NOAA Climate Services

June 9, 2009

Talking Points related to: *Is the U.S. Temperature Record Reliable?*

Q. Do many U.S. stations have poor siting by being placed inappropriately close to trees, buildings, parking lots, etc.?

A. Yes. The National Weather Service has station siting criteria, but they were not always followed. That is one reason why NOAA created the Climate Reference Network, with excellent siting and redundant sensors. It is a network designed specifically for assessing climate change. http://www.ncdc.noaa.gov/oa/climate/uscrn/. Additionally, an effort is underway to modernize the Historical Climatology Network, though funds are currently available only to modernize and maintain stations in the Southwest. Managers of both of these networks work diligently to put their stations in locations not only with excellent current siting, but also where the site characteristics are unlikely to change very much over the coming decades.

Q. How has the poor siting biased local temperatures trends?

A. At the present time (June 2009), to the best of our knowledge, there has only been one published peer-reviewed study that specifically quantified the potential bias in trends caused by poor station siting: Peterson, Thomas C., 2006: Examination of Potential Biases in Air Temperature Caused by Poor Station Locations. *Bulletin of the American Meteorological Society*, 87, 1073-1080. Written by a NOAA National Climatic Data Center scientist, it examined only a small subset of stations – all that had their siting checked at that time – and found no bias in long-term trends. The linear trend in adjusted temperature series over the period examined was nearly identical between the stations with good siting and the stations with poor siting, with the stations having poor siting showing slightly less warming. The following questions address implications from that paper.

Q. Does a station with poor siting read warmer than a station with good siting?

Not necessarily. A station too close to a parking lot would be expected to read warmer than a station situated over grass far from any human influence other natural obstructions. But a station too close to a large tree to the west, so that the station was shaded in the afternoon, would be expected to make the afternoon maximum temperature read a bit cooler than a station in full sunlight. Many local factors influence the observed temperature: whether a station is in a valley with cold air drainage, whether the station is a liquid-in-glass thermometer in a standard wooden shelter or an electronic thermometer in the new smaller and more open plastic shelters, whether the station reads and resets its maximum and minimum thermometers in the coolest time of the day in early morning or in the warmest time of the day in the afternoon, etc. But for detecting climate change, the concern is not the absolute temperature – whether a station is reading warmer or cooler than a nearby station over grass – but how that temperature changes over time.

Q. So a station moving from a location with good siting to a location with poor siting could cause a bias in the temperature record. Can that bias be adjusted out of the record?

