

# The Climate of Alaska for 2011

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This review of the climate of Alaska is predominantly based on the 20 first order climatological stations in Alaska, which are operated by NOAA's National Weather Service. These stations are all of high quality, operated by professional meteorologists with identical or similar meteorological instrumentation and observational practices. However, this should not be taken as a sign that stations, which might be operated by other agencies, industries or private individuals are of poor quality. We mention new record values of these latter stations in the monthly summaries.

## Temperature

The mean average annual temperature in 2011 for the 20 stations was 32.5°F, a small negative departure of 0.4°F from the 30-year normal of 32.9°F. It should be pointed out, that we used the normal from the time period 1981-2010 to determine the departure from the mean. NOAA's National Climate Data Center (NCDC), advised that for the months January – July, the old normals of 1971-2000 should be used, as the new normals were not calculated and quality controlled at the beginning of the year. During the middle of the year, they became available, and they were used since August 2011. For our monthly reviews, we followed their advice. Hence, when looking at the table in this write-up for a specific month and a specific station, you might find slight differences in the deviations reported in the monthly reports for the first 7 months of the year. All the new normals can be obtained from NCDC at:

<http://ggweather.com/normals/AK.html>.

For 2011, there were only 4 stations with a positive deviation, Barrow in Northern Alaska having the highest value with +2.2°F, continuing the trend of substantial warming observed on the North Slope over the last decades (Wendler, Shulski and Moore 2009). The other extreme was found in Homer, on the Kenai Peninsula, which recorded the highest negative deviation with -2.4°F. Altogether, the deviations from the mean were rather modest. In **Figure 1** we analyzed the data, and it can be seen that northwestern Alaska was above normal,

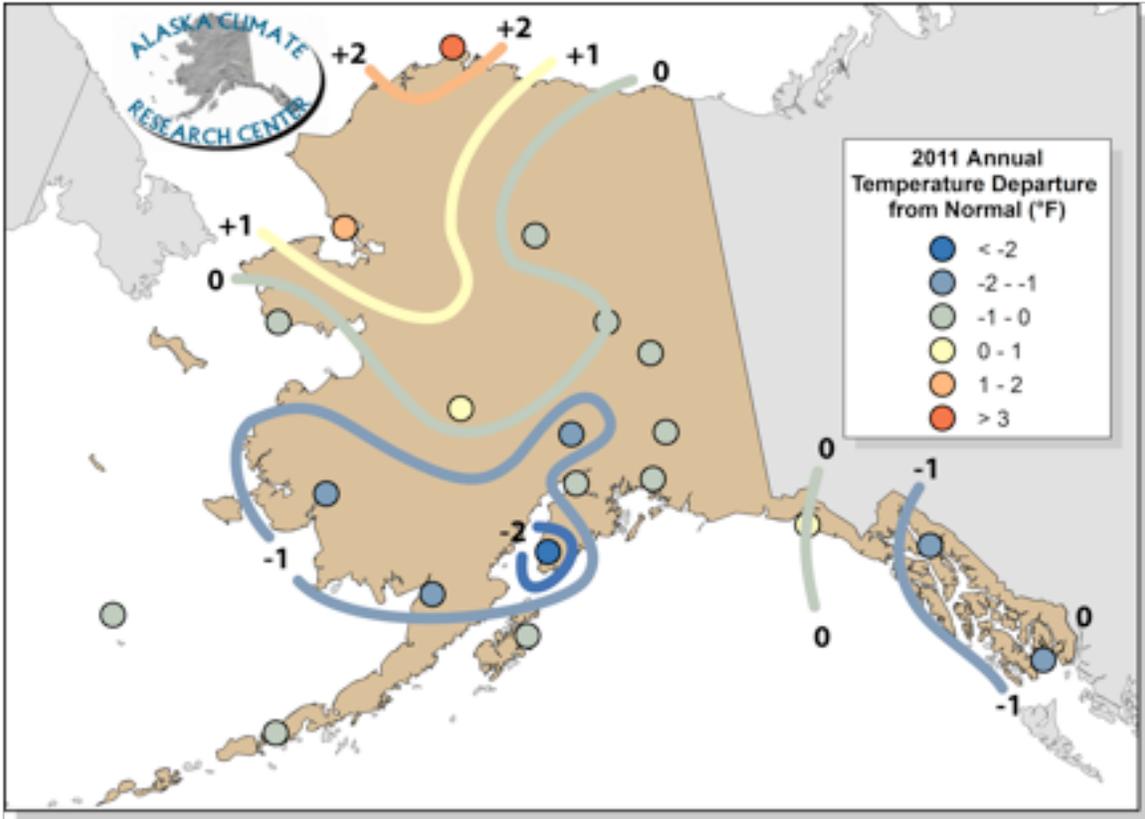


Figure 1: Isopleth presentation of the temperatures deviations from the normal (1981-2010) for 2011 based on all Alaskan 1<sup>st</sup> order meteorological stations.

while southern Alaska was below normal with the exception of Yakutat, which reported the exact climatic normal value. Actual temperature deviations by station can be seen from Table A. 15 of the 20 stations gave negative values with a mean negative deviation of -0.9°F, the mean value of the 4 positive deviation being +1.1°F.

Station	Temperature		
	Observed (°F)	Normal (°F)	Delta (°F)
Anchorage	36.7	37.1	-0.4
Annette	45.0	46.6	-1.6
Barrow	14.0	11.8	2.2

Bethel	<b>29.5</b>	<b>30.7</b>	<b>-1.2</b>
Bettles	<b>23.0</b>	<b>23.5</b>	<b>-0.5</b>
Big Delta	<b>28.6</b>	<b>29.0</b>	<b>-0.4</b>
Cold Bay	<b>38.6</b>	<b>38.8</b>	<b>-0.2</b>
Fairbanks	<b>27.7</b>	<b>27.7</b>	<b>0.0</b>
Gulkana	<b>27.8</b>	<b>28.2</b>	<b>-0.4</b>
Homer	<b>36.3</b>	<b>38.7</b>	<b>-2.4</b>
Juneau	<b>40.6</b>	<b>42.1</b>	<b>-1.5</b>
King Salmon	<b>34.1</b>	<b>35.2</b>	<b>-1.1</b>
Kodiak	<b>40.5</b>	<b>40.9</b>	<b>-0.4</b>
Kotzebue	<b>24.1</b>	<b>22.9</b>	<b>1.2</b>
McGrath	<b>27.5</b>	<b>27.4</b>	<b>0.1</b>
Nome	<b>26.7</b>	<b>27.4</b>	<b>-0.7</b>
St. Paul Island	<b>35.1</b>	<b>35.4</b>	<b>-0.3</b>
Talkeetna	<b>34.3</b>	<b>36.0</b>	<b>-1.7</b>
Valdez	<b>38.4</b>	<b>39.0</b>	<b>-0.6</b>
Yakutat	<b>41.0</b>	<b>40.3</b>	<b>0.7</b>

