Alaska Climate Research Center
The Alaska State Climate Center

STATEWIDE CLIMATE SUMMARY APRIL 2023

IN THIS ISSUE

Denali was out under blue skies on April 20. Photo: Carl Schmitt

Alaska's Statewide Climate Summary for April 2023 provides an overview of weather for the month based on data from selected weather stations throughout the state. "Departure from normal" refers to the climatological average over the 1991-2020 normal period. Here, we report on temperature, precipitation and drought conditions in the state, as well as the condition of the Arctic sea ice.

HIGHLIGHTS

Unusually cold month in all of Alaska

Two pronounced cold snaps in the West and Interior with numerous new daily low records

2-3 times more snow than normal in Fairbanks and Anchorage

Significant Weather Events and Synoptics

April 2023 was an exceptionally cold month throughout Alaska. The month started out with a long wave trough over Canada and the Eastern Interior, a not very pronounced ridge over the Bering Sea, and another trough over eastern Russia. This pattern shifted progressively east over the course of a few days, bringing changeable weather with some snow and initially mild temperatures, before colder weather moved in around April 5. A notable cold snap followed, particularly in western Alaska. The defining upper level feature during this unusually cold period was an upper level low centred just north of the Bering Strait (Fig. 1, upper panel). This low remained near stationary for a fairly prolonged period of time and caused advection of cold and relatively dry Arctic air masses to the south. A large area of upper level ridging over Canada prevented the movement of the low.

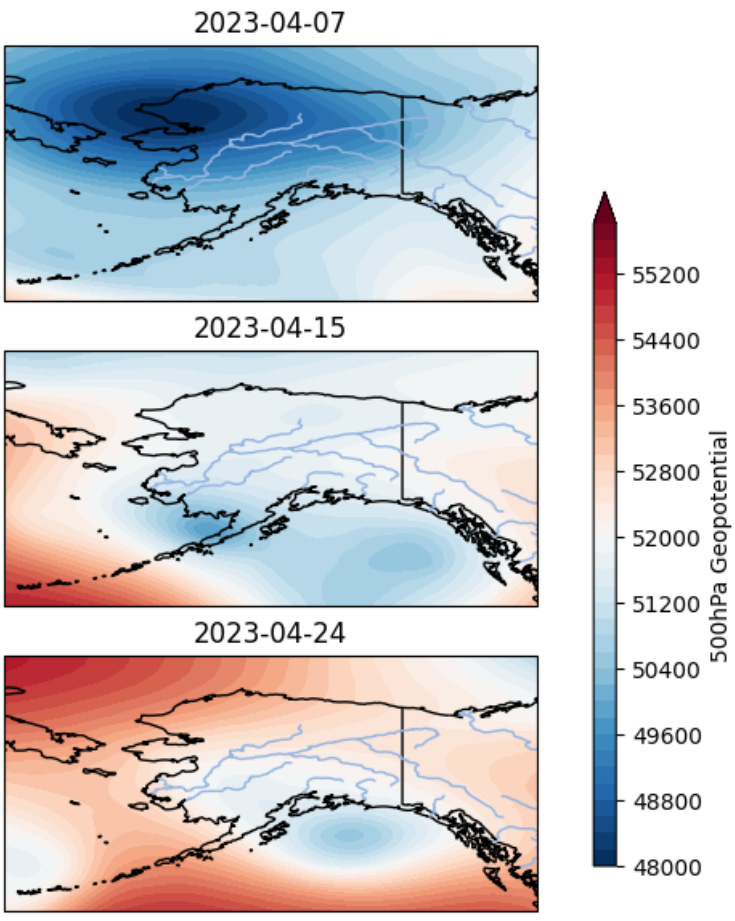

Figure 1. *Geopotentiial at the 500hPa level on April 7, 15, and 24, data courtesy of Copernicus ERA5 reanalysis.*

Large, wave-like patterns in the jet stream - like the low and high combination we saw during the second week of April - lead to slower eastward movement of the upper level features and can produce long periods of high or low pressure over the same area. The large-scale ridging over Canada eventually shifted eastwards and the Alaskan low gradually dissipated. By around April 11, the persistent low over northwest Alaska had shifted enough to allow a Bering Sea storm system to move in. This led to a short period of slightly warmer (near normal) temperatures roughly south of the Yukon, while the northern parts of the state remained unseasonably cold.

A large long wave trough stretching from the Arctic Ocean across the North Slope and into the Bering Sea subsequently moved in and temperatures dropped once more. In combination with a pronounced ridge over Siberia, this pattern was again very “wavy”, or meridional, and fairly persistent. Temperatures remained cooler than normal in most of the state with the exception of the Panhandle, which saw a southwesterly flow on the downstream edge of the large scale trough. By mid-month, widespread upper level troughing was centred over Alaska (Fig. 1, middle panel).

The high pressure in the east eventually moved into the Bering Sea and brought warmer temperatures to western Alaska by around April 19. Low pressure persisted in the Gulf of Alaska and a “high-over-low” or Rex-block pattern emerged, with high pressure stretching from the Bering Sea to Canada between the Gulf of Alaska low and a deep upper level low near the North Pole (Fig. 1, lower panel). This constellation developed into a pronounced Omega block in the following days - another very wavy pattern that blocks off the westerly circulation and forces the jet stream to meander. A pronounced upper level ridge extending from the Bering Sea far into the Arctic Ocean was sandwiched between upper level troughing over Siberia and over eastern Alaska and South-Central, forming a constellation in the shape of the Greek letter Omega (hence, “Omega block”).

The eastern trough and associated cold air mass moved retrogressively (west rather than east) further into Alaska during the last week of the month, causing another significant cold snap in the Interior. The cold and wintery weather shifted towards the western parts of the state for the last days of the month with temperatures rising again in the Interior and along the ALCAN border.

