

## Late Winter Sea Ice Conditions

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### Abstract

Typical sea ice types are shown here near the end of the winter season. Also shown is how often sea ice has been present at any location on the 26th February over the last 30 years. Based on the observations of sea ice extents and ice types over the last 30 years, this map shows how frequently sea ice has been present and what is the most likely predominant ice type and where. Sea ice is any form of ice that is found at sea and has originated from the freezing of seawater. The ice type gives an indication of the thickness of sea ice such as new ice, grey ice, grey-white ice, first year ice, and old ice. Ice represents a danger for navigation. Information on sea ice is essential in estimating transportation costs, and what type of vessel is appropriate.

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Late Winter Sea Ice Conditions shows the typical sea ice types near the end of the winter season (February 26) and as well as frequency of sea ice on that date. The frequency of sea ice indicates how often sea ice has been present on February 26 over the last 30 years.

The ice type gives an indication of the thickness of sea ice. When sea ice first forms it is referred to as new ice. As winter progresses it grows in extent and thickness. As sea ice thickens it is referred to successively as grey ice, grey-white ice and first year ice. During the summer sea ice melts and any first year ice remaining at the end of the summer melt is then renamed "old ice" on October 1.

Various ice types can be present in a given area, but one of them will be predominant. The predominant ice type is the one in greatest concentration in a particular area. However, because of the danger that old ice represents for navigation, and if 40% or more of the area contains old ice then the predominant ice type will be old ice even if thinner ice in greater concentration is present.

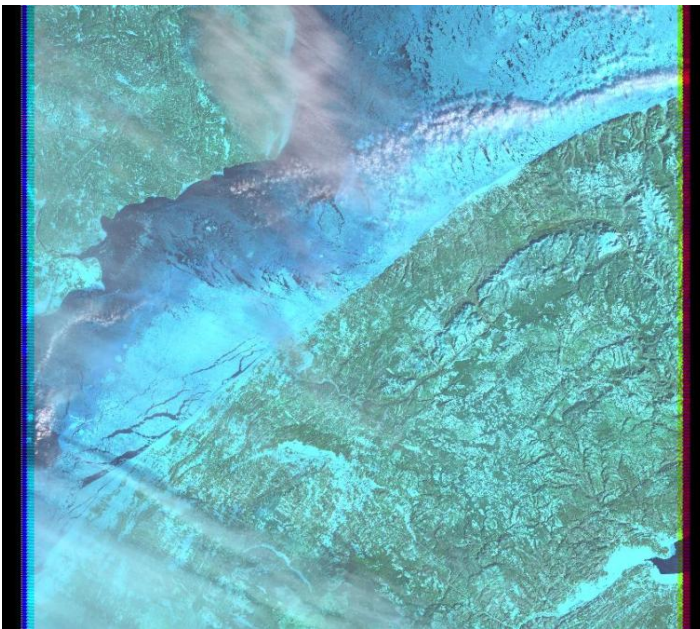
### Map Description

This map shows the frequency of sea ice and what is the most likely predominant ice type encountered near the end of the winter season (February 26). In the winter, sea ice is usually present in all coastal waters of Canada except for those of British Columbia where warm ocean currents from the south prevent the formation of sea ice. There is old ice in the Arctic and first year ice in most of the remaining waters except for thinner grey and grey-white ice in portions of the Gulf of St. Lawrence and East Newfoundland waters. This situation is normal in the winter as shown by the very high frequencies of sea ice present during the winter. In some years, with colder temperatures and strong north-westerly winds sea ice will extend further

eastward and southward along the east coast as shown by lower frequencies of sea ice in those areas. The extent of sea ice in those areas is limited by the heat exchange from warmer and deeper waters offshore that melts the sea ice moving in those areas.



**Figure 1:** Navigating in ice and smoke in the Gulf of St. Lawrence during winter time.  
**Source:** Environment Canada, Canadian Ice Service.



**Figure 2:** Landsat 7 image, taken on February 14th, 2002, in the St. Lawrence River at Baie Comeau (Quebec)  
**Source:** © CCRS/CCT 2002.

Also shown are areas of permanent ice and the estimated maximum extent of ice observed outside Canadian waters. Areas designated permanent ice indicate where ice has been observed all year round throughout the period 1969 to 1998. The estimated maximum extent of ice outside Canadian waters displays where ice has been observed on February 26 at least once over the 30 year period.

