Alaska Climate Dispatch

A state-wide seasonal summary & outlook

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Winter 2011 Issue

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1981-2010 Normals and Alaska

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The term "normal" is frequently used when we talk about weather and climate. For example, we regularly read things like "the average temperature was two degrees below normal last month" or "it has been snowier than normal so far this winter". When we talk about climate variability and climate change, we often talk about changes in normal, as in "the average temperature may increase by 3 degrees over the next century". The term "normal" as used in the climate and weather field have quite specific definitions. Normals are benchmarks for comparison that encapsulate the past several decades of climate.

NOAA's National Climatic Data Center (NCDC) released climatic normals taken from the 30 years spanning 1981 through 2010 on July 1, 2011. See **Figure 1** for a map of weather stations that generate Alaska climate normals. On August 1st the National Weather Service began using these new normals. For the past ten years, normals have been based on the 30 years from 1971 through 2000.

The World Meteorological Organization recommends

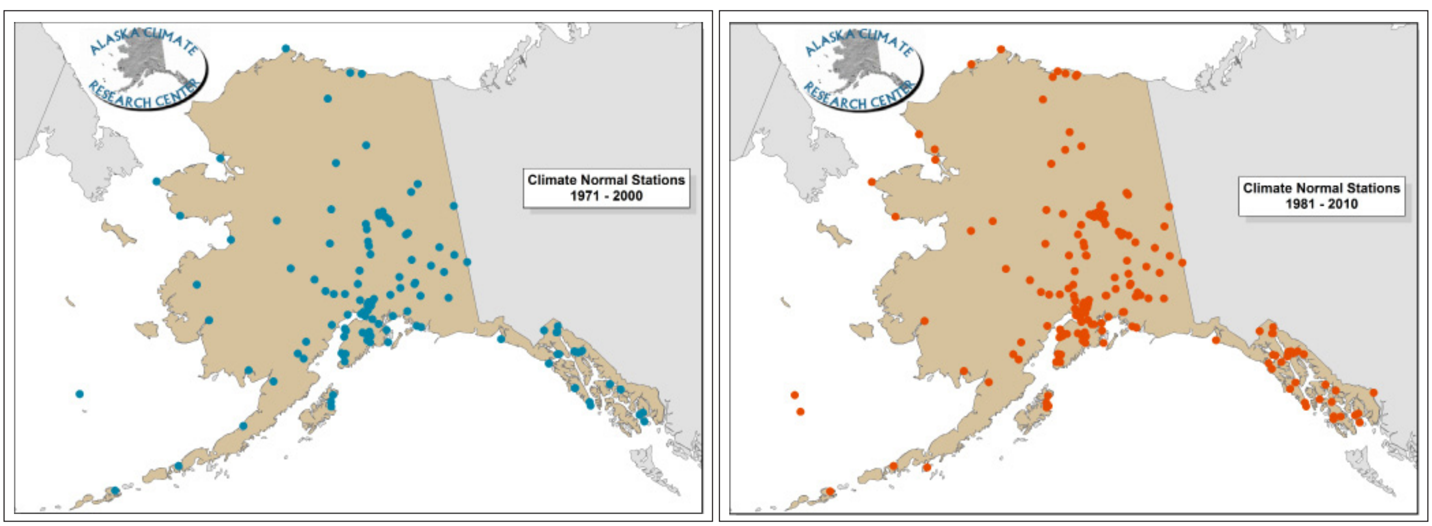

Figure1: Weather stations across Alaska used to generate "climate normals" in 1971-2001 (left) compared to 1981-2001 (right).

ACCAP Alaska Center for Climate Assessment & Policy

ACCAP is funded by the National Oceanic and Atmospheric Administration (NOAA) and is one of a group of Regional Integrated Sciences and Assessments (RISA) programs nation-wide. The RISA program supports research that addresses sensitive and complex climate issues of concern to decision-makers and policy planners at a regional level.

that climatic normals be updated every ten years, and the United States has followed this practice since the 1950s. For locations with complete data, the decade 1971-1980 is now excluded and 2001-2010 is added; while the 20 years from 1981-2000 are included in both sets of normals.

The use of 30 years to calculate climatic normals is a compromise between a longer time span that captures more variability and a shorter time span that could allow for a greater number of stations. The optimum period is also dependent on the climate parameter in question and the potential year to year variability. For example, in the tropics only a short period is needed to calculate normal temperatures because year to year variability is very small. Temperatures at middle and high latitudes, as well as precipitation and snowfall, have much larger variability and so require longer periods to obtain representative normals.

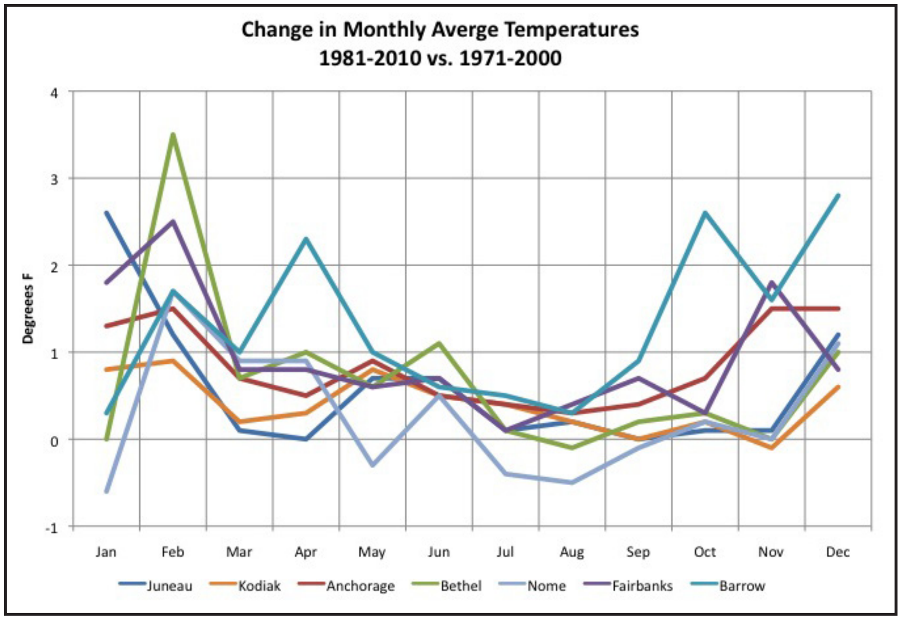

Figure 2. Change in monthly normal temperatures (°F) between 1971-2000 and 1981-2010. Overall, the updated normals in Alaska are somewhat warmer. By far the greatest absolute warming is in the winter, while most locations show no significant change in mid and late summer. However, all seven locations show warming in June of 0.5 to 1.1 degrees. In the winter, 2 and 3 degrees changes were common. Because the potential range of temperatures is so much smaller in June than in the winter, the warming in June is, at most locations, the most statistically significant change of any month. The seven stations that provide data for the figures were selected to represent population centers and different regions of the state.

