Significant Error in the Global Surface Temperature Trend Analyses of NCDC

by Roger Pielke Sr.

SPPI
Science & Public Policy Institute
"science-based policy for a better world"

SPPI BlogWatch Series ♦ August 19, 2009

SIGNIFICANT ERROR IN THE GLOBAL SURFACE TEMPERATURE TREND ANALYSES OF NCDC

by Roger Pielke Sr. | August 13, 2009

New Paper Documents A Warm Bias In The Calculation Of A Multi-Decadal Global Average Surface Temperature Trend – Klotzbach Et Al (2009).

When I served on the committee that resulted in the CCSP (2006) report on reconciling the surface and tropospheric temperature trends, one of the issues I attempted to raise was a warm bias in the construction of long term surface temperature trends when near surface land minimum temperatures (and maximum temperatures when the atmospheric boundary layer remained stably stratified all day, such as in the high latitude winter) were used. This error will occur even for pristine observing sites. Tom Karl and his close associates suppressed this perspective as I document in:

Pielke Sr., Roger A., 2005: Public Comment on CCSP Report "Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences". 88 pp including appendices.

As a result of the poor treatment by Karl as Editor of the CCSP (2006) report, I decided to investigate this issue, and others, in a set of peer reviewed papers with colleagues which include:

Pielke Sr., R.A., C. Davey, D. Niyogi, S. Fall, J. Steinweg-Woods, K. Hubbard, X. Lin, M. Cai, Y.-K. Lim, H. Li, J. Nielsen-Gammon, K. Gallo, R. Hale, R. Mahmood, S. Foster, R.T. McNider, and P. Blanken, 2007: Unresolved issues with the assessment of multi-decadal global land surface temperature trends. J. Geophys. Res., 112, D24S08, doi:10.1029/2006JD008229.

Pielke Sr., R.A., and T. Matsui, 2005: Should light wind and windy nights have the same temperature trends at individual levels even if the boundary layer averaged heat content change is the same?Geophys. Res. Letts., 32, No. 21, L21813, 10.1029/2005GL024407.

Lin, X., R.A. Pielke Sr., K.G. Hubbard, K.C. Crawford, M. A. Shafer, and T. Matsui, 2007:An examination of 1997-2007 surface layer temperature trends at two heights in Oklahoma. Geophys. Res. Letts., 34, L24705, doi:10.1029/2007GL031652.

Fall, S., D. Niyogi, A. Gluhovsky, R. A. Pielke Sr., E. Kalnay, and G. Rochon, 2009: Impacts of land use land cover on temperature trends over the continental United States: Assessment using the North American Regional Reanalysis.Int. J. Climatol., accepted.

We now have a new paper accepted which documents further a warm bias in the use of multi-decadal global surface temperature trends to assess global warming. It is:

Klotzbach, P.J., R.A. Pielke Sr., R.A. Pielke Jr., J.R. Christy, and R.T. McNider, 2009: An alternative explanation for differential temperature trends at the surface and in the lower troposphere. J. Geophys. Res., in press.

Our paper is also effectively discussed in my son's weblog:
Evidence that Global Temperature Trends Have Been Overstated.

The abstract of the Klotzbach et al (2009) paper reads:

"This paper investigates surface and satellite temperature trends over the period from 1979-2008. Surface temperature datasets from the National Climate Data Center and the Hadley Center show larger trends over the 30-year period than the lower-tropospheric data from the University of Alabama-Huntsville and Remote Sensing Systems datasets. The differences between trends observed in the surface and lower tropospheric satellite datasets are statistically significant in most comparisons, with much greater differences over land areas than over ocean areas. These findings strongly suggest that there remain important inconsistencies between surface and satellite records."

We tested the following two hypotheses:

1. *If there is no warm bias in the surface temperature trends, then there should not be an increasing divergence with time between the tropospheric and surface temperature anomalies [Karl et al., 2006]. The difference between lower troposphere and surface anomalies should not be greater over land areas.*
2. *If there is no warm bias in the surface temperature trends then the divergence should not be larger for both maximum and minimum temperatures at high latitude land locations in the winter.*

Both were falsified.

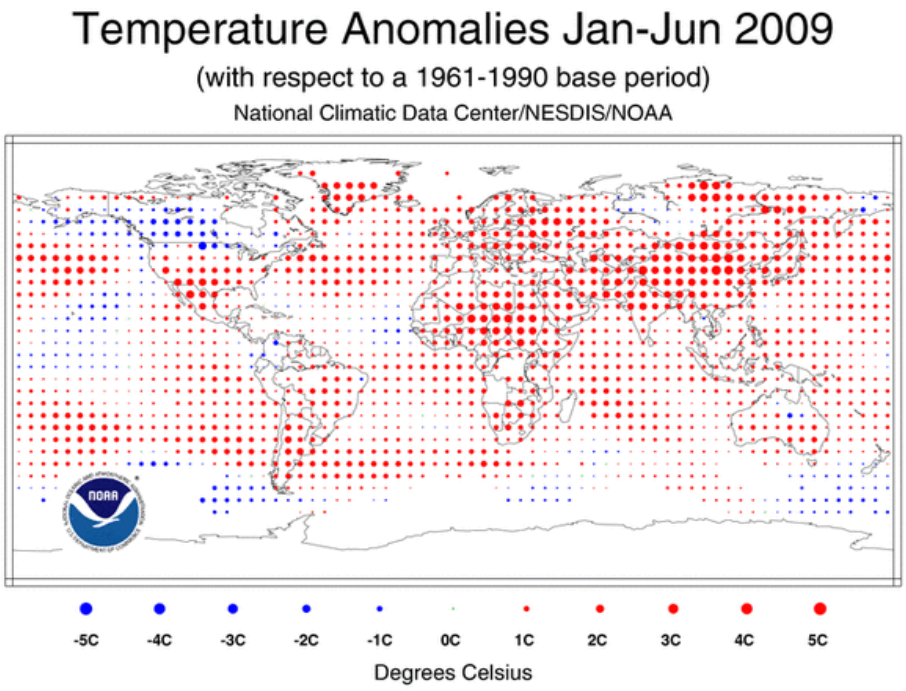
The paper has the following text:

"We find that there have, in general, been larger linear trends in surface temperature datasets such as the NCDC and HadCRUTv3 surface datasets when compared with the UAH and RSS lower tropospheric datasets, especially over land areas. This variation in trends is also confirmed by the larger temperature anomalies that have been reported for near surface air temperatures (e.g., Zorita et al., 2008; Chase et al., 2006; 2008, Connolley, 2008). The differences between surface and satellite datasets tend to be largest over land areas, indicating that there may still be some contamination due to various aspects of land surface change, atmospheric aerosols and the tendency of shallow boundary layers to warm at a greater rate [Lin et al., 2007; Esau, 2008; Christy et al., 2009]. Trends in minimum temperatures in northern polar areas are statistically significantly greater than the trends in maximum temperatures over northern polar areas during the boreal winter months.

We conclude that the fact that trends in thermometer-estimated surface warming over land areas have been larger than trends in the lower troposphere estimated from satellites and radiosondes is most parsimoniously explained by the first possible explanation offered by Santer et al. [2000]. Specifically, the characteristics of the divergence across the datasets are strongly suggestive that it is an artifact resulting from the data quality of the surface, satellite and/or radiosonde observations. These findings indicate that the reconciliation of differences between surface and satellite datasets [Karl et al., 2006] has not yet occurred, and we have offered a suggested reason for the continuing lack of reconciliation."

What our study shows is that maps prepared by NCDC, as given below, are biased presentations of the surface temperature anomalies.

BIASED NCDC MAP OF SURFACE TEMPERATURE ANOMALIES



While additional research is required in order to determine the magnitude of the bias, we can use the analysis of trends using two levels near the surface from the Lin et al (2007) paper as an estimate. I reported on this in my weblog:

A Significant Warm Bias With The Diagnosis Of A Global Average Surface Temperature Anomaly To Diagnose Global Warming – Part II From Our JGR Paper

where I wrote:

Back of the Envelope Estimate of Bias in Minimum Temperature Measurements.

To present a preliminary estimate, let's start with the value reported for the recent trend in the global average surface temperature. The 2007 IPCC Report presents a global average surface temperature increase of about 0.2C per decade since 1990 (see their Figure SPM.3). Their trend is derived from the average of the maximum and minimum surface temperatures; i.e.,

T(average) = [T(max) + T(min)]/2.

"From our papers (Pielke and Matsui 2005 and Lin et al. 2007), a conservative estimate of the warm bias resulting from measuring the temperature near the ground is around 0.21 C per decade (with the nighttime T(min) contributing a large part of this bias) . Since land covers about 29% of the Earth's surface (see), the warm bias due to this influence explains about 30% of the IPCC estimate of global warming. In other words, consideration of the bias in temperature would reduce the IPCC trend to about 0.14 degrees C per decade, still a warming, but not as large as indicated by the IPCC.

This is likely an underestimate, of course, as the value is not weighted for the larger bias that must occur at higher latitudes in the winter when the boundary layer is stably stratified most of the time even in the "daytime" . Moreover, the warm bias over land in the high latitudes in the winter will be even larger than at lower latitudes, as the nighttime surface layer of the atmosphere is typically more stably stratified than at lower latitudes, and this magnifies the bias in the assessment of temperature trends using surface and near surface measurements. [not coincidently, this is also where the largest warming is claimed; e.g., see the map on Andy Revkin's Dot Earth's weblog].

Land is also a higher fraction of the Earth's surface at middle and higher latitudes in the northern hemisphere and at the highest latitudes in the southern hemisphere (see)."

Our new paper Klotzbach et al (2009) provides evidence of the significant error in the global surface temperature trend analyses of NCDC, and well of other centers such as GISS and CRU, due to the sampling of temperatures at just one level near the surface. It is also important to recognize that this is just one error of a number that are in the NCDC, GISS and CRU data sets, as we have summarized in our paper:

Pielke Sr., R.A., C. Davey, D. Niyogi, S. Fall, J. Steinweg-Woods, K. Hubbard, X. Lin, M. Cai, Y.-K. Lim, H. Li, J. Nielsen-Gammon, K. Gallo, R. Hale, R. Mahmood, S. Foster, R.T. McNider, and P. Blanken, 2007: Unresolved issues with the assessment of multi-decadal global land surface temperature trends**. J. Geophys. Res., 112, D24S08, doi:10.1029/2006JD008229.**

Source: http://wattsupwiththat.com/2009/08/13/pielke-sr-on-warm-bias-in-the-surface-temperature-trend/.