

URBAN HEAT ISLAND CONTAMINATION

ISSUE SUMMARY

- (1) The EPA relied on IPCC and CCSP assessments that **cherry picked the starting year of the trend period to show warming not present in longer term trends.** 1970 is a relative minimum in the cyclical changes over the last century and 2000 a relative maximum.
- (2) The United States and Global Data Bases are Seriously Contaminated by urbanization for which **NO ADJUSTMENTS** are made. There is significant peer review research that supports the need to adjust for urban and local factors that was available before deadlines for the IPCC and CCSP and even more for the EPA review of the science in the IPCC and CCSP. **The EPA incorrectly states that urban heat island is already adjusted for in the data processing.** This is a fatal flaw in the trend analysis that renders the conclusions made invalid.

Specific Errors in the EF/TSD

TSD Page 17 L19-36

“Temperatures are rising”

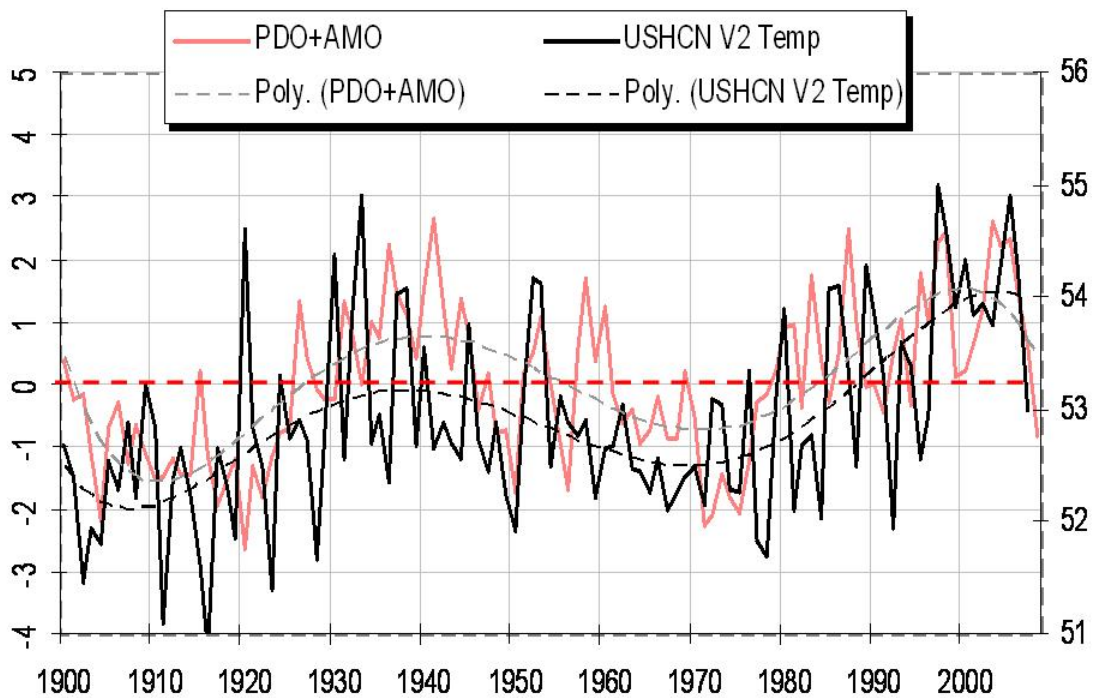
“Global average surface air temperature has been increasing rapidly since 1970. The estimated change in the average temperature of Earth’s surface is based on measurements made by satellites and at thousands of weather stations, ships, and buoys around the world. These measurements are independently compiled, analyzed, and processed by different research groups. An important step in the data processing is to identify and adjust for the effects of changes in the instruments used to measure temperature, the measurement times and locations, and the local environment around the measuring site (such as the growth of cities, and the development of so-called “urban heat island” effects) or within a satellite’s field of view. A number of research groups around the world have produced estimates of global-scale changes in surface temperature.”

