

## THE LOWEST AVERAGE WINTER TEMPERATURE IN THE UNITED STATES — UMIAT, ALASKA

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### ABSTRACT

Twenty years of winter (December through February) mean monthly temperature data from Umiat, Alaska are analyzed. The mean winter temperature of  $-21.7^{\circ}\text{F}$  at Umiat is shown to be statistically significantly lower than the mean winter temperature of  $-16.0^{\circ}\text{F}$  at Barter Island, Alaska. This enables Umiat to claim the lowest mean winter temperature anywhere in the United States.

### 1. INTRODUCTION

Barter Island, on the northeast coast of Alaska, is generally cited as having the lowest average winter (December through February) temperature,  $-16.0^{\circ}\text{F}$ , in the United States (2). However, after nearly twenty years of observations Umiat, Alaska can claim that distinction.

### 2. LOCATION AND HISTORY OF OBSERVATIONS

Umiat lies in the broad valley of the Colville River at  $69^{\circ}22'\text{N}$ ,  $152^{\circ}08'\text{W}$ . The Beaufort Sea is about 110km to the north, while the Brooks Range lies some 75km to the south (see Fig. 1). The terrain surrounding Umiat is generally rolling hills at elevations of 100 to 250 meters above sea-level (MSL). The elevation of Umiat is 81 meters MSL.

The period of climatological observation is a broken one, consisting of two roughly equal intervals. The first interval began in April 1945, with the establishment of a U.S. Naval Station, and ended in July 1954 as an Air Force Station. In between, Umiat was for the most part operated by the U.S. Weather Bureau.

After July, 1954 climatological observations were not made at Umiat for more than twenty years. However, the site did remain active as an airfield. Observations resumed in October 1975, and continue to the present.

Umiat is the only climatological station currently providing year-round data from the interior of the North Slope. During the 1970's, several stations were operated in conjunction with the construction of the Trans-Alaska Oil Pipeline. None of these stations are presently operating, nor does any station have more than eight years of records. In addition, the U.S. Army's Cold Regions Research and Engineering Laboratory (CRREL) operates a number of thermographs at various locations across the North Slope during the warmer months of the year (3).

### 3. DATA

The mean temperature for all available winter months for both Umiat and Barter Island are presented in Tables 1 and 2, respectively. Data for Umiat during the period 1945 through 1952 comes from Local Climatological Data (4), while data thereafter is from Climatological Data for Alaska (5). Data for Barter Island is from Local Climatological Data (6). Note that winter means are weighted to take into account the fact that February is somewhat shorter than either December or January.

### 4. STATISTICAL ANALYSIS

In order to show that the mean temperature at Umiat is indeed lower than the mean at Barter Island, the student-t statistic,  $T$ , was calculated by:

$$T = (X - U_0) / (S/n^{0.5}) \quad (1)$$

where  $x$  is the mean temperature for all winter months at Umiat,  $U_0$  is the 30-year mean winter temperature at Barter Island,  $S$  is the standard deviation of the Umiat mean winter temperature, and  $n$  is the number of monthly means used to calculate  $X$  and  $S$ . The result of equation (1) is  $T = -5.2$ . This indicates that to better the .005 level of significance, Umiat does indeed have a lower mean winter temperature than Barter Island.

### 5. DISCUSSION

The most striking comparison between Tables 1 and 2 is that Umiat's winter mean is more than five degrees colder than the 30-year mean at Barter Island, and that during those months when observations were taken at both locations, Umiat is colder by nearly seven degrees. Is such a large difference reasonable? Could some or all of that difference result from observational bias or errors? Systematic differences in mean temperatures based on the start-end time of the climatological day have been investigated by Scotto and Shulman (7). In fact, the time of observation at Umiat has varied quite a bit over the twenty years of records. Currently, mean temperatures are based on a 9pm-9pm Local Standard Time (LST) climatological day at Umiat, while the mean at Barter Island is based on a midnight to midnight LST period.

