



Seasonal Summary

North American Arctic Waters Summer 2016

By



Canadian Ice Service
Le service canadien des glaces

Summary over North American Arctic Waters

Early fracture of the southern Beaufort Sea ice and northern Baffin Bay sea ice led to above normal ice melt in 2016. Generally ice melt was 1-2 weeks ahead of normal across most of the Canadian Arctic, with some regions remaining 2-3 weeks ahead of normal through the summer. Early and rapid ice melt in the Western Arctic slowed in mid-summer due to stormier than normal conditions; however, the lack of ice coverage remained much less than normal.

Old ice from the northern Canadian Archipelago began to flow into Parry Sound in early September, unusually for that time of year.

Freeze up and new ice formation in the fall was delayed by 1-2 weeks across much of the Canadian Arctic.

The minimum sea ice coverage in early September was the third lowest on record, behind 2012 and 2011.

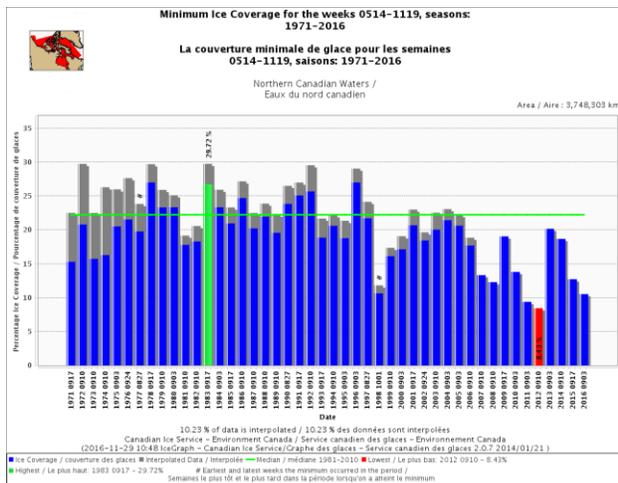


Figure 1: Minimum Ice coverage for Northern Canadian waters in 2016

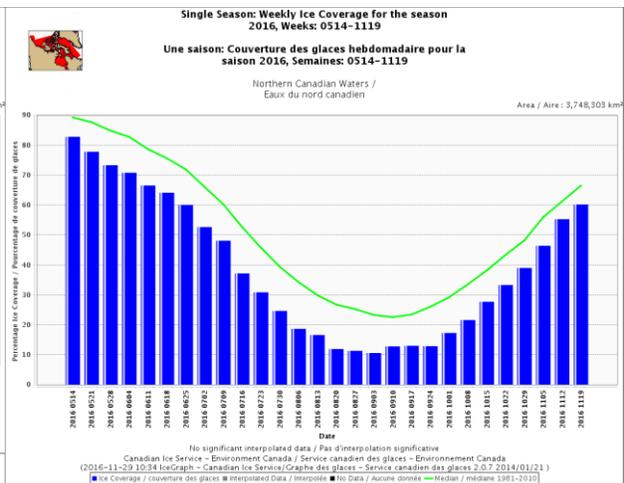


Figure 2: Weekly ice coverage for Northern Canadian waters in 2016

Hudson Bay and the Labrador Coast

Summer Ice Conditions and Fall Freeze-up

Summer Temperatures: June to September

Surface air temperatures were near normal values over most locations except slightly above normal over northern Hudson Bay and Foxe Basin (figure 3).

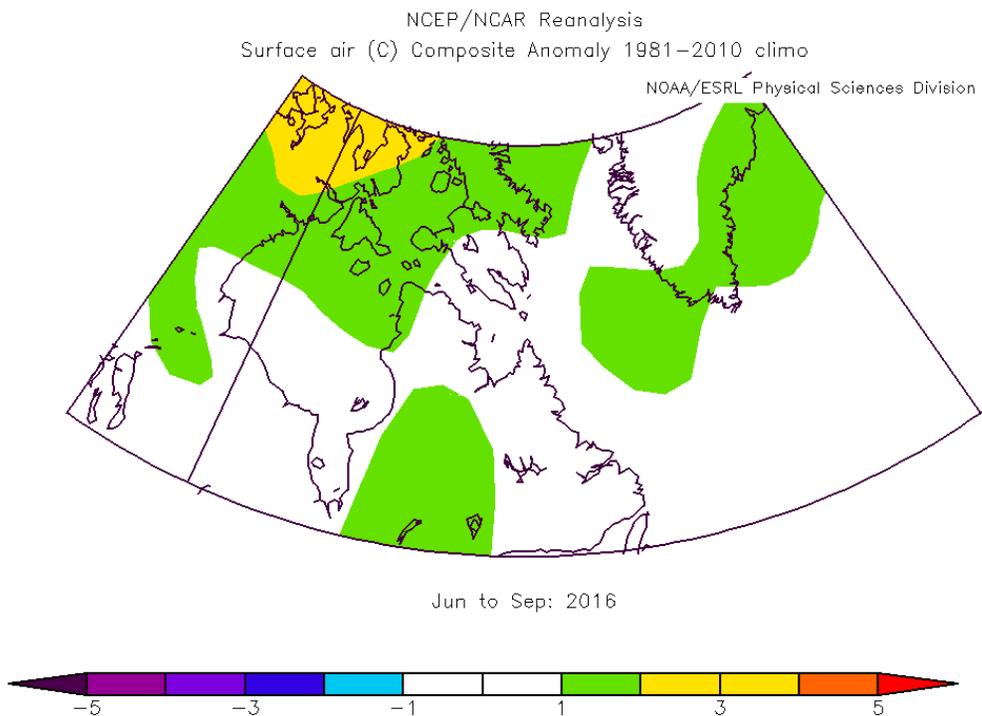


Figure 3: Air temperature anomaly for the Hudson Bay area from June to September

Summary of Ice Conditions:

At the start of June close to very close pack ice conditions were seen across the region, with unusually low ice coverage in northwestern Hudson Bay and along parts of the southeastern coast of Hudson Bay. In northwestern Hudson Bay, ice melt across the region through the summer months was generally 1-2 weeks ahead of normal.

By early August a small coverage of ice remained in southern Hudson Bay, slightly behind schedule for ice melt. The slightly cooler than normal air temperatures in southern Hudson Bay led to this ice remaining nearly 2 weeks later than the climate normal.

By the end of August ice had completely melted in the region, slightly earlier than the climate normal.

