WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

November 2022 – April 2023 Arctic Seasonal Review

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WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

AARI

ACF
Arctic Climate Forum

Content of seasonal review

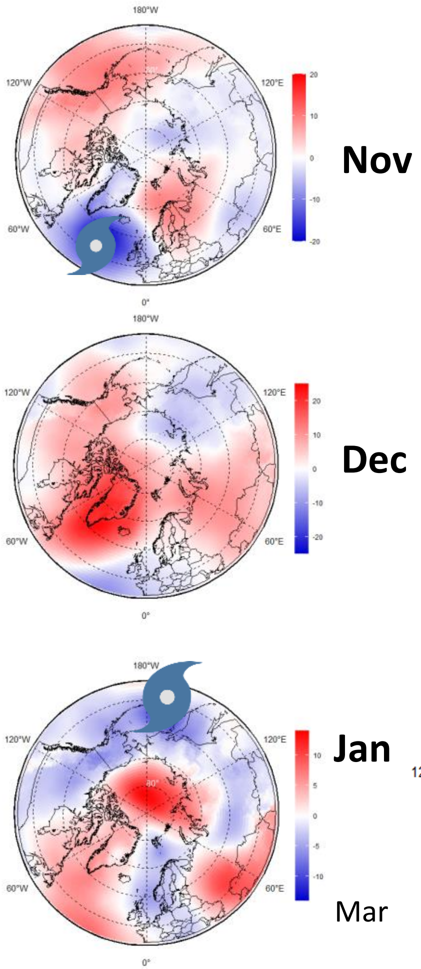
- **Review for NDJFMA (November 2022… April 2023)**
  - Atmosphere:
    - Atmospheric circulation
    - Surface air temperature – anomalies, ranks by Arctic regions
    - Precipitation – anomalies by Arctic regions
  - Sea ice:
    - Precursors in atmosphere and polar ocean
    - Ice extent – anomalies by regions
    - Ice conditions including February – March 2022 winter maximum
    - Sea ice thickness and volume variability
  - Polar Ocean:
    - Heat content, waves and swell height (storminess) - anomalies
    - pH (acidification/alkalization estimates) - anomalies
  - Land hydrology:
    - river discharge – anomalies
    - snow extent – anomalies and ranks
  - Bioclimatic weather severity (introduction to particular report by Anastassiya Revina and Svetlana Emelina)
- **Briefs for May 2023: SAT, winds, precipitation, sea ice, snow**

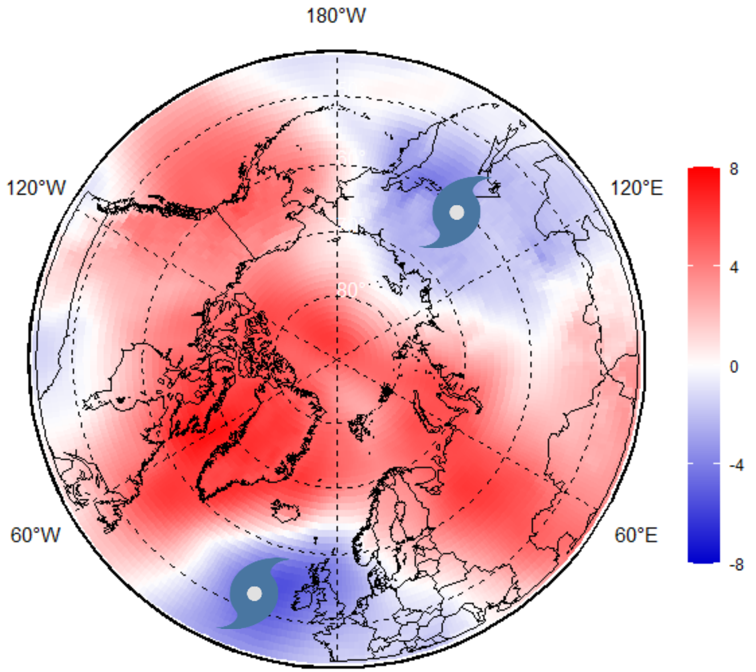
Majority of the described parameters are the WMO accepted Essential Climate Variables (ECV).
Anomalies based both on reanalysis and surface observations are given relative to the latest **3rd WMO period 1991-2020** while ranks are given for **1950…2022/2023** period.

Atmosphere

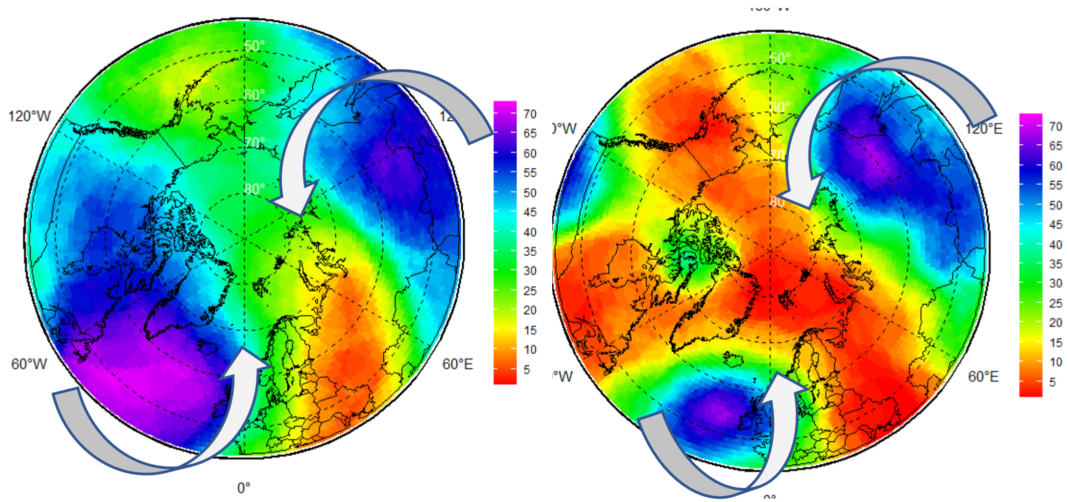
- Precursors: atmospheric circulation
- Surface air temperature
- Precipitation

Atmospheric circulation: NDJ 2022/2023





NDJ 2022/2023 MSLP hPa anomalies (1991-2020)

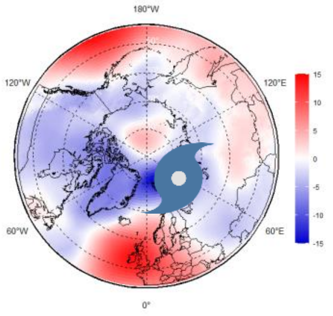


NDJ 2022/2023 H50 (left) and H500 (right) ranks (1950-2023/2023)

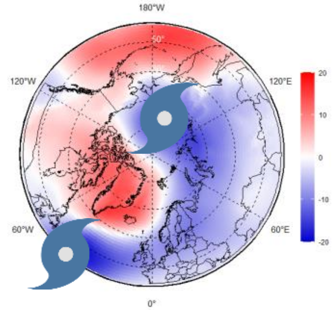
- ❖ **During November 2022 – January 2023 (NDJ) a bi-center polar vortex** (dark violet, 50hPa and 500hPa geopotential height patterns) **was observed with centers over the N Atlantic and the Eastern Siberia with a blocking atmospheric crest in between.** That led to prevalence of meridian circulation (transfer south/north) in the troposphere over W Siberian and Canadian regions and zonal one over other parts of the Arctic
- ❖ **For the surface atmosphere that meant predominance of** negative mean sea level atmospheric pressure (MSLP) anomalies (lower pressure, marked in blue) and **cyclonic activity over the southern Nordic, E Siberian regions.**
- ❖ **Opposite situation** (higher pressure, marked in red) **was observed over Alaska, Canada, Greenland, northern Nordic and W Siberia regions**

[AARI / CCCS ERA5]

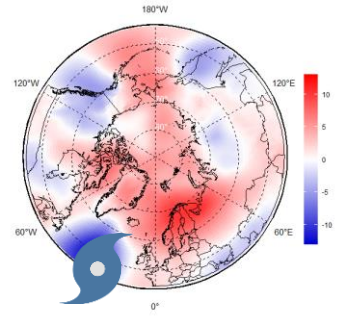
Atmospheric circulation: FMA 2023



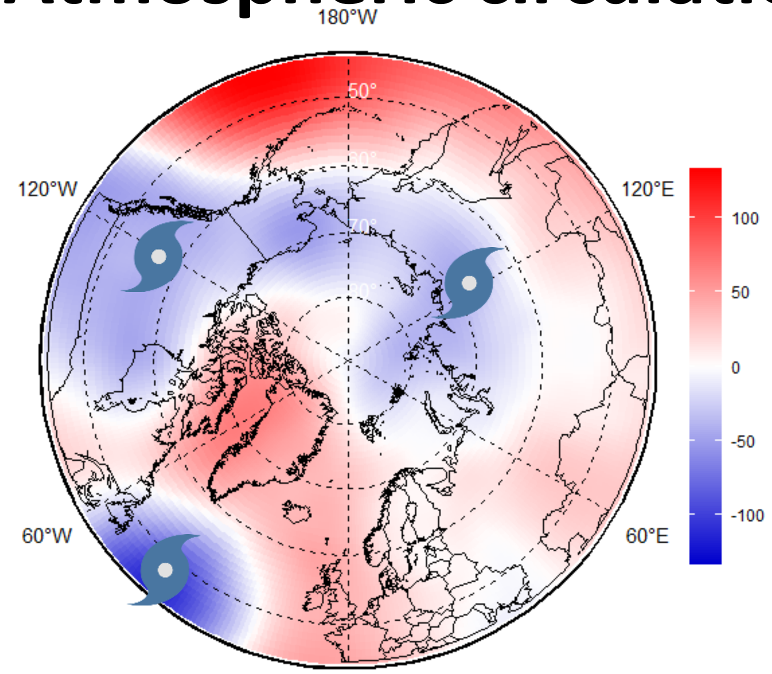
Feb



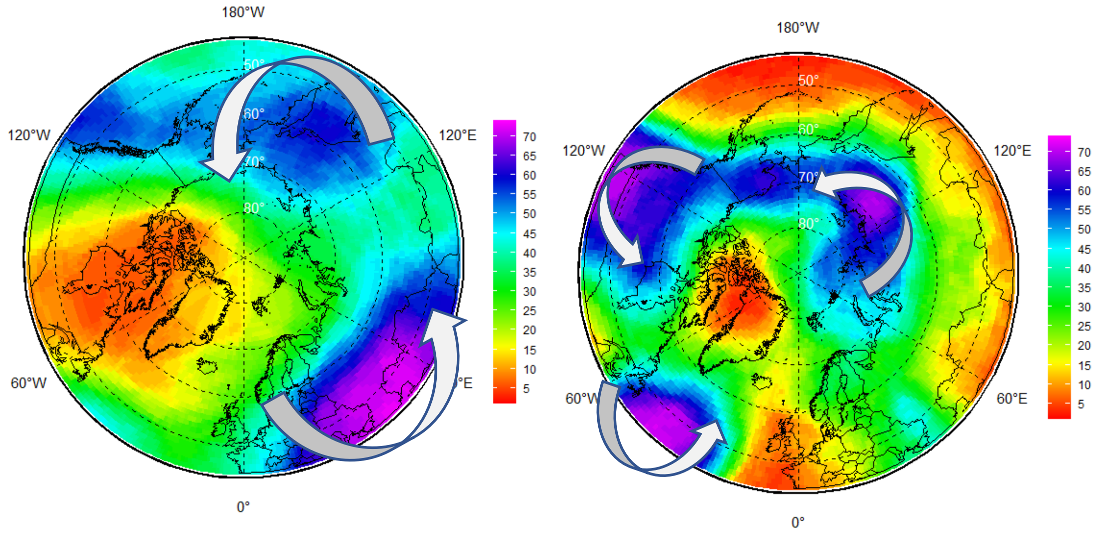
Mar



Apr



FMA 2023 MSLP hPa anomalies (1991-2020)

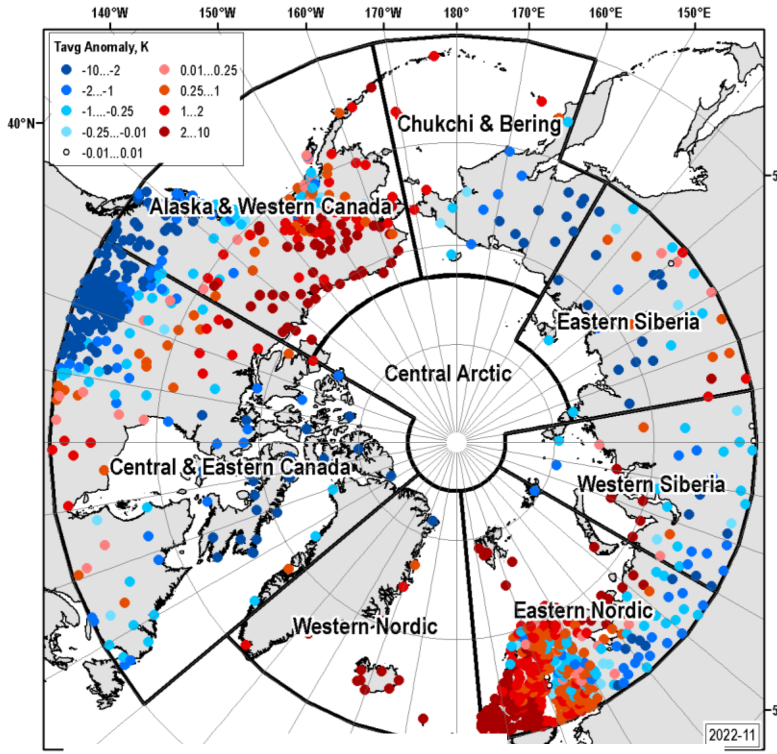


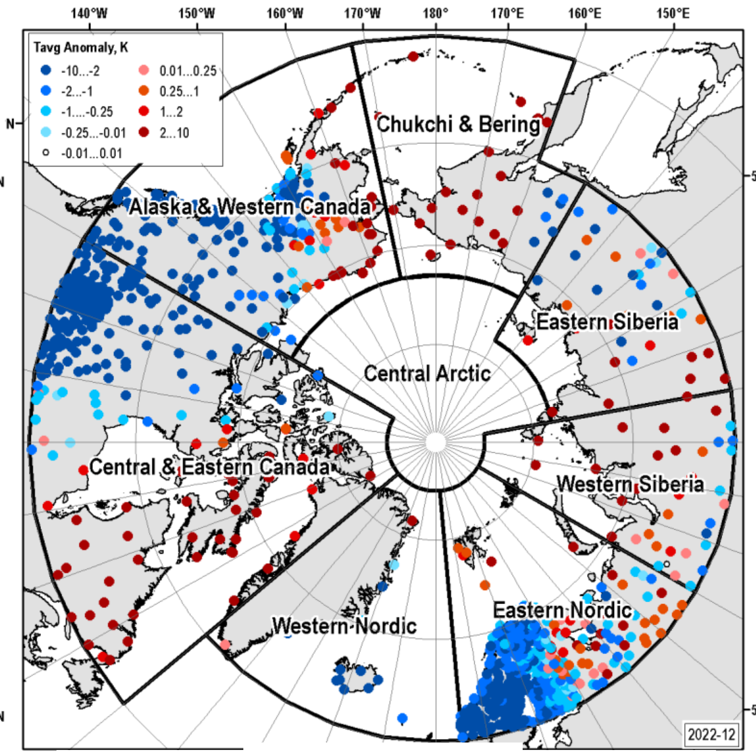
FMA 2023 H50 (left) and H500 ranks (1950-2022)

