

Implementing an Arctic Regional Climate Centre

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**WORLD
METEOROLOGICAL
ORGANIZATION**

DRAFT

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1. Background

Indigenous peoples and others who live and work at high latitudes are increasingly challenged by variations in weather and climate. Recorded changes to sea-ice extent and thickness, permafrost, glaciers, hydrology and temperature change are all evidence of climate change in the Arctic in recent decades. Over the past century, temperatures in the Arctic have been assessed to have increased at almost twice the rate of the rest of the world. Arctic Indigenous ways of life and infrastructure are being seriously affected by these rapid changes, and there are distinct concerns on the extent to which human and natural systems can adapt to them. Some indigenous groups that live close to shorelines along rivers, lakes and the ocean and are dependent on the environment for food and are highly vulnerable to the climate-related risks associated with increased storms and extreme weather events that are a result of climate change.

Climate-sensitive socio-economic changes such as increased marine transportation, increasing tourism and resource development in the region (e.g., exploration for and extraction of minerals, oil and gas) bring both benefits and risks, but certainly add to the issues that need to be managed. There is a growing need for useful and targeted climate information as an adaptation tool to support effective decisions, and to help mitigate risks to people, governments, businesses and the environment.

2. Difference between Weather and Climate

Most people use the terms weather and climate interchangeably, but these terms do differ in meaning.

2.1. Weather

Weather information tells us about the conditions of the:

- Atmosphere - such as temperature, wind (strength and direction, wind chill), humidity, pressure, precipitation (rain, snow) over short periods of time; and
- Marine environment - such as storm surge, waves, and sea-ice conditions.

Weather information for cities, towns and regions is available hourly, while forecast weather conditions are available hourly, daily and up to 2-weeks in advance. This information helps people plan their activities and answers such questions as: *What is the temperature right now? Will I need a coat this afternoon? Will it snow this weekend?*

2.2. Climate

Climate information tells us what the average weather is for an area over a period of many years. It summarizes the historical weather data and tells us what is normal for an area in order to answer such questions as: *What is an average winter like in Tromsø, Norway? What was the warmest summer on record in Anchorage, Alaska?*

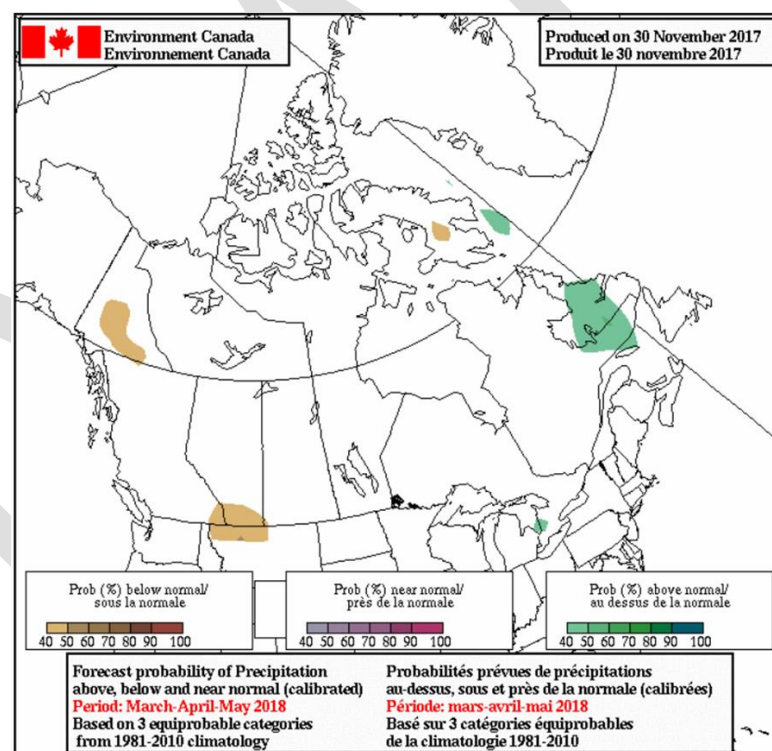
The ability to forecast climate conditions started in the 1990's when emerging global climate models began predicting climate change and its potential impacts. With advances in scientific research and

computer modelling, climate forecasts once only available at global scales are now becoming available to fill gaps at regional scales, see Table 1.

Time Scale	Days	Weeks	Months	Seasons	Years	Decades	Centuries
Weather or Climate Information	Weather forecasting		Emerging climate forecasts (outlooks)			Climate Change Models	
Geographic Scale	Local		Regional			Global	