*Table A: Mean temperature for 2011, normal temperature (1981-2010) and deviations from the mean for the 20 first order meteorological stations in for Alaska*

The mean deviation of temperatures by month is presented in Figure 2 for the 20 stations. The figure shows, that January and October were warmer than normal with positive deviations of above 2°F. All other stations were within 2°F deviations, be it positive or negative, with the exception of November,

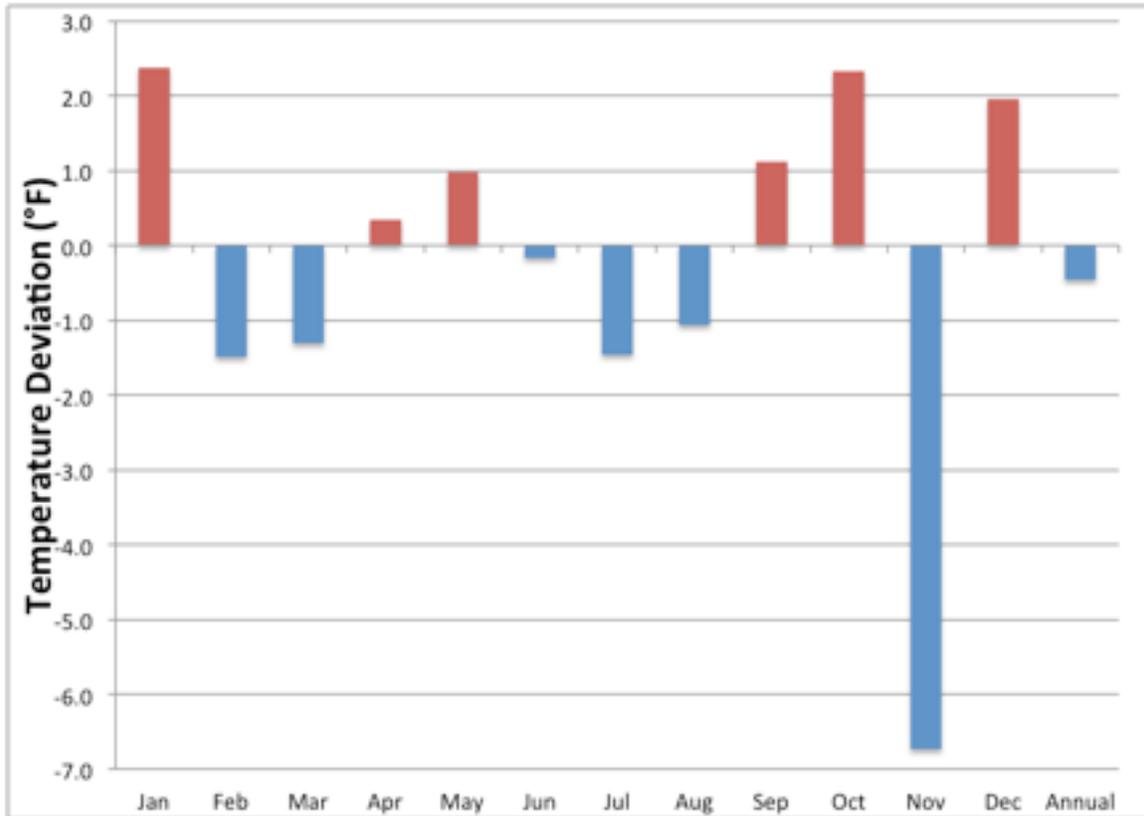


Figure 2: Mean monthly temperature deviation for the 20 first order stations in Alaska by month.

which was much colder than normal. The deviation of 6.7°F for the mean of the 20 stations is remarkable, and shows that all of Alaska was too cold during this month and it was indeed colder than December, an infrequent occurrence.

### Precipitation

The mean annual precipitation of the 20 stations was 36.03", which is close to the long-term mean of 36.86". As reported previously (Shulski and Wendler 2007), there is a very large variation in the precipitation amount, when going from the southeast, e.g. Yakutat reported in 2011 122.80", to the North (Barrow) with an annual value for 2011 of 6.59". It is even more remarkable, that for 2011 Barrow reported 145% of normal precipitation, a value which is, when expressed as a percentage, only surpassed by Kotzebue (149%) in northwest Alaska. This large gradient in precipitation explains the fact, that the most glaciers are found in southern Alaska, calving partly in the Ocean, while in the Brooks Range in Northern Alaska, the temperatures are much colder, and glaciers are not as frequent and smaller in size. In Fig. 3 the precipitation values are presented in graphical form, but we did not analyze the data with isolines, as