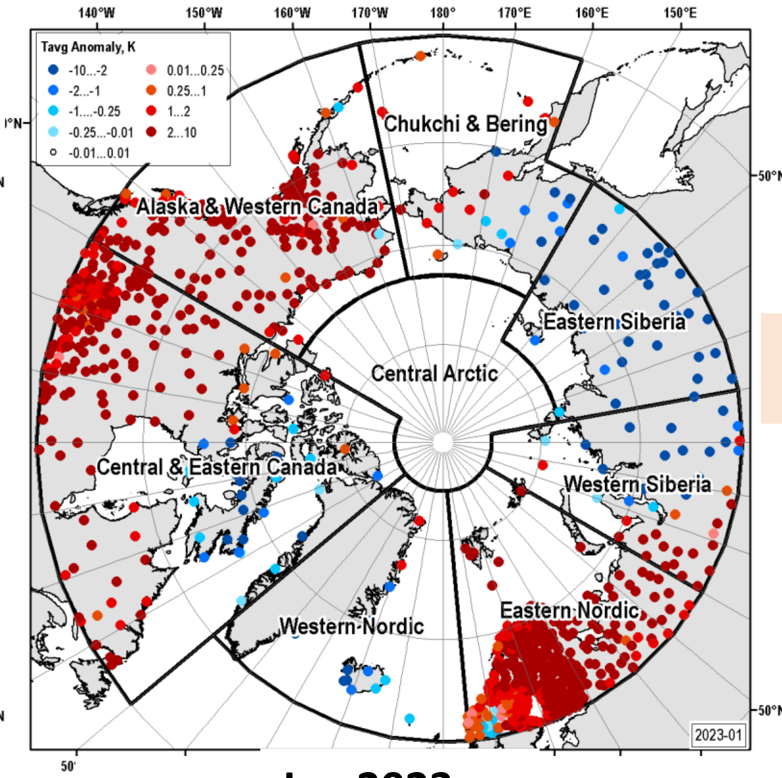
- **Further in season during February-April (FMA) 2023** bi-and tri-center polar vortex shifted to American side with centers over the Laptev Sea, central Canada and North Atlantic causing in general zonal circulation both in Siberia and Canada regions.
- Monthly patterns of the surface atmosphere circulation were fully different in February, March and April with negative MSLP anomalies - cyclonic activity over the whole Eurasian Arctic or Canadian Arctic.
- Blocking positive MSLP anomalies were observed in April from Nordic and W Siberia to Bering Sea.

[AARI / CCCS ERA5]

Surface air temperature: NDJ 2022-2023 anomalies (1991-2020)

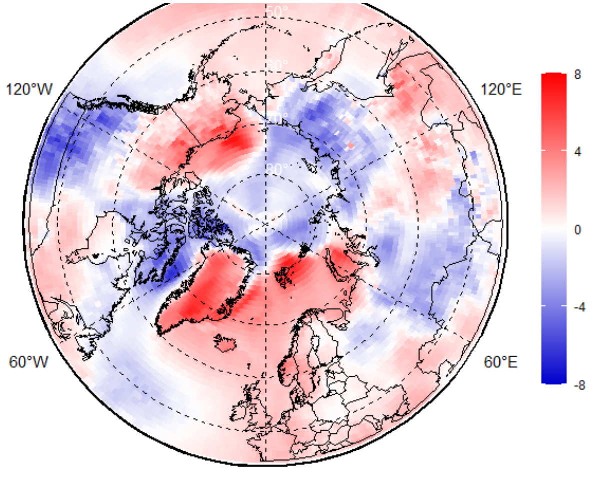




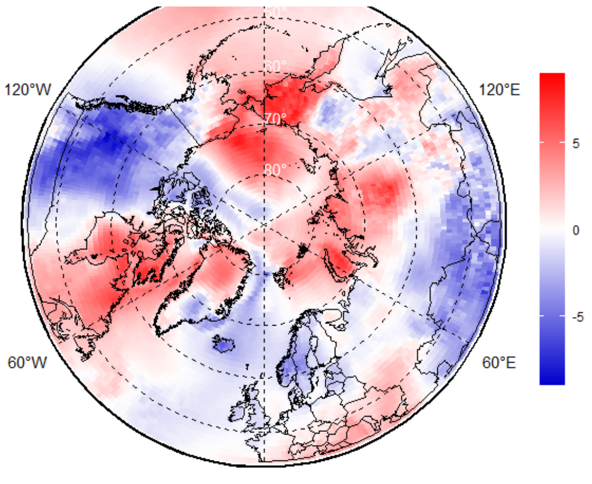


Obs

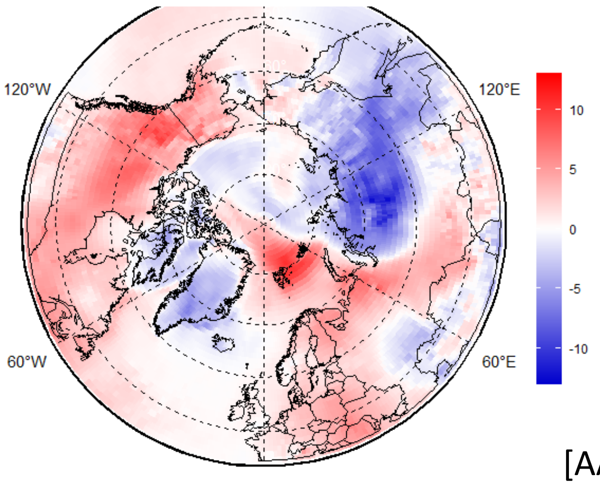
Nov 2022



Dec 2022



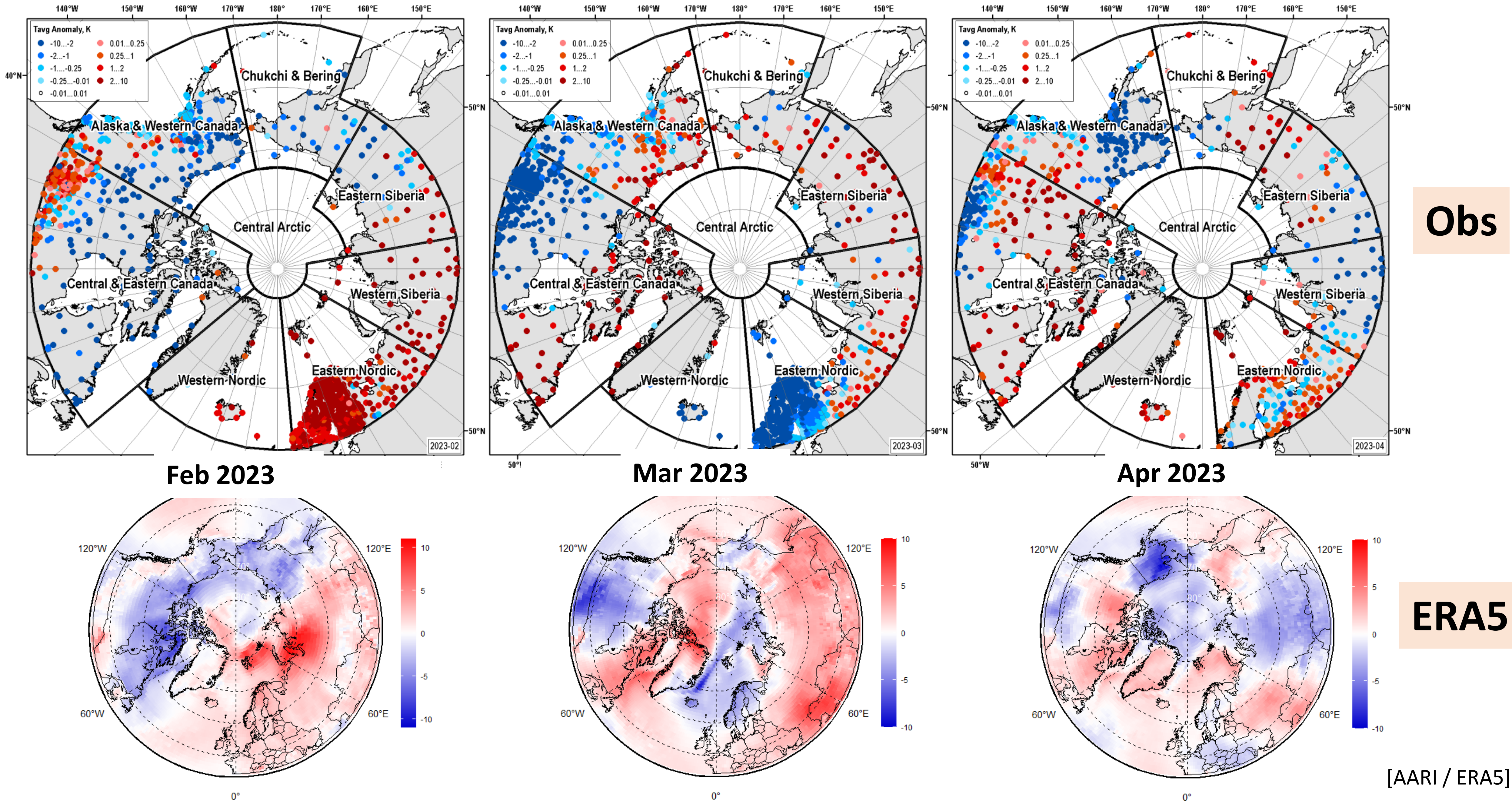
Jan 2023



ERA5

[AARI / ERA5]

Surface air temperature: FMA 2023 anomalies (1991-2020)



[AARI / ERA5]

Surface air temperature:

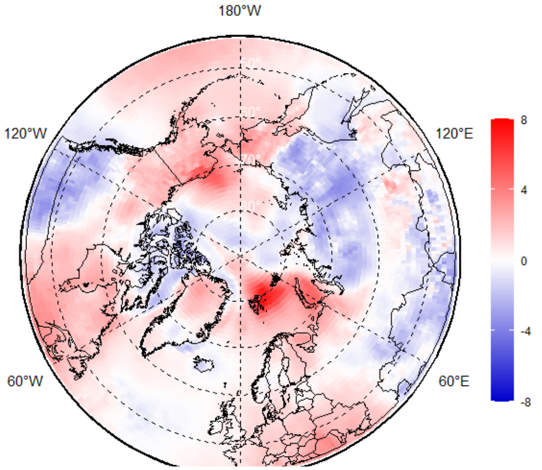
NDJ 2022/2022 and FMA 2023 anomalies and ranks (ERA5)

Nov 2022 - Apr 2023 anomalies and ranks (1093 st.)

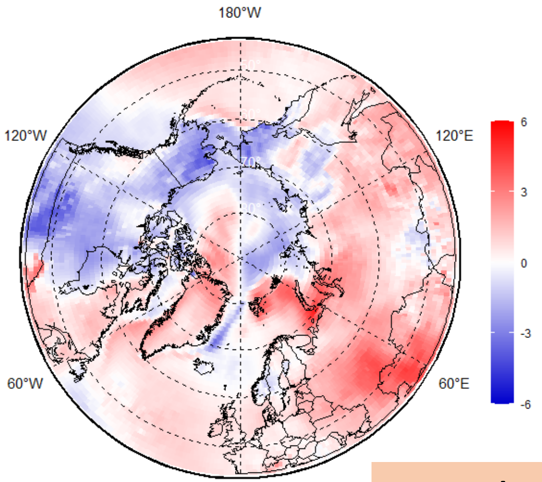
Anomalies relative to: 1991-2020

Ranks: based on 1950-2022/2023

Year min/max: based on 1900-2022/2023



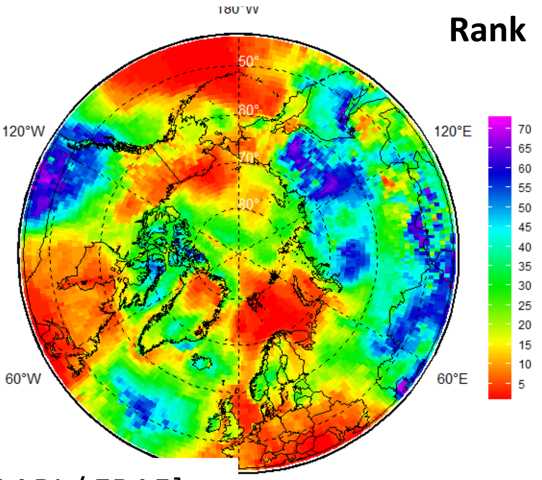
NDJ 2022-2023

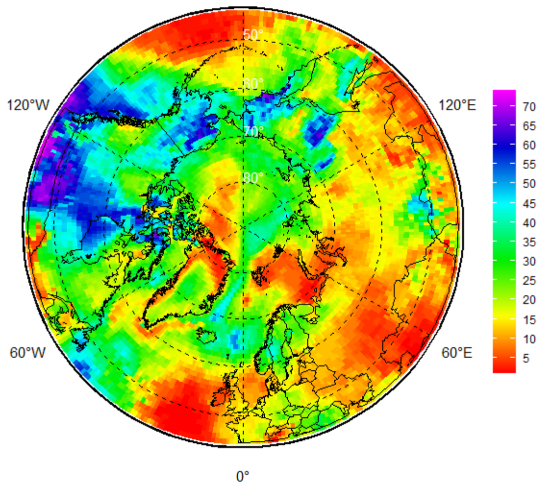


FMA 2023

Anom(Rank|Yearmin|Yearmax)

