

I. Background Information

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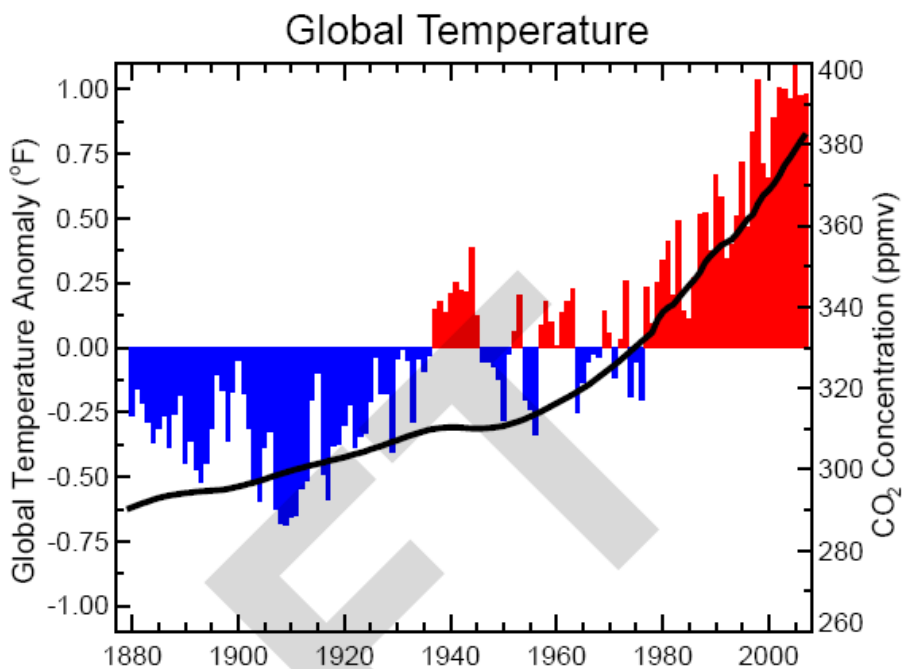
Area of Expertise: Climatology, Climate Forecasting for Agriculture and Energy

This comment therefore focuses on a **one fundamental issue** that must be corrected if the report is to have any credibility.

DATA INTEGRITY PROBLEMS CONTAMINATE THE HISTORICAL RECORD
THAT IS THE UNDERPINNING OF THE ENTIRE REPORT

The key citation addressed here.

Page 22: "Global average surface air temperature has been increasing, with the warming trend accelerating in recent decades. The record of temperature measurements comes from thousands of weather stations, ships, and buoys around the world; these measurements are independently compiled, analyzed, and processed by several different research groups."



Global average temperature (as measured over both land and oceans) difference from twentieth century average. Red bars indicate above-average temperatures. Black line shows carbon dioxide concentrations.

There are major data coverage and integrity issues with the global and US data bases that require a third party review and corrections before release of any official report and any policy decisions are made. It is impermissible to make this claim that the warming is as depicted in the diagram on the cover page and on page 22 given the following, confounding research/findings.

These include:

- (1) Major questions about the impact of major station dropout observed since 1990
- (2) Major questions about the handling of the missing data, which has in many large regions also increased dramatically since 1990
- (3) Major issues as to how urbanization and land use (siting) changes, clearly man's greatest effect on local climates, are handled.
- (4) Lack of visibility into the adjustments being made to the raw data. Some parts of this key process like time of observation adjustments are well documented and understood but most others are not. Data and documentation of the adjustments made is not being made available for independent review even when requests are being made through proper channels.
- (5) Some instrumentation changes have taken place without apparent adjustments for known biases
- (6) Ocean data given that 70% of the globe is ocean is critical to determining a global mean temperature. Changing methods not unlike changing instrumentation for land stations introduce biases and errors that must be properly accounted for. A potential remedy in the form of ARGO diving buoys is now in place, but the issue adds uncertainty to past assessment of global temperatures.

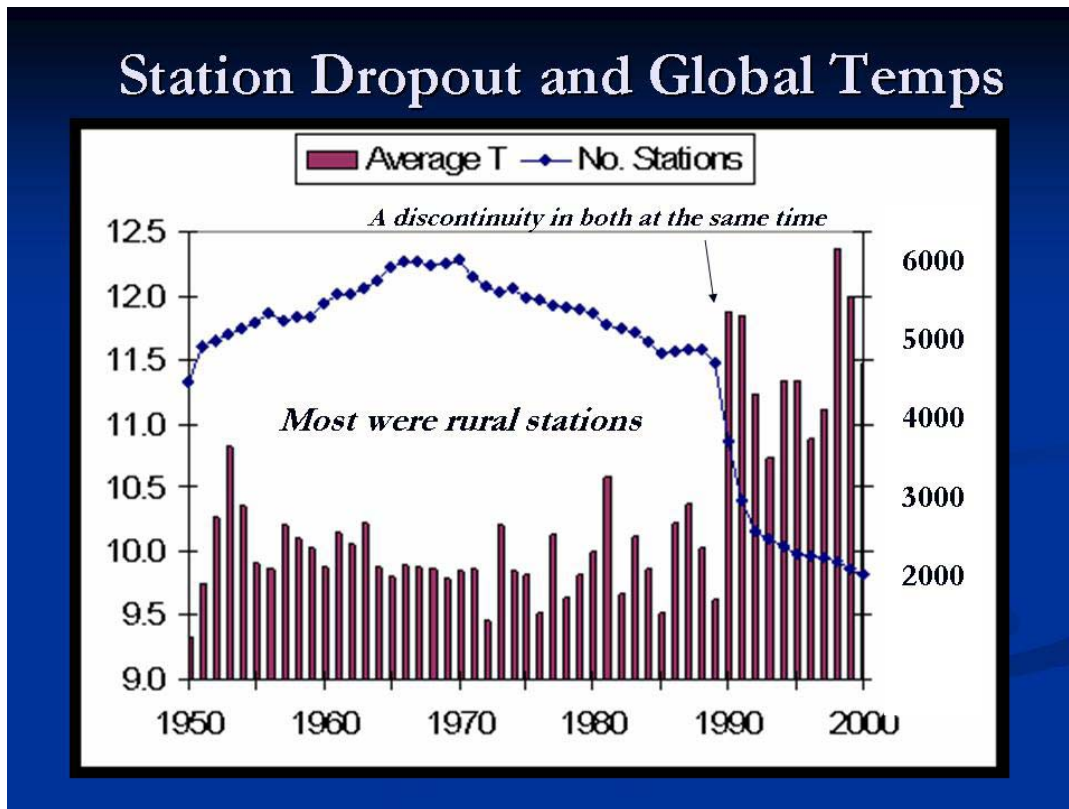
THE DATA BASE ISSUES

Though there has clearly been some cyclical warming in recent decades, the global surface station based data is seriously compromised by urbanization and other local factors (land-use /land-cover, improper siting, station dropout, instrument changes unaccounted for and missing data) and thus the data bases overestimate the warming. Numerous peer-reviewed papers in the last several years have shown this overestimation may be the order of 30 to 50%. Since the past temperature trends is the entire underpinning of the CCSP, and these issues are not properly addressed, the report itself should be put on hold and an independent third party audit of the temperature data bases and adjustments with full transparency is mandated. We can't make good policy decisions based on flawed, uncertain historical data. The major issues include:

STATION DROPOUT

Station drop-out has occurred-- from a peak of 6,000 stations in 1970 to 2,000 today. The biggest dropoff occurred around 1990. The plot was made with downloaded GHCN 2 data with Annual mean global temperature in degrees Celsius and number of stations.