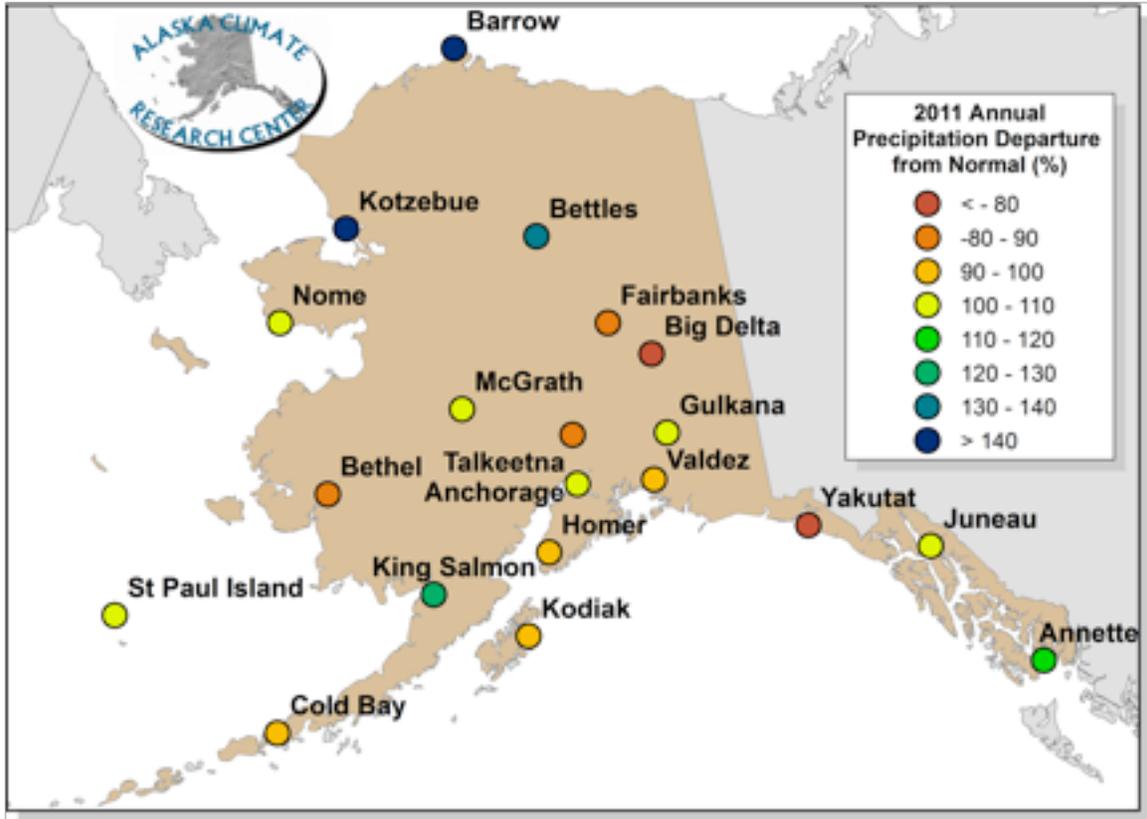


Figure 3: Precipitation deviations (%) from the normal (1981-2010) for 2011 based on all Alaskan 1<sup>st</sup> order meteorological stations.

large variations can occur over short distances, especially in the summer due to shower activities. The graph shows, that northwestern Alaska observed far above normal precipitation values, while southwestern Alaska recorded values below normal. For the rest of Alaska the results were mixed, but dominantly below normal. More details can be seen from Table B, in which the actual deviations by month and year are presented for all stations.

Station	Observed (in)	Normal (in)	Delta (in)	Delta %
Anchorage	17.16	16.58	0.58	3%
Annette	113.65	101.63	12.02	12%
Barrow	6.59	4.53	2.06	45%

Bethel	<b>16.52</b>	<b>18.54</b>	<b>-2.02</b>	<b>-11%</b>
Bettles	<b>19.65</b>	<b>14.90</b>	<b>4.75</b>	<b>32%</b>
Big Delta	<b>8.58</b>	<b>11.62</b>	<b>-3.04</b>	<b>-26%</b>
Cold Bay	<b>39.41</b>	<b>41.67</b>	<b>-2.26</b>	<b>-5%</b>
Fairbanks	<b>9.52</b>	<b>10.81</b>	<b>-1.29</b>	<b>-12%</b>
Gulkana	<b>11.65</b>	<b>11.26</b>	<b>0.39</b>	<b>3%</b>
Homer	<b>23.24</b>	<b>24.34</b>	<b>-1.10</b>	<b>-5%</b>
Juneau	<b>66.66</b>	<b>62.27</b>	<b>4.39</b>	<b>7%</b>
King Salmon	<b>23.89</b>	<b>19.49</b>	<b>4.40</b>	<b>23%</b>
Kodiak	<b>70.53</b>	<b>78.00</b>	<b>-7.47</b>	<b>-10%</b>
Kotzebue	<b>16.38</b>	<b>11.00</b>	<b>5.38</b>	<b>49%</b>
McGrath	<b>19.08</b>	<b>18.00</b>	<b>1.08</b>	<b>6%</b>
Nome	<b>18.43</b>	<b>16.81</b>	<b>1.62</b>	<b>10%</b>
St. Paul Island	<b>25.40</b>	<b>23.67</b>	<b>1.73</b>	<b>7%</b>
Talkeetna	<b>23.81</b>	<b>27.97</b>	<b>-4.16</b>	<b>-15%</b>
Valdez	<b>67.62</b>	<b>69.03</b>	<b>-1.41</b>	<b>-2%</b>
Yakutat	<b>122.80</b>	<b>155.12</b>	<b>32.32</b>	<b>-21%</b>

*Table B: Observed precipitation for 2011, normal precipitation (1981-2010) and deviations from the mean for the 20 first order meteorological stations in for Alaska*

The mean deviation of precipitation by month is presented in Figure 4 for the mean of the 20 stations. The figure shows, that February and December were wetter than normal with positive deviations of above 60%, while March and May were much drier than the norm.