Rank





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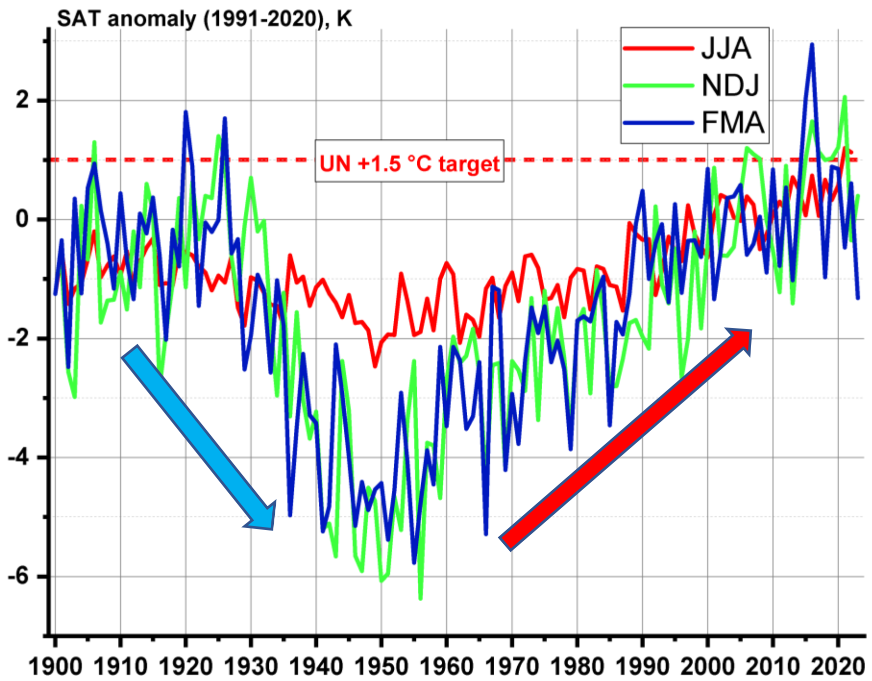
Region	Alaska & W Canada	Central & E Canada
2022-11	0.32 (37|2006|1979)	-2.17 (44|1985|1917)
2022-12	-2.31 (55|1933|1913)	-3.27 (53|1933|1930)
2023-01	3.47 (11|1909|1981)	3.46 (4|1950|1931)
2023-02	-1.40 (48|1904|1920)	-0.49 (24|1979|1931)
2023-03	-0.25 (41|2007|1915)	-2.02 (37|1964|2010)
2023-04	-2.96 (66|1972|1940)	-0.73 (28|1954|1915)
NDJ 2022/2023	0.44 (30|1946|1913)	-0.81 (24|1949|1930)
FMA 2023	-1.64 (54|1972|1906)	-1.89 (40|1948|1915)

Region	Western Nordic	Eastern Nordic
2022-11	2.01 (4|1971|1941)	1.32 (16|1902|2020)
2022-12	-3.23 (72|1965|1933)	-1.19 (38|1915|2006)
2023-01	-2.27 (59|1959|1933)	2.86 (4|1987|2020)
2023-02	1.50 (17|1969|1932)	3.02 (9|1966|1990)
2023-03	-1.80 (57|1967|1929)	-2.01 (51|1942|2007)
2023-04	3.19 (2|1983|1926)	-0.01 (29|1929|2011)
NDJ 2022/2023	-1.06 (49|1965|1933)	1.03 (14|2023|2011)
FMA 2023	0.77 (17|1969|1929)	-1.01 (38|1917|1990)

Region	Western Siberia	Eastern Siberia	Chukchi & Bering
2022-11	-0.44 (38|1968|2020)	-1.04 (35|1982|2020)	-0.65 (25|1905|1919)
2022-12	2.47 (19|1968|1913)	0.51 (30|1907|2013)	3.05 (10|1993|1911)
2023-01	0.46 (25|1969|2007)	-5.47 (70|1900|2007)	1.01 (32|1910|1926)
2023-02	6.72 (4|1966|2020)	-0.11 (31|1900|1934)	-1.28 (40|1902|1926)
2023-03	2.31 (10|1960|2017)	1.97 (15|1942|2017)	0.81 (16|1901|1926)
2023-04	-1.83 (43|1984|1995)	-0.38 (24|1956|1920)	0.97 (15|1976|1926)
NDJ 2022/2023	0.88 (22|1968|1936)	-1.81 (50|2023|1924)	1.18 (14|1994|1925)
FMA 202	2.43 (6|1966|2020)	0.32 (17|1966|1920)	0.08 (19|1902|1926)

Surface air temperature

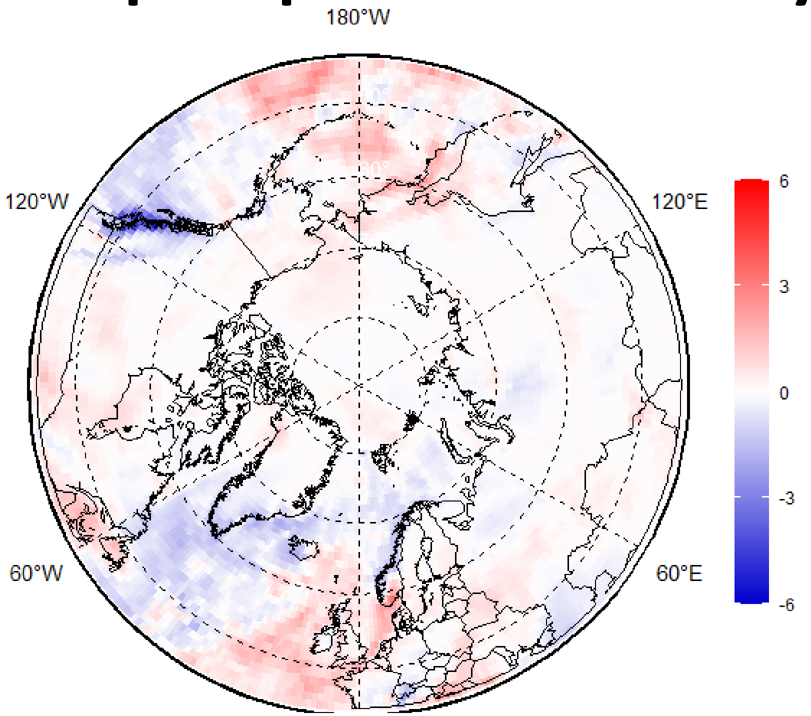


Region	Arctic total
2022-11	0.11 (17|1955|1924)
2022-12	-1.57 (34|1955|2006)
2023-01	**2.75** (1|1950|1926)
2023-02	**1.01** (8|1936|2016)
2023-03	-1.15 (35|1942|1926)
2023-04	-1.78 (41|1956|2016)
NDJ 2022/2023	0.40 (14|1955|2020)
FMA 2023	-1.32 (38|1955|2016)

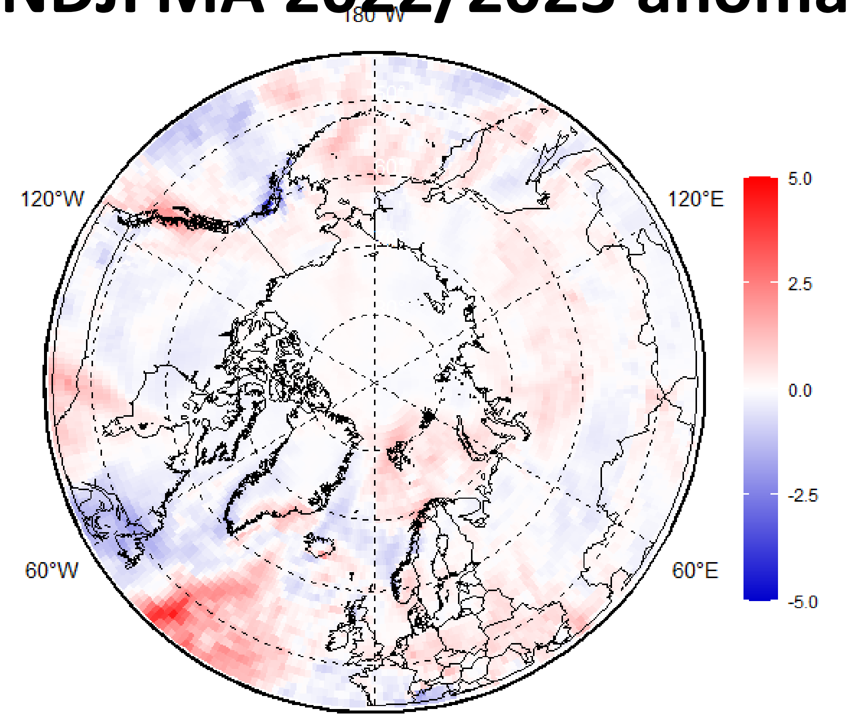
Anom(Rank|Yearmin|Yearmax)

- **The start of winter 2022 (November-December)** surface air temperature showed **prominent positive** anomalies **in W Nordic (4th** in row) and **Chukchi&Bering** (10th in row) and **negative** – **Alaska** (55th in row), **Central&Eastern Canada** (53rd in row) and **Western Nordic** (72nd in row) anomalies (to 3rd WMO reference period 1991-2020, ranks for 1950-2022 observation period).
- **During mid-winter (January-February 2023)** strong **positive** anomalies were observed over **Alaska&W Canada** (11th in row), **Central and E Canada** (4th in row), **Eastern Nordic** (4th and 9th in row), **W Siberia** (4th in row) with **negative** anomalies observed over **W Nordic region** (59th in row) and **E Siberia** (70th in row).
- **Further by the end of winter in March – April 2023** both **negative** and **positive** anomalies were observed over **W Nordic** (57th and 2nd in row), **negative** over **Alaska &W Canada** (66th in row) and **E Nordic** regions (57th and 51st in row) and **positive over W Siberia** (10th in row).
- **Due to lack of surface marine observations** conclusions for the **Central Arctic**, done on reanalysis, include **partly colder conditions in November** but **warmer in December 2022** and predominantly **colder during February – April 2023.**
- For the whole land Arctic **extremely warmer** conditions were observed in **January** and lesser extreme in **February** 2023 with preliminary ranks **1st** (from 1950) and 8th in row, though large regional and inner season variations and changes in anomaly sign did occur.
- Centennial long analysis show that extreme negative anomalies (to 1991-2020 period) in general occurred in mid 20th century with comparable to current decade positive anomalies occurred in 1910-1920s but that is again NOT the SAME for all of the Artic subregions. Though positive trends from 1940s-1950s are obvious, the quantitive estimates depend on the WMO reference period chosen, density and subset of the stations chosen for the analyzed subregion, in particular for the marine Arctic.

Surface precipitation: monthly NDJFMA 2022/2023 anomalies (1991-2020)

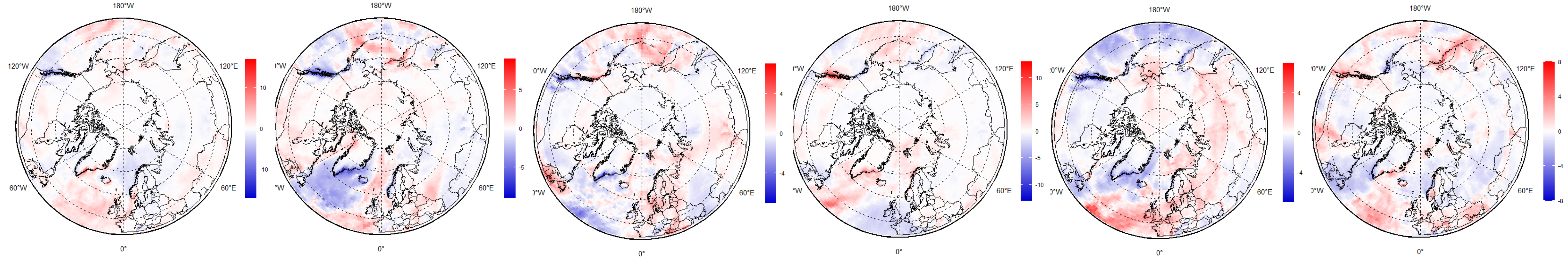


NDJ 2022/2023 precipitation anomaly



FMA 2023 precipitation anomaly

- ❖ In general, during the whole season **wetter** (snowy) conditions occurred in parts of Canadian, Alaska, Bering & Chukchi regions
- ❖ **Drier conditions** occurred in parts of E and W Nordic, parts of Canadian and Alaska regions



Nov **Dec** **Jan** **Feb** **Mar** **Apr**

[AARI / CCCS ERA5]

Surface precipitation: seasonal NDJ 2022/2023 & FMA 2023 anomalies (reanalysis)

Region	NDJ 2022/2023	FMA 2023
Western Nordic	drier	drier to wetter
Eastern Nordic	drier	wetter
Western Siberia	slightly drier	wetter
Eastern Siberia	normal	wetter
Bering & Chukchi	wetter	slightly drier to wetter
W Canada & Alaska	drier to normal	drier to wetter
Eastern Canada	slightly wetter	drier
Central Arctic	slightly wetter	normal

Reference period: 1991-2020

- **The least amount** of precipitation was for the **Western Nordic and parts of Alaska regions**
- More abundant precipitation was observed in the **Siberia regions**.
- Somewhat **wetter** or close to normal conditions are estimated for the Central Arctic

[AARI / CCCS ERA5]

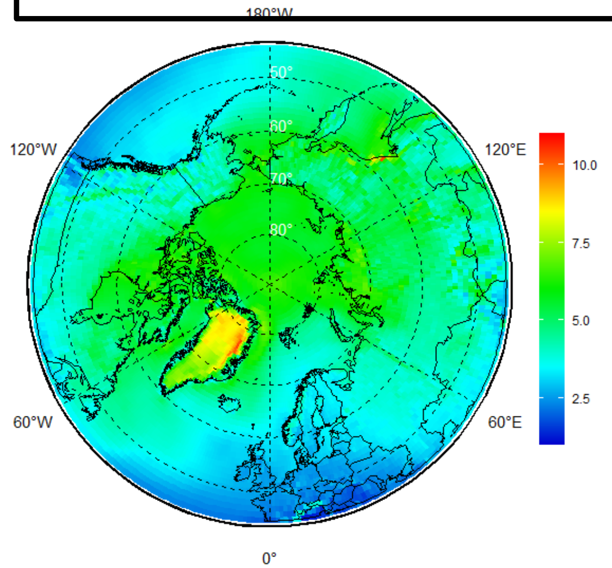
Bioclimatic weather severity

- During winter 2022/2023 milder than for the last 30 years weather severity can be attributed on a basis of Bodman's index to the most of Nordic, Western Siberia, Eastern and Central Canada and for NDJ 2022/2023 Alaska region.
- Opposite situation – harsher /more severe weather can be attributed to most of Siberia, parts of Chukchi and Bering and in FMA 2023 for Eastern Canada and Alaska region.
- Particular report on bioclimatic indexes synopsis and forecast will follow.