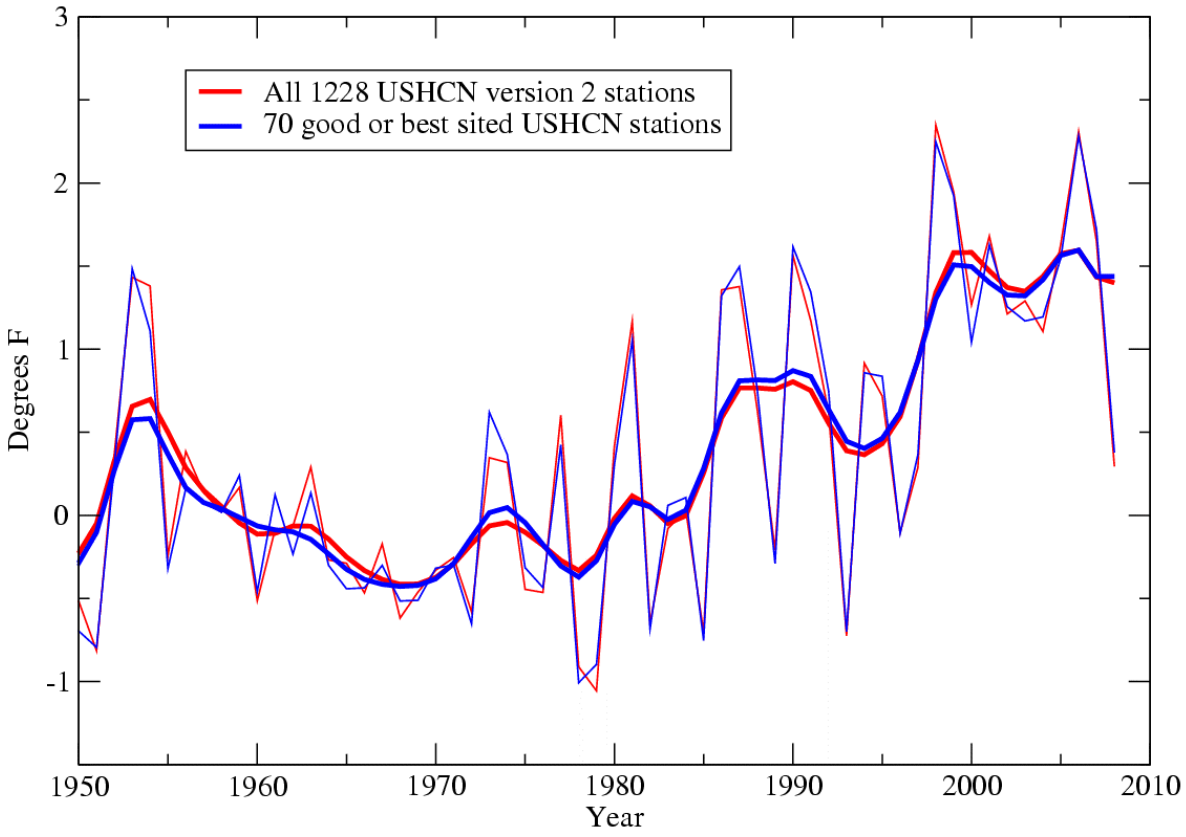
A. A great deal of work has gone into efforts to account for a wide variety of biases in the climate record, both in NOAA and at sister agencies around the world. Since the 1980s, scientists at NOAA's National Climatic Data Center are at the forefront of this effort developing techniques to detect and quantify biases in station time series. When a bias associated with any change is detected, it is removed so that the time series is homogeneous with respect to its current instrumentation and siting. The latest peer-reviewed paper which provides an overview the sources of bias and their removal (Menne et al., 2009 in press), including urbanization and nonstandard siting. At the time that paper was written, station site evaluations were too incomplete to conduct a thorough investigation (that analysis is forthcoming). However, they could evaluate urban bias and found that once the data were fully adjusted the 30% most urban stations had about the same trend as the remaining more rural stations.

Q. What can we say about poor siting's impact on national temperature trends?

A. We are limited in what we can say due to limited information about station siting. Surfacestations.org has examined about 70% of the 1221 stations in NOAA's Historical Climatology Network (USHCN). According to their web site of early June 2009, they classified 70 USHCN version 2 stations as good or best (class 1 or 2). The criteria used to make that classification is based on NOAA's Climate Reference Network Site Handbook so the criteria are clear. But, as many different individuals participated in the site evaluations, with varying levels of expertise, the degree of standardization and reproducibility of this process is unknown.

However, at the present time this is the only large scale site evaluation information available so we conducted a preliminary analysis.

Two national time series were made using the same gridding and area averaging technique. One analysis was for the full data set. The other used only the 70 stations that surfacestations.org classified as good or best. We would expect some differences simply due to the different area covered: the 70 stations only covered 43% of the country with no stations in, for example, New Mexico, Kansas, Nebraska, Iowa, Illinois, Ohio, West Virginia, Kentucky, Tennessee or North Carolina. Yet the two time series, shown below as both annual data and smooth data, are remarkably similar. Clearly there is no indication for this analysis that poor current siting is imparting a bias in the U.S. temperature trends.



Q. Is there any question that surface temperatures in the United States have been rising rapidly during the last 50 years?

A. None at all. Even if NOAA did not have weather observing stations across the length and breadth of the United States the impacts of the warming are unmistakable. For example, lake and river ice is melting earlier in the spring and forming later in the fall. Plants are blooming earlier

in the spring. Mountain glaciers are melting. And a multitude of species of birds, fish, mammals and plants are extending their ranges northward and, in mountainous areas, upward as well.

References

Menne, Matthew J., Claude N. Williams, Jr. and Russell S. Vose, 2009: The United States Historical Climatology Network Monthly Temperature Data – Version 2. *Bulletin of the American Meteorological Society,* in press.

Peterson, Thomas C., 2006: Examination of Potential Biases in Air Temperature Caused by Poor Station Locations. *Bulletin of the American Meteorological Society*, 87, 1073-1080. It is available from http://ams.allenpress.com/archive/1520-0477/87/8/pdf/i1520-0477-87-8-1073.pdf.