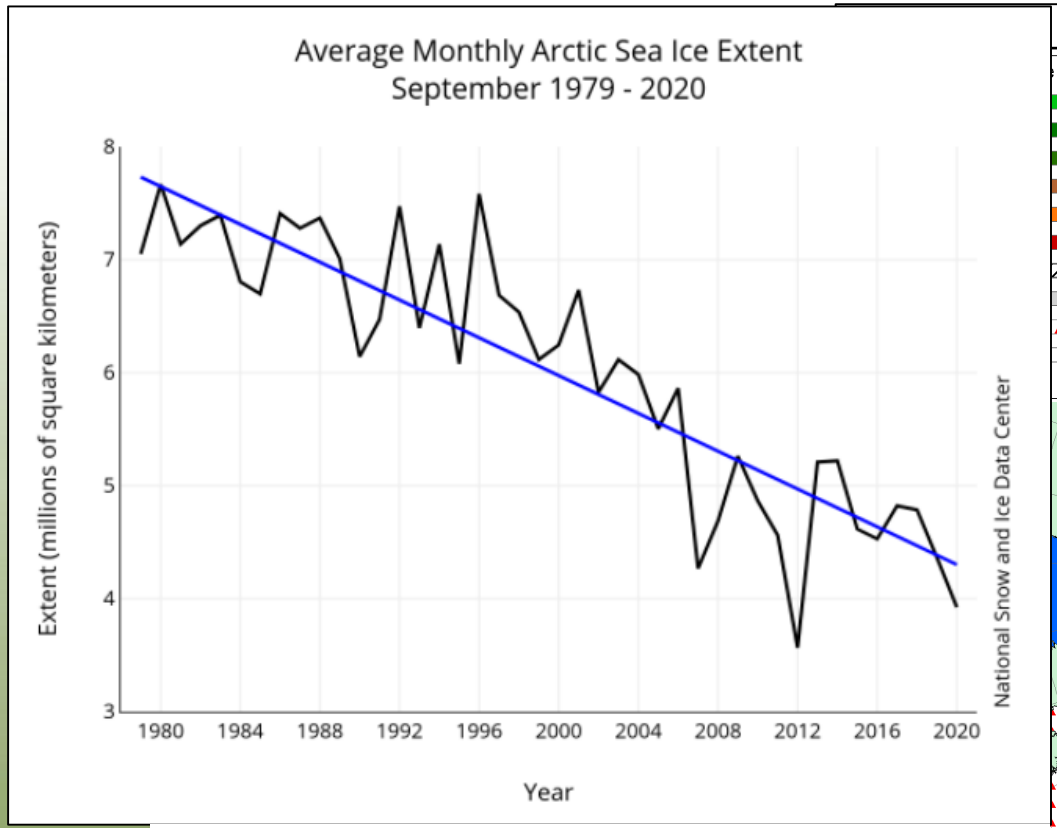
Arctic Regional Climate Centre

Review of 2020 Summer Sea-Ice Outlook
Present the 2020/21 Winter & Spring Sea-Ice Outlook

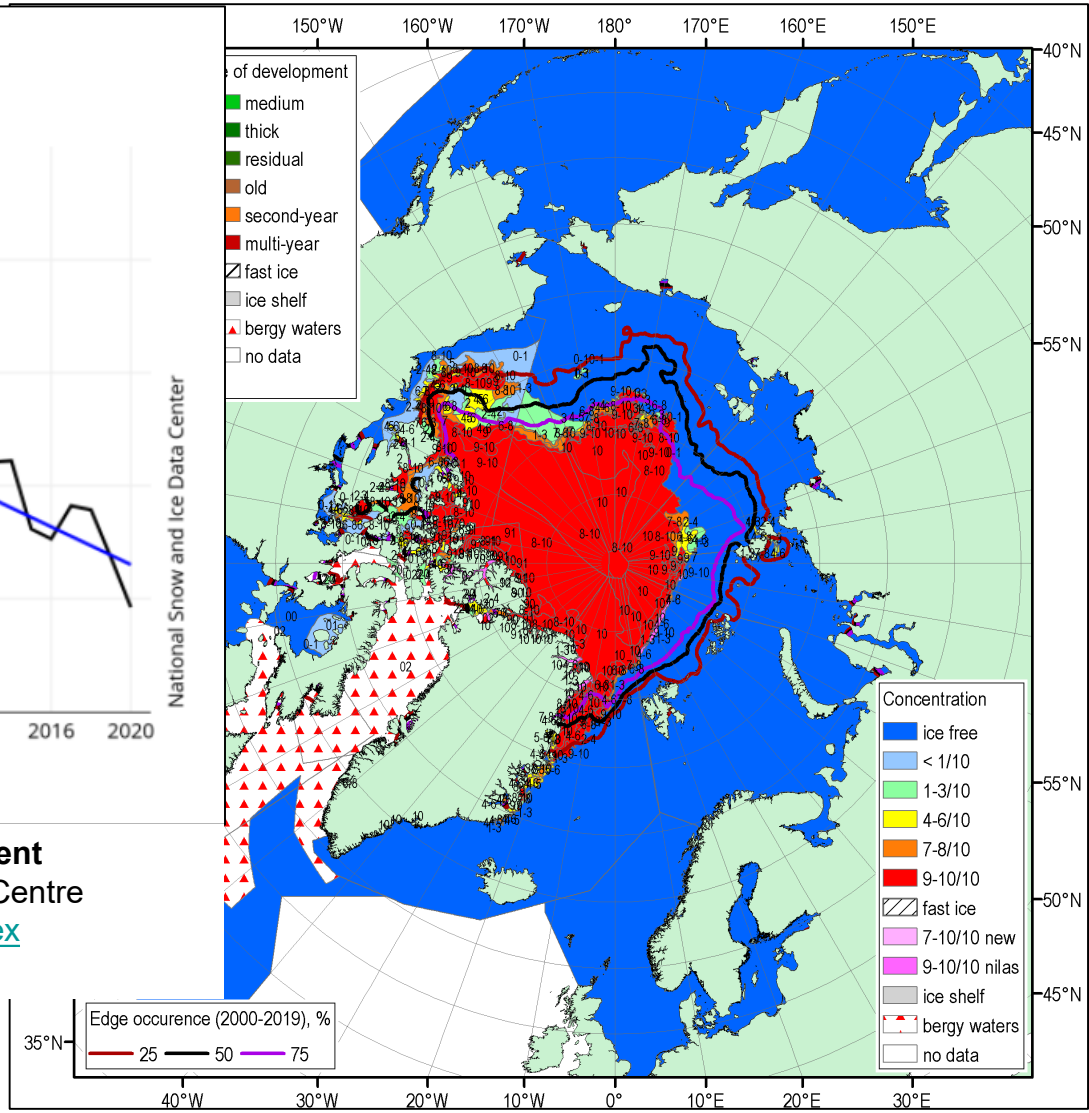
Scott Weese and Katherine Wilson
Canadian Ice Service

Part 1 Comparison:
Actual Summer 2020 Sea-Ice Conditions vs. the ArcRCC Sea-Ice Summer 2020 Outlook

September 2020 Minimum Sea-Ice Extent



September 15 Arctic Sea-Ice Extent
Source: National Snow and Ice Data Centre
https://nsidc.org/data/seaice_index

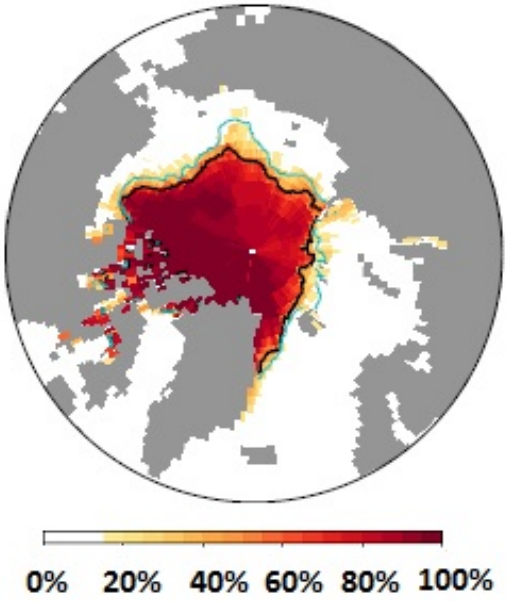


Arctic sea-ice extent for 14-17 September 2020 was the second lowest in the 42-year satellite record, behind only September 2012.