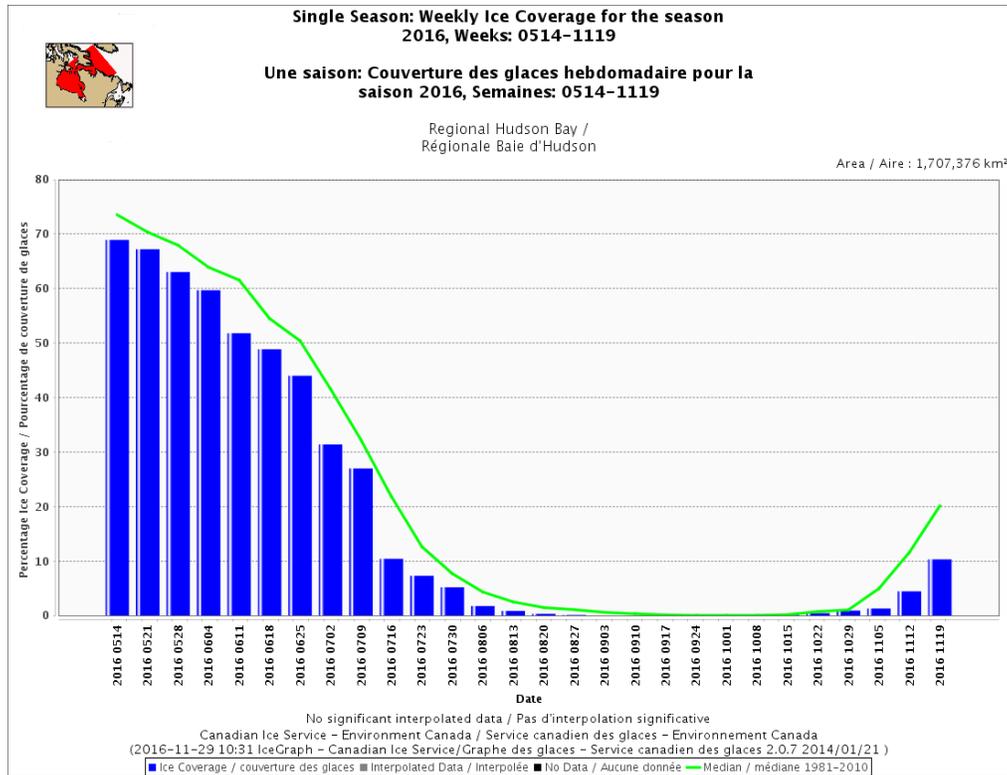


Figure 4: Weekly ice coverage for the Hudson Bay area for the 2016 season

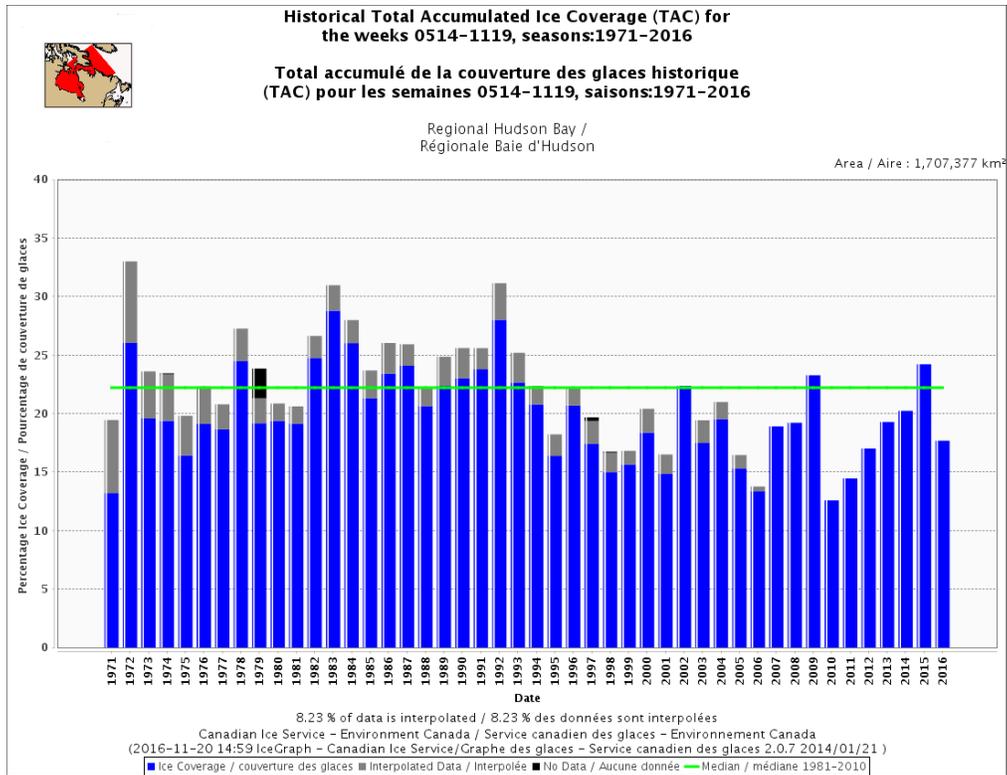


Figure 5: Historical Total Accumulated Ice Coverage for the Hudson Bay area

June Ice Conditions:

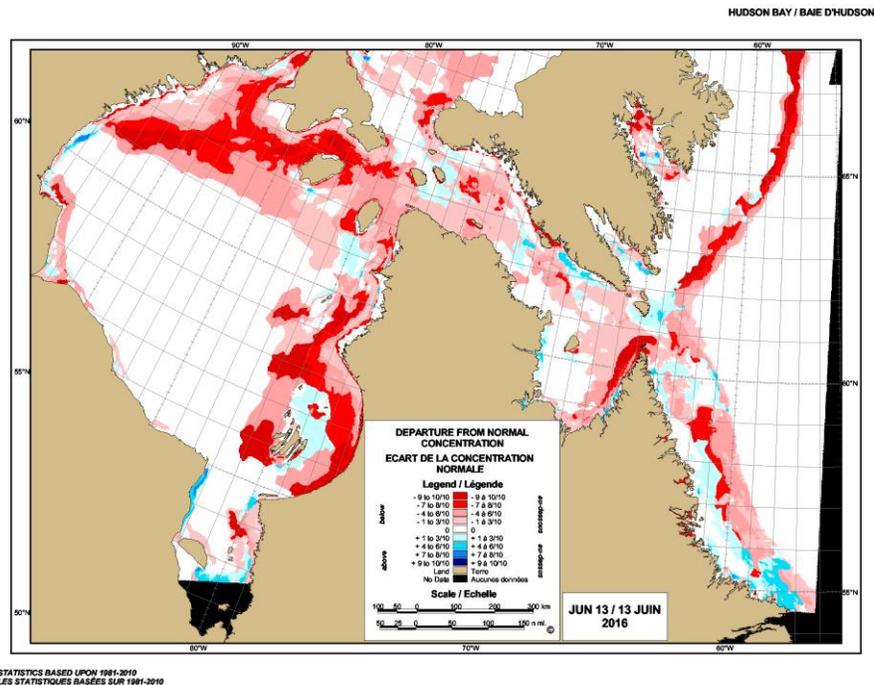


Figure 6: Departure from normal ice concentration for the Hudson Bay area near mid-June

At the start of June ice within 60 NM of the Labrador coast was mainly close to very close pack first-year ice including a trace of old ice. Ice in Lake Melville melted fully in the first few days of June. Ice coverage off the Labrador coast was less extensive than the climate normal, with close to very close first-year ice including a trace of old ice pack ice, with fast ice along the coast. By mid-June fast ice began to fracture and was completely melted by the end of the month. Ice concentrations decreased in the second half of the month with only patches of close pack to open drift ice between 55°N and 57°N and north of 59°N.

Unusually, some patches of close pack to open drift first-year ice including a trace of old ice persisted in the first three weeks of the month at the inlet to Lake Melville and stretched along the coast to just south of Cartwright. This ice melted in the last week of the month, almost 1 month later than the climatological normal.

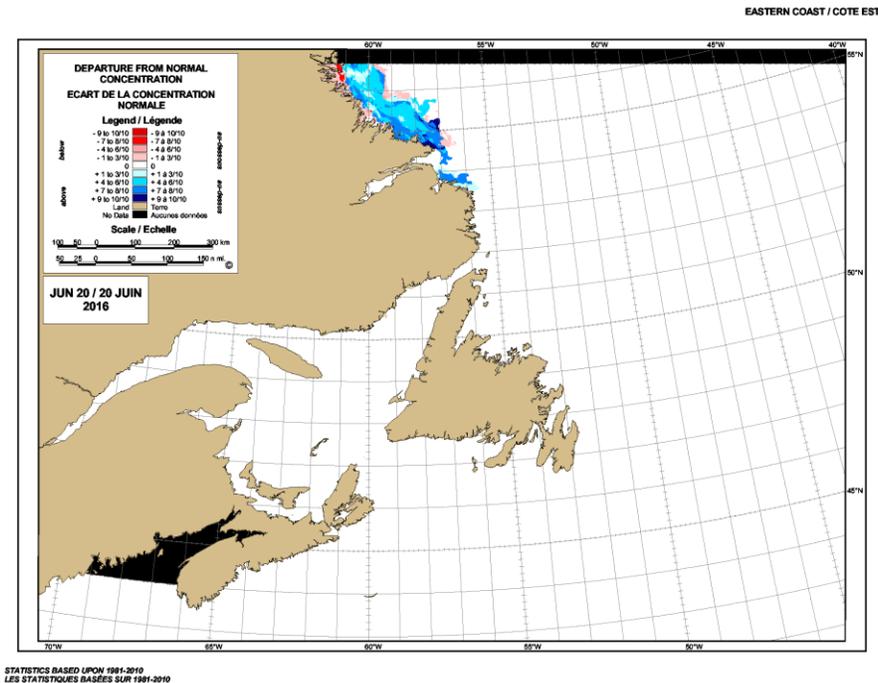


Figure 7: Departure from normal ice concentration for the east coast at the end of June

Fast ice in Frobisher Bay, along the coast of Cumberland Sound, and along southeastern Baffin Island diminished in coverage through June; however some fast ice remained in place at the end of the month. Bergy water in Cumberland Sound was present earlier than the climate median date. Ice concentrations dropped from very close pack to open to very open drift ice in Frobisher Bay in the second half of the

month. Ice coverage in Davis Strait was slightly below the normal coverage and ice in the region was close to very close pack first-year ice including a trace of old ice.

Northwestern Hudson Strait and southern Ungava Bay saw early ice melt and opening, with some bergy water already present by early June. Throughout the rest of Hudson Strait there was close to very close pack first-year ice including a trace of old ice. Through the second half of the month ice began to melt through Hudson Strait from the north, with the northern half becoming predominantly bergy water by the third week of the month. By the end of the month the extreme eastern and western sections of Hudson Strait saw close pack to open drift ice, with some higher concentrations of ice along the south coast and through parts of Ungava Bay.

Hudson Bay saw openings early in the northwestern and southeastern portions of the region by early June, ahead of the climate normal. The rest of the region contained close to very close pack medium and thick first-year ice. By mid-June ice melt continued in the northwest and southeastern sections with below normal ice concentrations in those two locations.

July Ice Conditions:

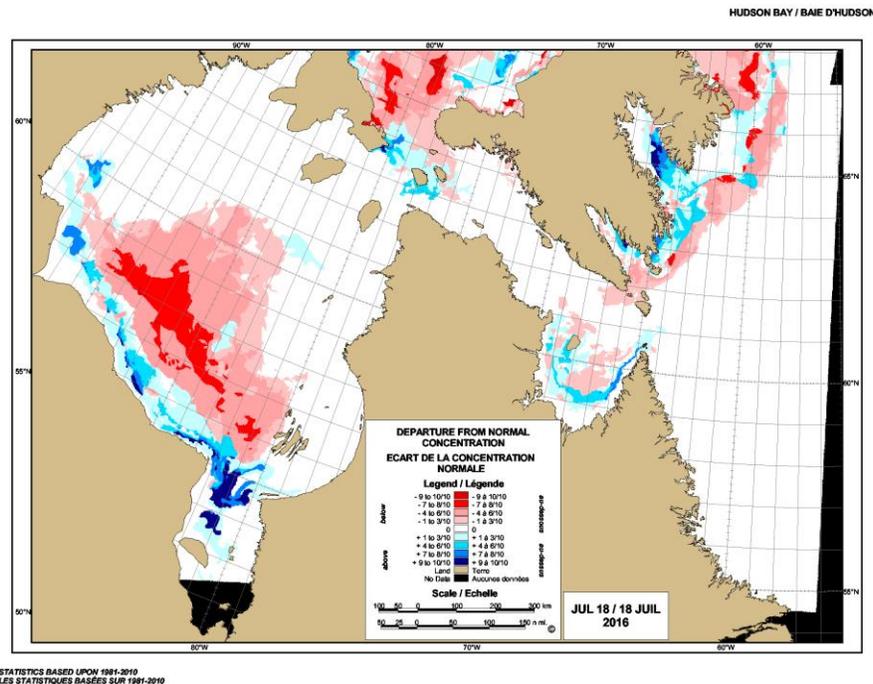


Figure 8: Departure from normal ice concentration for the Hudson Bay area near mid-July

In the first half of July the remaining ice in the Labrador sector melted.

