USDA United States Department of Agriculture

Natural Resources Conservation Service

Montana Water Supply Outlook Report

January 1, 2024

Snow Course measurements are collected manually during the last week of every month December through May across the western United States. The photo above is Lupine Creek Snow Course on December 27, 2023, located about 6 miles southeast of Mammoth in Yellowstone National Park. The average of the 5 point transect was 1.4 inches of snow water equivalent and 6 inches of depth. That's the lowest snow depth recorded during the last week of December in 65 years and is similar to snowpack conditions across Montana and northern Wyoming. (Photo: Daniel Kowalski)

Table of Contents

To access specific points of interest using links use PDF bookmarks

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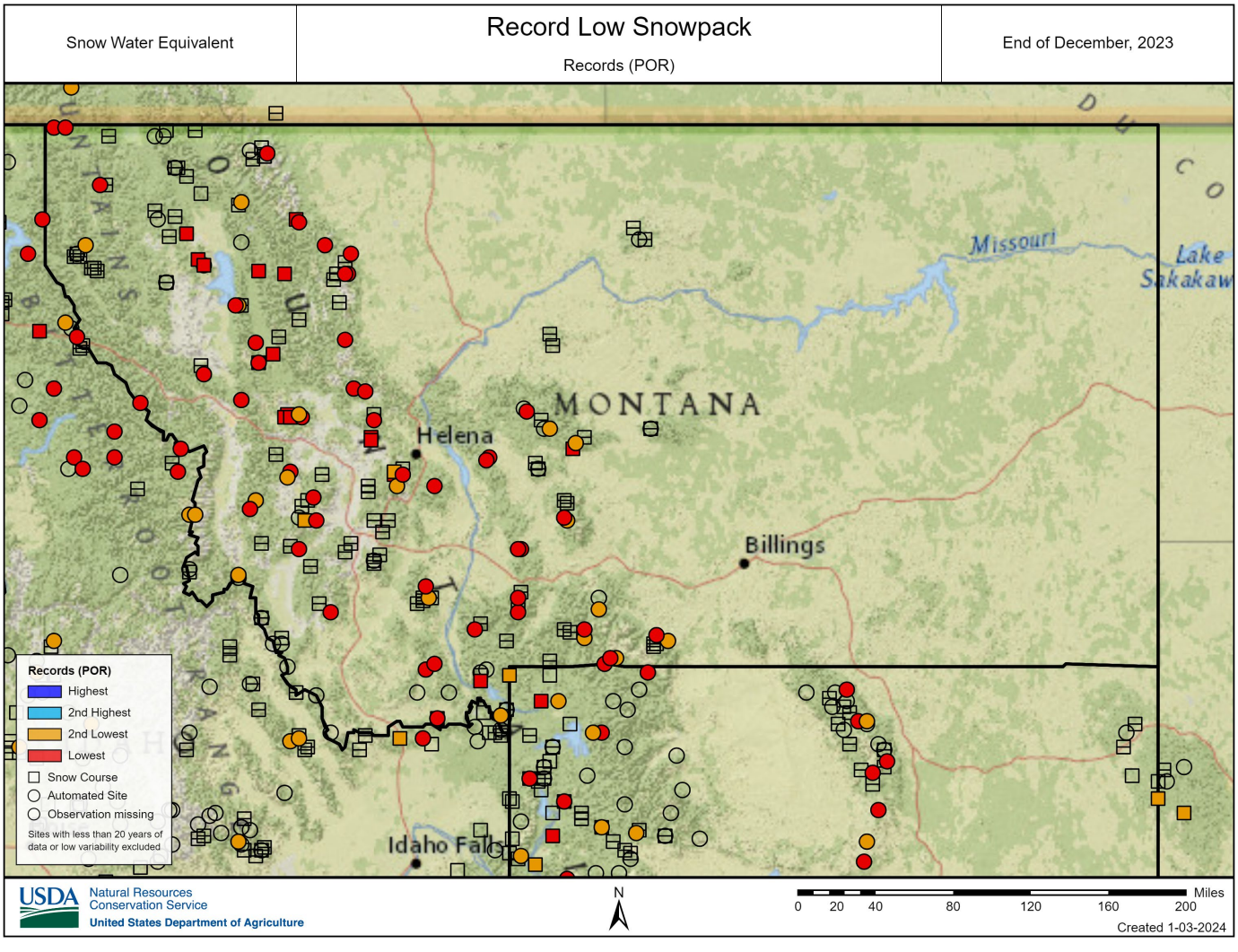
Statewide Overview

Summary

Warm temperatures and lack of precipitation over the last couple months have resulted in a bleak start to the seasonal snowpack in Montana and northern Wyoming. Precipitation since October 1 has mostly been well below normal. As a result, the snowpack is currently about 30-60% of what it normally is this time of the year, except for part of the southern Absaroka and Wind River Mountains. Currently many NRCS snow monitoring stations in the region are reporting their lowest snowpack on record. Additionally, temperatures have been significantly warmer than normal during the last two months, as a result the snowpack has experienced some melt.

The mountain snowpack in Montana typically peaks in April or early May, so there is still time to recover. Spring weather can be active in Montana, and in recent years water supply conditions have rebounded from record low April snowpack conditions due to well above normal spring precipitation. While it's still too early to tell what spring runoff will bring, the implications of a low snowpack extend well beyond water supply. Outdoor recreation during the winter is a major economic driver in Montana, and the lack of snow is certainly having an impact.

The following map shows January 1, 2024, snow water equivalent at SNOTEL sites and Snow Courses compared to the period of record (POR) for January 1. Red symbolizes the lowest snow water equivalent on record and orange symbolizes the second lowest on record, indicating that many SNOTEL sites and Snow Courses are experiencing record low snow water equivalent.



Statewide Overview

Precipitation

Water Year 2024 began with a mid-October snowstorm that brought significant precipitation to northern Wyoming basins and part of south central Montana. SNOTEL sites on the eastside of the Bighorn and Absaroka Mountains received about 2 to 5 inches of precipitation from this storm. Marquette SNOTEL about 20 miles southwest of Cody received over 5.5 inches of precipitation from October 11-12, which equated to 34 inches of snow. Lower elevation and the westside of these mountain ranges received about 1-2 inches of precipitation from this mid-October storm. Storms totals were less across Montana, particularly in the northwest where basins such as the Kootenai, Lower Clark Fork, Flathead, and Saint Mary received less than an inch of precipitation and less than half of their normal October precipitation.

Precipitation was largely absent during November and December, except in northwest Montana which received reasonable precipitation during the first half of each month. Lower mountain elevations in Kootenai, Lower Clark Fork, Flathead, and Saint Mary received about 3-5 inches of precipitation during November and December, while higher elevations received about 15-25 inches of precipitation. Two-month precipitation in that region was about 75-100% of normal. SNOTEL sites in the northern Whitefish Mountains received about 130% of normal precipitation over the two months. Across the rest of the region November and December precipitation was about 40-60% of normal, except in the Bighorn Mountains and Helena area where precipitation was about 35-45% of normal.

Water Year precipitation currently ranges from about 55-80% of normal on the west side of the Continental Divide to about 100-115% of normal in the Bighorn, Powder, and Tongue River basins, which are only above normal because of the large mid-October storm. Water Year precipitation has been lowest in the Sun-Teton-Marias River basin at about 50% of normal. Central, south central, and southwest Montana have received about 65-80% of normal precipitation since October 1, 2023.

December - Highest Total Accumulated Precipitation - SNOTEL/SNOLITE

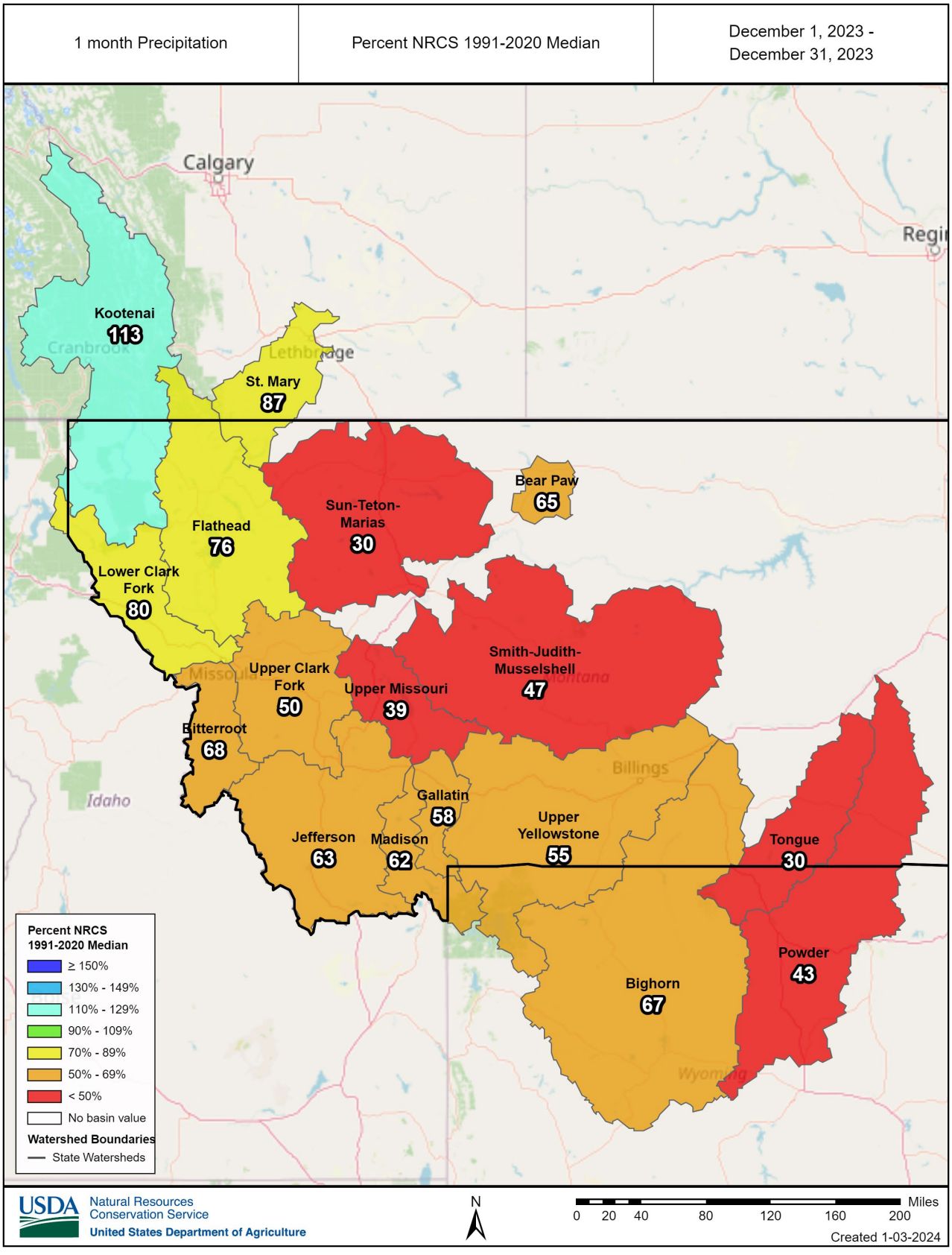
Station	Precipitation (Inches)	Median (Inches)	Elevation	Basin
Bear Mountain	13.2	11.4	5400	Lower Clark Fork, Kootenai
Mosquito Ridge	9.8	7.6	5260	Lower Clark Fork
Stahl Peak	8.6	6.3	6030	Flathead, Kootenai
Poorman Creek	8.3	8.8	5100	Lower Clark Fork, Kootenai
Grave Creek	8.0	4.8	4300	Flathead, Kootenai

December - Lowest Total Accumulated Precipitation- SNOTEL/SNOLITE

Station	Precipitation (Inches)	Median (Inches)	Elevation	Basin
Dome Lake	<0.3	1.6	8880	Tongue
Hansen Sawmill	0.3	1.0	8360	Powder
Wood Creek	0.3	2.5	5960	Sun-Teton-Marias
Big Goose	0.3	1.4	7990	Tongue
Soldier Park	0.3	1.0	8720	Powder

Statewide Overview

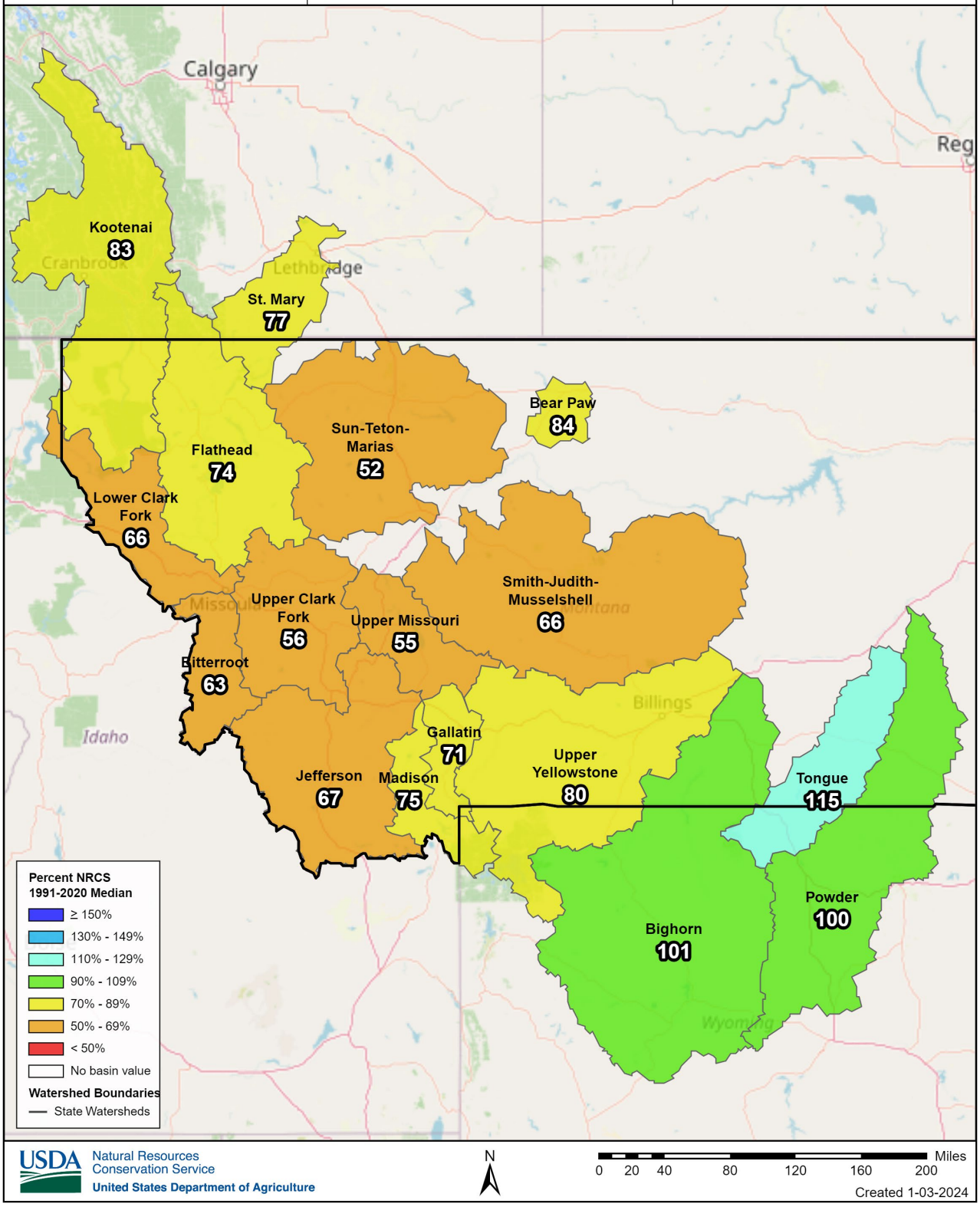
Precipitation (Continued)



Statewide Overview

Precipitation (Continued)

Water Year to Date Precipitation	Percent NRCS 1991-2020 Median	October 1, 2023 - December 31, 2023



Statewide Overview

Snowpack

As of January 1, 2024, Montana's seasonal snowpack ranges from about 25% of normal in Sun-Teton-Marias River basin to about 75% in the Bighorn River basin, with most basins reporting less than 60% of normal snowpack conditions. The Bighorn is highest because of the snowpack in southern Absaroka Mountains, which is only above normal in several isolated locations. The maximum snow depth across the region is currently about 36-38 inches in Glacier and Yellowstone National Park and surrounding areas, which is equivalent to about 10-12 inches of snow water equivalent and 60-80% of normal. Currently 14 low elevation SNOTEL sites and Snow Courses are snow free in Montana and its northern Wyoming river basins and about 110 are reporting their lowest snowpack or second lowest snowpack on record. Approximately 175 SNOTEL sites and Snow Courses are measured on January 1 with many of the records dating back over 50 years. One example is Marias Pass Snow Course, which on January 1, 2024, had 1.3 inches of snow water equivalent, the lowest in 89 years.

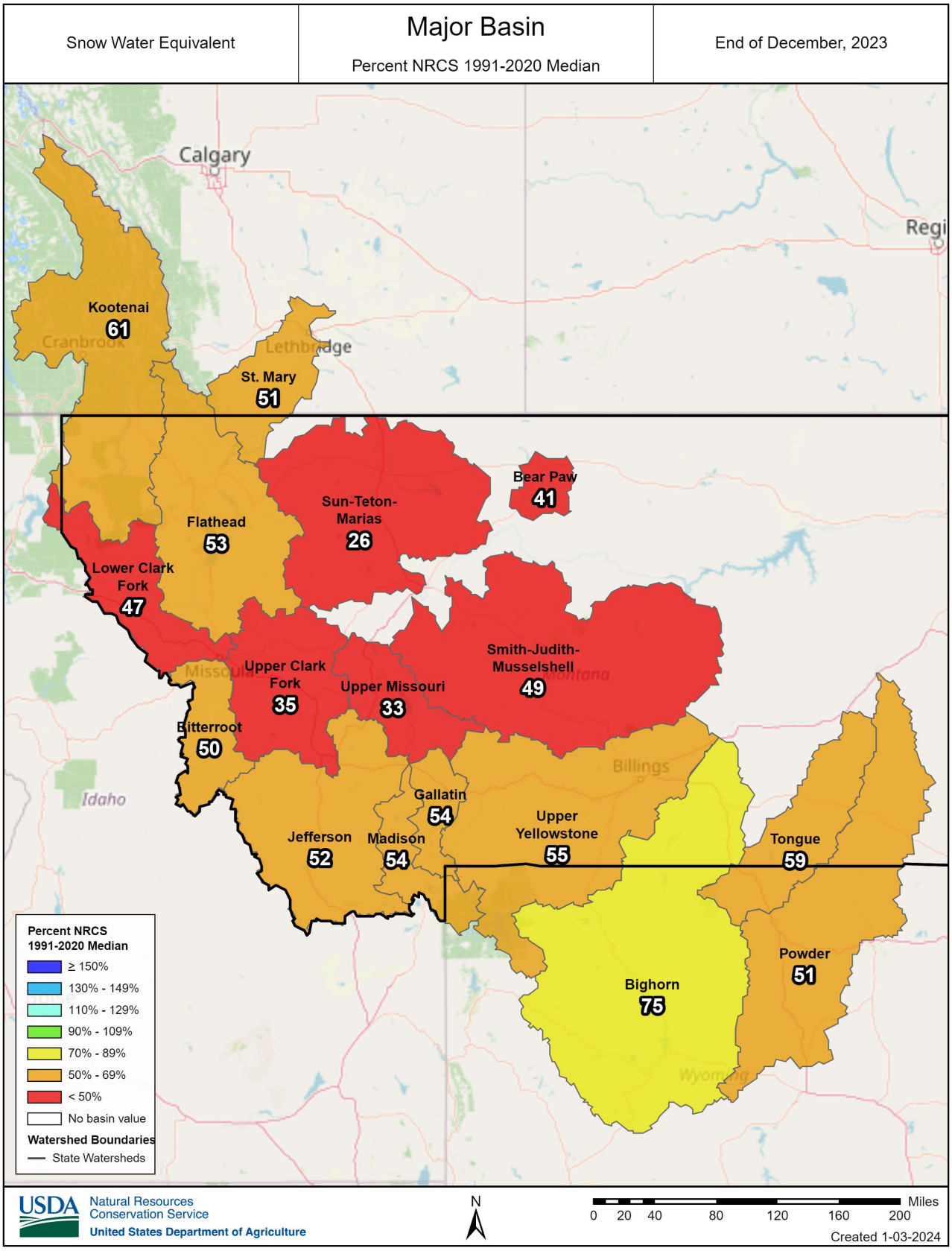
There are 3-4 months remaining in the normal snowpack accumulation season. Current snow water equivalent deficits are generally about 2-4 inches below normal, with several upper elevation locations in Montana having deficits of about 7-9 inches. It would take a major change in what the last couple months brought for weather, but the current deficit could be recovered in a couple large storms. Other years which had a relatively low January 1 snowpack include 1977, 1988, 2002, 2016, and 2017. In 2017 the snowpack made a full recovery in southwest Montana after receiving record high precipitation during February. However, the snowpack wasn't quite as low as it currently is and to rely on record high precipitation isn't ideal. Winter weather needs to arrive soon so the snowpack can recover. The further winter progresses with below normal precipitation, the harder it will become to make up from a snowpack deficit.