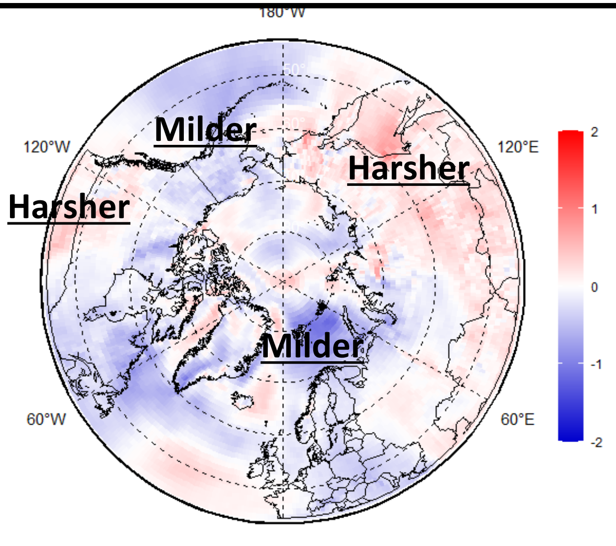
Bodman's weather severity index (S) (dimensionless) is used for bioclimatic evaluation of weather conditions for winter half year and is calculated according to Bodman's formula as follows: $S = (1 - 0.04\,T)\,(1 + 0.272\,v)$ where: v is wind speed (in m/s) at 10 m above ground level and T is air temperature (in °C)

The scale in use to assess using S is:

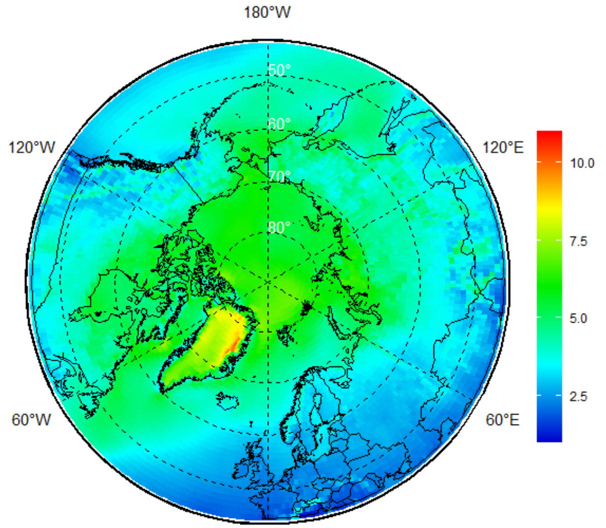
> 6 extraordinary severe 5– 6 extremely severe
3– 5 severe & very severe 1– 3 slightly&less severe
< 1– mild



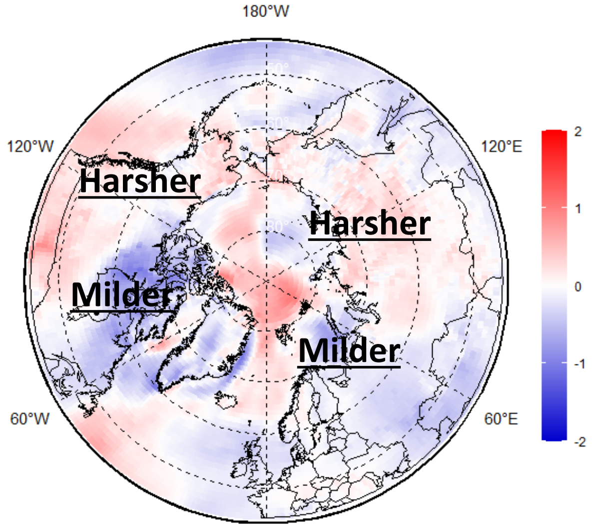
NDJ 2022/2023 Bodman's index



NDJ 2022/2023 Bodman's index anomaly (1991-2020)



FMA 2023 Bodman's index



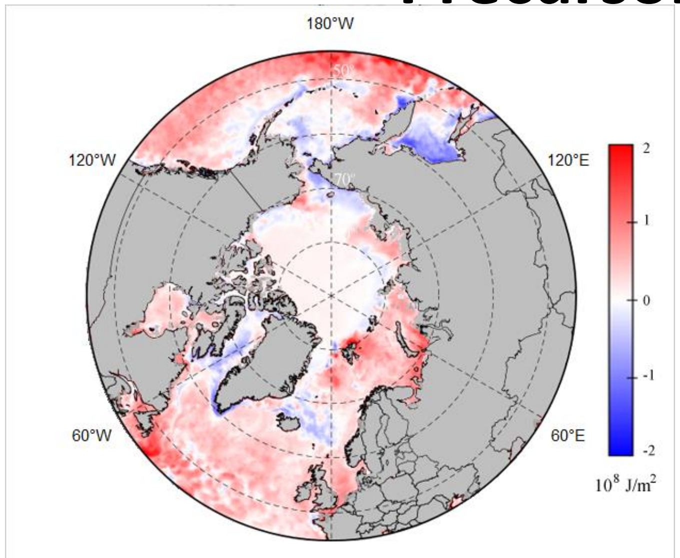
FMA 2023 Bodman's index anomaly (1991-2020)

[AARI / CCCS ERA5]

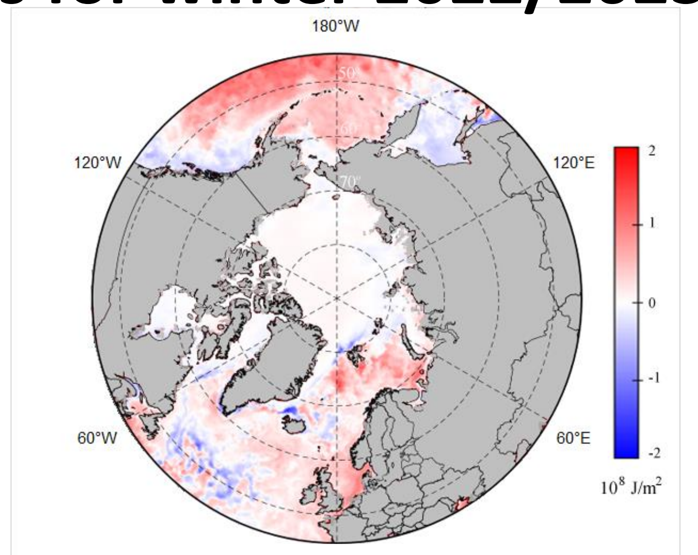
Sea ice

- Precursors in atmosphere and polar ocean
- Ice extent and ice conditions based on ice charting
- Sea ice thickness and volume based on reanalysis

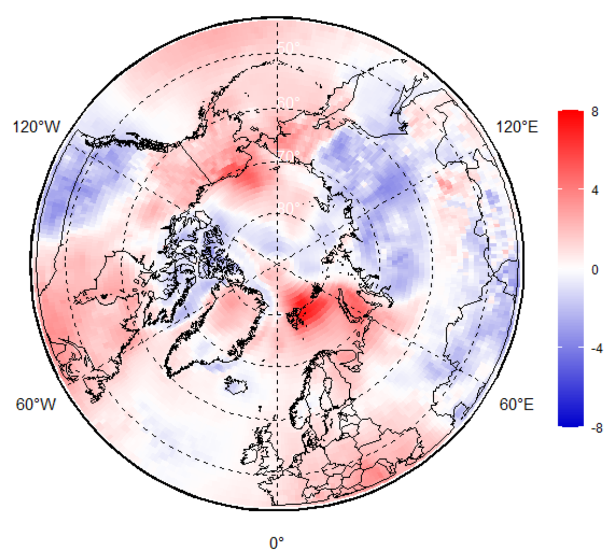
Precursors for winter 2022/2023 ice conditions



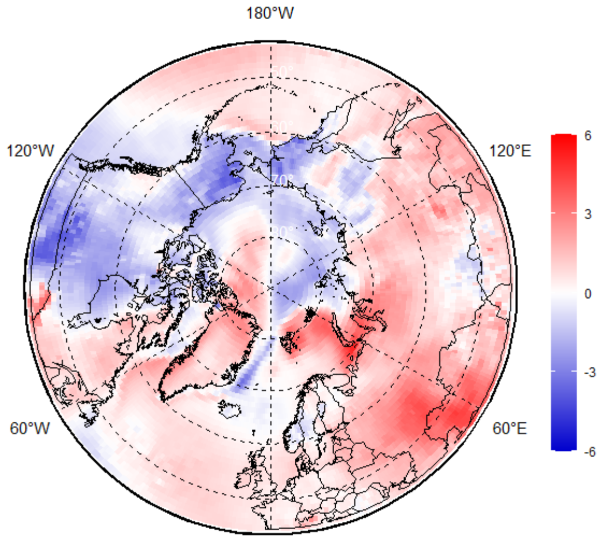
Sep - Nov 2022 Heat Capacity 15m anomaly, 1993-2020



Dec 2022-Feb 2023 Heat Capacity 15m anomaly, 1993-2020



Nov 2022 – Jan 2023



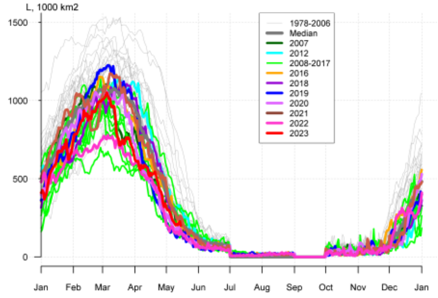
Feb – Apr 2023

SAT anomaly, 1991-2020

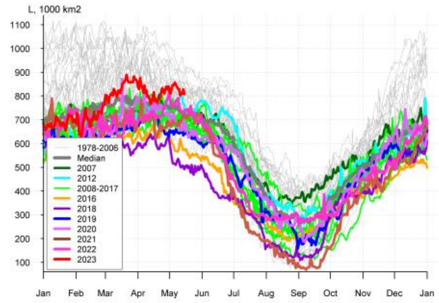
- ❖ Prevailing **positive** ocean heat capacity (HC) anomaly during Sep – Nov 2021 for the Svalbard, Barents, Kara, parts of Laptev and Hudson Bay slowed freezing processes in these regions
- ❖ Oppositely, zero or **negative** HC anomalies in Sep – Nov 2022 in ESS, Chukchi, Bering, Okhotsk, Baffin Seas provided background for close to normal freeze-up
- ❖ Further in winter occurrence of general **positive** SAT anomalies over Barents and Svalbard areas in February – April 2023 slowed the ice growth, however **negative** SAT anomalies during the same period stimulated ice growth in Eurasian Arctic, Bering and Okhotsk Seas

[AARI / CCCS MEMS & ERA5]

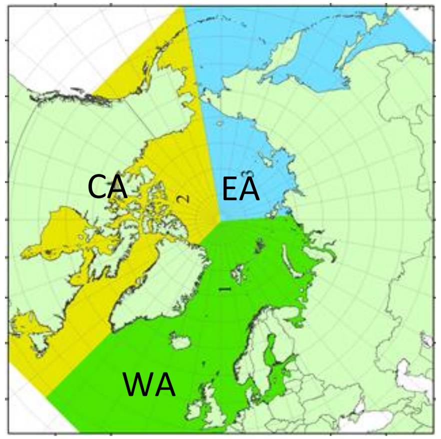
Arctic (NH) seasonal ice extent 1978…. 2022