COMMENTS:

UNITED STATES TEMPERATURE CYCLES

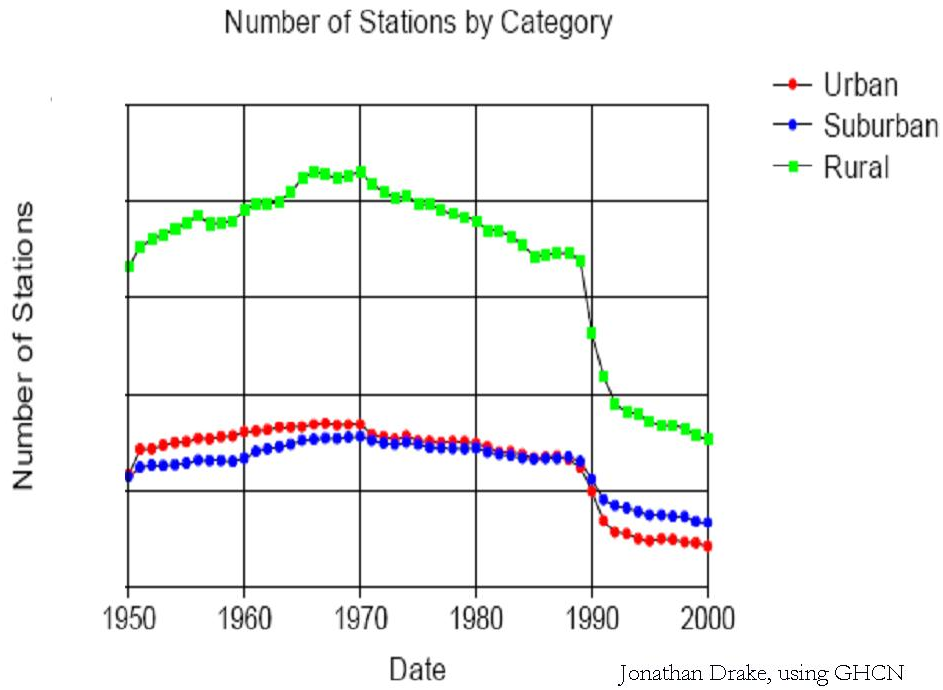
The US temperatures (US Historical Climate Network or USHCN) undergo a 70 year cycle (Minobe (1997) and many others related to the multidecadal ocean cycles (Pacific Decadal Oscillation or PDO and Atlantic Multidecadal Oscillation or AMO). Note the minima around 1970 and maxima around 2000. Note how the temperatures track with the ocean cycles, ignoring CO2 which rises slowly.