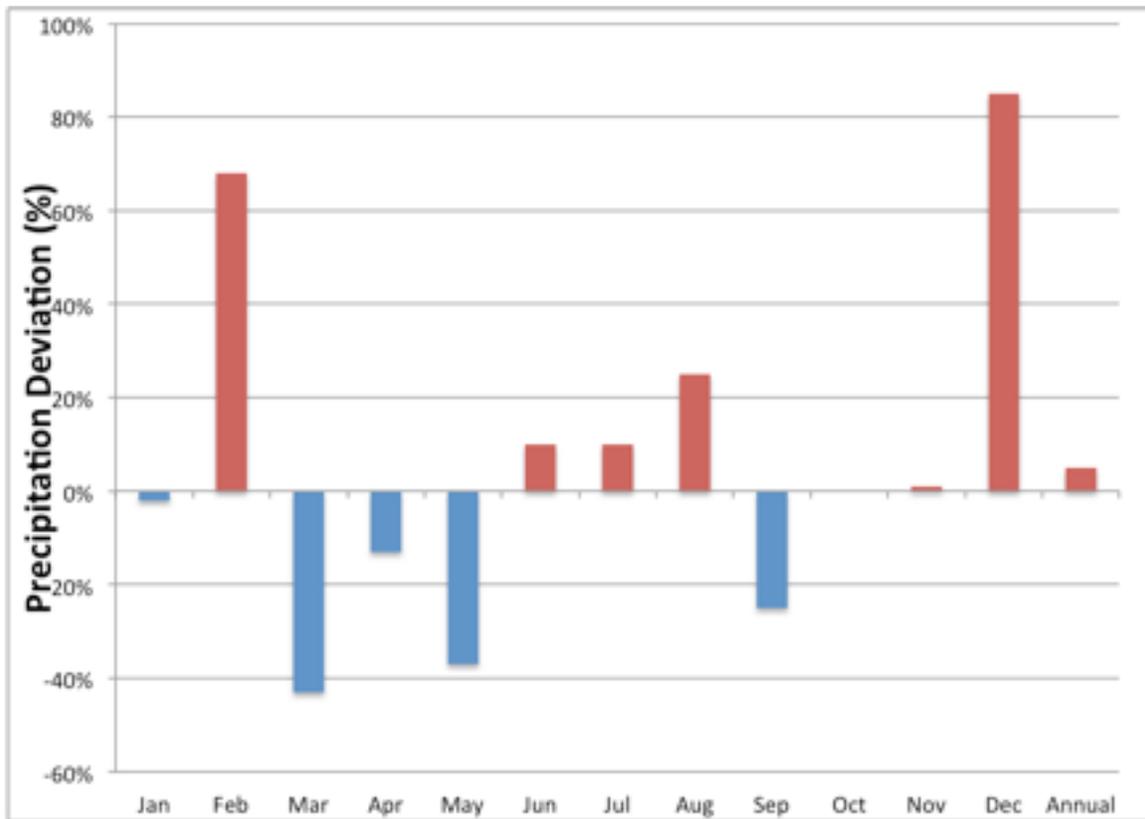


Figure 4: Mean monthly precipitation deviation for the 20 first order stations in Alaska by month.

## Snow

Precipitation falls in summer as rain, but in winter as snow. “Winter” is, of course, much longer in Northern Alaska, e.g. Barrow when compared to the Southeast, e.g. Annette. In Fig.5 the annual snowfall for the stations is presented. It should be pointed out, that 4 stations did not report snowfall amounts, namely Big Delta, Gulkana, Homer and Talkeetna.

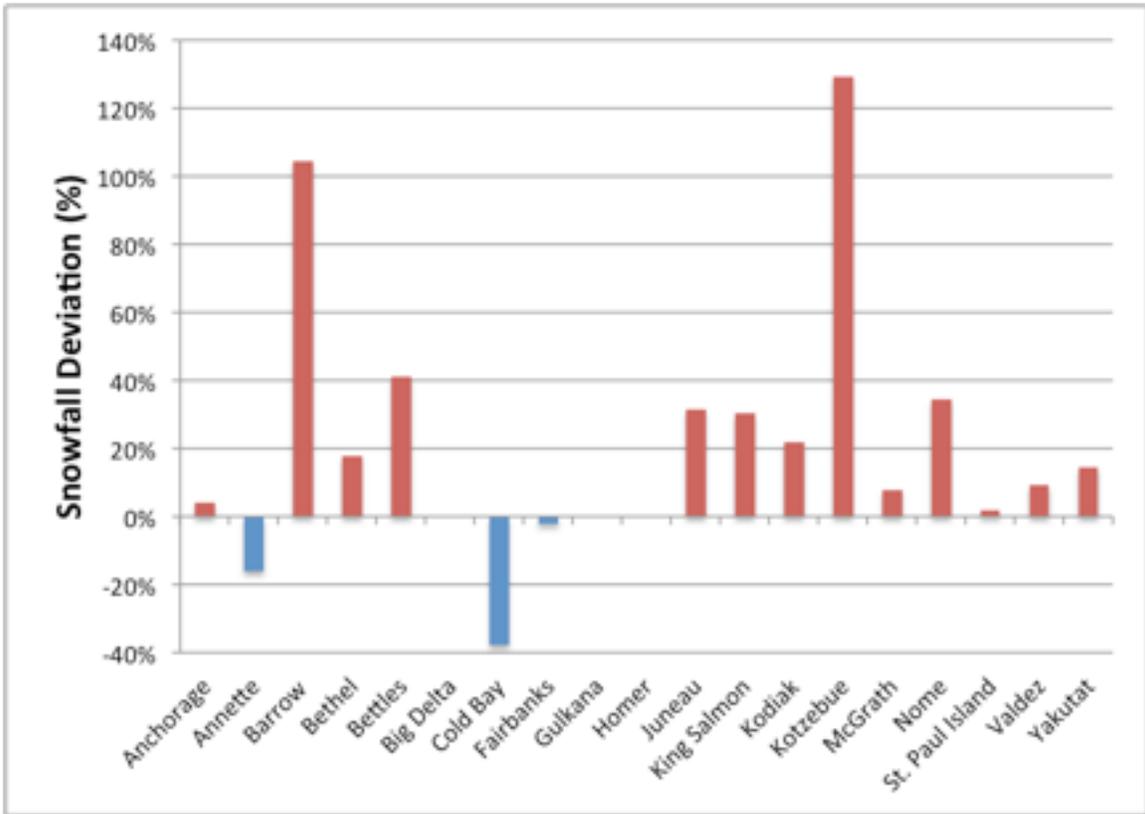


Figure 5: Mean annual snowfall deviations for 16 first order meteorological stations in Alaska

It can be seen that 2 stations, Kotzebue and Barrow, both situated in northwestern Alaska, measured more than twice the expected amount of snowfall. It might not be surprising, that this is the area where the highest positive temperature deviation was observed, and warmer air is able to hold a larger amount of water vapor when compared to a colder air-mass. Generally, snowfall was above the long term mean for most stations. The only strong negative deviation with -38% was found for Cold Bay. The detailed numbers can be obtained from Table C.

