



Annual Snowpack Report 2010-2011

Central Alaska Network

Natural Resource Data Series NPS/CAKN/NRDS—2014/605



ON THE COVER

Park pilot Colin Milone keeping the plane warm during a snow survey in Denali.
Photograph by: NPS Photo taken by Pam Sousanes

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Executive Summary

The snowpack once again varied across the state for the 2010 – 2011 season from well above normal in Northwest Alaska and in areas north of the Yukon River, to normal and just below normal in the central region of the state, to well below normal in Southcentral Alaska and along the Kenai Peninsula. Yakutat, and the north Gulf Coast, were well below normal, while the Southeast panhandle was above normal. Yukon Charley had near normal to above normal snowpack for the year with most of the snow accumulating in November and February. The northern regions of Denali were near normal at park headquarters to above normal in the western region. The south side of the Alaska Range was below normal. Wrangell-St. Elias had above normal conditions on the north side of the Alaska Range and near normal conditions in the Wrangell Mountains. The Chugach Range was about 80% of normal.

The snow season started later than normal at the northern sites, the same as 2009-2010. The first persistent snow started around October 25th, almost 2 weeks later than normal. In Wrangell- St. Elias, Chisana in the northeast area of the park had the first persistent snow on October 14th, while the May Creek snowpack started on November 2nd. The snow off dates for the region occurred during the first few weeks of May. Lake Minchumina, Coal Creek, and May Creek still had snow on the ground for the May 1 surveys.

Acknowledgments

The data and results in this report would not be possible without the help of a number of people. Thanks to Paul Atkinson for doing the snow surveys for Yukon-Charley National Preserve and to Pete Dalton and Mike Thompson for helping with the Wrangell-St. Elias National Park and Preserve snow surveys. Many thanks to the park pilots, Colin Milone and Peter Christian and Arctic Air Alaska pilot/owner Sandy Hamilton, for flying safely and getting field data during the coldest and darkest time of the year. I also would like to thank Rick McClure, Dan Kenny, and Daniel Fisher from NRCS, who make the surveys and data dissemination seamless.

Introduction and Methods

Denali National Park and Preserve, Wrangell – St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve make up the Central Alaska Inventory and Monitoring Network (CAKN) covering over 21 million acres. The network was established to monitor key components of ecosystems in the three parks and to provide that information back to park managers for use in the stewardship of natural resources. A predominate feature of climate in high latitude regions is the presence of a seasonal snowpack. The snow cover protects and insulates the ground and low-lying plants, reduces desiccation, and maintains ground temperatures near the freezing level. This seasonal snow cover, lasting up to eight months out of the year, is an important ecological factor for subarctic park ecosystems. A main objective of the CAKN snowpack monitoring program is to record long-term trends in snow and monitor changes in the extent, duration, and character of the seasonal snow cover. This is accomplished through an interagency agreement with the Natural Resources Conservation Service (NRCS) to survey snow courses and aerial snow markers and to install and maintain Snow Telemetry (SNOTEL) sites in all three CAKN parks. The SNOTEL sites have proven to be the most accurate instrumented sites to document all forms of precipitation in Alaska, including snowfall which is difficult to measure in remote locations. The agreement between the NPS and NRCS includes data dissemination and archiving. These summary reports compile snowpack data for the central Alaska region and are produced annually. The timing of the report follows the end of the water year which runs from October 1 through September 30. The data provided in this report comes almost exclusively from the NRCS Alaska Snow, Water and Climate Services web based server (NRCS 2011).

Snow pack is measured in several different ways in the Central Alaska Network. A brief description of the survey methods and data collection follows. For detailed methods refer to the Snowpack Monitoring Protocols for the CAKN (Sousanes, 2006).

SNOTEL

The most useful information available on snow pack is from the new CAKN automated SNOW TElemetry (SNOTEL) sites at Kantishna and Tokositna Valley in Denali National Park and Preserve and at May Creek and Chisana in Wrangell – St. Elias National Park and Preserve. . Each SNOTEL site has a year round precipitation gauge that measures snow and rain along with a meteorological station that records air temperature, solar radiation, summer rainfall, and snow depth. Most SNOTEL sites also have a pressure sensing snow pillow that records the density of the snowpack. The data are recorded and transmitted hourly from these sites. SNOTEL sites adjacent to CAKN parks are also useful, including the new American Creek site at Eagle near Yukon-Charley Rivers National Preserve, and the Upper Tsaina SNOTEL south of Copper Center near Wrangell – St. Elias National Park and Preserve.

Snow Courses and Aerial Markers

There are 20 snow courses and aerial snow markers in the three CAKN parks (Figure 1). Park staff, including park pilots, as well as contract pilots fly these surveys the last 3 days of each month from November through April. A certain amount of logistic flexibility and cold weather hardiness is necessary to undertake these surveys. Weather and daylight are critical factors in making sure they are done safely.

Snow Depth Sensors

Acoustic snow depth sensors were added to most of the CAKN and Remote Automated Weather Station (RAWS) climate stations that were installed in the past few years. This measurement offers a cumulative look at snowpack development through the season.

National Weather Service Sites

The McKinley Park, Eagle, Cantwell, McCarthy, and Yakutat National Weather Service Cooperative Observer sites, or COOP sites, manually record snow depth and precipitation on a daily basis. These sites have records dating back many decades and are valuable for long term trend analysis.



Figure 1. Example of a snow course (left), SNOTEL (center), and aerial snow marker (right).

Snow surveys in all three CAKN parks are done on Dec 1, Feb 1, March 1, April 1 and May 1, if weather conditions permitted. The snow monitoring sites for the CAKN are shown in Figure 2. Data are available on the NRCS website at <http://www.ak.nrcs.usda.gov/snow/>; the sites specific to the Central Alaska region are compiled in this report.

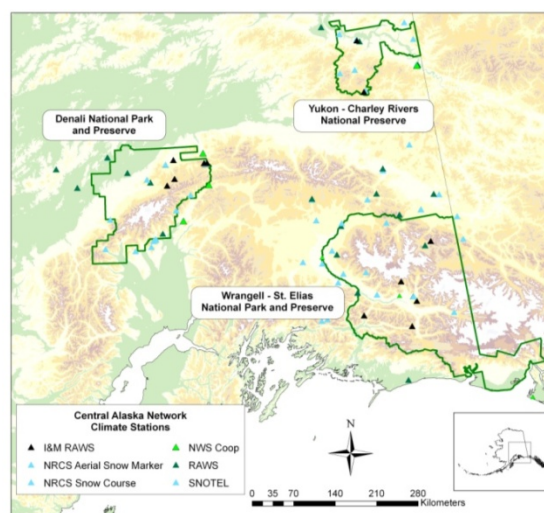


Figure 2. Locations of snow monitoring sites in the Central Alaska Network.

Results

The first persistent snowpack arrived around the week of October 25th, one to two weeks later than normal. In Denali, both the Kantishna and Tokositna Valley snowpack started on October 25th. The May Creek SNOTEL in Wrangell-St. Elias recorded the first persistent snowpack on November 2nd, while the Chisana site on the north side of the park started earlier on October 14. The snowpack persisted into May; snow off occurred at May Creek on May 4th, followed by Kantishna on May 15th, Chisana on May 17th, and Tokositna Valley on May 24th. The Coal Creek snow course in Yukon-Charley still had 8 inches of snow on April 30th; the snow depth sensor on the Coal Creek climate station indicates the snow off date was about May 9th.

Air temperatures around the region were above normal in October and well above normal in November. December temperatures were cold state wide with departures from normal that ranged from 13 to 16 degrees F colder than normal at sites north of the Alaska Range. The Central Yukon Basin, including the Yukon-Charley area, stayed cold through January while the rest of the CAKN region had temperatures well above normal. Temperatures were variable through February and March; February temperatures were above normal in YUCH, just about normal in Denali, and well below normal south of the Alaska Range and in the Copper River Basin. March temperatures had a strong negative departure from normal in the Copper River Basin, but it was warmer than normal in Talkeetna. The Tanana Basin, including Denali, was colder than normal and the central Yukon region was near normal. April temperatures were well above normal south of the Alaska Range in Denali, but were near normal everywhere else in the region. The following sections provides a summary of the snowpack season for each of the major hydrologic units in the central Alaska region including the Central Yukon Basin, Tanana Basin, Western Interior Basin, Copper River Basin, and the Matanuska-Susitna Basin (Figure 3).

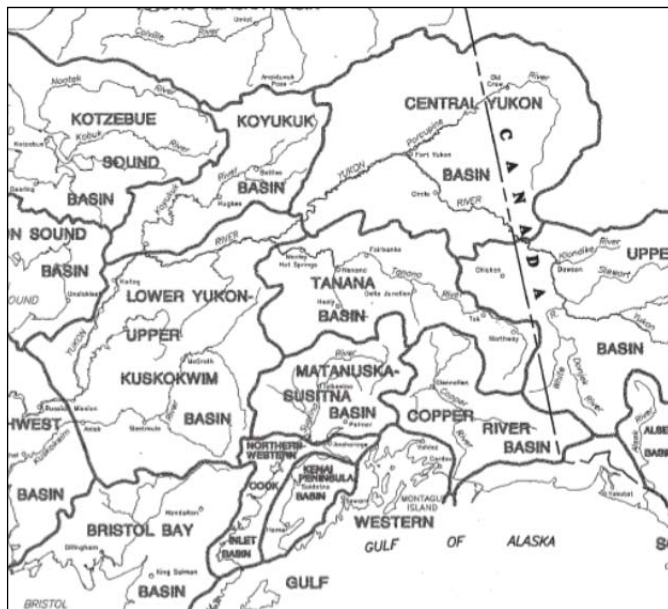


Figure 3. Map showing USGS hydrologic basins of Alaska. Map courtesy of the Natural Resources Conservation Service (NRCS, 2011) and available at <http://ambcs.org/pub/BasinRpt/2011/may.pdf>.

Central Yukon Basin

Yukon-Charley Rivers lies within the Central Yukon Basin. This region had a variable snowpack that ranged from above normal in central and western portions of the region, to normal and slightly below near the Canadian border. The Coal Creek climate station reported the first measurable snow on October 18, 2009. The long term cooperative weather station at Eagle reported a total of 7 inches of snow for October when the normal is 9.6 inches. In November, Eagle had 25 inches of snow for the month – well above the average of 10.6 inches, but the snow did not continue into December when the monthly total was 6 inches, or about 50% of normal. On December 1, the Coal Creek snow course had 18 inches of snow with 2.5 inches of snow water equivalent (SWE), last year there was only 6 inches of snow with 1.0 inch water content for the December survey. The aerial markers throughout the Preserve had between 7 and 18 inches of snow for the early season measurements.

By February 1, the snowpack on the north side of the Yukon River at Cathedral Mountain and Step Mountain aerial markers was between 23 and 28 inches with a water equivalent between 4 and 5 inches. Coal Creek had 21 inches of snow with a water content of 4.2 inches and as you progressed south the snowpack tapered off to 12 and 17 inches with 2.4 to 3.4 inches of water content at Crescent Creek and Copper Creek respectively. The Three Fingers site had 24 inches of snow in February. The snowpack increased to 36 inches at Cathedral Creek in the northeastern part of the preserve in March, the other sites had just a bit more than the February measurements. The snowpack remained about the same for the April 1 measurements with some variability among sites, Cathedral and Crescent Creek had slightly more snow than in March, and Step Mountain and Three Fingers had less, while the others remained about the same.

The spring melt was variable according to the May 1 measurements. Some of the sites in the central to western portions of the preserve had no snow reported for May 1, while other sites north of the Yukon River and in the Upper Charley River Basin still had close to two feet of snow on the ground. The low elevation site at Coal Creek still had 8 inches of snow with 2.1 inches of water content on May 1. The graphs taken from the NRCS Alaska Snow Survey Report for May 1 show the average of all of the snow courses within the watershed with temperatures from a nearby long-running climate station (Figure 4).

The new American Creek SNOTEL site was installed in summer of 2011 and will start reporting for the upcoming water year. The Eagle NWS COOP site recorded an annual snowfall amount of 55.4 inches or 92% of the normal 59.9 inches. See Appendix C for tables and graphs with long-term data.

