ACF
Arctic Climate Forum

Climate monitoring and seasonal summaries: what are the products and how support forecasting and consensus statement are developed (good practice of ArcRCC-Network)

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INAUGURAL SESSION OF THE THIRD POLE CLIMATE FORUM
4 – 6 June 2024, Lijiang, Yunnan Province, China

BCC
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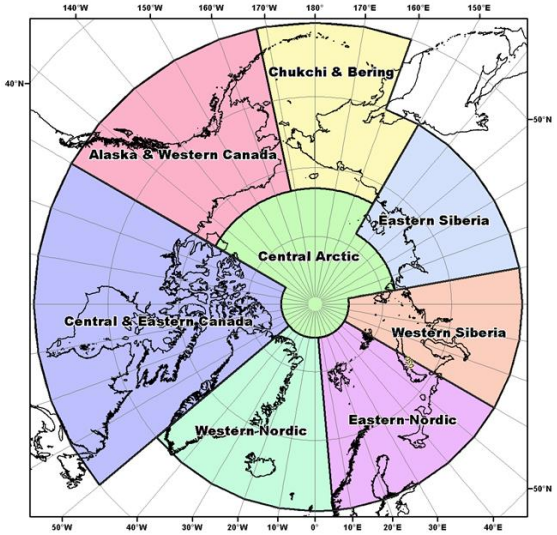
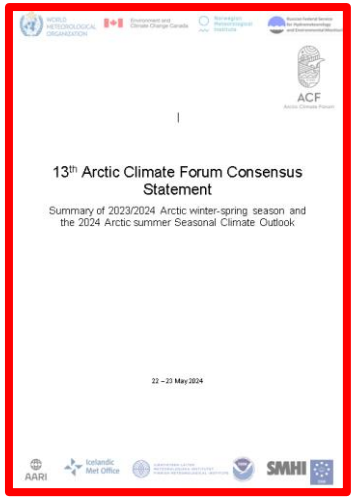
ArcRCC-N major products

Products

1. **ArcRCC Regional Climate Overview Briefings**
   Temperature, precipitation and sea-ice conditions and extremes for North America, Europe, Northern Eurasia, and Central Arctic Review of past season (e.g. NDJFMA 2023/2024) and outlook for the next season including the risks (e.g. JJAS 2024)
2. **ArcRCC Seasonal Summary**
   Review of atmosphere ECVs (MSLP, temperature, precipitation), hydrology (river discharge, SWE), sea-ice (SIE, SIC, SIT, ice volume), polar ocean (heat content, pH) for the past season (e.g. ONDJFMA 2023/2024)
3. **Climate Conditions and Socio-Ecological Impacts at the (Sub)Seasonal Timescale**
   Summary of bioclimatic indexes (currently Bodman's, ET) in the Arctic for the past season (e.g. NDJFMA 2023/2024) and verification of the previous forecast and forecast for the next season (e.g. JJA 2024)
4. **Outlook for atmosphere parameters**
   Validation of the forecast for the previous season (e.g. FMA 2024) and outlook of temperature, precipitation, and Snow/Water Equivalent (experimental) for the next season (e.g. JJA 2024) and model confidence
5. **Outlook for the regional specific parameters**
   Validation of the forecast for the previous season (e.g. NDJFMA 2023/2024) and outlook of SIE, SIC, phenomena dates (sea ice freeze-up/break-up) for the next season (e.g. JJAS 2024) and model confidence