Station	Observed (in)	Normal (in)	Delta (in)	Delta %
Anchorage	77.6	74.5	3.1	4%
Annette	29.3	34.9	-5.6	-16%

Barrow	<b>77.1</b>	<b>37.7</b>	<b>39.4</b>	<b>105%</b>
Bethel	<b>72.8</b>	<b>61.8</b>	<b>11.0</b>	<b>18%</b>
Bettles	<b>129.0</b>	<b>91.4</b>	<b>37.6</b>	<b>41%</b>
Big Delta		<b>54.2</b>		
Cold Bay	<b>45.5</b>	<b>73.1</b>	<b>-27.6</b>	<b>-38%</b>
Fairbanks	<b>63.6</b>	<b>65.0</b>	<b>-1.4</b>	<b>-2%</b>
Gulkana		<b>58.4</b>		
Homer		<b>47.4</b>		
Juneau	<b>114.1</b>	<b>86.7</b>	<b>27.4</b>	<b>32%</b>
King Salmon	<b>60.7</b>	<b>46.6</b>	<b>14.1</b>	<b>30%</b>
Kodiak	<b>83.9</b>	<b>68.9</b>	<b>15.0</b>	<b>22%</b>
Kotzebue	<b>137.2</b>	<b>59.8</b>	<b>77.4</b>	<b>129%</b>
McGrath	<b>104.8</b>	<b>97.3</b>	<b>7.5</b>	<b>8%</b>
Nome	<b>101.8</b>	<b>75.7</b>	<b>26.1</b>	<b>34%</b>
St. Paul Island	<b>60.9</b>	<b>59.8</b>	<b>1.1</b>	<b>2%</b>
Valdez	<b>356.1</b>	<b>326.3</b>	<b>29.8</b>	<b>9%</b>
Yakutat	<b>164.1</b>	<b>143.4</b>	<b>20.7</b>	<b>14%</b>

*Table C: Observed snowfall for 2011, normal snowfall (1981-2010) and deviations from the mean in % for the 16 first order meteorological stations of Alaska*

Finally, enclosed is a review on a monthly basis, which was taken to a great extent from our Statewide Summaries, which are also available from our website: <http://climate.gi.alaska.edu/>

**January** 2011 started out as a pleasant month. 18 of the 20 stations recorded above normal temperatures, with large positive deviations in northwestern Alaska. Nome reported the largest deviation with 9.7°F, followed by Kotzebue (+6.9) and Bethel (+5.0°F). The two stations with negative mean monthly temperature deviations were found in southeastern Alaska in Annette (-1.1°F) and Juneau (-0.1°F). The highest temperature for the month of 49°F was measured at Merrill Field, Anchorage on the 2<sup>nd</sup>, and then in Palmer a day later. January's lowest temperature of -58°F occurred at Chicken on the Taylor Highway, and at Ft. Yukon at the banks of the Yukon River, both happening on the 21<sup>st</sup> of the month.

Precipitation in January was normal with 98% of the expected value. Gulkana and Kotzebue were relatively the wettest with nearly twice the expected values, while on the other side of the coin, Fairbanks and Big Delta had roughly 1/3rd of the normal values. Little Port Walter, the station with the highest annual amount of precipitation in Alaska, also held the record for January with 23.94". The greatest snow depth of 112" occurred on the 22<sup>nd</sup> January at the top of Eaglecrest, a ski area close to Juneau.

**February** was generally cold in Alaska with a mean deviation of -1.5°F; 13 of the 20 stations were seasonably below normal. The strongest negative deviations in declining order were Big Delta (-7.0°F), Fairbanks (-5.2°F) and Bettles (5.0°F), all situated in Interior Alaska. In contrast to this, Northern Alaska was much warmer than normal. Barrow recorded a mean temperature of -6.1°F, a substantial deviation of +8.3°F above the long term mean. On the 24<sup>th</sup> a new high temperature record of 29°F was reported, a balmy temperature for the northernmost town in the USA. The old record of 1982 was smashed by 8°F. To surpass the old record by such an amount is remarkable, especially as the observation length is close to a century. Several new daily records were set, 3 of those for Kotzebue, however, we will not discuss those in detail in an annual review.

Precipitation was substantially higher than average, with 168% of normal values. The largest amount of deviation in declining order were observed in Kotzebue (556%), Barrow (443%), Fairbanks (386%), Gulkana (310%) and Bettles (258%), all located in Northern or Interior Alaska. In contrast to this, South Central and the Aleutians measured precipitation below the normal mark for February. Daily new records were found for a number of stations, but we report here only one: on the 17<sup>th</sup> February 1.37" of precipitation were recorded for Kotzebue, surpassing the old record of 1996 (0.14") by nearly 10 fold. The amount observed for this day is very close to the normal amount (1.40") for the whole month. It was also a record in snowfall at 9.9" and this precipitation event in connection with strong winds closed Kotzebue down.

**March** temperatures for most of Alaska were below normal. The mean deviation calculated to -1.3°F with 14 stations being below the long-term mean, one exactly at the mean, and 5 stations being above

the normal. Those are in declining order: Barrow (6.3°F), Kotzebue (4.1°F), St Paul Island (2.2°F), Kodiak (0.9°F) and Cold Bay (0.4°F). The strongest negative deviations were found in the Interior with -9.9°F at Gulkana and in the Southeast with -5.0°F at Juneau. Temperatures were highly above normal this March north of the Brooks Range and along the West Coast, the Pribilof and Aleutian Islands, while temperatures for the Interior, Southwest, South Central and Southeast were all below to near normal. Nevertheless, new high temperature records were set towards the end of March, all in the Southeast. There are too many to mention all, but the highest temperature was reported at Klawock on the 25<sup>th</sup> reaching a high of 58°F and surpassing the old record of 52°F set in 2004.

Precipitation was below normal for most of the state with the mean value for the 20 stations being 56% of normal. Exceptions were the Arctic and St. George Island. The March precipitation deviations are as follows: Barrow recorded 0.28"; the normal for March is just 0.09", making this a positive deviation of +211% above normal. The stations showing negative deviations are Talkeetna reported 0.14" (-89%), King Salmon 0.10" (-87%), Big Delta 0.04" (-82%), Juneau 1.28" (-64%), Nome 0.24" (-60%), Fairbanks 0.15" (-46%), Anchorage 0.45" (-31%) and Ketchikan 10.05" (-10%). Of note, Valdez reported the longest stretch of dry days since records began in 1972. Twenty-two (22) days with no precipitation (since February 20<sup>th</sup>); the previous record was 20-days, set in 1996.

**April's** temperatures were above normal in Southern Alaska, the Interior was close to normal and Arctic, Western and Southeast Alaska experienced temperatures below the expected values.

The temperature in Anchorage averaged 37.5°F, a +1.2°F deviation from the normal value. Fairbanks recorded 31.8°F, a small positive deviation of 0.1°F and Big Delta was temperature-wise very similar with 32.3°F with a positive deviation of 0.2°F. Below normal temperatures were measured in Nome 17.9°F (deviation -1.7°F), King Salmon 32.6°F (deviation -0.5°F), Juneau 39.1°F (deviation -1.7°F) and Ketchikan 41.0°F (deviation -2.0°F). Remarkable was Barrow on the Arctic coast. After 9 consecutive months of above normal temperatures, the monthly mean of -1.0°F was slightly (deviation -0.5°F) below the 30 year norm.