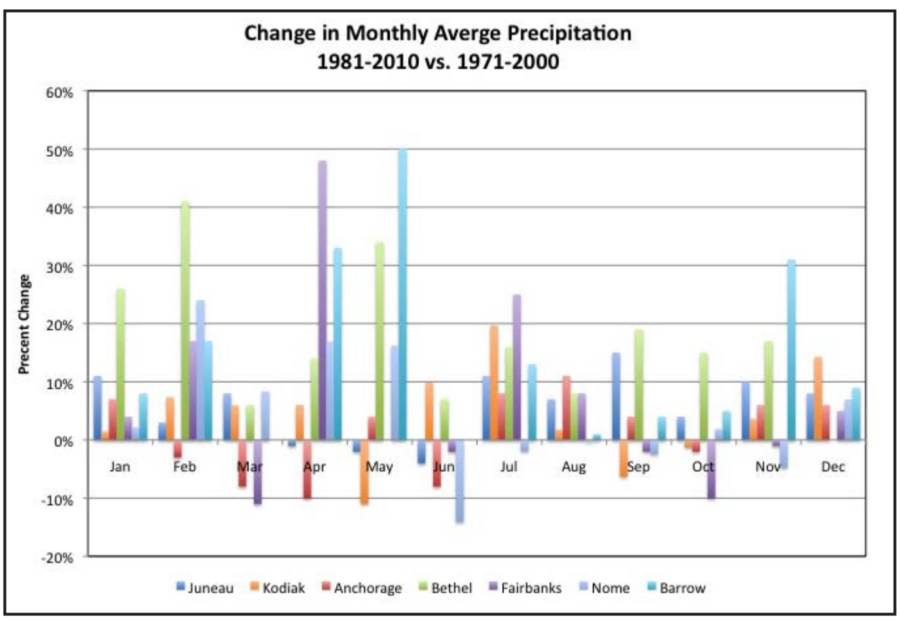

Figure 3. Change in monthly normal precipitation (%) between 1971-2000 and 1981-2010. Overall, the updated normals in Alaska are somewhat wetter. Because of the large variability of precipitation, the changes at any one station are not statistically significant. However, the changes are spatially coherent. The seven stations that provide data for the figures were selected to represent population centers and different regions of the state.

Recalculating normals every 10 years allows for incorporation of non-atmospheric factors like changes in instrumentation, station location and observing practices as well as ongoing environmental changes, such as the decline of autumn sea ice in the Arctic. It so happens that 1981-2010 normals comprise almost an entire a warm phase of the Pacific Decadal Oscillation (PDO), the multi-decadal pattern of sea surface temperatures in the north Pacific in which warmer than normal temperatures prevail in the Gulf of Alaska. South of the Brooks Range, mid-winter temperatures at most locations are fairly strongly correlated with the value of the PDO Index that particular winter (see the archived January 2009 ACCAP webinar on Alaska Climate Variability in the Modern Era for more on the PDO: www.accap.uaf.edu/

Month	Juneau	Kodiak	Anchorage	Bethel	Nome	Fairbanks	Barrow
January	28.3/+2.6°	30.5/+0.8°	17.1/+1.3°	6.6±/0.0°	5.2/-0.6°	-7.9/+1.8°	-13.4/+0.3°
February	30.1/+1.2°	30.8/+0.9°	20.2/+1.5°	11.1/+3.5°	7.4/+1.7°	-1.3/+2.5°	-14.2/+1.7°
March	33.8/+0.1°	32.8/+0.2°	26.6/+0.7°	15.2/+0.7°	10.3/+0.9°	11..4/+0.8°	-12.7/+1.0°
April	40.8/±0.0°	37.6/+0.3°	36.8/+0.5°	26.9/+1.0°	20.5/+0.9°	32.5/+0.8°	1.8/+2.3°
May	48.6/+0.7°	44.3/+0.8°	47.8/+0.9°	41.9/+0.6°	36.8/-0.3°	49.4/+0.6°	21.1/+1.0°
June	54.6/+0.7°	49.7/+0.5°	55.2/+0.5°	52.5/+1.1°	47.8/+0.5°	60.4/+0.7°	35.6/+0.6°
July	56.9/+0.1°	54.5/+0.4°	58.8/+0.4°	56.1/+0.1°	52.2/-0.4°	62.5/+0.1°	40.9/+0.5°
August	55.9/+0.2°	55.2/+0.2°	56.7/+0.3°	53.5/-0.1°	50.1/-0.5°	56.1/-0.1°	39.0/+0.3°
September	50.0/±0.0°	49.4/±0.0°	48.6/+0.4°	45.6/+0.2°	42.8/-0.1°	44.9/+0.4°	32.1/+0.9°
October	42.4/+0.1°	40.5/+0.2°	34.8/+0.7°	30.3/+0.3°	28.7/+0.2°	24.2/+0.7°	17.2/+2.6°
November	33.4/+0.1°	33.9/-0.1°	22.2/+1.5°	17.4/±0.0°	16.9/±0.0°	2.6/+0.3°	0.7/+1.6°
December	29.9/+1.2°	31.2/+0.6	19.0/+1.5°	10.4/+1.0°	9.5/+1.1°	-4.1/+1.8°	-7.8/+2.8°
Annual	42.1/+0.6°	40.9/+0.4	37.0/+0.8°	30.6/+0.7°	27.4/+0.3°	27.6/+0.8°	11.7/+1.3°

Table 1. 1981-2010 Normal average temperature (°F) and change from 1971-2000 normal.

telecon_archive.htm).