Many of the stations that were dropped were rural. A larger percentage of the stations remaining were urban. Notice the discontinuity of mean temperature at the same time as the dropoff suggesting a sampling error was introduced.



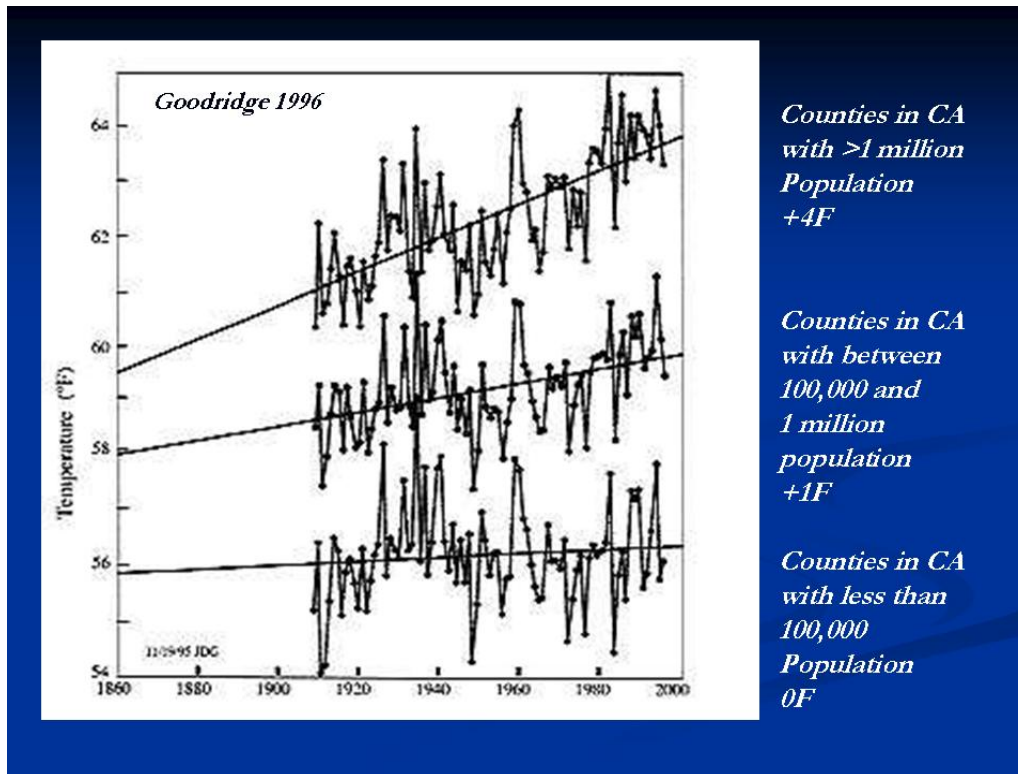
To see for yourself how rapid and extensive this is, look at [this animation](#) of reporting stations in recent decades, see the stations drop out rapidly around 1990.

URBANIZATION

The CCSP makes this following comment on page 48:

“Urban areas are among the most rapidly changing environments on Earth. As cities grow, they affect local climates. The urban heat island effect has raised average urban air temperatures by 2 to 5°F more than surrounding areas over the past 100 years, and by up to 20°F more at night.”

Dr. Thomas Oke (the winner of the American Meteorological Society Helmut Landsberg award in 2007 for his pioneer work in urbanization), in 1973 showed how even cities with 1000 population could have a significant warming relative to urban areas (2°C). The global data bases do not consider an area a city and adjust for urbanization until the population exceeded 100,000. This introduces a warm bias into the data bases.



Zhou et al (2005) have shown global data bases (for China) not properly adjusted for urbanization. Block (2004) showed the same problem exists in central Europe. Hinkel et al (2003) showed even the village of Barrow, Alaska with a population of 4600 has shown a warming of 3.4°F in winter over surrounding rural areas.

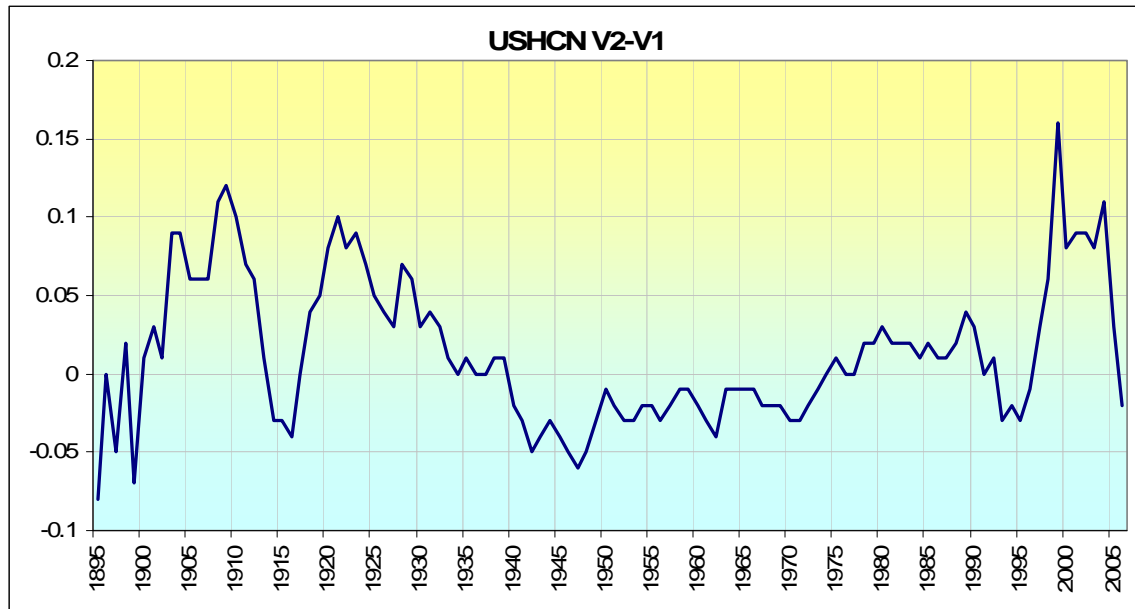
More and more of the world is urbanized (population increased from 1.5 B to 6.5 B today). Cities grow around airports where we measure temperatures. See [this detailed review](#) of this Urban Heat Island (UHI) issue. NOAA has argued urban contamination is not an issue based on papers by Parker and Peterson (which are challenged [here](#) and [here](#)). Even when adjustments are made, the adjustments are inconsistent with UHI.

In version 1 of NCDC's USHCN released in 1990, there was an urban adjustment based on Karl's own work (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). In a paper published in the *Bulletin of the American Meteorological Society* in 1989, Dr. Thomas R. Karl, senior scientist at the National Climate Data Center, corrected the U.S. surface temperatures for the urban heat-island effect and found that there has been a downward temperature trend since 1940. This suggested a strong warming bias in the surface-based temperature record.