Temperature

April 2023 in Alaska was substantially colder than the 1991-2020 climatological mean. All first order stations recorded a colder than normal monthly mean. The Panhandle and Southwestern islands were warmest in relative terms, with deviations from normal of -0.2°F to -1.3°F. The Interior and northwestern parts of the state saw consistently cold temperatures throughout the month. Six of the selected stations had deviations of more than 10°F below normal. Nome was coldest in relative terms with -14.2°F below normal, followed by Bettles and Kotzebue with about -13°F. McGrath unfortunately suffered a data

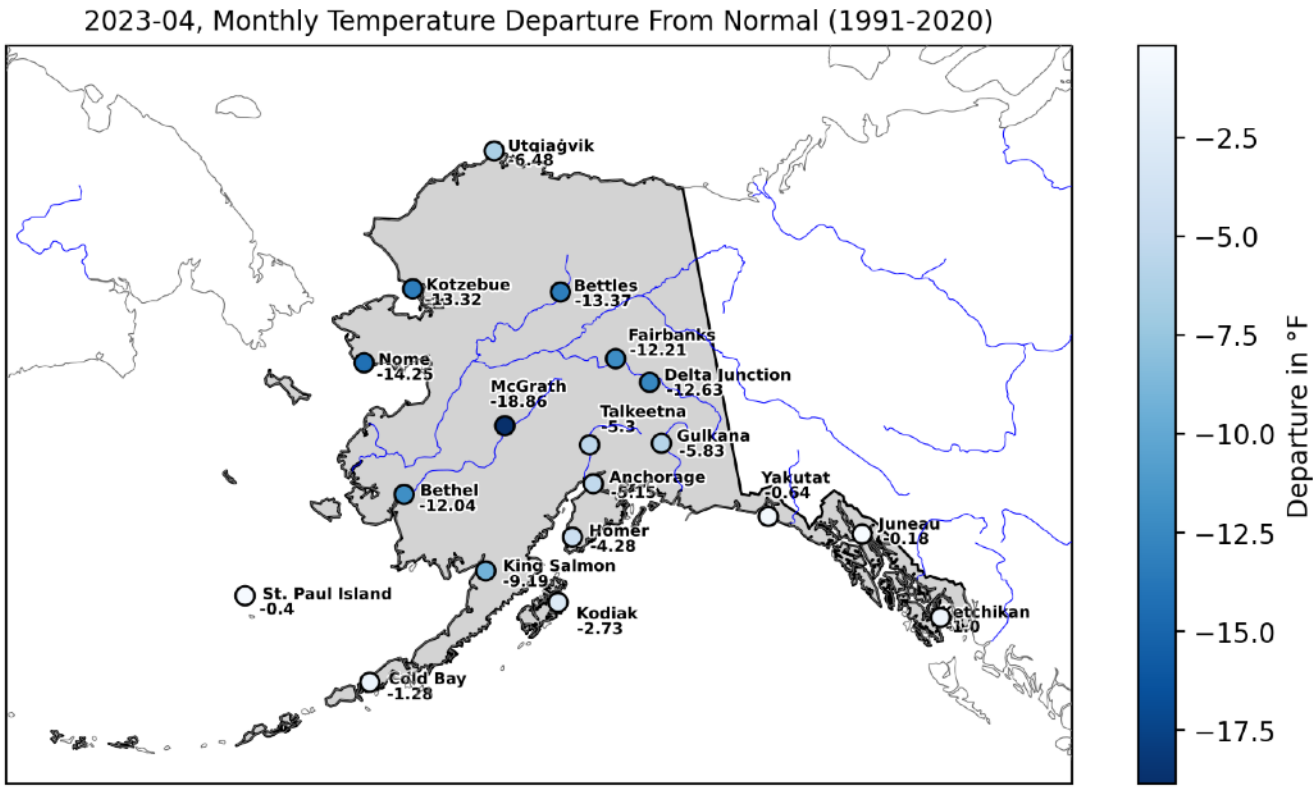

Figure 2. *Monthly mean temperature departure from normal (ºF), April 2023, at the selected First Order stations in Alaska.* ***Note that McGrath had a prolonged data outage during the second half of the month and the monthly value is not representative.***

outage of multiple days towards the end of the month, so the (very low) monthly mean at this station cannot be considered representative (Fig. 2, Table 1).

The daily anomalies reflect the unusually prolonged cold spell that affected much of Alaska this April. The North Slope, West Coast, and Interior first order stations all show large, negative daily deviations from normal and very few - if any - days with positive anomalies. Along the West Coast, e.g. in Kotzebue and Nome, it was coldest during the first pronounced cold snap from about April 5 - 10. Temperatures then recovered somewhat but remained below normal through the end of the month. In the Interior, a second cold snap in the last third of the month brought another round of very negative daily anomalies on par with the April 5 - 10 episode. The first very cold period was associated with the persistent upper level low near the Bering Strait (Fig. 1, upper panel). The second cold snap, most pronounced in the Interior, was due to the influx of cold air masses from the north east later in the month (Fig. 1, lower panel). Anomalies were less extreme overall in the southern parts of the state. St. Paul Island, the Aleutians, and

South-central saw a cooler than normal month as well, but with more moderate negative deviations and more milder days. Temperatures were near normal in the Southeast, with moderate ups and downs in terms of anomalies.