Although some of the difference in means could be attributable to the difference in observation

time, it seems unlikely to be extremely important. The sun is continuously below the horizon for more than half the winter — the first sunrise at Umiat is on January 15. By the end of February, the noon sun is still only a little more than 10 degrees above the horizon. These facts would suggest that observation time would be less critical than at mid-latitudes since the time of maximum and minimum temperatures would not be as strongly centered around early morning and late afternoon.

As mentioned previously, several climatological stations operated on the inland plain of the North Slope during the 1970s. The data obtained from these stations support the conclusion that inland valley locations are considerably colder than the Arctic coast in the winter. In particular, Happy Valley, located on the pipeline route about 140km east-southeast of Umiat in the Sagavanirktok River valley, recorded a winter mean temperature of about  $-20^{\circ}\text{F}$  in 16 winter months on record during the

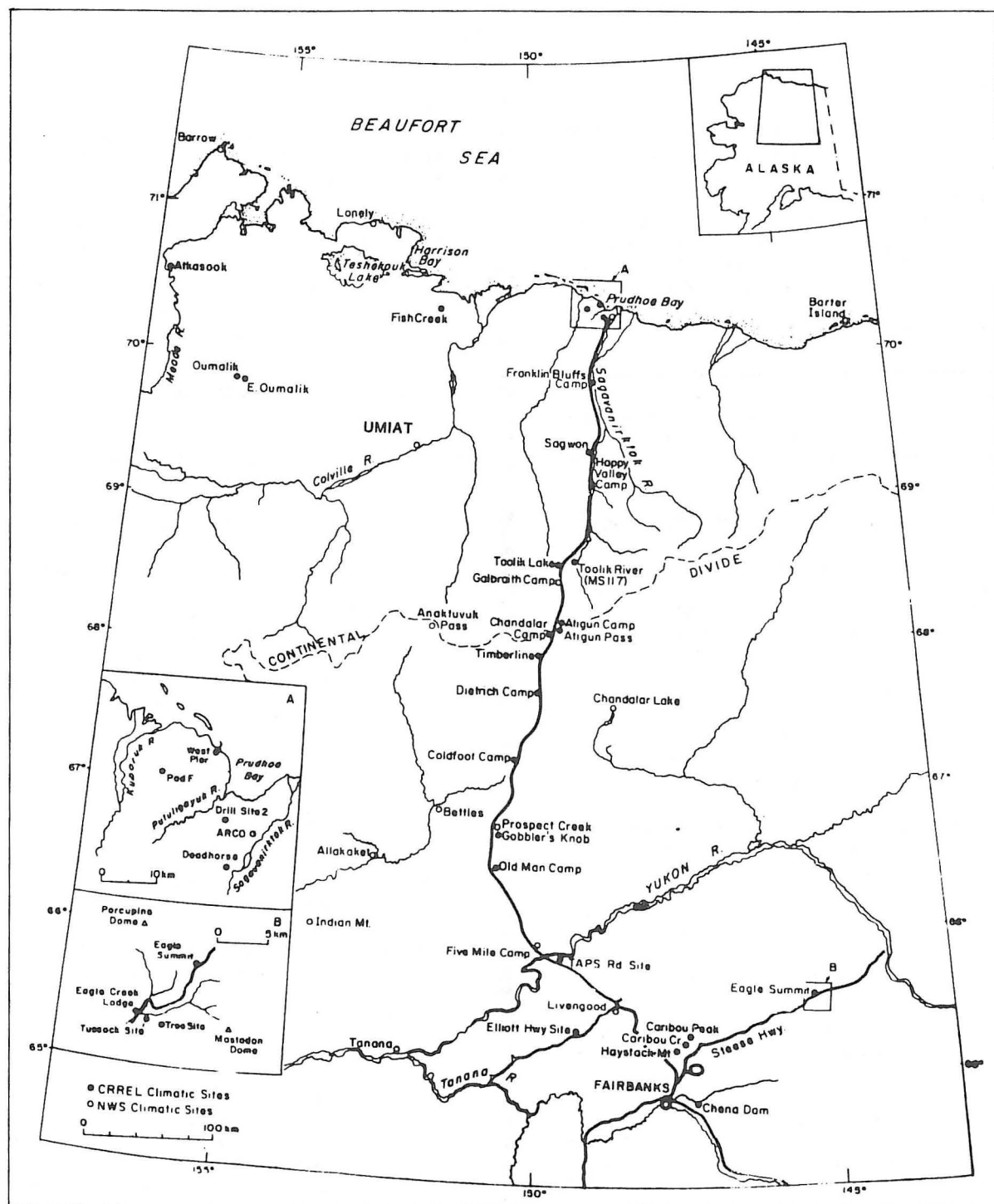


Fig. 1. Location of CRREL and National Weather Service stations in north-central Alaska. Reproduced from (3).

period 1970 through 1977.

Another point of interest is the fact that at Umiat, January is the warmest winter month, while February is the coldest. The difference between December and January is only a tenth of a degree, and is not statistically significant. Indeed, it is interesting to note that at Barter Island, the difference in means between December and January during those months when observations were made at both Umiat and Barter Island is only a tenth of a degree. However, the long-term mean at Barter Island for January is markedly lower than the December mean. This data supports the hypothesis that the milder January at Umiat is a statistical quirk, and will be eliminated as future observations are made. However, it should be pointed out that there are stations with long-term climatological records, primarily in western and northwest Alaska, that do have January as the warmest winter month, followed by February as the coldest.