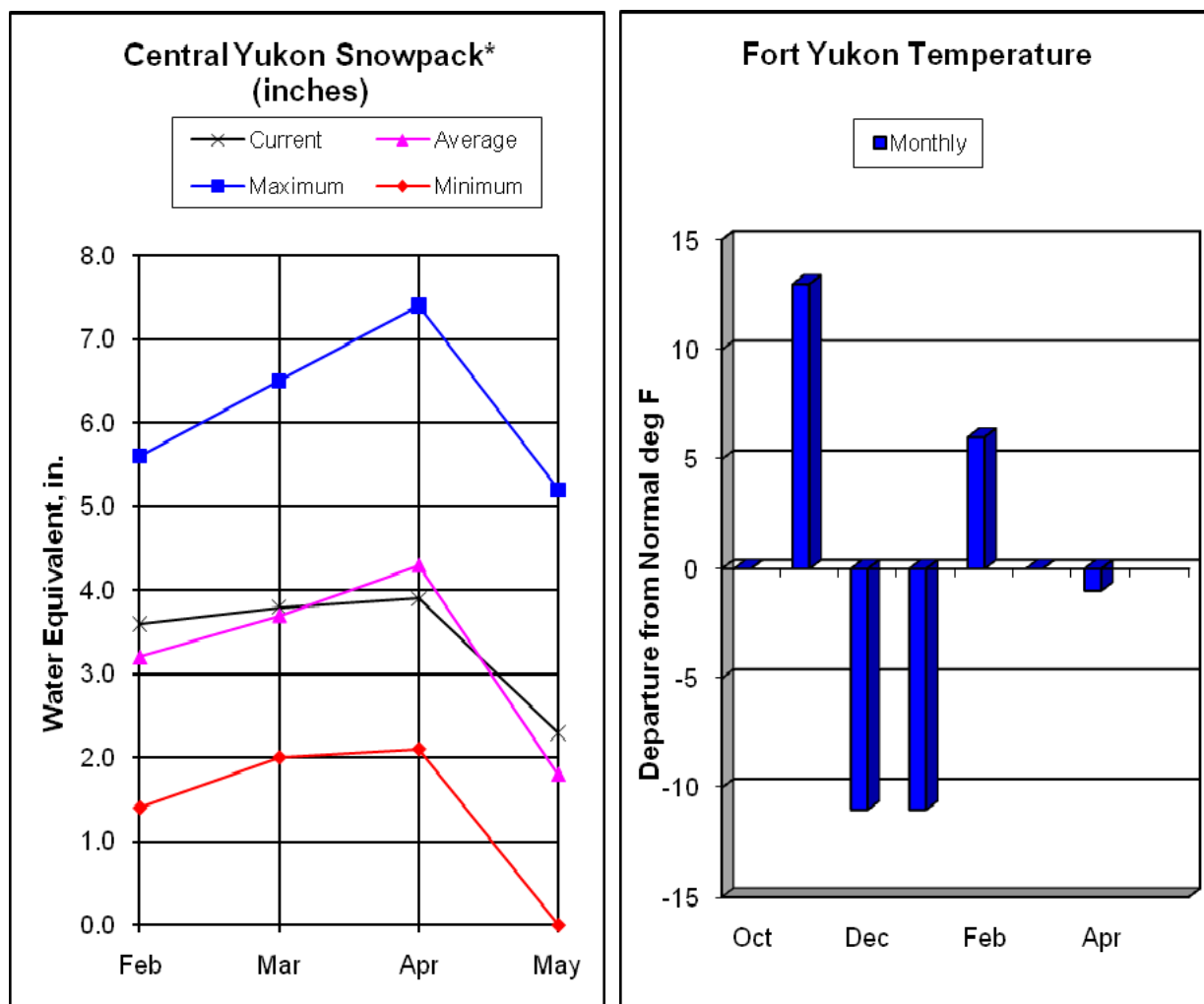


Figure 4. Central Yukon Basin 2010-2011 snow season. Courtesy of NRCS, Anchorage, AK (NRCS, 2011).

Tanana Basin

The park regions that are part of the Tanana Basin hydrologic, just north of the Alaska Range include the north side of Denali from park headquarters to Kantishna and the northern areas of Wrangell - St. Elias from the Canadian border to the northeastern areas of Wrangell – St. Elias, including Chisana. At the Denali park headquarters site the day of the first persistent snow was October 22, a few weeks later than normal, but the same as last year. The SNOTEL sites at Kantishna in Denali and Chisana in Wrangell–St. Elias record daily snow depth and precipitation data, which provides the “snow on” date for the seasonal snowpack, after this date snow generally remains on the ground for the rest of the winter. On October 25, Kantishna recorded the first persistent snow of the season and October 14 marked the beginning of the season at Chisana.

Very few of the sites were visited for the December 1 survey due to weather. The Kantishna SNOTEL showed 8 inches of snow on December 1 and Chisana had 10 inches. The Denali Park headquarters site had 7 inches of snow on November 30; the long-term average is 10 inches for

this date. Jatahmund Lake, north of Chisana in WRST, reported 15 inches of snow on November 30 which is just at normal.

By February, the snowpack in the western portion of the Tanana Basin was well below normal, Kantishna had 14 inches of snow with a SWE of 2.5 inches, normal is 26 inches of snow with a SWE of 4.5 inches. The middle Tanana Basin was still below normal, with sites at and around Denali park headquarters sites at about 70% of normal with depths around 14 inches and snow water content ranging from 40-70% of normal. The snow depth at Chisana increased to 75% of normal with 15 inches of snow and close to normal SWE at 2.9 inches. The Jatahmund Lake snow course had 17 inches of snow, 106% of normal.

Through March and April the eastern region had a snowpack that was similar to February. Jatahmund Lake was just above normal for snow depth while the water content was 131% of normal. At Chisana, the snow depth was just below normal, but the snow water equivalent was just above normal. The sites near Denali Park headquarters gained a bit of snow throughout February bring the snow depths to an average of 30 inches or ~ 130% of normal. Kantishna was just below normal and Lake Minchumina was slightly above normal for both snow depth and water content. The snowpack generally decreases throughout April with warming temperatures; however most of the sites still had snow cover for the May 1 snow survey. Chisana had 12 inches of snow and Jatahmund Lake had 15 inches – this region was about 204% of normal for this survey. Denali Park headquarters had 9 inches of snow on the ground on May 1 which is just at normal. Rock Creek Ridge still had 10 inches of snow, but the Rock Creek Bottom site had no snow. This site is not as protected as the other two headquarters sites, which most likely contributed to the early snow off date. Kantishna had 13 inches of snow, 86% of normal while Lake Minchumina still had 10 inches of snow on May 1, 200% of normal. Figure 5 shows the NRCS snow survey report graphs for the area. See Appendix A for individual site data.

The Kantishna SNOTEL site recorded 7.3 inches of total winter precipitation (snow water equivalent) from October 1, 2010 through May 1, 2011, 118% of average. The total annual precipitation for the site was 22.0 inches; the winter snow accounted for 33% of the total annual precipitation. Snow on data was October 25 and the snow off date was May 15, 2011. The Chisana SNOTEL site recorded 3.3 inches of total winter precipitation from Oct 1 through May 1. The total annual precipitation was 12.3 inches; the winter snow accounted for 27% of the total annual precipitation. The McKinley Park long-term NWS site was 101% of normal for the year with an annual total of 80.7 inches of snow. See Appendix B for snowfall and precipitation accumulation graphs. See Appendix C for tables and graphs with long-term data.

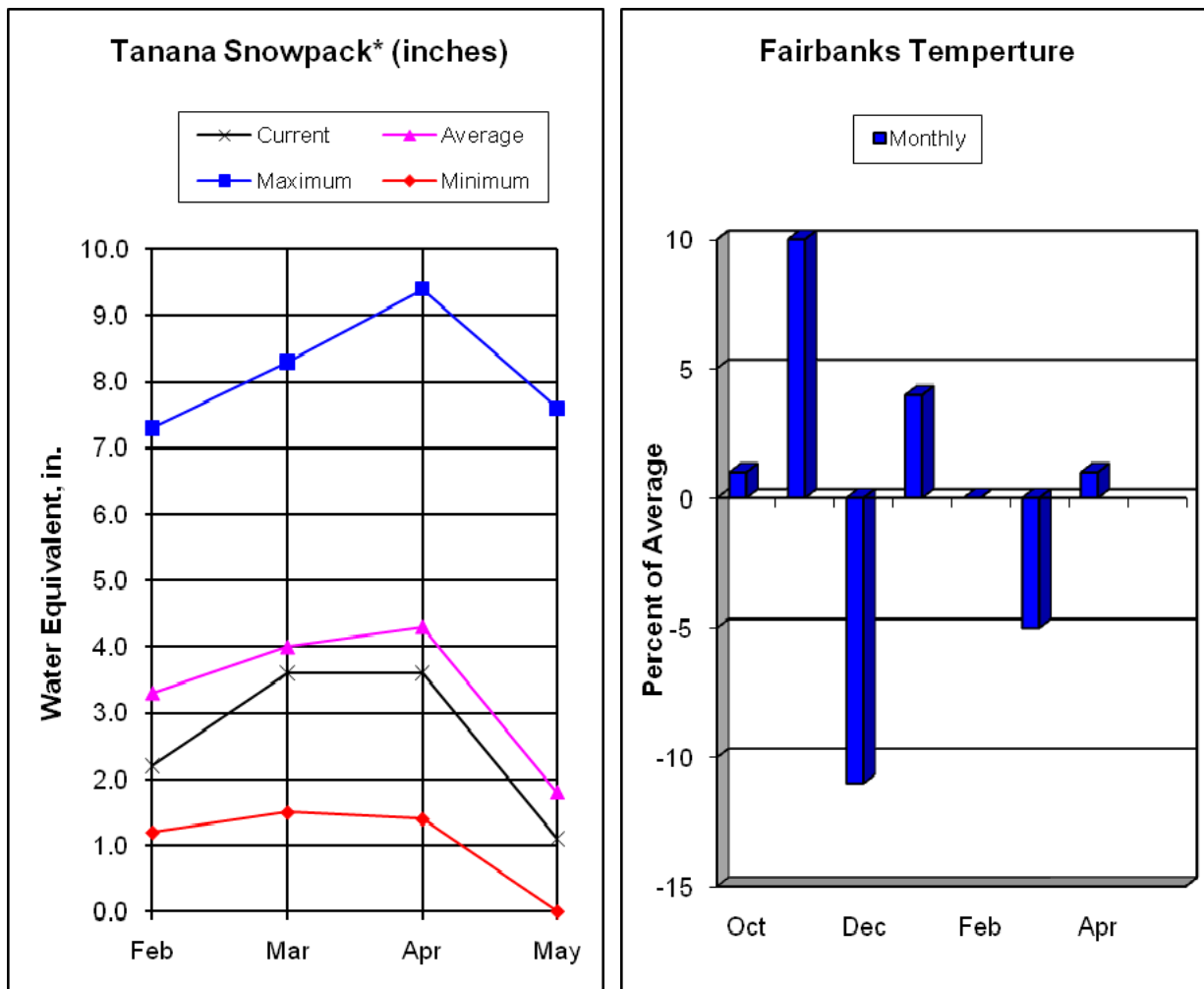


Figure 5. Tanana Basin 2010-2011 snow season. Graphs courtesy of the NRCS, Anchorage, AK (NRCS, 2010).

Western Interior Basin

The northwestern area of Denali is part of the Western Interior Basin. This region had a below normal snowpack from early season through February. February snowfalls bumped the snowpack to just above normal. On March 1, the Lake Minchumina site had 23 inches of snow and 3.7 inches of water content, normal is 21 inches and 4.0 inches of water content. Purkeypile Mine had 27 inches of snow, normal is 21 inches. The water content was 126% of normal. Lake Minchumina was 200 percent of normal on May 1 with 10 inches of snow and 2.2 inches of snow water content. Purkeypile was not visited due to weather on May 1, but normally should have 10 inches of snow on the ground for May 1. Figure 6 shows the NRCS snow survey report graphs for the area.