In the first two weeks of July the fast ice remaining in the Hudson Bay region fractured. The remaining ice in central Hudson Strait melted out with open to very open drift first-year ice including a trace of old ice remaining in central Ungava Bay and east of Southampton Island. By the end of July this ice had all melted leaving Hudson Strait ice free for the start of August. By the end of the month all ice in Davis Strait remained north of 62N.

In spite of early melt in June along the Hudson Bay southwestern coasts, there was only a small amount of ice reduction in the first two weeks of July due to below normal temperatures in the southern half of the Bay and above normal wind velocities. The third and fourth weeks of July saw a very significant reduction in both coverage and concentration in the central portion of Hudson Bay. By the third week only a few patches of very open drift first-year ice remained through the central region with a strip of higher concentration ice in the southwestern section, near the coast. By the end of the month, the only ice remained in the southern section south of 56°N and between 80°W and 88°W.

August Ice Conditions:

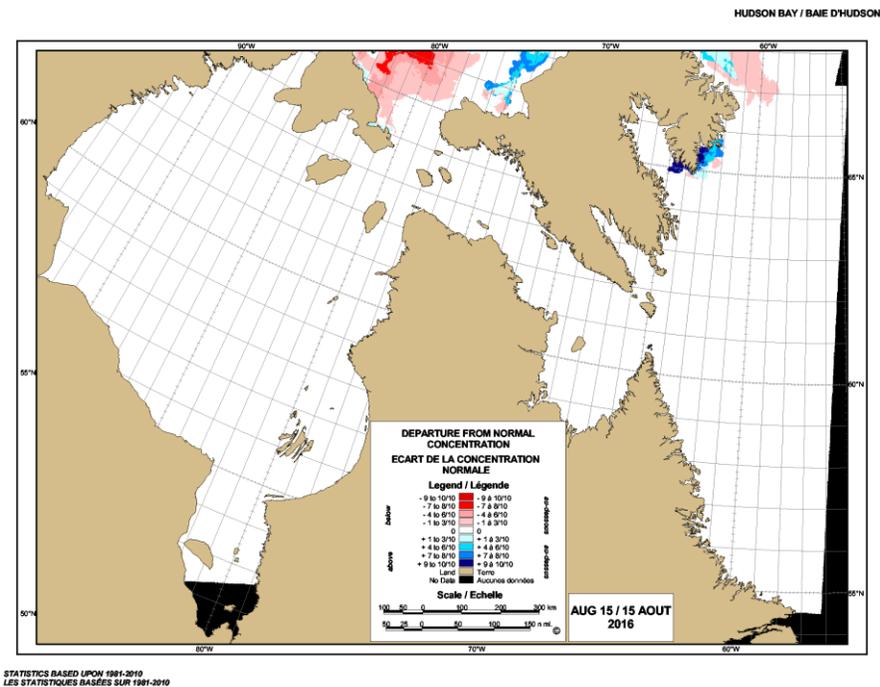


Figure 9: Departure from normal ice concentration for the Hudson Bay area near mid-August

The remaining ice in southwestern Hudson Bay at the start of August was close to very close pack first-year ice. Ice melted rapidly in the first 10 days to melt completely before the end of the second week.

Hudson Strait and the Labrador coast saw bergy water conditions through the month of August.

By the start of August Frobisher Bay was completely ice free. Ice along the Baffin Island coast was open drift to very close pack first-year ice including a trace of old ice. Ice concentrations diminished in the first two weeks of the month. By mid-August, the only remaining ice was present at the tip of the Cumberland Peninsula in a small area of high concentration of ice. By the end of August one small region of ice still remained at the extreme eastern edge of the peninsula.

September Ice Conditions:

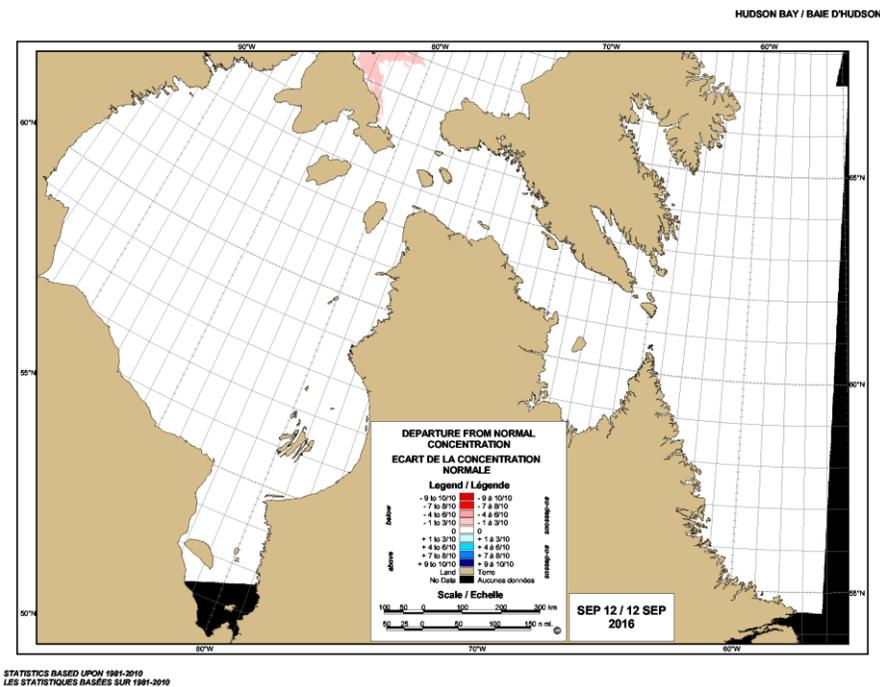


Figure 10: Departure from normal ice concentration for the Hudson Bay area near mid-September

During the first week of September the last remnants of ice along the Cumberland Peninsula melted. Bergy water and ice free conditions were present across the region through the end of the month.

Eastern Arctic and Canadian Archipelago

Summer Ice Conditions and Fall Freeze-up

Summer Temperatures: June to September

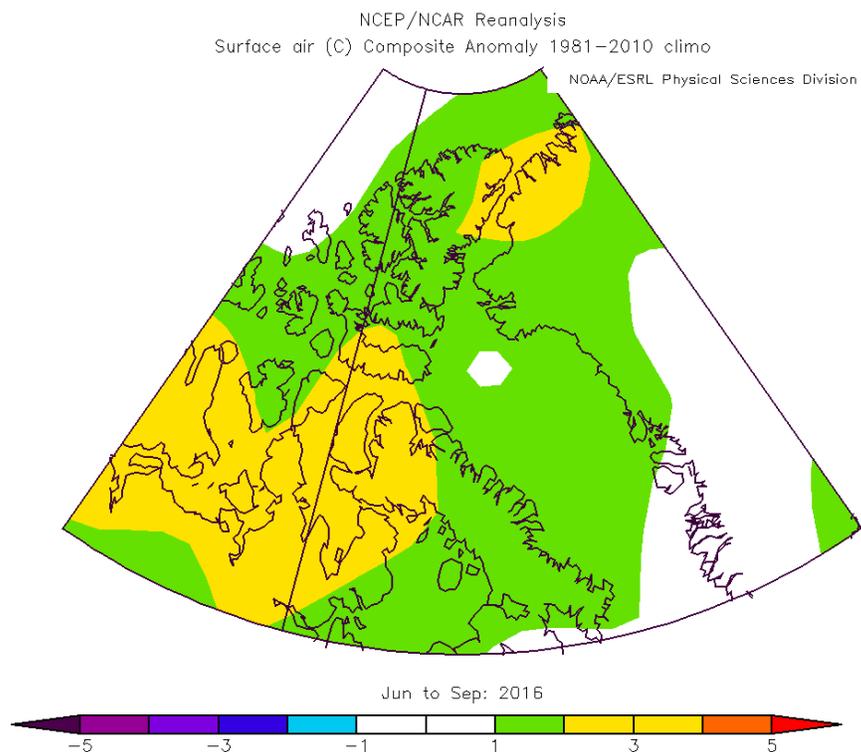


Figure 11: Air temperature anomaly for the Eastern Arctic area from June to September

From June to September, surface air temperatures were above normal over most locations, except near normal over southern Baffin Bay.

Summary of Ice Conditions:

At the beginning of June the ice melt in northern Baffin Bay had already started and conditions were mainly bergy water in the region.

