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CLIMATOLOGY AS THE MEAN OF TWO MODES: AN APPLICATION TO INTERIOR ALASKA TEMPERATURES FROM MEDIUM RANGE MOS

Timothy L. Shy*, Richard Thoman and Eric Stevens

NOAA/National Weather Service Forecast Office, Fairbanks, Alaska

1. INTRODUCTION

Climatology may be defined as the mean value of a meteorological parameter over a given, ideally lengthy, time scale. The climatological winter temperature is therefore an average of winter temperatures over a large number of winters. The paucity of direct solar heating for a significant period before and after the winter solstice affects winter temperatures, as does the formation of sharp radiational inversions, the presence of cloud cover, or the occurrence of Chinook winds.

Winter radiational inversions are particularly strong at Fairbanks International Airport due to its valley location and very light winds. Such conditions prove challenging for operational forecasters to forecast temperature. This challenge is exacerbated at longer time scales into the future.

Numerical guidance with its intentional bias towards climatology at valid times on the order of a week from the initialization has proven to be of limited usefulness, as the active controls of winter temperatures may not be expressly parameterized in the regression equations that generate the guidance. This difficulty presents the science question that asks if climatology is in fact the best statistical estimator for winter temperatures, and if not, what estimator would be better.

* *Corresponding author address*: Timothy L. Shy, NOAA/National Weather Service, P.O. Box 757345, Fairbanks, AK, 99775

2. DATA AND RESULTS

Fairbanks International Airport Automated Surface Observing System (ASOS) data were analyzed for three consecutive winters: 1997-1998, 1998-1999, and 1999-2000. Maximum temperature was defined as the greatest temperature recorded between 9 a.m. and 9 p.m. Alaska Standard Time, while the minimum temperature was defined as the least recorded between 9 p.m. and 9 a.m. Alaska Standard Time.

Figure 1 shows the distribution of maximum temperatures for all three years, along with the trace for the average temperature. The distribution of observed temperatures shows great variability and little correlation to the average temperature. Winter temperatures ranged from over 40 F above zero in December 1998 to -50 F in the following January.

Maximum and minimum temperatures estimated by the Medium Range Forecast (MRF) Model Output

Statistics (MOS) generated by the National Centers for Environmental Prediciton (NCEP) were analyzed in tandem with the ASOS observational record at Fairbanks International Airport over the three-winter study period. Four metrics were computed based on both the observations and the MRF MOS: the mean error, the mean absolute error, significant bias (where significant bias is defined as a temperature bias of 5^{o} F or more), and a skill score, S,

$$S = (R - E)/(T-E)$$

where R is the number of MOS forecasts that were deemed "correct" (within 10^{o} F of observed), E is the expected number of correct forecasts based on the 1961-1990 climatology alone, and T is the total number of forecasts. S = 0 when the MRF MOS agreed with observation at the chance level, S = 1 when the MRF MOS was perfectly correct, and S < 0 when MRF MOS showed less skill than climatology.

Table 1 shows the skill score for MRF MOS with the Fairbanks International Airport ASOS observed maximum and minimum temperatures for forecasts valid at Day + 3, +4, +5, +6 and +7. The skill scores deteriorate rapidly at longer ranges, and are, for the most part, at or near the chance level.

3. DISCUSSION

With climatology producing a skillful temperature forecast rarely, a suitable alternative statistic may be needed. One possibility would be a crude parameterization of the controls on temperature that would essentially reference a climatological record dependent on indicated meteorological conditions. For example, the presence of Chinook winds blowing from the south across the Alaska Range would produce one temperature regime and associated temperature climatological record, while the presence of a strengthening radiational inversion would produce a different temperature regime and associated climatology. A crude flag variable indicating which regime was forecast would then access the appropriate climatological database to refine the temperature forecast.

