

DIFFERENCES BETWEEN SATELLITE LOWER TROPOSPHERE AND SURFACE DATA CENTER ANALYSES AND MODEL FORECASTS

By Joseph D'Aleo, July 17, 2010

Introduction

Every month the world surface data centers (Hadley CRU, NOAA NCDC, NASA GISS) release monthly data with their assessment of the historic ranking of the previous month. Satellite data centers (UAH MSU and RSS MSU) will also release their assessments of monthly and global temperature. For reasons we will discuss their results are less remarkable. This has been the trend in recent years.

For instance NOAA announced that for the globe June 2009 (for the globe) was the [second warmest June](#) in 130 years falling just short of 2005. In sharp contrast to this NASA, The University of Alabama Huntsville, UAH and MSU satellite assessments had June virtually at the long term average (+0.001C or 15th coldest in 31 years) and Remote Sensing Systems, RSS (+0.075C or 14th coldest in 31 years).

NOAA proclaimed June 2008 to be the 8th warmest for the globe in 129 years. Meanwhile NASA satellites showed it was the 9th coldest June in the 30 years of its record.

Some continue to claim that satellite measured temperatures are in error. RSS and UAH agreed that there was a net cold bias of only 0.04C in their satellite measured temperatures. RSS and UAH corrected the data for this small bias. In contrast the traditional surface station data has been found to suffer from many warm biases that are orders of magnitude greater in size than the satellite data yet that fact is ignored.

Some argue that satellites measure a portion of the lower atmosphere and that this is not the surface. This difference may be real but it is irrelevant (Karl, et al 2006) Trying to make a big issue of this point is disingenuous. When the satellites were first launched, their temperature readings were in better agreement with the surface station data. There has been increasing divergence over time which can be seen below (derived from Klotzbach, et al 2009). In the first plot, we see the temperature anomalies as computed from the satellites and assessed by UAH and RSS and the station based land surface anomalies from NOAA (NCDC). That increased divergence is clear from Figure 1 below.