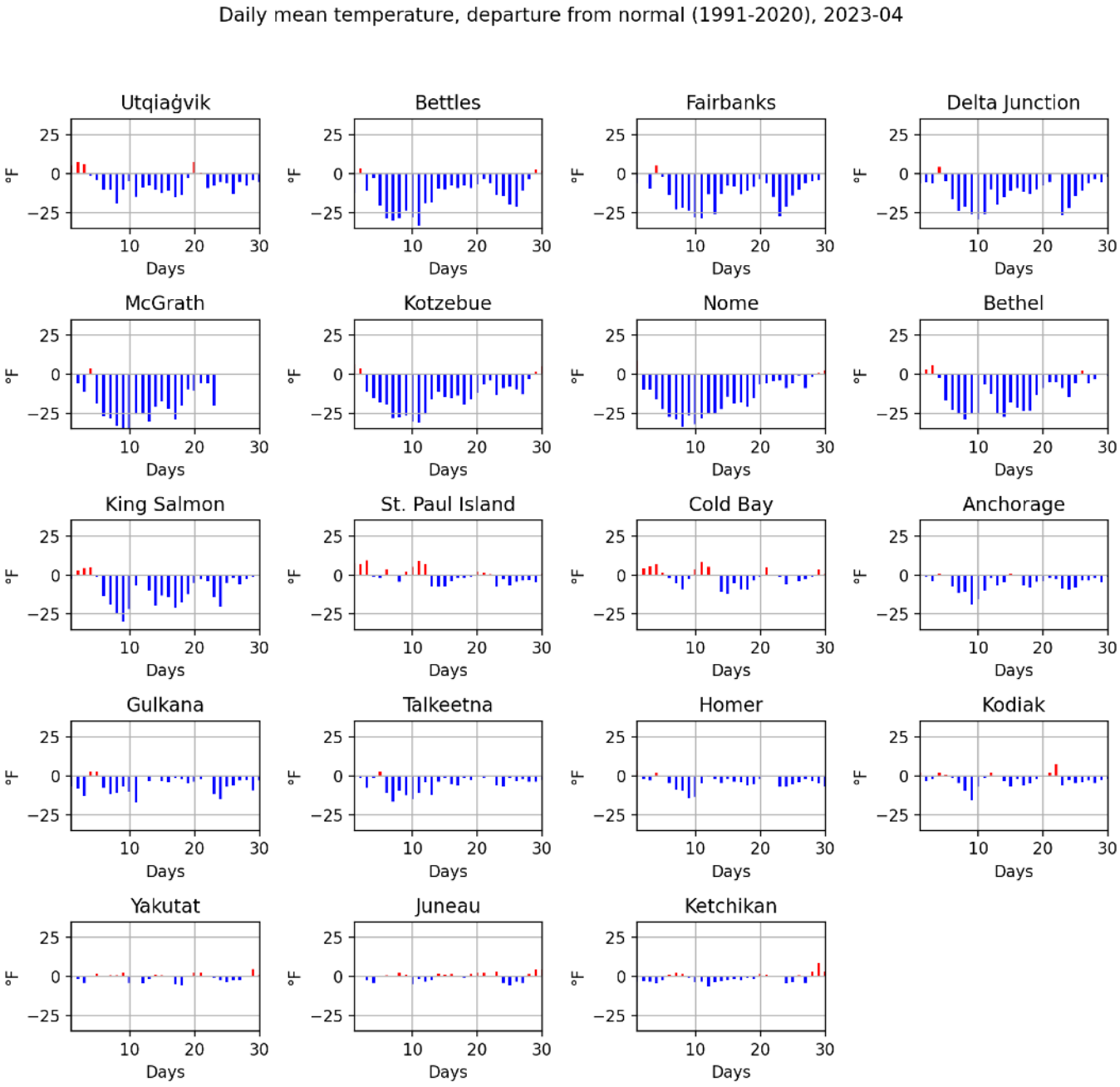

Figure 3. *Daily mean temperature departures for each day in April 2023 at the selected stations. Note data outage at McGrath during the last week of the month*

Daily temperature records for April reflect the very cold nature of the month. In a notable deviation from the patterns of previous months, numerous new low records were set, and hardly any new high records. Ten new low records for daily mean temperature were recorded during the cold snap in the first half of the month, particularly at stations in western Alaska. Similarly, maximum and minimum daily temperatures also reached new low records, mostly during the first cold snap in the west. Interior stations saw a few new low records during the second cold snap later in the month. However, the April 5-10 cold snap was more extreme in terms of daily records (see tables in the appendix for lists of daily temperature records at the selected first order stations).

Station	Observed (ºF)	Normal (ºF)	Departure (ºF)
Anchorage	32.4	37.5	-5.2
Bethel	17.0	29.1	-12.0
Bettles	11.2	24.6	-13.4
Cold Bay	33.7	35.0	-1.3
Delta Junction	21.0	33.8	-12.6
Fairbanks	21.4	33.7	-12.2
Gulkana	26.6	32.6	-5.8
Homer	34.3	38.7	-4.3
Juneau	40.6	40.8	-0.2
Ketchikan	42.5	43.5	-1.0
King Salmon	26.9	36.1	-9.2
Kodiak	36.4	39.1	-2.7
Kotzebue	3.0	16.3	-13.3
McGrath *	10.7	32.2	-18.9 (incomplete data)
Nome	8.4	22.6	-14.2
St. Paul Island	29.7	30.1	-0.4

Station	Observed (ºF)	Normal (ºF)	Departure (ºF)
Talkeetna	30.8	36.2	-5.3
Utqiaġvik	-2.4	4.1	-6.5
Yakutat	38.0	38.6	-0.6

Table 1. *Mean monthly air temperature, normal (1991-2020) and departure for selected stations throughout the state, April 2023. Color-coded to match Figure 2 (yellow-orange-red = warmer than usual; shades of blue = cooler than usual). *McGrath had a prolonged data outage during the second half of the month and the monthly value is not representative.*