PDO+AMO vs USHCN V2 Annual Temp

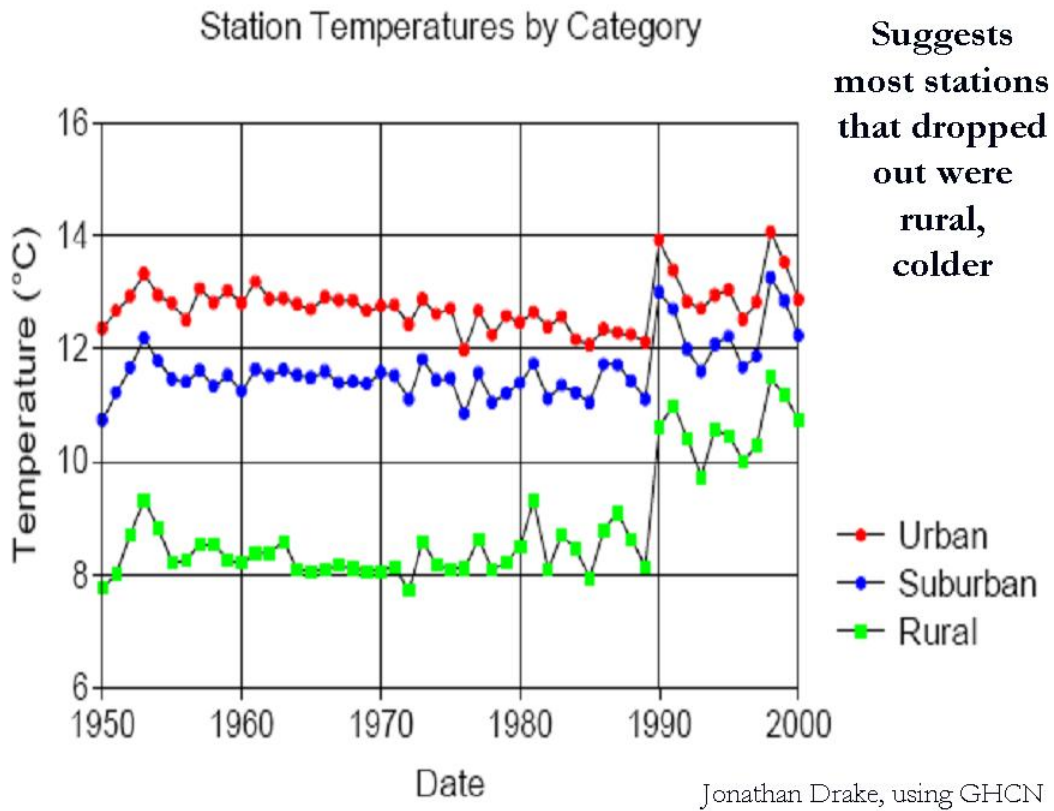


URBAN CONTAMINATION

The United States USHCN version 2, the global NOAA GHCN relied on by the CCSP and the Hadley global temperatures are **NOT** adjusted for UHI contamination. This is because of the flawed work of Jones et al. (1990) and then Peterson (2003) and Parker (2004), who claimed the urban contamination could be ignored in the global data bases. This may have been true at one time but in 1990, a major dropout of stations took place mainly rural and outside the United States.



This was accompanied by an accompanying discontinuity in temperatures upward as shown here.



This results in a bias towards urban areas, and a 'distribution change' related warming not a climate shift.

The urban contamination and distribution based errors can be also seen by comparing NOAA station and ocean based temperature anomalies with satellite derived temperatures. NOAA proclaimed June of 2008 as the eighth warmest June for the globe in the 129 years of record keeping with an anomaly of +0.9F while the University of Alabama Huntsville Microwave Sensing Unit (MSU) based lower tropospheric anomaly was actually below the normal for its period of record (-0.19F anomaly), ranking it as the 9th coldest June in its 30 years of record. RSS, the other satellite sensing data monitoring source ranked it as the 13th coldest of the prior 30 years.

Satellite not only provides more complete global coverage including the oceans, but also integrates the localized urban warming with the surroundings. NOAA according to Tom Karl has limited funding of station upgrades and the extent of the Climate Reference Network because it said we had more reliable satellite coverage. Unfortunately NOAA does not use this prize resource in tracking change.

