



Annual Climate Summary 2013

Central Alaska Network

Natural Resource Report NPS/CAKN/NRR—2015/1014



ON THE COVER

Photograph of glaciers in the Wrangell Mountains in Wrangell – St. Elias National Park and Preserve.
Photograph courtesy of Ken Hill/National Park Service

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Executive Summary

The Central Alaska Network's climate monitoring program has established seventeen remote weather stations to monitor climate in Denali National Park and Preserve, Wrangell -St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve. The main goal of the program is to operate these remote sites for the long-term in order to help scientists and park managers understand the climate patterns across these large parks. There are five other weather and climate stations around the parks operated by various state and federal agencies that are used as index sites to compare current climate conditions in the region to the climatological normal - the average weather conditions over a 30-year period. The current normal period is 1981-2010. This report summarizes the annual and monthly temperature and precipitation deviations for the index sites and compiles monthly and annual statistics for the sites with shorter records, including five additional fire weather stations located within park boundaries. A brief synopsis of regional, national, and global climate conditions for 2013 is included for climatic context.

The variability in the temperature and precipitation patterns across the Central Alaska region in 2013 was striking. The mean annual temperature at the index sites averaged an unremarkable +0.4°F warmer than the 1981-2010 normal, but there was impressive variability between months and seasons. The mean annual temperatures at Talkeetna, McKinley Park, and Eagle were at or near normal, while Gulkana was 1.4°F warmer than normal and Yakutat was 0.5°F warmer than normal for the year. The combined annual precipitation totals averaged ~3.4 inches above normal for the interior sites (which excludes Yakutat), with the largest deviation in Talkeetna with 9.3 inches more than normal for the year (133% of normal). McKinley Park was just about average at 98% of normal, while Yakutat was drier with annual precipitation at 88% of normal. The average annual temperatures and total annual precipitation values do not do justice to the extreme variability in month to month or season to season weather statistics for 2013.

The mean annual temperature for Alaska was 1.7°F warmer than normal and the precipitation totals were 125% of normal. Nationally temperatures were 0.3°F above the 20th century average making it the 37th warmest year on record, while globally 2013 was tied with 2003 as the fourth warmest year on record since records began in 1880.

Between May and September of 2013, the Central Alaska Network staff performed annual site maintenance at the thirteen weather stations in the three parks and assisted the Natural Resources Conservation Service with maintenance of the four snow telemetry sites in the network. The Wigand weather station was re-established on the north side of Denali in August 2013 driven by interest in permafrost dynamics and fire intensity in the area. This site has a 20 foot wind mast for calculating fire weather indices and is surrounded by an electric fence to protect it from wildlife.

Introduction

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 of the parks and to provide that information back to park managers for use in stewardship of park resources. Climate is considered to be the most important broad-scale factor influencing ecosystems and therefore the natural resources of parks. Because global climate models indicate that climate change and variability will be greatest at high latitudes, climate monitoring is critical to understanding the changing conditions of park ecosystems.

There are five National Weather Service (NWS) stations in the CAKN region that have been in operation for many decades that are used as index sites to place the current year regional weather conditions into climatological context. Monthly and annual statistics are compared to the latest climate normal period (1981-2010).

The CAKN parks represent a large portion of the mountainous environment of the state of Alaska and therefore provide an opportunity to understand climate gradients that have been, in the past, a challenge to instrument and monitor. The CAKN climate monitoring program deployed twelve climate stations between 2003 and 2005, mostly at higher elevations, to capture elevational and latitudinal climate gradients within the parks, and to capture data in areas where there were no baseline references. These sites are referred to as CAKN RAWS (remote automated weather stations). For detailed information on station locations, station design, and maintenance schedules see the CAKN climate monitoring protocols (Sousanes, 2006). There are nine additional sites that are analyzed in this report including four SNOTEL sites and five fire RAWS. The SNOTEL sites were installed in the CAKN parks to get year-round precipitation measurements from representative locations. These sites are operated and maintained under an interagency agreement between the NPS and the Natural Resources Conservation Service (NRCS). The five fire RAWS are located within the park boundaries and are part of a much larger national fire program and are maintained under contract with the National Interagency Fire Center. Monthly weather statistics are generated for the 22 CAKN RAWS, fire RAWS, and SNOTEL sites, however long-term trends will take time to develop.

The 2013 field season marked the sixth year of operational climate monitoring in CAKN parks. Annual maintenance was performed at 16 climate stations. Maintenance at the climate sites included sensor replacement, troubleshooting, upgrades, data downloads, and sensor calibrations. Station maintenance logs were used to keep track of the climate station inventory for the stations, which includes: sensors, data loggers, towers, solar panels, and batteries. Sensor and power performance was tracked and instrumentation was replaced as necessary. A station was re-established at Wigand Creek in Denali. The site had been removed in 2008 when the project it was supporting was completed. It is an area of particular interest for permafrost monitoring and fire managers. The McKinley River fire RAWS was also serviced this field season; maintenance for this site and all other NPS fire RAWS is usually done by the NPS radio shop. A maintenance report is completed

after each field season to document the details of the site visits – these reports include the field notes, photos, logistics, and sensor metadata (Hill and Sousanes, 2014).

This is the ninth in a series of annual data reports that summarize the annual and monthly weather statistics of the most recent year for the Central Alaska Network Climate Monitoring Program.

Central Alaska Network Climate Overview

The Central Alaska Network (CAKN) encompasses strong climate gradients, from the maritime climates in the southern parts of Wrangell – St. Elias National Park and Preserve (WRST) where it borders the North Pacific Ocean, to the strongly continental climates found in northern parts of Denali National Park and Preserve (DENA) and Yukon –Charley Rivers National Preserve (YUCH). A transitional climate region lies between the coast and the interior influenced by major mountain ranges which act not only as the environmental controls to drive climate but also contribute to the highly localized micro climates found in complex mountain terrain. The climate gradients are intrinsic to the ecosystem patterns, and vegetative and faunal communities found in CAKN parks. Redmond and Simeral (2006) provide a more detailed discussion of the climate of the Central Alaska Network.

The climate patterns of Alaska are primarily influenced by latitude, continentality, and elevation. The high latitude drives the seasonal pendulum of available solar radiation; areas farther north have limited incoming solar warmth in the winter and an abundance of available light in the summer. Major mountain ranges in the state act as barriers to the moisture spinning off of the Pacific Ocean to the south. The warm, moist air masses deposit precipitation on the windward sides of the mountains – rain at low elevations and snow at higher elevations. Large scale atmospheric and oceanic circulation patterns influence seasonal and annual weather patterns in the state, like the repositioning of the polar jet stream and the Aleutian low pressure system or the frequency of La Ninas and El Ninos (Papineau, 2001). Each of these can affect the regional patterns of storm tracks, prevailing winds, snowfall amounts, and the extent of sea ice (ACIA, 2004).

There are several large-scale climate patterns and indices that are of particular interest to Alaska, including the Pacific Decadal Oscillation (PDO) which is an index of sea surface temperatures in the North Pacific Ocean. Typical winter sea surface temperatures during the warm phase of the PDO are warmer off of the Gulf Coast of Alaska moderating air temperatures over Alaska (Hartmann and Wendler, 2005; Keen, 2013). The PDO seems to cycle through a warm and cool phase every 20 -30 years. Temperature trends that have shown climatic warming tend to be strongly biased by a sudden shift in 1976 from the cooler regime to a warmer regime. Since 2005 the index had been predominantly negative and air temperatures have been near or below normal – a possible indication of a phase shift from positive to negative. However, there appears to be more variation in the past few years. Large scale changes such as this may take a few decades to confirm.

While the north Pacific seems to explain some of the temperature trends in the region, the Arctic Ocean, and in particular the extent of sea ice will likely influence both temperature and precipitation patterns in Alaska. In recent years there has been a continued significant reduction in the extent of the summer sea ice cover and the decrease in the amount of relatively older, thicker ice (NSIDC,

2012). Models predict that retreating sea ice will affect the temperature and ecosystems of adjacent lands. An increase in the amount of energy absorbed by vegetation and its transfer to the atmosphere, will contribute to the further high-latitude amplification of climate warming (Chapin et al., 2005).

Methods

Data were compiled from the index sites; the five long-term climate stations with the most complete records nearest the three CAKN parks that represent the major climate regimes in the network (Table 1). These stations have records for a sufficient number of years to compare 2013 data with the latest normal period, 1981-2010. Temperature, precipitation, and snowfall were analyzed for the long-term sites. Monthly temperature means and precipitation totals for 2013 are compiled and compared with the 1981-2010 normal values for each site.

We found a discrepancy in the datasets used for the Eagle normal calculations. The 1981-2010 published normals are based on a newer airport site (Eagle Airport 26422; 1978-present) and not the long-term site we have been using as an index site for YUCH (Eagle COOP 502607; intermittent 1901-present). Instead of using the published normals, we calculated the averages for that time period for the long-term site and used that as our average baseline value (in the tables these are listed as ‘averages’ and not ‘normals’). The National Climate Data Center was notified of the discrepancy.

Data were also compiled from thirteen CAKN RAWS in the three parks and five additional fire RAWS in the parks (Figure 1; Table 2 and 3). During the annual site visits data were downloaded from each climate station and checked for quality. Errors or values outside a standard range were flagged and not used in the summary statistics. The quality checked data files were sent to the Western Regional Climate Center in October 2013 for archival purposes; there has been a lag between when these files are sent and when they get updated. A report on data quality is kept on file for each site. Monthly and annual means and totals were compiled for the climate variables measured at each location including, temperature, wind speed and direction, peak wind gust, relative humidity, solar radiation, soil temperatures, snow depth, and summer rainfall. Five snow telemetry (SNOTEL) sites were also analyzed for year-round precipitation and snowfall amounts at locations in and around the CAKN parks (Table 4).

Most of the summaries, analyses, charts, and graphs included in this report from the National Oceanic and Atmospheric Administration (NOAA) and from the Natural Resources Conservation Service (NRCS) are in standard units; for consistency all data are presented in standard units.

Table 1. Long-term index sites.

<i>Name</i>	<i>Lat</i>	<i>Long</i>	<i>Elev. (ft)</i>	<i>Network</i>	<i>Start of Record</i>	<i>End</i>	<i>Park</i>
Eagle	64.767	-141.200	850	COOP	1901*	Present	YUCH
McKinley Park	63.720	-148.966	2060	COOP	1925	Present	DENA
Talkeetna	62.180	-150.060	350	COOP	1919	Present	DENA
Gulkana	62.150	-145.450	1580	SAO	1909**	Present	WRST
Yakutat	59.500	-139.670	30	SAO	1918	Present	WRST

* Inermittent data from 1901-1918; good record 1918-1933; intermittent 1933-1947; goo 1947-present
 **Intermittent data 1909-1943; 1943-present good record.

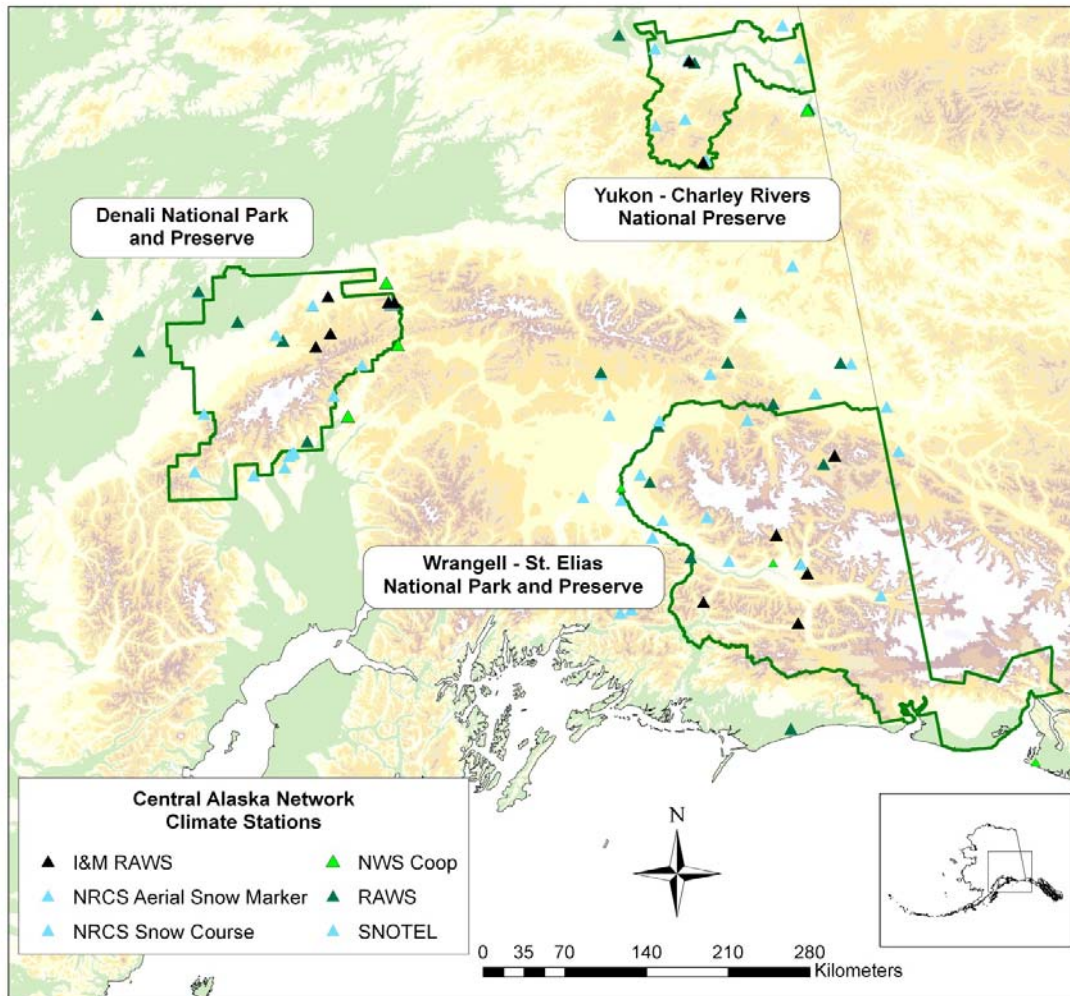


Figure 1. Map of CAKN climate station locations.

Table 2. CAKN RAWS sites.

<i>Name</i>	<i>Lat</i>	<i>Long</i>	<i>Elev (ft)</i>	<i>Network</i>	<i>Start</i>	<i>End</i>	<i>Park</i>
Dunkle Hills	63.2670	-149.5415	2651	CAKN RAWS	2003	Present	DENA
Eielson Visitor Center	63.4307	-150.3102	3730	CAKN RAWS	2005	Present	DENA
Ruth Glacier	62.7099	-150.5398	3301	CAKN RAWS	2008	Present	DENA
Stampede	63.7478	-150.3281	1800	CAKN RAWS	2003	Present	DENA
Toklat	63.5255	-150.0465	2920	CAKN RAWS	2005	Present	DENA
Wigand	63.8142	-150.1094	1717	CAKN RAWS	2013	Present	DENA
Coal Creek	65.3041	-143.1570	820	CAKN RAWS	2004	Present	YUCH
Upper Charley	64.5169	-143.2023	3654	CAKN RAWS	2005	Present	YUCH
Chicken Creek	62.1240	-141.8473	5260	CAKN RAWS	2004	Present	WRST
Chititu	61.2735	-142.6209	4554	CAKN RAWS	2004	Present	WRST
Gates Glacier	61.6029	-143.0132	4060	CAKN RAWS	2005	Present	WRST
Tebay	61.1810	-144.3392	1880	CAKN RAWS	2005	Present	WRST
Tana Knob	60.9080	-142.9013	3739	CAKN RAWS	2005	Present	WRST

Table 3. Fire RAWS.

<i>Name</i>	<i>Lat</i>	<i>Long</i>	<i>Elev. (ft)</i>	<i>Network</i>	<i>Start</i>	<i>End</i>	<i>Park</i>
Denali Visitor Center	63.7333	-148.9006	1670	RAWS	2007	Present	DENA
McKinley River	63.6487	-151.6421	840	RAWS	1992	Present	DENA
Wonder Lake	63.4900	-150.8800	2119	RAWS	1995	Present	DENA

Table 4. CAKN SNOTEL sites.

<i>Name</i>	<i>Lat</i>	<i>Long</i>	<i>Elev. (ft)</i>	<i>Network</i>	<i>Start</i>	<i>End</i>	<i>Park</i>
Kantishna	63.53845	-150.98365	1670	SNOTEL	2005	Present	DENA
Tokositna Valley	62.62942	-150.77578	850	SNOTEL	2006	Present	DENA
Chisana	62.07194	-142.06528	3320	SNOTEL	2007	Present	WRST
May Creek	61.34833	-142.69417	1650	SNOTEL	2008	Present	WRST

Results

Climate Year 2013 Synopsis

There was great variability in temperature and precipitation patterns across the CAKN region in 2013. The mean annual temperature at the CAKN index sites averaged +0.4° F warmer than the 1981-2010 normal, with impressive differences between months and between seasons. The mean annual temperature at Talkeetna, McKinley Park, and Eagle were at or near normal, while Gulkana was 1.4°F warmer than normal and Yakutat was 0.5°F warmer than normal for the year. Annual precipitation totals across the CAKN region varied from 88% of normal in Yakutat to 133% of normal at Talkeetna. Denali was near average for the year at 97% of normal. Eagle's annual precipitation was 120% of normal and Gulkana was 122% of normal. Figure 2 shows the combined monthly temperature and precipitation departures from normal for the index sites for 2013.

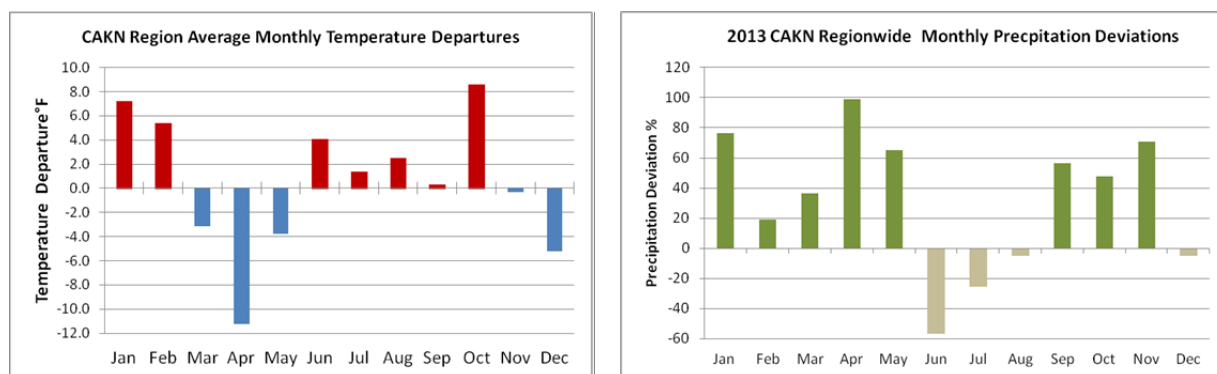


Figure 2. Average monthly temperature departures (left) and monthly precipitation deviations (right) for the five index sites around CAKN.

Temperatures were variable across the network from month to month, but the negative temperature departure in April and the positive temperature departure in October stand out. The winter started out with above normal temperatures in January and February and transitioned to cooler temperatures in March that persisted through the end of May, making it one of coldest spring seasons on record. During the last week of May the temperatures climbed into the 80s across much of Alaska, ushering in a warm June; break-up was instantaneous and caused some major issues with ice jams and flooding on the Yukon River (Figure 4). The summer was warm with temperatures above average in most locations. The transition to fall was cool at first, but by October the entire state was experiencing above normal temperatures. It was the warmest October on record for Eagle, Gulkana, Nabesna, and the third warmest on record at Denali. Temperatures cooled to near normal in November and were cooler than normal in December of 2013.

January was a particularly wet month for much of the region with monthly totals that were well above normal. April snowfall was impressive for the northern interior with precipitation values that range from 200 -350% of normal. Spring transitioned into a very dry summer across the network. Every index site was drier than normal in June. In Gulkana, June 2013 tied 2004 for the driest on record with only 19% of normal precipitation. Dry conditions persisted into July at most sites, except

for Eagle which was just above normal. In August, all sites were near normal. It was a wet autumn in the interior, with rain starting in September and carrying through October. Temperatures remained above freezing throughout the region and October precipitation fell as rain. The date of the first persistent snow was 2-3 weeks later than normal with the first persistent snows arriving in November. Snowfall totals were above normal across the CAKN region for November. December was snowy in the eastern portion of the network (Eagle and Gulkana) and below normal in Denali.

The 2012-2013 snow season was late to start, but ended up near or above normal because of the spring snowfall totals. In Eagle, The 2012-2013 seasonal snowfall by May 31 was 83.1 inches, which is 134% of normal. The snow-off date, which is the last day of where there is measureable snow on the ground, was May 22. In Denali snowpack melt-out date was May 25th, one day short of the latest melt-out date on record of May 26, 1964. The seasonal snowfall total was 79.9 inches, just above the 1981-2010 normal. 2013 tied with 1992 as the second latest melt-out date at park headquarters. Snow is not recorded in Gulkana, but the nearby Kenny Lake snow course typically melts out by May 1st, but still had 15 inches of snow in 2013 with 3.0 inches of water content, the highest May 1 reading since 1992.

Alaska Statewide Synopsis

According to National Climatic Data Center's (NCDC) State of the Climate Report for 2013, the average annual temperature for Alaska was 1.8°F above the 1971-2000 average and marked the 10th warmest year in the 95-year period of record for the state (Figure 3). The average annual temperature deviations for the first order stations in Alaska are shown in Figure 3. Based on the mean monthly temperature departures from normal, the warmest months of 2013, in decreasing order, were October (+7.4°F), January (+5.6°F), and June (+3.3°F), while April was the coldest month with a mean monthly temperature deviation of -6.9°F (Figure 4).

Precipitation statewide was 25.1% above average and ranked as the third wettest year on record, 1929 and 1963 were wetter (Figure 5). Spring precipitation statewide was 117% of normal; summer precipitation was near average, and the fall season precipitation totals statewide were 143% of average. It was the third wettest October on record. September was particularly wet and ranked as the 5th wettest September on record. December precipitation was 151% of normal for the state (NOAA 2014) (Figure 6). Note that the NCDC uses 1971-2000 as the normal base period for Alaska statistics. The snowpack continued to grow throughout the spring especially in the eastern interior and southern areas of the state, while the northwest region had below normal snowpack (Figure 7). Appendix B highlights Alaska weather extremes.

Climate Teleconnections

The El Nino Southern Oscillation index was in a neutral state during all of 2013. The Pacific Decadal Oscillation, an index of sea surface temperatures in the north Pacific was negative for all of 2013 indicating colder than normal sea surface temperatures off of Alaska's coast (NOAA, 2013b) (Figures 8 and 9). The Arctic Sea Ice extent in September 2013 was greater than it has been in the last few years, but still below the 1981-2010 average (NSIDC 2014) (Figure 10).

Wildfire Activity

According to the Alaska Interagency Coordination Center (AICC), the hot dry conditions of 2013 were similar to the summer of 2004 when 6.4 million acres burned across the state, but the lack of lightning in the interior in 2013 kept natural fire starts to a minimum. Statewide there were a total of 613 wild land fires in 2013, with a total of 1,316,289 acres burned. 211 of the 613 were lightning caused fires. The total area burned in the CAKN parks was 153,472 acres – 118,117 acres in Denali, 35,356 acres in Wrangell-St. Elias, and 0 acres in Yukon-Charley this year (AICC, 2014).

National and Global Synopsis

Based on data from January through December, the average annual temperature for the contiguous U.S. for 2013 was 52.4°F, 0.3°F above the 20th century average. It was the 37th warmest year over the 199 year record (tied with 1980) (NOAA, 2014c). 2013 was 2.9°F cooler than 2012 the warmest year on record for the lower 48 states. The temperature trend for the lower 48 states is + 0.13 °F per decade since records began in 1895. The average precipitation total for the lower 48 states in 2013 was 31.17 inches, 2.03 inches above average, making it the 21st wettest year on record. The precipitation trend for the contiguous U.S. has increased by about 0.17 inches per decade over the past 119 years.

