; colder than normal temperatures prevailed over the western half of Hudson Bay, which gradually warmed to above normal conditions in the eastern portion of the bay and along all of the east coast regions. During the last week of the month, temperature anomalies rebounded to above normal over the entire region. Towards the end of May, the ice concentrations continued to be much looser than normal in northern Hudson Strait and over eastern and northern Hudson Bay with many areas already showing open water conditions. The ice in central Frobisher Bay flushed out towards the entrance of the bay leaving only the fast ice in the western sections. Along the Labrador Coast, the ice had already retreated northward to near the entrance to Lake Melville. The ice breakup is about 3 weeks ahead of normal along the Labrador Coast. The decay of the ice in Hudson Strait and Hudson Bay is even more advanced and is about 4 to 5 weeks ahead of normal in those regions.

Observed Ice Conditions

The regional ice chart in figure 3 was based on the analysis of Radarsat 1 and 2 and NOAA/MODIS imagery from around May 24th, 2010. This chart revealed some of the following features:

a) The eastern ice edge lies about 60 miles further west than normal.

b) The bergy water leads and very open drift ice concentrations depicted over northern Hudson Strait, northern and eastern Hudson Bay usually appear towards late-June or early July; this suggests the breakup for those particular regions is occurring 4 to 5 weeks ahead of normal.

c) Trace amounts of old ice can be found within the ice along the east coast of Canada including the eastern entrance to Hudson Strait. Small areas in Davis Strait contain 2 to 4 tenths of old ice embedded within the ice pack north of 63°N.

d) All ice in Lake Melville melted 2 to 3 weeks earlier than normal.

e) Ice type in Hudson Bay is mostly medium first-year ice this year; normally thick first-year ice prevails.

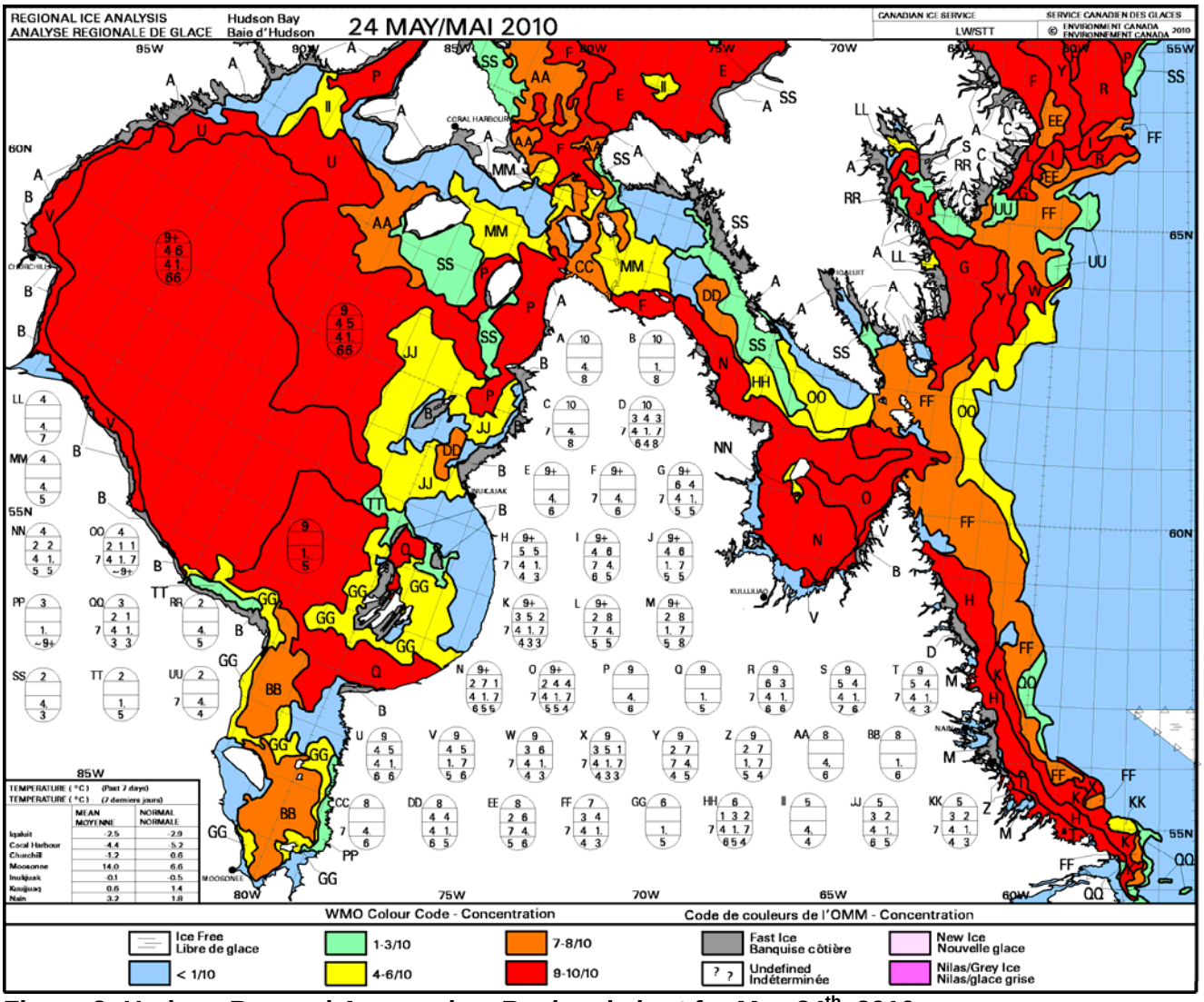

Figure 3: Hudson Bay and Approaches Regional chart for May 24th, 2010

Outlook for Hudson Bay and Approaches

The summer temperature outlook for June, July and August suggests the above normal trend seen this past winter and spring will continue; if this forecast holds true, the breakup should occur ahead of normal. Moreover, accumulated Freezing Degree Days achieved this winter reached all-time record low values for many coastal stations; this resulted in measured ice thicknesses 40-50 cm thinner than normal by the end of April. Consequently, all first-year ice present over much of Hudson Bay and the Labrador Coast should melt more rapidly than normal; hence all events typically forecast for the Hudson Bay region are forecast to occur ahead of normal while some could set new (early) record dates. Chronologically, the ice in James Bay should melt near the onset of summer setting a new record date; this is radically different than last summer when James Bay established a new record for late ice clearing. Then, an open water route will develop in northwestern Hudson Bay during the last week of June. The bergy water route in Hudson Strait, the clearing of the ice in Ungava Bay, the open water route to Churchill and the clearing of the ice in Hudson Bay are forecast to occur during the first week

of July. Before mid-July, the ice will clear along the Labrador Coast; this timing will also coincide with the open drift or less route into Frobisher Bay. The last events to take place will be the bergy water route into Frobisher Bay (during the 4th week of July) and the ice clearing out of Hudson Strait during the last week of July.

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

	2009	Median	Outlook for 2010
Labrador Coast to Cape Chidley **- Clearing**	16 Jul	24 Jul	06-08 Jul
Frobisher Bay **- Open drift or less** **- Clearing**	10 Jul 04 Aug	19 Jul 05 Aug	06-08 Jul 20-22 Jul
Ungava Bay **- Clearing**	31 Jul	03 Aug	03-05 Jul
Bergy water route through Hudson Strait (eastern entrance to south of Nottingham Island)	18 Jul	27 Jul	03-05 Jul
Hudson Strait **- Clearing**	26 Jul	07 Aug	26-28 Jul
Bergy/open water route to Churchill (eastern entrance of Hudson Strait to Churchill)	06 Aug	30 Jul	03-05 Jul
Open water route through northern Hudson Bay (south of Nottingham Island to Churchill)	06 Aug	20 Jul	28-30 Jun
Hudson Bay **- Clearing**	06 Sep	17 Aug	04-06 Jul
James Bay **- Clearing**	07 Sep	30 Jul	20-22 Jun

Eastern Arctic

Freeze-up and Winter Ice Regime

Overall, air temperatures in the eastern Canadian Arctic averaged above normal during the freeze-up period. The most consistent warming was observed along the north coast of Ellesmere Island where temperatures reached greater than 3-6°C above normal from mid-September to December. Over Nansen and Eureka Sounds, Norwegian Bay, Jones Sound and Lancaster Sound, air temperatures averaged 1-3°C above normal in the last half of September and in October, and reached up to greater than 5°C above normal in November and December. While during the early part of the freeze-up period air temperatures were near normal in Nares Strait, Baffin Bay and in the eastern half of Foxe Basin, they increased dramatically in these areas in December, particularly in western sections of Baffin Bay and Davis Strait where temperatures reached greater than 10°C above normal. North of ~75°N (except for Jones Sound), freeze-up was delayed by 1-2 weeks, especially in areas where end-of-melt-season ice concentrations were already below normal (e.g. Nares Strait, Nansen Sound, Eureka Sound, Norwegian Bay, Penny Strait, and Wellington Channel). Between 70°N and 75°N and also in Jones Sound, freeze-up was 3-4 weeks late (i.e. in Barrow Strait, Prince Regent Inlet, Lancaster Sound, Admiralty Inlet, and in Navy Board Inlet and Eclipse Sound). Freeze-up was 2-3 weeks late in the Gulf of Boothia, Pelly Bay and Committee Bay. In Baffin Bay, except for a brief 1-week earlier than normal freeze-up along the leading edge of the ice pack in the far northwest in early October, the general progression / advance of the ice from north to south was ~2 weeks later than normal. Similarly in Foxe Basin, in spite of an ~2 week early start in the ice formation around the islands in the northeast part of the basin, subsequent formation of the ice from north to south was generally delayed by ~2 weeks. By the end of January, measured ice thicknesses at Eureka were ~9 cm thinner than normal. At Resolute Bay, measured ice thicknesses were very close-to-normal until a strong and persistent northwesterly wind event caused an anomalous break-up of the local fast ice in the 3rd and 4th weeks of January. Subsequently, measured ice thicknesses in the last week of January were ~15cm thinner-than-normal. Although no ice thickness measurements are available for Baffin Island, anomalous local fast ice breakages were also reported at the communities of Qikiqtarjuaq and Clyde River at the end of December and beginning of January. In Hall Beach, November to mid-December measured ice thicknesses were 2-5cm thicker than normal.

At the end of the summer of 2009, the old ice distribution was slightly greater than normal in southern Kane Basin and in the extreme northwest part of Baffin Bay. There was considerably more old ice than normal in Belcher and Queens Channels and in the Hell Gate polynya region. Although less than normal, ice remained in the Gulf of Boothia or Committee Bay at the end of the summer for the first time in three years (after completely melting away by the end-of-summer in 2007 and 2008), leading to renewed areas of second year ice. Elsewhere in the Eastern Arctic, concentrations of old ice were generally less than normal.

September:

By mid-September, new ice had begun forming north of 77°N, in Nares Strait, Norwegian Bay, in the mouth of Nansen Sound and in the fiords along the north coast of

Ellesmere Island. By the end of September, predominantly grey ice filled Nansen and Eureka Sounds, eastern Kane Basin, and the fiords and inlets of Ellesmere and Axel Heiberg Islands. New ice formation had not developed much further, with the exception of patches of new ice between floes of old ice in western Barrow Strait, in northern Pelly Bay and in Fury and Hecla Strait.

October:
By mid-October, the ice in the northern Ellesmere Island fiords, Greely Fiord, the Axel Heiberg Island inlets and western Norwegian Bay had thickened to grey-white ice. Grey ice continued to predominate in eastern Kane Basin, Nansen and Eureka Sounds and in eastern Norwegian Bay. Grey ice had developed in parts of Jones Sound, Penny Strait, Barrow Strait, Prince-Regent Inlet and along the east coast of Devon Island, while new ice prevailed elsewhere in these areas. New ice now also covered most of the Gulf of Boothia, and patches had formed in southern Admiralty Inlet, in Eclipse Sound, along the north coast of Bylot Island and around the islands in northeastern Foxe Basin. By the end of October, thin first-year ice prevailed north of 77°N in areas not occupied by second-year or old ice, except in eastern Kane Basin and in the bays on its southwestern side, where grey-white ice prevailed. Nansen and Eureka Sounds had finally consolidated, 2-3 weeks later than normal. Grey-white ice covered most of Penny Strait, the western part of Jones Sound, Barrow Strait and the Gulf of Boothia. An anomalous patch of old ice had been detected in the eastern part of Lancaster Sound, at the leading edge of the grey-white ice area. A mixture of grey and grey-white ice had developed along the coasts and between the islands of northern Foxe Basin, while grey ice covered the eastern part of Jones Sound and the mouth of Lancaster Sound. Extensive new ice patches had developed in northern Baffin Bay, north of 72°N. Second year ice drifted through Fury and Hecla Strait into northwestern Foxe Basin.

November:
Jones Sound briefly consolidated near the beginning of November (a month earlier than normal), but the eastern half almost immediately re-fractured. Norwegian Bay consolidated in the first week of November, 1-2 weeks later than normal. By mid-November, medium first-year ice had developed in Nansen Sound and thin first-year ice prevailed elsewhere further south to 70°N. A few patches of thin new ice prevailed within the areas of thin first-year ice. New ice formed in leads along the north coast of Somerset Island, along the eastern shores of Prince Regent Inlet and Committee Bay, along the northeastern Baffin Island coast and in parts of northern Foxe Basin. The north central part of Baffin Bay contained primarily grey-white ice while the northeastern part was covered in a mix of grey and new ice. Grey-white ice extended southwards along the eastern Baffin Island coast from 70°N down to 65°N, and new and grey ice extended eastward from this to ~60°W. Grey-white ice prevailed east and south of Prince Charles Island in Foxe Basin and around the north coast of Southampton Island, with a mix of new and grey ice in between. Open water still prevailed in the very southern part of Foxe Basin. By the end of November, the ice in Eureka Sound and Norwegian Bay had thickened to medium first-year ice. The consolidated ice in the western part of Jones Sound had re-fractured and was now once again mobile. Thin first-year ice now covered the central part of Baffin Bay with a tongue reaching southwards from 70°N to 67°N. Patches of old ice continued to exit the Lincoln Sea drifting southwards into northwestern Baffin Bay. The thin first-year ice covering the northern half of

Foxe Basin now also covered its southeastern part. Grey ice extended from the mouth of Smith Sound southwards along the coast of Greenland to ~70°N, and the grey-white ice found between the coastal Greenland grey ice and the central Baffin thin first-year ice now extended south beyond these areas and around Cape Dyer to 65°N. Grey-white ice also covered most of the south-central and southwestern parts of Foxe Basin.

December:

The eastern part of Kane Basin consolidated in mid-December, 2 months later than normal. By the end of December, Jones Sound and Wellington Channel had yet to finally consolidate (both were now ~5 weeks late). Medium first-year ice prevailed in Nares Strait, Jones Sound, Lancaster Sound, the Gulf of Boothia, northern Foxe Basin and in western Baffin Bay. Thin first-year ice covered southern Foxe Basin and eastern Baffin Bay between the medium first-year ice and 58°W. Patches of 5 to 7 tenths of old ice existed in parts of Nares Strait, while areas of 1 to 3 tenths of old ice could be found among the medium first-year ice in western Baffin Bay. Traces of second year ice were in northwestern Foxe Basin. The bergy water lead along the west Greenland Coast extended north to ~75°N, containing new ice in its very northern extremity. On the last day of December, areas of the coastal fast ice along the east coast of Baffin Island broke away in very warm temperatures and strong southeasterly winds, affecting the communities of Qikiqtarjuaq and Clyde River, and creating many small areas of open water in some of the coastal inlets.

January:

Wellington Channel consolidated by mid-January, 7-8 weeks later than normal. At the same time, an ice arch developed in the Lincoln Sea but collapsed shortly thereafter. By the end of January, the western half of Jones Sound had finally re-consolidated, 11-12 weeks later than normal. Western Barrow Strait had not yet consolidated and Nares Strait (except for eastern Kane Basin) showed no signs of consolidation. Medium first year ice prevailed in almost all areas except along the leading edge of the ice pack in Baffin Bay, between 57°W and 60°W, and to the south of Smith Sound in the North Open Water polynya. Also, thick first year ice had developed in Norwegian Bay, Eureka sound and Nansen Sound. The bergy water lead along the west Greenland Coast had closed down to 71°N, now filled with grey-white ice in its northern parts. Overall concentrations of old ice averaged ~2 tenths along the length of Nares Strait and in western Baffin Bay. In southern Committee Bay there were patches of 1 to 4 tenths of old ice, after a two year absence. In Foxe Basin trace amounts of old ice extended to 66°N.

February:

Mean temperatures for the entire month remained well below zero in the Eastern Arctic but averaged 6 to 10 above normal over most locations; the cooler spots were found over the extreme northern (Eureka and Alert) and western regions (Resolute Bay) with only 4 degrees above normal. The warmest regions were the Kane Basin area (10 degrees above normal) and southern Davis Strait (16 degrees above normal). By mid-February, the prevailing ice type was thick first-year in the northern areas but was mixed with increasing amounts of medium first-year in the southern regions. Barrow strait remained mobile and was laced with areas of up to 5 tenths of old ice. Lancaster Sound and Prince Regent Inlet were similar in terms of mobility, however they only had smaller regions with up to 2 tenths of old

ice. Nares Strait did not consolidate and 2 tenths of old ice mixed with thick first year ice continued to move southward. At mid-month, large areas containing 4-6 tenths of old ice lay over northwestern Baffin Bay and south of Smith Sound; these higher-than-normal old ice concentrations rapidly thinned to areas of 2 tenths (or less) of old ice elsewhere in southern Baffin Bay and Davis Strait. The ice south of Smith Sound, but in the Greenland water, remained mobile and predominantly young; it rapidly thickened over northern Baffin Bay. The eastern ice edge was further west than normal as bergy water prevailed south of Disko Bay. As for most southern regions, Foxe Basin was covered by mostly medium first-year ice and a narrow band containing trace amount of old ice was showing in the central section. By the end of February, the ice conditions had not changed significantly except for the fact that thick first-year ice dominated many regions even though medium first-year ice dominated the regions south of 65°N.

March:

Temperatures continued to be warmer than normal throughout March with mean anomalies ranging between 4°C (western sections) to 8°C (eastern sections) above normal. The warmest anomaly remained in Davis Strait at 10 degrees above normal. By mid-month, ice conditions resembled the ones described in late February except for the following facts: Thick first-year ice dominated almost everywhere except for the extreme southern regions and in the Greenland waters where medium first-year ice prevailed. A new arch had recently developed atop Lincoln Sea (second formation this year). At the end of March, the same ice situation persisted almost everywhere with some more exceptions: The Lincoln ice arch held in place and much of the old ice flushed southward only to be replaced by young and thin first-year ice in northern Nares Strait. A large and unusual lead developed and refroze along the northwest coast of Ellesmere Island. Foxe Basin also developed small coastal leads in its eastern sectors. Finally, the eastern ice edge remained further west than normal influenced by the warm temperature anomaly over Davis Strait.

April:

Warmer than normal air temperatures persisted during the entire month; temperature anomalies ranged between +3 to +6 °C in the Eastern and Northern portions of the Arctic while the sectors further inland had anomalies of +7 to +9 °C. Ice growth was slow to moderate at best, however, many coastal leads started to develop in the eastern and southernmost sectors. Shortly after mid-April, the Lincoln Sea ice arch collapsed and trace amount of old ice started to pour into the northern sections of Nares Strait. Elsewhere the ice situation did not change significantly from previous descriptions. By the end of the month, a narrow bergy water lead had developed along the west Greenland Coast, off the fast ice, as far north as Melville Bay. Western Baffin Bay continued to have unusually more old ice concentration than normal since no ice bridge formed this past winter in Smith Sound. The above normal temperatures observed during the past winter yielded ice thickness thinner than normal by nearly 20 cm in the extreme north and by up to 50 cm in the south.

May:

Temperatures along the east coast of Baffin Island and throughout the High Arctic remained above normal during the month of May, reaching as much as 6°C above normal over northwestern Baffin Bay; the only exception was in the Gulf of Boothia where near

normal temperatures prevailed. With respect to ice conditions, the west Greenland bergy water lead gradually expanded northward and reached Melville Bay near the end of May. Old ice spilling from the Arctic Ocean into Nares Strait flowed rapidly down Kane Basin to reach the northwestern portion of Baffin Bay. This resulted in more old ice than normal in the northwestern portion of Baffin Bay and patches of old ice extending as far south as Davis Strait. Throughout the month, the fast ice around the edges of Kane Basin started to fracture and gradually flushed southward; this created unusually low sea ice concentrations in this portion of Nares Strait; normally such openings tend to occur south of Smith Sound because an ice bridge is usually present in this area at this time. During the last half of the month, the ice in northern Foxe Basin became increasingly mobile and ice concentrations thinned drastically in southern Baffin Bay. While many areas exhibited near normal breakup patterns, several sections were heading towards a 4 to 5 week earlier-than-normal breakup.

Observed Ice Conditions

The regional ice chart in figure 4 was based on the analysis of Radarsat 1 and 2 and NOAA/MODIS imagery from around May 24th, 2010. This chart revealed some of the following features:

a) Low ice concentrations in Kane Basin and further south into the northwestern portion of Baffin Bay.

b) A narrow bergy water lead along the west Greenland coast extending north to Melville Bay, something that is usually seen in late June or early July.

c) More old ice than normal in the western portions of Baffin Bay and Davis Strait.

d) An early opening of the ice in Cumberland Sound, in the northwestern section of Foxe Basin and in Penny Strait, a pattern which is not unusual in the spring but one which normally occurs 2 to 3 weeks later than the end of May.

e) Low concentrations of ice across southern Baffin Bay between 69 and 70°N; a similar situation typically occurs later, in early July, and further south than this (between 66 and 67°N) .

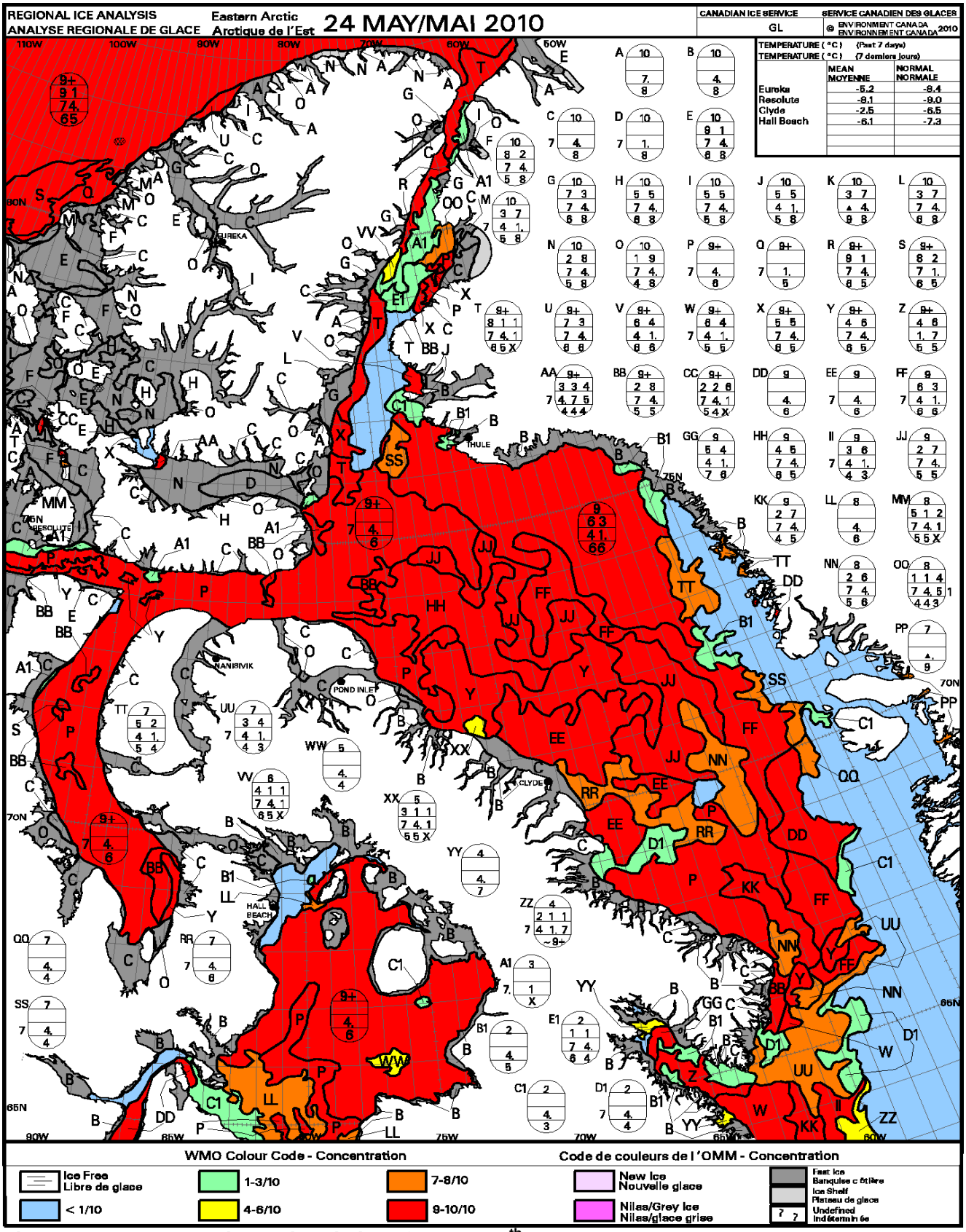

Figure 4: Eastern Arctic Regional chart for May 24th, 2010

Outlook for the Eastern Arctic

The summer temperature outlook for June through August is forecast to remain warmer than normal over all regions. This above normal temperature persistence will result in earlier than normal dates for most events this summer and could set new records for a few of them. The open drift or less route and the bergy water route into Thule as well as across northern Baffin Bay should develop much earlier than normal near mid-June. All main fracture events are forecast to occur earlier than normal near mid-July while the fracture of Eureka Sound is only expected to take place by the end of July (which is normal). Around the same time, the open drift or less routes into Cape Dyer will develop. In early August, the Home Bay route will be established and all ice in Davis Strait should be melted. By the end of August, an open water route into Hall Beach will have developed. The last significant event to occur will be the melt of abnormal old ice concentration in (southern) Baffin Bay.

Of concern this year, is the higher than normal amount of old ice in Penny Strait and in western Barrow Strait. All this old ice will move into eastern Barrow Strait and Lancaster Sound during late July and into August. Some old ice floes will actually move into Prince Regent Inlet and finally come to rest in Committee Bay; some of this old ice will even spill into northern Foxe Basin via Fury and Hecla Strait. The old ice in Prince Regent Inlet may cause problem for the resupply mission into Pelly Bay. Moreover, as mentioned in the April summary, the first-year ice in the Northern Arctic is thinner than normal by about 20 cm. Consequently, the Nansen ice plug is expected to break again this summer and old ice from the Arctic Ocean will, once again, move into Nansen Strait and eventually flush down into Eureka Sound and very possibly in Slidre Fjord.

Table 2: Eastern Arctic - Break-up Outlook Dates

	2009	Median	Outlook for 2010
Route across Northern Baffin Bay			
- Open drift or less	10 Jun	16 Jul	14-16 Jun
- Bergy water route	13 Jun	27 Jul	18-20 Jun
Baffin Bay			
- Clearing	28 Aug	07 Sep	07-09 Sep
Davis Strait			
- Clearing	28 Aug	02 Sep	06-08 Aug
Home Bay			
- Open drift or less	29 Jul	08 Aug	04-06 Aug
Cape Dyer			
- Open drift or less	30 Jul	27 Jul	23-25 Jul
Open water route			
to Hall Beach	26 Aug	03 Sep	27-29 Aug
Foxe Basin			
- Clearing	Never cleared	21 Sep	Never clear
Pond Inlet			
- Fracture[1]	22 Jul	24 Jul	12-14 Jul
- Clearing	11 Aug	11 Aug	29-31 Jul
Admiralty Inlet northern half			
- Fracture[1]	16 Jul	21 Jul	14-16 Jul
- Bergy water	31 Jul	09 Aug	09-11 Aug
Lancaster Sound			
- Fracture[1]	Not consolidated	08 Jul	Not consolidated
Barrow Strait to Resolute			
- Fracture/eastern[1]	Not consolidated	11 Jul	Not consolidated
- Fracture/western[1]	17 Jul	25 Jul	13-15 Jul
Wellington Channel			
- Fracture[1]	17 Jul	28 Jul	13-15 Jul
McDougall Sound			
- Fracture[1]	28 Jul	02 Aug	13-15 Jul
Kane Basin			
- Fracture[1]	Not consolidated	23 Jul	Not Consolidated
Jones Sound			
- Fracture[1]	28 Jul	31 Jul	12-14 Jul
Norwegian Bay			
- Fracture/southern[1]	29 Jul	01 Aug	12-14 Jul
- Fracture/northern[1]	11 Jul	08 Aug	12-14 Jul
Eureka Sound			
- Fracture[1]	28 Jul	02 Aug	25-27 Jul
- Bergy water	Never cleared	18 Aug	Never clear
Pacer Goose route to Thule			
-Open drift or less	24 Jun	16 Jul	18-20 Jun
-Bergy water route	24 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 September-December freeze-up period, averaging from 1-5°C warmer over the Central Arctic to greater than 8°C warmer over the western Beaufort Sea. Although a period of 1-4°C colder than normal air temperatures affected the region encompassing Larsen Sound and Queen Maud Gulf to Amundsen Gulf in late October to early November, this was more than balanced by a period of >5°C warmer than normal temperatures over the same region in late November. Temperatures in Viscount Melville Sound and northwards reached greater than 10°C warmer than normal during this same late-November period. As a result, freeze-up and consolidation were delayed everywhere. New ice formation in Coronation and Amundsen Gulfs and between the Beaufort Sea pack ice and the Canadian mainland coast began 1-2 weeks later than normal and ice thicknesses in these areas did not reach the thin first-year ice stage until mid-December, 1 month later than normal. The inter-island ice north of M'Clure Strait, in Byam Martin Channel and Penny Strait normally consolidates by mid-October. This winter season, although 2 weeks later than normal, the ice over most of this area *had* consolidated but then, as a result of the extremely warm temperatures in the last part of November which were accompanied by very strong winds, the bulk of the inter-island fast ice broke up and did not re-consolidate until the last week of December (10 weeks later than normal). M'Clure Strait and Viscount Melville Sound, which normally begin to consolidate during the last week of November to the first week of December, only began to partially re-consolidate once again in mid-to-late-February. Further south, M'Clintock Channel and the corridor running from Peel Sound to Coronation Gulf did not begin to consolidate until the week of December 21 (5 weeks later than normal). Larsen Sound and M'Clintock Channel only finally completely consolidated towards the end of January (8 weeks later than normal), but the northern part of M'Clintock then fractured again at the end of February. By the end of January, measured ice thicknesses were 17cm thinner than normal at Cambridge Bay. Measured ice thicknesses were 18cm thinner than normal at Inuvik at the end of December.

At the end of September 2009, old ice concentrations were considerably less than normal in central and northern parts of the Beaufort Sea, especially north of 73°N and west of 135°W. The southern extent of the old ice pack, however, although less than normal north of the Alaskan coast, was greater than normal in places north of the Yukon coast and north of Mackenzie Bay. Pockets of greater than normal concentrations of old ice could be found in Belcher Channel, Penny Strait and Queens Channel, Byam Martin Channel, Barrow Strait, Peel Sound and M'Clintock Channel. However, less than normal concentrations of old ice prevailed in M'Clure Strait and Viscount Melville Sound, in Victoria Strait, along the north coast of Melville Island and in the Peary and Sverdrup Channels. No persistent leads developed between the Arctic Ocean pack ice and the northeast coast of Ellesmere Island in the summer of 2009. There were no ice shelf breakups; no new ice islands resulted. A fragment of the original Ayles Ice Island could still be found in the Belcher Channel, while a number of ice islands derived from the 2008 break-up of the Serson, Ward Hunt and Markham Ice Shelves could be found between and to the northwest of Meighen Island and Ellef Ringnes Island. To the south, ice-free water extended from Rae Strait, through Queen

Maud Gulf, Coronation Gulf, Amundsen Gulf, and along the Mackenzie Delta. Ice-free water also prevailed north of Point Barrow. Pockets of open water and very open drift ice could be found in Victoria Strait, Larsen Sound, and from M'Clure Strait east to Barrow Strait. In 2009, the southern route of the Northwest Passage became navigable. However, the northern route, through M'Clure Strait and Viscount Melville Sound, did not become navigable in 2009.

September:

New and grey ice growth began in Norwegian Bay and along the coasts of Axel Heiberg, Amund Ringnes and Ellef Ringnes Islands in mid-September. By the third week of September, new ice had formed in M'Clure Strait and Viscount Melville Sound and had formed along the western side of the Beaufort Sea multi-year ice pack. The ice in Norwegian Bay had thickened to grey ice. By the end of September, a mix of new and grey ice prevailed among the Arctic islands, in between the areas of multi-year ice, north of 75°N and also in M'Clure Strait and Viscount Melville Sound. New ice had also formed in parts of western Barrow Strait, Peel Sound, M'Clintock Channel and in the western part of Larsen Sound. New ice also extended westward in a strip from the southwest extremity of the Beaufort Sea multi-year ice pack. Anomalous areas of ice-free water still prevailed north of Point Barrow and in a large swath along the Mackenzie Delta to Amundsen Gulf and eastwards to Rae Strait.

October:

By mid-October, old-ice from the Beaufort Sea ice pack, compressed against the Canadian Arctic Archipelago east of 135°W, now trailed westwards in a narrow band between 72-73°N to just north of Point Barrow. North of this trail of old ice and west of the main pack, an area of grey-white ice prevailed, which thickened to thin first-year east of 140°W and thinned to new and grey ice west of 150°W. A mix of grey-white and thin first-year ice prevailed in Norwegian Bay and in M'Clure Strait and Viscount Melville Sound. A mix of grey and grey-white ice prevailed in Penny Strait and Wellington Channel, in Barrow Strait, in Peel and Larsen Sounds, and in and around the old ice in M'Clintock Channel. An area of old ice had descended into Wellington Channel from Queens Channel. New ice was forming in Rae Strait, in Victoria Strait and in Mackenzie and Liverpool Bays and westward along the coast towards Point Barrow. New and grey ice filled Prince of Wales Strait and had developed in the large lead between the Beaufort Sea old ice pack and the west coast of Banks Island. A large anomalous swath of open water still extended from between the Beaufort Pack and the Alaskan coast all the way eastward to Queen Maud Gulf. By the end of October, the inter-island ice north of 75°N had mostly consolidated (2 weeks later than normal), except for an area between Borden and Ellef Ringnes Islands. Thin first year ice now prevailed to the west and north of the arced Beaufort Sea multi-year ice pack and in most inter-island areas north of 75°N, between the areas of multi-year ice. The southern halves of M'Clure Strait, Viscount Melville Sound and western Barrow Strait were also covered in thin first-year ice, but their northern halves remained covered in grey-white ice, with even thinner areas of new and grey ice to be found in western Barrow Strait. Thin first-year ice could also be found in northern M'Clintock Channel and in Peel Sound. Larsen Sound and Rae Strait were primarily covered in grey-white ice, while Victoria Strait and Queen Maud Gulf were covered in grey ice. Grey ice was also forming in Amundsen Gulf and now prevailed in the large lead to the west of Banks Island, while new ice was now

forming in Coronation Gulf and between the Beaufort Sea ice pack and the mainland coast. Some open water remained west of Point Barrow, however. Areas of coastal fast ice had formed around Point Barrow and eastward along the coast to Mackenzie Bay and along the Tuktoyaktuk peninsula.

November:

By mid-November, a large portion of the inter-island fast ice extending from Prince Gustaf Adolf Sea down to the head of Byam Martin Channel had re-fractured and was now mobile. The ice in Peel sound, Rae Strait and Prince of Wales Strait had consolidated, but the ice in Victoria Strait, Queen Maud Gulf and Coronation Sound remained mobile. A large open water lead had opened between the Borden and Prince Patrick Island coastal fast ice and the offshore pack ice, although this quickly became partly covered with a layer of new ice. Thin first-year ice prevailed almost everywhere except: 1) north of 77°N where ice had thickened to medium first-year ice; and 2) between the Beaufort Sea multi-year pack ice and the mainland coast where grey-white ice prevailed, extending into Amundsen Gulf and also filling a wide swath immediately west of Banks Island. Coronation Gulf remained covered in grey ice and large leads containing new ice could be found in Queen Maud Gulf and Larsen Sound. Large leads containing new ice could also be found in southeastern Viscount Melville Sound and in southern Barrow Strait. By the end of November, large portions of the inter-island ice north of 75°N remained fractured and mobile, showing no signs of consolidation. M'Clure Strait, western Viscount Melville Sound, M'Clintock Channel, Larsen Sound and Queen Maud Gulf to western Amundsen Gulf also remained abnormally unconsolidated. Discontinuous but growing areas of fast ice (thin first-year) now extended from Point Barrow eastwards to Mackenzie Bay and into Franklin Bay and Darnley Bay. The ice west of Banks Island had thickened to thin first-year ice, although a thin open water lead remained between the coastal fast ice and the predominantly multi-year pack ice. Elsewhere most of the open water leads created earlier in the month now contained grey and grey-white ice, although the one in Larsen Sound still primarily contained new ice.

December:

By mid-December, the inter-island ice between Bathurst and Ellef Ringnes Island (north of 75°N) had begun to reconsolidate, although large swaths remained anomalously mobile in this area. The ice in M'Clure Strait, Melville Sound, M'Clintock Channel, Larsen Sound and Queen Maud Gulf to western Amundsen Gulf remained mobile. Medium first-year ice prevailed north of 73°N between existing areas of multi-year ice, and extended into Larsen Sound, Rae Strait, Victoria Strait and Bathurst Inlet. Elsewhere, thin first-year ice prevailed except in areas that had experienced recent fracturing due to the mobility of the ice. These leads contained primarily grey-white ice, including a narrow band of grey-white ice north of the fast ice in Mackenzie Bay and along the Tuktoyaktuk Peninsula. By the end of December, the predominantly multi-year ice in the Beaufort pack was just off-shore of the Alaskan coast, arcing to the northwestern shores of Banks Island. The ice west of Banks Island was predominantly medium first-year. The inter-island ice north of 75°N (except in Penny Strait and Wellington Channel) had finally consolidated by December's end (10 weeks later than normal). The western part of Viscount Melville Sound had consolidated, although the eastern half remained mobile. Larsen Sound, Queen Maud Gulf and westward to the western edge of Amundsen Gulf had also finally consolidated (6 weeks later than normal),

although the ice in M'Clintock Channel remained mobile. Medium first-year ice prevailed everywhere except west of 120°W, where thin first-year ice still prevailed in a narrow band south of 72.5°N and north of the mainland coastal fast ice. Large areas of grey-white ice had also developed in wide leads in western Amundsen Gulf, to the west of Banks Island, in northern M'Clure Strait and to the west of Prince Patrick Island.

January:

At the beginning of January, a large anomalous open water lead (wider than 15km in places) developed between the coastal fast ice of the Queen Elizabeth Islands and the Canada Basin pack ice. To the east, the ice finally consolidated in Penny Strait but the fast ice in Larsen Sound had re-fractured. By mid-January, the fast ice in western Viscount Melville Sound had also re-fractured, while the ice in Wellington Channel had now finally consolidated (6-7 weeks later than normal). The ice in M'Clintock Channel remained unconsolidated. Medium first-year ice prevailed everywhere in the western Arctic not covered in multi-year ice, except where leads had previously opened – these areas mostly contained thin first-year ice. By the end of January, the ice in M'Clintock Channel and Larsen Sound had reconsolidated but the ice in M'Clure Strait, Viscount Melville Sound and western Barrow Strait remained mobile. Open water leads had also re-developed to the north of the coastal fast ice in Mackenzie Bay and along the Tuktoyaktuk Peninsula and to the west of Banks Island.

February:

Mean temperature anomalies for February ranged between 2 to 4 °C above normal which allowed for near normal ice growth; the prevailing ice had thickened to thick first-year ice north of 72°N, but medium first-year ice persisted in the extreme southern regions. By mid-month, the ice situation continued to be unusual in several sections of the Western Arctic. Periodic fractures off Tuktoyaktuk Peninsula, west of Banks and the Queen Elizabeth Islands as well as over the eastern sections of Amundsen Gulf and M'Clure Strait continued to occur but, young ice would quickly reform in these leads. The old ice in the southern Beaufort Sea lay near Point Barrow and further west except for a narrow band of old ice which remained trapped in the coastal fast ice north of Prudhoe Bay. 4 to 9 tenths concentrations of old ice were found on a 180 mile-wide band in the Beaufort Sea (between 72 and 75°N), but this area was even wider (about 250 mile-wide) as one moved northward off the Queen Elizabeth Islands. In the Central Arctic, the eastern half of Viscount Melville Sound and most parts of Barrow Strait remained mobile. By the end of February, the same ice situation persisted in the Western Arctic except for a general eastward motion of the ice during the later half of the month; refrozen leads had almost disappeared and any ice left had thickened to the thin first-year stage.

March:

Air temperatures remained above normal during March with mean anomalies reaching up to 6°C above normal in the southern portion of the Central Arctic and in the northern portion of the Beaufort Sea. The Alaskan Coast was the only region reporting near normal temperatures. During the first half of the month, another episode of prevailing easterly ice drift created a huge lead in eastern section of Amundsen Gulf and M'Clure Strait and due west of Banks and the Queen Elizabeth Islands. By mid-March, the lead widened to 30-40

miles and quickly refroze with mostly young ice. Elsewhere, the ice growth continued and thick first-year ice dominated the entire Arctic region. During this time, the old ice near Point Barrow retreated further north and west and only trace amounts were left close to the shore. During the last half of the month, more leads opened up in the same areas described before. The ice in a portion of Barrow strait remained mobile, however, the eastern portion of Viscount Melville Sound finally consolidated (2 months later than normal).

April:

Air temperatures remained above normal for the entire month of April with anomalies ranging between 6°C (in the Canada Basin) to 9°C (in the south Central Arctic region). Ice growth was slow to moderate at best. Prevailing easterly winds widened the leads which kept forming in eastern section of Amundsen Gulf and M'Clure Strait and west of Banks Island. At the end of April the air temperature rose above freezing values in some southern locations and new ice was barely re-forming in these leads. The main old ice pack in southern Beaufort Sea lay 40 to 60 miles west-northwest of Point Barrow with only trace amount closer to the shore. Elsewhere, thick first-year consolidated ice dominated in the Central Arctic region but remained 20 to 30 cm thinner than normal. New leads also developed just west of the Queen Elizabeth Islands.

May:

Mean temperatures were near normal or slightly below normal during the first three weeks of May over the southern Beaufort Sea and the southern portion of the Central Arctic (south of 73°N), but remained above normal over the Canada Basin and in the Central Arctic north of 73°N. During the last week of the month, mean temperatures rebounded to above normal over the entire region. During the first half of May, the ice situation did not change significantly - the unusual leads, described in previous months, still persisted. New and young ice redeveloped in some of the northern leads early in the month, but open water conditions prevailed in the leads almost everywhere towards the end of May. The latest lead of note developed along the Alaskan Coast between Point Barrow and Cape Lisburne; this lead expanded steadily throughout the month to become 100 miles wide. Similar leads developed in 2007 (a year of record-low ice extent in the entire Arctic Ocean) and 2008 (a year of record-low ice conditions in the Canadian Western Arctic) but these occurred 1-2 weeks later than the one which has developed this year. At the end of May, most of the ice was still consolidated in the Central Arctic region and the breakup pattern in this area appears to be near normal. However, the eastern half of Viscount Melville Sound has been mobile since the beginning of May and this region usually becomes mobile towards the end of July. In the Beaufort Sea (and Amundsen Gulf), the open water leads which were witnessed this May do not usually form for another 4 to 6 weeks.

Observed Ice Conditions

The regional ice charts in figures 5 and 6 were based on the analysis of Radarsat 1 and 2 and NOAA/MODIS imageries from around May 24th, 2010. These charts revealed some of the following features:

a) An unprecedented early mobility of the ice in eastern Viscount Melville Sound.

b) A huge open water lead in the northwestern part of M'Clure Strait.

c) Only up to one tenth of old ice in the western portion of the Northwest Passage, south of Peel Sound.

d) Many areas of old ice with concentrations ranging from 5 to 9 tenths in western Barrow Strait and eastern Viscount Melville Sound, in Penny Strait and in M'Clintock Channel, which will likely invade the traditional Northwest Passage after the first-year ice melts.

e) A southern edge of the old ice pack in the Beaufort Sea that is 60 to 90 miles further north than normal in the Canadian waters west of Cape Parry, but which lies 60 miles further south than normal near Point Barrow.

f) Very little old ice in M'Clure Strait and only a trace of old ice in the northern sections of Viscount Melville Sound (although the southern sections contain 6 tenths of old ice); this represents significantly less old ice than normal for these regions.

g) A wider than normal lead along the Alaskan Coast between Cape Lisburne and Point Barrow.

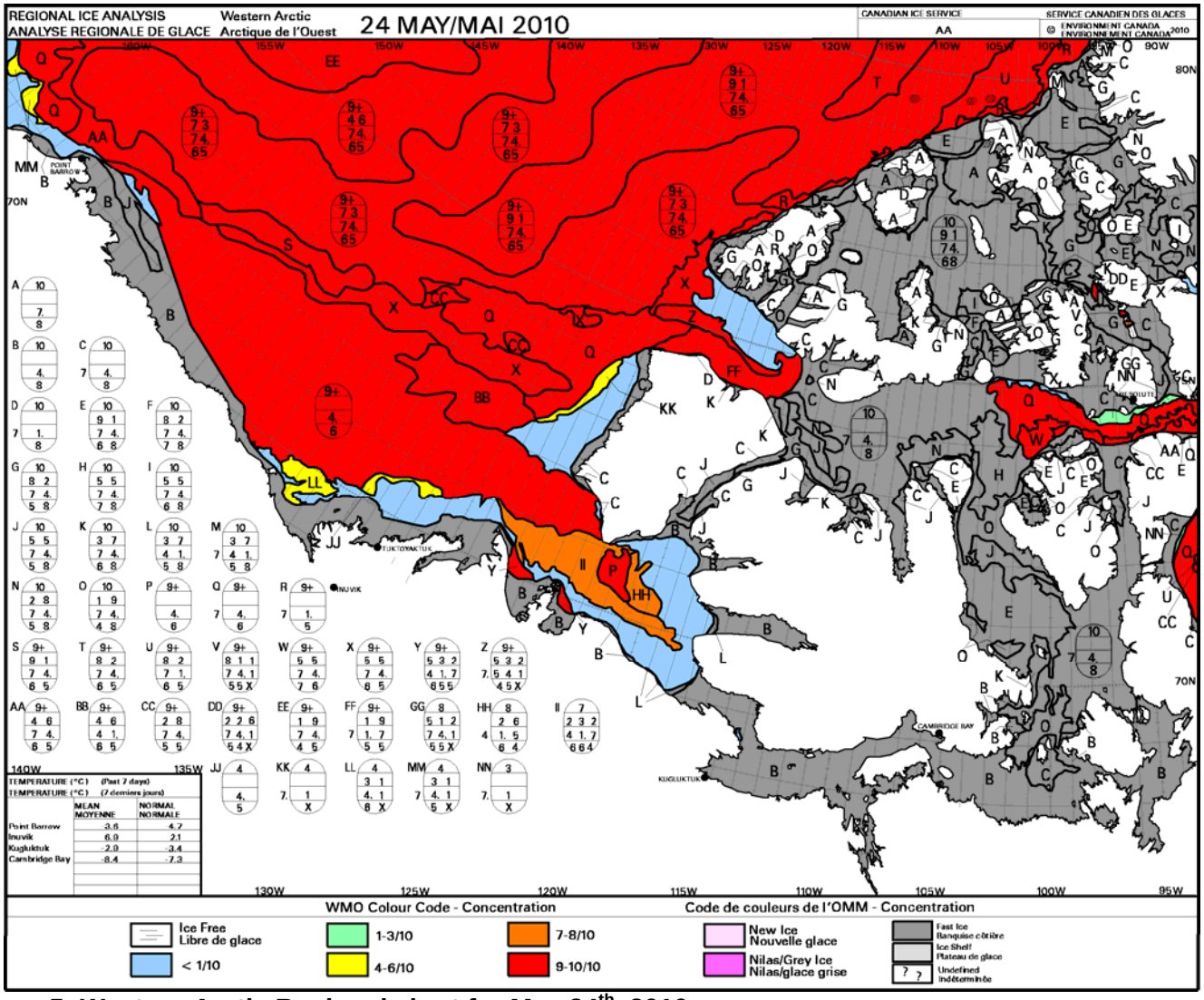

Figure 5: Western Arctic Regional chart for May 24th, 2010

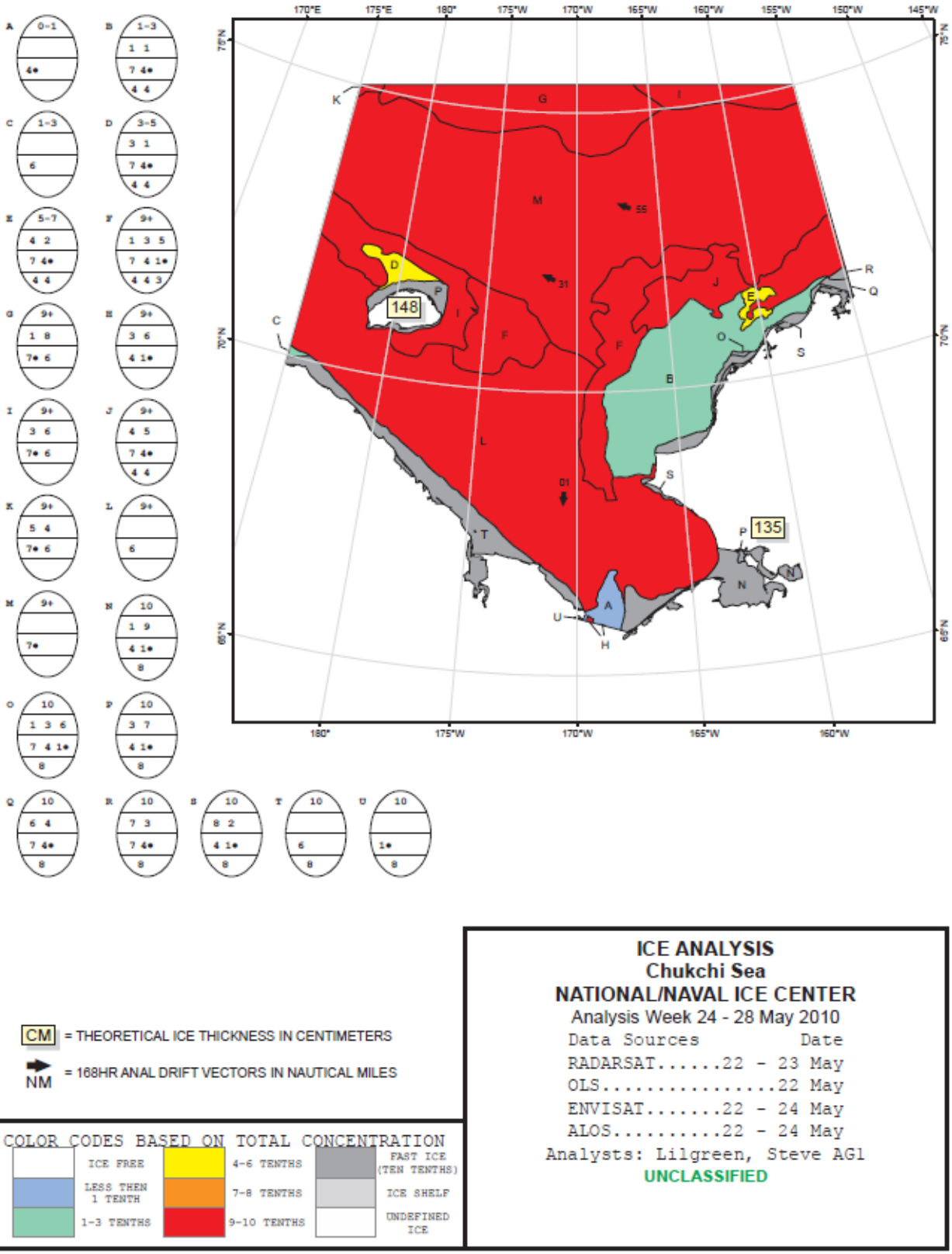

Figure 6: Chukchi Sea Regional chart for May 24th, 2010

Outlook for the Western Arctic

The summer temperature outlook for June through August continues to promote above normal temperatures over the entire region. If the forecast holds true, all monitored events are expected to occur earlier than normal or on near normal dates. Ice in Mackenzie Bay will melt by mid-June and the ice along the Tuktoyaktuk Peninsula will fracture at a similar time. During the last 10 days of June, an open water route will develop between Mackenzie Bay and Cape Bathurst; ice in Kugmallit bay will also clear during the same period. All other fracture events in the Central Arctic region are forecast to occur near mid-July. Open drift or less route will expand westward from the Canadian waters along the Alaskan Coast near or after mid-July, but the area between Prudhoe Bay and Point Barrow may incur further delays (early August) because of old ice presence in the fast ice. Coronation Gulf is forecast to clear towards the end of July. During the first week of August, the open water route into Taloyoak will develop, and at the same time, Amundsen Gulf is expected to clear. For these last two events, the presence of old ice (in Prince of Wales Strait and Victoria Strait) will influence the clearing of the ice in these regions.

Of concern for the Western Arctic region for this summer, is the amount of old ice in southern M'Clintock Channel which could easily drift into Larsen Sound. Similarly, the unusual old ice concentrations in the eastern portion of Viscount-Melville Sound and Western Barrow Strait will most certainly affect the clearing of Peel Sound this summer. Moreover, the lack of old ice in the northern portions of M'Clure Strait and Viscount Melville Sound coupled with the thinner than normal first-year ice measured in the Western Arctic will allow for the thicker multi-year ice to leave the Archipelago area and move southward into the Northwest Passage.

Table 3: Western Arctic - Break-up Outlook Dates

	2009	Median	Outlook for 2010
Mackenzie Bay			
- Clearing	18 Jul	19 Jun	09-11 Jun
Kugmallit Bay			
- Clearing	09 Jul	26 Jun	22-24 Jun
Tuktoyaktuk Peninsula			
- Fracture[1]	05 Jul	02 Jul	11-13 Jun
Mackenzie Bay to Cape Bathurst			
- Open water route	26 Jul	26 Jul	19-21 Jun
Coastal waterway Mackenzie Bay to Prudhoe Bay			
- Open drift or less	07 Jul	13 Aug	13-15 Jul
Coastal waterway Prudhoe Bay to Point Barrow			
- Open drift or less	11 Jul	11 Aug	03-05 Aug
- Close pack (refreeze)	19 Oct	08 Oct	12-14 Oct
Cape Lisburne to Point Barrow			
- Open drift or less	14 Jul	03 Aug	19-21 Jul
- Open water route	12 Aug	17 Aug	01-03 Aug
Wainwright			
- Open drift or less	27 Jun	29 Jun	27-29 Jun
Coastal waterway Prudhoe Bay to Barter Island			
- Open drift or less	07 Jul	13 Aug	13-15 Jul
Open water route to Taloyoak	27 Aug	16 Aug	03-05 Aug
Amundsen Gulf			
- Fracture[1]	27 Jun	07 Jul	Not consolidated
- Clearing	28 Aug	15 Aug	04-06 Aug
Coronation Gulf			
- Fracture[1]	18 Jul	16 Jul	12-14 Jul
- Clearing	19 Aug	01 Aug	27-29 Jul
Queen Maud Gulf			
- Fracture[1]	28 Jul	23 Jul	14-16 Jul
Larsen Sound			
- Fracture[1]	27 Jul	31 Jul	14-16 Jul
Peel Sound			
- Fracture[1]	27 Jul	31 Jul	14-16 Jul

[1] Fracture indicates complete breakage of consolidated ice.

Table 4: Selected Sea Ice Data and Severity Index for the north coast of Alaska (1953-2009)

		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	2009	161	425	161	445	10 Jul	19 Oct	60	100	83	1103	148
3	2008	0	318	213	318	07 Jul	10 Oct	66	91	86	879	170
4	2004	13	238	70	260	16 Jul	08 Oct	71	68	77	637	602
5	1958	50	150	50	210	19 Jul	25 Oct	92	99	74	624	446
6	1968	25	165	30	200	19 Jul	18 Oct	86	91	74	615	495
7	1998	15	105	20	240	15 Jul	21 Oct	72	100	78	584	486
8	2005	70	130	85	250	23 Jul	03 Oct	63	70	70	580	381
9	2003	18	167	27	185	21 Jul	20 Oct	52	92	72	568	481
10	1993	0	130	5	185	18 Jul	07 Nov	64	112	75	565	388
11	2002	0	135	18	225	13 Aug	14 Oct	32	64	49	504	293
12	1962	25	150	30	150	19 Jul	30 Sep	49	68	74	490	406
13	1973	5	80	5	190	31 Jul	20 Oct	73	82	62	486	344
14	1954	20	115	20	210	01 Aug	30 Sep	38	61	61	484	552
15	1997	28	150	40	150	08 Aug	10 Oct	47	63	54	463	297
16	1963	5	130	5	130	13 Aug	18 Oct	67	67	49	442	351
17	1990	0	90	40	90	23 Jul	12 Oct	75	105	70	429	173
18	1961	15	105	15	135	25 Jul	24 Sep	49	62	68	418	414
19	1996	10	65	70	155	16 Jul	25 Sep	37	71	77	405	446
20	1979	0	125	0	125	04 Aug	08 Oct	31	56	58	394	178
21	1989	10	70	55	110	19 Jul	22 Oct	34	95	74	383	284
22	1974	10	100	10	100	06 Aug	05 Oct	35	61	56	351	372
23	1978	5	70	30	95	25 Jul	09 Oct	35	76	68	343	492
24	1986	10	80	10	110	29 Jul	21 Oct	30	58	64	342	517
25	1999	15	45	45	105	30 Jul	08 Oct	56	70	63	338	98
26	1977	5	55	25	85	02 Aug	15 Oct	63	74	60	336	381
27	1959	20	65	20	65	19 Jul	06 Oct	42	86	74	331	271
28	1995	30	30	50	50	15 Jul	17 Oct	70	94	78	329	477
29	1972	0	60	30	90	31 Jul	01 Oct	45	63	62	320	251
30	1982	0	85	0	95	03 Aug	10 Oct	21	69	59	318	271
31	2006	17	18	17	69	04 Aug	13 Oct	60	70	58	275	-462
32	1994	10	35	10	60	05 Aug	24 Sep	44	55	57	251	334
33	1957	5	45	70	60	01 Aug	06 Oct	18	67	61	250	300
34	1987	0	10	0	85	05 Aug	30 Oct	35	59	57	250	299
35	1981	0	0	35	100	26 Jul	01 Oct	0	66	67	232	521
36	2000	10	70	10	75	31 Jul	02 Oct	19	33	62	228	274
37	1985	0	35	0	55	01 Aug	15 Oct	22	52	61	224	245
38	1967	15	0	30	50	25 Jul	12 Oct		68	68	213	212
39	1984	0	25	0	50	11 Aug	15 Oct	21	42	51	209	219
40	1966	5	0	5	45	01 Aug	22 Oct	24	65	61	194	296
41	1992	15	0	15	75	09 Aug	19 Sep	24	37	53	188	560
42	1965	0	10	0	70	25 Aug	25 Sep	25	32	37	173	182

		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	2001	0	25	15	25	17 Aug	08 Oct	26	52	45	172	262
44	1980	15	25	15	25	05 Aug	30 Sep	11	42	57	159	426
45	1953	0	0	5	35	27 Jul	16 Sep	5	52	66	157	213
46	1976	0	15	0	15	15 Aug	07 Oct	21	53	47	150	106
47	1971	0	0	0	30	23 Aug	01 Nov	8	71	39	147	166
48	1991	0	0	0	20	16 Aug	02 Oct	0	46	46	111	199
49	1960	0	0	20	20	05 Aug	07 Sep	0	34	57	110	231
50	1988	0	0	0	25	09 Aug	20 Sep	0	32	53	110	354
51	1964	0	0	0	5	13 Aug	20 Sep	0	39	49	95	536
52	1983	0	10	0	10	08 Aug	16 Sep	0	21	54	92	41
53	1970	0	0	5	0	06 Aug	14 Sep	0	32	56	87	251
54	1956	0	0	0	40	07 Sep	30 Sep	0	24	24	87	93
55	1969	0	0	0	30	07 Sep	18 Sep	5	12	24	70	157
56	1955	0	0	5	15	13 Sep	24 Sep	0	12	18	44	44
57	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/products/egg_code.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