



Annual Snowpack Report 2009-2010

Central Alaska Network

Natural Resource Data Series NPS/CAKN/NRDS—2014/604



ON THE COVER

Dan Kenney troubleshooting a power problem in January at -22°F in Kantishna, Denali National Park and Preserve.
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. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. 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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Abstract

The snowpack once again varied across the state for the 2009-2010 season. The southeast region of the state, including the Kenai Peninsula and the southern portions of Wrangell St. Elias had normal to just above normal snowpacks for the year. The central interior was below normal for most areas, with the lowest snow fall totals through the center of the state between the Books Range and the Alaska Range. There was record low snow water content in the spring at Lake Minchumina in the northwest portion of Denali and sites on the south side of the Alaska Range in Denali. The snowpack in Wrangell-St. Elias in the Chugach and Wrangell Mountains was near normal to above normal, however the Copper basin floor was about 75% of normal. For the central Alaska region the snowpack accumulation started a bit later than usual at most sites, with the first persistent snow of the season beginning around the week of October 27th, almost 2 weeks later than normal. Other areas had 1-2 inches of snow starting the first week of October. The snow off dates for the region occurred during the last week of April and the first few days of May.

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

A predominate feature of climate in high latitude regions is the presence of a seasonal snowpack. The snowpack is a major influence on hydrology, vegetation, and faunal communities. A main objective of the Central Alaska Network's (CAKN) snowpack monitoring program is to record long-term trends in snow by engaging in an interagency agreement with the Natural Resources Conservation Service (NRCS) to survey snow courses, aerial snow markers, and install and maintain recording precipitation gauges (as part of the snow telemetry [SNOTEL] network) in all three CAKN parks, including Denali National Park and Preserve (DENA), Wrangell – St. Elias National Park and Preserve (WRST), and Yukon-Charley Rivers National Preserve. (YUCH). 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 data provided in this report comes almost exclusively from the NRCS Alaska Snow, Water and Climate Services web based server (NRCS 2010).

Snow pack is measured in several different ways in the Central Alaska Network. The objective of a snow survey or snow measurement is to determine the snow water equivalent or SWE, which is the amount of water in the snowpack. Snowpack monitoring for the CAKN is done through an interagency agreement with NRCS in Anchorage. For detailed methods refer to the Snowpack Monitoring Protocols for the CAKN (Sousanes 2004). The snow monitoring sites for the CAKN are shown in Figure 1.

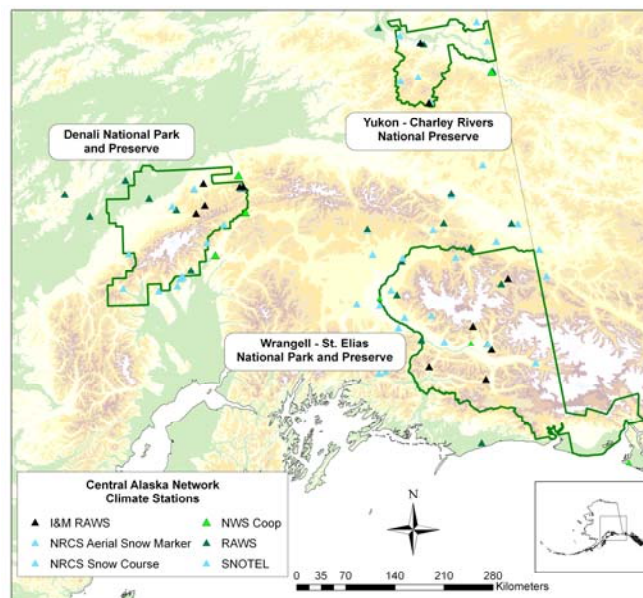


Figure 1. Locations of snow monitoring sites in the Central Alaska Network.

Snotel

The most useful information we have on snow pack is from the new CAKN 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. SNOTEL sites adjacent to CAKN parks are useful as well, including Mission Creek 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 2). Park staff, including park pilots and contracted 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 2. Example of a snow course in Denali National Park and Preserve

Results

Snow surveys in all three CAKN parks were done on Dec 1, Feb 1, March 1, April 1 and May 1 if weather conditions permitted. Data from these surveys 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. For the central Alaska region the snowpack accumulation started a bit later than usual at most sites, with the first persistent snow of the season beginning around the week of October 27th, almost 2 weeks later than normal. Other areas had 1-2 inches of snow starting the first week of October. The snow off dates for the region occurred during the last week of April and the first few days of May.

Air temperatures around the region were well above normal in October, and well below normal in November, back above normal in December, and then below normal again in January. As the season progressed air temperatures in most part of the region were above normal for February through April. With April temperatures for the interior, especially the eastern interior, about 9 degrees warmer than normal leading to a rapid and early melt at the end of the snow season. The following sections provides a summary of the snowpack season for each of the major hydrologic units in the central Alaska region including the Tanana Basin, Central Yukon Basin, Western Interior Basin, Copper River basin, and the Matanuska-Susitna Basin (Figure 3).

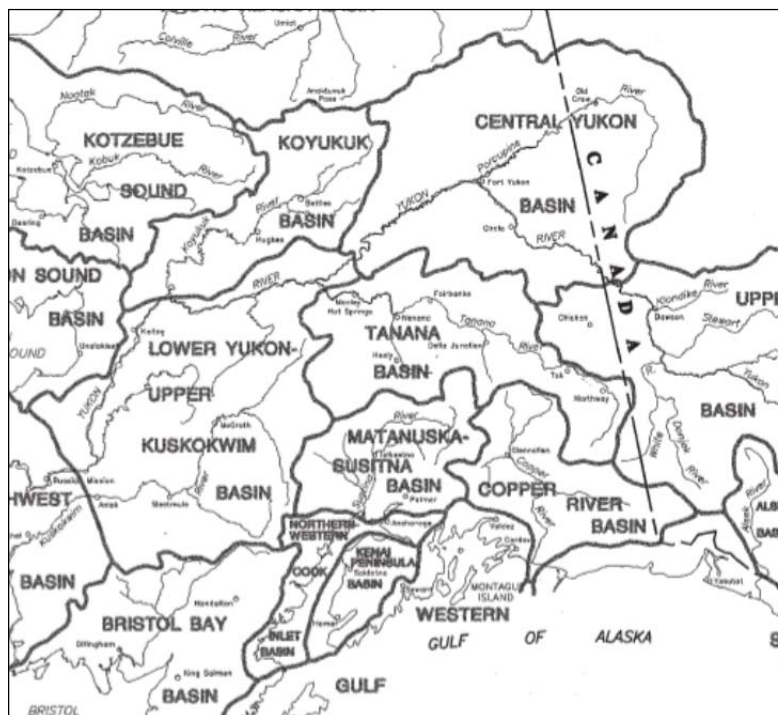


Figure 3. Map showing hydrologic basins of Alaska. Map courtesy of the Natural Resources Conservation Service Snow Survey Report (NRCS, 2009) and available at <http://ambcs.org/pub/BasinRpt/2009/may.pdf>

Tanana Basin

The Tanana Basin includes 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 Denali park headquarters, the day of the first persistent snow was October 27, a few weeks later than normal. The new SNOTEL sites at Kantishna in Denali and Chisana in Wrangell-St. Elias now 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 1, Kantishna recorded 2 inches and Chisana recorded 1 inch of snow, which marked the beginning of the season at both locations.

The start of the water year was warm, with October temperatures well above normal in most interior Alaska locations. In November the trend reversed and temperatures averaged colder than normal throughout the region. The October average was 4-6 degrees warmer than normal for most of the interior. Very few sites were visited during the first survey due to weather; the Kantishna site was off line due to power issues from mid-November through mid-January leaving a data gap at this site. Chisana had 11 inches with 2.0 inches of snow water equivalent (swe), which is 83% of normal. The Denali Park headquarters site had 6 inches of snow on November 30th; the long-term average is 10 inches for this date. Jatamund Lake, located north of Chisana in WRST, reported 9 inches of snow on November 30 which is 56% of normal.

By February, the snowpack in the western portion of the Tanana Basin was well below normal, Kantishna had 13 inches of snow with a swe of 1.9 inches, normal is 26 inches of snow with a swe of 4.5 inches. The Lake Minchumina snow course, in the lower Tanana basin recorded 1.0 inch of snow water content for February 1, a record low for that location, which has been in operation since 1967. The middle Tanana Basin was still below normal, with sites at and around Denali park headquarters site at about 50-75% of normal with depths around 12 inches and snow water content ranging from 32-43% of normal. Chisana’s snow depth increased to 75% of normal with 15 inches of snow and 90 % of normal for swe at 2.6 inches. May 2 was the snow off date for Chisana. The Jatahmund Lake snow course had 12 inches, 67% of normal. Temperatures for February were well above normal for the interior region of the state.

March air temperatures were near normal, warming in April to 4 to 5 degrees warmer than normal. Through March and April the eastern region including Chisana and Jatahmund Lake continued to have snowpacks that were just below normal, while the central and western areas remained well below normal. At the end of March, the upper Tanana Basin sites were about 92% of normal, the middle basin remained at 47-50% of normal, and the western sites were 38% of normal. The snowpack generally decreases throughout April with warming temperatures; most of the sites sampled in the region recorded 0 inches of snow for the May 1 survey. Chisana still had 3 inches of snow and Rock Creek ridge above Denali Park Headquarters had 1 sample point with snow; normal at this site for this survey is 14 inches of snow with 4.9 inches of snow water equivalent. Lake Minchumina, Kantishna, and most other sites reported 0 inches of snow. See Appendix A for individual site data and Appendix B for the 1971-2000 normal values.

The Kantishna SNOTEL site recorded 3.0 inches of total winter precipitation (snow water equivalent) from October 1, 2009 through May 1, 2010, 12.5% of the total annual precipitation of 24.0 inches. See Appendix B for snowfall and precipitation accumulation graphs. The McKinley Park long-term NWS site was 60% of normal for the year with an annual total of 47.0 inches of snow, the average snowfall is 79.5 inches. See Appendix C for tables and graphs with long-term data. Figure 4 shows the NRCS snow survey report graphs for the area.