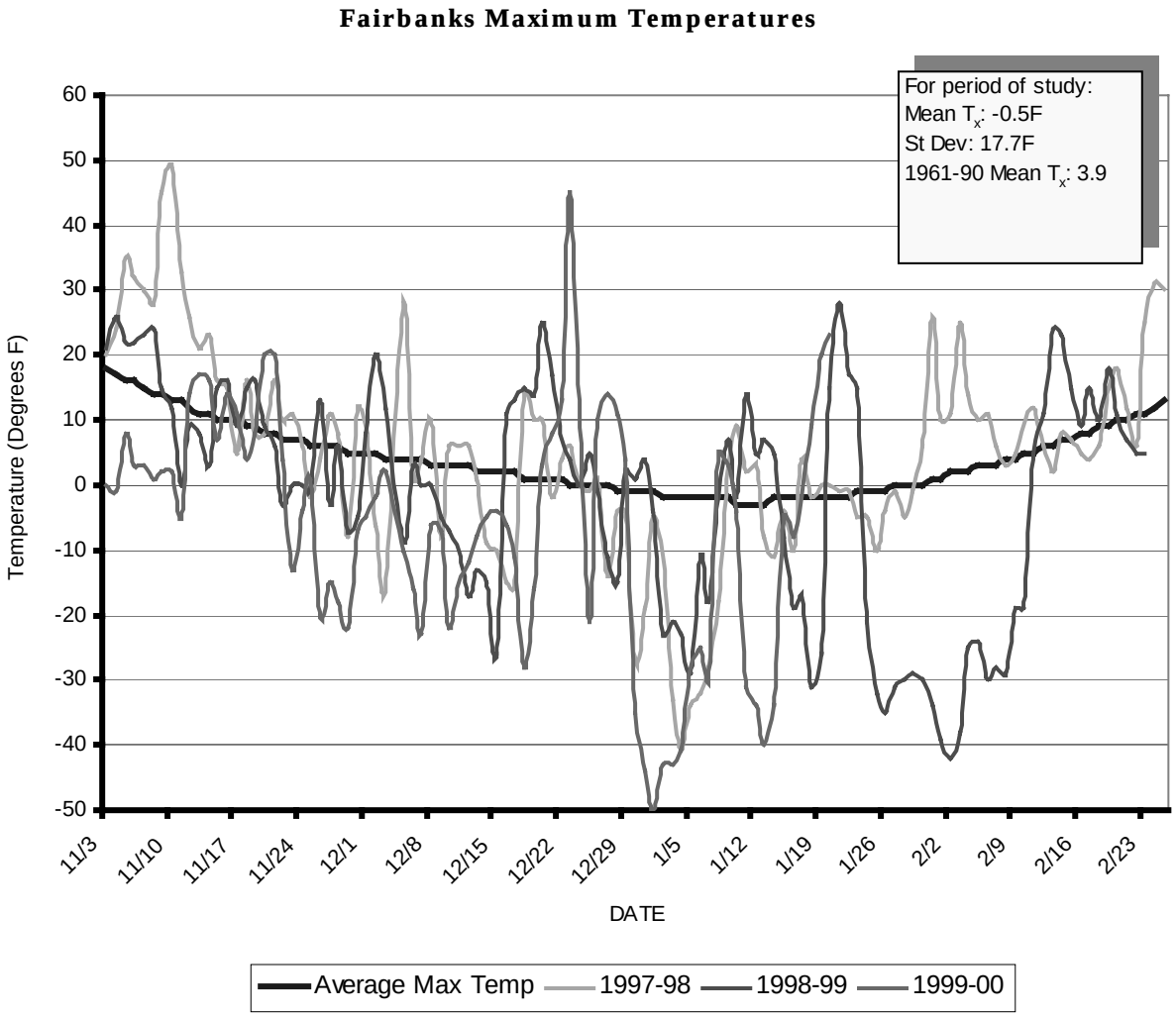

Figure 1: Fairbanks Maximum Temperatures for the three-winter study period

MRF MOS Valid Day	Min T Skill Score (S)	Max T Skill Score (S)
Day 3	+0.12	+0.20
Day 4	+0.06	+0.04
Day 5	+0.06	+0.02
Day 6	+0.09	-0.05
Day 7	+0.06	-0.10

Table 1: Skill scores, S, by MRF MOS valid day