Globally, the year 2013 ties with 2003 as the fourth warmest year globally since records began in 1880. Over land and ocean combined, 2013 was 1.1°F above the 20th century average of 57.0°F. Including data from 2013, the Earth is warming at a rate of 0.11°F per decade since 1880. Currently the warmest year on record is 2010; 9 out of 10 of the warmest years on record have occurred since the start of the 21st century. Precipitation, globally, was near average, but varied from region to region (NOAA, 2014c). See Appendix C for more information on national and global climate anomalies.

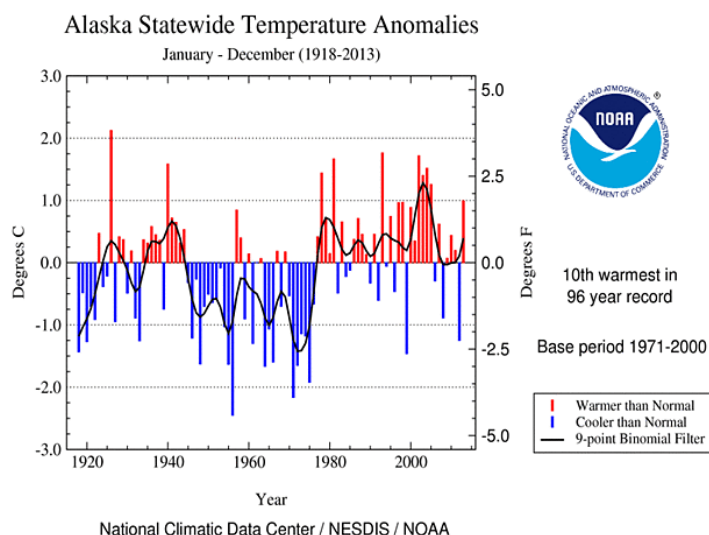


Figure 3. Average temperatures across Alaska in 2013 were 1.8° F below the 1971-2000 mean. Graph courtesy of NOAA (NOAA 2014a).

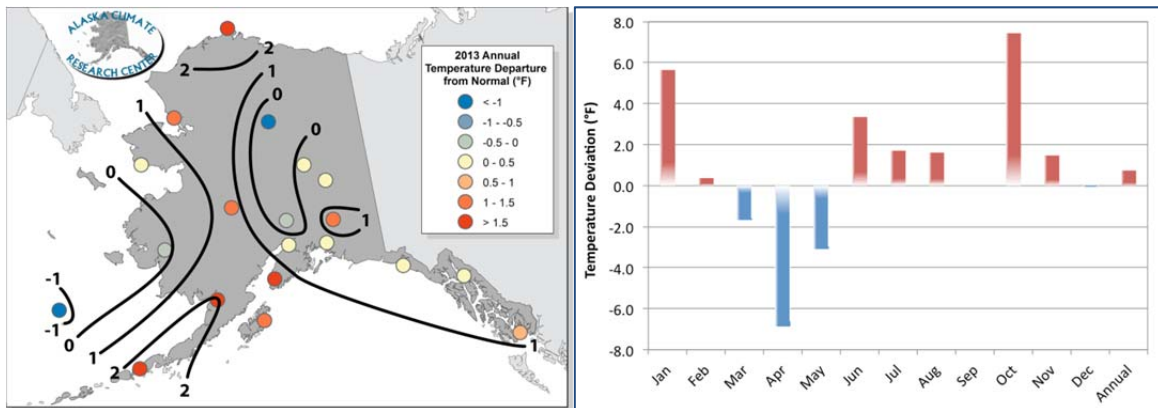


Figure 4. Statewide temperature departures for 2013 (left) and mean monthly temperatures deviation for the 20 first order stations in Alaska by month for 2013 (right). Graphs courtesy of the Alaska Climate Research Center (ACRC 2014).

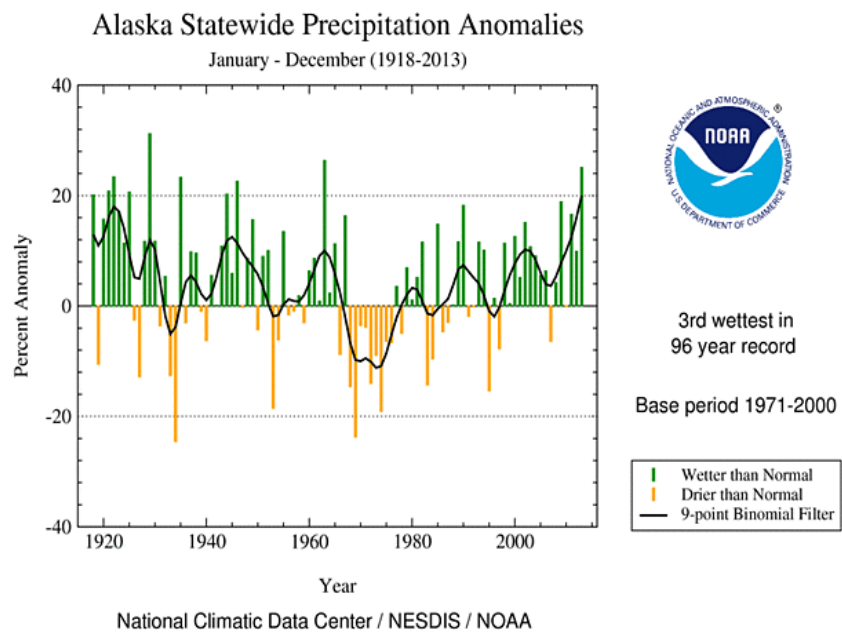


Figure 5. Annual precipitation anomalies 1918-2013. Graph courtesy of NOAA (NOAA 2014a).

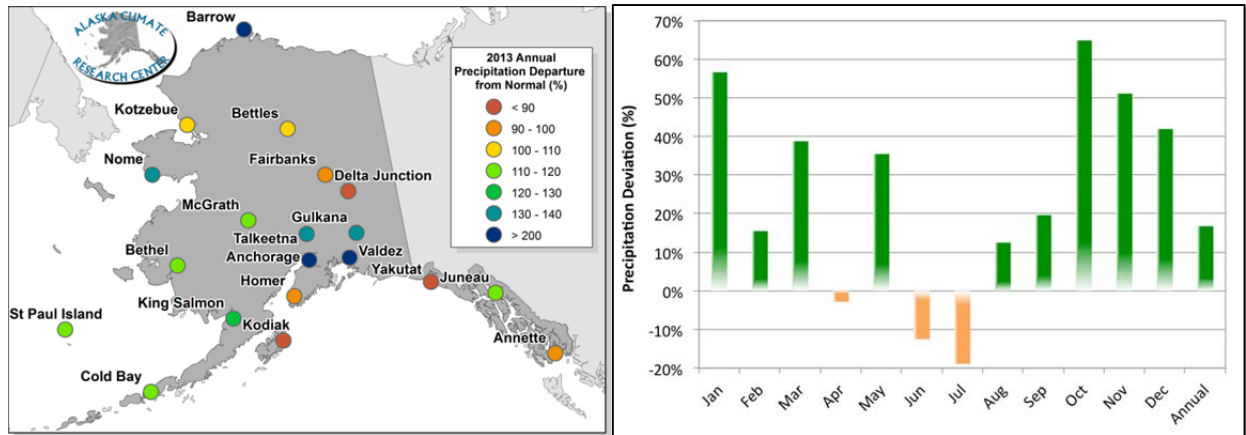


Figure 6. Annual precipitation departures from normal for 2013 (left) and monthly deviations (right) for the 20 first order climate stations in Alaska. Graphs courtesy of the Alaska Climate Research Center (ACRC 2014).

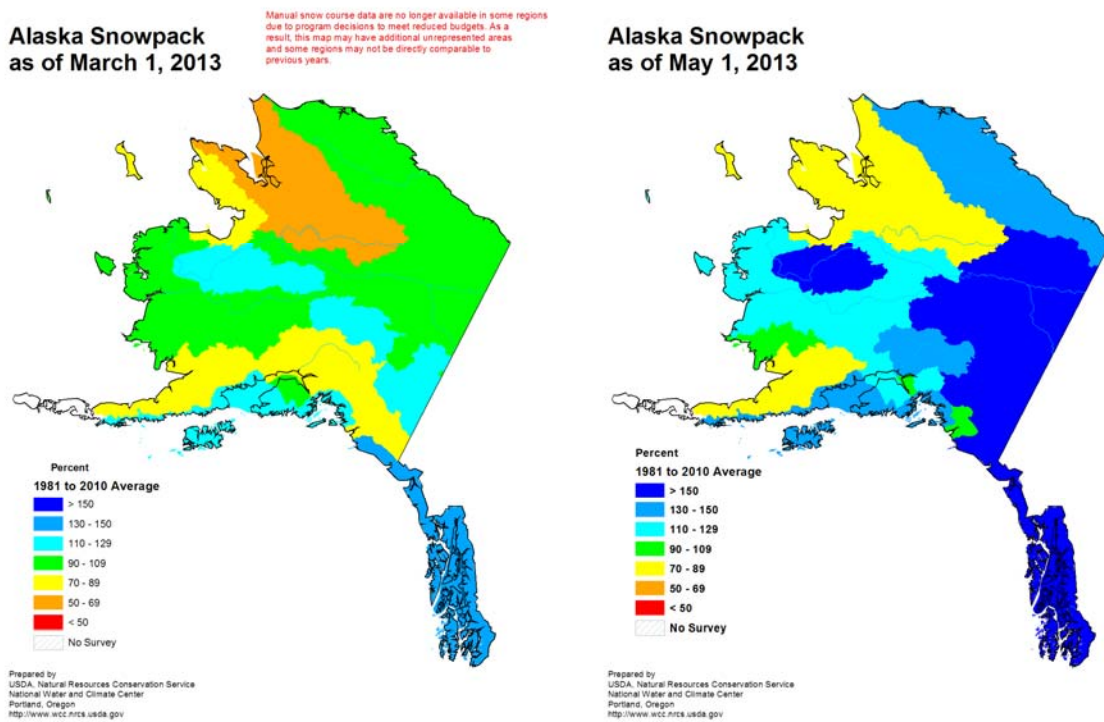


Figure 7. March 1 and May 1 snowpack percent of average for Alaska 2013 (NRCS 2014).

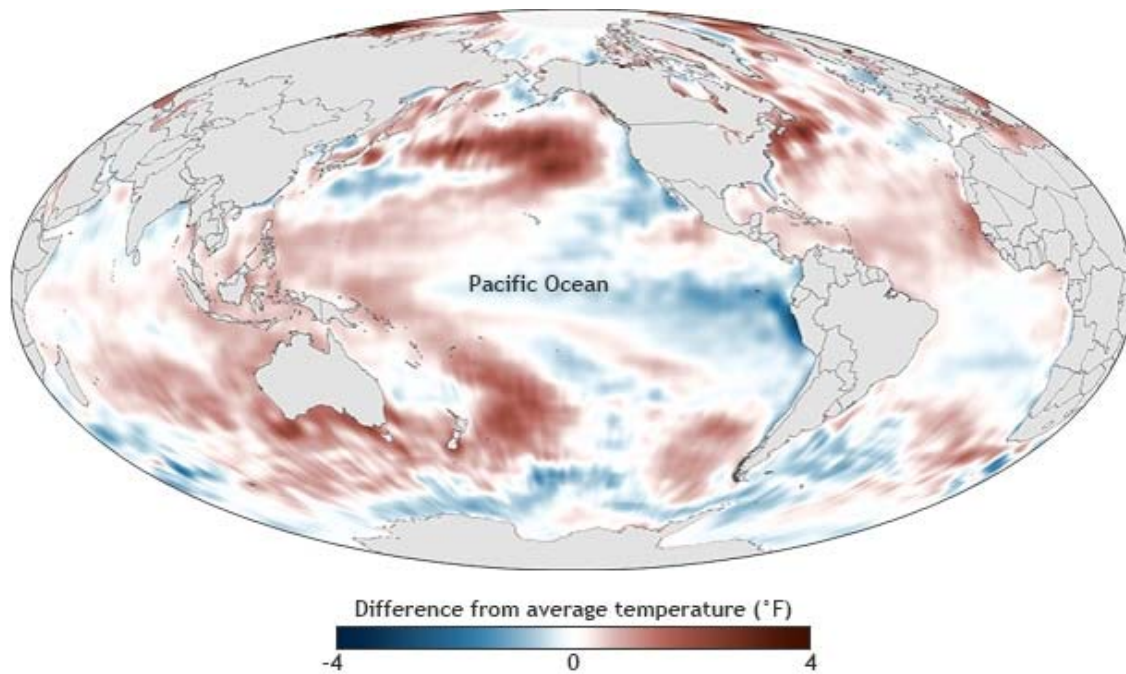


Figure 8. 2012 State of the Climate Sea Surface Temperature in 2013 compared to the 1981-2010 average. Graph courtesy of NOAA (2014d).

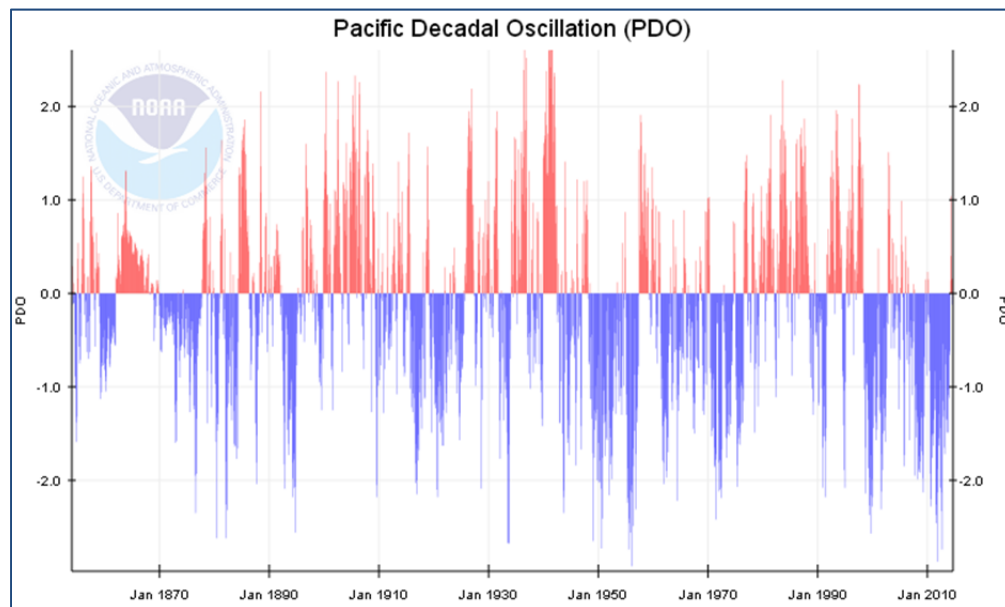


Figure 9. Pacific Decadal Oscillation index based on NOAA's extended reconstruction of SSTs (ERSST Version 3). Graph retrieved from <http://www.ncdc.noaa.gov/teleconnections/pdo.php> (NOAA, 2013b).

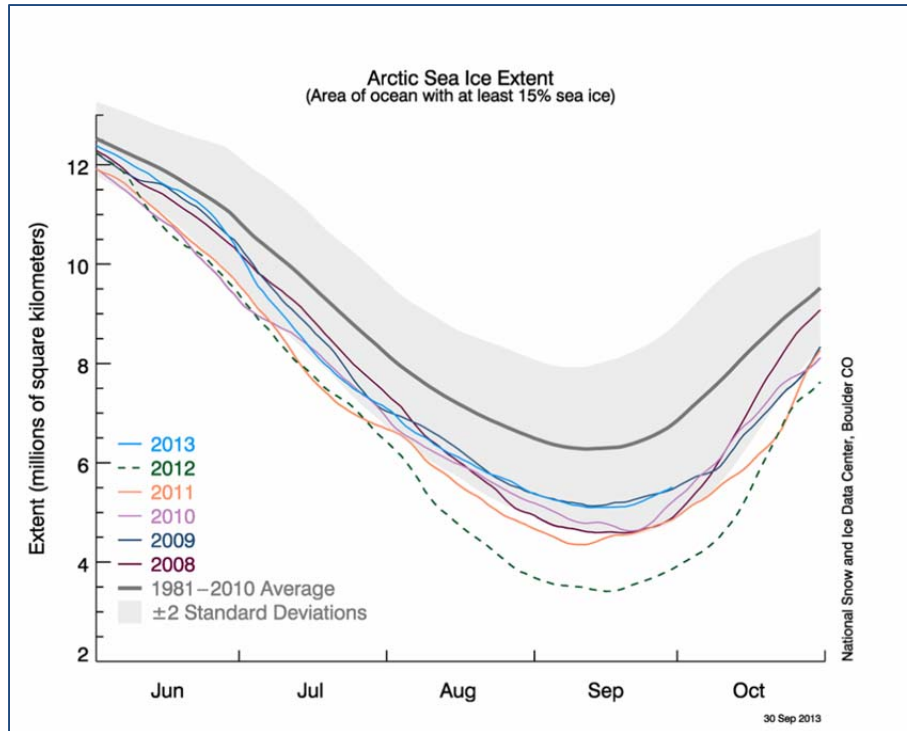


Figure 10. Arctic Sea Ice extent 1979-2013. 2012 was the lowest seasonal minimum extent on record (NSIDC 2014).

Climatically Significant Events of 2013

- Warm temperatures and measurable rainfall were recorded at many Alaska stations in mid-January 2013.
- Spring 2013 was one of the coldest on record for many locations. Coldest April on record at Denali and Eagle.
- Persistent May snowfall and cool temperatures led to unusually late snow melt-out dates. Heavy snows the first week of May dropped up to two feet in Nabesna and Mentasta Pass.
- Later than normal break up across many of the rivers. Flooding from an ice jam on the Yukon hit Eagle on May 17th. The flooding impacted Circle on the 19th, and Galena on the 26th, resulting in most of the town being evacuated. Damage was substantial in all of the communities (Figure 11).



Figure 11. Destruction from spring break-up on the Yukon River at Eagle May 17, 2013.

- Green-up in Fairbanks was recorded on May 26th, the latest on record.
- Latest date on record for the Tanana River ice break up at Nenana. The tripod erected on the river ice fell on May 20 at 2:41 p.m.—the latest date and time, a record which extends for nearly a century.
- Summer of 2013 was one of the warmest on record for much of the state. (Figure 12).

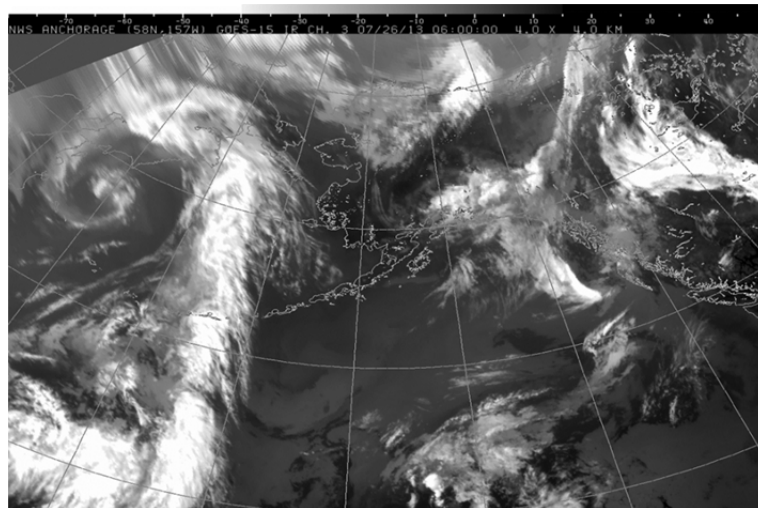


Figure 12. An infrared satellite image from the National Weather Service from Friday, July 25th, 2013 demonstrates the 'omega block' that set up over the western portion of the state leading to very nice summer weather for the entire month.

- It was the warmest October on record for the state of Alaska, with a temperature 8.8°F (4.9°C) above the 1971–2000 average (Figure 13).

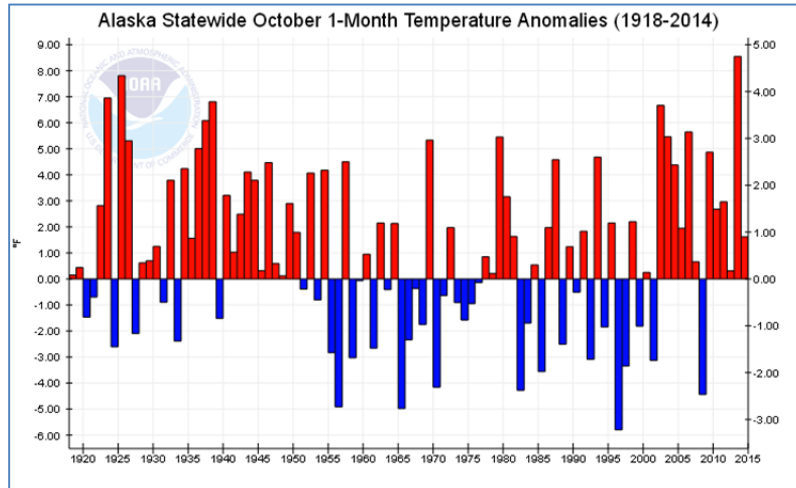


Figure 13. October monthly temperature departures for Alaska 1918-2014 (NOAA 2014a).

- A mid-November storm barreled across the state accompanied by high winds that caused widespread power outages and freezing rain.

Temperature Analysis

Index Sites

Temperatures were variable across the network from month to month, but the negative temperature departure in April and the positive temperature departure in October stand out. The calendar year started out with warm temperatures; January and February were both warmer than normal for every station in the network, with monthly January temperatures on average ~ 7 degrees warmer than normal, with the largest deviations in Eagle and Gulkana, both locations were 9.8°F warmer than normal.

The pattern shifted in March and air temperatures around the region cooled and remained that way through the end of May. Spring 2013 was unusually cold and snowy across the CAKN parks and across the state in general. April was on average $\sim 11^{\circ}\text{F}$ colder than normal at the CAKN sites. It was one of the coldest spring seasons on record, and the coldest April on record for Denali and Eagle. The persistence of the cold temperatures and snowpack through the end of May made it feel like a year without a spring season. During the last week of May the temperatures reached into the 80s across much of Alaska, ushering in a warm June; break-up was instantaneous and caused some major issues with ice jams and flooding.

Average monthly temperatures for June were 4.1°F warmer than normal. It was the second warmest June on record at Denali and Eagle and the third warmest on record at Gulkana. July temperatures remained above normal with a region wide positive deviation of $\sim 1.4^{\circ}\text{F}$; however, most sites were within a half degree of normal, while Gulkana was 3.1°F warmer than normal. All of the long-term CAKN sites were warmer than normal in August with the largest deviation in Denali with a monthly average temperature almost 5°F warmer than normal; the other sites were $\sim 2.5^{\circ}\text{F}$ warmer.

September started out cooler than normal but ended up being near normal by the end of the month. October was very warm; the northern interior sites were on average ~11.3°F warmer than normal. It was the warmest October on record for Eagle, Gulkana, Nabesna, and the third warmest on record at Denali. Temperatures cooled to near normal for the month of November and were cooler than normal in December of 2013.

The 2013 monthly mean temperature deviations at CAKN index sites are listed in Figure 14. Table 5 lists the monthly average temperatures and the annual temperatures at each location compared to the 1981-2010 normal value.