Water Year 2024 - Major Basin - Snowpack Percent of Normal ('91-'20)

Basin	Nov 1	Dec 1	Jan 1	Feb 1	Mar 1	Apr 1	May 1	Jun 1
Kootenai	59	63	61	-	-	-	-	-
Flathead	67	63	53	-	-	-	-	-
Upper Clark Fork	116	37	35	-	-	-	-	-
Bitterroot	144	35	50	-	-	-	-	-
Lower Clark Fork	90	58	47	-	-	-	-	-
Jefferson	91	48	52	-	-	-	-	-
Madison	86	58	54	-	-	-	-	-
Gallatin	81	52	54	-	-	-	-	-
Upper Missouri	125	41	33	-	-	-	-	-
Smith-Judith-Musselshell	116	63	49	-	-	-	-	-
Sun-Teton-Marias	121	48	26	-	-	-	-	-
St. Mary	77	72	51	-	-	-	-	-
Bear Paw	-	-	41	-	-	-	-	-
Upper Yellowstone	103	60	55	-	-	-	-	-
Bighorn	117	85	75	-	-	-	-	-
Powder	93	60	51	-	-	-	-	-
Tongue	154	87	59	-	-	-	-	-

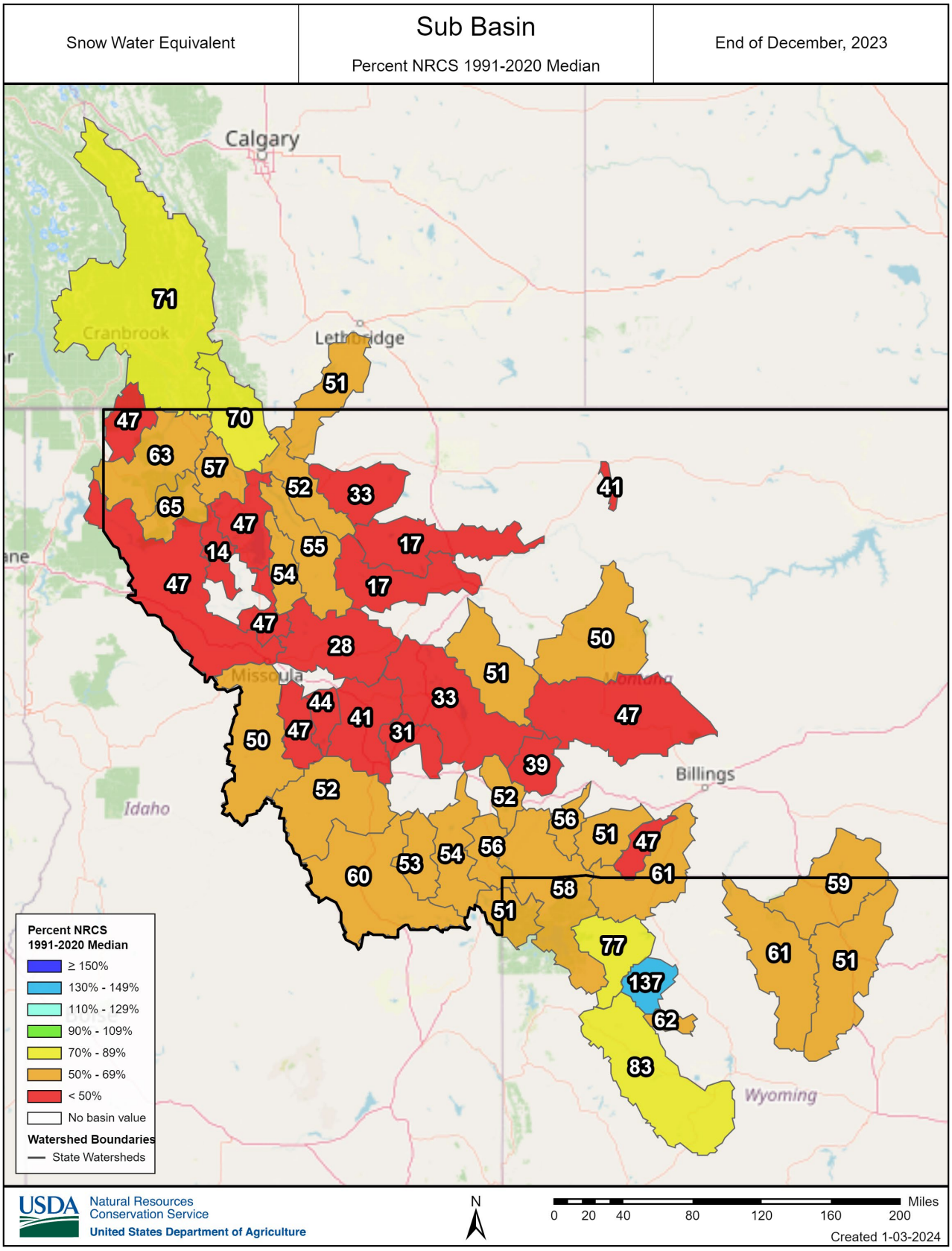
Statewide Overview

Snowpack (Continued)



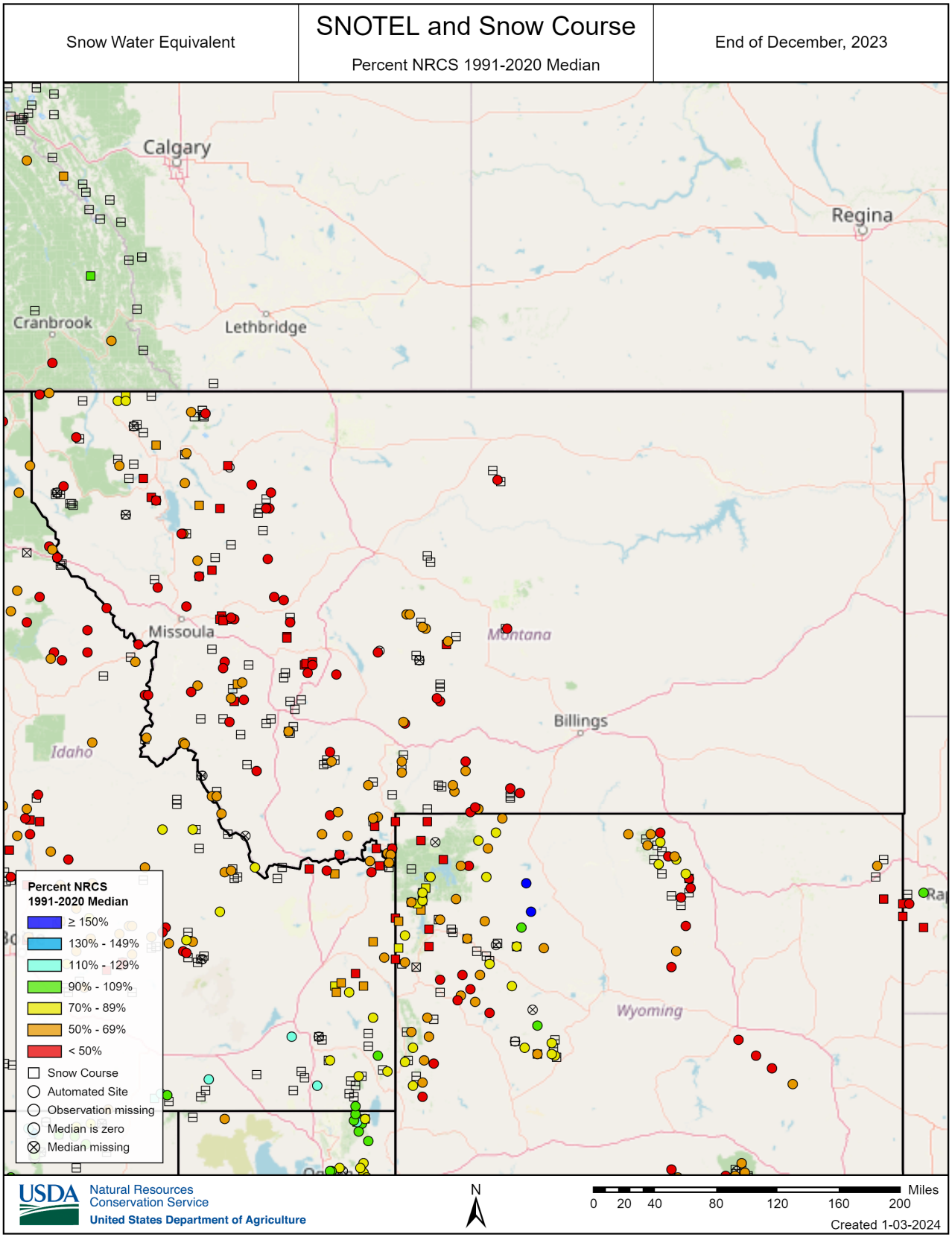
Statewide Overview

Snowpack (Continued)



Statewide Overview

Snowpack (Continued)

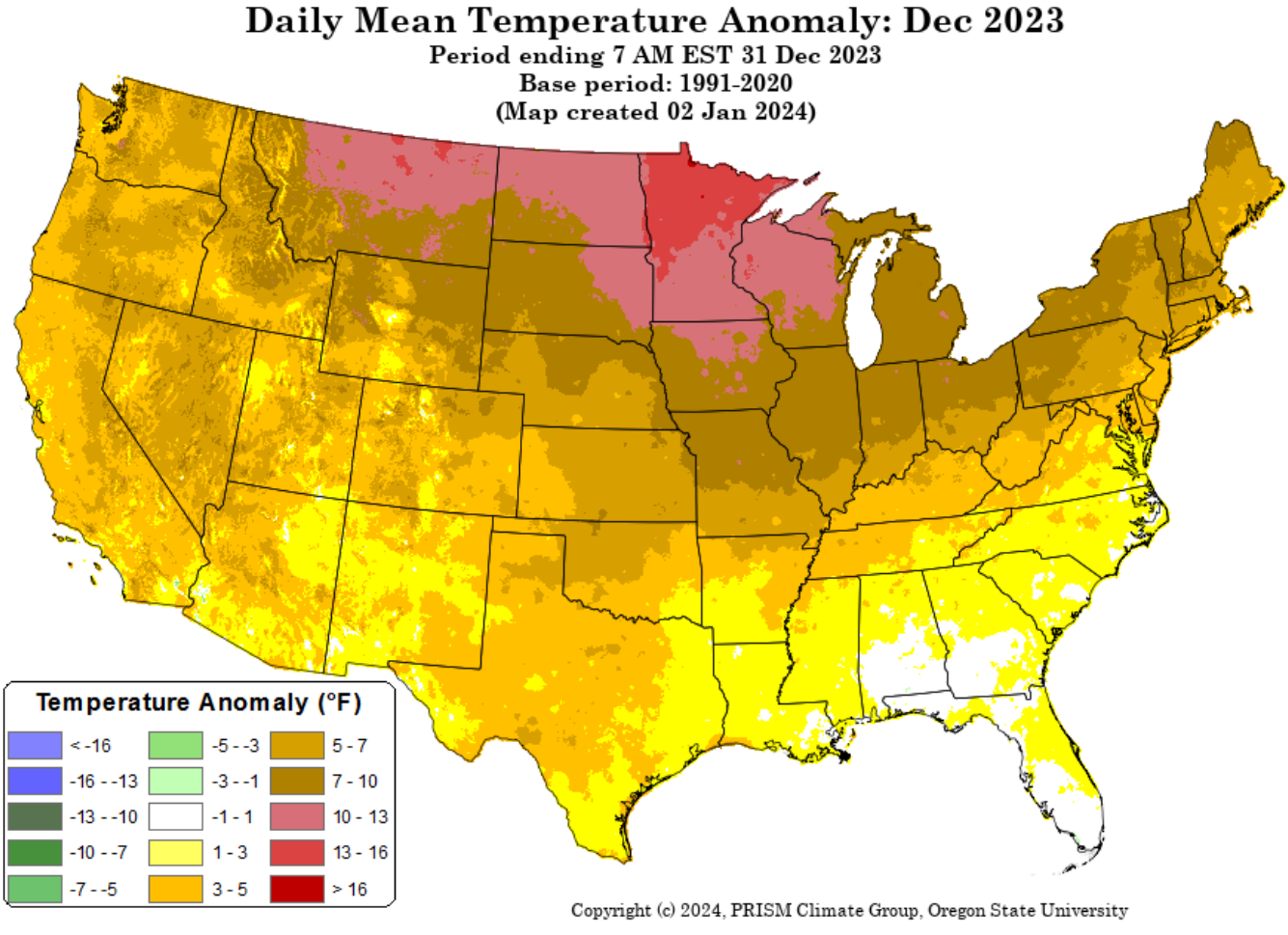


Statewide Overview

Temperature

The temperature has primarily been above normal in Montana since October 1. One exception was during the last week of October when the temperature was below normal in all but western Montana. During November the mean monthly temperature was about 3-5 °F warmer than normal. The warmest days during November were November 12-15 and November 21. During those days mountain temperatures exceeded 50 °F across Montana and northern Wyoming.

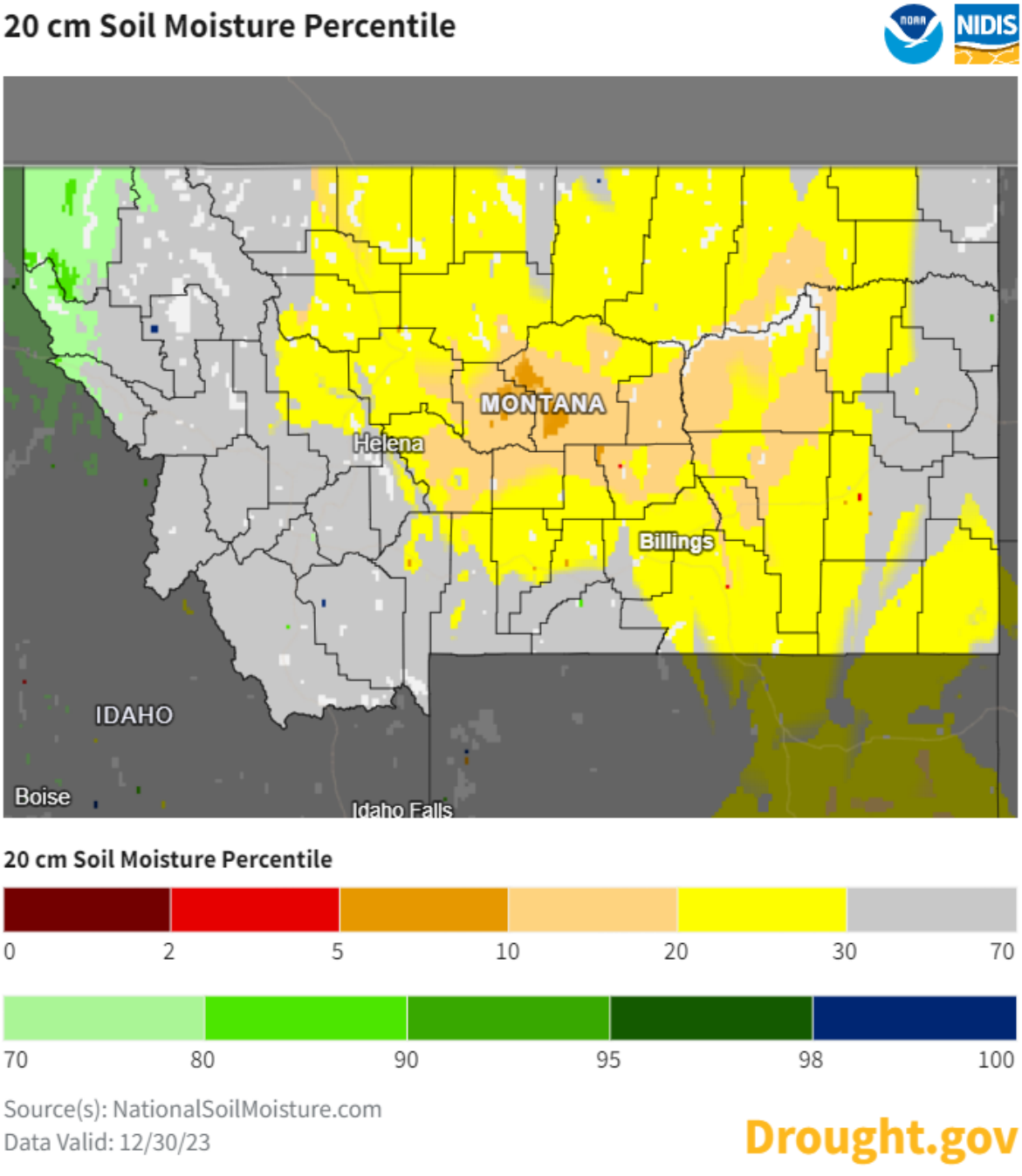
The anomaly was even more remarkable during December when the mean monthly temperature was about 5-10 °F warmer than normal in southern and western Montana and 10-16 °F warmer than normal in northern Montana. The warmest days last month were December 4-5, 15-22, and 27-31, when SNOTEL stations set new records for warmest daily average temperature. On December 6, 18, and 30 the daily maximum temperature exceeded 50 °F at Parker Peak SNOTEL (9400 ft) in Yellowstone National Park. Across the region several mid-December nights didn't drop below freezing at mountain elevations. Examples include Lick Creek SNOTEL (Gallatin Range – 6890 ft) on December 20 and Stahl Peak SNOTEL (Whitefish Range – 6030 ft) from December 19-22. Cooler temperatures will be essential over the next couple months to prevent any melting of the already lacking snowpack.



Statewide Overview

Soil Moisture

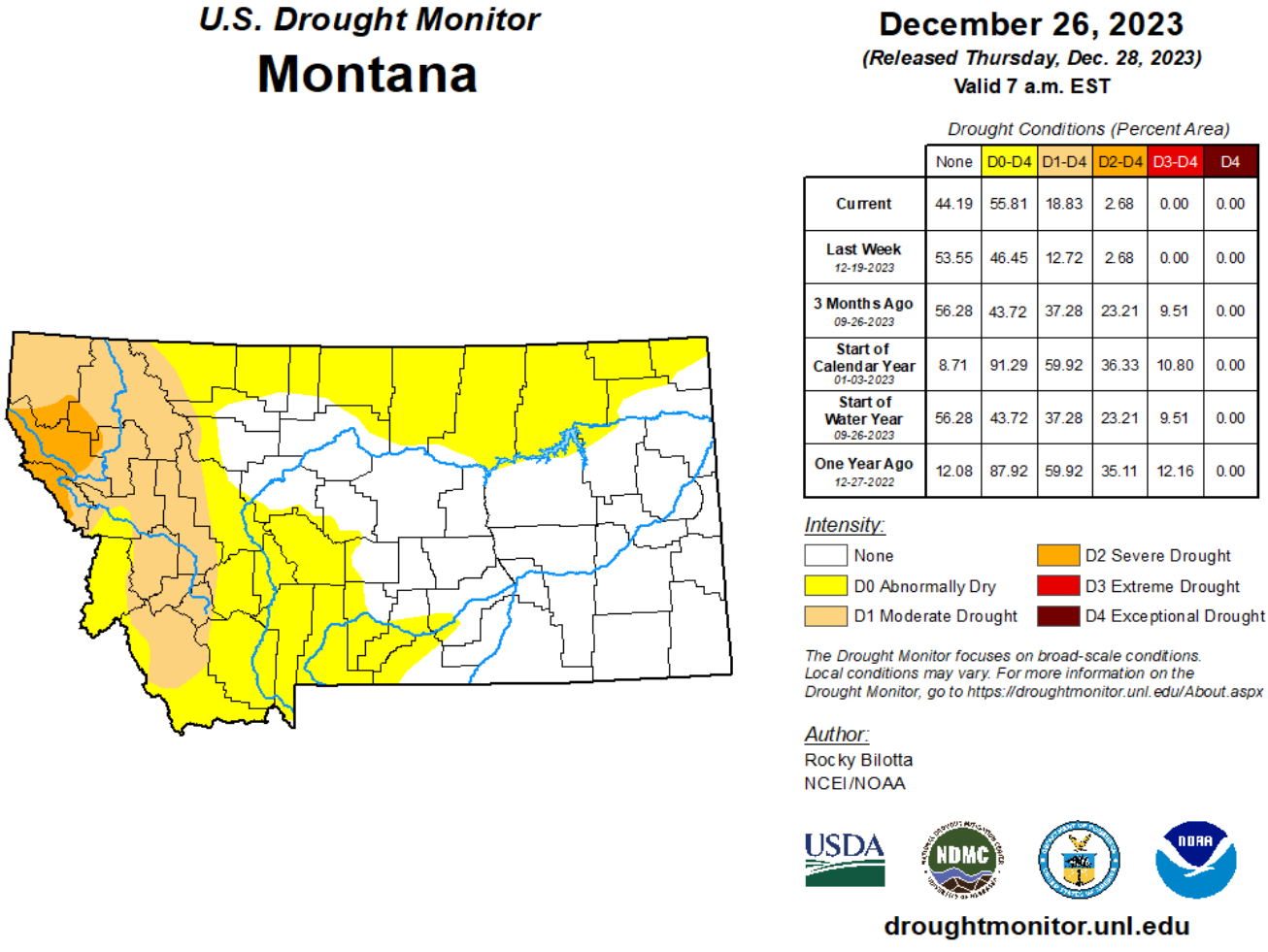
Soil moisture in the top 20 cm is highest in the northwest corner of Montana where recent precipitation has been near normal. In Lincoln and the western part of Sanders County soil moisture is currently above normal, about the 70 percentile or higher. Soil moisture in the top 20 cm is currently well below normal in central Montana, about the 5-20 percentile. Soil moisture in most of eastern Montana is currently below normal, 20-30 percentile. Elsewhere conditions are closer to normal. Given current soil moisture conditions across the state and lack of recent precipitation in most of the state, above normal precipitation is needed in the months ahead.



Statewide Overview

Drought Monitor

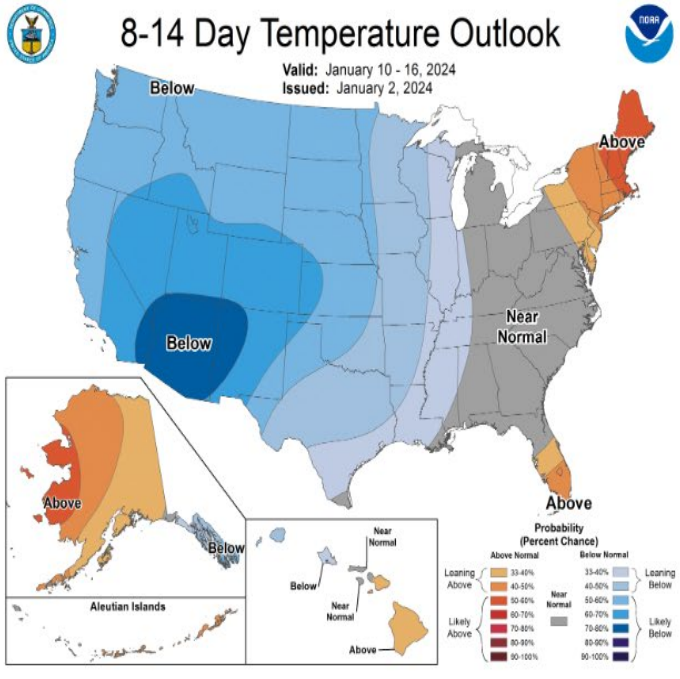
The recent U.S. Drought Monitor map, released on December 28, 2023, classifies 56% of Montana as D0 (abnormally dry conditions), D1 (moderate drought), or D2 (severe drought). There are currently no regions in Montana that are classified in the D3 (extreme drought) category or above. Recent precipitation has allowed for a 1-3 class improvement in the northern third of Montana since October 1, 2023. Most of Sanders County and part of its surrounding counties have improved but are still experiencing D2 drought. Lack of precipitation in southwest Montana has warranted a 1-3 class degradation and much of that region is currently experiencing D0 or D1 drought conditions.

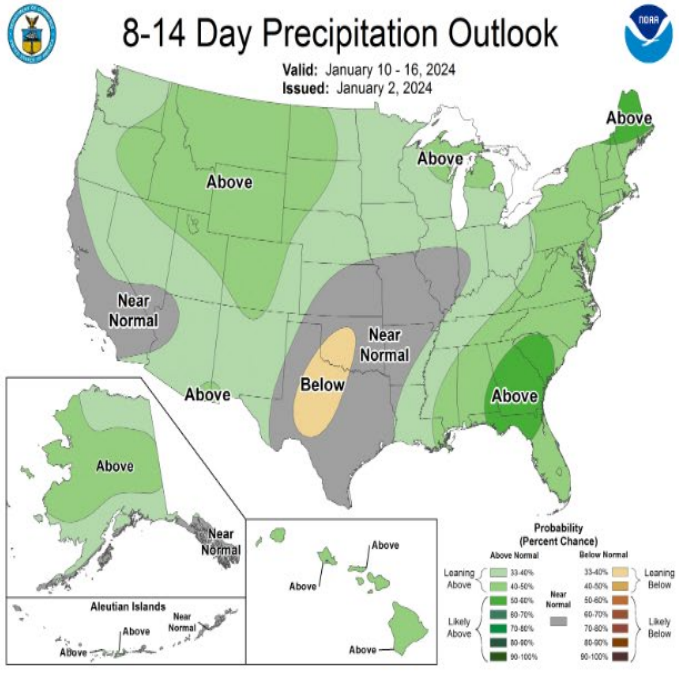


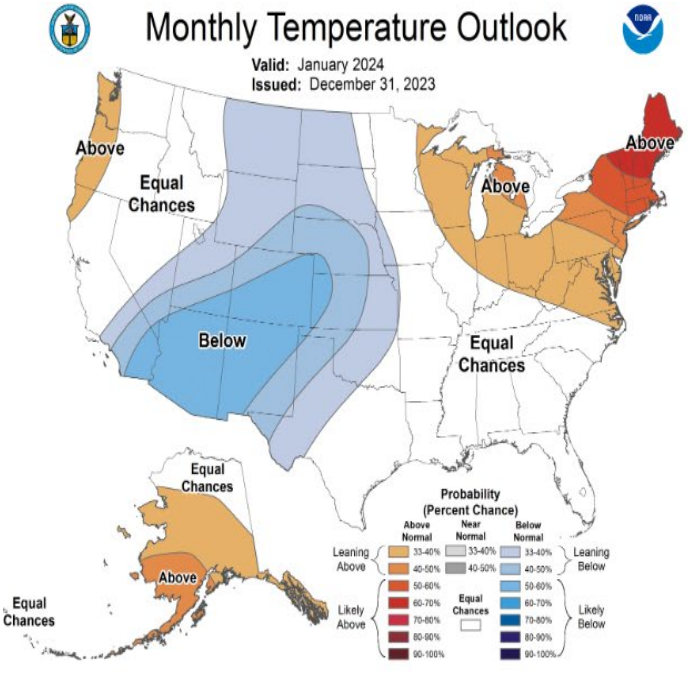
Statewide Overview

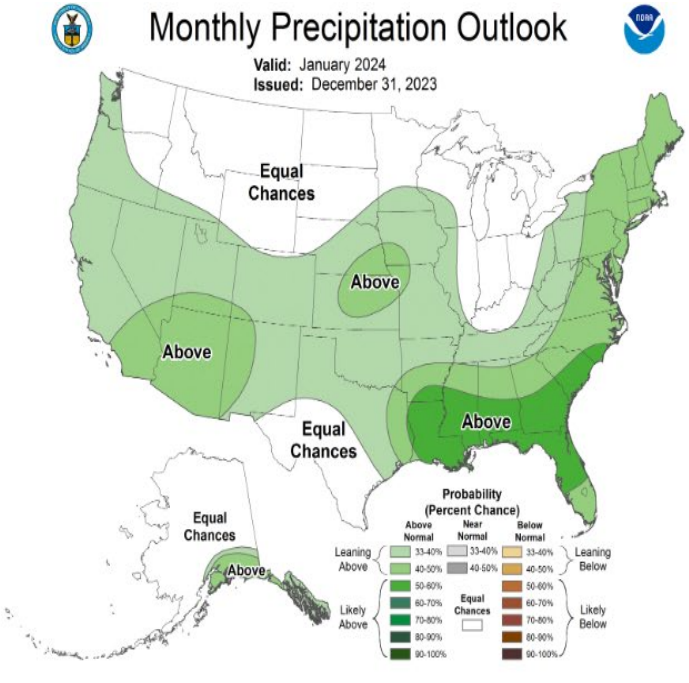
Weather Outlook

The NOAA Climate Prediction Center's 8-14 day outlook indicates that below normal temperatures and above normal precipitation will likely occur across most of Montana during the week of January 10-16. NOAA's 1-month outlook indicates below normal temperature is likely for central and eastern Montana during January, but equal chances of either above or below normal temperatures in western Montana. There are equal chances of above or below normal precipitation in Montana for January. Needless to say, seasonally normal temperatures and well above normal precipitation would be welcomed across the entire region.