UNITED STATES HAD A UHI ADJUSTMENT BUT REMOVED IT

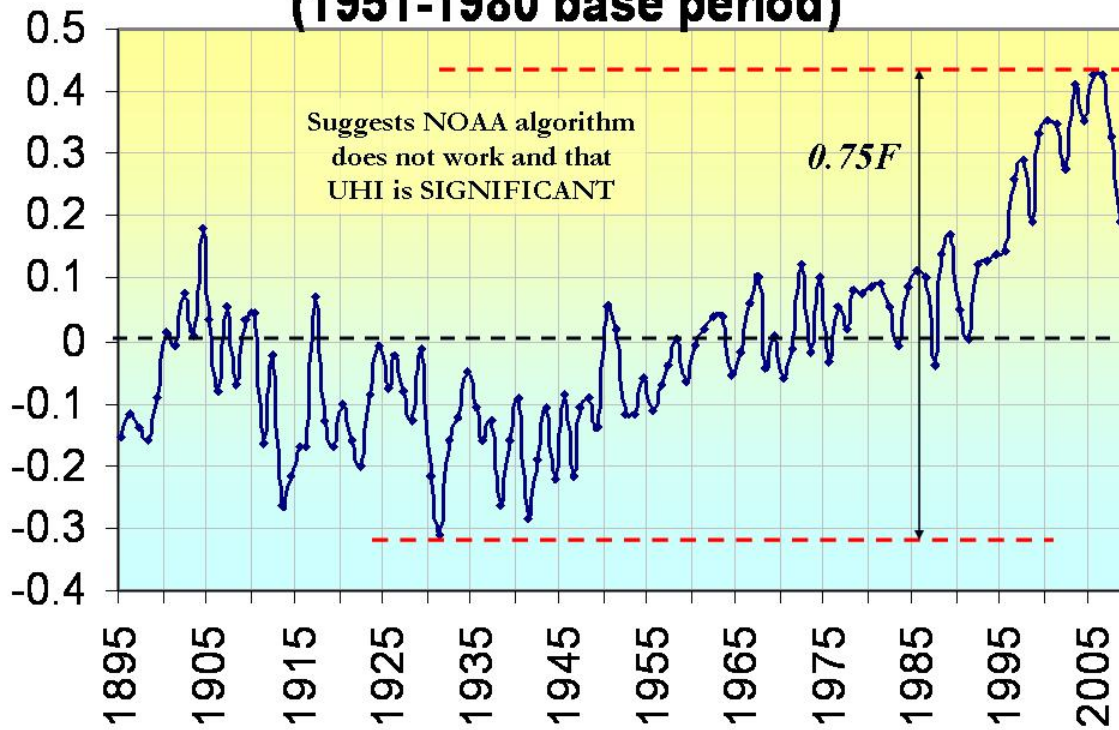
The USHCN version 2 in 2007 removed the UHI adjustment originally specified by Karl et.al. (1988) which had been implemented in the 1990 version 1 of USHCN. Karl had shown its importance [here](#) based on the pioneer work of Helmut Landsberg (1981) and Thomas Oke (1973).

NASA GISS continues to use a UHI adjustment for the United States based on satellite night light determinations. Though one could question the threshold of 10,000 population used for rural as Oke (1973) and Torok et al (2001) show that even towns with populations of 1000 people have urban heating of about 2.2 C compared to the nearby rural countryside.