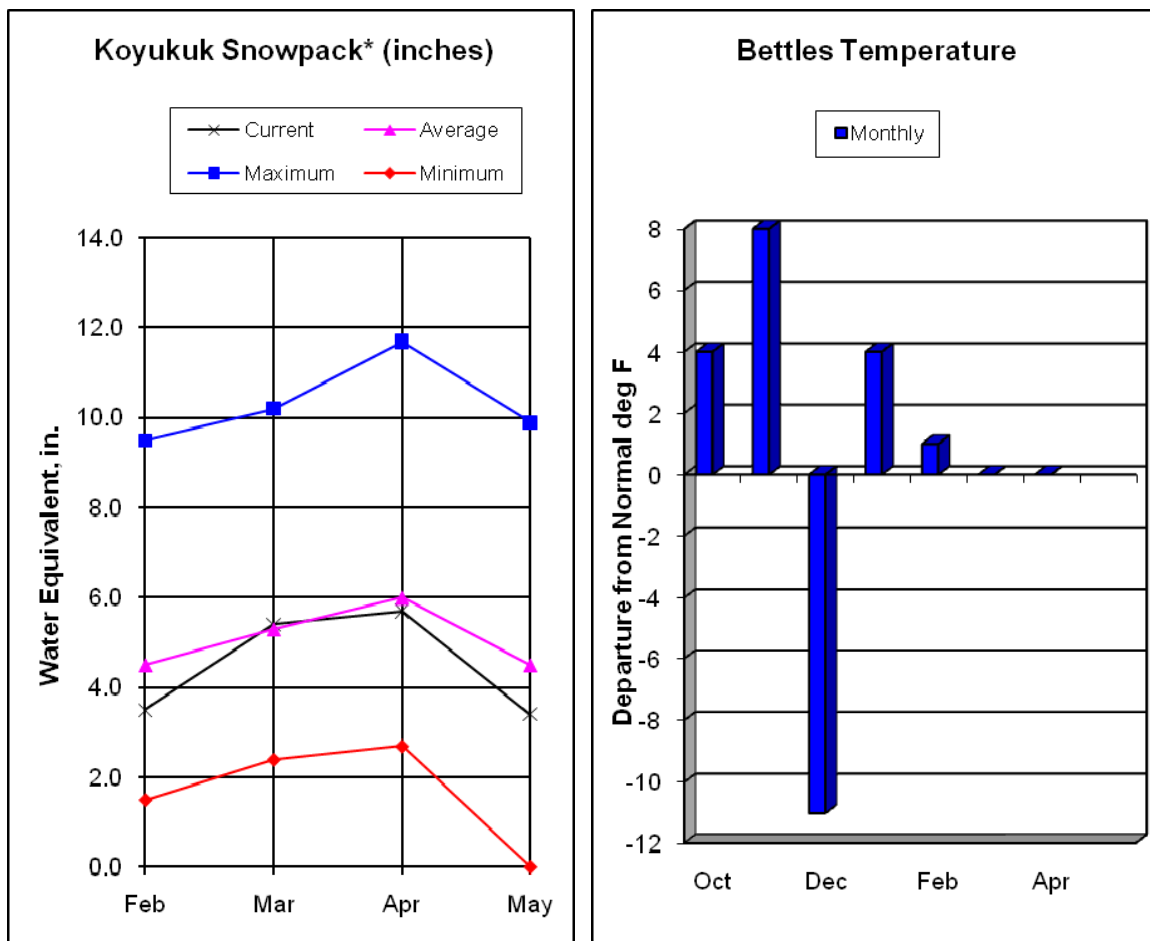


Figure 6. Western Interior (Koyukuk Basin) 2010-2011 snow season. Courtesy of NRCS, Anchorage, AK

Copper Basin

The Copper Basin is divided into 3 regions that encompass Wrangell – St. Elias: the Chugach Range, the Basin Floor and the Wrangell Mountains. The two SNOTEL sites in the park, one at May Creek on the Basin Floor, and one at Chisana, however the Chisana data is included in the Tanana Basin hydrologic unit. The data from the early season surveys showed the Basin Floor at 96% of normal, the Chugach Range at 87% of normal, and the Wrangell Mountains at 85% of normal. The May Creek SNOTEL did not show snow on the ground until November 2nd, but by December 1st had 9 inches of snow – this was still below the normal 12 inches for this date. It remained below average through December, but by February 1st had a normal snow depth with a water content of 72% of normal.

For the March 1 surveys the snow courses in the area were near normal in the Wrangell Mountains, 79% of normal in the Chugach Range, and 89% of normal on the Basin Floor. The Long Glacier aerial marker had 24 inches of snow on March 4th and the Notch marker in the eastern area of the park near the Chitina Glacier had 16 inches of snow. The snowpack lingered on the Basin Floor, and on May 1 there was still 7 inches of snow at May Creek; there is usually no snow on May 1st at this site. The snowpack did melt over the next few days. The Basin Floor was at 111% of normal for the last survey of the season. The Chugach Range was about 79% of

normal on May 1. Figure 7 shows the NRCS snow survey report graphs for the area (NRCS, 2010).

The SNOTEL site at May Creek reported 4.3 inches of snow water equivalent on May 1st; the annual total precipitation was 12.7 inches, so the winter snowfall accounted for 33% of the total precipitation for the year. The snow off date was May 4, 2011.

The Yakutat summary is included in this section because it helps characterize the north Gulf Coast and the southern extent of WRST. There are no snow courses in this area, but the NWS Yakutat COOP station records snowfall. The site reported a total of 74.1 inches of snow for the year, or 40% of the 185 inches the site normally receives. Every month was well below average. On average March total snowfall for Yakutat is 36.8 inches, this year there was 2.2 inches. October, November and January were also well below normal. See Appendix C for graphs related to the Yakutat site.

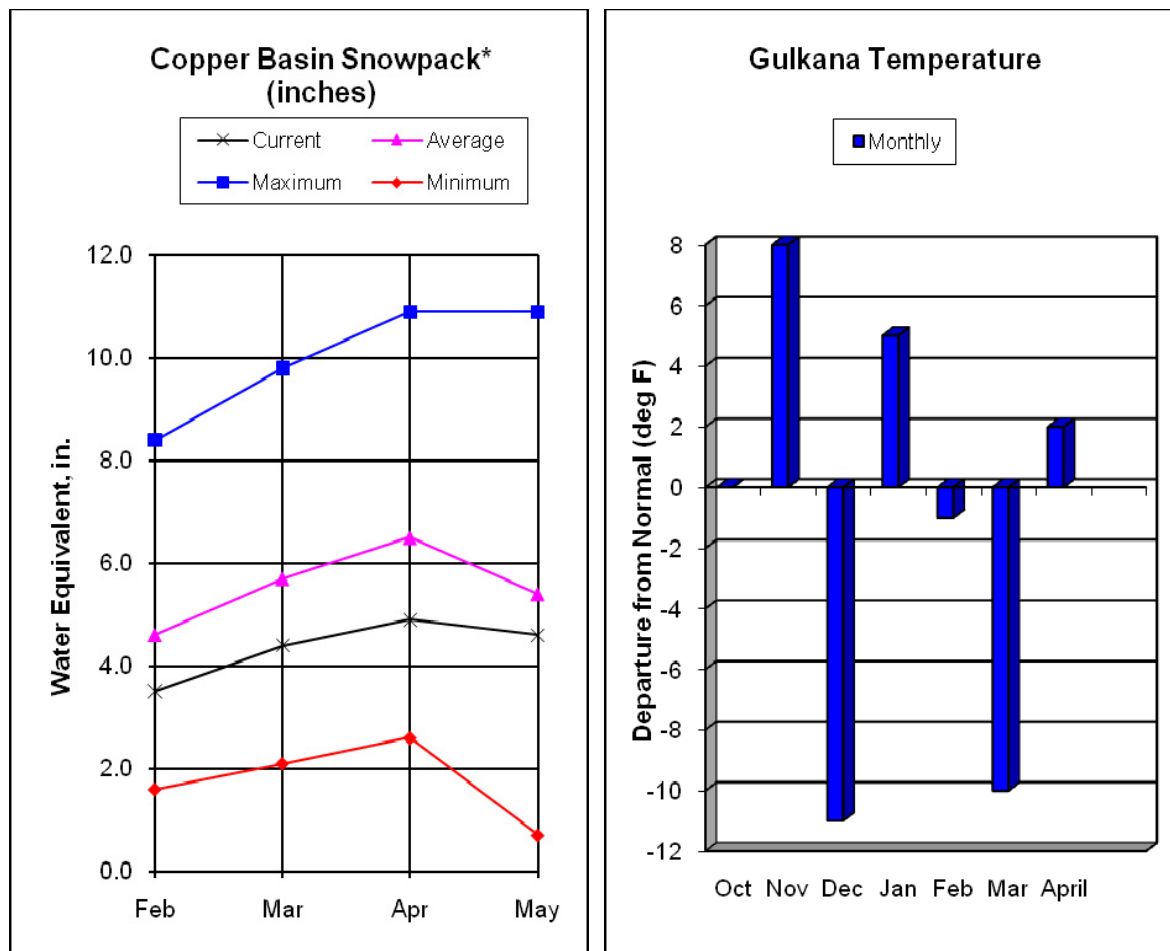


Figure 7. Copper Basin 2010-2011 snow season. Courtesy of NRCS, Anchorage, AK

Matanuska – Susitna Basin

According to the CAKN Tokositna Valley SNOTEL site the first measurable snow that persisted through the winter was on October 25, 2010. The early season measurements for the aerial snow

markers are not available for the early season due to weather that was not suitable for flying, but the Tokositna SNOTEL site was reporting near normal conditions for December. By January 1 there was 41 inches of snow on the ground, normal is 51 inches and the water content was 9.6 inches, which is just at normal. There was not much additional snow accumulation in January and February throughout the region. The Tokositna site had 52 inches of snow on March 1, which is 77% of normal. There was some additional snow accumulation in April and by May 1st the Tokositna Valley site had 45 inches of snow with 14.1 inches of water content, which is 83% of normal. The aerial markers were on average about 71 % of normal. Nugget Bench had 32 inches of snow and the normal for this time of year is 46 inches. Dutch Hills had 57 inches of snow, normal is 74 inches and Chelatna Lake had 23 inches and normal is 33 inches for the May 1 snow survey. Figure 8 shows the NRCS snow survey report graphs for the area.

The precipitation gage at Tokositna Valley recorded 21.5 inches of precipitation from October 1, 2010 through May 1, 2011, which is 0.6 inches below the 1971-2000 normal. This is 48% of the total annual precipitation of 44.4 inches for the 2011 water year. See Appendix B for more information on the Tokositna SNOTEL data.

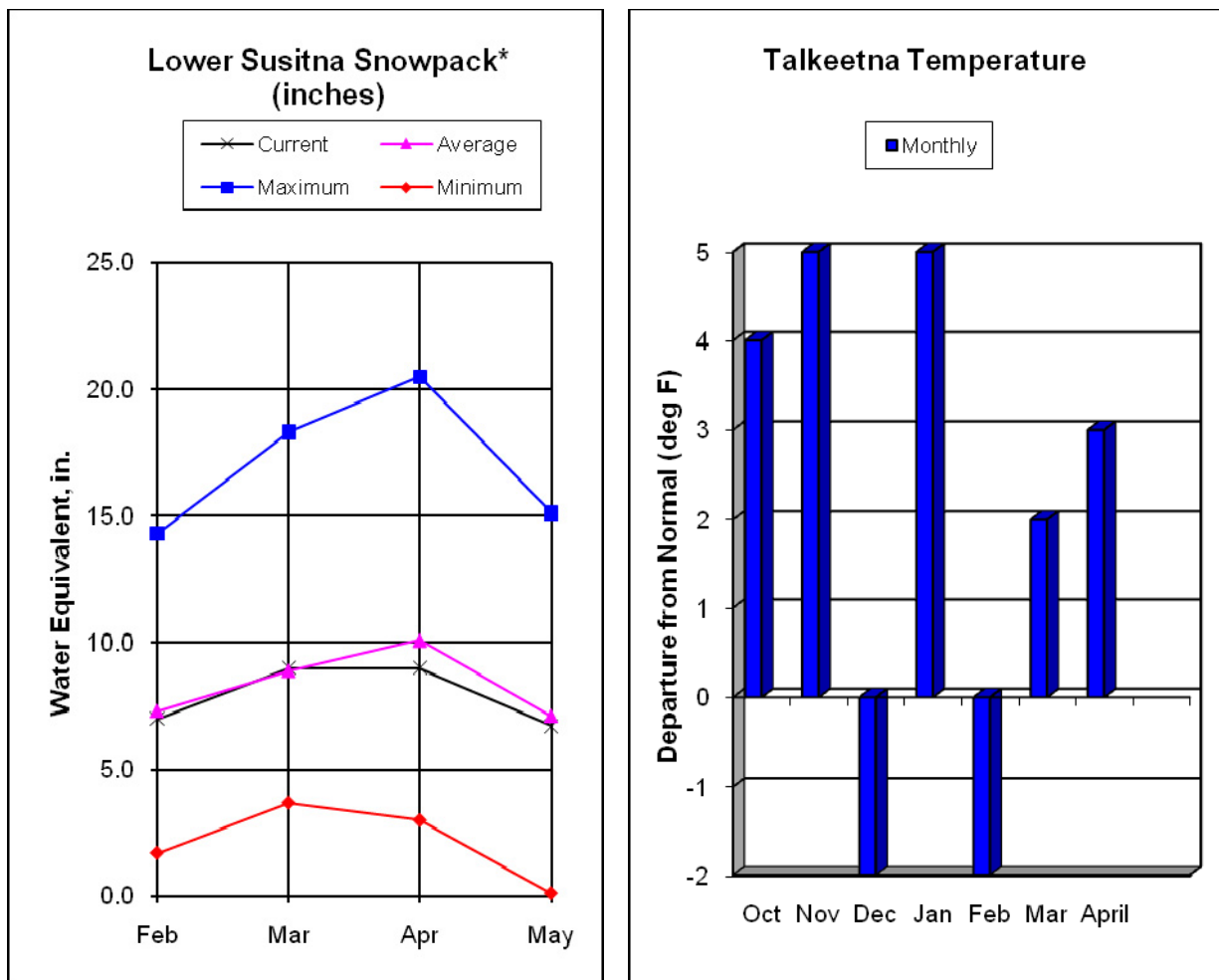


Figure 8. Lower Susitna Basin 2010-2011 snow season. Courtesy of NRCS, Anchorage, AK