For most locations, the 1981-2010 normals include monthly and daily values for basic climatological variables such as high, low and average temperatures, total and cumulative precipitation and snowfall, and measures of the variability of these parameters. Also included are more specialized statistics such as heating and cooling degree days and frequencies of specific thresholds. This last category includes things like the number of days with high temperatures below freezing and the number of days with more than a quarter of an inch of precipitation. The normals do not include any information about snow depth or any parameters that are recorded only at a small number of stations, such as wind speed or amount of sunshine.

Month	Juneau	Kodiak	Anchorage	Bethel	Nome	Fairbanks	Barrow
January	5.35/+11%	8.29/+1%	0.73/+7%	0.78/+26%	0.94/+3%	0.58/+4%	0.13/ +8%
February	4.13/+3%	6.14/+7%	0.72/-3%	0.72/+41%	0.93/+24%	0.42/+17%	0.14/+17%
March	3.78/+8%	5.53/+6%	0.60/-8%	0.71/+6%	0.65/+8%	0.25/-11%	0.09/±0%
April	2.94/-1%	5.81/+6%	0.47/-10%	0.74/+14%	0.76/+17%	0.31/+48%	0.16/+33%
May	3.40/-2%	5.62/-2%	0.72/+4%	1.14/+34%	0.86/+16%	0.60/±0%	0.18/+50%
June	3.24/-4%	5.91/+10%	0.97/-8%	1.72/+7%	0.98/-14%	1.37/-2%	0.32/ ±0%
July	4.60/+11%	4.93/+20%	1.83/+8%	2.36/+16%	2.11/-2%	2.16/+25%	0.98/+13%
August	5.73/+7%	4.56/+2%	3.25/+11%	3.25/+8%	3.22//±0%	1.88/+8%	1.05/+1%
September	8.64/+15%	7.35/-6%	2.99/+4%	2.75/+19%	2.45/-2%	1.10/-2%	0.72/+4%
October	8.63/+4%	8.26/-1%	2.03/-2%	1.65/+15%	1.61/+2%	0.83/-10%	0.41/+5%
November	5.99/+10%	6.87/+4%	1.16/+6%	1.60/+17%	1.22/-5%	0.67/-1%	0.21/+31%
December	5.84/+8%	8.73/+14%	1.11/+6%	1.12/±0%	1.08/-16%	0.64/5%	0.14/+9%
Annual	62.27/+7%	78.00/+4%	16.58/+3%	18.54/+15%	16.81/+2%	10.81/+5%	4.53/+9%

Table 2. 1981-2010 Normal average precipitation (inches) and percentage change from 1971-2000 normal.

In Alaska, 127 stations are used for the 1971-2000 normals, while for 1981-2010 normals 203 stations are used. There are more than 76 new stations, as a few locations that ceased operation prior to 2000 had 1971-2000 normals but none in the new normals. Most of the new stations are either from Automated Surface Observing Systems (ASOS) stations deployed in the 1990s or cooperative stations along the highway corridor. This increase in the number of stations was achieved through calculating normals for locations with fewer than 30 years of data by comparing the station values to surrounding locations with longer periods of record. This became practical thanks to the great increase in computing power over the past twenty years. A convenient website that includes the available monthly normals for around Alaska is at: *http://ggweather.com/normals/AK.html* .

Overall, the updated normals in Alaska are somewhat warmer and wetter, as shown in **Tables 1 & 2** and **Figures 2 & 3**. The seven stations that provide data for the figures were selected to represent population centers and different regions of the state. By far the greatest absolute warming is in the winter, while most locations show no significant change in mid and late summer. This not the whole story: all seven locations show warming in June of 0.5 to 1.1 degrees. This is not as much as the 2-3 degree changes common in the winter. However, because the potential range of temperatures is so much smaller in June than in the winter, the warming in June is, at most locations, the most statistically significant change of any month.

Autumn Weather Conditions in Alaska

Prepared by the Alaska Climate Research Center

This article presents a summary of Autumn 2011 (September, October, November) temperatures and precipitation from the first-order meteorological stations (operated by the National Weather Service meteorologists) in Alaska.

Temperature

Figure 4 shows the fall temperature departure from the 30-year average (1981-2010). It can be seen that most of Alaska had seasonal temperatures below normal. This is a continuation of the trend seen in summer, particularly in July and August. The average value of all stations can be calculated as -1.2°F for the fall season.

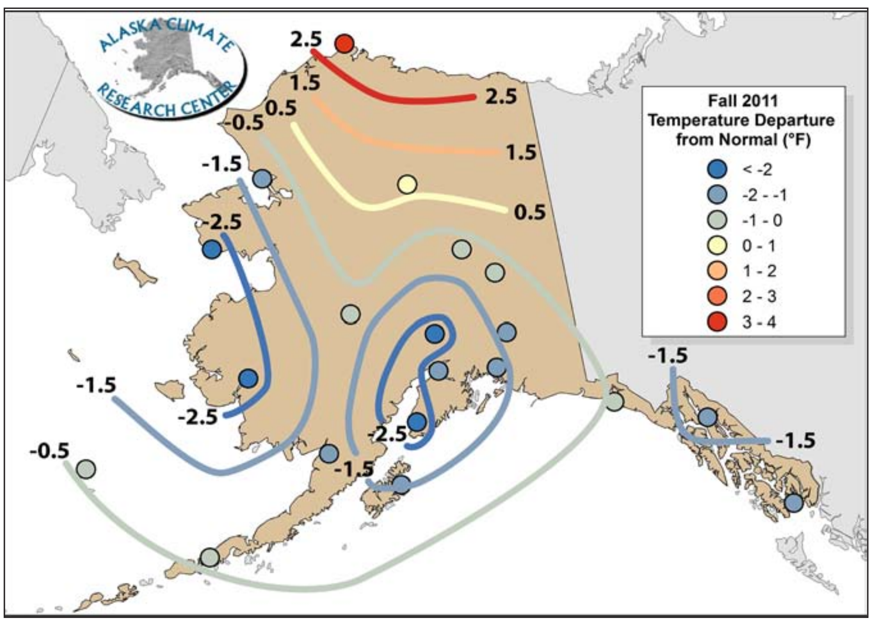

Figure 4. Autumn 2011 isotherm map of the deviation in temperature (°F) from the 30-year normal (1981-2010) based on all first order meteorological stations in Alaska (http://akclimate.org).