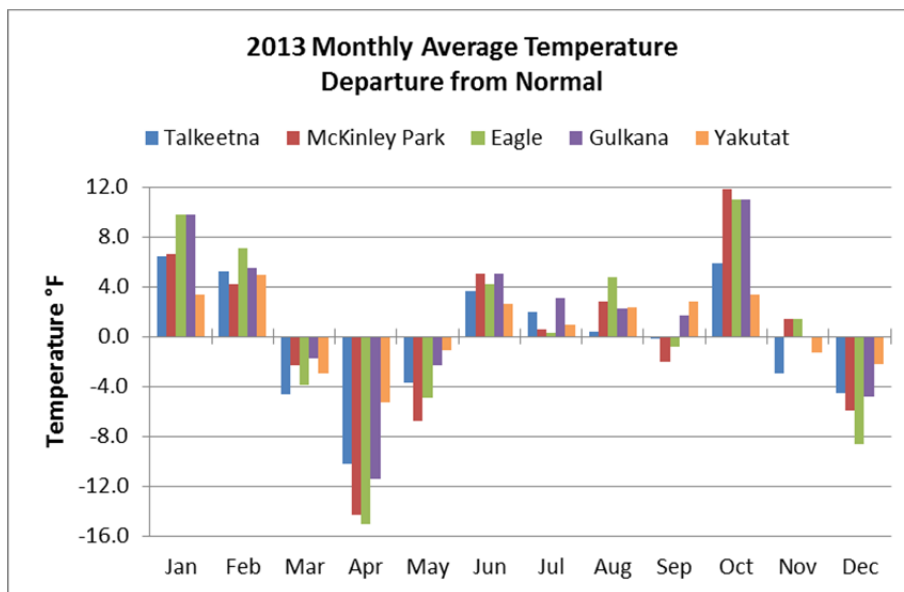


Figure 14. 2013 average monthly temperature departure from normal (1981-2010) at long-term sites.

Table 5. Mean monthly and annual temperatures (°F) for 2013 from long-term sites compared to the 1981-2010 normal period.

Site	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Ann
Talkeetna													
2013	20.6	23.3	20.3	25.7	44.1	60.6	62.1	57.1	47.3	39.1	16.5	11.5	35.7
1981-2010 normal	14.2	18.1	24.9	35.9	47.8	57.0	60.1	56.7	47.5	33.2	19.5	16.0	36.0
McKinley Park													
2013	9.7	11.8	11.1	13.6	36	57.8	56.2	53.4	38.4	34.7	10.3	1.0	27.8
1981-2010 normal	3.1	7.6	13.4	27.9	42.8	52.8	55.6	50.6	40.4	22.9	8.9	6.9	27.8
Eagle													
2013	0.3	3.4	3.3	13.8	41.2	62.2	60.7	58.5	41	34	4	-12.6	25.8
1981-2010 average*	-9.6	-3.7	7.2	29.0	46.3	58.0	60.4	53.7	41.8	23.0	2.6	-4.0	25.7
Gulkana													

Site	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Ann
2013	6.9	11	13.8	20.4	42.9	59.4	60.7	55.7	45	37.6	5.8	-4.4	29.6
1981-2010 normal	-2.9	5.5	15.6	31.8	45.2	54.4	57.6	53.5	43.3	26.6	5.8	0.4	28.2
Yakutat													
2013	31.5	34.6	28.9	32.5	43.6	53.4	55.2	56.1	51.2	44.3	31	27.4	40.8
1981-2010 normal	28.1	29.7	32	37.8	44.7	50.8	54.3	53.8	48.4	41	32.3	29.6	40.3

CAKN RAWS

Although the CAKN climate stations and other Remote Automated Weather Stations (RAWS) around the CAKN parks have relatively short records, measurements from these sites fill in some of the large spatial gaps in the network and provide information on climate patterns related to elevation and topography. Table 6 lists the monthly and annual temperatures for these sites grouped by park. Deviations or departures from normal cannot be calculated for these new sites.

Table 6. Monthly mean temperatures (°F) from CAKN stations 2013¹.

Site	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Denali VC	8.7	9.4	12.6	16.7	39.8	60.3	55.2	54.6	40.3	36.4	10.6	-3.1	28.5
Dunkle Hills	13.1	15.3	11.6	14.6	32.9	54.2	53.1	49.5	38.0	31.7	11.0	8.0	27.8
Eielson VC	17.5	18.1	15.4	14.2	34.6	54.8	52.0	49.3	36.4	34.9	16.0	17.9	30.1
Kantishna₂	0.6	-2.6	10.2	16.0	40.7	58.4	55.8	52.3	37.9	31.6	11.7	-1.4	25.9
McKinley R	-16.9	-3.2	7.3	19.0	43.3	63.0	59.8	54.0	m	m	m	m	X
Ruth Glacier	19.4	20.4	17.1	19.1	35.8	52.7	51.1	48.0	38.8	33.0	16.9	19.8	31.0
Stampede	0.4	-0.8	9.4	15.7	39.1	58.8	56.6	52.1	37.8	31.6	9.0	-0.9	25.7
Toklat	10.3	12.0	12.5	11.5	33.9	55.9	53.8	50.2	37.1	34.3	14.1	9.0	27.9
Tokositna₂	18.2	22.7	19.3	23.6	40.4	55.5	56.4	53.0	42.7	36.5	16.5	13.3	18.2
Wigand³	X	X	X	X	X	X	X	X	39.0	33.9	11.9	3.2	X
Wonder Lake	4.8	3.8	12.4	16.0	39.3	59.5	56.4	52.1	37.0	30.8	11.1	3.8	27.3
Coal Creek	-5.6	-4.1	3.4	16.9	42.6	61.8	60.7	55.5	40.1	32.1	1.0	-15.5	24.1
Upper Charley	-2.2	5.6	7.8	12.4	36.3	55.3	53.9	51.3	36.0	28.9	2.7	-1.9	23.8
Chicken Creek	11.9	15.6	11.5	14.0	35.1	48.6	49.2	49.0	36.4	31.2	9.5	10.3	26.9
Chisana²	-3.4	2.0	6.3	16.4	40.1	54.6	55.5	52.2	38.6	29.2	0.0	-8.6	23.6
Chititu	17.2	19.3	13.6	15.5	35.7	49.4	50.1	48.5	37.4	32.8	12.8	15.1	28.9
Gates Glacier	19.6	21.7	16.5	19.0	37.3	50.5	51.3	49.3	39.0	33.6	14.5	17.1	30.8

Chicken Ck.	11.9	15.6	11.5	14.0	35.1	48.6	49.2	49.0	36.4	31.2	9.5	10.3	26.9
Chisana²	-3.4	2.0	6.3	16.4	40.1	54.6	55.5	52.2	38.6	29.2	0.0	-8.6	23.6
May Creek²	9.4	14.8	17.0	27.0	45.7	59.5	59.4	54.7	42.9	35.8	10.4	-1.5	31.3
Tebay	14.3	18.7	16.2	22.8	37.9	52.2	54.6	51.5	43.4	36.8	15.6	4.5	30.7
Tana Knob⁴	19.5	22.3	17.4	20.5	38.7	51.6	m	m	m	m	m	m	X

¹ Please note that the monthly values for individual sites may differ from those in the seasonal weather summaries – we use real-time transmitted data to generate the summaries, which may have some data gaps; ² Snotel sites; ³ Installed August 13, 2013; ⁴ datalogger failure – no data recoverable from June 2, 2013 – June 2014.

The patterns and variability in temperatures show up well when all of the CAKN RAWS sites are combined into one graph (Figure 15 and 16). Note the large variation in winter temperatures between sites versus other seasons. The curve for 2013 is a bit unusual due to the cool spring and instant switch to summer in early June; usually, there is a more gradual curve leading up to the summer peak in temperatures. The peak often occurs in July, but in 2013 the warmest month of the year was June for many of the sites. January is usually the coldest month, but January 2013 was, on average, 5.0°F warmer than December of 2013.

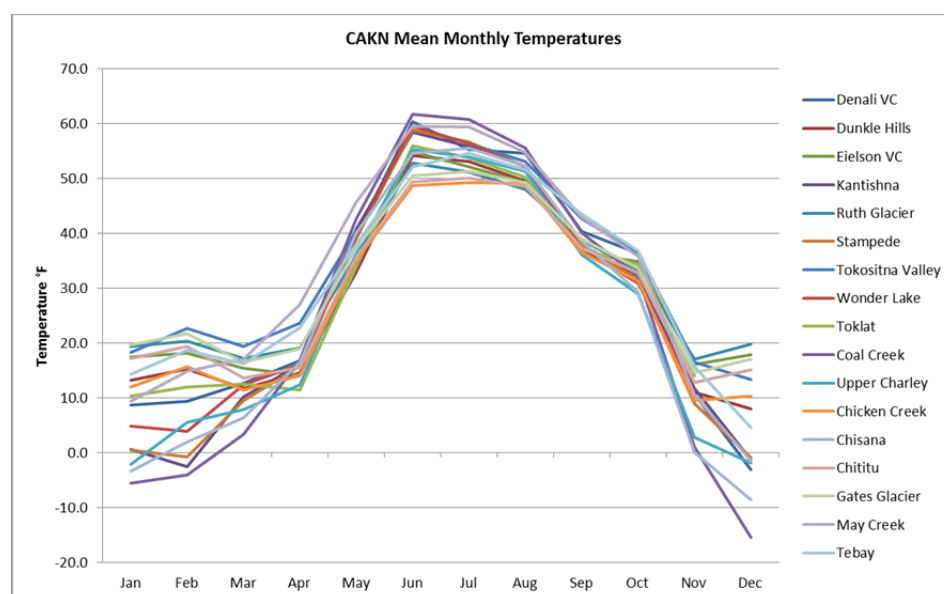


Figure 15. CAKN 2013 mean monthly temperatures.

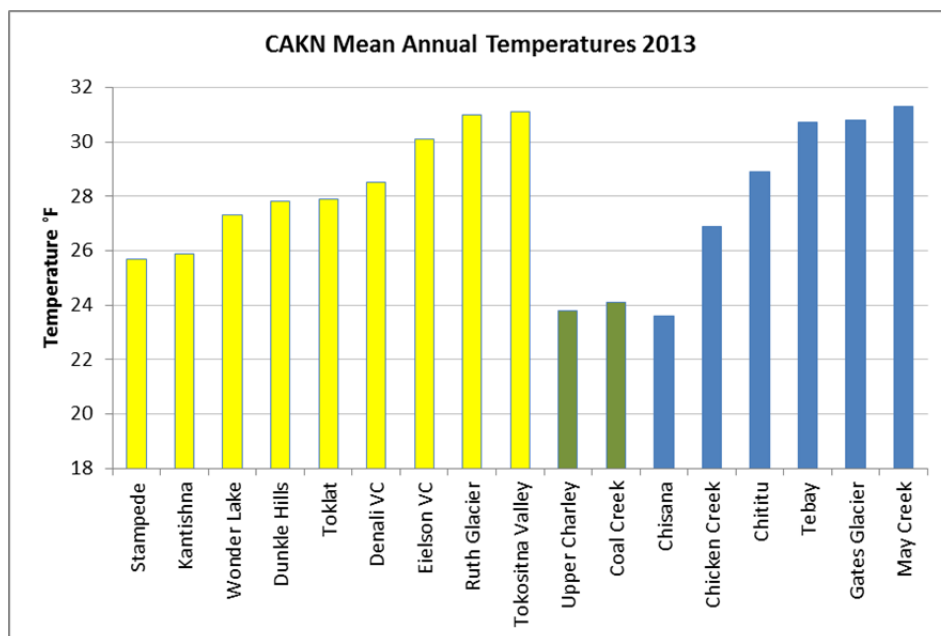


Figure 16. CAKN 2013 mean annual temperatures. Yellow sites DENA, green YUCH, and blue WRST.

One of the objectives of the CAKN climate program was to instrument these higher elevation sites to acquire information related to temperature gradients in complex topography. In some cases higher sites were deployed in the vicinity of existing lower elevation sites for comparison. Correlations between the paired high and low elevation sites are best described by monthly means rather than annual means. In the warm season, the higher sites tend to be 5 to 10°F colder depending on the elevation, but in the winter during cold spells, a persistent inversion can set up and the higher elevations can be 10 to 20°F warmer than the surrounding lowlands. The air is often calm in the darker winter months due to the lack of solar radiation that generates the surface winds that are so common in the summer. There are exceptions to winter inversions however, a storm system can move in from the Gulf of Alaska or Bering Sea, bringing warm maritime winds (called Chinooks) that funnel through the mountain passes, raising temperatures and mixing the air. The areas just north of these mountain passes often get winds > 40 mph during these events.

The following tables show the monthly and annual variation between low and high elevation sites in the three CAKN parks. Table 7 shows Chicken Creek and Chisana, sites located in the continental interior region of northeastern WRST, north of the Chugach and Wrangell Mountain ranges. Chicken Creek is in the Nutzotin Mountains and Chisana is in the Chisana River flood plain below the terminus of the Chisana Glacier. The annual temperature was 3.3°F warmer at Chicken Creek, the higher site. Table 7 also shows May Creek and Gates Glacier. Gates Glacier is located within the Wrangell Mountains on a ridge between the Gates and Kennicott Glaciers and May Creek is in the valley between the Wrangell Mountains and the Chugach Mountains. The average annual temperature between Gates Glacier and May Creek was only 0.5°F, but the average difference in each individual monthly temperature was 7.1°F.

Table 6. Mean monthly temperatures for 2013 at high and low elevation paired sites in WRST.

Month	Chicken Creek Elev. - 5260'	Chisana Elev. - 3320'	Gates Glacier Elev. - 4060'	May Creek Elev. - 1600'
Jan	11.9	-3.4	19.6	9.4
Feb	15.6	2.0	21.7	14.8
Mar	11.5	6.3	16.5	17.0
Apr	14.0	16.4	19.0	27.0
May	35.1	40.1	37.3	45.7
Jun	48.6	54.6	50.5	59.5
Jul	49.2	55.5	51.3	59.4
Aug	49.0	52.2	49.3	54.7
Sep	36.4	38.6	39.0	42.9
Oct	31.2	29.2	33.6	35.8
Nov	9.5	0.0	14.5	10.4
Dec	10.3	-8.6	17.1	-1.5
Annual	26.9	23.6	30.8	31.3

Note: Red = warmer temperatures; blue = colder temperatures.

Table 8 shows the high and low elevation sites in YUCH and DENA. The Upper Charley site in YUCH is located in the southern extent of the Preserve at the headwaters of the Charley River and Coal Creek is located along the Yukon –River Valley about 4 miles upstream on the Coal Creek tributary. The mean annual temperature at Upper Charley in YUCH, the higher elevation site, was 2.8 °F warmer than Coal Creek. The Upper Charley site was warmer for each of the winter months, and also November in the fall and March in the spring. In Denali, Eielson Visitor Center is located at a high elevation site just north of the crest of the Alaska Range. This site is compared with Stampede which is located farther north and east from the crest of the range. The mean annual temperature at Eielson was 4.4 °F warmer than Stampede (Table 8). The monthly average temperatures were warmer at Eielson Visitor Center in January, February, March, October, November, and December, or 6 out of 12 months. This site is subject to the warm Chinook winds that come through the passes in the winter.

Table 7. Mean monthly temperatures (°F) for 2013 at high and low elevation paired sites in YUCH (left) and DENA (right).

Month	Upper Charley Elev. - 3654'	Coal Creek Elev. - 802'	Eielson VC Elev. - 3730'	Stampede Elev. - 1800'
Jan	11.9	-5.6	17.5	0.4
Feb	15.6	-4.1	18.1	-0.8
Mar	11.5	3.4	15.4	9.4
Apr	14.0	16.9	14.2	15.7
May	35.1	42.6	34.6	39.1
Jun	48.6	61.8	54.8	58.8
Jul	49.2	60.7	52.0	56.6
Aug	49.0	55.5	49.3	52.1
Sep	36.4	40.1	36.4	37.8
Oct	31.2	32.1	34.9	31.6
Nov	9.5	1.0	16.0	9.0
Dec	10.3	-15.5	17.9	-0.9
Annual	26.9	24.1	30.1	25.7

Coal Creek had the most extreme temperature swing between summer and winter in 2014. The mean monthly temperature for January at Coal Creek was -15.5°F and in June it was 61.8°F, a 77°F difference. Gates Glacier in Wrangell – St. Elias had the least amount of variation, the December – June difference was 33.4°F. See Appendix A for complete monthly weather summaries of the CAKN sites.

Precipitation Analysis

Index Sites

Annual precipitation totals across the CAKN region varied from 88% of normal in Yakutat to 133% of normal at Talkeetna. Denali was near average for the year at 97% of normal. Eagle was 120% of normal and Gulkana was 122% of normal. January was a particularly wet month for Talkeetna and Gulkana with monthly totals that were 246% and 263% of normal, respectively. Eagle was not far behind at 198% of normal for the month. April snowfall was impressive for the northern interior; generally the snowpack starts to deteriorate and there is little additional accumulation. Precipitation values were much higher than normal for April at Gulkana (308%), Eagle (353%), and Denali (205%). Winter did not let go in Gulkana, and May precipitation was an impressive 327% of normal; all of the precipitation for the month was recorded during the first three weeks of May when the temperatures were still cold.

The summer months were dry across the network. Every site was drier than normal in June. In Denali only 0.79 inches of rainfall compared to a normal of 2.15 inches, or 37% normal rainfall. It didn't rain at all from June 12-26. In Gulkana, June 2013 tied 2004 for the driest on record with only 19% of normal precipitation. Dry conditions persisted into July at most sites, except for Eagle which was just above normal. In August all sites were near normal.

It was a wet September in the CAKN with rainfall totals above normal at almost all of the sites except for Yakutat where dry conditions persisted. The rain continued into October in the interior, with Talkeetna and Denali Park at 296% and 271% of normal precipitation totals for the month. Because of the warm temperatures, precipitation fell as rain rather than snow in Denali. There were only 2 days with measurable snow in October with a total of 1.1 inches; on average there is ~10 inches of snow in October. In Eagle, there was very little rain or snow in October; the total for the month was 0.34 inches, which all fell as rain, which is 36% of normal precipitation. There was no snowfall recorded in October in Eagle, which is quite unusual.

In Denali there were 21 days in November with measurable snow. A total of 21.5 inches of snow fell during the month; normal snowfall in November is 13.2 inches and the precipitation equivalent was 270% of normal. In Eagle, 15 inches of snow fell in November, which is 120% of normal. The total precipitation was just above normal for the month. November 6th marked the first day of the persistent snowpack for the season in Eagle, which is also referred to as the “snow on” date. This is ~3 weeks later than normal. Precipitation in Gulkana for November was 250% of normal. In December precipitation totals were higher than normal in Eagle and Gulkana and lower than normal in Denali and Talkeetna. The 2013 annual precipitation totals expressed as a percentage of normal

are shown in Figure 17. Table 9 lists the monthly precipitation totals and the annual totals at each location compared to the 1981-2010 normal value. Figure 9 shows the compiled monthly precipitation deviation (%) for the index sites for 2013.

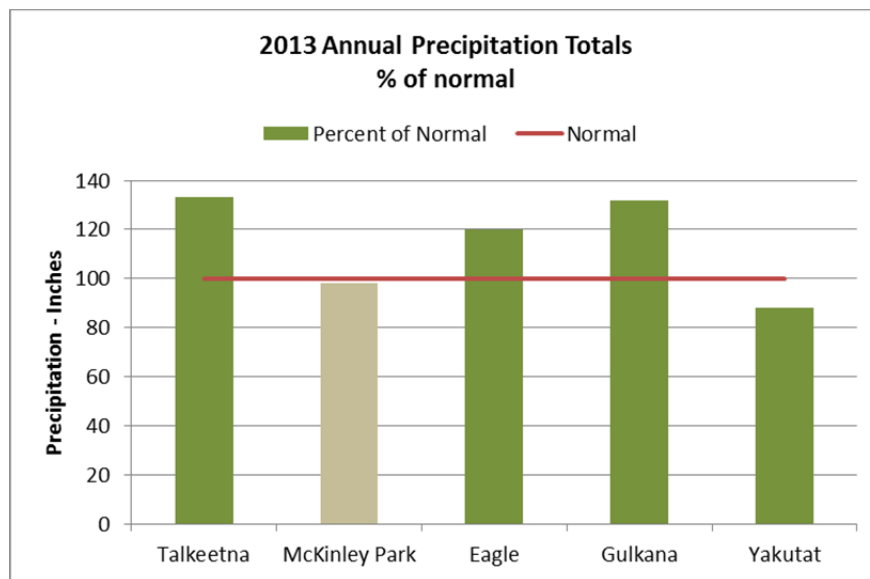


Figure 17. Annual precipitation totals (% of normal) at long-term CAKN sites – 2013.

Table 8. Total monthly precipitation (inches) at long-term CAKN sites for 2013 compared to normal.

Site	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Talkeetna													
2013	3.34	1.96	1.24	0.47	3.00	0.67	1.66	4.99	7.94	8.57	2.53	0.94	37.31
1981-2010 normals	1.36	1.45	1.05	1.29	1.62	1.92	3.39	5.11	4.32	2.90	1.63	1.93	27.97
McKinley Park													
2013	0.6	0.35	0.97	0.82	0.33	0.79	1.91	2.57	2.15	1.79	2.03	0.42	14.73
1981-2010 normals	0.63	0.54	0.39	0.40	0.87	2.15	3.22	2.71	1.70	0.78	0.75	0.92	15.06
Eagle													
2013	1.05	0.61	0.37	1.06	0.71	1.15	2.83	2.07	2.57	0.34	0.92	1.23	14.91
1981-2010 normals	0.53	0.47	0.40	0.30	1.10	1.54	2.43	1.86	1.17	0.95	0.73	0.70	12.41
Gulkana													
2013	1.21	0.65	0.51	0.74	2.13	0.26	1.23	1.9	2.58	0.71	1.8	1.16	14.88
1981-2010 normals	0.46	0.51	0.30	0.24	0.65	1.40	1.81	1.80	1.58	1.01	0.72	0.78	11.26
Yakutat													
2013	11.08	14.89	5.93	8.36	17.25	3.49	6.51	9.55	18.53	23.87	7.68	9.68	136.8
1981-2010 normals	13.66	10.86	11.04	9.19	8.21	6.39	7.88	14.07	21.11	21.98	14.45	16.28	155.1

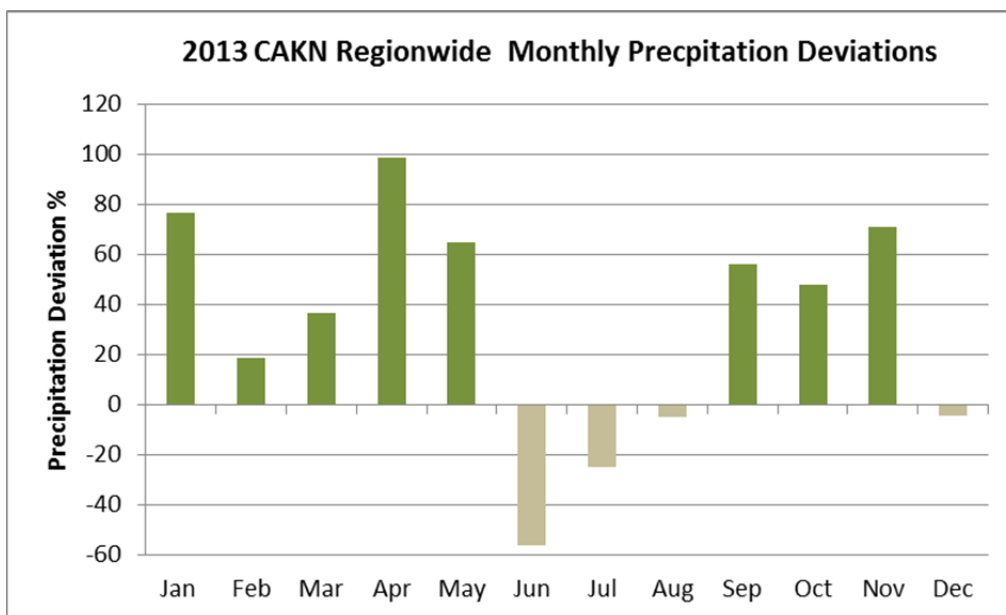


Figure 18. Mean monthly precipitation deviations - % from normal for 2013 for all index sites combined.

2012-2013 Snow Season

In Eagle, the 2012-2013 seasonal snowfall by May 31 was 83.1 inches, which is 134% of normal. The snow-off date, which is the last day of where there is measureable snow on the ground, was May 22. In Denali snowpack “melt-out” date was May 25th, one day short of the latest melt-out date on record of May 26, 1964. This year tied with 1992 as the second latest melt-out date at park headquarters. Snow is not recorded in Gulkana, but the nearby Kenny Lake snow course typically melts out by May 1st, but still had 15 inches of snow this year with 3.0 inches of water content, the highest May 1 reading since 1992.