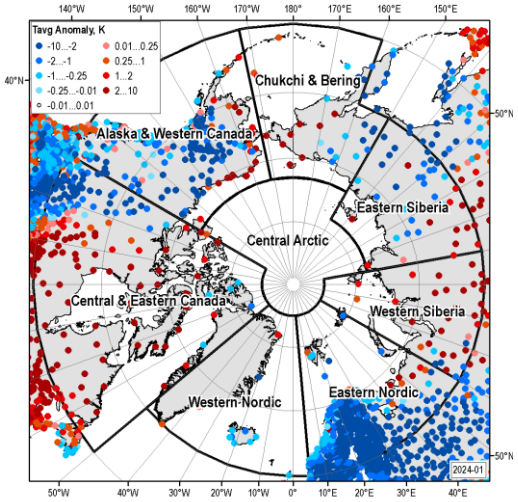
6. ACF Consensus Statement

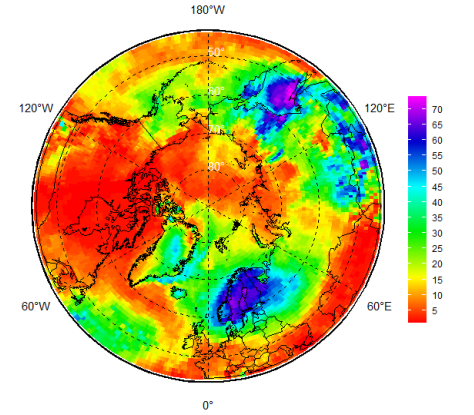


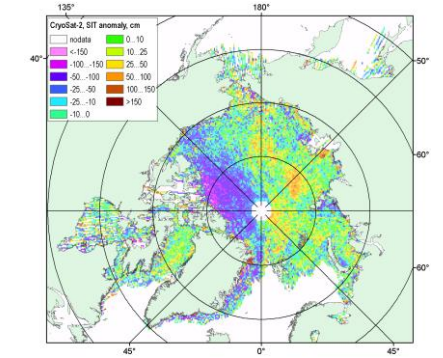
ArcRCC-N major data sources

Data sources

1. **Regional Climate Overview Briefings** are based on a synthesis of regional NMHS observations, bulletins and relevant data sources (2) – (5)
2. **Seasonal summaries** are based on a synthesis of observations at polar stations, marine platforms, sea-ice analysis, satellite estimates, WMO GCW and modern reanalysis (CCCS ERA5, CMEMS, GloFAS-ERA5) and NCEP-NCAR reanalysis with anomalies given to the new 3rd WMO reference period 1991-2020
3. **Bioclimatic indexes** are based for validation on ERA5 reanalysis and for the forecasts on INM RAS/Hydrometcenter of Russia INM-CM5 climate model
4. **The seasonal outlooks (forecasts)** for temperature and precipitation are based on thirteen WMO Global Producing Centers of Long-Range Forecasts (GPCs-LRF) models consolidated by the WMO Lead Centre for Long Range Forecast Multi-Model Ensemble (LC-LRFMME) - the MME approach is a methodology well-recognized by the WMO to be providing the most reliable objective forecasts
5. **Sea-ice and snow water equivalent outlooks** are based primarily on the Canadian Seasonal to Inter-annual Prediction System (CanSIPSv2.1) with additional use of sea-ice forecasts from the NOAA Coupled Unified Forecast System and INM RAS/Hydrometcenter of Russia INM-CM5 climate model