There were only two stations with a positive departure from the average for the autumn, namely Barrow (+3.1°F) in northern Alaska and Bettles (+0.6°F), in the Northern Interior. During the last decade, Barrow, on the North Slope, has shown the strongest warming tendency in Alaska. This can be connected with more open water in the Southern Beaufort Sea - the average annual ice-free area has tripled since the early 1970s, the point when good satellite observations became available. The time period with open water has extended further into fall, and this relatively "warm" water produces warming in the coastal areas. This is especially pronounced in fall when open water areas freeze. Historical data show that the greatest warming at Barrow

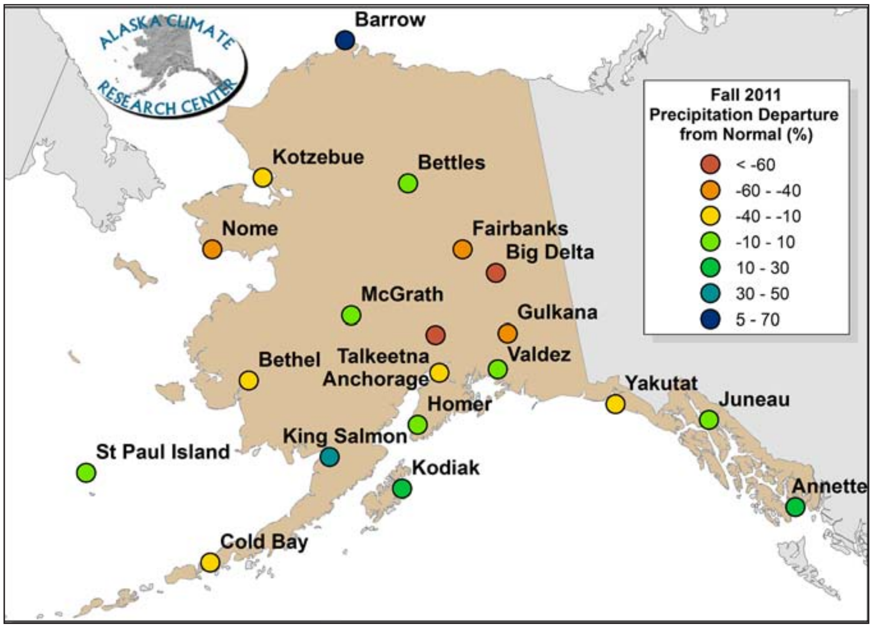

Figure 5. Autumn 2011 precipitation departures (%) from the 30-year normal (1981-2010) based on all first order meteorological stations in Alaska (http://akclimate.org).

has occurred during autumn and early winter, with especially strong warming in October.

The other 18 first-order stations reported negative values from normals with the largest deviations reported in Homer (-3.2°F), Talkeetna (-2.8°F), Nome and Bethel (both -2.6°F). All other stations had a deviation of -2°F or less, hence were relatively close to normal.

Looking at the temperatures for the 3 months individually, September started out with above normal temperatures for 13 of the 20 stations. The average value of all stations for the month was calculated as +1.1°F. Barrow recorded the highest deviation with a value of +4.6°F, followed by Bettles and Fairbanks, both with a value of +4.0°F. Even of greater importance, especially for gardeners and agriculture, were the late occurrences of frost. No temperature below the freezing point (32°F/0°C) was observed during September for Juneau, Ketchikan and Anchorage, and the 26th of September finally brought the first frost to Fairbanks, Big Delta and King Salmon; which is quite late in the season.

September 12th saw several record high temperatures set across the Southeast, with Sitka reaching 74°F/23.3°C +3°F above the record of 1973. Klawock also hit 74°F/23.3°C, 2°F above the 2007 record. On the 13th, unseasonably warm weather reached eastern Interior and Big Delta set a new record of 71°F/21.6, topping the 1956 record of 67°F/19.4°C. Also on that date Northway had a high temperature of 74°F/23.3°C, surpassing the 1990 record value of 69°F/20.6°C.

October was a pleasant month for most of Alaska with 16 of the 20 stations reporting above normal temperatures. Bettles (+6.4F), Barrow (+5.6°F), McGrath (+5.4°F), Fairbanks (+4.7°F) and Big Delta (+4.3°F) were particularly warm when compared to the 30-year average. Even the four stations that were seasonally too cold were still close to normal with the following values: Nome (-0.7°F), St. Paul Island (-0.3°F), Juneau (-0.2°F) and Annette (-0.1°F). The average value at the 20

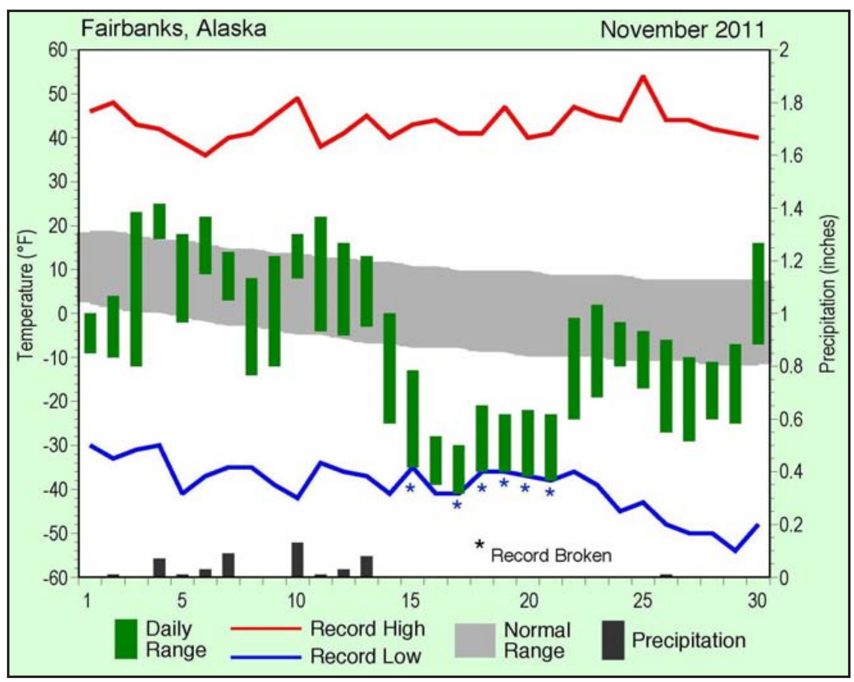

Figure 6. The grey band shows the 30-year normal (1981-2010) temperature range for November, the green bars the daily range of actual temperatures in 2011, the red line shows record highs, the blue line record lows, and the blue stars depict 2011 low temperature records broken. In November 2011, Fairbanks averaged 10.8°F colder than the 30-year normal. In one week, six new November low temperature records were set, with the coldest minimum temperature on November 17th at -41°F/-40.6°C. These are temperatures normally experienced in December-February. (http://akclimate.org).

stations was calculated as a positive temperature deviation of 2.2°F. Details can be seen in Table 4.