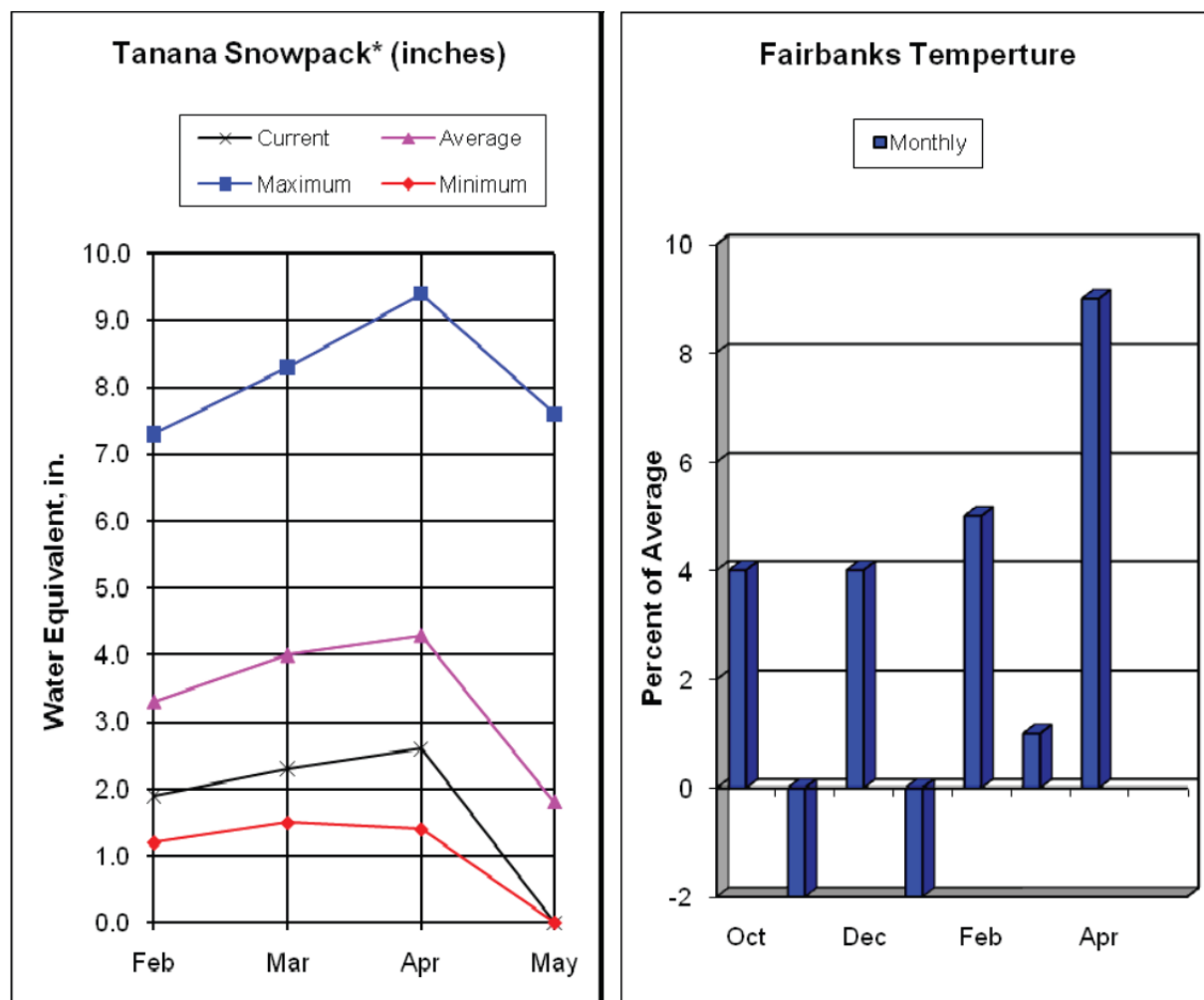


Figure 4. Tanana Basin 2009-2010 snow season. Graphs courtesy of the NRCS, Anchorage, AK (NRCS, 2010).

Central Yukon Basin

The Central Yukon Basin encompasses all of Yukon-Charley Rivers National Preserve (YUCH). This part of the state had a snowpack that was just below normal for the entire season, according to long-term records at Eagle. The Coal Creek climate station reported the first measurable snow on October 26, 2009. The long term cooperative weather station at Eagle reported a total of 4 inches of snow for October when the normal is 9.6 inches. November and December measurements were closer to normal for Eagle. The December measurements of the Yukon-Charley snow markers and Coal Creek snow courses ranged from 3 inches to 7 inches.

By February 1, the snowpack on the north side of the Yukon River at Cathedral Mountain and Step Mountain aerial markers was between 15 and 18 inches, Coal Creek had 15 inches and as you progressed south the snowpack tapered off to 13 and 8 inches at Crescent Creek and Copper Creek respectively. The Three Fingers site had 15 inches of snow in February. The snowpack was about the same in March for most sites except for Copper Creek and Three Fingers which both had a 5 inch increase from February to March. 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. None of the sites in Yukon Charley had any snow for the May 1 survey. The graphs taken from the NRCS Alaska Snow Survey Report for May 1 shows the average of all of the snow courses within the watershed; with temperatures from a nearby long-running climate station (Figure 5).

The May 5, 2009 ice jam on the Yukon River near Eagle destroyed the Mission Creek SNOTEL site; water year measurements are not available from the site. There were plans to replace the site in summer of 2010, but the field work was postponed due to flooding on the Taylor Highway that leads to Eagle. The Eagle NWS COOP site recorded an annual snowfall amount of 54.5 inches or 91% of the normal 59.9 inches. See Appendix C for tables and graphs with long-term data.

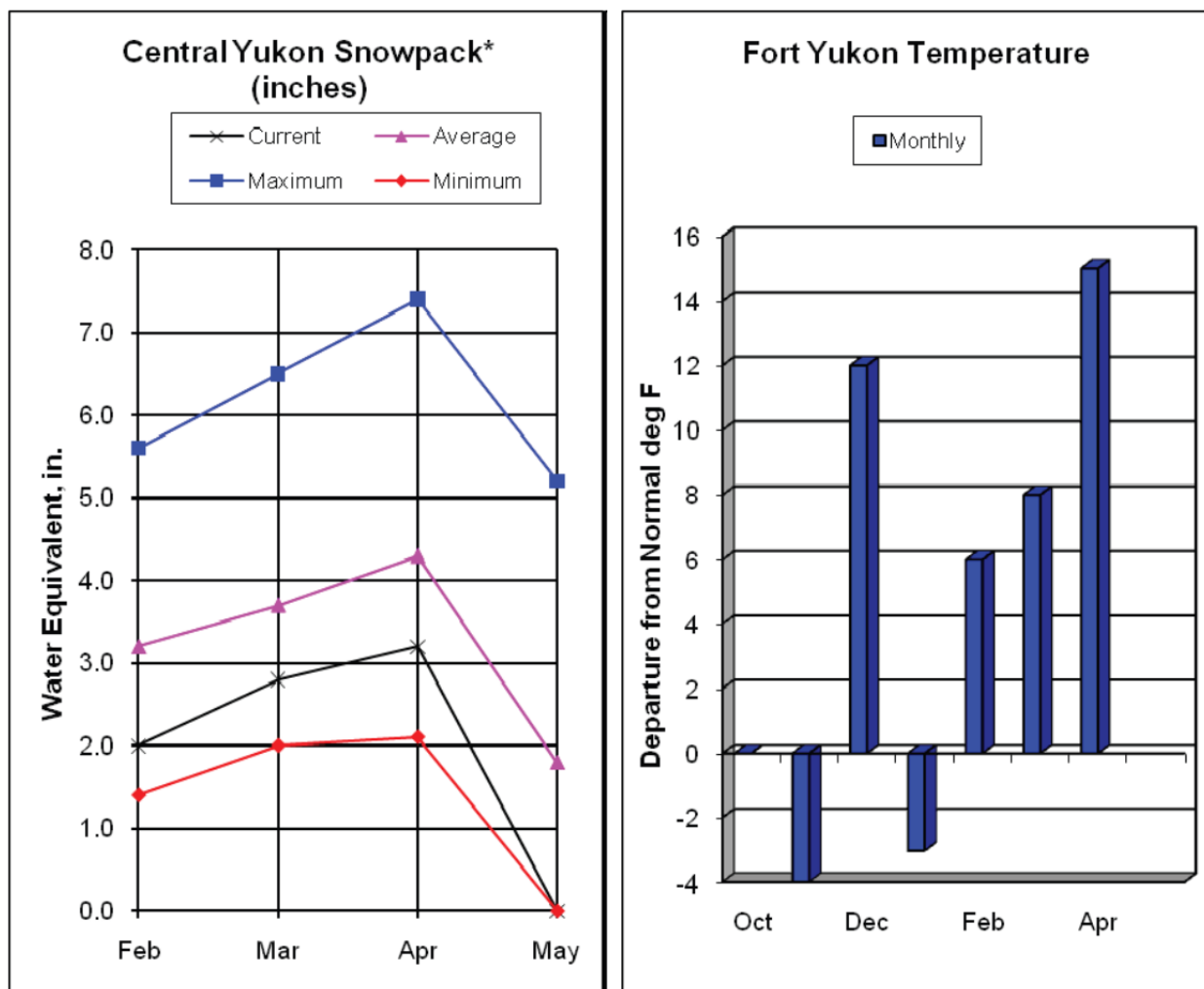


Figure 5. Central Yukon Basin 2009-2010 snow season. Courtesy of NRCS, Anchorage, AK (NRCS, 2010).

Western Interior Basin

Lake Minchumina and Purkeypile in Denali, are the two sites within the CAKN that are included in this hydrological division. This region had snowpacks that were below to well below normal for the year with snow depths at Lake Minchumina at 13 inches for April with 1.7 inches of snow water content, the second lowest year on record. The snow depth was 61% of normal. Purkeypile was about 85% of normal with 18 inches of snow and 3.1 inches of water content. There was no snow at either site for the May 1 survey. Figure 6 shows the NRCS snow survey report graphs for the area.