CAKN Snotel Sites

Year round precipitation is recorded at the snow telemetry (SNOTEL) sites deployed in Denali and Wrangell-St. Elias as part of the CAKN climate and snow program. The Kantishna SNOTEL is on the north side of the Alaska Range in Denali, and the Tokositna Valley is on the south side of the range. In Wrangell-St. Elias, the Chisana SNOTEL site is located on the north side of the Wrangell Mountain Range near the town of Chisana, and the May Creek SNOTEL is between the Wrangell and Chugach Mountain Ranges near the town of McCarthy. The American Creek SNOTEL site near Eagle is a good index site for Yukon-Charley Rivers.

The SNOTEL sites provide an accurate representation of winter snow water equivalent at remote sites as well as summer rainfall. The data from these sites, along with the snow courses and aerial markers, surveyed monthly throughout the winter season, are based on the ‘water year’ running from October 1 through September 30. An annual report summarizing the snow and precipitation data from snow courses, aerial markers, and SNOTEL sites around the network is produced in the late fall of each year.

For water year 2013, the Kantishna SNOTEL site recorded 6.7 inches of total winter precipitation (snow water equivalent) from October 1, 2012 through May 1, 2013, which is 134% of the 1981-2000 normal. The total annual precipitation for the site was 20.8 inches; the winter snow accounted for 32% of the total annual precipitation. Snow-on date was October 9 and the snow-off date was May 30, 2013. The precipitation gage at Tokositna Valley recorded 22.3 inches of precipitation from October 1, 2012 through May 1, 2013. This is 46% of the total annual precipitation of 48.6 inches for the 2013 water year. The annual precipitation was 113% of normal (Figure 19). The snow on date at this site was October 16, 2012 and the snow off date was June 3, 2013.

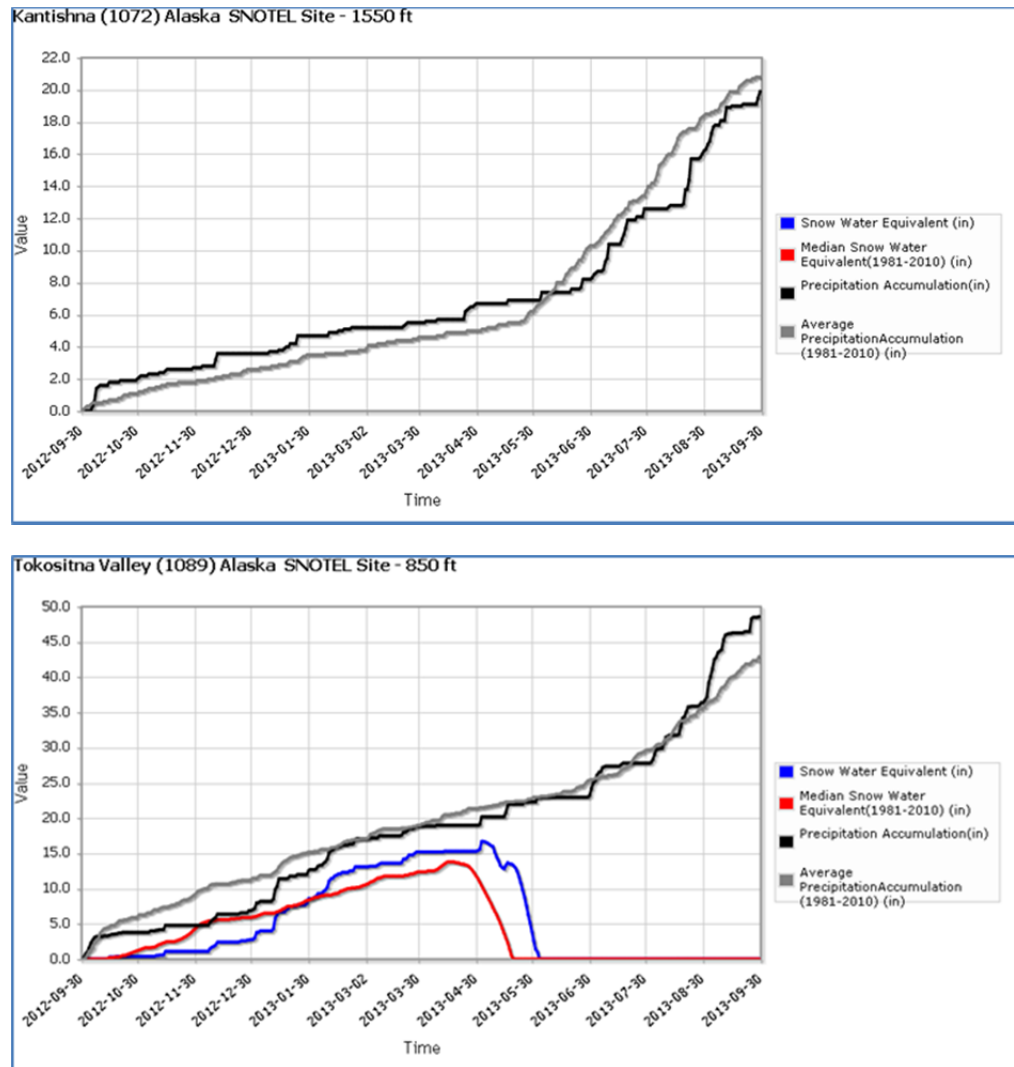


Figure 19. Cumulative precipitation for Water Year 2013 (Oct. 1 – Sep.30) at Kantishna and Tokositna Valley in DENA. Graphs generated from NRCS (2014b).

The SNOTEL site at May Creek reported 6.9 inches of snow water equivalent on May 1st; the annual total precipitation was 15.9 inches, 103% of normal. The winter snowfall accounted for 43% of the total precipitation for the year. The snow-on date was October 17, 2012 and the snow-off date was May 14, 2013. The Chisana SNOTEL site recorded 3.7 inches of total winter precipitation from Oct

1 through May 1. The total annual precipitation was 14.8 inches; the winter snow accounted for 25% of the total annual precipitation for the 2013 water year (Figure 20). The record at the site is not long enough to calculate normals.

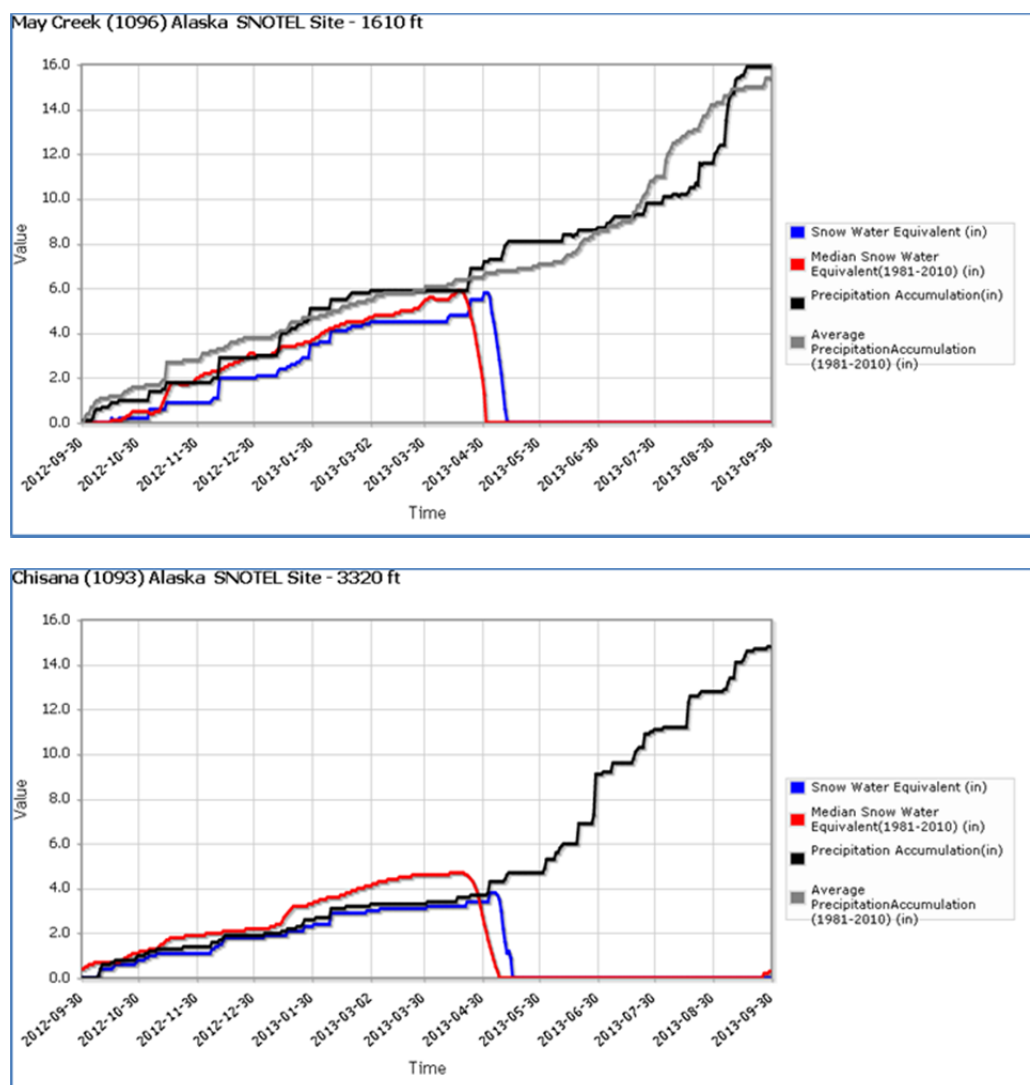


Figure 20. Cumulative precipitation for Water Year 2013 (Oct. 1 – Sep.30) at May Creek and Chisana in WRST. Graphs generated from NRCS (NRCS 2014b).

The American Creek SNOTEL site near Eagle recorded a total of 3.8 inches of precipitation from October 1 through May. The total precipitation for the water year of 2013 was 12.6 inches, the winter precipitation accounted for 30 % of the annual total. Cumulative precipitation graphs for the five SNOTEL sites are presented in Figure 21 (note the differences in scale).

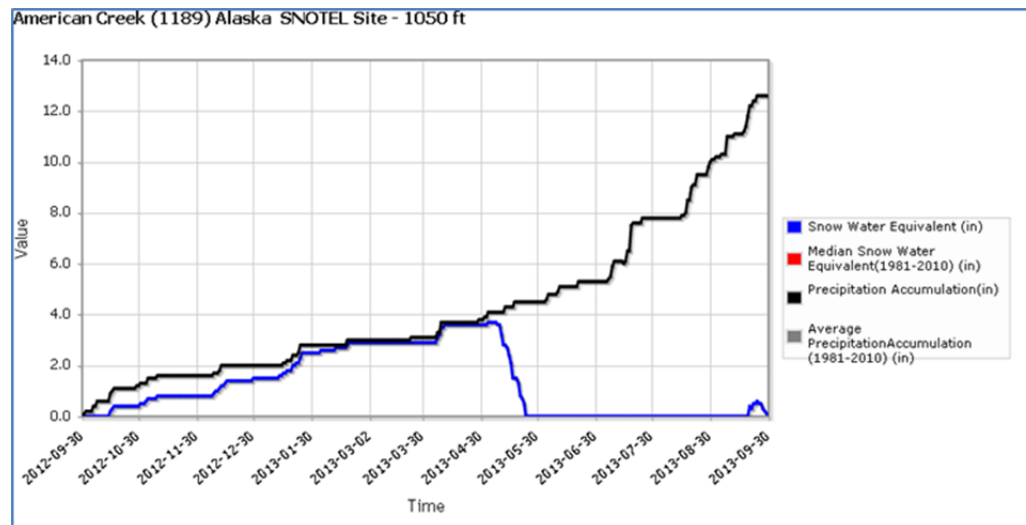


Figure 21. Cumulative precipitation for Water Year 2013 (Oct. 1 – Sep.30) at American Creek near YUCH. Graphs generated from NRCS (NRCS 2014b).

Discussion

The climate data for 2013 was compiled and summarized using CAKN data from the NPS sites and from index sites around the region. The variations in temperature and precipitation from season to season in 2013 were impressive; individual monthly statistics deviations from normal and seasonal statistics help characterize a year with extremes, more so than an annual average that turned out to be near normal. We also produce seasonal weather summaries four times a year for DENA, WRST, and YUCH that provide timely and relevant information on current weather statistics. These summaries are available from the network website or from the [Integrated Resource Management Application \(IRMA\)](#) portal.

The data from long-term sites are available from the [National Climate Data Center](#). The CAKN climate stations transmit data via satellite and are available on the web from [MesoWest](#) and the [Western Regional Climate Center](#). Products that are available include daily and monthly summaries, time series graphs, wind rose graphs, data inventories, and station metadata for all of the automated stations. The data are downloaded from the stations each year and are QA/QC by network staff and sent to WRCC to fill in any gaps from missed satellite transmissions. The raw data are also available for download through the ‘data lister’ tool on the WRCC website. These data are also ingested by multiple other networks and agencies and displayed in various formats.

An interagency agreement is in place for the maintenance, data archiving, and data dissemination for the four SNOTEL sites in the network. The data from the stations are transmitted hourly via meteor burst communication and are on-line at [National Water and Climate Center](#).

This annual report provided a climate summary for the CAKN region in 2013 with brief references to the Alaska regional climate and the global climate for 2013.

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Appendix A. 2013 CAKN Climate Station Data by Park

Yukon-Charley Rivers National Preserve

Climate Summary

Yukon-Charley Rivers National Preserve lies within the continental interior climate zone and is characterized by large variations in seasonal temperatures. The Preserve is subject to long, very cold winters and short, warm summers. July temperatures at lower elevations along the Yukon River average $\sim 16^{\circ}\text{C}$ (60°F), while January temperatures average $\sim -25^{\circ}\text{C}$ (-12.5°F). Cold temperatures in the -40°C (-40°F) range are not uncommon, nor are summer temperatures in the high 20°C (80°F) range in summer. The higher elevations of the Preserve are cooler than the river valleys in the summer, yet are often warmer in the winter due to persistent inversions that last from about October through March. The average annual temperature is -4.2°C (24.5°F). The lowest temperature recorded in the Preserve, thus far, is -51°C (-59°F) and the highest is 33°C (91°F).

The Preserve receives very little precipitation, which contributes to the role of fire as a major natural disturbance. On average, 8,100 ha (20,000 acres) burn within the preserve each year, nearly all of which are ignited by lightning. Average summer (June, July, and August) rainfall totals average ~ 178 mm (7.0 inches). Although year-round precipitation is not measured within the Preserve boundary, in nearby Eagle, the average annual precipitation total is ~ 315 mm (12.4 inches). The seasonal snow pack within the Preserve begins to develop in early to mid-October and by January the snowpack average about 41 cm (16 inches). The snowpack reaches its peak in March with average depths of about 51 cm (20 inches). Generally, by the end of April warmer temperatures return and bring a quick demise to the seasonal snowpack.



Coal Creek – Yukon-Charley Rivers National Preserve

Period of record: 9/17/2004 – Present

Coal Creek site is a classic continental interior climate location at an elevation of 958'. The site is very cold in the winter and very warm in the summer. The station sits on the edge of an old fire burn in a mixed spruce and deciduous forest approximately 5 km south of the Yukon River. The site is in a well-protected valley and hence has light winds. This is a good location to measure interior soil temperatures as well as a good location for snow measurements. The period of record average air temperature is 24.5°F. The lowest temperature recorded thus far is -58.9° on 1/29/2012 and the highest is 91.2°F on 7/29/2009. The maximum snow depth recorded at the site is 28 inches.

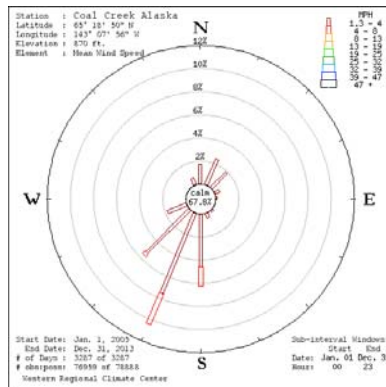


2013 Summarized Data

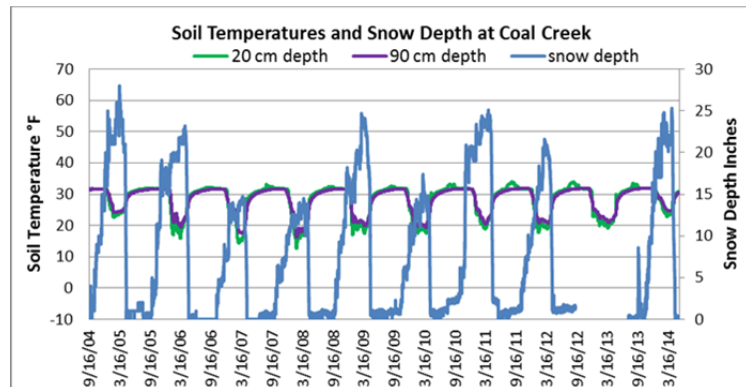
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Month	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	47	1	150	10	-6	37	-55	-5	-7	11	23	24	m	
Feb-13	107	2	173	9	-4	27	-35	-3	-5	13	21	23	m	
Mar-13	726	2	164	9	3	43	-36	5	1	13	20	22	m	
Apr-13	853	2	188	13	17	51	-22	19	15	17	21	22	m	
May-13	907	2	174	12	43	81	9	44	41	31	27	26	m	
Jun-13	985	2	178	11	62	89	34	64	60	43	31	30	m	2.54
Jul-13	902	2	188	11	61	86	36	62	59	48	31	31		2.30
Aug-13	636	1	178	8	55	88	26	57	54	46	33	31		1.90
Sep-13	460	1	175	9	40	71	21	41	39	35	33	32	2	
Oct-13	352	1	169	9	32	52	10	33	31	32	32	32	1	
Nov-13	142	1	172	17	1	46	-41	2	0	25	32	32	5	
Dec-13	9	0	153	6	-16	31	-57	-14	-17	21	32	31	13	

Coal Creek Climatology 2004-2013:

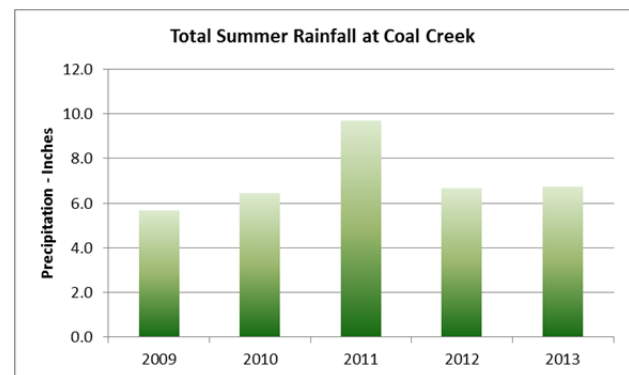
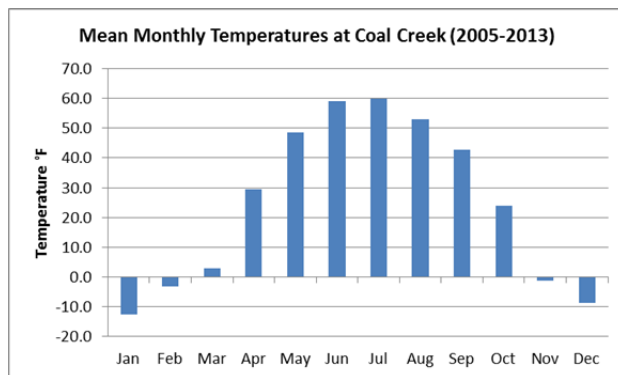
Wind rose climatology



Soil Temperatures and Snow Depth



Coal Creek mean monthly and annual temperatures and summer rainfall (Jun-Aug)



Coal Creek	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2004									31.3	23.9	-0.3	-12.1	
2005	-10.8	-5.6	11.4	30.9	52.5	60.6	58.0	51.0	42.5	29.4	19.5	15.6	29.6
2006	-0.1	5.8	5.8	21.8	45.4	57.8	59.3	51.8	46.1	28.9	-16.4	-4.8	25.1
2007	-2.9	-17.2	-9.2	35.6	49.2	61.0	62.6	55.6	42.0	18.2	11.2	-6.7	24.9
2008	-16.5	-9.4	6.6	31.9	48.6	57.4	56.6	49.3	41.2	12.4	0.1	-18.5	21.6
2009	-18.2	1.0	-1.7	30.3	48.9	58.2	63.1	51.7	43.2	27.7	-4.2	-2.4	24.8
2010	-17.4	0.3	10.4	36.3	51.8	58.4	60.1	55.6	40.5	22.4	10.7	-26.1	25.2
2011	-13.6	-6.6	1.8	26.6	50.9	56.1	58.9	52.2	44.2	25.6	-12.3	1.8	23.8
2012	-27.8	6.9	-1.2	34.5	46.5	59.8	58.7	54.4	44.2	19.3	-20.4	-21.2	21.2
2013	-5.6	-4.1	3.4	16.9	42.6	61.8	60.7	55.5	40.1	32.1	1.0	-15.5	24.1
Period of Record Average	-12.5	-3.2	3.0	29.4	48.5	59.0	59.8	53.0	42.6	24.0	-1.2	-8.6	24.5

Upper Charley - Yukon-Charley Rivers National Preserve

Period of Record 8/3/2005-Present

The Upper Charley site is near the southern boundary of the Preserve, approximately 5 km south of the Three Fingers airstrip in an area of gentle rolling hills. At an elevation of 3655' the site is cooler than the lower valleys in the summer, but often warmer in the winter due to persistent inversions that last from about October through March. Winds in the spring and fall tend to blow from the southeast and in mid-summer from the southwest. The period of record average air temperature is 23.5°F. The highest temperature recorded thus far is 81°F on 6/26/2013 and the lowest is -38°F on 2/23/2007. The maximum snow depth recorded at the site is 30 inches.