In version 2 released in 2007, NCDC has removed the urban adjustment and employed a change point algorithm designed to find previously undocumented inhomogenities like changes in siting, and land use. (the national version is available but there is no ready access to the individual stations yet). As [Anthony Watts](#) commented after his visit to NCDC at their invitation to discuss his efforts to document siting issues: the new

change point algorithm that replaces the prior adjustments for siting and urbanization can't be expected to catch and correct for things like: gradual UHI increase in the surrounding area, tree shading/vegetation growth/loss near the sensor increasing or decreasing gradually, a gradual buildup of surface elements around the sensor, such as buildings, asphalt, concrete etc.

Indeed the difference pattern between the two versions are hard to explain with early 20th century and again recent warming and a very slight cooling in between. This plot uses NCDC version 1 and version 2 US Annual Mean temperatures.



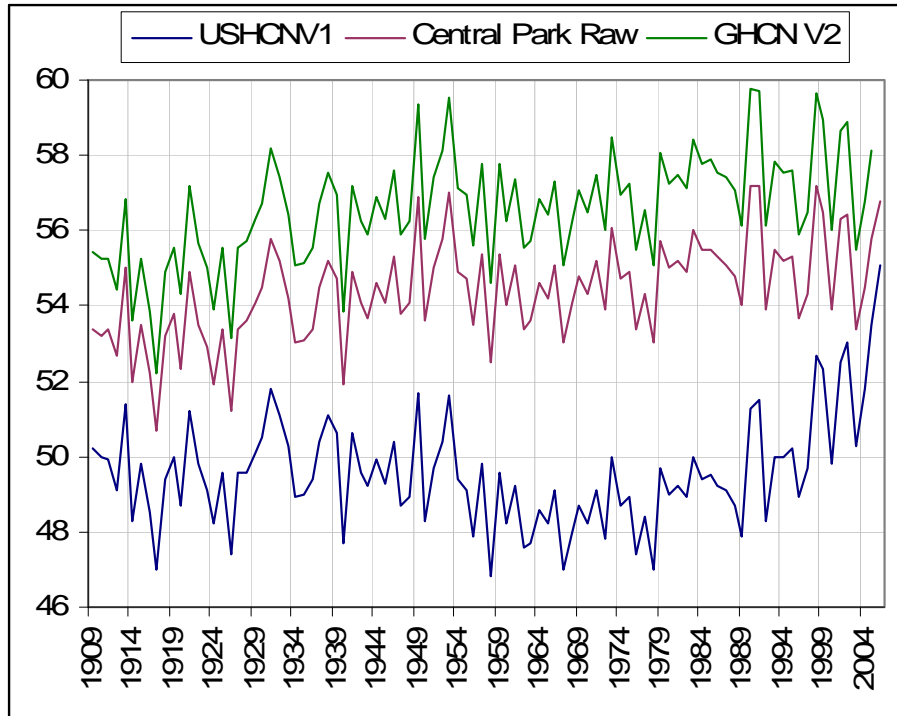
URBANIZATION ADJUSTMENTS MADE AND UNMADE - ONE TEST CASE

I will provide one key example of how the urban adjustment by NCDC has been used in two different data bases to adjust in one data base for the station down significantly and the other up, calling into question the processes involved and the overall integrity of the data.

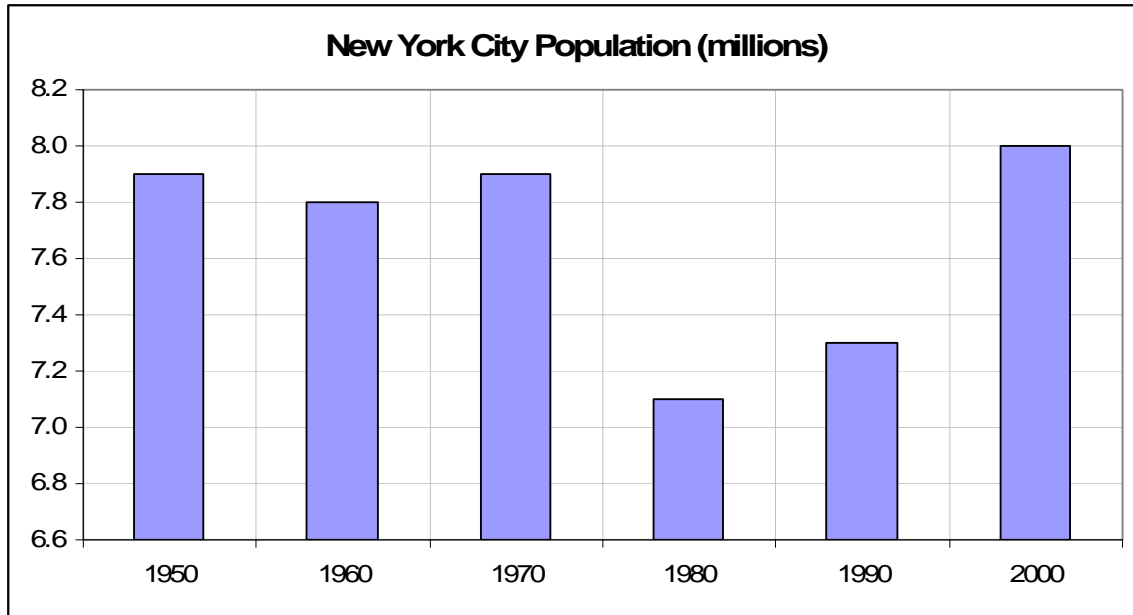
The station is New York City's Central Park. Raw observed data is available from NOAA's NWS in New York City on a monthly and annual basis extending back to 1869. NCDC takes that data and applies their adjustments for the US called USHCN and separately in the global data base GHCN now in release version 2.

Historical Central Park observations were taken from the periphery of the park from 1909 to 1919 at the Arsenal Building 5th Ave (between 63rd & 64th) and then since 1920 at the Belvedere Castle on Transverse Rd (near 79th & 81st).