Through the summer season the eastern arctic ice melt was roughly 2 weeks ahead of the climate normal. The overall minimum ice coverage was lower than the climate normal and similar to ice coverages over the last decade.

Lancaster Sound saw early breakup and melt of sea ice. By early September old ice flowing in from Wellington Channel began to fill Lancaster Sound from the west.

Ice conditions in early June in central and southern Baffin Bay were very close pack first-year ice including a trace of old ice. In the archipelago, ice remained consolidated. A trace of old ice was present through much of the Eastern Arctic. At the end of the melt season, ice remained in the waterways of Ellesmere Island, north of 79°N in Nares Strait, in Committee Bay, and a small patch of ice lingered near Cape Dyer on Baffin Island.

Foxe Basin saw slightly early melt in the northwestern section of the region. Ice melt remained 1-2 weeks ahead of normal with full ice melt by early September.

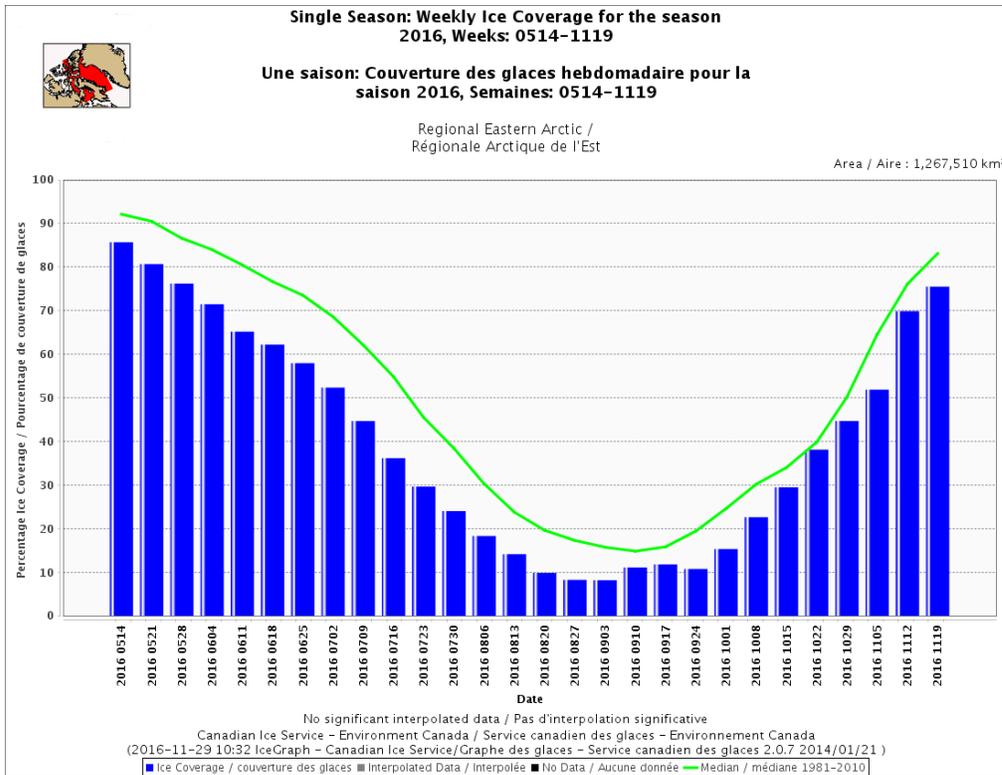


Figure 12: Weekly ice coverage for the Eastern Arctic area for the 2016 season

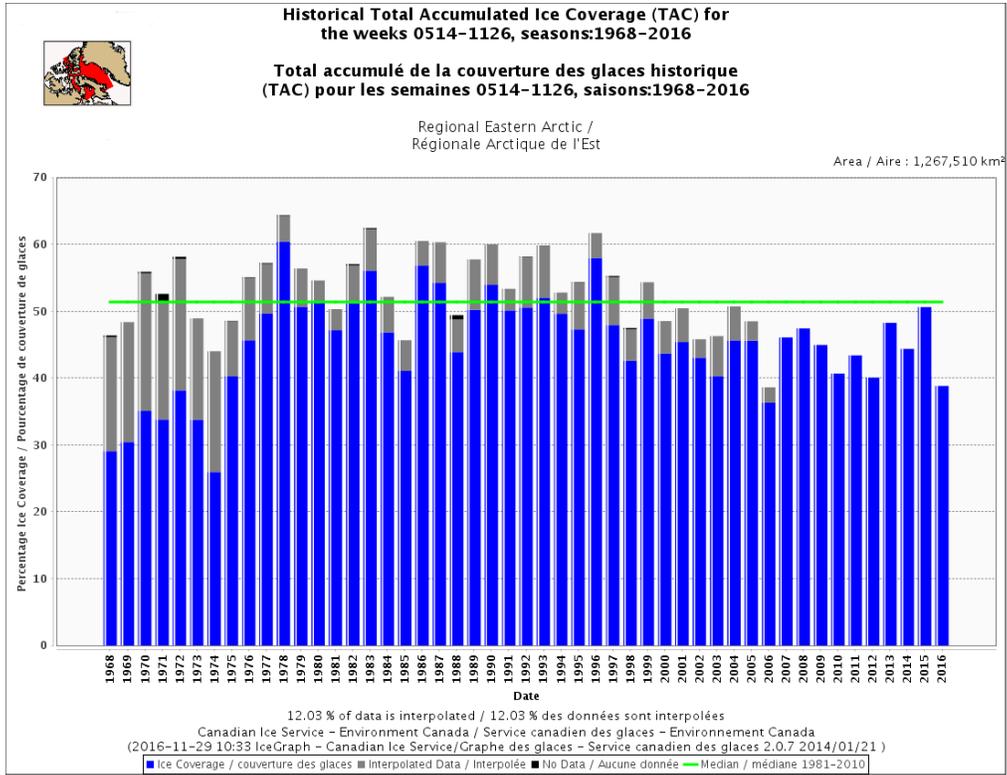


Figure 13: Historical Total Accumulated Ice Coverage for Eastern Arctic area

June Ice Conditions:

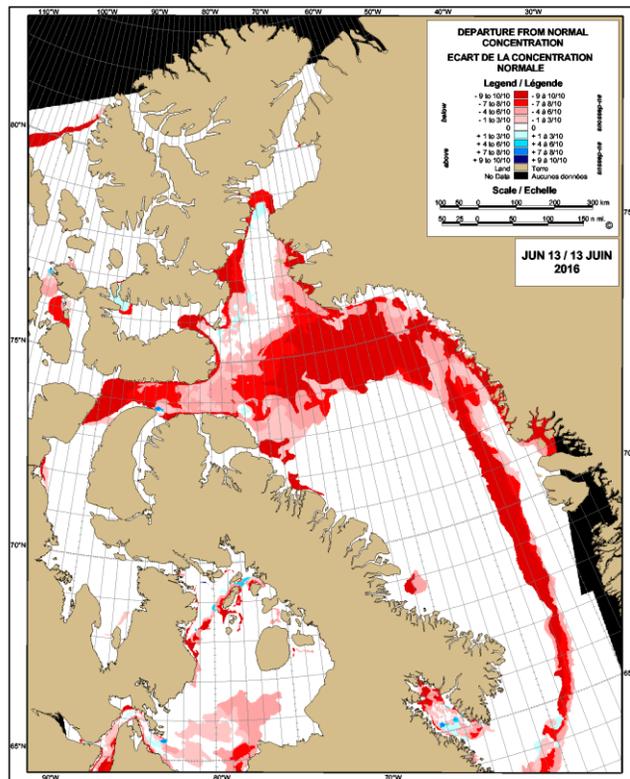


Figure 14: Departure from normal ice concentration for the Eastern Arctic area near mid-June

At the beginning of June, large areas of bergy water and very open drift first-year ice were present in eastern Barrow Strait, western Lancaster Sound and the extreme northwestern section of Baffin Bay. Significantly below normal ice conditions were seen in these locations. A small section of close pack first-year ice including a trace of old ice in northeastern Baffin Bay was the only ice preventing an open lead from stretching from southern Greenland to northern Baffin Bay. This ice had fully melted by the third week of the month.

Foxe Basin saw early breakup in the northwestern portion of the basin. By mid-month areas in the southern portion of the region became close pack first-year ice as ice began to melt.

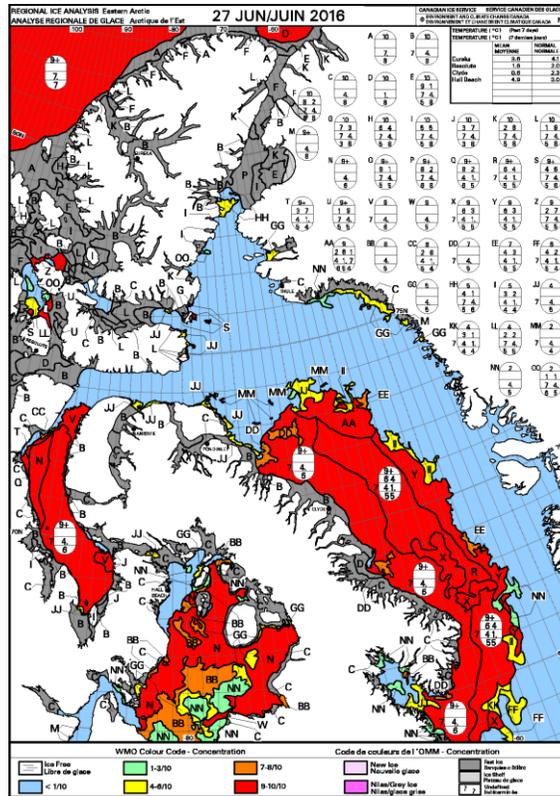


Figure 15: Eastern Regional ice chart near the end of June 2016

Ice melt progressed at the usual rate through June however the early melt of ice in the northern section of Baffin Bay meant that ice melt was 2-3 weeks ahead of the normal throughout the month. Small sections of open drift ice in Lancaster Sound early in the month melted in the first half of the month. Ice coverage eroded from the north and east in Baffin Bay with well below normal ice amounts in northeastern Baffin Bay and normal coverages closer to Baffin Island.