Summary

The snowpack across the Central Alaska Network was variable through the 2010-2011 season, which is not unusual. The network encompasses over 21 million acres and includes north and south aspects of four major mountain ranges. The region north of the Alaska Range had normal to above normal snowfall totals while the areas south of the range were below normal for the year. Northwest Alaska and the Seward Peninsula had snowpacks well above normal, indicating that the storms that brought precipitation from the Bering Sea deposited most of the winter snow for the state. Interestingly, the southeast panhandle also had above normal snowfall, but this did not reach the Southcentral region of the state along the Gulf of Alaska and the northern Cook Inlet region.

According to the NRCS, the central Yukon region, which includes Yukon-Charley Rivers, had variable snow conditions with near normal snow pack near the Canadian normal and increasing farther west. The Yukon-Charley area seemed to have near normal to just above normal levels of snow for the 2010-2011, based on the last few years of data and the fact that the snowpack did persist through to the May 1 survey. Long term records from Eagle show that site just below normal. The upper Tanana Basin including the northern region of Wrangell-St. Elias was well above normal with record high water contents at the snow course sites just north of the park boundary at Jatahmund Lake. The middle Tanana Basin including the Denali park headquarters area was near normal for the year with significant snow fall in February. The areas in the western region of the park were above normal by the end of the season with the Lake Minchumina well above average for May 1st. The south side of the Alaska Range in the southern portions of Denali had below normal snow depths and water content for the season. This was very apparent to climbers on Mt. McKinley which reported icy conditions due to lack of snow even high up on the mountain. The Wrangell Mountain Range in the central region of Wrangell-St. Elias had near normal conditions by March while the Chugach Range was about 80% of normal and the Basin Floor was about 90% of normal. The snowpack persisted into May along the Basin Floor and sites that are normally snow free by May 1 still had snow. Yakutat, as well as most of the north Gulf Coast, was well below normal for the season.

The NRCS publishes Alaska snowpack maps for each month the snow surveys are done starting on Feb 1. These maps give a nice overall picture of snowpack variability around the state (See Appendix E).

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Appendix A. CAKN Snow Course Data from 2011

SNOW COURSE	ELEV.	FEB		MAR		APR		May	
Name	ft.	depth	swe	depth	swe	depth	swe	depth	swe
		in.	in.	in.	in.	in.	in.	in.	in.
Talkeetna	350	30	6.3	27	6.5	24	6.3	14	4.1
Tokositna Valley	850	51	10.7	52	12.4	50	12.0	45	4.1
Chelatna Lake	1450	***	***	***	***	35	9.1	23	8.1
Nugget Bench	2010	***	***	***	***	34	9.0	32	10.5
Ramsdyke Creek	22200	***	***	***	***	45	13.0	44	15
Dutch Hills	3100	***	***	***	***	45	13.5	57	17.5
Lake Minchumina	730	***	***	23	3.7	20	3.7	10	2.2
Kantishna	1550	14	2.5	25	4.6	23	4.8	13	4.0
Jatahmund Lake	2180	17	2.8	22	3.8	19	4.4	15	4.0
Rock Creek Bottom	2250	14	2.2	29	4.2	21	4.0	0	0
Rock Creek Ridge	2600	14	1.7	33	5.1	***	***	10	0
Lost Creek	3030	***	***	***	***	15	2.7		
Chisana	3320	15	2.9	20	3.9	19	4.2	12	4.0
Purkeypile Mine	2025	***	***	27	5.3	26	5.4	***	***
Tazlina	1225	16	2.1	24	3.1	24	5.2	0	0
Kenny Lake School	1300	16	2.5	22	3.0	22	4.8	6	1.3
Chokosna	1550	***	***	26	4.9	24	5.0		
May Creek	1610	26	2.0	26	3.8	24	4.4	7	2.0
Tsaina River	1750	55	10.7	47	11.8	46	11.7	29	9.6
Chistochina	1950	18	2.4	21	3.0	20	3.6	0	0
Tolsona Creek	2000	18	2.3	25	4.2	24	4.1	9	2.6
Dadina Lake	2160	28	4.4	28	5.2	30	6.5		
Sanford River	2280	22	3.8	28	5.2	29	6.5		

SNOW COURSE	ELEV.	FEB		MAR		APR		May	
Name	ft.	depth	swe	depth	swe	depth	swe	depth	swe
		in.	in.	in.	in.	in.	in.	in.	in.
Long Glacier	4820	***	***	24	4.2	21	4.6		
Tebay Lake	1930	***	***	***	***	54	12.4		
Notch	2643	***	***	16.0	3.0	16	3.5		
Coal Creek	1000	21	4.2	22	4.3	21	4.3	8	2.1
Cathedral	1800	28	5.0	36	7.2	29	7.2	18	5.6
Copper Creek	2000	17	3.4	17	3.5	17	3.7	0	0
Crescent Creek	2600	12	2.4	13	2.5	12	2.6	0	0
Three Fingers	3350	24	4.5	27	5.5	27	5.7	24	5.7
Step Mountain	2850	23	4.2	28	5.8	27	6.0	16	4.5

*** no report; blank space = no scheduled survey

Snow Course Averages 1971-2001

Snow Course Averages	1971-2000								
SNOW COURSE	ELEV.	FEB		MAR		APR		May	
Name	ft.	depth	swe	depth	swe	depth	swe	depth	swe
		in.	in.	in.	in.	in.	in.	in.	in.
Talkeetna	350	28	6.2	32	7.6	34	8.7	16	5.4
Tokositna Valley	850	55	13.6	67	15.7	62	18.7	43	17
Chelatna Lake	1450	36	8.3	42	10	44	11.6	33	10.9
Nugget Bench	2010	45	10.9	51	12.9	55	15.5	46	15.3
Ramsdyke Creek	2220	61	16.3	66	18.9	69	22	57	21.9
Dutch Hills	3100	69	19.6	76	23	80	27.5	74	28.7
Fairbanks Field Off.	450	21	3.5	23	4.1	23	4.5	3	0.8
Lake Minchumina	730	19	3.2	21	4	21	4.4	5	1.3
Kantishna	1550	26	4.5	28	5.3	30	5.7	15	3.1
Jatahmund Lake	2180	16	2.3	18	2.9	18	3.2		
Rock Creek Bottom	2250	20	3.7	22	4.2	22	4.3	8	2.2
Rock Creek Ridge	2600	24	4.3	26	4.9	26	5.3	14	4.9
Lost Creek	3030	25	4.8	26	4.8	21	4.2		***
Chisana	3320			22	3.4	22	3.6		
Purkeypile Mine	2025	20	3.9	21	4.2	21	4.1	10	2.5
Valdez	50	45	11.9	51	15.5	54	17.8	33	12.6
Tazlina	1225	17	3	20	3.7	19	4.2		
Kenny Lake School	1300	14	2.6	18	3.4	17	3.7	3	0.9
Chokosna	1550			21	3.2	22	3.9		
May Creek	1610			21	3.8	21	4.5		

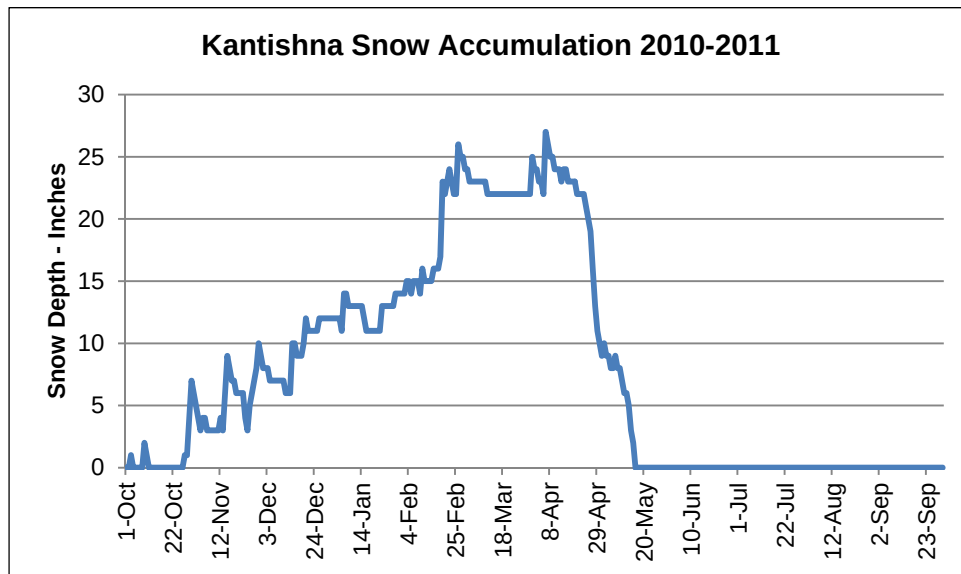
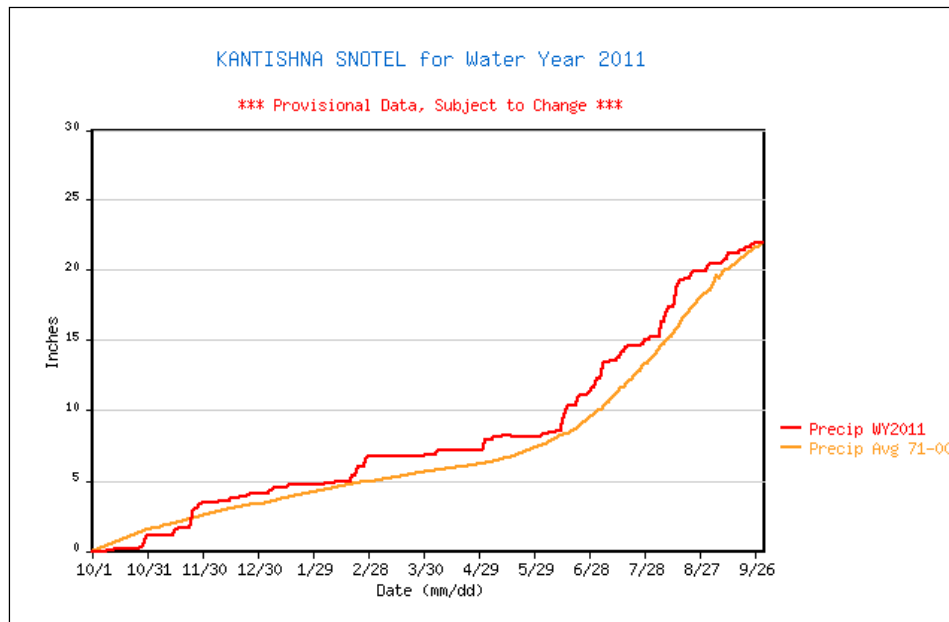
Tsaina River	1650	50	12.5	56	15.7	57	17.6	41	14.6
Chistochina	1950	18	3	22	3.5	22	4.1	4	1.2
Tolsona Creek	2000	19	3.2	22	3.8	22	4.1	5	2.1
Dadina Lake	2160	24	4.1	29	5.1	27	5.9		
Sanford River	2280	24	4.2	28	5.4	28	6.2	15	4
Mission Creek	900	15	3.1	18	3.6	18	4.1	2	0.5
Upper Chena	3000	28	6.2	30	6.9	33	7.8	25	7.5