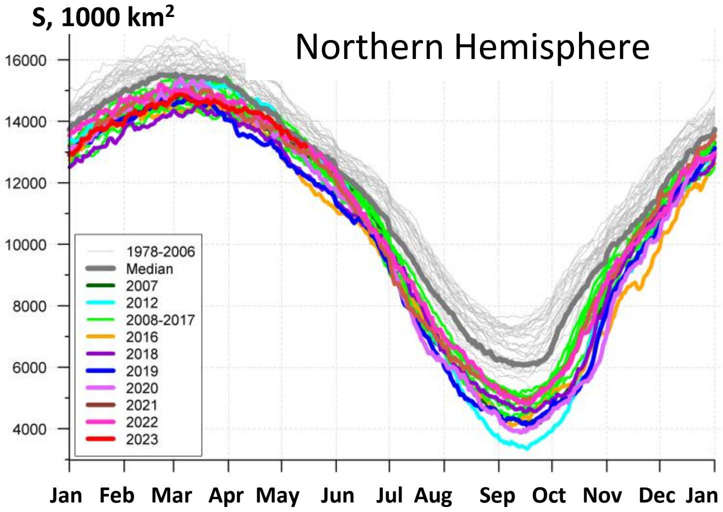


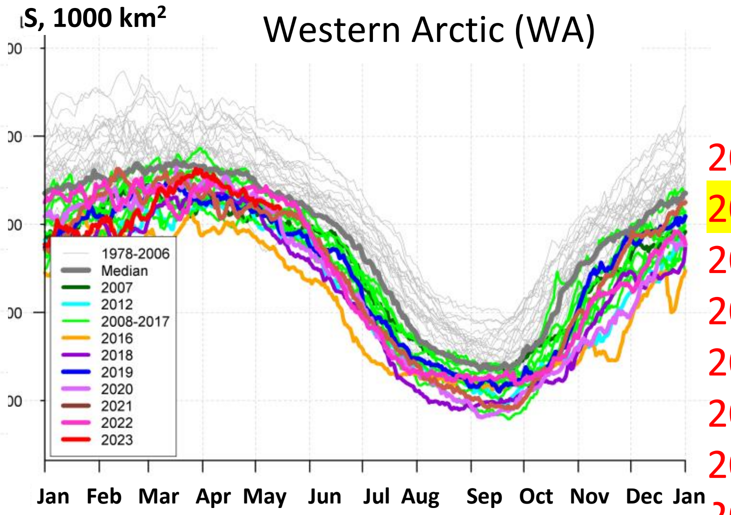
Sea of Okhotsk

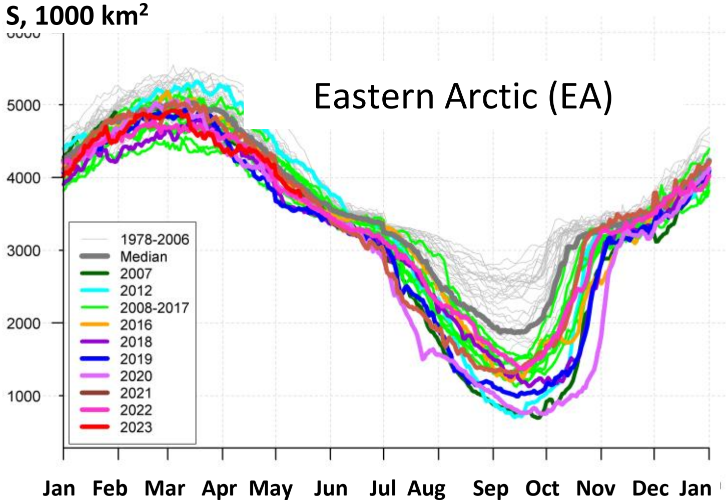


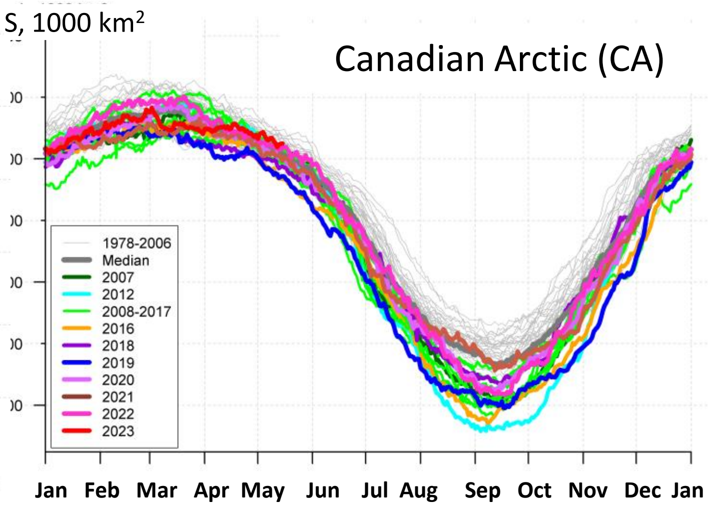
Greenland Sea











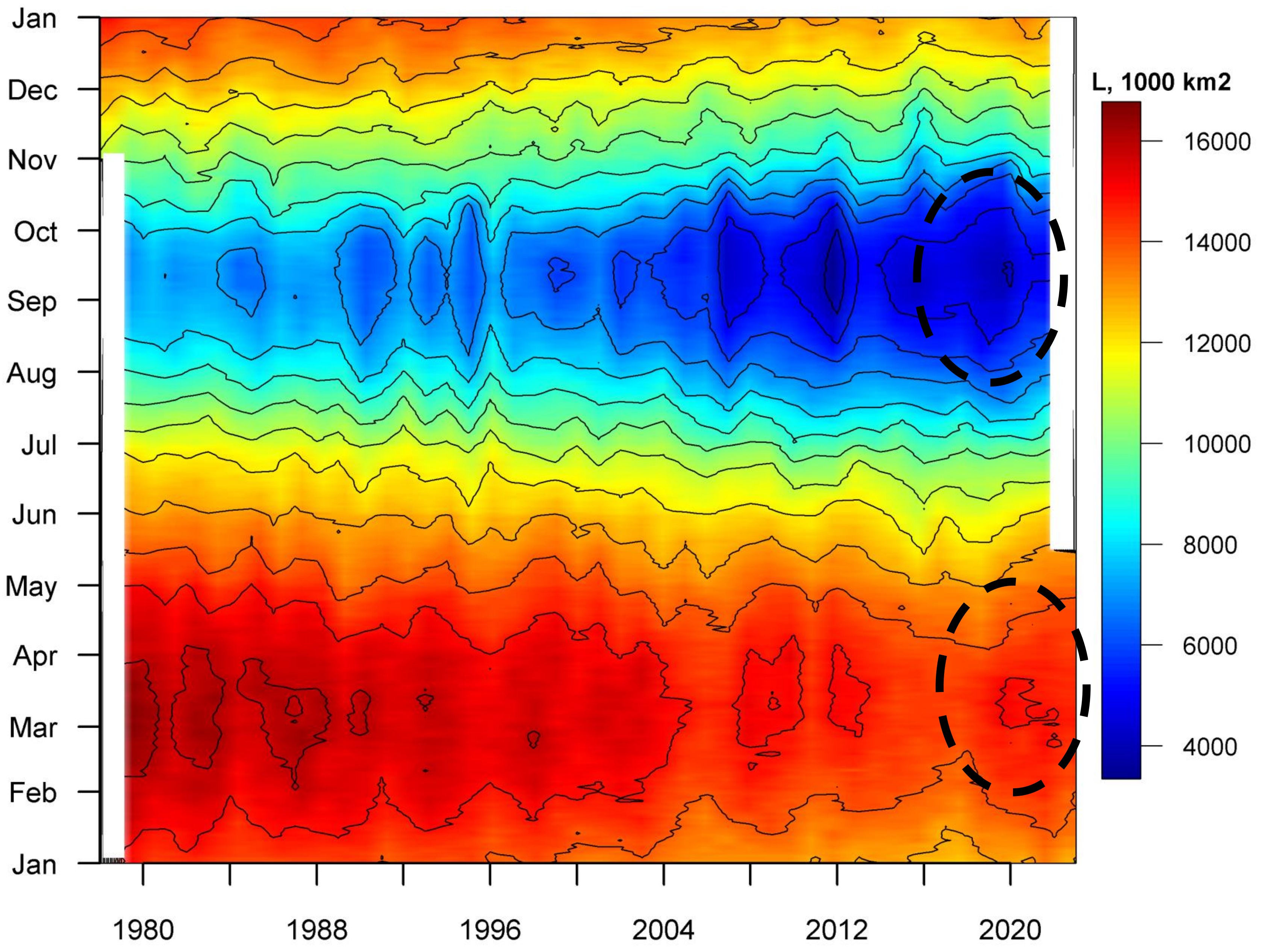
S, 1000 km²

Sep (Min)			Feb/Mar (Max)		
2012	3346	1	2017	14467	1
2020	3882	2	2018	14516	2
2016	4099	3	2015	14526	3
2019	4103	4	2016	14580	4
2007	4189	5	2011	14701	5
2011	4312	6	2006	14867	6
2015	4350	7	2023	14875	7
2018	4557	8	2019	14891	8
2008	4588	9	2007	14931	9
2017	4622	10	2014	14972	10
2010	4641	11	2021	15100	11
2022	4808	12	…	…	
2021	4848	13	2022	15210	14
…	…		…	…	
1982	7246	42	1988	16461	43
1983	7285	43	1983	16547	44
1980	7611	44	1979	16769	45

[AARI / NSIDC]

- Maximum Arctic (NH) winter ice extent, 7th in row, ~14.9 mln km² (~15,2 in 2022, 14th in row) was reached 4-5 March 2023, which is close in time to climatic date and later by 2 weeks than previous year. With exception of the Barents Sea, prominent area of residual ice in late summer led to decadal normal ice extent growth in the Eurasian and Canadian Arctic. Opposite to 2022 the Sea of Okhotsk had ice extent close to 45-years median and the Greenland Sea ice extent exceeding the 45-years median in late winter 2023.

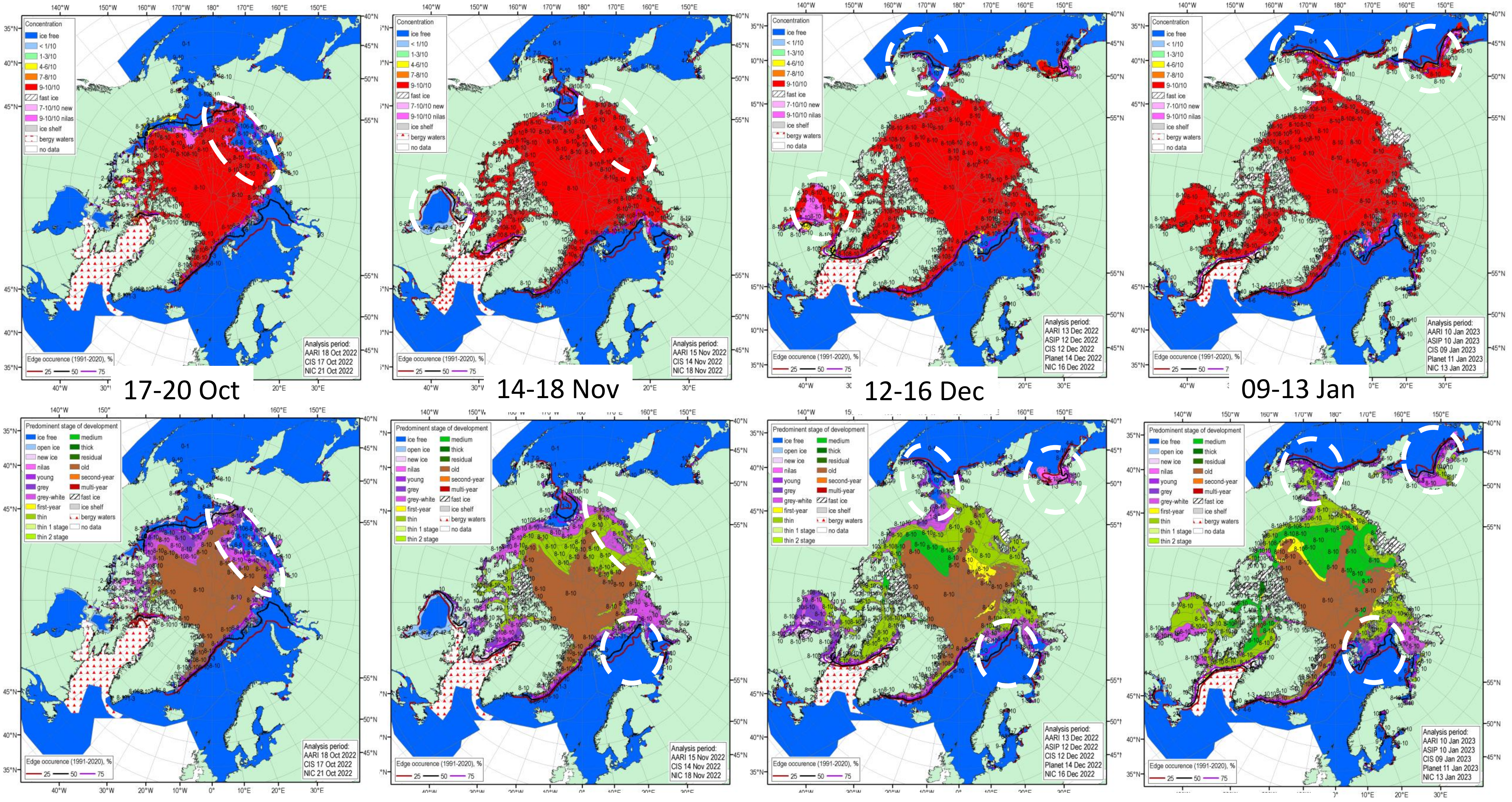
Seasonal NH ice extent variability: 1978 -2023



- ❖ Seasonal patterns of daily ice extent allow to retrieve additional information on interseasonal variability of ice extent
- ❖ Though both winter maximums and summer minimums continue to diminish there are certain hints to possibility for summer ice cover in 2023 be greater than in 2019-2020 and close to 2021-2022

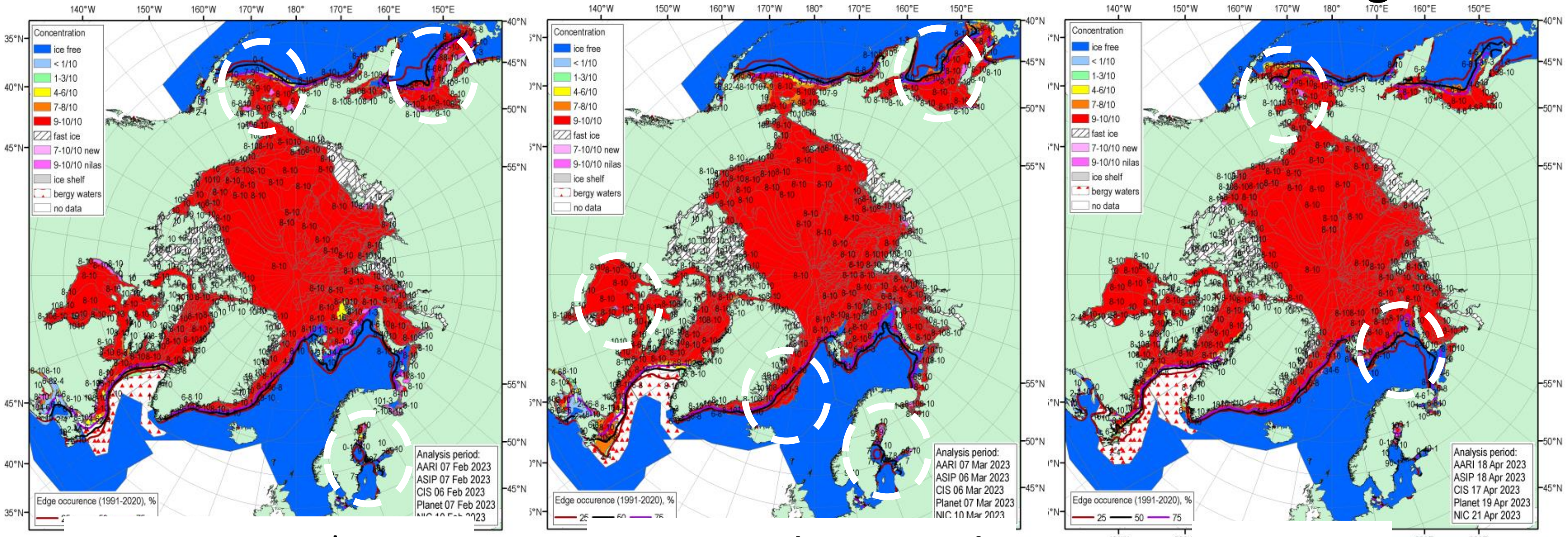
[AARI / NSIDC]

ONDJ 2022/2023 Arctic sea ice – concentration and stage of development



[sea ice analysis - AARI/ASIP/CIS/Planet/NIC; ice edge – AARI/NSIDC, nearest 5days, reference period: 1991-2020]

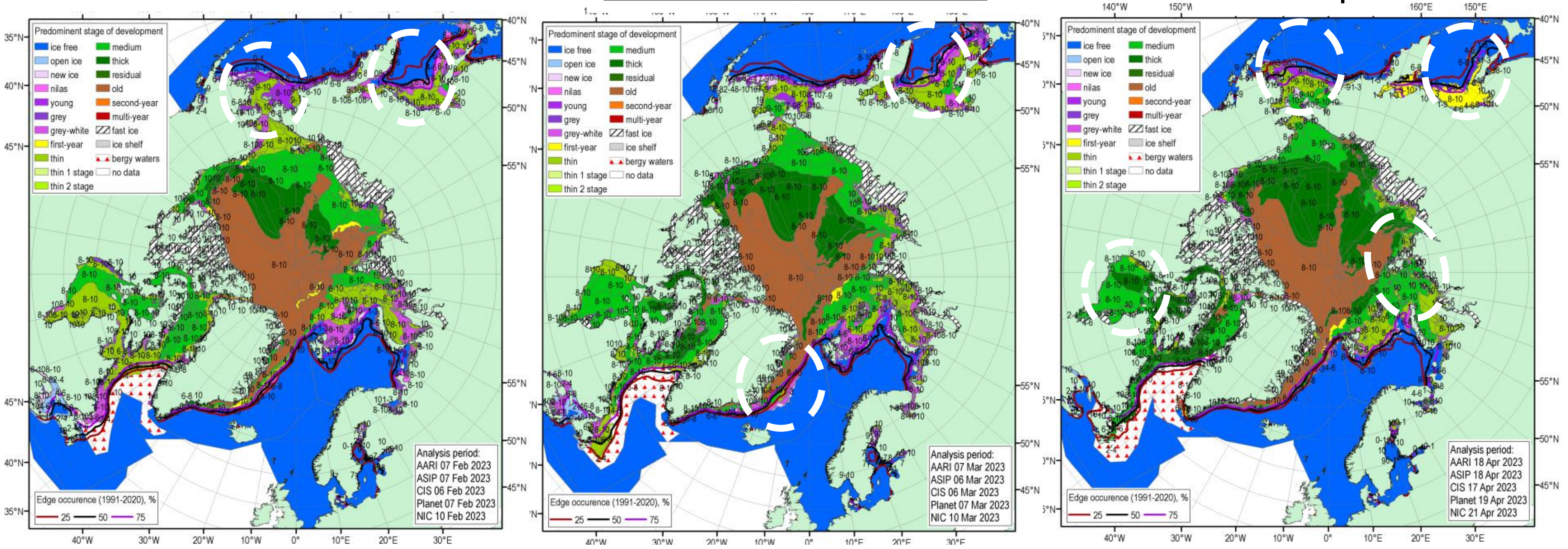
FMA 2023 Arctic sea ice – concentration and stage of development



