SURFACE TEMPERATURE RECORDS: POLICY-DRIVEN DECEPTION?

by Joseph D'Aleo and Anthony Watts

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

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Preface

This paper is, as intended, a work in progress as a compilation of what's current and important relative to the data sets used for formulating and implementing unprecedented policy decisions seeking a radical transformation of our society and institutions.

It was necessitated by the extraordinary revelations in the recently released CRU emails, including the admissions of Ian "Harry" Harris, the CRU programmer. He lamented about *"[The] hopeless state of their (CRU) database. No uniform data integrity, it's just a catalogue of issues that continues to grow as they're found"* and *"Aarrggghhh! There truly is no end in sight. This whole project is SUCH A MESS. No wonder I needed therapy!!"* CRU member, Phil Jones, candidly confessed in a BBC interview that *"his surface temperature data are in such disarray they probably cannot be verified or replicated."*

This reflects on both NOAA and NASA in the United States. Phil Jones also admits that *"Almost all the data we have in the CRU archive is exactly the same as in the GHCN archive used by the NOAA National Climatic Data Center"* and that NASA's GISS uses the GHCN, applying its own adjustments, as it explains: *"The current analysis uses surface air temperatures measurements from the following datasets: the unadjusted data of the Global Historical Climatology Network (Peterson and Vose, 1997 and 1998), United States Historical Climatology Network (USHCN) data, and SCAR (Scientific Committee on Antarctic Research) data from Antarctic stations."*

The paper is also a natural progression of the ongoing work of the authors, who have focused on actual data instead of models and theories. Anthony Watts put together a volunteer team to do the due diligence the government said it could not afford on the stations and found the vast majority (90%) to be sited poorly by the governments own standards. He has documented issues with the equipment and shelters and he and his *Watts Up With That*[1] bloggers have documented many station issues created by post—processing of raw data.

Joe D'Aleo was inspired many years ago by association with the father of Climatology, Helmut Landsberg, to study the effects of urbanization and land use changes on micro-climates. He has tracked research on data quality issues including station dropout, increasingly missing months and contamination by urbanization and land use changes. Joe has alerted NOAA and the EPA about poor integrity of the data bases.

Also as a contributing programmer/researcher, E.M. Smith has been working with the NOAA Global Historical Climate Network (GHCN) and NASA's GIStemp program for processing the NOAA global data. Smith's forensic background and skills allowed him to parse the data by country, latitude and elevation characteristics. Watts and Smith are intimately familiar with the poor metadata, which makes the critical analysis of the historical record and data adjustments challenging or even impossible.

1 http://www.wattsupwiththat.com/.

The first version of this paper inspired and motivated others toward a more in depth look into the data and methodology – a positive and welcome development long overdue. It is now essential that there be carried out an independent review of NOAA data methods and quality control procedures, such as is in process within CRU.

Future updated versions of this paper will include additional findings, corrections and enhancements based on additional feedback and constructive discussion.

Much attention and comment has focused on the station dropout issue. The loss of stations in the USA and worldwide is a real issue that NOAA does not dispute. NOAA claims that by focusing on temperature *anomalies* instead of *actual* temperatures the problem is resolved. In places with a reasonable density of stations, a random station dropout would likely not affect anomalies but where the data is already sparse or where the dropout was biased towards a certain character station, biases can be real and even significant. Further study is needed.

This does not mitigate the fact that missing data (40% of GHCN is missing at least one month of data), poor station siting and urbanization all contaminate data toward a warming bias.

Over a dozen recent peer reviewed papers (including one by Dr. Phil Jones) have shown this to be the case. Dr. Jones showed a data contamination of 1C per century. Updates to this paper will provide more details and additional case studies attesting to this *bias* outcome.

In the words of two of the authors frequently mentioned in the paper, we need:

> ***"…independent groups doing new and independent global temperature analyses—not international committees of Nobel laureates passing down opinions on tablets of stone."*** (–Roy Spencer)

and

> ***"an inclusive assessment of the surface temperature record of CRU, GISS and NCDC. We need to focus on the science issues. This necessarily should involve all research investigators who are working on this topic, with formal assessments chaired and paneled by mutually agreed to climate scientists who do not have a vested interest in the outcome of the evaluations."*** (–Roger Pielke Sr.)

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SUMMARY FOR POLICY MAKERS

(by SPPI)

1. Instrumental temperature data for the pre-satellite era (1850-1980) have been so widely, systematically, and uni-directionally tampered with that it cannot be credibly asserted there has been any significant "global warming" in the 20th century.
2. All terrestrial surface-temperature databases exhibit signs of urban heat pollution and post measurement adjustments that render them unreliable for determining accurate long-term temperature trends.
3. All of the problems have skewed the data so as greatly to overstate observed warming both regionally and globally.
4. Global terrestrial temperature data are compromised because more than three-quarters of the 6,000 stations that once reported are no longer being used in data trend analyses.
5. There has been a significant increase in the number of missing months with 40% of the GHCN stations reporting at least one missing month. This requires infilling which adds to the uncertainty and possible error.
6. Contamination by urbanization, changes in land use, improper siting, and inadequately-calibrated instrument upgrades further increases uncertainty.
7. Numerous peer-reviewed papers in recent years have shown the overstatement of observed longer term warming is 30-50% from heat-island and land use change contamination.
8. An increase in the percentage of compromised stations with interpolation to vacant data grids may make the warming bias greater than 50% of 20th-century warming.
9. In the oceans, data are missing and uncertainties are substantial. Changes in data sets introduced a step warming in 2009.

10. Satellite temperature monitoring has provided an alternative to terrestrial stations in compiling the global lower-troposphere temperature record. Their findings are increasingly diverging from the station-based constructions in a manner consistent with evidence of a warm bias in the surface temperature record.

11. Additional adjustments are made to the data which result in an increasing apparent trend. In many cases, adjustments do this by cooling off the early record.

12. Changes have been made to alter the historical record to mask cyclical changes that could be readily explained by natural factors like multi-decadal ocean and solar changes.

13. Due to recently increasing frequency of eschewing rural stations and favoring urban airports as the primary temperature data sources, global terrestrial temperature data bases are thus seriously flawed and can no longer be representative of both urban and rural environments. The resulting data is therefore problematic when used to assess climate trends or VALIDATE model forecasts.

14. An inclusive external assessment is essential of the surface temperature record of CRU, GISS and NCDC "chaired and paneled by mutually agreed to climate scientists who do not have a vested interest in the outcome of the evaluations."

15. Reliance on the global data by both the UNIPCC and the US GCRP/CCSP should trigger a review of these documents assessing the base uncertainty of forecasts and policy language.

A QUESTION OF GLOBAL TEMPERATURE

Recent revelations from the Climategate[2] whistleblower emails, originating from the Climatic Research Unit at the University of East Anglia followed by the candid admission by Phil Jones, the director of the CRU in a BBC interview that his "*surface temperature data are in such disarray they probably cannot be verified or replicated*" certainly should raise questions about the quality of global data.

This reflects on both NOAA and NASA in the United States. Phil Jones admitted "*Almost all the data we have in the CRU archive is exactly the same as in the GHCN archive used by the NOAA National Climatic Data Center.*" NASA uses the GHCN as the main data source for the NASA GISS data.

These facts have inspired climate researchers worldwide to take a hard look at the data proffered by comparing it to the original data and to other data sources. This report compiles some of the initial findings.

There has clearly been evidence of some cyclical warming in recent decades, most notably 1979 to 1998. However, the global surface-station data is seriously compromised. First, there is a major station dropout, which occurred suddenly around 1990 and a significant increase in missing monthly data in the stations that remained. A bias was found towards disappearance of cooler higher elevation, higher latitude and rural stations during this culling process – though leaving the cooler station data in the base periods from which 'averages' and anomalies are computed. Though the use of anomalies mitigates the possible bias in data rich areas we will show by example it does not eliminate them universally.

The data suffers significant contamination by urbanization and other local factors such as land-use/land-cover changes and improper siting and use of poorly designed or inappropriate sensors. There are uncertainties in ocean temperatures; no small issue, as oceans cover 71% of the earth's surface.

These factors all lead to significant uncertainty and a tendency for over-estimation of century-scale temperature trends. A conclusion from all findings suggest that global data bases are seriously flawed and can no longer be trusted to assess climate trends or rankings or validate model forecasts. And, consequently, such surface data should be ignored for decision making.

THE GLOBAL DATA CENTERS

Five organizations publish global temperature data. Two – Remote Sensing Systems (RSS) and the University of Alabama at Huntsville (UAH) – are satellite datasets. The three terrestrial datasets provided by the institutions – NOAA's National Climatic Data Center

[2] http://scienceandpublicpolicy.org/reprint/climategate_analysis.html.

(NCDC), NASA's Goddard Institute for Space Studies (GISS/ GISTEMP), and the University of East Anglia's Climatic Research Unit (CRU) – all depend on data supplied by surface stations administered and disseminated by NOAA under the management of the National Climatic Data Center in Asheville, North Carolina. The Global Historical Climatology Network (GHCN) is the most commonly cited measure of global surface temperature for the last 100 years.

Around 1990, NOAA/NCDC's GHCN dataset lost more than three-quarters of the climate measuring stations around the world. It can be shown that country by country, they lost stations with a bias towards higher-latitude, higher-altitude and rural locations, all of which had a tendency to be cooler.

The remaining climate monitoring stations were increasingly near the sea, at lower elevations, and at airports near larger cities. This data were then used to determine the global average temperature and to initialize climate models. Interestingly, the very same often colder stations that have been deleted from the world climate network were retained for computing the average-temperature in the base periods, further increasing the potential bias towards overstatement of the warming. A study by Willmott et al. (1991) calculated a +0.2C bias in the global average owing to pre-1990 station closures. Douglas Hoyt had estimated approximately the same value in 2001 due to station closures around 1990. A number of station closures can be attributed to cold-war era military base closures, such as the DEW Line (The Distant Early Warning Line) in Canada and its counterpart in Russia.

Around 1990, NOAA lost more than three-quarters of the climate measuring stations around the world. It can be shown that country by country, they lost stations with a bias towards higher-latitude, higher-altitude and rural locations, all of which had a tendency to be cooler.

The world's surface observing network had reached its golden era in the 1960s-1980s, with more than 6000 stations providing valuable climate information. Now, there are fewer than 1500 remaining.

It is a fact that the three data centers each performed some final adjustments to the gathered data before producing their own final analysis. These adjustments are frequent and often poorly documented. The result was almost always to produce an enhanced warming even for stations which had a cooling trend in the raw data. The metadata, the information about precise location, station moves and equipment changes was not well documented and shown frequently to be in error which complicates the assignment to proper grid boxes and makes the efforts of the only organization that attempts to adjust for urbanization, NASA GISS problematic.

As stated here[3], "The problem [accuracy of the latitude/longitude coordinates in the metadata] is, as they say, "even worse than we thought." One of the consumers of GHCN metadata is of course GISTEMP, and the implications of imprecise latitude/longitude for GISTEMP are now considerably greater, following the change in January 2010 to use of satellite-observed night light radiance to classify stations as rural or urban throughout the world, rather than just in the contiguous United States as was the case previously. As about a fifth of all GHCN stations changed classification as a result, this is certainly not a minor change."

Among some major players in the global temperature analyses, there is even disagreement about what the surface air temperature really is. (See "The Elusive Absolute Surface Air Temperature (SAT)" by Dr. James Hansen here[4]. Essex et al. questioned whether a global temperature existed here[5].)

> ***All these issues with the underlying data ensure that the mean global surface temperature for each month and year would show a false-positive temperature anomaly.***

All these issues with the underlying data ensure that the mean global surface temperature for each month and year would show a false-positive temperature anomaly. This method would also ensure that the trend in the temperature change would be enhanced beyond the natural 60-year climate cycles.

After every month, season and year the world data centers release their assessment of the historic ranking of the period. NOAA/NCDC, NASA/GISS, and Hadley/CRU, compilers of the three terrestrial global-temperature datasets, announce the ranking of the period historically. Invariably in recent years, the months, seasons and years have all ranked among the warmest in the record in their assessments. NOAA announced that December 2009 ranked as the 8th warmest December and the winter the 5th warmest for the globe. This seemed incongruous in vast Northern Hemispheric areas that had suffered a third winter of brutal cold and snow that month and this winter, in many places the coldest in 3 to 5 decades and for some the snowiest in history.

The institutions also announced that 2009 was one of the warmest years on record. (NOAA 5th warmest, NASA tied for 2nd warmest). Many in the United States found this hard to believe, given the very cold winter, spring and past summer. October 2009 was the third coldest in 115 years of record-keeping. December 2009 was also very cold, the 14th coldest. The terrestrial institutions also solemnly announced that the 2000s was the warmest decade

3 http://oneillp.wordpress.com/2010/03/13/ghcn-metadata/.
4 http://data.giss.nasa.gov/gistemp/abs_temp.html.
5 http://www.uoguelph.ca/~rmckitri/research/globaltemp/globaltemp.html.

in the historical record. Some have ignored the inconvenient truths contained within CRU's Climategate emails, and have pronounced that the 2000s was the warmest decade in a millennium or two.

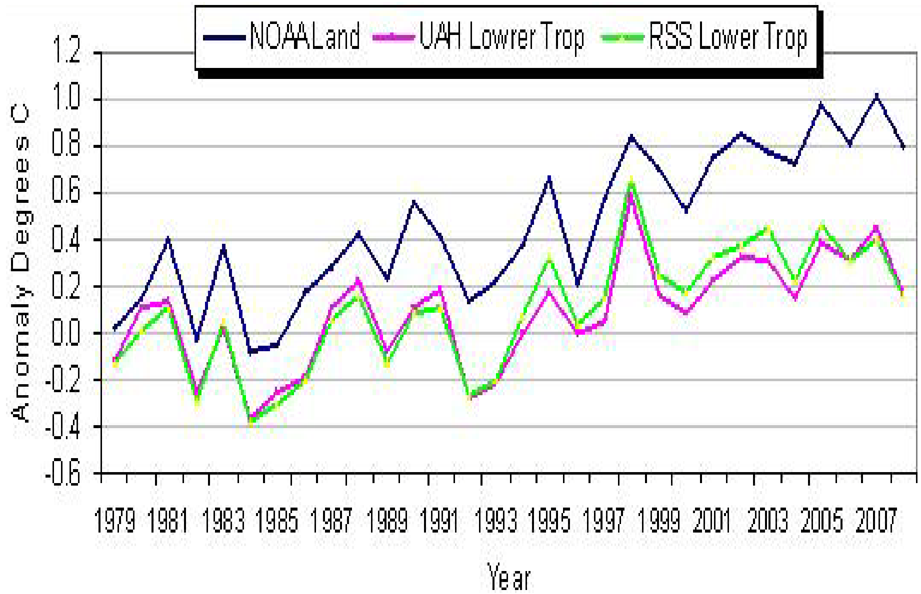
Satellite data centers over recent years have not confirmed the persistent warmth of the surface networks in their assessments of monthly and yearly global temperature though they did record a jump up typically observed with a moderate to strong El Nino event this fall and winter.

This has been the trend in recent years. As example of the divergence, NOAA announced that for the globe June 2009 (for the globe) was the second warmest June[6] in 130 years falling just short of 2005. In sharp contrast to this NASA, The University of Alabama Huntsville, (UAH) Microwave Sounder Unit (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 May 2009 to be the 4th warmest for the globe in 130 years of record keeping. Meanwhile NASA, UAH and MSU satellite assessments showed it was the 15th coldest May in the 31 years of its record keeping. This divergence is not new and has been growing. Just a year ago 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.

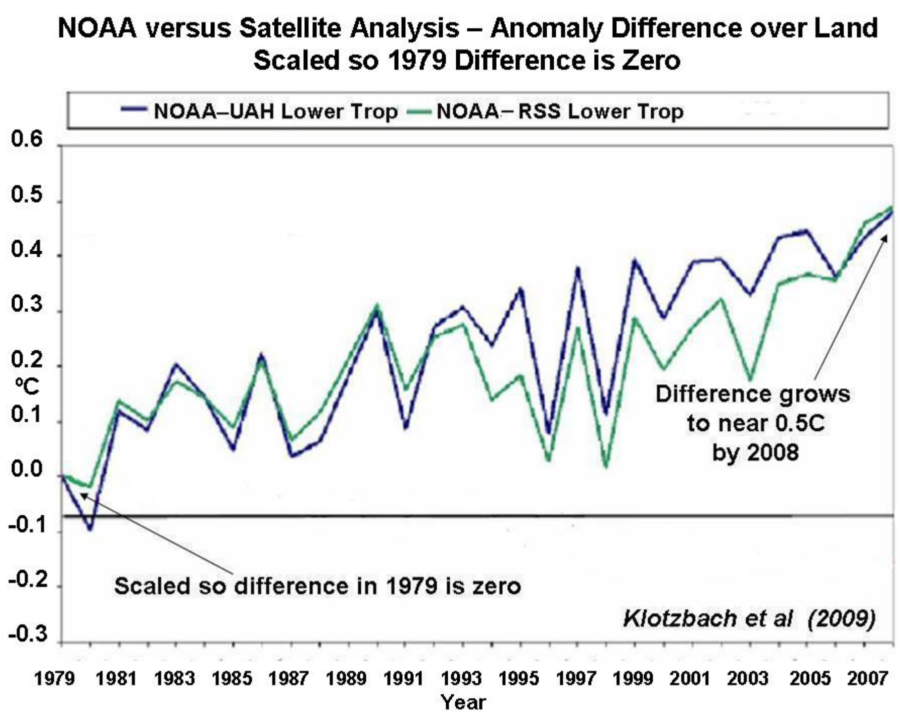
Some still claim the satellite-measured temperatures are in error. RSS and UAH in 2005 jointly agreed[7] that there was a small net cold bias of 0.03 C° in their satellite-measured temperatures, and corrected the data for this small bias. In contrast, the traditional surface station data have been found to suffer from many warm biases that are orders of magnitude greater in size than the satellite data, yet that fact is often ignored by consumers of the data.

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 (CCSP[8]). 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 the following graph.

6 http://www.ncdc.noaa.gov/oa/climate/research/2009/jun/global.html#temp.
7 http://www.marshall.org/article.php?id=312.
8 http://www.climatescience.gov/Library/sap/sap1-1/finalreport/.



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.