Winter descended with force across Alaska in November with storms lashing coastal communities from the Southeast to the Bering Strait, while record cold settled in over the Interior (**Figure 6**). As a result November was substantially colder than normal in Alaska, with all stations reporting below normal values. The average monthly deviation of all stations was 6.8°F below the long-term climatic value. Very sizeable negative deviations were observed (in declining order) for Big Delta (-11.1°F), McGrath (-11.0°F), Fairbanks and Talkeetna (both with -10.8°F), Bethel (-10.2°F), Nome (-9.5°F), Homer (-8.4°F), Anchorage (-8.2°F) and Kotzebue (-8.0°F). Hence the largest deviations were found in the Interior and western Alaska. Fairbanks, for example, reported six new minima in one week, with the coldest minimum temperature on the November 17th at -41°F/-40.6°C. (See **Table 3** for details of these events.) These are temperatures normally experienced in December, January and February. Manley Hot Springs, not a first order station and located some 100 miles WNW from Fairbanks, reported a low of 54°F/-47.8°C on November 16th. Stations relatively close to the long term average, but nevertheless colder than normal, were the following: St. Paul Island (-0.6°F), Barrow (-0.9°F) and Cold Bay (-1.1°F).

Numerous record temperature minima were set in the fall, and unsurprisingly all occurred in the second half of November. Aside from the previously mentioned Fairbanks events, McGrath and Big Delta set new records (-22°F/-30°C and -39°F/-39.4°C respectively) during the cold snap in the Interior. Valdez set four new record lows, the most notable of which occurred the 20th, when the temperature dropped to 4°F, -4°F below the 2009 record. Kodiak also set four new low temperature records between the 21st and 27th. On the 22nd, Kodiak reached 4°F/-15.6°C, -8°F below the 2008 record. On the 26th both Bethel and King Salmon reported new record lows of -22°F/-30°C and -25°F/-31.7°C respectively.

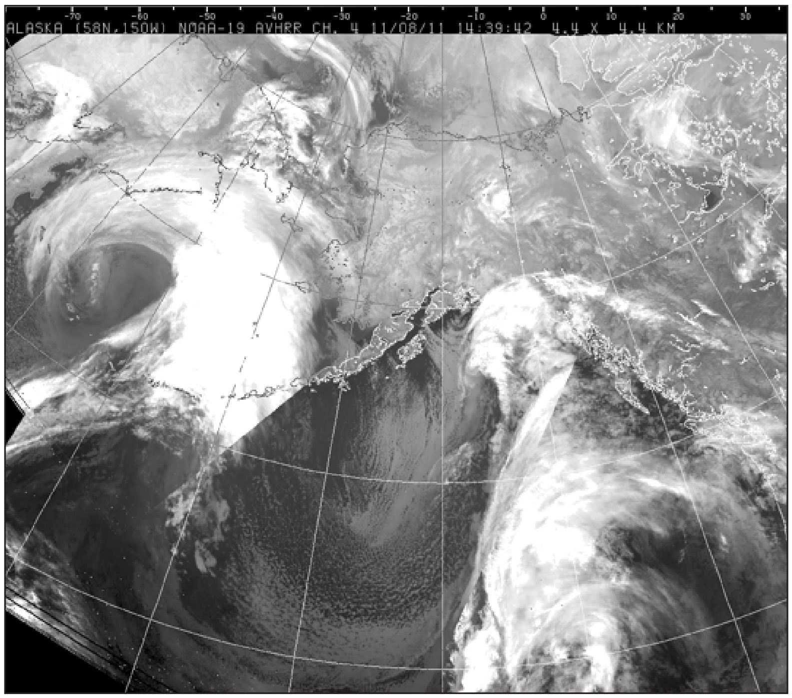

Figure 7. NOAA satellite image from November 8th, 2011 showing the powerful storm heading for Western Alaska.

Precipitation

As stated previously in the Alaska Climate Dispatch, the precipitation gradient is very strong in Alaska when going from the wet Southeast to the dry North Slope. For the long term average, Little Port Arthur reported 73.5in/186.7cm for the autumn season while Barrow measured 1.2in/3cm for the same season only. Due to these extremes, actual deviations are not very meaningful; hence precipitation deviations are expressed as percentages from normal. In **Figure 5**, these data are plotted for all first order meteorological stations in Alaska. In general, the autumn season was deficient in precipitation, with only 5 of the 20 stations reporting values above the long term average. The average value of the 20 stations was calculated as -12%. The largest positive deviation was found for Barrow with 70%, however, as precipitation there is quite low, the actual amount to fall is quite small. The high value could be attributed to the more frequent open water offshore Barrow, which acts as a source of water vapor. As long as the warming continues for this area, and it experiences more open water, higher fall precipitation values are expected. Juneau (+43%) and Annette (+27%) also reported substantially above

Date	New Record (°F/°C)	Old Record (°F/°C)	Year Set
15-Nov	-35/-37.2	-33/-36.1	1969, 1956
17-Nov	-41/-40.6	-39/-39.4	1969
18-Nov	-36/-37.8	-33/-36.1	1969
19-Nov	-36/-37.8	-33/-36.1	1969
20-Nov	-37/-38.3	-35/-37.2	1904
21-Nov	-38/-38.9	-35/-37.2	1904

Table 3. New minimum temperature records for Fairbanks November 15-21, 2011 (http://akclimate.org).

normal values. The largest negative deviations for the fall were found in Big Delta (-71%) and (Talkeetna -64%) Looking at the months separately, September was drier by 25%, October slightly above normal (+7%), while November experienced normal precipitation. The deviation for all first order stations by month and for the season, both for temperature and precipitation, are presented in the **Table 4**.