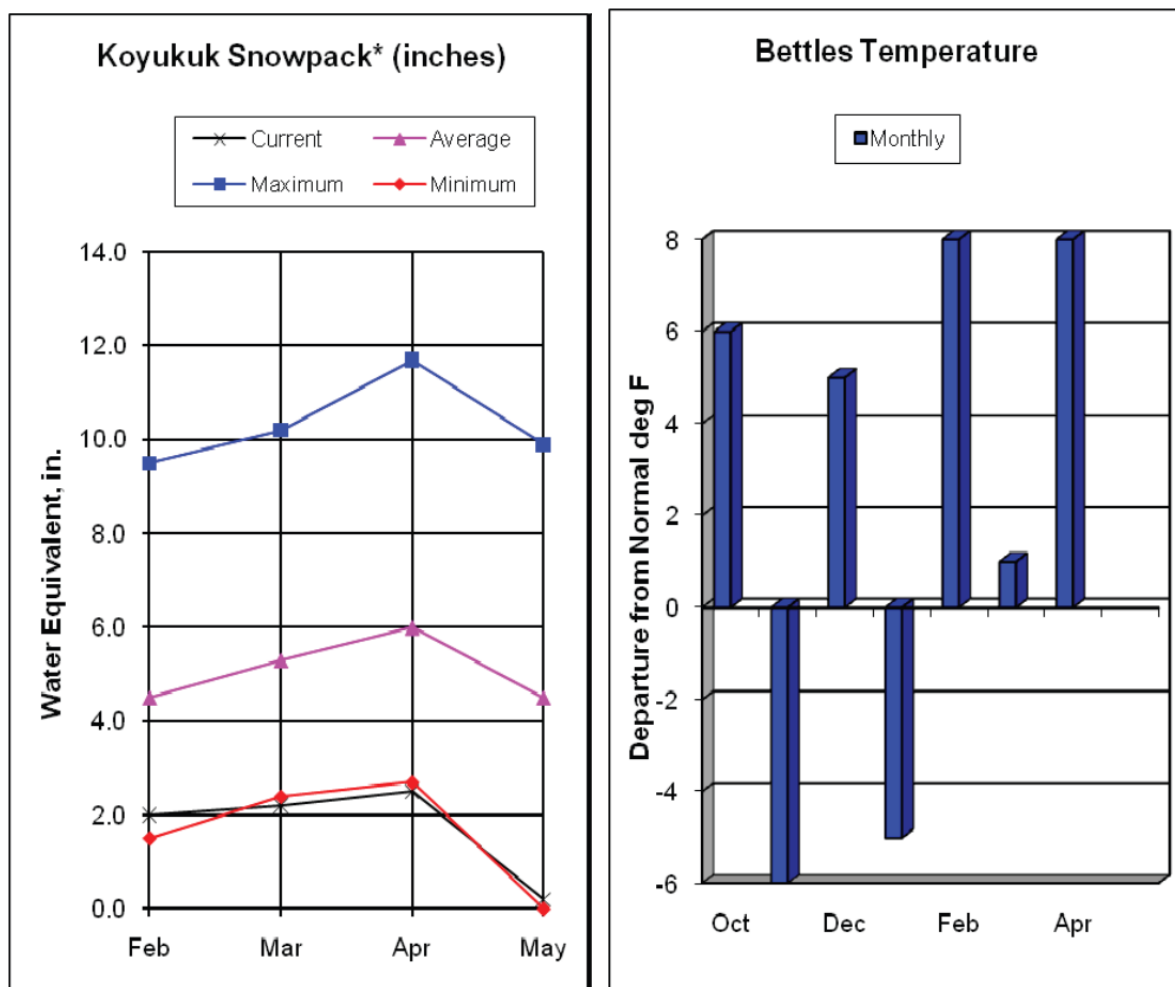


Figure 6. Koyukuk Basin 2009-2010 snow season. Courtesy of NRCS, Anchorage, AK

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 surveys within the park were done February 1 and April 1, however there are other snow course around the park that provide estimates for the region for other months and the two SNOTEL sites at May Creek and Chisana provide daily data. The data from the early season surveys showed the Basin Floor at 76% of normal, the Chugach Range at 80% of normal, and the Wrangell Mountains at 100% of normal. The new May Creek SNOTEL showed snow on the ground starting on October 22 with 1 inch of snow. By the March 1 surveys the snow courses in the Chugach Range increased to 89% of normal, while the Wrangell Range courses dropped to 73% of normal. The Basin Floor snowpack was about the same at 78% of normal. On May 1 there was no snow at the lower elevation sites in the region. The Chugach Range was about 113% 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 precipitation, snow water equivalent, and cumulative precipitation. There was 6.0 inches of snow water equivalent on May 1st; the annual total precipitation was 16.3 inches, so the winter snowfall accounted for 37% of the total precipitation for the year. The snow off date was April 29, 2010. The McCarthy NWS COOP that had been recording snowfall for the previous 13 years took very sporadic measurements in 2009-10, so the data could not be used.

The data from Yakutat is included in this section. It does not fall within the Copper Basin, but it does describe the coastal southeast area of WRST. There are no snow courses in this area, but the NWS Yakutat COOP station records snowfall. The site reported a total of 110.9 inches of snow for the year, or 60% of the 185 inches the site normally receives. There was no snow in October and very little accumulation in February.

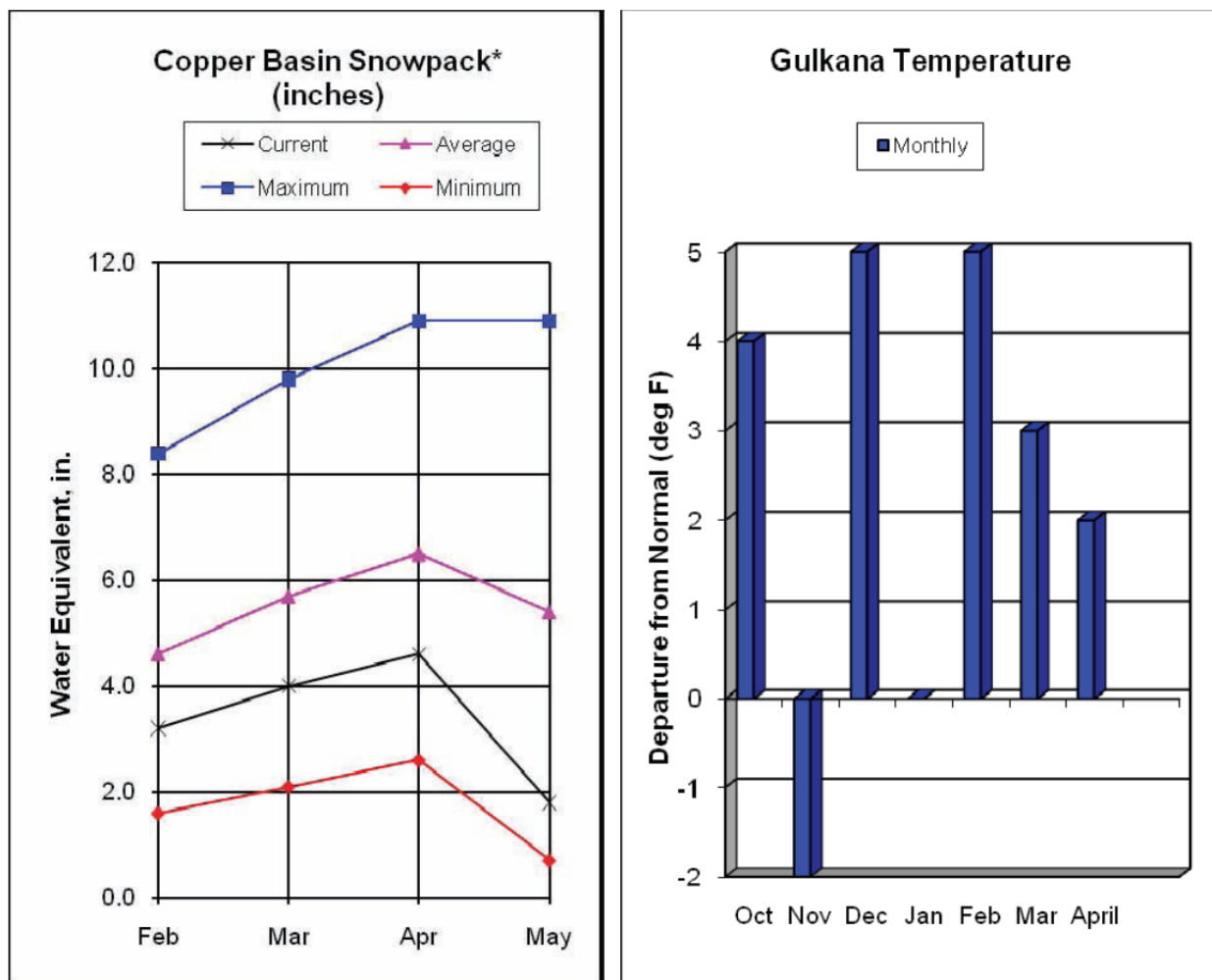


Figure 7. Copper Basin 2009-2010 snow season. Courtesy of NRCS, Anchorage, AK

Matanuska – Susitna Basin

The new CAKN Tokositna Valley SNOTEL site now provides daily measurements of precipitation and snow. The first measurable snow that persisted was on October 19, 2009. The early season measurements for the markers in the western part of the Susitna Valley were below normal to well below normal with the Tokositna SNOTEL reporting 21 inches of snow with 3.2 inches of water content for December 1, which is 80% of average. There was little additional snow accumulation in February and March. By April 1 the snow markers in this area were about 59% of average with Nugget bench at 67% of average and Dutch Hills showing 45 inches of snow with an estimated 14 inches of water content, or 51% of average. This is a record low water content for this location (NRCS, 2010). There was a bit of snow accumulation in April and by the May 1 survey the snow courses were about 68 percent of average. Figure 8 shows the NRCS snow survey report graphs for the area.

The precipitation gage at Tokositna Valley recorded 15.8 inches of precipitation from October 1, 2009 through May 1, 2010, which is 6.3 inches below the 1971-2000 normal. This is 39% of the total annual precipitation of 40.2 inches for the 2010 water year. See Appendix B for more information on the Tokositna SNOTEL data.

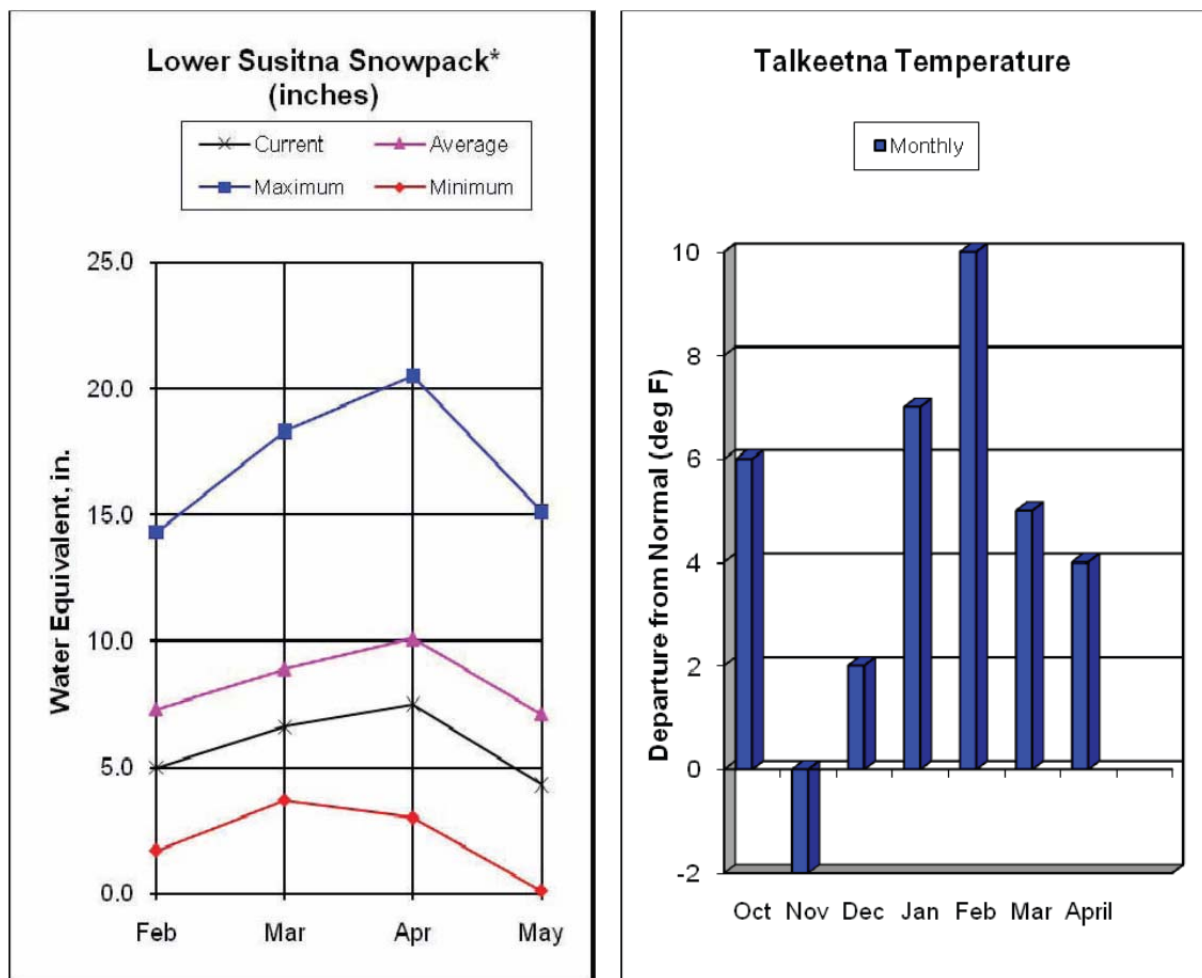


Figure 8. Lower Susitna Basin 2009-2010 snow season. Courtesy of NRCS, Anchorage, AK

Discussion

The snowpack across the Central Alaska Network varied quite a bit, mainly because the network encompasses over 21 million acres and includes north and south aspects of four major mountain ranges. The only region which had near normal snow conditions was the Chugach and Wrangell Mountains areas in Wrangell-St. Elias, extending into the northeast corner of the park near Chisana. The snow tracks tended to taper off by the time they reached the interior leaving that portion of the state with lower than normal snowpacks; the same pattern has occurred the past few years. An interesting note is that while the snow water content along the southern portion of Wrangell St. Elias was near normal, the snow fall total and annual precipitation amounts for Yakutat were below normal for the year.