Precipitation was below normal for most of the State with exceptions of western and southwestern Alaska. King Salmon reported 1.09", or 116% of the normal value of 0.94". In Nome, further north along the Bering Sea coast, the precipitation (0.64") was very close to normal, 99% of the expected value of 0.65". Barrow showed the strongest negative deviation with only 17% of the expected value. However, it should be pointed out that the precipitation is light in Northern Alaska, especially in spring, when cloudiness is at a minimum. The precipitation for the month was 0.02" water equivalent, while the monthly norm is 0.20". From these values it can be easily deduced, that one single snowfall could substantially change these statistics. Other stations gave the following values expressed again as the percentage of normal: Fairbanks 33%, Juneau 62%, Ketchikan 63%, Anchorage 77% and Big Delta 85%.

**May's** temperatures were above normal for much of Alaska, with a mean value for all stations of 1.0°F. Deviations from the mean were especially pronounced for Northern and Interior Alaska. Here are the temperatures given in order of declining deviations from the norm. Fairbanks held the record for the month with 52.4°F, 2.9°F above the normal. The temperature in Big Delta averaged 50.5°F, a +2.4°F deviation from the normal value. The same deviation of +2.4°F was found for Barrow, which recorded a mean monthly temperature of 22.5°F. King Salmon reported 32.6°F (deviation -0.5°F), Ketchikan 45.1°F (deviation +1.6°F), Anchorage 48.4°F (deviation + 1.5°F), Nome 38.4°F (deviation +1.3°F), Ketchikan 48.9°F (deviation +0.4°F) and Juneau 48.2°F (deviation +0.3°F). Northern Alaska resumed its warming trend with Barrow, which last month had a negative temperature deviation, the first in 10 months, which was once again warmer than the long term mean. May was also the first month of the year where the Interior became warmer than the southern region, which is rather typical for the relatively warm continental summer conditions of the Interior. For example, the monthly mean temperature for Fairbanks was 52.4°F, with a monthly maximum of 86°F on the 28<sup>th</sup>. In contrast to this, the mean monthly temperature of Anchorage was 48.4°F, and a maximum of 70°F, which occurred on 26 and 27 May.

Precipitation was below normal for most of the State with a mean value 63% of normal. Exceptions could be found in parts of South Alaska, where King Salmon reported 143% and Ketchikan 111% of normal. Below normal precipitation were recorded for Fairbanks (7%), Big Delta (22%), Anchorage (50%), Barrow (75%), Nome (78%), Juneau (81%). It should be pointed out that precipitation is light in Interior and especially Northern Alaska in spring, when cloudiness is at a minimum. The above normal temperatures and far below normal precipitation values in Interior Alaska caused very dry surface conditions, enhancing wildfires ignition and spreading, and by the end of the month a great number of wildfires had occurred, far above normal for the time of year.

**June's** temperatures were generally close to normal for all of Alaska: the mean deviation from the normal was -0.2°F. Nome measured 49.2°F, having the greatest positive deviation of 1.9°F. Other stations with positive deviations in declining order were Ketchikan with 48.7°F (deviation + 1.2°F), Fairbanks with 60.4°F (deviation also +0.7°F), Barrow with 35.2°F (deviation +0.2°F) and Juneau with 57.5°F (deviation +0.1°F). For Big Delta the June temperature matched the long-term mean of 57.5°F, while Anchorage with 54.0°F (deviation - 0.7°F) and King Salmon with 48.7°F (deviation -2.2°F) were colder when compared to the 30-year norm.

Fairbanks reported on the 25<sup>th</sup> of June a temperature of 88°F. While not a new maximum for the day, it was remarkable insofar, that strong thunderstorm activity was reported in the evening and 4,300 lightning strikes were recorded for this day, which ignited 10 new wildfires in the Interior Alaska. No new high temperatures were set in June in Alaska, however, on the 16<sup>th</sup> of June a minimum temperature of a chilly 38°F was observed for Valdez, which was cooler than the old record low of 41°F, which was set in 1985. Further, Bethel Airport reported on the 28<sup>th</sup> June a maximum temperature of 47°F. This is a very low maximum temperature of the day, and one has to go back to 1952 to find the same low temperature. King Salmon reported 30°F on the 2<sup>nd</sup> of June, and was the last day of

frost. This tied the record low for the day, which was previously set in 1991 and the low temperature of 35°F on the 23<sup>rd</sup> of June broke the old record set in 1949 by one degree.

Precipitation was varied with about half the stations reporting above normal values, while the rest were seasonably too dry. Precipitation values are expressed as percentages of normal; this means that values above 100% are amounts above the expected values, while values below 100% indicate a shortage of precipitation when compared to the long term mean. King Salmon in southwestern Alaska reported 2.77", or 163% of the normal of 0.94". In Nome, further north along the Bering Sea coast, the precipitation (0.86") was 75% of normal. Barrow in the Arctic, reported 0.54", which represent 169% of normal, as the precipitation is light north of the Brooks Range. Fairbanks recorded 1.77" or 126% of normal. However, substantially more precipitation was recorded in the upper Chena Basin; large variations are typical for the summer season for the Interior region, due to shower activity caused by thunderstorms, which are more patchy than precipitation due to frontal activity. The Chena River was close to flood stage, and on the Salcha River some minor flooding did occur. Juneau reported 4.25", or 126% of normal. On the 14<sup>th</sup> 1.03" of rain was measured, a new record for this day, surpassing previous maximum amount of 0.66", recorded in 1951. Ketchikan had a monthly sum of 2.84", only 41% of the expected value, as southeast Alaska experiences a large amount of rain. The Anchorage precipitation value (1.19") was 112%, which is slightly above normal. Precipitation (2.00") was below normal for Big Delta, totaling 81% of the expected amount. However, on the 28<sup>th</sup> June a new record rainfall was observed with a total 0.74", surpassing the old record for the day of 0.42", which was set in 1948.

A strong storm was observed in the Aleutians in late June, and new record wind speeds were recorded at Cold Bay. On the 23<sup>rd</sup> of June, a gust of 31 mph was recorded, surpassing the old record by 1 mph. On the 25<sup>th</sup> a gust of 51 mph was observed, surpassing the previous value of 45 mph set in 2007, and once again on the following day, a new daily record of 58 mph was observed, again surpassing the previous value of 45 mph, which had also been set in 2007.