Fast ice remained in place through the month along Baffin Island, Ellesmere Island, and the Greenland coast. Ice in Barrow and Nares Straits began to fracture in the last days of the month.

July Ice Conditions:

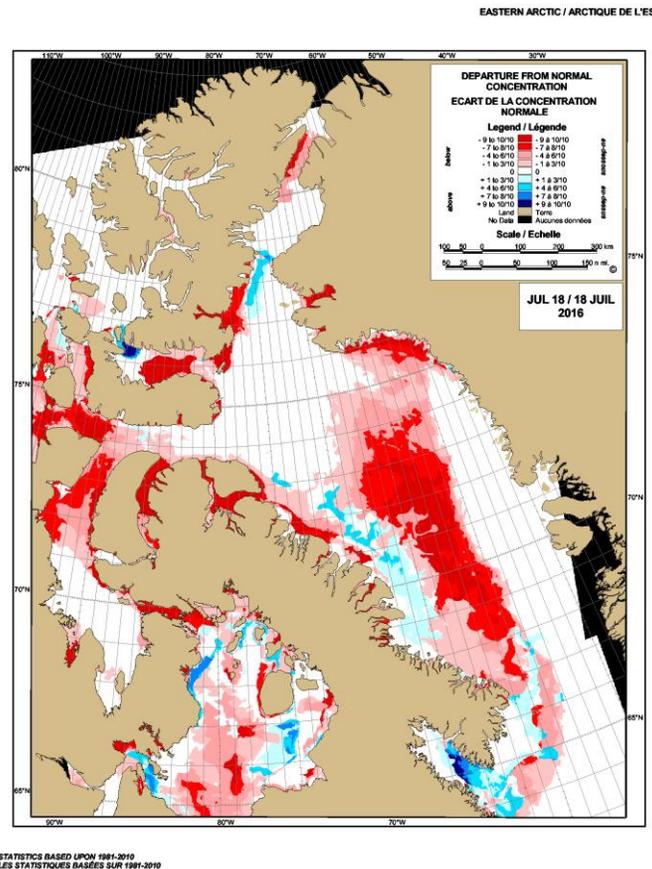


Figure 16: Departure from normal ice concentration for the Eastern Arctic area near mid-July

Well below normal ice coverages continued through July with ice melt remaining 2-3 weeks ahead of normal. In the first half of the month fast ice in Jones Sound, Barrow Strait, Nares Strait, and along northern Baffin Island fractured. Once fractured, the ice in Admiralty, Pond, and Navy Board Inlets rapidly melted by the end of July.

In Baffin Bay ice continued to diminish in coverage from the north and east with ice only present within 100 NM of the Baffin Island coast by the third week of the month with bergy water elsewhere.

By the end of the month all fast ice south of 77°N had fractured with open water conditions present throughout much of eastern Parry Sound, Jones Sound, and Baffin Bay. The only ice remaining in Baffin Bay remained close pack to open drift ice south of 72°N near the Baffin Island coast. This ice was more expansive in coverage than is usual for that time of the year.

Ice in Prince Regent Inlet and the Gulf of Boothia diminished from very close pack early in the month to a mixture of bergy water and areas of close to very close pack old ice by the end of the month. Ice in Committee Bay was close to very close pack, near normal for that time of year.

Foxe Basin saw a continuation of the ice melt begun in June in the northwestern and southeastern sections. Most fast ice over the northern islands and Fury and Hecla Strait was completely fractured by the end of the second week of the month. By the end of the month close pack first-year ice remained in the southern, central and eastern sections. Open water was present in the northwestern and south-central sections of the basin.

August Ice Conditions:

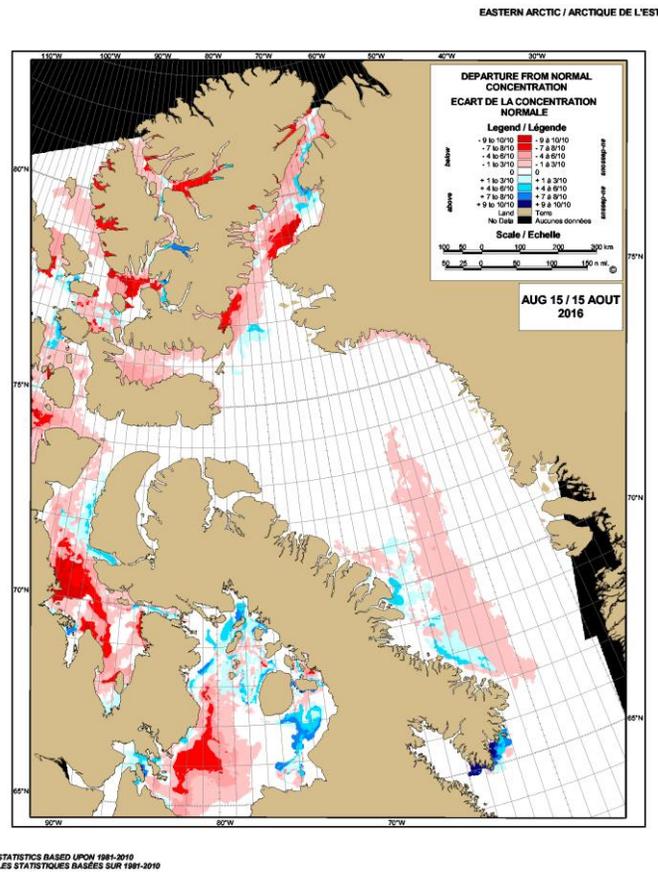


Figure 17: Departure from normal ice concentration for the Eastern Arctic area near mid-August

The first week of August saw the last of the fast ice in Norwegian Bay and Eureka Sound fracture. Throughout the month ice conditions gradually diminished in

Norwegian Bay, especially the eastern section where, by the end of the month, only very open drift old ice remained.

Close to very close pack old ice flowing from the north in Nares Strait slowed in early August with ice north of 79°N by the end of the month and bergy water to the south.

In the first half of the month ice concentrations in Prince Regent Inlet diminished with full ice melt by mid-month. The Gulf of Boothia saw a mixture of close pack to very open drift first-year ice with a trace of old ice, mainly in Committee Bay. In the second half of the month ice in Committee Bay diminished to very open drift.

Ice south of 72N in Baffin Bay diminished to a patch of very open drift first-year ice including a trace of old ice southeast of Clyde River by mid-month which melted completely by the end of the month.

At the end of August the only ice remaining in the Eastern Arctic was located in the waterways of Ellesmere Island, north of 79°N in Nares Strait, in Committee Bay, and a small patch of ice near Cape Dyer on Baffin Island.

Foxe Basin saw continued ice melt at 1-2 weeks ahead of the climatological normal. By mid-month open drift first-year ice remained in the north-central and in small patches in the eastern and southwestern sections. By the third week open water was present from Hudson Strait through to Hall Beach with open to very open first-year ice present in parts of the eastern section. By the end of the month only a few patches of very open drift first-year ice remained near Prince Charles Island.

September Ice Conditions:

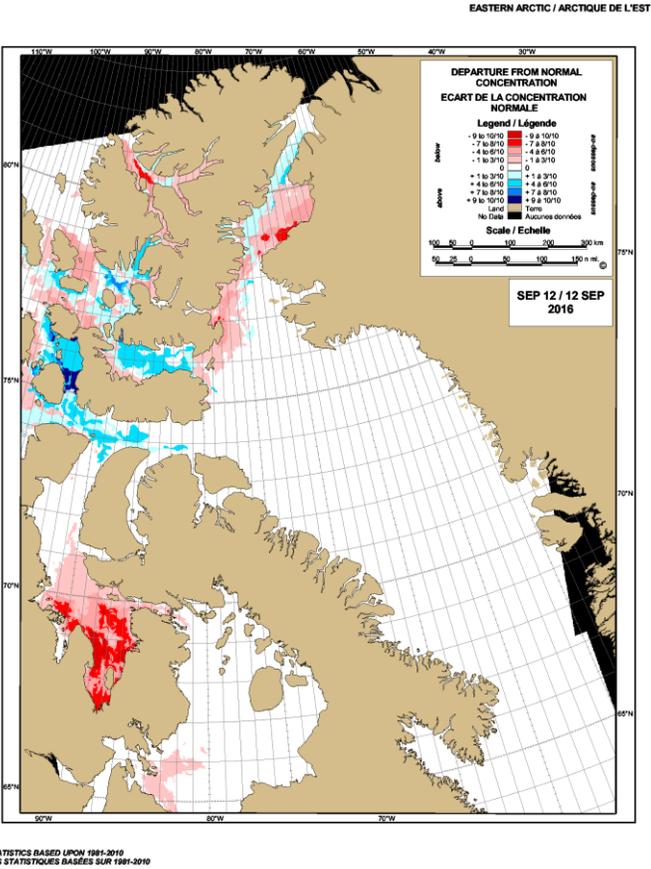


Figure 18: Departure from normal ice concentration for the Eastern Arctic area near mid-September

Bergy water conditions in Wellington Channel and Hell Gate Strait allowed old ice to begin to flow into Lancaster Sound and Jones Sound from the northern regions of the Canadian Arctic Archipelago by mid-month. Lancaster Sound saw zones of close pack to open drift old ice, unusual for this time of year.