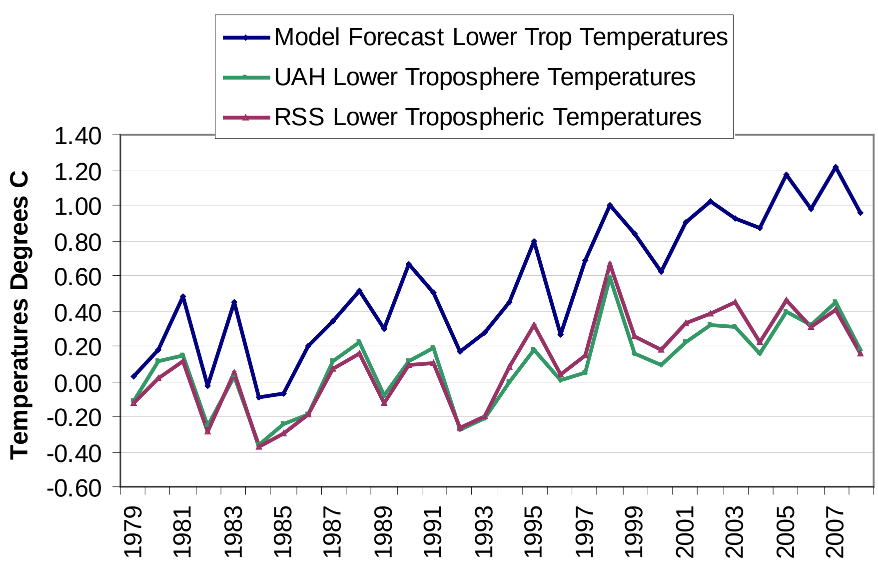
NOAA annual land temperatures minus annual UAH lower troposphere (blue line) and NOAA annual land temperatures minus annual RSS lower troposphere (green line) differences over the period from 1979 to 2008.

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 Dr. John Christy, keeper of the UAH satellite dataset 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).

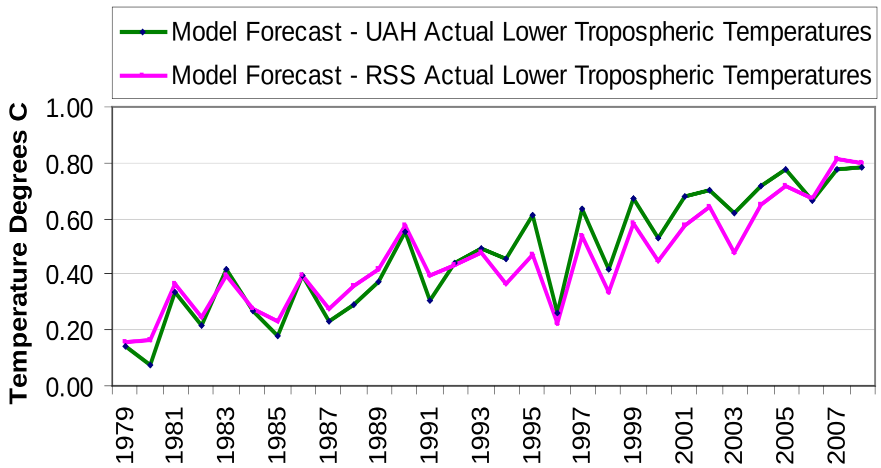
The amplification factor was calculated from the mean and median of the 19 GCMs that were in the CCSP SAP 1.1 report (Karl et al., 2006). A fuller discussion of how the amplification factor was calculated is available in the Klotzbach paper here[9].

The ensemble model forecast curve (upper curve) in the figure 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.



9 http://pielkeclimatesci.files.wordpress.com/2009/11/r-345.pdf.

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



These 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 fully adjusted for, trends from the surface networks are not reliable.

In this document we will explain why the NOAA, NASA and the Hadley Center press releases should be ignored. The reason is that the surface based data sets have become seriously flawed and can no longer be trusted for reliable climate trend assessment.

THE GOLDEN AGE OF SURFACE OBSERVATION

In this era of ever-improving technology and data systems, one would assume that measurements would be constantly improving. This is not the case with the global station observing network. The Golden Age of Observing was several decades ago. It is gone.

The Hadley Centre's Climate Research Unit (CRU) at East Anglia University is responsible for the CRU global data. NOAA's NCDC, in Asheville, NC, is the source of the Global Historical Climate Network (GHCN) and of the US Historical Climate Network (USHCN). These two datasets are relied upon by NASA's GISS in New York City and by Hadley/CRU in England.

All three have experienced a degradation in data quality in recent years.

Ian "Harry" Harris, a programmer at the Climate Research Unit, kept extensive notes of the defects he had found in the data and computer programs that the CRU uses in the compilation of its global mean surface temperature anomaly dataset. These notes, some 15,000 lines in length, were stored in the text file labeled "Harry_Read_Me.txt", which was among the data released by the whistleblower with the Climategate emails. This is just one of his comments –

"[The] hopeless state of their (CRU) database. No uniform data integrity, it's just a catalogue of issues that continues to grow as they're found...I am very sorry to report that the rest of the databases seem to be in nearly as poor a state as Australia was. There are hundreds if not thousands of pairs of dummy stations, one with no WMO and one with, usually overlapping and with the same station name and very similar coordinates. I know it could be old and new stations, but why such large overlaps if that's the case? Aarrggghhh! There truly is no end in sight.

"This whole project is SUCH A MESS. No wonder I needed therapy!!"

"This whole project is SUCH A MESS. No wonder I needed therapy!!

"I am seriously close to giving up, again. The history of this is so complex that I can't get far enough into it before by head hurts and I have to stop. Each parameter has a tortuous history of manual and semi-automated interventions that I simply cannot just go back to early versions and run the updateprog. I could be throwing away all kinds of corrections - to lat/lons, to WMOs (yes!), and more. So what the hell can I do about all these duplicate stations?"

Phil Jones, the director of the CRU in a BBC interview ultimately agreed with "Harry" that his *"surface temperature data are in such disarray they probably cannot be verified or replicated"* and that at least some of the original raw data was lost which certainly should raise questions about the quality of global data.

In the following email, CRU's Director at the time, Dr. Phil Jones, acknowledges that CRU mirrors the NOAA data:

"Almost all the data we have in the CRU archive is exactly the same as in the GHCN archive used by the NOAA National Climatic Data Center."

And NASA's GISS uses the GHCN, applying its own adjustments, as it explains:

"The current analysis uses surface air temperatures measurements from the following datasets: the unadjusted data of the Global Historical Climatology Network (Peterson and Vose, 1997 and 1998), United States Historical Climatology Network (USHCN) data, and SCAR (Scientific Committee on Antarctic Research) data from Antarctic stations."

Dr. Roger Pielke Sr. in this post[10] on the three data sets notes:

> "The differences between the three global surface temperatures that occur are a result of the analysis methodology as used by each of the three groups. They are not "completely independent." Each of the three surface temperature analysis suffer from unresolved uncertainties and biases as we documented, for example, in our peer reviewed paper[11]"

Dr. Richard Anthes, President of the University Corporation for Atmospheric Research, in testimony to Congress[12] in March 2009, noted:

> "The present federal agency paradigm with respect to NASA and NOAA is obsolete and nearly dysfunctional, in spite of best efforts by both agencies."

VANISHING STATIONS

For the present evaluation, the data was downloaded in its entirety from NOAA's GHCN data servers. It also includes all the descriptor documentation by E.M. Smith, a software engineer who analyzed the data and provided it for review by meteorologists, climatologists, and statisticians.

Perhaps one of the biggest issues with the global data is the disappearance of temperature monitoring stations from the networks after 1990. More than 6000 stations were in the NOAA data base for the mid- 1970s, but just 1500 or less are used today. NOAA claims the real-time network includes 1200 stations with 200-300 stations added after several months and included in the annual numbers. NOAA is said to be adding additional US stations now that USHCN v2 is available, which will inflate this number, but make it disproportionately U.S.

There was a major disappearance of recording stations in the late 1980s to the early 1990s. The following figure compares the number of global stations in 1900, the 1970s and 1997, showing the increase and then decrease (Peterson and Vose[13]).

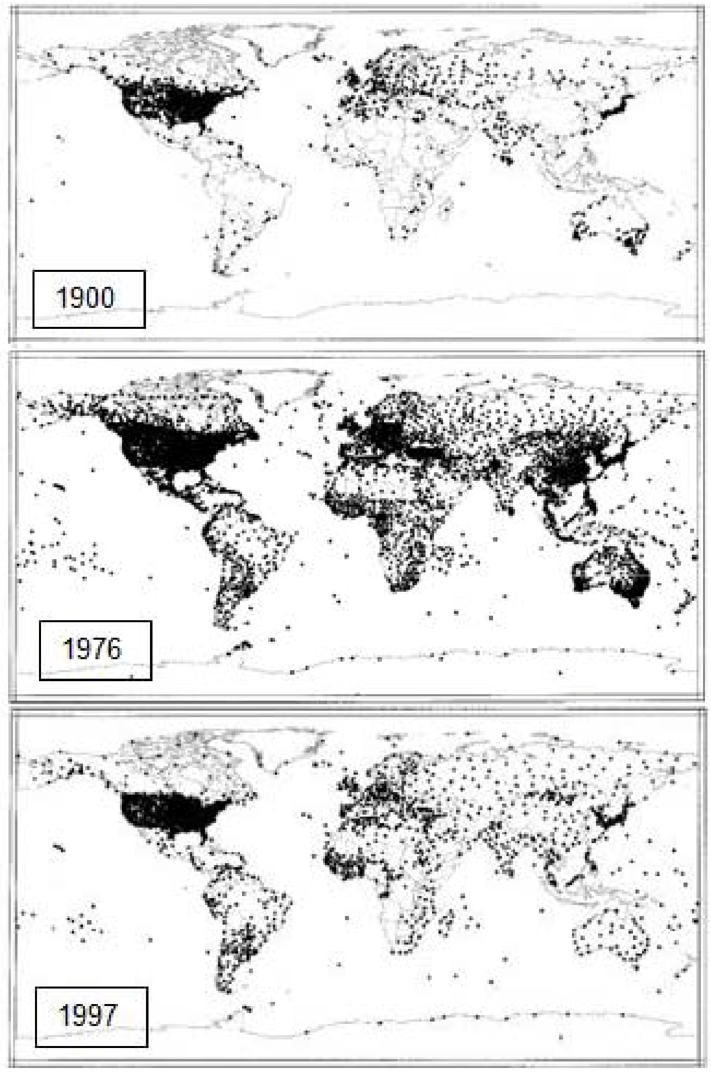
[10] http://pielkeclimatesci.wordpress.com/2009/11/25/an-erroneous-statement-made-by-phil-jones-to-the-media-on-the-independence-of-the-global-surface-temperature-trend-analyses-of-cru-giss-and-ncdc/.

[11] http://pielkeclimatesci.files.wordpress.com/2009/10/r-321.pdf.

[12] http://www.ucar.edu/oga/pdf/Anthes%20CJS%20testimony%203-19-09.pdf.

[13] http://www.ncdc.noaa.gov/oa/climate/ghcn-monthly/images/ghcn_temp_overview.pdf.

Perhaps one of the biggest issues with the global data is the disappearance of temperature monitoring stations from the networks after 1990. More than 6000 stations were active in the mid-1970s. 1500 or less are in use today.



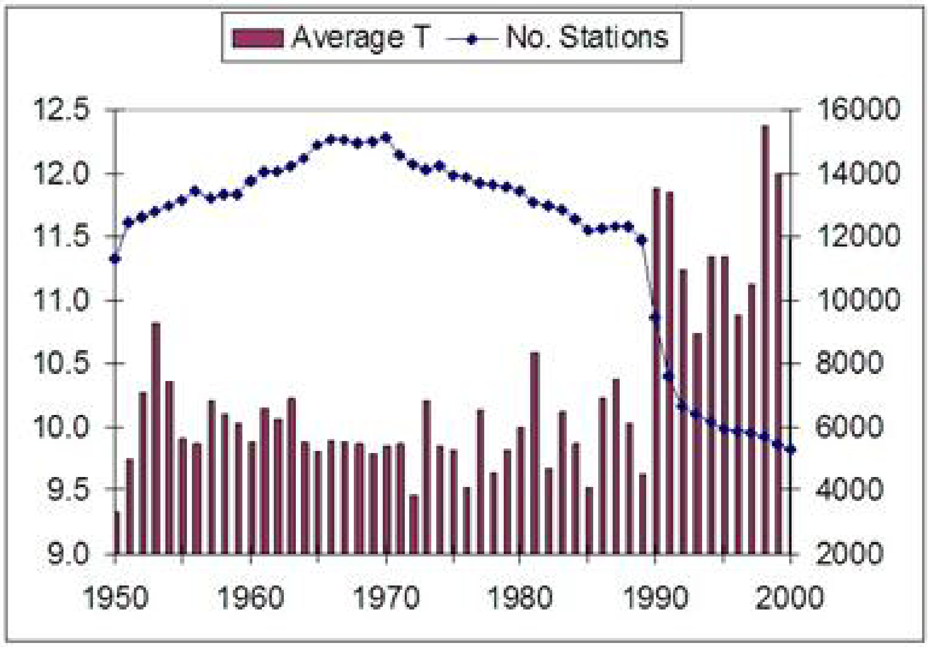
Dr. Kenji Matsuura and Dr. Cort J. Willmott at the University of Delaware have prepared this animation[14]. See the lights go out in 1990, especially in Asia.

The following chart[15] of all GHCN stations and the average annual temperature show the drop focused around 1990. In this plot, those stations with multiple locations over time are given separate numbers, which inflates the total number. While a straight average is not meaningful for global temperature calculation (because areas with more stations would have higher weighting), it illustrates that the disappearance of so many stations may have introduced an upward temperature bias.

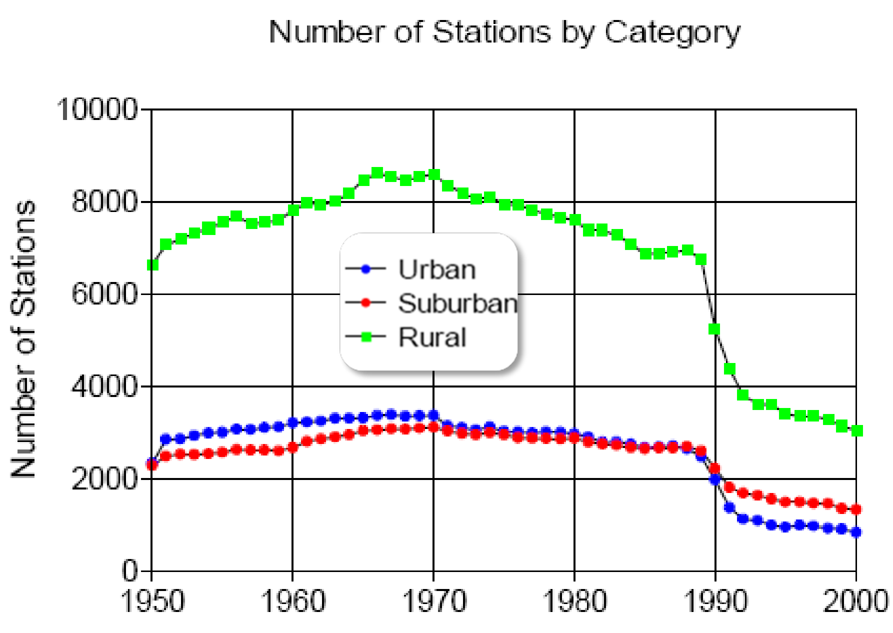
As can be seen in the figure, the straight average of all global stations does not fluctuate much until 1990, at which point the average temperature jumps up. This observational bias

14 http://climate.geog.udel.edu/~climate/html_pages/Ghcn2_images/air_loc.mpg.
15 http://www.uoguelph.ca/~rmckitri/research/nvst.html.

can influence the calculation of area-weighted averages to some extent. A study by Willmott, Robeson and Feddema ("Influence of Spatially Variable Instrument Networks on Climatic Averages," 1991) calculated a +0.2C bias in the global average owing to pre-1990 station closures.



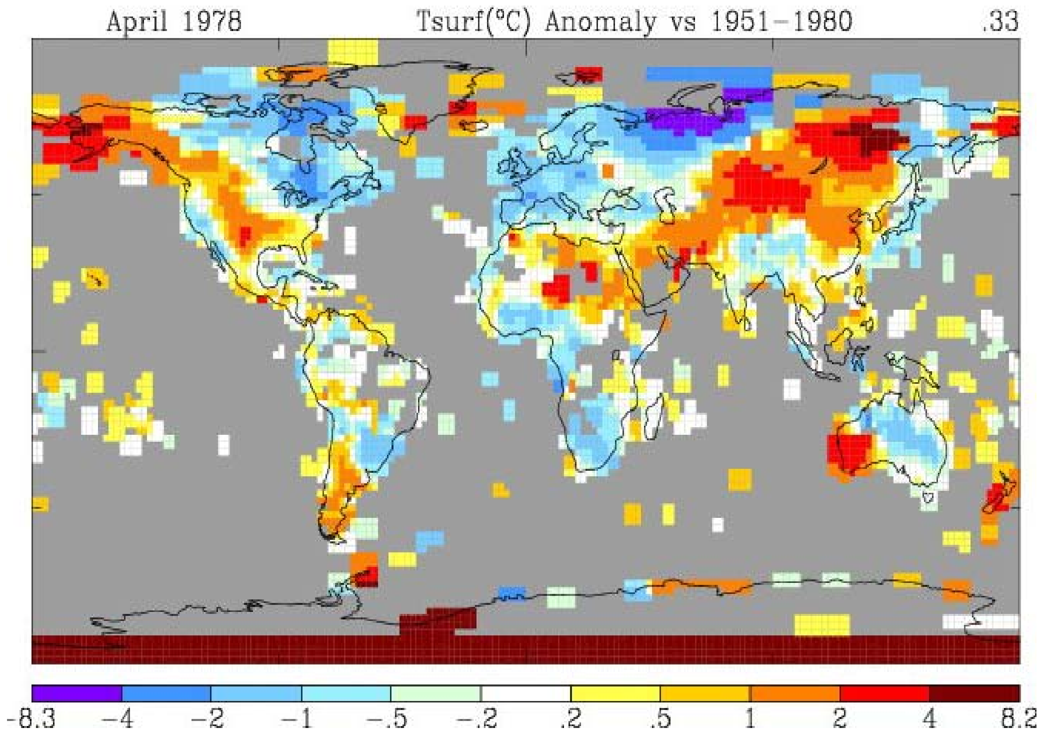
The number of stations that dropped out tended to be disproportionally rural –

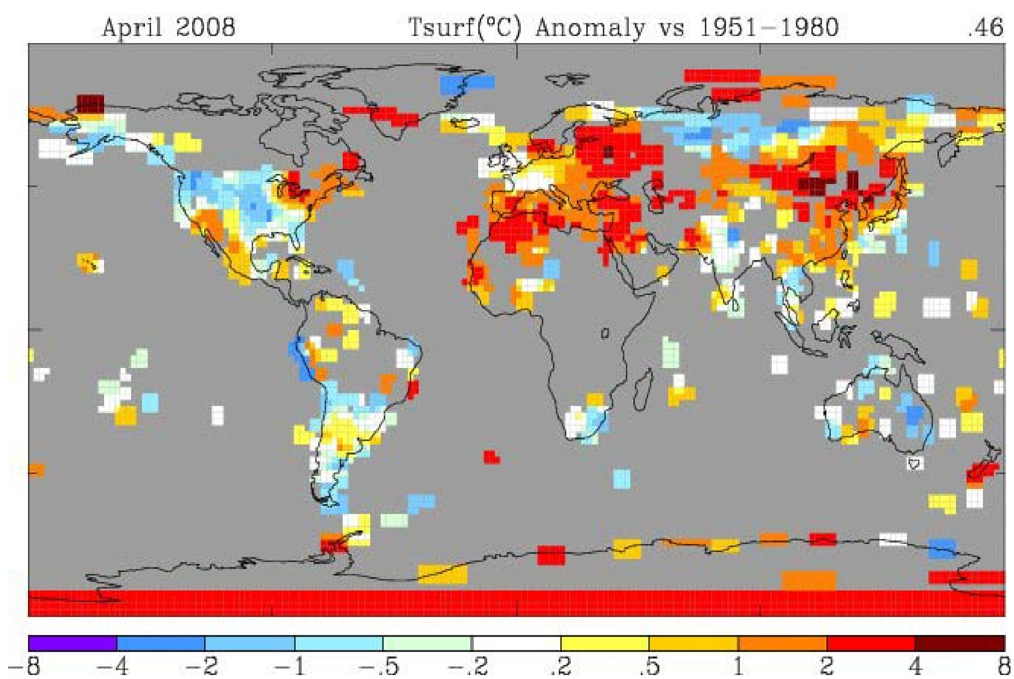


(Station count represent every station reported by GHCN - analyses above from Jonathan Drake.)