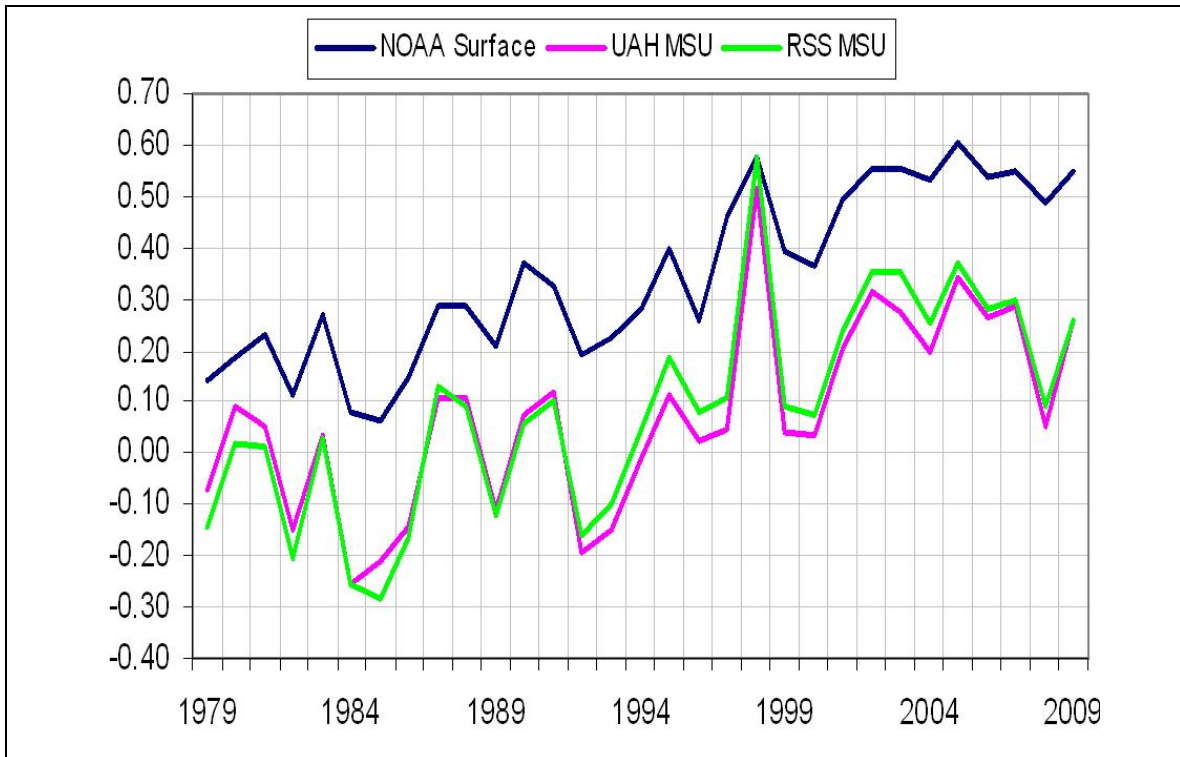


Figure 1: NOAA (NCDC) land (black line) and UAH lower troposphere (purple line) and RSS lower troposphere (green line) annual land temperature anomalies over the period from 1979 to 2009.

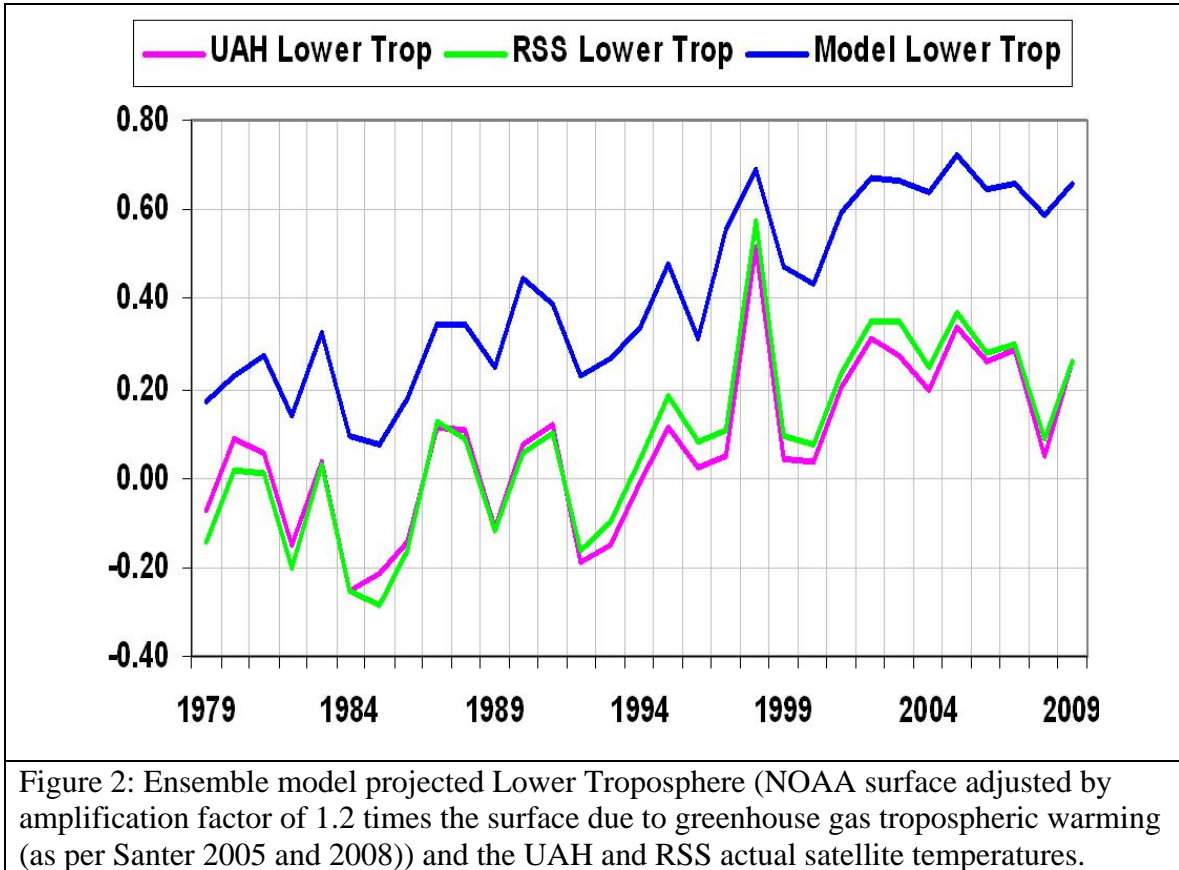
The Klotzbach paper finds that the divergence between surface and lower-tropospheric trends is consistent with evidence of a warm bias in the surface temperature record but not in the satellite data.