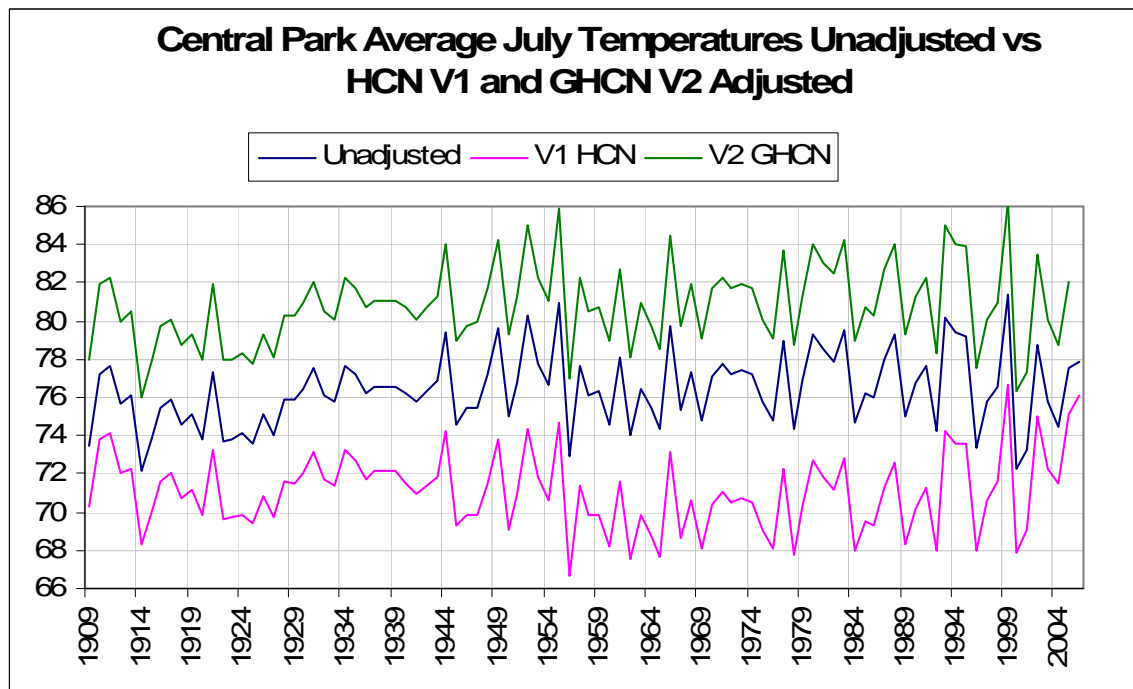
Here is a plot of the annual temperature from the three data set (RAW, USHCN V1 and GHCN V2) for New York City's Central Park. Data sources here are NWS NYC and NCDC.



You can clearly see there is a startling significance in the three data sets with the USHCN V1 adjusted down significantly from the raw due to the urban adjustment and the GHCN inexplicably adjusted up from the raw observed annual means in the middle. The difference between the data sets exceed 8F for most of the period from the 1950s to the early 90s. Then again inexplicably after about 1991, the USHCN downward adjustment diminished to less than 5F, implying a population decline. That has not been the case for New York City where the 5 borough population rose.

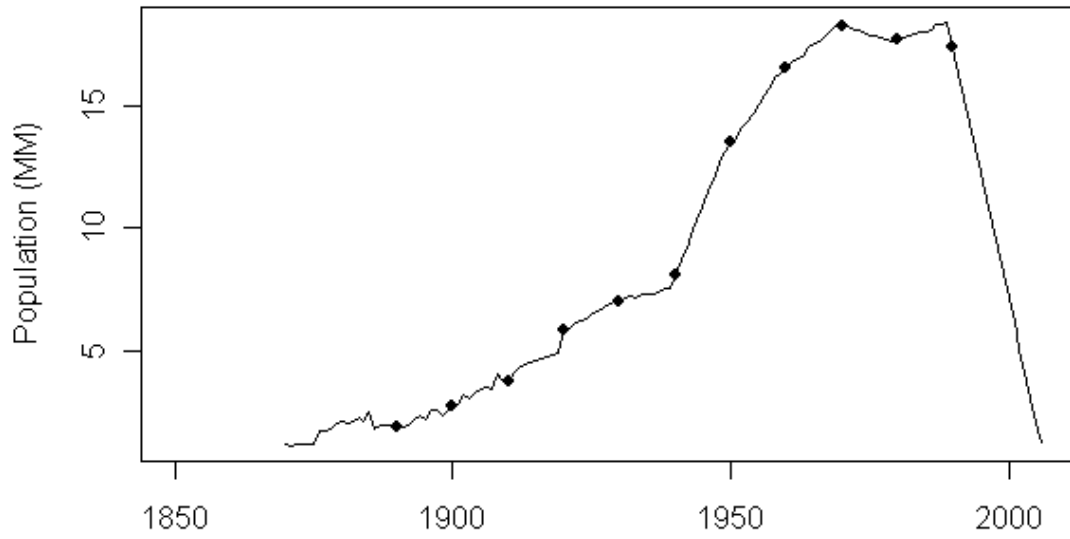


The differences were even more exaggerated for the July monthly averages with differences exceeding 11F, again diminishing to 6F by 2006.



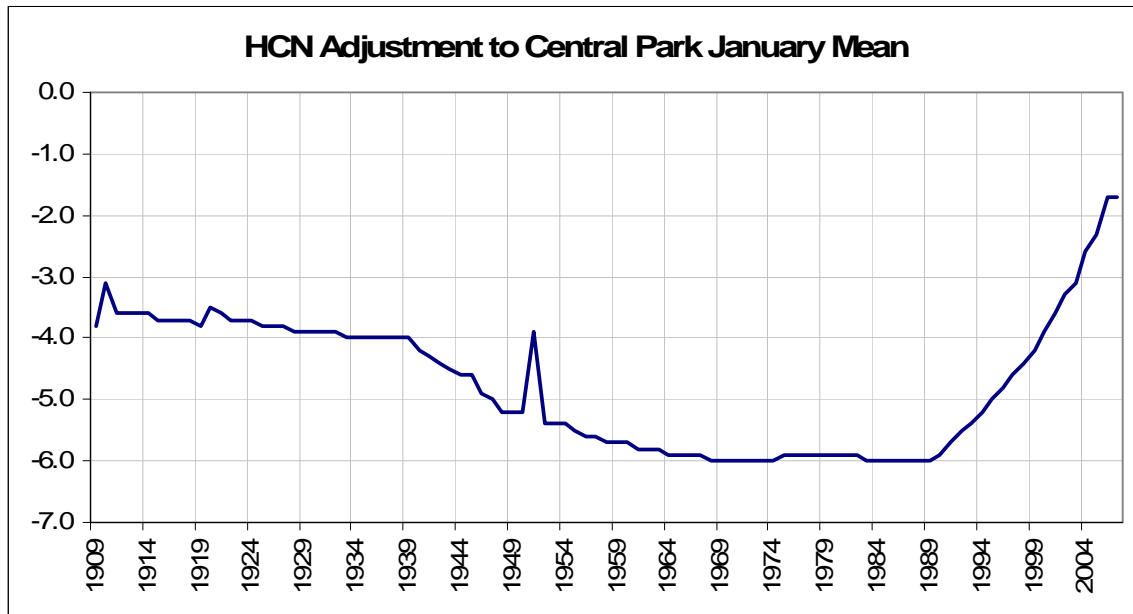
[Steve McIntyre](#) reverse engineered this adjustment to calculate the New York City population that would have to be used in the USHCN urban adjustment. It would have had to revert to the population of the 19th century to produce that change.

USHCN NYC Population



The analysis was repeated for January Central Park temperatures, and again a significant adjustment was noted to USHCN and again that adjustment diminished in the last two decades though New York did not become less urban.

HCN Adjustment to Central Park January Mean



If our own NCDC can't determine what the correct temperature for July should be to within 11F or annual to within 8F for a well established major center with a well maintained and complete record, how can we trust the data base to give us changes the order of a few tenths of a degree for trend analysis and critical policy making when other data sites are less consistently available or of this quality.

GHCN's adjustment **up** of NYC data, clearly an urban location, also calls into question the global adjustment process. These kinds of what appears to be arbitrary adjustments imply lack of *data quality assurance and constitute a clear violation of the data quality act.*

NASA's adjustments of GHCN raw data have been shown by [Steve McIntyre](#) to be erratic with the majority actually warming urban areas like GHCN did for Central Park instead of adjusting temperatures down.