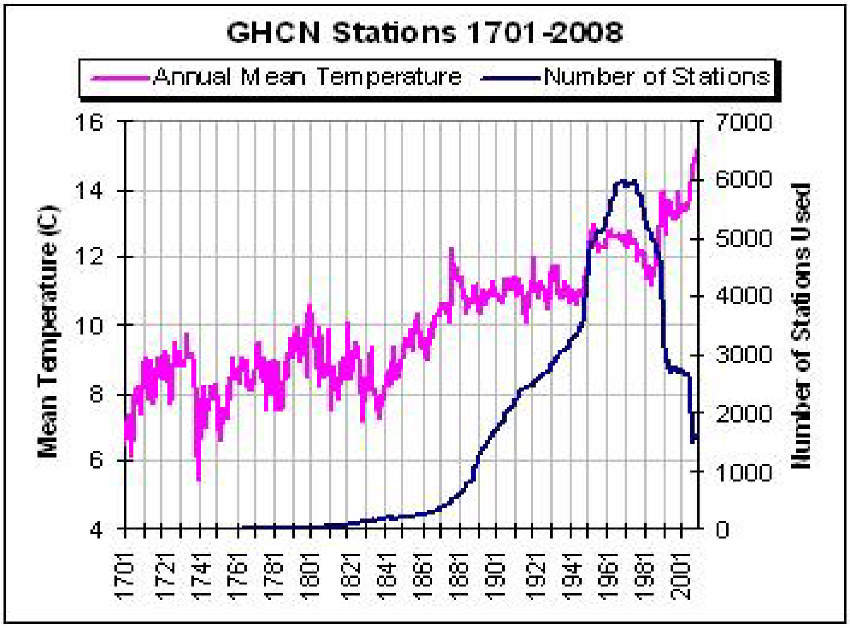
Global databases all compile data into latitude/longitude-based grid boxes and calculate temperatures inside the boxes using data from the stations within them or use the closest stations (weighted by distance) in nearby boxes.

See the huge dropout of data in Africa, Canada and Siberia in the two maps from NASA GISS with 250 kilometer smoothing from 1978 to 2008.





This exhaustive study[16] by E.M. Smith has documented the significant dropout globally around 1990 and the accompanying discontinuity in the mean temperature of the remaining data sets. This suggests again at least part of the recent warming may be due to the distribution changes of the stations.



We fully understand that the NOAA GHCN trends are with regards to anomalies from normal for a global grid and not mean temperatures of the available stations. However, we do not believe that this use of grids and anomalies fully eliminate the effects of the station loss.

The use of anomalies instead of mean temperatures greatly improve the chances of filling in some of the smaller holes (empty grid boxes) or not producing significant differences in areas where the station density is high, they can't be relied on to accurately estimate anomalies in the many large data sparse areas shown on the 2008 map above (Canada, Greenland, Brazil, Africa, parts of Russia) even with the 250 km smoothing applied as in that map. To fill in these areas requires NOAA to reach out maybe 1250 km or more (in other words using Atlanta to estimate a monthly or annual anomaly in Chicago).

There are 8000 grid boxes globally (land and sea). If the earth is 71% ocean, approximately 2320 grid boxes would be over land (actual number will vary as some grid boxes will overlap or may just touch the coast).

With 1200 stations in the real time GHCN network that would be enough to have 51.7% of the land boxes with a station. However, since stations tend to cluster, that number is smaller. Our calculation is that that number is around 44% or 1026 land grid boxes without a station.

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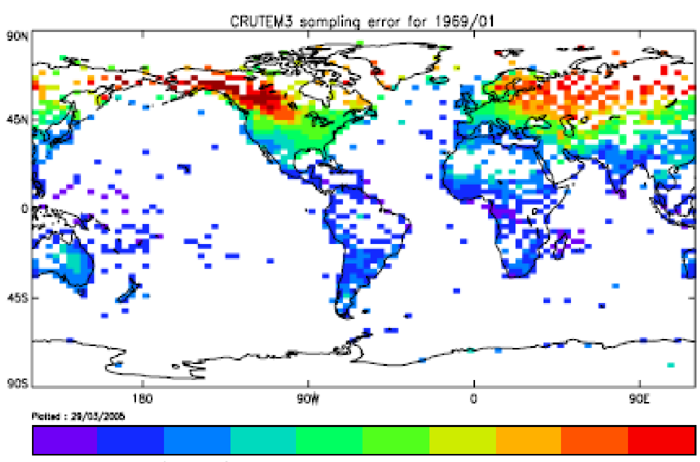
16 http://chiefio.wordpress.com/2009/11/03/ghcn-the-global-analysis/.

For data in empty boxes, GHCN will look to surrounding areas as far away as 1200 kilometers. Certainly an isolated vacant grid box surrounded by boxes with data in them may be able to obtain a reasonably representative extrapolated anomaly value from the surrounding data.

But in data sparse regions, such as is much of the southern hemisphere, when you have to extrapolate from more than one grid box away you are increasing the data uncertainty. If you bias it towards having to look further south (as in Canada) towards more urbanized or airport regions, you are added potential warm bias to uncertainty. This has been the case in the north in the large countries bordering on the arctic (Russia and Canada) where the greatest warming is shown in the data analyses. Some other areas may of course see a bias cold.

To ascertain whether a net bias exists, E.M. Smith has conducted first an analysis of mean temperatures for whatever stations existed by country or continent/sub continent. He then applied a dT method[17] which is a variation of 'First Differences' as a means of examining temperature data anomalies independent of actual temperature. dT/yr is the "average of the changes of temperature, month now vs. the same month that last had valid data, for each year". An anomaly process similar to First Differences. Then dT is the running total of those changes, or the total change, the "Delta Temperature" to date." He is doing this for every country (see here[18]). His next step will be to attempt to splice/blend the data into the grids.

Even then uncertainty will remain that only more complete data set usage would improve. The following graphic powerfully illustrates this was a factor even before the major dropout. Brohan (2005) showed the degree of uncertainty in surface temperature sampling errors for 1969 (here for CRUTEM3). The degree of uncertainty exceeds the total global warming signal.



Source *here*[19].

[17] http://chiefio.wordpress.com/2010/02/28/last-delta-t-an-experimental-approach/.
[18] http://chiefio.wordpress.com/.
[19] http://strata-sphere.com/blog/wp-content/uploads/hadcrut3_gmr_defra_report_200503.pdf.

See for Yourself – The Data is a Mess

Look for yourself following these directions using the window into the NOAA, GHCN data provided by NASA GISS here[20].

Point to any location on the world map (say, central Canada). You will see a list of stations and approximate populations. Locations with less than 10,000 people are assumed to be rural (even though Oke has shown that a town of 1,000 can have an urban warming bias of 2.2C).

You will see that the stations have a highly variable range of years with data. Try to find a few stations where the data extends to 2009. If you find some, you may see gaps in the graphs. To see how incomplete the dataset is for that station, click in the bottom left of the graph *Download monthly data as text*.

For many, many stations you will see the dataset in a monthly tabular form has many missing data months mostly after 1990 (designated by 999.9).

The following table of monthly average surface temperature data is an illustration of this –

SVERDLOVSK, RUSSIA

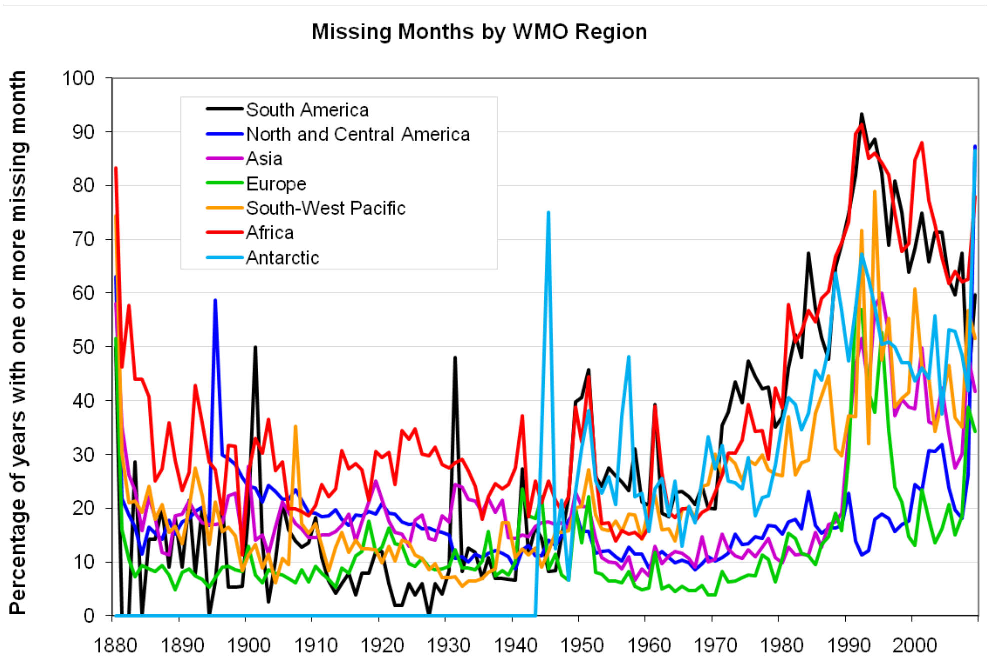
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1987	-18.6	-8.3	-5.5	0.9	14.9	20	19.3	16.2	8.6	2.1	-11.2	-11.5
1988	-12.7	-9.6	-2.6	4.8	10.3	19.5	22.6	18.3	9.7	3.9	-7	-9.9
1989	-15.1	-9.6	-0.3	1.5	11.9	21.4	22.8	14.2	10.2	2.8	-4.2	-10.2
1990	-14.2	-6.8	0.1	5.3	9.6	999.9	19	16.4	999.9	1.2	-5	-8.3
1991	999.9	-12.6	-7.1	9.2	15.5	999.9	17.6	13.6	10.6	7.2	-3.6	-13.6
1992	-12	-9.2	-4.1	1.8	10.1	14	16.3	13.8	10.9	2.1	-5.3	999.9
1993	-8.9	-11.8	-6	3.2	10.8	17.9	18.6	16.5	5.8	2.4	-13.2	-9.9
1994	-10.2	-17.2	999.9	999.9	11.4	999.9	999.9	14.9	11	6.6	-7	-14
1995	-10.2	-4.2	-0.6	10.7	13	17	999.9	16.9	999.9	3.9	-3.7	-12.7
1996	-14.1	-11.2	-3.9	0.6	12.2	19.1	19.2	999.9	7.1	1.9	-2.3	-10.2
1997	-18.4	-9.4	-2.1	6.2	12	16.7	15.9	14	11.2	5.9	-7.3	-14.7
1998	-11	-14.8	-3.3	-1.4	11.8	18.5	21.6	17.6	8.3	3.5	-12.7	-7.1
1999	-12.6	-7.8	-8.6	4.8	9	15.1	20.2	15.6	9.3	7	-10.4	-6.4
2000	-12.9	-6.9	-1.7	7.2	8.3	19.1	20.5	999.9	8.9	2.3	-6.5	-12.2
2001	-12.1	-14.9	-3.4	6.8	13	14.6	17.9	999.9	10.7	0.6	-4.6	-12.3
2002	-9.2	-4.2	-1	3	9.3	14	19	13.1	11.1	2.1	-3.7	-18.5

These facts suggest that the golden age of observations was in the 1950s to 1980s. Data sites before then were more scattered and did not take data at standardized times of day. After the 1980s the network suffered from loss of stations and missing monthly data. To fill in these large holes, data was extrapolated from greater distances away.

20 http://data.giss.nasa.gov/gistemp/station_data/.

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

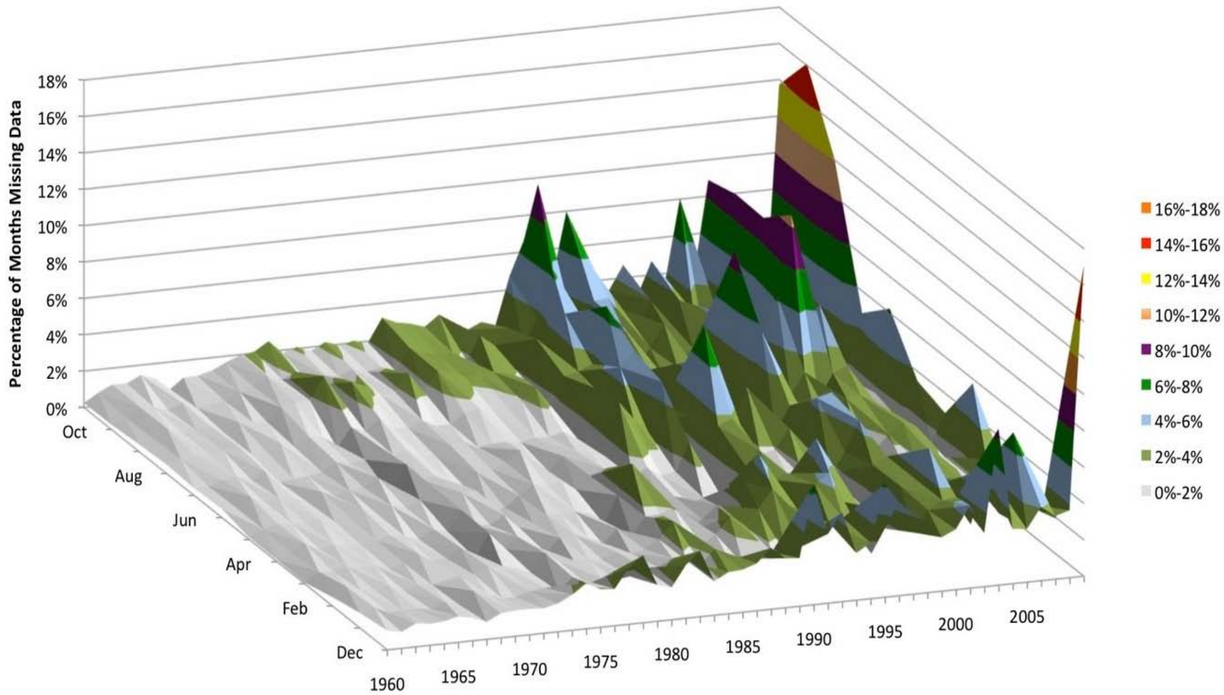
Indeed this is more than just Russia. Forty percent of GHCN v2 stations have at least one missing month.



Quantification of missing months in annual station data.
(Analysis and graph: Andrew Chantrill.)

This is concentrated in the winter months as analyst Verity Jones has shown here[21].

[21] http://digginginthe clay.blogspot.com/2010/03/of-missing-temperatures-and-filled-in.html.



As Verity Jones notes *"Much of the warming signal in the global average data can be traced to winter warming (lows are not as low). If we now have a series of cooler years, particularly cooler winter months with lower lows, my concern is that missing months, particularly winter months could lead to a warm bias."*

NOAA tells us that by 2020, we will have as much data for the 1990s and 2000s as we had in the 1960s and 1970s. We are told that other private sources have been able to assemble more complete data sets in near real time (weathersource). Why can't our government with a budget far greater than these private sources do the same or better? This question has been asked by others in foreign nations.

STATION DROPOUT WAS NOT TOTALLY RANDOM

RUSSIA

The Ria Novosti agency reported that the Moscow-based Institute of Economic Analysis (IEA) issued a report[22] claiming that the Hadley Center for Climate Change had probably tampered with Russian climate data:

[22] http://en.rian.ru/papers/20091216/157260660.html.

> "The IEA believes that Russian meteorological station data did not substantiate the anthropogenic global-warming theory. Analysts say Russian meteorological stations cover most of the country's territory and that the Hadley Center had used data submitted by only 25% of such stations in its reports. The Russian station count dropped from 476 to 121 so over 40% of Russian territory was not included in global temperature calculations for some other reasons rather than the lack of meteorological stations and observations."

The data of stations located in areas not listed in the Hadley Climate Research Unit Temperature UK (HadCRUT) survey often show no substantial warming in the late 20th century and the early 21st century.

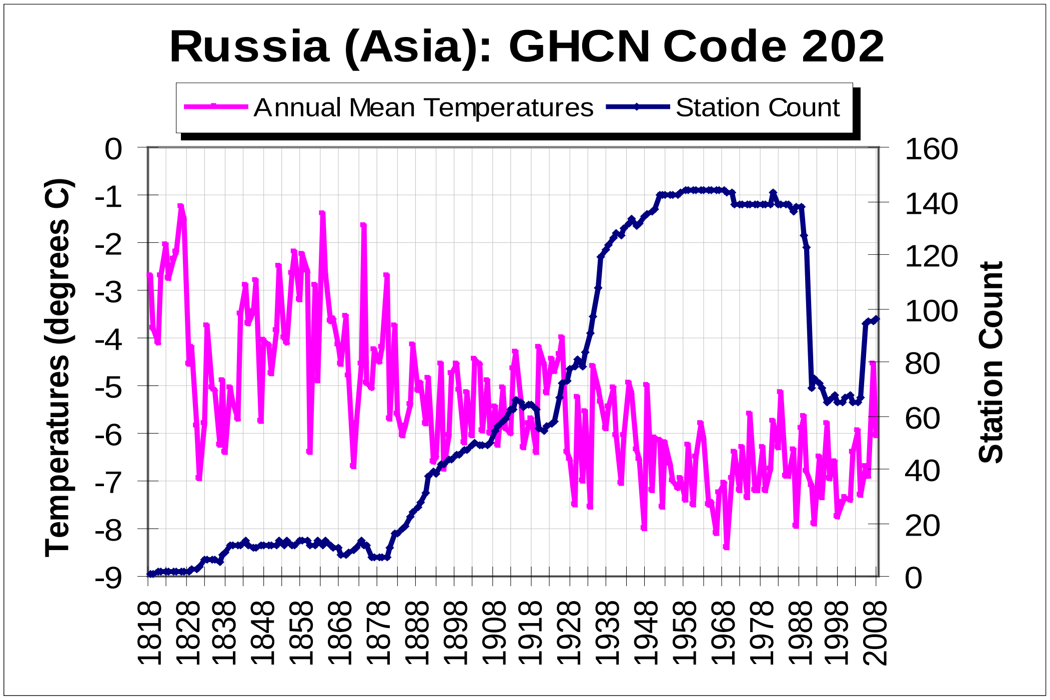
The HadCRUT database includes specific stations with incomplete data, highlighting apparent global warming, rather than stations with uninterrupted observations. The Russians concluded that climatologists used the incomplete findings of meteorological stations far more often than those providing complete observations. These stations are located in large populated centers that are influenced by the urban warming effect.

