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THE IMPACT OF MMTS ON THE NEW BRUNSWICK CLIMATE RECORD

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1. INTRODUCTION

With the continuing threat of global and regional changes in climate resulting from human activities, it is imperative that a stable, accurate, and homogeneous record of United States climate be maintained. Of recent concern in this regard is the replacement of liquid-in-glass thermometers mounted in Cotton Region Shelters (LiG/CRS) with electronic thermometers mounted in "beehivelike" shelters (Maximum Minimum Temperature System: MMTS) at official U.S. cooperative climate observing stations. Over half of the U.S. cooperative sites observing temperature have undergone conversion from LiG/CRS to MMTS in the past decade. Although this change in thermometry is a logical step forward in the pursuit of continuous and accurate climate observations, its potential impact on the homogeneity of temperature records must be assessed (Robinson, 1990). This can only be accomplished through direct comparisons with previous instrumentation for an extended interval. Such a study should examine not only mean differences and lengthy time series, but also differences according to prevailing synoptic and surface conditions.

Quayle et al. (1991) examined mean differences in temperature between LiG/CRS and MMTS measurements. They found MMTS readings of minimum temperatures to be roughly 0.3°C higher than LiG/CRS measurements and mean maxima to be about 0.4°C lower. They also indicated that this offset was rather easily identified, thus could be accounted for when examining time series of temperature spanning the conversion period.

The Quayle et al. study derived means from a large number of stations, it did not examine parallel LiG/CRS and MMTS observations from the same site, nor were time series or potential associations of differences between the two observations with synoptic and surface conditions examined. Here, two of the missing components of the earlier study are addressed. Close to eight years of mean offsets as well as time series of differences between daily parallel observations at the New Brunswick, NJ cooperative station are presented and discussed.

2. METHODOLOGY

Parallel LiG/CRS and MMTS observations for New Brunswick have been gathered since September 1984. Observations consist of 24-hour maximum and minimum and observation time temperatures. This station is located in a suburban park, with trees, shrubs, and only two small out buildings located within several hundred meters of the grassy site. The station has not moved during the study period, nor have any major changes been made to its surroundings.

Data for the 28 September 1984 through 30 April 1992 study period were quality controlled by first examining the daily observation logs to determine instrumentation problems or failures. In nine instances, separations were recognized in either the maximum and/or minimum LiG thermometers, and daily observations were omitted from this study until the instrument was corrected. A new liquid minimum thermometer was installed on 10 September 1986 (day number 713 of the study period), and new liquid maximum and minimum thermometers were installed on 24 August 1988 (day 1426). No step-wise changes in the relationships between LiG/CRS and MMTS observations were observed at these points. In several instances, power failures, or failure of the observer to reset the instrument, resulted in missed or incorrect MMTS observations, and these data were also omitted. Quality control continued by eliminating any remaining cases where LiG/CRS and MMTS observations differed by more than 1.7°C. It is likely that in most of these instances a

thermometer was misread or the observer recorded the data incorrectly. In total, approximately 9% of the original observations were unavailable for further analysis.

Daily differences in the maximum, minimum and derived mean LiG/CRS and MMTS observations were calculated for the remaining observations. Means and time series of offsets were next derived and standard parametric statistical analyses employed to determine whether differences between observations from the two systems and changes in these differences over the observation period were significant.

3. RESULTS

Means derived from the nearly eight years of observations show the MMTS maxima to run 0.6°C lower, minima 0.3°C higher and means 0.2°C lower than the respective LiG/CRS values. A student's paired t-test indicates that the LiG/CRS and MMTS observations of these variables are significantly different from one another at the one percent level. These results are close to those of Quayle et al., (1991).

Histograms show maxima, minima and mean differences to be normally distributed around these means (figure 1). However, this should not be misconstrued as an indication that the temperature offsets were consistent through the eight years. Trends in the differences of LiG/CRS and MMTS maxima, minima and means are apparent, and are significant at the one percent level (figure 2).