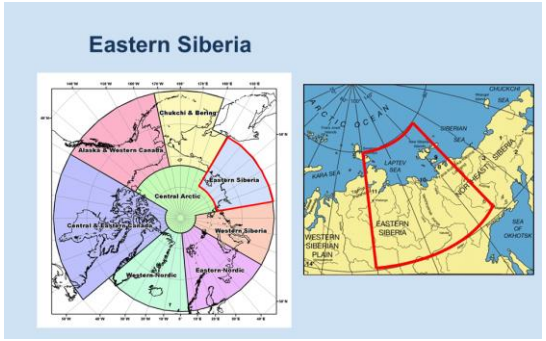


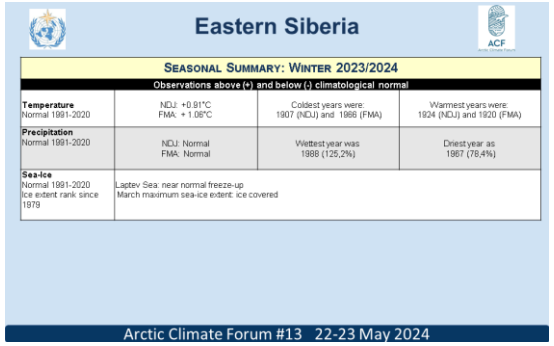


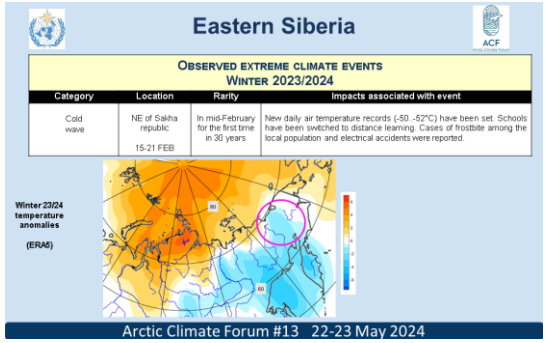


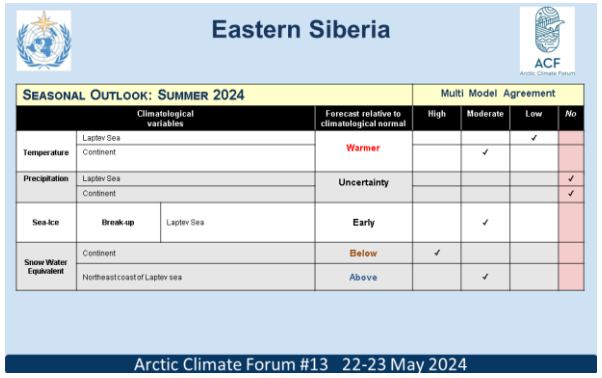
(1) ArcRCC Regional Climate Overview Briefings

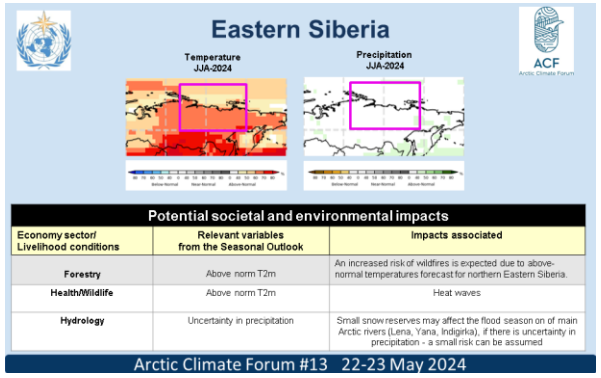
- Produced by the ArcRCC-N 8 regions by the NMHS within the relevant domain
- Developed using an established template: (1) map of the region, (2) seasonal summary, (3) observed extreme events, (4) seasonal outlook, and (5) potential social and environmental impacts - all sections withlevel of details chosen by the NMHS