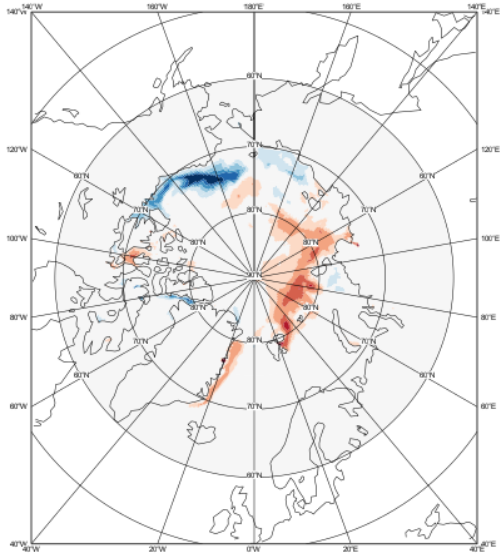
Models used for the Sea-Ice Extent Outlooks

- **Based on 4 experimental forecasts from 4 WMO Global Producing Centers Output:** France - ECMWF, United States- NOAA/CPC, Canada - ECCC/CCCMA and the UKMetOffice, 3 shown below)
- **Experts at the ArcRCC compare these models, so you don't have to, and develop products for users.**

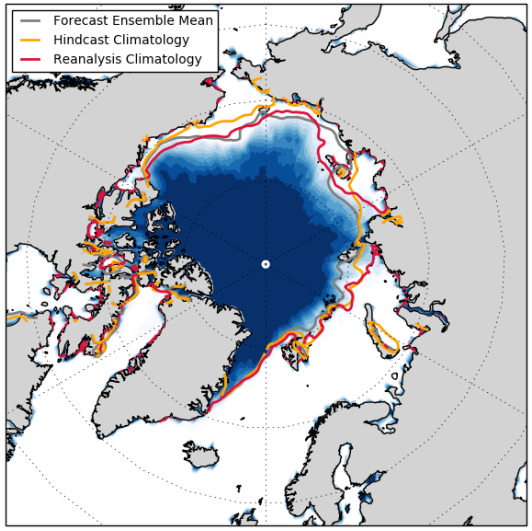
Probability of Sea Ice > 15%
September 2018
ECCC (CanCM3+CanCM4)



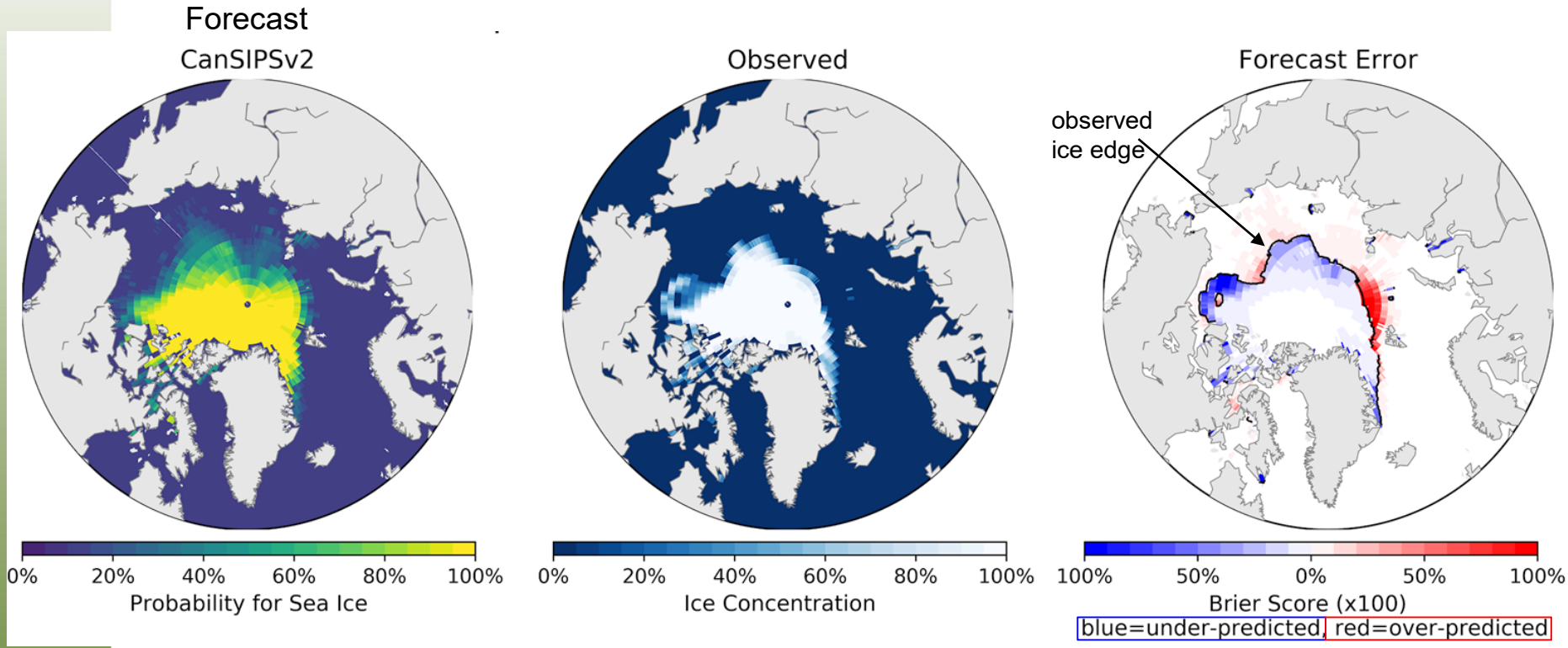
Sea Ice Concentration Anomaly
September 2019
ECMWF (SEAS5)



Probability of Sea Ice > 15%
September 2019
UK Met Office (GloSea5)

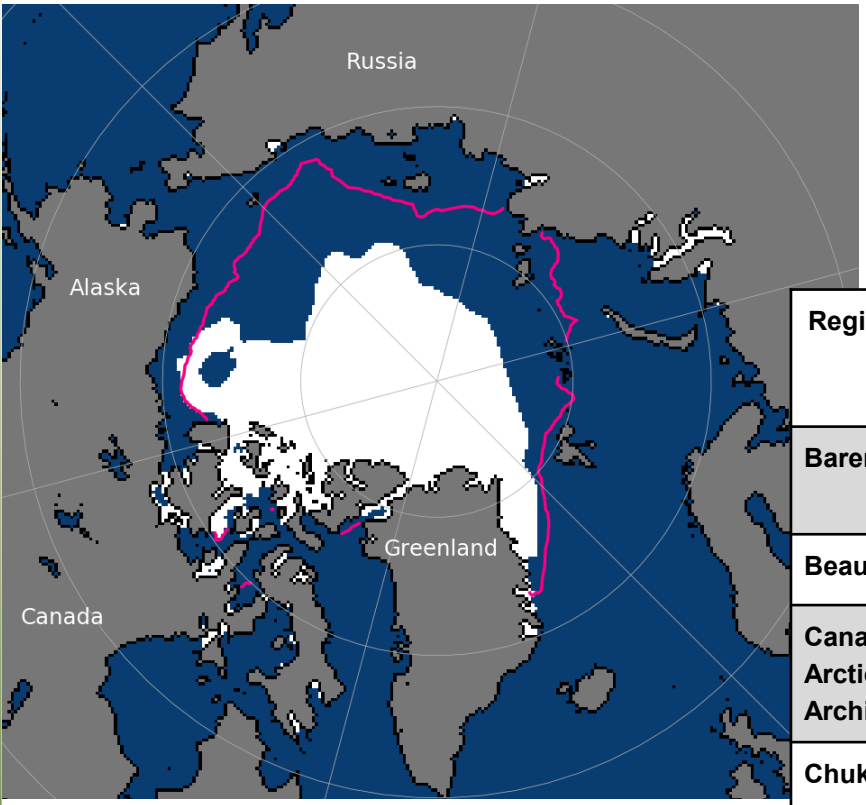


September 2020 Sea Ice Extent Outlook



September 2020 Sea-Ice Extent Outlook

Minimum = September



September 15 Arctic Sea-Ice Extent
Source: National Snow and Ice Data Centre
https://nsidc.org/data/seaice_index

Regions	CanSIPS Sea-Ice Forecast Confidence	CanSIPS Sea-Ice Forecast	Observed Conditions	Forecast Accuracy
Barents Sea	Low	Above normal (northern section)	Below normal	X
Beaufort Sea	Moderate	Below normal	Below-Near normal	✓
Canadian Arctic Archipelago	Moderate	Below normal	Below normal	✓
Chukchi Sea	High	Below normal	Below normal	✓
Eastern Siberian Sea	Moderate	Below normal	Below normal	✓
Greenland Sea	High	Above normal	Below normal	X
Kara Sea	High	Below normal	Below normal	✓
Laptev Sea	High	Below normal	Below normal	✓