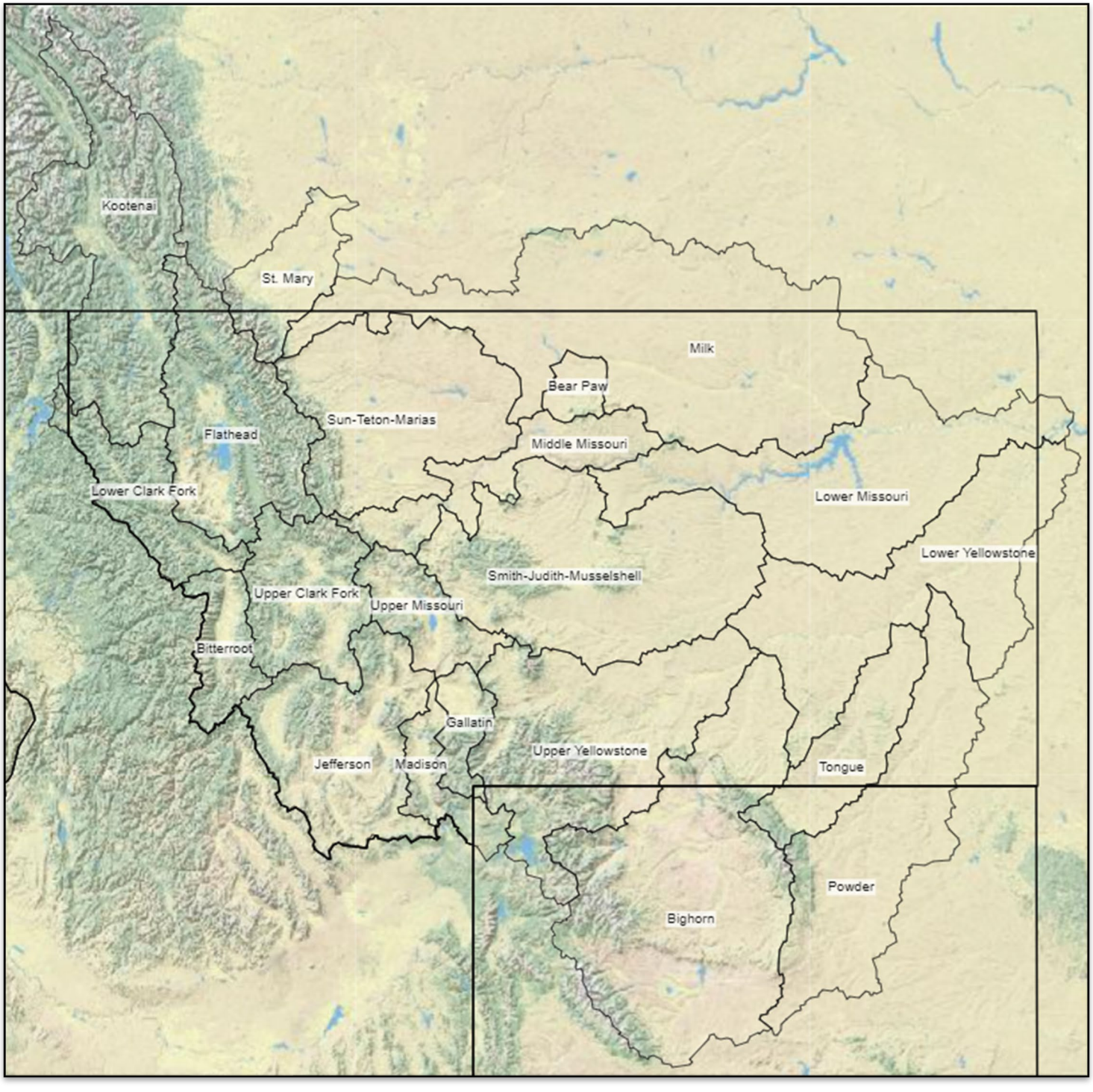






Basin Overview

Montana River Basin Definitions

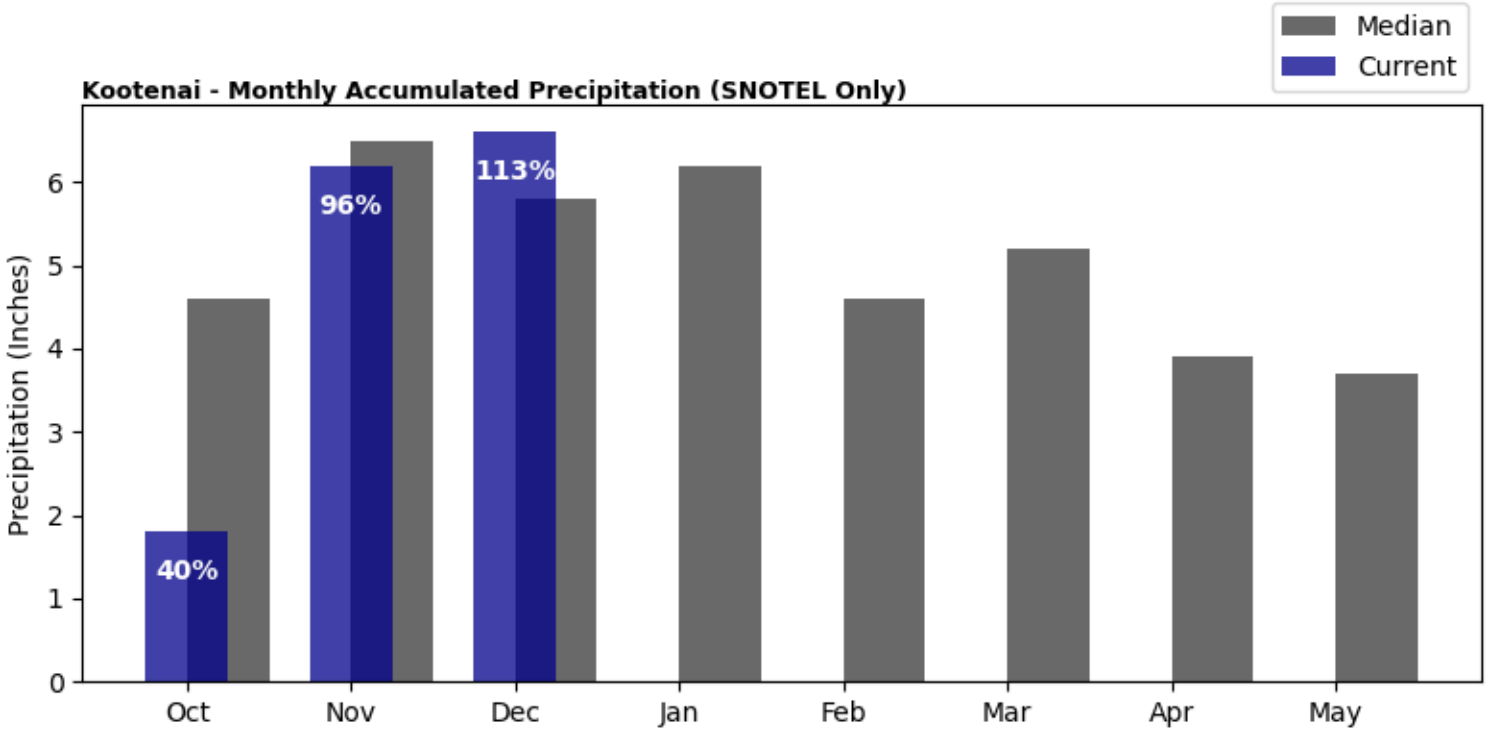


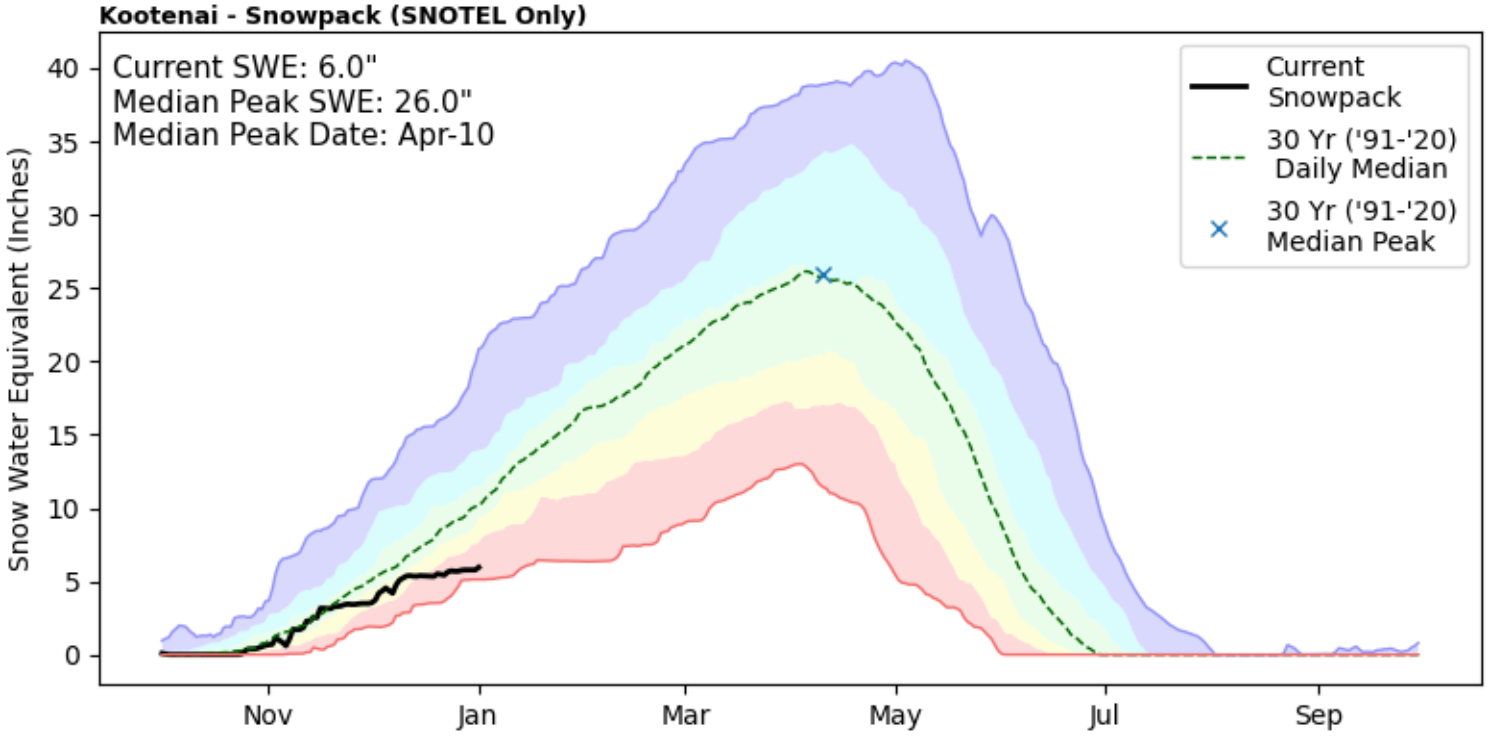
The following basin overview sections only include basins that have SNOTEL sites. For example, there is no basin overview for the Lower Yellowstone, because there are no SNOTEL sites associated with that basin. Water supply information for basins not included in the following sections can be found at https://nwcc-apps.sc.egov.usda.gov/

Basin Overview

Kootenai

Precipitation in December was above normal at 113%, which brings the seasonal accumulation (October-December) to 83% of median. The snowpack in the Kootenai is well below normal at 61% of median, compared to 106% at this time last year.

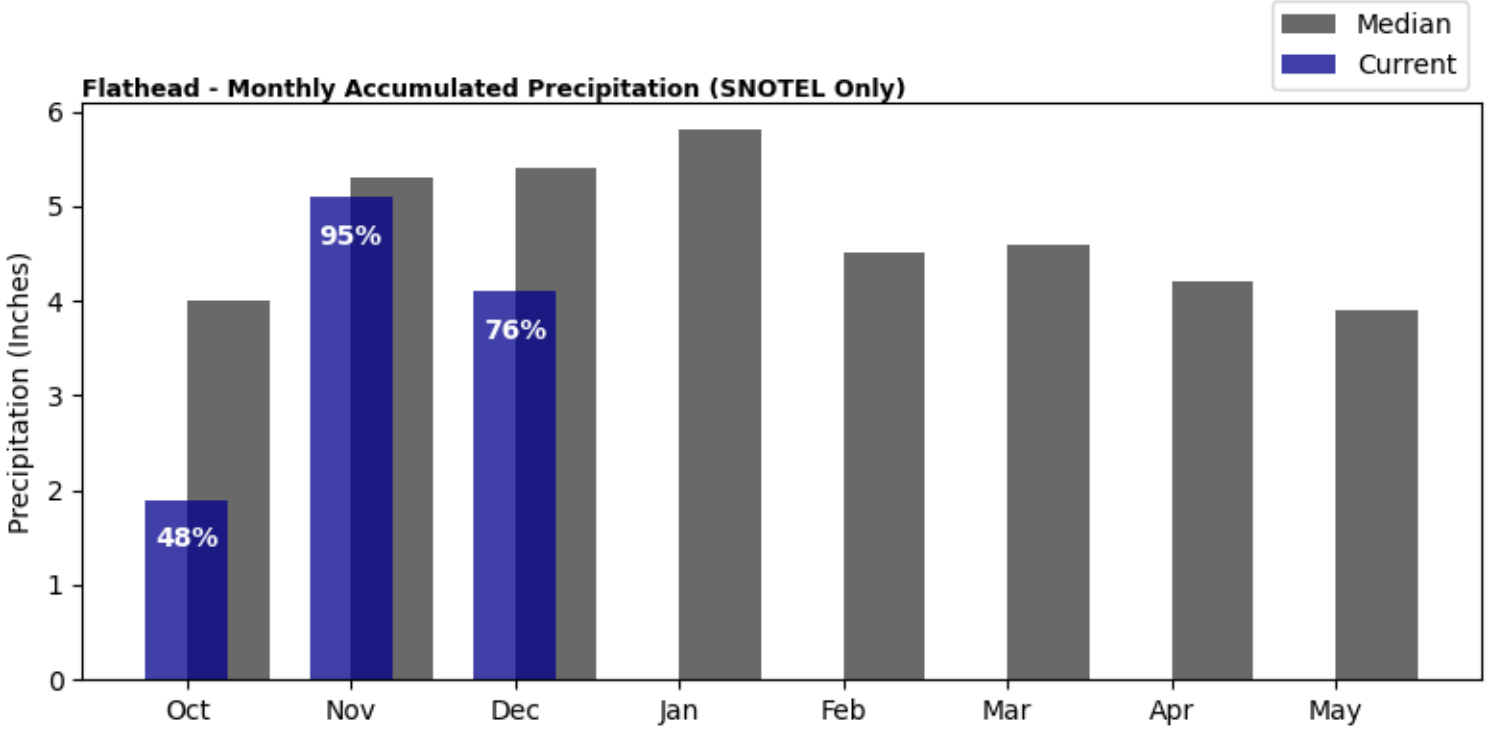


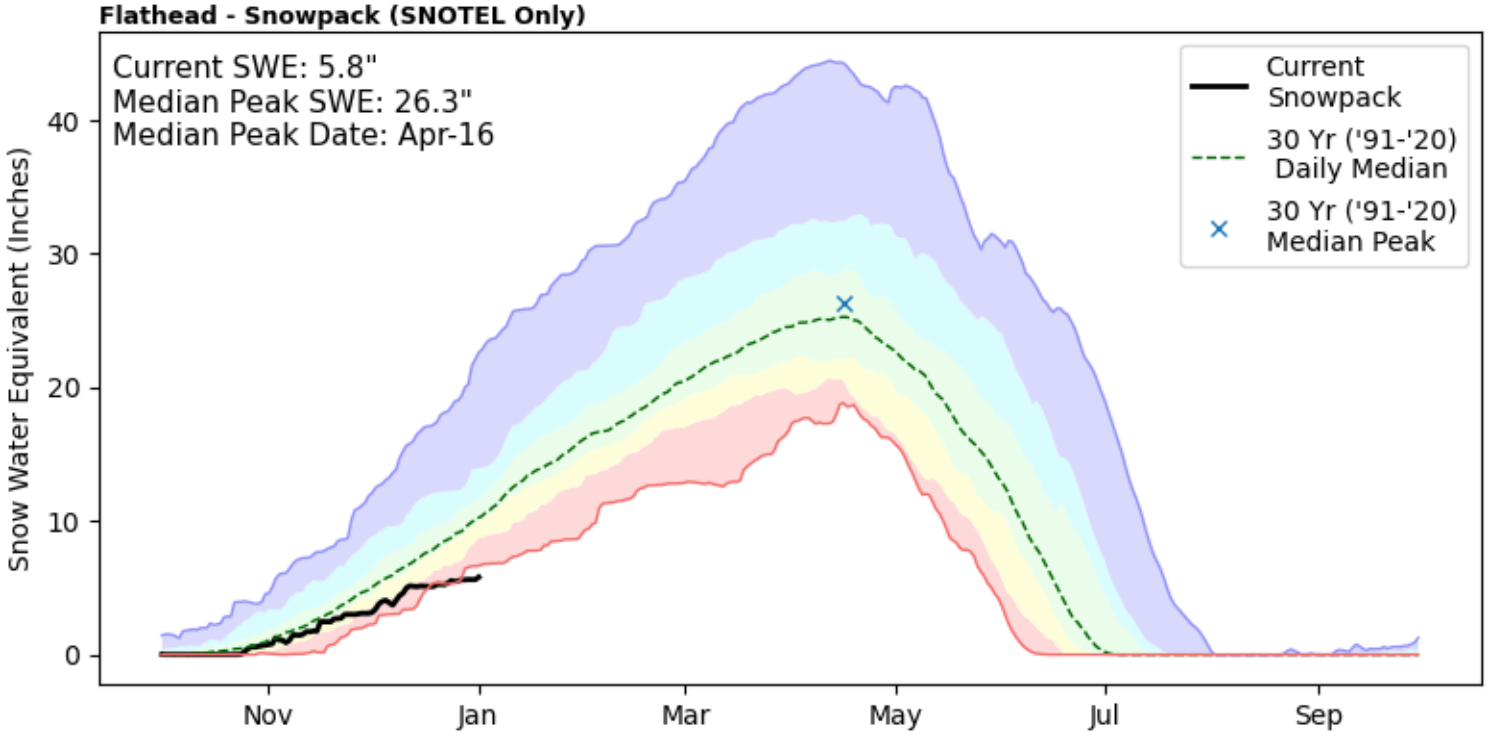


Basin Overview

Flathead

Precipitation in December was well below normal at 76%, which brings the seasonal accumulation (October-December) to 74% of median. The snowpack in the Flathead is well below normal at 53% of median, compared to 117% at this time last year.