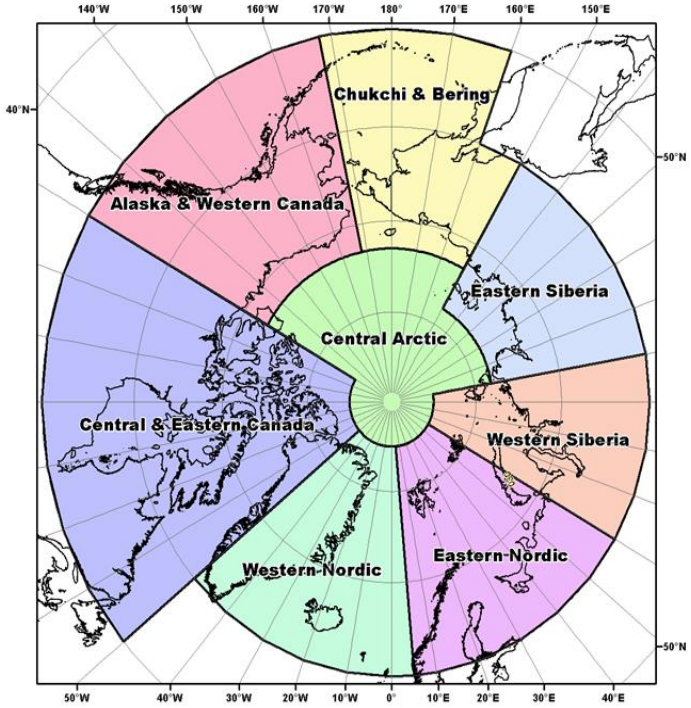






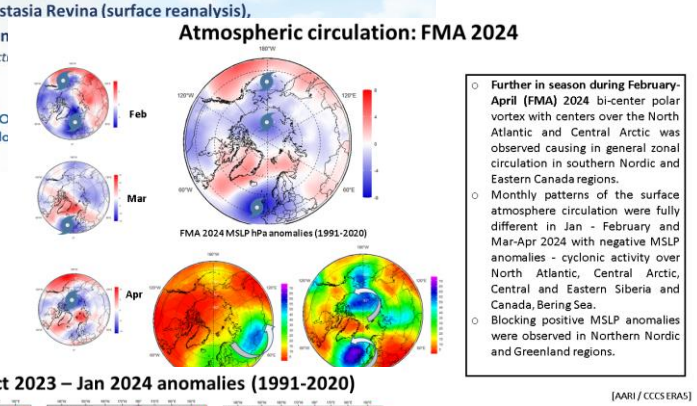


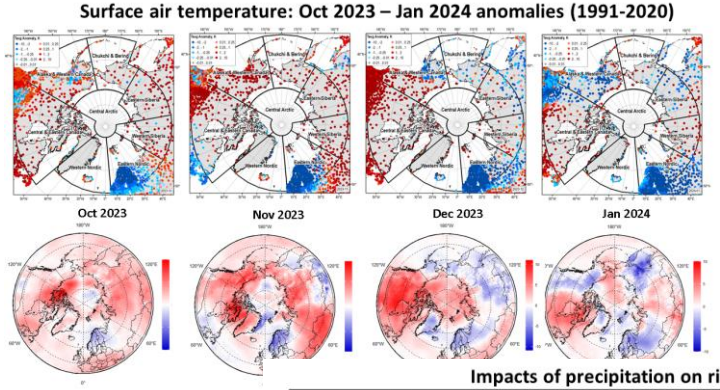


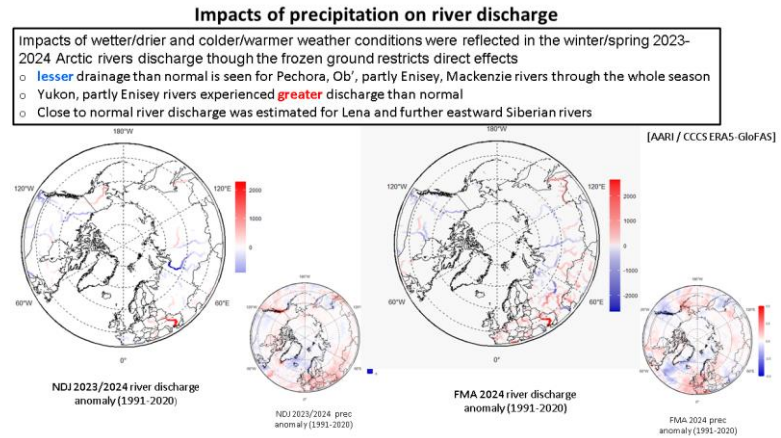


(2) ArcRCC seasonal summaries

- **Produced** by the ArcRCC-N North Eurasia node (AARI)
- **Atmosphere:**
  - Precursors in atmospheric circulation
  - Surface air temperature and precipitation– statistics by ArcRCC-N regions
- **Sea ice:**
  - Precursors in atmosphere and polar ocean
  - Sea ice extent, conditions, including March'23 maximum
  - Sea ice thickness, and volume
- **Polar Ocean:**
  - Heat content
  - pH (acidification/alkalization)
- **Land hydrology:**
  - river discharge
  - snow extent
- Majority of the described parameters are the **WMO Essential Climate Variables (ECV)**. Information is based on reanalysis and surface observations and is provided:
  - for anomalies relative to the latest **3rd WMO period 1991-2020**
  - for ranks to period of observation or reanalysis **1950-2023/2024** or **1979…2024**)