NASA Urban Adjustments

Negative adjustments	1848	45%
Positive adjustments	2236	55%
Total adjustments	4084	100%

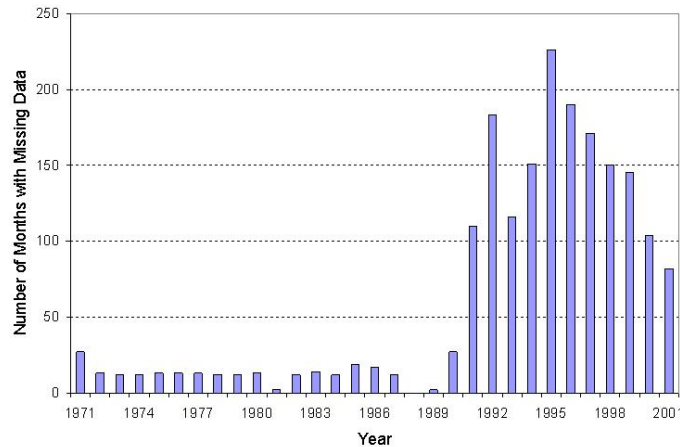
Steve McIntyre, Climate Audit

The GISS GHCN adjustments also were observed to occur frequently. [John Goetz](#) in February 2008 found on average 20% of the historical record was modified 16 times in the prior 2 1/2 years. The largest single jump was 0.27 C. This occurred between the Oct 13, 2006 and Jan 15, 2007 records when Aug 2006 changed from an anomaly of +0.43C to +0.70C, a change of nearly 68%.

MISSING DATA

Another issue that has been an issue over the entire history of observations is the erratic nature of station histories and the missing data that must be somehow accounted for.

Number of Missing Months



For the 110 Russian weather stations reporting weather data continuously from 1971 to 2001, the total number of missing monthly observations each year (McKittrick and Michaels)

To see how pervasive and serious the station dropout and missing data is, go to [this site](#), scroll down to the map and click on any region. You will see stations listed - notice the highly variable reporting periods. Start clicking on stations. You will get plots. But before you move to other stations go to the bottom and click on “Download monthly data as text”. You will see for many/most stations numerous “999.9”'s meaning missing data. How do you come up with annual averages when one or more months are missing?

I was told that in most cases the data is available (Environment Canada told Ross McKittrick when he inquired while doing his study with Pat Michaels on data issues they have their data we show as missing) but that NOAA and NASA are making no efforts to go out and get it. This is a violation of the Data Quality Act. NOAA NCDC is obliged to retrieve and maintain the most complete global data base for processing, not try and make due with a data base full of holes.

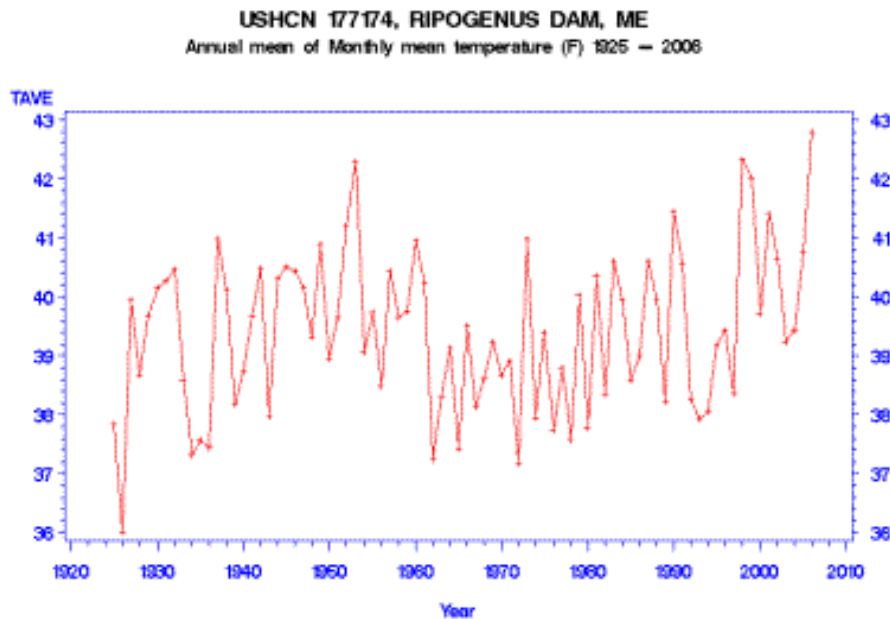
INFILLING OF MISSING DATA

The approach of estimating missing data using surrounding stations works if the stations are nearby and their anomalies were spatially consistent. The same or interpolated anomaly could be applied to the missing station, This is no easy task in the global data bases when surrounding stations are often hundreds of miles away as is the case in vast areas of the world. Other efforts have included using prior or surrounding months to estimate the missing month or months. Even when surrounding stations exist, if they are contaminated by siting or urban issues then we are introducing errors into the data base.

EXAMPLE RIPOGENUS DAM, MAINE

Last summer, volunteers from the Kristen Byrnes Science Foundation completed surveys of the United States Historic Climate Network (USHCN) temperature stations in Maine that are used to measure climate change. The survey determined that none of the stations in Maine were free of microclimate or urbanization biases. One station did surprise the surveyors. Ripogenus Dam, a station that was officially closed in 1995.

Despite being closed in 1995, USHCN data for this station is publicly available until 2006.



Source: CN Williams Jr, MJ Menne, RS Vose, DR Easterling, NOAA, National Climatic Data Center, Asheville, NC

Part of the USHCN data is created by a computer program called “filnet” which estimates missing values. According to the NOAA, filnet works by using a weighted average of values from neighboring stations. In this example, data was created for a no longer existing station from surrounding stations which in this case were all subject to microclimate and urban bias.

INSTRUMENTATION CHANGES UNADJUSTED FOR

Stephen McIntyre has shown in [The HO-83 Hygro-thermometer](#) that the change to the HO-83 went unadjusted for even though Karl 1995 noted a discontinuity of about 0.5°C before and after switchover. No record of procedures for adjusting for this instrument bias change has been found.