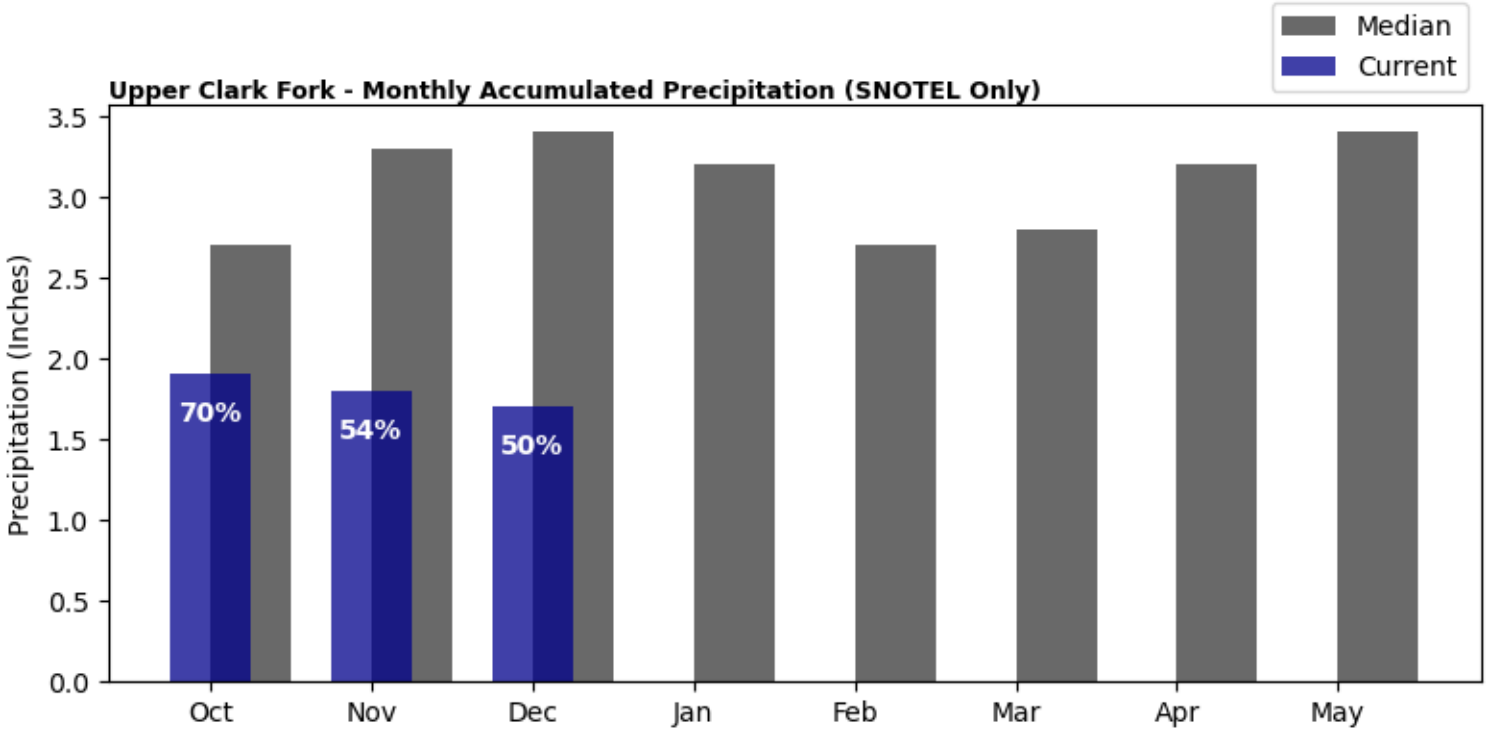


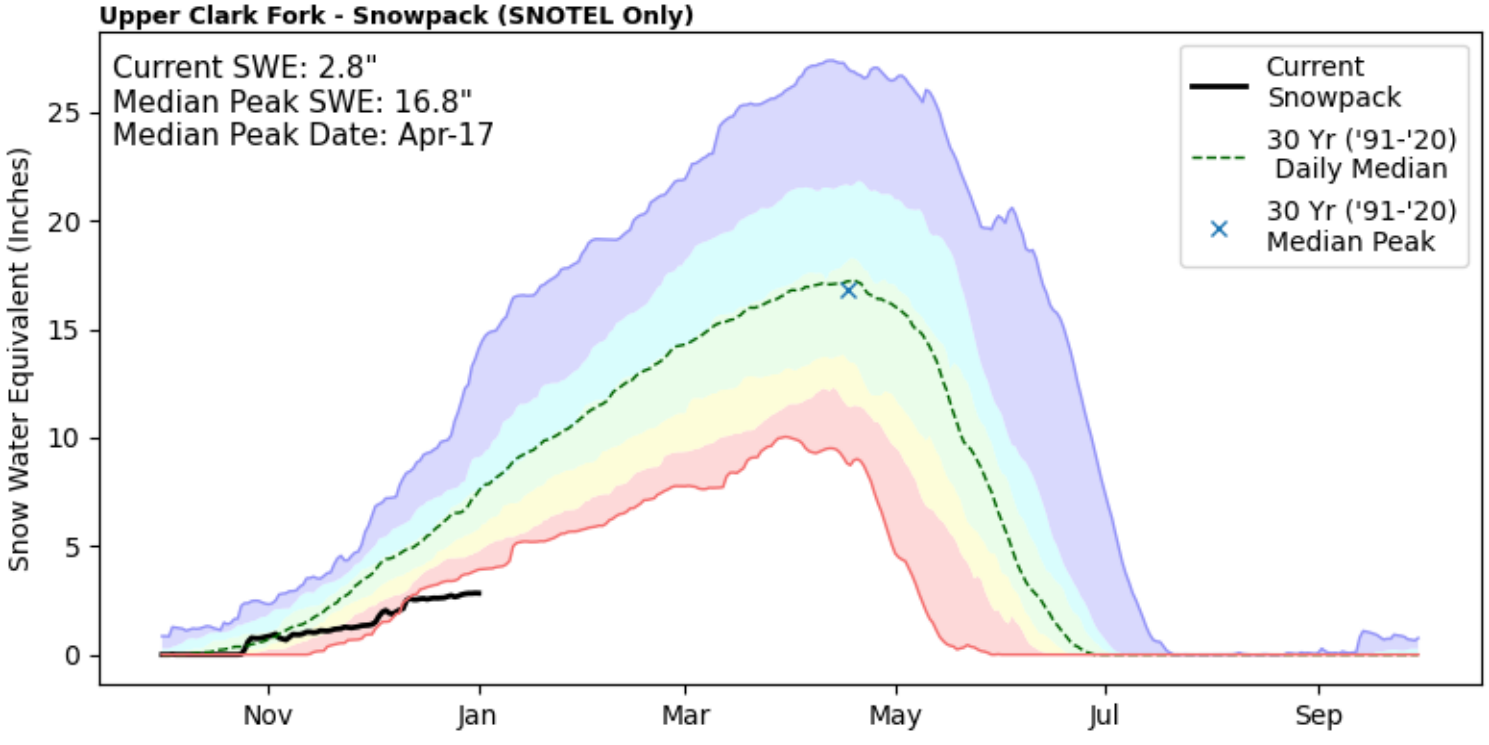


Basin Overview

Upper Clark Fork

Precipitation in December was well below normal at 50%, which brings the seasonal accumulation (October-December) to 56% of median. The snowpack in the Upper Clark Fork is well below normal at 35% of median, compared to 103% at this time last year.

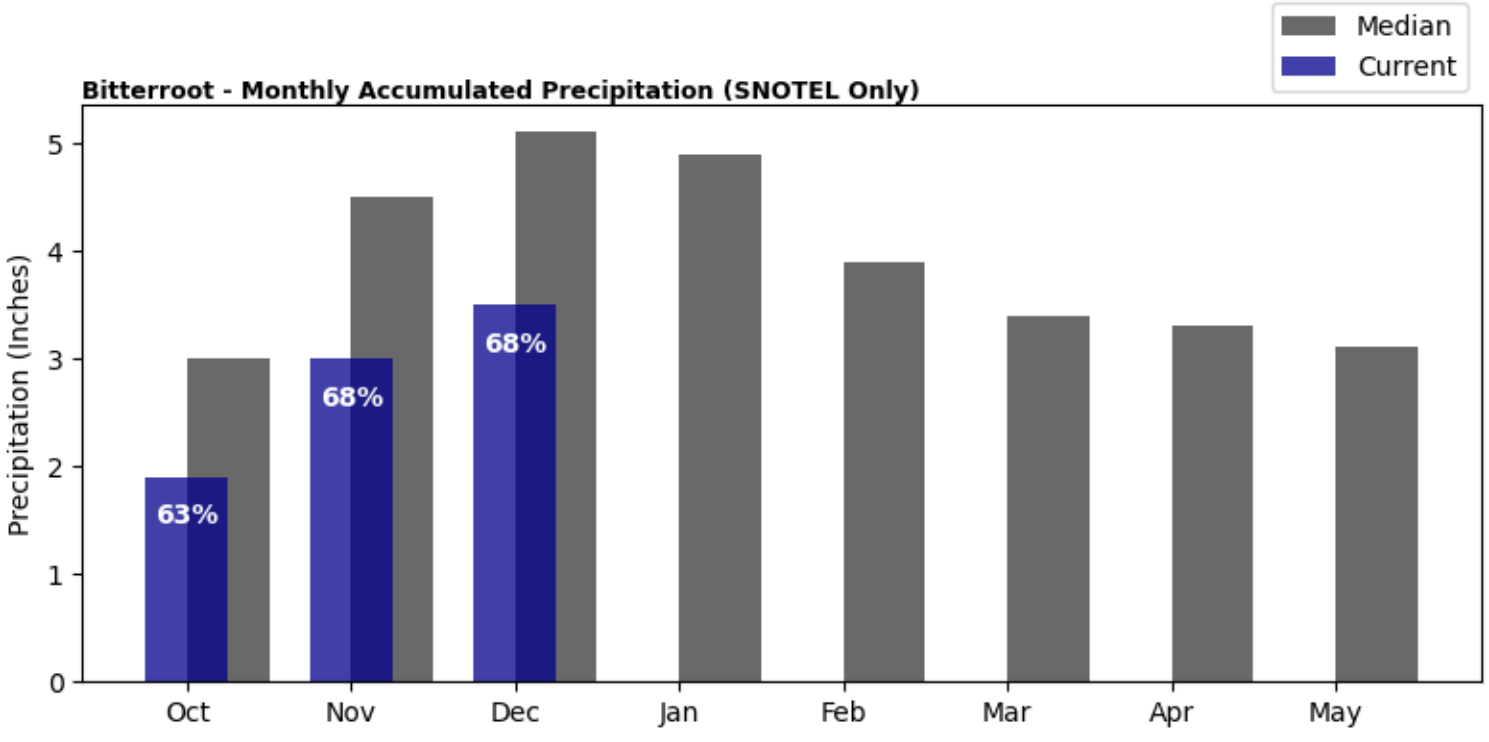


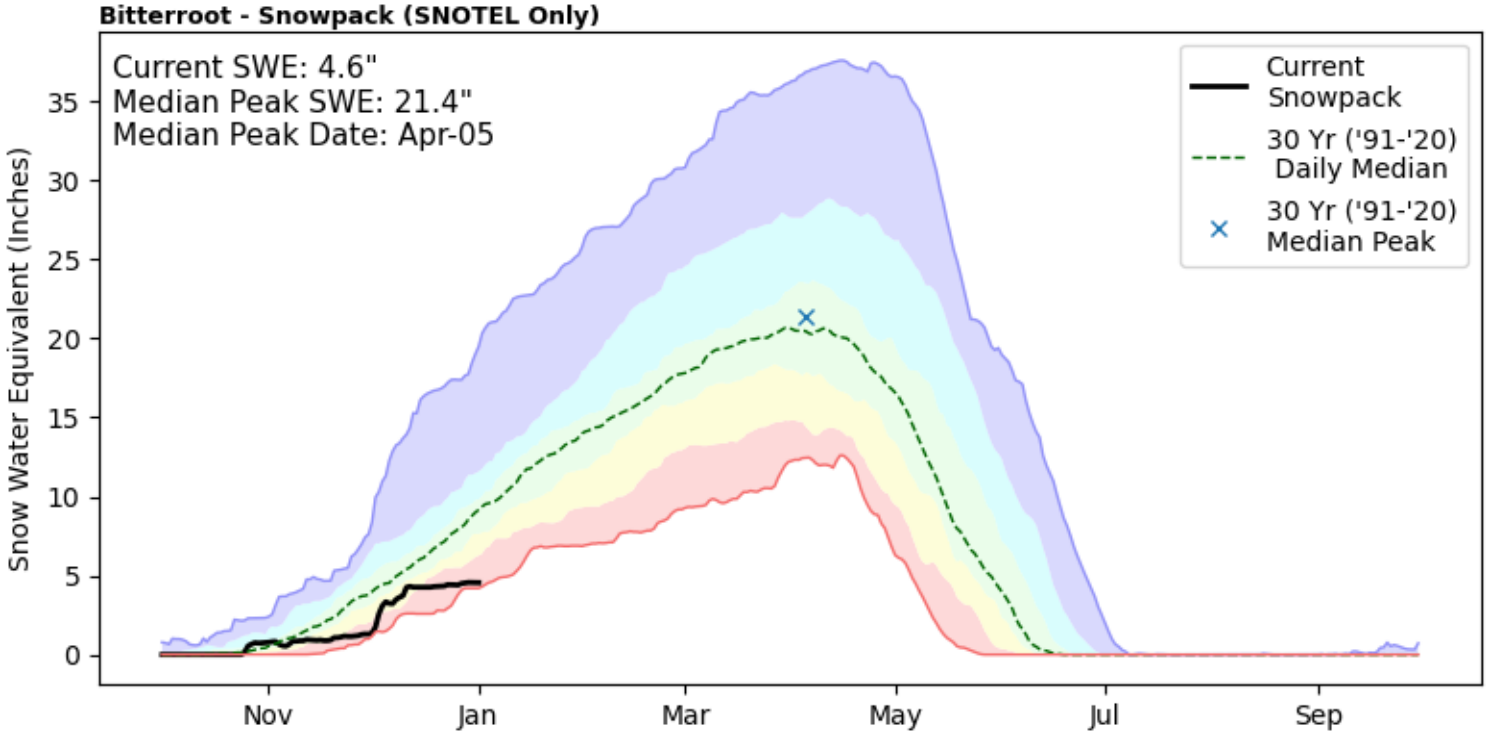


Basin Overview

Bitterroot

Precipitation in December was well below normal at 68%, which brings the seasonal accumulation (October-December) to 63% of median. The snowpack in the Bitterroot is well below normal at 50% of median, compared to 100% at this time last year.

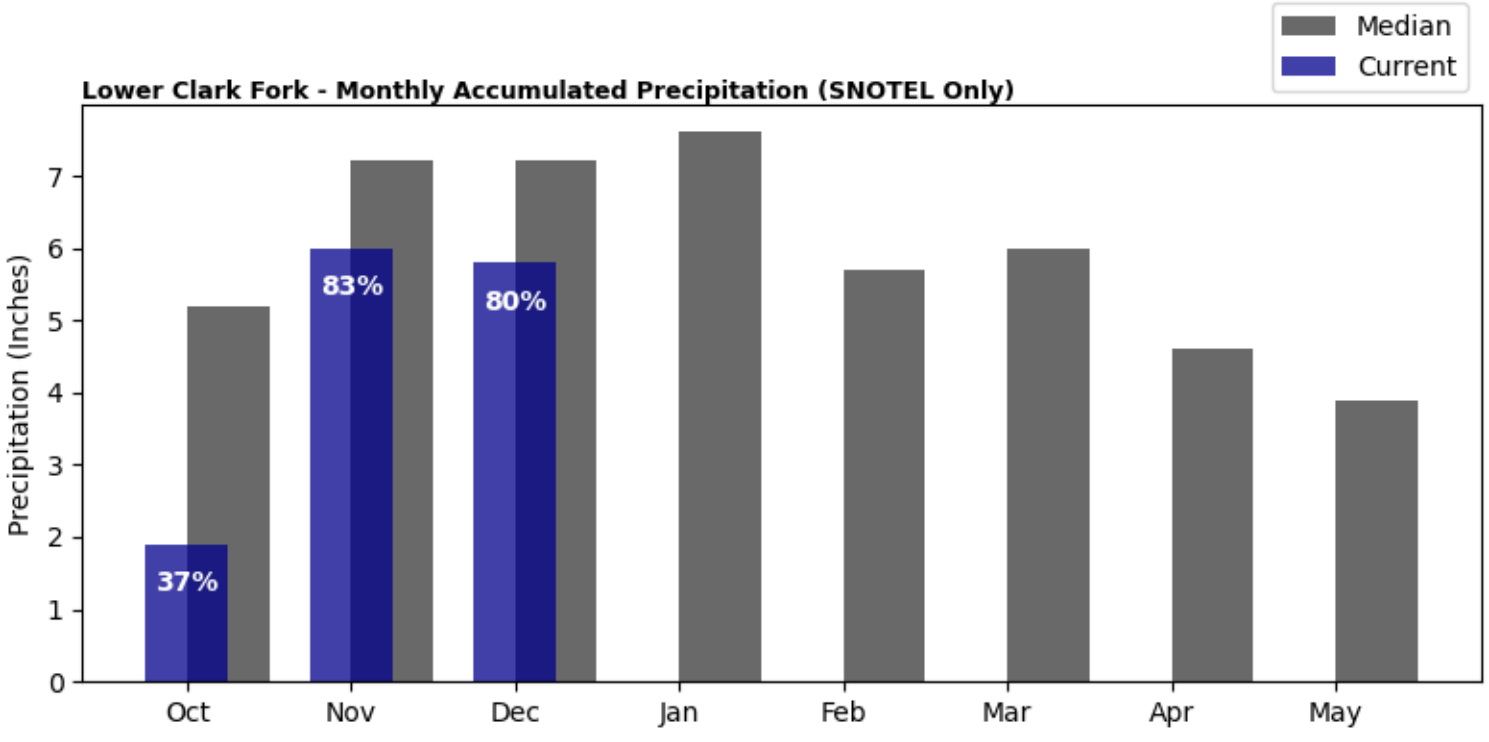


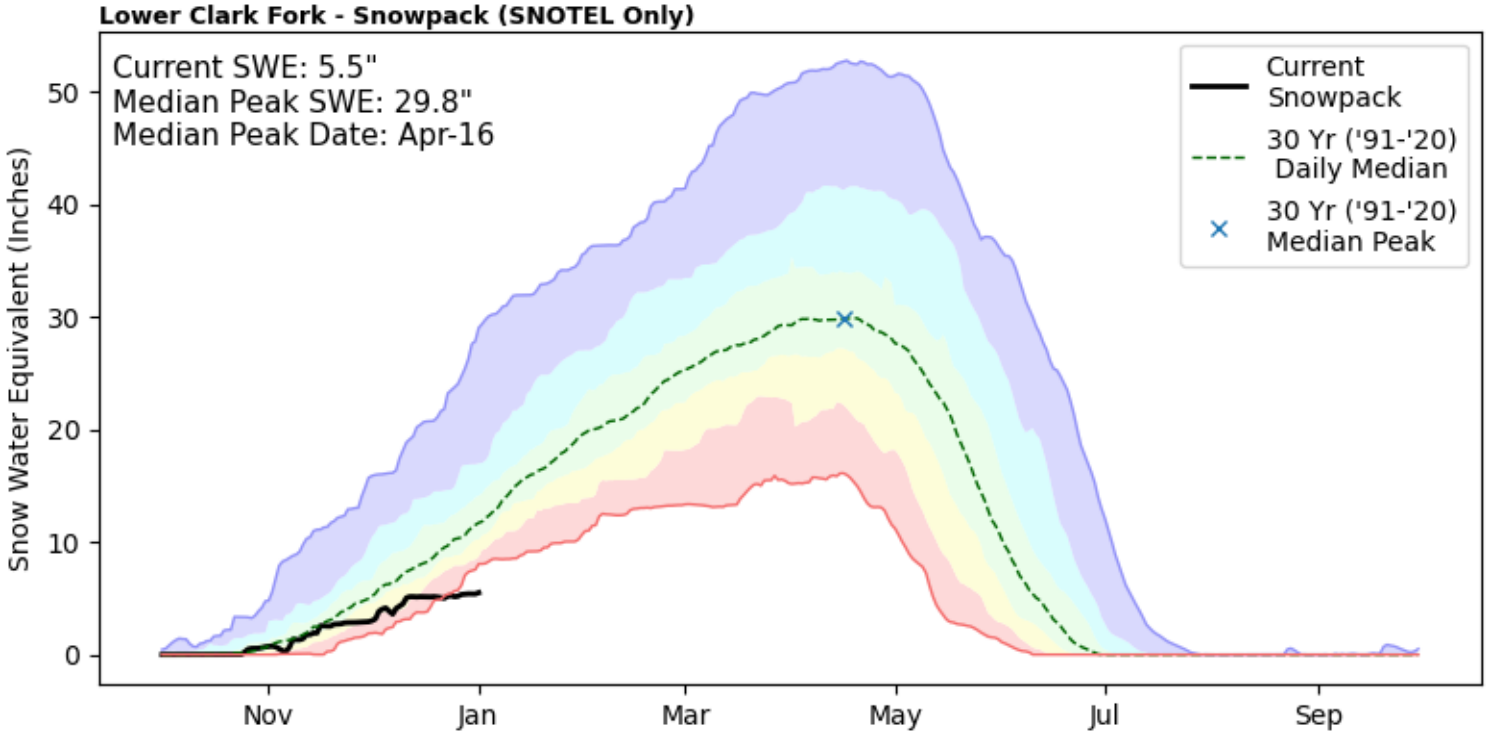


Basin Overview

Lower Clark Fork

Precipitation in December was below normal at 80%, which brings the seasonal accumulation (October-December) to 66% of median. The snowpack in the Lower Clark Fork is well below normal at 47% of median, compared to 113% at this time last year.

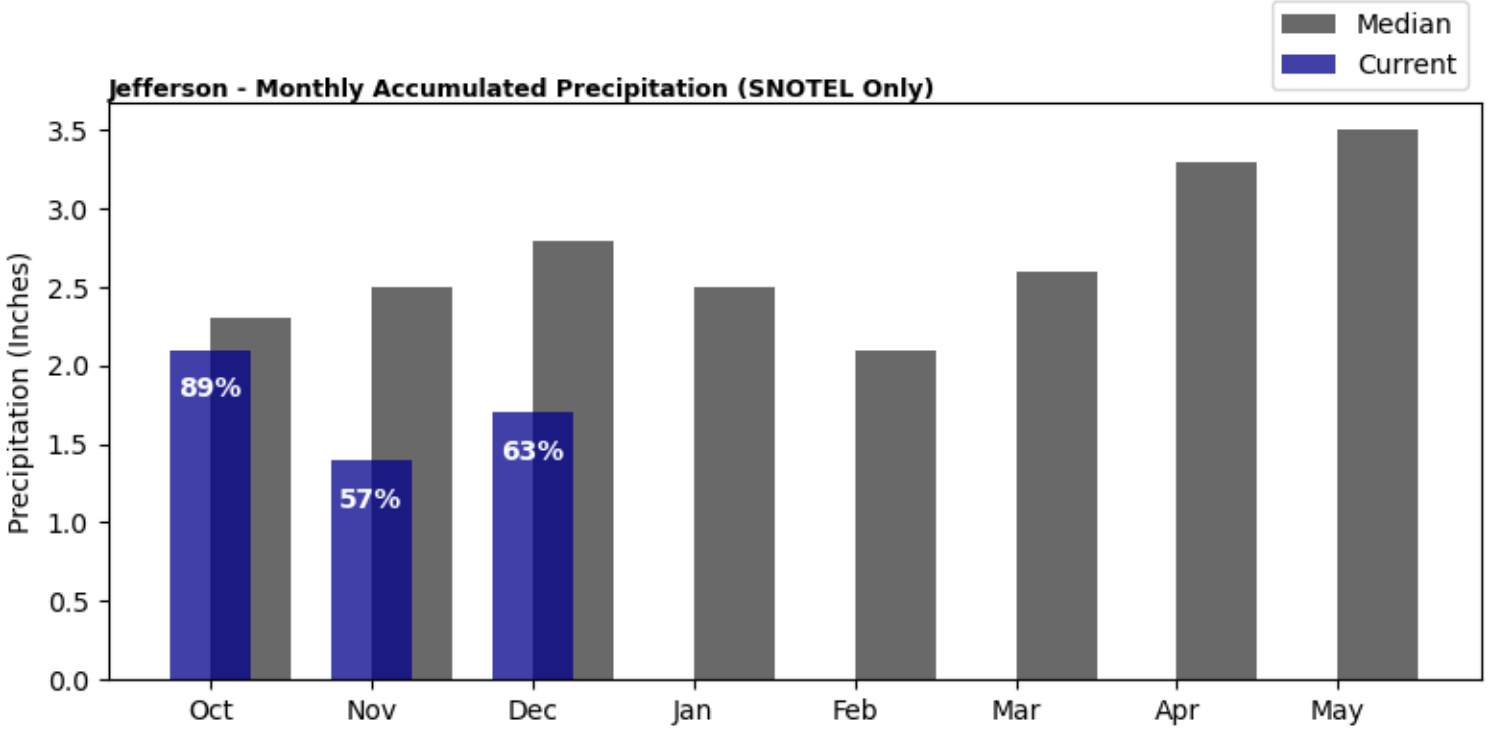


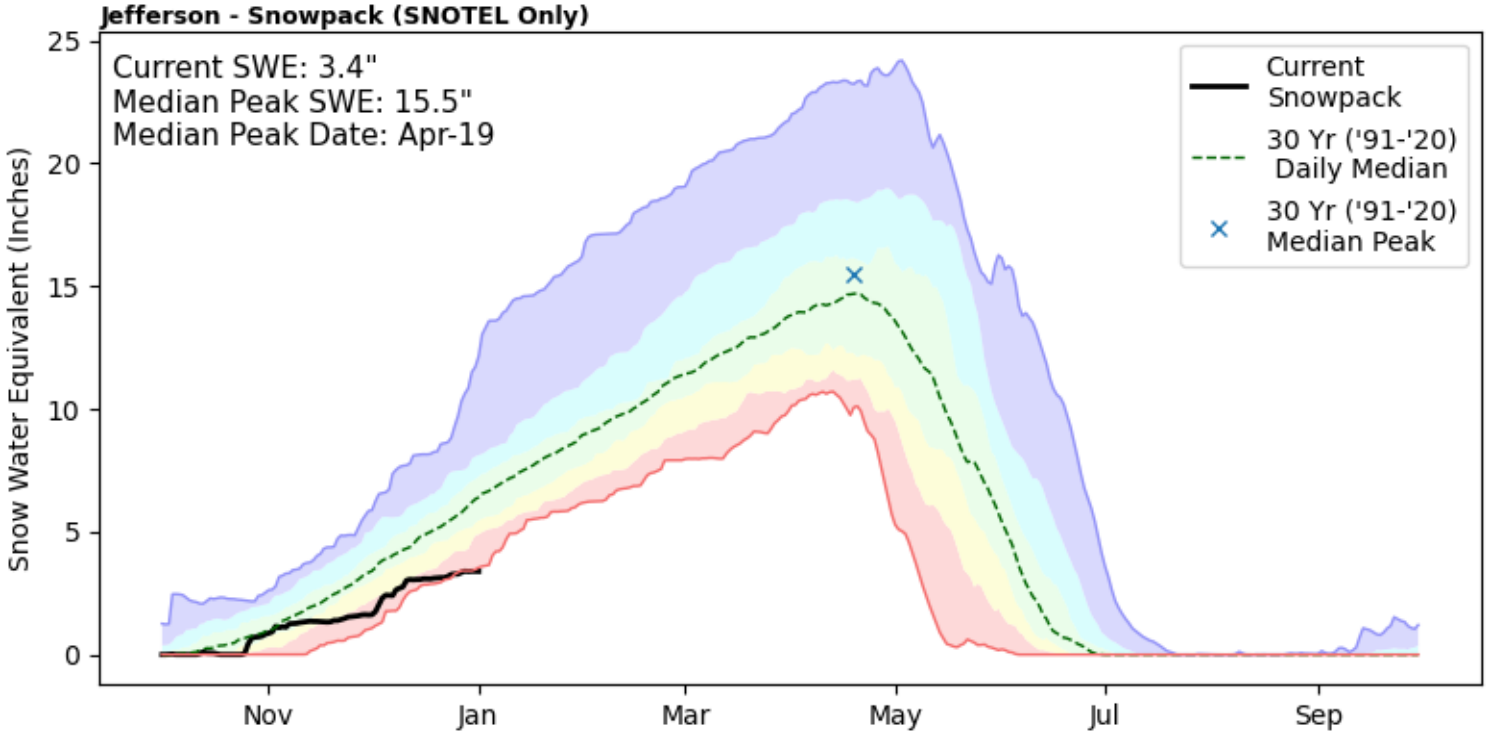


Basin Overview

Jefferson

Precipitation in December was well below normal at 63%, which brings the seasonal accumulation (October-December) to 67% of median. The snowpack in the Jefferson is well below normal at 52% of median, compared to 112% at this time last year.