The storm that hit coastal Alaska at the beginning of November (**Figure 7**) was notable. A storm of its intensity has not occurred in nearly 40 years. It brought many new daily records in precipitation, wind speed and snow fall; some are described below. Besides the climatological events, many power lines were downed and electricity was interrupted in many communities from Juneau, to Valdez, the Kenai Peninsula and coastal Western Alaska. The only road which connects Valdez with the rest of Alaska was closed at the Thompson Pass area, where winds were reported at 85mph/136.8kph with gusts up to 120mph/193.1kph. Visibility became close to zero with large amounts of blowing snow.

Despite the overall lower than expected precipitation, a large number of record precipitation events occurred this autumn. On September 3rd a storm hit the Southeast and several records were set. The most extreme was at Klawock, where the 2004 record of 1.1in/2.7cm was more than doubled at 2.5in/6.4cm. September 5th saw even more

Station	Temperature Deviation (°F)				Precipitation Deviation (%)			
	Sept	Oct	Nov	Seasonal	Sept	Oct	Nov	Seasonal
Anchorage	0.3	2.0	-8.2	-2.0	-66%	-16%	100%	-12%
Annette	-0.1	-0.1	-2.9	-1.0	85%	15%	-5%	27%
Barrow	4.6	5.6	-0.9	3.1	28%	176%	10%	70%
Bethel	0.9	1.4	-10.2	-2.6	-69%	2%	42%	-19%
Bettles	4.0	6.4	-8.5	0.6	-6%	28%	-49%	-7%
Big Delta	3.9	4.3	-11.1	-1.0	-74%	-76%	-60%	-71%
Cold Bay	-1.9	0.7	-1.1	-0.8	-18%	-39%	-38%	-32%
Fairbanks	4.0	4.7	-10.8	-0.7	-41%	-61%	-31%	-45%
Gulkana	0.1	3.1	-7.0	-1.3	-77%	-64%	40%	-48%
Homer	-1.4	0.1	-8.4	-3.2	-6%	26%	-43%	-9%
Juneau	-1.2	-0.2	-3.7	-1.7	1%	-14%	28%	2%
King Salmon	0.2	4.1	-7.6	-1.1	-29%	178%	96%	43%
Kodiak	-0.5	1.4	-5.5	-1.5	111%	-37%	-34%	12%
Kotzebue	2.3	2.4	-8.0	-1.1	-69%	73%	-14%	-14%
McGrath	3.0	5.4	-11.0	-0.9	-59%	17%	77%	-1%
Nome	2.3	-0.7	-9.5	-2.6	-63%	-4%	-60%	-44%
St. Paul Island	-1.1	-0.3	-0.6	-0.7	-42%	6%	7%	-10%
Talkeetna	0.6	1.7	-10.8	-2.8	-75%	-60%	-42%	-64%
Valdez	-0.1	0.8	-5.6	-1.6	-21%	1%	-5%	-9%
Yakutat	1.5	1.9	-5.1	-0.6	-3%	-20%	-8%	-11%

Table 4. The deviation in temperature (°F) and in precipitation (%) from the 30-year normal (1981-2010) is presented for all Alaska first order stations for each autumn month and for the autumn season (http://akclimate.org).

precipitation events in Southeast including Pelican with 3.4in/8.7cm, breaking the old record of 2.8in/7cm from 1981. On September 12th Kodiak measured 3.5in/8.8cm, just doubling the 1979 record of 1.7in/4.3cm. Fewer events were set in October and November, however Valdez received 2.6in/6.7cm on October 25th, 1.1in/2.9cm above the 2002 record. In addition, Kotzebue and King Salmon set new precipitation records on that day.

As would be expected from the storms of November, a large number of snowfall records were broken. Reviewing a few of them, Kotzebue set new back-to-back records on October 25th and 26th with a total for both days of 12.5in/31.8cm of snow. Juneau set two new records, first on the 4th with 4.3in/10.9cm above the 1984 record of 1.0in/2.5cm. Then on the 14th a heavy 11.6in/29.5cm fell, more than doubling the 6.3in/16cm total from 2009. Yakutat also set two new records; first on the 16th with 12.3in/31.2cm of snow, just 0.6in/1.5cm more than the 1956 record. Then on the 22nd Yakutat received 12.5in/31.8cm of snow, 2.3in/5.8cm above the 10.2in/25.9cm from 1973. Yakutat also totaled 81.6in/207.3cm of snowfall for November, more than four times the normal of 18.2in/46.2cm. Finally on the 30th Valdez saw 17.5in/44.5cm of snow drop, beating the 1992 record of 11.4in/29cm. Sitka reported 32in/81.3cm snowfall for the month, slightly more than the previous record of 30.7in/78cm set in November 1990.

This information consists of preliminary climatological data compiled by the Alaska Climate Research Center, Geophysical Institute, University of Alaska Fairbanks. This summary is based on the 20 first order stations in Alaska operated by the National Weather Service. Extreme events of other stations are also mentioned. It should be noted that the new climate normals for the time period of 1981-2010 are applied for the calculations of the deviations, and they can be slightly different from the old normals (1971-2000), which were in use up until end of July 2011. For more information on Alaskan weather and climatology, contact the center at 474-7885 or visit the center web site at http://akclimate.org.

Sea Ice Update

Prepared by John Walsh, President's Professor of Climate Change & Chief Scientist, International Arctic Research Center, UAF.

The extreme summer retreat of sea ice, described in the previous issue of the Climate Dispatch, let to a near-record sea ice minimum in early September 2011. By most metrics, the 2011 minimum was second only to 2007 as the lowest extent of the satellite era, which dates back to 1979. By a few metrics (e.g., ice-covered area rather than extent), the ice minimum of 2011 was even more extreme than that of 2007. The early September 2011 ice minimum was followed by a relatively rapid recovery of pan-Arctic ice extent. The departure from normal, which exceeded 2 million square kilometers in early September, was reduced to 0.76 million square kilometers on December 1, 2011, as shown below in **Figure 8**. This rapid recovery by the growth of new (thin) ice is typical of the past several years.