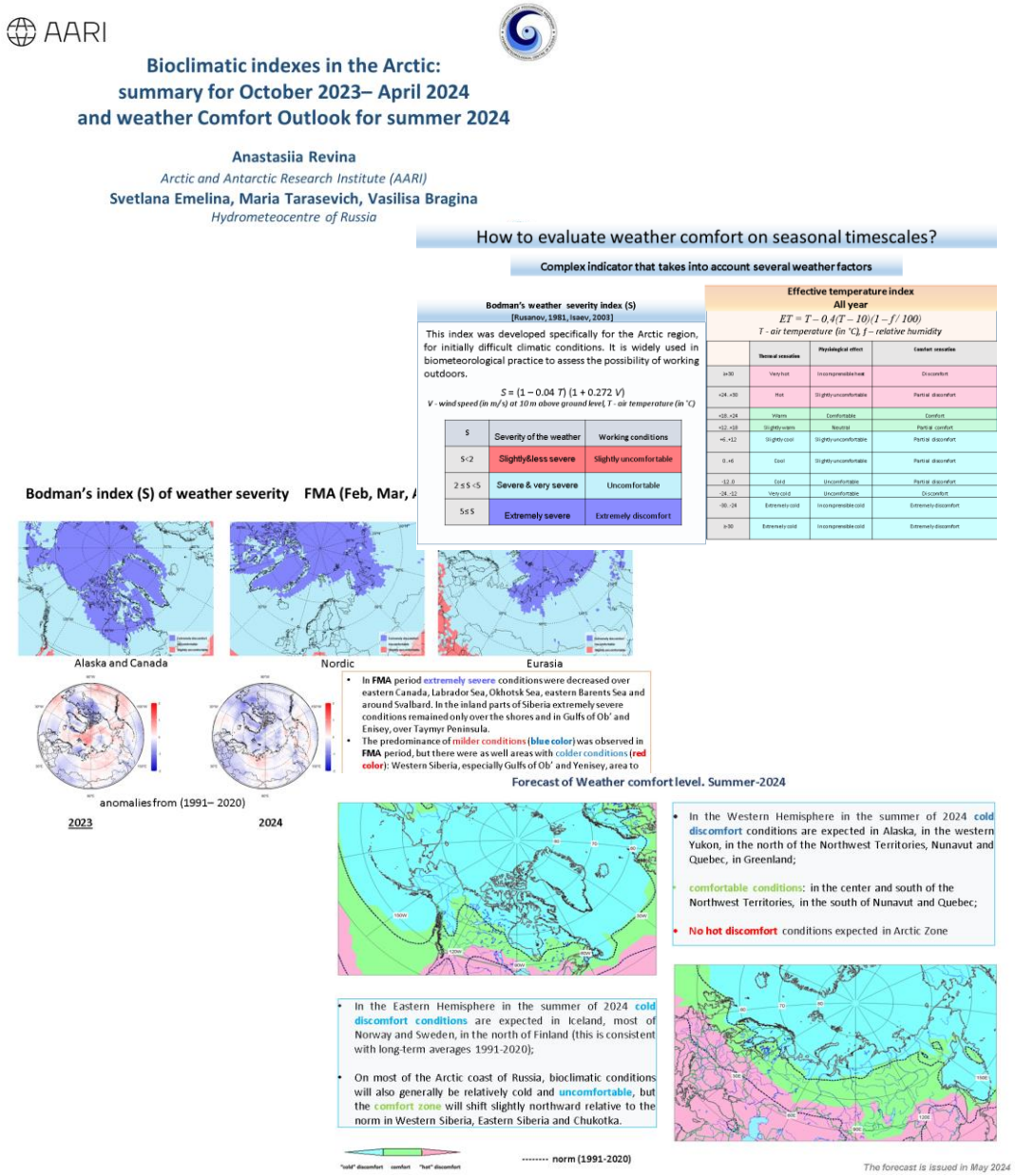






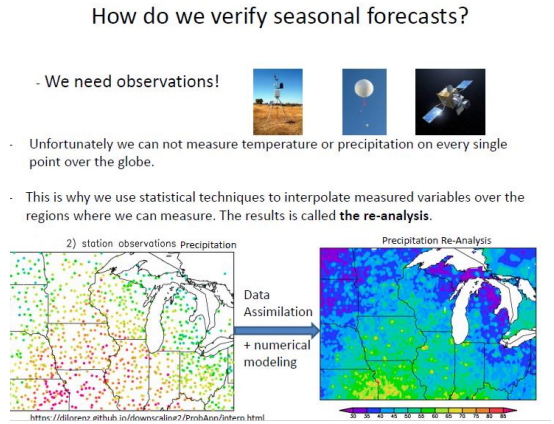
(3) ArcRCC seasonal Climate Conditions and Socio-Ecological Impacts at the (Sub)Seasonal Timescale

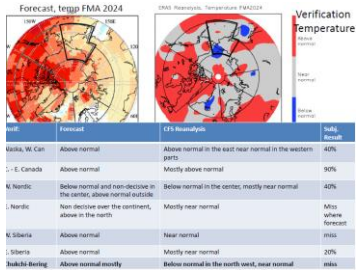
- **Based** on bioclimatic indexes - currently Bodman's weather severity and effective temperature in the Arctic for the past season, verification of the previous forecast and forecast for the next season
- **Produced** by the ArcRCC-N North Eurasia node – AARI jointly with Hydrometcenter Russia
- Product has a **growing interest** during the last forums
- At the moment interpretation is tuned for the areas with **continental climate**, in the future impacts will be developed for other types of climate as well as other indexes will be proposed