Precipitation and snow

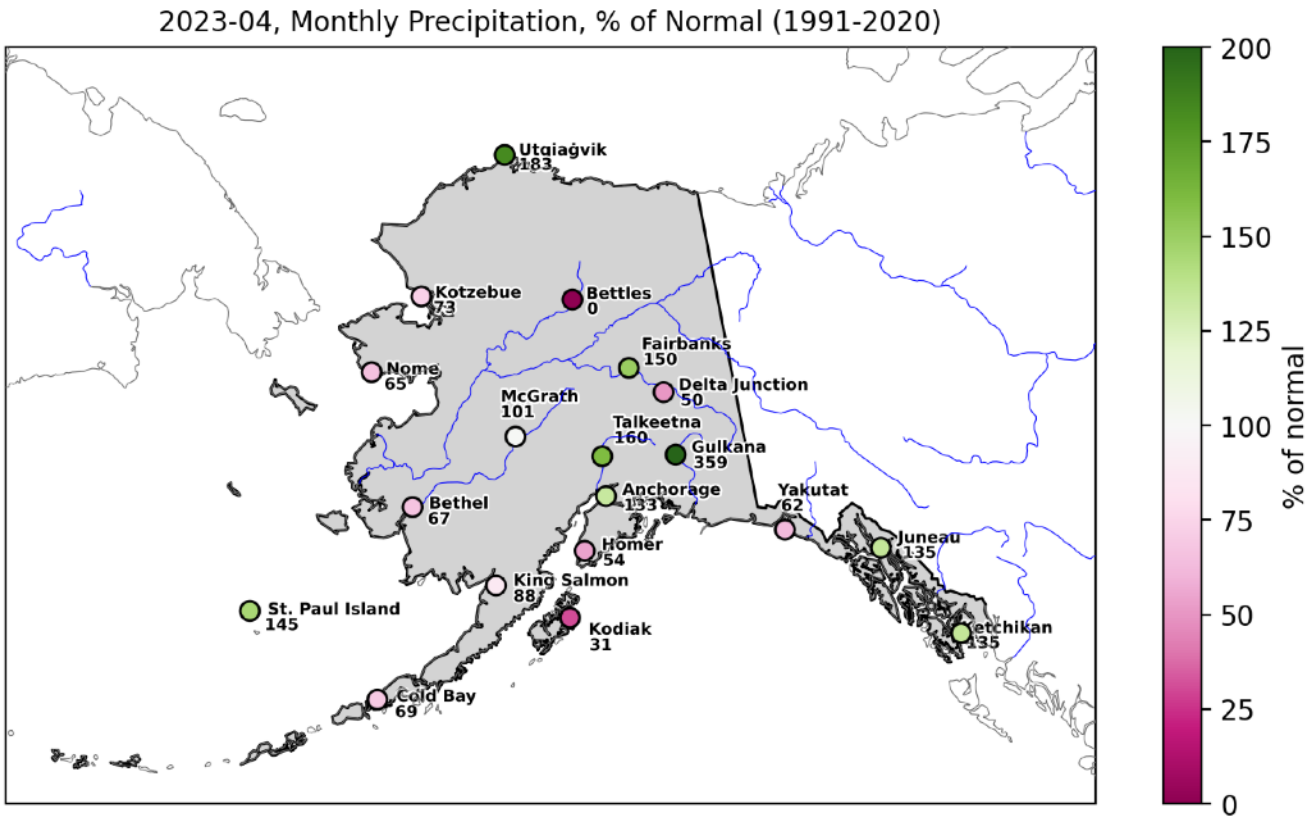

Figure 4. *Monthly mean precipitation departure from normal (in percent), April 2023, for selected stations around the state of Alaska. Note that McGrath suffered a prolonged data outage during the second half of the month and the monthly value is unreliable.*

April was relatively dry in most of the state, with regional exceptions. Gulkana was by far the wettest station in relative terms with 359% of normal, followed by Utqiaġvik with 183% of normal. Fairbanks, Anchorage, St. Paul Island, Juneau and Ketchikan had a moderately wet month with around 120-170% of normal. Kodiak was the driest station, relatively speaking, with only 26% of normal. Bettles did not record any precipitation, but the cause of that may have been an instrument failure and the data point seems questionable (Fig. 4 and 5, Table 2). Generalising very broadly, regions that had a very cold month also had a drier than normal month. Cold air contains less moisture and this month's deep cold was therefore not conducive to precipitation.

Four of the first order stations have long term, continuous snow measurements,. Fairbanks and Anchorage recorded 277% and 250% of normal snowfall in April - a very snowy month! Juneau and Bettles had 67% and 23% of normal, although the Bettles data