06-10 Feb

06-10 Mar (maximum)

17-21 Apr

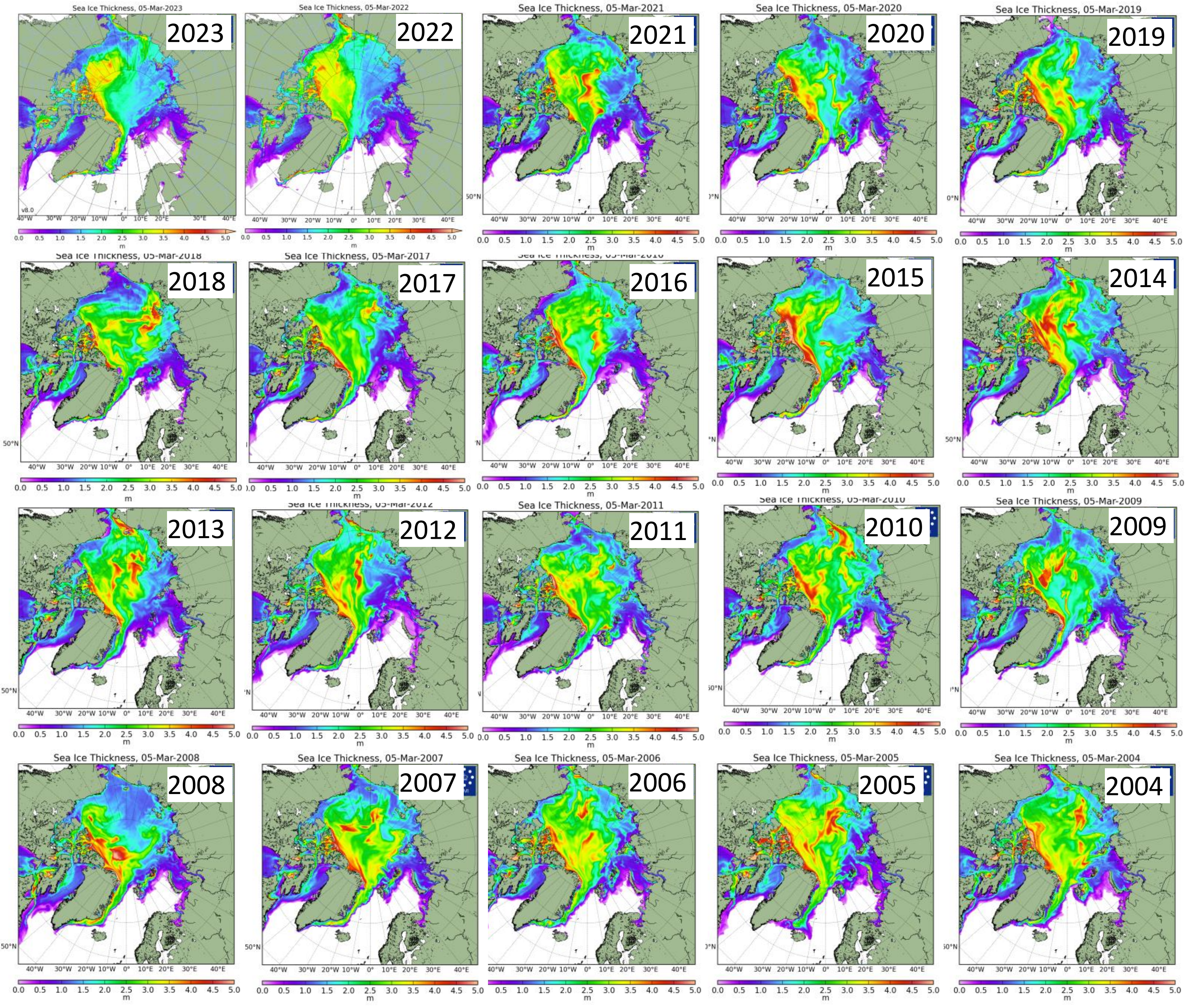


[sea ice analysis - AARI/ASIP/CIS/Planet/NIC; ice edge – AARI/NSIDC, nearest 5days, reference period: 1991-2020]

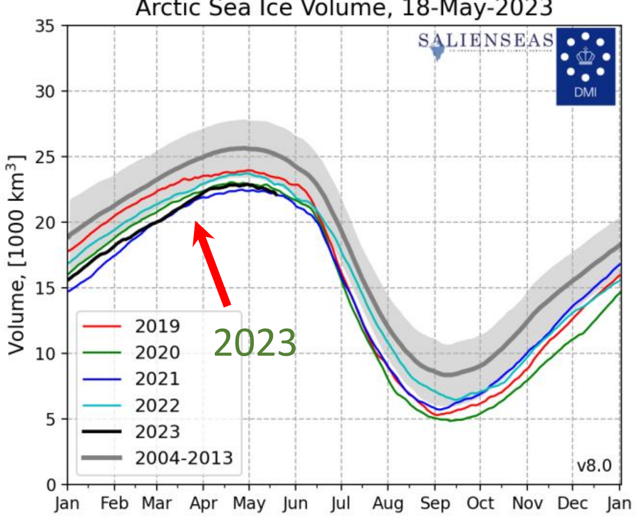
Special features of ice conditions in the Arctic during autumn – winter 2022/2023 included:

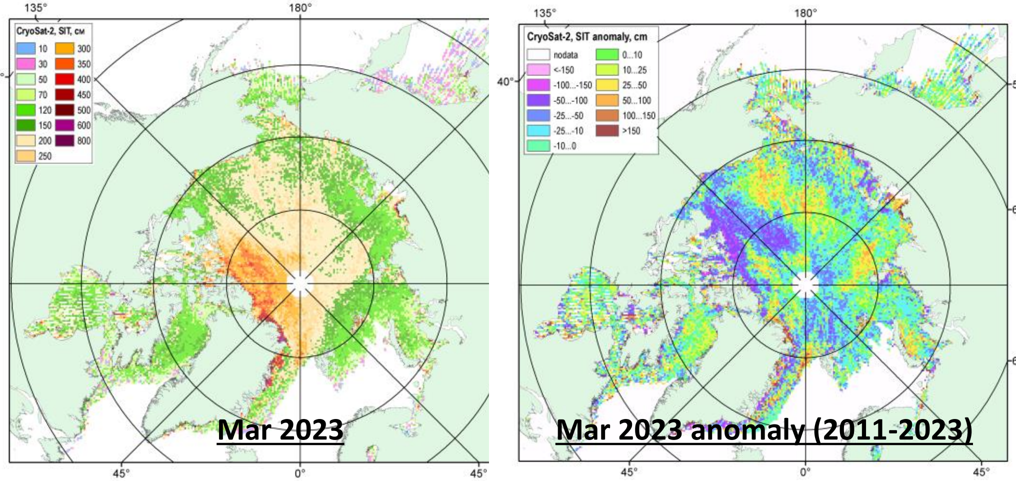
- ❖ occurrence of residual and further in season the second-year ice in the parts of the Laptev and East Siberian Sea and close to normal autumn ice growth within eastern lanes of the NSR,
- ❖ Close to decadal normal ice conditions in the Canadian Arctic
- ❖ Close to normal ice conditions in the Sea of Okhotsk which is opposite to 2022

Sea ice thickness for 5 Mar 2004…2023, ice volume and CryoSAT-2 SIT



[DMI North Atlantic - Arctic Ocean model HYCOM-CICE - http://ocean.dmi.dk/models/hycom.uk.php]





ESA CryoSAT-2 sea ice thickness (AWI v2p5)

Cryosat-2 measurements show the general Arctic Basin SIT distribution in March 2022 similar to mean 2011-2023. Estimate of the total Arctic ice volume, based on modelling is close to ~2[nd] lowest for 2004-2023 after 2020 and 2021 due to SIT loss in Canadian Arctic

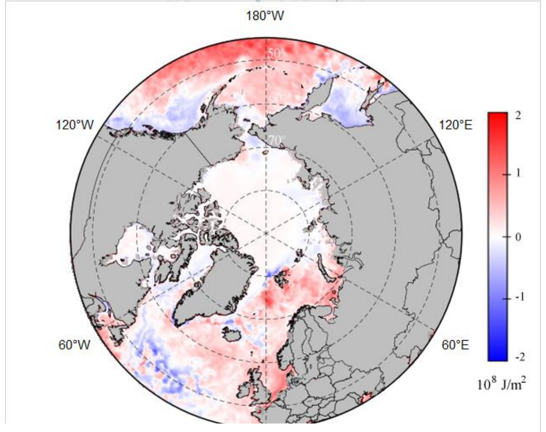
Polar Ocean

- Sea surface temperature
- Storms - Wave and swell height
- pH and acidification or alkalization of the Arctic ?

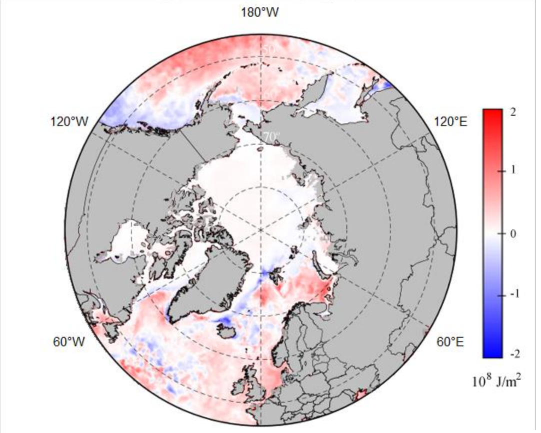
Heat content, waves and pH – NDJ 2022/2023 & FMA 2023

- During first part of the winter 2022/2023 **higher** 15 m upper ocean layer Heat Content (HC) was noticed in the E Bering, Svalbard, southern Greenland waters. **Lower** HC was noticed in Chuchki and Okhotsk seas with somewhat neutral over other parts of the Arctic. **Calmer** sea surface conditions were observed in the Barents and Greenland Seas with **higher** stormier conditions in the Bering and Okhotsk Seas.
- Later in winter the HC was mostly neutral to 1993-2020 average for most of the Arctic with the same **lower** exception for the Sea of Okhotsk and **higher** for parts of Svalbard and Barents Sea. Prominent **higher** stormier sea was observed for the open-water Atlantic sector of the Arctic, Barents and W Bering sea.
- Numerical models show for the current winter season both neutral and **positive pH anomalies** (alkalization) for the Arctic Basin, Laptev, Chukchi Seas and **negative pH** for the Barents, parts of the Kara, East Siberian, Greenland Seas) anomalies to the 1993-2020 period, which is in general similar to 2022, the latter may point to **acidification** processes though need further verification with ground-truth data.

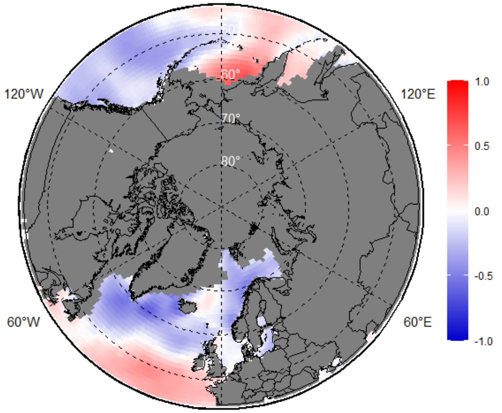
[AARI / CCCS MEMS & ERA5]



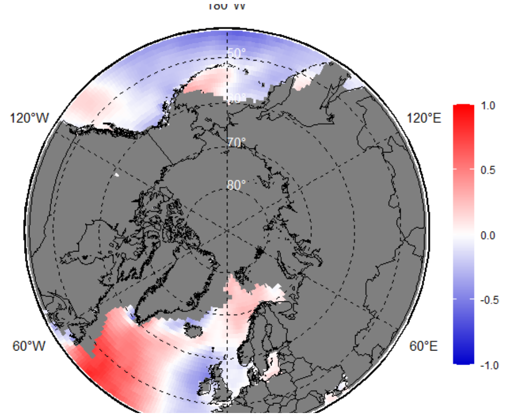
NDJ Heat Content anomaly (1993-2020)



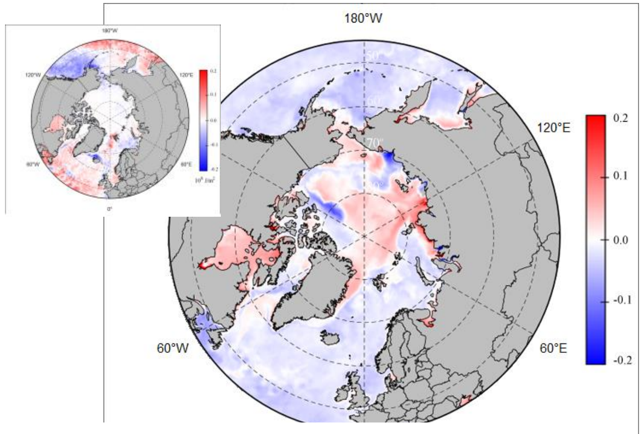
FMA Heat Content anomaly (1993-2020)



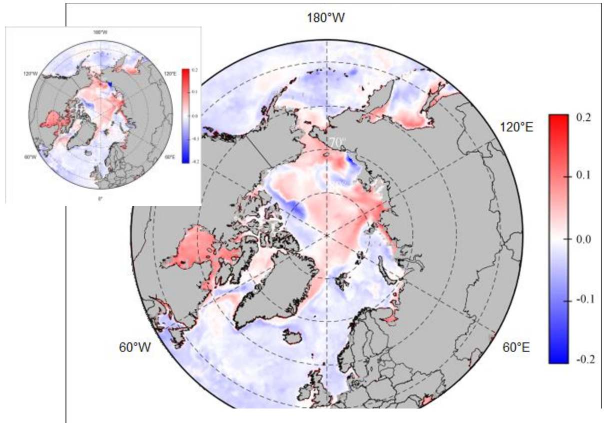
NDJ WW&S height anom (1991-2020)



FMA WW&S height anom (1991-2020)



NDJ pH anomaly 2m (1993-2020)



FMA pH anomaly 2m (1993-2020)