Freeze-up along the northern and western coasts of Alaska was delayed by several weeks relative to its long-term average.

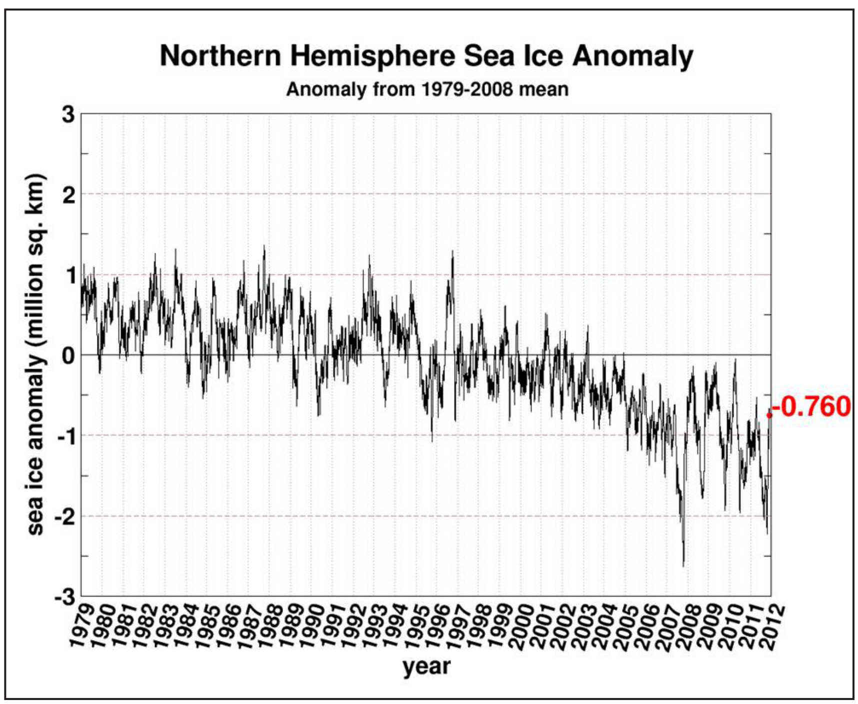

Figure 8. The early September 2011 ice minimum was followed by a relatively rapid recovery of pan-Arctic ice extent. The departure from normal, which exceeded 2 million square kilometers in early September, was reduced to 0.76 million square kilometers on December 1, 2011, as depicted by the red dot above.

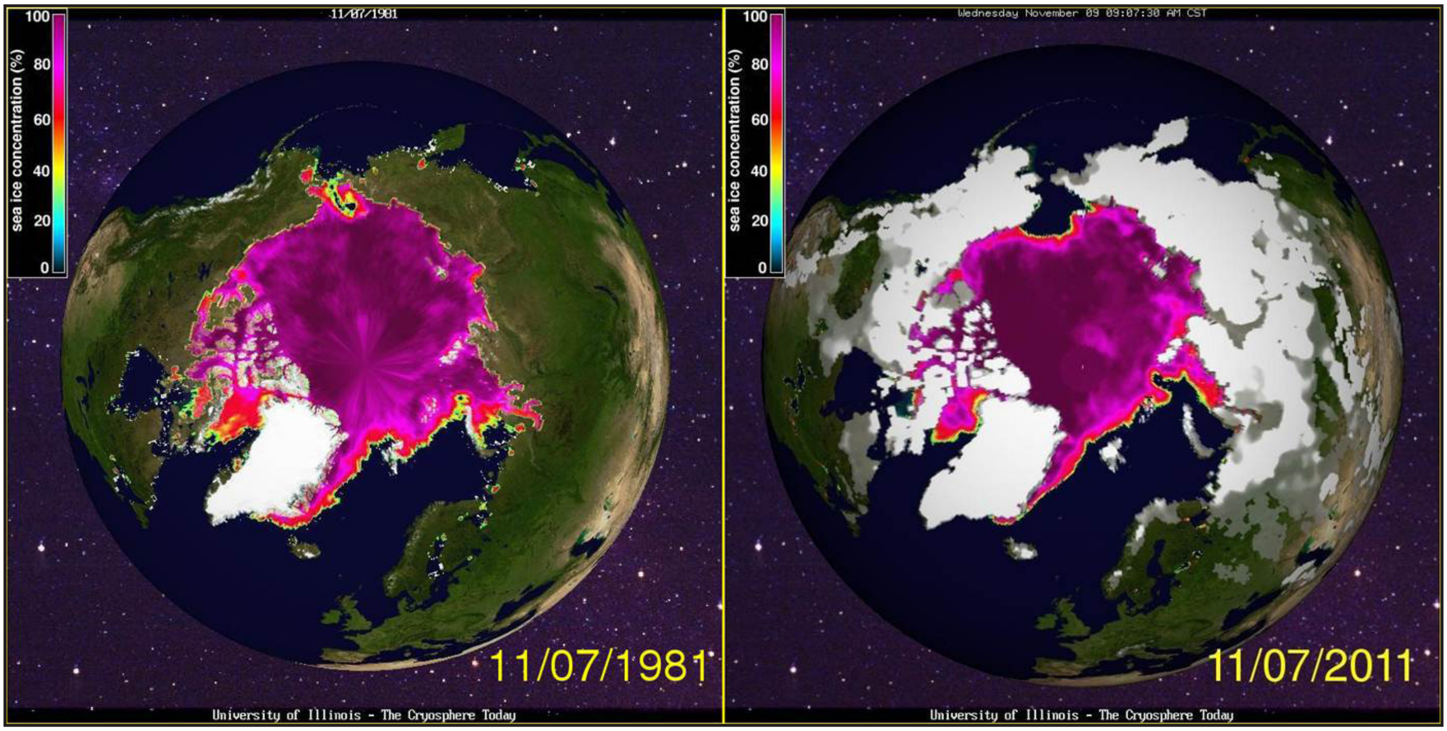

Figure 9. Satellite passive microwave-derived concentrations of sea ice on November 7 of 1981 (left panel) and 2011 (right panel). Concentrations are scaled by color bar in the upper left corner of each panel. Snow cover data for land areas was available in 2011 but not in 1981. Image from The Cryosphere Today, http://arctic.atmos.uiuc.edu/cryosphere.

