

## Freeze-up of Sea Ice

---

### Abstract

Typical advance of sea ice over from late summer to late winter is shown on this map. Sea ice is any form of ice that is found at sea and has originated from the freezing of seawater. 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 the first of January, 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.

---

Freeze-up of Sea Ice shows the typical advance of the sea ice cover from late summer (mid-September) to late winter (mid-March). The dates shown in the legend of the map indicate the extent of the sea ice cover at those dates.

### Map Description

Ice will form first in shallow water, near the coast, over shoals, banks; particularly in bays, inlets and straits in which there are no currents. Also in areas of low salinity (near the mouths of rivers). Shallow water is conducive to ice formation because of the relatively small depth of water that has to be cooled. The greater the depth of high-salinity water, later the time of freezing. In fact, deep waters may never freeze over entirely, as not enough heat can be removed from the water during the course of a winter to bring this about.

Formation of sea ice begins in mid-September in the Canadian Arctic and advances southward through to 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.



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

## 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

## Map Sources

### Freeze-up of Sea Ice

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/>