This created 0.64C greater warming than was exhibited by using 100% of the raw data. Given the huge area Russia represents, 11.5% of global land surface area, this significantly affected global land temperatures.

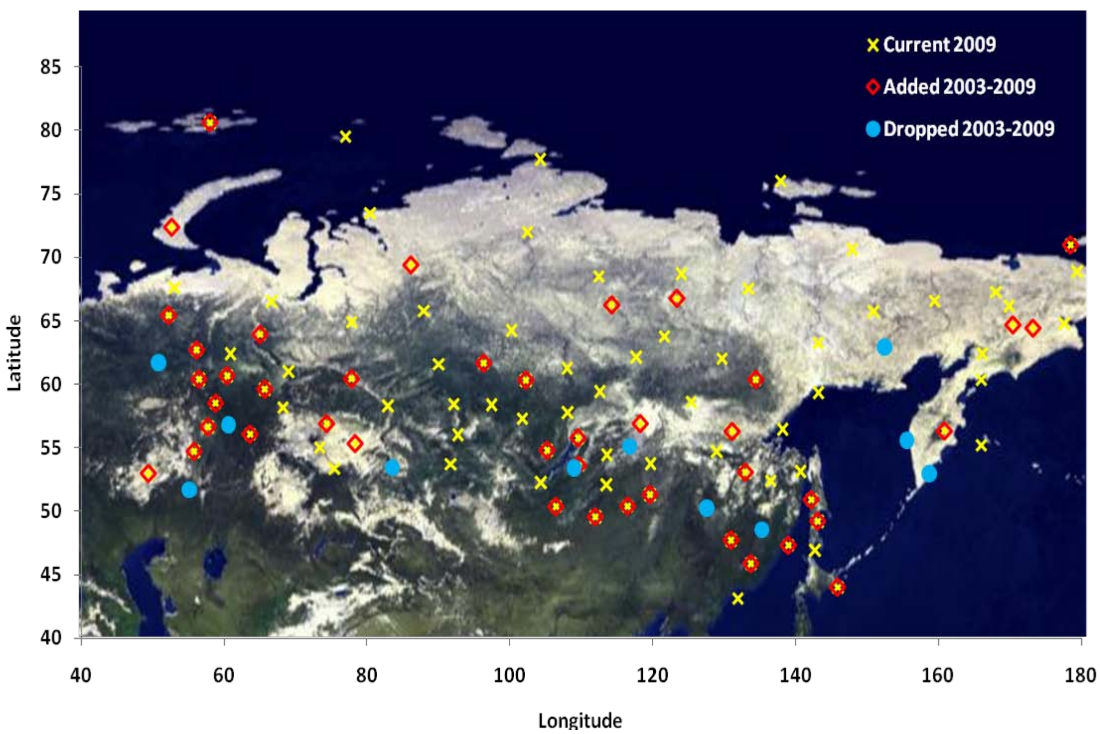
In the cold countries of Russia and Canada, the rural stations in the Polar Regions were thinned out leaving behind the lower latitude more urban stations (more here[23]). The data from the remaining stations were used to estimate the temperatures to the north. As a result the computed new averages were higher than the averages when the cold stations were part of the monthly/yearly assessment. Note how in the GHCN unadjusted data, regardless of station count, temperatures have cooled in these countries. It is only when data from the more southerly, warmer locations is used in the interpolation to the vacant grid boxes that an artificial warming is introduced –

It is only when data from the more southerly, warmer locations is used in the interpolation to the vacant grid boxes that an artificial warming is introduced.

[23] http://chiefio.wordpress.com/2009/10/27/ghcn-up-north-blame-canada-comrade/.

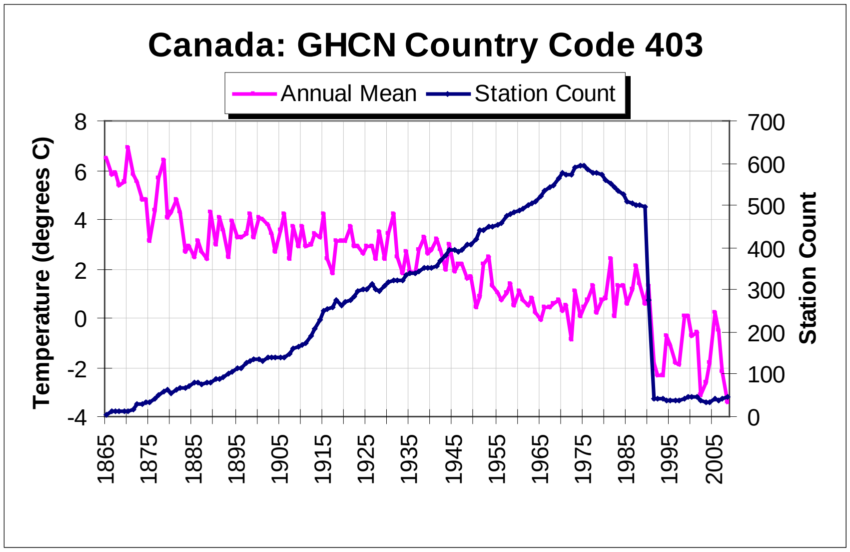


The changes in the distribution continue. E.M. Smith shows how the number of added stations since 2003 was primarily in the south of the normal winter snowpack –



CANADA

In Canada, the number of stations dropped from 600 to less than 50. The percentage of stations in the lower elevations (below 300 feet) tripled and those at higher elevations above 3000 feet were reduced by half. Canada's semi-permanent depicted warmth comes from interpolating from more southerly locations to fill northerly vacant grid boxes, even as a simple average of the available stations shows an apparent cooling.



Just one thermometer remains for everything north of the 65th parallel. That station is Eureka, which has been described as "The Garden Spot of the Arctic" thanks to the flora and fauna abundant around the Eureka area, more so than anywhere else in the High Arctic. Winters are frigid but summers are slightly warmer than at other places in the Canadian Arctic.

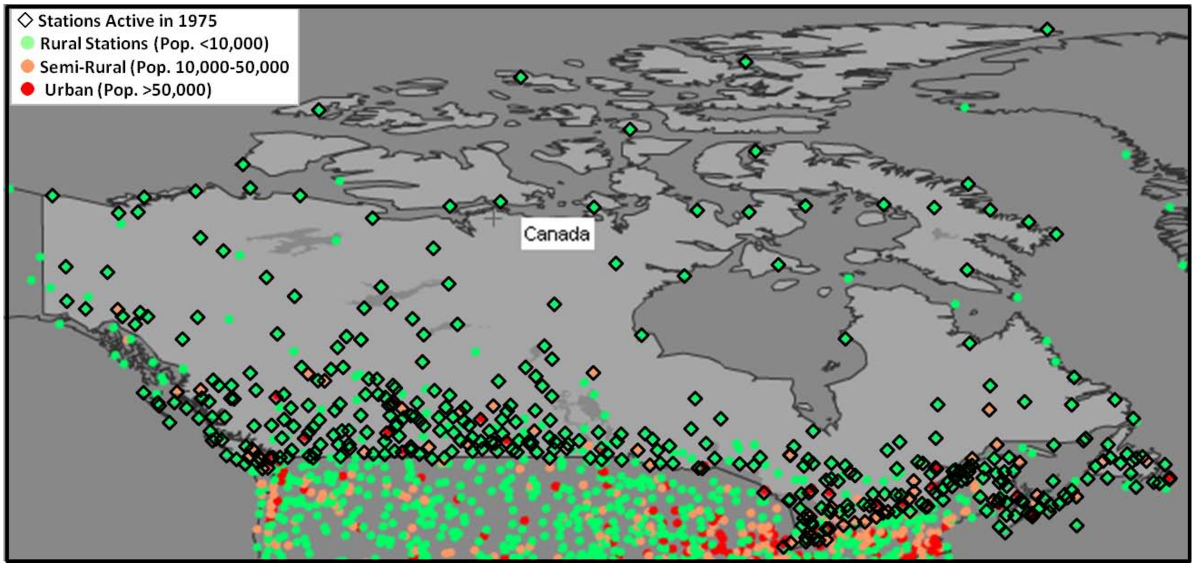
Just one thermometer remains for everything north of the 65th parallel. That station is Eureka, which has been described as "The Garden Spot of the Arctic".

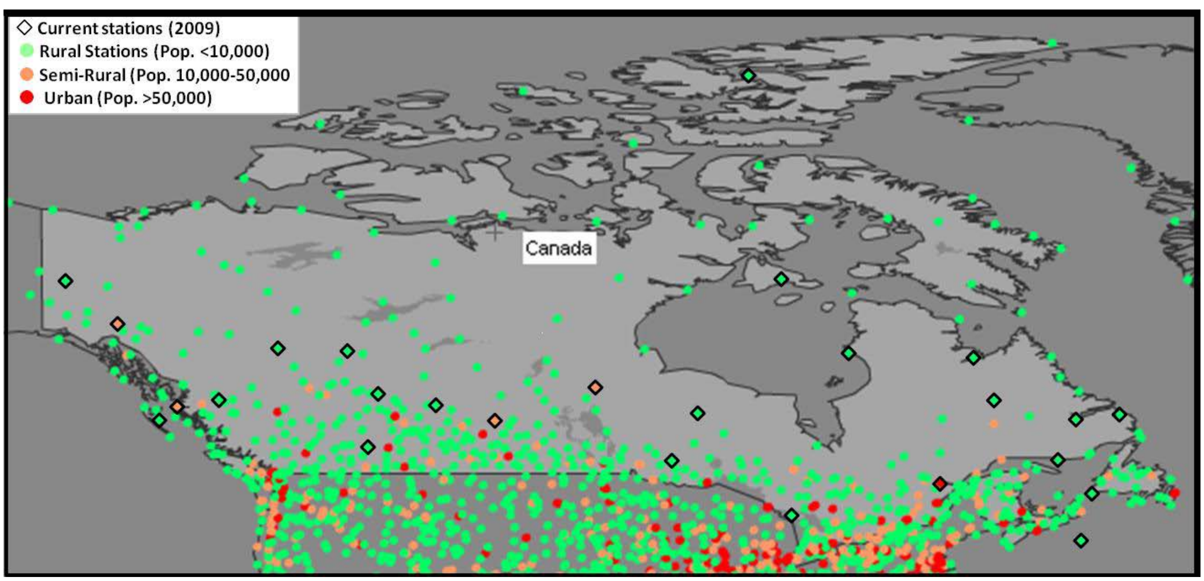
NOAA GHCN used only 35 of the 600 Canadian stations in 2009, down from 47 in 2008. A case study later in this report by Tim Ball will show weather data is available elsewhere from airports across Canada and indeed hourly readings can be found on the internet for many places in Canada (and Russia) not included in the global data bases. Environment Canada reported in the National Post here[24], that there are 1400 stations in Canada with 100 north of the Arctic Circle, where NOAA uses just 1. See E.M. Smith's analysis here[25].

24 http://www.nationalpost.com/news/story.html?id=2465231#ixzz0dY7ZaoIN.

25 http://chiefio.wordpress.com/2009/11/13/ghcn-oh-canada-rockies-we-dont-need-no-rockies/.

Verity Jones plotted the stations from the full network rural, semi-rural and urban for Canada and the northern United States both in 1975 and again in 2009. She also marked with diamonds the stations used in the given year. Notice the good coverage in 1975 and very poor, virtually all in the south in 2009. Notice the lack of station coverage in the higher latitude Canadian region and arctic in 2009.

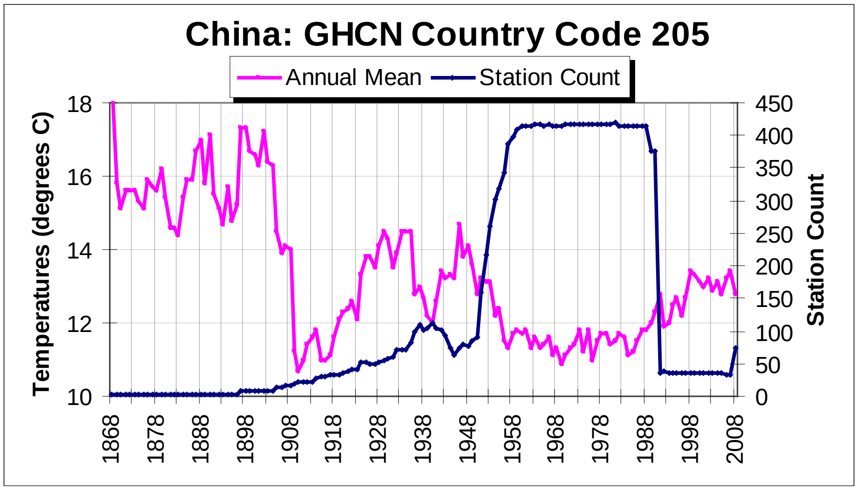




CHINA

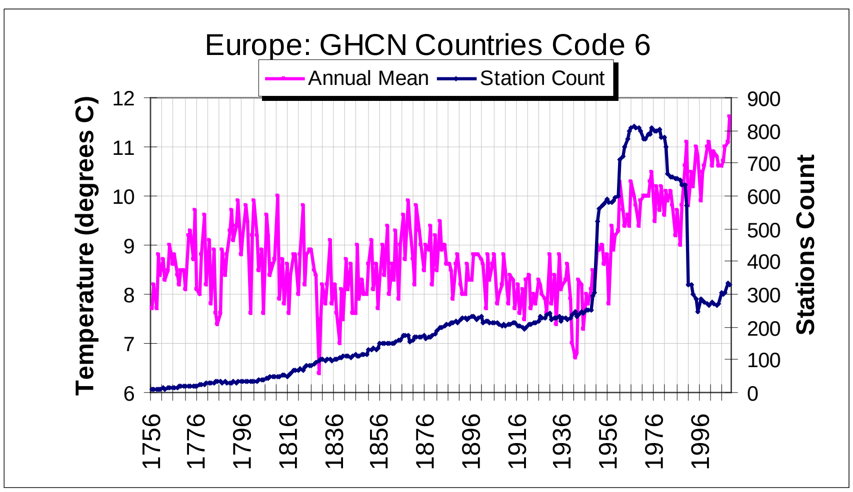
China's station count jumped from 1950 to 1960, held steady to about 1990, then collapsed. China had 100 stations in 1950, over 400 in 1960, then only 35 by 1990. Temperatures showed the results of the station distribution changes, likely the result of urbanization. Dr. Phil Jones et al. (2009) showed a contamination of temperatures in China of 0.1°C per decade (1°C per century).

See E.M. Smith's The Dragon Ate the Thermometers *here*[26].



EUROPE

In Europe higher mountain stations were dropped, leaving behind more coastal cities. The thermometers increasingly moved to the Mediterranean and lower elevations with time. This enhances the urbanization and cyclical warming. The dropout in Europe as a whole was almost 65%. In the Nordic countries it was 50%.



Notice how in the Nordic countries the coldest period coincided with the greatest station density, with a warm-up after the drop-off.

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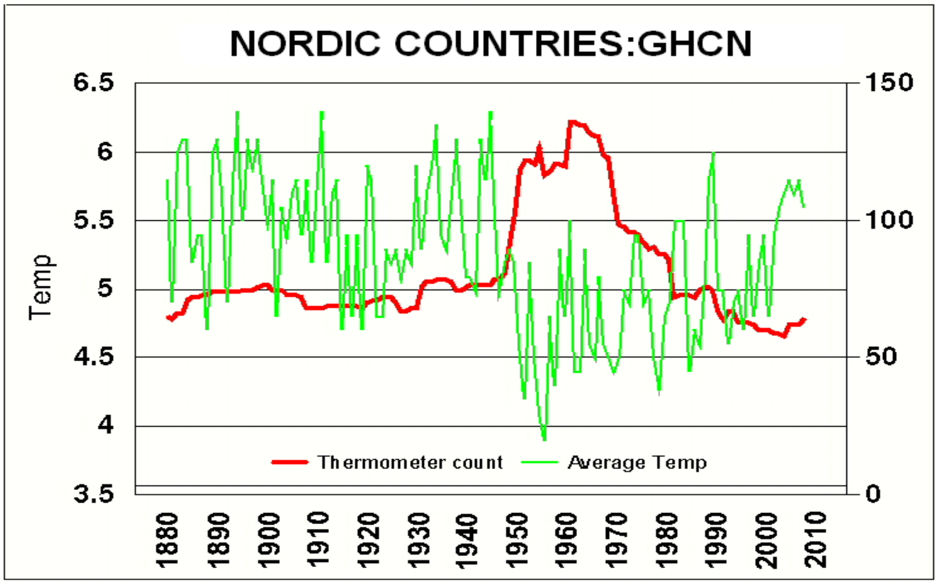
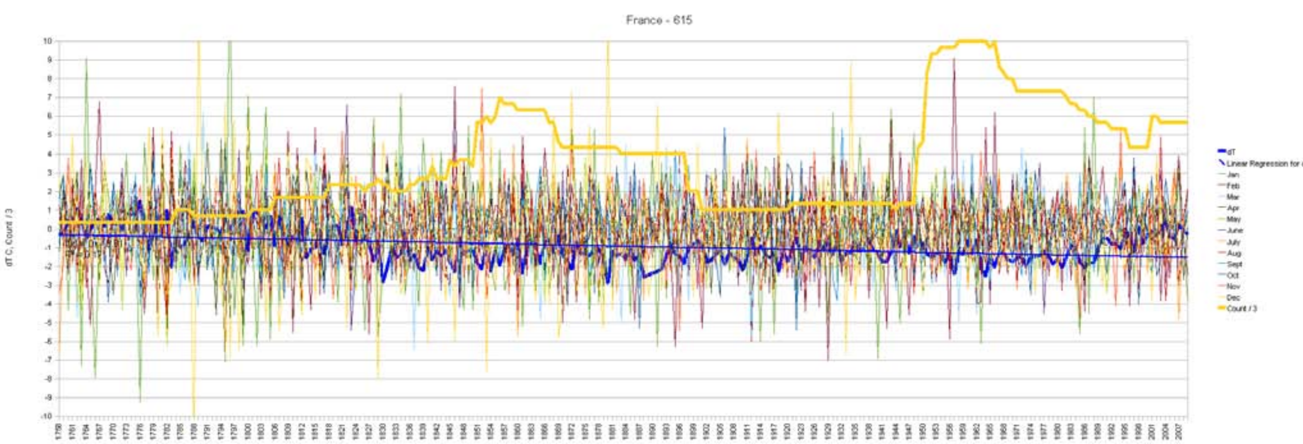
26 http://chiefio.wordpress.com/2009/10/28/ghcn-china-the-dragon-ate-my-thermometers/.