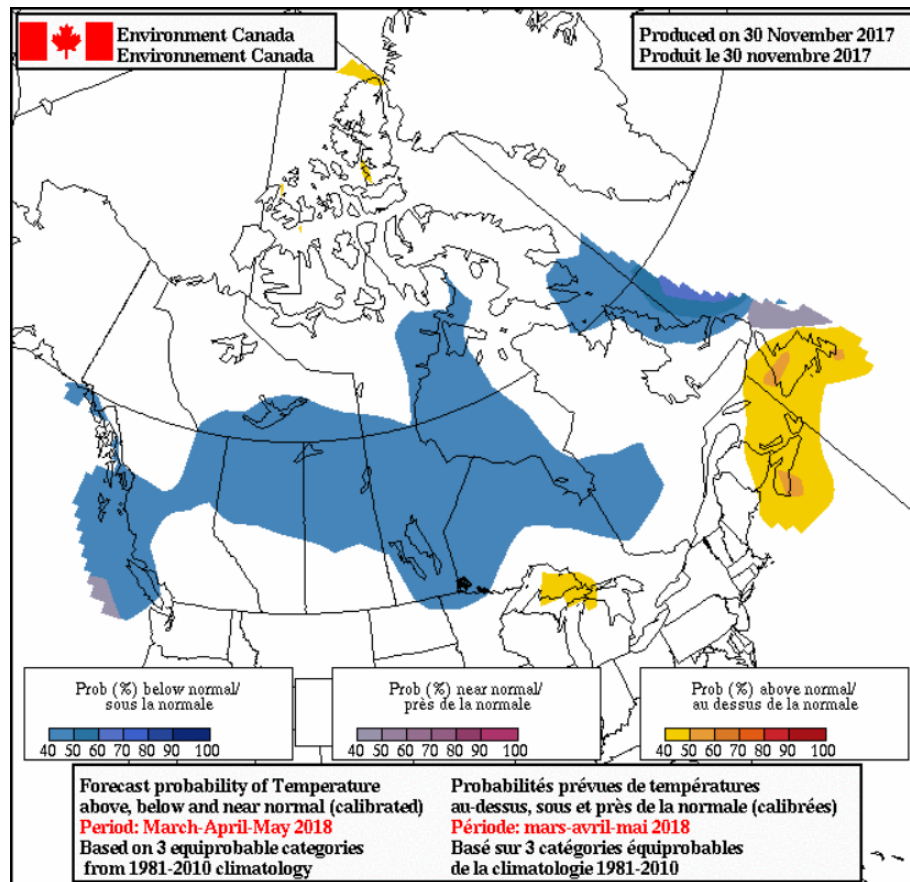
Table 1: Geographic and Time Scales for Weather and Climate Information

Current climate forecasts at regional scales (called **Outlooks**) provide monthly and seasonal (a summary for three months such as March, April May) predictions of temperature and precipitation. The outlook maps show areas being above, normal or below compared to historical conditions. See Figures 1 and 2 for examples of Canadian climate outlook products.



**Figure 1: Example of Canadian National Climate Products:
Seasonal Precipitation Forecast, spring 2018.**

Source https://weather.gc.ca/saisons/index_e.html



**Figure 2: Example of Canadian National Climate Products:
Seasonal Temperature Forecast, spring 2018**

These advances in climate models at regional scales means that decision-makers are starting to gain access to information to assist them in planning and preparing in the months and seasons ahead. Examples could include planning for: flooding if climate outlook shows above normal levels of precipitation in the spring; or forest fires if climate outlooks show above normal temperatures during the summer.

3. Users of Climate Information

With globalization, economic sectors are now demanding climate information for all corners of the planet, and other decision-makers are in greater need of this information in understanding the impacts and adaptation needs from climate change. Examples of climate-users are listed below; however as climate information continues to advance and become available, we expect the variety and number of users to expand.

- All levels of Indigenous and government organizations
- Industry
- General Public
- Climate Scientists
- National meteorological services. These organizations are users who analyze climate information in order to produce climate products

4. Regional Climate Centres

Currently meteorological services are provided within national jurisdictions; however the earth's climate is linked globally and goes beyond national borders. Gaps also exist in the geographical coverage of climate information between countries and there are differences in the capabilities and services amongst countries. As a result, the World Meteorological Organization (WMO) has started to implement Regional Climate Centres (RCCs) around the world, see Figure 3.

RCCs take a regionalized approach that link national meteorological services as climate centres of excellence to: fill geographical and user gaps; aggregate skills and investments in research and development; and provide a mechanism to share, coordinate, enhance and in some cases, harmonize products and services into a single data portal.

NATIONAL		REGIONAL		CIRCUMPOLAR
Countries	Meteorological Organizations	Regional Climate Centres (RCCs)		Arctic Polar Regional Climate Centre (ArcPRCC)
United States	NOAA	North American Node	Forecasting	
Canada	ECCC			
Denmark	DMI	Northern European / Greenland Node	Data Services	
Iceland	IMO			
Norway	NMI			
Sweden	SMHI			
Finland	FMI			
Russia	AARI	Northern Eurasia Node	Monitoring	

Table 2: ArcPRCC: Collaboration/Networking across regional nodes and Meteorological Organizations

5.1. Potential ArcPRCC products and services

Members of the ArcPRCC-Network would collaborate to develop the following temperature, precipitation and sea-ice products for the circumpolar Arctic:

- Descriptions of the previous month/season conditions
- Monthly and seasonal (Winter/Summer) outlooks/forecasts
- Bulletins updating the monthly and seasonal (Winter/Summer) outlooks/forecasts

These products would be developed and accessible through a single ArcPRCC portal for the following example regions in Figure 4. Please see Appendix A for example ArcPRCC products for from the North American Node for the Alaskan and Northwestern Canada region.