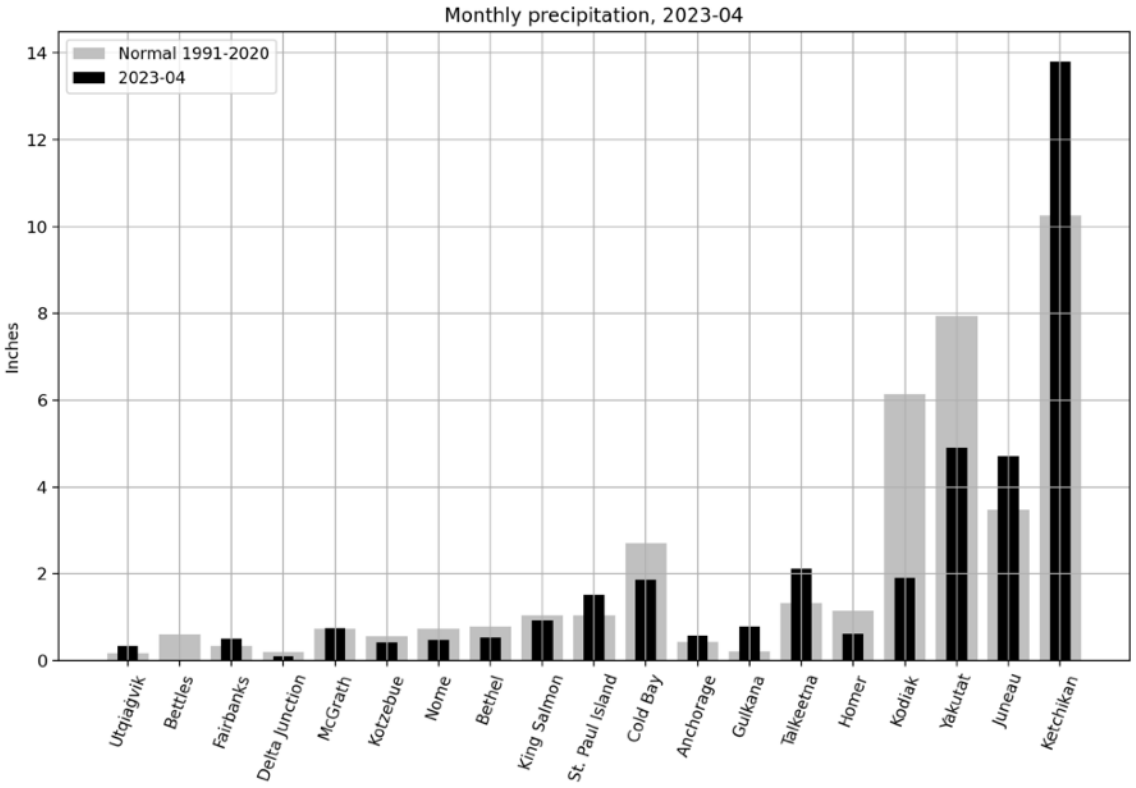

Figure 5. *Monthly precipitation sums for April 2023 at the selected First Order stations compared to the normal (1991-2020), in inches.*

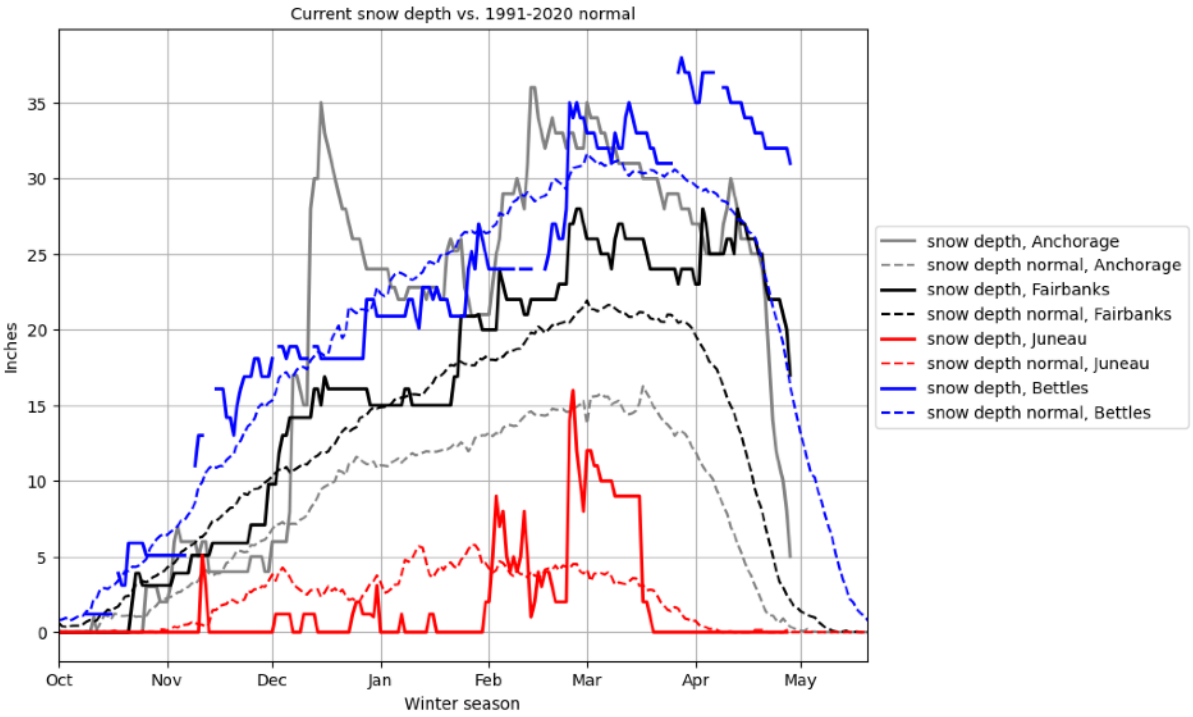

Figure 6. *Snow depth in Anchorage (grey), Fairbanks (black), Juneau (red), Bettles (blue) through April 28. Solid lines show current snow depth at the respective stations. Dashed lines show the 1990/91-2019/20 mean value throughout the winter season.*

appears unreliable this month with gaps in the snowdepth time series and questionable precipitation values. The GHCN-Daily snowdepth data plotted in Fig. 6 shows some suspicious jumps for Bettles, which may be corrected in a future version of the data set.

Snow depth in Fairbanks, Bettles, and Anchorage remains above normal for the time of year but has begun to decline. Since about mid-month, snow depth has decreased sharply, particularly at the Anchorage first order station. The snow season in Juneau ended in March - at least in terms of seasonal snow pack - and the snow pack is now declining quickly in the southern parts of the states. SWE values from the SNOTEL network suggest that snowpack is well above average in most basins, with around 200% of normal in parts of the Interior (Fig. 7).