The remaining ice in Committee Bay melted by the end of the month, with the majority of the ice melted completely by mid-month with only small zones of very open drift first-year ice including a trace of old ice near Fury and Hecla Strait.

New ice started to form by mid-month at latitudes north of 77°N, especially through Ellesmere Island and in Nares Strait. Ice became close to very close pack new and old ice in Nares Strait by the end of the month.

The remaining ice in Foxe Basin melted fully in the first week of the month. Ice free conditions were seen through the month, except for a few strips of first-year ice moving

through Fury and Hecla Strait mid-month. This ice melted rapidly once it entered Foxe Basin.

Western Arctic

Summer Ice Conditions and Fall Freeze-up

Summer Temperatures: June to September

From June to September, surface air temperatures were above normal over most locations except near normal over the Beaufort Sea.

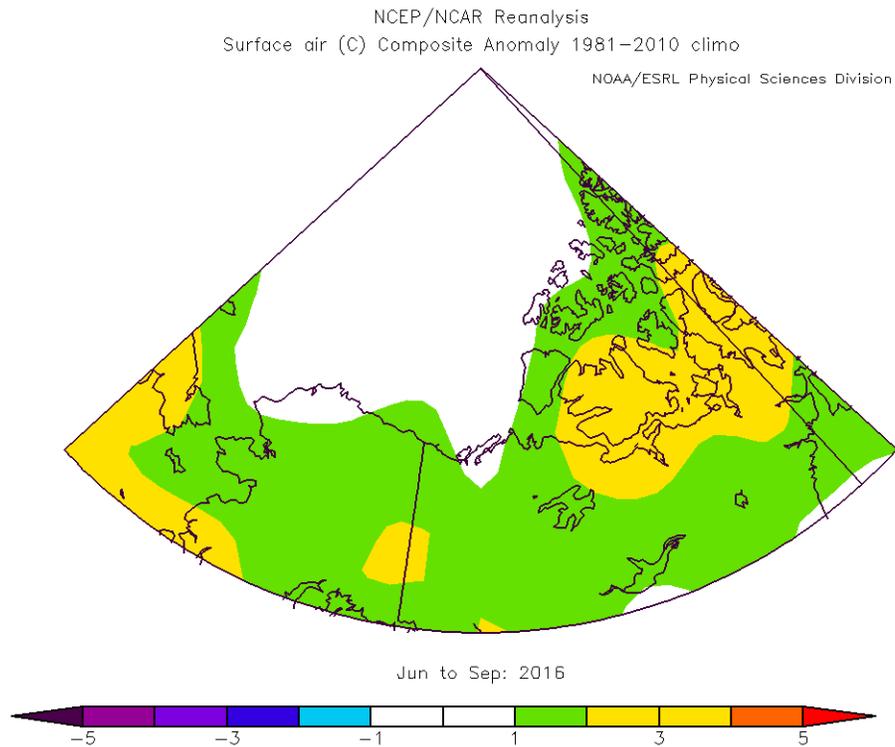


Figure 19: Air temperature anomaly for the Western Arctic area from June to September

Summary of Ice Conditions:

The southern Beaufort saw a very early sea ice breakup (6 weeks ahead of normal) with open water already present in the region by the start of June. Throughout the summer coverage remained near record lows in the Beaufort Sea, with only 2012 seeing lower sea ice coverage at

the end of the melt season. Throughout the western Canadian Arctic the minimum sea ice coverage was reached in early September and ranked in the lowest 5 coverages in the climate record.

In early June consolidated ice was present across the Archipelago with predominantly first-year ice over areas south of the Queen Elizabeth Islands and old ice in areas to the north. Significantly less old ice was present in Viscount Melville Sound and M'Clintock Channel at the start of the melt season when compared to climatology.

Melt in much of the Archipelago was 2 weeks ahead of normal with the southern Northwest Passage having less than 10% ice cover from early August through to early October.

As the melt season progressed much of the Parry Channel saw ice melt ahead of normal with lower than climate ice coverages. Because of this, old ice from the northern Archipelago and from the eastern Beaufort drifted into Parry Channel and M'Clintock Channel.

Freeze up began in northern regions in the second half of September with ice growth delayed by 1-2 weeks across much of the region.