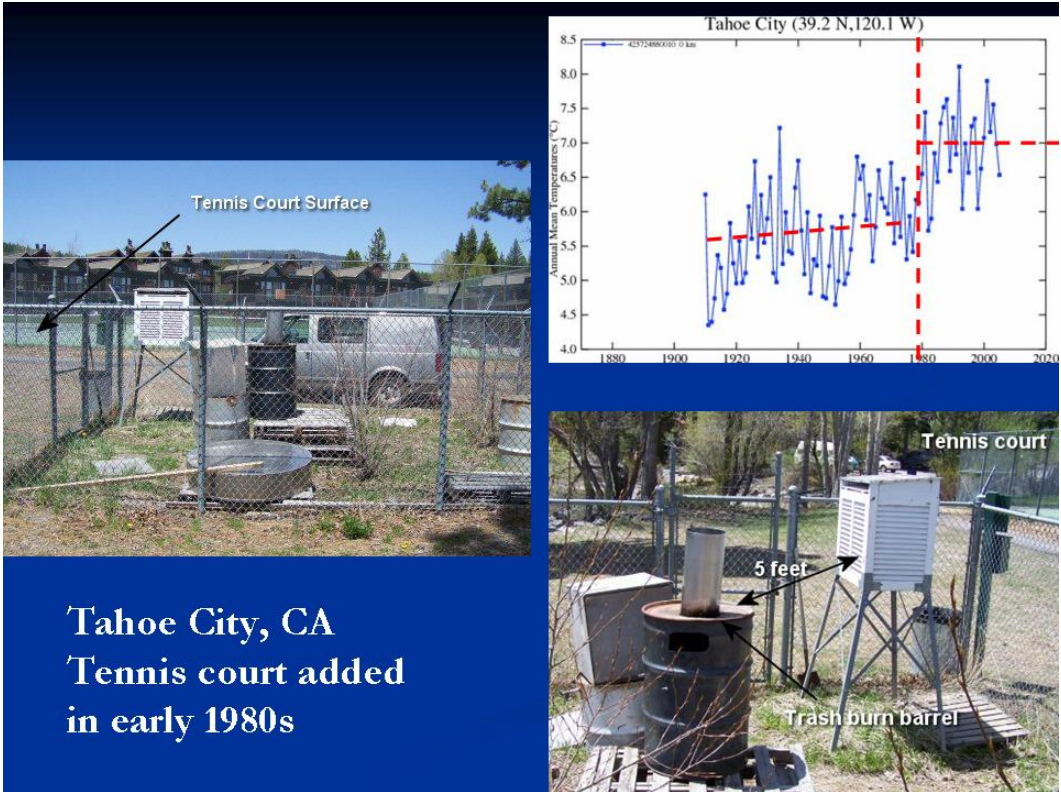
Since the UHI increases as the logarithm of the population or as about 0.73 log (pop), a village with a population of 10 has an urban warming of 0.73 C, a village with 100 has a warming of 1.46 C, a town with a population of 1000 people already has an urban warming of 2.2 C, and a large city with a million people has a warming of 4.4 C (Oke, 1973).

Comparing the NASA GISS version of USHCN with the UHI adjustment and USHCN v2 shows a difference of 0.75 from 1930 to 2005. This artificial warming is the result of removing the urban adjustment.

NOAA USHCN V2- GISS US (1951-1980 base period)

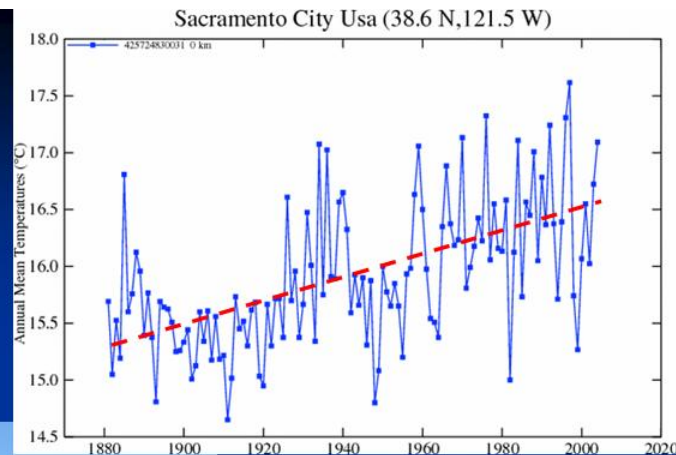


NOAA substituted a change point algorithm for the UHI adjustment. Although it is claimed to be capable of catching all local changes, it looks for sudden discontinuities. These are usually signs of a site change or other very local land use changes. UHI is typically a slow ramp up as population grows and the city grows around the station.



The kind of change, a “change-point algorithm” is best suited for catching.

**Sacramento
urban growth
and warming
will not be seen**



The slow growth of an urban area would not be caught and adjusted for by the ‘change point algorithm’.

GLOBAL DATA IS UNADJUSTED

The IPCC refers to Jones et al. (1990) for its claim that the non-climatic bias due to urbanization is less than one-tenth of the global trend. Aside from being a very old reference, this paper does not settle the issue because of numerous inherent limitations. For one thing it is not a global analysis. It ran comparisons of urban and rural (or rural-urban) composites only for three regions: Eastern Australia, Eastern China and Western USSR. It used inconsistent definitions for urban areas (i.e. allowing communities up to 100,000 people to be classified as ‘rural’ in China), yet they still found warming biases in urban records in almost all locations.