**July's** temperatures were generally close to normal for all of Alaska with the exception of the Bering Sea Region, which was much colder than normal. Nome measured 48.6°F, having the greatest negative deviation of 4.0°F, followed by King Salmon (-3.7°F). Other stations with negative deviations in declining order were Ketchikan with 56.8°F (deviation -0.9°F), Juneau 55.9°F (deviation also -0.9°F), Fairbanks with 61.7°F (deviation -0.8°F) and Anchorage 57.8°F (deviation -0.6°F). Barrow, which has had a strong temperature increase over the last decade, measured 41.9°F, a positive deviation of 1.5°F, while Big Delta's July temperature was 1.0°F above the normal of 57.5°F.

Precipitation was varied, but was generally above normal. Nome and Ketchikan were very wet with nearly twice the monthly precipitation, while Kodiak was drier than average. In the Interior, where thunderstorms and showers frequently occur in the summer, large variation in the amount of precipitation can be found over short distances. For example, Fairbanks reported 1.73", just a tiny amount (2%) below normal, while at Angle Creek in the upper Chena Basin 4.83" were measured.

Further, the rainfall in Ketchikan in the 1<sup>st</sup> of the month was remarkable with an amount of 3.69", setting a new record for this day. It surpasses the old record by about 1/3, which was set in 1917 at 2.49".

Early in the month, a strong storm occurred in the Bering Sea. In Cold Bay, in the Aleutians, a peak wind speed of 54 mph was recorded on the 5<sup>th</sup> July, surpassing the previous wind maximum of this day (44 mph) set in 2009. The following day a peak wind speed of 49 mph was reported breaking the old record in 2009 by 5 mph. On the 8<sup>th</sup> July a peak wind speed of 54 mph was measured, surpassing the old record of 2008 by 3 mph.

**August** was seasonally cooler than normal in Alaska with 17 of the 20 stations reporting below normal values. The mean monthly deviation of all stations was 1.1°F below the long-term climatic value. High negative deviations (<-2°F) were observed in declining order for Juneau (-2.9°F), King Salmon (-2.5°F) and Nome (-2.1°F), while Barrow (+3.1°F) was substantially warmer and no frost occurred at that station in August, which is unusual. The only other 2 stations, which reported above normal temperatures were Fairbanks (+1.1°F) and Yakutat (+0.6°F), an indication that negative deviations were widespread and fairly uniform.

Precipitation was for most stations above normal in August, with a maximum in Southeast Alaska, reporting nearly twice the expected amount. The mean value for all stations was 25% above normal. 65% of the stations gave above normal values, while 35% were drier. Far above normal values were reported for Annette (210%), Juneau (187%) and Kodiak (163%), while Cold Bay was the driest with 64% of the expected amount. In Juneau, precipitation totaled 10.72". This value came close to the maximum amount ever observed in August, which was set in 2006 at 11.02". As might be deduced from the high precipitation amount in Juneau, sky cover averaged 90%, with 30 cloudy days and some rain occurring on 28 days of the month.

**September** was seasonally warmer in Alaska with 13 of the 20 stations reporting above normal values. The mean monthly deviation of all stations was 1.1°F above the long-term climatic value. High positive deviations (>2°F) were observed in declining order for Barrow (4.6°F), Fairbanks (4.3°F), Bettles (4.0°F), Big Delta (3.9°F), McGrath (3.0°F), Nome and Kotzebue (both 2.3°F). As the month before, Barrow in the North recorded the highest monthly positive deviation. Temperatures below the long-term mean were measured at coastal stations, they were fewer in amount when compared to the positive values. Here we list of the stations with more than 1°F negative deviation in declining order: Cold Bay (-2.0°F), Homer (-1.4°F) Juneau and St Paul Island (both -1.2°F).

Even of greater importance than the generally above normal temperatures, was the late occurrence of frost, especially for gardeners and agriculture. No temperature below the freezing point (32°F) was observed during September for Juneau, Ketchikan and Anchorage; however, on the 26<sup>th</sup> a minimum temperature of 32°F was observed for the latter station. Furthermore, the 26<sup>th</sup> of September brought the first frost to Fairbanks, Big Delta and King Salmon.

Precipitation was mostly below normal in September. Only 3 stations were substantially wetter than normal, namely Kodiak (213%), Annette (192%) and Barrow (128%) of normal. Yakutat (deviation from norm -3%) and Juneau (+1%) were very close to normal, while the other 15 stations gave below normal values, with many stations less than half of the expected values, especially in Interior Alaska. Gulkana measured 23% of normal, Talkeetna 25%, Anchorage and Big Delta each 26%, to mention only the most extreme. The mean of the 20 stations gave a value of 75% of normal.

**October** was a pleasant month for most of Alaska with 16 of the 20 stations reporting above normal temperatures. Bettles (+6.5°F), Barrow (+5.6°F), McGrath (+5.4°F), Fairbanks (+4.7°F) and Big Delta (+4.3°F) were especially warm, when compared to the 30-year mean. Even the four stations, which 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 mean value of the 20 stations was calculated as a positive temperature deviation of 2.3°F.

Precipitation records for October were mixed, 10 stations recorded values above the expected value, while 10 stations were below the norm. The mean of the 20 stations gave the exact long-term mean value. Only 3 stations were substantially wet, namely Barrow (276%), Kotzebue (173%) and King Salmon (156%) of normal. Less than half of the expected precipitation values were observed especially in Interior Alaska. Big Delta measured 24% of normal, Gulkana 36% Fairbanks 39% and Talkeetna 40%.

**November** was substantially colder than normal in Alaska with all stations reporting below normal values. The mean monthly deviation of all stations was 6.8°F below the long-term climatic value. This is in contrast to the previous month, when 79% of the stations reported temperatures above the long term mean. Very high negative deviations were observed in declining order for Big Delta (-11.1°F), McGrath (-11.0°F), Fairbanks and Talkeetna (both -10.8°F), Bethel (-10.2°F), Nome (-9.5°F), Homer (-8.4°F), Anchorage (-8.2°F) and Kotzebue (-8.0°F). It can be seen that the largest deviations were found in the Interior and western Alaska. Stations relatively close to the long term mean, but nevertheless colder than normal, were: St. Paul Island (-0.6°F), Barrow (-0.9°F) and Cold Bay (-1.1°F), all coastal or island stations. Coastal stations are under the maritime influence, as the large water body nearby makes deviations less pronounced. However, this was not the case for all stations, see for example Nome.