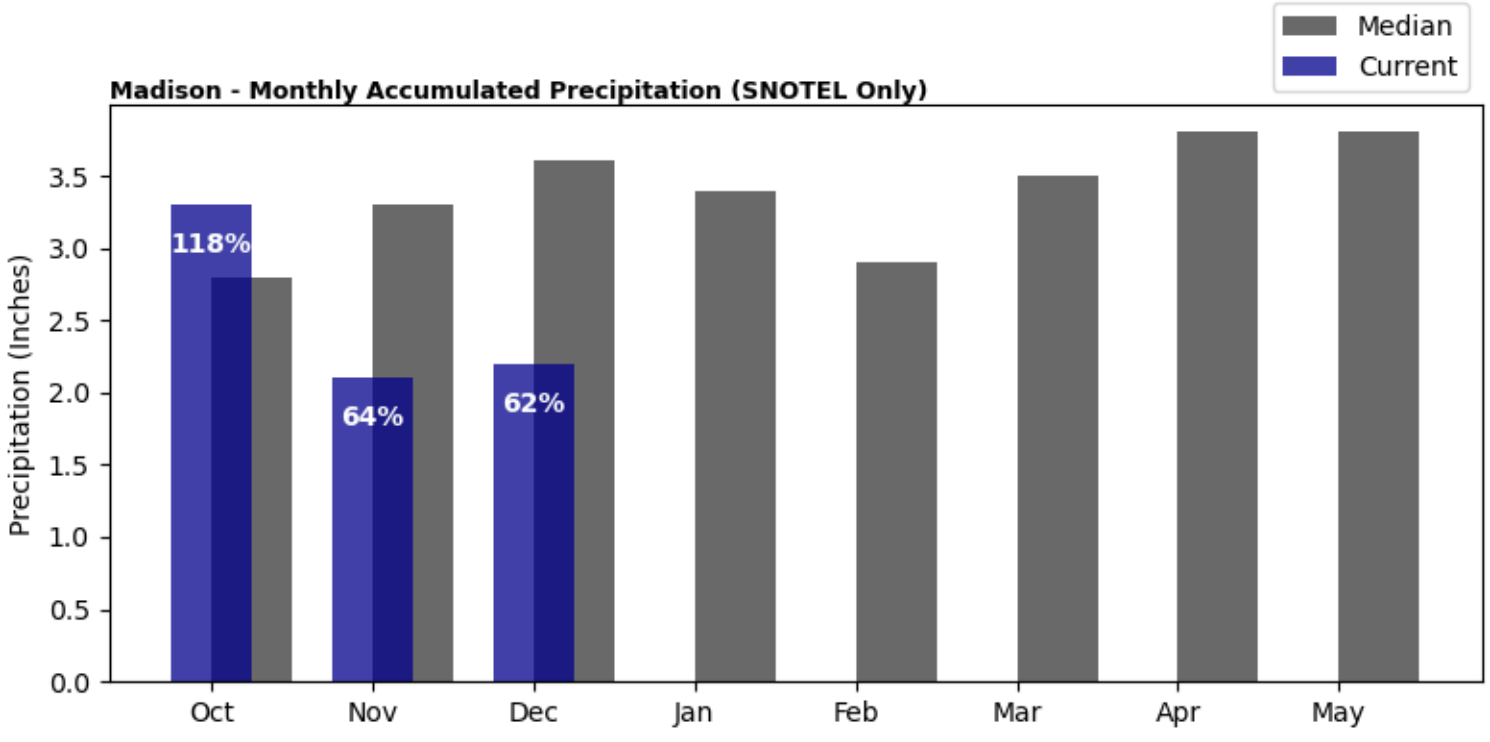


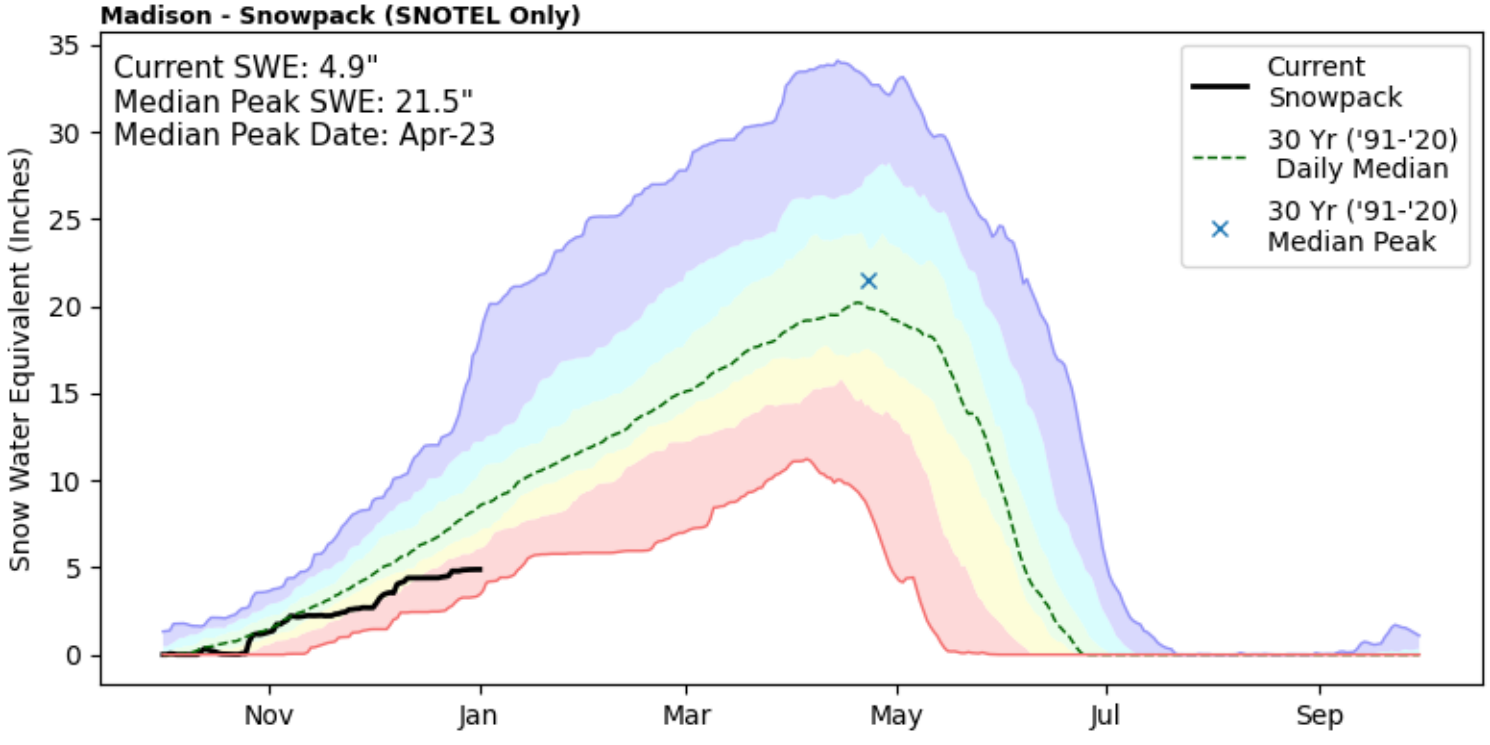


Basin Overview

Madison

Precipitation in December was well below normal at 62%, which brings the seasonal accumulation (October-December) to 75% of median. The snowpack in the Madison is well below normal at 54% of median, compared to 136% at this time last year.

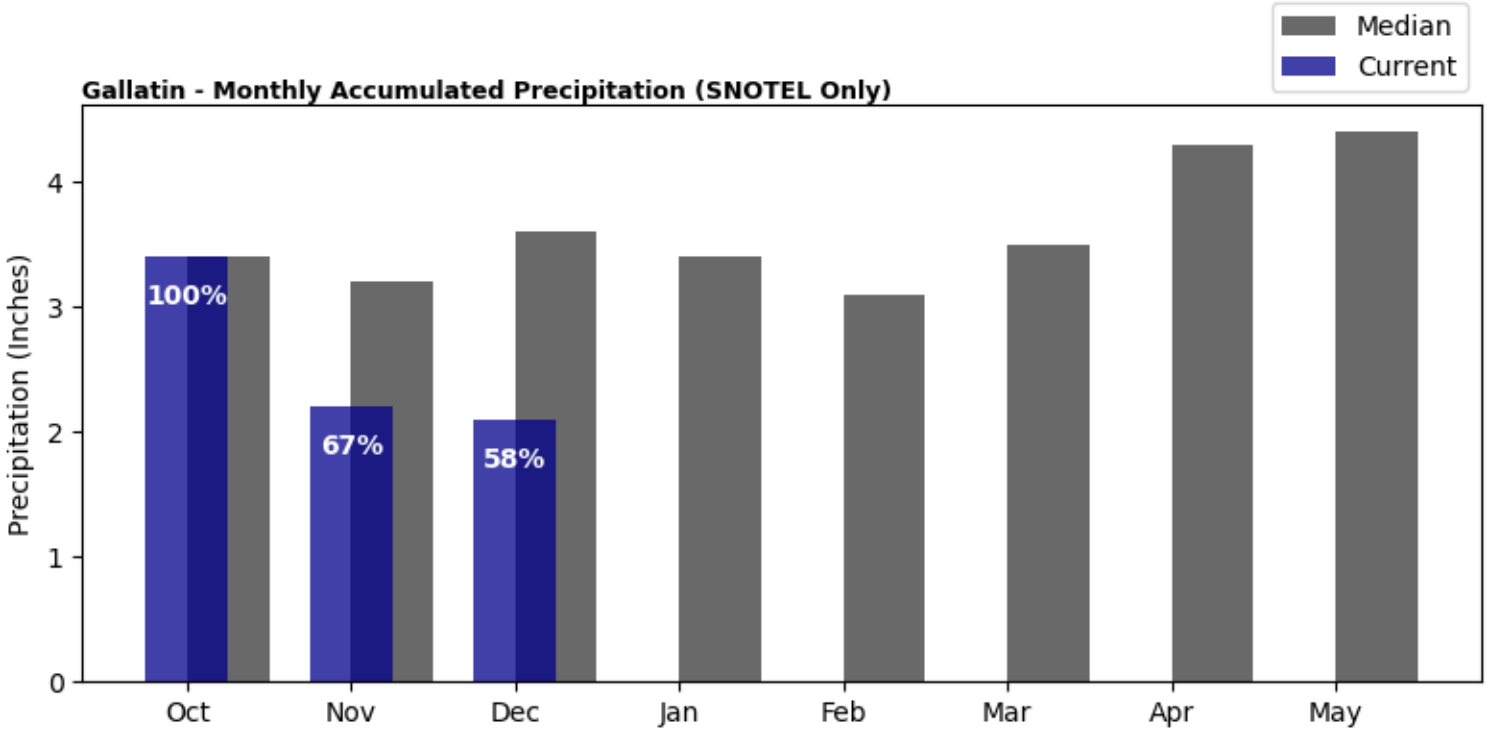


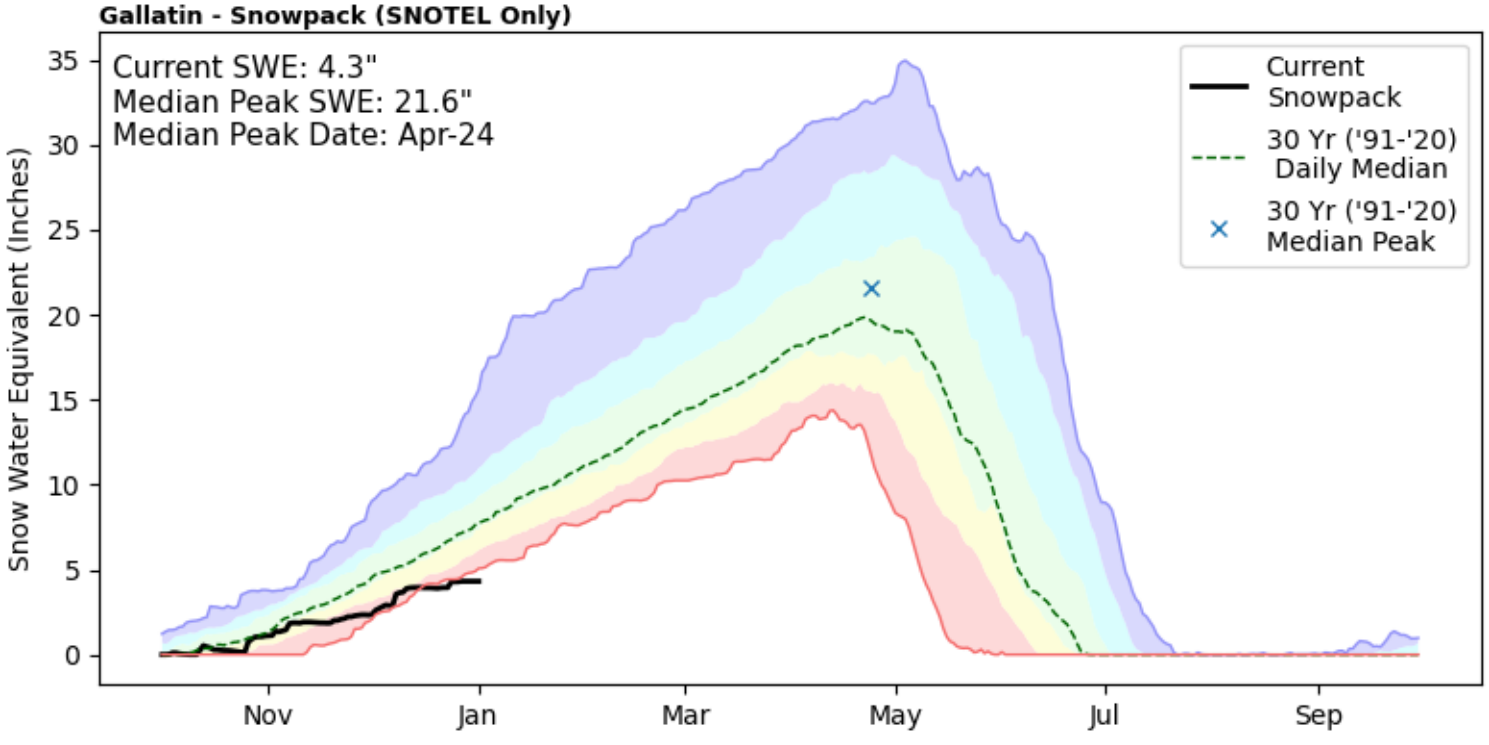


Basin Overview

Gallatin

Precipitation in December was well below normal at 58%, which brings the seasonal accumulation (October-December) to 71% of median. The snowpack in the Gallatin is well below normal at 54% of median, compared to 123% at this time last year.

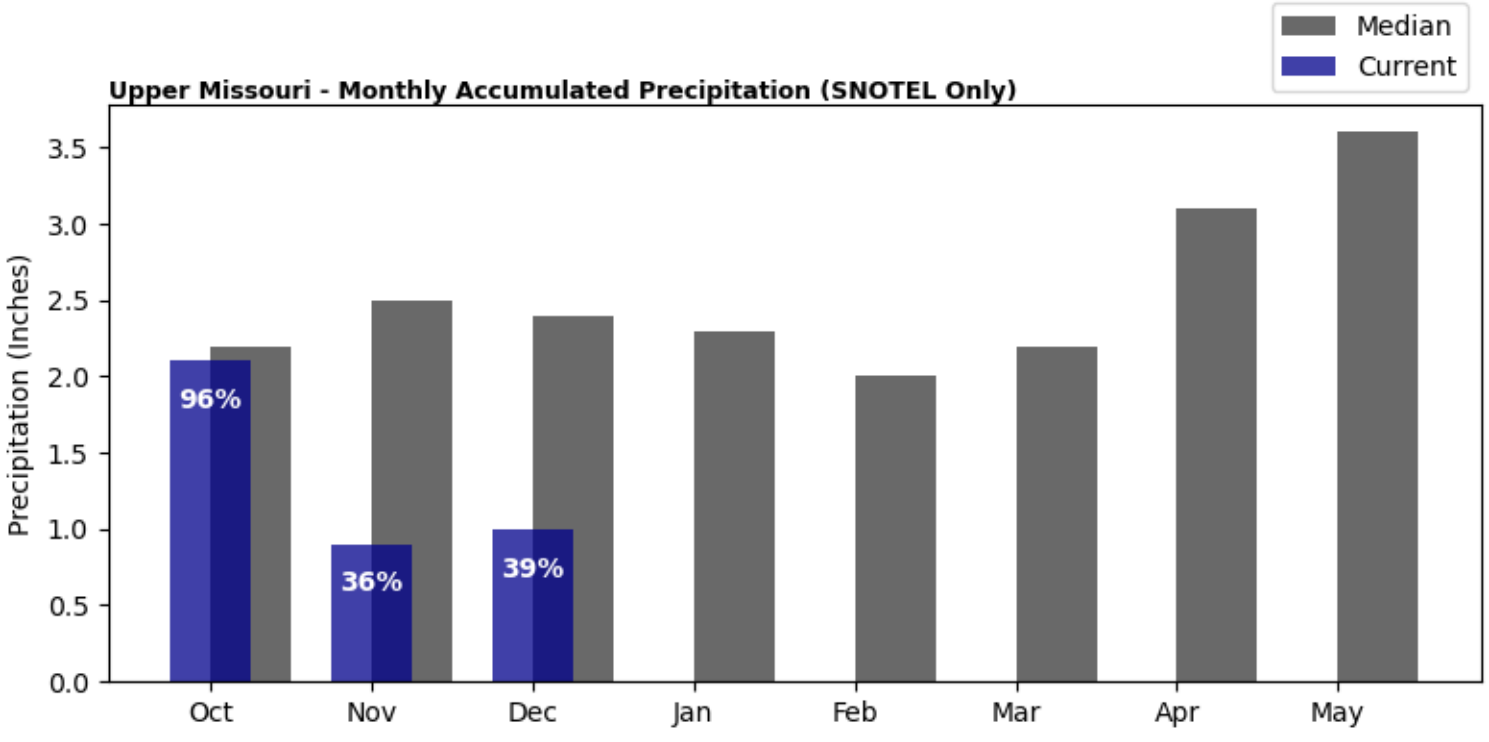


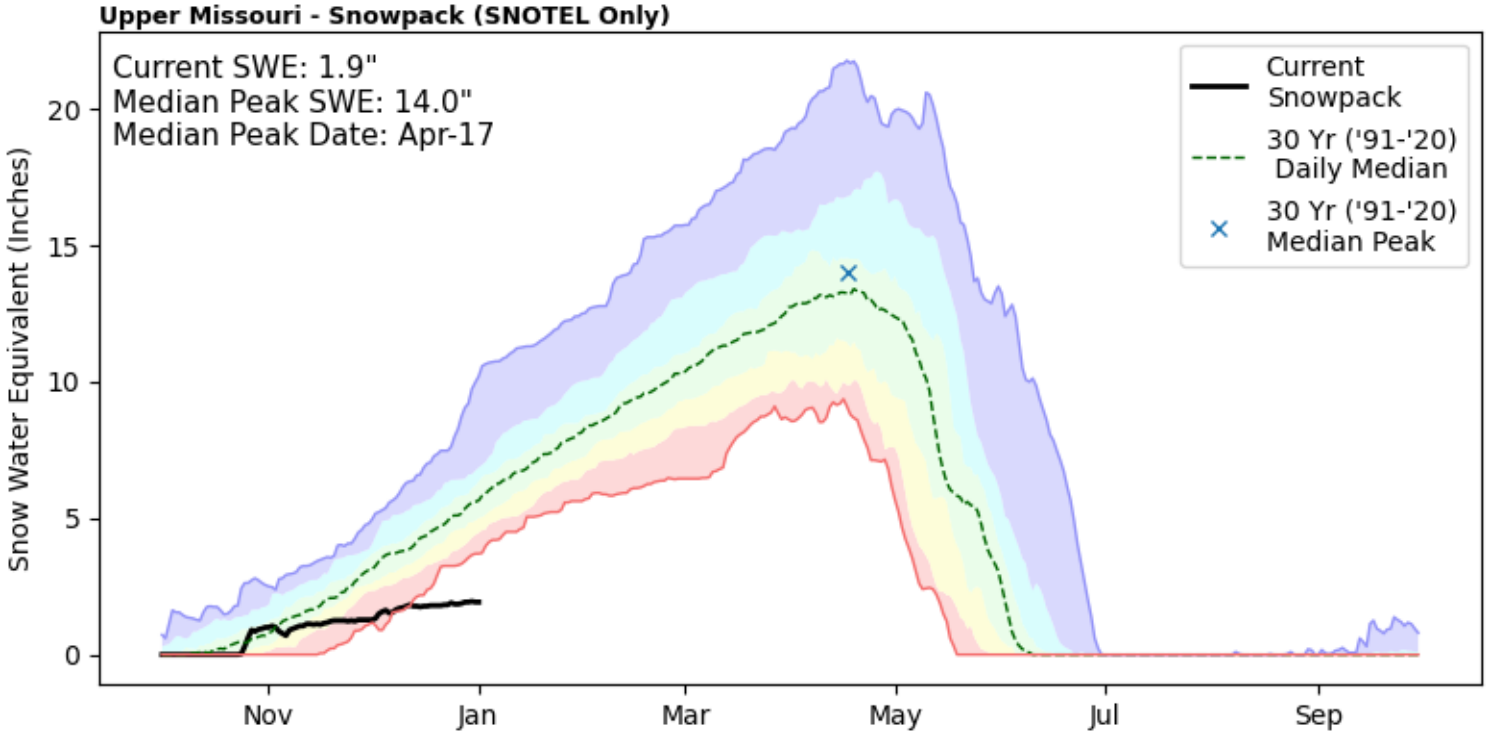


Basin Overview

Upper Missouri

Precipitation in December was well below normal at 39%, which brings the seasonal accumulation (October-December) to 55% of median. The snowpack in the Upper Missouri is well below normal at 33% of median, compared to 115% at this time last year.