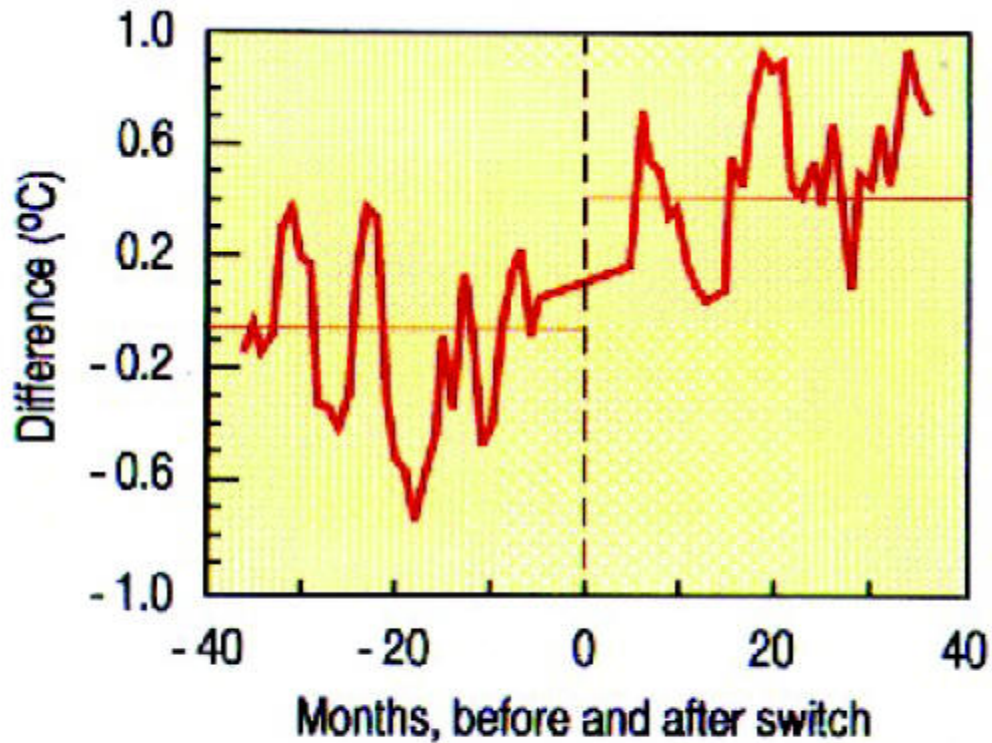
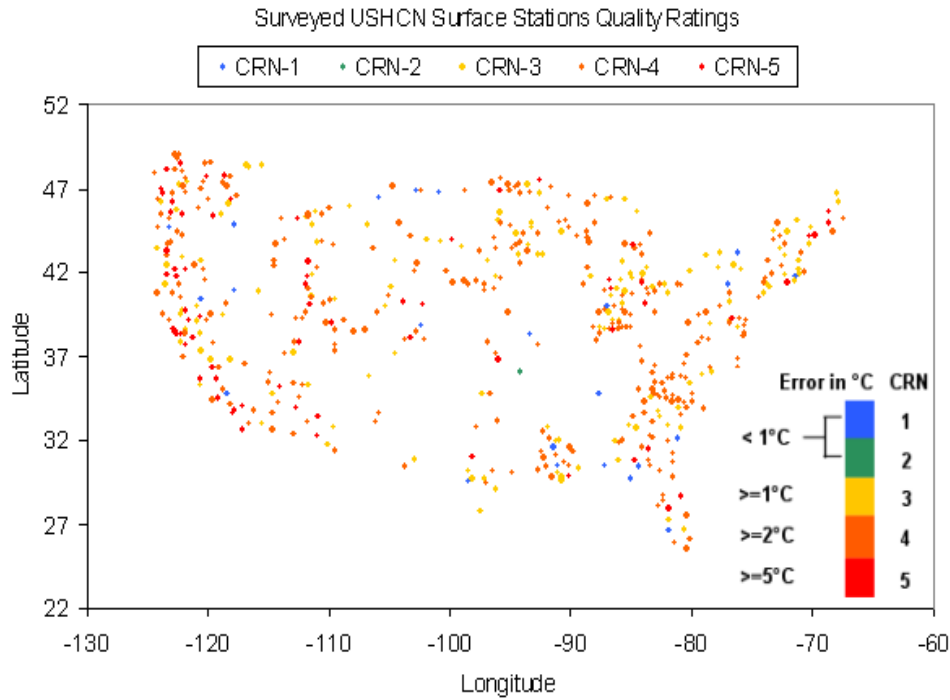


FIG. 2. Effects of changing instruments from the HO63 to the HO83 series on the maximum temperature in the United States (Karl et al. 1995).

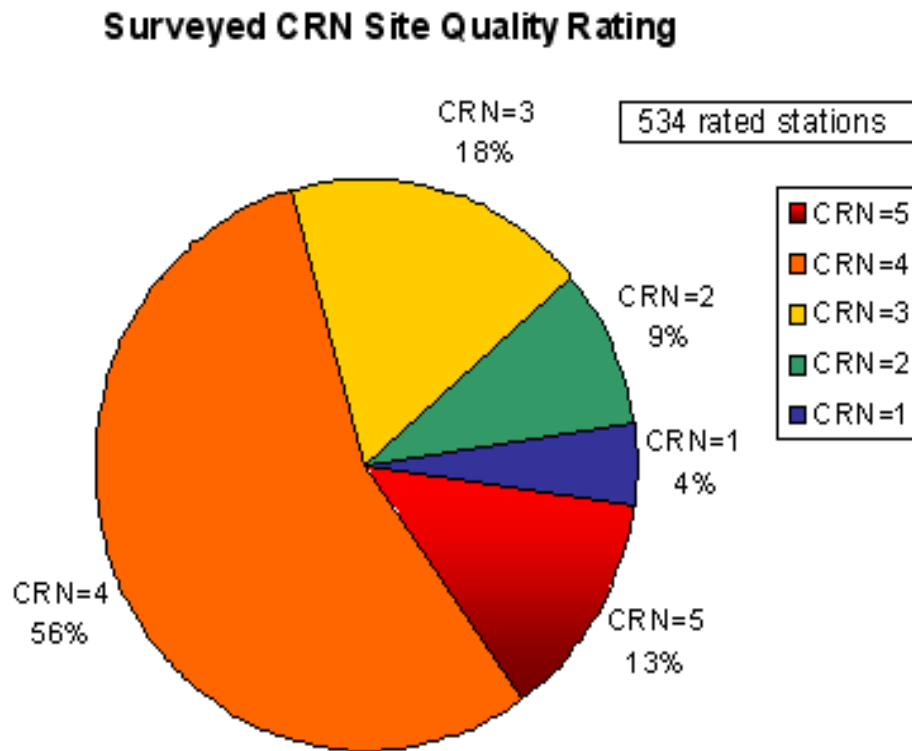
BAD SITING

Pielke and Davey (2005) found a majority of stations including climate stations in eastern Colorado did not meet WMO requirements for proper siting. He has extensively documented poor siting and land use change issues in numerous peer review papers, many summarized in the landmark paper [Unresolved issues with the assessment of multi-decadal global land surface temperature trends](#) (2007).

Anthony Watts started a volunteer effort to document siting issues with all 1221 stations in US. He and his team is now through over 554 stations. He and his team is now through over 554 stations. See the results on <http://surfacestations.org> and numerous examples highlighted on <http://wattsupwiththat.wordpress.com>. All of these siting issues identified introduce a warm bias.

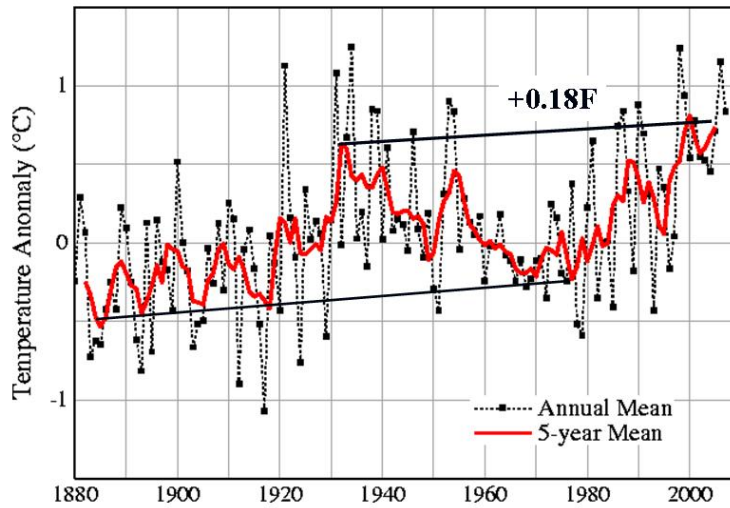


Using the government's own rating system, Anthony has shown a majority of the stations are inadequately sited (87% are CRN 3-5).