Hydrology and land Snow

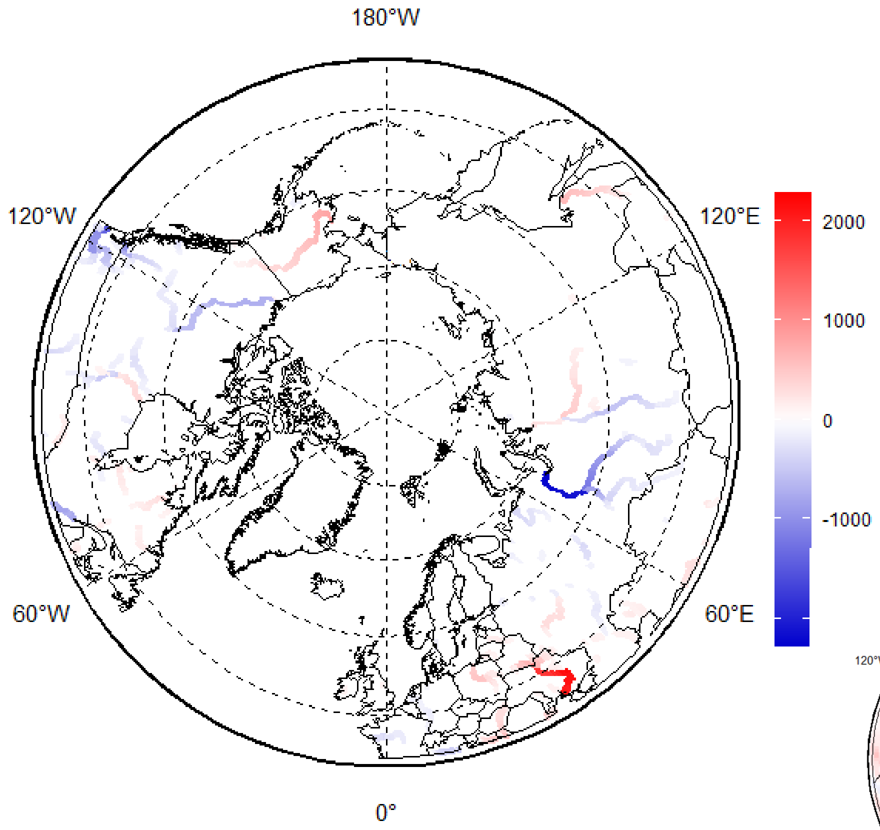
- River discharge
- Snow water equivalent
- Snow extent

Impacts of precipitation on river discharge

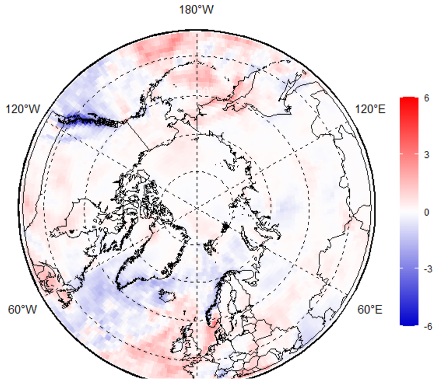
Impacts of wetter/drier and colder/warmer weather conditions were reflected in the winter/spring 2022-2023 Arctic rivers discharge though the frozen ground restricts direct effects

- ❖ **lesser** drainage than normal is seen for Pechora, Ob’, most of Enisey and Mackenzie rivers through the whole season
- ❖ Yukon, partly Enisey rivers experienced **greater** discharge than normal
- ❖ Close to normal river discharge was estimated for Lena and further eastward Siberian rivers

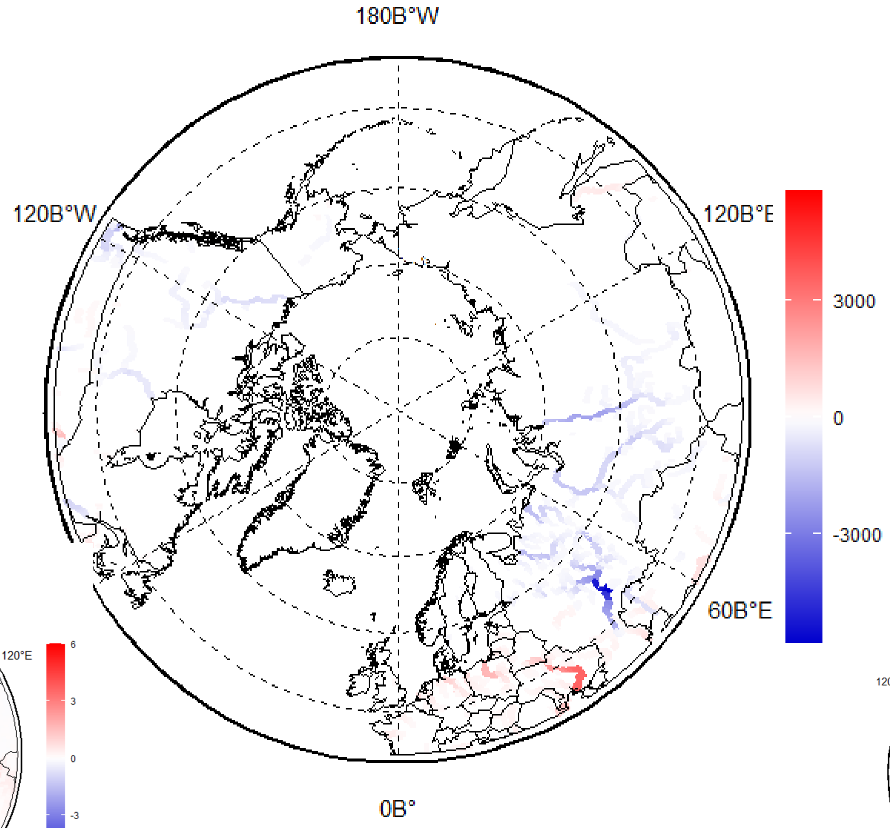
[AARI / CCCS ERA5-GloFAS]



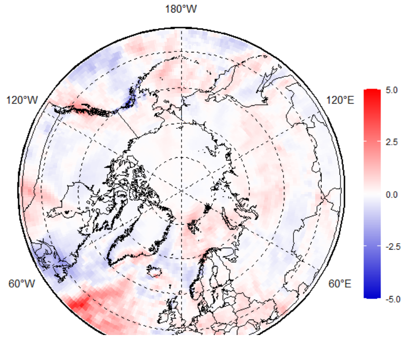
NDJ 2022/2023 river discharge anomaly (1991-2020)



NDJ 2022/2023 prec anomaly (1991-2020)



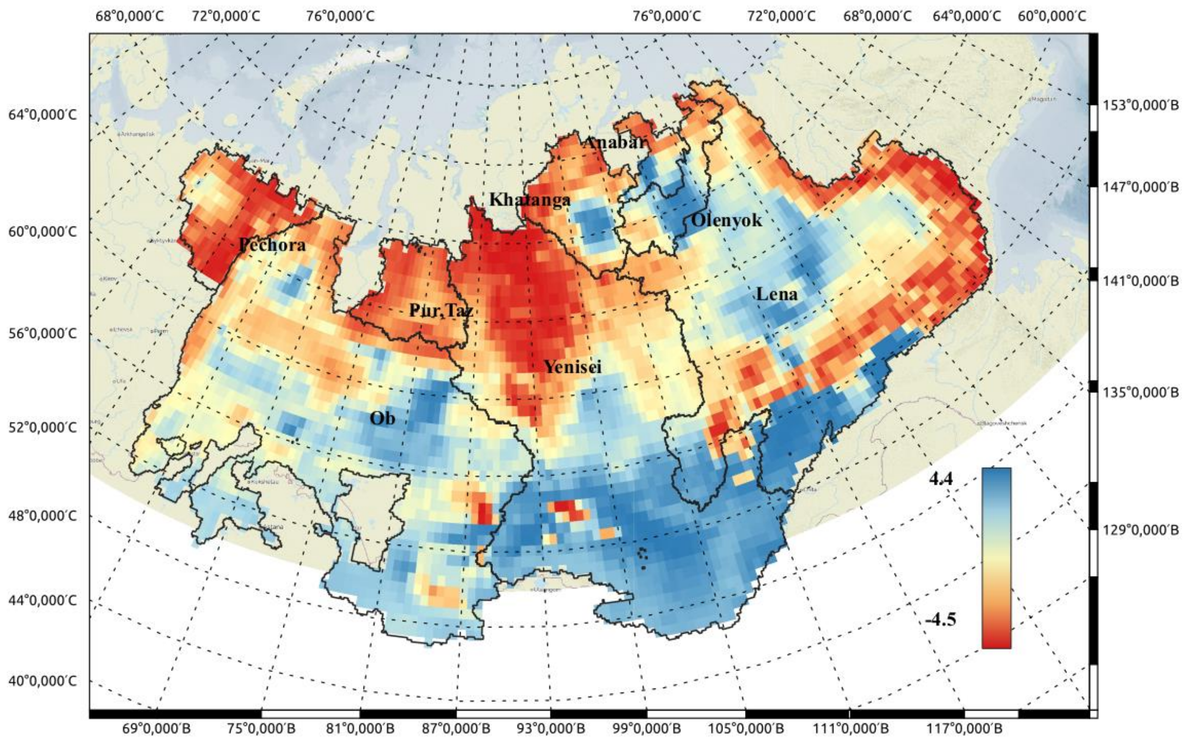
FMA 2023 river discharge anomaly (1991-2020)



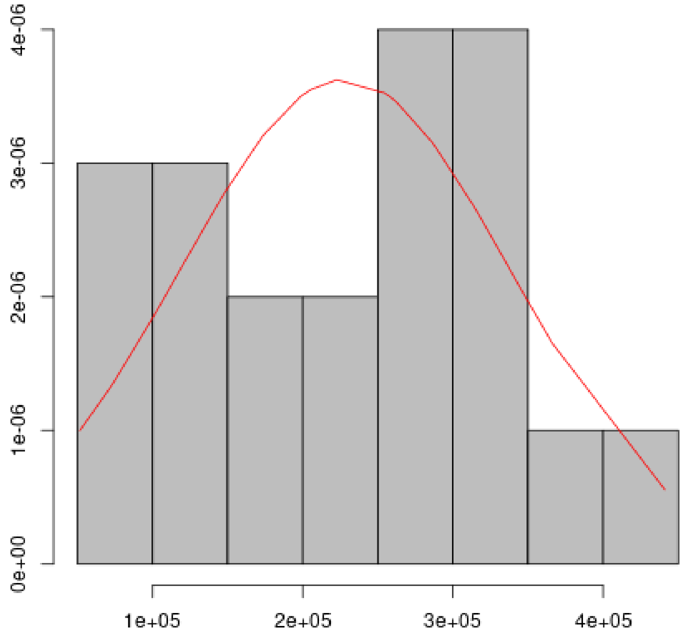
FMA 2023 prec anomaly (1991-2020)

River discharge trends (Eurasian Arctic) based on MERRA2 reanalysis

Linear regression of river discharge 2013-2022, April-May



Normal distribution and histogram.

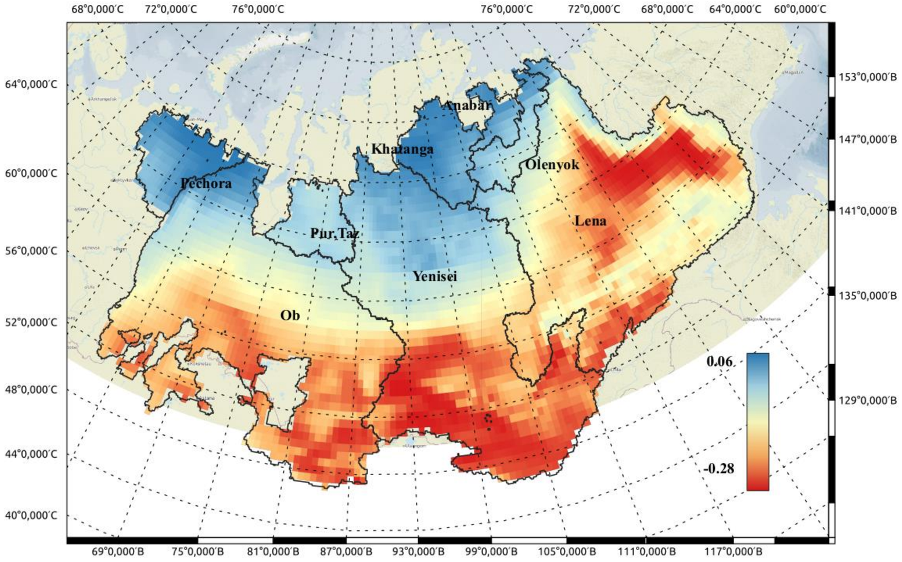


watersheds	mean	median	std	min	max
Pechora	-1,39	-1,44	0,67	-3,21	-0,09
Ob	-0,27	-0,17	0,34	-3,86	0,31
Pur_Taz	-1,18	-1,22	0,36	-2,04	-0,41
Yenisei	-0,61	-0,23	0,92	-4,50	0,70

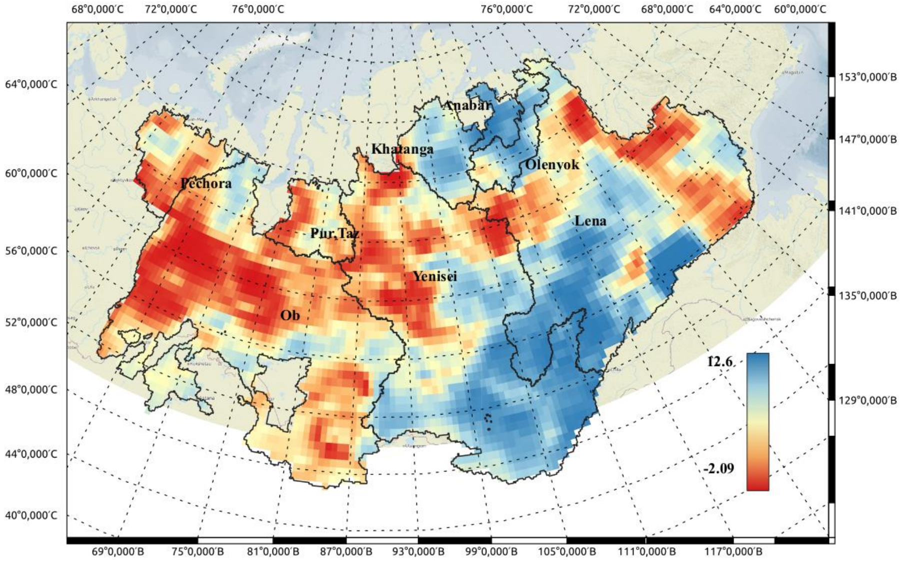
watersheds	mean	median	std	min	max
Khatanga	-0,73	-0,73	0,58	-2,47	0,26
Anabar	-0,47	-0,22	0,62	-1,61	0,50
Olenyok	-0,31	-0,25	0,42	-1,42	0,36
Lena	-0,43	-0,26	0,67	-4,05	4,43

MERRA2 reanalysis (2013-2022), April-May, of river discharge precursors (Eurasian Arctic)