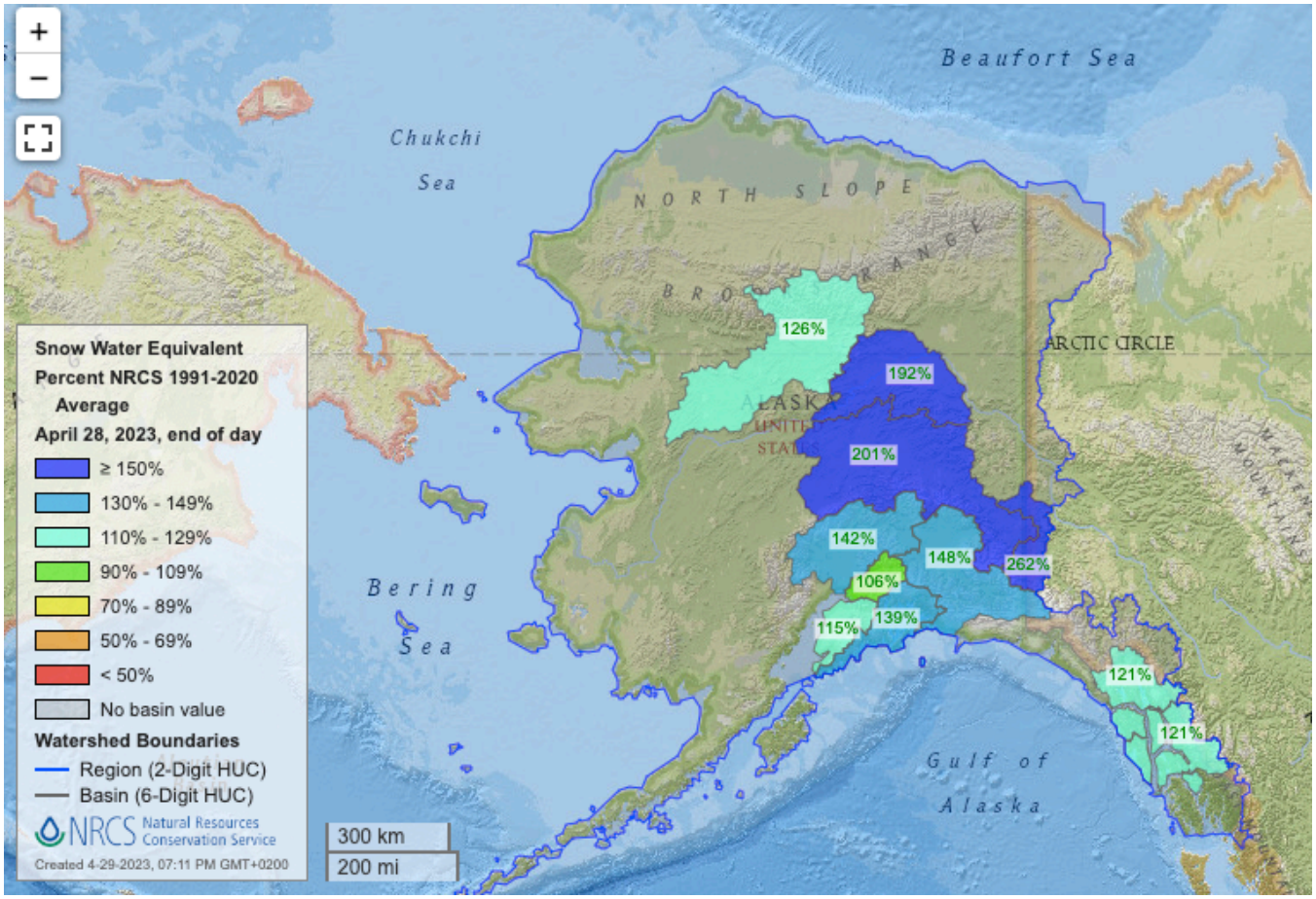

Figure 7. *SWE as % of basin-wide normal. Data and graphic: NRCS, USDA, https://www.nrcs.usda.gov/*

Station	Precipitation (in)	Normal (in)	% of Normal
Anchorage	0.6	0.4	132.6
Bethel	0.5	0.8	67.1
Bettles *	0.0	0.6	0.0
Cold Bay	1.9	2.7	68.9
Delta Junction	0.1	0.2	50.0
Fairbanks	0.5	0.3	150.0
Gulkana	0.8	0.2	359.1
Homer	0.6	1.2	53.9
Juneau	4.7	3.5	135.4
Ketchikan	13.8	10.3	134.6
King Salmon	0.9	1.0	88.5
Kodiak	1.9	6.1	31.1
Kotzebue	0.4	0.6	73.2
McGrath *	0.8	0.7	101.4
Nome	0.5	0.7	64.9
St. Paul Island	1.5	1.0	145.2
Talkeetna	2.1	1.3	159.8
Utqiaġvik	0.3	0.2	183.3
Yakutat	4.9	7.9	61.7

Table 2. *Monthly precipitation sum, normal (1991-2020) and departure expressed as a percentage of the normal (1991-2020) for selected stations throughout the state, April 2023. Colors match the color scale in Figure 4. *Incomplete or questionable monthly value*

Arctic Sea Ice

Arctic sea ice extent showed a lot of daily up and down variability throughout April. During the last week of the month, sea ice decrease was consistent at a rate of slightly over 2% per week. As of April 27, Arctic sea ice extent was 13.690 M km2, down from 14.284 M km2 on March 30. Figure 9 shows a time series of sea ice extent while Figures 10 A and B show the sea ice extent and concentrations as of April 30 2023 compared to the average from 1981-2010.