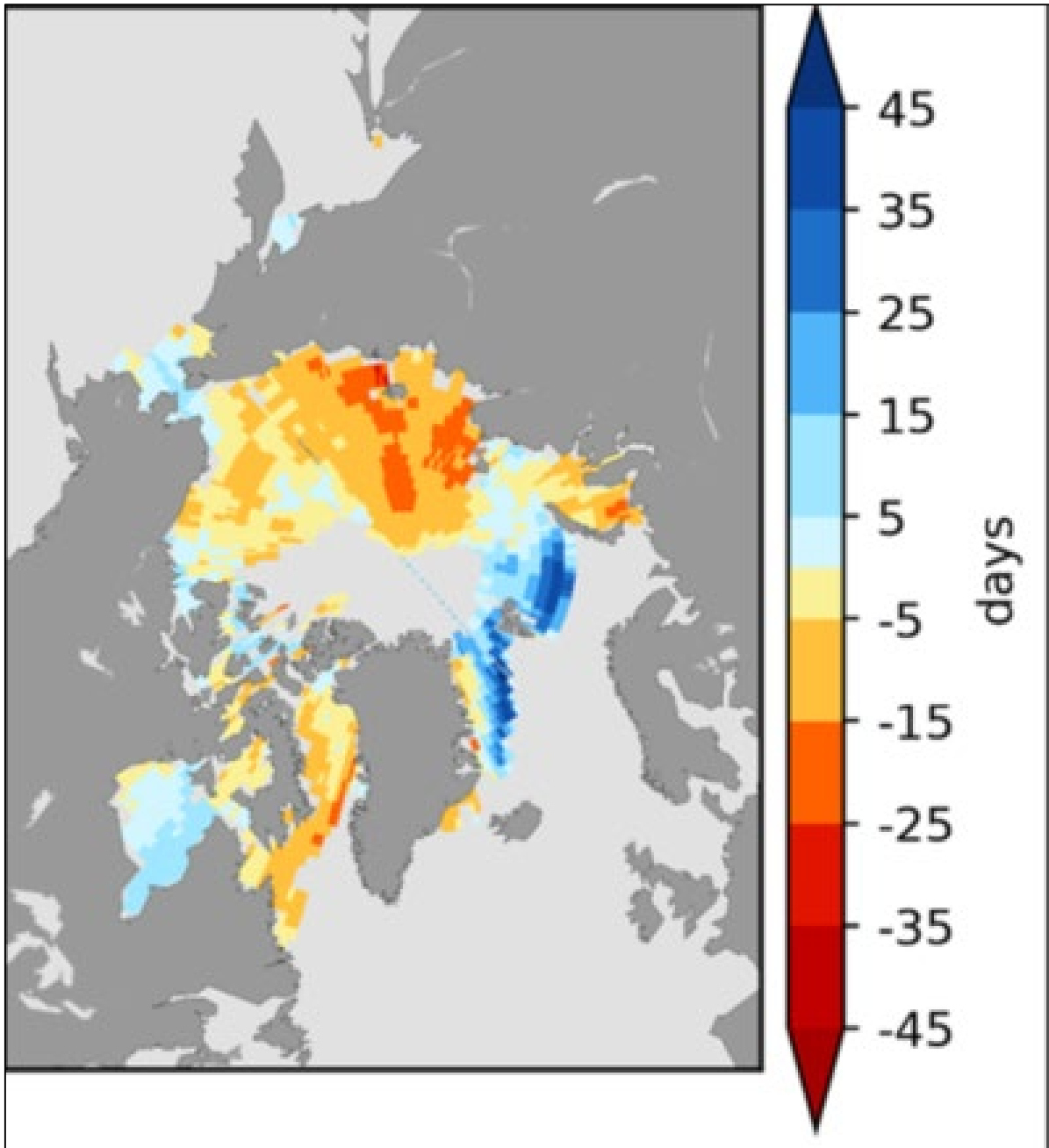
Summer 2020 Sea-Ice Break-up Outlook

What is Normal break-up?

- The date when the ice concentration goes below 50%
- Based on climatological period (2009-2017)

Break-Up Categories:

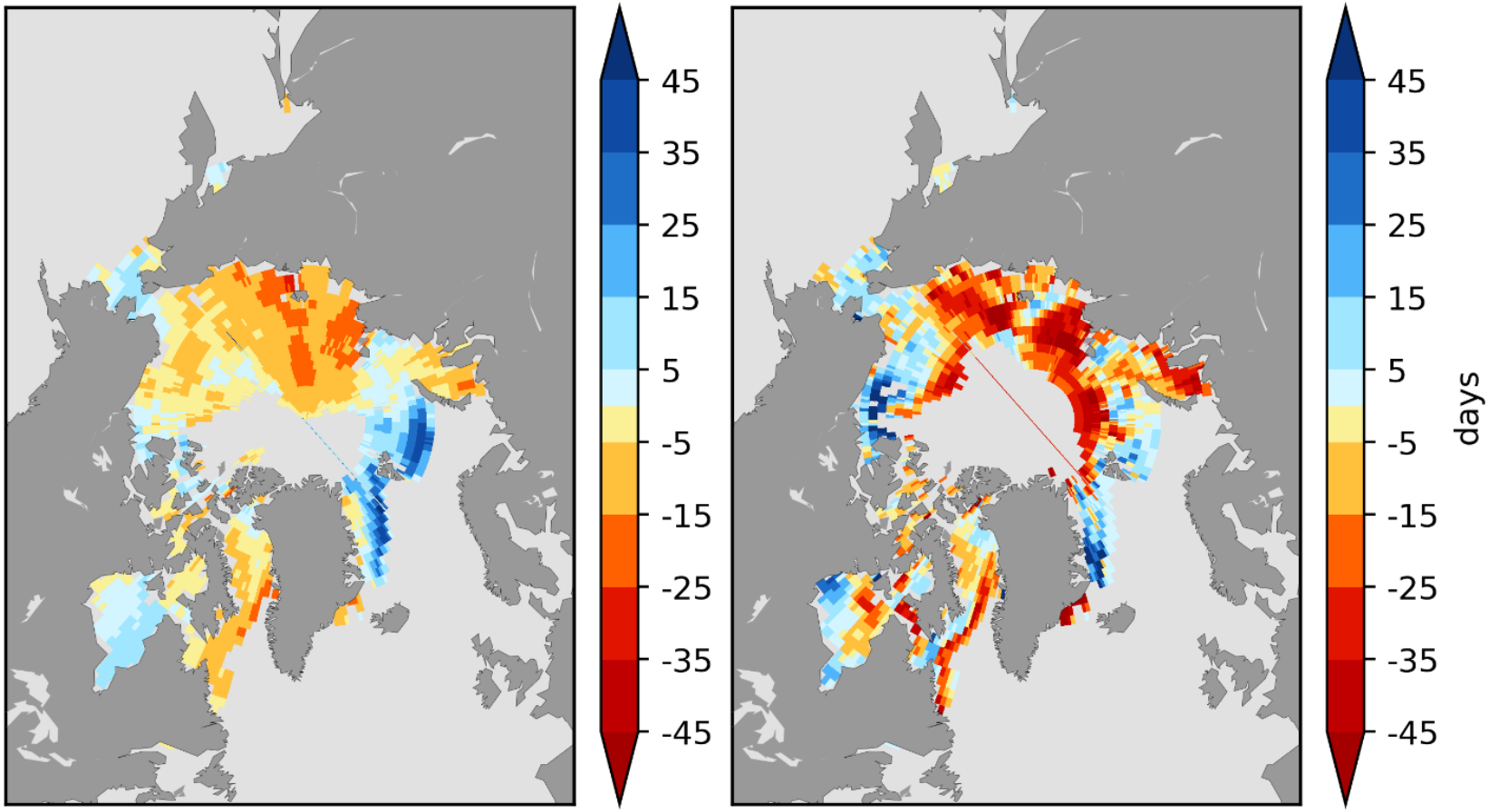
- Red = Late break-up
- Grey = Near normal break-up
- Blue = Early break-up



Summer 2020 Break-up Outlook

Forecast anomaly
(base: 2011-19)

Observed anomaly
(base: 2011-19)