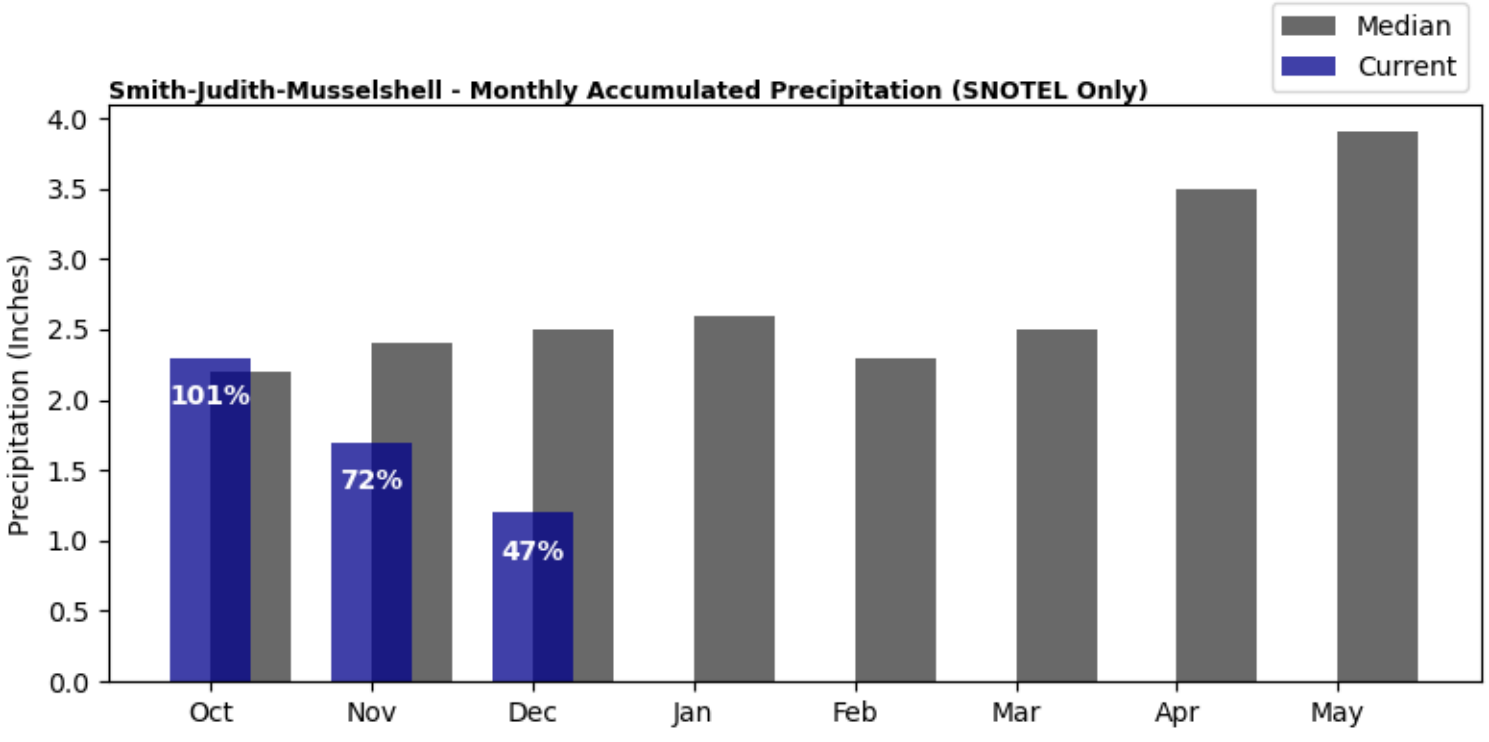


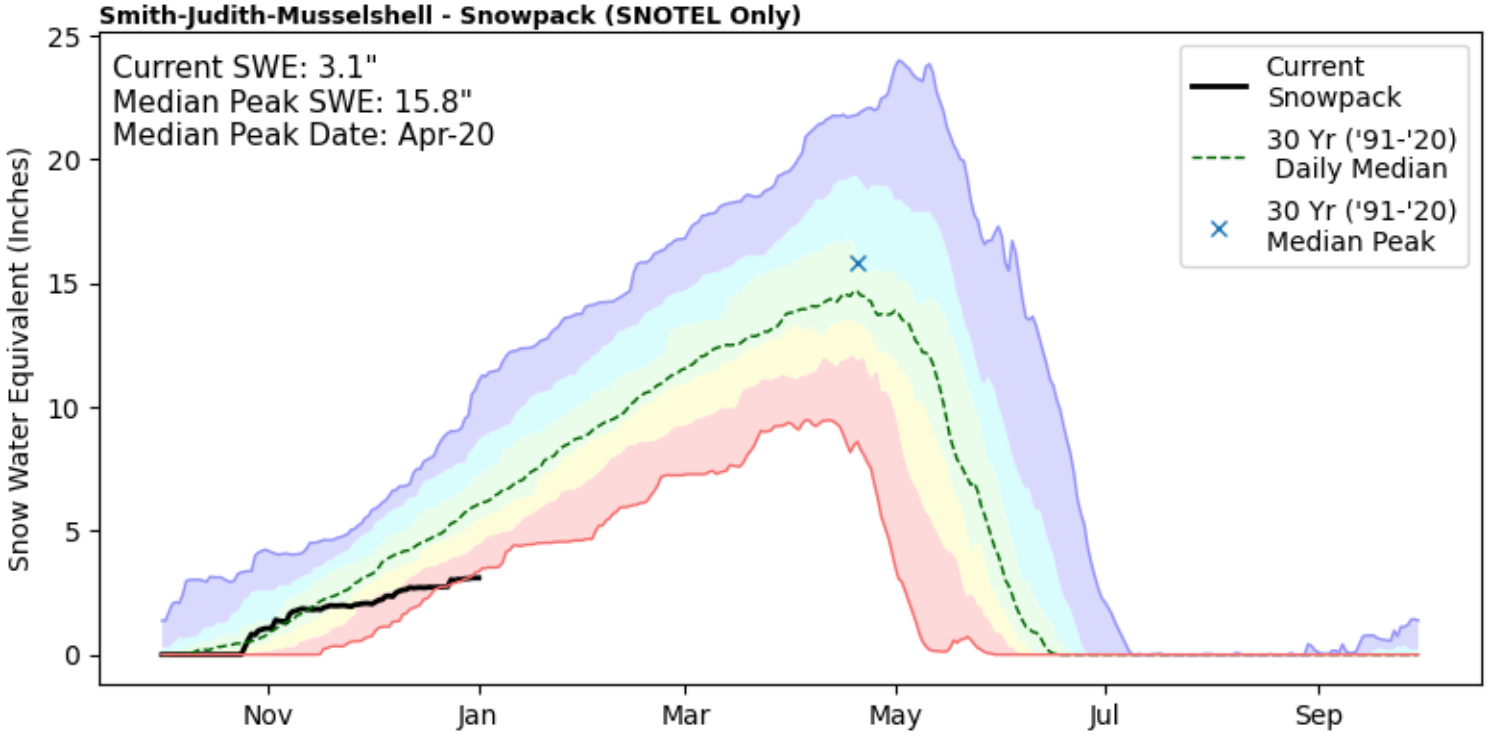


Basin Overview

Smith-Judith-Musselshell

Precipitation in December was well below normal at 47%, which brings the seasonal accumulation (October-December) to 66% of median. The snowpack in the Smith-Judith-Musselshell is well below normal at 49% of median, compared to 119% at this time last year.

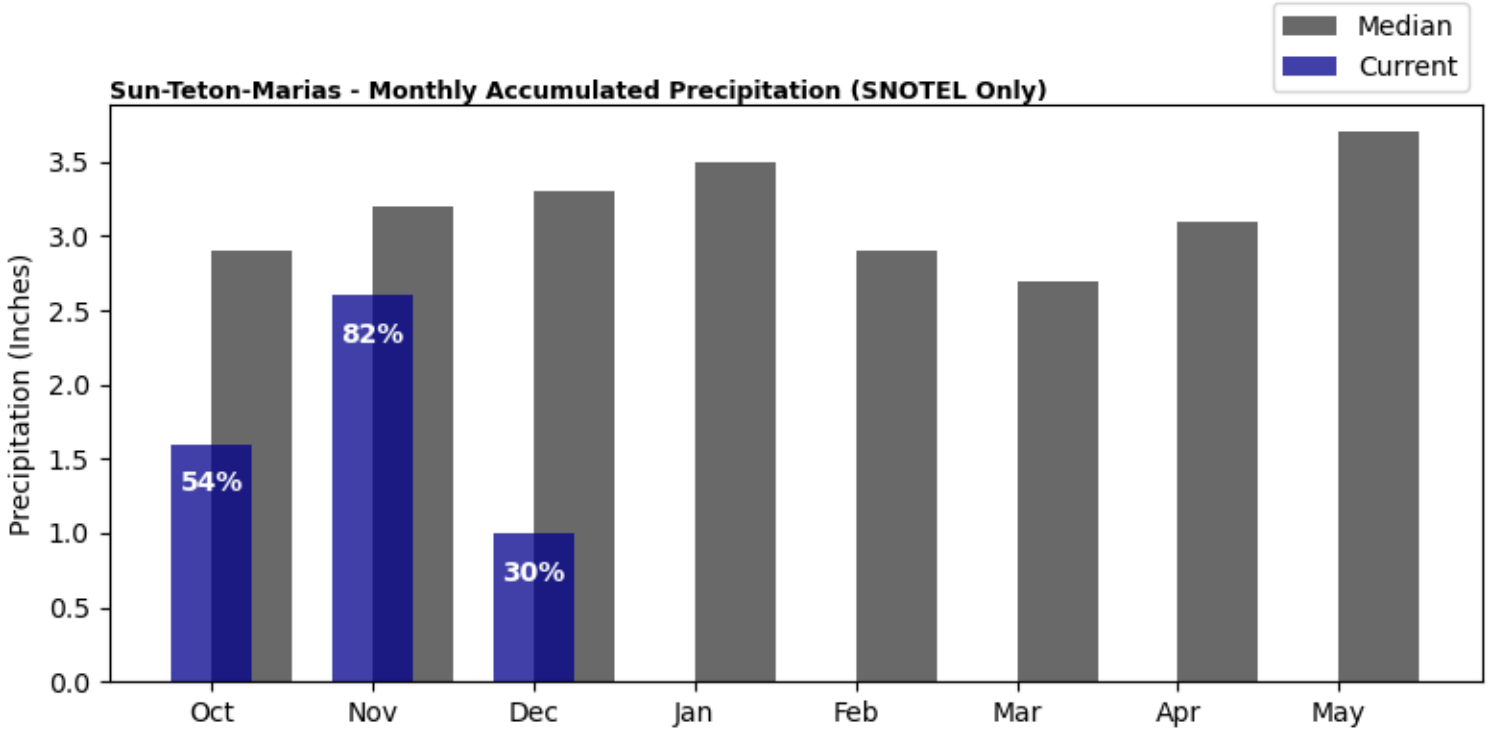


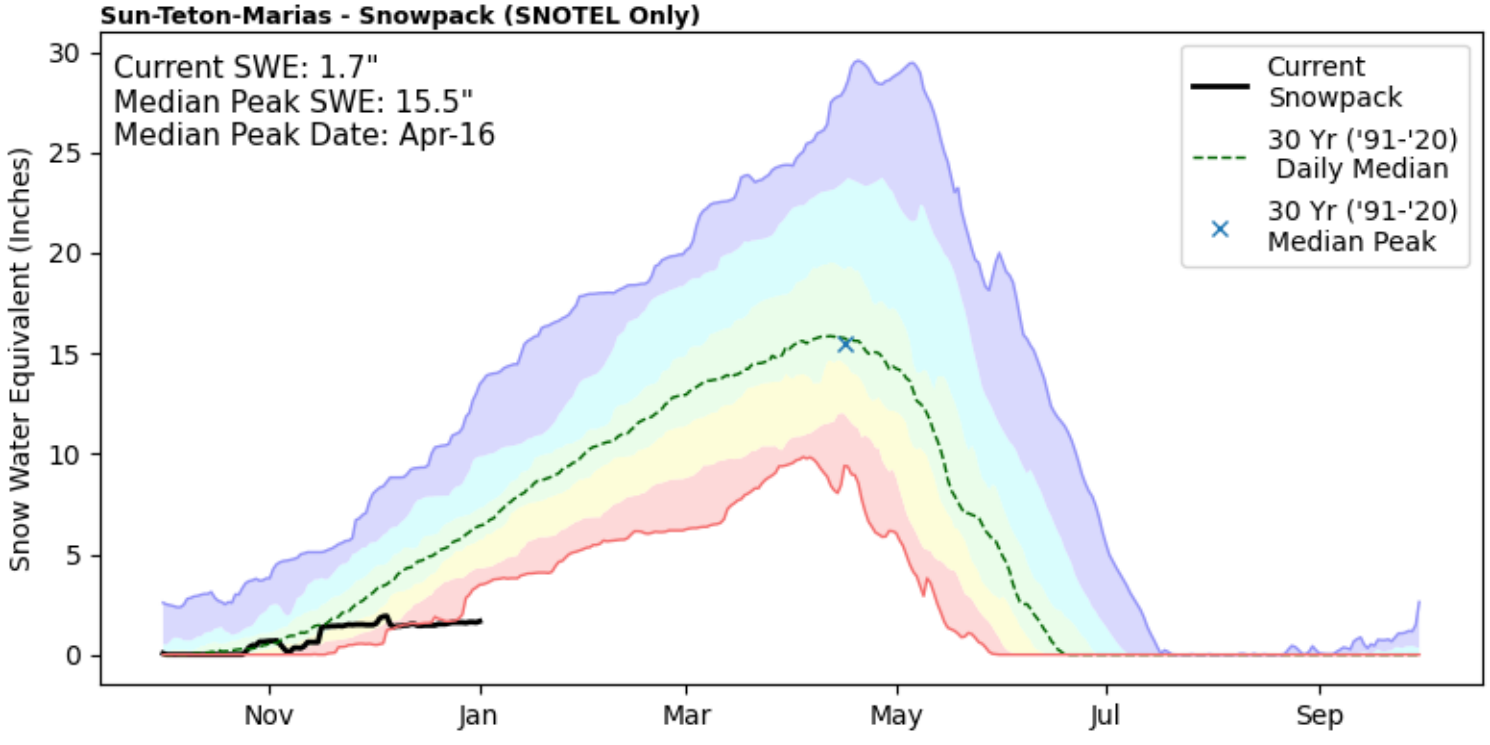


Basin Overview

Sun-Teton-Marias

Precipitation in December was well below normal at 30%, which brings the seasonal accumulation (October-December) to 52% of median. The snowpack in the Sun-Teton-Marias is well below normal at 26% of median, compared to 121% at this time last year.

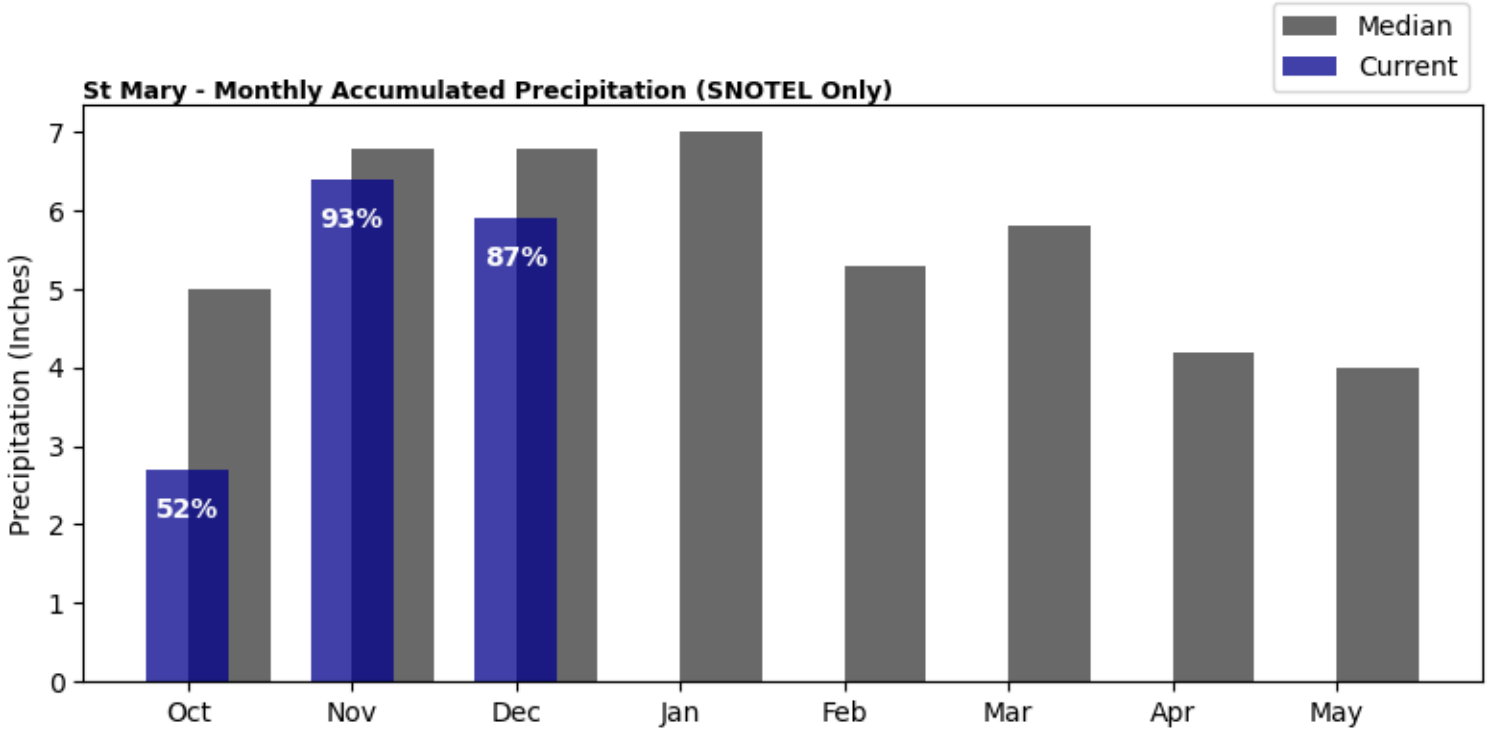


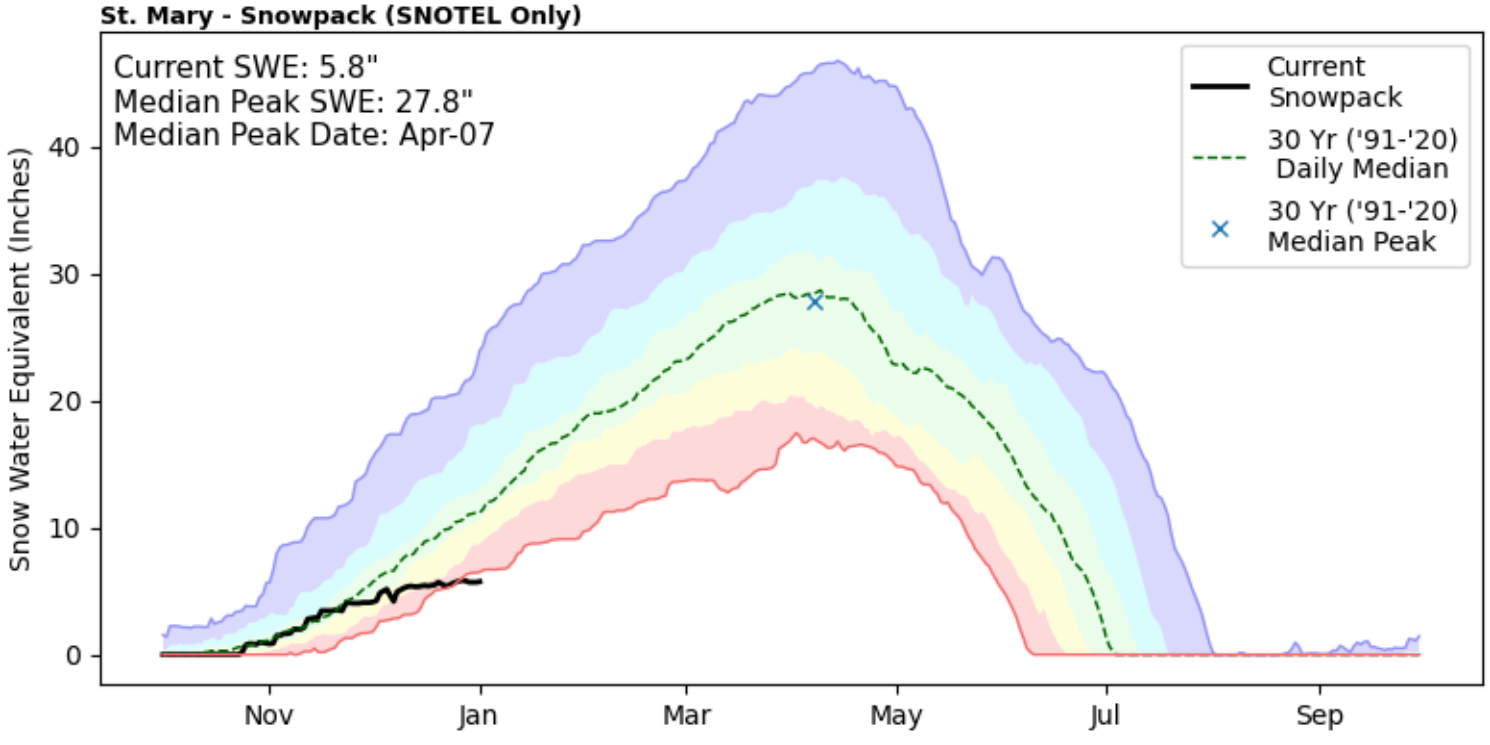


Basin Overview

St. Mary

Precipitation in December was below normal at 87%, which brings the seasonal accumulation (October-December) to 77% of median. The snowpack in the St. Mary is well below normal at 51% of median, compared to 111% at this time last year.