There were not as many storms coming in from the Bering Sea this season, leaving the western portion of the state with below normal snow and snow water content for the year, and contributing to the record low snow content on both the north and south side of the Alaska Range in Denali. The new climate stations have acoustic depth sensors that provide information on snow depth and timing of snow on and off dates. The data from these sites is included in Appendix D. The NRCS publishes Alaska snowpack maps for each month the snow surveys are done starting on February 1. These maps provide an overall picture of snowpack variability around the state (See Appendix E).

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Appendix A. Snow Course Data from 2010

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	19	4.0	21	4.5	18	5.7	0	0
Tokositna Valley	850	32	7.5	36	9.9	39	11	0	0
Chelatna Lake	1450	30	6.9	22	3.0	30	8.6	23	7.5
Nugget Bench	2010	22	5.6	**	**	39	10.4	34	11
Ramsdyke Creek	22200	42	10	**	**	44	13	45	15
Dutch Hills	3100	40	10.8	**	**	45	14	57	18
Lake Minchumina	730	12	1.0	**	**	13	1.7	0	0
Kantishna	1550	13	1.9	**	**	15	2.2	0	0
Jatahmund Lake	2180	12	1.8	**	**	16	2.9	0	0
Rock Creek Bottom	2250	13	1.6	15	1.8	15	2.0	0	0
Rock Creek Ridge	2600	12	1.4	15	1.9	14	2.2	1	0.2
Lost Creek	3030	11	2.0	**	**	**	**	**	**
Chisana	3320	15	2.6	17	3.1	18	3.4	3	0.8
Purkeypile Mine	2025	14	2.3	**	**	18	3.1	0	0
Tazlina	1225			22	3.7	17	3.8	0	0
Kenny Lake School	1300	14	2.6	18	3.3	16	3.2	0	0
Chokosna	1550	18	3.1	**	**	**	**	**	**
May Creek	1610	21	4.3	28	3.2	21	4.8	0	0
Tsaina River	1750	39	9.6	**	**	64	17.9	48	17.8
Chistochina	1950	17	2.0	20	3.0	17	3.1	0	0
Tolsona Creek	2000	17	2.1	20	2.9	19	3.3	**	**
Dadina Lake	2160	28	5.0	**	**	25	5.3	**	**
Sanford River	2280	22	3.9	**	**	24	5.6	**	**
Long Glacier	4820	19	3.5	**	**	26	6.5	**	**
Tebay Lake	1930	43	8.6	**	**	30	8.4	**	**
Mission Creek	900					14	2.5		
Coal Creek	1000	15	1.9	16	2.4	16	2.7	0	0
Cathedral	1800	18	2.4	16	2.5	21	3.5	0	0
Copper Creek	2000	8	1.0	17	2.5	15	2.7	0	0
Crescent Creek	2600	13	1.6	16	2.3	20	3.4	0	0
Three Fingers	3350	15	1.9	20	2.7	19	3.1	0	0
Step Mountain	2850	15	1.9	16	2.4	14	2.6	0	0

Appendix B. Snow Course Averages 1971-2001

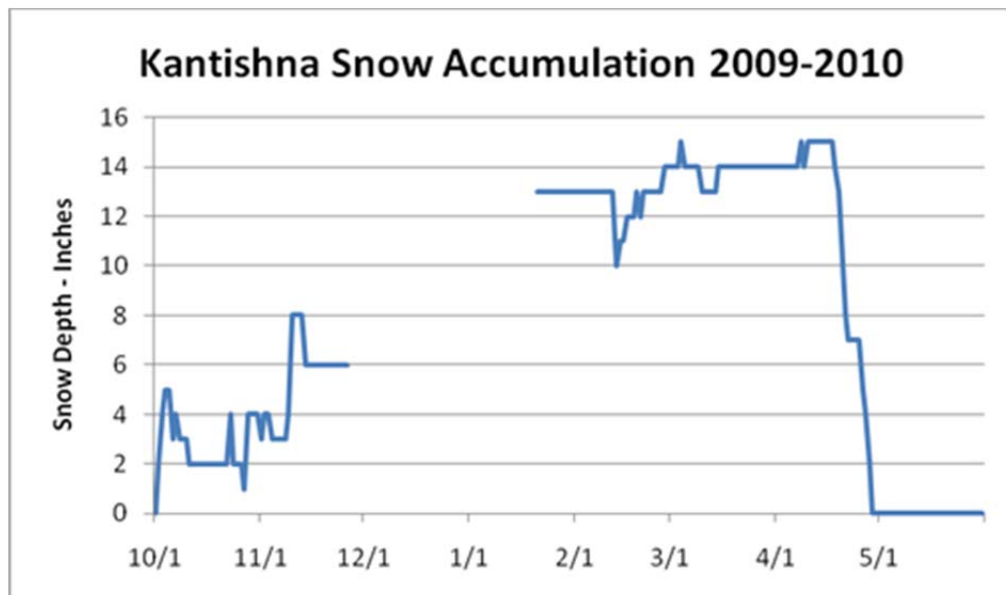
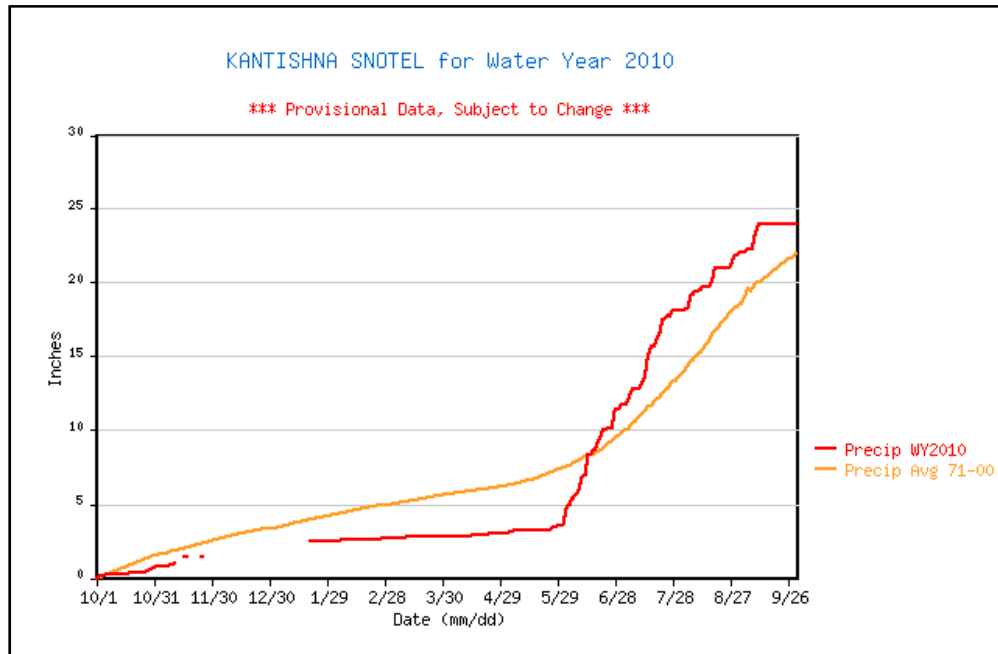
SNOW COURSE	ELEV.	FEB		MAR		APR		May	
Name	ft.	depth	swe	depth	swe	depth	swe	depth	swe
		in.	in.	in.	in.	in.	in.	in.	in.
Matanuska Susitna Basin									
Talkeetna	350	28	6.2	32	7.6	34	8.7	16	5.4
Tokositna Valley	850	55	13.6	67	15.7	62	18.7	43	17
Chelatna Lake	1450	36	8.3	42	10	44	11.6	33	10.9
Nugget 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

*** no survey done

Appendix C. Snotel Site Data

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

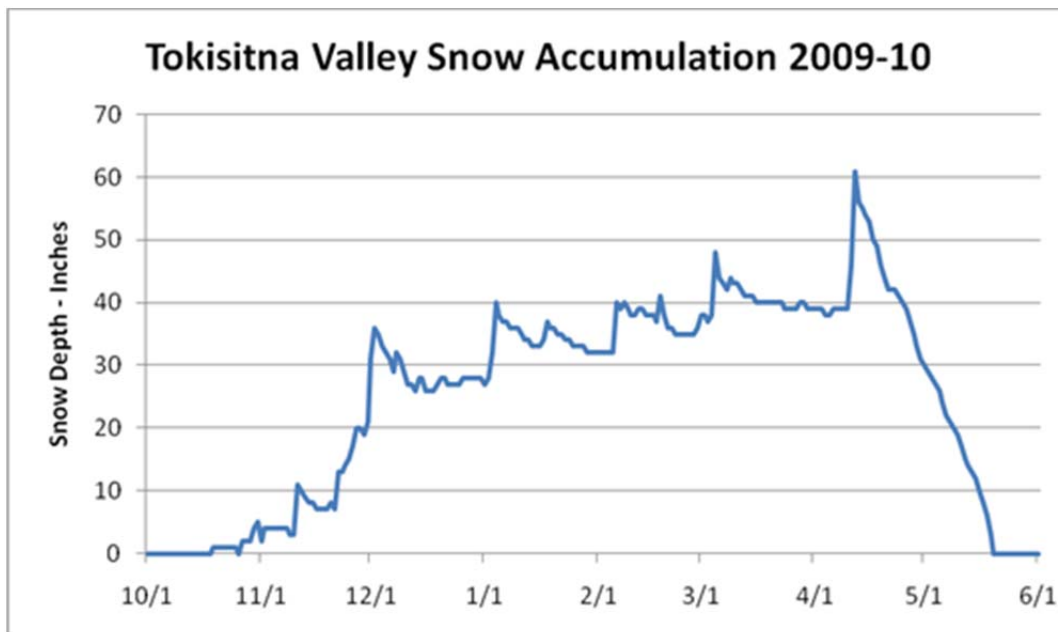
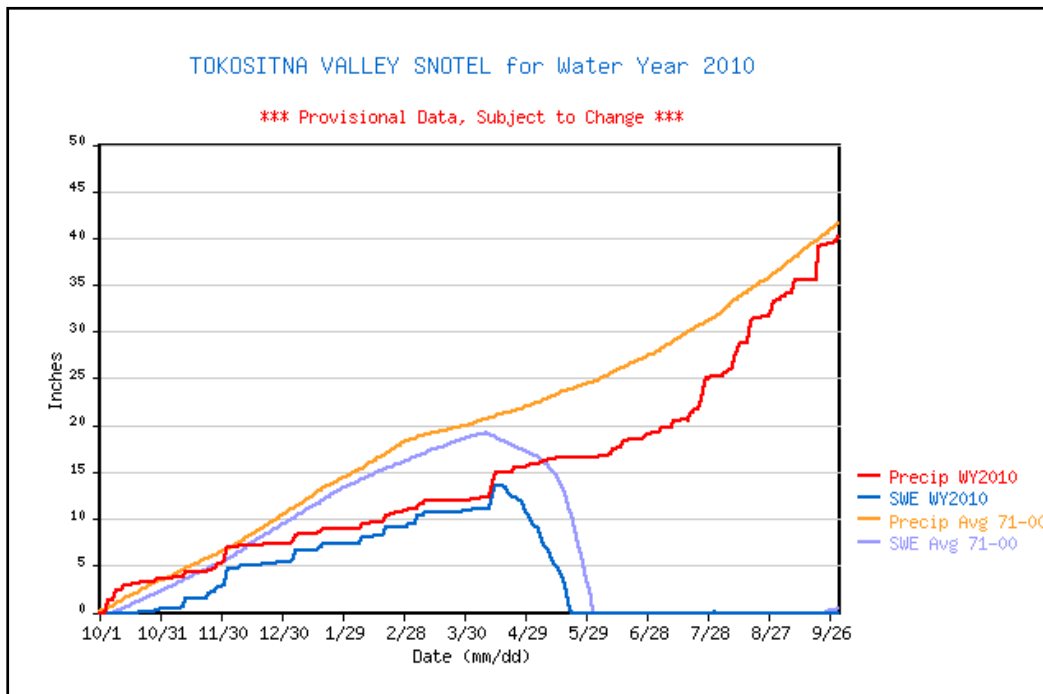
Kantishna: North Side Denali National Park and Preserve