Klotzbach et al described an ‘amplification’ factor for the lower troposphere as suggested by Santer et al (2005) and Santer et al (2008) due to greenhouse gas trapping relative to the warming at the surface. Santer refers to the effect as "tropospheric amplification of surface warming". This effect is a characteristic of all of the models used in the UNIPCC and the USGRCP "ensemble" of models by Karl, et.al. (2006) which was the source for Karl et al (2009) which in turn was relied upon by EPA in its recent Endangerment Finding.(Federal Register / Vol. 74, No. 239 / Tuesday, December 15, 2009 / Rules and Regulations at 66510)

As John Christy describes it “The amplification factor is a direct calculation from model simulations that show over 30 year periods that the upper air warms at a faster rate than the surface - generally 1.2 times faster for global averages. This is the so-called “lapse rate feedback” in which the lapse rate seeks to move toward the moist adiabat as the surface temperature rises. In models, the convective adjustment is quite rigid, so this vertical response in models is forced to happen. The real world is much less rigid and has ways to allow heat to escape rather than be retained as models show.” This latter effect has been documented by Chou and Lindzen (2005) and Lindzen and Choi (2009).

The amplification factor was calculated from the mean and median of the 19 GCMs that were in the CCSP SAP 1.1 report (Karl et al, 2006). A fuller discussion of how the amplification factor was calculated is available in the Klotzbach paper [here](#).

The ensemble model forecast curve (upper curve) in Figure 2 below was calculated by multiplying the NOAA NCDC surface temperature for each year by the amplification factor, since this would yield the model projected tropospheric temperature. The lower curves are the actual UAH and RSS lower tropospheric satellite temperatures.



The total divergence of the observed NOAA temperature and satellite temperature difference from the model forecast trends is depicted in Figure 3 below.