Using the dT/dt and dT analysis for France, we see a cooling till the station rejuggling and dropout in 1990 when an apparent warming ensued.



Enlarged image can be found here[27]. In the full post here[28], note the warming post 1990 in Belgium, but no change in the Netherlands.

Africa

Africa is hot, but it is not getting hotter. It's hard to have "global warming" when Africa is not participating. And this stability is despite clear attempts to redact thermometers from cool areas like the Morocco coast, and move them into the hot area like toward the Sahara: See analysis here[29].

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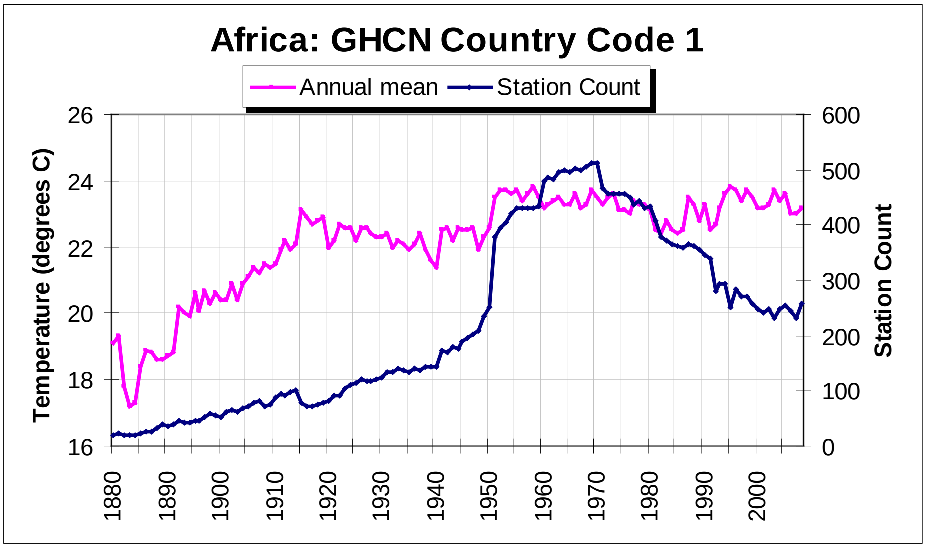
27 http://chiefio.files.wordpress.com/2010/03/france_hair_seg.png.

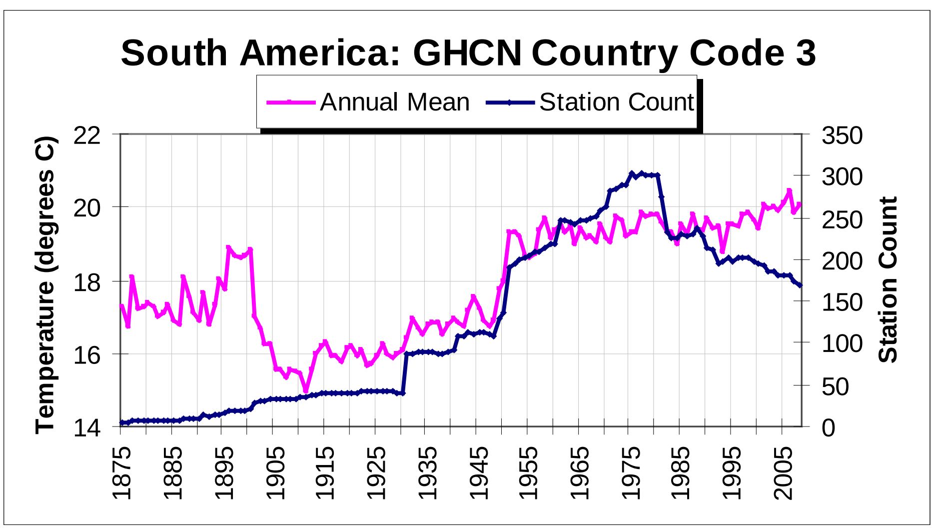
28 http://chiefio.wordpress.com/2010/03/30/europe-atlantic-and-coastal/.

29 http://chiefio.wordpress.com/2009/12/01/ncdc-ghcn-africa-by-altitude/.



South America

Throughout South America the higher elevation stations disappeared, while the number of coastal stations increased. The 50% decline in stations and changing distributions may help explain some of the warming since 1990, an enhanced increase in temperature appeared in South America after 1990.

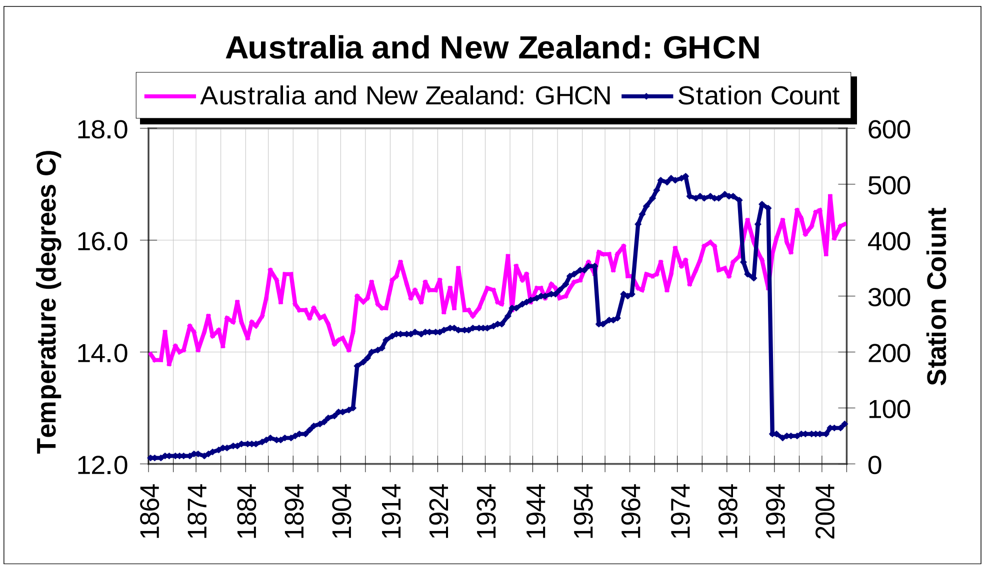


New Zealand and Australia

Smith found that in New Zealand the only stations remaining had the words "water" or "warm" in the descriptor code. Some 84% of the sites are at airports, with the highest percentage in southern cold latitudes.

In Australia, Torok *et al.* (2001)[30] observed that in European and North American cities urban-rural temperature differences scale linearly with the logarithms of city populations. They also learned that Australian city heat islands are generally smaller than those in European cities of similar size, which in turn are smaller than those in North American cities. The regression lines for all three continents converge in the vicinity of a population of 1000 people, where the urban-rural temperature difference is approximately 2.2 ± 0.2°C, essentially the same as what Oke (1973) had reported two decades earlier.

Smith finds the Australian dropout[31] was mainly among higher-latitude, cooler stations after 1990, with the percentage of city airports increasing to 71%, further enhancing apparent warming. The trend in "island Pacific without Australia and without New Zealand" is dead flat. The Pacific Ocean islands are NOT participating in "global" warming. Changes of thermometers in Australia and New Zealand are the source of any change.

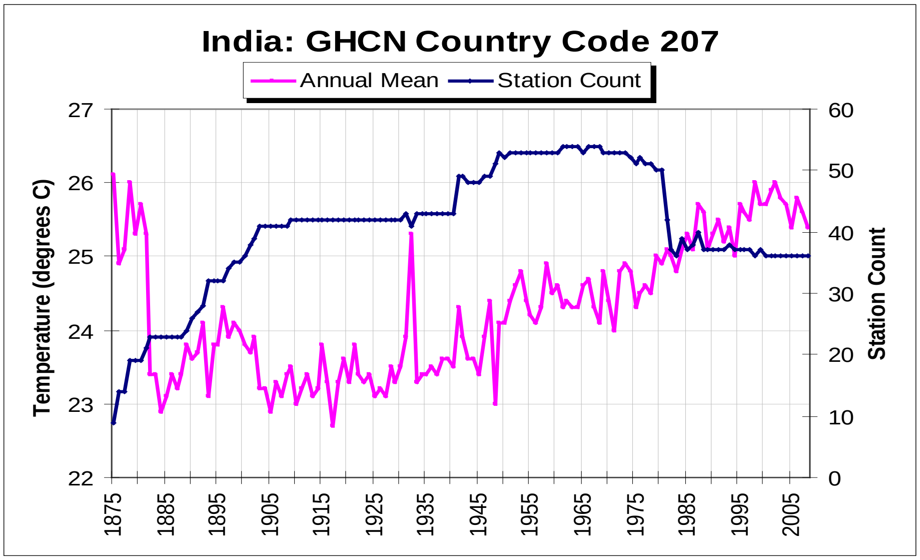


India

India saw a dropout after 1990 though there was never much of an observing network of climate sites in the first place. The dropout may have accelerated the warming that is very probably the result of strong population growth/urbanization.

30 http://www.co2science.org/articles/V5/N20/C3.php.

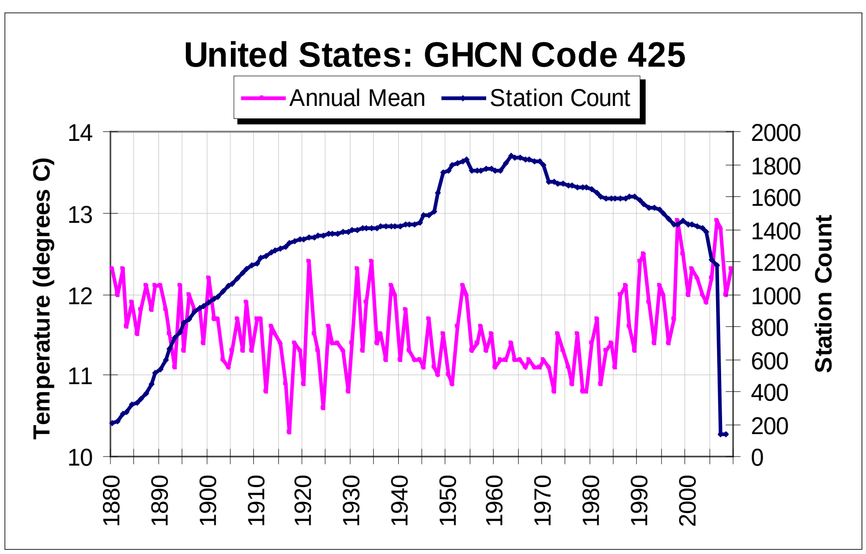
31 http://chiefio.wordpress.com/2009/10/23/gistemp-aussy-fair-go-and-far-gone/.



UNITED STATES

We shall discuss the US climate network, USHCN, later. It is among the most stable databases. Yet Anthony Watts, Dr. Roger Pielke Sr. and others have clearly shown that it is not without its problems.

Amazingly, the same NCDC that manages the USHCN dropped out 90% of all the climate stations in GHCN version 2. E.M. Smith found that most of the stations remaining are at airports and that most of the higher-elevation mountain stations of the west are gone. In California the only remaining stations were San Francisco, Santa Maria, Los Angeles and San Diego.

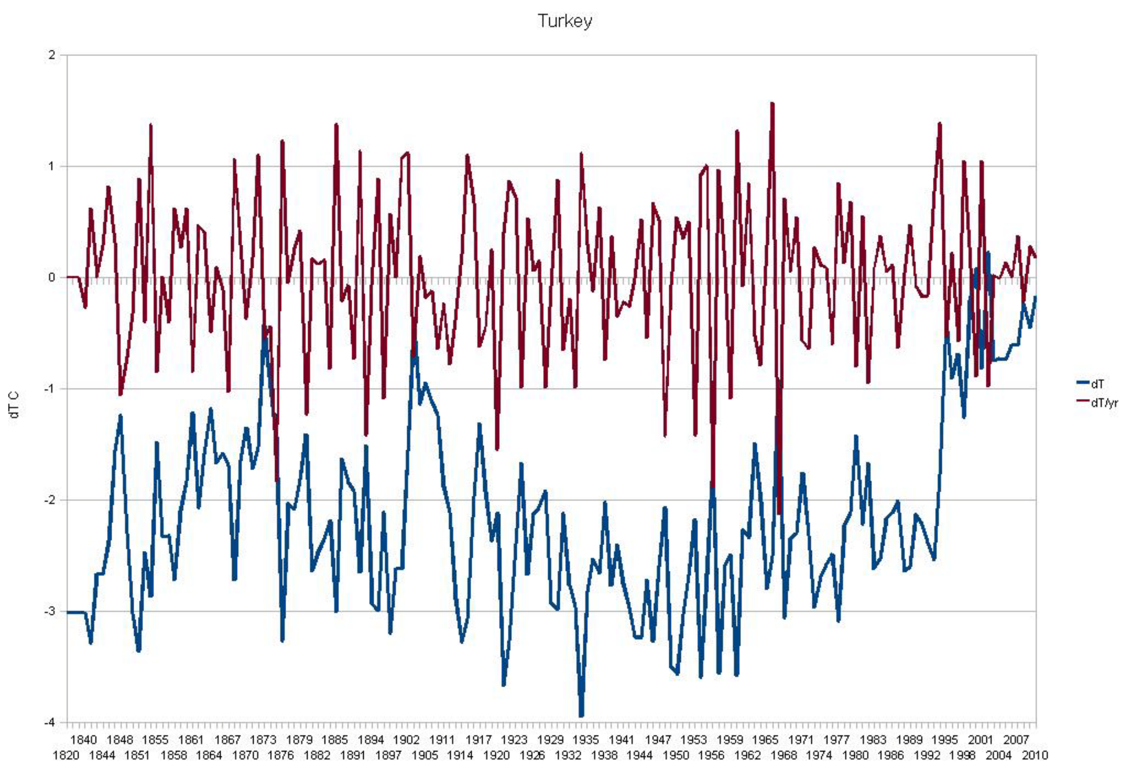


Since the first analysis, E.M. Smith has done an anomaly process detecting change per year and cumulative change for most continents and many countries and smaller regions. One small example is shown below. See many more on his website *Musings from the Chiefio* here[32].

TURKEY

Turkey had one of the densest networks of stations of any country. E.M. Smith calculated cumulative change in temperature and the change per year for Turkey here[33].

His dT method[34] is a variation of 'First Differences' as a means of examining temperature data anomalies independent of actual temperature. dT/yr is the "average of the changes of temperature, month now vs. the same month that last had valid data, for each year". An anomaly process similar to First Differences. Then dT is the running total of those changes, or the total change, the "Delta Temperature" to date." Note the step up after 1990.



Despite that apparent warming, the Turkish Met Service finds evidence for cooling. This peer reviewed paper: Murat Turke, Utku M. Sumer, Gonul Kilic, State Meteorological Service, Department of Research, Climate Change Unit, 06120 Kalaba-Ankara, Turkey which concludes:

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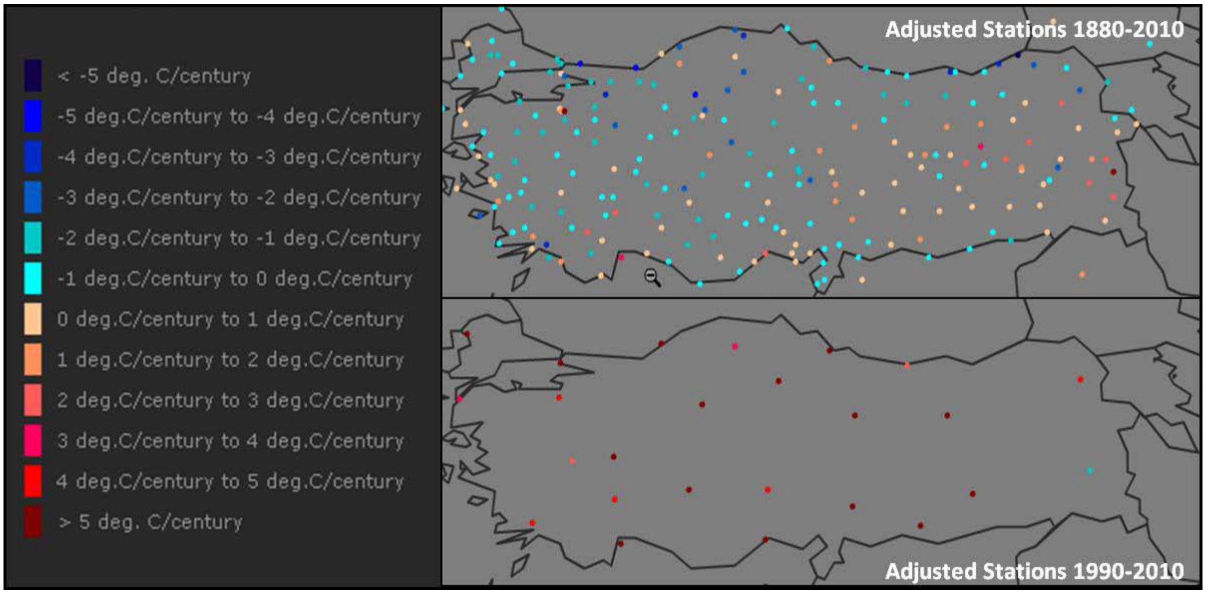
32 http://chiefio.wordpress.com/.

33 http://chiefio.wordpress.com/2010/03/10/lets-talk-turkey/.

34 http://chiefio.wordpress.com/2010/02/28/last-delta-t-an-experimental-approach/.

"Considering the results of the statistical tests applied to the 71 individual stations data, it could be concluded that annual mean temperatures are generally dominated by a cooling tendency in Turkey." See in Verity Jones website *Digging in the Clay* here[35], the dropout of stations from nearly 250 to 39 leaving behind warming stations. 25 of the 39 stations are shown as the other stations did not have complete enough data to determine a reliable trend (less than 10 years without missing months).



Maps showing station temperature trends for (top) all stations active during 1880 to 2010 and (bottom) for stations active after 1990. The result is that Turkey is shown to be warming when the data shows cooling.

INSTRUMENT CHANGES AND SITING

The World Meteorological Organization (WMO), a specialized agency of the United Nations[36], grew out of the International Meteorological Organization (IMO), which was founded in 1873. Established in 1950, the WMO became the specialized agency of the United Nations (in 1951) for meteorology, weather, climate, operational hydrology and related geophysical sciences.

According to the WMO's own criteria, followed by the NOAA's National Weather Service, temperature sensors should be located on the instrument tower at 1.5 meters (5 feet) above the surface of the ground. The tower should be on flat, horizontal ground surrounded by a clear surface, over grass or low vegetation kept less than 4 inches high. The tower should be at least 100 meters (110 yards) from tall trees, or artificial heating or reflecting surfaces, such as buildings, concrete surfaces, and parking lots.