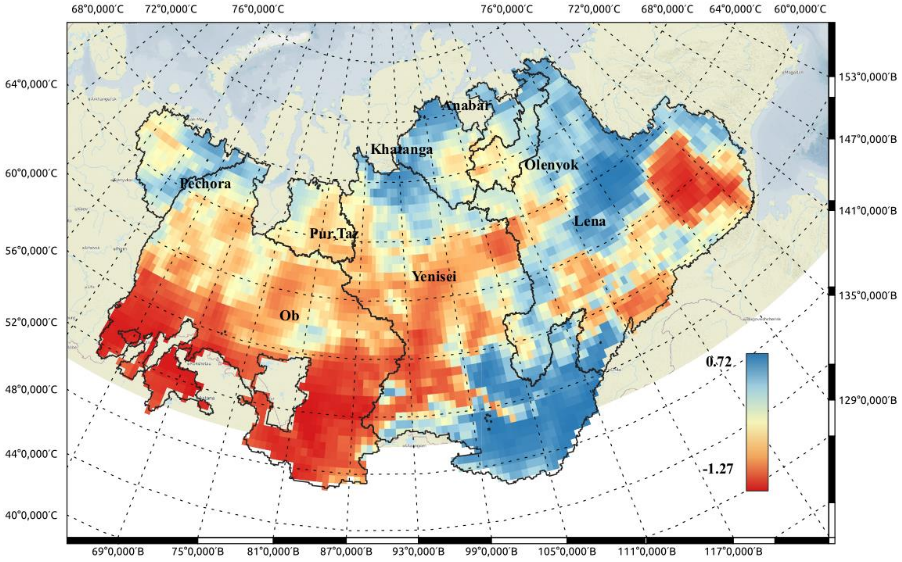
Linear regression, 2m air temperature



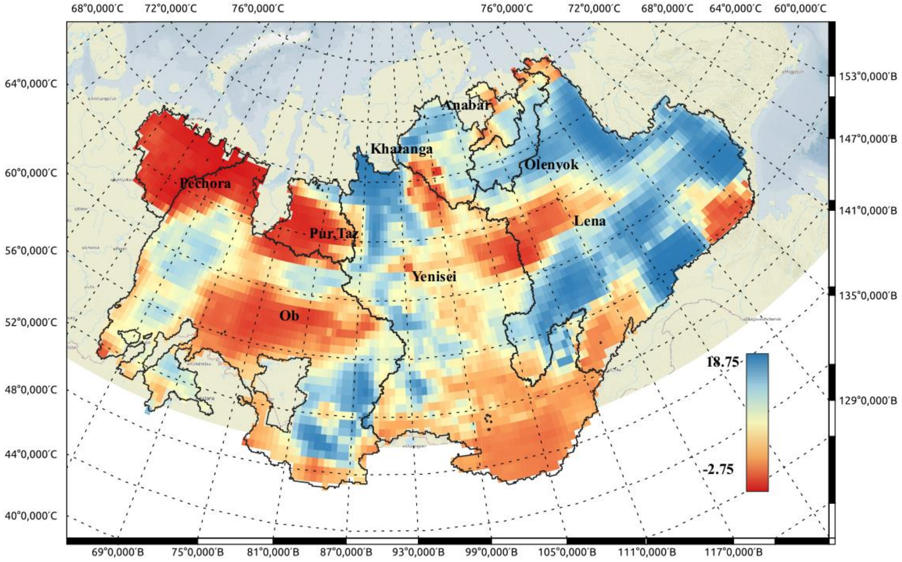
Linear regression of corrected land precipitaion



Linear regression of evaporation

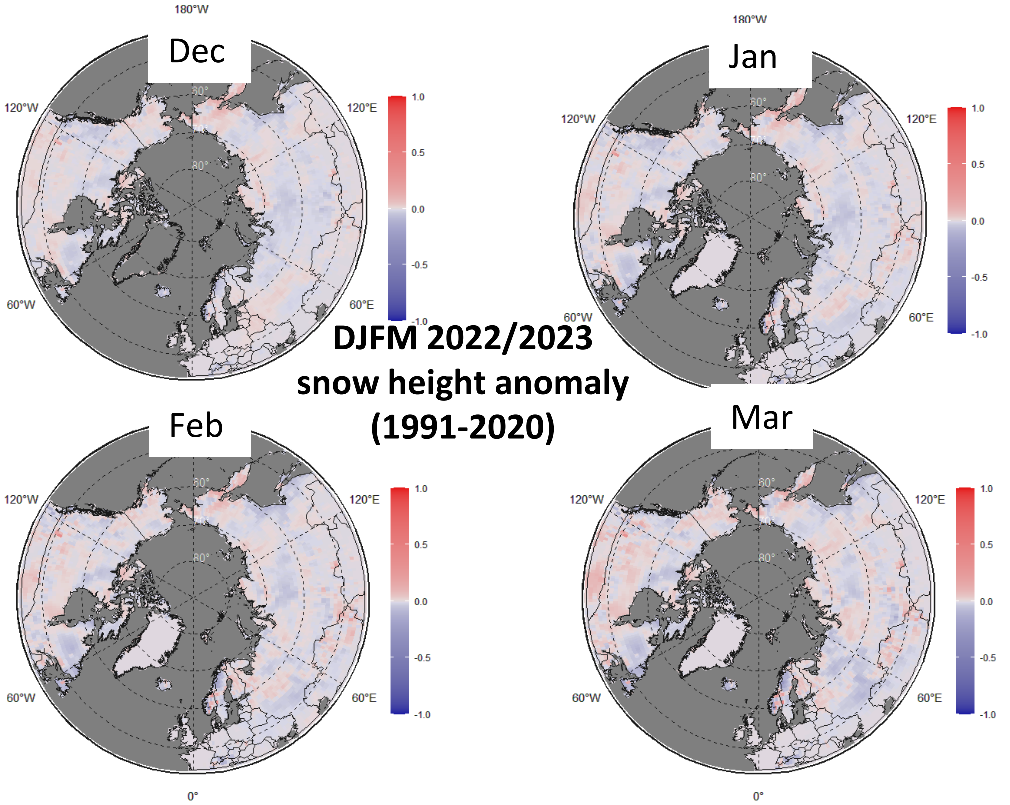


Linear regression of snow water equivalent



NDJFMA 2022-2023 land snow

- During NDJFMA 2022-2023 **lesser** snow height as well as snow water equivalent dominated over parts of Siberia and N Canada
- Positive anomalies (**greater snow height**) were observed in parts of Alaska, C Canada, Nordic and E Siberia
- The snow extent over Eurasia was below 1991-2020 normal. Alaska and Canada in general experienced normal or somewhat greater snow extent

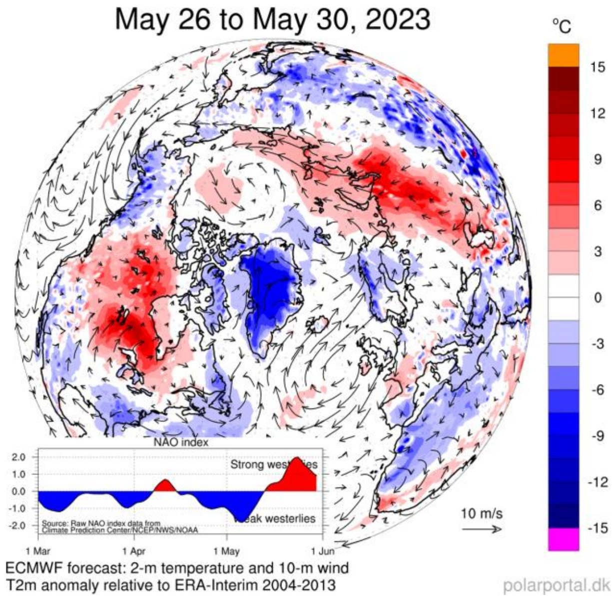


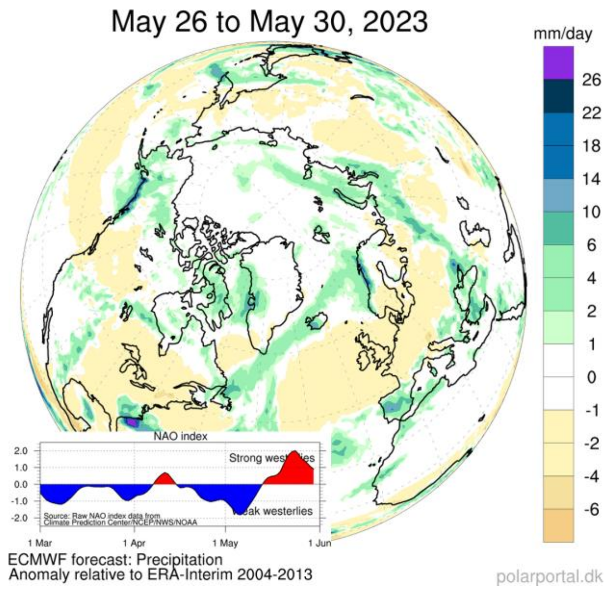
[GCW / Rutgers Global SnowLab]

2022-2023		1991-2020 Normal		Period of Record from Nov 1966		
Month	Area, 1000 km^2	Mean	Departure	Rank	Maximum (Year)	Minimum (Year)
Eurasia						
4	16,347	16,759	-412	43/57	20,687 (1981)	14,767 (2014)
3	22,266	24,091	-1,825	52/57	27,950 (1981)	20,183 (2002)
2	28,210	28,515	-305	37/57	32,285 (1978)	25,913 (2002)
1	28,607	29,647	-1,040	48/57	32,265 (2008)	25,823 (1981)
12	26,119	27,365	-1,246	48/57	29,699 (2002)	22,882 (1980)
11	22,494	21,181	1,313	11/57	24,132 (1993)	16,796 (1979)
Canada						
4	8,984	8,787	197	27/57	9,860 (1979)	6,939 (2010)
3	10,323	10,074	248	07/57	10,368 (1982)	9,486 (1981)
2	10,325	10,309	16	24/57	10,424 (2013)	10,015 (1981)
1	10,299	10,319	-20	35/57	10,424 (1982)	10,060 (1981)
12	10,259	10,147	112	14/57	10,403 (2016)	9,691 (1980)
11	9,667	8,948	718	05/57	9,978 (2018)	7,254 (1987)
Alaska						
4	1,500	1,461	39	2-15/57	1,526 (2018)	1,360 (2016)
3	1,530	1,495	35	05/57	1,534 (2008)	1,293 (1968)
2	1,527	1,513	14	25/57	1,534 (tie)	1,417 (1968)
1	1,502	1,505	-3	14-16/57	1,534 (tie)	1,423 (1986)
12	1,529	1,495	34	04-05/57	1,534 (tie)	1,330 (1967)
11	1,483	1,416	67	07/57	1,521 (2021)	950 (1979)

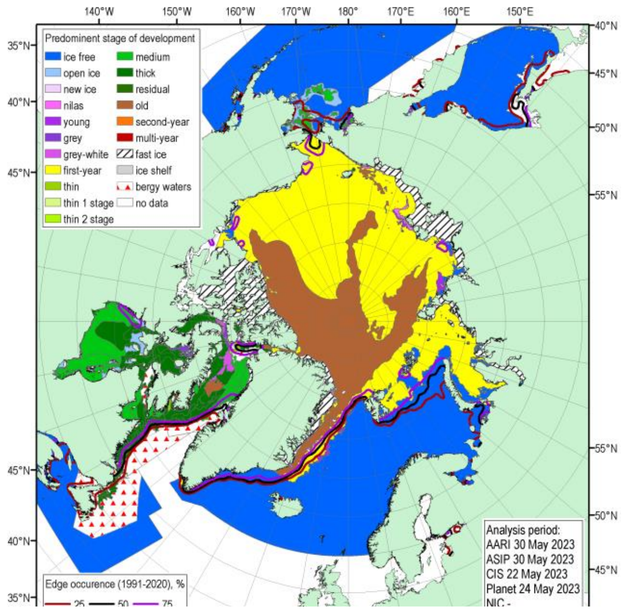
[AARI / CCCS ERA5 / GCW / Rutgers Global SnowLab]

Current Conditions (update closer to ACF11)

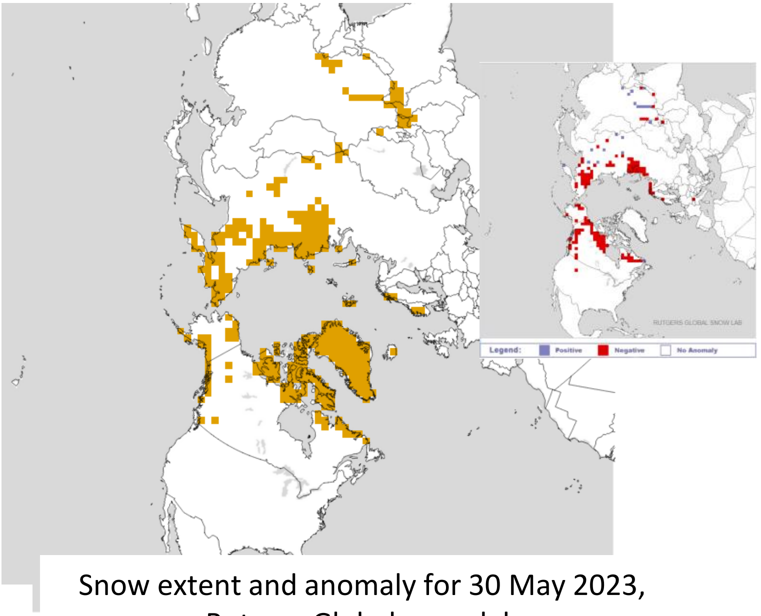




SAT, precipitation, mean wind vectors, NAO for 26-30 May 2023 (http://polarportal.dk)



AARI/ASIP/NIC ice chart for 19-24 May 2022



Snow extent and anomaly for 30 May 2023, Rutgers Global snow lab

- Since mid May strong westerly winds dominate in Nordic, SW winds over Siberia and Alaska sectors with southern winds over Canada
- Lower SAT is observed over European, Alaska, E Canadian and Greenland regions
- Higher SAT observed over central and eastern Siberia and central Canada regions
- Northmost Scandinavia, eastern Siberia? Chukchi, parts of Alaska, N Canada are under snow with overall negative anomalies for snow extent for all regions
- Bering and Sea of Okhotsk are under intense melting, with parts of the Kara, W Laptev Sea and Beaufort Seas under start of melt
- Other parts of the Arctic with fast ice zones in Siberia and Canadian Arctic are still well preserved, which is similar to 2021 and 2022

Data sources:

1. Copernicus Climate Change Service
   - ❖ ERA5 monthly averaged data on pressure and single levels (ERA5)
   - ❖ Marine environment monitoring service (CMEMS)
   - ❖ GloFAS operational global river discharge reanalysis (ERA5-GloFAS)
2. Weekly ice charts from AARI, CIS, NIC, ASIP, Planet / WMO GDSIDB project (http://wdc.aari.ru)
3. NSIDC Near-Real-Time DMSP SSMIS Daily Polar Gridded Sea Ice Concentrations
4. ESA CryoSAT-2 data (AWI)
5. DMI PolarPortal (http://polarportal.dk)
6. WMO GCW SnowWatch (FMI, ECCC, Rutgers Glob Snow Lab, http://climate.rutgers.edu/snowcover/)

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Thank you! Merci! Takk! Спасибо!
Tak! Tack! Kiitos! þakka þér fyrir!
Naqurmiik ! Qaĝaasakuq !
Giitu! Vielen Dank!
Dhanyavaad !

Monthly and seasonal graphs at full resolution and for all ECVs are available at:

- http://wdc.aari.ru/prcc/reanalysis/era5/png/monthly/arctic/0/
- http://wdc.aari.ru/prcc/reanalysis/era5/png/season/arctic/0/
- http://wdc.aari.ru/datasets/d0040/arctic/png/ArcRCC/

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale