



Annual Climate Summary 2012

Central Alaska Network

Natural Resource Data Series NPS/CAKN/NRDS—2014/606



ON THE COVER

Gates Glacier climate station - Wrangell – St. Elias National Park and Preserve
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Natural Resource Data Series NPS/CAKN/NRDS—2014/606

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

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Executive Summary

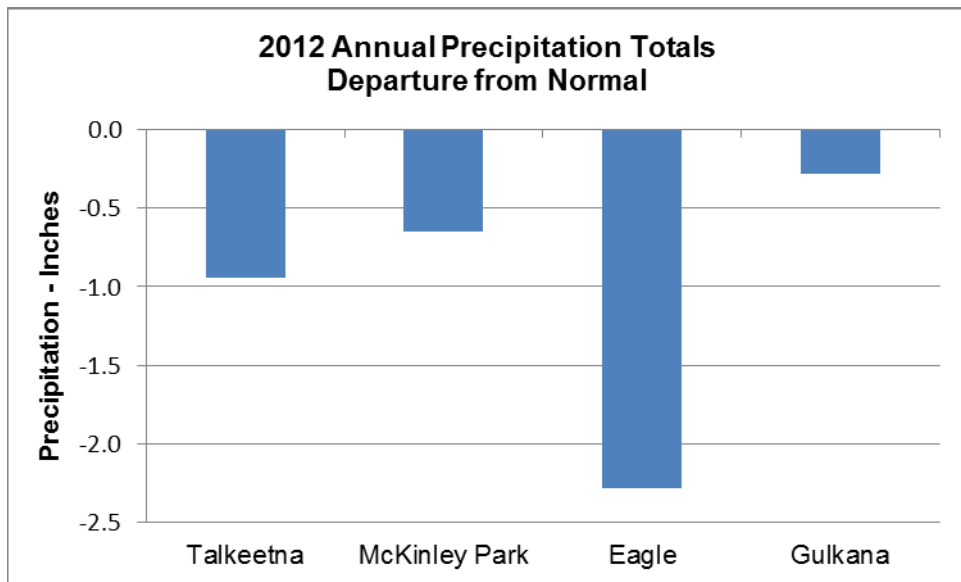
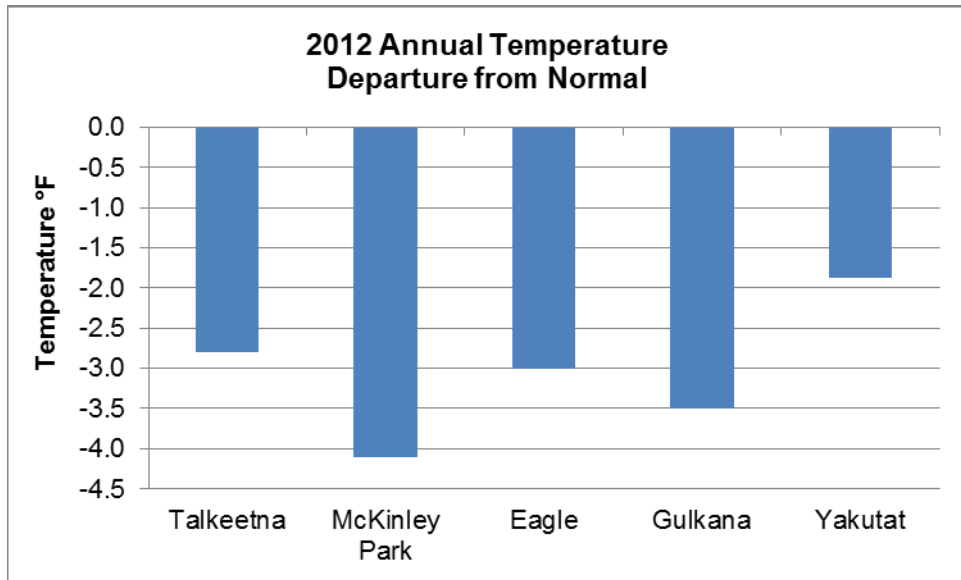
Using methodologies developed for the Central Alaska Network (CAKN), climate was monitored at existing National Weather Service stations and new CAKN climate stations in and around Denali National Park and Preserve, Wrangell -St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve. The few index sites with long-term records are used to look at the current year temperature and precipitation departure from normals. “Normals” are used to place recent climate conditions into historical context. It takes 30 years of continuous weather data at one location to calculate what makes temperatures or precipitation amounts “normal”. The latest normal period is 1981-2010.

The CAKN climate records show that on average the Central Alaska region was cooler and drier in 2012 compared to normal. The combined mean annual temperature at the longer-term sites averaged -3.0 degrees F colder than the 1981-2010 normal. The combined annual precipitation totals averaged ~1.0 inch below normal, with the strongest deviations in Eagle and Yakutat.

Temperatures were variable across the network from month to month, but the negative temperature departures in January, November, and December stand out. January 2012 was an exceptionally cold month; the mean monthly temperature departure region wide was -13.1 degrees F. It was the 2nd coldest January on record at McKinley Park (1933 was the coldest). It was the coldest January on record at other locations around the state including Nome, Bethel, Bettles, Galena, and Homer. The mean deviation in CAKN in November was -9.7 degrees F and in December it was -8.3 degrees F.

February 2012 was the only month with a strong positive deviation for the year with an average departure of +8.1 degrees F for all the CAKN long-term sites. It was warmer in the northern and eastern regions of the network in February, with a +15.2 departure from normal at Eagle and +9.0 at both McKinley Park and Gulkana. The region experienced a cool spring with a mean departure of -1.8 degrees F; temperatures were coolest in March followed by May. April temperatures were warmer than normal at all of the CAKN index sites. The summer of 2012 was cool region wide; July was on average -2.3 degrees F cooler than normal. June temperatures were just below normal and August was -1.1 degrees cooler than normal. The start of the fall season was mild, but the last 3 months of 2012 were cold.

The annual precipitation totals were just about normal at Talkeetna, McKinley Park, and Gulkana, at 97%, 96%, and 98% of normal respectively. In Eagle, the annual total was 81% of normal and in Yakutat it was 70% of normal. October, November, and December were particularly dry in Yakutat - a total of 22.7 inches of precipitation was recorded for October, November, and December, normal is 52.7 inches. The monthly precipitation totals for Eagle were below normal from May through October. In Talkeetna, every month was drier than normal except for September when the station recorded 6.4 inches more rain than normal. In McKinley Park, the wettest month was June with a positive departure of 2.61 inches for the month, 221% of normal, this was followed by a dry July, which was 2.44 inches below normal.



Based on the 1981-2010 normal period

Yakutat precipitation is not included due to scaling issues. The 2012 annual total was 108.8 inches, normal is 155.1 inches per year.

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 will be critical to understanding the changing conditions of park ecosystems.

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 sixteen new 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. The analyses for this annual report are based on the long-term National Weather Service cooperative sites in and around the CAKN parks that have been in operation for 64 to 87 years. The new high elevation sites are analyzed for comparison, but long-term trends will take time to develop. For detailed information on station locations, station design, and maintenance schedules see the CAKN Climate Monitoring protocols (Sousanes 2006). This is the eighth in a series of annual data reports for the Central Alaska Network Climate Monitoring Program.

Central Alaska Network Climate Characterization

The central Alaska climate can be characterized by the three major climate regimes that span from the southern boundaries of the network along the coast to the interior. The southern coast of Wrangell-St. Elias is significantly affected by the Gulf of Alaska. The Pacific Ocean moderates the temperature along the coast in both summer and winter, and brings a considerable amount of precipitation to the coastal areas and the southern flanks of the mountain ranges that ring the gulf coast, including the Chugach and St. Elias Ranges. Just north of these mountain ranges the precipitation tapers off and seasonal temperatures are more extreme. The winters are cold and the summers can get hot. The CAKN areas farthest north, and the farthest from the coast, are true interior climates characterized by low annual precipitation and large seasonal variation in temperature.

The climate of Alaska in general is affected by solar radiation, atmospheric gases (volcanic eruptions, CO₂), the water temperature of the Pacific Ocean, and ocean currents. These large scale processes drive changes in atmospheric patterns, like the repositioning of the polar jet stream and the Aleutian low pressure system or the frequency of La Ninas and El Ninos (Papineau, 2003). Each of these can affect the regional patterns of storm tracks, prevailing winds, snowfall amounts, and the extent of sea ice (ACIA, 2005).

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, 2008). 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 has been predominantly negative and air temperatures have been near or below normal – a possible indication of a phase shift from positive to negative. Unfortunately large scale changes such as this take at least a decade 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, 2009). Models have predicted that the retreating sea ice should 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 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 2012 data with the latest normal period, 1981-2010. For these sites temperature, precipitation, and snowfall are analyzed. Monthly temperature means and precipitation totals are compiled from the Western Regional Climate Center and compared with the new 1981-2010 normal values for each site.

Fifteen NPS Remote Automated Weather Station (RAWS) sites were analyzed to capture winter temperature inversions and climate deviations at higher elevations (Table 2). Monthly means and annual totals were compiled for the NPS RAWS including, temperature, wind, relative humidity, solar radiation, snow depth, and summer rainfall (Figure 2).

Five snow telemetry (SNOTEL) sites were also analyzed for year-round precipitation and snowfall amounts at five locations in and around the CAKN parks. 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; in order to standardize units throughout the report, data are presented in standard units. Period of record averages for the long-term sites are available in Appendix A, and extremes and records for these sites are listed in Appendix B.

Table 1. Long-term sites used in CAKN analysis.

Name	Lat	Long	Elev. (ft)	Network	Start	End	Park
Eagle	64.7666	-141.2000	850	COOP	1949	Present	YUCH
McKinley Park	63.7195	-148.9656	2060	COOP	1925	Present	DENA
Talkeetna	62.1800	-150.0600	350	COOP	1949	Present	DENA
Gulkana	62.1502	-145.4500	1580	SAO	1949	Present	WRST
Yakutat	59.5000	-139.6700	30	SAO	1936	Present	WRST

Table 2. CAKN and Remote Automated Weather Station (RAWS) sites.

Name	Lat	Long	Elev (ft)	Network	Start	End	Park
Stampede	63.7478	-150.3281	1800	CAKN RAWS	2003	Present	DENA
Toklat	63.5255	-150.0465	2920	CAKN RAWS	2005	Present	DENA
Eielson Visitor Center	63.4307	-150.3102	3730	CAKN RAWS	2005	Present	DENA
Wonder Lake	63.4900	-150.8800	2119	RAWS	1995	Present	DENA
Dunkle Hills	63.2670	-149.5415	2651	CAKN RAWS	2003	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
Chisana	62.0775	-142.0500	3320	RAWS	1988	Present	WRST
Chititu	61.2735	-142.6209	4554	CAKN RAWS	2004	Present	WRST
May Creek	61.3208	-142.5844	1650	CAKN RAWS	1990	Present	WRST
Gates Glacier	61.6029	-143.0132	4060	CAKN RAWS	2005	Present	WRST
Klawasi	62.1469	-144.9269	3100	RAWS	1991	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

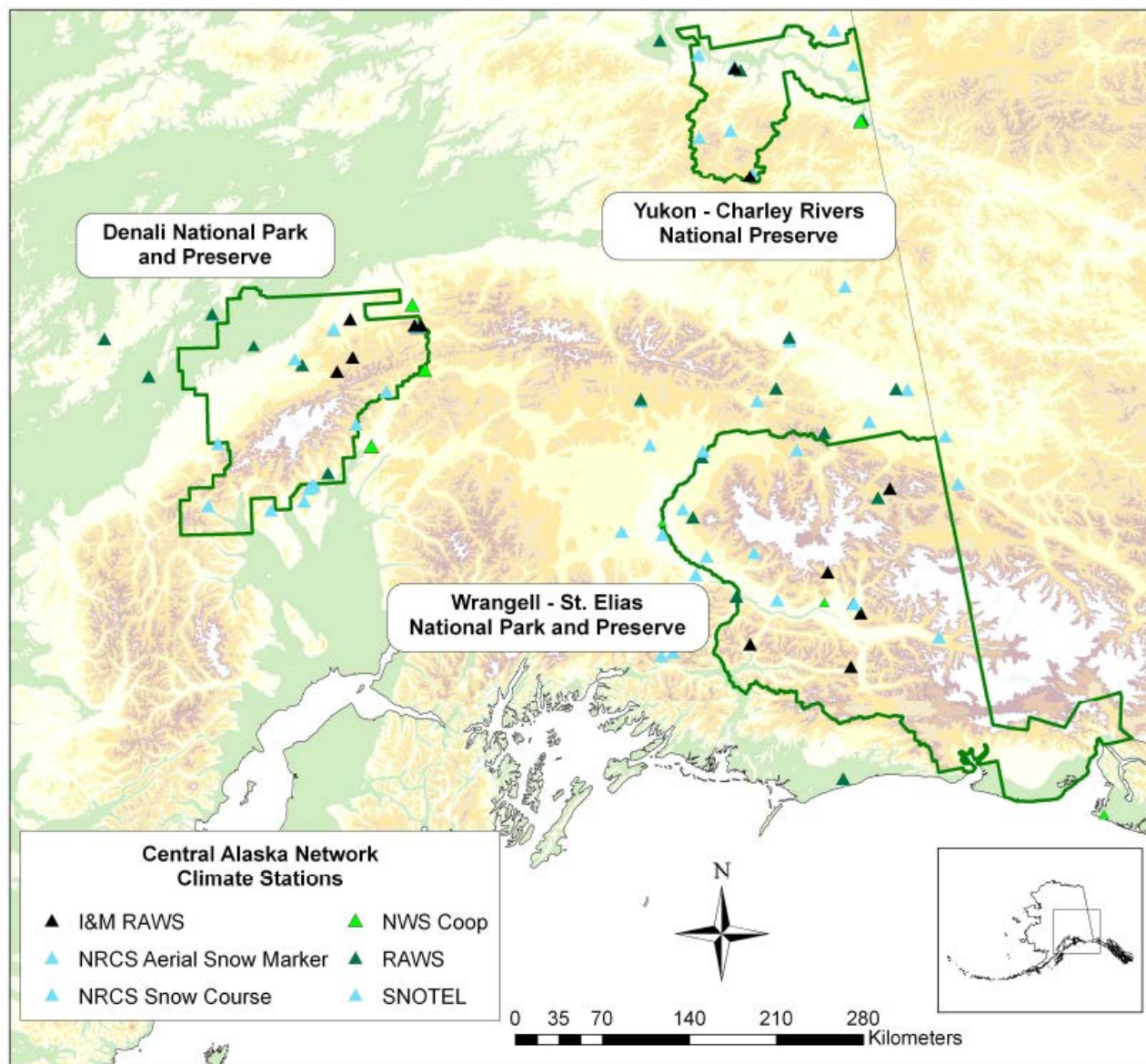


Figure 1. Map of CAKN climate station locations.

Results

Climate Year 2012 Synopsis

CAKN Synopsis

The CAKN climate index sites indicate that on average the Central Alaska region was cooler and drier than normal in 2012. The mean annual temperatures at the long-term sites averaged 3.0 degrees F colder than the 1981-2010 normal. The winter temperatures were extremely variable with warm temperatures in both December and February at most sites and very cold temperatures at all of the sites in January. There was extreme variability in the winter temperatures, yet the average of December (2011), January, and February “winter” monthly averaged 0.4 degrees F above normal. Spring temperatures across the network averaged 1.8 degrees F below normal, summer was 1.4 degrees F cooler than normal, and the fall season was 4.0 degrees F colder than normal.

The annual precipitation totals were just about normal at Talkeetna, McKinley Park, and Gulkana, at 97%, 96%, and 98% of normal, respectively. The winter season was just above normal, spring and summer were just below normal, and the fall precipitation totals averaged just above normal. Yakutat precipitation values are averaged separately. In Yakutat, each season was below normal as far as precipitation totals, with the fall season having the strongest departure from normal. Figure 2 shows the 2012 annual temperatures and total precipitation amounts compared with the 1981-2010 normals.

The Central Alaska Network (CAKN) region had a variable snowpack that ranged from well above normal along the southern coast of Wrangell –St. Elias National Park and Preserve, to above normal south of the Alaska Range and in the western areas of Denali NP&P, to near normal in Yukon Charley, and just below normal in the central region (the eastern/central regions of Denali). The first persistent snowpack arrived around the week of October 16. The snowpack persisted into May at most sites in the CAKN region, with a few exceptions. Snow off dates were recorded at May Creek on April 27, followed by Kantishna on May 7, Chisana on May 9, American Creek on May 12, and Tokositna on May 27.

Alaska Statewide Synopsis

The average annual temperature for the entire state of Alaska was 2.3°F cooler than normal (Figure 3). Winter temperatures in 2011-12 which includes December, January and February, were 1.4°F below normal (this includes December of 2011 and January and February of 2012); spring temperatures were 2.7° F below normal; summer was 0.7° F below normal, and fall was 1.1° F cooler than the normal (Figure 4).

Precipitation statewide was 9.2% above average, with the strongest deviations along the southern coast (Figure 5). The snowfall totals were impressive and winter precipitation totals for the state were 42% above average. Spring precipitation statewide was 10.5 % more than normal; summer precipitation was 19.3% above average, and the fall season precipitation totals statewide were 11.6% above average. September was particularly wet and ranked as the 5th wettest September on record.

Statewide snowfall totals were variable for 2011-2012 with much of the attention focused on the south central and south east regions of Alaska where record snowfall totals were recorded. Snowfall totals were also above normal in the west and northwest areas of the state (Figure 6).

Climate Indices

A relatively strong phase of La Niña opened the year. La Niña is defined by cooler-than-normal waters in the eastern and central equatorial Pacific Ocean that affects global weather patterns. In the spring of 2012 La Nina conditions moderated in the spring and remained neutral for the rest of the year. With records of El Nino/La Nina events dating back to 1950, 2011 ranked globally as the 3rd warmest "La Niña year" in the 1950–2011 period of record NOAA, 2013a). The Pacific Decadal Oscillation, an index of sea surface temperatures in the north Pacific was negative for all of 2012 indicating colder than normal sea surface temperatures off of Alaska's coast (NOAA, 2013b) (Figures 7 and 8) . The Arctic Sea Ice extent in September 2012 was the lowest seasonal minimum extent in the satellite record since 1979 (NSIDC, 2013) (Figure 9).

Wildfire Activity

The dry April was a bad start with respect to wildfires, however, the following three months were cool and wet, which resulted in a below average fire season in terms of number of acres burned, number of fires, and amount of lightning activity. The total area burned in the CAKN parks was 9,994.9 acres - 289 acres in Denali, 22 acres in Wrangell-St. Elias, and 9,684 acres in Yukon-Charley this year. Statewide there were a total of 416 wild land fires in 2012, with a total of 286,888 acres burned. 143 of the 416 were lightning caused fires (AICC, 2012).

Climatically Significant Events of 2012

- It was the coldest January on record at many locations around the state. According to the Alaska Climate Research Center, "For one station it would be a very large deviation, however for the mean value of 20 stations, fairly well distributed over such a large area as Alaska, it is astounding" (ACRC, 2013) (Figure 10). Only Barrow had annual temperature departures that were above normal, this is in large part due to the minimal sea ice extent in the Arctic Ocean for 2012. The Arctic Sea Ice extent in September 2012 was the lowest seasonal minimum extent in the satellite record since 1979 (NSIDC, 2013).
- Repeated early autumn storms pounded south-central Alaska in September - some of the high wind and water levels pushed into the CAKN region and several new daily precipitation records were broken in Denali and Wrangell - St. Elias. The Nenana River, on the eastern boundary of Denali, hit a record stage of 14.9 feet in mid-September, topping the old record of 14.1 feet from 1990.
- There was little snow in November and December, allowing for the frost to penetrate deeper into the ground than normal.

National and Global Synopsis

Based on data from January through December, the average annual temperature for the contiguous U.S. for 2012 was 55.3°F, 3.2°F above the 20th century average and ranks as the warmest year on record (NOAA, 2013c). The record breaking annual temperature was 1.0° F degrees above the previous record warm year of 1998. The temperature trend for the lower 48 states is + 0.13°F per decade. The average precipitation total for the lower 48 states in 2012 was

26.57 inches, 2.57 inches below average. The precipitation trend for the contiguous U.S. has increased by about 0.16 inches per decade.

Globally, the year 2012 ranked among the top 10 warmest years on record. Over land and ocean combined, 2012 was between 0.25° and 0.31° F above the 1981–2010 average, depending on the analysis. Including data from 2012, the Earth is warming at a rate of 0.11°F per decade. (NOAA, 2013c).

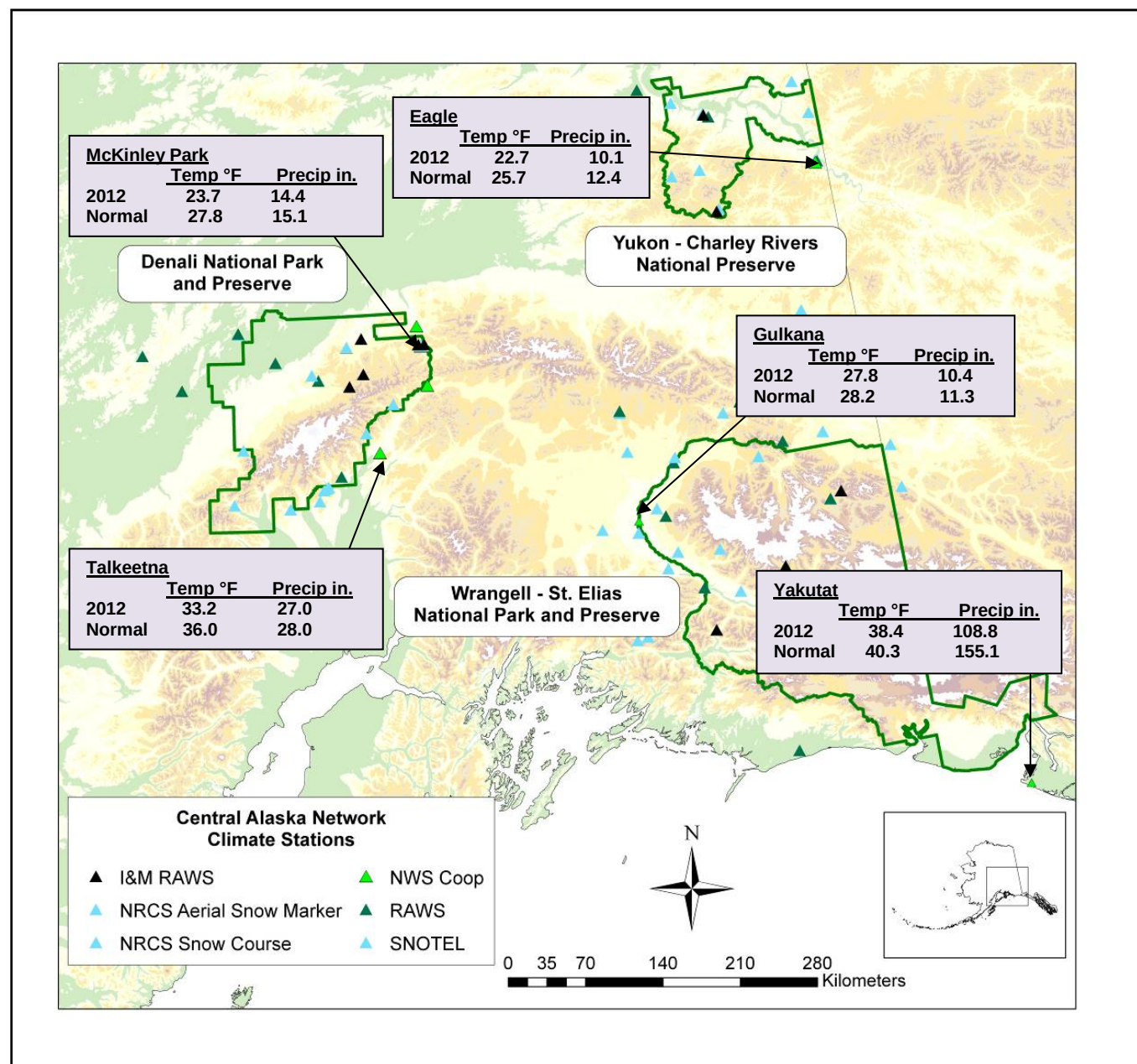


Figure 2. Mean annual temperature and precipitation totals for long-term sites in CAKN for 2012 compared with 1981-2010 normals.

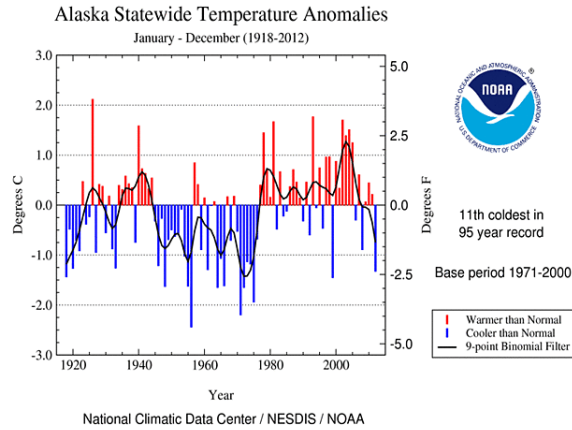


Figure 3. Average temperatures across Alaska were 2.3 °C below the 1971-2000 mean (NOAA 2013). Figure retrieved from <http://www.ncdc.noaa.gov/sotc/2012/13>.

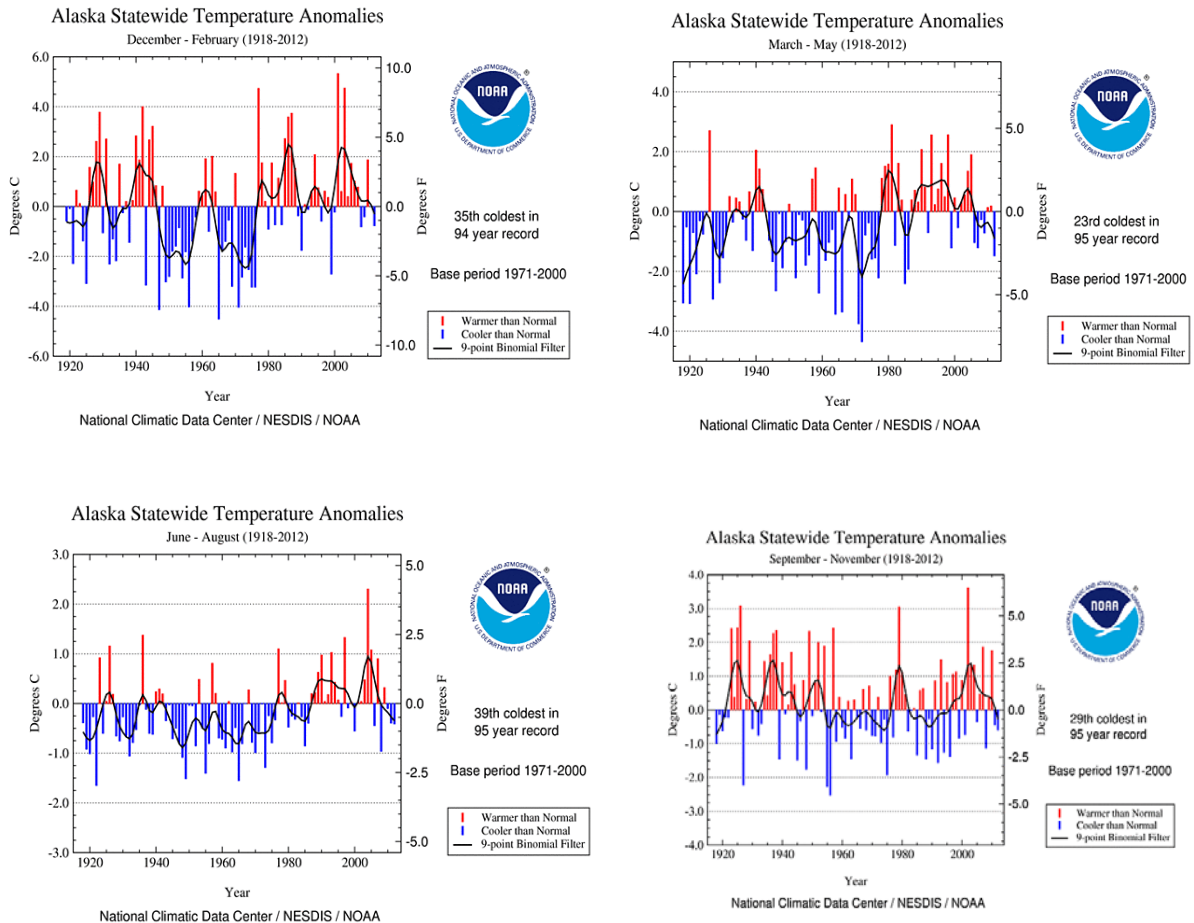


Figure 4. Seasonal statewide temperature anomalies 2012. Figures retrieved from <http://www.ncdc.noaa.gov/sotc/national/2011/13>.

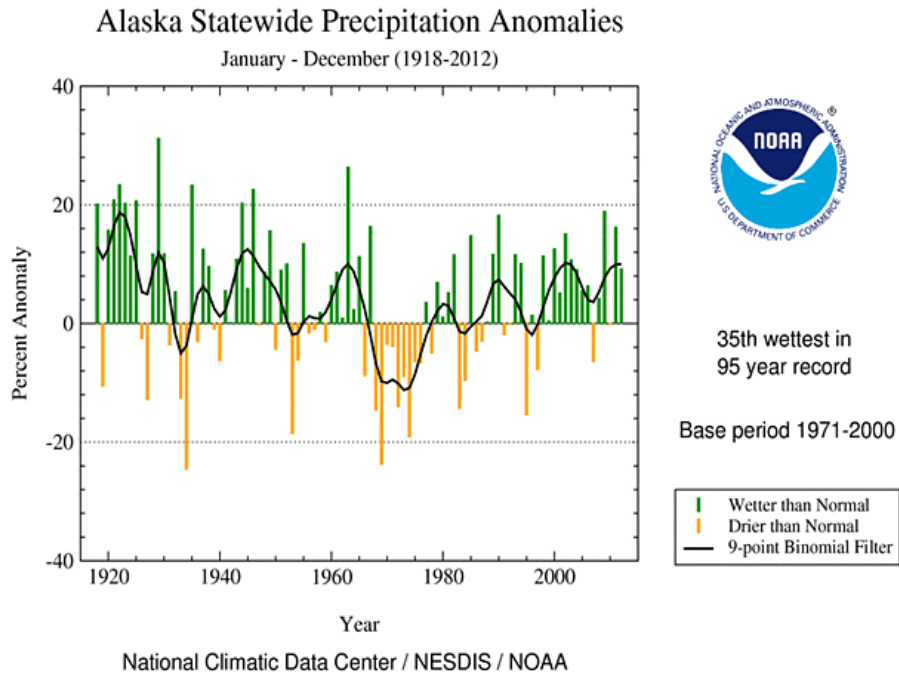


Figure 5. Annual precipitation anomalies 1918-2012. Figures retrieved from <http://www.ncdc.noaa.gov/sotc/national/2012/13#analysis>.

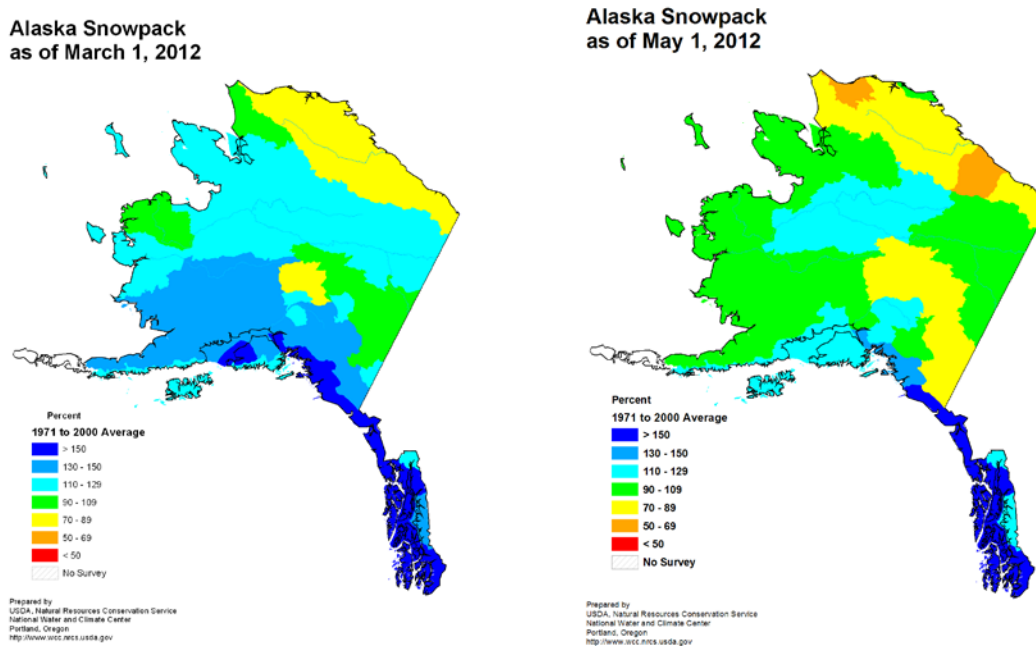


Figure 6. March 1 and May 1 snowpack percent of average for Alaska 2012 (NRCS 2013).

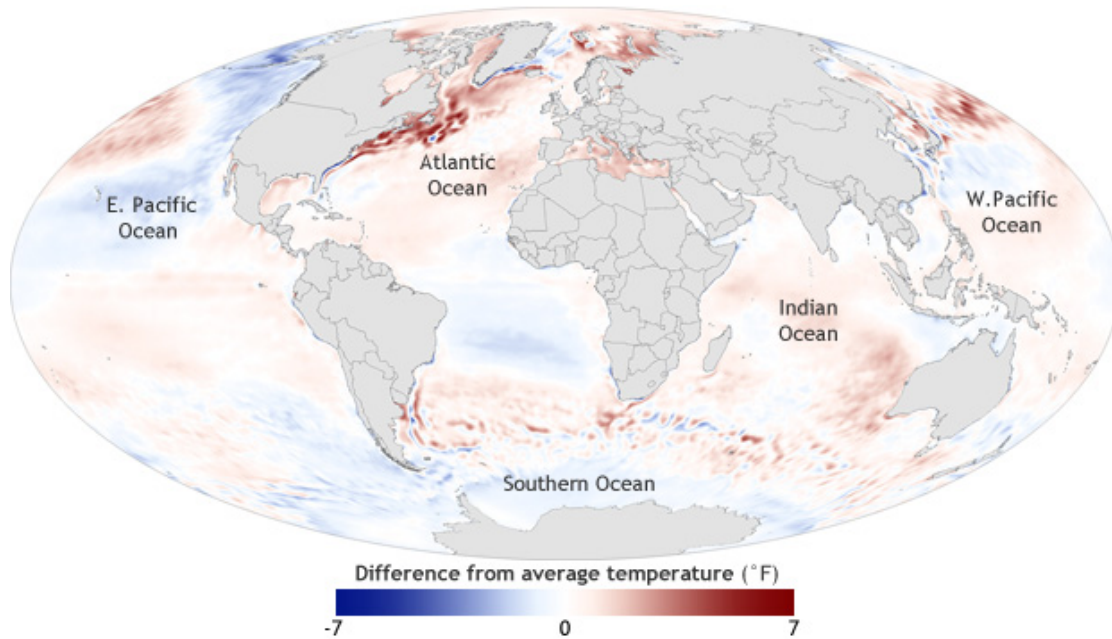


Figure 7. 2012 State of the Climate Sea Surface Temperature. Graph retrieved from <http://www.climate.gov/news-features/understanding-climate/2012-state-climate-sea-surface-temperature> (NOAA, 2013d).

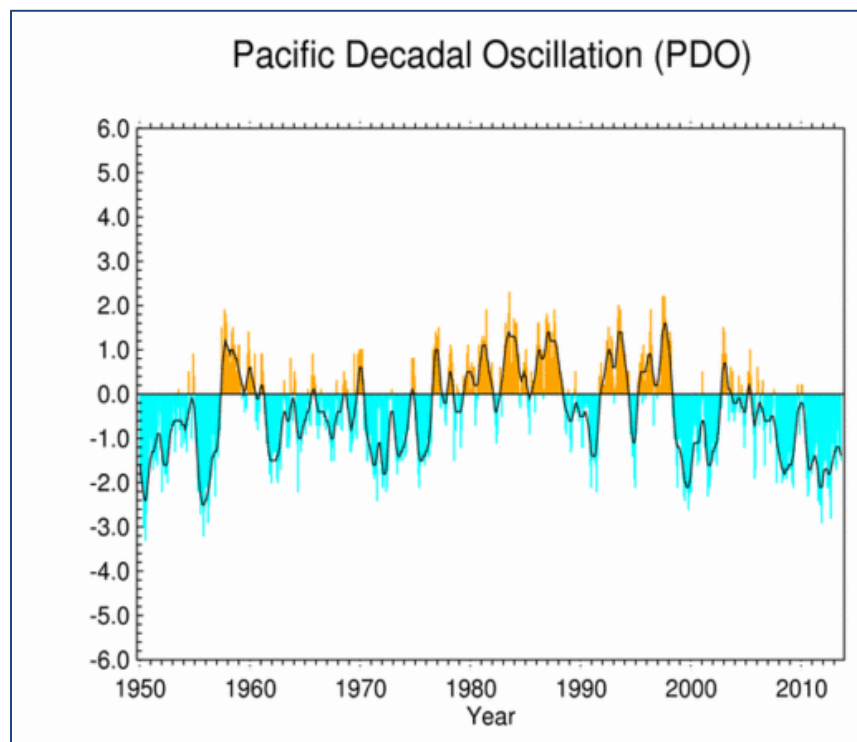


Figure 8. Pacific Decadal Oscillation index based on NOAA's extended reconstruction of SSTs ([ERSST Version 3](#)). Graph retrieved from <http://www.ncdc.noaa.gov/teleconnections/pdo.php> (NOAA, 2013b).

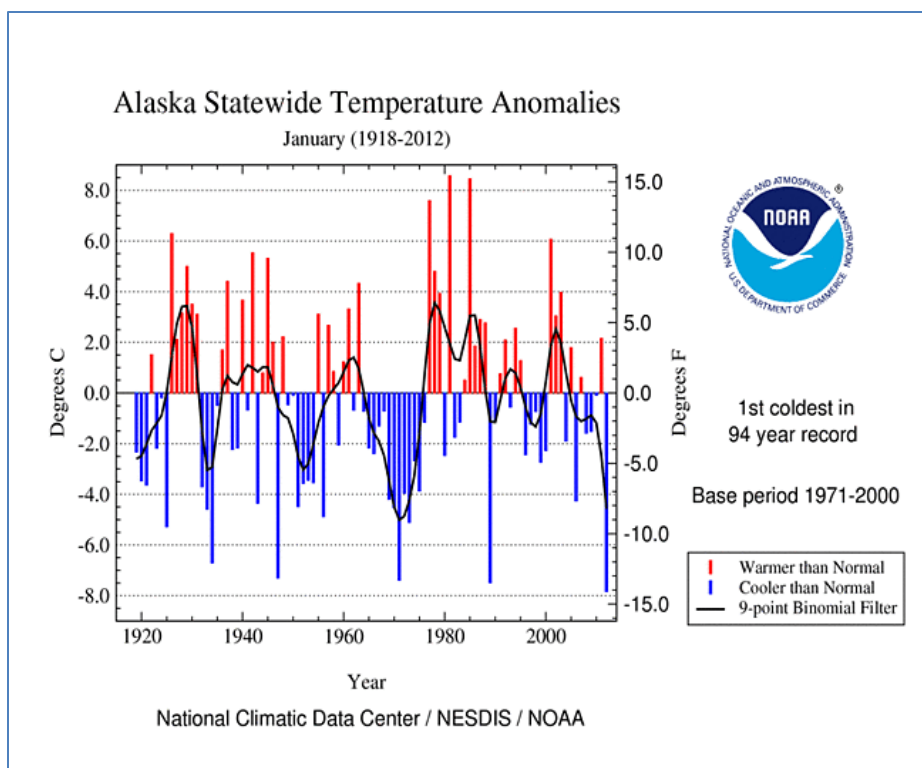


Figure 9. January 2012 was the coldest on record (NOAA, 2013c)

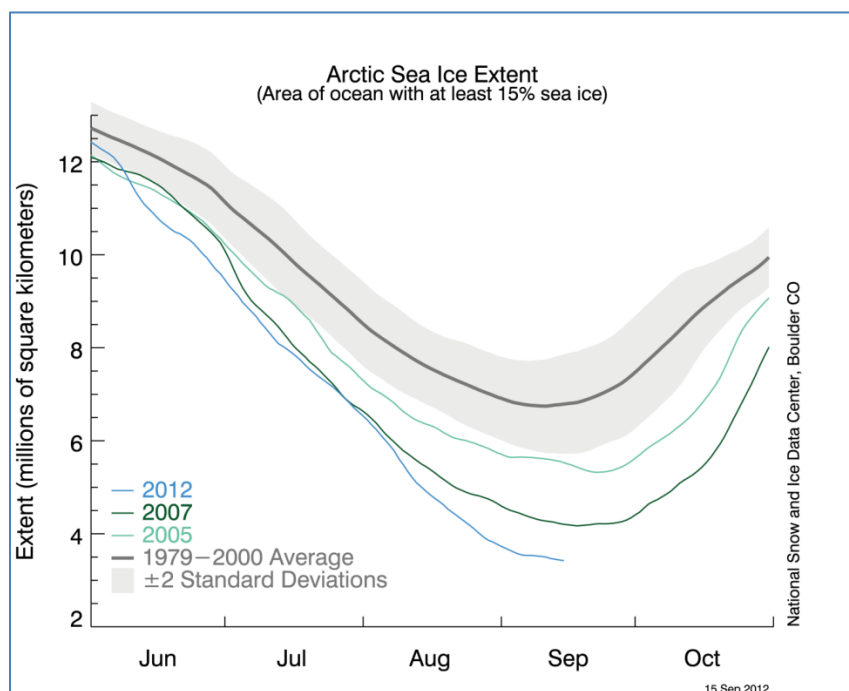


Figure 10. Arctic Sea Ice extent 1979-2013. This was the lowest seasonal minimum extent on record. Graph retrieved from <http://nsidc.org/arcticseaicenews/2012/09/> (NSIDC, 2013).

Temperature

In 2012, the mean annual temperatures for the long-term sites around the CAKN region averaged -3.0° F below the 1981-2010 normal (Figure 11 and Table 3). The strongest negative departure was at Denali, followed by Gulkana, and Eagle. Temperatures were less variable across the network from month to month than they have been in recent years, with a stronger tendency toward cooler temperatures (Table 4). The exception was the extreme temperature variations between the 2011-2012 winter months where December 2011 was warmer than normal, followed by a very cold January, followed by a warm February. February 2012 had the strongest positive temperature departure of any other month in 2012.

January 2012 was a cold month throughout the region. Most of Alaska was under the influence of the persistent cold air mass for the start of 2012 and many communities around the state reported January 2012 as the coldest on record including, Nome, Bethel, Bettles, Galena, and Homer. March, November, and December were also particularly cold months March was on average 6.0 degrees colder than normal around the CAKN region with all of the long-term sites showing negative departures. McKinley Park, at -10.4 degrees F, had the largest departure from normal.

The spring of 2012 was cooler than normal overall with an average seasonal temperature departure of -1.8 degrees. March was the coldest spring month with temperatures ranging from 2.5 degrees cooler in Yakutat to 10.4 degrees F colder than normal in McKinley Park. April temperatures warmed up and all locations reported warmer than normal temperatures for the month. May 2012 was cool throughout the region with an average temperature departure of -2.5 degrees F.

The cool trend continued through the summer of 2012. The combined average temperature departure for the season was -1.4 degrees F. It was much cooler at the southern sites. Talkeetna had the strongest departure from normal at -2.3 degrees F, followed by Gulkana at -2.2 degrees F, and Yakutat at -1.9 degrees F. The two northern sites had temperatures in June and August that were at or just below normal. July 2012 was on average 2.3 degrees F cooler than normal across the CAKN region. Only Eagle had positive temperature departures for the summer.

Fall of 2012 was colder than normal, with the strongest negative departures in November. The average seasonal departure was -4.0 degrees F. September temperatures were cool along the coast and warmer in the northern regions. Overall there was a positive temperature departure of 1.0 degree F for the month. The temperatures dropped in October; every site in the CAKN region had negative temperature departures for October, November and December. October was -3.4 degrees F cooler than normal and November was 9.7 degrees F colder than normal. Talkeetna and Yakutat were only a few degrees cooler than normal, while the northern and eastern sites ranged from 13 to 19 degrees colder than normal. December was almost as cold with negative departures from 3.8 to 12.8 degrees F colder than normal, again all sites were cooler than normal for December with the strongest departures in the northern and eastern areas.

Figure 12 shows the monthly departure from normal at the long term sites around CAKN. See Appendix A for 'period of record' data for the long-term sites and Appendix B for individual site records and extremes.

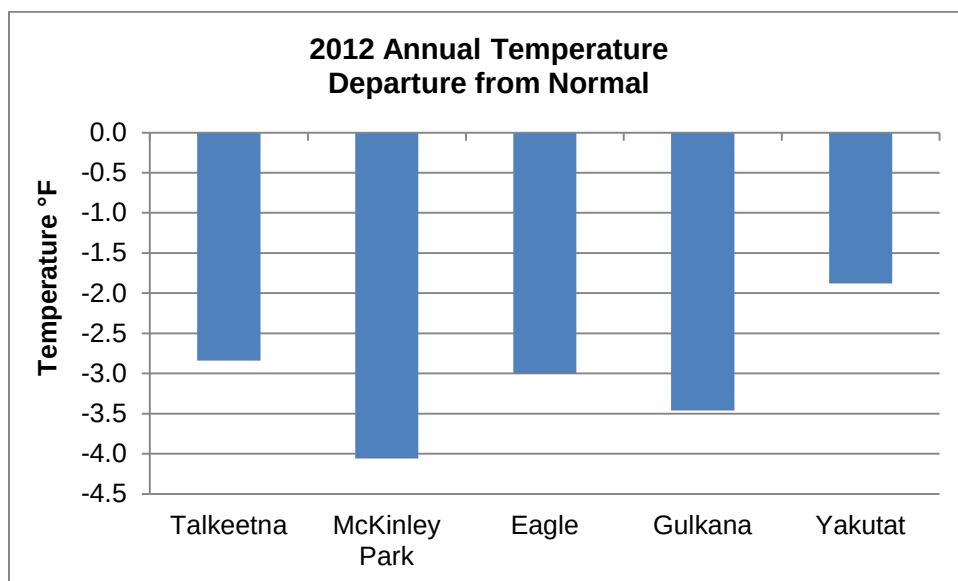


Figure 11. 2012 Mean annual temperature departure from normal at long-term CAKN sites.

Table 3. 2012 monthly average temperature departure from normal (1981-2010) for long-term sites in CAKN.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Talkeetna	-14.3	4.2	-7.4	1.9	-2.5	-1.5	-3.5	-1.9	-2.0	-1.1	-1.0	-3.8	-2.8
McKinley Park	-21.7	9.0	-10.4	5.4	-2.4	0.0	-1.7	-0.3	1.1	-2.9	-14.0	-10.0	-4.1
Eagle	-14.6	15.2	-5.3	4.1	-2.6	1.0	-1.3	0.1	4.0	-3.7	-19.4	-10.3	-3.0
Gulkana	-10.6	9.1	-4.3	3.6	-2.6	-1.8	-2.7	-1.9	2.1	-5.3	-12.7	-12.8	-3.5
Yakutat	-4.3	3.2	-2.5	0.2	-2.7	-2.2	-2.2	-1.3	0.1	-4.0	-1.3	-4.6	-1.9

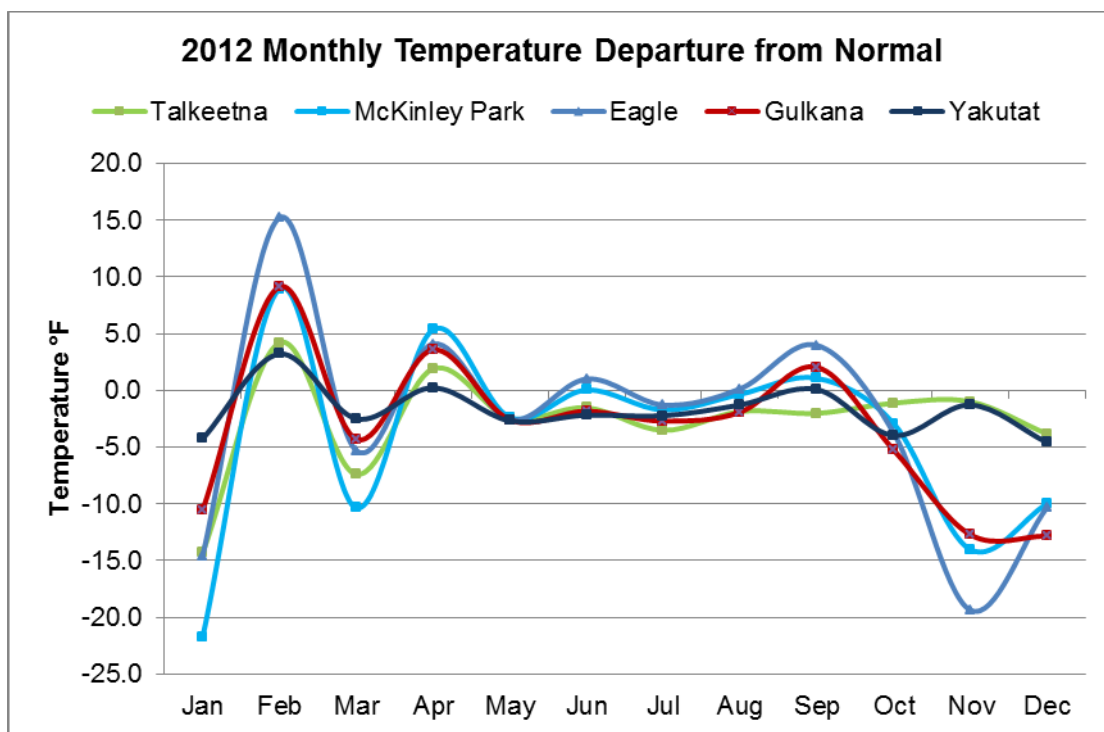


Figure 12. CAKN 2012 mean monthly temperatures departure from normal at long-term sites.

Table 4. Mean monthly and annual temperatures for 2012 from long-term sites compared the 1981-2010 normal period.

Site	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Talkeetna													
2012	-0.1	22.3	17.5	37.8	45.4	55.5	56.6	54.8	45.5	32.1	18.5	12.2	33.2
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													
2012	-18.6	16.6	3.0	33.3	40.4	52.8	53.9	50.3	41.5	20.0	-5.1	-3.1	23.7
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													
2012	-24.2	11.5	1.9	33.2	43.7	59.0	59.1	53.9	45.7	19.3	-16.8	-14.2	22.7
1981-2010 normal	-9.6	-3.7	7.2	29.1	46.3	58.0	60.4	53.7	41.7	23.0	2.6	-3.9	25.7
Gulkana													
2012	-13.5	14.6	11.3	35.4	42.6	52.6	54.9	51.6	45.4	21.4	-6.9	-12.4	24.7
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													
2012	23.9	32.9	29.5	38.0	42.0	48.6	52.1	52.5	48.5	37.0	31.0	25.0	38.4
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

Temperature at CAKN RAWS

Although the new CAKN climate stations and other Remote Automated Weather Stations (RAWS) around the CAKN parks have relatively short records, the monthly and annual averages and totals fill in some of the large spatial gaps in the network and provide information on climate patterns related to elevation and topography. Table 5 lists the monthly and annual temperatures for these sites grouped by park and Figure 13 and 14 shows them graphically. The monthly average temperatures are warmer for the lower elevation interior sites during the summer months, while the winter monthly average temperatures are warmer at higher elevations, effectively smoothing the annual averages. See Appendix C for complete monthly summaries from the CAKN climate sites.

Table 5. Monthly mean temperatures from CAKN stations 2012.

	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>Jun</i>	<i>Jul</i>	<i>Aug</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Annual</i>
Stampede	-23.0	9.6	0.3	32.5	41.6	53.3	52.8	49.4	40.2	18.0	-7.6	-11.3	21.3
Toklat	-14.3	18.2	4.6	30.0	38.5	49.8	50.5	47.9	38.9	19.3	-1.6	1.8	23.6
Eielson VC	-6.4	19.5	10.8	31.1	36.5	47.8	48.3	46.8	37.8	24.2	13.3	12.0	26.8
Wonder Lake	-15.8	11.9	2.1	31.9	41.5	53.1	53.6	50.5	39.1	19.3	0.0	-2.9	23.7
Dunkle Hills	-5.4	15.5	7.7	28.6	36.0	48.5	48.5	46.7	37.1	23.2	6.4	5.2	24.8
Denali VC	-23.9	16.5	4.1	35.1	43.4	55.3	55.9	52.2	42.8	19.5	-10.7	-10.3	23.3
Coal Creek	-27.2	6.7	-0.7	34.0	46.0	59.3	58.3	53.9	43.8	19.0	-20.0	-21.0	21.0
Upper Charley	-14.7	11.2	3.8	30.4	37.8	50.9	50.8	48.6	39.0	17.3	-4.6	-9.5	21.8
Chicken Creek	-0.8	16.1	10.2	28.3	31.9	42.4	45.7	44.6	37.1	18.8	2.9	2.3	23.3
Chisana	-20.0	6.6	5.7	32.2	38.9	49.9	53.3	48.9	40.3	15.2	-10.7	-18.9	20.1
Chititu	5.4	20.8	15.5	30.7	34.3	42.9	44.3	44.5	36.8	20.6	6.8	5.8	25.7
May Creek	-10.9	17.8	15.7	37.4	43.1	52.9	54.8	52.0	45.2	21.0	-6.5	-12.9	25.8
Gates Glacier	5.8	21.6	16.3	30.9	33.8	43.0	45.1	45.5	37.9	23.8	9.8	8.9	26.9
Tebay	-3.0	18.3	12.9	30.8	36.6	45.4	49.0	48.9	41.7	25.5	5.4	-0.1	25.9
Tana Knob	-0.2	21.2	16.6	31.8	35.7	44.1	47.1	47.2	39.8	24.5	4.4	5.3	26.5

Yellow – YUCH, Green – DENA, Blue – WRST

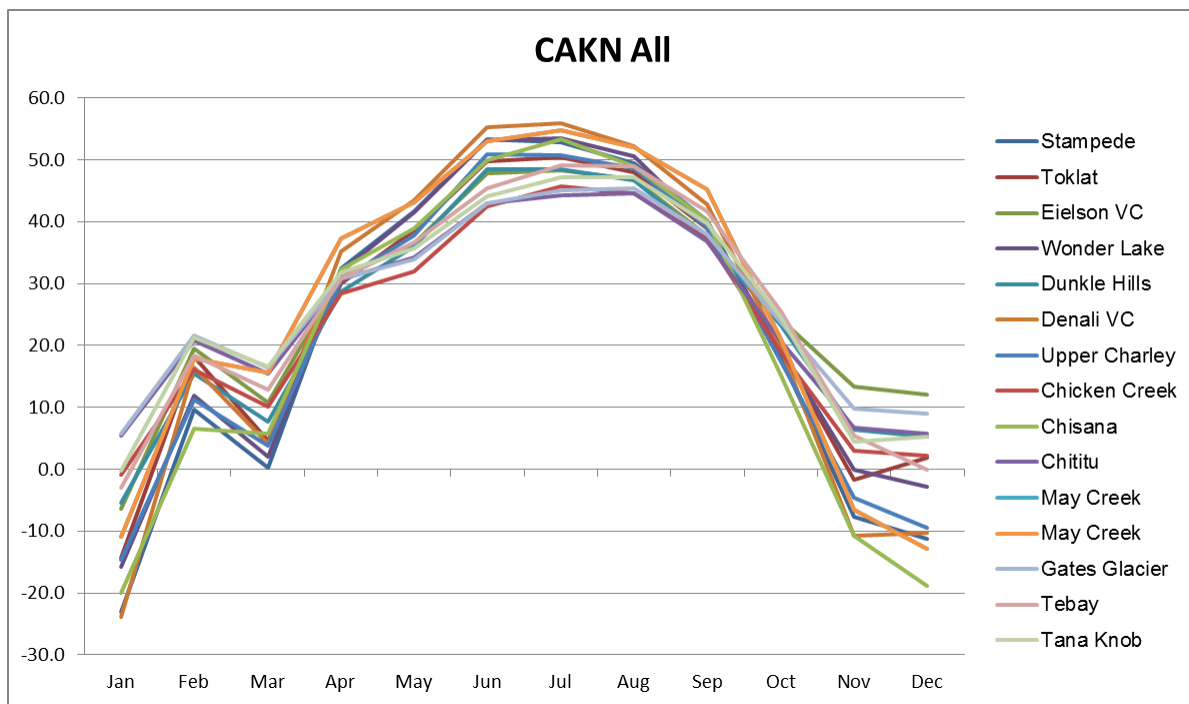


Figure 12. CAKN mean monthly temperatures 2012

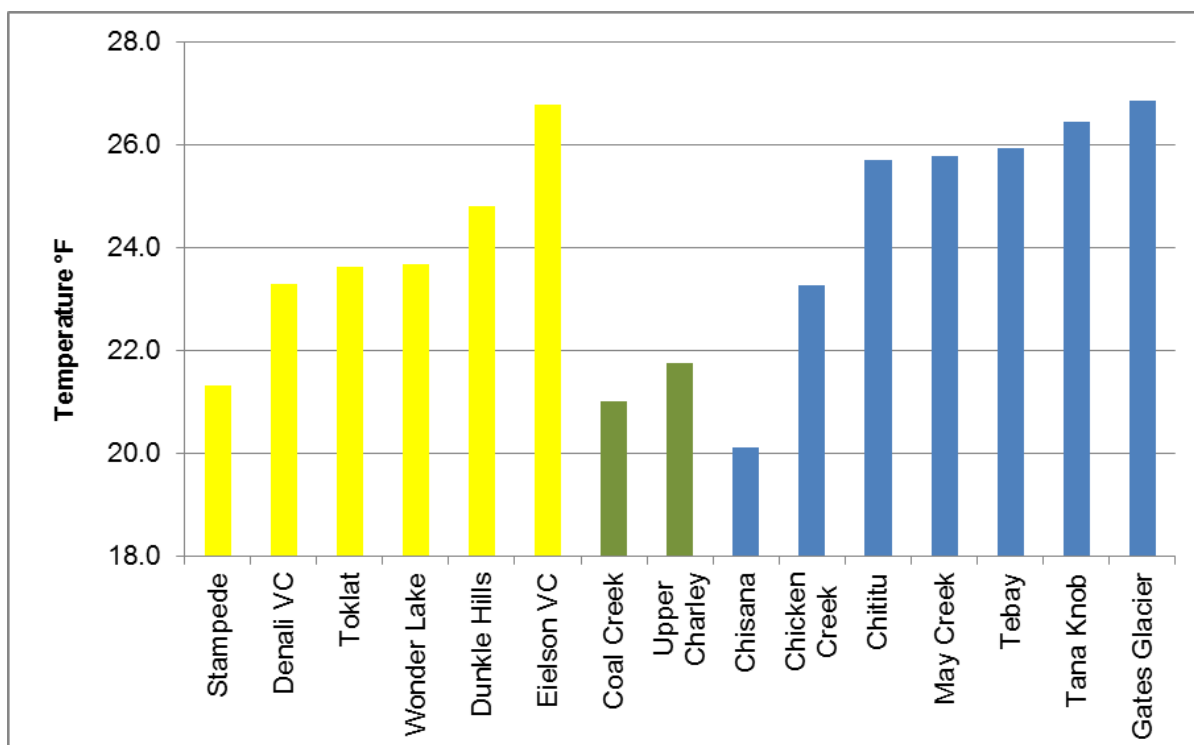


Figure 13. CAKN 2012 mean annual temperatures. Yellow sites are DENA, green YUCH, and blue WRST.

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 many 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° 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 still 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 (known as Chinooks) that funnel through the mountain passes, raising temperatures and mixing the air. The areas just north of these mountain passes often get winds in excess of 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 6 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 up in the Nutzotin Mountains and Chisana is in the Chisana River flood plain below the terminus of the Chisana Glacier. The annual temperature was 3.2 degrees warmer at Chicken Creek, the higher site. Table 6 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 temperature at Gates Glacier was 1.1 degrees warmer than the lower elevation site at May Creek. The higher sites were warmer in the winter and cooler in the summer, but the winter differences were more extreme.

Table 6. Mean monthly temperatures for 2012 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	-0.8	-20.0	5.8	-10.9
Feb	16.1	6.6	21.6	17.8
Mar	10.2	5.7	16.3	15.7
Apr	28.3	32.2	30.9	37.4
May	31.9	38.9	33.8	43.1
Jun	42.4	49.9	43.0	52.9
Jul	45.7	53.3	45.1	54.8
Aug	44.6	48.9	45.5	52.0
Sep	37.1	40.3	37.9	45.2
Oct	18.8	15.2	23.8	21.0
Nov	2.9	-10.7	9.8	-6.5
Dec	2.3	-18.9	8.9	-12.9
Annual	23.3	20.1	26.9	25.8

Red = warmer temperatures; blue = colder temperatures.

Table 7 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 0.8°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 5.5°F warmer than Stampede (Table 7). The monthly average temperatures were warmer in January, February, March, September, October, November, and December, or 7 out of 12 months. This site is subject to the warm Chinook winds that come through the passes in the winter. Figure 15 highlights the differences in seasonal temperatures at both high and low elevation sites.

Table 7. Mean monthly temperatures for 2012 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	-14.7	-27.2	-6.4	-23.0
Feb	11.2	6.7	19.5	9.6
Mar	3.8	-0.7	10.8	0.3
Apr	30.4	34.0	31.1	32.5
May	37.8	46.0	36.5	41.6
Jun	50.9	59.3	47.8	53.3
Jul	50.8	58.3	48.3	52.8
Aug	48.6	53.9	46.8	49.4
Sep	39.0	43.8	37.8	40.2
Oct	17.3	19.0	24.2	18.0
Nov	-4.6	-20.0	13.3	-7.6
Dec	-9.5	-21.0	12.0	-11.3
Annual	21.8	21.0	26.8	21.3

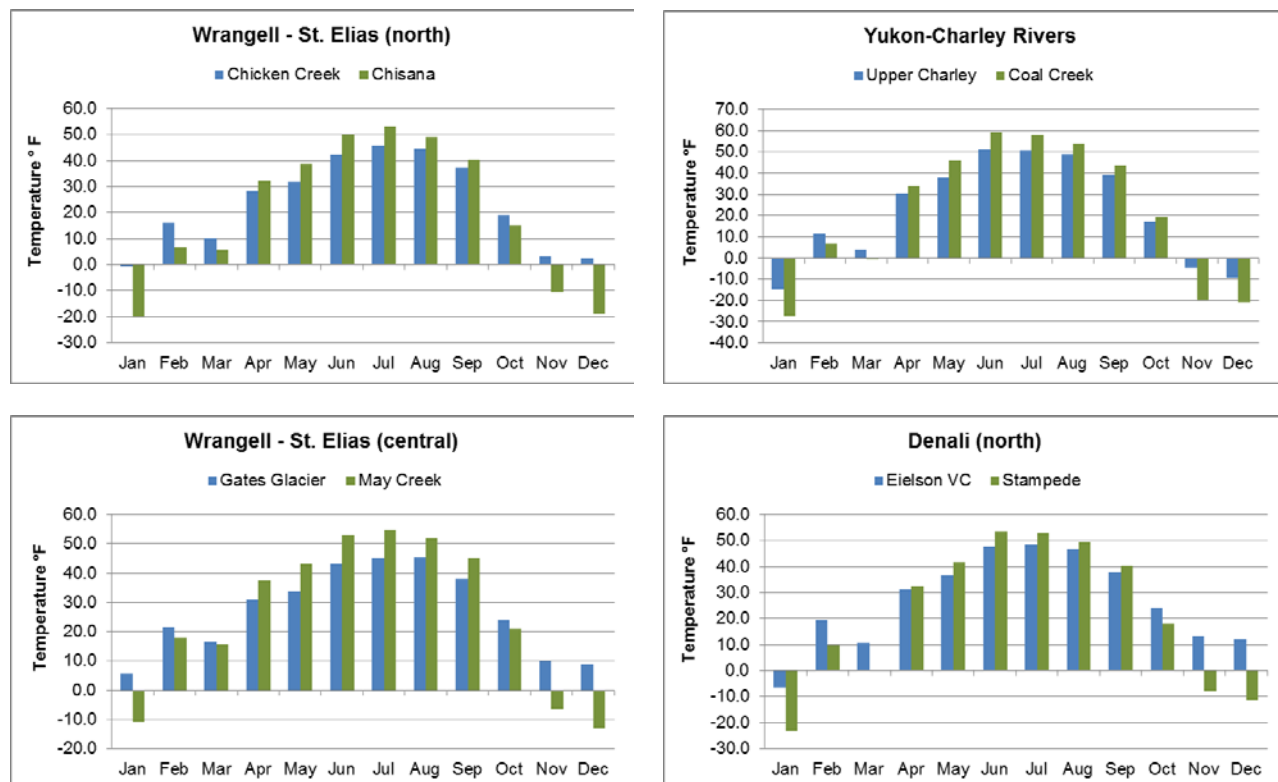


Figure 15. CAKN mean monthly temperatures – paired high and low elevation sites for 2012

Precipitation

The annual precipitation totals were just about normal at Talkeetna, McKinley Park, and Gulkana, at 97%, 96%, and 98% of normal respectively. In Eagle, the annual total was 81% of normal and in Yakutat it was 70% of normal (Table 8 and Figure 16). October, November, and December were particularly dry in Yakutat - a total of 22.7 inches of precipitation was recorded for October, November, and December, normal is 52.7 inches. The monthly precipitation totals for Eagle were below normal from May through October. In Talkeetna, every month was drier than normal except for September when the station recorded 6.4 inches more rain than normal. There was severe flooding in town associated with the fall storms that brought this much precipitation. In McKinley Park, the wettest month was June with a positive departure of 2.61 inches for the month, 221% of normal, this was followed by a dry July, which was 2.44 inches below normal.

See Appendix B for records for all long-term sites.

Table 8. Annual precipitation totals - departure from normal 2012.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Talkeetna	1.12	1.34	0.49	0.51	0.38	1.87	2.2	4.32	10.72	2.72	0.31	1.05	27.03
McKinley Park	1.01	0.73	0.29	0.11	0.6	4.76	0.78	1.78	2.4	1.05	0.5	0.4	14.41
Eagle	0.91	0.52	0.27	0.38	0.81	0.24	2.37	1.41	0.53	1.64	0.44	0.61	10.13
Gulkana	1.51	0.36	0.63	0.12	1.15	1.63	1.41	0.93	1.35	0.77	0.85	0.27	10.98
Yakutat	10.91	10.49	5.77	3.88	13.32	7.89	5.28	7.02	21.51	6.85	7.63	8.26	108.81

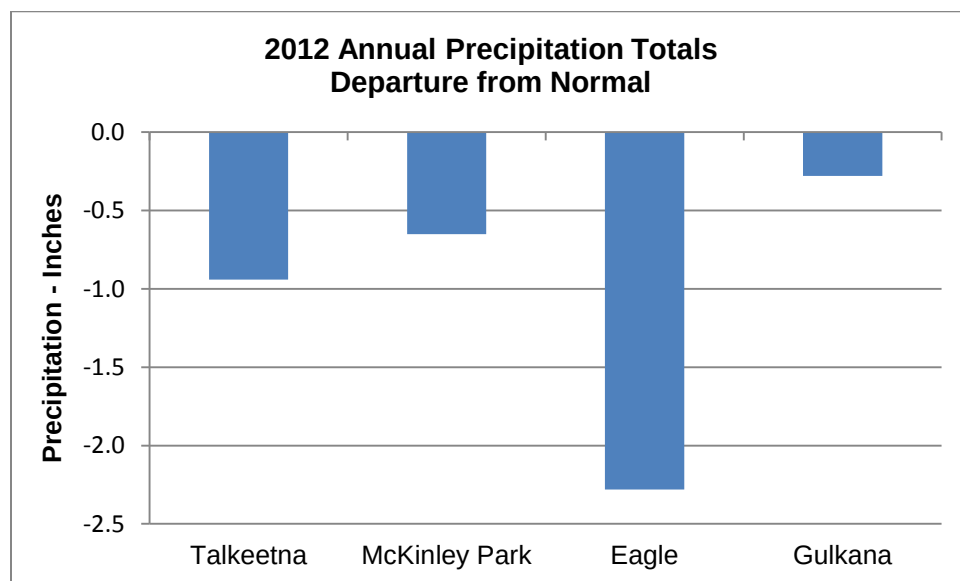
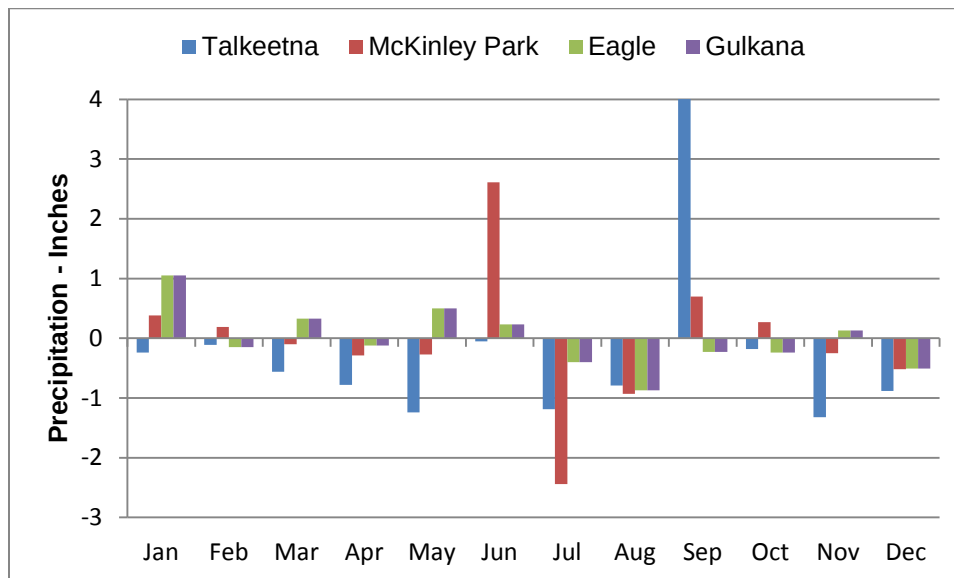


Figure 16. Annual precipitation totals departure from normal for long-term CAKN sites – 2012.

Table 9. Total monthly precipitation at long-term CAKN sites for 2012 compared with 1981-2010 normals

Site	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Talkeetna													
2012	1.12	1.34	0.49	0.51	0.38	1.87	2.2	4.32	10.72	2.72	0.31	1.05	27.03
1981-2010 normals	1.36	1.45	1.05	1.29	1.62	1.92	3.39	5.11	4.32	2.9	1.63	1.93	27.97
McKinley Park													
2012	1.01	0.73	0.29	0.11	0.6	4.76	0.78	1.78	2.4	1.05	0.5	0.4	14.41
1981-2010 normals	0.63	0.54	0.39	0.4	0.87	2.15	3.22	2.71	1.7	0.78	0.75	0.92	15.06
Eagle													
2012	0.91	0.52	0.27	0.38	0.81	0.24	2.37	1.41	0.53	1.64	0.44	0.61	10.13
1981-2010 normals	0.53	0.47	0.38	0.26	1.1	1.64	2.43	1.92	1.31	0.95	0.73	0.69	12.41
Gulkana													
2012	1.51	0.36	0.63	0.12	1.15	1.63	1.41	0.93	1.35	0.77	0.85	0.27	10.98
1981-2010 normals	0.46	0.51	0.3	0.24	0.65	1.4	1.81	1.8	1.58	1.01	0.72	0.78	11.26
Yakutat													
2012	10.91	10.49	5.77	3.88	13.32	7.89	5.28	7.02	21.51	6.85	7.63	8.26	108.81
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	155.12

**Figure 17.** Monthly precipitation totals departure from normal for 2012.

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 - the 2011-2012 snow monitoring report is the latest available in the series (Sousanes, 2013).

For water year 2012, the Kantishna SNOTEL site recorded 5.2 inches of total winter precipitation (snow water equivalent) from October 1, 2011 through May 1, 2012, which is 84% of average. The total annual precipitation for the site was 23.5 inches; the winter snow accounted for 22% the total annual precipitation. Snow-on date was October 16 and the snow-off date was May 7, 2012. The precipitation gage at Tokositna Valley recorded 24.6 inches of precipitation from October 1, 2011 through May 1, 2012. This is 41% of the total annual precipitation of 60.6 inches for the 2012 water year.

The SNOTEL site at May Creek reported 5.2 inches of snow water equivalent on May 1st; the annual total precipitation was 14.0 inches, so the winter snowfall accounted for 37% of the total precipitation for the year. The snow-on date was October 18, 2011 and the snow-off date was April 27, 2012. The Chisana SNOTEL site recorded 4.1 inches of total winter precipitation from Oct 1 through May 1. The total annual precipitation was 12.3 inches; the winter snow accounted for 33% of the total annual precipitation for the 2012 water year.

The new American Creek SNOTEL site was installed in summer of 2011. There was a total of 4.0 inches of precipitation accumulated from October 1 through May. The Eagle NWS COOP site recorded an annual snowfall amount of 62.0 inches or 103% of the normal 59.9 inches. See Appendix C for tables and graphs with long-term data. Cumulative precipitation graphs for the five SNOTEL sites are presented in Figure 18 (note the differences in scale).

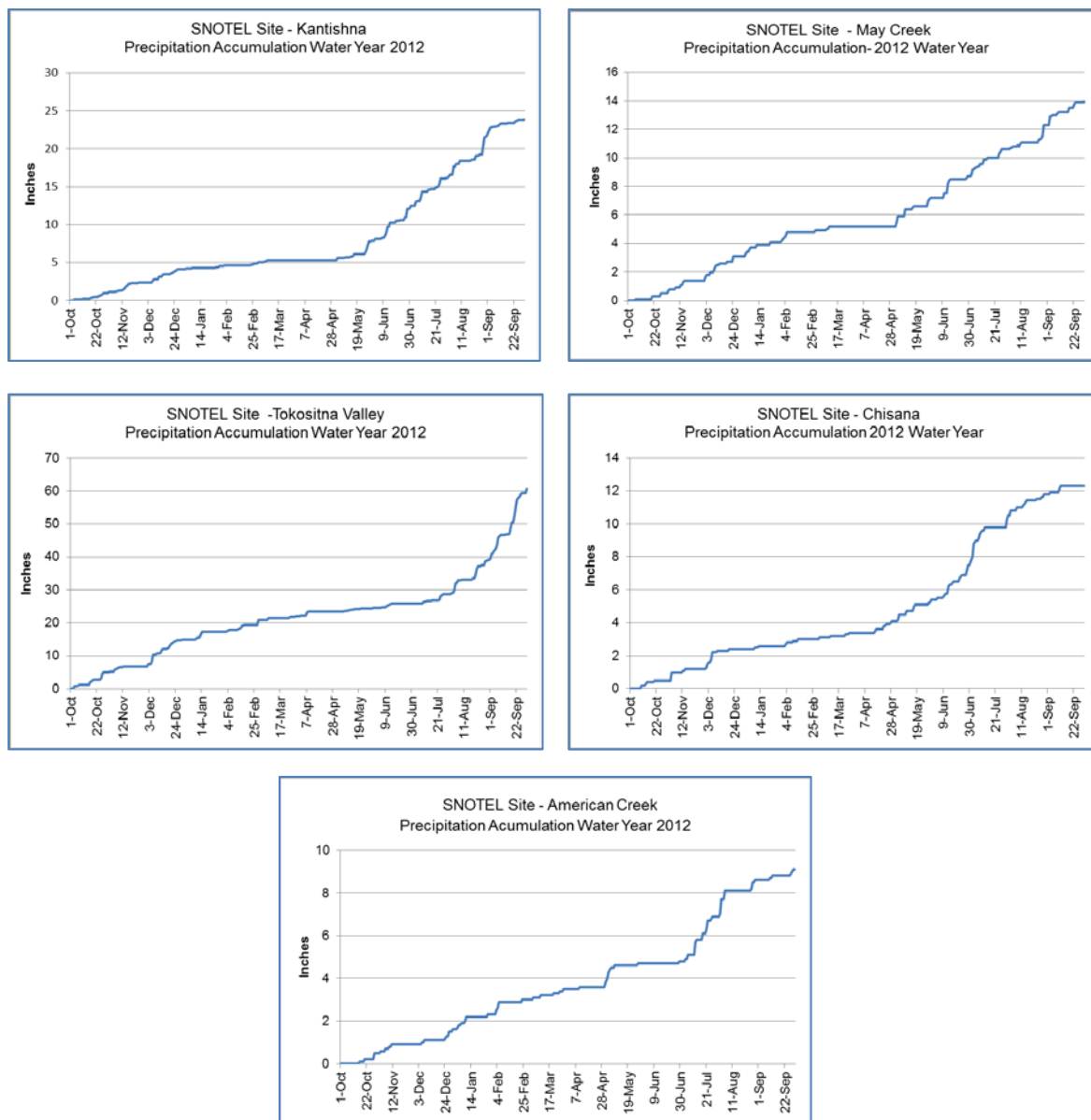


Figure 18. Cumulative precipitation for Water Year 2012 (Oct. 1 – Sep.30) for the five CAKN SNOTEL sites.

Summary

The 2012 field season marked the fifth year of operational climate monitoring in CAKN parks. Annual maintenance was performed on all, but one, of climate and snow monitoring instruments in the three CAKN parks. We did not get to the Dunkle Hills climate station in Denali due to weather and timing, the station was running and in good order going into the 2012-2013 winter. Maintenance at the 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 DENA, WRST, and YUCH which includes; sensors, data loggers, towers, solar panels, and batteries. Sensor and power performance was tracked and instrumentation was replaced as necessary. A separate 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 2013)

The data from long-term sites are available at the Western Regional Climate Center (<http://www.wrcc.dri.edu/CLIMATEDATA.html>) and the National Climatic Data Center (<http://www.ncdc.noaa.gov/oa/climateresearch.html>). The CAKN climate stations transmit data via satellite and are available on the web at <http://www.wrcc.dri.edu/NPS.html>. Data 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. The University of Utah provides a well organized link to all of the Alaska data on their web site at <http://mesowest.utah.edu/index.html>.

An interagency agreement is in place for the maintenance, data archiving, and data dissemination for the four SNOTEL sites in the network (note American Creek in Eagle is not funded through CAKN). The data from the stations are transmitted hourly via meteor burst communication and are on-line at <http://www.ak.nrcs.usda.gov/snow/>.

This annual report provided a climate summary for the CAKN region in 2012 with brief references to the Alaska regional climate, the climate of the contiguous U.S., and the global climate for context. For a graphic display of worldwide significant climate anomalies for 2012 see Appendix D.

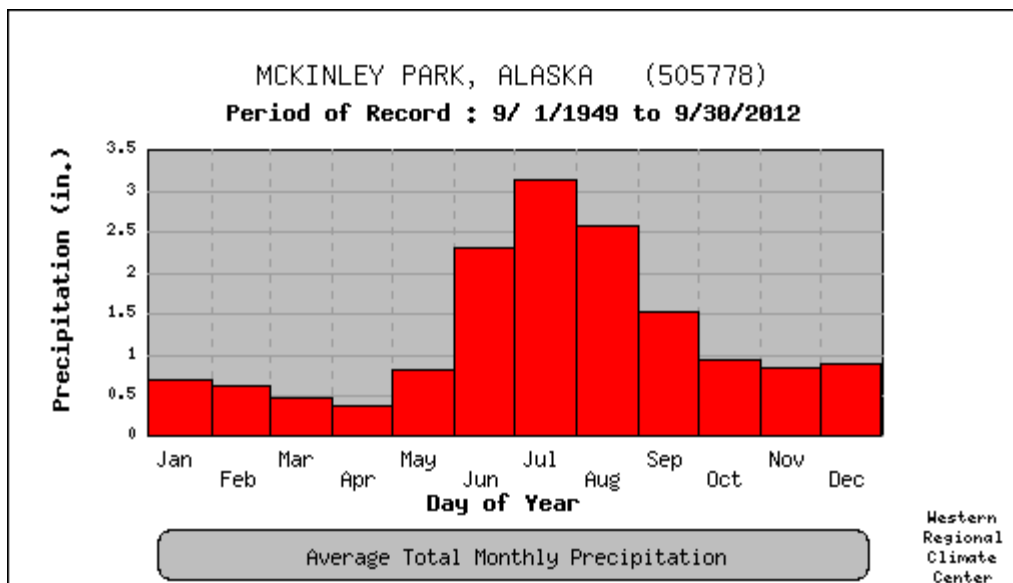
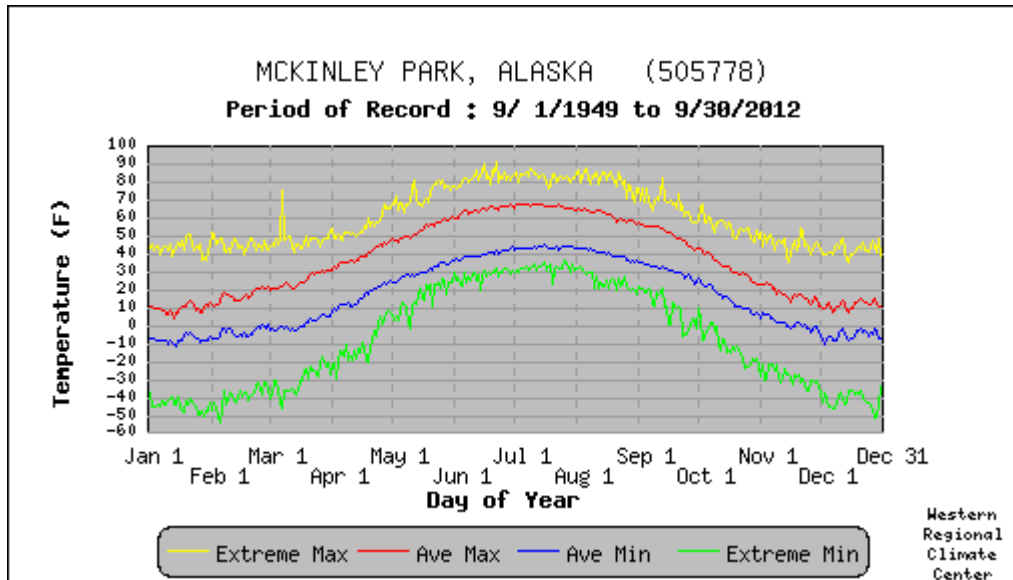
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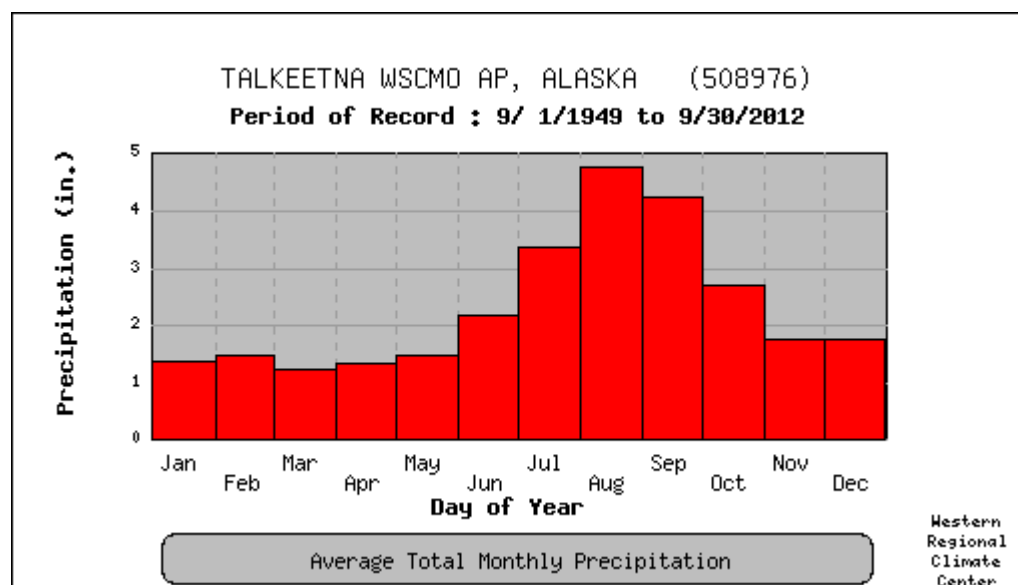
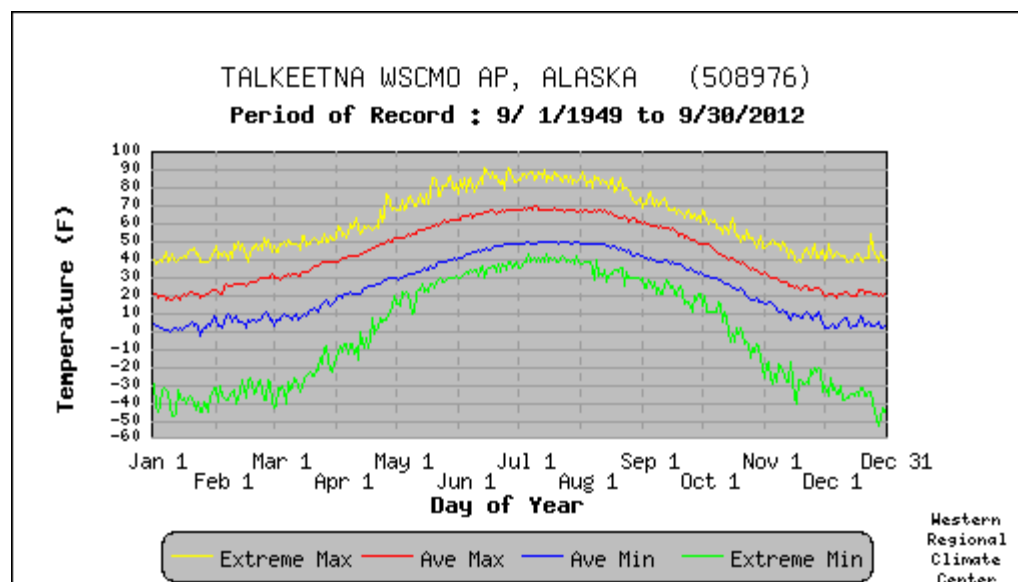
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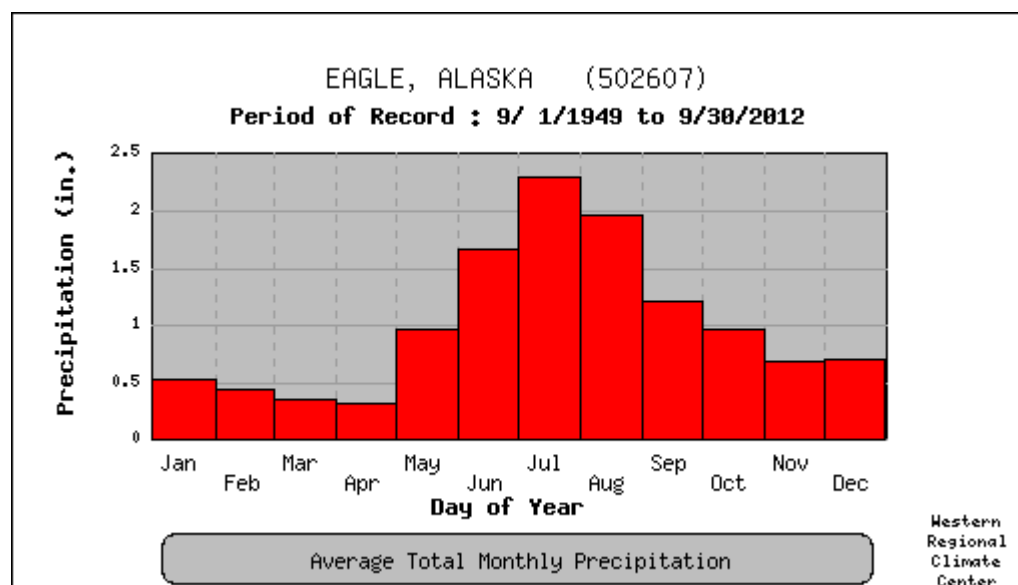
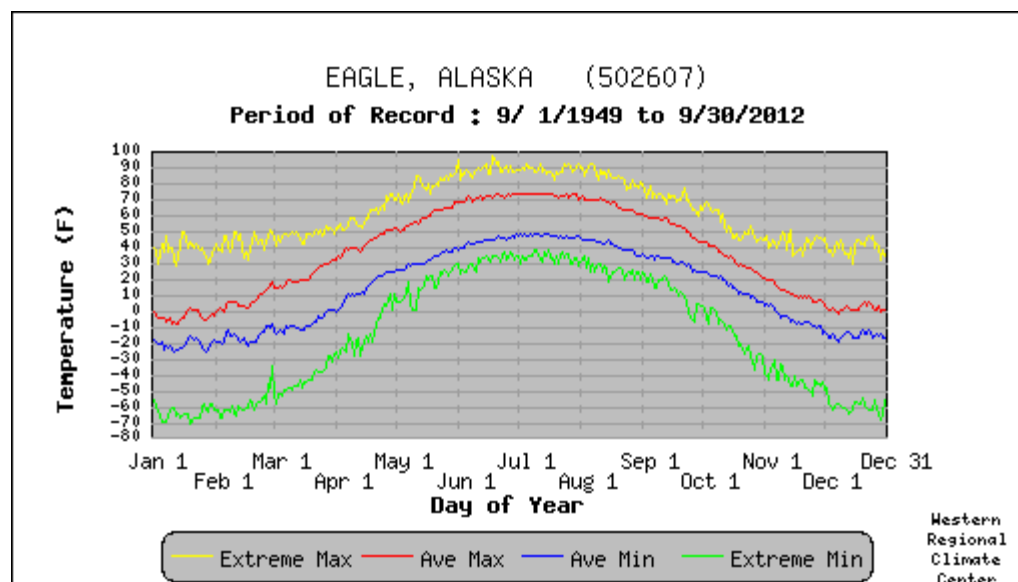
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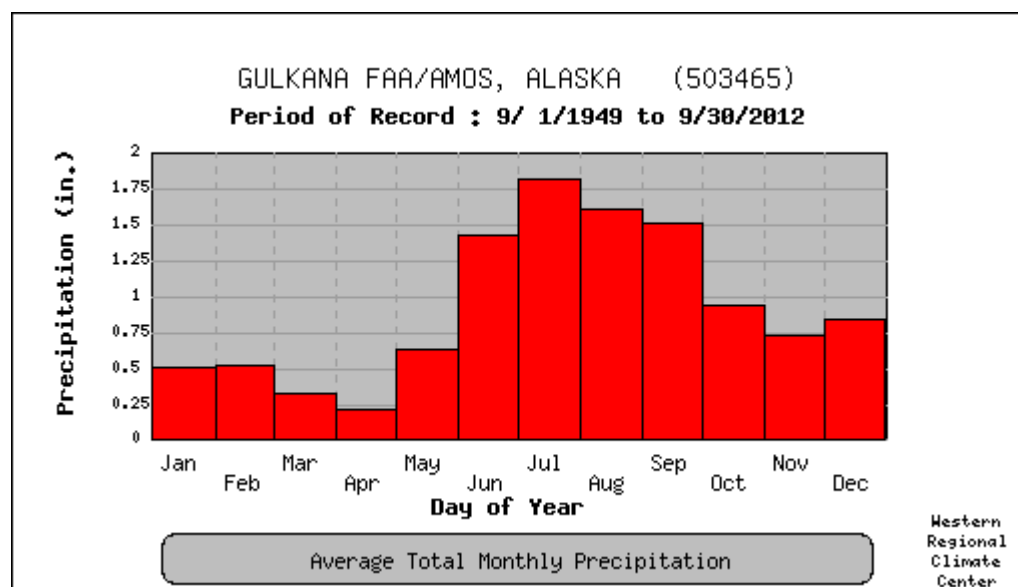
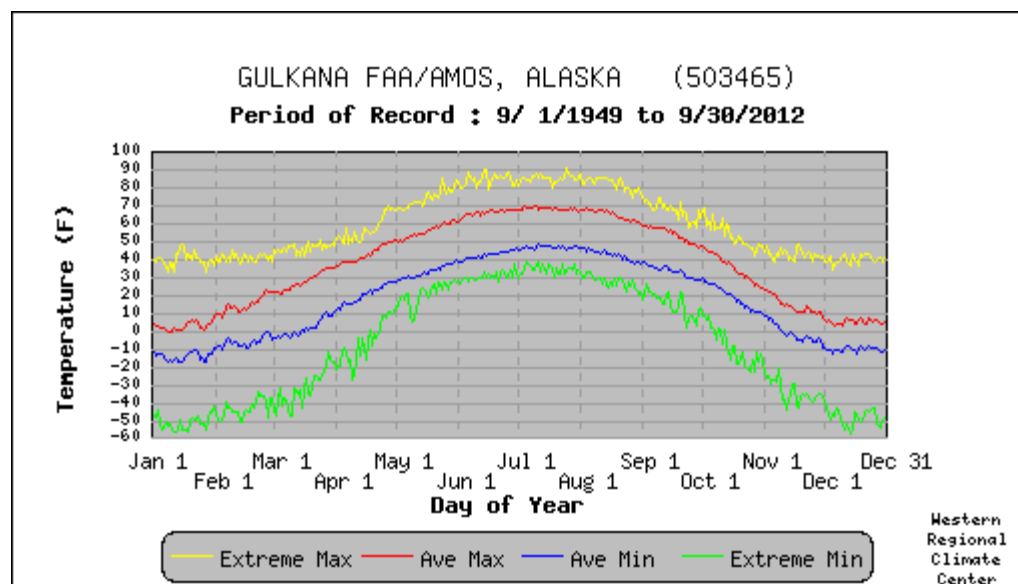
Appendix A. Period of Record Means at Long-term Sites

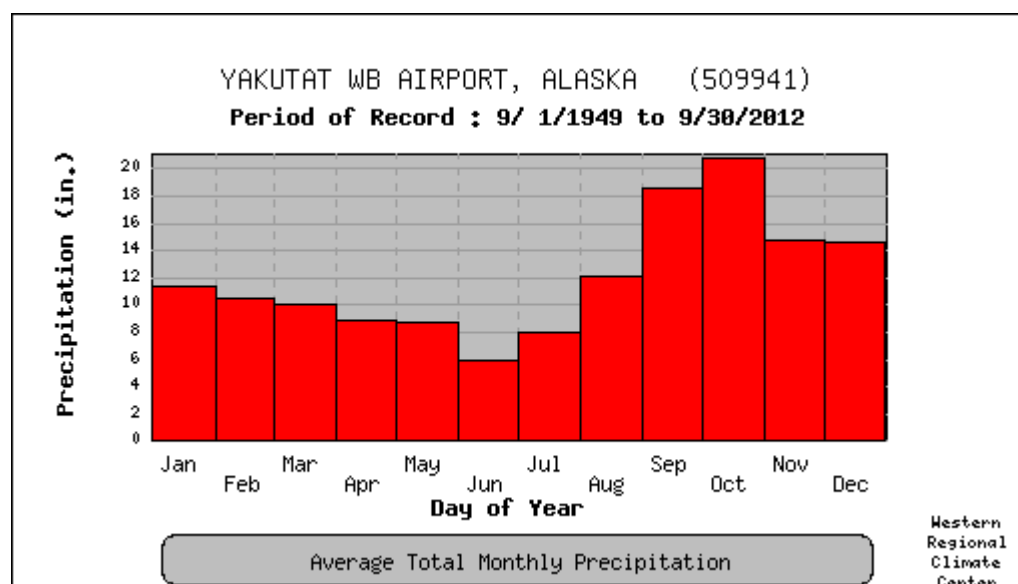
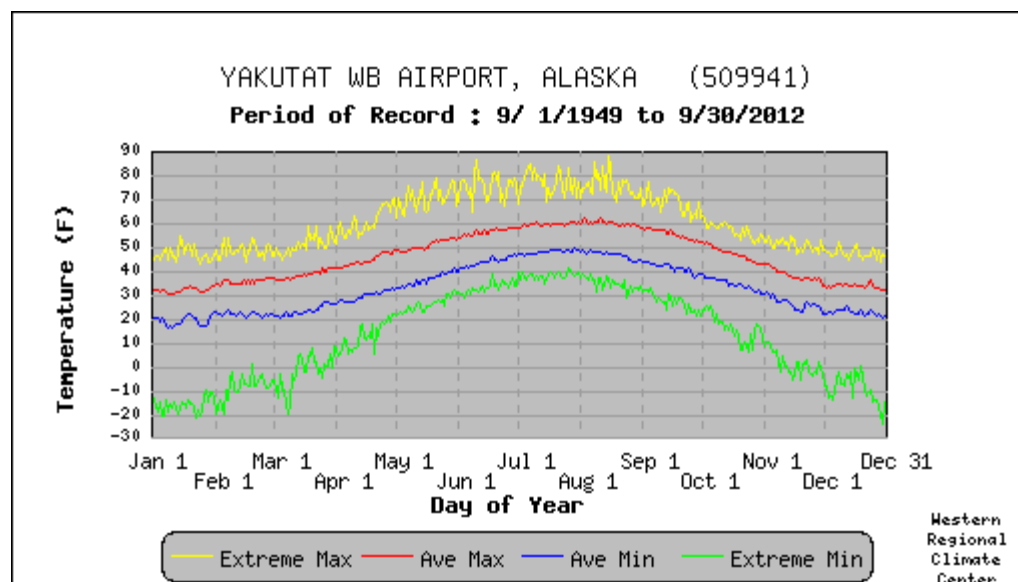
Graphs retrieved from <http://www.wrcc.dri.edu/summary/Climsmak.html>











Appendix B. 2012 Climate Extremes at Long-term Sites updated on Sept 26 2012

Daily summary stats retrieved from:

<http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak5778>

Monthly summary stats retrieved from:

<http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak5778>

McKinley Park - 2012 Records – 88 years

Record High Temperatures °F	51, 55, 54	Apr 14, 17, 18
	66	Sep 23
Record Low Temperatures °F	32	Jul 9
	34	Jul 11
	1.50	Jun 2
Record precipitation - inches	0.70	Aug 27
	0.72	Sep 20
	2.5	Feb 14
Record snowfall - inches	1.3	May15

Note: These statistics are based on the McKinley Park record that dates back to 1925 – the records listed on the WRCC website only include the period from 1949 to the present.

Talkeetna – 2012 Records – 63 years

Record High Temperatures °F	55	Apr 14
	56	Apr 19
Record Low Temperatures °F	41	Jul 9
Record precipitation - Inches	0.88	Jul 21
	2.3	Sep 19
Record High Monthly Precip - inches	10.72	September

Eagle – 2012 Records -59 years

Record High Temperatures °F	33	Feb 15
	90, 91	Jun 24, 25
	88	Jul 28
	71	Sep 6
	70	Sep 23
Record low temperatures °F	38	Jul 9
Record Snowfall – in.	3.4	Jan 2
	4.5	Feb 4

Gulkana 2012 records – 62 years of data

Record high temperatures °F	33	Jan 11
	37	Feb 13
	50, 51, 56	Apr 12, 14, 16
	62, 64, 66	Sep 19, 21, 22

Record low temperatures °F	34, 29 30 22	Jun 27, 28 Aug 18 Sep 14
Record daily rainfall - inches	0.81 0.98	Jul 10 Sep 1
Record High Monthly Precip - inches	1.51	January

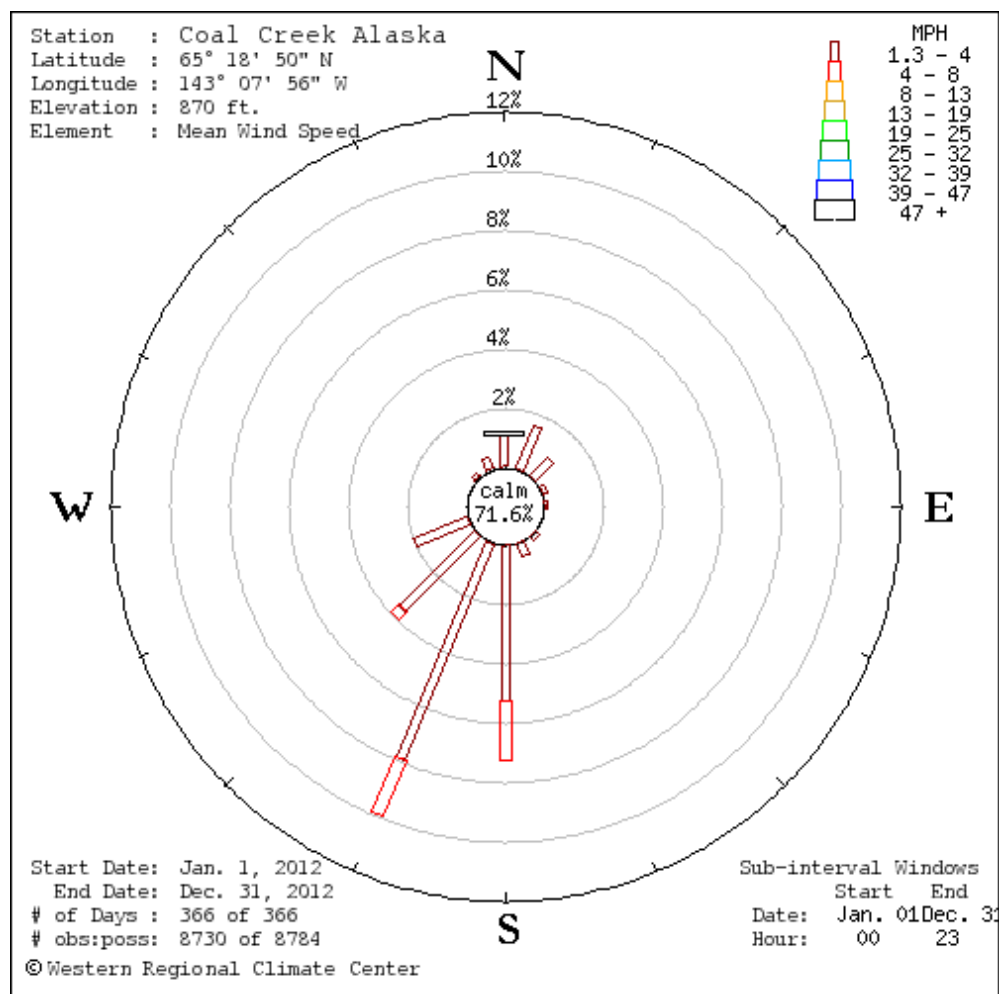
Yakutat 2012 records – 63 years of data

Record high temperatures °F:	45 48, 47 54	Feb 3 Feb 8, 9 Apr 12
Record rainfall - inches	1.69	Apr 29

Appendix C. 2012 CAKN Climate Station Monthly Data

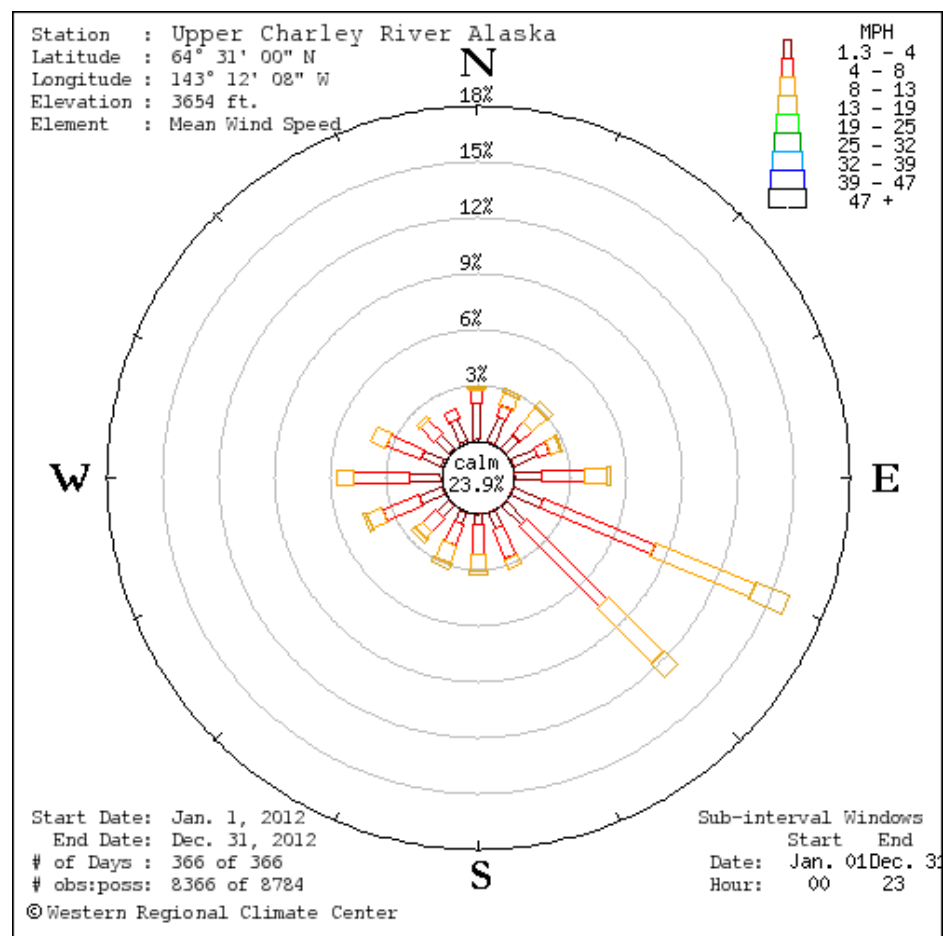
Coal Creek Alaska

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature Inches			Relative Humidity	Snow Depth	Summer Precip*
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10 cm	20 cm	50 cm	Ave.	Ave.	Total
Jan-12	31	1	166	11	-27	25	-58	2	22	24	69	14	
Feb-12	658	1	158	14	7	44	-39	13	19	21	79	17	
Mar-12	3266	2	183	10	-1	32	-32	16	19	21	69	20	
Apr-12	10802	1	170	7	34	58	-10	26	24	24	63	12	
May-12	11769	2	164	12	46	72	14	34	30	29	58	1	
Jun-12	13862	1	184	13	59	85	33	44	31	30	63	1	2.4
Jul-12	10444	1	182	10	58	82	38	47	31	31	72	1	3.23
Aug-12	8839	1	178	9	54	77	28	45	33	31	73	1	1.02
Sep-12	4120	1	170	13	44	71	22	37	32	31	75	1	
Oct-12	1321	1	167	8	19	51	-17	30	31	31	86	m	
Nov-12	112	0	153	8	-20	14	-45	22	31	31	73	m	
Dec-12	10	1	117	8	-21	22	-53	8	28	28	71	m	



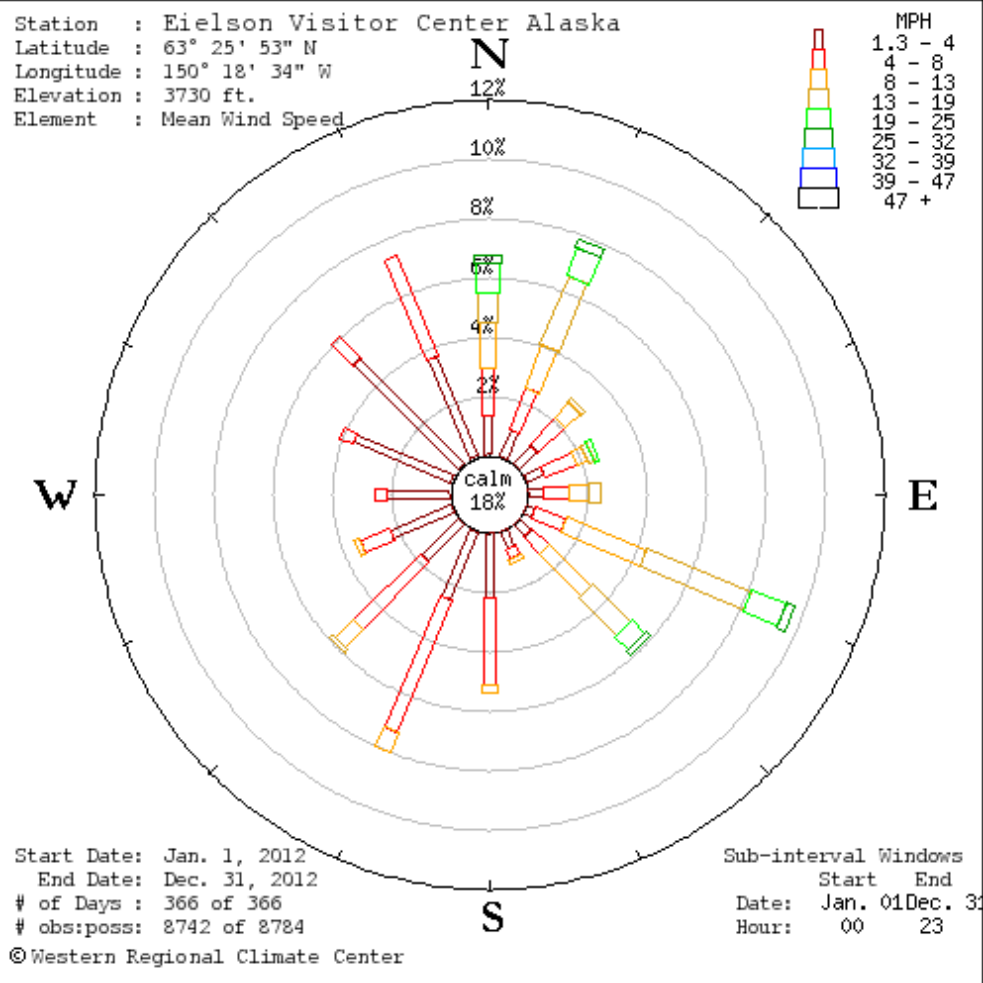
Upper Charley River Alaska

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth	Summer Precip
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10 cm	20 cm	50 cm	Ave.	Ave.	Total
Jan-12	177	3	171	23	-15	12	-37	13	18	17	81	8	
Feb-12	3241	8	142	24	11	27	-17	16	18	17	87	10	
Mar-12	10278	5	136	25	4	35	-20	15	18	17	81	12	
Apr-12	19339	5	143	29	30	48	2	25	24	23	70	10	
May-12	21375	6	167	25	38	57	15	35	31	30	66	1	
Jun-12	19377	5	170	27	51	71	33	48	38	38	67	0	2.97
Jul-12	18837	5	202	22	51	73	38	49	45	43	71	0	3.51
Aug-12	17554	5	219	21	49	69	28	49	57	44	16	0	0.39
Sep-12	9270	7	168	28	39	58	21	41	34	38	56	0	
Oct-12	3608	4	154	28	17	43	0	m	m	m	87	3	
Nov-12	807	4	155	25	-5	15	-22	m	m	m	83	6	
Dec-12	96	3	189	16	-9	20	-32	m	m	m	81	8	



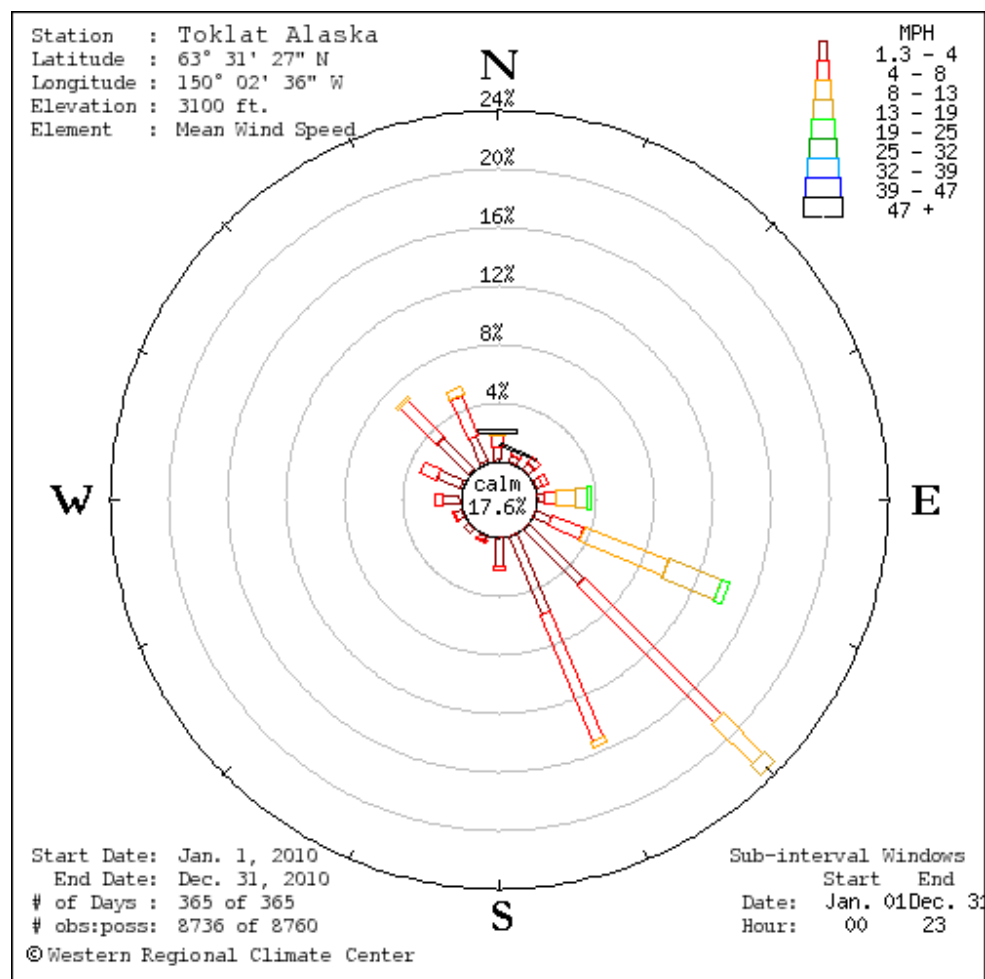
Eielson Visitor Center

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Relative Humidity	Summer Precip
Date	ly	mph	Deg	mph	Deg F			%	In.
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave.	Total
Jan-12	469	6	219	38	-6	30	-37	58	
Feb-12	2013	8	163	35	19	44	-20	59	
Mar-12	6603	4	222	32	11	46	-15	48	
Apr-12	12040	5	198	36	31	50	2	63	
May-12	15456	6	166	26	36	55	8	60	
Jun-12	11346	5	201	23	48	68	34	75	7.07
Jul-12	11718	5	175	23	48	65	36	75	3.22
Aug-12	9116	5	185	27	47	65	33	74	3.28
Sep-12	6203	8	164	39	38	57	18	71	
Oct-12	2992	6	170	31	24	54	1	66	
Nov-12	773	8	157	36	13	36	-21	57	
Dec-12	146	8	199	35	12	38	-26	54	



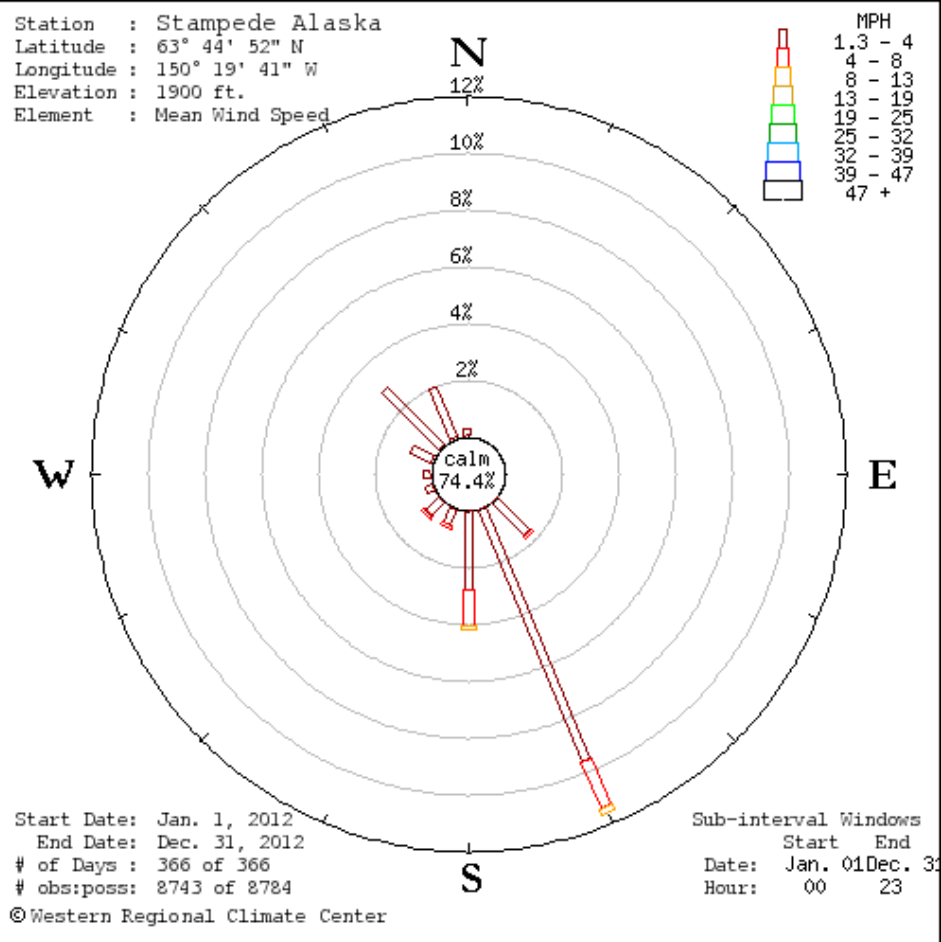
Toklat Alaska

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth	Summer Precip
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10cm	20cm	50cm	Ave.	Ave.	Total
Jan-12	380	5	142	35	-14	31	-45	21	21	23	71	11	
Feb-12	1950	9	124	36	18	40	-24	25	25	26	66	8	
Mar-12	5917	5	140	29	5	41	-29	24	24	25	72	11	
Apr-12	10342	6	133	26	30	49	-4	32	31	30	68	5	
May-12	14425	6	130	41	39	58	3	44	42	40	58	1	
Jun-12	11451	4	138	20	50	71	34	55	53	51	73	0	4.57
Jul-12	11942	5	112	25	51	67	31	56	54	52	70	0	1.98
Aug-12	8623	6	123	25	48	67	31	52	50	49	74	0	3.45
Sep-12	5582	8	128	34	39	57	16	39	39	39	72	0	
Oct-12	2141	5	148	27	19	53	-10	30	31	32	81	4	
Nov-12	556	4	141	18	-2	36	-32	23	25	27	79	9	
Dec-12	151	7	136	35	2	39	-40	22	23	24	71	12	



Stampede Alaska

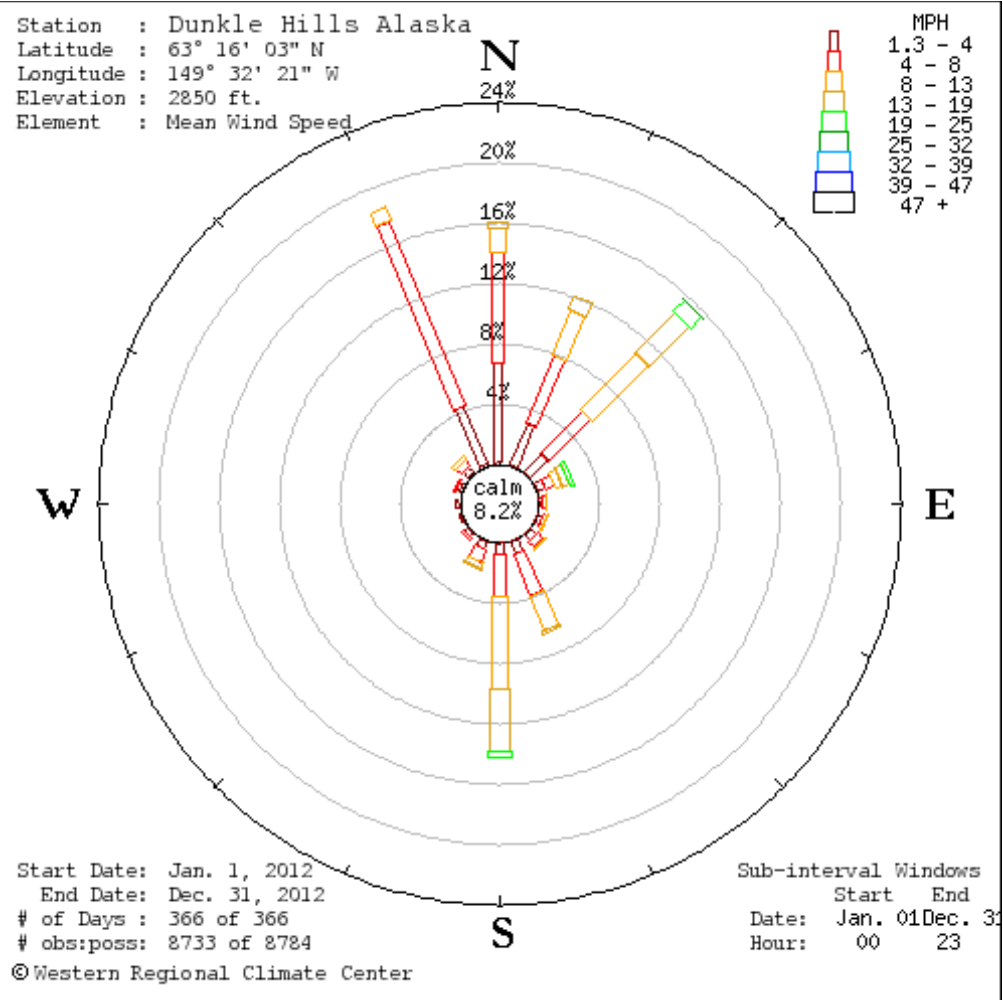
	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth	Summer Precip
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10cm	20cm	50cm	Ave.	Ave.	
Jan-12	90	1	234	10	-23	35	-49	15	19	22	73	18	
Feb-12	1947	1	167	18	10	42	-29	18	19	21	77	20	
Mar-12	2776	1	177	11	0	35	-32	17	19	21	72	24	
Apr-12	12284	1	155	11	32	55	-4	27	28	26	66	14	
May-12	13731	2	158	15	42	63	9	43	42	37	59	1	
Jun-12	12008	1	154	12	53	79	33	55	54	48	72	1	2.5
Jul-12	11636	1	148	10	53	74	32	56	56	52	77	1	2.0
Aug-12	8697	1	146	10	49	74	31	51	52	50	81	1	1.5
Sep-12	5955	1	167	15	40	64	20	41	42	43	76	1	
Oct-12	2220	1	227	9	18	57	-12	30	32	34	88	4	
Nov-12	523	1	209	6	-8	25	-34	23	26	30	83	10	
Dec-12	119	1	189	13	-11	43	-43	18	21	24	77	16	



Dunkle Hills

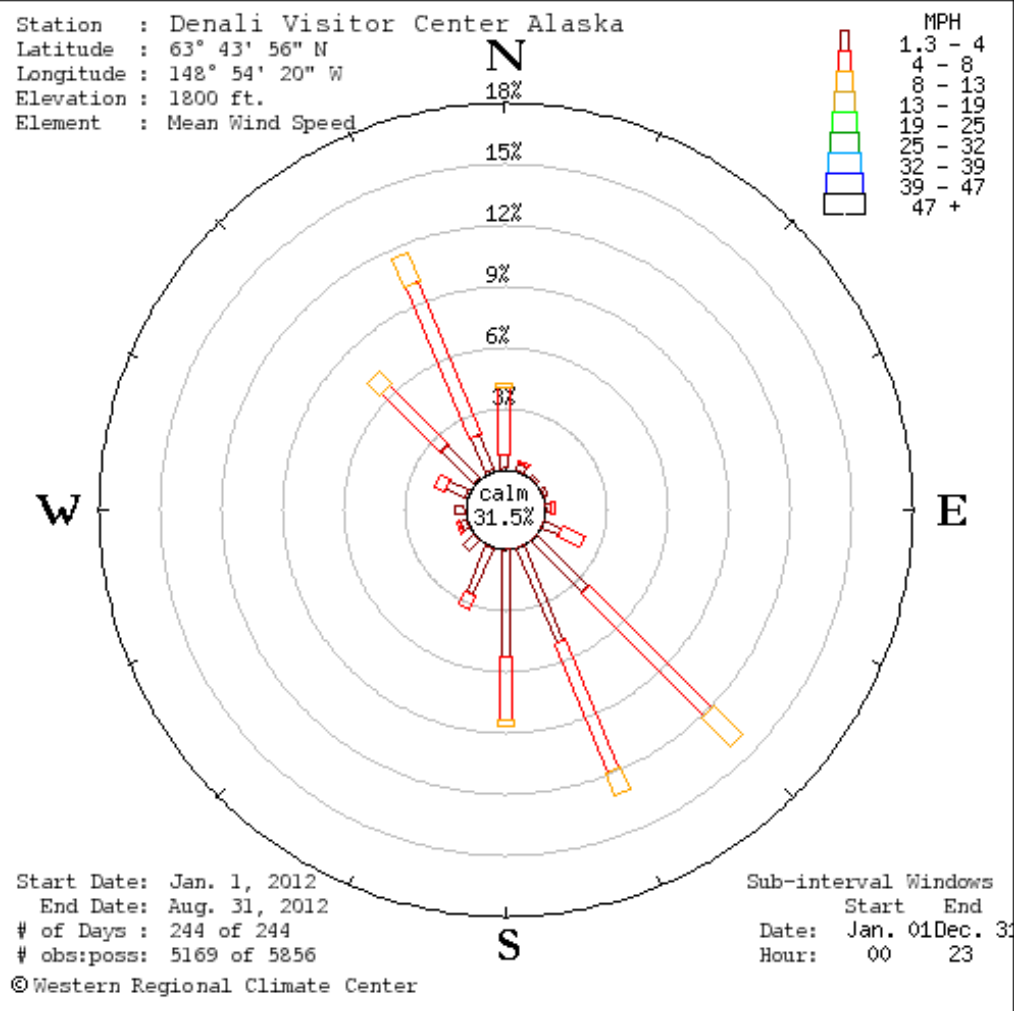
	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10cm	20cm	50cm	Ave.	Ave.
Jan-12	823	10	110	33	-5.4	26.0	-30.0	19	20	m	71	16
Feb-12	2314	6	153	31	15.5	36.0	-9.0	20	20	m	82	17
Mar-12	7050	6	195	26	7.7	41.0	-17.0	19	19	m	73	17
Apr-12	13970	5	222	24	28.6	46.0	0.0	26	26	m	73	16
May-12	16534	5	196	31	36.0	56.0	5.0	37	36	m	69	1
Jun-12	12640	5	193	23	48.5	72.0	31.0	49	48	m	75	0
Jul-12	11965	8	180	24	48.5	69.0	30.0	51	50	m	78	0
Aug-12	9239	7	192	27	46.7	67.0	28.0	49	48	m	83	0
Sep-12	4316	6	188	33	37.1	49.0	14.0	37	38	m	86	0
Oct-12	3240	6	120	23	23.2	42.0	2.0	28	30	m	75	0
Nov-12	1138	7	99	25	6.4	28.0	-15.0	17	19	m	71	1
Dec-12	340	7	124	26	5.2	39.0	-22.0	12	13	m	71	4

m = missing data



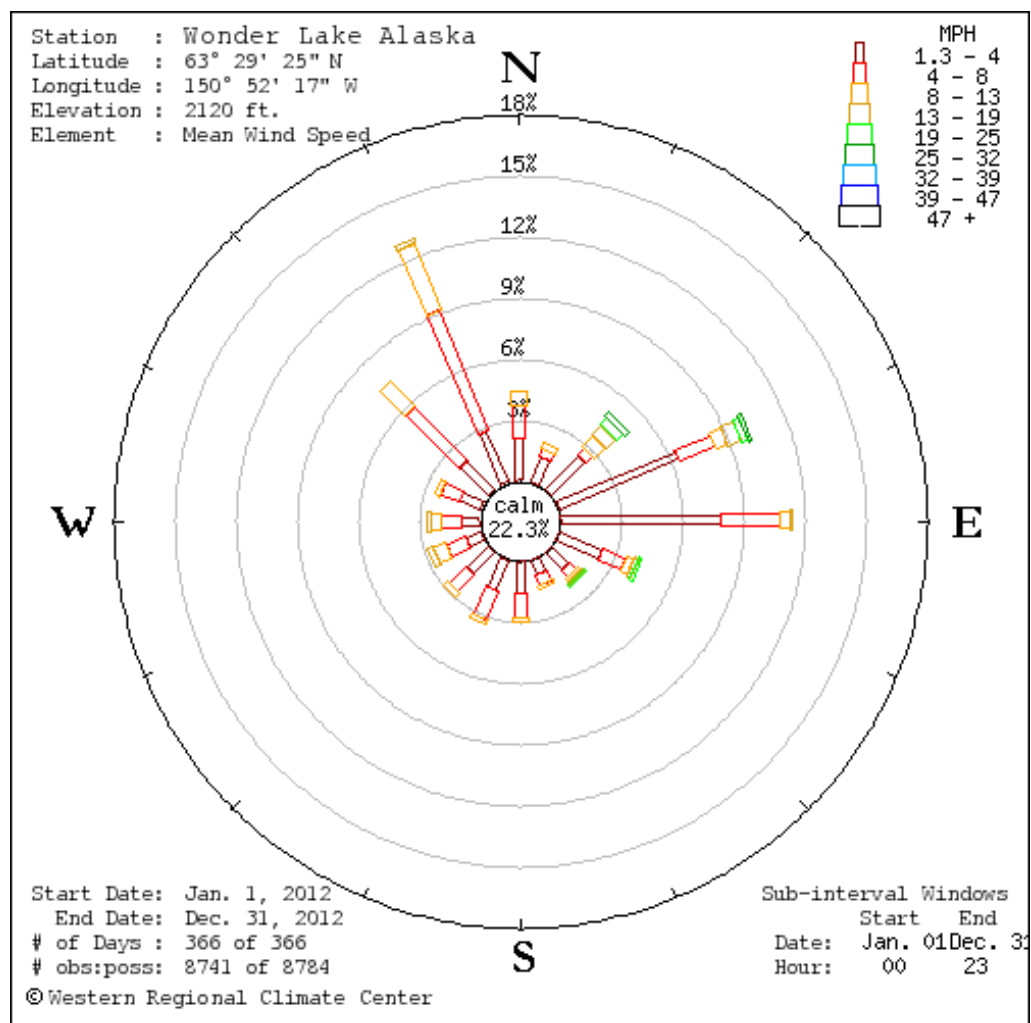
Denali Visitor Center

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Relative Humidity			Precipitation
Date	ly	mph	Deg	mph	Deg F			%			in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave.	Max.	Min.	Total
Jan-12	58	2	160	27	-24	31	-53	70	87	57	
Feb-12	1499	4	169	28	16	42	-29	69	94	28	
Mar-12	5274	3	170	24	4	51	-32	64	89	27	
Apr-12	12253	4	164	26	35	61	-6	60	97	16	
May-12	14244	4	154	25	43	70	7	56	97	14	
Jun-12	12301	3	163	22	55	86	29	68	97	22	4.64
Jul-12	12970	4	153	26	56	80	29	64	100	18	0.82
Aug-12	m	4	185	25	52	78	26	70	100	26	1.3
Sep-12	m	4	187	31	43	69	16	74	100	27	
Oct-12	m	2	199	24	20	54	-19	81	100	35	
Nov-12	m	0	238	16	-11	33	-36	76	94	44	
Dec-12	m	1	231	28	-10	44	-46	73	96	42	



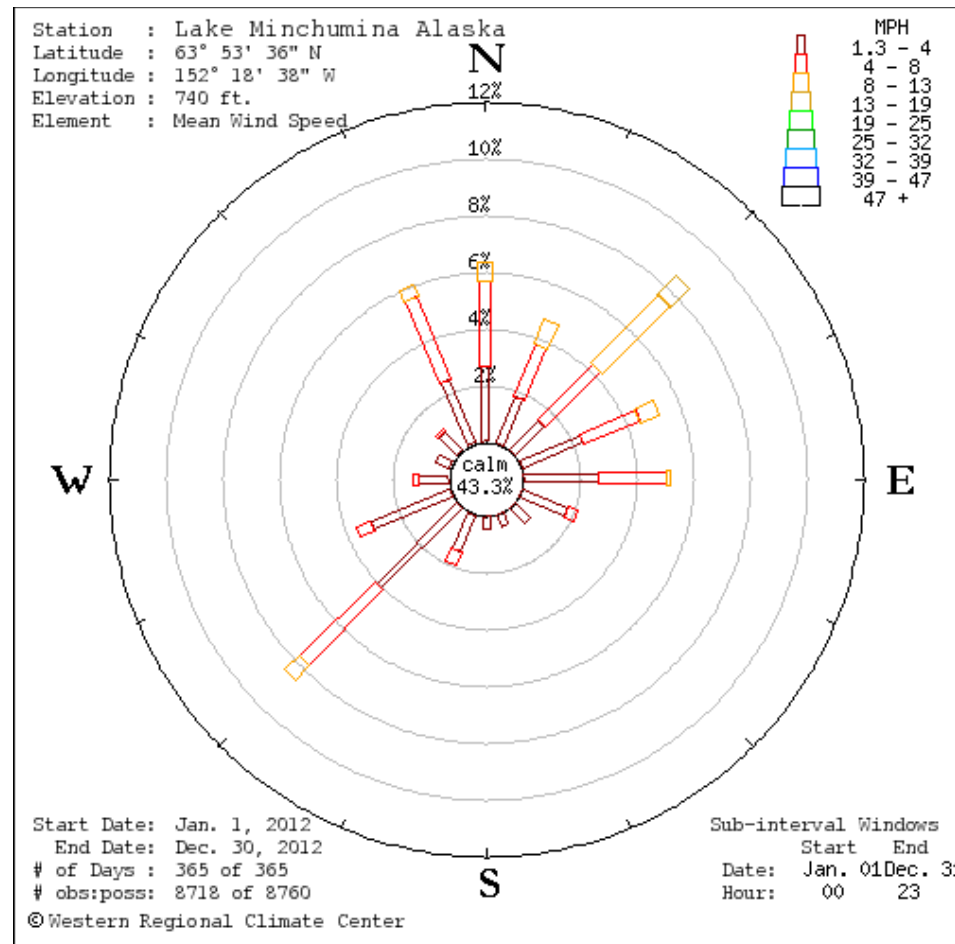
Wonder Lake Alaska

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Fuel Temp			Relative Humidity			Precipitation
Date	ly	mph	Deg	mph	Deg F			Deg F			%			in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Total
Jan-12	264	4	59	43	-16	26	-38	-17	24	-39	67	84	34	
Feb-12	1509	4	76	41	12	40	-25	11	42	-24	66	93	29	
Mar-12	5711	4	33	37	2	34	-25	3	42	-28	66	89	27	
Apr-12	11978	4	42	34	32	61	0	33	67	-2	63	95	20	
May-12	14706	4	98	29	42	63	8	43	73	6	57	96	17	
Jun-12	12253	4	12	29	53	82	31	54	93	30	72	96	20	6.52
Jul-12	12799	4	348	24	54	75	33	54	80	31	70	95	27	3.97
Aug-12	9382	5	360	30	50	75	30	m	m	m	69	92	27	4.63
Sep-12	5534	4	48	39	39	66	14	m	m	m	67	92	25	
Oct-12	2314	4	31	41	19	54	-9	m	m	m	66	92	19	
Nov-12	483	4	6	40	0	33	-23	m	m	m	55	84	19	
Dec-12	134	5	68	45	-3	42	-32	m	m	m	53	86	15	



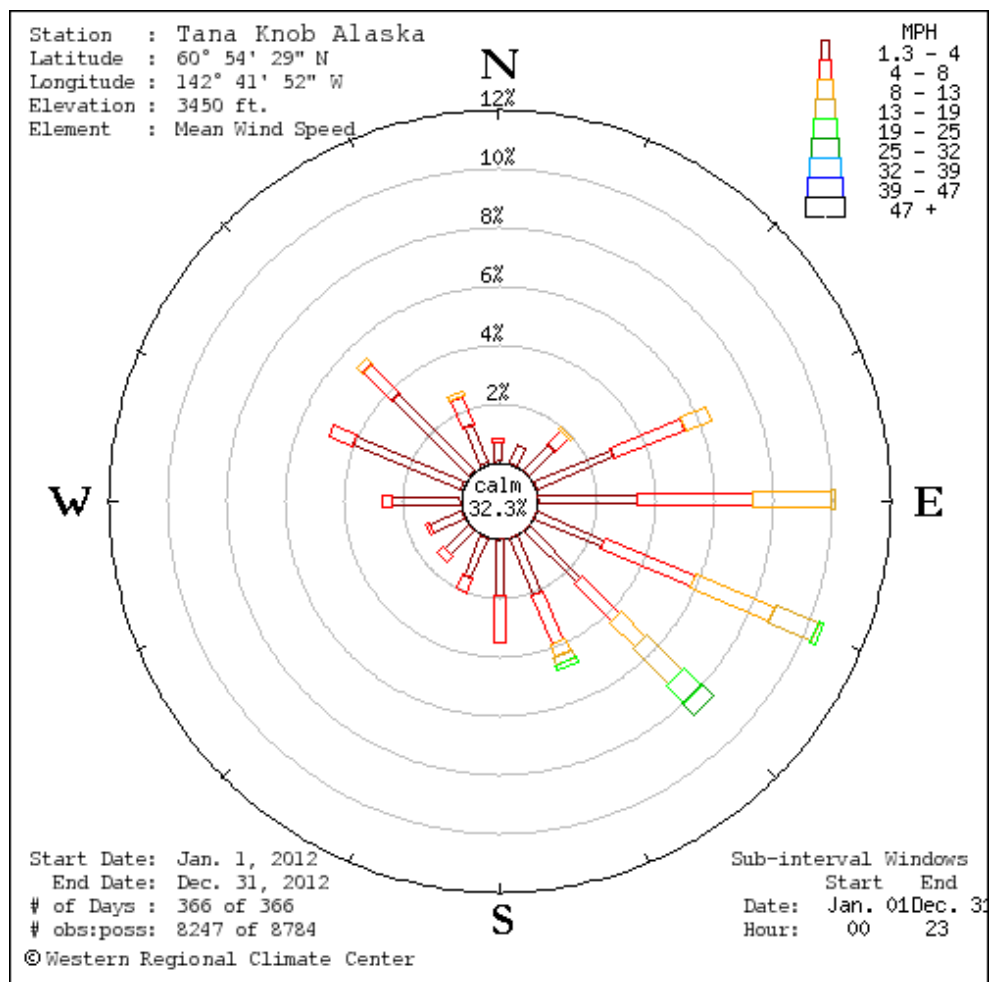
Lake Minchumina

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Fuel Temp			Relative Humidity			Precipitation
Date	ly	mph	Deg	mph	Deg F			Deg F			%			in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Total
Jan-12	119	2	333	31	-24	8	-51	-18	7	-43	70	90	52	
Feb-12	637	2	347	30	7	30	-34	7	21	-26	82	97	54	
Mar-12	5435	3	45	26	7	39	-23	9	26	-16	68	98	30	
Apr-12	11899	3	40	16	37	59	1	26	54	7	59	99	27	
May-12	14845	3	21	26	48	72	15	m	m	m	54	100	0	
Jun-12	12564	2	257	25	60	88	36	m	m	m	70	100	17	2.99
Jul-12	11075	2	246	27	58	81	41	m	m	m	77	100	27	2.73
Aug-12	7998	2	258	21	54	80	34	m	m	m	83	100	32	3.26
Sep-12	4765	3	315	28	43	65	25	m	m	m	81	100	35	
Oct-12	1780	3	7	26	24	57	-3	m	m	m	84	100	32	
Nov-12	775	6	20	35	3	20	-16	m	m	m	72	98	44	
Dec-12	165	3	6	36	-7	32	-45	m	m	m	80	100	45	



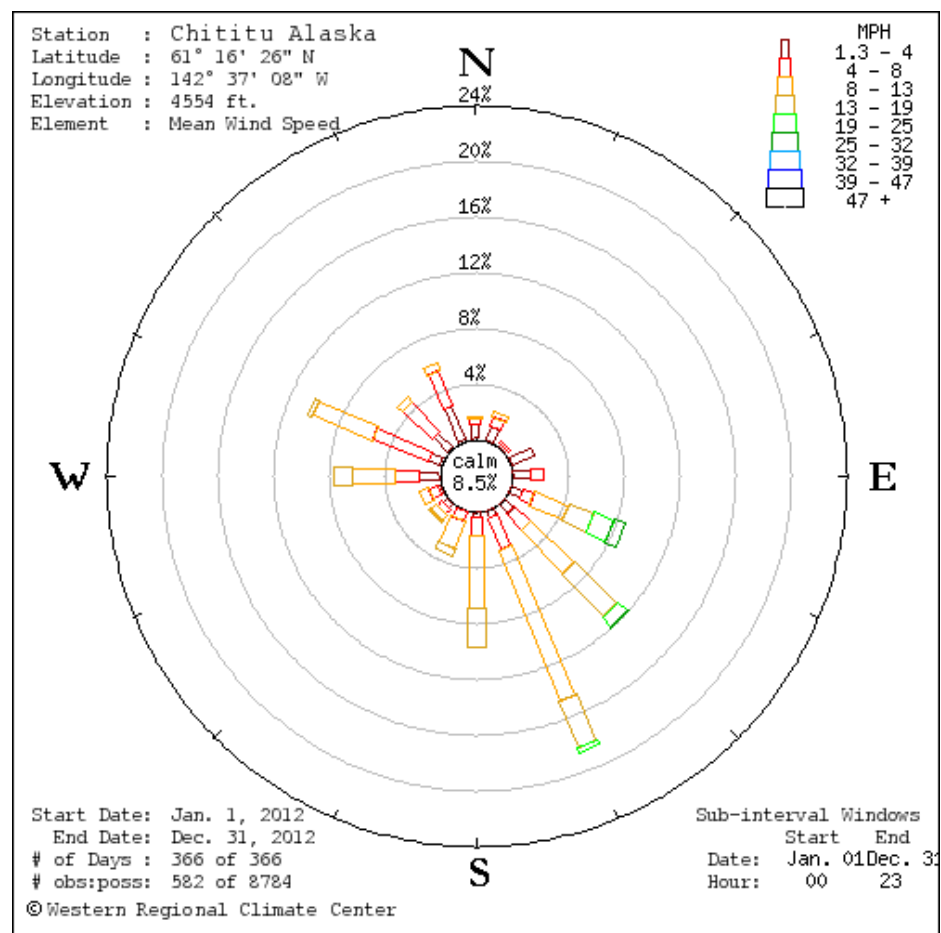
Tana Knob

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth	Summer Precip
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	In.
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10cm	20cm	50cm	Ave.	Ave.	Total
Jan-12	778	5	197	37	0	29	-29	30	31	32	91	74	
Feb-12	2533	7	143	44	21	37	-2	30	31	31	98	73	
Mar-12	6574	3	151	24	17	39	-6	30	31	31	94	77	
Apr-12	11462	2	178	21	32	49	16	30	30	31	72	75	
May-12	15680	5	181	37	36	53	23	31	32	31	72	60	
Jun-12	13824	3	205	19	44	66	32	34	33	32	72	21	1.58
Jul-12	11897	3	153	22	47	66	35	52	49	42	72	0	0.89
Aug-12	9342	4	152	30	47	64	36	49	50	46	74	0	1.78
Sep-12	5256	8	117	35	40	60	26	39	41	41	79	0	6.34
Oct-12	2840	3	199	34	24	55	2	30	33	35	82	1	
Nov-12	264	1	145	17	4	31	-18	27	29	30	87	8	
Dec-12	211	4	129	41	5	38	-27	23	24	27	80	16	



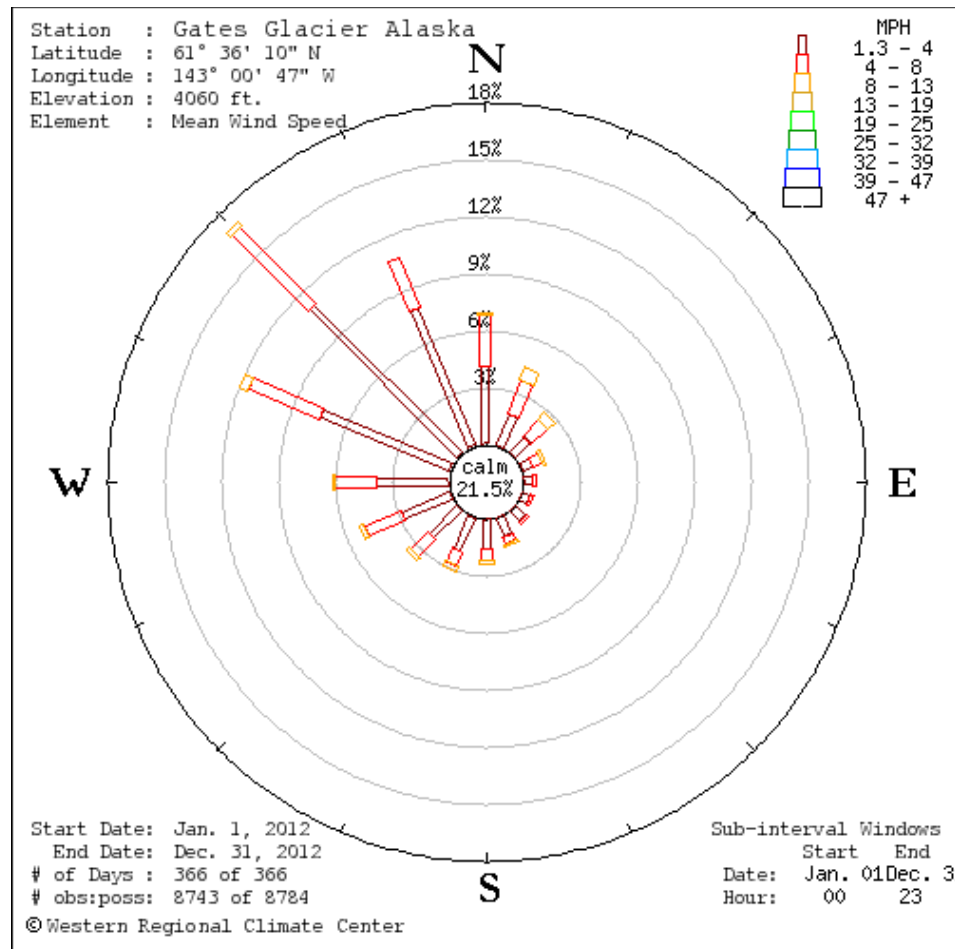
Chititu

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth	Summer Precip
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10cm	20cm	50cm	Ave.	Ave.	Total
Jan-12	8516	14	163	63	5	29	-20	8	10	13	75	16	
Feb-12	26065	13	129	81	21	36	-1	15	16	16	68	16	
Mar-12	75205	7	149	36	15	38	-4	14	16	15	70	16	
Apr-12	121303	6	188	25	31	44	14	31	30	27	71	16	
May-12	131906	8	186	38	34	54	22	34	31	33	73	16	
Jun-12	98576	6	222	34	43	71	31	45	37	42	81	11	0.3
Jul-12	117374	5	212	43	44	66	31	49	45	44	80	0	2.1
Aug-12	97265	6	201	39	45	65	27	48	45	49	79	0	1.8
Sep-12	52424	15	144	59	37	57	22	37	36	41	76	0	2.1
Oct-12	33451	7	208	43	21	54	0	32	31	37	85	m	
Nov-12	8648	5	217	28	7	28	-13	25	22	33	82	m	
Dec-12	4157	7	245	50	6	34	-25	16	14	26	75	m	



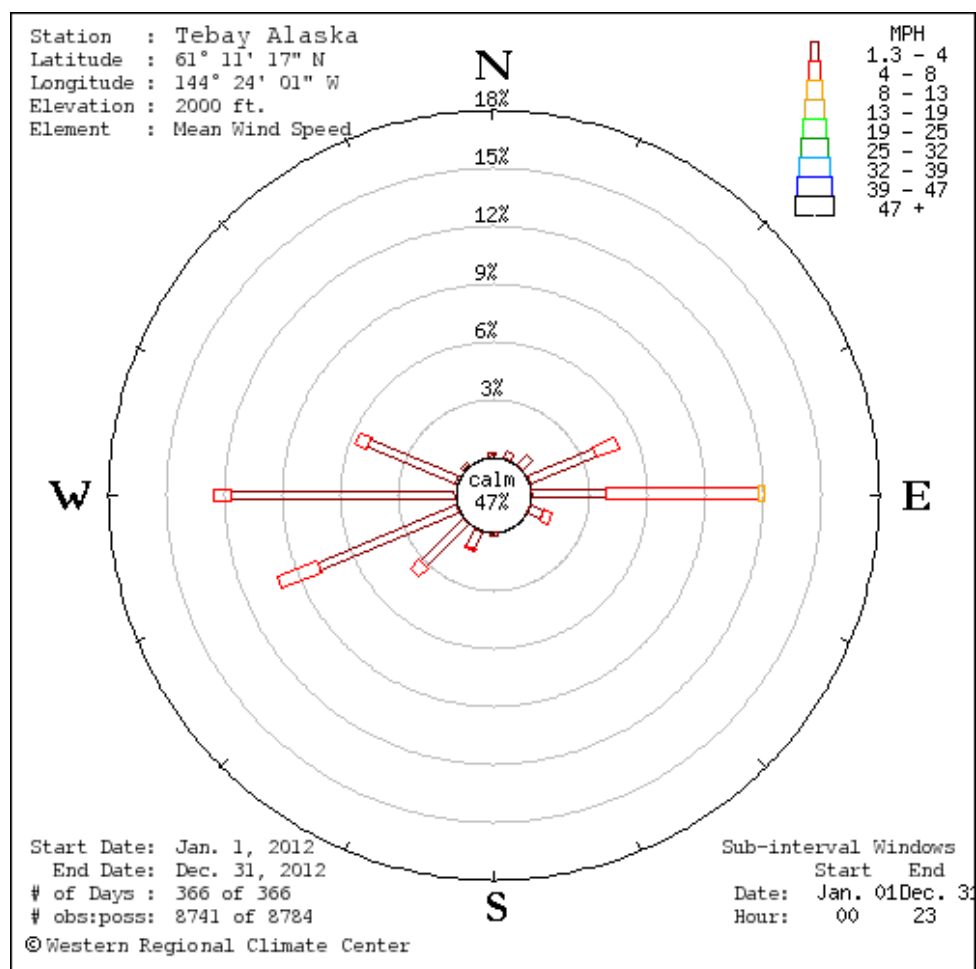
Gates Glacier

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth	Summer Precip
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10cm	20cm	50cm	Ave.	Ave.	Total
Jan-12	764	4	260	27	6	30	-20	31	31	33	72	62	
Feb-12	2156	4	260	33	22	40	-3	31	31	33	72	68	
Mar-12	5594	2	266	21	16	39	-3	31	31	32	69	72	
Apr-12	12822	2	262	15	31	48	15	31	31	32	63	68	
May-12	14441	3	231	25	34	56	18	31	31	32	69	61	
Jun-12	14515	3	218	21	43	65	31	37	35	34	73	22	0.04
Jul-12	12654	3	219	22	45	65	32	49	49	43	74	0	3.72
Aug-12	10051	3	225	17	45	61	33	49	49	46	71	0	3.03
Sep-12	3686	4	194	27	38	55	24	38	38	40	73	0	6.03
Oct-12	2913	3	252	28	24	52	3	32	33	36	76	5	
Nov-12	603	2	278	17	10	33	-12	29	29	32	77	14	
Dec-12	343	3	264	24	9	38	-22	29	29	31	70	27	



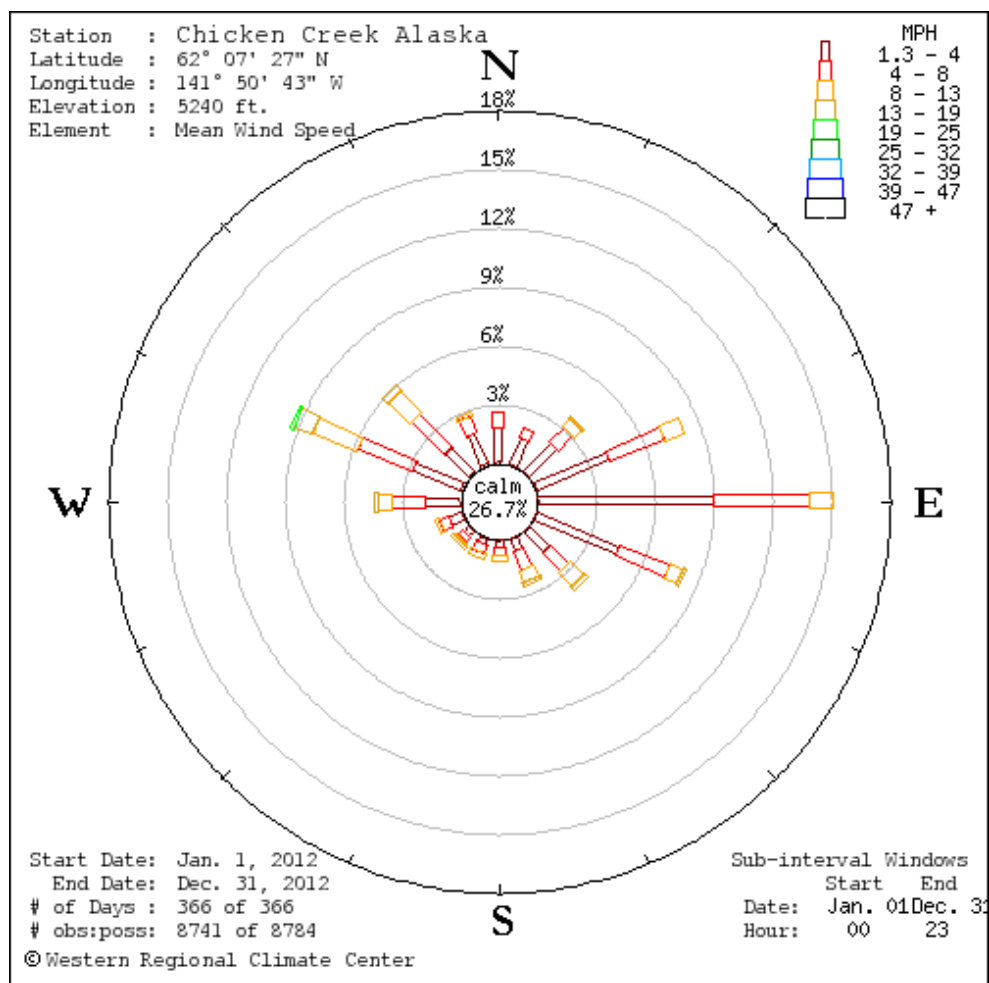
Tebay

	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth	Summer Precip
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10cm	20cm	50cm	Ave.	Ave.	Total
Jan-12	70	3	118	13	-3	29	-30	31	32	32	86	73	
Feb-12	210	1	65	18	18	32	-6	31	31	32	97	80	
Mar-12	3156	0	24	6	13	43	-12	31	31	32	95	78	
Apr-12	11643	2	193	9	31	55	0	31	31	32	82	71	
May-12	13716	2	222	16	37	58	20	31	31	31	80	42	
Jun-12	12247	2	246	12	45	70	30	43	42	37	79	7	2.42
Jul-12	10344	2	254	10	49	73	36	51	51	46	81	6	1.57
Aug-12	8207	2	230	9	49	68	30	51	51	48	83	6	1.66
Sep-12	3346	2	219	13	42	60	23	44	44	44	88	5	11.06
Oct-12	2248	2	127	12	25	51	1	35	35	37	83	6	
Nov-12	466	2	79	10	5	29	-18	29	29	32	81	10	
Dec-12	143	2	88	11	0	36	-27	26	27	29	80	17	



Chicken Creek

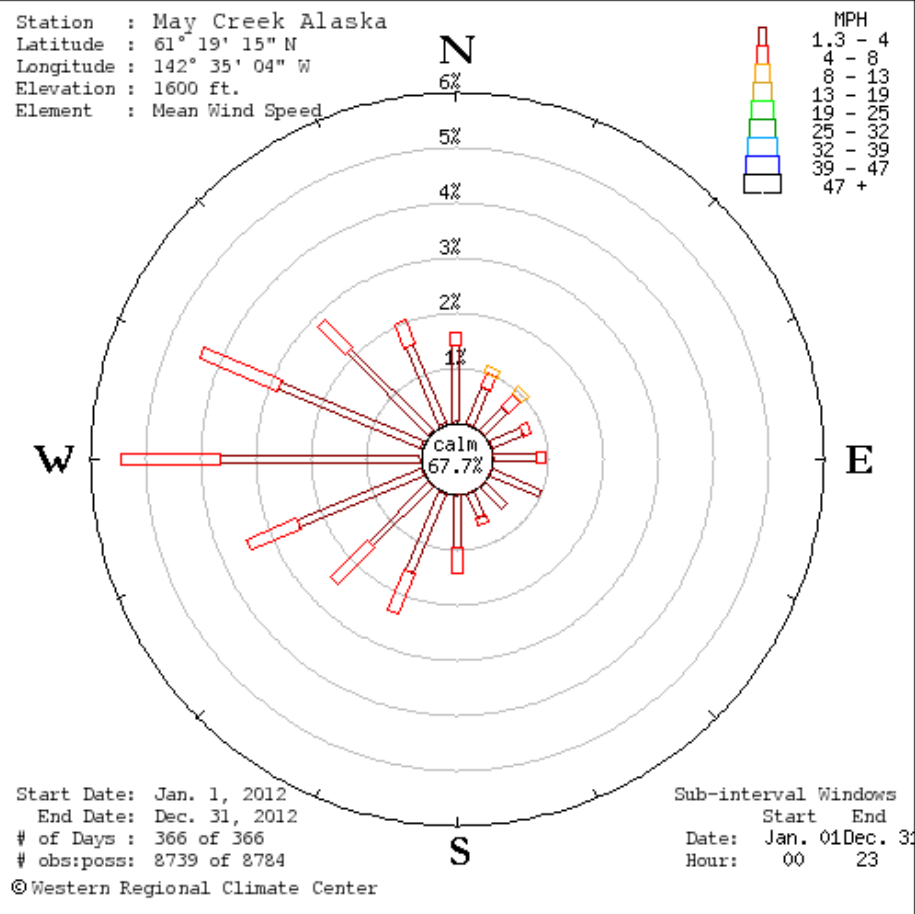
	Solar Radiation	Wind Speed	Wind Direction	Wind Gust	Air Temperature			Average Soil Temperature			Relative Humidity	Snow Depth	Summer Precip
Date	ly	mph	Deg	mph	Deg F			Deg F			%	in	in
	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	10cm	20cm	50cm	Ave.	Ave.	Total
Jan-12	904	3	151	37	-1	29	-25	12	10	15	65	4	
Feb-12	2605	4	127	32	16	32	-8	14	12	14	62	4	
Mar-12	6964	2	142	25	10	39	-9	13	11	14	67	4	
Apr-12	12471	3	157	21	28	50	10	21	20	19	68	7	
May-12	15829	5	168	30	32	51	15	24	25	23	67	16	
Jun-12	11578	5	190	39	42	67	29	36	35	30	76	1	4.09
Jul-12	12879	5	197	27	46	66	32	45	43	37	69	0	4.75
Aug-12	9997	5	183	26	45	60	27	43	43	39	67	0	1.74
Sep-12	6289	7	161	37	37	59	20	34	35	35	60	1	
Oct-12	3002	3	165	25	19	57	-7	31	31	31	74	2	
Nov-12	442	1	104	10	3	28	-17	25	25	29	77	6	
Dec-12	380	3	141	24	2	34	-29	17	18	22	67	8	



May Creek

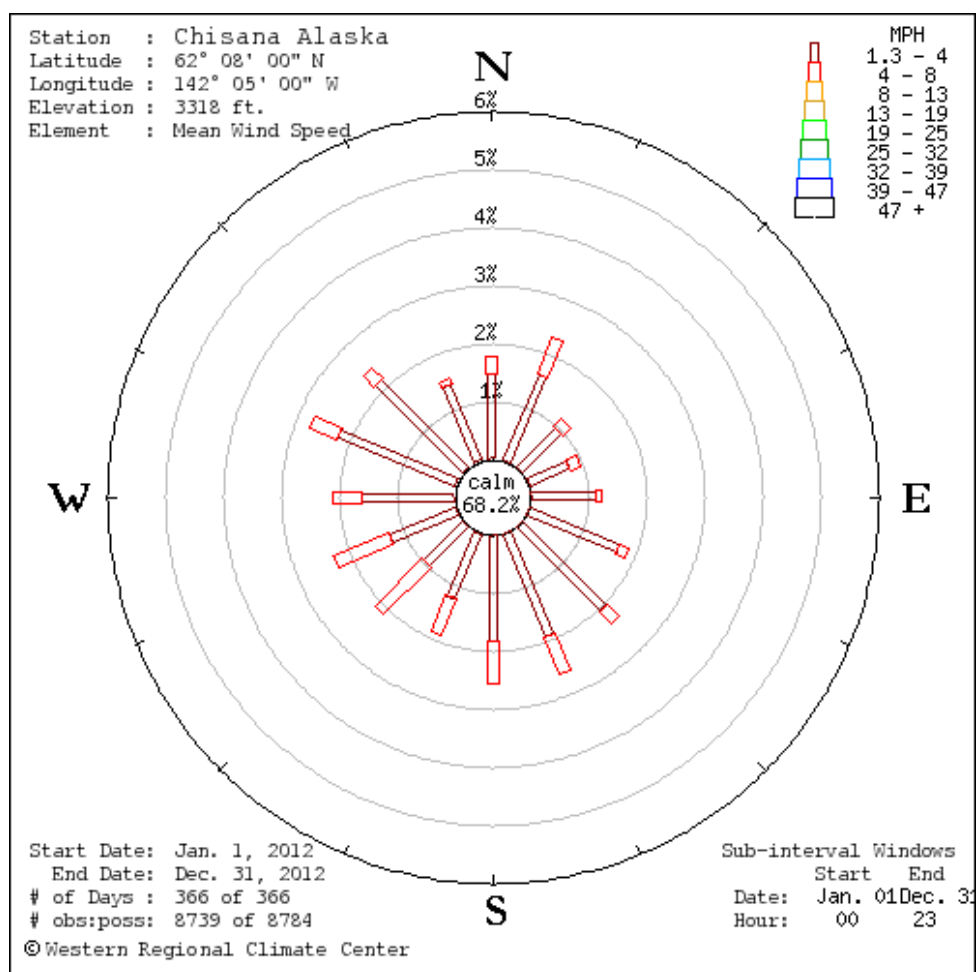
	Solar Radiation	Mean Wind Speed	Mean Wind Direction	Maximum Wind Gust	Average Air Temperature			Ave Fuel Temp			Average Relative Humidity			Precipitation
Date	ly	mph	Deg	mph	Deg F			Deg F			%			in
mm/yyyy	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Total
Jan-12	200	1	175	f	-11	34	-46	-4	21	-35	72	89	42	
Feb-12	2421	1	172	22	18	43	-15	16	26	-1	71	92	28	
Mar-12	6810	1	198	f	16	53	-26	14	28	-3	62	88	23	
Apr-12	12841	2	224	25	37	59	1	35	72	13	57	92	20	
May-12	12949	2	233	22	43	71	21	44	85	19	59	93	21	
Jun-12	13718	2	248	19	53	85	31	55	100	29	64	95	22	1.78
Jul-12	13511	2	251	20	55	81	27	56	103	26	66	94	22	1.78
Aug-12	11256	1	226	21	52	80	25	m	m	m	69	95	20	1.54
Sep-12	5764	2	225	29	45	74	20	m	m	m	67	95	24	
Oct-12	3321	1	189	31	21	65	-18	m	m	m	75	95	26	
Nov-12	297	0	167	29	-7	28	-38	m	m	m	76	90	58	
Dec-12	91	0	80	28	-13	36	-44	m	m	m	74	94	60	

f = flagged value/questionable data



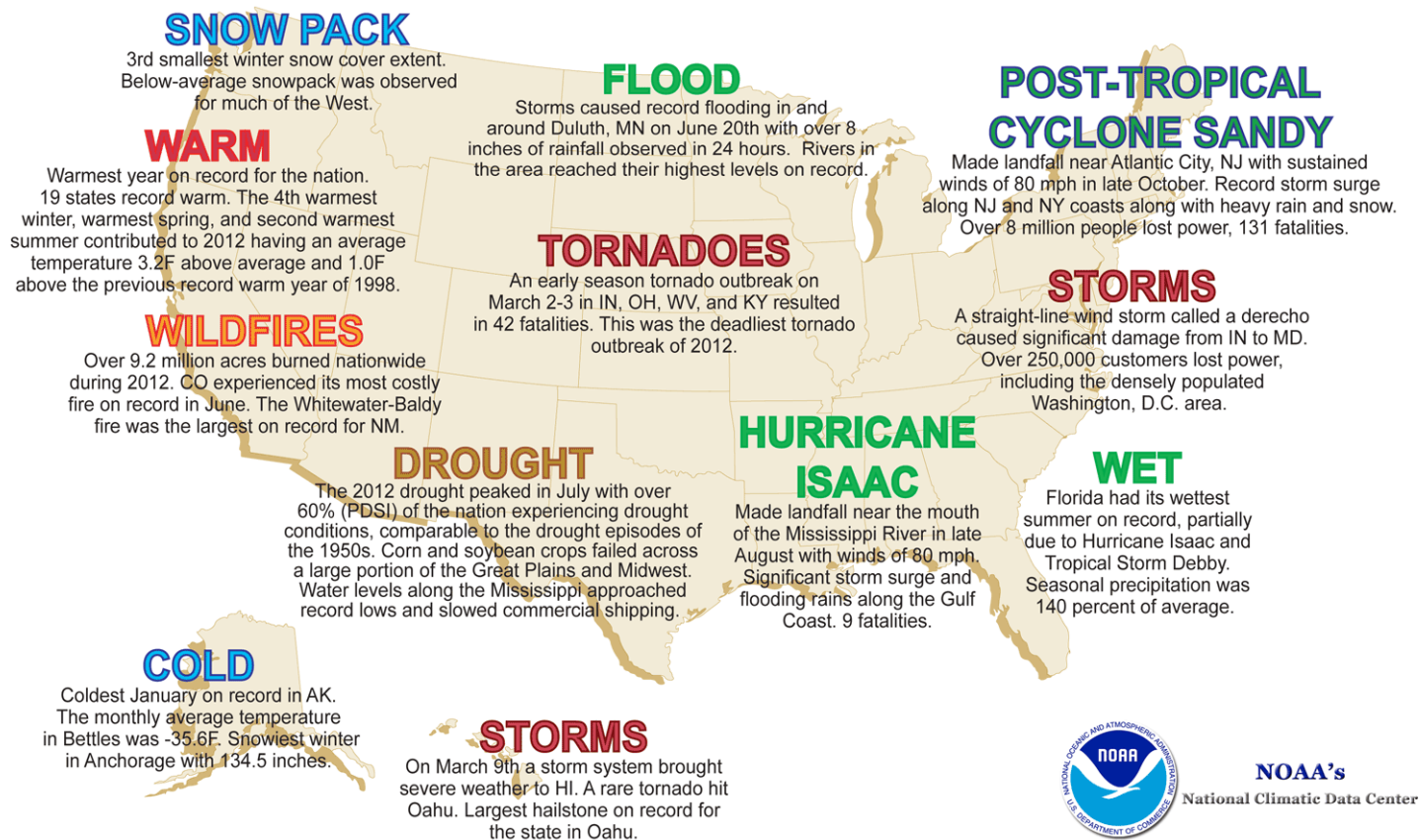
Chisana

	Solar Radiation	Mean Wind Speed	Mean Wind Direction	Maximum Wind Gust	Average Air Temperature			Ave Fuel Temp			Average Relative Humidity			Snow Depth	Precipitation
Date	ly	mph	Deg	mph	Deg F			Deg F			%			in	in
mm/yyyy	Total	Ave.	Ave.	Max.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Total
Jan-12	152	0.4441	111.8	24	-20	26	-46	-16	21	-33	64	92	48	11	
Feb-12	1230	1.088	116.7	28	7	39	-21	4	26	-17	68	91	1	13	
Mar-12	5597	1.101	120.2	15	6	44	-30	7	34	-14	59	88	20	14	
Apr-12	12576	1.346	131.5	15	32	54	-10	33	71	-3	65	100	18	11	
May-12	14404	1.974	102.2	20	39	63	11	42	75	8	61	100	18	1	
Jun-12	13419	1.622	133.1	18	50	80	26	52	94	23	72	100	20	0	2.6
Jul-12	15586	2.007	153.9	23	53	80	25	56	95	23	65	100	18	0	2.6
Aug-12	11693	1.702	145	20	49	74	16	m	m	m	68	100	19	0	0.81
Sep-12	6572	2.26	127.2	31	40	72	13	m	m	m	62	100	18	0	
Oct-12	2134	0.9046	87.69	21	15	67	-25	m	m	m	76	99	25	3	
Nov-12	351	0.1389	112.1	7	-11	22	-44	m	m	m	76	95	58	6	
Dec-12	150.1	0.3419	108	14	-19	31	-49	m	m	m	73	98	54	8	



Appendix D. Worldwide Significant Climate Anomalies

Preliminary Significant U.S. Weather and Climate Events for 2012



Graph courtesy of the National Oceanic and Atmospheric Administration (NOAA). Retrieved from <http://www.ncdc.noaa.gov/sotc/service/global/significant-extremes/201113.gif>

Land & Ocean Temperature Anomalies Jan–Dec 2012

(with respect to a 1981–2010 base period)

Data Source: GHCN–M version 3.2.0 & ERSST version 3b

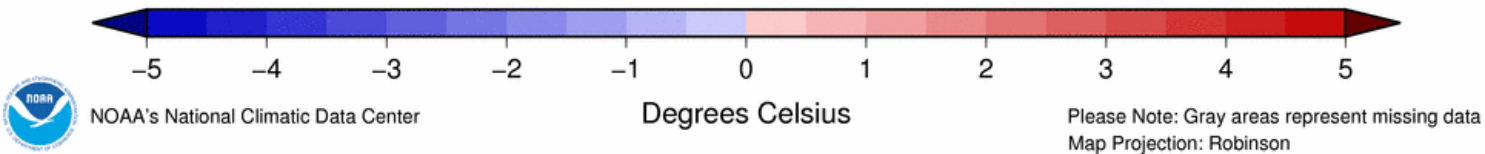
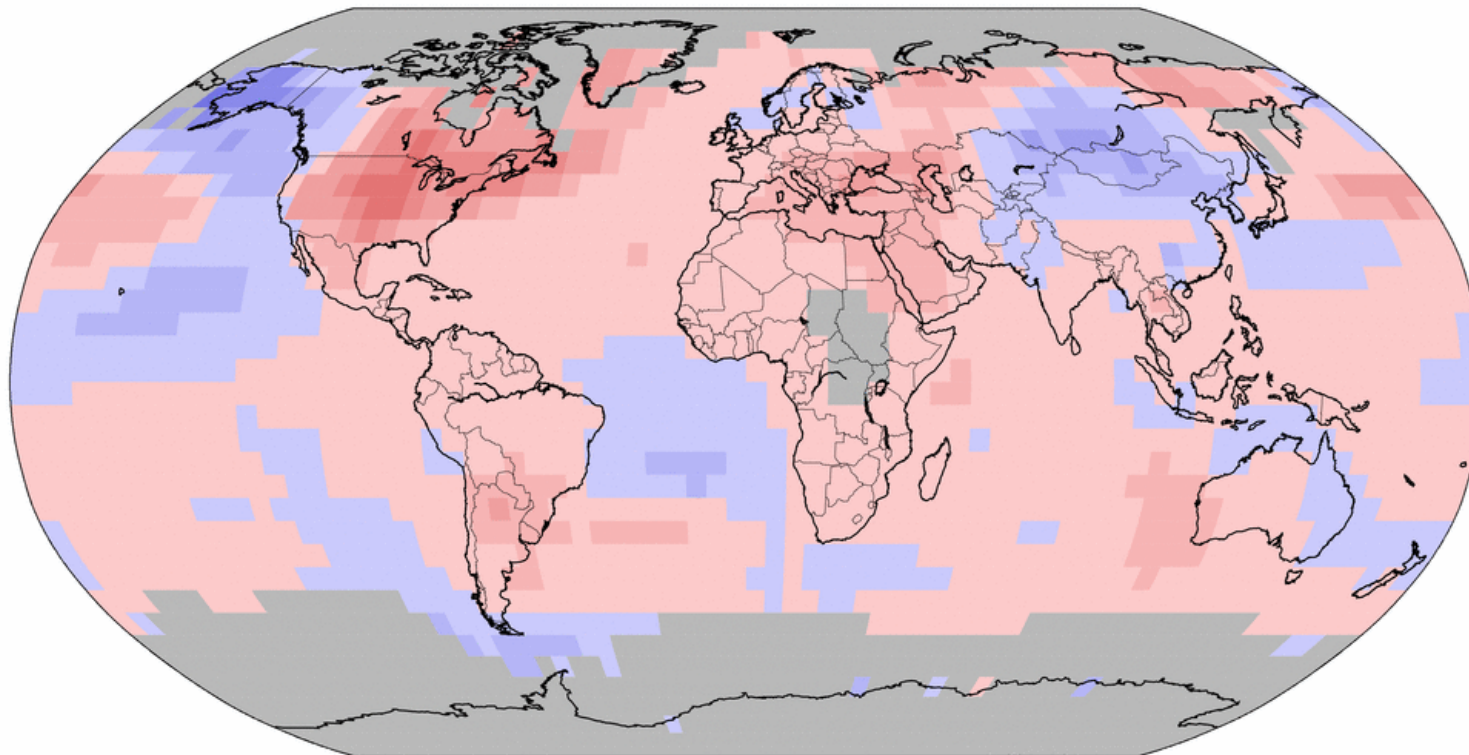


Figure courtesy of NOAA. Retrieved from <http://www.ncdc.noaa.gov/sotc/service/global/map-land-sfc-mntp/201201-201212.gif>

Land-Only Precipitation Anomalies Jan-Dec 2012 (with respect to a 1961-1990 base period)

Data Source: GHCN-M version 2

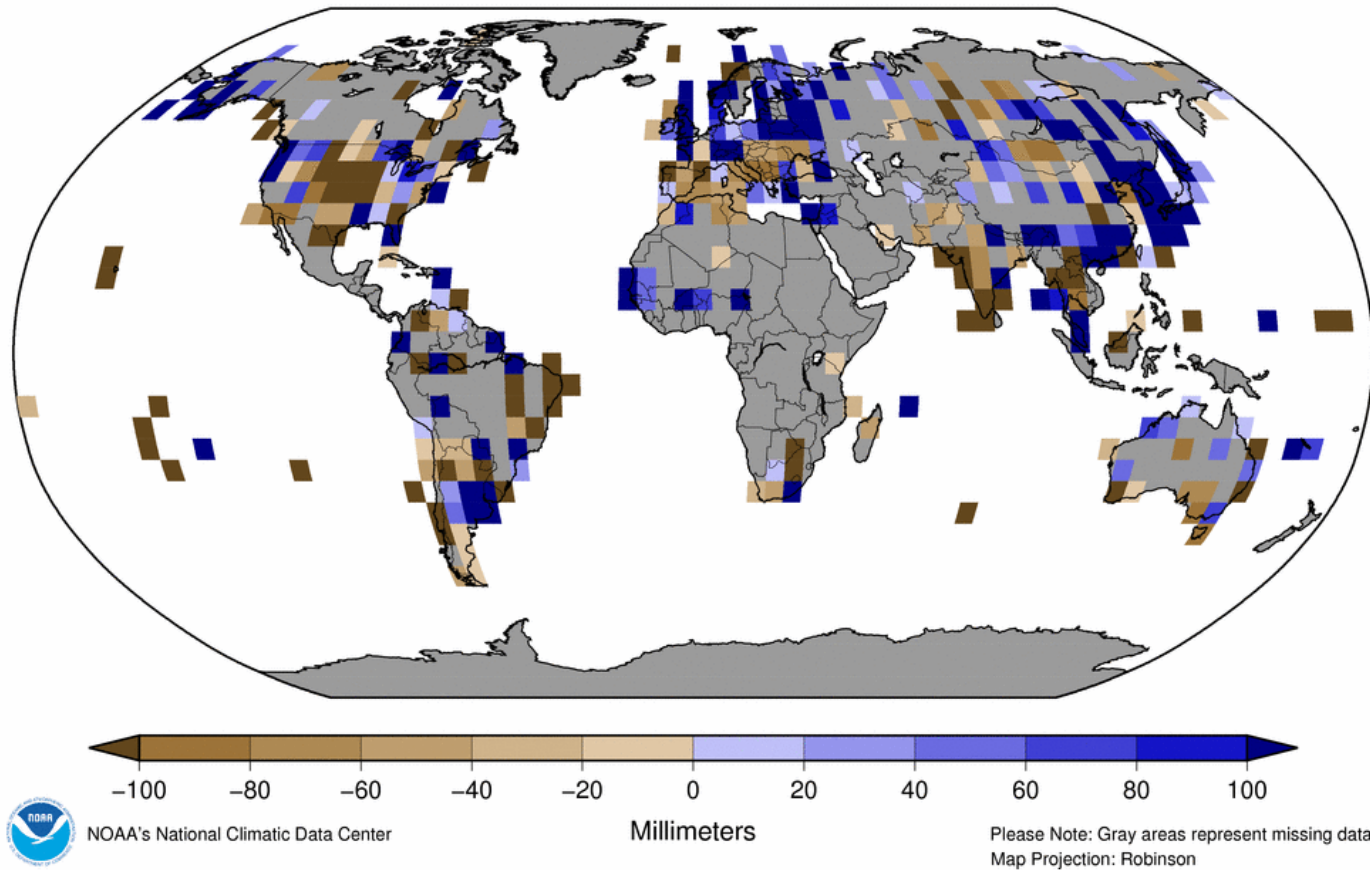
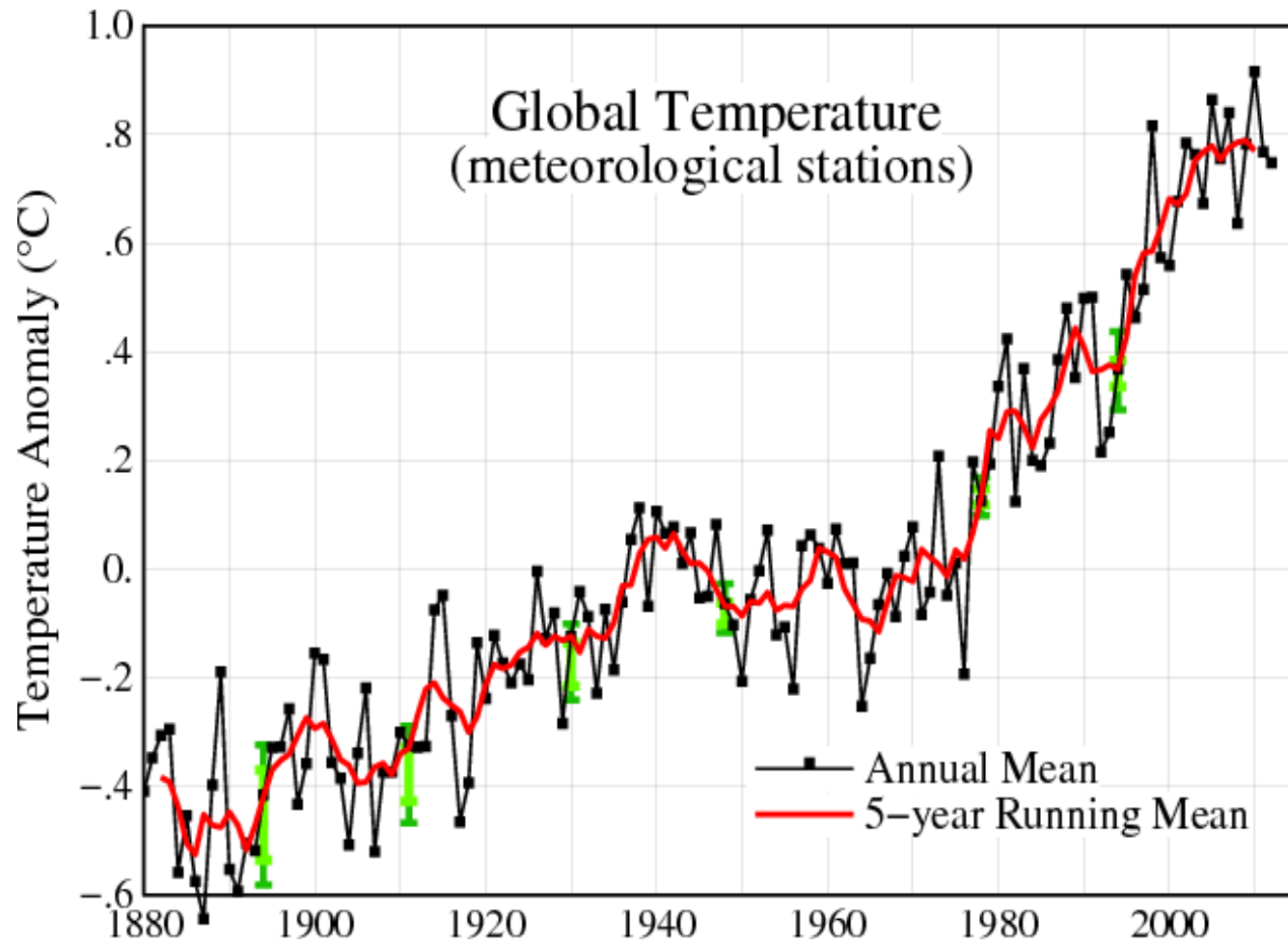


Figure courtesy of NOAA. Retrieved from [http://www.ncdc.noaa.gov/temp-and-precip/global-maps.php?imgs\[\]=map-prcp&year=2012&month=13](http://www.ncdc.noaa.gov/temp-and-precip/global-maps.php?imgs[]=map-prcp&year=2012&month=13).



Graph courtesy of NASA Goddard Institute for Space Studies (GISS). Retrieved from http://data.giss.nasa.gov/gistemp/graphs_v3/.