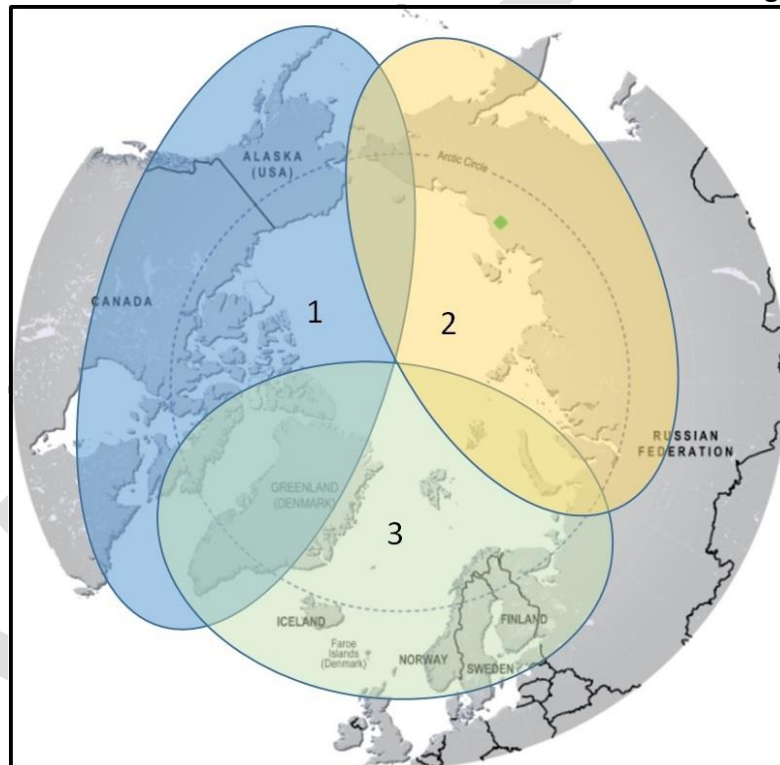


Figure 4: Potential Regional Climate Centre geographic areas of coverage for the Arctic
1=North American node, 2= Northern Eurasian node and 3= Northern European node

Climate products from the ArcPRCC would benefit the producers of Arctic climate information by enhancing Arctic collaboration on: climate forecast modelling and monitoring; and climate products, services and delivery. For users of this climate information, the ArcPRCC would provide:

- complete coverage for the circumpolar Arctic to link Arctic nations;
- fill geographical gaps in coverage;
- a one window approach through its data portal; and
- contribute to better understanding regional variability and climate processes in adapting to climate change in the Arctic.

6. Pan-Arctic Regional Climate Outlook User Forums (PARCOF)

PARCOF is based on the Regional Climate Outlook Forum (RCOF) concept (https://library.wmo.int/opac/doc_num.php?explnum_id=3191) developed and supported by WMO in many regions around the world over the past two decades, as a key activity of WMO Regional Climate Centres (RCCs). Bi-annual forums are being planned to meet with users twice per year: a face-to-face meeting in May prior to the Arctic summer season, and a virtual meeting in October prior to the Arctic winter season. The face to face forums are expected to be 2-days in length dedicated to meeting and working with Arctic climate users to:

- Share the current state of climate products available for the Arctic
- Better understand their needs
- Co-produce the output products (i.e. regions, graphics, plain language text)
- Develop a model for engaging with users in future outlook forums