Blank space =
record not long
enough for
normal
calculation

Appendix B. SNOTEL Site Data

These data are available from the NRCS website and can be accessed at <http://www.ambcs.org/dbArchive.html> and <http://www.wcc.nrcs.usda.gov/>

Kantishna: North Side Denali National Park and Preserve

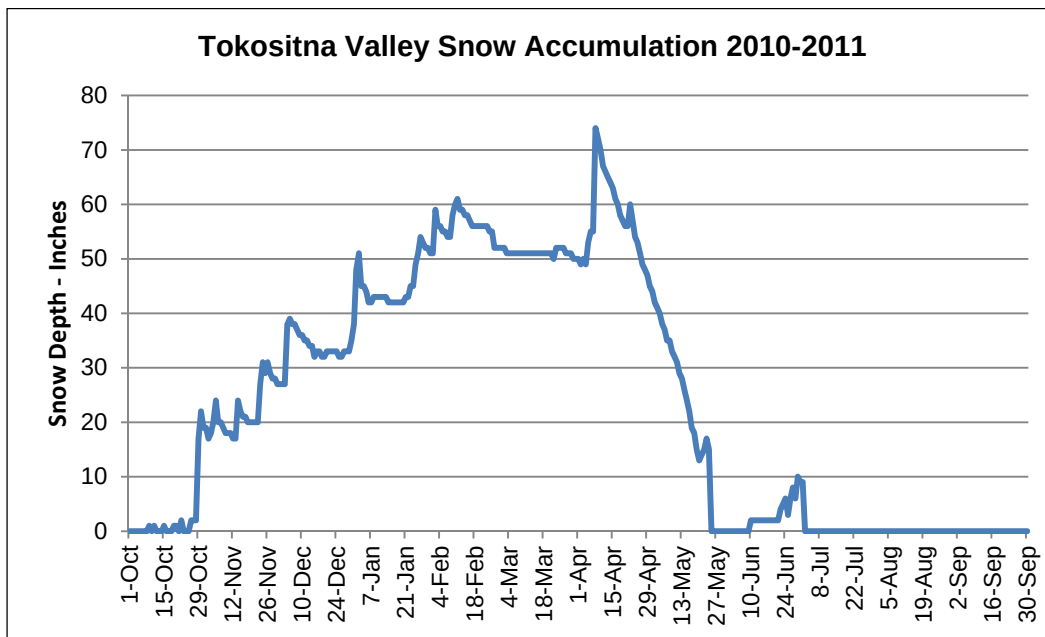
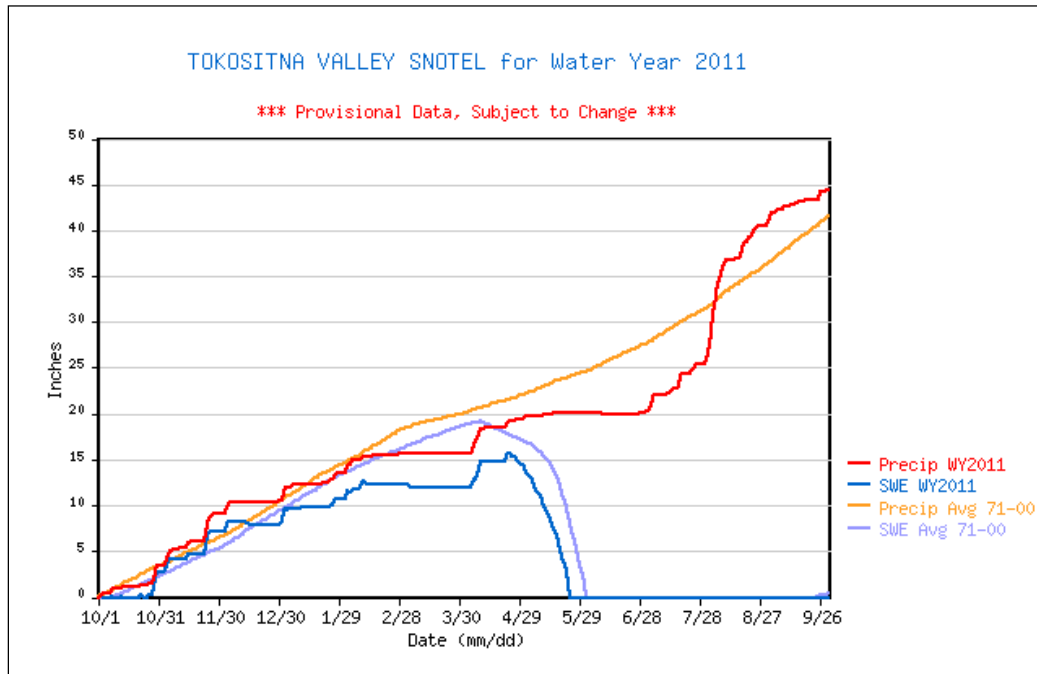


Daily precipitation totals for Kantishna for 2010-2011 season Oct 1 – Sep 30.

Unit = inches

day	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep
---	---	---	---	---	---	---	---	---	---	---	---	---
1	0.0	1.1	3.5	4.1	4.7	6.8	6.9	7.3	8.1	12.0	15.3	20.5
2	0.0	1.1	3.5	4.1	4.7	6.8	6.9	7.9	8.2	12.3	15.3	20.5
3	0.0	1.1	3.5	4.1	4.7	6.8	6.9	7.9	8.3	12.3	15.3	20.5
4	0.0	1.1	3.5	4.1	4.8	6.8	6.9	7.9	8.3	12.6	15.3	20.5
5	0.0	1.1	3.5	4.3	4.8	6.8	6.9	7.9	8.4	13.2	15.3	20.5
6	0.0	1.1	3.5	4.3	4.8	6.8	7.1	7.9	8.5	13.5	16.3	20.5
7	0.0	1.1	3.5	4.4	4.8	6.8	7.2	8.1	8.5	13.5	16.3	20.5
8	0.0	1.1	3.5	4.5	4.8	6.8	7.2	8.1	8.5	13.5	17.0	20.6
9	0.1	1.1	3.6	4.5	4.8	6.8	7.2	8.1	8.5	13.6	17.1	20.7
10	0.1	1.1	3.6	4.5	4.9	6.8	7.2	8.1	8.6	13.6	17.4	20.8
11	0.1	1.1	3.6	4.5	4.9	6.8	7.2	8.1	8.6	13.6	17.4	21.2
12	0.1	1.1	3.6	4.5	4.9	6.8	7.2	8.2	8.6	13.6	17.4	21.2
13	0.2	1.1	3.6	4.5	4.9	6.8	7.2	8.2	9.4	13.8	17.6	21.2
14	0.2	1.3	3.6	4.5	4.9	6.8	7.2	8.2	9.5	13.8	18.8	21.2
15	0.2	1.5	3.8	4.6	5.0	6.8	7.2	8.2	10.0	14.1	19.1	21.2
16	0.2	1.5	3.8	4.7	5.0	6.8	7.2	8.2	10.4	14.2	19.3	21.2
17	0.2	1.6	3.8	4.7	5.0	6.8	7.2	8.1	10.4	14.5	19.3	21.2
18	0.2	1.6	3.8	4.7	5.0	6.8	7.2	8.1	10.4	14.5	19.3	21.4
19	0.2	1.6	3.8	4.7	5.4	6.8	7.2	8.1	10.4	14.6	19.4	21.4
20	0.2	1.6	3.9	4.7	5.4	6.8	7.2	8.1	10.4	14.6	19.4	21.4
21	0.2	1.6	3.9	4.7	5.7	6.8	7.2	8.1	10.8	14.6	19.4	21.6
22	0.2	1.6	3.9	4.7	6.0	6.8	7.2	8.1	11.0	14.6	19.7	21.6
23	0.2	2.0	3.9	4.7	6.0	6.8	7.2	8.1	11.1	14.6	19.8	21.6
24	0.2	2.7	4.0	4.7	6.0	6.8	7.2	8.1	11.1	14.6	19.9	21.9
25	0.2	2.9	4.0	4.7	6.0	6.8	7.2	8.1	11.1	14.6	19.9	21.9
26	0.2	3.0	4.1	4.7	6.5	6.8	7.2	8.1	11.1	14.7	19.9	22.0
27	0.3	3.1	4.1	4.7	6.7	6.8	7.2	8.1	11.2	14.7	19.9	22.0
28	0.4	3.3	4.1	4.7	6.8	6.8	7.2	8.1	11.3	15.1	19.9	22.0
29	0.7	3.4	4.1	4.7	---	6.8	7.2	8.1	11.7	15.1	19.9	22.0
30	1.0	3.5	4.1	4.7	---	6.8	7.2	8.1	11.7	15.1	19.9	22.0
31	1.1	---	4.1	4.7	---	6.9	---	8.1	---	15.3	20.3	---
mean	0.2	1.7	3.8	4.5	5.3	6.8	7.1	8.1	9.8	14.0	18.3	21.2
max	1.1	3.5	4.1	4.7	6.8	6.9	7.2	8.2	11.7	15.3	20.3	22.0
min	0.0	1.1	3.5	4.1	4.7	6.8	6.9	7.3	8.1	12.0	15.3	20.5

Tokositna Valley: South Side of Denali National Park and Preserve

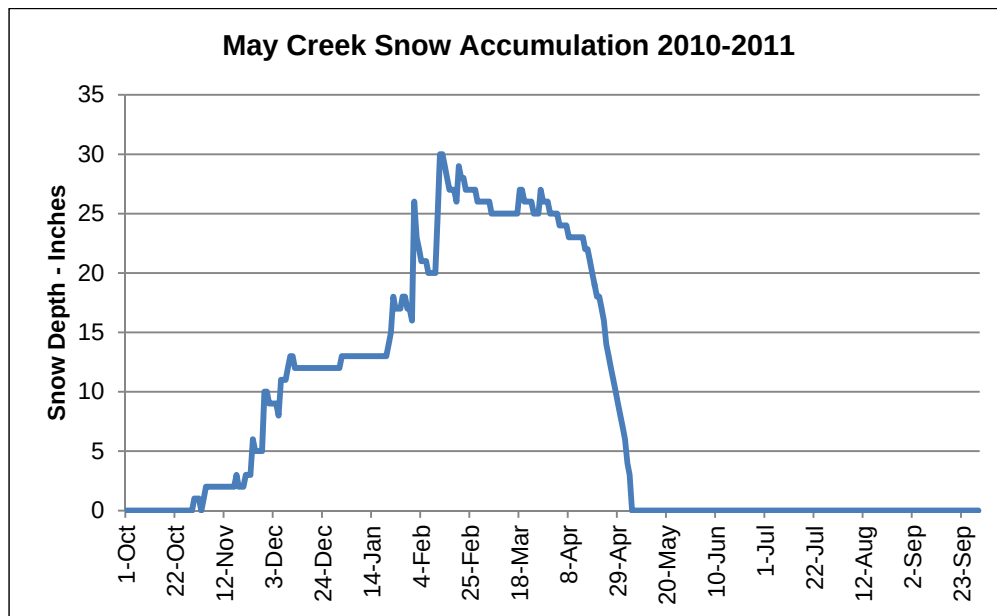
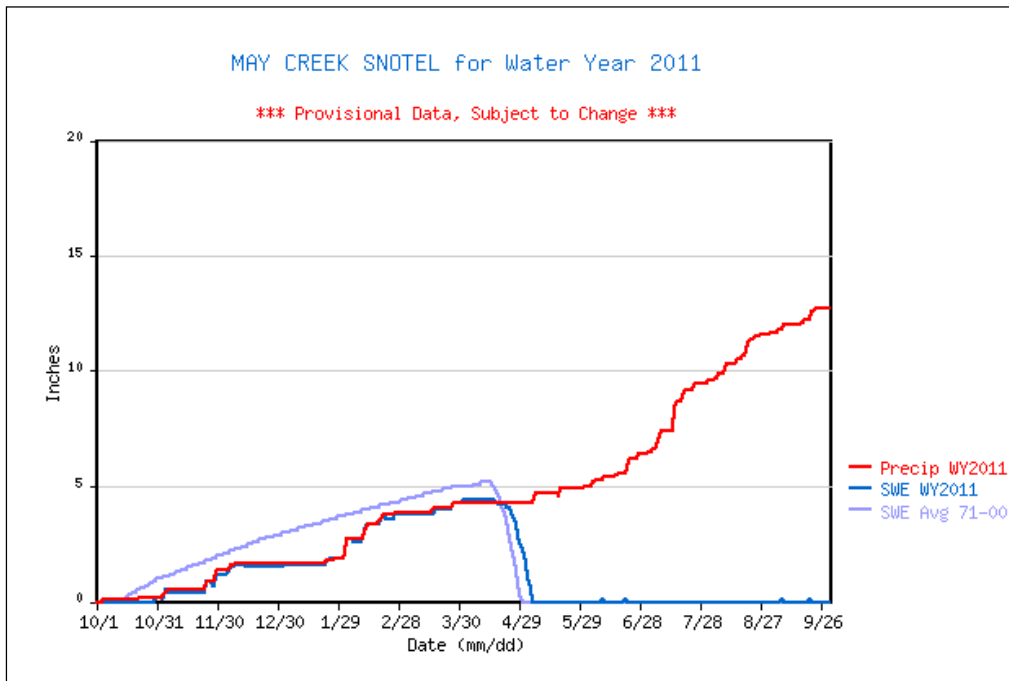


Daily precipitation totals for Tokositna Valley for 2010-2011 season Oct 1 – Sep 30.