Daily precipitation totals (inches) for Kantishna for 2010 water year: Oct 1 – Sep 30

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0	0.8			2.5	2.7	2.8	3	3.7	11.8	18.1	22.1
2	0.2	0.8			2.5	2.7	2.8	3	4.6	11.8	18.1	22.1
3	0.2	0.8			2.5	2.7	2.8	3	4.9	11.8	18.2	22.1
4	0.2	0.8			2.5	2.7	2.8	3.1	5	12	18.2	22.2
5	0.2	0.8			2.6	2.7	2.8	3.1	5.4	12.3	18.3	22.3
6	0.3	0.8			2.6	2.7	2.8	3.2	5.4	12.5	19.1	22.3
7	0.3	0.8			2.6	2.7	2.8	3.2	5.6	12.8	19.2	22.3
8	0.3	0.9			2.6	2.7	2.8	3.2	5.8	12.8	19.4	22.9
9	0.3	0.9			2.6	2.7	2.8	3.2	6.1	12.8	19.4	23.4
10	0.3	1			2.6	2.7	2.8	3.2	6.6	12.8	19.4	24
11	0.3				2.6	2.8	2.8	3.2	6.9	12.9	19.5	24
12	0.3				2.6	2.8	2.8	3.2	7	13.4	19.7	24
13	0.3				2.6	2.8	2.8	3.2	8.4	13.6	19.7	24
14	0.3				2.6	2.8	2.9	3.2	8.4	14.5	19.7	24
15	0.3	1.4			2.6	2.8	2.9	3.2	8.4	15	19.7	24
16	0.3				2.6	2.8	2.9	3.2	8.7	15.7	19.8	24
17	0.3	1.4			2.6	2.8	2.9	3.2	8.7	15.7	20	24
18	0.4				2.6	2.8	2.9	3.2	9	15.7	20.6	24
19	0.4				2.6	2.8	2.9	3.2	9.2	16	21	24
20	0.4			2.5	2.6	2.8	2.9	3.2	9.7	16.5	21	24
21	0.4			2.5	2.6	2.8	2.9	3.2	10	16.7	21	24
22	0.4			2.5	2.6	2.8	2.9	3.2	10	17.5	21	24
23	0.4			2.5	2.6	2.8	3	3.2	10	17.5	21	24
24	0.4	1.4		2.5	2.6	2.8	3	3.2	10.2	17.6	21	24
25	0.4	1.4		2.5	2.6	2.8	3	3.2	10.2	17.8	21	24
26	0.4			2.5	2.7	2.8	3	3.5	10.2	17.7	21	24
27	0.5			2.5	2.7	2.8	3	3.5	11.1	18	21.1	24
28	0.6			2.5	2.7	2.8	3	3.5	11.4	18.1	21.8	24
29	0.6			2.5	---	2.8	3	3.6	11.4	18.1	21.9	24
30	0.7			2.5	---	2.8	3	3.6	11.5	18.1	21.9	24
31	0.7	---		2.5	---	2.8	---	3.6	---	18.1	22	---
Mean	0.4	1		2.5	2.6	2.8	2.9	3.2	8.1	15.1	20.1	23.5
Max	0.7	1.4		2.5	2.7	2.8	3	3.6	11.5	18.1	22	24
Min	0	0.8		2.5	2.5	2.7	2.8	3	3.7	11.8	18.1	22.1

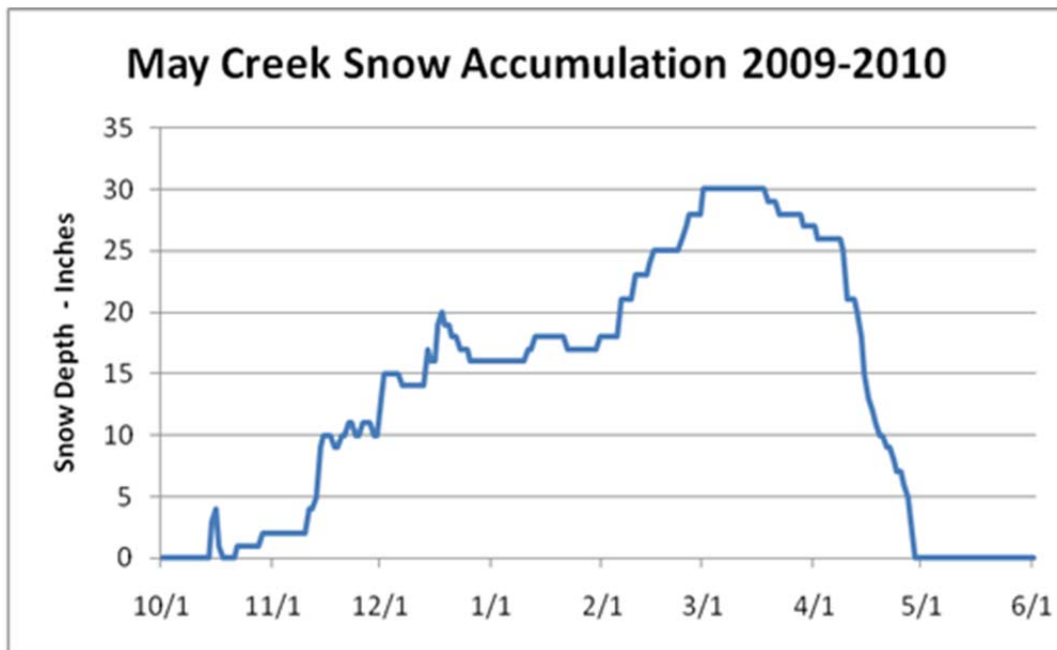
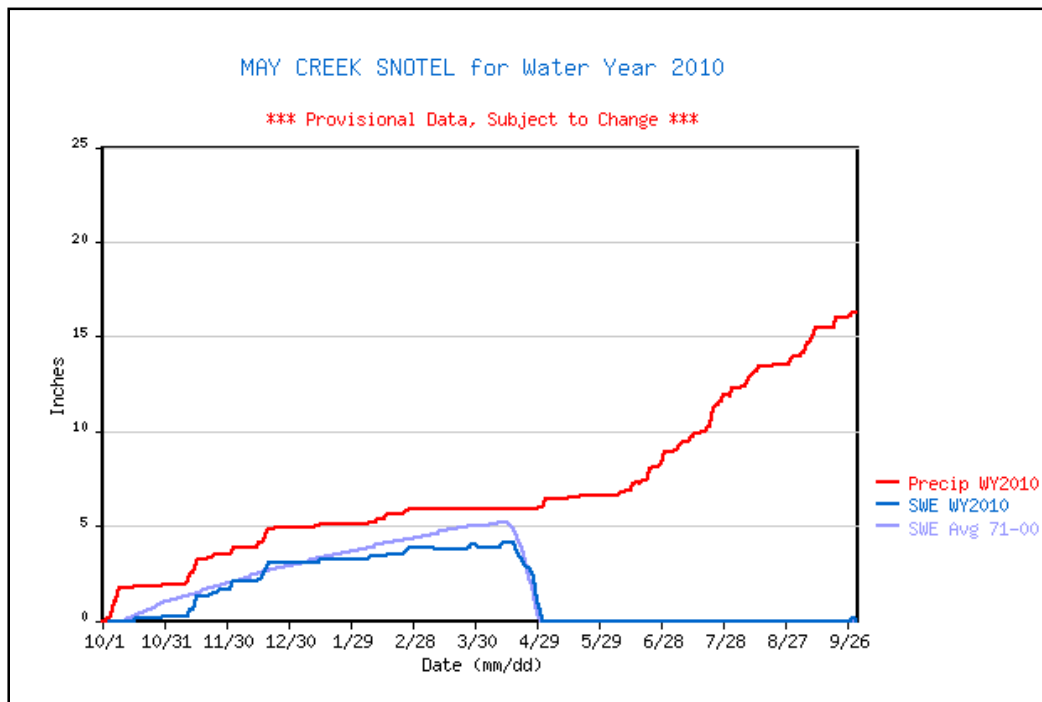
** There was a power failure in mid-November; it was fixed in mid-January. Precipitation amounts for that time were estimated.



Daily precipitation totals (inches) for Tokositna Valley for 2010 water year: Oct 1 – Sep 30

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0	3.7	5.6	7.4	8.9	10.9	12	15.8	16.6	19.2	25.3	33.5
2	0	3.7	6.6	7.4	8.9	11	12.1	15.8	16.6	19.2	25.3	33.7
3	0	3.7	7	7.4	8.9	11	12.1	15.9	16.6	19.2	25.3	33.7
4	0.4	3.7	7	7.8	8.9	11.1	12.1	15.9	16.7	19.5	25.3	33.7
5	1.4	3.7	7	8.3	8.9	11.1	12.1	15.9	16.7	19.7	25.7	34.2
6	1.4	3.8	7	8.3	9	11.1	12.1	16	16.7	19.8	25.7	34.2
7	1.4	3.9	7	8.4	9.5	11.5	12.3	16.1	16.7	19.8	25.9	34.2
8	1.7	3.9	7	8.4	9.5	11.7	12.4	16.3	16.7	19.8	25.9	35
9	2.4	3.9	7.2	8.4	9.5	11.7	12.4	16.3	17	19.8	26.1	35.5
10	2.4	3.9	7.2	8.4	9.5	11.9	12.4	16.4	17	19.8	27.2	35.5
11	2.4	3.9	7.2	8.4	9.5	11.9	12.4	16.4	17.5	20.4	28.1	35.5
12	2.6	4.3	7.2	8.4	9.6	12	13	16.4	17.5	20.4	28.4	35.5
13	2.9	4.3	7.2	8.5	9.6	12	14.4	16.4	17.7	20.4	28.8	35.5
14	2.9	4.3	7.2	8.5	9.7	12	14.9	16.6	17.7	20.5	28.8	35.5
15	2.9	4.3	7.2	8.5	9.7	12	14.9	16.6	17.7	20.6	28.9	35.5
16	2.9	4.3	7.2	8.5	9.7	12	14.9	16.6	18.3	20.7	28.9	35.6
17	3.1	4.3	7.2	8.6	9.7	12	14.9	16.6	18.4	20.6	29.9	35.6
18	3.1	4.3	7.2	8.7	9.8	12	14.9	16.6	18.4	20.5	31.1	35.6
19	3.1	4.3	7.2	8.9	10.4	12	14.9	16.6	18.5	21.1	31.3	35.6
20	3.1	4.3	7.2	8.9	10.4	12	15	16.6	18.5	21.3	31.4	39.1
21	3.2	4.3	7.4	8.9	10.5	12	15	16.6	18.5	21.7	31.4	39.1
22	3.2	4.3	7.4	8.9	10.5	12	15	16.6	18.5	21.7	31.5	39.3
23	3.2	4.6	7.4	8.9	10.6	12	15.5	16.6	18.5	21.8	31.5	39.3
24	3.2	4.6	7.4	8.9	10.7	12	15.6	16.6	18.5	22.1	31.6	39.3
25	3.2	4.6	7.4	8.9	10.8	12	15.6	16.6	18.5	23.6	31.6	39.4
26	3.2	4.7	7.4	8.9	10.8	12	15.6	16.6	18.7	24.4	31.7	39.5
27	3.2	4.9	7.4	8.9	10.8	12	15.6	16.6	18.8	25	31.7	39.5
28	3.4	5.2	7.4	8.9	10.9	12	15.6	16.6	19.1	24.9	32.5	39.6
29	3.6	5.2	7.4	8.9	---	12	15.6	16.6	19.1	25.2	33.3	39.6
30	3.6	5.2	7.4	8.9	---	12	15.7	16.6	19.2	25.3	33.2	40.2
31	3.7	---	7.4	8.9	---	12	---	16.6	---	25.3	33.5	---
Mean	2.5	4.3	7.2	8.5	9.8	11.8	14	16.4	17.8	21.4	29.3	36.6
Max	3.7	5.2	7.4	8.9	10.9	12	15.7	16.6	19.2	25.3	33.5	40.2
Min	0	3.7	5.6	7.4	8.9	10.9	12	15.8	16.6	19.2	25.3	33.5