## 6. WINTER TEMPERATURE EXTREMES AT UMIAT

Of interest are the extremes of temperature experienced during the winter months at Umiat. Temperatures drop past 50°F below almost every winter, with about a quarter of the winters having a low temperature below -60°F. The lowest temperature on record during the years of operation as a climatological station is -65°F, observed on 3 February 1977. For comparison, the lowest on record at Barter Island is -59°F. Maximum winter temperatures are somewhat higher than might be expected from such a cold climate. Above freezing temperatures have been observed every month of the year at Umiat. The highest winter temperature on record is 37°F, last recorded on 29 December 1982. This is similar to all-time winter maximums on the Arctic coast.

Also of interest are individual monthly means. In twenty years of records, no winter month has had a mean temperature above zero. For stations with more than 15 years of observations, this appears to be unique in the United States. The lowest monthly mean, -42.1°F in February 1984 is remarkably low. The lowest mean temperature for a single month ever recorded in Alaska is -48.5°F at Fort Yukon, in January 1917; the second lowest mean is -45.8°F, recorded at Eagle, also in January 1917 (8). In recent times, the lowest monthly mean appears to be -44.5°F at Allakaket in January 1971.

## 7. CONCLUSIONS

The statistical analysis clearly shows that Umiat is colder, on average than Barter Island during the period December through February. While winter data from the interior of the North Slope is scarce, it seems unlikely that there is no other place in Alaska that is much colder than Umiat.

The Colville River, one of the major rivers draining the North Slope, is nearly five kilometers wide at Umiat. In addition to the broad valley, low hills to both the north and south of the station aid in reducing winds and allow the maximum cold air drainage. Umiat is far enough inland to avoid the strong coastal winds, while at the same time being far enough north of the Brooks Range to avoid warming up too dramatically on southerly winds.

Of course, it is possible that future climatological observations will reveal a colder spot, but that is not likely for some decades. For now, Umiat can safely claim to be the coldest spot during the winter, on average, anywhere in Alaska and the United States.