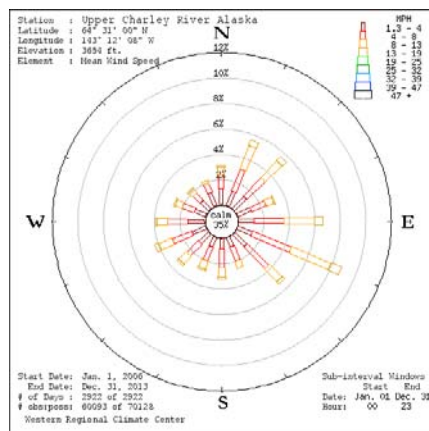


2013 Summarized Data

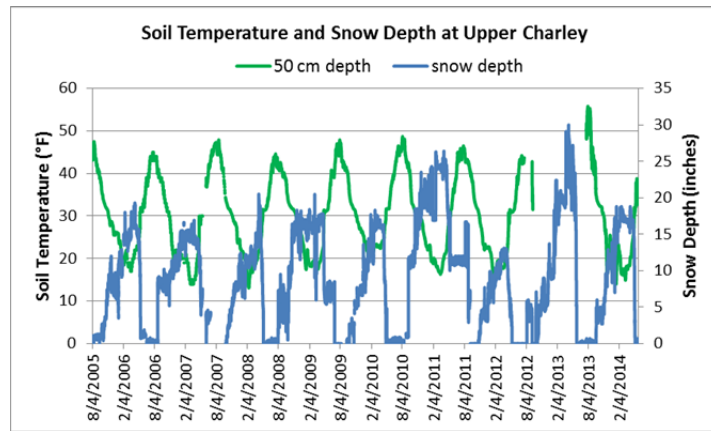
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	45	4	163	21	-2	31	-36	-2	-3	m	m	m	13	
Feb-13	77	4	180	19	6	27	-23	6	5	m	m	m	19	
Mar-13	944	6	169	24	8	37	-21	9	7	m	m	m	21	
Apr-13	1346	6	171	26	12	39	-13	14	11	m	m	m	24	
May-13	1375	5	194	23	36	68	12	38	35	m	m	m	17	
Jun-13	1478	6	188	23	55	81	35	57	54	m	m	m	0	2.07
Jul-13	1368	6	223	22	54	74	42	55	53	53	51	57	0	2.09
Aug-13	803	5	180	24	51	77	28	53	50	50	49	54	0	2.84
Sep-13	601	6	165	24	36	58	20	37	35	38	38	42	2	
Oct-13	383	7	155	22	29	45	14	30	28	31	32	36	4	
Nov-13	146	4	207	33	3	33	-26	3	2	22	24	28	8	
Dec-13	84	6	181	23	-2	38	-30	-1	-3	18	19	25	11	

Upper Charley Climatology 2005-2013:

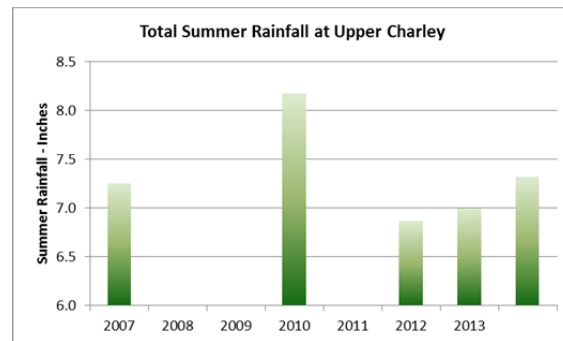
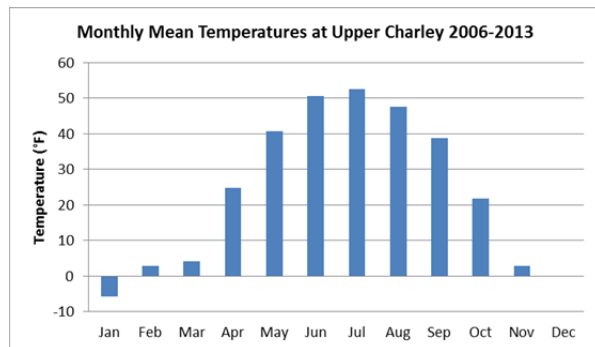
Wind rose climatology



Soil Temperatures and Snow Depth



Upper Charley mean monthly and annual temperatures and summer rainfall (Jun-Aug)



Upper Charley	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2005									38.2	20.3		9.9	
2006	-8.0	6.3	0.6	20.7	39.7	47.6	52.3	45.4	40.6	24.3	-7.7	8.7	22.5
2007	m	-5.1	-8.1	29.6	m	52.2	54.2	m	m	19.3	14.1	-1.8	m
2008	-7.5	-2.1	8.9	25.6	40.2	49.0	48.6	44.0	38.1	13.9	7.7	-4.4	21.8
2009	-7.2	-1.3	-1.0	25.8	42.6	50.5	57.0	46.8	39.7	24.5	2.1	9.0	24.0
2010	-1.7	10.8	13.3	29.5	44.7	49.4	52.2	50.0	38.3	22.7	13.5	-9.9	26.1
2011	1.5	-2.2	7.7	23.9	42.7	48.8	51.4	46.6	39.8	22.8	-4.8	7.0	23.8
2012	-14.7	11.3	3.4	30.9	38.4	51.4	51.3	49.1	39.5	17.8	-4.8	-8.6	22.1
2013	-2.2	5.6	7.8	12.3	36.3	55.3	53.9	51.3	36.0	28.9	2.7	-1.9	23.8
Period of Record Average	-5.7	2.9	4.1	24.8	40.6	50.5	52.6	47.6	38.9	21.8	2.8	-0.2	23.5

Denali National Park and Preserve

Climate Summary

There are two distinct climates in the park, separated by the Alaska Range. They differ not only in physical measurements, but also in the types of vegetation and landscape features they produce. The transitional maritime climate on the south side of the Alaska Range is influenced by the prevailing weather patterns of the Gulf of Alaska, with milder air temperatures with less seasonal variation and more precipitation. Temperatures in the northwest area of the park are typical of an interior climate with very warm summers and cold winters. Park headquarters lies in another transitional zone between the northern flanks of the Alaska Range and the Interior and has slightly cooler summers and warmer winters than sites farther north away from the direct effects of the Alaska Range.

At park headquarters, daily weather observations have been recorded since 1925. Temperature extremes range from 91° F (33°C) to -54° F (-48°C). Summers are short and warm, and winters are long and cold. The average daily high temperature in July is 66° F (19°C), and the average daily low temperature in January is -8° F (-22°C). Total precipitation is relatively low at 15 inches (382 millimeters). The sub-zero temperatures in winter coupled with relatively low snowfall contribute to the presence of widespread permafrost.

The climate south of the Range is transitional between the mild and moist conditions near the Gulf of Alaska and the cold and dry of Interior Alaska. The mean annual precipitation at Talkeetna, just southeast of the Park, is 28 inches (711 mm), nearly double that at headquarters. The average daily high in July is 68° F (20 °C) and the average daily low temperature in January is 1.4° F (-17°C). Along the southern flanks of the Alaska Range snowfall is high, and snowcover is often present through late spring. Permafrost is generally absent.



Eielson Visitor Center – Denali National Park and Preserve
Period of Record 7/26/2005 - Present

The Eielson Visitor Center station is located on rolling tundra on the southern flanks of the Alaska Range at an elevation of 3944'. In the summer it is cooler and wetter than surrounding low elevation areas. Persistent winter inversions keep this site remarkably warm in the winter. The period of record average air temperature is 29.0°F. The total summer rainfall is on average 17.21 inches. The highest temperature recorded thus far is 76°F on 8/13/2005 and the lowest is -38°F on 1/25/2012.



2013 Summarized Data

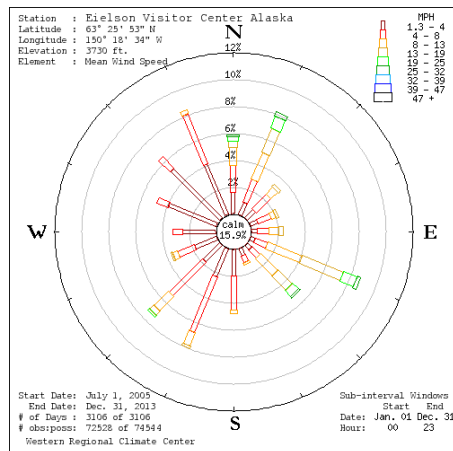
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	7	7	193	37	17	43	-26	19	16	X	X	X	m	
Feb-13	40	6	207	33	18	42	-17	20	17	X	X	X	m	
Mar-13	109	7	192	43	15	41	-19	17	14	X	X	X	m	
Apr-13	173	6	185	30	14	40	-13	16	13	X	X	X	m	
May-13	285	5	201	21	35	68	7	36	33	X	X	X	m	
Jun-13	244	7	181	27	55	76	37	56	54	X	X	X		1.74
Jul-13	192	6	208	32	52	74	37	53	51	X	X	X		8.55
Aug-13	147	6	178	28	49	70	34	50	48	X	X	X	1	6.83
Sep-13	84	6	169	32	36	58	17	37	36	X	X	X	2	
Oct-13	52	9	163	39	35	51	20	36	34	X	X	X	4	
Nov-13	12	7	207	42	16	44	-10	17	15	X	X	X	10	
Dec-13	3	5	234	33	18	47	-22	19	16	X	X	X	13	

m = missing data

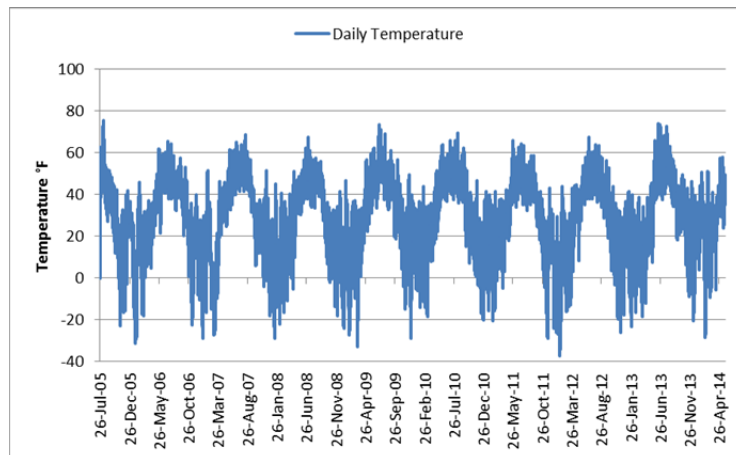
X Soil temperatures not measured at this site

Eielson Visitor Center Climatology 2005-2013:

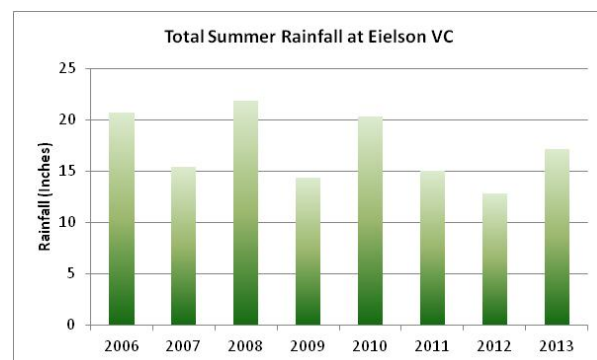
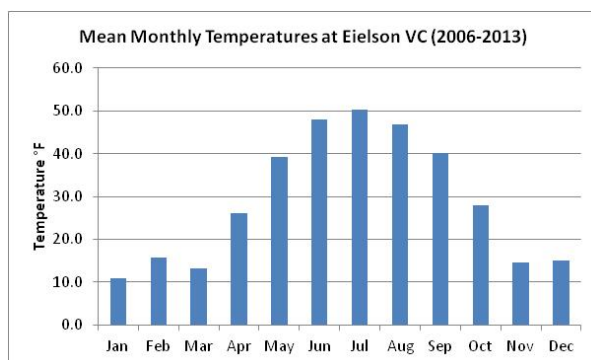
Wind rose climatology



Daily temperatures 2005-2013



Eielson VC mean monthly and annual temperatures and summer rainfall totals (Jun-Aug)



Eielson VC	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2005									38.2	20.3	m	9.9	X
2006	-8.0	6.3	0.6	20.7	39.7	47.6	52.3	45.4	40.6	24.3	-7.7	8.7	22.5
2007	m	-5.1	-8.1	29.6	m	52.2	54.2	m	m	19.3	14.1	-1.8	m
2008	-7.5	-2.1	8.9	25.6	40.2	49.0	48.6	44.0	38.1	13.9	7.7	-4.4	21.8
2009	-7.2	-1.3	-1.0	25.8	42.6	50.5	57.0	46.8	39.7	24.5	2.1	9.0	24.0
2010	-1.7	10.8	13.3	29.5	44.7	49.4	52.2	50.0	38.3	22.7	13.5	-9.9	26.1
2011	1.5	-2.2	7.7	23.9	42.7	48.8	51.4	46.6	39.8	22.8	-4.8	7.0	23.8
2012	-14.7	11.3	3.4	30.9	38.4	51.4	51.3	49.1	39.5	17.8	-4.8	-8.6	22.1
2013	-2.2	5.6	7.8	12.3	36.3	55.3	53.9	51.3	36.0	28.9	2.7	-1.9	23.8
Period of Record Average	-5.7	2.9	4.1	24.8	40.6	50.5	52.6	47.6	38.9	21.8	2.8	-0.2	23.5

Toklat Alaska – Denali National Park and Preserve
Period of Record 7/28/2005 - Present

The Toklat station sits on the banks of the Toklat River near the road camp on the north side of the Alaska Range at an elevation of 2920'. The Toklat River is a braided river fed by several large glaciers. High mountains surround the wide river valley. North winds (up valley) or south winds (down valley) are most common. The period of record average air temperature is 26.4°F. The total summer rainfall on average is 9.97 inches. The highest temperature recorded thus far is 79°F on 7/8/2009 and the lowest is -49°F on 2/10/2008.

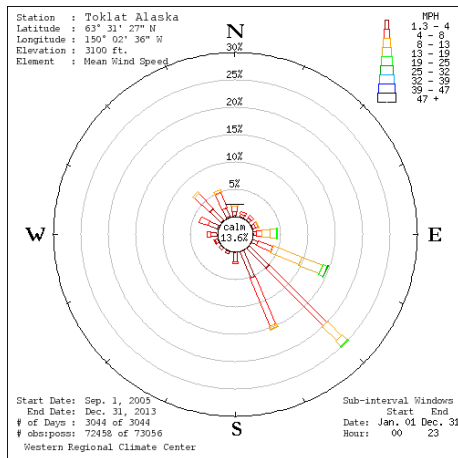


2013 Summarized Data

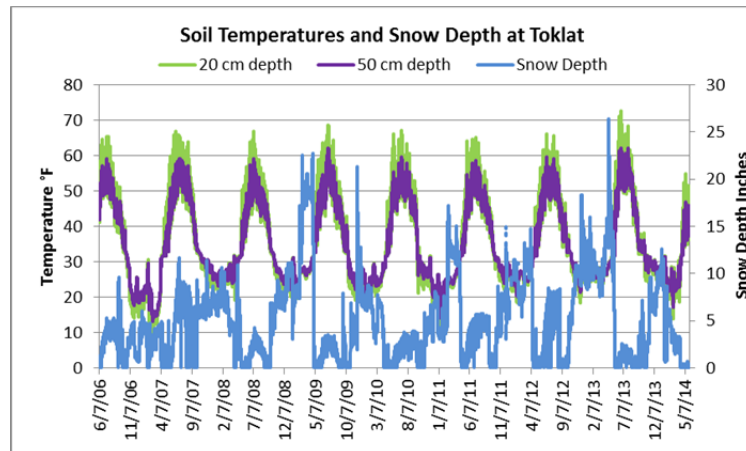
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	5	6	168	34	10	42	-45	12	8	27	26	27	10	
Feb-13	34	6	171	33	12	38	-30	14	10	27	26	27	10	
Mar-13	98	7	172	41	12	39	-23	14	10	26	25	26	9	
Apr-13	157	5	187	18	11	43	-28	14	9	28	28	28	15	
May-13	260	5	171	25	34	69	-4	36	32	33	34	33	10	
Jun-13	246	5	196	28	56	78	35	57	54	53	57	53	0	1.09
Jul-13	190	5	197	24	54	76	34	55	53	55	57	55	0	4.03
Aug-13	138	6	183	25	50	71	30	51	49	52	53	51	0	3.93
Sep-13	79	6	188	27	37	59	8	38	36	38	39	39	1	
Oct-13	45	8	148	30	34	52	11	36	33	31	32	32	2	
Nov-13	11	6	159	31	14	50	-26	16	12	28	29	30	6	
Dec-13	3	5	166	27	9	43	-30	12	6	27	27	28	8	

Toklat Climatology 2005-2013:

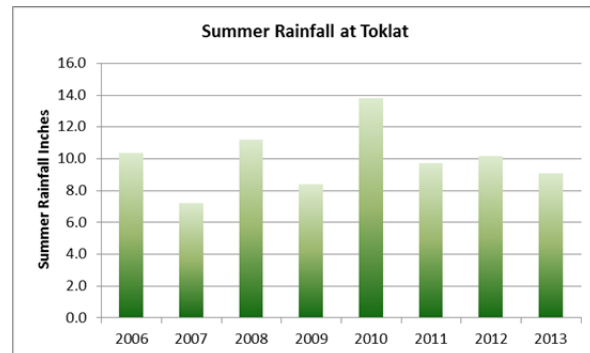
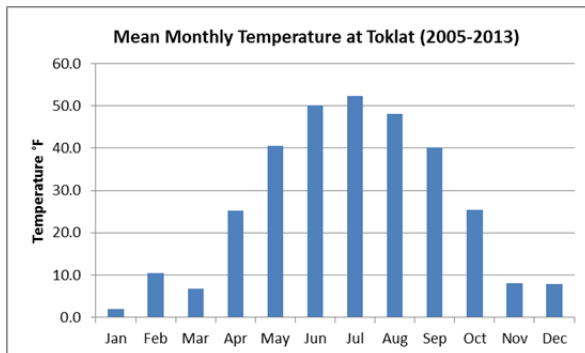
Wind rose climatology



Soil Temperatures and snow depth



Toklat mean monthly and annual temperatures and summer (Jun-Aug) rainfall 2006-2013.



Toklat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2005							48.6	50.8	40.5	23.5	-3.0	20.5	X
2006	-3.8	16.5	7.7	23.5	41.1	48.6	51.6	46.2	43.3	30.2	-1.6	11.8	26.2
2007	7.3	5.1	-8.5	33.1	42.0	51.3	53.3	51.2	41.4	20.6	22.8	10.3	27.5
2008	0.7	2.2	14.3	23.0	39.2	47.6	49.6	45.5	39.2	14.6	8.2	6.4	24.2
2009	1.6	9.6	4.7	25.3	42.3	49.1	57.0	47.2	39.2	30.3	6.3	17.9	27.5
2010	2.2	14.5	11.4	29.8	44.8	48.8	51.7	49.6	39.9	26.3	17.4	-3.7	27.7
2011	11.8	6.0	8.8	25.5	42.0	49.3	50.3	46.6	41.9	26.9	-1.3	9.6	26.4
2012	-14.7	18.5	3.9	30.5	39.1	50.3	50.9	48.4	39.4	19.8	-1.8	1.8	23.9
2013	10.3	12.0	12.5	11.5	33.9	55.9	53.8	50.2	37.1	34.3	14.1	9.0	27.9
Period of Record Average	1.9	10.6	6.8	25.3	40.5	50.1	52.3	48.1	40.2	25.4	8.0	7.9	26.4

Stampede – Denali National Park and Preserve
Period of Record 6/24/2003 – Present

The Stampede station is located in a mixed spruce and deciduous forest near treeline at 1800'. The site is on the eastern edge of the Kantishna Hills; the Toklat River Valley and Toklat Basin are to the east and to the west are rolling hills and high alpine peaks. It is cold in the winter and warm in the summer, with low annual precipitation. The winds are often calm at this site. The period of record average air temperature is 24.5°F. The total summer rainfall on average is 9.97 inches. The highest temperature recorded thus far is 87°F on 6/25/2013 and the lowest is -52°F on 1/29/2012.

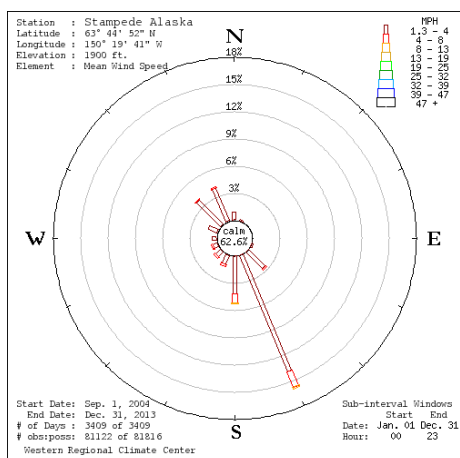


2013 Summarized Data

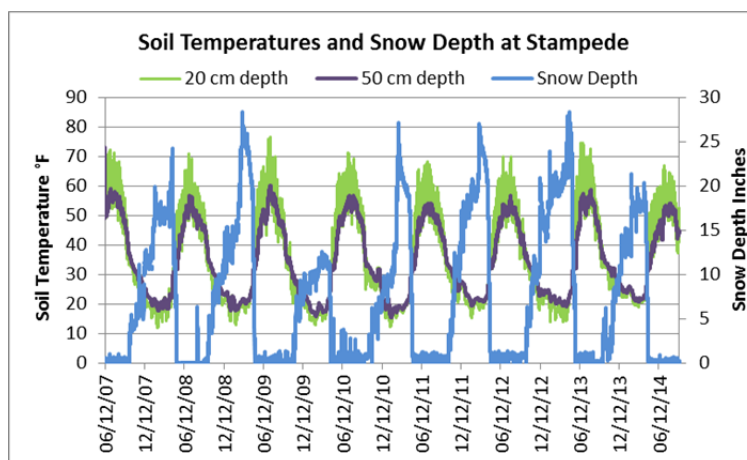
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	2	1	210	17	0	38	-49	2	-1	18	21	24	18	
Feb-13	7	1	213	9	-1	37	-44	1	-3	15	19	22	20	
Mar-13	104	2	199	19	9	48	-30	12	7	14	18	21	20	
Apr-13	157	2	207	10	16	50	-30	18	14	16	19	21	24	
May-13	267	2	205	10	39	79	3	41	38	35	34	31	13	
Jun-13	263	2	230	11	59	87	31	61	57	61	58	50	1	0.74
Jul-13	194	2	232	9	57	83	35	58	55	59	59	54	1	0.78
Aug-13	145	1	220	13	52	83	25	53	51	55	55	53	0	2.16
Sep-13	68	1	212	10	38	67	8	39	37	39	40	42	0	
Oct-13	38	1	188	15	32	54	11	33	30	30	32	34	2	
Nov-13	5	1	202	16	9	49	-41	10	8	27	28	31	6	
Dec-13	1	1	188	11	-1	42	-46	0	-2	24	25	27	11	

Stampede Climatology 2004-2013:

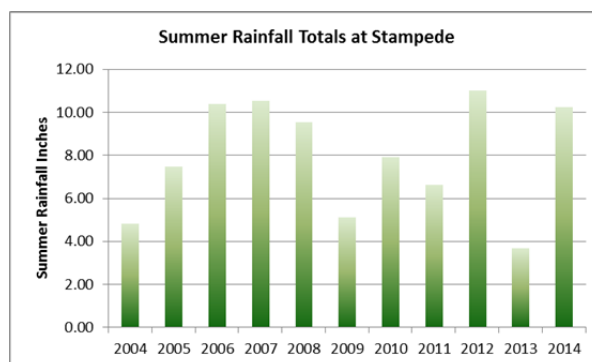
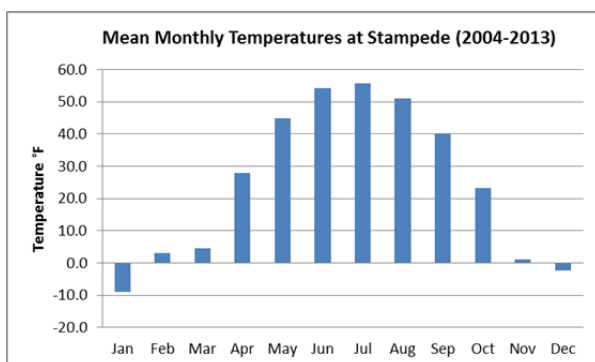
Wind rose climatology



Soil Temperatures and snow depth



Stampede mean monthly and annual temperatures and summer (Jun-Aug) rainfall 2004-2013:



Stampede	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2003						55.7	56.1	50.7	35.1	27.6	10.8	-8.9	X
2004	-15.0	5.1	2.9	31.5	47.5	60.3	59.3	56.3	33.4	25.9	10.6	-1.4	26.4
2005	-3.6	1.9	14.9	27.5	48.9	54.8	56.8	53.2	41.0	21.5	-9.1	4.5	26.0
2006	-17.7	12.4	2.7	23.8	44.8	52.5	54.5	48.4	44.3	28.9	-10.7	-0.9	23.6
2007	-2.3	-4.2	-9.1	34.7	45.3	54.1	56.6	53.2	41.8	17.8	14.8	-0.4	25.2
2008	-5.8	-4.8	10.7	26.2	42.5	51.0	52.7	47.5	39.8	13.1	0.2	-4.4	22.4
2009	-10.7	4.3	1.7	28.5	44.8	52.2	59.4	49.1	40.6	27.0	-0.5	3.5	25.0
2010	-11.2	5.1	8.0	32.1	47.2	52.3	54.6	52.3	40.0	23.7	13.4	-15.8	25.1
2011	-1.3	1.2	5.0	27.0	44.9	52.7	53.8	48.5	42.5	24.7	-9.3	3.8	24.4
2012	-23.4	9.8	-0.1	33.0	42.1	53.9	53.3	49.9	40.7	18.4	-7.8	-11.5	21.5
2013	0.4	-0.8	9.4	15.7	39.1	58.8	56.6	52.1	37.8	31.6	9.0	-0.9	25.7
Period of Record Average	-9.1	3.0	4.6	28.0	44.7	54.3	55.8	51.0	40.2	23.3	1.1	-2.4	24.5

Dunkle Hills – Denali National Park and Preserve Period of Record 8/5/2004 - Present

The Dunkle Hills station sits above treeline on the south side of the Alaska Range in rolling hills just south of Broad Pass at an elevation of 2651'. Temperatures are moderated by the warmer air flow coming from the North Pacific Ocean.