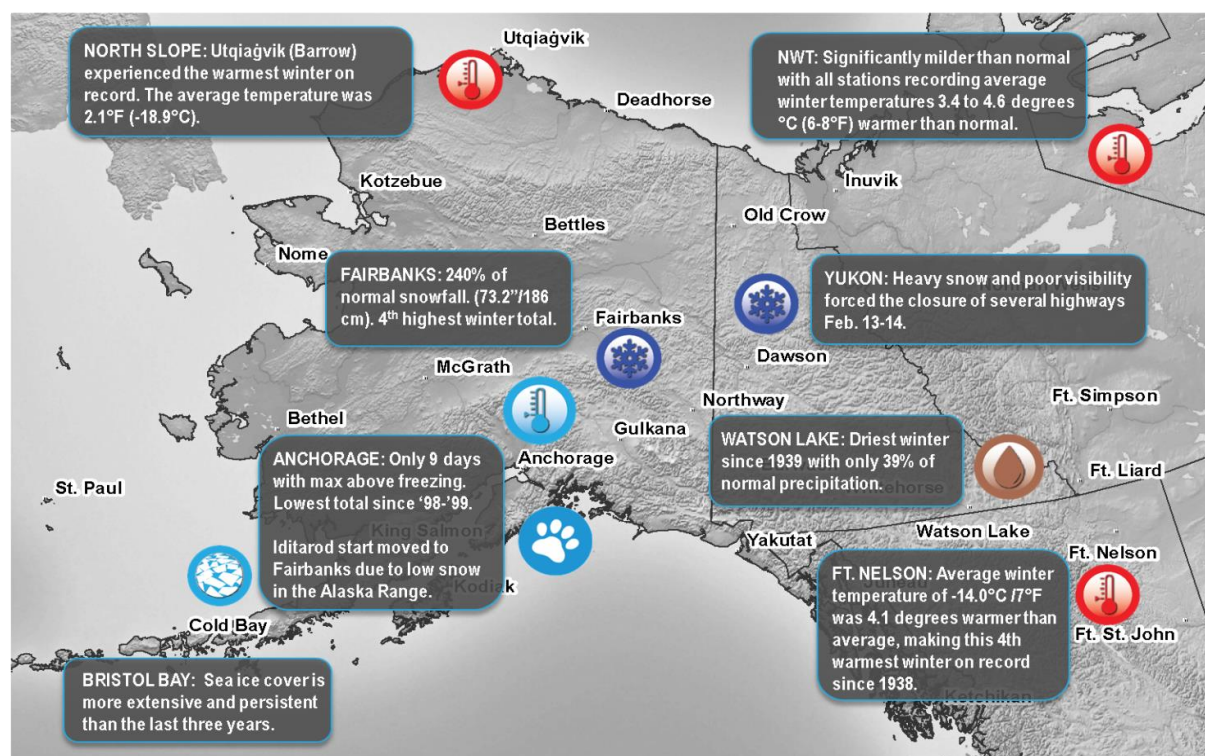
The North American Node is hosting the PARCOF in Canada in May of 2018. Participation in the face-to-face forum is by invitation only to manage the number of participants to approximately 50 people. The May 2018 forum will focus on meeting with Arctic Commercial Shipping users (tourism, re-supply, resource extraction and fishing). Permanent participants of the Arctic Council will be invited to all the user forums.

For future forums, network members of ArcPRCC will meet with other Arctic climate users such as (but not limited to):

- Arctic Defence, Marine Safety, Regulators, Pollution/Oil Spills
- Arctic Health and Populations
- Arctic Ecosystems and Wildlife
- Natural Resource Development
- Infrastructure: Terrestrial, Marine, Telecommunications
- Arctic Policy/Science

Appendix A: Example North American Node products for Alaska and Northwestern Canada

Climate Highlights



**Figure 5: Climate Highlights of significant climate and weather events
December 2016 to February 2017**

Long description

- North SLOPE: Utqiagvik (Barrow) experienced the warmest winter on record. The average temperature was 2.1°F (-18.9°C).
- Fairbanks: 240% of normal snowfall. (73.2"/186 cm). 4th highest winter total.
- Anchorage: Only 9 days with max above freezing. Lowest total since '98-'99. Iditarod start moved to Fairbanks due to low snow in the Alaska Range.
- Bristol Bay: Sea ice cover is more extensive and persistent than the last three years.
- NWT: Significantly milder than normal with all stations recording average winter temperatures 3.4 to 4.6 degrees °C (6-8°F) warmer than normal.
- Yukon: Heavy snow and poor visibility forced the closure of several highways Feb. 13-14.
- Watson Lake: Driest winter since 1939 with only 39% of normal precipitation.
- Ft. Nelson: Average winter temperature of -14.0°C / 7°F was 4.1 degrees warmer than average, making this 4th warmest winter on record since 1938.

Climate Temperature SUMMARY

Alaska's North Slope, northeastern British Columbia and the whole Mackenzie Delta experienced significantly higher than normal temperatures this winter. These milder than normal conditions are because of a persistent southerly circulation of air along the eastern side of the Rockies throughout most of the winter. Temperatures over the majority of Alaska and the Yukon were close to normal except for the area between King Salmon and Gulkana, AK, which experienced colder than normal conditions.