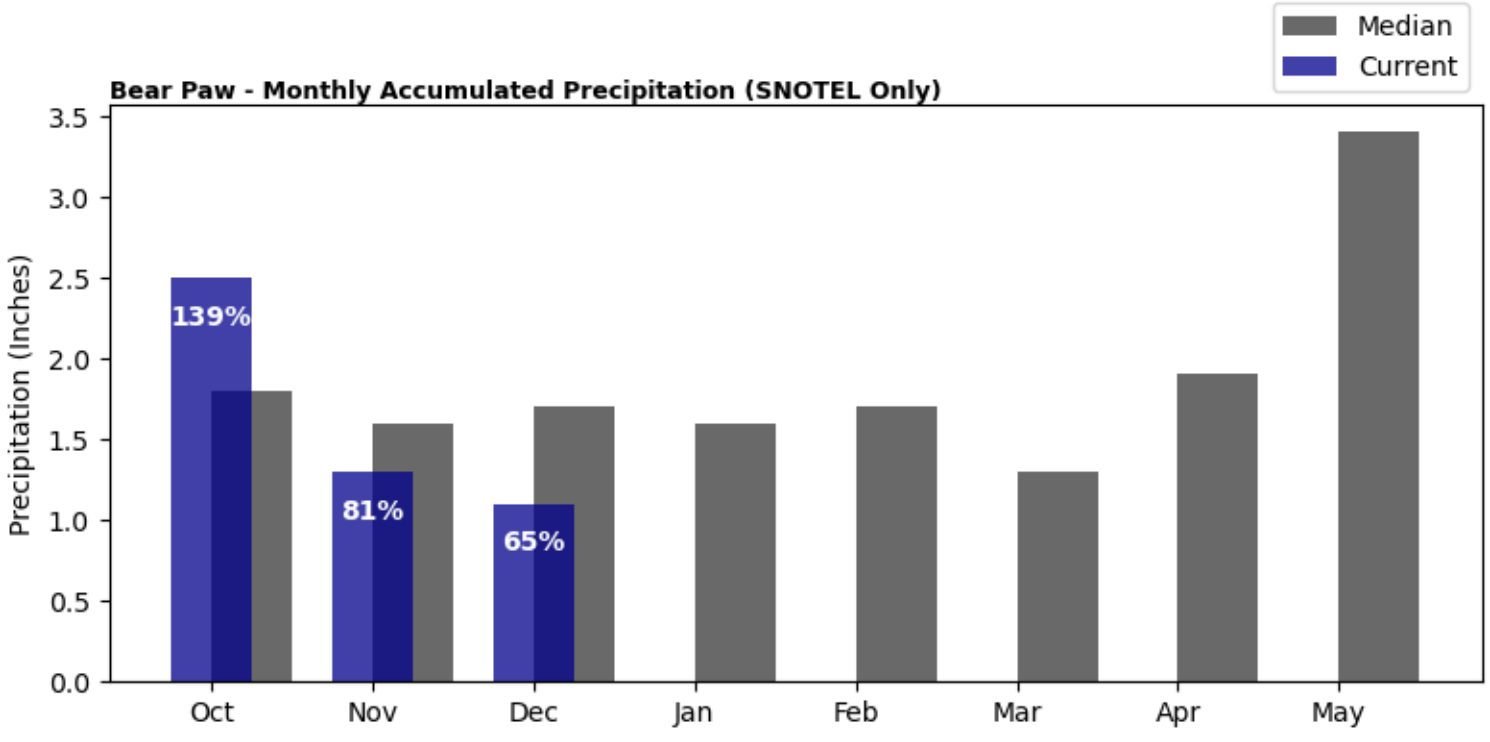


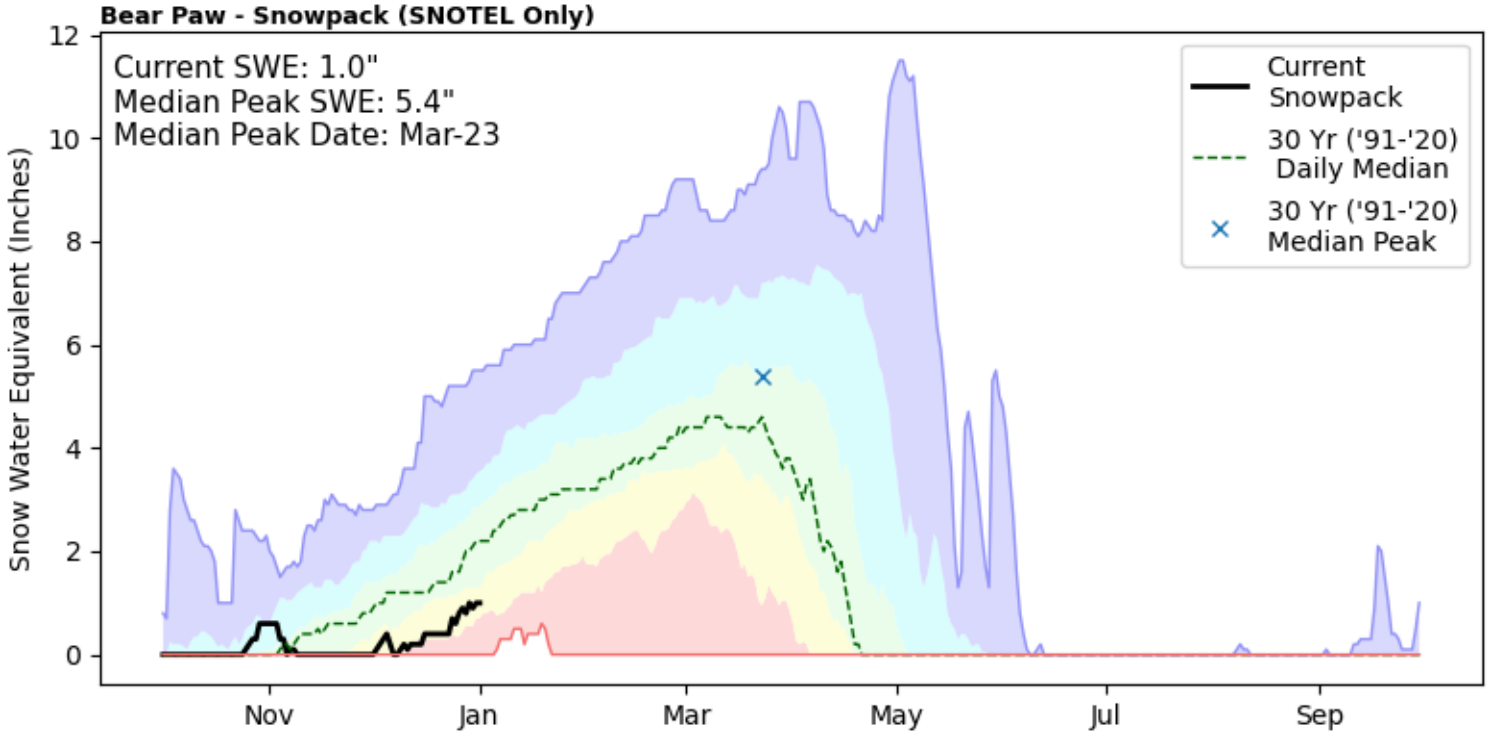


Basin Overview

Bear Paw

Precipitation in December was well below normal at 65%, which brings the seasonal accumulation (October-December) to 84% of median. The snowpack in the Bear Paw is well below normal at 41% of median, compared to 159% at this time last year.

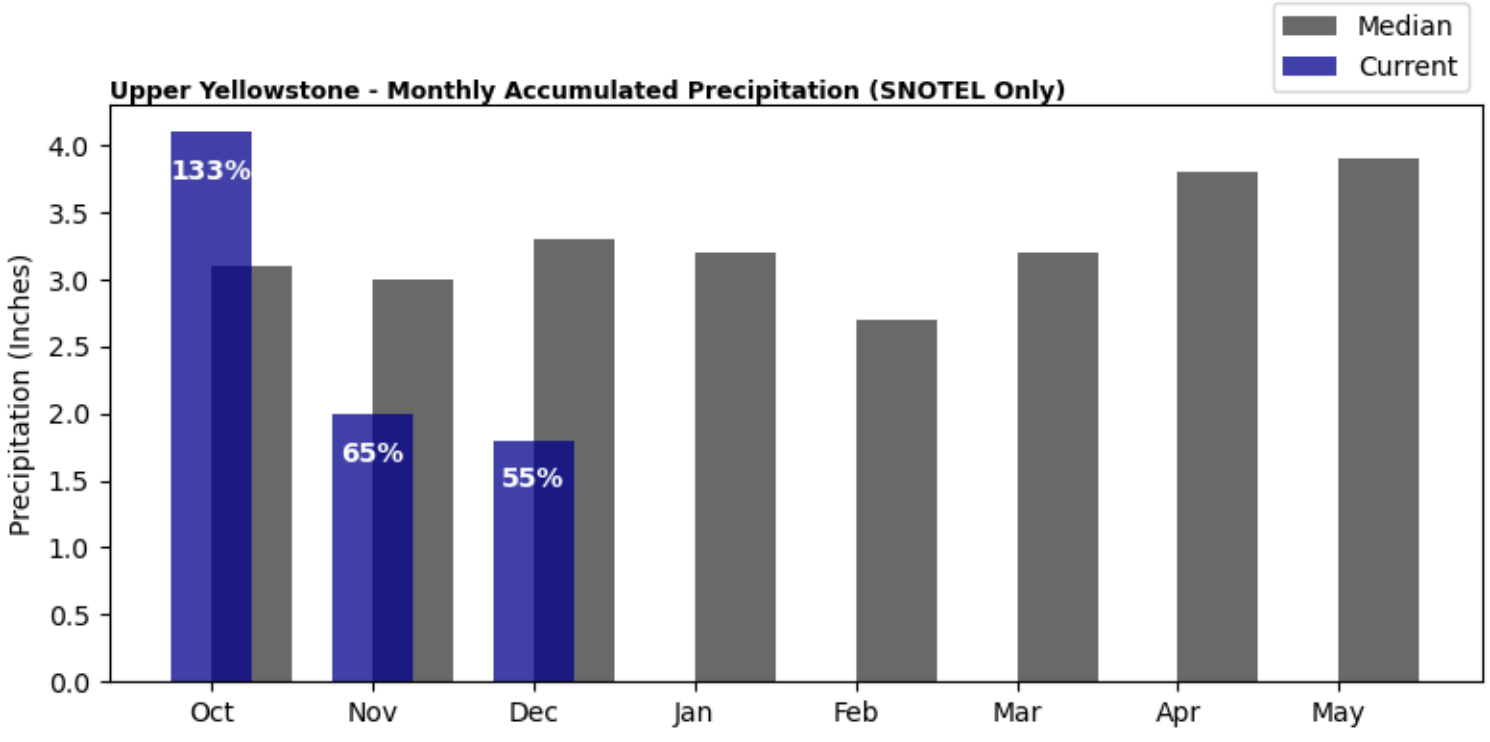


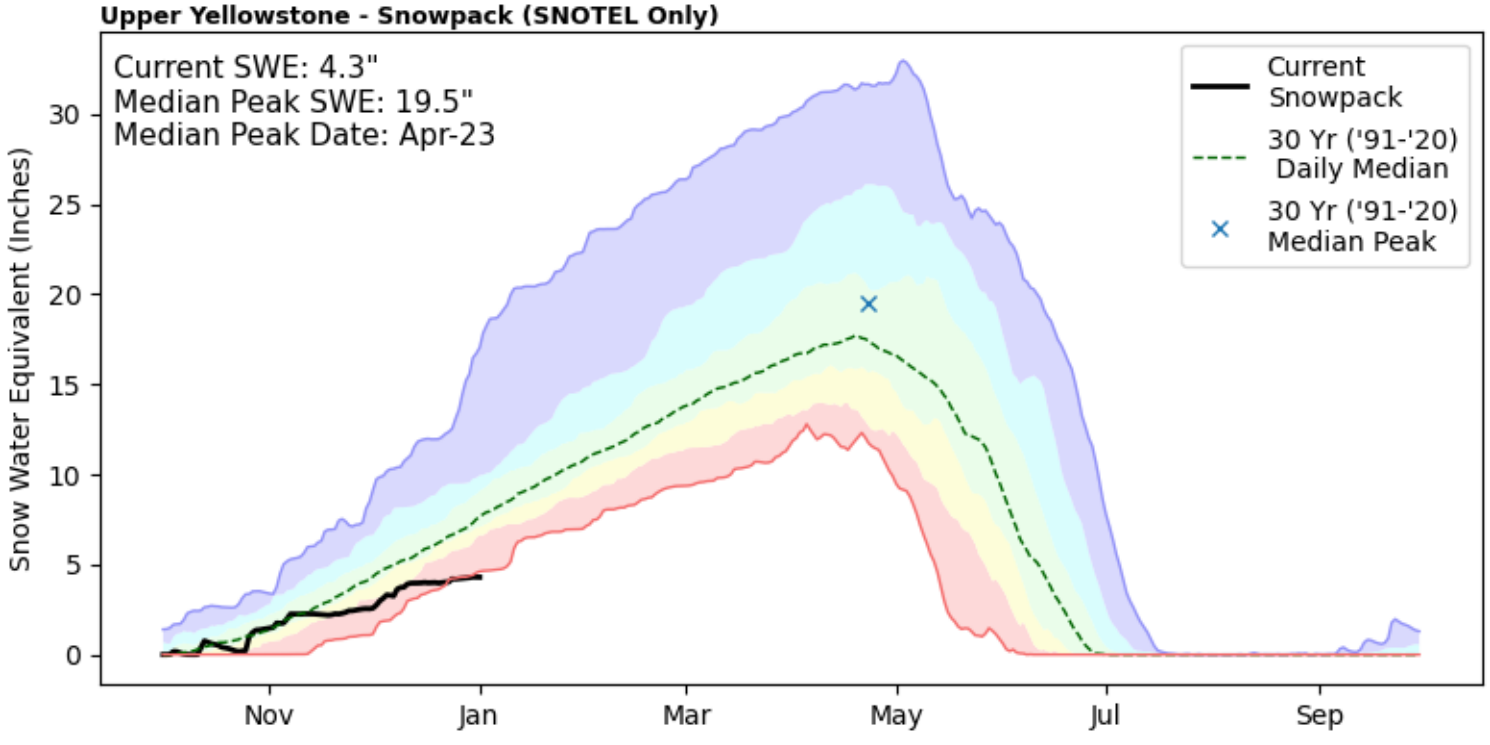


Basin Overview

Upper Yellowstone

Precipitation in December was well below normal at 55%, which brings the seasonal accumulation (October-December) to 80% of median. The snowpack in the Upper Yellowstone is well below normal at 55% of median, compared to 111% at this time last year.

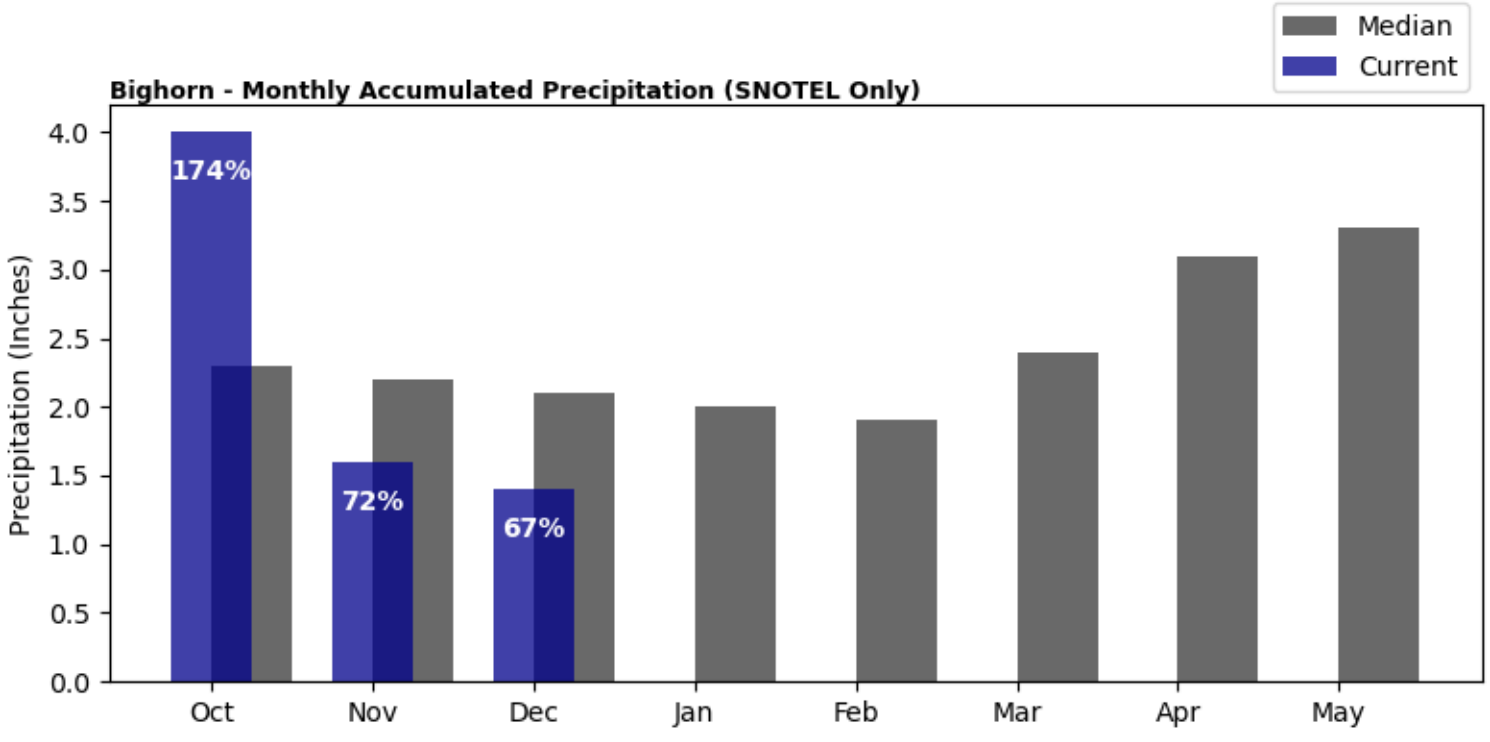


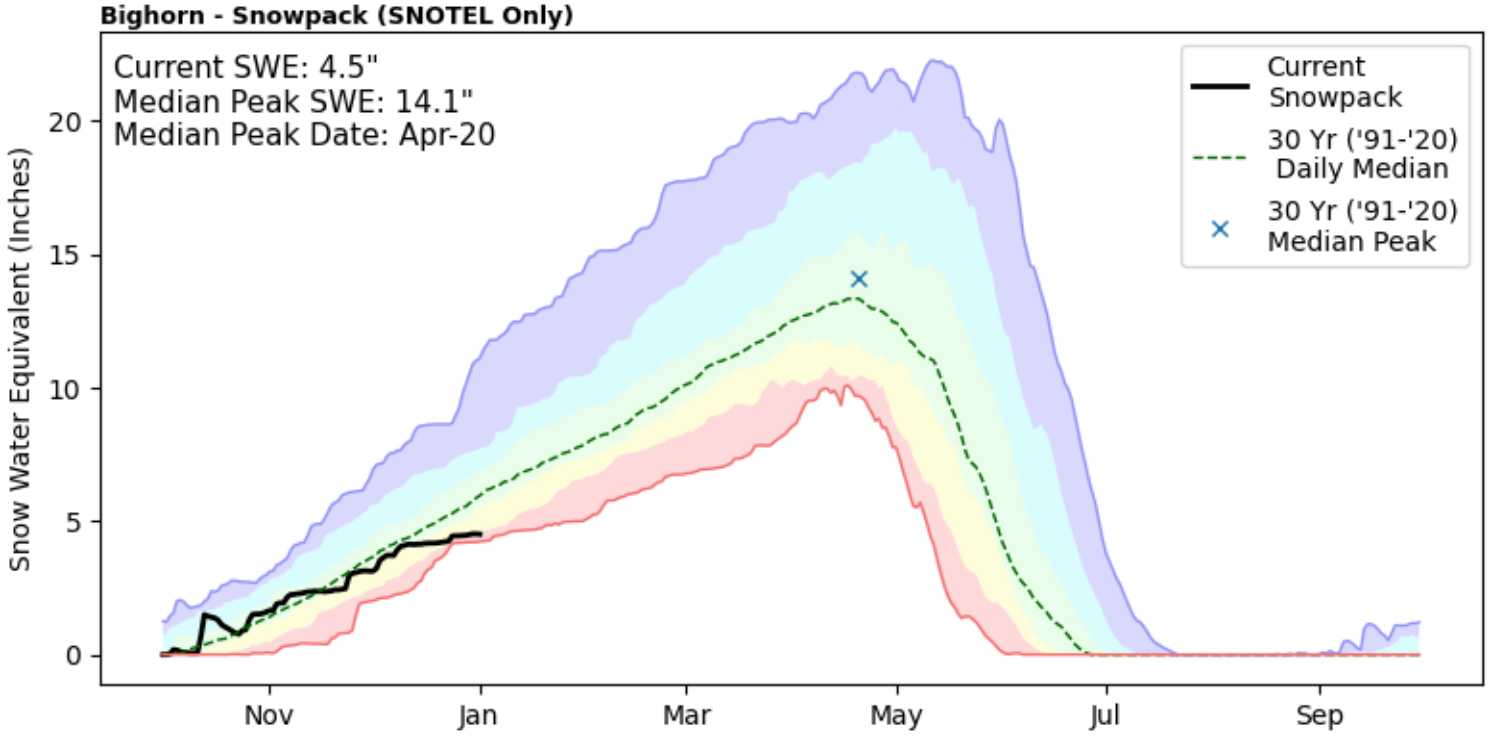


Basin Overview

Bighorn

Precipitation in December was well below normal at 67%, which brings the seasonal accumulation (October-December) to 101% of median. The snowpack in the Bighorn is well below normal at 75% of median, compared to 108% at this time last year.

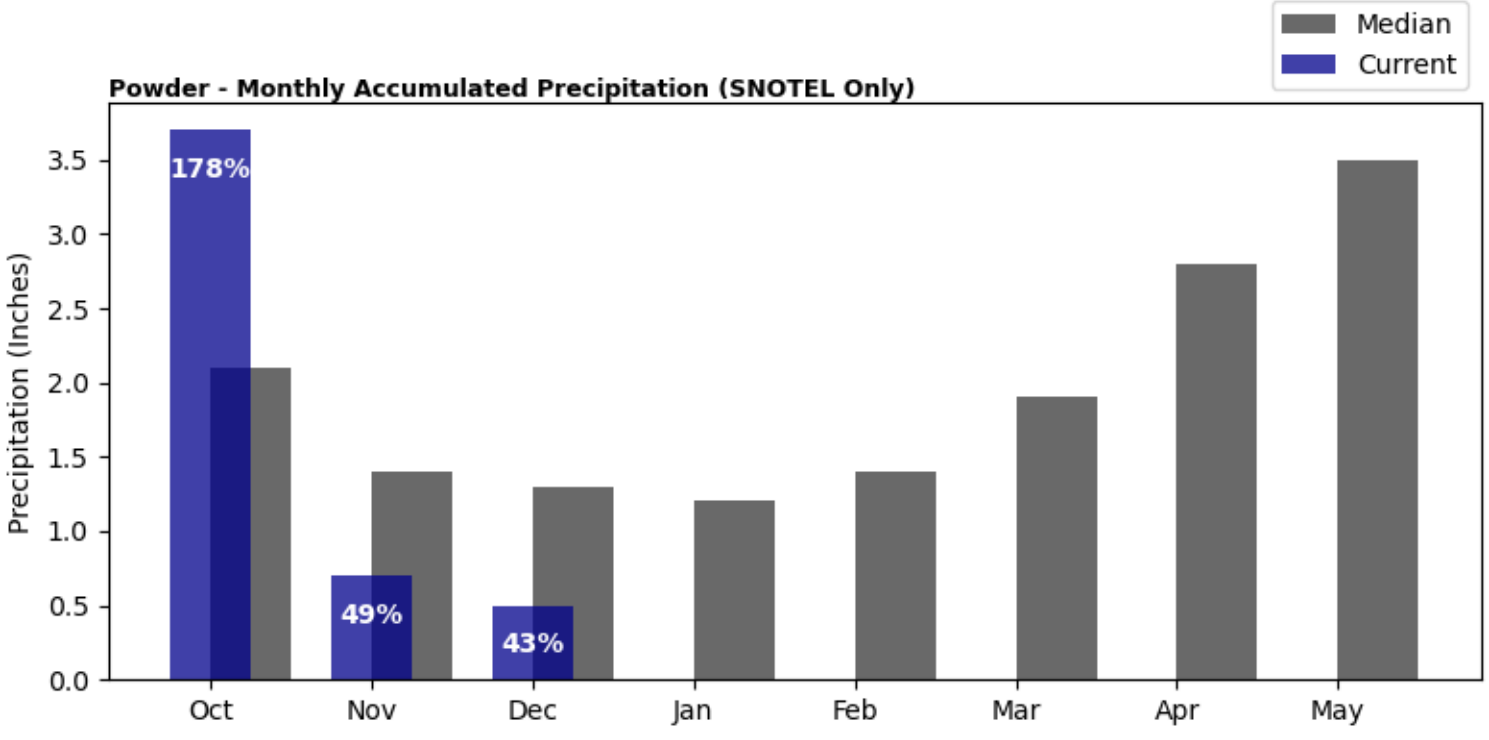


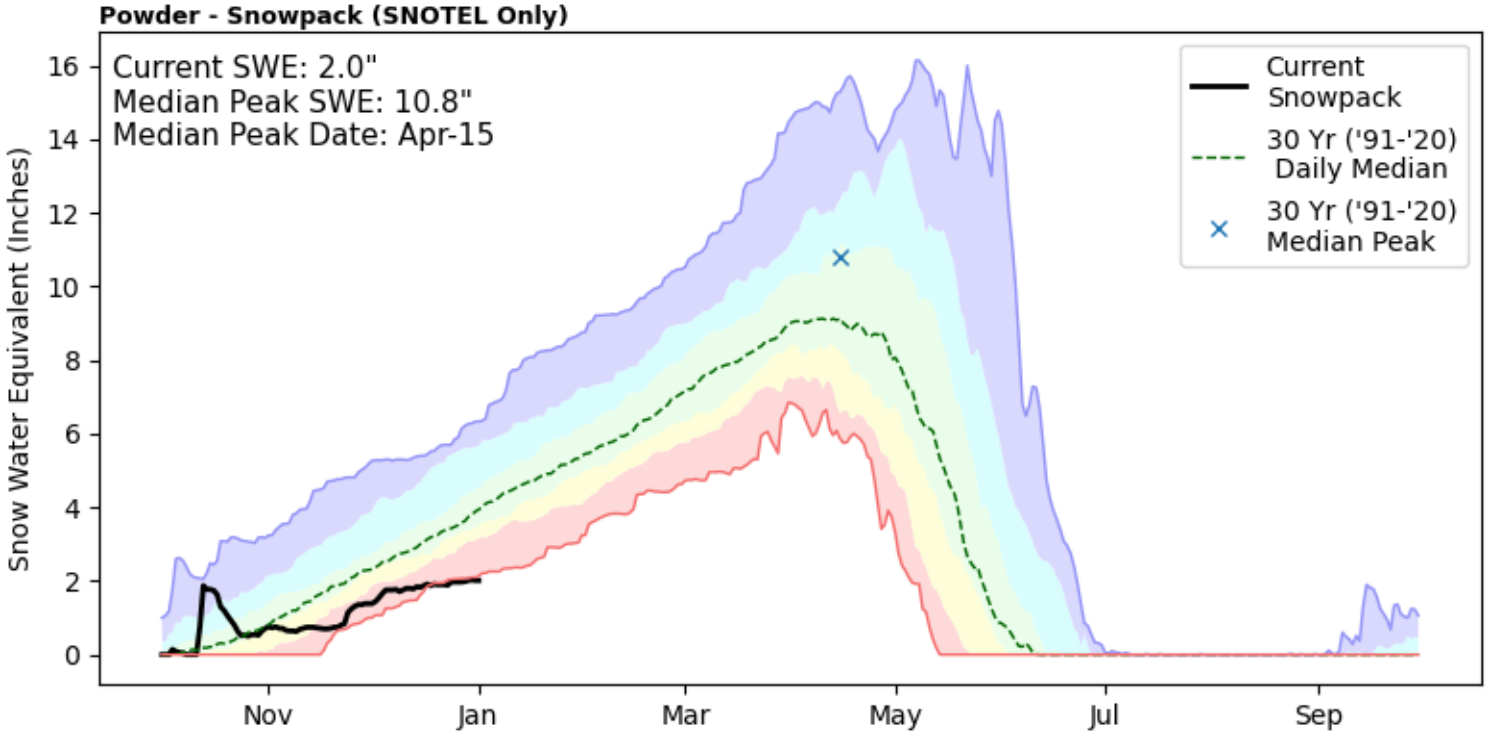


Basin Overview

Powder

Precipitation in December was well below normal at 43%, which brings the seasonal accumulation (October-December) to 100% of median. The snowpack in the Powder is well below normal at 51% of median, compared to 113% at this time last year.