Temperatures are cool in the summer and relatively warm in the winter, typical of a transitional maritime climate. Snowfall is abundant. The period of record average air temperature is 27.1°F. The total summer rainfall on average is 10.02 inches. The highest temperature recorded thus far is 84°F on 6/26/2013 and the lowest is -34°F on 2/3/2009.



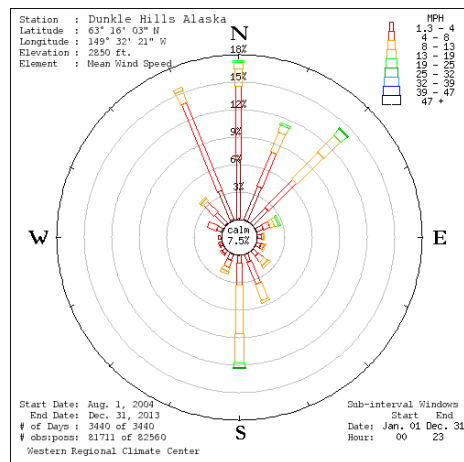
2013 Summarized Data

2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	8	7	124	32	13	34	-27	14	12	20	21	m	10	
Feb-13	31	6	139	36	15	32	-22	17	14	22	22	m	14	
Mar-13	116	7	156	25	12	39	-23	13	10	22	23	m	16	
Apr-13	214	8	163	29	15	43	-13	16	13	22	23	m	21	
May-13	287	6	213	25	33	66	3	34	32	29	29	m	20	
Jun-13	270	7	186	31	54	84	31	56	53	50	48	m	0	0.62
Jul-13	201	7	195	25	53	77	36	54	52	54	53	m	0	0.68
Aug-13	156	7	192	26	50	70	27	51	49	51	51	48	0	3.61
Sep-13	76	6	196	29	38	56	10	39	37	39	39	39	0	
Oct-13	37	6	190	30	32	45	13	32	31	33	33	33	4	
Nov-13	16	7	206	33	11	33	-26	12	10	32	32	32	29	
Dec-13	6	8	220	33	8	34	-21	10	6	31	31	32	30	

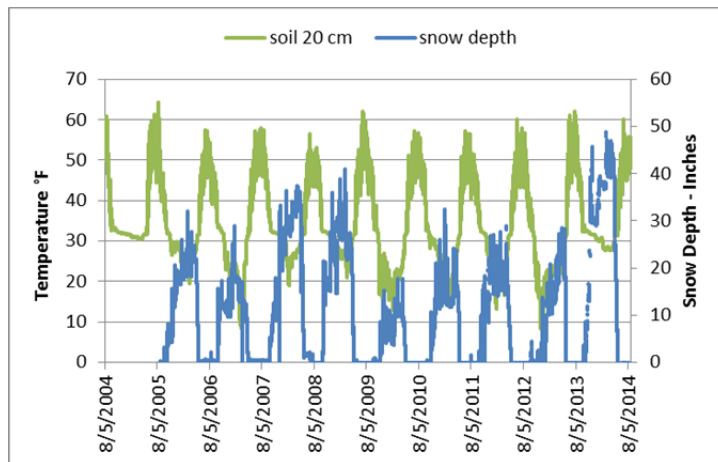
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Dunkle Hills Climatology 2004-2013:

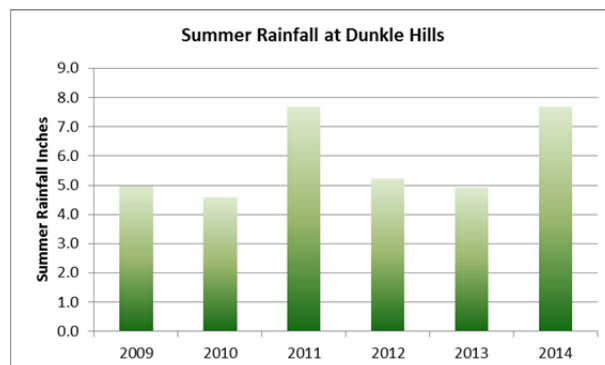
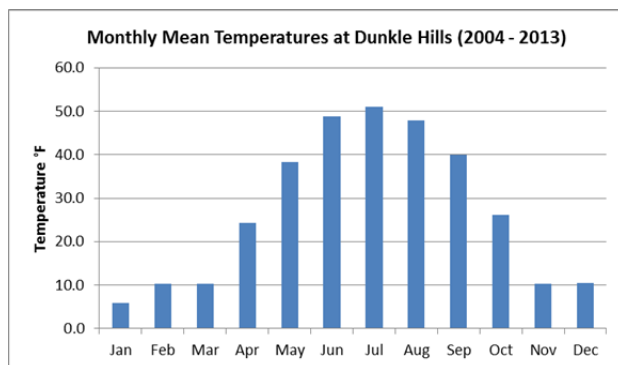
Wind rose climatology



Soil Temperatures and snow depth



Dunkle Hills mean monthly and annual temperatures and summer (Jun – Aug) rainfall



Dunkle Hills	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2004								55.0	32.4	25.5	17.1	11.5	28.3
2005	7.5	9.4	17.8	25.0	37.5	50.3	52.6	50.3	39.3	24.8	5.1	16.4	27.2
2006	-0.6	9.9	6.4	21.1	37.4	46.5	51.3	45.6	41.4	27.1	3.5	13.6	26.2
2007	9.2	6.3	-1.8	30.1	40.4	50.5	51.7	50.3	40.1	23.9	22.0	10.7	29.4
2008	4.6	5.9	16.3	22.7	36.6	46.0	48.1	46.8	39.6	18.1	13.1	6.9	24.9
2009	3.8	7.1	8.8	24.2	40.6	48.3	55.4	46.9	40.8	31.1	9.1	16.2	28.8
2010	10.0	16.1	15.6	27.0	42.8	46.8	48.6	48.5	41.2	28.2	19.5	3.7	28.2
2011	11.3	6.3	10.3	25.7	39.9	48.3	50.1	46.1	40.9	26.5	2.4	12.7	25.7
2012	-5.6	15.9	7.3	29.1	36.5	49.0	49.0	47.1	37.6	23.7	6.7	5.3	24.1
2013	13.1	15.3	11.6	14.6	32.9	54.2	53.1	49.5	38.0	31.7	11.0	8.0	27.7
Period of Record Average	5.9	10.2	10.2	24.4	38.3	48.9	51.1	47.9	39.9	26.1	10.3	10.4	27.1

Ruth Glacier– Denali National Park and Preserve
Period of record 9/2008 -Present

The Ruth Glacier station sits on the southern flanks of the Tokosha Mountains just west of the terminus of the Ruth Glacier in the Alaska Range at an elevation of 3300'. It is an alpine site within the transitional maritime climate region influenced by the moisture and warmth of the Pacific Ocean. The temperatures are cool in summer and relatively warm in the winter. The site gets abundant snowfall and summer rain. The period of record average air temperature is 31.8°F. The total summer rainfall on average is 17.93 inches. The highest temperature recorded thus far is 81°F on 6/26/2013 and the lowest is -17°F on 1/27/2013.

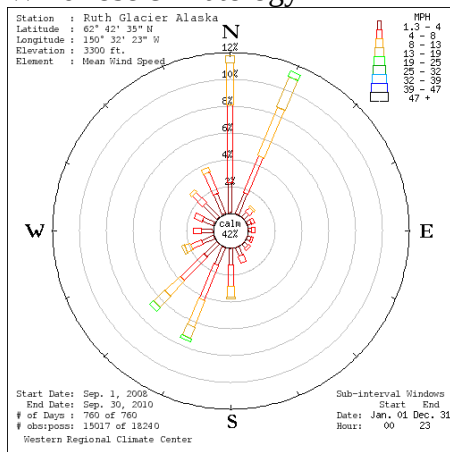


2013 Summarized Data

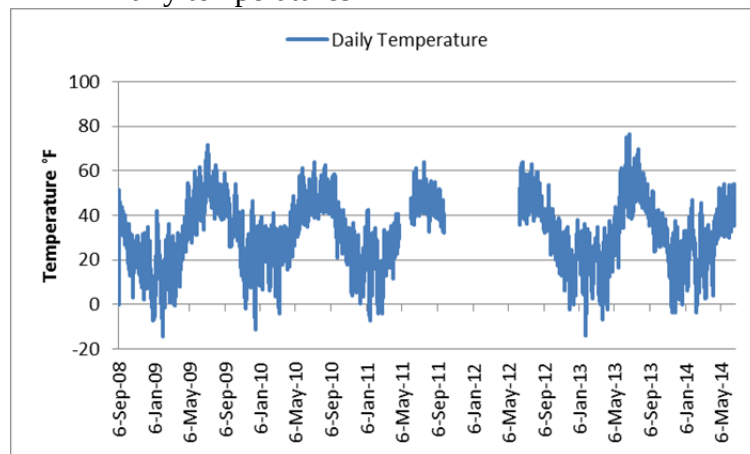
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	191	6	308	49	19	36	-17	20	18	20	m	m	7	
Feb-13	322	5	270	30	20	35	1	21	20	25	m	m	26	
Mar-13	581	5	289	38	17	38	-8	19	16	24	m	m	23	
Apr-13	773	5	272	23	19	47	-4	21	18	25	m	m	26	
May-13	1147	5	347	32	36	64	15	37	35	30	m	m	32	
Jun-13	1202	5	355	36	53	81	34	54	51	55	m	m	1	0.79
Jul-13	1060	7	m	34	51	71	36	52	50	53	m	m	0	3.82
Aug-13	913	7	m	30	48	64	37	49	47	50	m	m	0	10.25
Sep-13	592	7	m	41	39	52	23	40	38	39	m	m	0	
Oct-13	426	11	m	42	33	44	24	34	32	33	m	m	9	
Nov-13	208	9	m	38	17	35	-6	18	16	32	m	m	20	
Dec-13	99	7	m	<u>53</u>	20	38	-2	21	18	31	m	m	26	

Ruth Glacier Climatology 2008-2013:

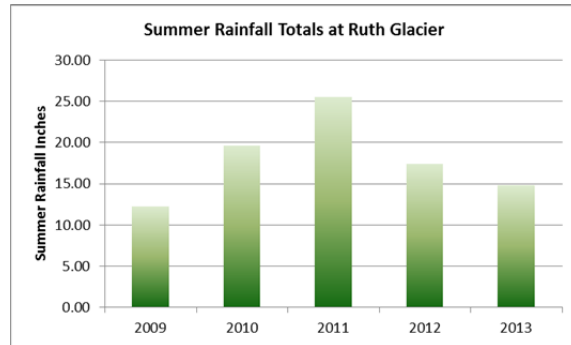
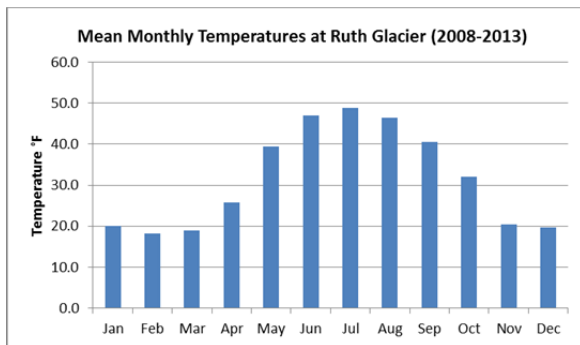
Wind rose climatology



Daily temperatures



Ruth Glacier mean monthly and annual temperatures and summer (Jun-Aug) rainfall



Ruth Glacier	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008									37.4	23.4	20.3	17.2	
2009	14.7	14.8	16.1	27.0	40.7	45.6	54.1	46.3	41.3	34.8	17.5	25.5	31.5
2010	24.7	24.2	21.5	28.9	41.9	43.2	45.6	47.3	43.5	31.4	24.3	17.1	32.8
2011	21.4	13.7	21.5	28.1	m	44.7	47.3	44.5	41.6	m	m	m	m
2012	m	m	m	m	m	48.5	46.2	45.7	37.4	29.0	22.7	16.2	m
2013	19.4	20.4	17.1	19.1	35.8	52.7	51.1	48.0	38.8	33.0	16.9	19.8	31.0
Period of Record Average	20.0	18.3	19.0	25.8	39.5	46.9	48.8	46.4	40.5	32.1	20.4	19.7	31.8

Wigand – Denali National Park and Preserve
Installed August 13, 2013

The Wigand Creek site (Elev. 1717') is located on the flat tundra plain of the Toklat Basin, north of the Alaska and Outer Ranges. The area is underlain by permafrost with shrubby vegetation and tussock tundra. Lightning and wild fires are common in the summer. The temperatures are warm in the summer and cold in the winter; there is low annual precipitation. The area is often scoured by wind in winter. This site was installed in 2013 near the location of a site by the same name that collected weather data from 2003-2007.



2013 Summarized Data

2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Sep-13	83	5	206	29	39	67	14	40	38	35	34	32	1	1.87
Oct-13	46	5	189	41	34	56	17	35	32	32	32	32	1	
Nov-13	11	6	207	50	12	49	-24	13	11	30	32	32	2	
Dec-13	3	4	187	30	3	43	-34	5	2	26	28	31	6	

Fire RAWS sites in Denali – 2013 Summary

Denali Visitor Center: Located in a mixed forest near the entrance of the park.

	Wind Speed	Wind Direction	Wind Gust	Temperature			Summer Rain
Date	mph	Deg	mph	°F			In.
	Ave.	Ave.	Max.	Ave.	Max.	Min.	Total
Jan-13	3	198	24	9	41	-48	
Feb-13	8	220	23	9	41	-41	
Mar-13	4	208	<u>31</u>	13	46	-31	
Apr-13	3	232	23	17	49	-30	
May-13	4	249	24	40	83	7	
Jun-13	3	196	23	60	91	28	0.5
Jul-13	3	190	24	55	79	35	1.54
Aug-13	3	201	24	55	83	25	3.55
Sep-13	3	218	26	40	64	8	
Oct-13	4	193	27	36	54	9	
Nov-13	2	211	28	11	39	-39	
Dec-13	2	193	29	-3	35	-42	

Wonder Lake RAWS: Located NW of Wonder Lake, near the Ranger Station.

	Wind Speed	Wind Direction	Wind Gust	Temperature			Summer Rain
Date	mph	Deg	mph	°F			In.
	Ave.	Ave.	Max.	Ave.	Max.	Min.	Total
Jan-13	5	32	49	5	44	-34	
Feb-13	3	56	26	4	35	-31	
Mar-13	4	79	<u>46</u>	12	45	-22	
Apr-13	5	80	39	16	54	-20	
May-13	4	37	92	39	79	9	
Jun-13	6	34	23	60	84	34	0.88
Jul-13	5	326	34	57	82	36	3.74
Aug-13	4	9	33	52	80	30	3.22
Sep-13	4	16	29	37	63	8	
Oct-13	4	74	44	31	48	13	
Nov-13	5	42	53	11	45	-22	
Dec-13	4	51	54	4	39	-34	

Lake Minchumina: Located west of Lake Minchumina and west of the airstrip.

	Wind Speed	Wind Direction	Wind Gust	Temperature			Summer Rain
Date	mph	Deg	mph	Deg F			In.
	Ave.	Ave.	Max.	Ave.	Max	Min	Total
Jan-13	4	25	42	3	35	-41	
Feb-13	3	65	23	1	22	-28	
Mar-13	3	20	34	11	45	-22	
Apr-13	4	26	31	23	55	-15	
May-13	3	16	21	45	86	14	
Jun-13	2	297	28	65	90	42	0.54
Jul-13	1	269	22	61	89	42	2.11
Aug-13	1	278	25	57	83	35	1.88
Sep-13	1	348	17	41	61	21	
Oct-13	2	332	27	34	50	21	
Nov-13	3	276	<u>44</u>	11	42	-18	
Dec-13	3	12	41	1	28	-30	

Wrangell – St. Elias National Park and Preserve

Climate Summary

Wrangell – St. Elias has four major mountain ranges that affect the climate of the park. The St. Elias Range curves northeast from the Canadian border and merges with the Wrangell Mountain Range forming the mountainous heart of the park. The Chugach Mountain Range defines the southern boundary, and the eastern portion of the Alaska Range makes up the northern region. Most of the precipitation coming off of the Pacific Ocean is deposited with the first 100 km of the coast in the high mountains and icefields that dominate the southern regions of the park. The climate quickly transitions to an interior continental climate as you travel north from the coast. The large river valleys of the Copper and Chitina Rivers have long, cold winters, and short, warm, relatively dry summers. The low temperature on record for May Creek, between the Chitina and Nizina Rivers is -51°F; the high temperature on record is 92°F – a difference of 143 degrees. The valley bottoms in the northern region of the park between the Wrangell and Alaska Range have some of the coldest winter temperatures in the state and with relatively warm summers.

The southeast portion of Wrangell – St. Elias has locations that are viable candidates for the wettest location in the world, where climate models have estimated annual precipitation amounts as high as 470 inches. Most of the Chugach Range receives between 115-275 in. of precipitation annually, and above about 5000 ft. most of this precipitation falls as snow. The transition to drier climates occurs over a very short distance. Along the Chitina River on the north side of the coastal ice fields, the annual precipitation range is as low as 12-20 in. The central mountain peaks of the Wrangell Mountains (Mt. Sanford, Mt. Wrangell, etc.) receive “only” 80-120 in. of precipitation. On the north side of this range, annual precipitation declines to only 8 – 12 inches, most of that falling as rain in the summer.



Tana Knob

Period of record 7/6/2005 - Present

Tana Knob (Elev. 3739') is located in the Chugach Mountain Range in the Tana River valley south of the Bagley Icefield. The site sits on the high bench above the confluence of the Tana and West Fork Tana Rivers. The temperatures are cool in the summer and moderate in the winter. There is abundant snowfall and summer rain due to the elevation and proximity to the Gulf of Alaska. The site has had frequent problems with wildlife reducing the availability of good data for analysis. Based on complete available years of record the average air temperature is 28.8°F. The highest temperature recorded thus far is 75°F on 8/13/2005 and the lowest is -32°F on 1/7/2009.

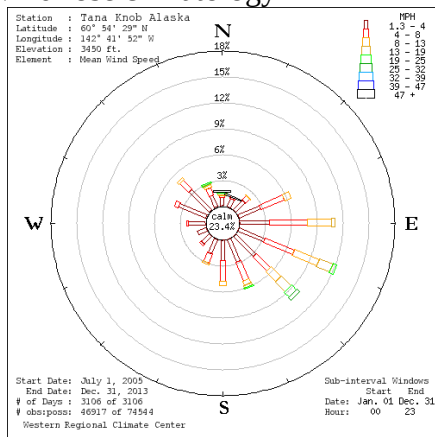


2013 Summarized Data

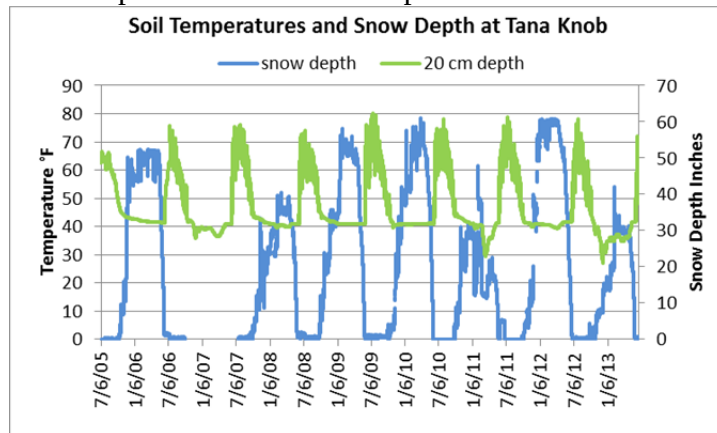
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	11	6	161	35	20	41	19	21	-28	27	27	29	21	
Feb-13	39	6	142	43	23	38	22	24	4	28	28	29	36	
Mar-13	110	7	176	41	18	40	17	19	-3	27	28	29	39	
Apr-13	209	6	190	42	21	38	20	23	7	27	28	29	37	
May-13	263	7	176	38	39	65	38	40	23	31	31	31	26	
Jun-13	m	m	m	m	m	m	m	m	m	m	m	m	m	m
Jul-13	m	m	m	m	m	m	m	m	m	m	m	m	m	m
Aug-13	m	m	m	m	m	m	m	m	m	m	m	m	m	m
Sep-13	m	m	m	m	m	m	m	m	m	m	m	m	m	m
Oct-13	m	m	m	m	m	m	m	m	m	m	m	m	m	m
Nov-13	m	m	m	m	m	m	m	m	m	m	m	m	m	m
Dec-13	m	m	m	m	m	m	m	m	m	m	m	m	m	m

Tana Knob Climatology 2005-2013:

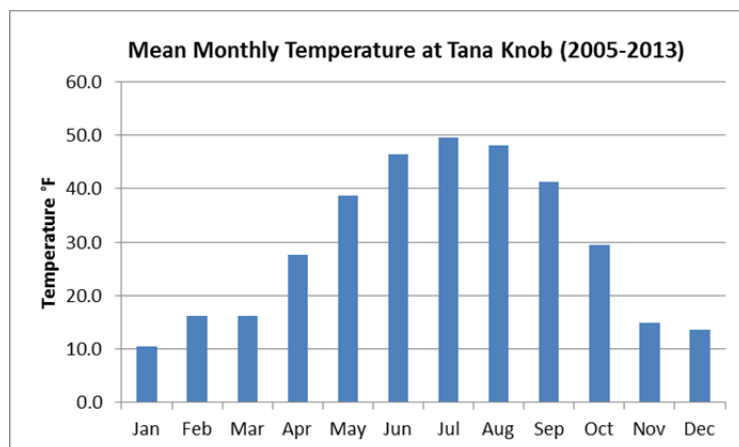
Wind rose climatology



Soil temperatures and snow depth



Tana Knob mean monthly and annual temperatures



Note: There are not enough good quality precipitation values for analysis at this site.

Tana Knob	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2005							49.5	50.5	41.2	26.7	8.5	20.8	X
2006	6.4	10.6	7.7	23.6	35.9	45.3	49.6	45.9	42.0	36.0	m	m	X
2007	m	m	m	m	m	m	50.5	50.7	41.4	29.0	26.1	15.1	X
2008	11.2	9.5	21.9	28.7	38.1	43.7	46.4	45.9	40.1	24.5	19.2	8.8	28.2
2009	6.6	13.5	14.3	28.9	40.9	48.3	55.5	47.7	42.2	33.1	14.9	22.5	30.7
2010	12.8	24.7	21.6	29.3	40.4	m	48.3	49.5	42.9	30.2	22.3	1.2	X
2011	15.7	10.4	13.5	29.2	40.4	46.2	49.2	46.0	40.4	31.4	9.6	21.0	29.4
2012	0.8	21.6	16.6	32.5	36.1	44.6	47.6	47.8	40.2	24.9	4.4	5.2	26.9
2013	19.9	22.7	17.9	21.4	39.2	50.3	m	m	m	m	m	m	
Period of Record Average	10.5	16.1	16.2	27.6	38.7	46.4	49.6	48.0	41.3	29.5	15.0	13.5	28.8

Chititu

Period of Record 8/20/2004 - Present

Chititu sits high on a ridge between the Chugach and Wrangell Mountain Ranges at an elevation of 4544'. It is a windy location with gusts up to 70 mph. Temperatures are cool in the summer and warm in the winter due to persistent inversions. The area is scoured in the winter, so any snow that falls is quickly redistributed. Summer rainfall is also difficult to catch due to the exposure. The period of record average temperature is 28.8°F. The highest temperature recorded thus far is 73°F on 6/26/2013 and the lowest is -30°F on 1/28/2013.