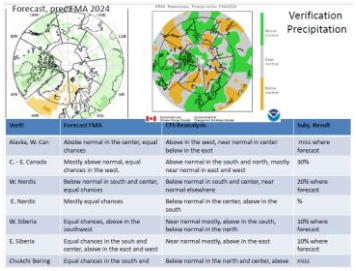


(4) ArcRCC Outlook for atmosphere parameters

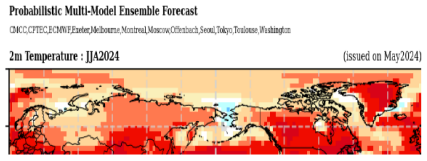
- Includes **scientific background** of the forecast, explanation of **verification technique**, **validation** of the forecast for the previous season (e.g. FMA 2024) and **outlook** of temperature, precipitation, and Snow/Water Equivalent (experimental) for the next season (e.g. JJA 2024) and model confidence
- Along with CanSIPSv2.1, the WMO LC-LRF-MME products are extensively used







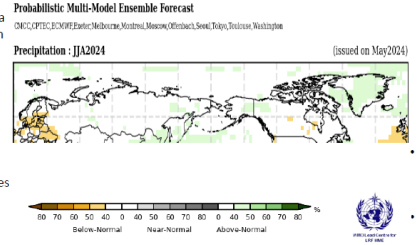
Temperature outlook over the Arctic:
Jun-Jul-Aug 2024



1. Alaska W. Canada
2. Eastern Canadian Arctic
3. Western Nordic
4. Eastern Nordic
5. West Siberia
6. East Siberia
7. Chukchi and Bering

- The redder the color does not mean it is warmer.
- It means we have more confidence in the above normal forecast over that region.

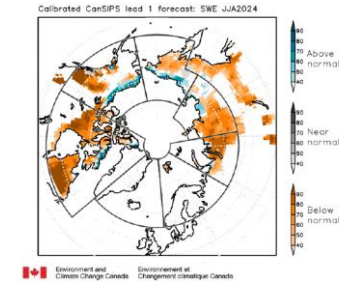
Precipitation outlook over the Arctic:
Jun-Jul-Aug 2024



1. Alaska W. Canada
2. Eastern Canadian Arctic
3. Western Nordic
4. Eastern Nordic
5. West Siberia
6. East Siberia
7. Chukchi and Bering

- The greener the color does not mean it will precipitate more.
- It means we have more confidence in the above normal precipitation forecast over that region.

Snow Water Equivalent outlook over the Arctic:
Jun-Jul-Aug 2024



1. Alaska W. Canada
2. Eastern Canadian Arctic
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4. Eastern Nordic
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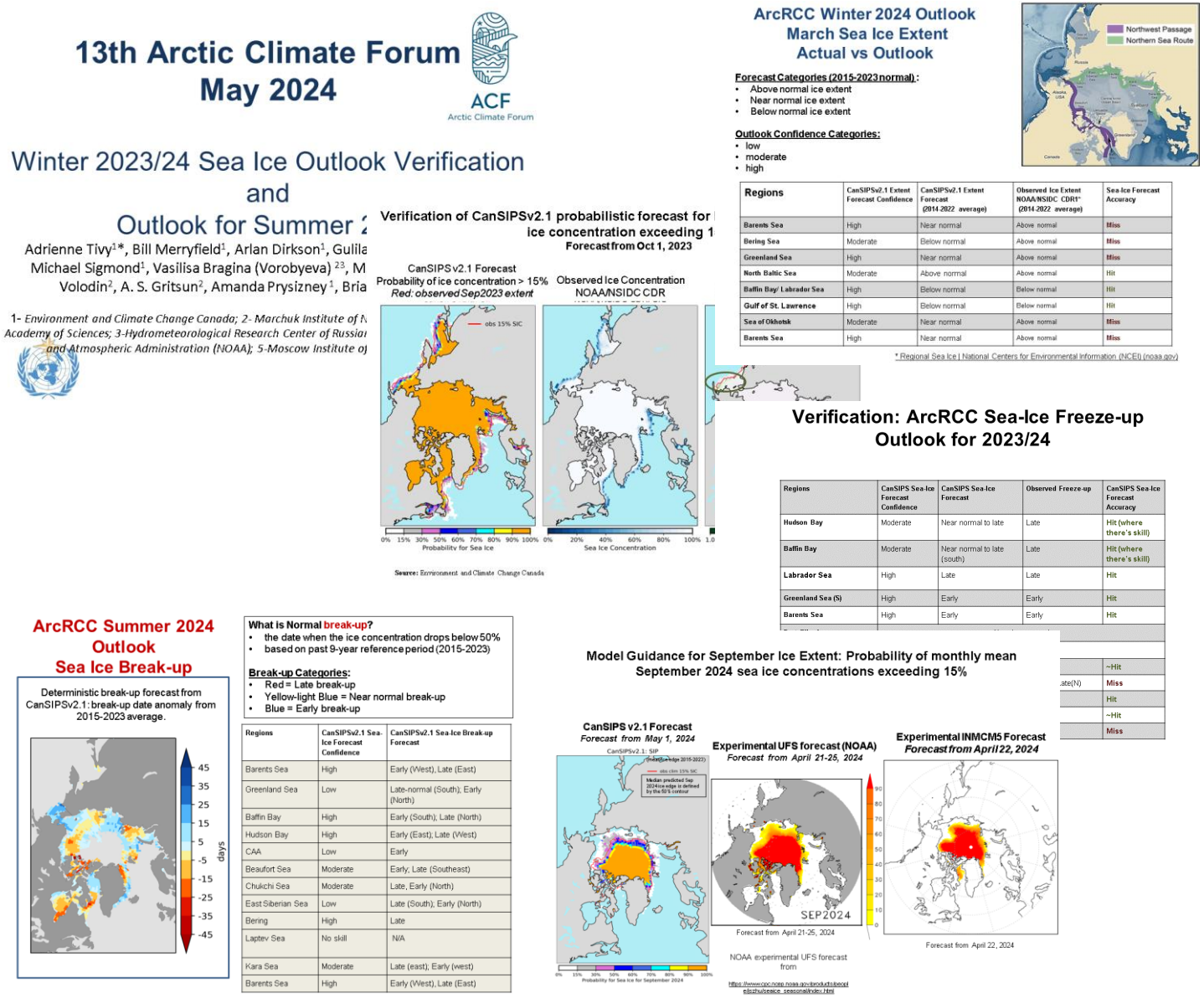
6. East Siberia
7. Chukchi and Bering