Even with the issues, the US network because it does not suffer from the same extent of station dropout and missing data shows minimal warming since the last cyclical peak in 1930.

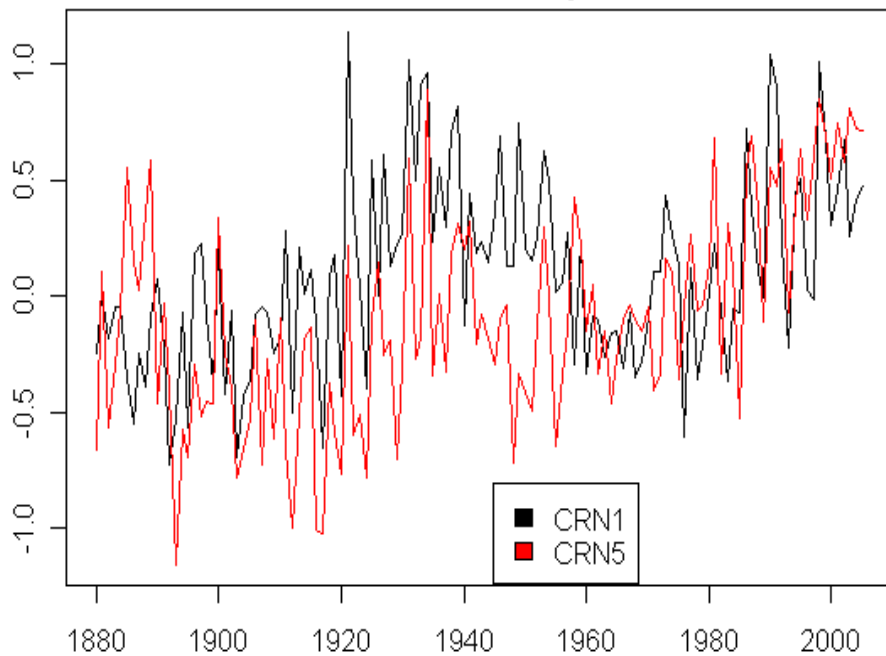
NASA GISS US DATA



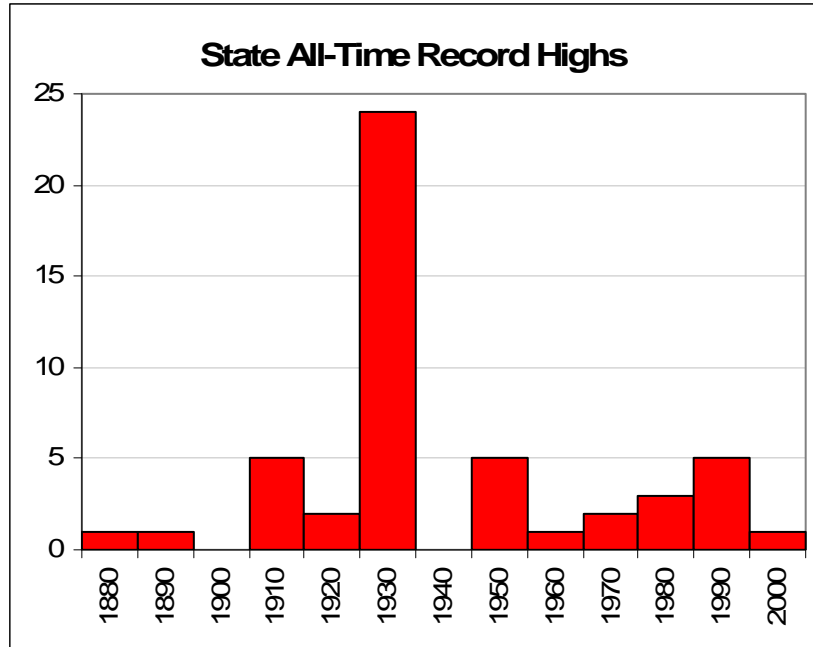
Even with siting and urbanization issues, not much warming

In fact the trend for only the well sited stations rated CRN 1 show a lower second peak.

USHCN TOBS Comparison



This is supported by the plot of All-time Record State Temperatures in which 38 of the 50 states set their new records in the decades prior to 1960.



OCEAN TEMPERATURE MEASUREMENTS

The change of methodology from buckets to ship intake and satellite raise question as to the accuracy of the global ocean temperatures at least in time relative terms. Since 70% of the world is ocean, this is no small issue. Hadley admits their ocean data is seriously lacking with coverage limited to maritime ship routes. Their coverage of the southern hemisphere is especially lacking and the southern hemisphere is 80% ocean. The new ARGO buoy deployment of 3000 diving sensing buoys is a welcome addition and should improve this in the future but will not help with the past data.