Very few stations meet these criteria.

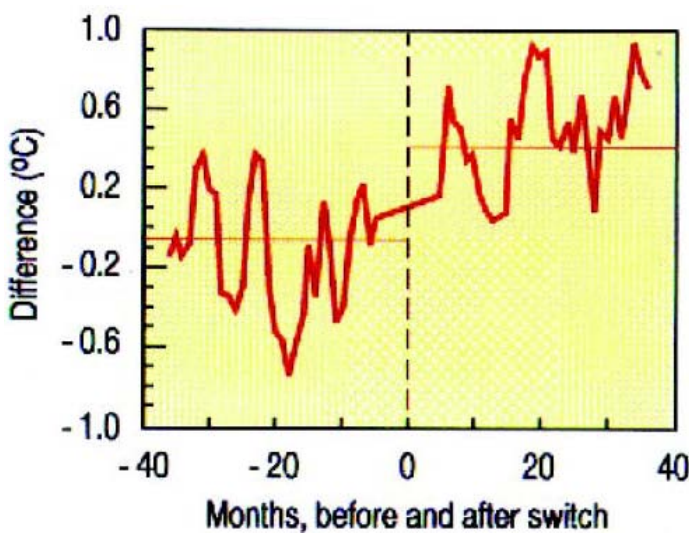
[35] http://diggingintheclay.blogspot.com/2010/03/no-more-cold-turkey.html.
[36] http://www.unsystem.org/en/frames.alphabetic.index.en.htm#w.

ALONG COMES 'MODERNIZATION'

Albert Einstein used to say, "Not everything that can be counted counts, and not everything that counts can be counted." We might add some things that count should be counted.

The modernization of weather stations in the United States replaced many human observers with instruments that initially had major errors, or had "warm biases" (HO-83) or were designed for aviation and were not suitable for precise climate trend detection [Automates Surface Observing Systems (ASOS) and the Automated Weather Observing System (AWOS)]. Also, the new instrumentation was increasingly installed on unsuitable sites that did not meet the WMO's criteria.

Dr. Ben Herman at the University of Arizona confirmed in working with the climate station in Tucson, AZ that the new HO-83 thermometer had a significant warm bias. This observation was based on the work by Gall et al. (1992) and Jones (1995). Stephen McIntyre has summarized in The HO-83 Hygro-thermometer[37] the findings by Tom Karl et al. in 1995 of a sudden jump in temperature of about 0.5°C after the new thermometer was introduced. This discontinuity caused by the introduction of the HO-83 apparently was not adjusted for in the USHCN database for the period from the 1980s to the late 1990s, when the instruments were replaced.



Effects of changing from the HO-63 to the HO-83 thermometer series on maximum temperature in the United States. Source: Karl et al., 1995.

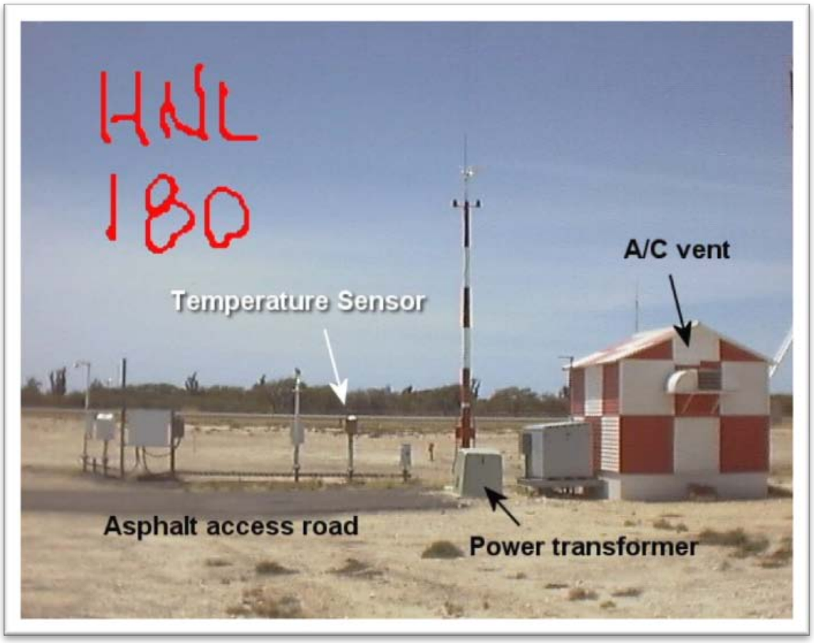
[37] http://www.climateaudit.org/?p=1954.

Then there was the "upgrade" to automated surface observing systems at airports. ASOS[38] was designed mainly for aviation purposes. It has an error tolerance of +/-0.9F for air temperature.

Temperature Sensor's Range, Accuracy, and Resolution

Parameter	Range	RMSE	Max Error	Resolution
Ambient Temperature	-80°F to -58°F	1.8°F	± 3.6°F	0.1°F
	-58°F to +122°F	0.9°F	± 1.8°F	
	+122°F to +130°F	1.8°F	± 3.6°F	
Dew Point Temperature	-80°F to -0.4°F	3.1°F to 7.9°F	4.5°F to 13.9°F	0.1°F
	-0.4°F to +32°F	2.0°F to 7.9°F	3.4°F to 13.9°F	
	+32°F to +86°F	1.1°F to 4.7°F	2.0°F to 7.9°F	

In June 2009, the ASOS station at the Honolulu, HI International airport malfunctioned[39], resulting in new record high temperatures being introduced into the NOAA records database. Despite the NWS office in Honolulu admitting the error, the faulty high temperature records were retained in NOAA's database[40]. Anthony Watts demonstrates with NOAA photography that the HNL ASOS station itself has siting issues related to nearby heat sources.



The majority of US airports used by GHCN use equipment identical to this ASOS station.

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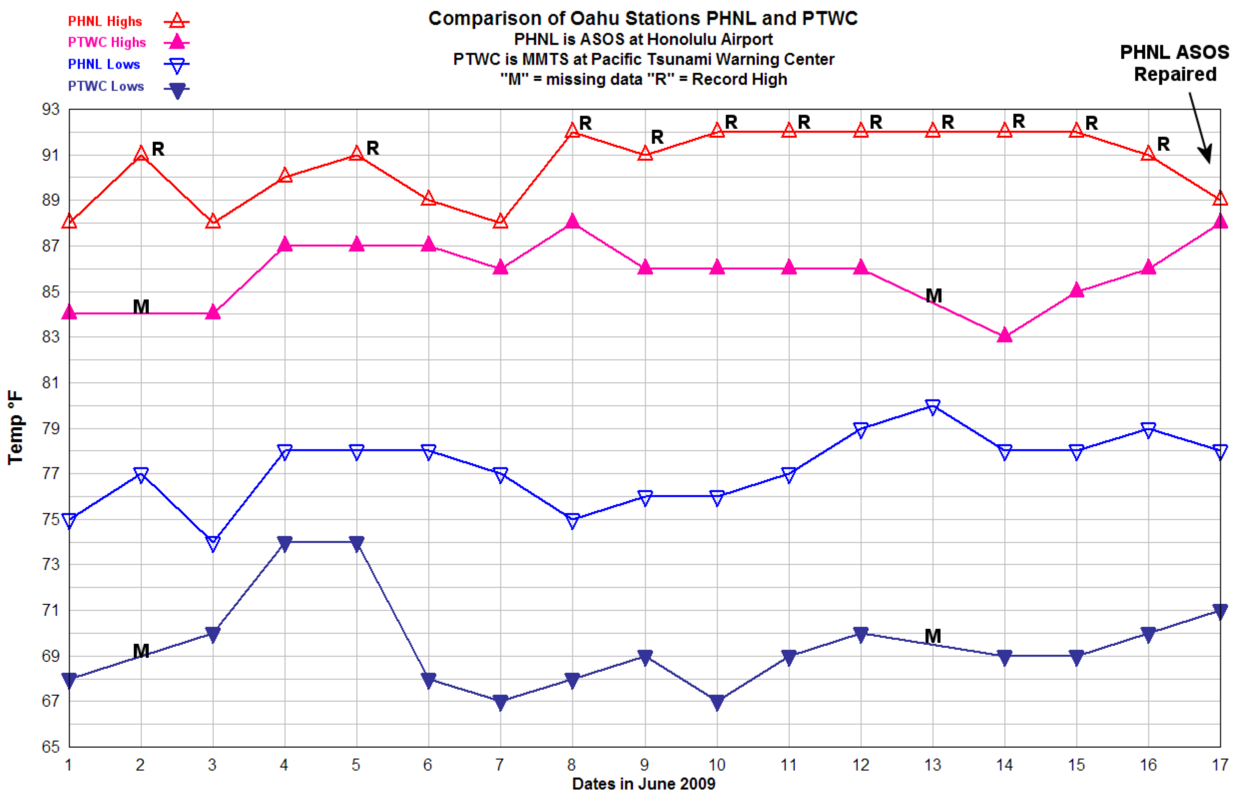
[38] http://www.nws.noaa.gov/asos/aum-toc.pdf.

[39] http://wattsupwiththat.com/2009/06/16/how-not-to-measure-temperature-part-88-honolulus-official-temperature-2/.

[40] http://wattsupwiththat.com/2009/06/17/noaa-fubar-high-tempclimate-records-from-faulty-sensor-to-remain-in-place-at-honolulu/.

Using temperature data from the nearby NOAA station at the Pacific Tsunami Warning Center (PTWC) only 3.9 miles away, it is easy to [demonstrate the magnitude of the temperature error of the HNL airport ASOS station][41] prior to its repair.

The difference in the high temperature between the two stations ranges from 2 degrees to as much as 9 degrees Fahrenheit during the period that new high temperature records were set at the Honolulu airport. The graph below prepared by Anthony Watts demonstrates the magnitude of the difference between stations separated by a short distance.



During recent decades there has been a migration away from old instruments read by trained observers. These instruments were generally in shelters that were properly located over grassy surfaces and away from obstacles to ventilation and heat sources.

Today we have many more automated sensors (The MMTS) located on poles cabled to the electronic display in the observer's home or office or at airports near the runway where the primary mission is aviation safety.

> ***During recent decades there has been a migration away from old instruments read by trained observers.***

[41] http://wattsupwiththat.com/2009/06/19/more-on-noaas-fubar-honolulu-record-highs-asos-debacle-plus-finding-a-long-lost-giss-station/.

The installers of the MMTS instruments were often equipped with nothing more than a shovel. They were on a tight schedule and with little budget. They often encountered paved driveways or roads between the old sites and the buildings. They were in many cases forced to settle for installing the instruments close to the buildings, violating the government specifications in this or other ways.

Left: USHCN climate station in Bainbridge, GA, showing the MMTS pole sensor in the foreground near the parking space, building, and air conditioner heat exchanger, with the older Stevenson Screen in the background located in the grassy area.

Pielke and Davey (2005) found a majority of stations, including climate stations in eastern Colorado, did not meet WMO requirements for proper siting.

They extensively documented poor siting and land-use change issues in numerous peer-reviewed papers, many summarized in the landmark paper Unresolved issues with the assessment of multi-decadal global land surface temperature trends[42] (2007).

In a volunteer survey project, Anthony Watts and his more than 650 volunteers www.surfacestations.org found that over 900 of the first 1067 stations surveyed in the 1221 station US climate network did not come close to meeting the specifications. Only about 3% met the ideal specification for siting. They found stations located next to the exhaust fans of air conditioning units, surrounded by asphalt parking lots and roads, on blistering-hot rooftops, and near sidewalks and buildings that absorb and radiate heat. They found 68 stations located at wastewater treatment plants, where the process of waste digestion causes temperatures to be higher than in surrounding areas. In fact, they found that 90 percent of the stations fail to meet the National Weather Service's own siting requirements that stations must be 30 meters (about 100 feet) or more away from an artificial heating or reflecting source.

The average warm bias for inappropriately-sited stations exceeded 1 C° using the National Weather Service's own criteria, with which the vast majority of stations did not comply.

Here[43] was a report from last spring with some of the earlier findings. Some examples from these sources:

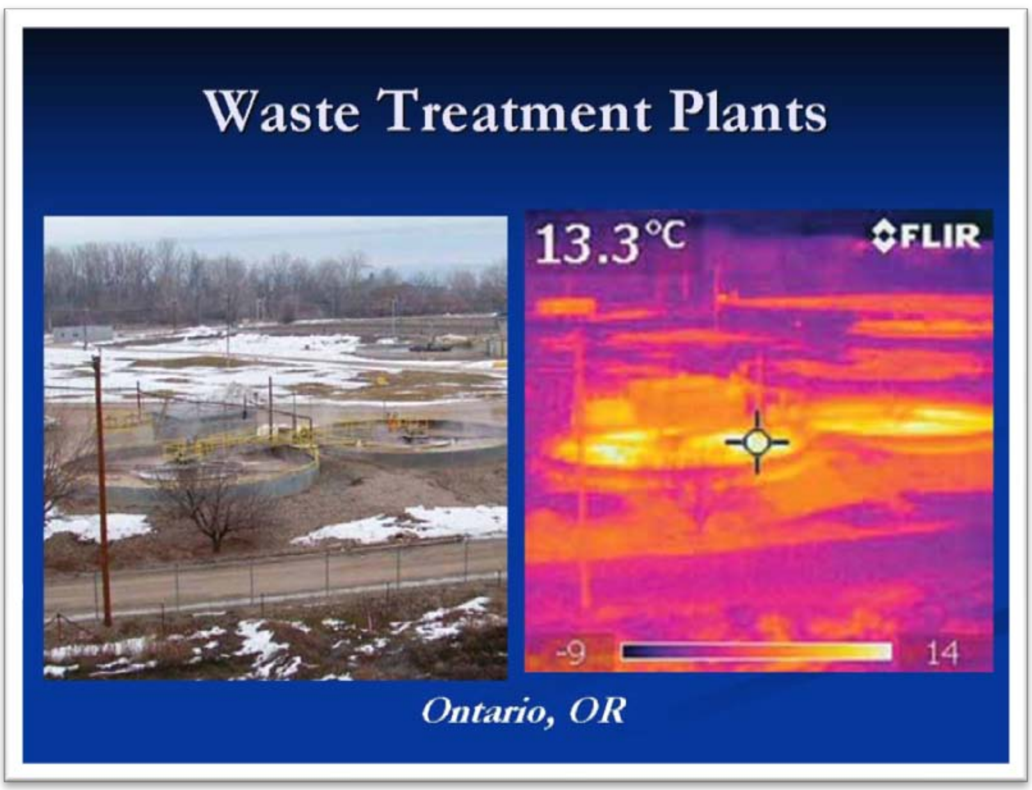
42 http://pielkeclimatesci.files.wordpress.com/2009/10/r-321.pdf.

43 http://wattsupwiththat.files.wordpress.com/2009/05/surfacestationsreport_spring09.pdf.

USHCN weather station at Hopkinsville, KY (Pielke et al., 2006). The station is sited too close to a building, too close to a large area of tarmac, and directly above a barbecue.

Max/Min temperature sensor near John Martin Reservoir, CO (Davey, 2005).

A station at Tucson, AZ, in a parking lot on pavement.
(Photo by Warren Meyer, courtesy of surfacestations.org.)



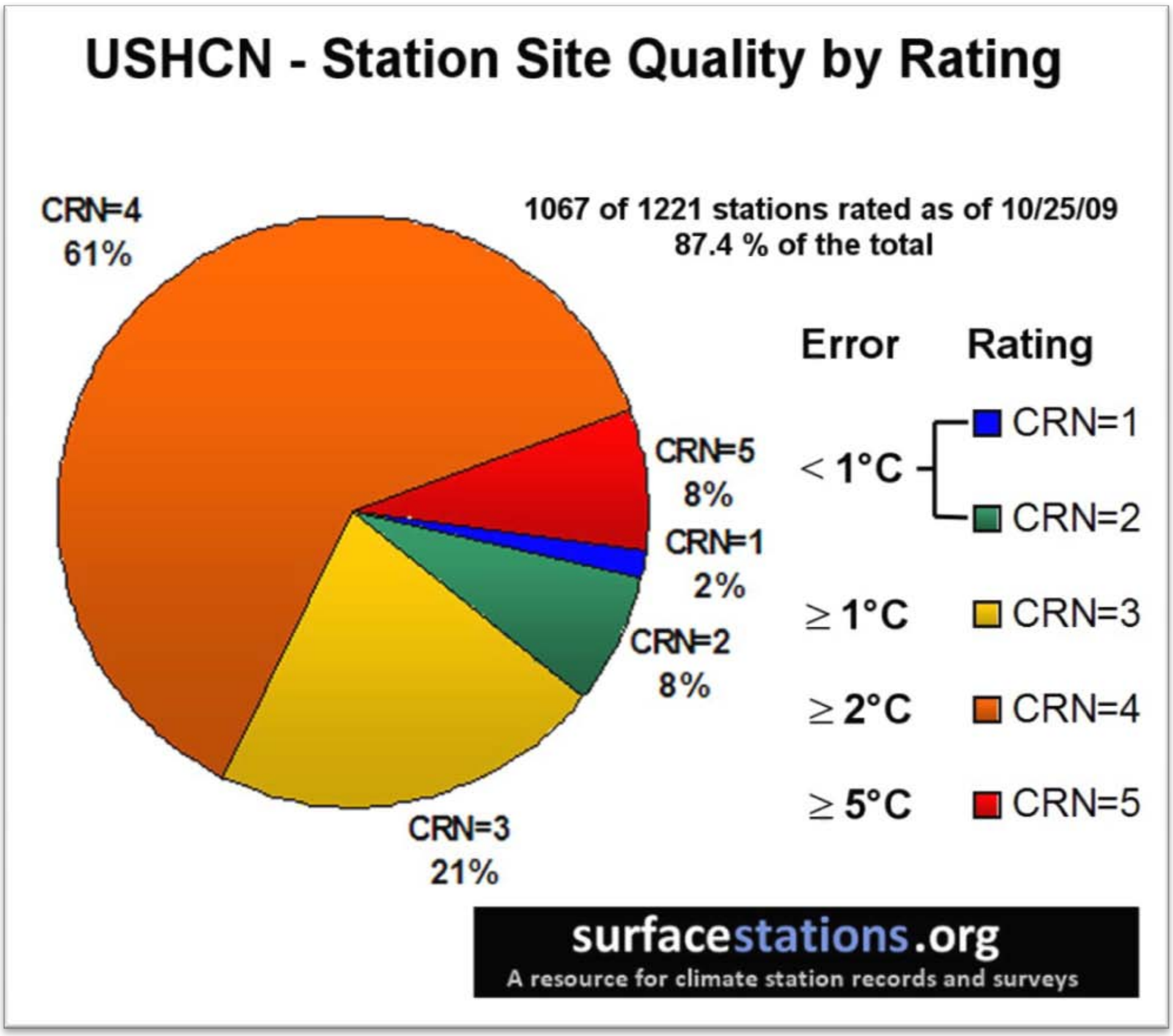
Numerous sensors are located at waste treatment plants. An infrared image of the scene shows the output of heat from the waste treatment beds right next to the sensor.
(Photos by Anthony Watts, surfacestations.org.)