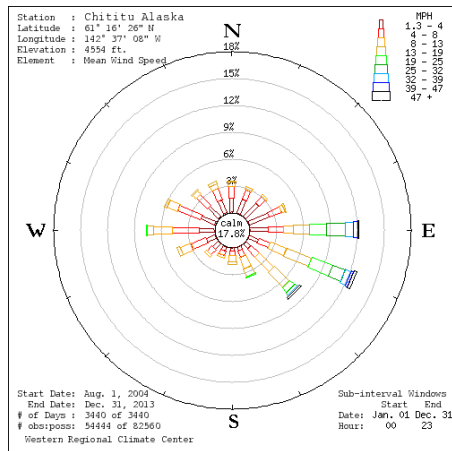
2013 Summarized Data

2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth*	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	104	10	152	45	17	37	-30	18	19	20	19	24	m	
Feb-13	313	13	135	57	19	32	0	20	21	18	18	20	m	
Mar-13	541	9	175	58	14	32	-12	15	15	14	14	15	m	
Apr-13	702	8	216	41	16	35	-4	17	17	19	19	19	m	
May-13	774	8	197	53	36	62	14	37	36	35	33	31	m	
Jun-13	849	6	220	40	49	73	30	51	49	52	47	40	m	0.67
Jul-13	855	6	269	26	50	68	37	51	50	55	50	47	m	1.24
Aug-13	743	6	195	32	49	67	33	50	48	51	49	50	m	1.71
Sep-13	637	9	196	65	37	50	23	38	38	38	42	42	m	
Oct-13	409	14	163	<u>70</u>	33	48	18	33	33	32	36	36	m	
Nov-13	246	8	228	68	13	34	-23	14	13	25	26	30	m	
Dec-13	99	5	205	50	15	33	-18	16	15	18	18	25	m	

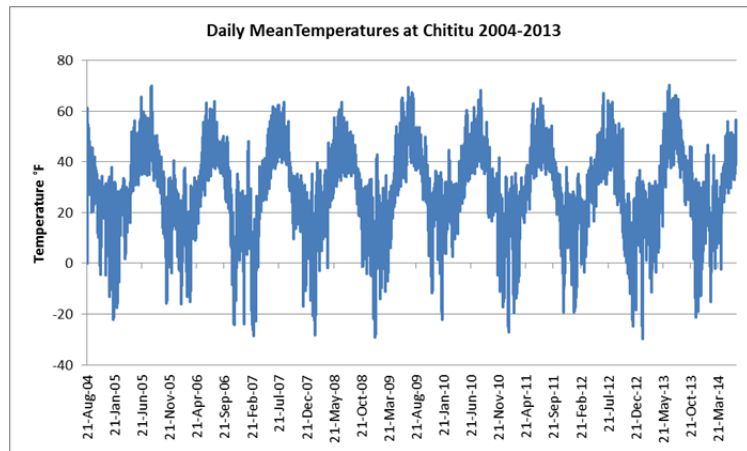
* snow depth sensor not working correctly

Chititu Climatology 2004-2013:

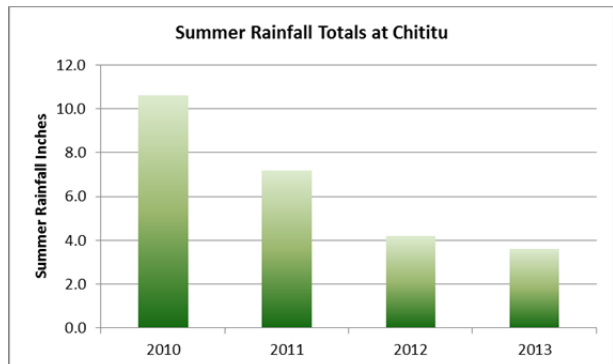
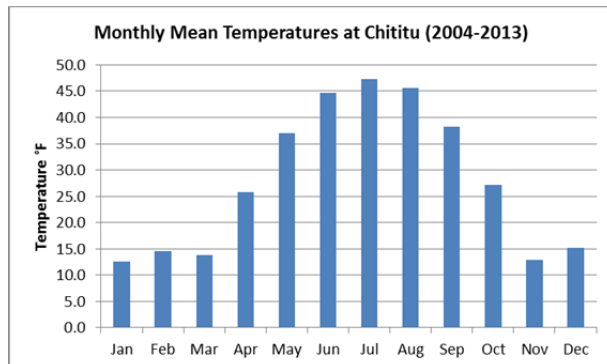
Wind rose climatology



Daily Mean Temperatures



Chititu mean monthly and annual temperatures and summer (Jun-Aug) rainfall totals 2010-2013



Chititu	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2004								48.1	32.9	26.4	21.1	16.4	
2005	12.3	14.2	21.3	29.4	39.7	45.6	45.7	48.4	38.2	25.3	11.7	23.0	29.6
2006	11.2	14.3	10.0	22.1	34.8	43.1	47.9	43.0	38.9	29.0	-3.6	19.5	25.8
2007	16.4	6.1	1.3	29.0	35.8	47.7	47.5	48.3	38.4	26.0	24.4	14.4	27.9
2008	10.9	9.3	19.4	26.0	36.8	42.5	43.9	42.7	37.4	22.4	19.0	9.8	26.7
2009	8.8	12.2	12.2	26.4	38.7	45.7	53.6	45.1	39.8	30.7	15.0	24.0	29.4
2010	16.2	25.7	19.9	27.4	40.1	41.6	46.0	46.7	39.4	28.5	20.8	5.4	29.8
2011	15.4	8.1	11.7	26.2	38.2	43.8	46.6	43.2	38.1	28.8	9.0	19.4	27.4
2012	4.1	21.2	15.3	30.4	33.7	42.5	44.3	44.5	36.8	20.6	6.8	5.7	25.5
2013	17.2	19.3	13.6	15.5	35.7	49.4	50.1	48.5	37.4	32.8	12.8	15.1	28.9
Period of Record Average	12.5	14.5	13.8	25.8	37.0	44.6	47.3	45.6	38.3	27.1	12.9	15.2	27.9

Gates Glacier

Period of Record 7/6/2005 - Present

The Gates Glacier site is located on a ridge between the Gates and Kennicott Glaciers in the Wrangell Mountains at an elevation of 4060'. Temperatures are cool in the summer and moderate in the winter due to a persistent inversion that generally sets up in mid-October. Winds move up and down valley, but are not terribly gusty. The site receives an abundant amount of snow in winter and has on average ~ 10.35 inches of summer rainfall. The period of record average temperature is 28.9°F. The lowest temperature recorded thus far is 74°F on

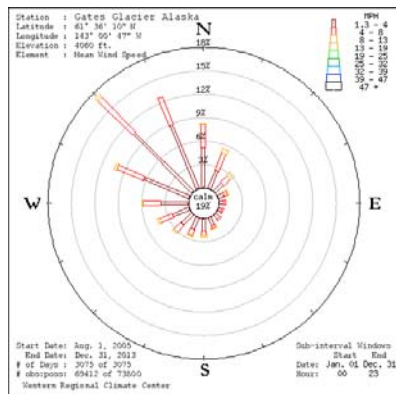


2013 Summarized Data

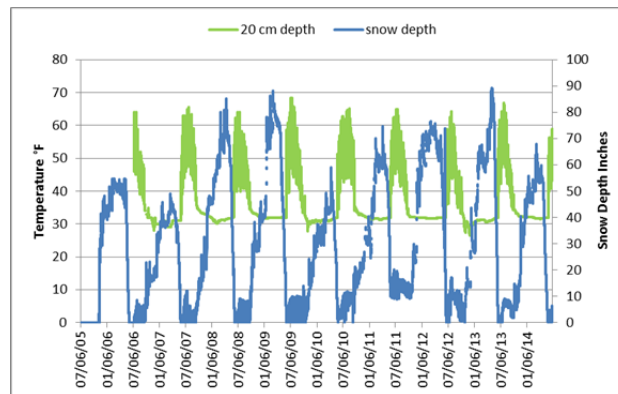
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	5	4	232	33	20	36	-31	21	19	31	31	32	38	
Feb-13	33	4	264	25	22	37	4	23	21	31	31	32	63	
Mar-13	112	4	256	29	16	38	-7	18	15	31	31	32	60	
Apr-13	196	4	227	33	19	39	3	21	17	30	31	32	69	
May-13	240	4	232	20	37	64	18	39	36	31	31	32	78	
Jun-13	281	4	217	38	50	73	32	52	49	40	38	33	19	0.45
Jul-13	220	3	212	19	51	68	37	53	50	55	53	45		3.12
Aug-13	165	3	209	16	49	68	36	50	48	52	51	48		6.1
Sep-13	70	4	224	22	39	50	26	40	38	40	41	43	6	
Oct-13	34	4	202	27	34	49	21	35	33	34	34	37	8	
Nov-13	20	3	243	29	15	35	-20	16	13	32	33	35	18	
Dec-13	7	3	257	20	17	35	-15	19	15	32	32	34	36	

Gates Glacier Climatology 2005-2013:

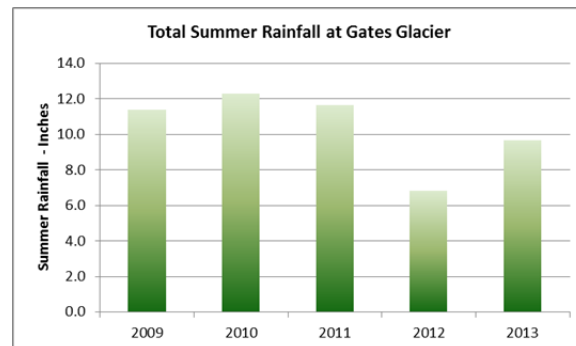
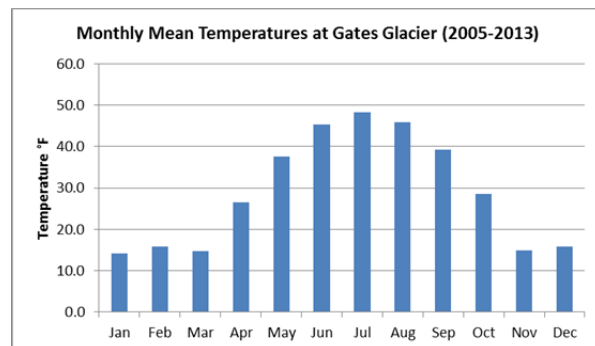
Wind rose climatology



Soil Temperature and snow depth



Gates Glacier mean monthly and annual temperatures and summer rainfall 2009-2013



Gates Glacier	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2005							47.5	49.8	39.0	27.0	13.4	24.0	
2006	12.3	14.0	11.7	23.2	36.4	44.5	49.1	42.9	39.6	28.9	-0.8	20.8	26.9
2007	17.3	8.0	4.0	29.4	36.6	48.5	48.4	49.1	38.8	26.9	25.7	16.8	29.1
2008	13.0	11.4	20.6	26.4	37.1	42.6	44.0	43.4	37.7	23.2	20.3	11.9	27.6
2009	10.0	13.1	13.5	27.1	39.2	46.4	54.6	45.3	40.8	32.3	16.2	24.3	30.2
2010	17.9	26.8	21.4	28.1	40.7	42.4	46.1	47.6	40.8	29.5	22.5	7.2	30.9
2011	16.7	9.8	14.2	27.0	39.0	44.3	47.2	43.9	38.6	29.4	11.2	19.9	28.4
2012	6.0	22.1	16.6	31.4	34.3	43.5	45.6	46.0	38.4	24.2	10.1	9.1	27.3
2013	19.6	21.7	16.5	19.0	37.3	50.5	51.3	49.3	39.0	33.6	14.5	17.1	30.8
Period of Record Average	14.1	15.9	14.8	26.5	37.6	45.3	48.3	45.9	39.2	28.5	15.0	15.9	28.9

Tebay

Period of Record 7/8/2005 – Present

The Tebay site is located on the shores of the upper Tebay Lake in a spruce forest that has been devastated by beetles at an elevation of 1880'. This site is surrounded by high peaks of the Chugach Mountain Range between the Chitina and Copper river Valleys. The summers are warm and the winter temperatures are moderate given the proximity to the Gulf of Alaska. There is abundant snowfall in winter and on average ~ 5.49 inches of rainfall in the summer. The period of record average temperature is 28.9°F. The highest temperature recorded thus far is 84°F on 6/17/2013 and the lowest is -36°F on 1/1/2009.

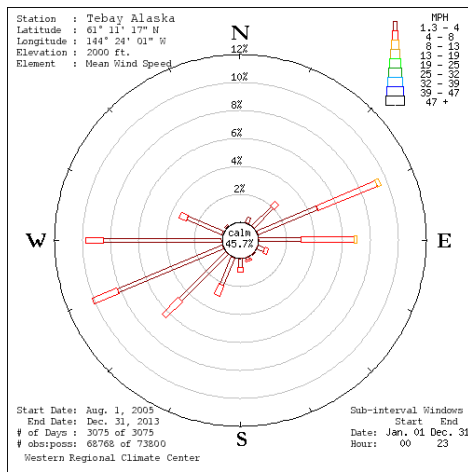


2013 Summarized Data

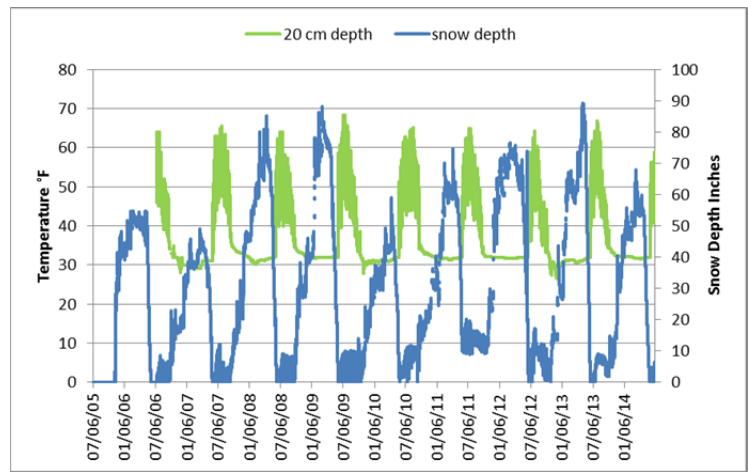
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	5	2	132	14	14	38	14	15	-20	30	30	31	18	
Feb-13	14	2	134	11	19	37	18	19	-2	30	31	31	36	
Mar-13	58	2	149	<u>22</u>	16	43	14	18	-14	30	30	31	38	
Apr-13	159	2	162	19	23	45	21	24	-10	30	30	31	43	
May-13	213	2	204	13	38	63	37	39	17	32	32	31	27	
Jun-13	256	3	230	14	52	86	51	54	31	45	45	37	1	0.38
Jul-13	222	3	232	10	55	79	53	56	40	54	54	48	0	1.3
Aug-13	150	3	231	11	52	69	51	53	33	53	53	50	0	2.74
Sep-13	65	2	168	10	43	58	43	44	29	46	46	46		
Oct-13	34	2	184	12	37	52	36	38	19	37	38	39	4	
Nov-13	8	2	137	13	16	40	15	16	-24	32	32	34	17	
Dec-13	1	3	86	13	4	26	4	5	-26	32	32	33	24	

Tebay Climatology 2005-2013:

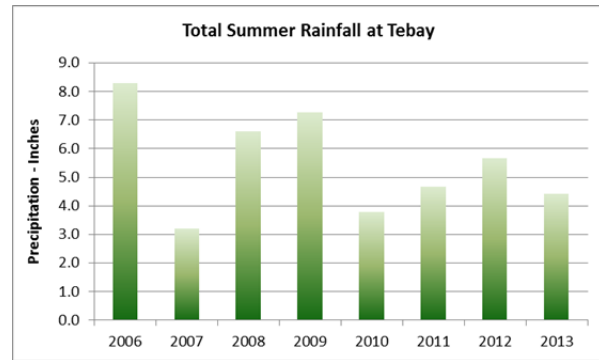
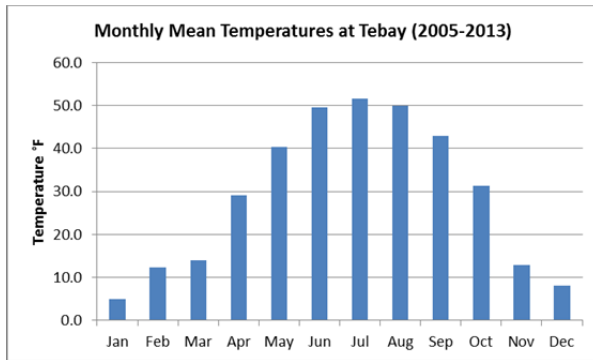
Wind rose climatology



Soil Temperatures and snow depth



Tebay mean monthly and annual temperatures and summer (Jun-Aug) rainfall 2006-2013

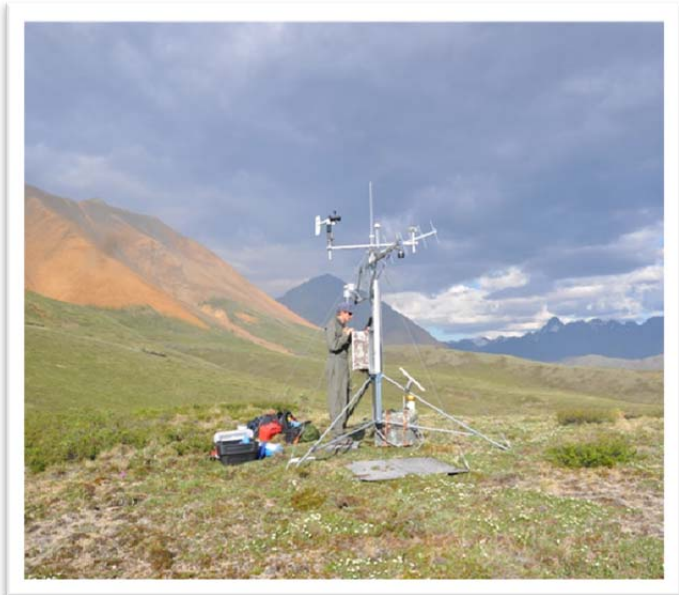


Tebay	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2005							53.6	52.8	44.0	29.4	8.3	14.1	
2006	-2.9	10.5	9.0	26.5	38.7	48.6	52.8	48.6	43.7	34.1	-1.1	14.4	26.9
2007	12.9	7.0	6.0	31.4	41.3	51.3	53.1	52.1	43.6	30.6	23.3	11.1	30.3
2008	3.8	7.6	19.5	30.1	40.1	46.4	48.7	48.2	42.1	26.0	16.4	2.5	27.6
2009	4.3	9.3	16.0	30.3	43.8	54.9		49.1	43.4	34.7	13.3	13.3	28.4
2010	3.2	18.1	20.8	29.5	41.0	48.4	49.9	51.2	42.6	30.8	21.1	-1.4	29.6
2011	6.6	8.7	11.2	30.9	42.9	49.6	52.6	49.1	42.3	31.9	8.4	19.9	29.5
2012	-3.1	18.8	12.8	31.3	37.1	45.9	49.5	49.4	42.2	25.9	5.5	-0.2	26.3
2013	14.3	18.7	16.2	22.8	37.9	52.2	54.6	51.5	43.4	36.8	15.6	4.5	30.7
Period of Record Average	4.9	12.3	13.9	29.1	40.3	49.7	51.6	49.9	42.9	31.3	12.8	8.0	28.9

Chicken Creek

Period of Record 8/1/2004 - Present

The Chicken Creek site is located in the Nutzotin Mountains north of the Wrangell Mountain Range and east of the Chisana River valley at an elevation of 5240'. This high alpine site is cool in the summer and cold in the winter, although not as cold as the surrounding low valleys thanks to a persistent inversion that lasts from October through March. The surrounding low river valley is one of the coldest regions in the state in winter. The snow gets scoured away in the winter and the summer rainfall is on average ~ 10.9 inches. The period of record average temperature is 25.6°F. The highest temperature recorded thus far is 84°F on 8/11/2005 and the lowest is -37°F on 1/27/2013.

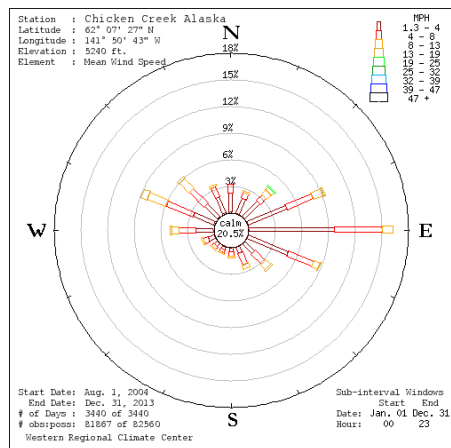


2013 Summarized Data

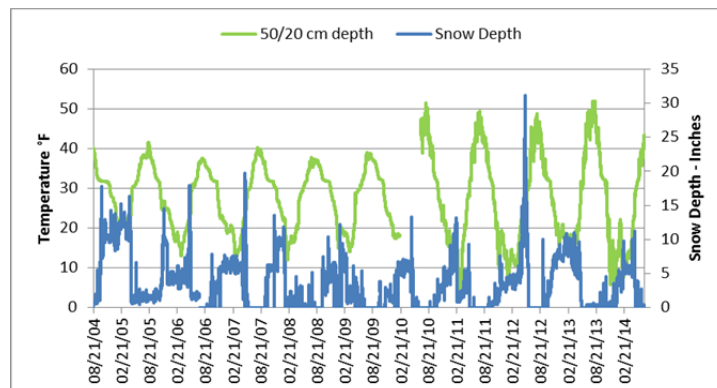
2013	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature					Average Soil Temperature			Snow Depth	Summer Rain
Date	W/m^2	mph	Deg	mph	Deg F					Deg F			In.	In.
	Ave.	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave. Max	Ave. Min	10cm	20cm	50cm	Ave.	Total
Jan-13	11	4	129	23	12	42	-37	13	11	18	18	21	8	
Feb-13	49	4	120	29	16	32	-10	17	14	18	18	19	9	
Mar-13	125	4	137	32	11	35	-16	13	10	16	16	18	8	
Apr-13	205	5	167	30	14	40	-4	16	12	18	18	19	6	
May-13	242	5	158	24	35	61	11	37	34	29	28	25	3	
Jun-13	212	6	199	37	49	72	31	50	47	43	42	35		4.62
Jul-13	194	6	195	27	49	68	35	50	48	48	47	41		4.50
Aug-13	175	5	177	24	49	70	32	50	48	46	47	44		1.68
Sep-13	88	5	183	28	36	62	20	37	36	37	38	38	0	
Oct-13	54	5	143	33	31	51	11	32	30	31	32	32	1	
Nov-13	20	4	153	38	9	39	-22	11	8	20	17	24	0	
Dec-13	6	3	136	30	10	37	-21	12	-21	15	11	16	1	

Chicken Creek Climatology 2004-2013:

Wind rose climatology

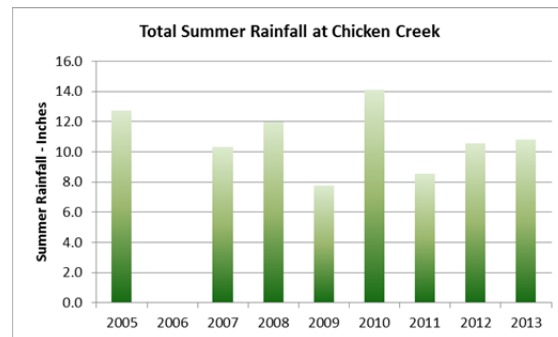
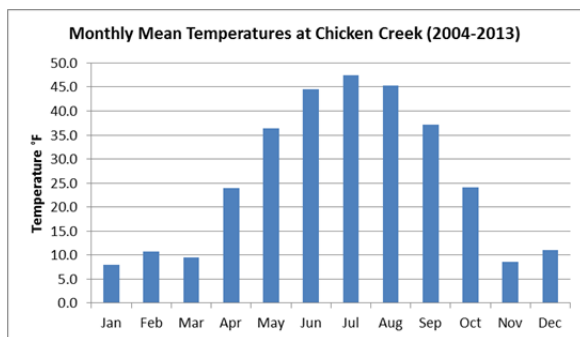


Soil temperatures and snow depth



Soil sensor was at 50 cm depth from 2004-2009 and at 20 cm from 2010-2013.