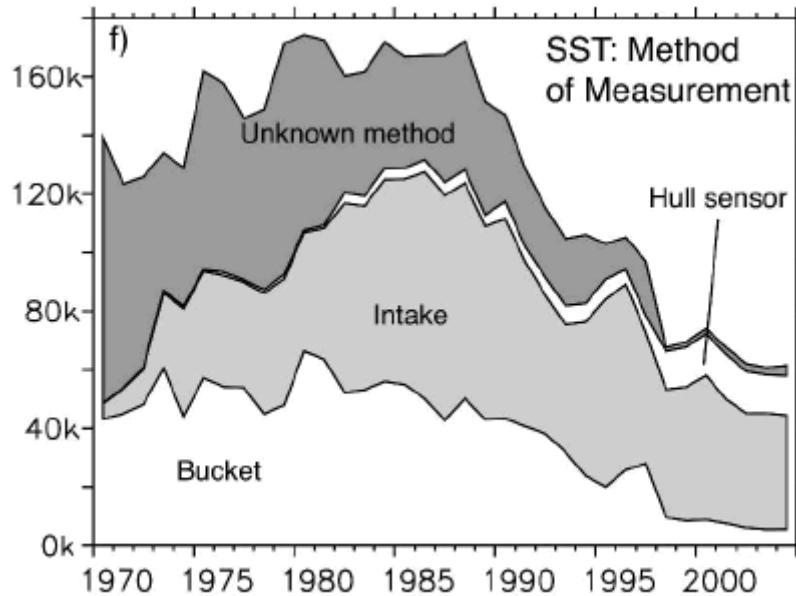
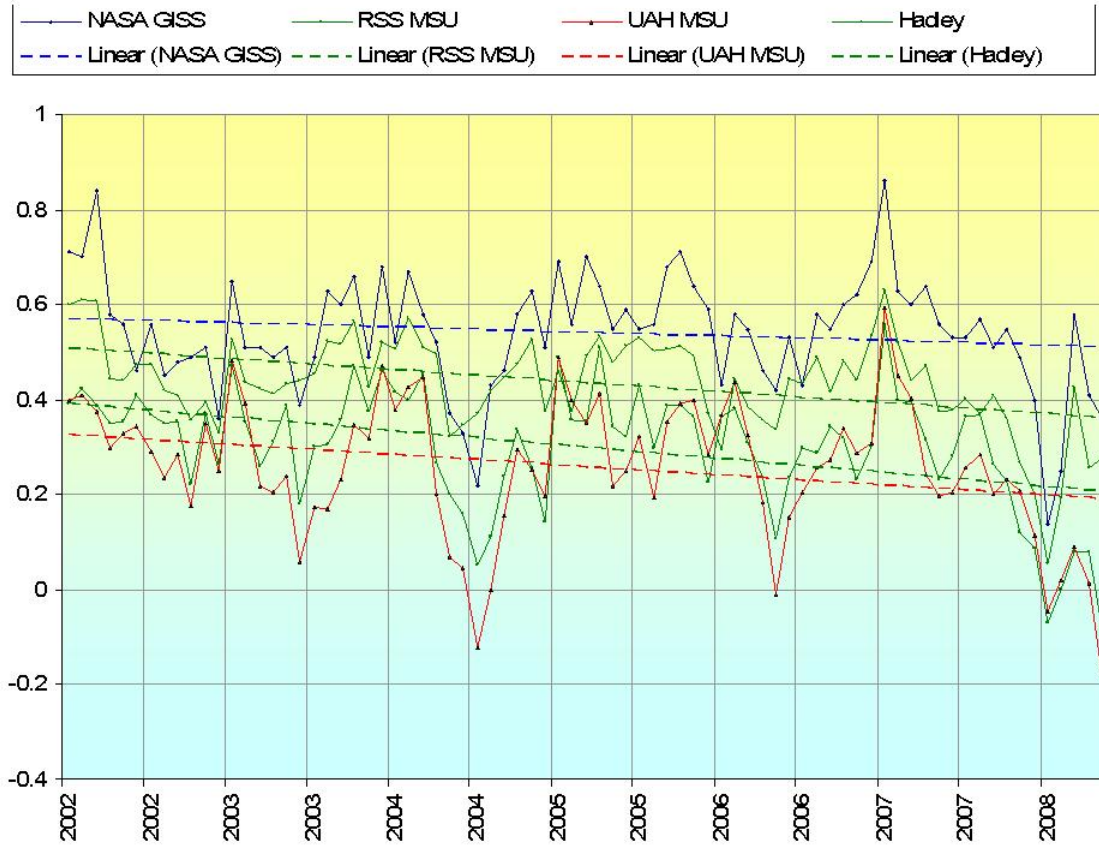
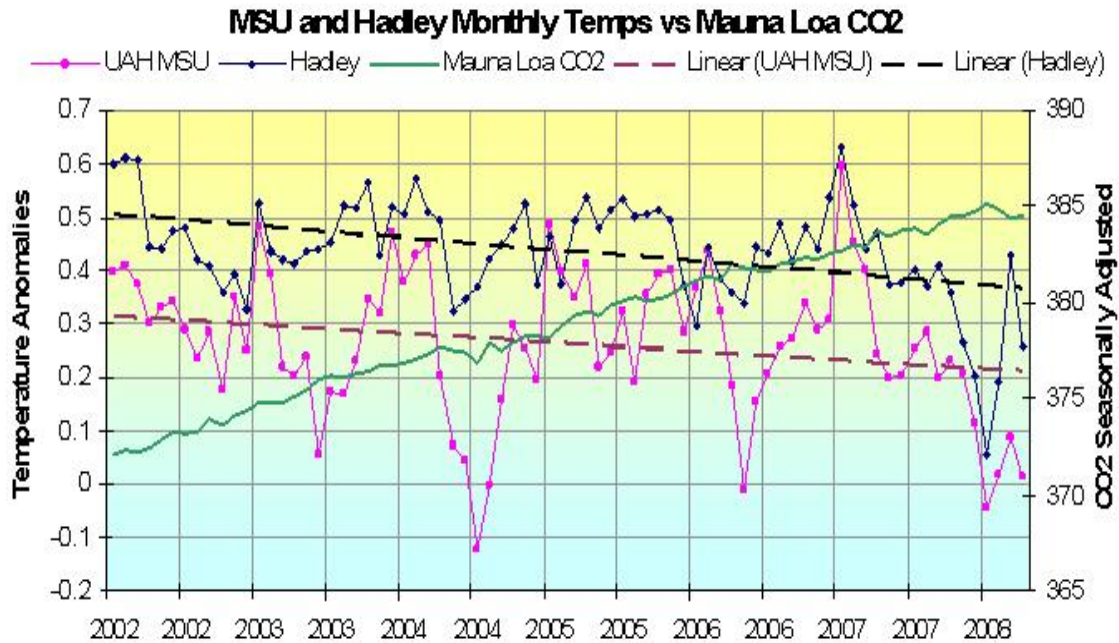


Chart from Kent (Kent, E. C., S. D. Woodruff, and D. I. Berry. 2007. Metadata from WMO Publication No. 47 and an Assessment of Voluntary Observing Ship Observation Heights in ICOADS. *Journal of Atmospheric and Oceanic Technology* 24, no. 2: 214-234.)

The deployed buoys and all the global data bases including satellite and land/sea surface have shown a trend down since 2002 (even as CO2 has increased 3.5%) clearly not depicted in the title page graph.





SUMMARY

The United States and especially the global data bases have serious problems that render them highly questionable for determining accurate long term temperature trends. Especially since most of the issues mentioned produces a warm bias in the data.

As stated earlier and shown here, though there has clearly been some cyclical warming in recent decades (most notably 1979 to 1998) confirmed by satellites, the global surface station based data is seriously compromised by urbanization and other local factors (land-use /land-cover, improper siting, station dropout, instrument changes unaccounted for and missing data) and thus the data bases overestimate the warming. Numerous peer-reviewed papers (referenced below in bold) in the last several years have shown this overestimation are the order of 30 to 50% from these issues alone.

CORRECTION REQUESTED

Because of these serious data contamination issues of major station dropout, a large increase in missing months in remaining stations, inconsistencies in adjustments for urbanization, land use changes, poor siting and no adjustment for known errors in new instrumentation and uncertainties introduced due to changes in ocean temperature measurement techniques, we therefore request that the ***statement and graph on page 22 and cover page be removed from the document.***

If you wish to correct these data issues and correctly show the historical changes, it is suggested that the following steps be taken:

- (1) Formation of an independent third party audit group of climatologists and statisticians (similar to the Wegman group formed for the Barton Committee to resolve the MBH98.MBH99 vs McKittrick and McIntyre 2003 dispute) to examine all the data, algorithms and adjustment processes. In addition, a record of the past history of changes must be made available for their review. The group would meet with or discuss the data issues with both the government sources and independent scientists who have experience with these data sets. A report should be generated with recommendations for further action including suggested corrections to the data or future processing methodology for a more accurate assessment in accordance with Federal Information Quality Act (IQA).
- (2) This should be done with full visibility and public release of the report
- (3) An independent third party group should be formed to maintain a future version of the data bases much as RSS and UAH does with satellite. It makes no sense to have government agencies which benefit budget wise from any climate change and who do model projections of future conditions also maintain and modify the data that is used to verify their forecasts.

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