ArcRCC Summer Sea-Ice Break-up Outlook 2020

Regions	CanSIPS Sea-Ice Forecast Confidence	CanSIPS Sea-Ice Break-up Forecast	Observed Conditions	Forecast Accuracy
Baffin Bay	High	Early	Early	✓
Barents Sea	High	Late in northern section	Near normal	~
Beaufort Sea	High	Early	Early	✓
Bering Sea*	Moderate	Near normal to late	Near normal	✓
Chukchi Sea	High	Early	Early	✓
East Siberian	Low	Early southern section, near normal northern section	Early	~
Greenland Sea	High	Late	Late	✓
Hudson Bay	Moderate	Late eastern half, near normal western half	Early eastern half, late western half	X
Kara Sea	Moderate	Early in the west, near normal in the east	Early	~
Labrador Sea	High	Early	Early	✓
Laptev Sea	Low	Early	early	✓

2020 Summer Ice Conditions in Key Shipping Areas

Produced by the National Ice Services (forecaster experience and statistical methods)

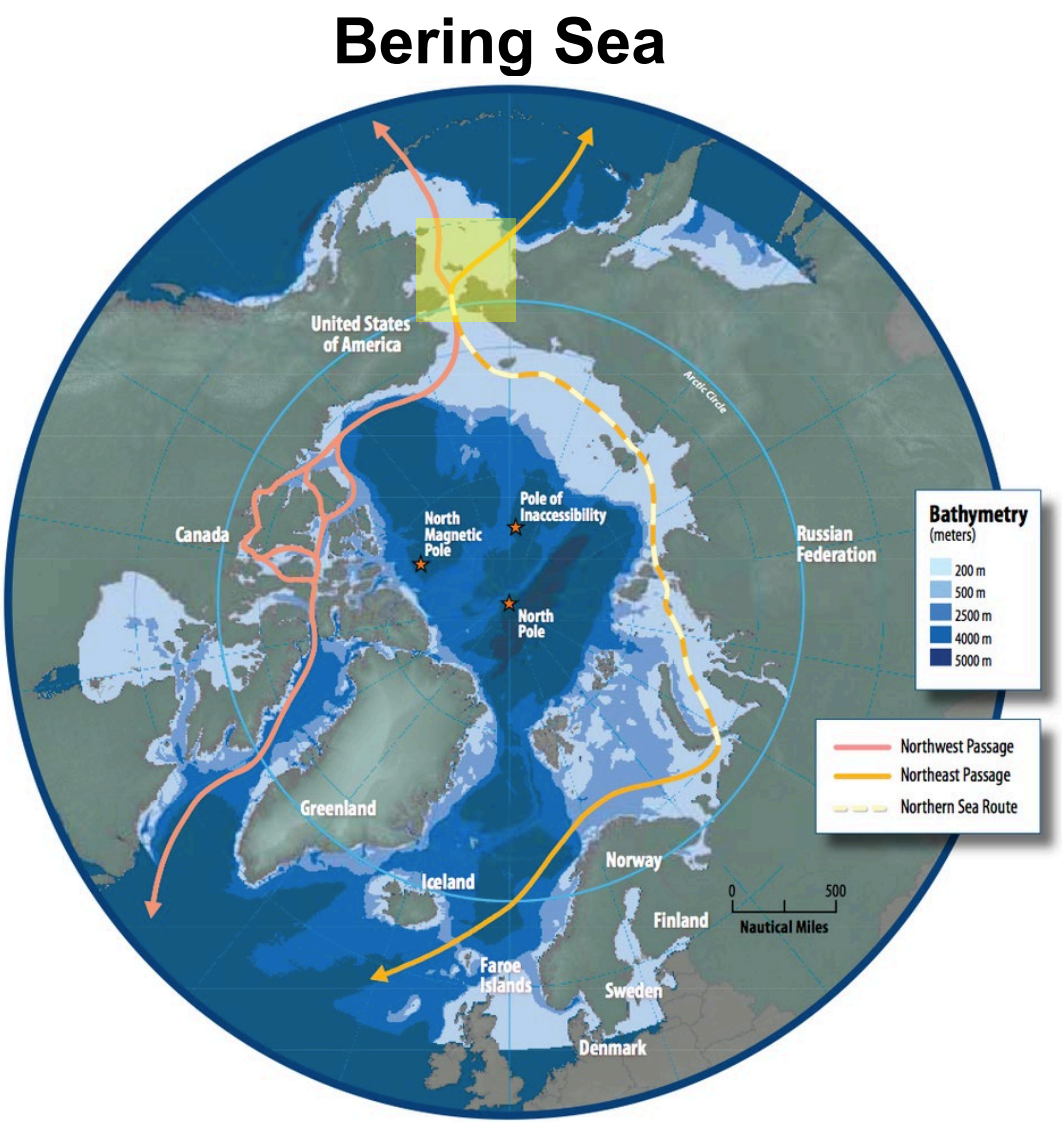


Figure from Arctic Council - Arctic marine shipping assessment

Forecast

- Ice extent was below the 1981-2010 average in early March and in May was at about 75% of the 30-year median for this date.
- There will be limited ice remaining in the Bering Sea by the end of May 2020

What happened

- Melt-out was the latest since 2014.
- However, this was still earlier than the 1981-2010 average. Patches of remnant ice persisted into mid-June.

Coastal Beaufort Sea/ Northwest Passage

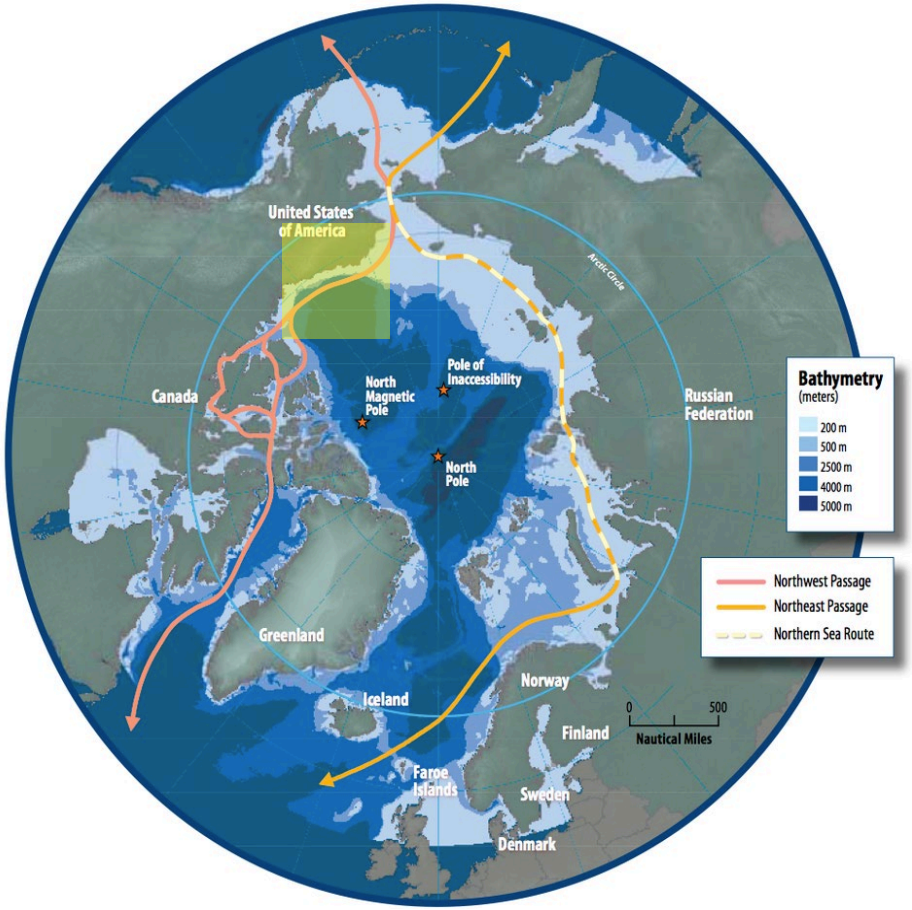


Figure from Arctic Council - Arctic marine shipping assessment

Summer 2020 Forecast

- Break-up earlier than normal with areas of consolidated ice becoming mobile earlier in the season.
- Concentrations of old ice were identified as potential hazards for the northern and western portion, as higher than normal amounts were present in these areas.