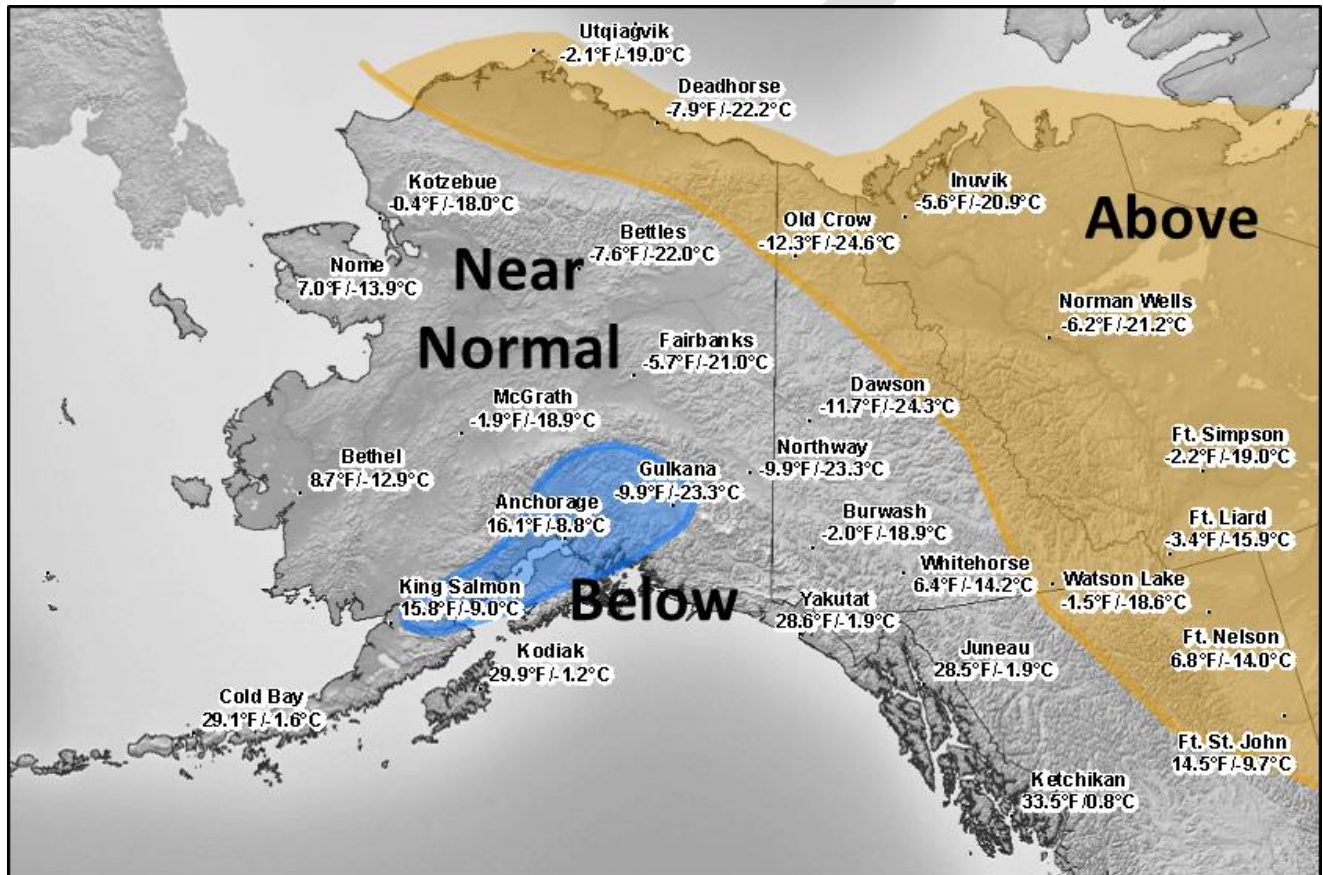


Figure 6: Mean temperature for Alaska and NW Canada
December 2016 to January 2017

Climate Precipitation SUMMARY

Several areas saw above normal precipitation during winter 2016-17 including the northern half of Alaska, the majority of the Yukon and the northern region of the Northwest Territories. Areas further south including south-central Alaska experienced a drier than normal winter. The Aleutian Islands and much of northern Alaska and the Yukon along with north eastern NWT were wetter than normal. The south Alaska coast and Southwestern NWT were drier than normal with other regions being near normal.

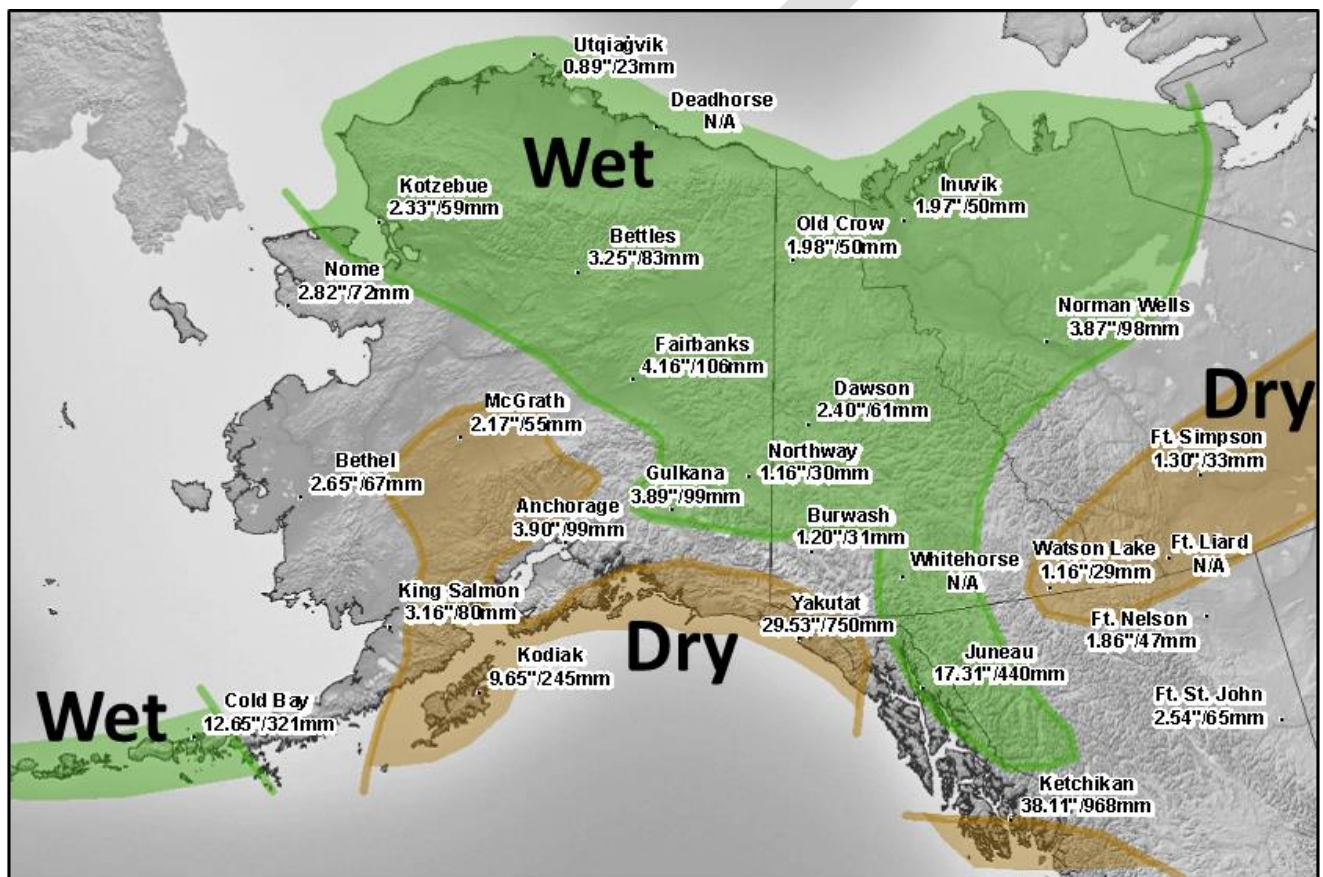


Figure 7: Total Precipitation for Alaska and NW Canada
December 2016 to February 2017

Climate Old Ice (Multi-Year) SUMMARY

Ice conditions in the Beaufort Sea reached full wintertime coverage by the end of November 2016 and ice coverage has maintained a consistent value from December to February. The coverage of old (multi-year) ice compared to normal (depicted to the left), has been significantly below normal. This is due to very low old ice coverage in the Beaufort Sea in the fall of 2016.

December and January brought exceptionally low sea ice coverage to the northern Bering Sea. The first week of January saw open water at Little Diomed, which extended into the southernmost Chukchi Sea. This was the result of unfavorable weather for sea ice formation during the early winter as well as unusually warm ocean temperatures left over from summer 2016. There was such a lack of ice that on January 9th at Savooga, AK, the Siberian Yupik hunters of St. Lawrence Island landed a bowhead whale. For the first time in living memory, hunters were out in boats in January in completely ice-free waters hunting whales. During February, more favorable weather allowed sea ice to form around St Lawrence Island and push south. By the end of the month, ice had not yet reached St. Paul Island.

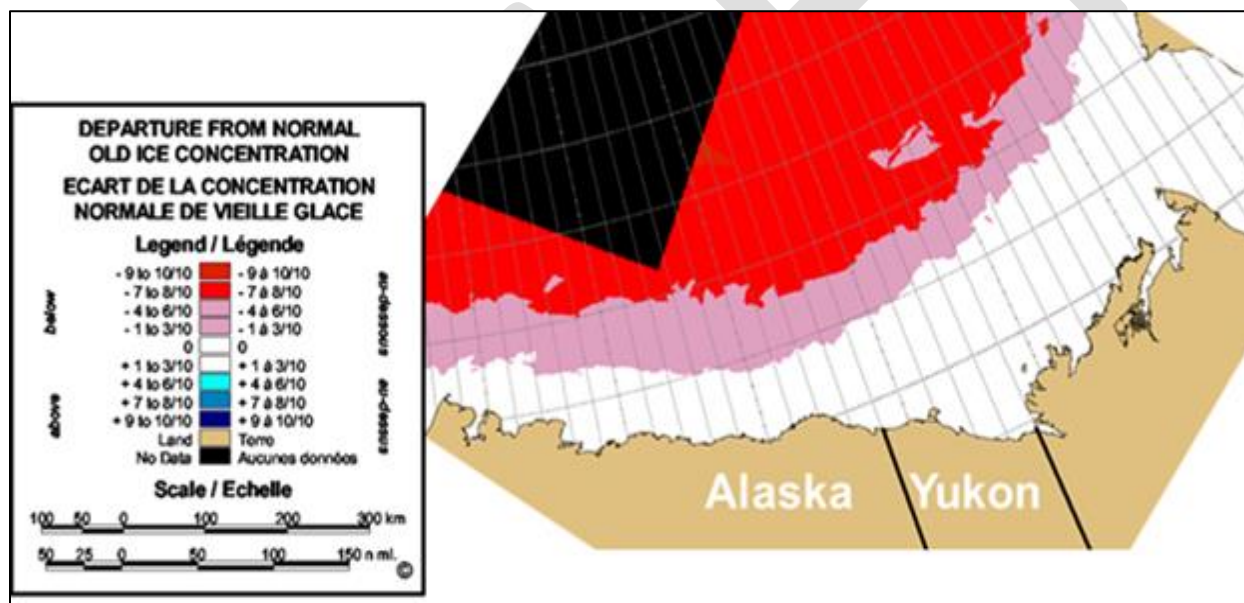
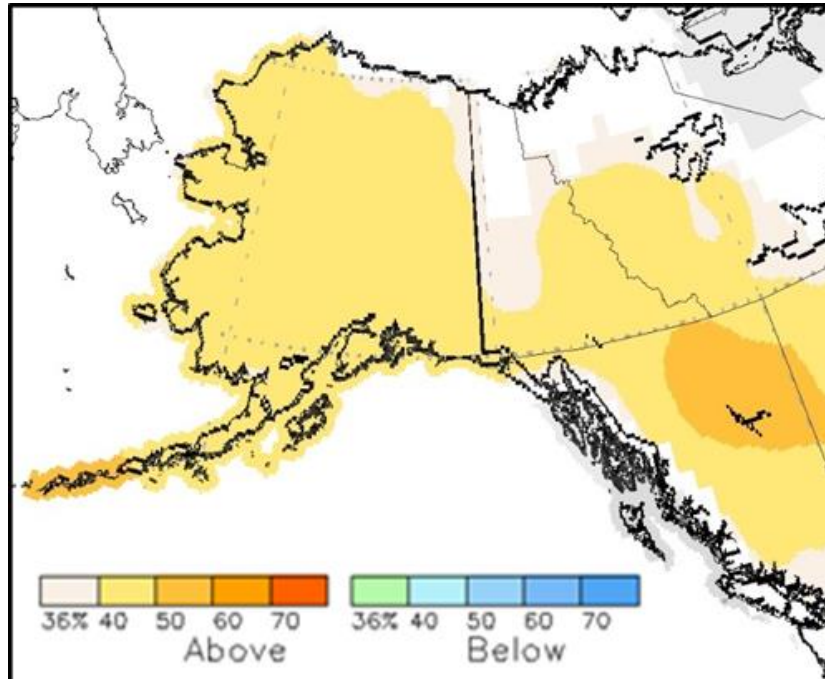


Figure 8: Departures from normal of old sea-ice over the Beaufort Sea. North of 72°N the departure from normal old ice concentration is below nine to ten tenths of ice.

Source: Canadian Ice Services, Environment and Climate Change Canada

Climate Temperature OUTLOOK

All of Alaska is predicted to have 40-50% probability of being above average temperature for April to June 2017. The southeast Yukon and southwestern NWT are also 40-50% probability of being above normal. All of the northern half of BC is above zero as well with a region along the Rocky Mountains in northern BC has a 50-60% probability of being above average temperature.



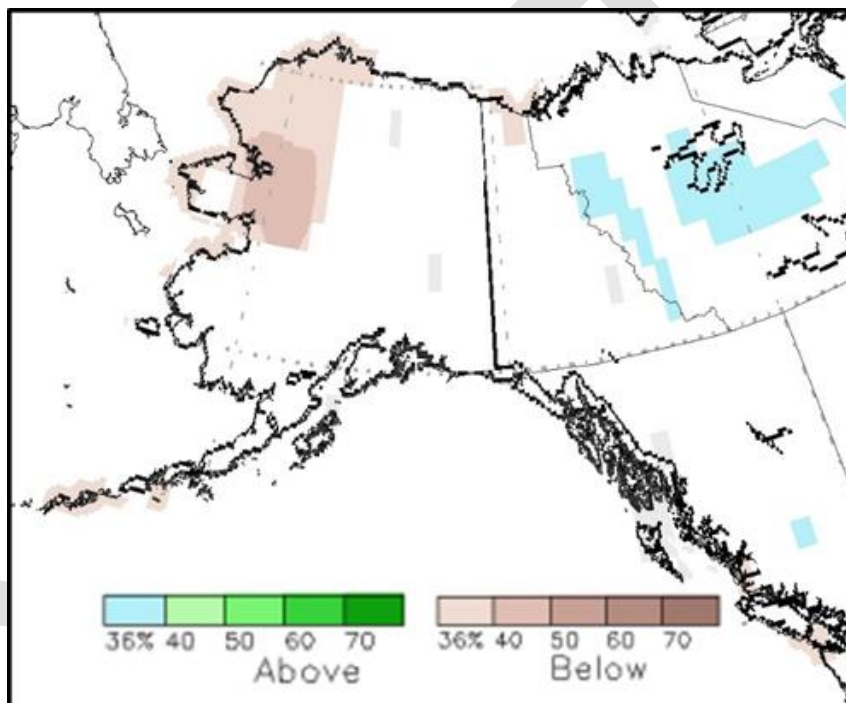
**Figure 9: Climate temperature Outlook for Alaska and NW Canada
April 2017 to June 2017, forecast issued March 7, 2017.**

Source: The North American Multi-Model Ensemble (NMME)

Climate Precipitation OUTLOOK

The March through May time period is the driest three-month period of the year. The forecast is for near normal precipitation across most of the region. The exceptions are: a drier season in northwest Alaska *having a 36-50% chance of below normal precipitation over the period*; and a slightly wetter in the Northwest Territories *near Great Bear Lake southward to the tip of Great Slave Lake with a 36% probability of having above normal precipitation for the period*.