Season	Dec	Jan	Feb	Winter
1945-46	-21.0	-23.8	-25.8	-23.5
1946-47	-25.5	-23.5	-24.7	-24.6
1947-48	-11.1	-24.2	-12.6	-16.0
1948-49	-31.2	-16.2	-27.9	-25.0
1949-50	-17.8	-2.0	-29.8	-16.1
1950-51	-19.2	-37.8	-28.5	-28.3
1951-52	-17.3	-26.4	-36.5	-26.5
1952-53	-18.3	-25.6	-28.4	-24.0
1953-54	-28.0	-23.1	-25.2	-25.4
1975-76	-28.0	-26.2	-25.2	-26.5
1976-77	-33.7	-17.7	-21.8	-24.5
1977-78	-10.5	-8.1	-19.7	-12.5
1978-79	-17.2	-10.9	-25.9	-17.7
1979-80	-21.9	-18.9	-13.1	-18.1
1980-81	-20.9	-1.7	-21.8	-14.6
1981-82	M	-25.1	-11.2	M
1982-83	-19.5	-31.3	-26.4	-25.7
1983-84	-12.2	-22.3	-42.1	-25.2
1984-85	-24.8	-11.6	-25.7	-20.5
1985-86	-13.4	-33.5	-12.9	-20.2
MEAN	-20.6	-20.5	-24.3	-21.7

Table 1. The mean monthly and seasonal winter temperature in °F for Umiat, Alaska for the period 1945-1954 and 1975-1986.

## NOTES AND REFERENCES

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Season	Dec	Jan	Feb	Winter
1947-48	M	-15.6	-10.4	M
1948-49	-25.6	-12.2	-20.8	-19.5
1949-50	-14.2	-6.9	-33.4	-17.7
1950-51	-10.7	-26.6	-21.9	-19.7
1951-52	-8.6	-15.4	-23.4	-16.6
1952-53	-9.9	-20.1	-18.4	-16.1
1953-54	-16.4	-16.8	-19.0	-17.3
1954-55	-15.3	-12.5	-26.4	-17.8
1955-56	M	M	-26.2	M
1956-57	-12.7	-4.2	-24.0	-13.3
1957-58	-23.0	-18.1	-26.0	-22.2
1958-59	-6.0	-17.4	-5.8	-9.9
1959-60	-20.7	-27.3	-8.8	-19.2
1960-61	-2.5	-11.0	-26.1	-12.8
1961-62	-19.2	-4.0	-4.9	-9.5
1962-63	-4.6	-10.6	-13.5	-9.4
1963-64	-0.5	-18.2	-24.5	-14.2
1964-65	-23.2	-22.6	-32.0	-25.7
1965-66	-13.2	-18.1	-24.5	-18.4
1966-67	-10.7	-10.5	-20.7	-13.7
1967-68	-8.6	-9.4	-26.7	-14.6
1968-69	-13.1	-16.4	-24.8	-17.9
1969-70	-5.8	-15.7	-17.2	-12.8
1970-71	-14.8	-22.7	-30.2	-22.3
1971-72	-12.3	-16.5	-19.8	-16.1
1972-73	-4.7	-12.3	-16.5	-11.0
1973-74	-6.1	-10.9	-29.3	-15.0
1974-75	-29.1	-27.8	-18.6	-25.4
1975-76	-20.9	-20.5	-23.2	-21.5
1976-77	-22.3	-10.1	-17.2	-16.5
1977-78	-7.1	-2.5	-13.4	-7.5
1978-79	-8.1	0.1	-20.6	-9.2
1979-80	-14.3	-15.7	-9.7	-13.3
1980-81	-15.9	4.5	-16.4	-9.0
1981-82	-7.6	-14.7	-9.1	-10.5
1982-83	-12.2	-21.8	-12.2	-15.5
1983-84	-2.6	-15.5	-33.1	-16.7
1984-85	-19.4	-8.4	-21.9	-16.4
1985-86	-2.9	-16.4	-9.6	-9.6
Record Mean	-12.6	-14.2	-20.1	-15.5
1951-80 Mean	-12.9	-15.1	-20.5	-16.0
Common Period Mean*	-12.9	-13.0	-18.7	-14.8

Table 2. The mean monthly and seasonal winter temperatures in °F for Barter Island for the period 1947-1986. \*Common Period are those months when both Umiat and Barter Island reported a monthly mean temperature; December, 1947 to February, 1954 and December, 1975 to February, 1986 (except December, 1981).