What happened

- Sea ice melted faster than normal along the coastal margins of the Beaufort Sea and maintained a corridor of open water throughout the summer.
- Higher than normal concentrations of sea ice did remain ~100 nm offshore throughout most of the summer in the eastern most section but no chokepoint developed.
- Old ice remained offshore thanks to favourable wind and ocean currents

Hudson Bay/ Hudson Strait

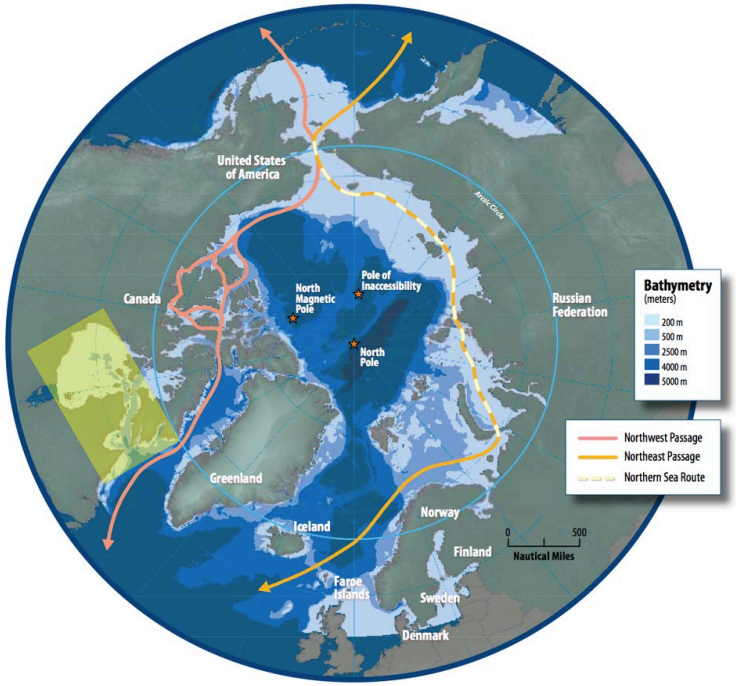


Figure from Arctic Council - Arctic marine shipping assessment

Summer 2020 Forecast

- Faster than normal sea ice break-up for Hudson Strait.
- Near normal break-up for the western portion of Hudson Bay and later than normal in the eastern section.
- Ice thicknesses throughout Hudson Bay were thicker last spring than spring 2019, with predominantly thick first-year ice covers the western and central portions of the bay
- Thicker ice coverage and colder than normal temperatures could lead to a more challenging navigation season, particularly in the eastern half of Hudson Bay

What Happened

- Earlier than normal breakup in northern Hudson Bay and Hudson Strait.
- Western Hudson Bay did experience near normal to later than normal breakup and melt, while the eastern section was generally near normal.
- Shipping activities did not experience any notable setbacks due to the rapid opening of Hudson Strait and northern Hudson Bay.

Baffin Bay

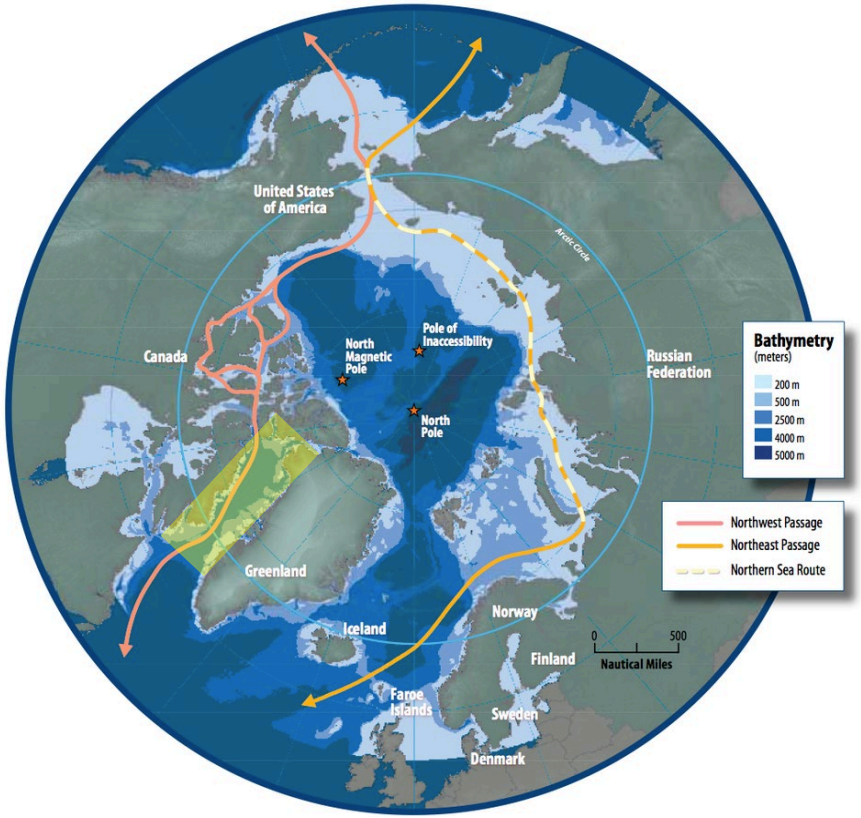


Figure from Arctic Council - Arctic marine shipping assessment

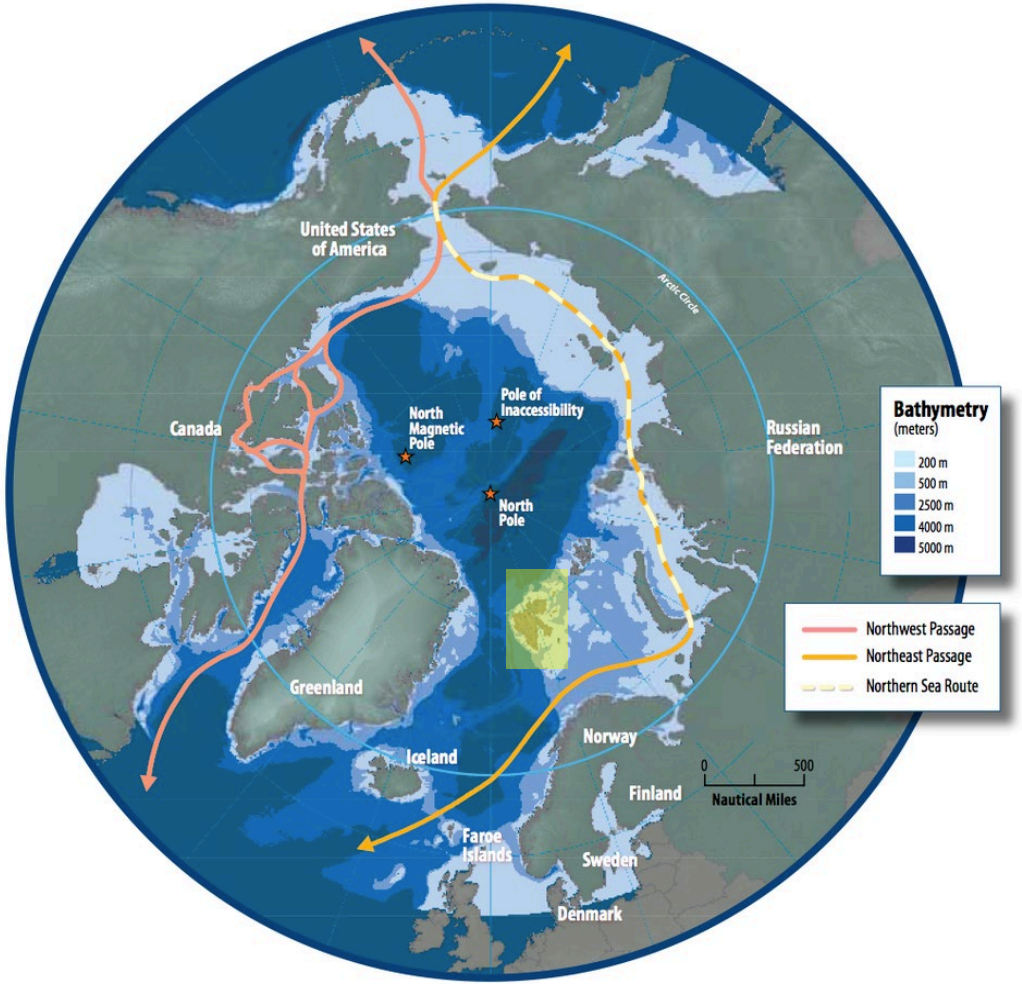
Summer 2020 Forecast

- Early than normal sea ice break-up due to lower than normal ice extents in the region and predicted warmer temperatures.
- Old ice concentrations were in line with climatological normals and no specific hazards were anticipated.
- The ice bridge in Nares Strait will cut off the inflow of old ice from the Arctic Ocean into northern Baffin Bay, thereby maintaining a limited influx of old ice into the region.