The April-June forecast reflects the recent demise of La Nina. Deterministic models are hinting at a return of El Nino. This may cause significant changes to the seasonal forecast.



**Figure 10: Climate Precipitation Outlook for Alaska and NW Canada
April 2017 to June 2017, forecast issued March 7, 2017.
Source: The North American Multi-Model Ensemble (NMME)**

Climate Sea-Ice OUTLOOK

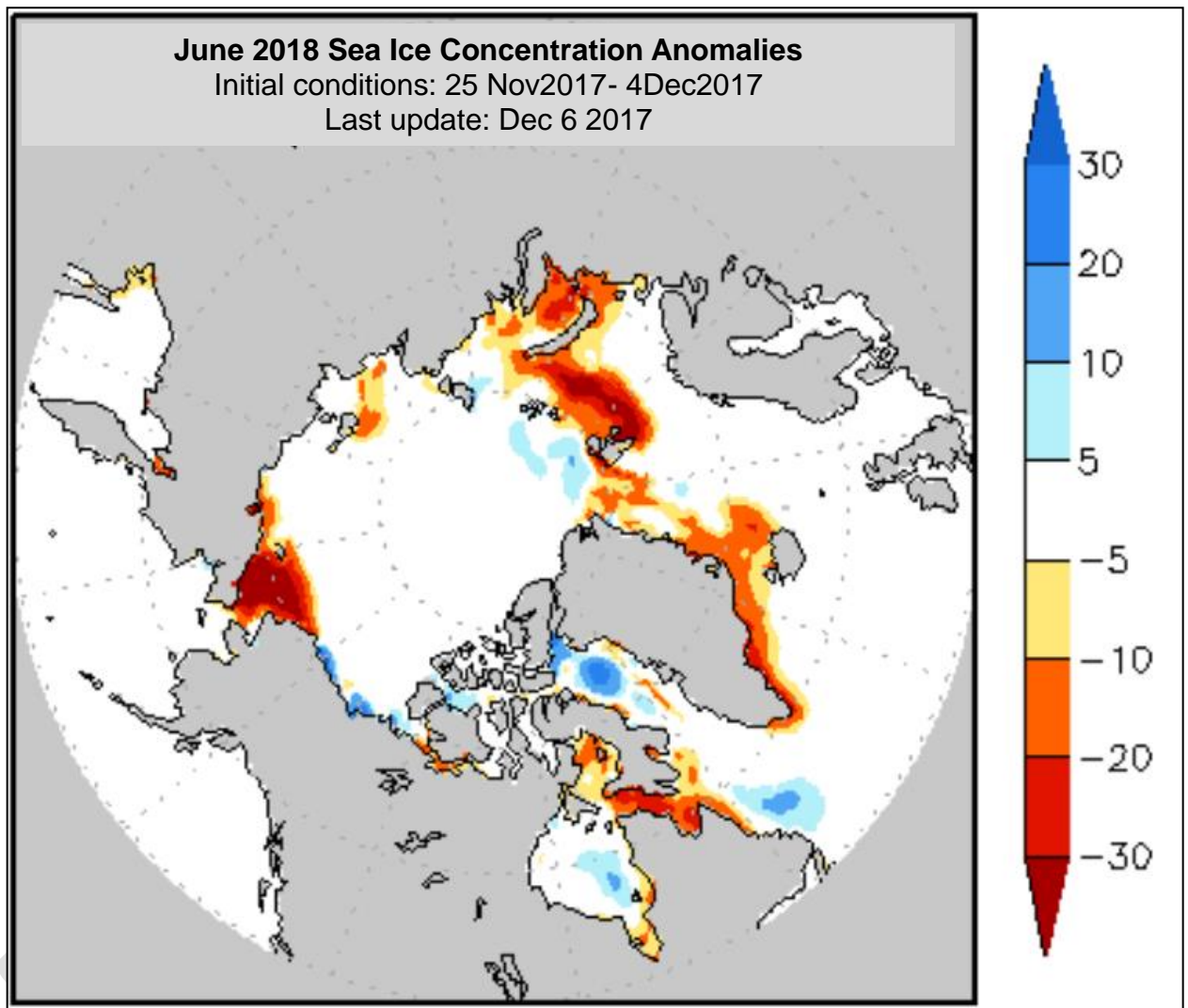


Figure 11: June 2018 Climate Sea-Ice Concentration OUTLOOK for the Circumpolar Arctic
Forecast issued Dec 6, 2017 based on Initial conditions from November 25 to December 4 2017
Source: NOAA NWS/NCSP/CPC/CFSv2