Chicken Creek mean monthly and annual temperatures and summer (Jun-Aug) rainfall



Chicken Creek	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2004								45.4	30.7	23.3	17.7	12.1	
2005	8.9	11.0	18.6	27.6	40.5	45.2	45.3	48.1	37.9	22.5	7.4	18.7	27.6
2006	6.6	12.2	5.4	20.2	34.5	43.9	48.0	43.2	38.3	26.8	-5.9	13.7	23.9
2007	11.8	2.7	-4.4	26.6	36.2	47.2	48.1	48.0	36.4	21.6	20.9	9.0	25.4
2008	6.8	4.7	15.7	24.8	35.2	42.1	43.9	41.7	36.2	18.9	14.3	6.8	24.3
2009	4.0	9.9	6.3	24.3	37.5	44.8	52.5	44.3	38.6	27.1	8.8	21.6	26.6
2010	10.7	19.5	15.2	25.7	39.0	42.1	47.7	46.3	36.2	23.9	16.6	1.5	27.1
2011	11.7	5.0	6.9	24.0	37.0	43.5	46.3	42.6	36.8	25.5	2.7	15.4	24.8
2012	-0.8	16.5	10.1	28.8	32.4	43.0	46.2	45.1	37.5	19.3	3.0	2.4	23.6
2013	11.9	15.6	11.5	14.0	35.1	48.6	49.2	49.0	36.4	31.2	9.5	10.3	26.9
Period of Record Average	7.9	10.8	9.5	24.0	36.4	44.5	47.5	45.4	37.2	24.1	8.6	11.0	25.6

Fire RAWS sites in Wrangell-St. Elias

May Creek Fire RAWS: Located in a cleared area at May Creek camp.

	Wind Speed	Wind Direction	Wind Gust	Temperature			Summer Rain
Date	mph	Deg	mph	Deg F			In.
	Ave.	Ave.	Max.	Ave.	Max	Min	Total
Jan-13	1	199	28	9	43	-38	
Feb-13	1	185	16	15	44	-19	
Mar-13	2	190	35	17	49	-26	
Apr-13	3	251	34	27	51	-4	
May-13	2	213	27	46	81	16	
Jun-13	2	251	<u>36</u>	59	90	25	0.71
Jul-13	1	224	22	59	86	36	0.00
Aug-13	1	200	21	55	85	27	1.80
Sep-13	1	188	22	43	65	22	
Oct-13	1	180	25	36	59	10	
Nov-13	1	183	28	10	42	-38	
Dec-13	0	92	21	-2	17	-35	

Chisana: Located on the west side of the Chisana Airstrip.

	Wind Speed	Wind Direction	Wind Gust	Temperature			Summer Rain
Date	mph	Deg	mph	Deg F			In.
	Ave.	Ave.	Max.	Ave.	Max	Min	Total
Jan-13	1	104	14	-3	37	-53	
Feb-13	1	117	19	2	34	-25	
Mar-13	1	124	19	6	44	-34	
Apr-13	2	172	24	16	51	-23	
May-13	2	220	19	40	76	7	
Jun-13	2	254	<u>26</u>	55	84	25	3.12
Jul-13	2	245	21	55	83	26	1.75
Aug-13	2	142	19	52	86	21	1.2
Sep-13	1	23	20	39	70	17	
Oct-13	1	125	29	29	62	4	
Nov-13	1	106	21	0	41	-41	
Dec-13	0	349	7	-10	25	-38	

Klawasi: Located in the Copper River Valley west of Mt. Drum and east of Glenallen

	Wind Speed	Wind Direction	Wind Gust	Temperature			Summer Rain
Date	mph	Deg	mph	Deg F			In.
	Ave.	Ave.	Max.	Ave.	Max	Min	Total
Jan-13	m	m	m	m	m	m	m
Feb-13	m	m	m	m	m	m	m
Mar-13	m	m	m	m	m	m	m
Apr-13	m	m	m	m	m	m	m
May-13	m	m	m	m	m	m	m
Jun-13	m	m	m	m	m	m	m
Jul-13	9	164	44	57	77	41	1.69
Aug-13	11	165	49	54	76	30	0.2
Sep-13	12	159	67	42	61	23	
Oct-13	15	148	78	37	53	15	
Nov-13	8	133	59	10	39	-27	
Dec-13	2	118	53	3	32	-19	

Chitina: Located in the town of Chitina on the north side of the road.

	Wind Speed	Wind Direction	Wind Gust	Temperature			Summer Rain
Date	mph	Deg	mph	Deg F			In.
	Ave.	Ave.	Max.	Ave.	Max	Min	Total
Jan-13	1	119	26	11	42	-36	
Feb-13	1	164	20	18	39	-10	
Mar-13	2	185	31	18	47	-17	
Apr-13	2	181	37	29	53	1	
May-13	4	181	36	45	86	24	
Jun-13	5	178	33	60	97	34	0.24
Jul-13	5	174	28	61	86	42	1.5
Aug-13	4	173	26	57	75	33	1.79
Sep-13	2	164	27	46	63	27	
Oct-13	3	168	32	40	53	20	
Nov-13	1	94	26	11	44	-33	
Dec-13	0	26	10	-1	23	-35	

Appendix B. 2013 Alaska Extremes

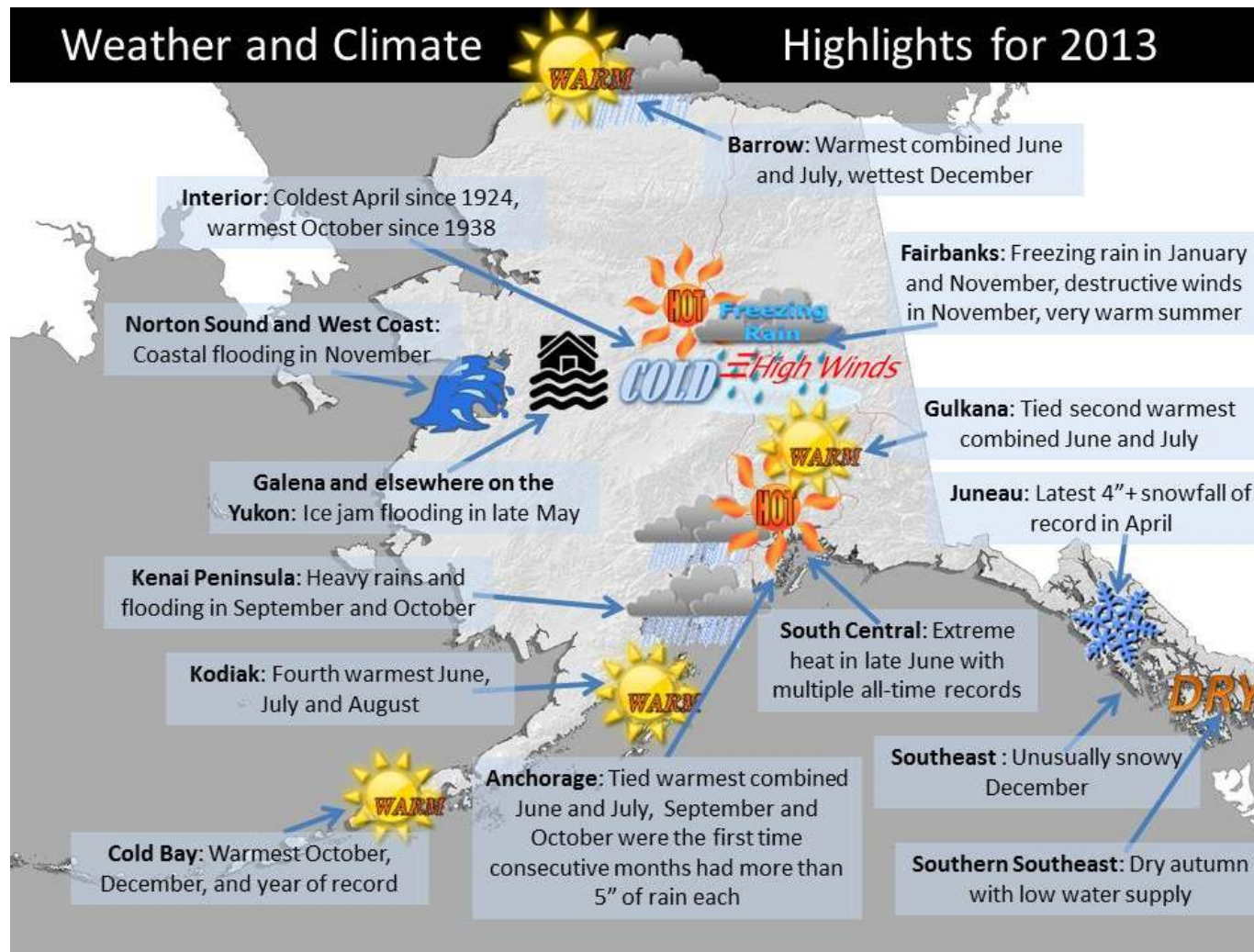
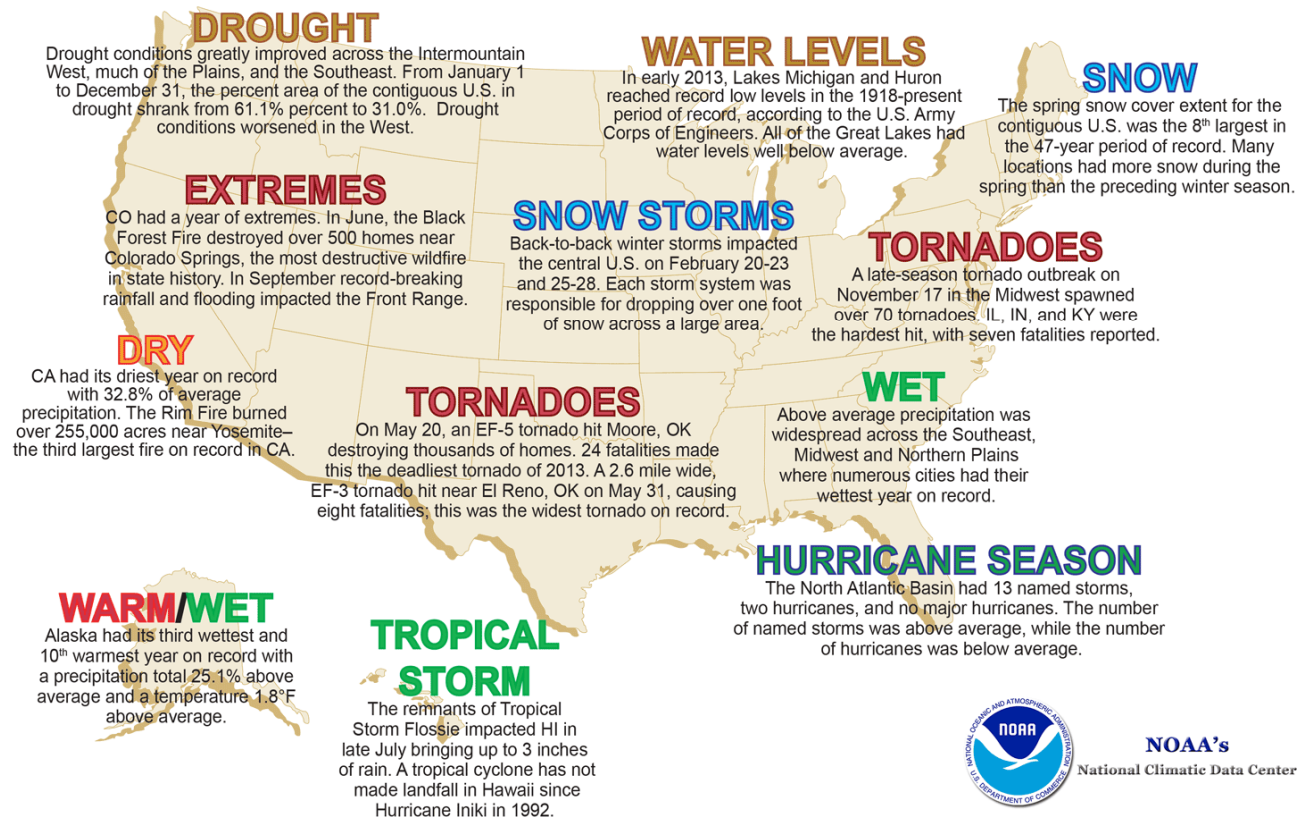


Image courtesy of NOAA (NOAA 2014a).

Preliminary Significant U.S. Weather and Climate Events for 2013



NOAA's
National Climatic Data Center

Graph courtesy of NOAA (NOAA 2014a).

Appendix C. Worldwide Significant Climate Anomalies

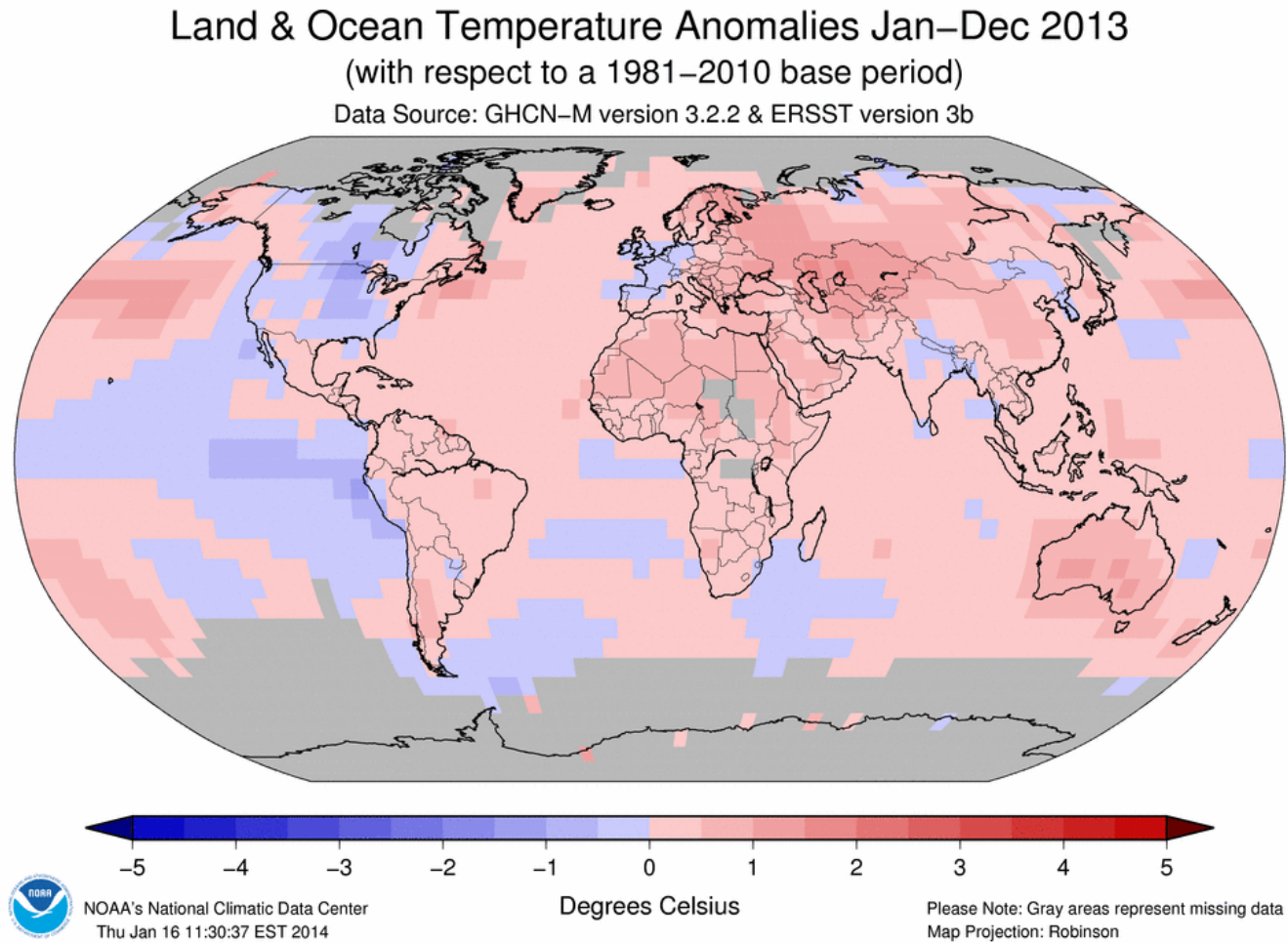


Figure courtesy of NOAA (NOAA 2014c).

Land-Only Precipitation Percentiles Jan-Dec 2013

NOAA's National Climatic Data Center

Data Source: GHCN-M version 2

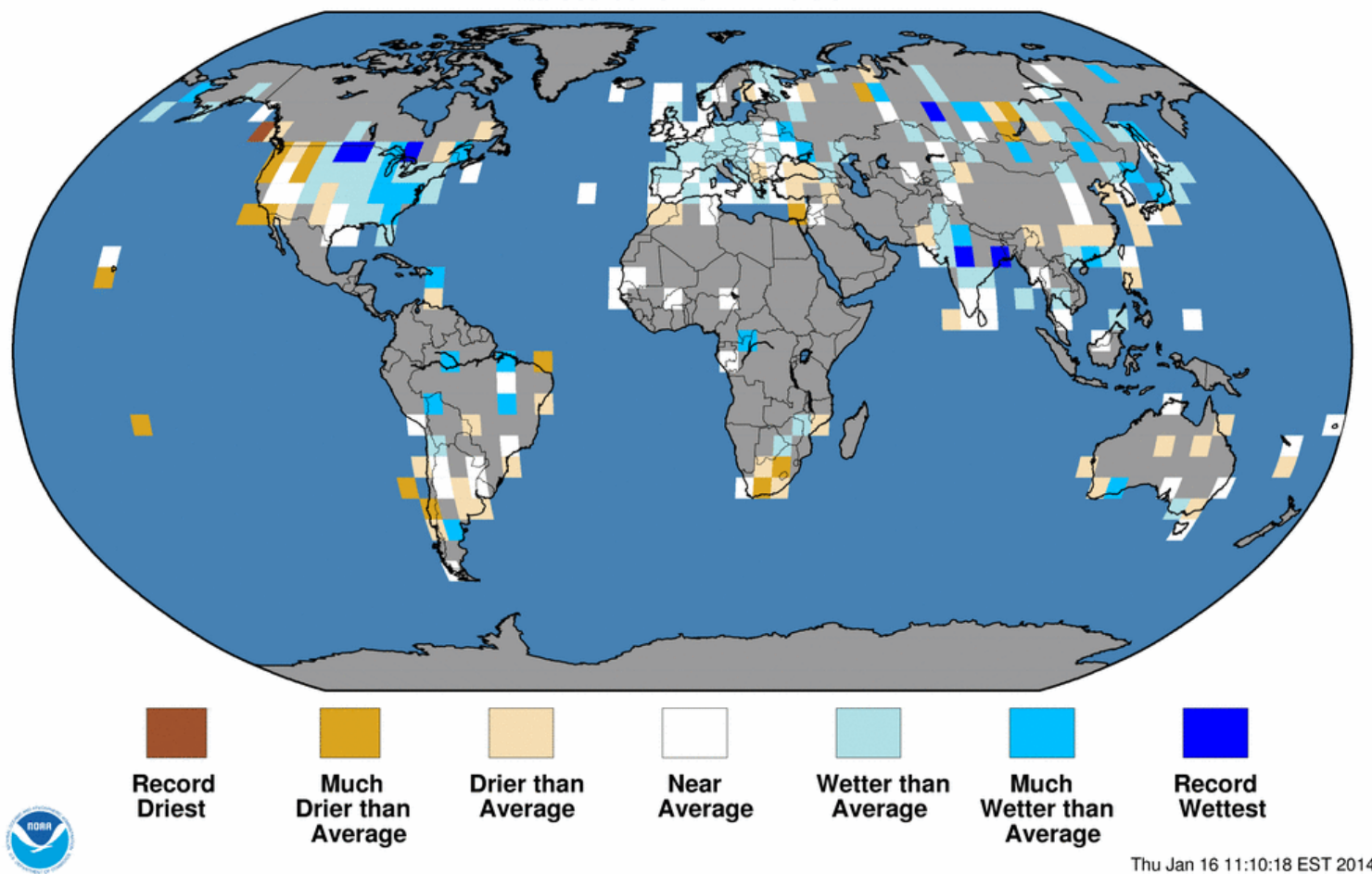
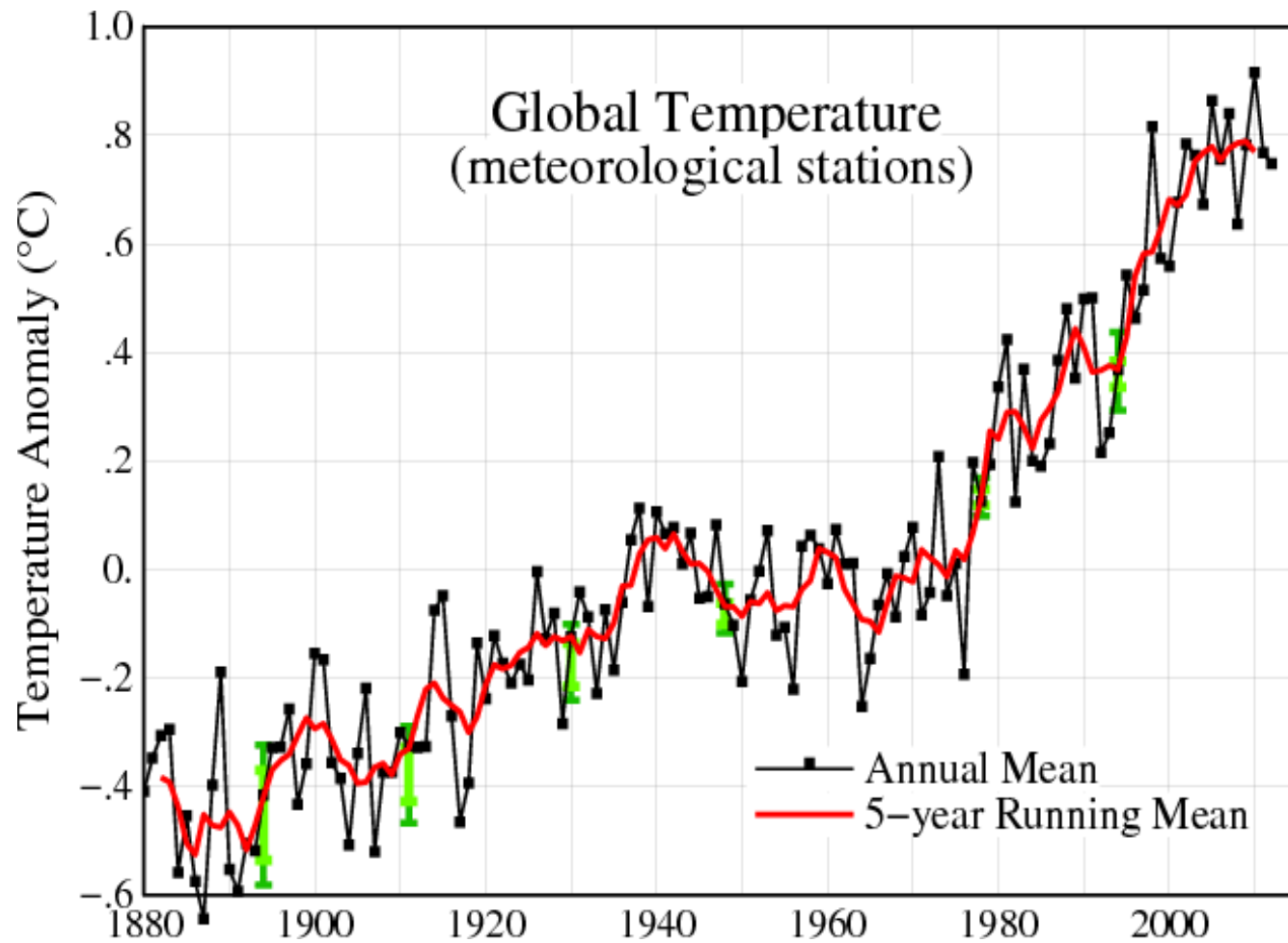


Figure courtesy of NOAA (NOAA 2014c).



Global mean annual temperature departure (°C) from the 1951-1980 normal (the reference period used by NASA Goddard Institute for Space Studies [GISS]). Graph courtesy of GISS (GISS 2014).

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National Park Service
U.S. Department of the Interior



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