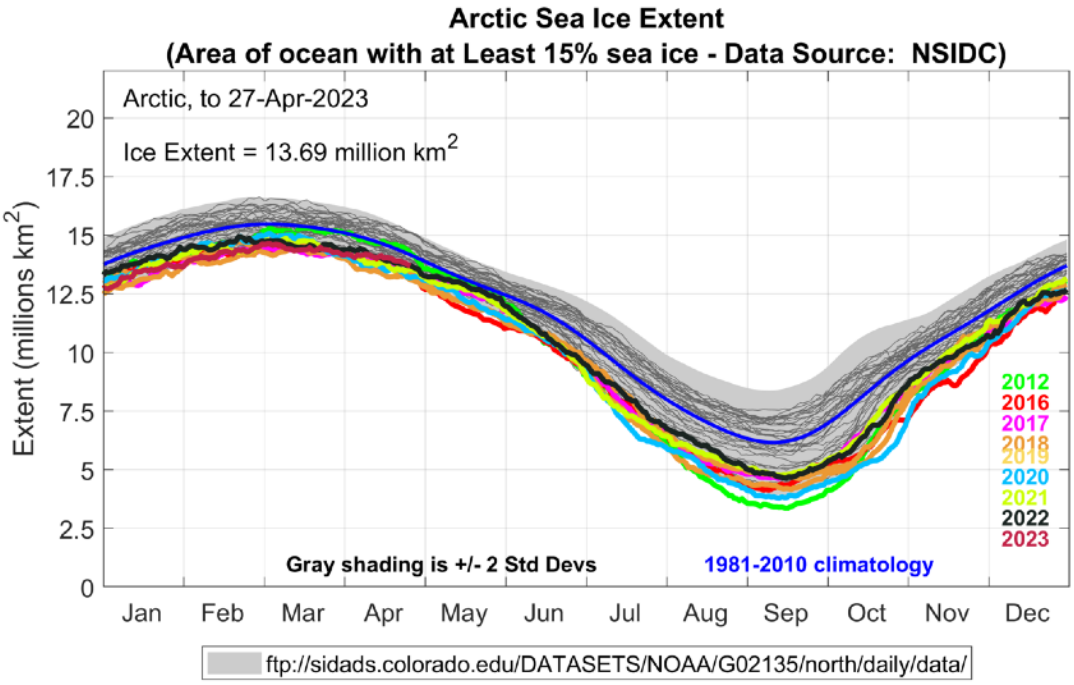

Figure 9. *Time series of daily Arctic sea ice extent. This year's data (black) are updated until April 27, 2023. The median sea ice extent for the 1981-2010 reference period is depicted in blue. Specific years are highlighted in colors. Plot Compiled by: Howard J. Diamond, PhD; Climate Science Program Manager at NOAA's Air Resources Laboratory Data Source: National Snow & Ice Data Center (nsidc.org/)*