Wickenburg, Arizona next to a building on a paved surface.
(Photo by Warren Meyer, courtesy of surfacestations.org.)

Waterville, WA, over volcanic cinders, near parking.
(Photo by Bob Meyer, courtesy of surfacestations.org.)

As of October 25, 2009, 1067 of the 1221 stations (87.4%) had been evaluated by the surfacestations.org volunteers and evaluated using the Climate Reference Network (CRN) criteria[44]. 90% were sited in ways that result in errors exceeding 1°C according to the CRN handbook.

This siting issue remains true even by the older "100 foot rule" criteria for COOP stations, specified by NOAA[45] for the US Cooperative Observer network where they specify "The sensor should be at least 100 feet (~ 30 meters) from any paved or concrete surface."



44 http://www1.ncdc.noaa.gov/pub/data/uscrn/documentation/program/X030FullDocumentD0.pdf.
45 http://www.nws.noaa.gov/om/coop/standard.htm.

There are many instruments globally at airports, some in areas affected by jet exhaust.

(Photo from Bing Maps, located by Paolo Mezzasalma, annotated by Anthony Watts.)

Dr. Vincent Gray, IPPC Reviewer for AR1 through IV published on some issues related to temperature measurements here[46].

Two years ago, Joe D'Aleo asked NCDC's Tom Karl about the problems with siting and why they could not speed up the plans for a Climate Reference Network (CRN - at that time called NERON). He said he had presented a case for that to NOAA but had it turned down with the excuse from high levels at NOAA that the surface stations did not matter because we had satellite monitoring. The Climate Reference Network was capped at 114 stations but will not provide meaningful trend assessment for about 10 years. NOAA has recently reconsidered and now plans to upgrade about 1000 climate stations, but meaningful results will be even further in the future.

In monthly press releases no satellite measurements are ever mentioned, although NOAA claimed that was the future of observations.

46 http://icecap.us/images/uploads/Gray.pdf.

ADJUSTMENTS NOT MADE, OR MADE BADLY

The Climategate whistleblower proved what those of us dealing with data for decades already knew. The data were not merely degrading in quantity and quality: they were also being manipulated. This is done by a variety of post measurement processing methods and algorithms. The IPCC and the scientists supporting it have worked to remove the pesky Medieval Warm Period, the Little Ice Age, and the period emailer Tom Wigley referred to as the "warm 1940s blip." There are no adjustments in NOAA and Hadley data for urban contamination. The adjustments and non-adjustments instead increased the warmth in the recent warm cycle that ended in 2001 and/or inexplicably cooled many locations in the early record, both of which augmented the apparent trend.

The Climategate whistleblower proved what those of us dealing with data for decades already knew. The data were not merely degrading in quantity and quality: they were being manipulated.

HEAT FROM POPULATION GROWTH AND LAND-USE CHANGES

URBAN HEAT ISLAND

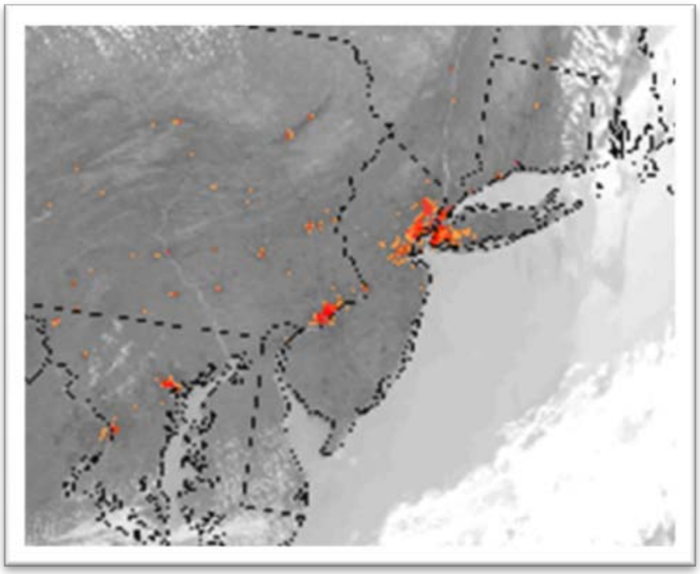
Weather data from cities as collected by meteorological stations are indisputably contaminated by urban heat-island bias and land-use changes. This contamination has to be removed or adjusted for in order to accurately identify true background climatic changes or trends. In cities, vertical walls, steel and concrete absorb the sun's heat and are slow to cool at night. More and more of the world is urbanized (population increased from 1.5 B in 1900 to 6.7 B in 2010).

Weather data from cities as collected by meteorological stations are indisputably contaminated by urban heat-island bias and land-use changes.

The urban heat-island effect occurs not only for big cities but also for towns. Oke (who won the 2008 American Meteorological Society's Helmut Landsberg award for his pioneer work on urbanization) had a formula for the warming that is tied to population. Oke (1973) found that the urban heat-island (in °C) increases according to the formula –

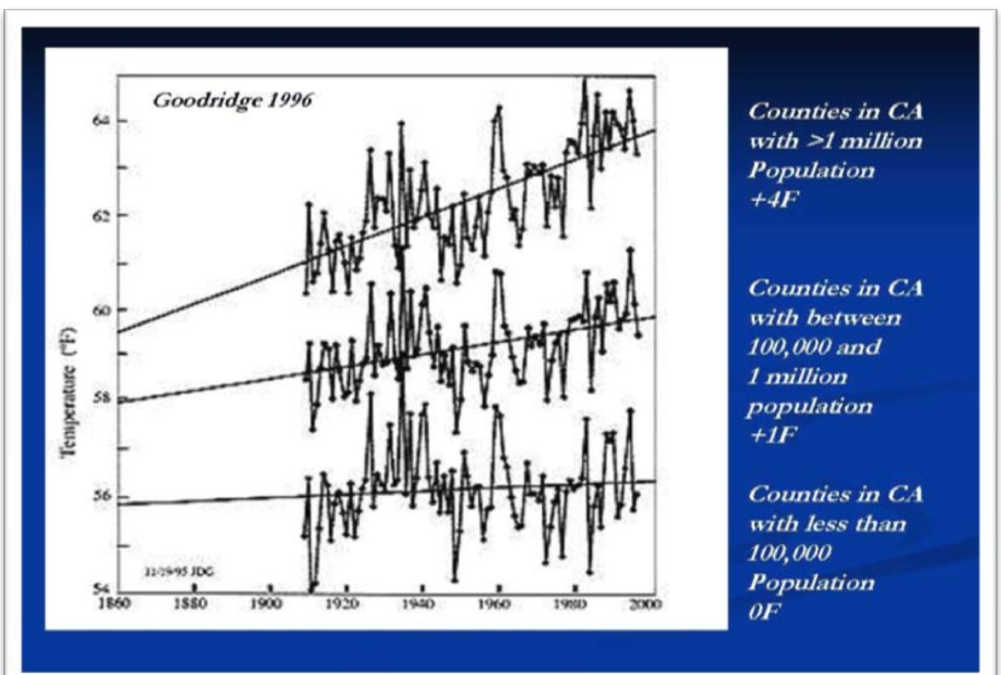
- Urban heat-island warming = 0.317 ln P, where P = population.

Thus a village with a population of 10 has a warm bias of 0.73°C. A village with 100 has a warm bias of 1.46°C and a town with a population of 1000 people has a warm bias of 2.2°C. A large city with a million people has a warm bias of 4.4°C.



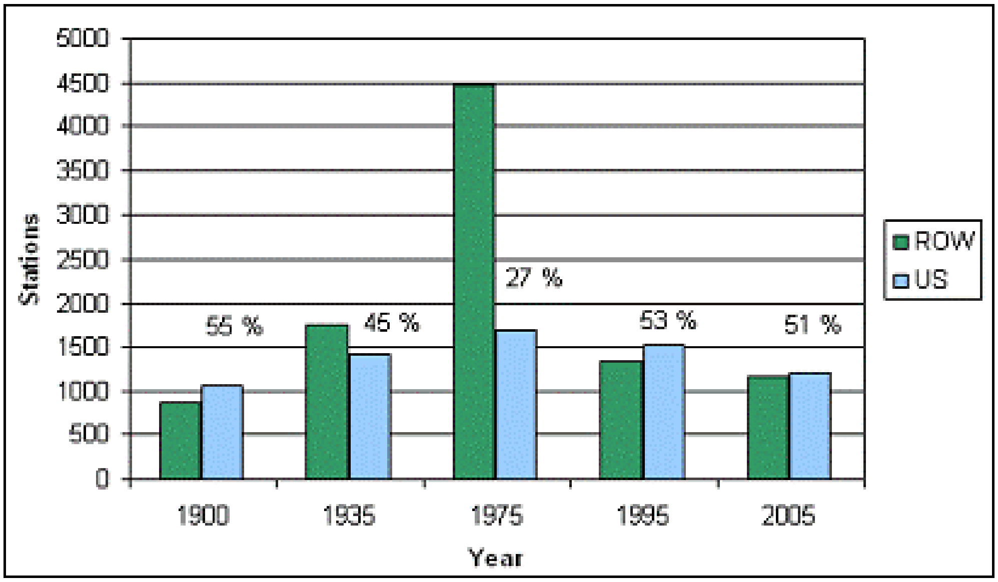
Urban heat islands as seen from infrared sensors on board satellites.

Goodrich (1996) showed the importance of urbanization to temperatures in his study of California counties in 1996. He found for counties with a million or more population the warming from 1910 to 1995 was 4°F, for counties with 100,000 to 1 million it was 1°F and for counties with less than 100,000 there was no change (0.1°F).



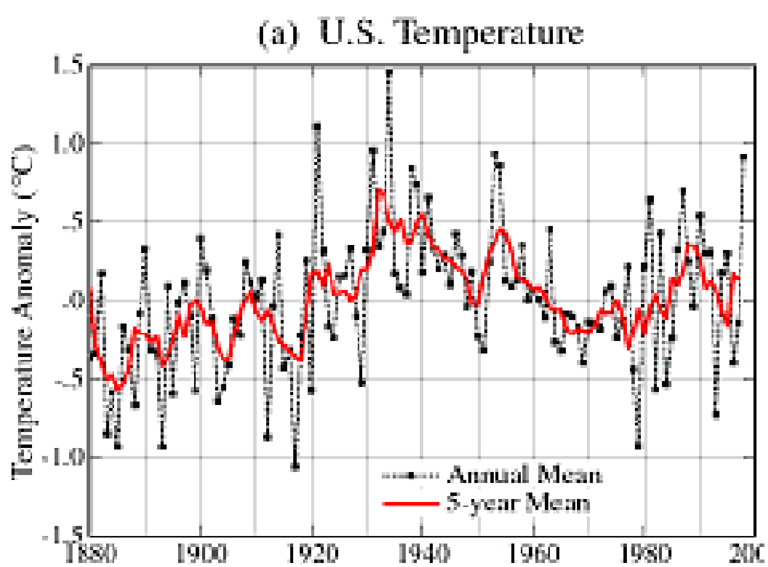
US Climate Data

Compared to the GHCN global database, the USHCN database is more stable.



Comparison of Number of GHCN Temperature Stations in the US versus rest of the world (ROW).

When first implemented in 1990 as Version 1, USHCN employed 1221 stations across the United States. In 1999, NASA's James Hansen published this graph of USHCN v.1 annual mean temperature:



Hansen correctly noted:

> "The US has warmed during the past century, but the warming hardly exceeds year-to-year variability. Indeed, in the US the warmest decade was the 1930s and the warmest year was 1934."

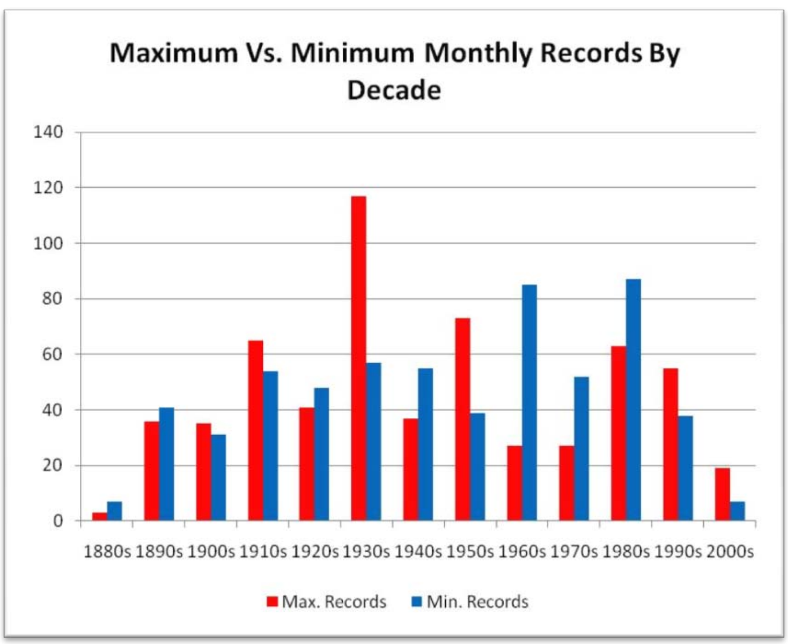
The 1930s were, by far, the hottest period for the timeframe. In absolute terms the 1930s had a much higher frequency of maximum temperature extremes than the 1990s or 2000s or the combination of the last two decades.

USHCN was generally accepted as the world's best database of temperatures. The stations were the most continuous and stable and had adjustments made for time of observation, urbanization, known station moves or land-use changes around sites, as well as instrumentation changes.

Note how well the original USHCN agreed with the state record high temperatures.

US State Heat Records Suggest Recent Decades are Not the Warmest

The 1930s were, by far, the hottest period for the timeframe. In absolute terms the 1930s had a much higher frequency of maximum temperature extremes than the 1990s or 2000s or the combination of the last two decades. This was shown by Bruce Hall and Dr. Richard Keen here[47], also covering Canada.



NCDC's Tom Karl (1988) employed an urban adjustment scheme for the first USHCN database (released in 1990). He noted that the national climate network formerly consisted of predominantly rural or small towns with populations below 25,000 (as of 1980 census) and yet that an urban heat-island effect was clearly evident.

47 http://icecap.us/index.php/go/new-and-cool/more_critique_of_ncar_cherry_picking_temperature_record_study/.

Tom Karl *et al.*'s adjustments were smaller than Oke had found (0.22°C annually on a town of 10,000 and 1.81°C on a city of 1 million and 3.73°C for a city of 5 million).

Karl observed that in smaller towns and rural areas the net urban heat-island contamination was relatively small, but that significant anomalies showed up in rapidly growing population centers.

MAJOR CHANGES TO USHCN IN 2007

In 2007 the NCDC, in its version 2 of USHCN, inexplicably removed the Karl urban heat-island adjustment and substituted a change-point algorithm that looks for sudden shifts (discontinuities). This is best suited for finding site moves or local land use changes (like paving a road or building next to sensors or shelters), but not the slow ramp up of temperature characteristic of a growing town or city.

Joe D'Aleo had a conversation with NCDC's Tom Karl two years ago when the USHCN version 2 was announced. D'Aleo told Karl he had endorsed his 1988 Journal of Climate paper (Urbanization: Its Detection and Effect in the United States Climate Record), based on the work of Landsberg and Oke on which that paper had depended.

D'Aleo asked him if USHCN v2 would no longer have an urbanization adjustment. After a few moments of silence he stated he had asked those who had worked on version 2 that same question and was reassured that the new algorithms would catch urban warming and other changes, including "previously undocumented inhomogeneities" (discontinuities that suggest some local site changes or moves that were never documented).

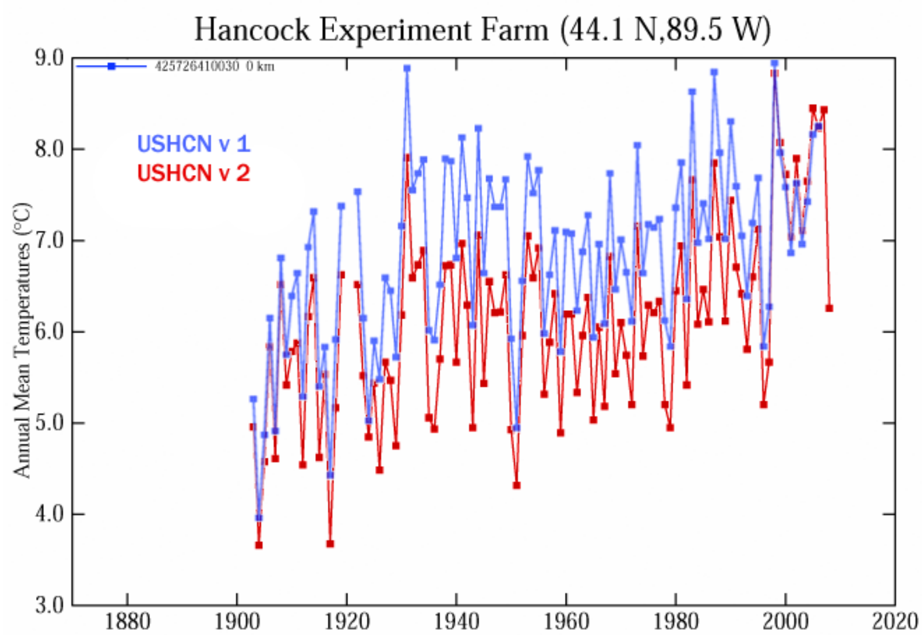
The difference between the old and new is shown here. Note the significant post-1995 warming and mid-20th century cooling owing to de-urbanization of the database.

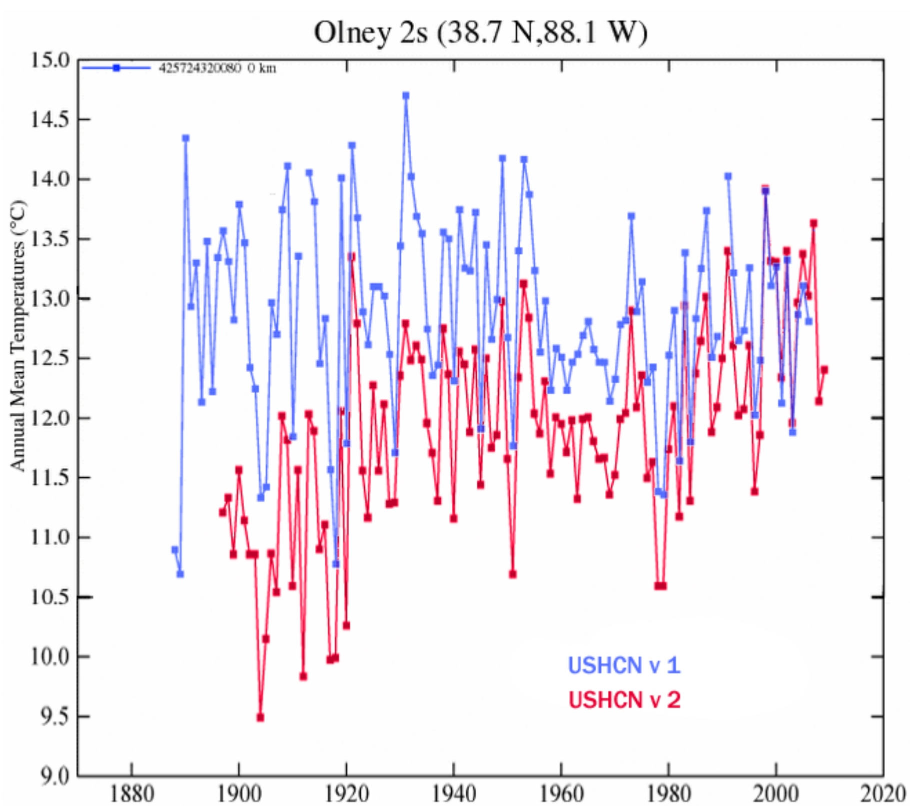
The change can be seen clearly in this animation[48] and in 'blink charts for Wisconsin here[49] and Illinois here[50].