There were 2 major events, which occurred during the month. First, at the beginning of the month, a strong storm occurred, associated with record high wind speeds and a large amount of snowfall. This event was pronounced in South and West Alaska. Secondly, shortly after the middle of the month, the advection of an arctic air-mass brought record low temperature to most of Alaska. This event caused the temperatures to be much colder than expected for November. Numerous new record low temperatures were reported. For Fairbanks the coldest temperature occurred on the 17<sup>th</sup> with -41°F. In November temperatures below -40°F are seldom observed in Interior Alaska, and for Fairbanks one has to go back to 1994 to find such a low temperature. The absolute record low during the cold spell is held by Manley Hot Springs, some 100 miles WNW from Fairbanks with a value of -54°F.

Precipitation records for November were mixed, 8 stations recorded values above the expected value, while 12 stations were below the norm. The mean of the deviations expressed as percentages gave exactly a value of 0%. Only 2 stations were substantially wet, namely Anchorage with 100% and King Salmon with 96% above normal. At the other end of the scale were Big Delta and Nome with 40% of the expected value, followed by Bettles (51%), Homer (57%) and Talkeetna (58%). At first glance, the normal precipitation value for Alaska as a whole is surprising, as Alaska was much colder in November, hence less than normal precipitation might be expected. However, at the beginning of the month, a strong storm hit Alaska, bringing large amounts of rain and snow to places. On the 1<sup>st</sup> of November the storm hit South Alaska. The only road connection of Valdez to the rest of Alaska had to be closed in the Thompson Pass area. Wind speeds in the area were 85 mph, with gusts up to 120 mph. Visibility was extremely poor. In Juneau and the Kenai Peninsula (Homer, Soldotna, Kenai, Nikiski, Sterling, Kasinof) power outages were reported due to downed transmission lines. Somewhat later, snow and hurricane-force winds battered the Alaskan West-Coast. It was the strongest storm in nearly 40 years, ripping off roofs and forcing some residents to board their windows and look for higher ground. On St. Paul Island the wind speed reached 70 mph, which set a new record for any November. In some of the native villages (e.g. Tunanak and Kipnuk) the water reached some homes. However, on the positive side, the 14ft rock seawall, which was built to protect the village of Kivalina from coastal erosion, held.

**December** brought relief with mostly above normal temperatures after the extremely cold November. Twelve of the stations were seasonally above normal, with very high positive deviations. In declining order these are: Gulkana (11.1°F), Fairbanks (8.1°F), Big Delta (7.5°F), McGrath (6.9°F) and Anchorage (4.4°F). The 8 stations which were seasonally below normal were much closer to normal, with a maximal deviation of -3.0°F observed for Nome. The mean monthly deviation of all stations could be calculated as 2.1°F above the long-term climatic value.

Normally, the 3 winter months of December, January and February are the coldest of the year, which can be clearly seen from the long-term averages. However, in 2011 15 of the 20 stations analyzed were colder in November than in December, which is quite unusual. In addition, one station (Kodiak) had the identical temperature of 28.4°F for both months. The greatest difference in temperature was found in Gulkana (12.7°F) and Fairbanks (12.2°F), with December being substantially warmer than November. Not only the mean temperatures, but also the minima were frequently lower in November than in December. In general, for the first two-thirds of December, above normal temperatures were observed, but during the last 10 days of the month the temperature dropped sharply, with lower monthly minima observed towards the end of the month.

Precipitation totals for December were in general above average; 18 stations measured values above expectation, while only two stations were below the norm, one of these only slightly so (Annette -4%). The other (Kodiak) recorded a lower value by -38%. The mean of the deviations expressed as percentages gave a value of +78%, a substantial deviation for such a large area as Alaska, or differently expressed, Alaska was wet in December with, on average, nearly 80% additional rain or

snowfall. The most extreme values expressed as percentages above normal were found in Barrow (329%), Bettles (251%), McGrath (162%), Kotzebue (146%), Anchorage (138%) and Talkeetna (111%).

Looking at snowfall, again expressed as percentage above or below normal, Barrow had the highest deviation (+349%), followed by Kotzebue (+205%) and Valdez (+112%). On the other side of the spectrum, Annette, in the southeast corner of Alaska, reported a deviation of -64%. However, it should be pointed out that only 15 of the 20 stations supplied snowfall observations.

December brought quite a number of special events. A storm brought strong winds, warm air and precipitation. On the 1<sup>st</sup> of December a temperature of 54°F was recorded in Big Delta, a new record for this day, smashing the old record of 42°F set in 1976. An increase in a record by 12°F is rare, and this was an extraordinary event. It was caused by strong southerly flow across the Alaska Range –so called Chinook winds, which are gusty. The air is cooled moist-adiabatical when it rises due to precipitation on the south side, but descends dry-adiabatical on the north side of the range. As the dry adiabatical rate is higher than the moist-adiabatic rate, the air arrives warmer in Interior Alaska, when compared to the temperature it started out with on the south side of the Range.

The storm, which moved over Alaska at the beginning of the month, brought a wind gust of 74 mph on the 3<sup>rd</sup> of December at St. Paul Island in the Southern Bering, and two days later a gust of 118mph was recorded at Glen Alps. On the 4<sup>th</sup>, the maximum temperature of +47°F was recorded in Fairbanks - a balmy temperature, for Interior Alaska in winter. A mean temperature for the day was 37°F, a rare event, as mean daily temperatures above freezing are infrequent in winter in Fairbanks. Also on the 4<sup>th</sup>, at Barrow in Northern Alaska, average wind speeds were recorded at 30 mph, with gusts exceeding 50 mph. These are high, uncommon values, however they do not represent new records. More unique was the precipitation record of Barrow with 0.33" (water-equivalent), beating the previous record for the 4<sup>th</sup> December of 0.19 set in 1922. This was associated with a new snowfall record of 6.5", surpassing the old record of 2.5" set on the same day in 1922. Both these values are in fact new records for **all** days in December. The previously highest precipitation amount for any day in December had occurred on 13<sup>th</sup> December 1930 with 0.26", and the highest amount of snowfall (5.0") had been observed on 29<sup>th</sup> December 1922. Also Nome and Kotzebue reported new snowfall and precipitation records. Further, in Valdez 2.80" of precipitation were recorded on the 4<sup>th</sup>, which more than doubled the old record of 1.37" set in 1984.

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