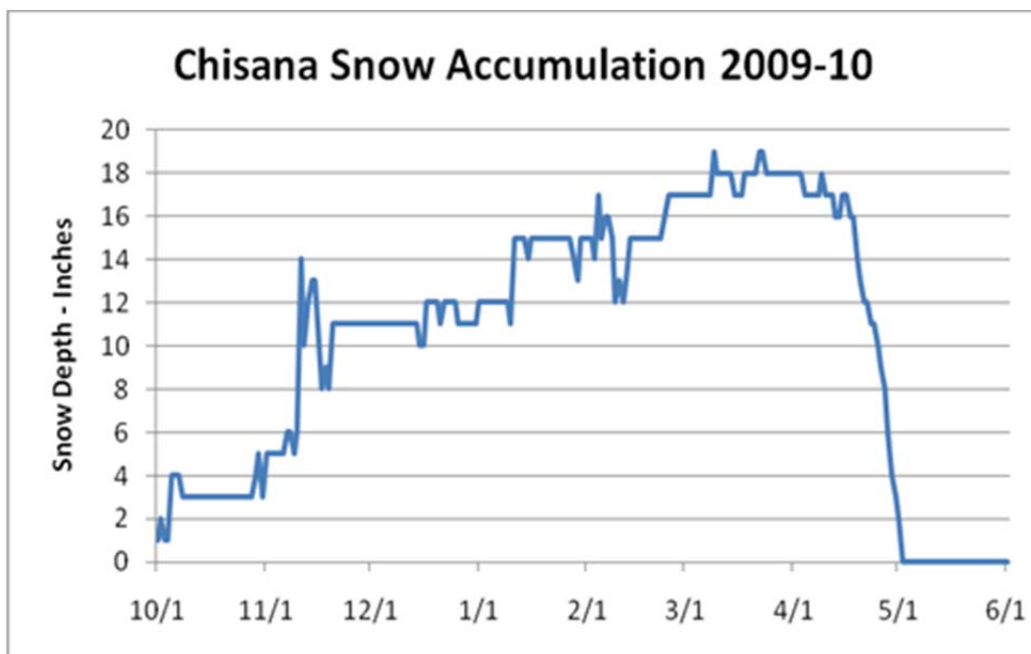
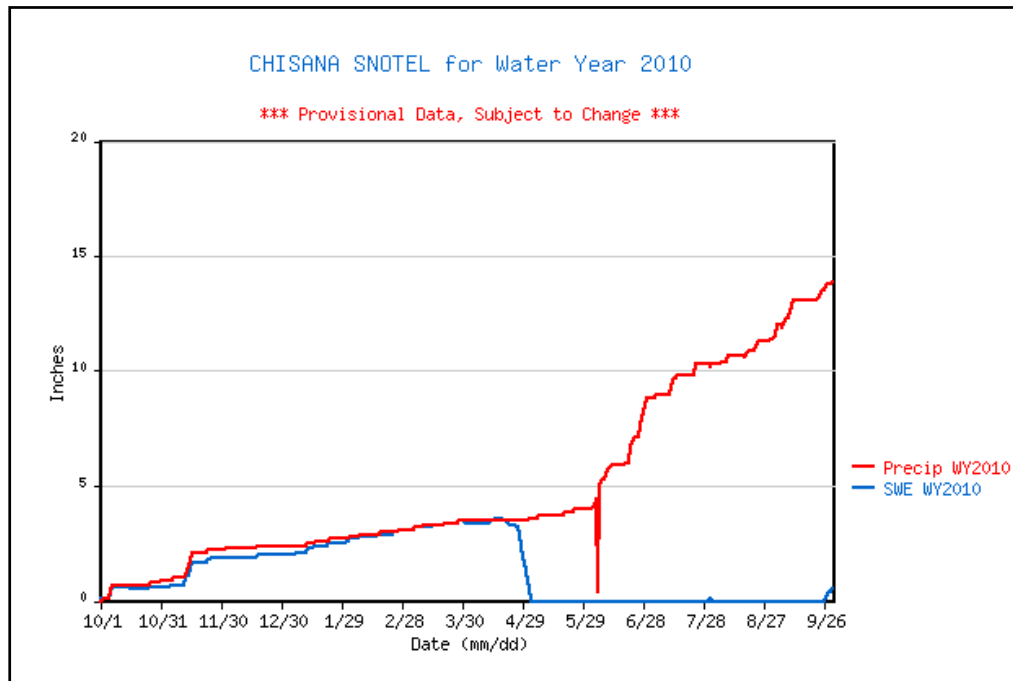
May Creek SNOTEL: Wrangell –St. Elias National Park and Preserve



Daily precipitation totals (inches) for May Creek for 2010 water year: Oct 1 – Sep 30

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0	1.9	3.5	4.9	5.1	5.9	5.9	6	6.6	8.9	12.3	14
2	0	1.9	3.6	4.9	5.1	5.9	5.9	6.1	6.6	8.9	12.3	14
3	0.1	1.9	3.9	4.9	5.1	5.9	5.9	6.4	6.6	8.9	12.3	14
4	0.1	1.9	3.9	4.9	5.1	5.9	5.9	6.4	6.6	9	12.3	14.1
5	0.2	1.9	3.9	4.9	5.1	5.9	5.9	6.4	6.6	9	12.3	14.1
6	1	1.9	3.9	4.9	5.1	5.9	5.9	6.4	6.6	9.1	12.4	14.7
7	1	1.9	3.9	4.9	5.2	5.9	5.9	6.4	6.6	9.3	12.4	14.7
8	1.5	1.9	3.9	4.9	5.2	5.9	5.9	6.4	6.8	9.4	12.5	14.8
9	1.7	1.9	3.9	4.9	5.2	5.9	5.9	6.4	6.8	9.4	12.7	14.9
10	1.7	2	3.9	4.9	5.2	5.9	5.9	6.4	6.8	9.4	12.9	15.5
11	1.7	2.1	3.9	4.9	5.4	5.9	5.9	6.4	6.9	9.4	13.1	15.5
12	1.7	2.4	3.9	5	5.4	5.9	5.9	6.4	6.9	9.7	13.2	15.5
13	1.7	2.5	3.9	5	5.4	5.9	5.9	6.4	6.9	9.7	13.2	15.5
14	1.7	2.7	3.9	5.1	5.4	5.9	5.9	6.5	7.2	9.9	13.4	15.5
15	1.7	3.1	4.1	5.1	5.5	5.9	5.9	6.5	7.2	9.9	13.4	15.5
16	1.8	3.2	4.1	5.1	5.6	5.9	5.9	6.5	7.3	9.9	13.4	15.5
17	1.8	3.2	4.1	5.1	5.6	5.9	5.9	6.5	7.2	10	13.4	15.5
18	1.8	3.2	4.4	5.1	5.6	5.9	5.9	6.5	7.3	10	13.4	15.5
19	1.8	3.2	4.7	5.1	5.6	5.9	5.9	6.5	7.4	10	13.4	15.5
20	1.8	3.2	4.8	5.1	5.6	5.9	5.9	6.6	7.4	10.2	13.4	16
21	1.8	3.3	4.8	5.1	5.6	5.9	5.9	6.6	7.5	10.2	13.5	16
22	1.8	3.3	4.8	5.1	5.6	5.9	5.9	6.6	8	10.9	13.5	16
23	1.8	3.4	4.9	5.1	5.6	5.9	5.9	6.6	8	11.1	13.5	16
24	1.8	3.5	4.9	5.1	5.7	5.9	5.9	6.6	8.1	11.3	13.5	16
25	1.8	3.5	4.9	5.1	5.8	5.9	5.9	6.6	8.1	11.4	13.5	16
26	1.8	3.5	4.9	5.1	5.9	5.9	5.9	6.6	8.1	11.6	13.5	16
27	1.8	3.5	4.9	5.1	5.9	5.9	5.9	6.6	8.2	11.6	13.5	16.1
28	1.8	3.5	4.9	5.1	5.9	5.9	5.9	6.6	8.3	11.9	13.5	16.3
29	1.8	3.5	4.9	5.1	---	5.9	5.9	6.6	8.9	11.9	13.8	16.3
30	1.9	3.5	4.9	5.1	---	5.9	6	6.6	8.9	11.9	13.9	16.3
31	1.9	---	4.9	5.1	---	5.9	---	6.6	---	11.8	14	---
Mean	1.4	2.7	4.3	5	5.4	5.9	5.9	6.5	7.3	10.2	13.1	15.4
Max	1.9	3.5	4.9	5.1	5.9	5.9	6	6.6	8.9	11.9	14	16.3
Min	0	1.9	3.5	4.9	5.1	5.9	5.9	6	6.6	8.9	12.3	14

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

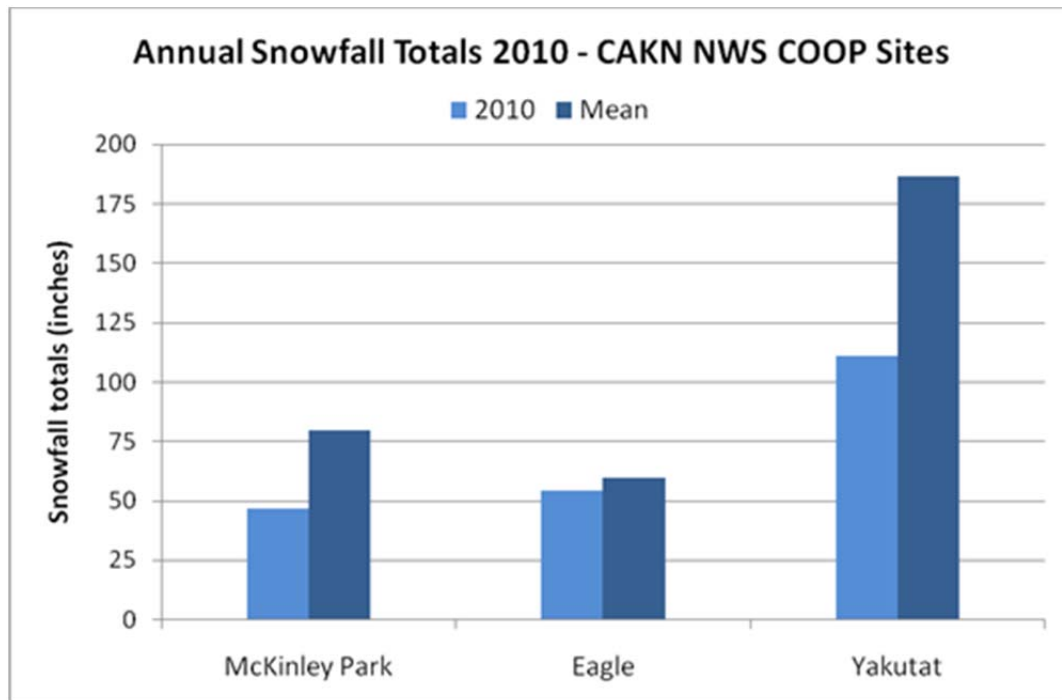


Daily precipitation totals (inches) for Chisana for 2010 water year: Oct 1 – Sep 30

