Comparison of Temperature Trends Using an Unperturbed Subset of The U.S. Historical Climatology Network

**Trend Comparisons**

(All Unperturbed Stations vs. Official Record)

| Raw, Class 1/2 (Compliant): | +0.204 |
| Raw, Class 3/4/5 (Non-Compliant): | +0.319 |
| All 1218 Official NOAA-Adjusted, Class 1-5 (All): | +0.324 |

**Introduction**

A 410-station subset of U.S. Historical Climatology Network (version 2,5) stations is identified that experienced no changes in time of observation or station moves during the 1979-2008 period. These stations are classified based on proximity to artificial surfaces, buildings, and other such objects with unnatural thermal mass using guidelines established by Leroy (2010). The United States temperature trends estimated from the relatively few stations in the classes with minimal artificial impact are found to be collectively about 2.3°F as large as US trends estimated in the classes with greater expected artificial impact. The trend differences are largest for minimum temperatures and are statistically significant even as the regional scale and across different types of instrumentation and degrees of urbanization. The homogeneity adjustments applied by the National Centers for Environmental Information (formerly the National Climatic Data Center) greatly reduce those differences but produce trends that are more consistent with the stations with greater expected artificial impact. Trend differences are not found during the 1999-2008 sub-period of relatively stable temperatures, suggesting that the observed differences are caused by a physical mechanism that is directly or indirectly caused by changing temperatures.

**Method**

Comprehensive metadata analysis for each U.SHCN site in this study was performed. Ground photography (Figure 1), Google Earth street level, and or aerial photography (Figure 2) was obtained.

**Discussion**

Distances measurements of visible encroachments were made, and a calculation was done to determine the percentage of area within the different radii (10m, 30m, 100m) surrounding the thermometer per Leroy (2010), containing heat sinks and/or heat sources. The class rating assigned to the stations corresponds to the portion of the Leroy (2010) rating system dealing with artificial surfaces.

**Results**

The difference in temperature at a nearby sensor is greater at the end of a warming phase than at the start of it. Therefore, the trend will be spuriously exaggerated by warming over the 30-year study period (Figure 4).

Conversely, the effect of a heat sink is less at the end than at the beginning of an overall cooling phase. Therefore, the cooling phase is exaggerated in the reverse manner as a warming phase. This explains why warming is exaggerated from 1979 - 2008 and from 1979 - 1998, when overall warming was reported. Likewise, it also explains why the cooling from 1999 - 2008 is exaggerated. We contend that heat sinks will amplify the trends.

Furthermore, if there is no trend in either direction (as during the last decade-plus), there will be no divergence. This explains why there has been no overall divergence between USHCN and CRN since CRN was not activated until 2005, and the CONUS Tmean trend has been flat.

**Key findings**

1. Comprehensive and detailed evaluation of station metadata, on-site station photography, satellite and aerial imaging, street level Google Earth imagery, and curator interviews have yielded a well-distributed 410 station subset of the 1218 station USHCN network that is unperturbed by Time of Observation changes, station moves, or rating changes. A complete and fully populated 30-year dataset. It must be emphasized that the perturbed stations dropped from the USHCN set show significantly lower trends than those retained in the sample, both for well and poorly sited station sets.

2. Bias at the microlevel (the immediate environment of the sensor) in the unperturbed subset of USHCN stations has a significant effect on the mean temperature (Tmean) trend. Well sited stations show significantly less warming from 1979 - 2008. These differences are significant in Tmean, and most pronounced in the minimum temperature data (Tmin).

**3. Equipment bias (CRS vs. MMTS stations) in the unperturbed subset of USHCN stations has a significant effect on the mean temperature (Tmean) trend when CRS stations are compared with MMTS stations. MMTS stations show significantly less warming than CRS stations from 1979 - 2008.** (Table 1) These differences are significant in Tmean and most pronounced in the maximum temperature data (Tmax).

4. The 30-year Tmean temperature trend of unperturbed, well sited stations is significantly lower than the Tmean temperature trend of NOAA/NCDC official adjusted-homogenized surface temperature record for all 1218 USHCN stations.

5. We believe the NOAA/NCDC homogenization adjustment causes well sited stations to be adjusted upwards to match the trends of poorly sited stations.

6. The data suggests that the divergence between well and poorly sited stations is gradual, not a result of spurious step change due to poor metadata.