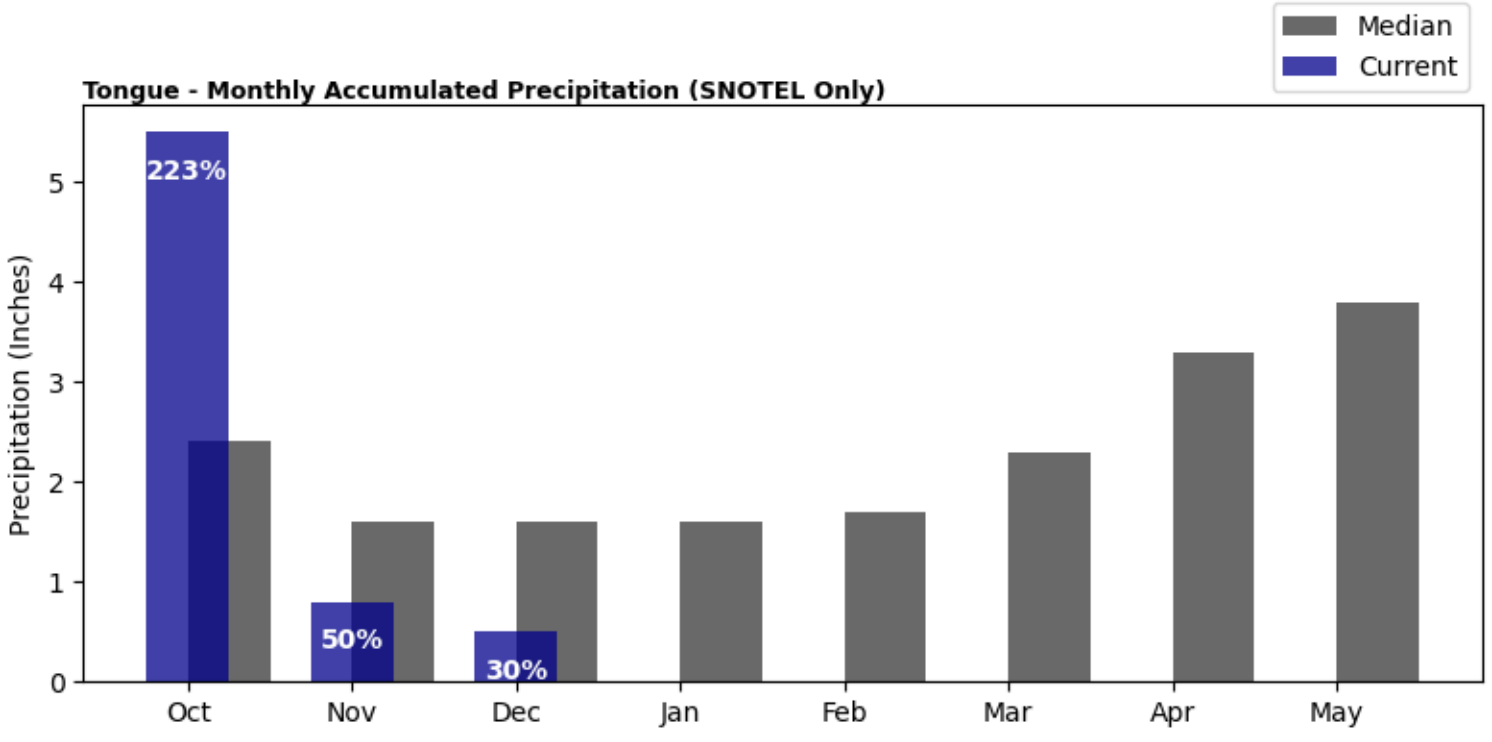


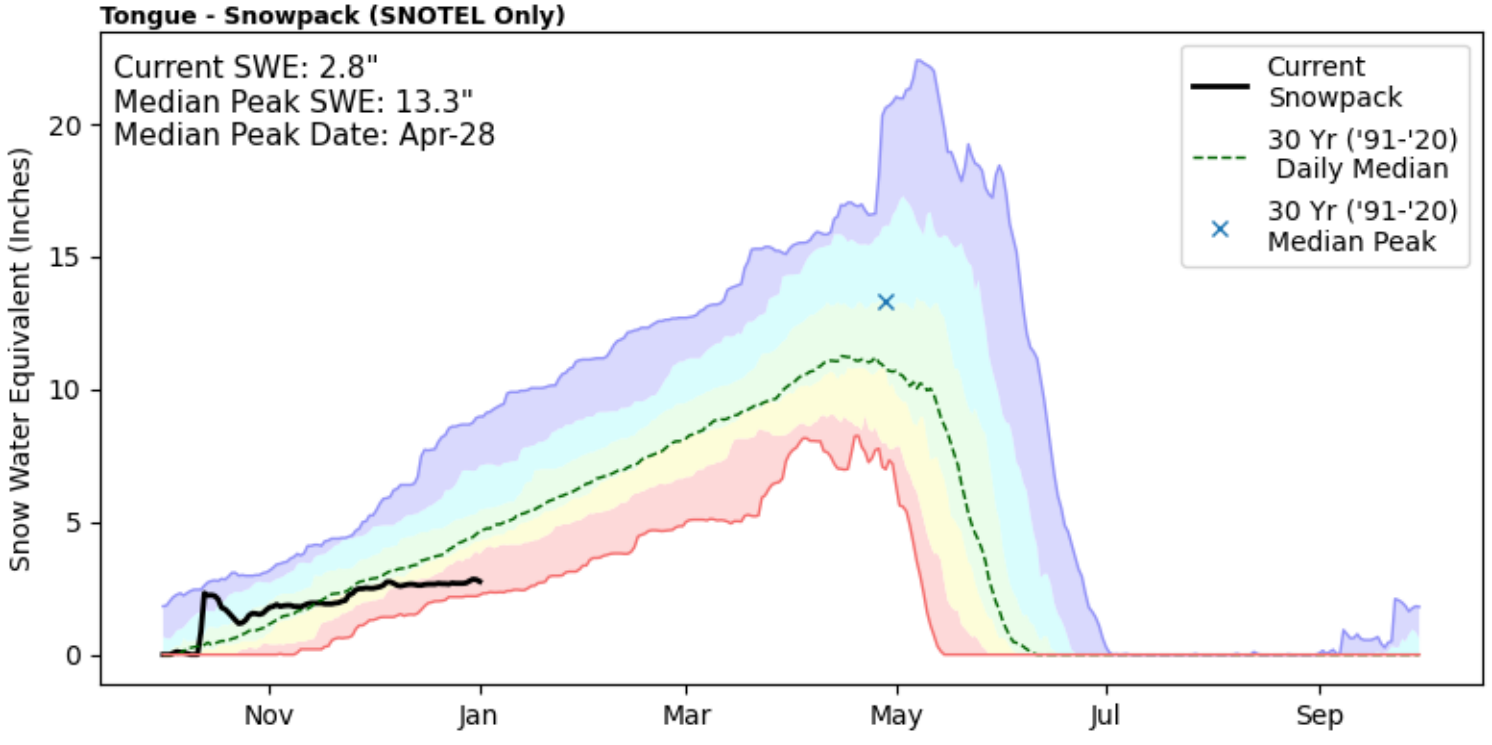


Basin Overview

Tongue

Precipitation in December was well below normal at 30%, which brings the seasonal accumulation (October-December) to 115% of median. The snowpack in the Tongue is well below normal at 59% of median, compared to 103% at this time last year.



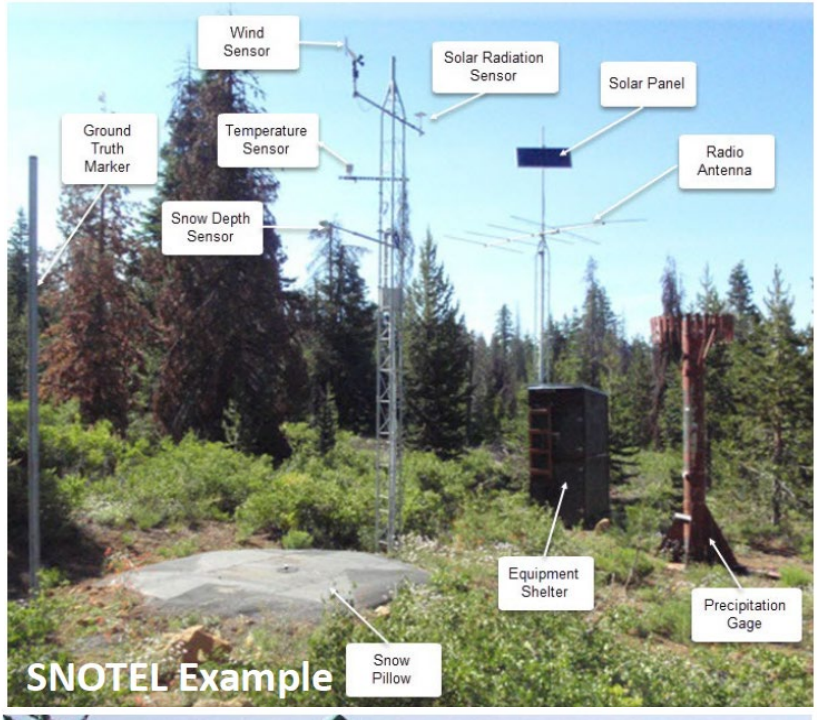


Appendix

Monitoring Station Overview

SNOTEL

The NRCS operates an extensive, automated data collection network called SNOTEL (short for Snow Telemetry). SNOTEL sites are designed to operate unattended in remote mountain locations. Data are collected and transmitted hourly and available on the internet. Daily data (midnight values) are quality checked by NRCS hydrologists on at least a weekly basis. SNOTEL sites provide snowpack water content data via a pressure-sensing snow pillow. Other data include snow depth, water year precipitation accumulation, air temperature with daily maximums, minimums, and averages. The earliest NRCS SNOTEL sites have data back to the mid-1970s.



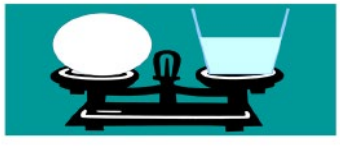
Snow Course

Snow courses are measurement transects where snow tubes are used by snow surveyors during the winter season to determine the depth and water content of the snowpack. Hollow snow tubes are used to vertically core the snowpack. The tubes are then weighed to determine the water content of the snow. Generally, snow courses are situated in meadows or forest openings protected from the wind. A snow course measurement is the average of a number of sample points, typically 5 or 10. Snow courses are measured on a monthly basis typically between January 1 and June 1. Snow courses provide a longer record than SNOTEL. The earliest snow courses in the Montana have data back to the 1920s.

Snow Water Equivalent (SWE)

Sometimes also called snow water content, this is the amount of water contained within the snowpack. It can be thought of as the depth of water (in inches) that would result if you melted the snowpack. For example, if a snowpack containing 12 inches of SWE melted instantaneously, there would be a puddle of water 12 inches deep on the ground.

SWE measurements made by snow pillows or snow tubes rely on the fact that water weighs the same whether it is liquid or frozen.



Weight of frozen water = Weight of liquid water

Snow core inside snow tubes

Appendix

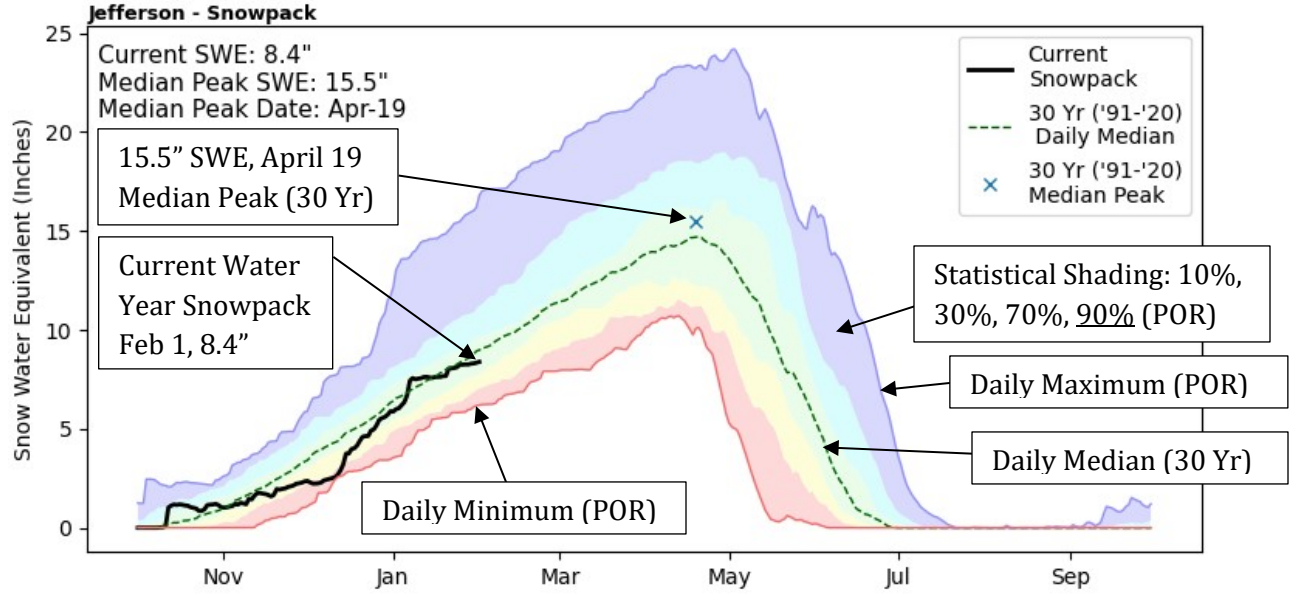
Additional Information

Climatic and Hydrologic Normals

The Snow Survey and Water Supply Forecasting (SSWSF) normals are site-specific measures of central tendency (either the median or average) for a data type, such as snow water equivalent (SWE). The statistics are calculated over a 30-year period and updated each decade, in agreement with World Meteorological Organization (WMO) standards. This 30-year reference period was chosen to characterize the current hydroclimatology at each station. The most recent medians and averages have been updated to include data for the water years 1991-2020. The National Water and Climate Center (NWCC) also provides medians and averages for the 1981-2010 and 1971-2000 reference periods for stations with sufficient data. The normals available from the NWCC include the median and average for SWE, snow depth (snow courses only), precipitation, volumetric streamflow, and reservoir storage. Values are calculated from data collected by NRCS-managed stations and external agencies such as the U.S. Geological Survey (USGS), National Weather Service (NWS), state agencies, and private organizations. Normal is calculated for various durations including daily, month-to-date, semi-monthly, monthly, seasonal, and annual based on the data type. More information is available here: https://www.nrcs.usda.gov/resources/data-and-reports/climatic-and-hydrologic-normals

Interpreting Snowpack Charts

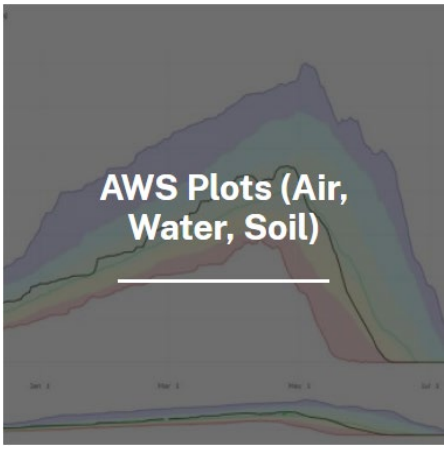
Snowpack charts displayed in this report are created using daily (midnight) snow water equivalent (SWE) values at SNOTEL sites determined to represent the basin. Snow Course data is not included. Plotted lines are the average of each SNOTEL's individual values. For example, the "Current Snowpack" on January 1st is the average all SNOTEL SWE values in that basin for that day. The "30 Yr. ('91-'20) Daily Median" is the average of each SNOTEL's median SWE value for a given day. The upper and lower extent (blue/red lines) show the maximum/minimum daily SWE values, which is determined using the "Current Snowpack" SWE value for all days in the period of record (POR). Snowpack peak SWE dates differ from season to season, as a result the high point on the "30 Yr. ('91-'20) Daily Median" line is not the true median peak SWE. The point "X" is plotted by calculating the median peak date and median peak value independently. Similar charts with other basin definitions are available here: https://nwcc-apps.sc.egov.usda.gov/basin-plots/#mt

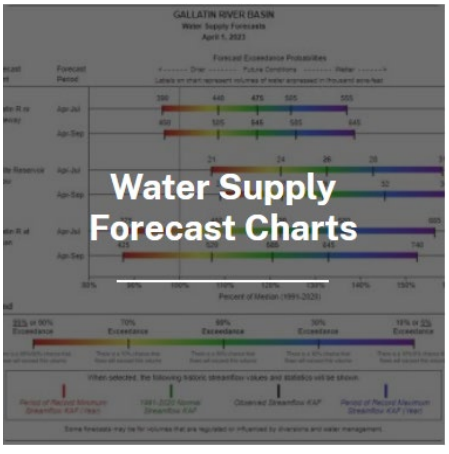


Appendix

Links and Resources

Products and Reports (click image)





Interactive Map Predefined Links

Snow

- Snow Water Equivalent > Daily > Percent of 1991-2020 Median > **Stations** | **Basins**
- Snow Water Equivalent > End of Previous Month (SNOTEL and Snow Course) > Percent of 1991-2020 Median > **Stations** | **Basins**
- Snow Depth > Daily > **Stations**
- Snow Density > End of Previous Month (SNOTEL and Snow Course) > **Stations**

Precipitation

- Month-to-Date > Daily > **Stations**
- Water Year-to-Date > Daily > Percent of 1991-2020 Median > **Stations** | **Basins**
- Previous Month > Percent of 1991-2020 Median > **Stations** | **Basins**
- Previous 3 Months > Percent of 1991-2020 Average > **Stations** | **Basins**

Streamflow

- Observed (Adjusted Volume) > Previous Month > Percent of 1991-2020 Median > **Stations** | **Basins**
- Forecast (Adjusted Volume) > Most Recent (Available March 1 through June 1) > Percent of 1991-2020 Median > **Stations** | **Basins**

Reservoir Storage

- End of Previous Month > Percent of 1991-2020 Median > **Stations**

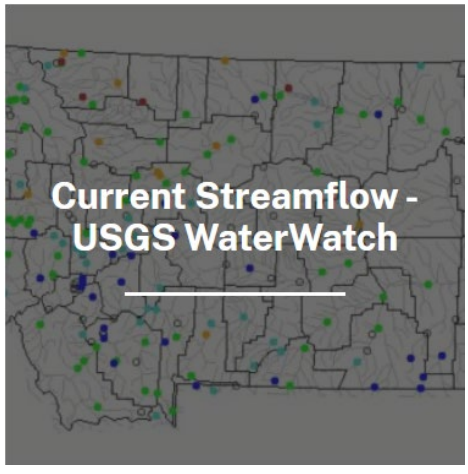
Other

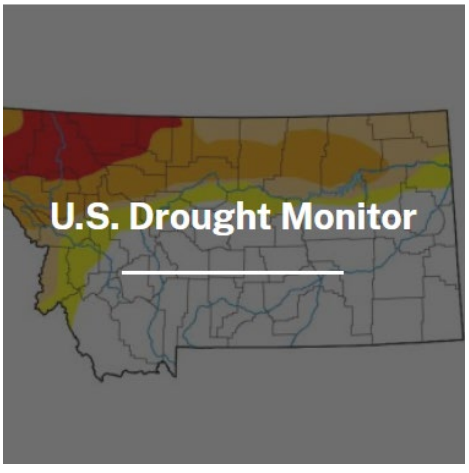
- Snow Water Equivalent > Daily > Compared to POR > **Stations**
- Snow Water Equivalent > End of Previous Month (SNOTEL and Snow Course) > Percentile > **Stations**
- Water Year-to-Date Precipitation > Daily > Compared to POR > **Stations**

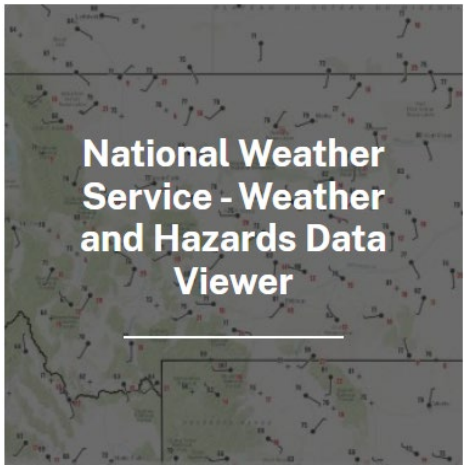
Appendix

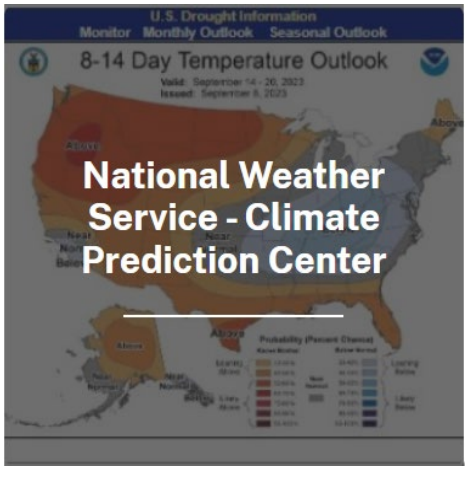
Links and Resources (Continued)

External Agencies (click image)









Additional Drought Information

- U.S. Drought Monitor
- National Integrated Drought System (Drought.gov)
- USDA Drought Portal (News and Resources)
- Farm Services Agency Montana News Releases (Information on Programs and Deadlines)
- Farm Services Agency Disaster Assistance Programs
- Montana Department of Natural Resources and Conservation Drought Management

Snow Survey Program FAQ

Frequently Asked Snow Survey Questions - Montana | Natural Resources Conservation Service (usda.gov)

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https://www.nrcs.usda.gov/montana/snow-survey

Montana Water Supply Outlook Report

Natural Resources Conservation Service