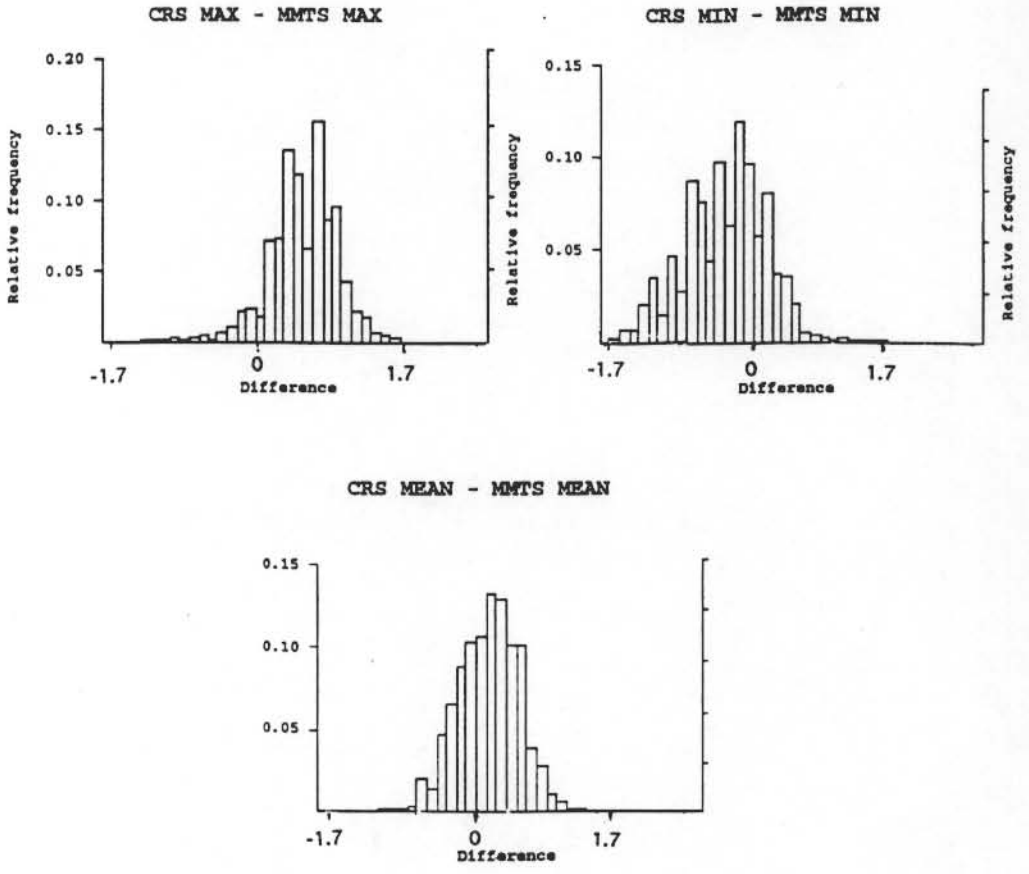

Figure 1. Histograms of difference sets for LiG/CRS and MMTS maximum, minimum and mean temperatures at the New Brunswick, NJ cooperative station over the period 28 Sep 84 to 30 April 92.

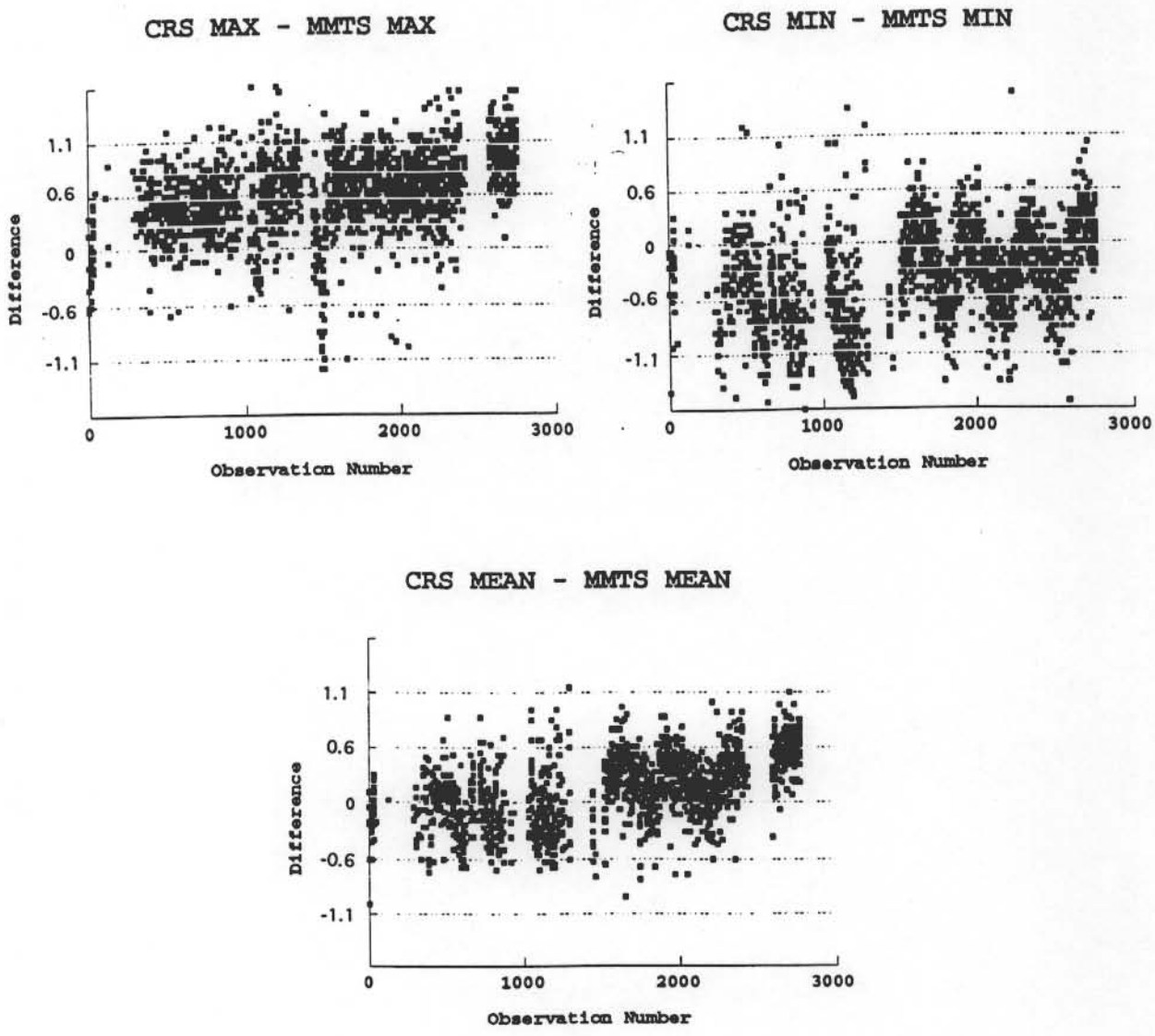

Figure 2. Differences between LiG/CRS and MMTS observations against time (days since 28 September 1985) for maximum, minimum and mean temperatures at the New Brunswick, NJ cooperative station.