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0	0.9	2.2	2.4	2.7	3.1	3.5	3.5	4	8.8	10.3	11.5
2	0.1	0.9	2.3	2.4	2.8	3.1	3.5	3.6	4	8.8	10.3	12
3	0.1	0.9	2.3	2.4	2.8	3.1	3.5	3.6	4.1	8.8	10.3	12
4	0.1	0.9	2.3	2.4	2.8	3.1	3.5	3.6	4.4	9	10.3	12
5	0.1	0.9	2.3	2.4	2.8	3.1	3.5	3.6	0.4	9	10.3	11.9
6	0.7	1	2.3	2.4	2.8	3.2	3.5	3.6	5	9	10.4	12.2
7	0.7	1	2.3	2.4	2.9	3.2	3.5	3.7	5.2	9	10.4	12.3
8	0.7	1	2.3	2.4	2.9	3.2	3.5	3.7	5.3	9	10.4	12.3
9	0.7	1	2.3	2.4	2.9	3.2	3.5	3.7	5.5	9	10.7	12.6
10	0.7	1	2.3	2.4	2.9	3.3	3.5	3.7	5.7	9	10.7	13.1
11	0.7	1	2.3	2.4	2.9	3.3	3.5	3.7	5.8	9	10.7	13.1
12	0.7	1.1	2.3	2.5	2.9	3.3	3.5	3.7	5.9	9.6	10.7	13.1
13	0.7	1.5	2.3	2.5	2.9	3.3	3.5	3.7	5.9	9.7	10.7	13.1
14	0.7	1.7	2.3	2.5	2.9	3.3	3.5	3.7	5.9	9.7	10.7	13.1
15	0.7	2.1	2.3	2.5	2.9	3.3	3.5	3.7	5.9	9.8	10.7	13.1
16	0.7	2.1	2.3	2.6	2.9	3.3	3.5	3.7	5.9	9.8	10.7	13.1
17	0.7	2.1	2.3	2.6	3	3.3	3.5	3.7	5.9	9.8	10.6	13.1
18	0.7	2.1	2.4	2.6	3	3.3	3.5	3.7	5.9	9.8	10.7	13.1
19	0.7	2.1	2.4	2.6	3	3.3	3.5	3.7	6	9.8	10.8	13.1
20	0.7	2.1	2.4	2.6	3	3.3	3.5	3.9	6	9.8	10.9	13.1
21	0.7	2.1	2.4	2.6	3	3.4	3.5	3.9	6.7	9.8	10.9	13.1
22	0.7	2.1	2.4	2.6	3	3.4	3.5	3.9	6.9	9.8	10.9	13.1
23	0.7	2.2	2.4	2.7	3	3.4	3.5	3.9	7	9.8	11	13.2
24	0.7	2.2	2.4	2.7	3	3.4	3.5	3.9	7.1	10.3	11.3	13.4
25	0.7	2.2	2.4	2.7	3	3.4	3.5	4	7.1	10.3	11.3	13.5
26	0.8	2.2	2.4	2.7	3.1	3.4	3.5	4	7.6	10.3	11.3	13.5
27	0.8	2.2	2.4	2.7	3.1	3.4	3.5	4	7.9	10.3	11.3	13.8
28	0.8	2.2	2.4	2.7	3.1	3.5	3.5	4	8.2	10.3	11.3	13.8
29	0.8	2.2	2.4	2.7	---	3.5	3.5	4	8.8	10.3	11.3	13.8
30	0.8	2.2	2.4	2.7	---	3.5	3.5	4	8.8	10.3	11.4	13.9
31	0.9	---	2.4	2.7	---	3.5	---	4	---	10.2	11.4	---
Mean	0.6	1.6	2.3	2.5	2.9	3.3	3.5	3.8	6	9.6	10.8	12.9
Max	0.9	2.2	2.4	2.7	3.1	3.5	3.5	4	8.8	10.3	11.4	13.9
Min	0	0.9	2.2	2.4	2.7	3.1	3.5	3.5	0.4	8.8	10.3	11.5

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>.



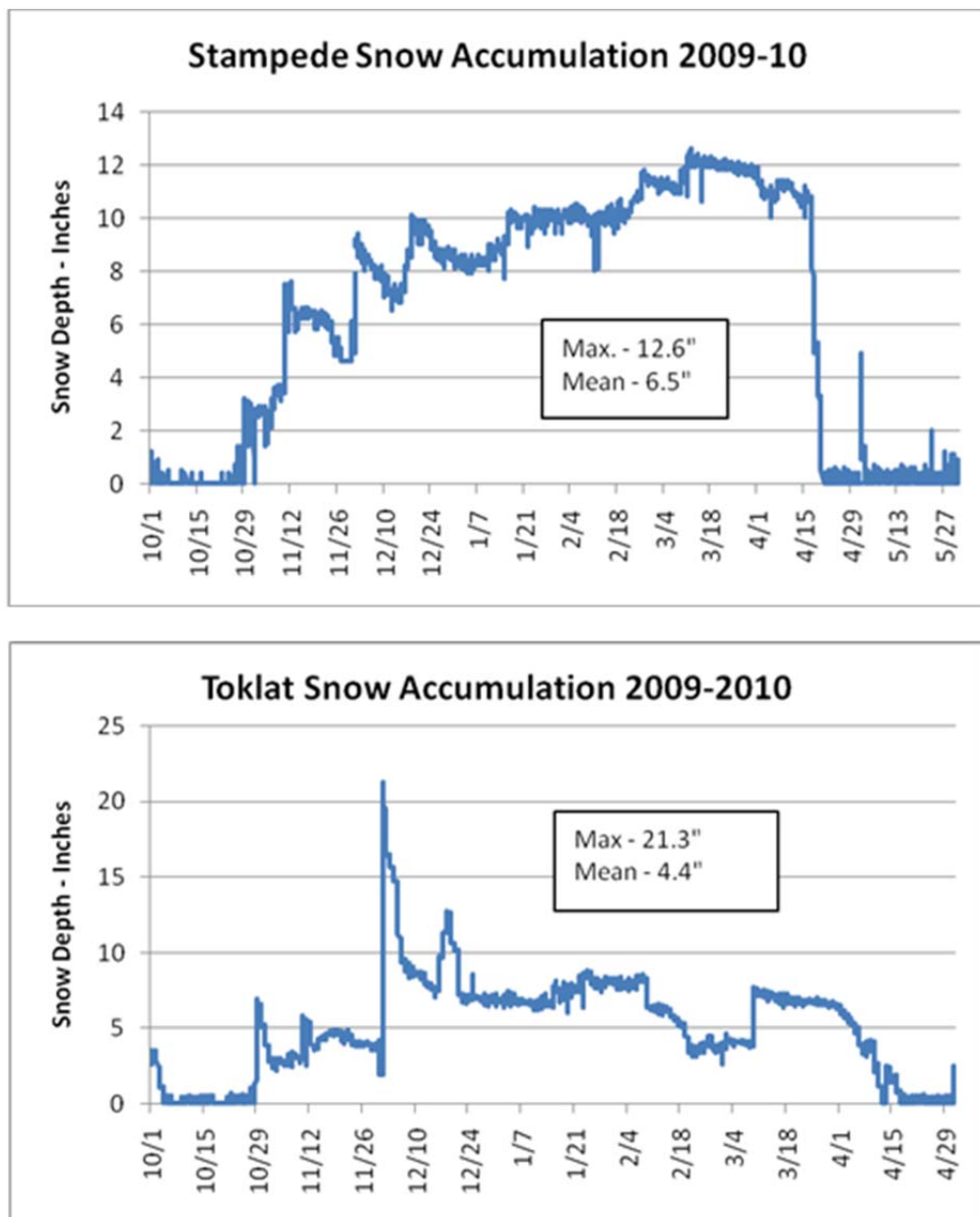
NWS COOP sites with monthly snowfall measurements

Site (# of years)	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
McKinley Park (78)													
2009-10	0	0	4.7	2.7	9.3	10.6	6	2.9	7.6	3.2	0	0	47.0
MEAN	0.0	0.0	3.4	12.8	12.7	12.6	11.7	9.9	7.8	5.9	2.7	0.2	79.9
Eagle (29)													
2009-10	0	0	0	4	13	10.5	11	8.5	3.5	4	0	0	54.5
MEAN	0.0	0.0	0.9	9.7	10.6	11.3	7.7	6.9	5.3	3.1	0.8	0.0	60.0
Yakutat (49)													
2009-10	0	0	0	0	31.7	16.0	21.2	5.2	33.0	3.8	0	0	110.9
MEAN	0.0	0.0	0.0	4.9	20.9	36.1	35.4	35.4	36.9	15.3	1.0	0.0	186.6

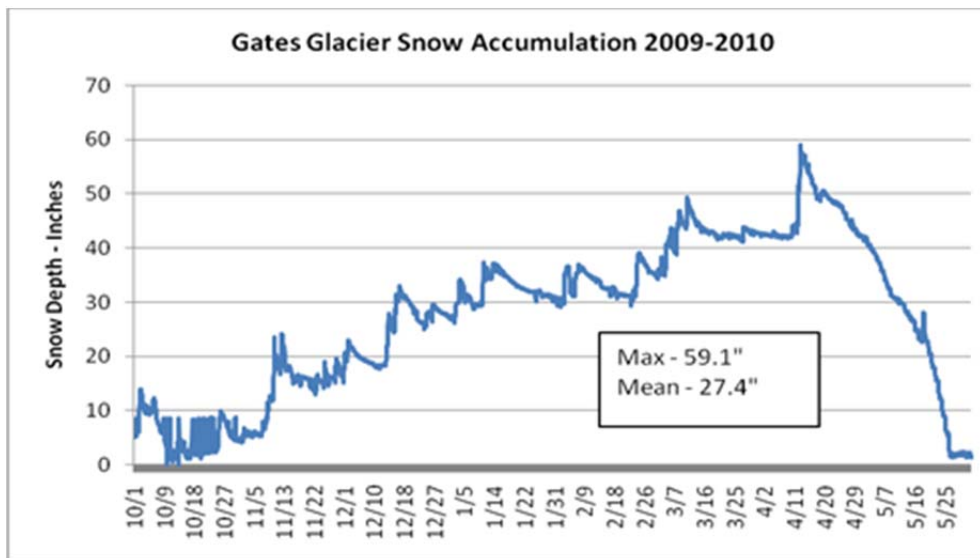
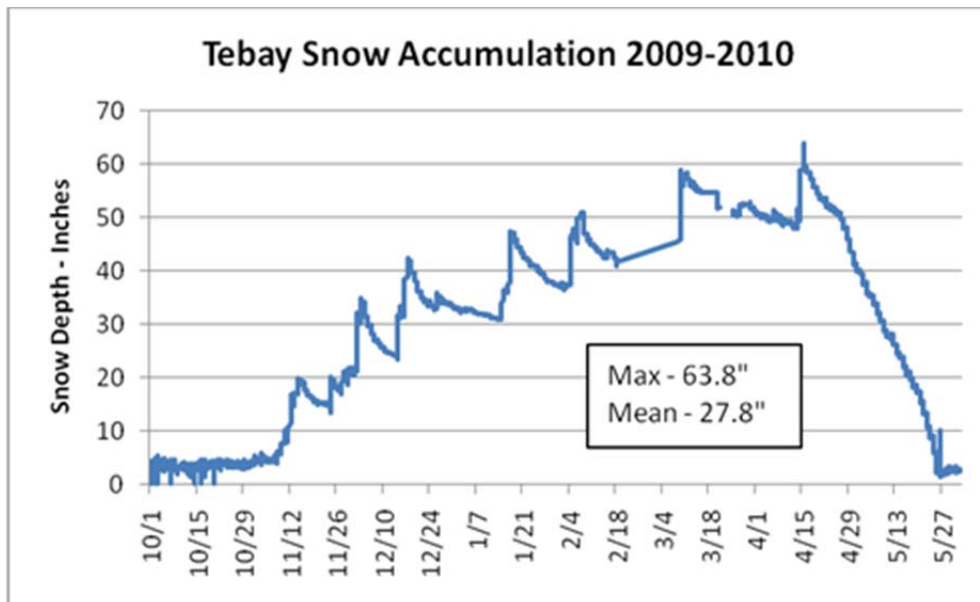
Appendix D. Cumulative snow depths at CAKN climate stations