What Happened

- Baffin Bay was well below normal this summer, its 4th lowest ice cover since 1968.
- The ice bridge in Nares Strait remained intact until late June and little old ice entered from Arctic Ocean (despite bridge fracturing three weeks early with respect to 1981-2010 climatology).
- Old ice concentrations are still below normal in northern Baffin at this point due to late freeze-up.

Svalbard



Forecast

- Summer minimum sea ice extent was forecast to be somewhat above normal, but with low forecast confidence.
- Expected near normal impacts from sea ice cover around Svalbard for the 2020 summer indicating normal shipping activities.

What Happened

- Conditions rapidly went from above average in early spring, to below average extent in late summer.
- This was caused by advection and melt of the older (2nd year) sea ice, that had been present, out of the area.

Figure from Arctic Council - Arctic marine shipping assessment

Northern Sea Route

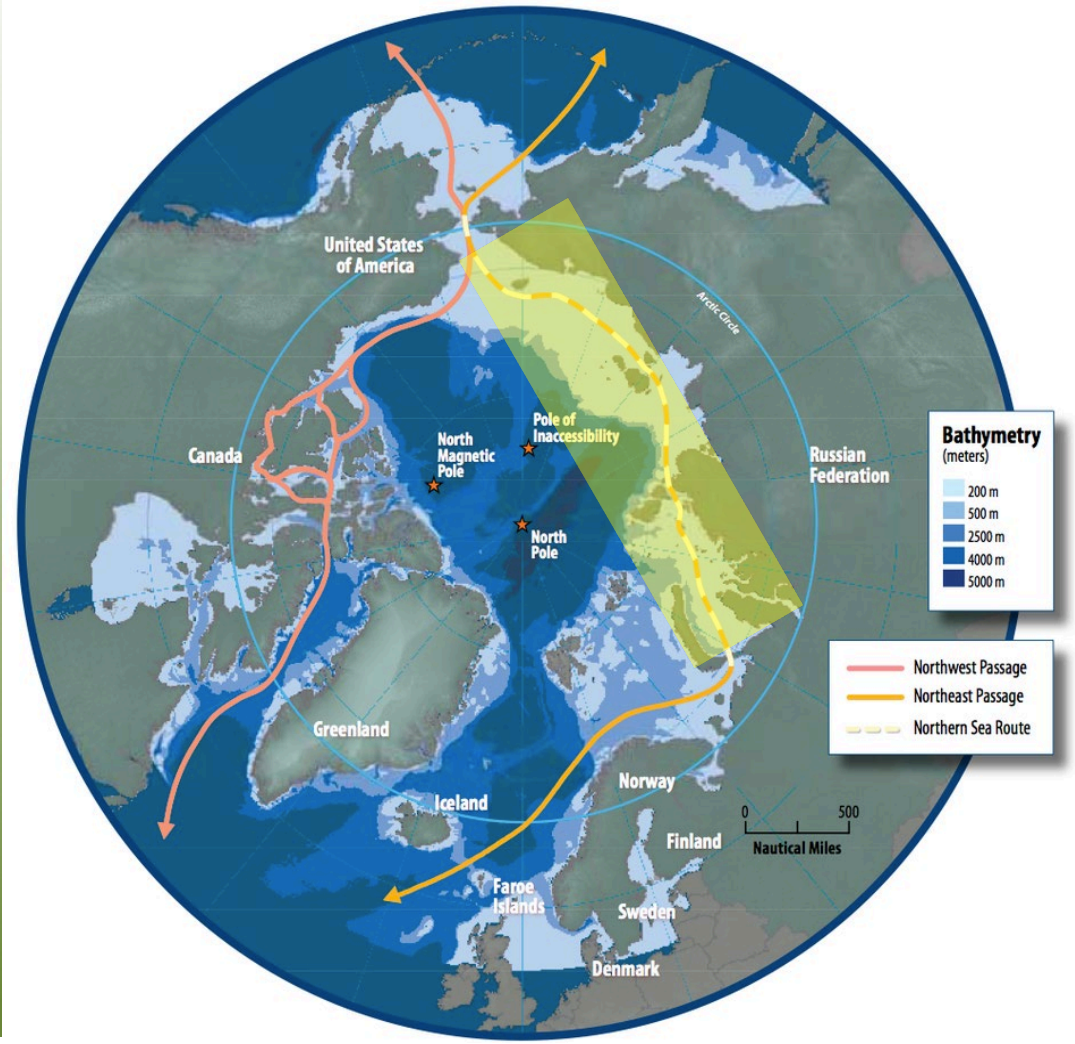


Figure from Arctic Council - Arctic marine shipping assessment

Forecast

- Light ice conditions throughout the route
- Areas of landfast ice would break-up earlier than normal.
- Significant incursions of old ice not expected along the route this summer season.

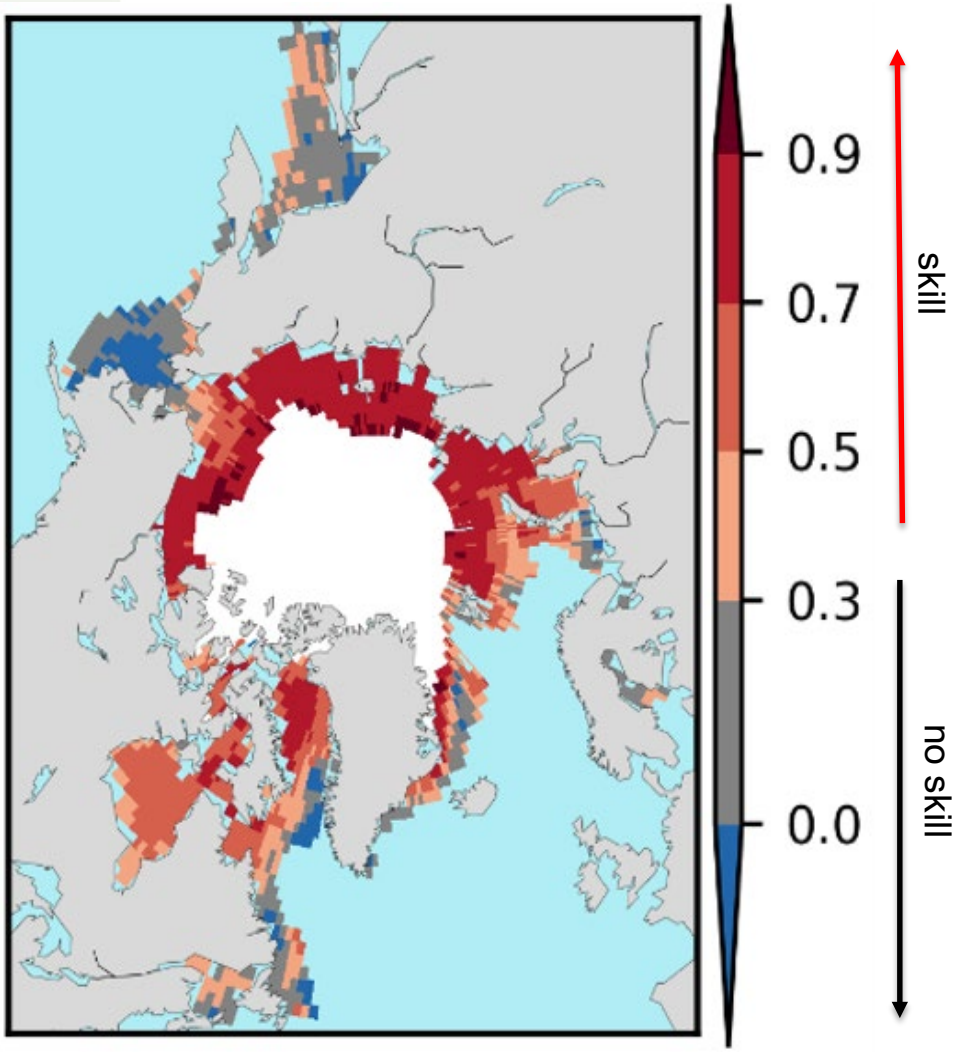
What Happened

- Overall very light ice conditions
- Comparable to 2012 and 2016
- Fast ice break-up in June – July was observed in the Kara Sea
- Eastern Siberian Sea was completely open mid Aug till mid Oct with a single exception – Vilkitsky Strait, fully open from end of Aug.
- Melting in the Chukchi Sea was slower and comparable to the last 10 years.

Part 2: ArcRCC Sea-Ice Outlook

Winter 2020/21

ArcRCC Sea-Ice Freeze-up Outlook 2020 Categories



Freeze-Up Outlook Confidence

- Forecast anomaly is based on 2011 to 2019 period and compared to actual freeze-up dates
- Only regions where the model has historical forecast skill are included in the outlook (all white areas are excluded, detrended for 1981-2019)
- The freeze-up outlook has three confidence categories

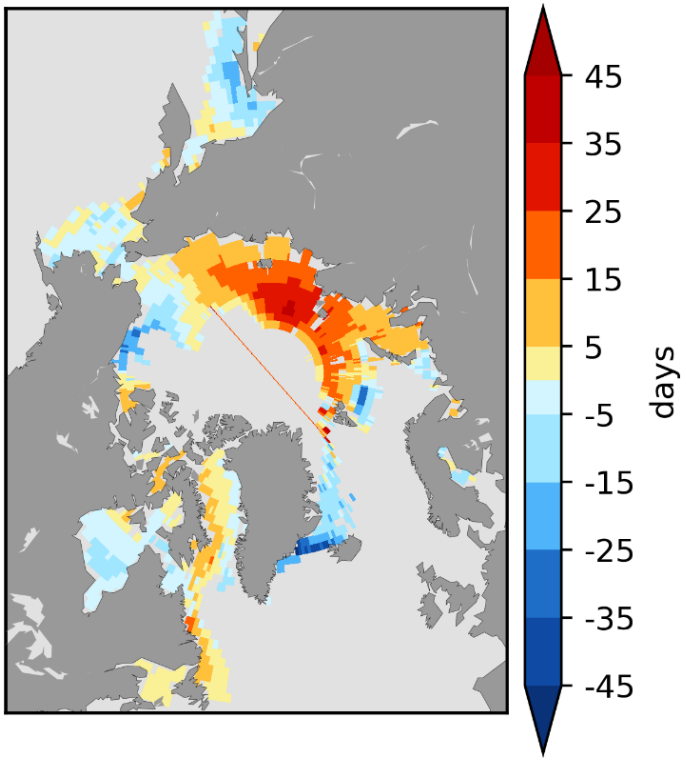
  low = low historical skill
  moderate = moderate historical skill
  high = high historical skill

Source: CanSIPSv2 (ECCC)

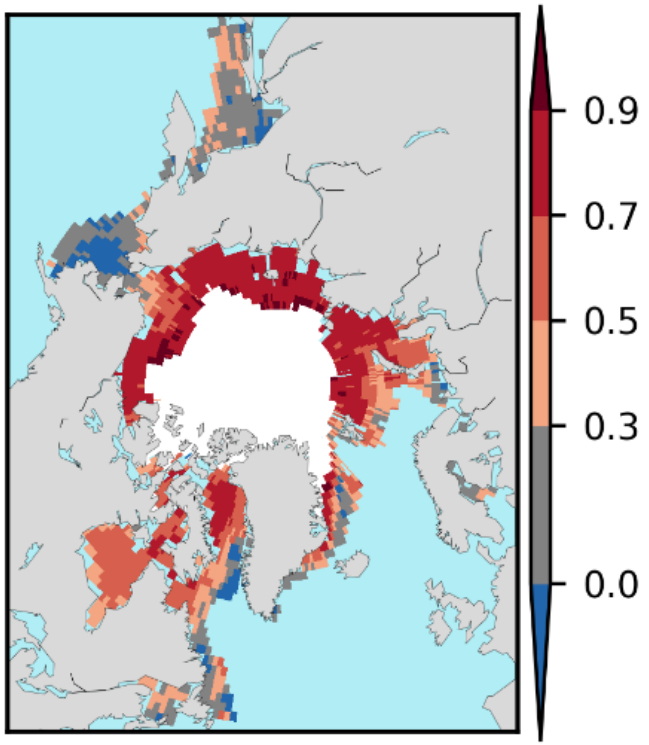
CanSIPS forecast, Oct 1, 2020 initialization

Freeze-up date (forecast anomaly and skill)

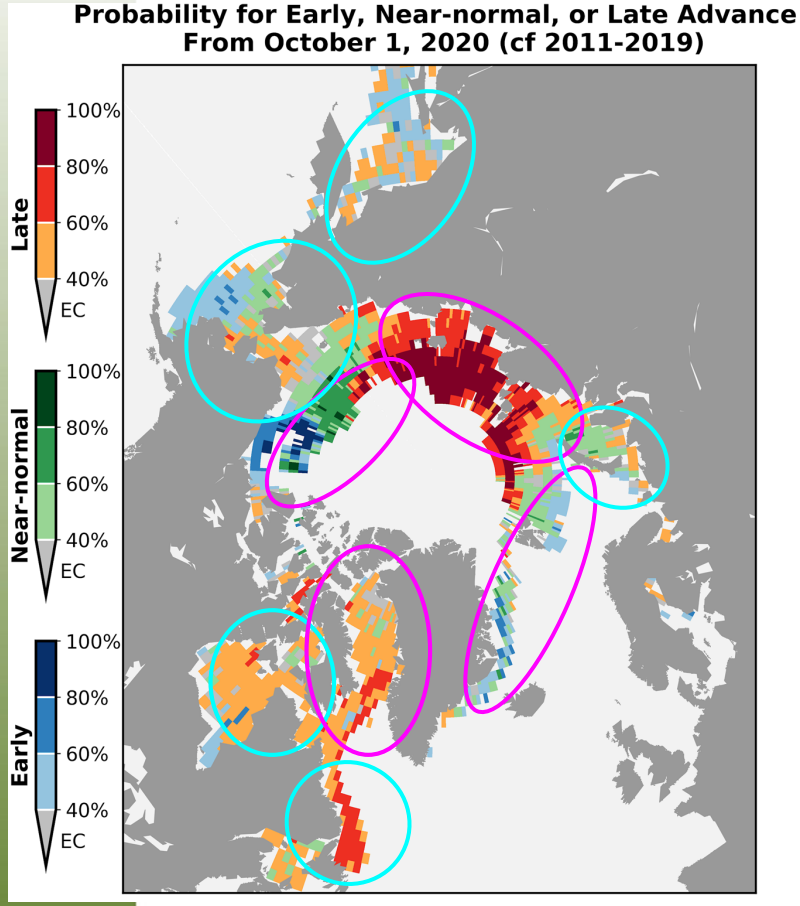
Forecast anomaly
(base: 2011-19)

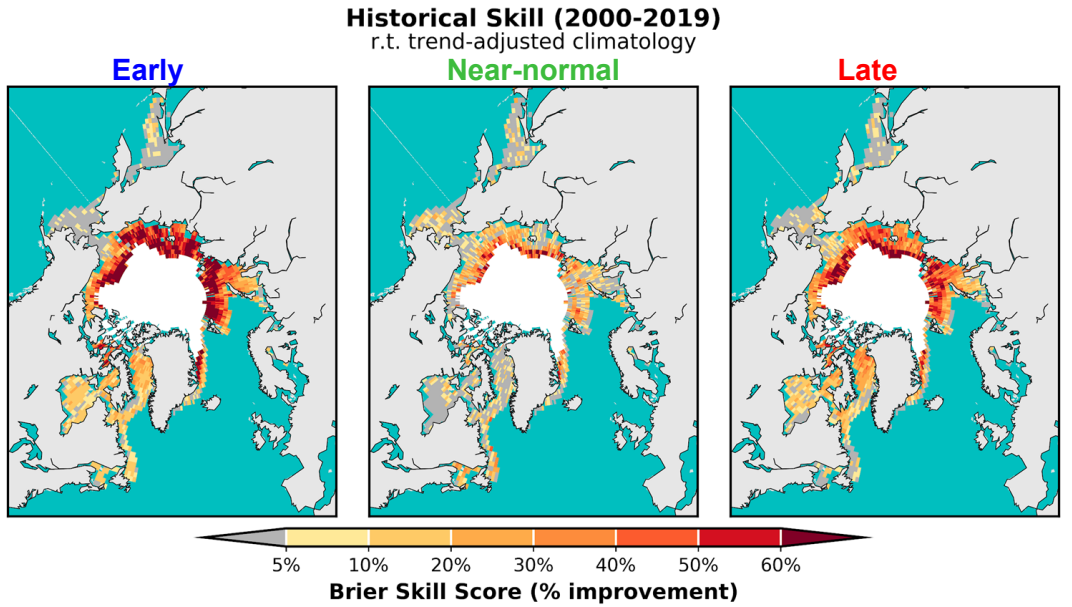


Historical skill
(detrended ACC for 1981-2019)