Unit = inches

day	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep
---	---	---	---	---	---	---	---	---	---	---	---	---
1	0.0	3.5	9.2	11.5	13.5	15.7	15.7	19.6	20.1	20.3	26.5	41.9
2	0.2	3.4	9.2	11.9	14.2	15.7	15.7	19.7	20.1	20.3	28.6	41.9
3	0.4	3.6	9.2	12.0	14.5	15.7	15.7	19.7	20.1	20.8	31.1	42.0
4	0.5	4.2	9.9	12.0	14.9	15.7	15.7	19.7	20.2	21.8	31.4	42.1
5	0.5	5.0	10.3	12.1	14.9	15.7	15.9	19.7	20.2	22.0	33.1	42.3
6	0.5	5.1	10.3	12.3	15.0	15.7	16.5	19.7	20.2	22.0	34.1	42.3
7	0.6	5.2	10.3	12.3	15.0	15.7	16.9	19.7	20.2	22.1	35.2	42.3
8	0.9	5.3	10.3	12.4	15.0	15.7	17.6	19.7	20.2	22.1	35.9	42.6
9	0.9	5.3	10.3	12.4	15.2	15.7	18.4	19.7	19.9	22.1	36.3	42.7
10	1.0	5.4	10.3	12.4	15.4	15.7	18.4	19.8	20.0	22.1	36.8	42.7
11	1.0	5.4	10.3	12.4	15.4	15.7	18.4	19.9	20.0	22.1	36.8	42.8
12	1.0	5.4	10.3	12.4	15.4	15.7	18.5	20.0	20.0	22.2	36.8	42.8
13	1.1	5.4	10.3	12.4	15.4	15.7	18.5	20.0	20.0	22.5	36.8	42.8
14	1.2	6.0	10.3	12.4	15.4	15.7	18.5	20.0	20.0	22.6	36.8	43.0
15	1.2	6.0	10.3	12.4	15.5	15.7	18.5	20.0	20.0	22.7	37.0	43.1
16	1.2	6.1	10.3	12.4	15.5	15.7	18.5	20.1	20.0	22.7	37.0	43.1
17	1.2	6.1	10.3	12.4	15.5	15.7	18.5	20.1	20.0	22.9	37.1	43.1
18	1.2	6.2	10.3	12.4	15.5	15.7	18.5	20.1	20.0	24.1	37.8	43.2
19	1.2	6.2	10.3	12.4	15.5	15.7	18.5	20.1	20.0	24.3	38.5	43.3
20	1.2	6.2	10.3	12.4	15.5	15.7	18.5	20.1	20.0	24.3	38.8	43.3
21	1.2	6.2	10.3	12.5	15.6	15.7	18.5	20.1	20.0	24.3	39.2	43.3
22	1.3	6.2	10.3	12.5	15.6	15.7	18.7	20.1	20.0	24.3	39.3	43.3
23	1.3	6.9	10.3	12.5	15.6	15.7	19.1	20.1	20.0	24.3	39.5	43.3
24	1.4	8.0	10.3	12.6	15.6	15.7	19.2	20.1	20.0	24.7	40.2	43.3
25	1.4	8.6	10.3	12.9	15.6	15.7	19.2	20.1	20.0	25.1	40.3	43.3
26	1.5	9.0	10.3	13.0	15.6	15.7	19.2	20.1	20.0	25.4	40.5	44.3
27	1.5	9.2	10.3	13.3	15.6	15.7	19.4	20.1	20.0	25.4	40.5	44.3
28	1.8	9.2	10.3	13.5	15.7	15.7	19.4	20.1	20.1	25.5	40.5	44.3
29	2.8	9.2	10.3	13.5	---	15.7	19.4	20.1	20.1	25.5	40.6	44.4
30	3.5	9.2	10.5	13.5	---	15.7	19.4	20.1	20.1	25.5	40.6	44.4
31	3.5	---	10.6	13.5	---	15.7	---	20.1	---	25.8	40.9	---
mean	1.2	6.2	10.2	12.5	15.3	15.7	18.1	20.0	20.1	23.3	36.9	43.0
max	3.5	9.2	10.6	13.5	15.7	15.7	19.4	20.1	20.2	25.8	40.9	44.4
min	0.0	3.4	9.2	11.5	13.5	15.7	15.7	19.6	19.9	20.3	26.5	41.9

May Creek SNOTEL: Wrangell –St. Elias National Park and Preserve

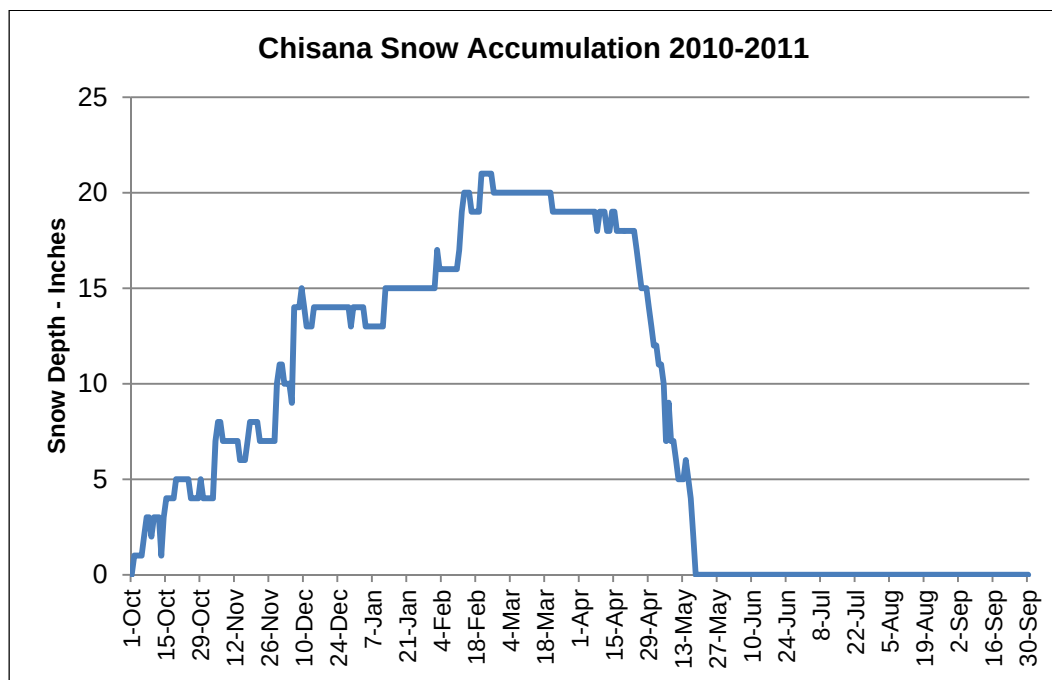
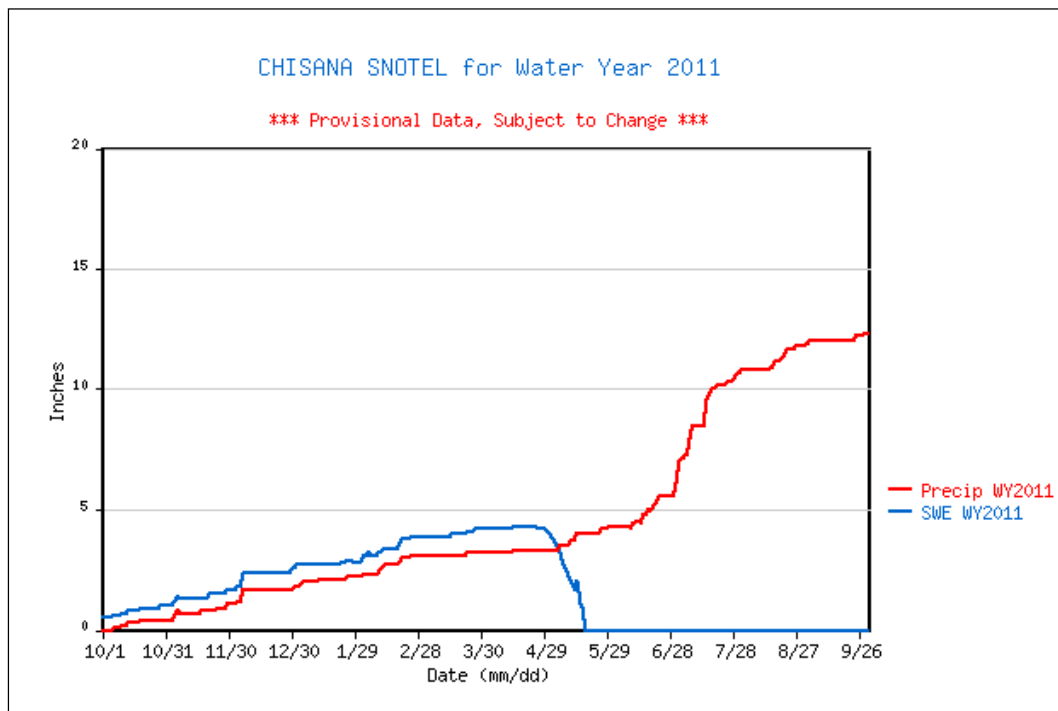


Daily precipitation totals for May Creek for 2010-2011 season Oct 1 – Sep 30.