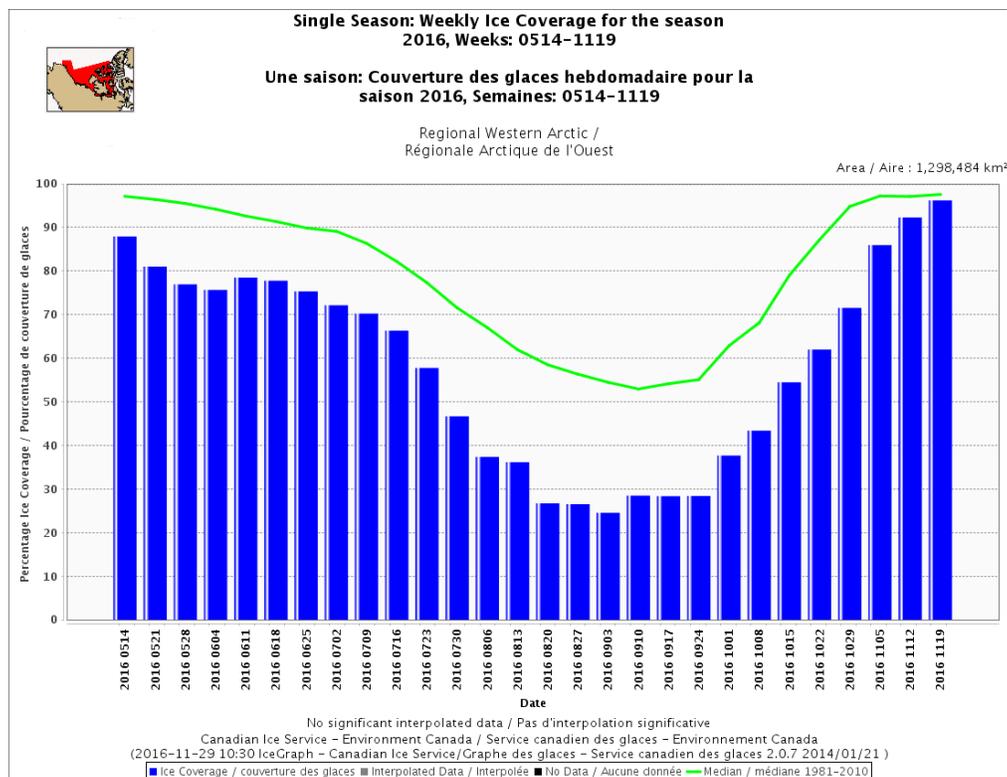


Figure 20: Weekly ice coverage for Western Arctic area for the 2016 season

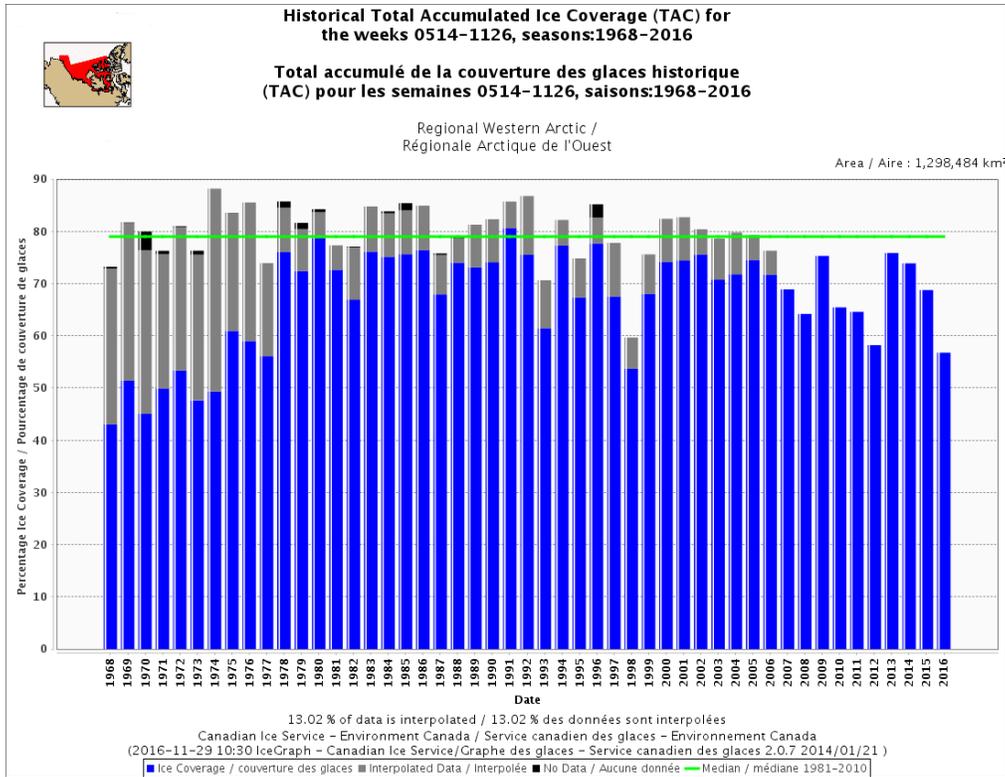


Figure 21: Historical Total Accumulated Ice Coverage for Western Arctic area

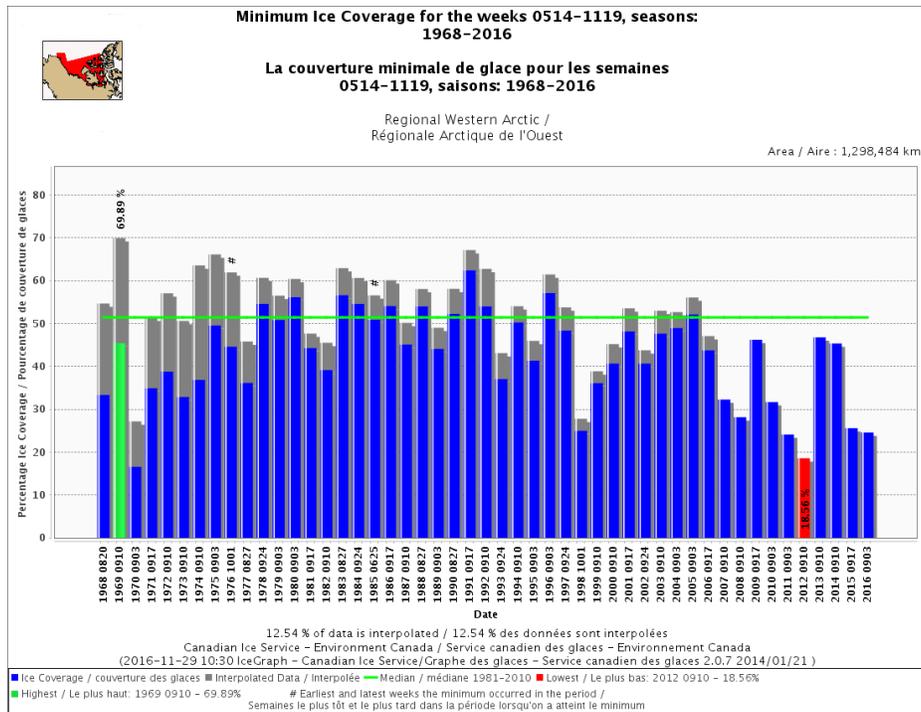


Figure 22: Minimum Ice Coverage for the Western Arctic area, 1971-2016

June Ice Conditions:

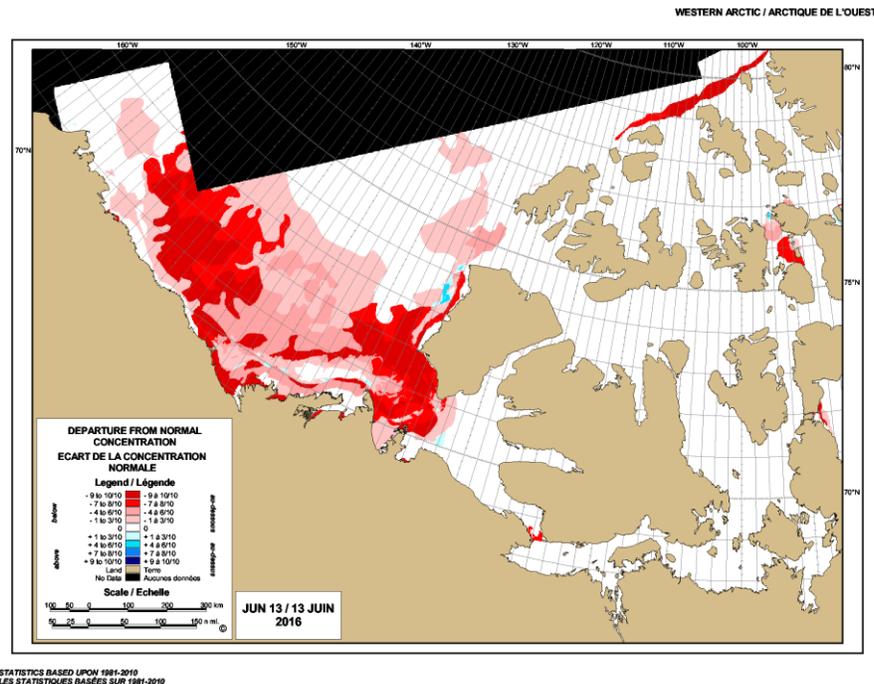


Figure 23: Departure from normal ice concentration for the Western Arctic area near mid-June

Areas of open water were already present over the southeastern Beaufort Sea at the beginning of June and persisted until the end of June, well below the climate normal of ice coverage through the month (6 weeks ahead of normal). Consolidated first-year ice remained in place across the Amundsen Gulf.

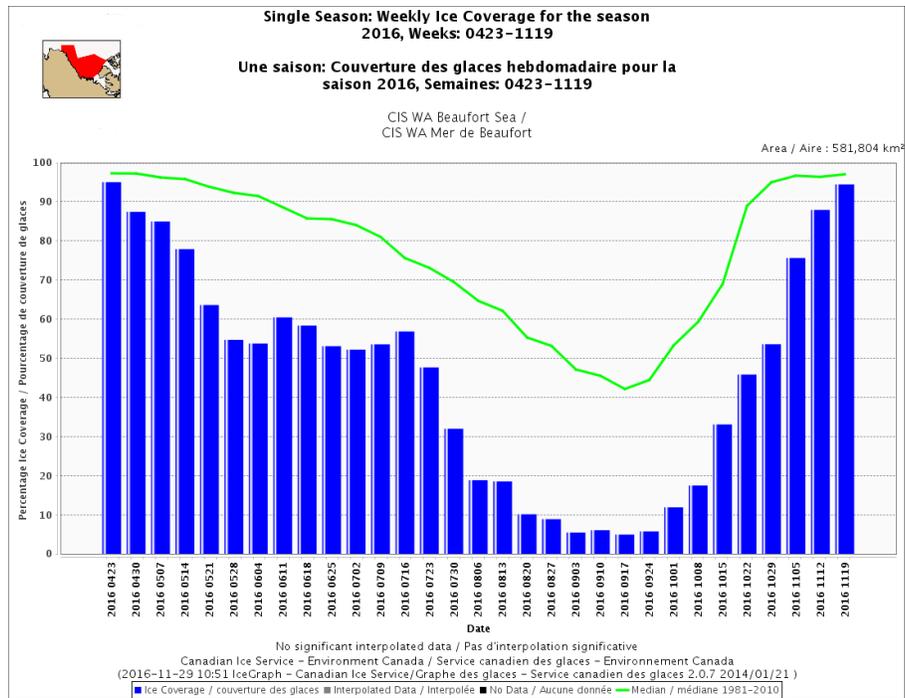


Figure 24: Ice coverage Beaufort Sea 2016 – early breakup and lower coverages

Consolidated ice was present over the Archipelago with predominantly first-year ice over areas to the south of Queen Elizabeth Islands and old ice in areas to the north. Mainly first-year ice including a trace of old ice from M'Clure Strait to Cornwallis Island with some incursions of higher concentrations of old ice, especially over the southern sections of these regions.

Fracture of the Amundsen Gulf consolidated ice and ice along the coast from Paulatuk to Point Barrow happened by mid-June. By the end of June small fractures began in the consolidated ice in Victoria Strait and Coronation Gulf while ice melt continued along the Alaska and Northwest Territories coasts and in the southeastern Beaufort.

July Ice Conditions:

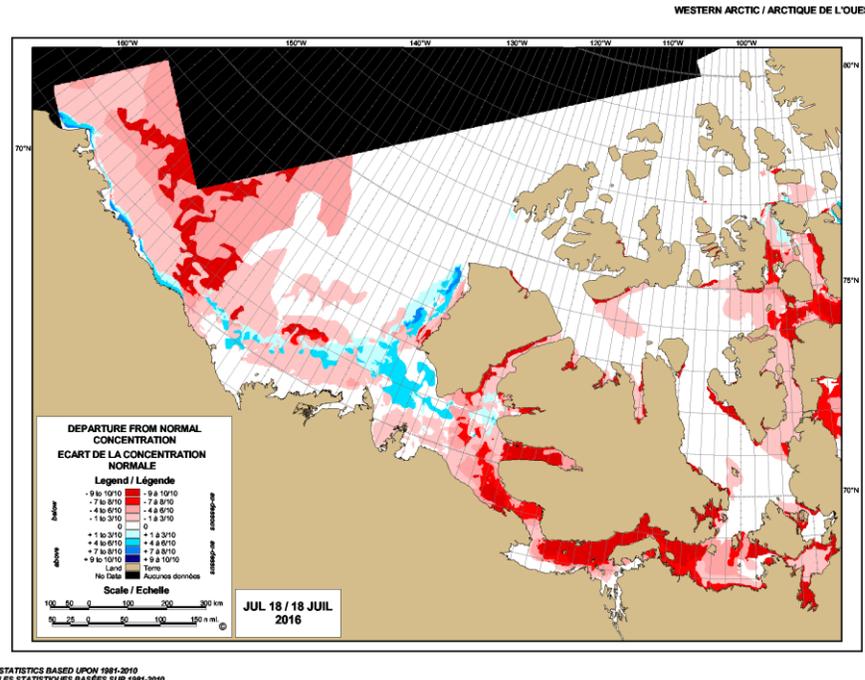


Figure 25: Departure from normal ice concentration for the Western Arctic area near mid-July

Early in July the remaining coastal ice from the Amundsen Gulf and westward melted completely. Through mid-July ice melted faster than the climate normal through the southern Amundsen Gulf all the way to Cambridge Bay.