They found strong urban warming in China relative to the rural and pooled series, and in the USSR they found stronger relative cooling post-1930 in the rural stations. Eastern Australia yielded no differences. (The China findings in particular contradict those of Li et al (2004) as cited by the IPCC in AR4 Section 3.2.2.2). They also cited earlier results finding strong relative urban warming in the contiguous USA. Their concluding claim that urbanization represents “at most” one-tenth of the global trend is not derived or proved in the paper, it simply appears in the conclusion as an unsupported conjecture. Yet this conjecture has been repeated in several IPCC reports since then, including the new Fourth Assessment Report, as

if it were a proven result. Consequently the IPCC's appeal to Jones et al. (1990) to support the claim that the global data are free of substantial bias is unpersuasive.

The IPCC also relies on Parker (2004) to argue that Urban Heat Island (UHI) effects are not global. Parker's study compared temperature trends between urban samples taken on calm nights versus windy nights. He found the trends were visually similar and concluded that UHI effects were unlikely to influence the global average. However, the maintained hypothesis is that elevated windspeed reliably reduces UHI effects. This idea has been disputed (see discussion in McKendry 2003), so the similarity in trends may simply indicate that the non-climatic effects exert a similar influence under both conditions (on this see also Pielke Sr. and Matsui 2006).

Jones et al (2008) has since shown urban-related warming over China is shown to be about $0.1^{\circ}\text{C decade}^{-1}$ over the period 1951–2004. This is more consistent with Ren et al (2007) who in the abstract of their GRL paper noted that “annual and seasonal urbanization-induced warming for the two periods at Beijing and Wuhan stations is also generally significant, with the annual urban warming accounting for about 65-80% of the overall warming in 1961-2000 and about 40-61% of the overall warming in 1981-2000. Zhou (2004) also showed significant urban contamination in China data.

Numerous other papers have shown that contamination by urbanization and other local changes may account for 30-50% of the changes since 1900 (De Laat and Maurellis (2006), Kalney and Cai (2003), Pielke, Davey et al (2007), Pielke, Neilson (2007), Michaels and McKittrick (2007)). Instead the CCSP and IPCC chose to cherry pick the papers that supported the no urban adjustment methodology (Jones (1990), Peterson (2003) and Parker (2004)).

As Doug Hoyt has noted, in 1900, world population is 1 billion and in 2000, it is 6 billion for an increase of a factor of six. If the surface measuring stations are randomly distributed and respond to this population increase, it would equal $2.2 \log(6)$ or 1.7 C, a number already greater than the observed warming of 0.6 C. If however we note that UHIs occur only on land or 29% of the Earth's surface, than the net global warming would be $0.29 * 1.7$ or 0.49 C which is close the observed warming. **It is not out of the realm of possibility that most of the twentieth century warming was urban heat island and unrelated to greenhouse gases.**

Summary:

The EPA relied on IPCC and CCSP assessments that cherry picked the starting year of the trend period to show warming not present in longer term trends. 1970 is a relative minimum in the cyclical changes over the last century and 2000 a relative maximum. The warming related well to the cyclical warming of the Pacific and Atlantic.

The claim that the warming trends found in the data bases over the last century have been adequately adjusted for urban contamination is shown to be false. The IPCC, CCSP and EPA have ignored peer review papers, many of which were before the IPCC deadline which showed this contamination and cherry picked papers by authors employed by the

data centers that allowed them to ignore the urban issue. Comparisons between satellite and global data bases also show significant divergence suggesting this local contamination.

References:

De Laat, A.T.J., and A.N. Maurellis (2006). "Evidence for Influence of Anthropogenic Surface Processes on Lower Tropospheric and Surface Temperature Trends." *International Journal of Climatology* 26:897—913.