Unit = inches

day	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep
---	---	---	---	---	---	---	---	---	---	---	---	---
1	0.0	0.2	1.4	1.7	2.1	3.9	4.3	4.3	5.0	6.4	9.6	11.7
2	0.0	0.2	1.4	1.7	2.7	3.9	4.3	4.3	5.0	6.5	9.6	11.7
3	0.0	0.3	1.4	1.7	2.7	3.9	4.3	4.3	5.0	6.5	9.6	11.7
4	0.1	0.4	1.4	1.7	2.7	3.9	4.3	4.3	5.2	6.6	9.7	11.7
5	0.1	0.5	1.4	1.7	2.7	3.9	4.3	4.3	5.2	6.6	9.7	11.8
6	0.1	0.5	1.6	1.7	2.7	3.9	4.3	4.4	5.3	6.7	9.9	11.8
7	0.1	0.5	1.6	1.7	2.7	3.9	4.3	4.7	5.3	7.0	9.9	12.0
8	0.1	0.5	1.6	1.7	2.7	3.9	4.3	4.7	5.3	7.4	9.9	12.0
9	0.1	0.5	1.7	1.7	2.7	3.9	4.3	4.7	5.3	7.4	10.0	12.0
10	0.1	0.5	1.7	1.7	2.7	3.9	4.3	4.7	5.4	7.4	10.3	12.0
11	0.1	0.5	1.7	1.7	3.0	3.9	4.3	4.7	5.4	7.4	10.3	12.0
12	0.1	0.5	1.7	1.7	3.4	3.9	4.3	4.7	5.4	7.4	10.3	12.0
13	0.1	0.5	1.7	1.7	3.4	3.9	4.3	4.7	5.4	7.4	10.3	12.0
14	0.1	0.5	1.7	1.7	3.4	3.9	4.3	4.7	5.4	7.4	10.3	12.0
15	0.1	0.5	1.7	1.7	3.4	3.9	4.3	4.7	5.4	8.5	10.5	12.0
16	0.1	0.5	1.7	1.7	3.4	3.9	4.3	4.7	5.5	8.7	10.5	12.1
17	0.1	0.5	1.7	1.7	3.4	4.0	4.3	4.7	5.6	8.7	10.5	12.1
18	0.1	0.5	1.7	1.7	3.5	4.1	4.3	4.6	5.6	8.7	10.7	12.2
19	0.1	0.5	1.7	1.7	3.6	4.1	4.3	4.9	5.6	8.9	10.7	12.2
20	0.1	0.5	1.7	1.7	3.8	4.1	4.3	4.9	5.6	9.2	11.2	12.2
21	0.1	0.5	1.7	1.7	3.8	4.1	4.3	4.9	5.8	9.2	11.3	12.6
22	0.2	0.5	1.7	1.7	3.8	4.1	4.3	4.9	6.1	9.2	11.4	12.6
23	0.2	0.5	1.7	1.8	3.8	4.1	4.3	4.9	6.2	9.2	11.4	12.7
24	0.2	0.8	1.7	1.8	3.8	4.1	4.3	4.9	6.2	9.2	11.5	12.7
25	0.2	0.9	1.7	1.8	3.8	4.1	4.3	4.9	6.2	9.5	11.5	12.7
26	0.2	0.9	1.7	1.8	3.9	4.1	4.3	4.9	6.2	9.5	11.5	12.7
27	0.2	0.9	1.7	1.9	3.9	4.3	4.3	4.9	6.4	9.5	11.6	12.7
28	0.2	0.9	1.7	1.9	3.9	4.3	4.3	4.9	6.4	9.5	11.6	12.7
29	0.2	1.3	1.7	1.9	---	4.3	4.3	4.9	6.4	9.5	11.6	12.7
30	0.2	1.4	1.7	1.9	---	4.3	4.3	4.9	6.4	9.5	11.6	12.7
31	0.2	---	1.7	1.9	---	4.3	---	5.0	---	9.5	11.6	---
mean	0.1	0.6	1.6	1.7	3.3	4.0	4.3	4.7	5.6	8.2	10.6	12.2
max	0.2	1.4	1.7	1.9	3.9	4.3	4.3	5.0	6.4	9.5	11.6	12.7
min	0.0	0.2	1.4	1.7	2.1	3.9	4.3	4.3	5.0	6.4	9.6	11.7

Chisana SNOTEL: Wrangell –St. Elias National Park and Preserve



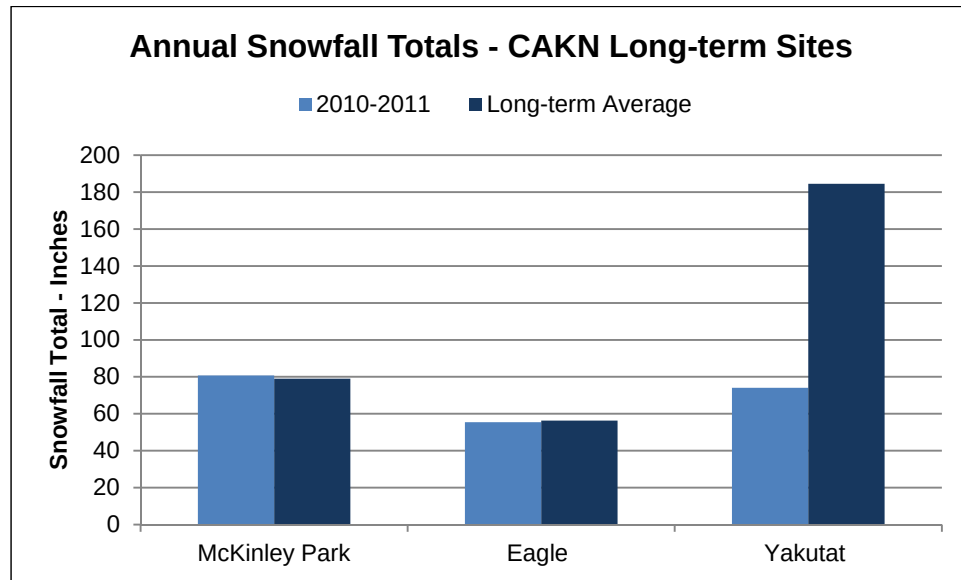
Daily precipitation totals for Chisana for 2010-2011 season Oct 1 – Sep 30.

Unit = inches

day	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep
---	---	---	---	---	---	---	---	---	---	---	---	---
1	0.0	0.4	1.1	1.8	2.2	3.1	3.2	3.3	4.3	6.2	10.8	11.9
2	0.0	0.4	1.1	1.8	2.3	3.1	3.2	3.3	4.3	7.0	10.8	12.0
3	0.0	0.4	1.1	1.9	2.3	3.1	3.2	3.3	4.3	7.1	10.8	12.0
4	0.0	0.6	1.2	2.0	2.3	3.1	3.2	3.3	4.3	7.1	10.8	12.0
5	0.0	0.8	1.2	2.0	2.3	3.1	3.2	3.3	4.3	7.3	10.8	12.0
6	0.1	0.7	1.7	2.0	2.3	3.1	3.2	3.5	4.3	7.3	10.8	12.0
7	0.1	0.7	1.7	2.0	2.3	3.1	3.2	3.5	4.3	7.8	10.8	12.0
8	0.1	0.7	1.7	2.0	2.3	3.1	3.2	3.5	4.3	8.5	10.8	12.0
9	0.1	0.7	1.7	2.0	2.4	3.1	3.2	3.5	4.2	8.5	10.8	12.0
10	0.2	0.7	1.7	2.0	2.5	3.1	3.2	3.5	4.4	8.5	10.8	12.0
11	0.2	0.7	1.7	2.0	2.6	3.1	3.2	3.6	4.4	8.5	10.8	12.0
12	0.2	0.7	1.7	2.1	2.7	3.1	3.2	3.7	4.5	8.5	10.8	12.0
13	0.3	0.7	1.7	2.1	2.7	3.1	3.2	3.7	4.5	8.5	10.8	12.0
14	0.3	0.7	1.7	2.1	2.7	3.1	3.3	4.0	4.4	8.5	10.8	12.0
15	0.3	0.7	1.7	2.1	2.7	3.1	3.3	4.0	4.8	9.5	10.9	12.0
16	0.3	0.7	1.7	2.1	2.7	3.1	3.3	4.0	4.8	9.8	11.1	12.0
17	0.3	0.8	1.7	2.1	2.7	3.1	3.3	4.0	5.0	9.9	11.2	12.0
18	0.3	0.8	1.7	2.1	2.7	3.1	3.3	4.0	4.9	10.0	11.2	12.0
19	0.4	0.8	1.7	2.1	2.8	3.1	3.3	4.0	5.0	10.0	11.2	12.0
20	0.4	0.8	1.7	2.1	3.0	3.1	3.3	4.0	5.2	10.2	11.3	12.0
21	0.4	0.8	1.7	2.1	3.0	3.1	3.3	4.0	5.3	10.2	11.4	12.0
22	0.4	0.8	1.7	2.1	3.0	3.1	3.3	4.0	5.4	10.2	11.5	12.0
23	0.4	0.8	1.7	2.1	3.0	3.2	3.3	4.0	5.6	10.2	11.7	12.0
24	0.4	0.9	1.7	2.1	3.0	3.2	3.3	4.0	5.6	10.2	11.7	12.2
25	0.4	0.9	1.7	2.2	3.1	3.2	3.3	4.0	5.6	10.3	11.7	12.2
26	0.4	0.9	1.7	2.2	3.1	3.2	3.3	4.2	5.6	10.3	11.7	12.2
27	0.4	0.9	1.7	2.2	3.1	3.2	3.3	4.2	5.6	10.3	11.8	12.2
28	0.4	0.9	1.7	2.2	3.1	3.2	3.3	4.2	5.6	10.4	11.8	12.3
29	0.4	1.1	1.7	2.2	---	3.2	3.3	4.2	5.6	10.6	11.8	12.3
30	0.4	1.1	1.7	2.2	---	3.2	3.3	4.3	5.9	10.7	11.8	12.3
31	0.4	---	1.8	2.2	---	3.2	---	4.3	---	10.7	11.8	---
mean	0.3	0.8	1.6	2.1	2.7	3.1	3.3	3.8	4.9	9.1	11.2	12.1
max	0.4	1.1	1.8	2.2	3.1	3.2	3.3	4.3	5.9	10.7	11.8	12.3
min	0.0	0.4	1.1	1.8	2.2	3.1	3.2	3.3	4.2	6.2	10.8	11.9

Appendix C. Long-term snowfall data – NWS COOP

These data are available courtesy of the Western Regional Climate Center web site at <http://www.wrcc.dri.edu>



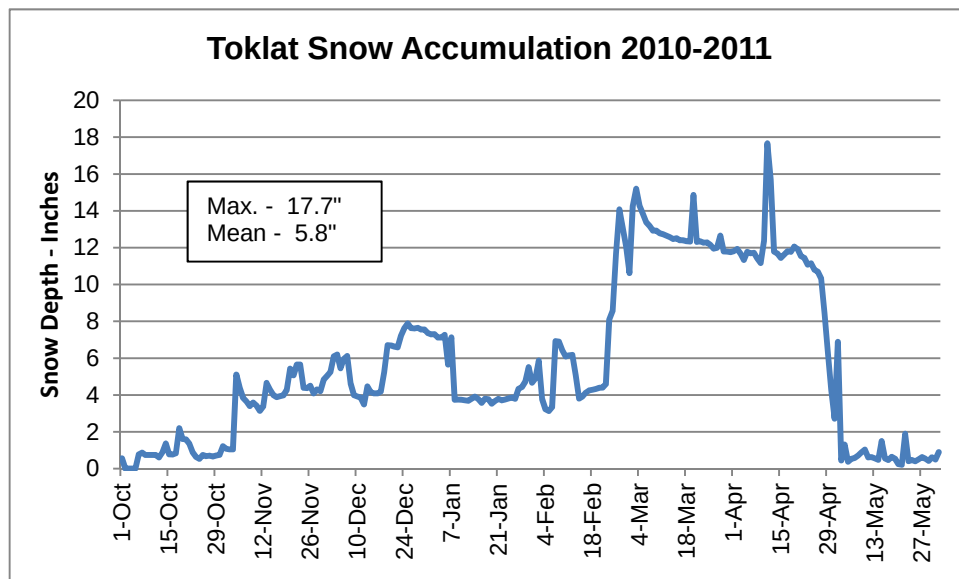
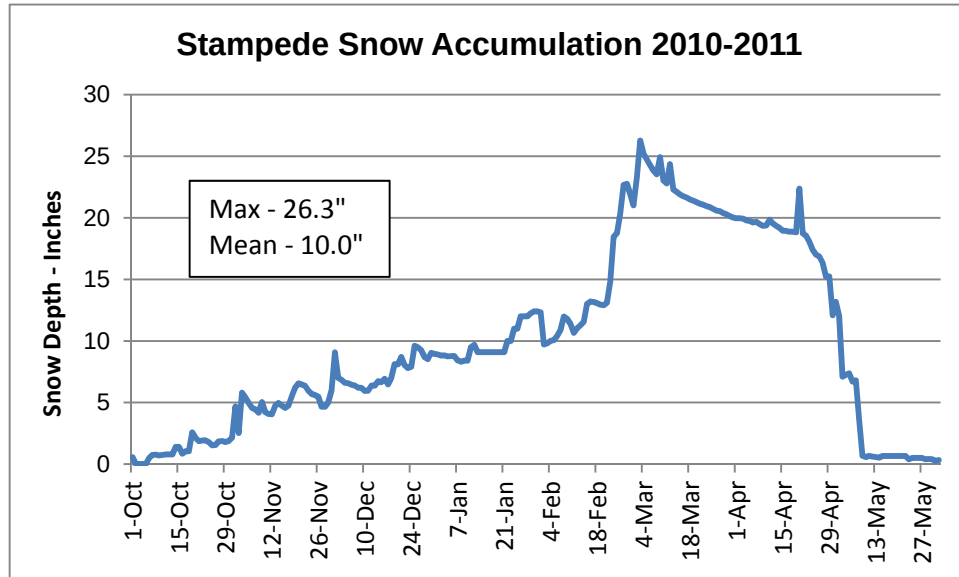
NWS COOP sites with monthly snowfall measurements