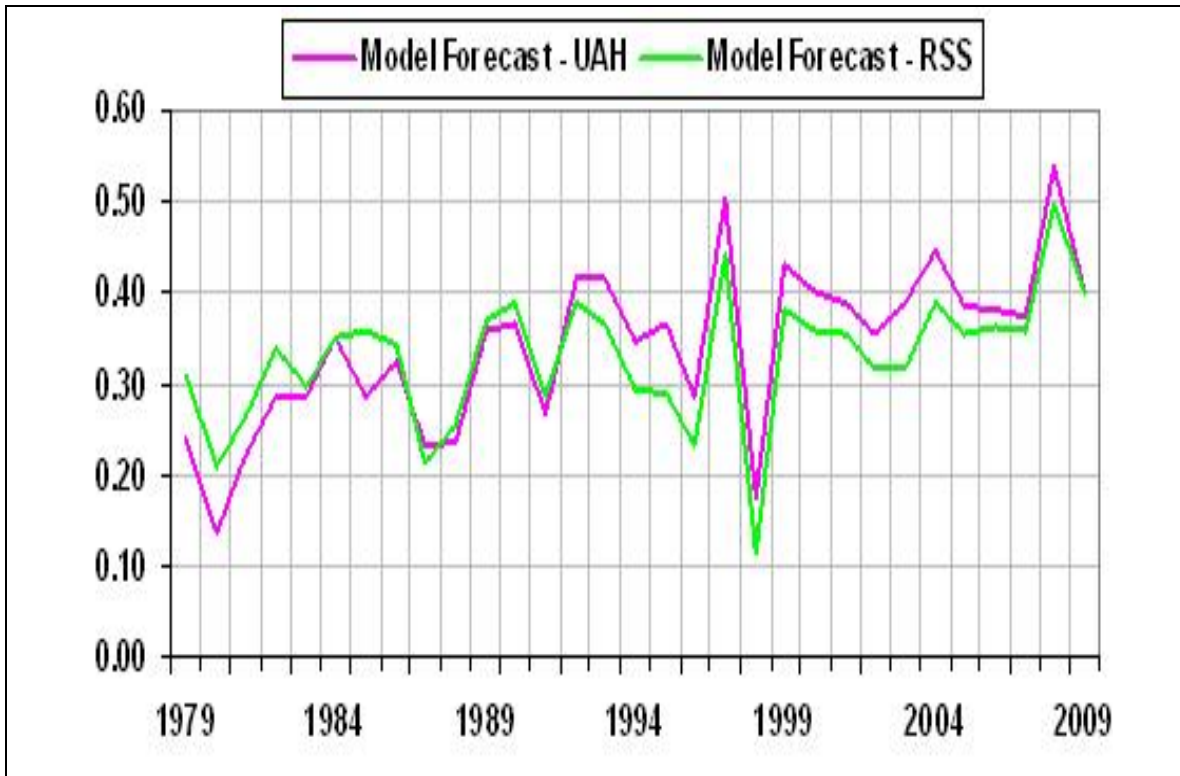


Figure 3: The total annual differences between ensemble model projections and actual UAH and RSS lower tropospheric temperatures

These figures strongly suggest that instead of atmospheric warming from greenhouse effects dominating, surface based warming due to factors such as urbanization and land use changes are driving the observed changes. Since these surface changes are not adjusted for, neither trends from the surface networks nor forecasts from the models can be considered reliable and should not be used for planning and policy decisions.

References:

Chou and Lindzen (2005), Comments on "Examination of the Decadal Tropical Mean ERBS Nonscanner Radiation Data for the Iris Hypothesis", J. Climate, 18, 2123-2127)

Lindzen, R. S., and Y.-S. Choi (2009), On the determination of climate feedbacks from ERBE data, Geophys. Res. Lett., 36, L16705, doi:10.1029/2009GL039628.

Karl, T.R., Hassol, S.J., Miller, C.D., Murray, W.L., Editors, SAP 1.1" Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences." 2006. A Report by the Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC.

Karl, T., J. Melillo, and T. Peterson (Eds.) (June 2009) Global Climate Change Impacts in the United States. Cambridge University Press, Cambridge United Kingdom. This is the CCSP Unified Synthesis Product.

<http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts>

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., 114, D21102, doi:10.1029/2009JD011841.

Santer, B.D., Wigley, T.M.L., Mears, C., Wentz, F.J., Klein, S.A., Seidel, D.J., Taylor, K.E., Thorne, P.W., Wehner, M.F., Gleckler, P.J., Boyle, J.S., Collins, W.D., Dixon, K.W., Doutriaux, C., Free, M., Fu, Q., Hansen, J.E., Jones, G.S., Ruedy, R., Karl, T.R., Lanzante, J.R., Meehl, G.A., Ramaswamy, V., Russell, G. and Schmidt, G.A. 2005. Amplification of surface temperature trends and variability in the tropical atmosphere. Science 309: 1551-1556.

Santer, B. D., et al. (2008), Consistency of modeled and observed temperature trends in the tropical troposphere, Int. J. Climatol., 28, 1703– 1722, doi:10.1002/joc.1756.