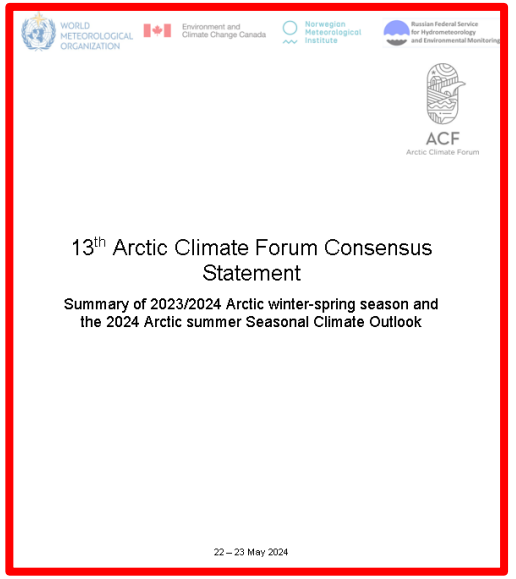
(5) ArcRCC Outlook for the regional specific parameters

- Includes validation of the forecast for the previous season and outlook for the next one for ice extent, concentration and phenomena dates (sea ice freeze-up/break-up) using deterministic and probabilistic approach as well as ice edge at summer/winter extreme
- Includes interpretation of the forecast for key shipping areas using additional information from the national ice services



(6) ArcRCC Consensus Statement – major synthetic product

- Major synthetic document based and incorporating information from all previous products
- It is a joint effort by all NMHs of the ArcRCC
- Consensus statement document draft is circulated among the team
- Final version published after the Arctic Climate Forum
- Contains 13 sections:
  - ✓ Introduction to the Arctic Climate Forum CS
  - ✓ Highlights for decision making
  - ✓ Understanding the Consensus Statement
  - ✓ Temperature (summary, verification, outlook)
  - ✓ Precipitation, hydrology (summary, verification, outlook)
  - ✓ Polar Ocean (summary for Heat Content and pH)
  - ✓ Sea-ice (summary, verification, outlook)
  - ✓ Snow Water Equivalent (outlook)
  - ✓ Bioclimatic indexes (summary, verification, outlook)
  - ✓ Observed extreme events
  - ✓ Possible impacts for next season
  - ✓ Data sources and useful links
  - ✓ Background and Contributing institutions



Introduction to the Arctic Climate Forum Consensus Statement

Arctic temperatures continue to rise at rates greater than the global average. Both the annual and all season's air temperatures since early 2000s in the Arctic (northward of 50°N within the ArcRCC-N domain) have been close to the highest in the time series of observations for 1900-2024 period (figure 1) though significant interannual variations occur for all Arctic Essential Climate Variables (ECV), including the surface atmosphere, sea-ice and polar ocean ECVs.