Site (# of years)	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
McKinley Park (79)													
2010-11	0.0	0.0	0.0	3.4	12.1	9.5	8.0	43.9	0.3	0.5	3.0	0.0	80.7
Long-term Average	0.0	0.0	3.3	12.5	12.5	12.5	11.6	10.2	7.7	5.9	2.6	0.2	79.5
Eagle (30)													
2010-11	0.0	0.0	0.4	7.0	25.0	6.0	3.5	7.5	0.5	5.5	0.0	0.0	55.4
Long-term Average	0.0	0.0	0.9	9.6	10.7	11.3	7.7	6.9	5.3	3.1	0.8	0.0	59.9
Yakutat (50)													
2010-11	0.0	0.0	0.0	1.0	7.9	22.9	12.8	19.2	2.2	8.1	0.0	0.0	74.1
Long-term Average	0.0	0.0	0.0	4.8	21.1	35.7	35.1	34.9	36.8	15.1	1.0	0.0	185.2

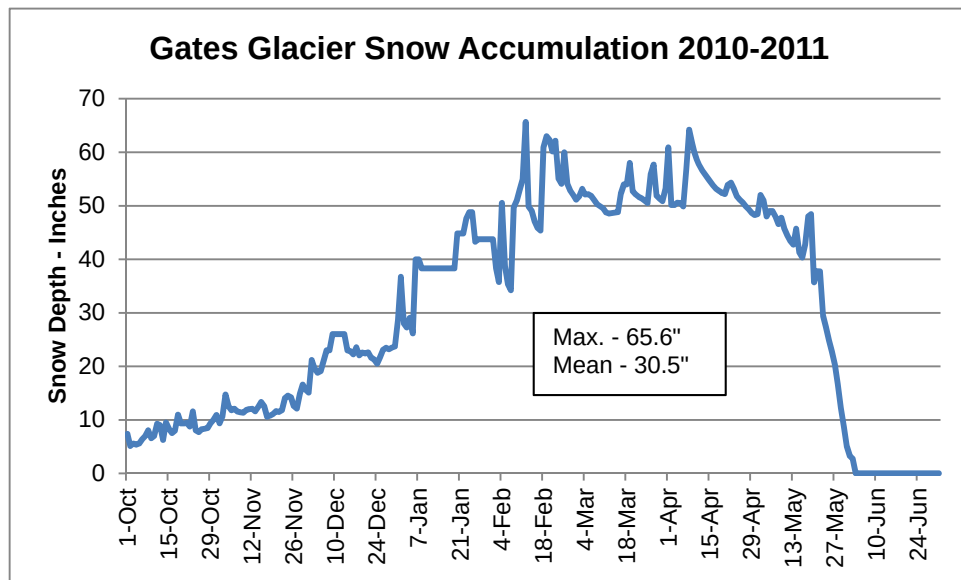
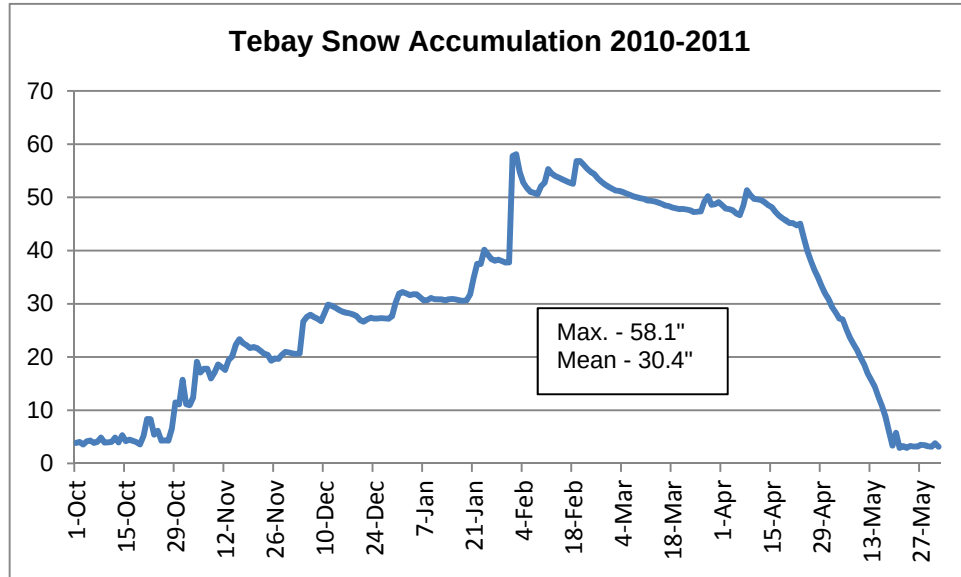
Appendix D. Cumulative Snow Depths at CAKN Climate Stations

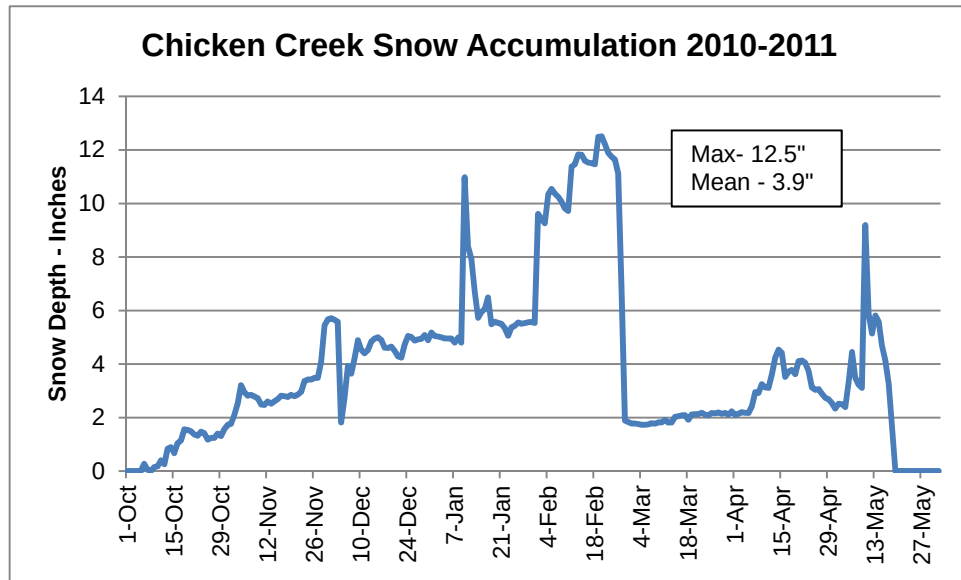
These data and additional graphs are available at <http://www.wrcc.dri.edu/NPS.html>.

Denali

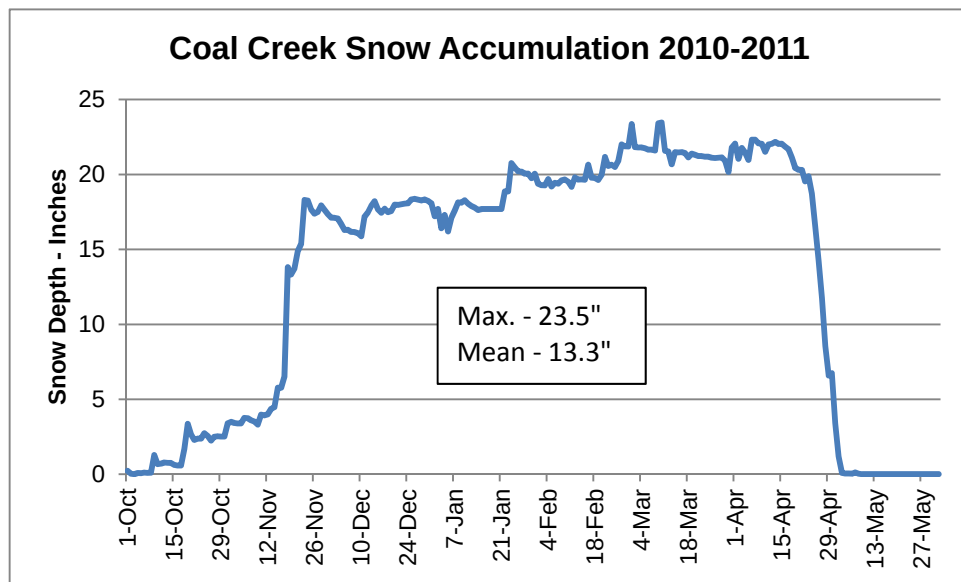


Wrangell – St. Elias





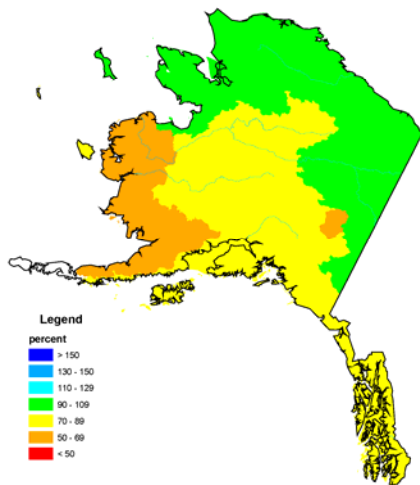
Yukon-Charley Rivers



Appendix E. Statewide Snowpack Maps for 2010 - 2011

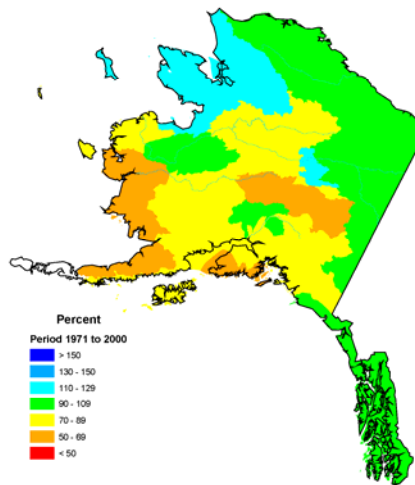
Published by the Natural Resources Conservation Service each month during the season and available online at http://www.wcc.nrcs.usda.gov/cgibin/ak_snow.pl?state=alaska

**Alaska Snowpack
as of January 1, 2011**



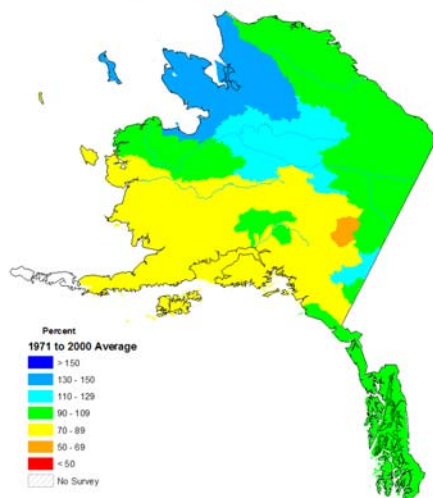
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**Alaska Snowpack
as of February 1, 2011**



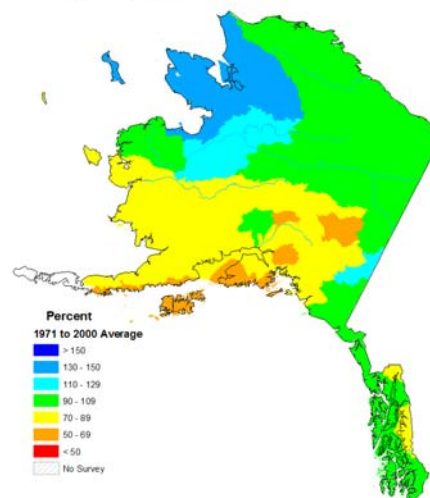
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**Alaska Snowpack
as of March 1, 2011**



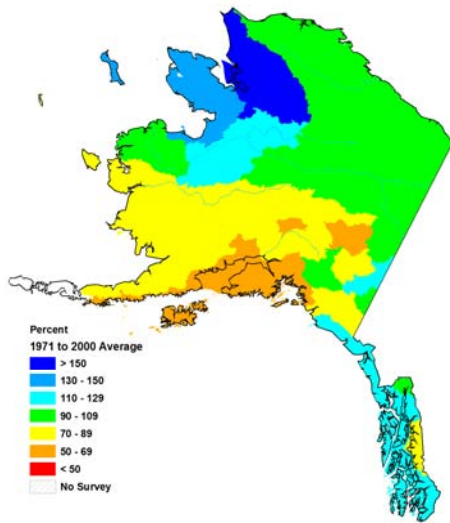
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**Alaska Snowpack
as of April 1, 2011**



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