Most of the remaining consolidated ice south of the Queen Elizabeth Islands fractured during the second half of July, however close to very close pack first-year and old ice remained over these regions.

In the third week of July the old ice pack pushed southwards in the Beaufort Sea with a band of ice stretching from the southeastern Beaufort to Franklin Bay. At the same time rapid diminishments of the concentrations of ice in the southern Beaufort were seen with some regions of open water forming near 74°N 140°W.

By the end of the month open water was present from King William Island to west of Point Barrow except for a few areas of open to very open drift old ice near Franklin Bay.

August Ice Conditions:

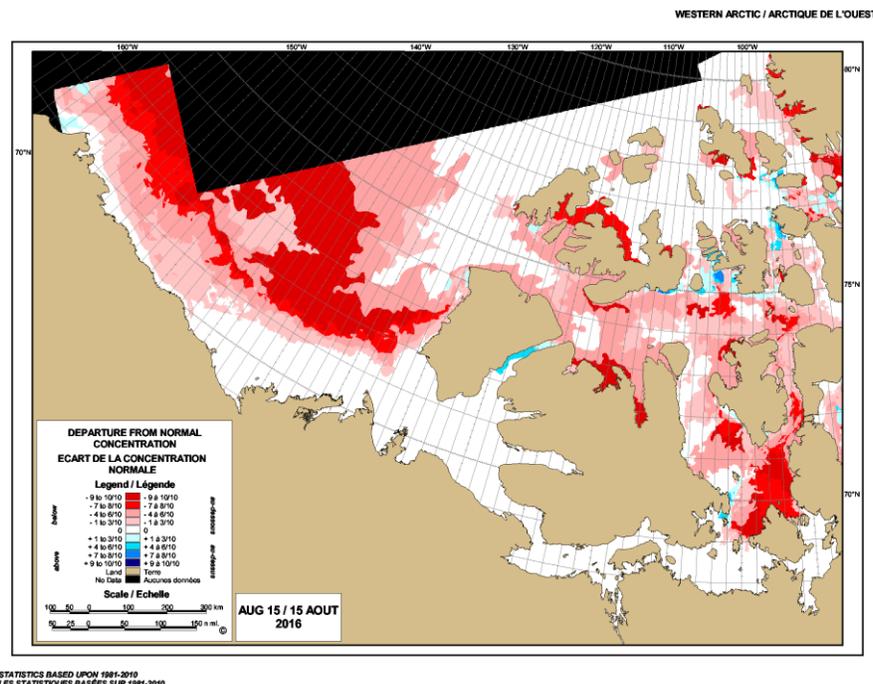


Figure 26: Departure from normal ice concentration for the Western Arctic area near mid-August

Ice concentrations continued to diminish during August. Consolidated ice near the Queen Elizabeth Islands fractured during the first week with open water developing in portions of Barrow Strait and near northern Prince of Wales Island.

In the first half of August ice concentrations rapidly diminished in the southern Beaufort with only small amounts of open drift old ice remaining south of 74°N near Banks Island and near 145°W. Open to very open drift first-year ice remained in a strip just north of Point Barrow. Prince of Wales Strait, Peel Sound, and the entire Queen Maud Gulf saw open water conditions.

During the second half of August ice concentrations continued to diminish with only small concentrations of very open drift old ice remaining in M'Clintock Channel and southern Viscount Melville Sound. Because of the open water conditions, old ice from the Queen Elizabeth Islands began flooding through Byam Martin Channel into Parry Channel.

Over the Beaufort Sea, large areas of open water existed west of 135°W while close pack to very close old ice remained present north of Banks Island and the Queen Elizabeth Islands.

September Ice Conditions:

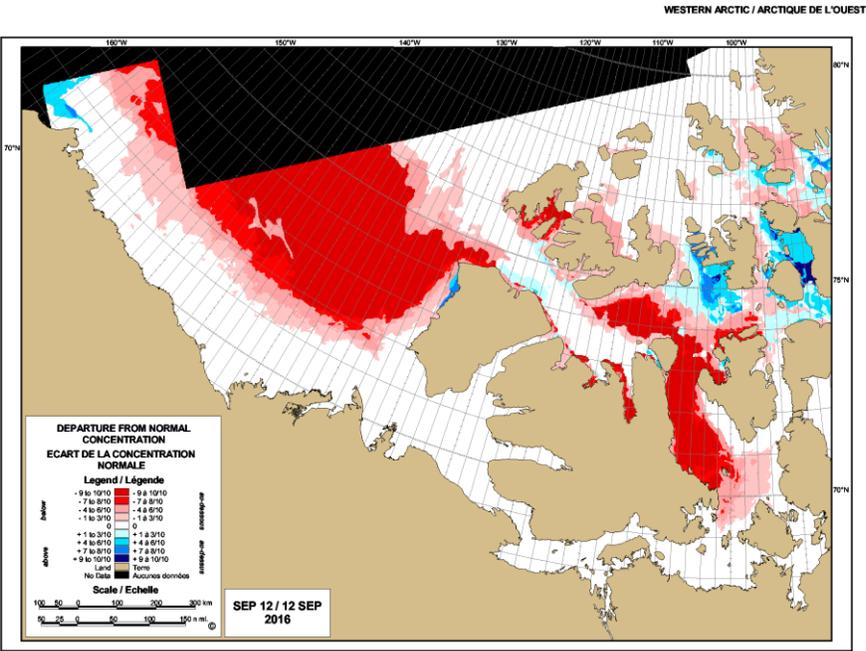


Figure 27: Departure from normal ice concentration for the Western Arctic area near mid-September

During the first two weeks of September little ice remained through the southern waterways of the Northwest Passage. Parry Channel contained open drift to close pack old ice which was pushing through M’Clure Channel from the west and through Byam Martin and Wellington Channels from the north. Open water was present up to 76°N in the Beaufort Sea, except for a small patch of open drift first-year ice near Point Barrow.

The second half of September saw a slowing of the retreat of ice as temperatures began to cool and a stabilization of the ice situation, except in M’Clintock Channel where, due to lack of first year sea ice, old ice began to descend into the Channel.

The Beaufort Sea saw its seasonal ice coverage minimum near 4.9%, the second lowest coverage on record behind 2012 (2.2%). This minimum occurred mid-month, before the production of new ice began in the northern Beaufort Sea.

New ice started to appear over the northern Beaufort Sea and Queen Elizabeth Islands during the second and third weeks of September and spread southward to Parry Channel by the end of the month.

Western Beaufort Sea

The following summary was prepared by the National Weather Service, Alaska Region

May: Shore fast ice persisted most of the month even as ice decay offshore spread westward from the MacKenzie River delta, helped along by near shore temperatures that averaged 3-6°C above normal. At the end of the month open water beyond the shore fast ice extended to 72N as far west as Harrison Bay.

June: Low pressure was persistent across the high Arctic, resulting in increased westerly winds over the western Beaufort Sea. As a result, temperatures near shore were kept to generally 1-2°C above normal. Shore fast ice largely melted out during the month except inside of some barrier island. The ice pack continued to fracture, making the ice pack quite mobile, however sea ice concentrations decreased very slowly through the month. At the end of June open water to very open pack ice conditions extended to the coast as far as Kaktovik, while west of Harrison Bay, higher concentrations persisted.

July: Mean low pressure shifted to the East Siberian Sea, resulting in winds closer to normal than in June. Nearshore temperatures averaged 1.5-3°C above normal. The remaining pack ice continued to fracture and spread through the first half of the month. Sea ice remained quite mobile with areas largely clearing to sea ice free conditions, only to have ice spread back into those regions owing to favorable winds. Ice concentrations decreased significantly during the last two weeks of the month. By the end of July much of the western Beaufort Sea south of 73N had only 1-3 tenths coverage, but with somewhat higher concentrations 10 to 20 miles offshore from Point Barrow eastward to Camden Bay.

August: Slightly higher than average pressure in the southern Beaufort Sea resulted in typical winds for the season, with temperatures averaging 1.5-3°C above normal. By mid-month waters were open over the entire western Beaufort Sea within 60nm of the coast, and by the end of the month the Beaufort Sea was ice-free south of 74N.

September: Strong low pressure in the northeast Beaufort Sea resulted in much stronger than normal westerly winds over western regions. Nearshore temperatures averaged 1.5-3°C above normal. Over the far southwest Beaufort Sea, lingering ice from the Chukchi Sea was at times pushed east of Point Barrow by the coastal current and wind forcing as far east as Harrison Bay, but melted out in short order. In the northern Beaufort, ice continued to retreat during the month, and by month's end, except for the low concentrations of nearshore ice Harrison Bay westward, the western

Beaufort Sea was ice free south of 75N, with no significant ice development even inside the barrier islands and river outlets