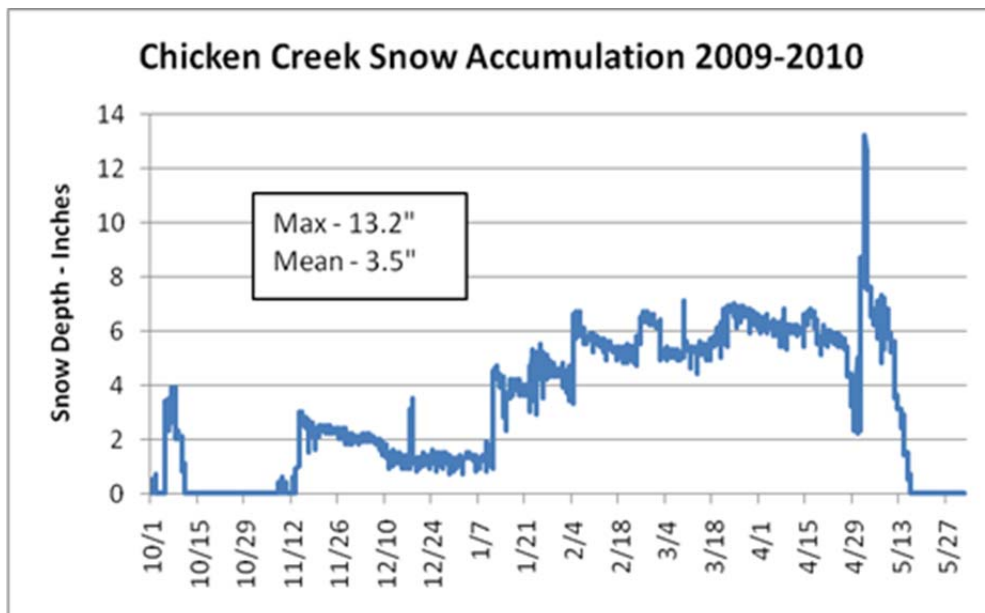
These data and additional graphs are available at <http://www.wrcc.dri.edu/NPS.html>.

Denali

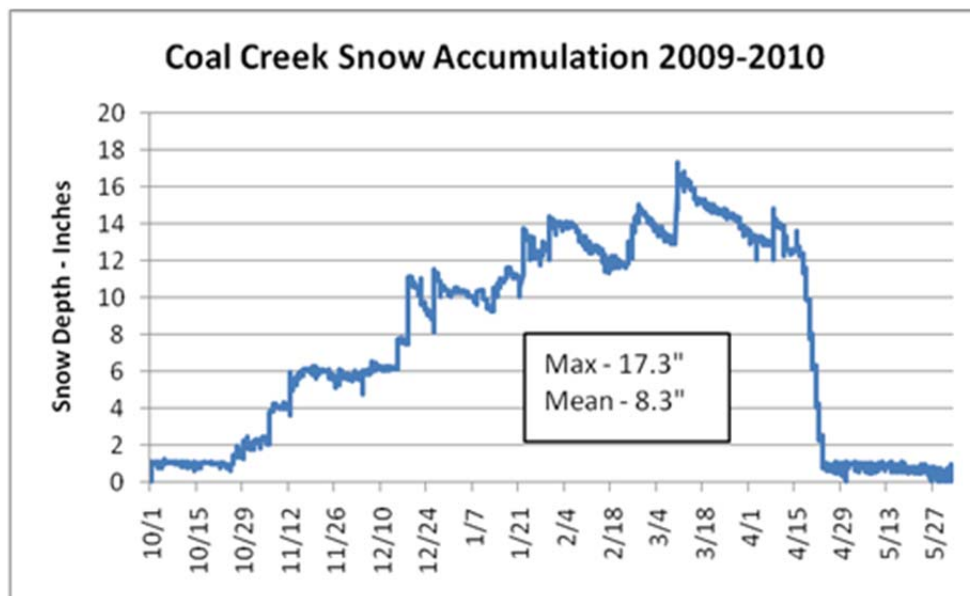


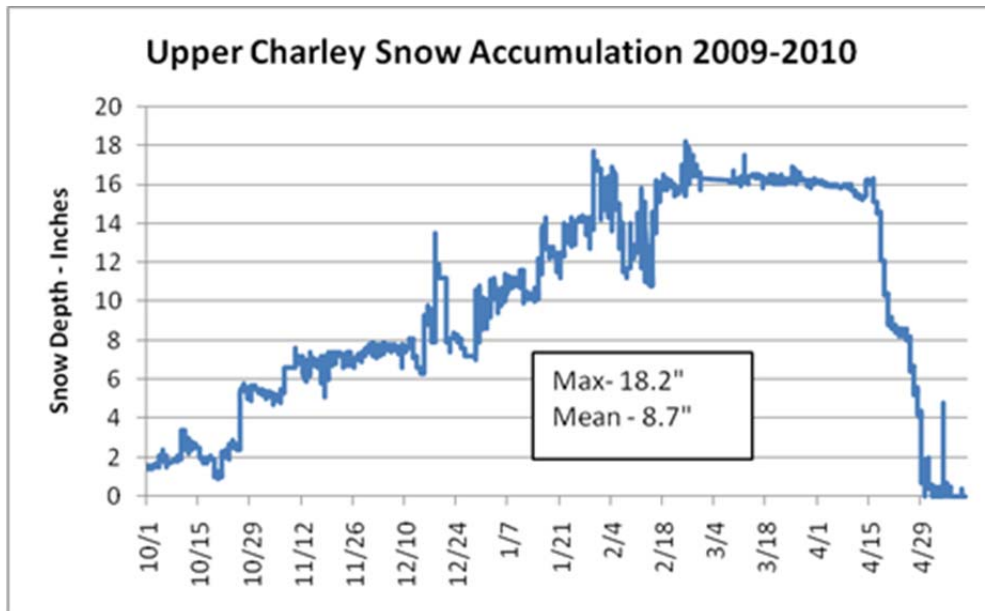
Wrangell – St. Elias





Yukon-Charley Rivers

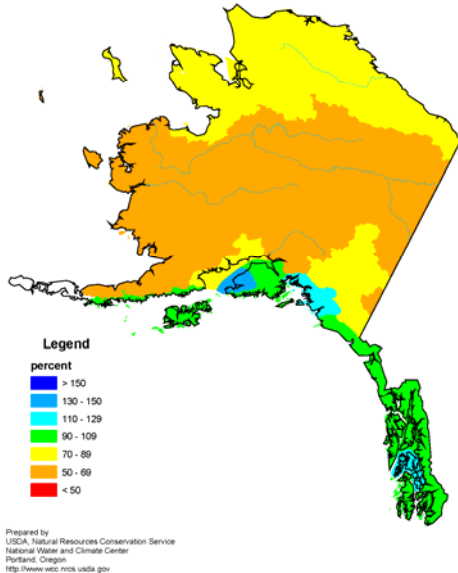




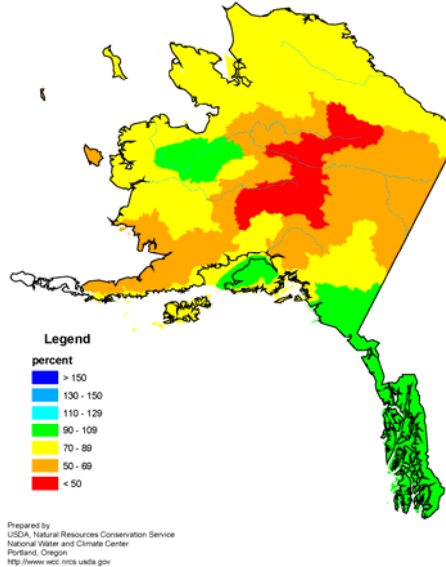
Appendix E. Statewide snowpack maps for 2009 -2010

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

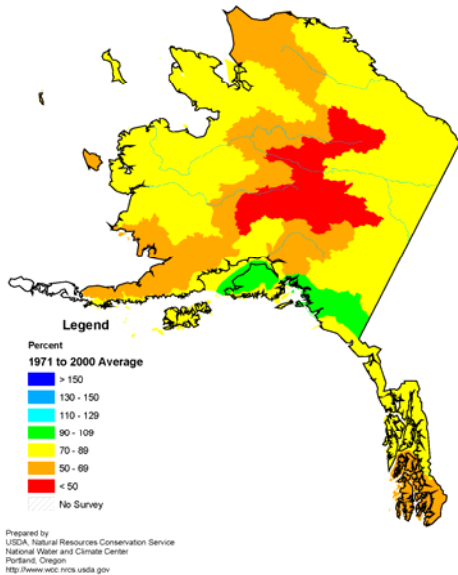
**Alaska Snowpack
as of January 1, 2010**



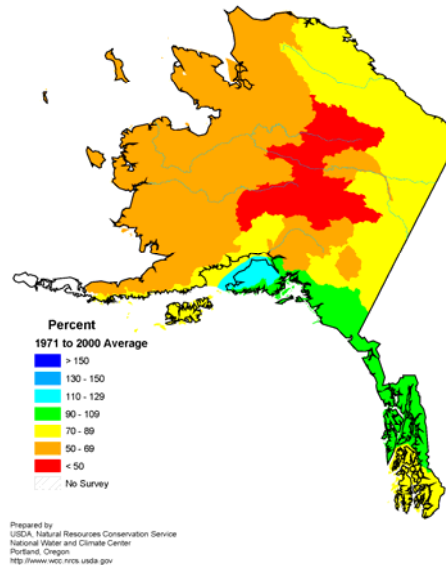
**Alaska Snowpack
as of February 1, 2010**



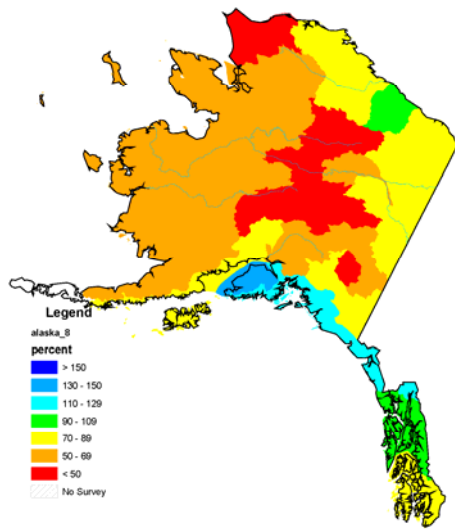
**Alaska Snowpack
as of March 1, 2010**



**Alaska Snowpack
as of April 1, 2010**



**Alaska Snowpack
as of May 1, 2010**



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