The role of the ArcRCC-Network is to foster collaborative regional climate services amongst Arctic (hydro)meteorological and ice services, as to meet climate adaptation and decision-making needs among societal actors across the Arctic.

Arctic Climate Forums (ACFs) were established in 2018 and are convened by the Arctic Regional Climate Centre Network (ArcRCC-N) under the auspices of the World Meteorological Organization (WMO).

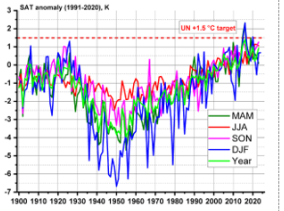


Figure 1: Annual, spring (MAM), summer (JJA), autumn (SON) and winter (DJF) average surface air temperature anomalies (ref. 1991-2020) for 1900-2023/2024 period. Graphics produced by the AARI. Data source: WMO stations within the ArcRCC-N domain (see fig.2).

Highlights for decision making

Temperature: For the whole land Arctic extremely warmer conditions were observed in November 2023 and February – April 2024 with colder in January 2024 with preliminary ranks 2nd (for 1950-2023/2024 period) and 5-6th in row.

Precipitation: The least amount of precipitation was for the Western Nordic, parts of WCanada & Alaska regions which is close to winter 2022/2023. More abundant precipitation was observed in the Eastern Nordic, parts of Alaska and Bering and Chukchi regions.

Sea-ice: Maximum Arctic (Northern Hemisphere) winter ice extent occurred 12-14 March 2024, which is close in time to climatic date, with a value of ~15.3 mln km² or 15-16th in row since 1979. Prominent area of residual ice in late summer led to decadal normal.

Ongoing Impacts of Climate Change: Increase risk of coastal flooding and thawing permafrost lead to coastal erosion and losses of community infrastructure. All marine mammals with habitat on sea ice may be more difficult to harvest. Increasing interannual and intraseasonal variability lowers predictability of weather extremes.

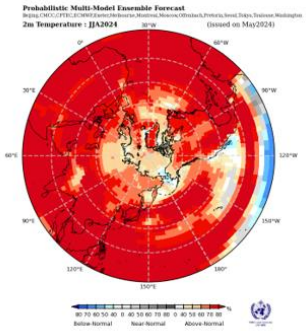


Figure 6: Multi model ensemble probability forecast for temperature for June, July, August 2024. Red indicates warmer conditions, blue colder conditions and white, no agreement amongst the models. Source: www.wmolc.org.

Table 2: June, July, August 2024 outlook: Arctic regional forecasts for surface air temperature

Arctic Region	MME Temperature Forecast Agreement	MME Temperature Forecast
Alaska and Western Canada	Low (eastern part), moderate to high (western part)	Above normal with exception of western part adjacent to Bering Strait and Chukchi Sea
Central and Eastern Canada	High (continental part), low (some marine parts)	Above normal for most of area, normal or below normal in parts of Hudson Bay and Labrador Sea
Western Nordic	High (Greenland, Icelandic waters, eastern part), low (parts of Greenland Sea)	Above normal (Greenland, Icelandic waters), below normal (parts of Greenland Sea)

Observed extreme events

Category	Location	Rarity	Impacts associated with event
Alaska and Western Canada			
Precipitation and temperature (winter)	Alaska	2nd snowiest January on record at the Juneau Intl Airport followed by melt. Nov-Dec: extreme snow fall Anchorage area (Highest Nov-Dec amount on record).	Record snow fall in a two-week period in Juneau followed by a rapid warm-up and rainfall caused local flooding issues. Weeks-long travel hazard in the Anchorage area from heavy snow fall and numerous structure collapses due to heavy snow load.
Temperature (spring)	Alaska	April: Extreme cold during the first week of April.	Delayed snow melt-off. Concern regarding the late-month breakup did not materialize.
Precipitation (winter)	Yukon	Unusually thin ice on the Yukon River at Dawson City.	The government-sponsored ice bridge across the Yukon River at Dawson City was not built this year due to warm temperatures and thin ice.
Precipitation (spring)	Alaska	March-April: Very heavy snow along most of the Alaska west coast. High season SWE.	Travel impacts. Subsistence impacts
Flooding	Alaska and Yukon	April-May: early river breakup at most locations. Flooding significant in a few areas.	Road damage and severe erosion along the lower Kuskokwim River.

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Thank you for attention!

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4 – 6 June 2024, Lijiang, Yunnan Province, China

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