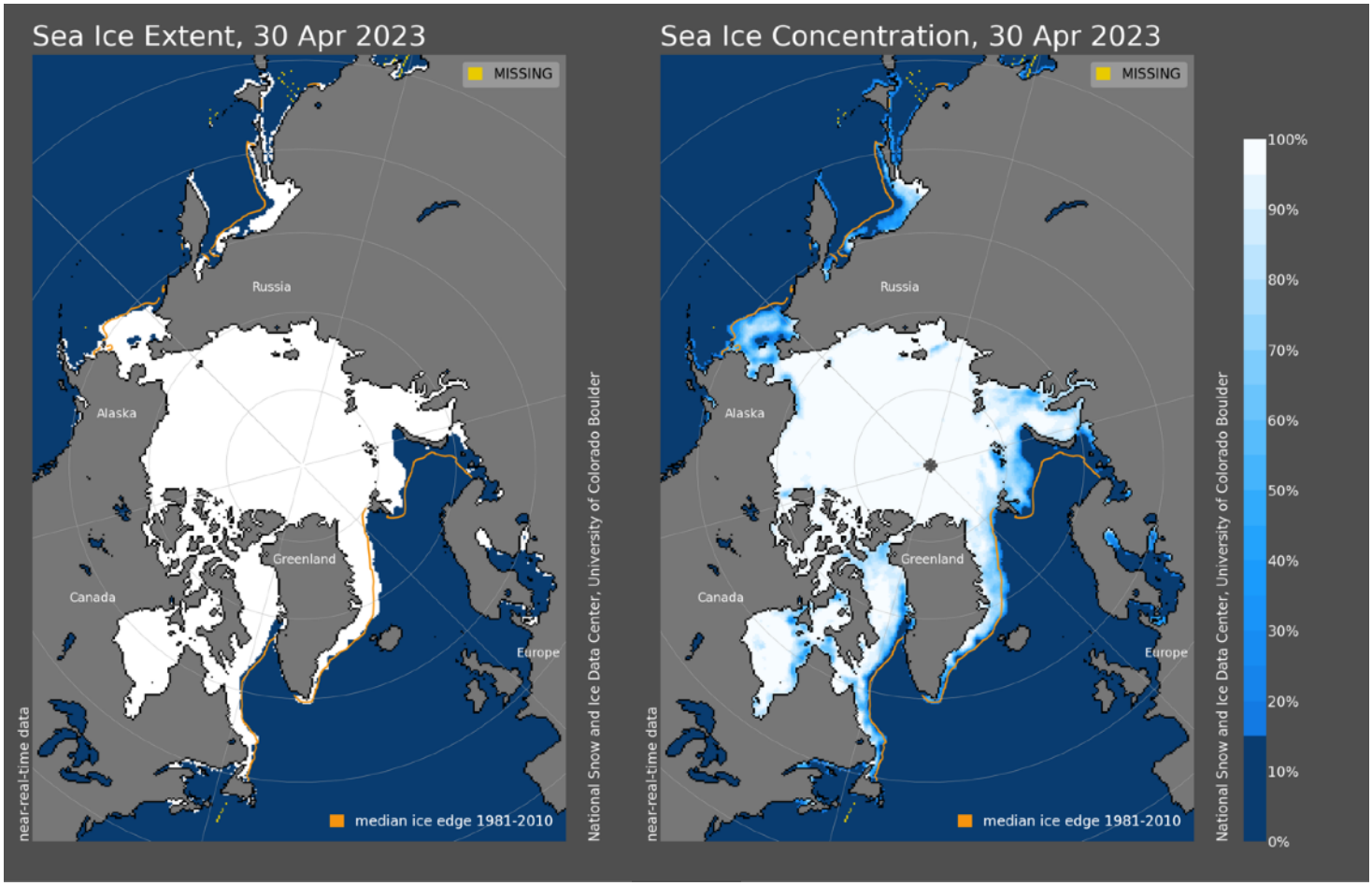

Figure 10. *A (left) Arctic sea ice extent and B (right concentrations as of April 30, 2023 compared to the average from 1981-2010 (Data and images: NSIDC)*

Newsworthy Information

Unusual spiral in the sky: April brought a number of opportunities for viewing the Aurora. On April 15, the night time sky over Alaska not only glowed green with northern lights, a bright spiral shape also appeared. The mysterious lights were caused by a SpaceX rocket launch, explained Don Hampton, geophysicist and chief scientist at the Poker Flat rocket Range. More information.

UAF researcher shows geological history of Alaska graphite: Graphite is needed for lithium-ion batteries and in high demand. New research details the metamorphic history of a graphite deposit on the Seward Peninsula. The findings are relevant for graphite potential mining projects and geological exploration in Alaska. More information.

Increased activity at Aniakchak volcano: The Alaska Volcano Observatory (AVO) put out a statement on recent volcanic activity at Aniakchak volcano in the Aleutians. Observations suggest that magma is intruding at a depth of 3-4km under the Aniakchak caldera. This increases the likelihood of an eruption over the coming months to years. AVO report.

Eruption of Sheveluch volcano (Russia) affected air traffic: Sheveluch volcano on the Kamchatka Peninsula erupted on April 11. The plume lead to partial, temporary closures of the Pacific airspace, affecting flights into and out of Alaska. More information.

Appendix

Lowest Mean Daily Temperature on Record				
Station	**Date**	**New Record (°F)**	**Year of Old Record**	**Old Record (°F)**
Bethel	2023-04-08	-5.0	2021	-1.5
Bettles	2023-04-11	-12.5	1984	-4.0
King Salmon	2023-04-09	3.0	2021	4.0
Kotzebue	2023-04-07	-18.0	1903	-14.0
Kotzebue	2023-04-10	-18.0	1903	-16.5
Kotzebue	2023-04-11	-18.0	1977	-12.5
Kotzebue	2023-04-12	-12.0	1985	-10.0
McGrath	2023-04-08	-7.0	2022	-4.0
McGrath	2023-04-09	-10.0	2021	-7.5
Nome	2023-04-08	-15.5	1920	-14.5

Table A1: March 2023 daily records of mean daily temperature, i.e. highest/lowest values of mean daily temperature ever recorded on specific days. Records are computed since the beginning of the respective time series. 10 new lowest mean daily temperature records were set and none were set for highest mean daily temperature.

Highest Maximum Daily Temperature Record				
Station	**Date**	**New Record (°F)**	**Year of Old Record**	**Old Record (°F)**
Cold Bay	2023-04-21	53.0	1981	51.0
Kodiak	2023-04-22	58.0	1979	54.0
Lowest Maximum Daily Temperature Record				
Bethel	2023-04-08	0.0	1985	5.0

Bettles	2023-04-11	6.0	1985	8.0
Delta Junction	2023-04-23	18.0	1948	19.0
Fairbanks	2023-04-23	17.0	1948	21.0
King Salmon	2023-04-08	14.0	1918	15.0
King Salmon	2023-04-09	12.0	2021	13.0
Kotzebue	2023-04-08	-10.0	1984	-9.0
Kotzebue	2023-04-11	-9.0	1977	-3.0
McGrath	2023-04-08	10.0	1984	13.0

Table A2: April 2023 daily records of maximum daily temperature, i.e. highest/lowest values of maximum daily temperature ever recorded on specific days. Records are computed since the beginning of the respective time series. Two new highest maximum daily temperature records were set and nine new lowest records were set.

Lowest Minimum Daily Temperature Record				
Station	**Date**	**New Record (°F)**	**Year of Old Record**	**Old Record (°F)**
Bettles	2023-04-11	-31.0	1984	-24.0
Bettles	2023-04-26	-7.0	1973	-1.0
King Salmon	2023-04-09	-6.0	2021	-5.0
Kotzebue	2023-04-07	-28.0	1988	-25.0
Kotzebue	2023-04-10	-27.0	1903	-24.0
Kotzebue	2023-04-11	-27.0	1977	-22.0
Kotzebue	2023-04-12	-24.0	1984	-21.0
McGrath	2023-04-07	-23.0	1946	-20.0
McGrath	2023-04-09	-28.0	2021	-22.0
Nome	2023-04-08	-30.0	1920	-25.0
Nome	2023-04-10	-26.0	1920	-24.0

Nome	2023-04-13	-20.0	1964	-16.0

Table A3: April 2023 daily records of minimum daily temperature, i.e. highest/lowest values of minimum daily temperature ever recorded on specific days. Records are computed since the beginning of the respective time series. No new records for highest minimum daily temperature were set. 12 were set for lowest minimum daily temperature.

This information consists of climatological data compiled by the Alaska Climate Research Center, Geophysical Institute, University of Alaska Fairbanks. For more information on weather and climatology, visit the center website at http://akclimate.org. Please report any comments, ideas or errors to uaf-climate@alaska.edu.