## Sea Ice Animations

### Minimum Extent of Sea Ice 1969 to 1998

Animation of the Minimum Extent of Sea Ice 1969 to 1998 presents the variation of the minimum extent of ice between each year for the period 1969 to 1998, with a concentration of 9/10 or greater. A concentration of 9/10 corresponds to at least 90% of the water which is covered by ice. The animation, `extent_sea_ice(1).gif` is located in the animated gif folder.



At the end of the summer high concentrations (9/10 or greater) of mobile old ice are found in the Arctic Ocean and the nearby Arctic islands. Some of this old ice under the influence of winds and currents can penetrate further into the Canadian Arctic waters where it can be found in lower concentrations.

The minimum sea ice extent at the end of the summer varies from year to year due to a number of environmental factors such as wind speed and direction, ocean currents, sea and air temperatures, solar radiation and others. Also in a global warming scenario we would expect a reduction of this Arctic Ocean sea ice.

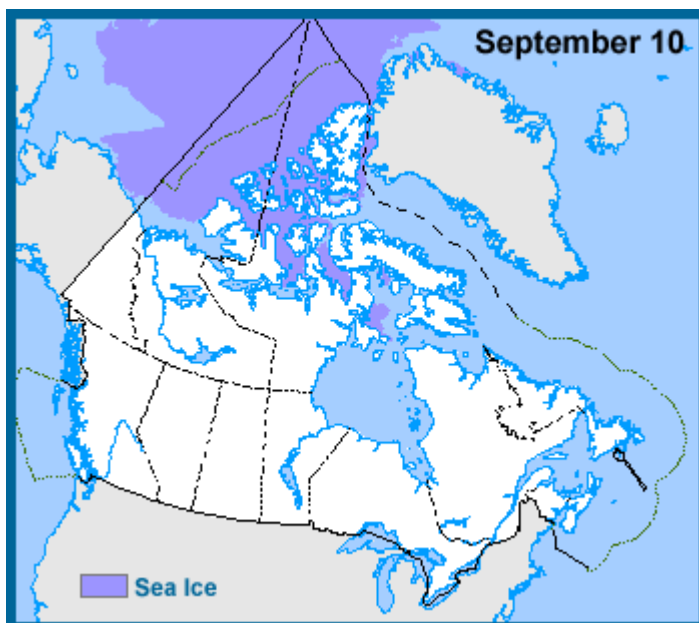
In this animation, a sea ice concentration threshold of 9/10 (90%) or greater was chosen in defining the minimum extent in order to focus on changes occurring in the main Arctic Ocean sea ice at the end of the summer melt season.

As can be seen in the animation the ice does vary in shape and extent from one year to the next due to the variations of environmental factors. However, the animation doesn't show the reduction of the ice indicating the onset of global warming. It should be noted that 1998 was an exceptionally mild year all over the Arctic and this is reflected in the minimum extent of sea ice for that year.

Source: Environment Canada. Canadian Ice Service. Regional Charts for the period 1969 to 1998

### Seasonal Change of Sea Ice

Animation of the Seasonal Change of Sea Ice presents a normal ice season in Canadian waters by showing the normal evolution of sea ice throughout the course of a year. The animation does not reflect any real observed sea ice season, but rather a 30-year statistical compilation. The animation, `seasonal_change_sea_ice(1).gif` is located in the animated gif folder.



Formation of sea ice begins in mid-September in the Canadian Arctic and advances southward through the onset of winter. Sea ice begins to form in the St. Lawrence estuary around January 1st and advances from coastal inlets into the Gulf of St. Lawrence. Sea ice in Canada normally reaches a maximum extent at the beginning of March. At that time, sea ice is usually present in coastal waters of Canada except for those of British Columbia where warm ocean currents from the south prevent the formation of sea ice.

Decay or melt of sea ice begins in the spring in the Gulf of St. Lawrence and over East Newfoundland waters and retreats northward towards the Labrador coast. In June openings appear in the northern portion of Baffin Bay and along the Western coast of Greenland which progress eastward and southward during June and July. During that time the Beaufort Sea begins to show signs of break-up while clearing is underway in Hudson Bay. Break-up continues throughout the summer months, reaching a minimum extent around mid-September, after which freeze-up begins through the remainder of September.

Source: Environment Canada. Canadian Ice Service. Regional Charts for the period 1969 to 1998

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## Definitions of underlined terms

**First Year Ice:** Ice resulting from not more than one winter's growth, ranging in thickness from 30 cm to 2 m. It is usually greenish-white in colour and contains some salt.

**Grey Ice:** Young ice 10 – 15 cm thick

**Grey-white Ice:** Young ice 15 – 30 cm thick

**Ice Concentration:** The ratio (in tenth) expressing the proportion of water surface covered by ice in a given area. Based on concentration, drift ice is identified as very open (1/10 – 3/10), open (4/10 – 6/10), close (7/10 – 8/10), very close (9/10 – < 10/10) or compact (10/10).

**New Ice:** General term for recently formed sea ice up to 10 cm in thickness. It can consist of ice crystals barely held together or of thin elastic crust of ice.

**Old Ice:** Ice that has survived through at least one summer's melt and increased again in thickness. It is harder and contains less salt than first-year ice, and has a pale blue colour.



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## Map Sources

### **Late Winter Frequency of Sea Ice (February 26)**

Regional Ice Charts from 1969 to 1998, Canadian Ice Service, Environment Canada.

### **Late Winter Predominant Ice Type (February 26)**

Regional Ice Charts from 1969 to 1998, Canadian Ice Service, Environment Canada.

## References

Canada. Environment Canada. 2001. Sea Ice Climatic Atlas: East Coast of Canada, 1971-2000. Ottawa: Canadian Government Publishing.

Canada. Environment Canada. 2002. Sea Ice Climatic Atlas: Northern Canadian Waters, 1971-2000. Ottawa: Canadian Government Publishing.

## Related Web sites (1999 – 2009)

### **Federal Government**

Environment Canada: Canadian Ice Service  
<http://ice-glaces.ec.gc.ca/>

Environment Canada, Canadian Ice Service: Climatic Ice Atlas  
<http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?ID=115&LnId=23&Lang=eng>

Environment Canada, Canadian Ice Service: Ice Terminology  
<http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?ID=181&LnId=22&Lang=eng>

Environment Canada. Cryosphere System in Canada (CRYSYS): Learn More About Sea Ice  
[http://www.msc.ec.gc.ca/crysys/education/seaice/seaice\\_edu\\_e.cfm](http://www.msc.ec.gc.ca/crysys/education/seaice/seaice_edu_e.cfm)

Environment Canada. Cryosphere System in Canada (CRYSYS): Photo Gallery  
[http://www.msc.ec.gc.ca/crysys/education/photogallery/photogallery\\_edu\\_e.cfm](http://www.msc.ec.gc.ca/crysys/education/photogallery/photogallery_edu_e.cfm)

Environment Canada. Cryosphere System in Canada (CRYSYS): Publications  
[http://www.msc.ec.gc.ca/crysys/science/research/crysys\\_research\\_seaice\\_e.cfm](http://www.msc.ec.gc.ca/crysys/science/research/crysys_research_seaice_e.cfm)

Environment Canada, Ecological Monitoring and Assessment Network: Ice Watch  
<http://www.naturewatch.ca/english/icewatch/>

Fisheries and Oceans Canada, Canadian Coast Guard: Icebreaking Program  
[http://www.ccg-gcc.gc.ca/eng/CCG/Ice\\_Home](http://www.ccg-gcc.gc.ca/eng/CCG/Ice_Home)

## **Other**

United States Government. Department of Commerce. National Oceanic and Atmospheric Administration. National Ice Centre  
<http://www.natice.noaa.gov/>

The National Ice Center (NIC) is a multi-agency operational center representing the Department of Defense (Navy), the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), and the Department of Homeland Security (Coast Guard).

University of Colorado. National Snow and Ice Data Centre. Current View of Sea Ice Concentration (United States)

<http://nsidc.org/data/seaice/current.html>

NSIDC is part of the University of Colorado Cooperative Institute for Research in Environmental Sciences, and is affiliated with the National Oceanic and Atmospheric Administration National Geophysical Data Center through a cooperative agreement.

University of Colorado. National Snow & Ice Data Centre (NSIDC): NSIDC's Image and Photo Gallery (United States)

<http://nsidc.org/gallery/index.html>

University of Waterloo, State of the Canadian Cryosphere: Current Arctic Sea Ice Extent

[http://www.socc.ca/seaice/seaice\\_current\\_e.cfm](http://www.socc.ca/seaice/seaice_current_e.cfm)

## **International Government**

United Nations Environment Programme. Environment Network: Arctic Environment Atlas

<http://maps.grida.no/arctic/>