ECCC Probabilistic Freeze-Up Date Forecast Winter 2020 (Experimental)



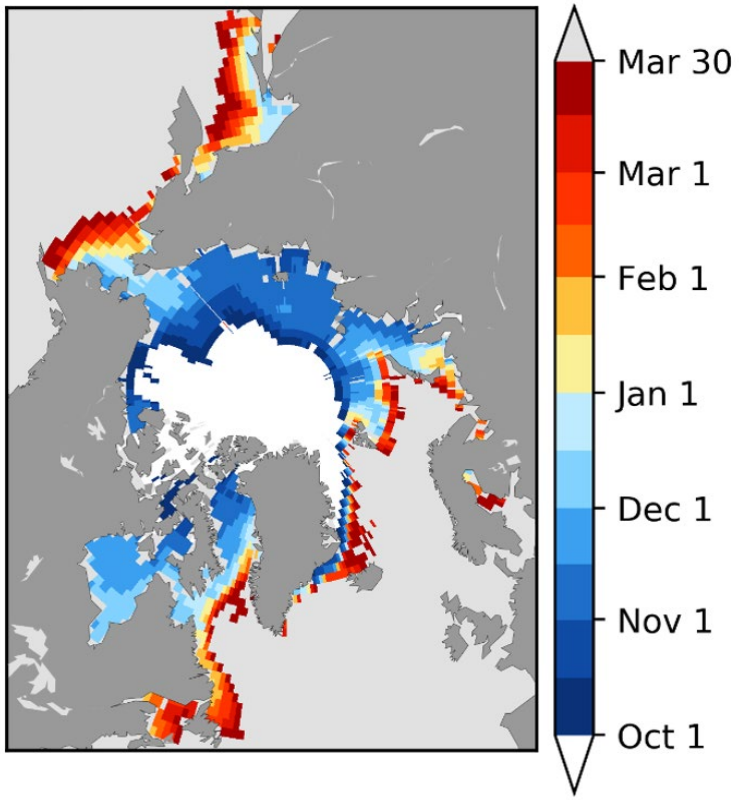


Poor/Neutral historical skill for forecast event

Positive historical skill for forecast event

ArcRCC Sea-Ice Freeze-up Outlook 2020

Deterministic Freeze-Up Forecast 2020-21



What is Normal freeze-up?

- The date when the ice concentration goes above 50%
- based on climatological period (2011-2019)

Source: CanSIPSv2 (ECCC)

Freeze-Up Categories:

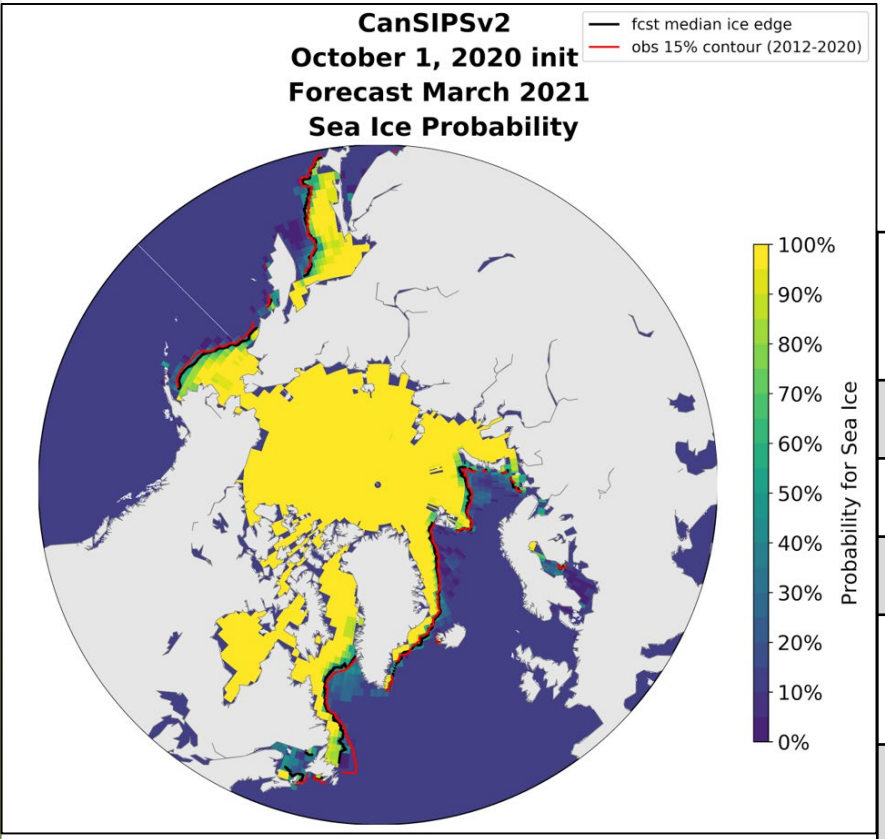
- Late freeze-up
- Near normal freeze-up
- Early freeze-up

Regions	CanSIPS Sea-Ice Forecast Freeze-up Confidence	CanSIPS Sea-Ice Freeze-up Forecast
Baffin Bay	Moderate	Late
Barents Sea	High	Near normal
Beaufort Sea	High	Near normal to early
Bering Sea	Low	Near normal to early
Chukchi Sea	Moderate	Near normal
East Siberian	High	late
Greenland Sea	High	Near normal to early
Hudson Bay	Moderate	Early to near normal
Kara Sea	High	late
Labrador Sea	Moderate	late
Laptev Sea	High	late
Sea of Okhotsk	Low	Near normal

ArcRCC Sea-Ice Extent Outlook Winter 2020/21

Maximum = March

Average ice extent based 2009-2017 conditions



Regions	CanSIPS Sea-Ice Forecast Extent Confidence	CanSIPS Sea-Ice Forecast Extent
Barents Sea	moderate	Near normal
Bering Sea	High	Near normal
Greenland Sea	Moderate	Near normal
Northern Baltic Sea	Moderate	Below normal
Gulf of St. Lawrence	Moderate	Below normal
Labrador Sea	Low	Below normal
Sea of Okhotsk	High	Near normal

Sources: CanSIPSv2 (ECCC), ECMWF LRF, UK MetOffice, NOAA CFS

Winter 2020/21 Sea Ice Conditions in Key Shipping Areas

Produced by the National Ice Services (forecaster experience and statistical methods)

Gulf of St. Lawrence: Below normal sea ice conditions are expected this winter based on current sea surface temperatures, forecasted surface air temperatures and numerical model guidance. Forecasted lighter ice conditions should mitigate any significant difficulties encountered in the Gulf and in individual ports. The expected winter air temperature regime may delay freeze-up significantly and reduced ice thickening may lead to rapid and early spring break-up.

The Baltic Sea: The ice season in the Baltic Sea regime is expected to become mild according to the seasonal sea ice forecast. Navigation will be affected by ice mainly in the Bay of Bothnia and in the eastern Gulf of Finland. A mild winter with its fluctuating weather typically causes ice deformation and brash ice barriers to form at the ice edge, both of which are difficult for shipping.

Svalbard and Barents Sea: The sea ice freeze-up time and March extent around Svalbard and in the northern part of the Barents Sea is expected to be close to normal for the upcoming winter season, based on the forecast model. However, since the model does not show if the ice extent is composed of older ice advected into the area or new ice grown in situ, the impact for users is difficult to ascertain.

Winter 2020/21 Sea Ice Conditions in Key Shipping Areas

Produced by the National Ice Services (forecaster experience and statistical methods)

Northern Sea Route: Present and forecasted higher sea surface and air temperatures will support later than average freeze-up in the NSR Seas by several weeks and subsequently very light sea-ice conditions till end of November. The expected winter air temperature regime will continue to support lower than normal for the last decade stages of ice development with predominance of medium first year ice in the Kara Sea and later appearance of thick first year ice in the Laptev and Eastern Siberian Seas. That should mitigate any significant difficulties to ice navigation in the area. Expected greater snow height may delay start of melting processes.

Sea of Okhotsk: Due to current lower ocean temperatures slightly earlier than average freeze-up is expected for most of sea area though it will be further compensated by the expected above normal air temperatures. Close to average for the last decade ice conditions are expected by the summit of ice season in March 2021.

Questions?