Jones, P.D., P. Ya. Groisman, M. Coughlan, N. Plummer, W-C. Wang and T.R. Karl (1990). "Assessment of Urbanization Effects in Time Series of Surface Air Temperature Over Land." *Nature* 347 169—172.

Jones, P. D., D. H. Lister, and Q. Li (2008), Urbanization effects in large-scale temperature records, with an emphasis on China, *J. Geophys. Res.*, 113, D16122, doi:10.1029/2008JD009916.

Kalnay, E., Cai, M., Impacts of urbanization and land-use change on climate, 2003, *Nature*, 423, 528-531

Karl, T.R., H.F. Diaz, and G. Kukla, 1988: Urbanization: its detection and effect in the United States climate record, *J. Climate*, **1**, 1099-1123.

Kalnay, E. and M. Cai, 2003. Impact of urbanization and land-use change on climate. *Nature* 423, 528 - 531

Landsberg, H.E., 1981: *The Urban Climate*, Academic Press

Li, Q. et al., 2004: Urban Heat Island Effect on Annual Mean Temperatures during the Last 50 Years in China. *Theor. Appl. Climatol.*, 79, 165-174.

McKendry, Ian G. (2003) "Progress Report: Applied Climatology" *Progress in Physical Geography* 27(4) pp. 597–606

McKittrick, R.R. and P.J. Michaels (2007), Quantifying the influence of anthropogenic surface processes and inhomogeneities on gridded global climate data, *J. Geophys. Res.*, 112, D24S09, doi:10.1029/2007JD008465.

Minobe, S. 1997: A 50-70 year climatic oscillation over the North Pacific and North America. *Geophysical Research Letters*, Vol 24, pp 683-686.

Oke, T.R. 1973. City size and the urban heat island. *Atmospheric Environment* **7**: 769-779.

Parker, D.E. (2004). "Climate: Large-Scale Warming is not Urban." *Nature* 432, 290 (18 November 2004); doi:10.1038/432290a.

Peterson T.C. and R.S. Vose (1997) “An Overview of the Global Historical Climatology Network Temperature Database.” *Bulletin of the American Meteorological Society* 78:2837—2849.

Peterson, T.C. (2003). “Assessment of Urban Versus Rural *in situ* Surface Temperatures in the Contiguous United States: No Difference Found.” *Journal of Climate* 16(18) 2941—2959.

Pielke, RA Sr. 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?” *Geophysical Research Letters* (32) L21813, doi:10.1029/2005GL024407, 2005

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. J. Nielsen-Gammon, C. Davey, J. Angel, O. Bliss, N. Doesken, M. Cai., S. Fall, D. Niyogi, K. Gallo, R. Hale, K.G. Hubbard, X. Lin, H. Li, and S. Raman, 2007: Documentation of uncertainties and biases associated with surface temperature measurement sites for climate change assessment. *Bull. Amer. Meteor. Soc.*, 88:6, 913-928.

Ren G. Y., Z. Y. Chu, Z. H. Chen, Y. Y. Ren (2007), [Implications of temporal change in urban heat island intensity observed at Beijing and Wuhan stations](#), *Geophys. Res. Lett.*, 34, L05711, doi:10.1029/2006GL027927

Runnalls, K.E. and Oke, T.R. 2006. A technique to detect microclimatic inhomogeneities in historical records of screen-level air temperature. *Journal of Climate* **19**: 959-978.

Trenberth, K. 2007: Predictions of climate. Posted on Climate Feedback, The Climate Change Blog, June 4, 2007.
http://blogs.nature.com/climatefeedback/2007/06/predictions_of_climate.html

Zhou, L., Dickinson, R, Tian, Y., Fang, J, Qingziang, L., Kaufman, R, Myneni, R., Tucker, C., 2004, Rapid Urbanization warming China’s climate faster than other areas, *Proceedings of the National Academy of Science*, June 29, 2004