Ice developed along the coasts in November, while October has historically been the month in which ice returns to the coastal areas. **Figure 9** shows the ice cover in early November 2011, in comparison with the ice cover on the same date in 1981. (Earlier years of this product did not include the display of snow on land, whereas snow is included in the more recent years). The northern Bering Sea and much of the Chukchi remained ice-free on November 7 of this year, while ice covered the western coastal waters as far as southern Norton Sound on November 7, 1981. It should be noted that thin shore-fast ice is not always resolved in satellite passive microwave depictions such as those in **Figure 9**.

The difference in autumn ice coverage between 2011 and previous decades has implications for impacts of storms, which can be strong and frequent in Alaskan coastal regions during October and November. Sea ice provides a protective buffer against coastal erosion and flooding driven by the waves and swell of strong storms. In early November 2011, the western coast of Alaska was hit by one of the strongest storms in decades. The storm, in which the central pressure dropped to 943 mb (comparable to a Category 3 hurricane), tracked across the Bering Sea and northward through Bering Strait into the Chukchi Sea. During this November 8-10 event, winds gusted in excess of 80 mph at Wales and over 70 mph at Kotzebue. Flooding occurred in several communities, including Nome and Point Hope, as sea level rose 10 feet in some coastal areas. Since the coast at this time was largely ice-free (**Figure 9**, right panel), wave action on top of the elevated sea level added to the flooding and erosion of the coast.

By enhancing ocean heat storage and delaying freeze-up, the extreme summer sea ice retreat of recent years is making Alaska's northern and western coasts more vulnerable to autumn storms. But are the frequencies of intense coastal storms also increasing? A database compiled by Jon Gottschalck and collaborators of NOAA's Climate Prediction Center (http://www.cpc.ncep.noaa.gov/products/precip/CWlink/stormtracks/mstrack.shtml) makes it possible to address this question. **Figure 10** shows how the strongest storms (based on a percentile threshold of central pressure) along Alaska's northern coast have been distributed across

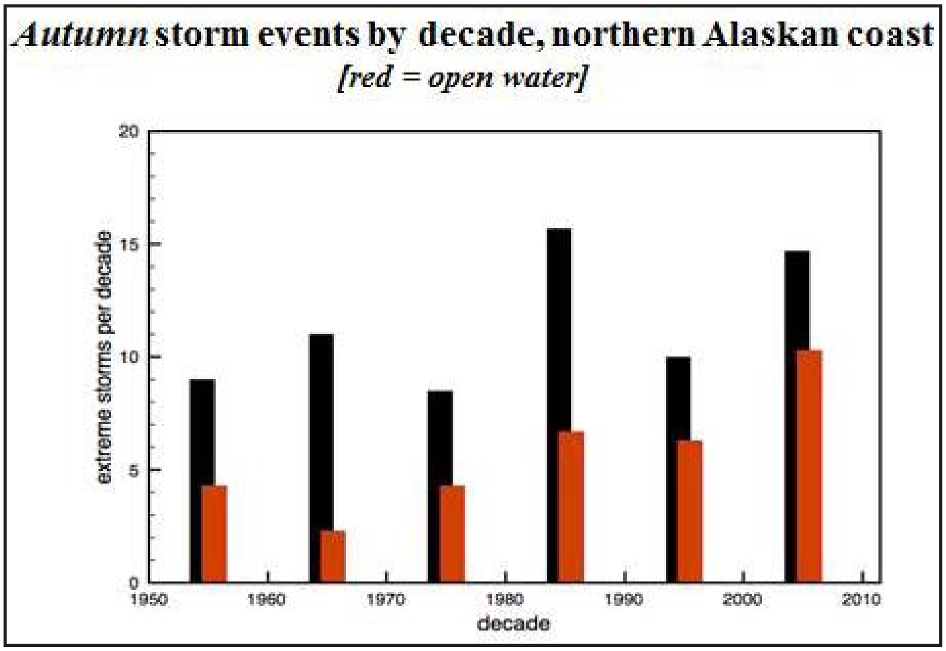

Figure 8. Numbers of strong storms (lowest percentile of all low pressure systems) affecting northern Alaska (black bars) and corresponding numbers of such storms occurring with at least 100 km of open water offshore (red bars). Numbers are shown for each decade back to the 1950's.

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decades since 1950. The black bars, which represent the occurrences of all strong storm events, show decade-to-decade variability, with some indication of larger numbers of strong storm events in the past 30 years than in the preceding 30 years. The red bars, which depict the occurrences of such storms when there was at least 100 km of open water offshore, show a more distinct increase, pointing to the contribution of sea ice retreat to the increased vulnerability of the shoreline. If the same analysis is performed for the western Alaskan coast, there is no significant increase of overall occurrence of strong storms, but there is a significant increase in the number of strong storm occurrences with open water offshore. This preliminary analysis suggests that retreating sea ice, more than a change in storminess alone, is responsible for the increased susceptibility to coastal erosion and flooding in Alaska.

Upcoming ACCAP Events:

Next ACCAP Alaska Climate Webinar:
Tuesday, January 31, 2012; 10-11am Alaska Local Time. An Updated Precipitation Frequency Analysis for the State of Alaska, by Doug Kane and Sveta Stuefer, Water and Environmental Research Center, University of Alaska Fairbanks.

To register: www.accap.uaf.edu/teleconference.htm

Events at the Alaska Forum on the Environment in Anchorage, February 6-12, 2012 (http://akforum.com/):

• *Changing Landscapes: Sea Ice, Snow and Permafrost in Alaska. Tuesday, February 7, 10:30-11:45 am. Join this session to learn how the findings from a recent Snow, Ice and Permafrost hazards workshop will guide future research and collaboration state wide. Provide your input on the design and development of a new digital Sea Ice Atlas created to aid Alaskan coastal communities, marine navigation, the military, industry and researchers.*

• *National Climate Assessment: Alaska Technical Report. Wednesday, February 8, 2-3:15pm. The purpose of the presentation is to provide a brief background on the NCA, present a draft of the 2013 Alaska Technical Report, and seek public feedback.*