Here are three example stations with USHCN version 1 and version 2 superimposed. The first is from Wisconsin, the next two Illinois (thanks to Mike McMillan).

Notice the clear tendency to cool off the early record and leave the current levels near recently reported levels or increase them. The net result is either reduced cooling or enhanced warming not found in the raw data.

48 http://climate-skeptic.typepad.com/.a/6a00e54eeb9dc18834010535ef5d49970b-pi.
49 http://www.rockyhigh66.org/stuff/USHCN_revisions_wisconsin.htm.
50 http://www.rockyhigh66.org/stuff/USHCN_revisions.htm.


Hancock Experiment Farm (44.1 N,89.5 W)
425726410030 0 km
USHCN v 1
USHCN v 2
Annual Mean Temperatures (°C)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
1880
1900
1920
1940
1960
1980
2000
2020


Olney 2s (38.7 N,88.1 W)
425724320080 0 km
USHCN v 1
USHCN v 2
Annual Mean Temperatures (°C)
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
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10.5
10.0
9.5
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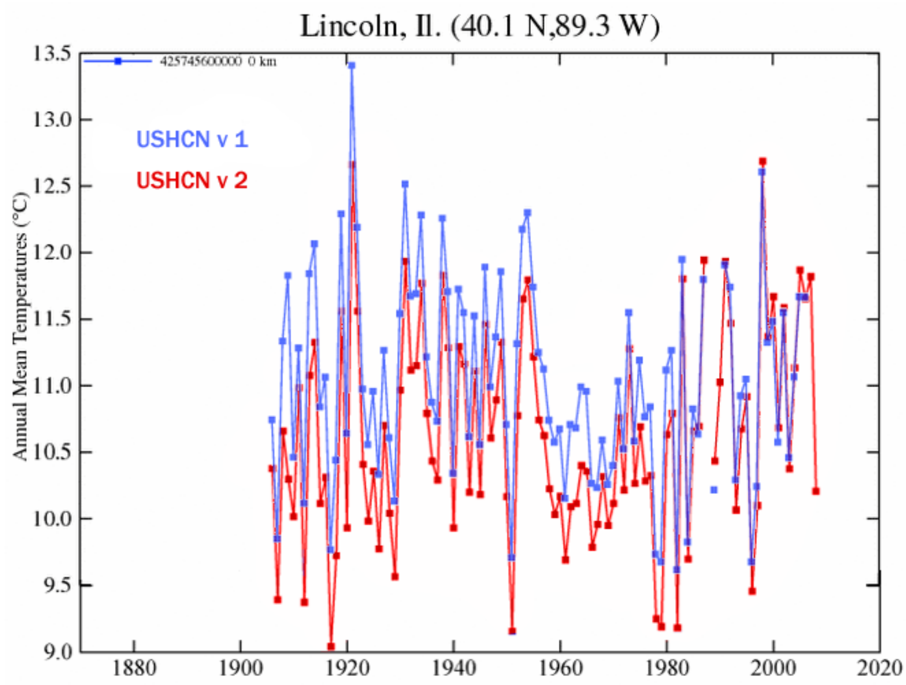
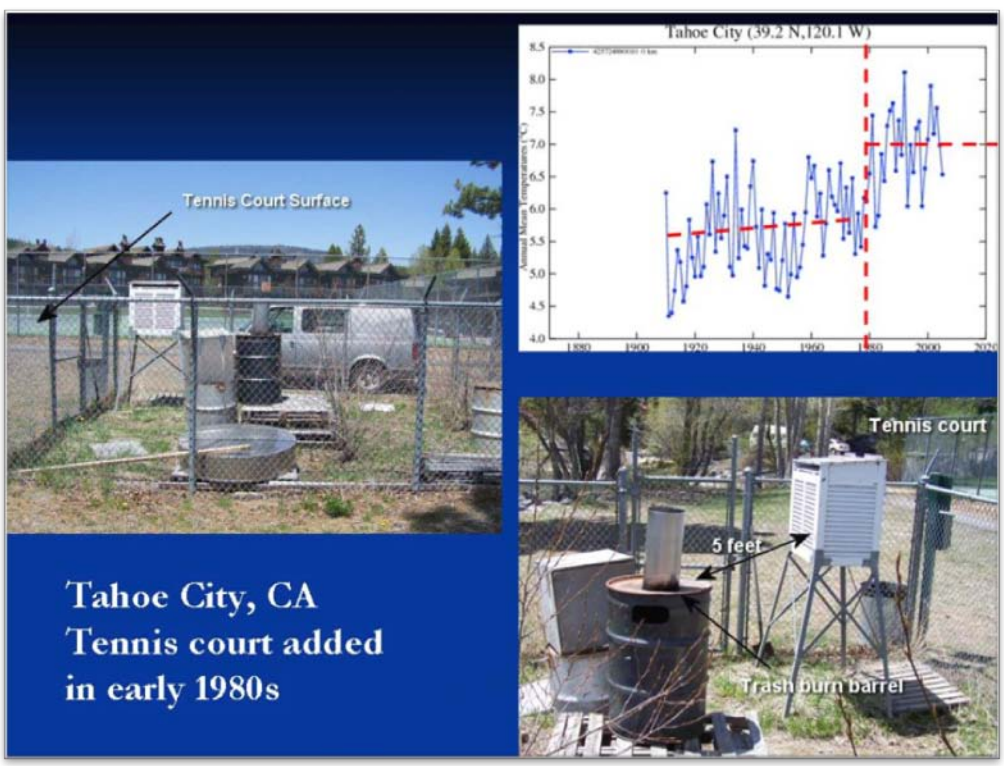
1880
1900
1920
1940
1960
1980
2000
2020

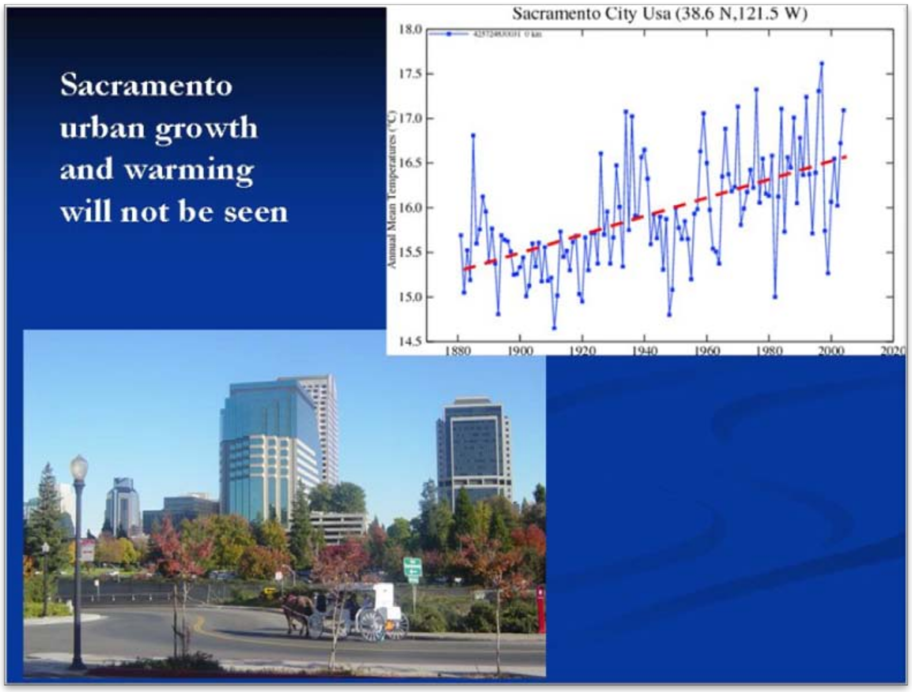


The new algorithms are supposed to correct for urbanization and changes in siting and instrumentation by recognizing sudden shifts in the temperatures.



(Photos by Anthony Watts, surfacestations.org.)

It should catch the kind of change shown above in Tahoe City, CA.



It is unlikely to catch the slow warming associated with the growth of cities and towns over many years, as in Sacramento, CA, above.

In a conversation during Anthony Watts invited presentation about the surface stations projects to NCDC, on 4/24/2008, he was briefed on USHCN2's algorithms and how they operated by Matt Menne, lead author of the USHCN2 project. While Mr. Watts noted improvements in the algorithm can catch some previously undetected events like undocumented station moves, he also noted that the USHCN2 algorithm had no provision for long term filtering of signals that can be induced by gradual local urbanization, or by long term changes in the siting environment, such as weathering/coloring of shelters, or wind blocking due to growth of shrubbery/trees.

When Mr. Menne was asked by Mr. Watts if this lack of detection of such long term changes was in fact a weakness of the USHCN algorithm, he replied "Yes, that is correct". Essentially USHCN2 is a short period filter only, and cannot account for long term changes to the temperature record, such as UHI, making such signals indistinguishable from the climate change signal that is sought.

See some other examples of urban versus nearby rural here[51]. Doug Hoyt, who worked at NOAA, NCAR, Sacramento Peak Observatory, the World Radiation Center, Research and Data Systems, and Raytheon where he was a Senior Scientist did this analysis[52] of the urban heat island. Read beyond the references for interesting further thoughts.

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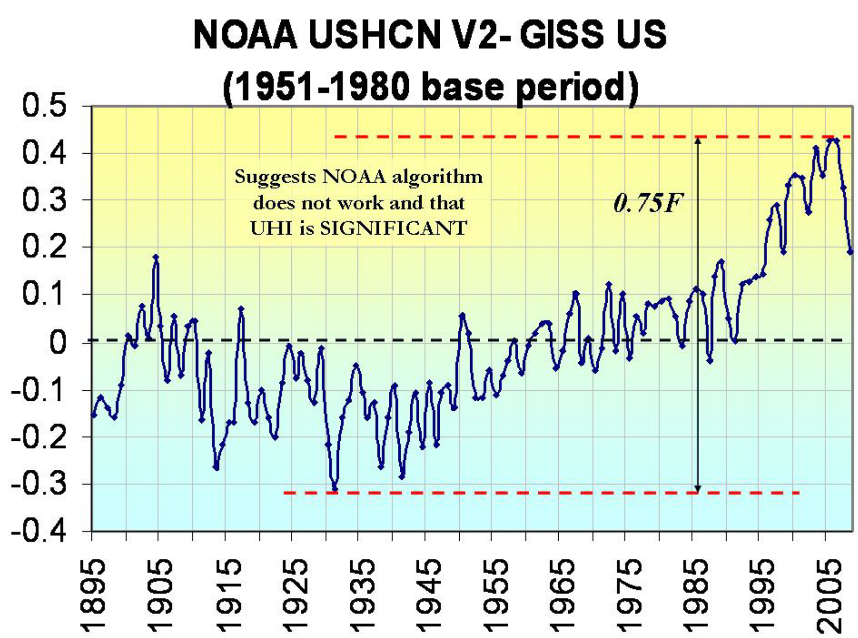
[51] http://www.appinsys.com/GlobalWarming/GW_Part3_UrbanHeat.htm.
[52] http://www.warwickhughes.com/hoyt/uhi.htm.

NASA's GISS (US)

In the USA, southern Canada, and northern Mexico, GISS uses an urbanization adjustment based on the amount of night-time light measured by satellites. Unlit stations are classified as rural stations. This does produce some adjustment and a reasonable plot of temperatures, but, as GISS notes, this is less than 2% of the globe. As McIntyre notes here[53], this "NASA GISS adjustment to the US temperatures for UHI using nightlights information, coerces the low-frequency data to the higher-quality stations. The trend difference between NOAA and NASA GISS is approximately 0.7°F/century in the 1950-2008 period in question: obviously not a small proportion of the total reported increase."

Indeed, the difference between the GISS adjusted values and the NOAA values, no longer adjusted, shows NOAA scientists were misguided in their removal of the urban adjustment. This removal produced a net cooling of 0.2 to 0.3°F in the 1930s and warming of 0.4°F near 2005. Below is the NOAA data adjusted to the GISS base period of 1951-1980.



The net warming in the urban heat-island adjusted GISS US dataset from the peak around 1930 to the peak near 2000 was a meager 0.15 C°. It may be assumed the same would be true for the world if we could make a similar needed urban heat-island adjustment.

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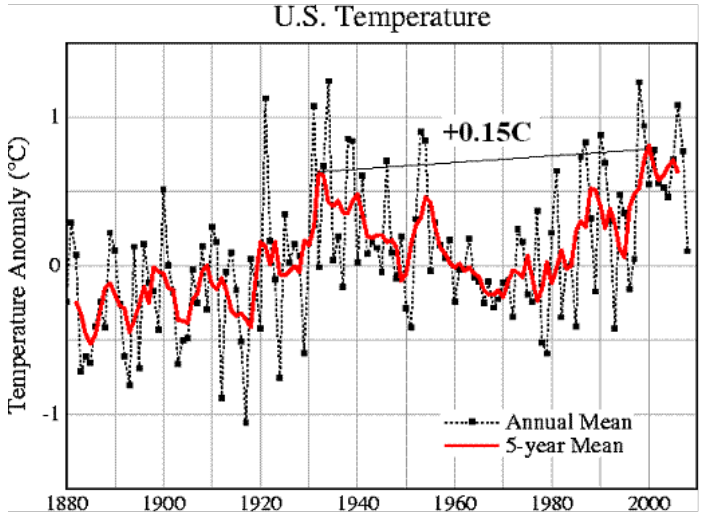
[53] http://climateaudit.org/2009/06/29/the-talking-points-memo/.



GISS Adjusted US Temperatures

Even before the version 2, Balling and Idso (2002)[54] found that the adjustments being made to the raw USHCN temperature data were "producing a statistically significant, but spurious, warming trend" that "approximates the widely-publicized 0.50°C increase in global temperatures over the past century." There was actually a linear trend of progressive cooling of older dates between 1930 and 1995.

"It would thus appear that in this particular case of "data-doctoring," the *cure* was much worse than the *disease*. And it likely still is! In fact, it would appear that the cure may actually ***be*** the disease."

HADLEY AND NOAA

No real urbanization adjustment is made for either NOAA's or CRU's global data. Jones *et al*. (1990: Hadley/CRU) concluded that urban heat-island bias in gridded data could be capped at 0.05°C/century. Jones used data by Wang which Keenan[55] has shown was fabricated. Peterson et al. (1998) agreed with the conclusions of Jones, Easterling *et al.* (1997) that urban effects on 20th century globally and hemispherically-averaged land air temperature time-series do not exceed about 0.05°C from 1900-1990.

Peterson (2003) and Parker (2006) argue urban adjustment is not really necessary. Yet Oke (1973) showed a town of 1000 could produce a 2.2°C (3.4°F warming). The UK Met Office (UKMO) has said[56] future heat waves could be especially deadly in urban areas, where the temperatures could be 9°C or more above today's, according to the Met Office's Vicky Pope. As usual, the warmers want to have it both ways. They argue that the urban heat island effect is insignificant, but also argue future heat-waves will be most severe in the urban areas. This is especially incongruous given that greenhouse theory has the warming greatest in winters and at night.

54 http://www.co2science.org/articles/V12/N50/C1.php.
55 http://www.informath.org/WCWF07a.pdf.
56 http://icecap.us/index.php/go/joes-blog/cities_to_sizzle_as_islands_of_heat/.

The most recent exposition of CRU methodology is Brohan *et al*. (2006), which included an allowance of 0.1°C/century for urban heat-island effects in the uncertainty but did not describe any adjustment to the reported average temperature. To make an urbanization assessment for all the stations used in the HadCRUT dataset would require suitable meta-data (population, siting, location, instrumentation, etc.) for each station for the whole period since 1850. No such complete meta-data are available.

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The homepage for the NOAA temperature index here[57] cites Smith and Reynolds (2005) as authority. Smith and Reynolds in turn state that they use the same procedure as CRU: i.e. they make an allowance in the error-bars but do not correct the temperature index itself. The population of the world went from 1.5 to 6.5 billion in the 20^{th} century, yet NOAA and CRU ignore population growth in the database with only a 0.05 to 0.1 °C uncertainty adjustment.

Steve McIntyre challenged Peterson (2003), who had said, "Contrary to generally accepted wisdom, no statistically significant impact of urbanization could be found in annual temperatures" here[58], by showing that the difference between urban and rural temperatures for Peterson's station set was 0.7°C and between temperatures in large cities and rural areas 2°C. He has done the same for Parker (2006) here[59].

Runnalls and Oke (2006) concluded that –

> "Gradual changes in the immediate environment over time, such as vegetation growth or encroachment by built features such as paths, roads, runways, fences, parking lots, and buildings into the vicinity of the instrument site, typically lead to trends in the series.
>
> "Distinct régime transitions can be caused by seemingly minor instrument relocations (such as from one side of the airport to another or even within the same instrument enclosure) or due to vegetation clearance. This contradicts

[57] http://www.ncdc.noaa.gov/oa/climate/research/anomalies/anomalies.html.
[58] http://climateaudit.org/2007/08/04/1859/.
[59] http://climateaudit.org/2007/06/14/parker-2006-an-urban-myth/.

the view that only substantial station moves involving significant changes in elevation and/or exposure are detectable in temperature data."

Numerous other peer-reviewed papers and other studies have found that the lack of adequate urban heat-island and local land use change adjustments could account for up to half of all apparent warming in the terrestrial temperature record since 1900.

Numerous other peer-reviewed papers and other studies have found that the lack of adequate urban heat-island and local land use change adjustments could account for up to half of all apparent warming in the terrestrial temperature record since 1900.

Siberia is one of the areas of greatest apparent warming in the record. Besides station dropout and a tenfold increase in missing monthly data, numerous problems exist with prior temperatures in the Soviet era. City and town temperatures determined allocations for funds and fuel from the Supreme Soviet, so it is believed that cold temperatures were exaggerated in the past. This exaggeration in turn led to an apparent warming when more honest measurements began to be made. Anthony Watts has found that in many Russian towns and cities uninsulated heating pipes[60] are in the open. Any sensors near these pipes would be affected. The pipes also contribute more waste heat to the city over a wide area.

The physical discomfort and danger to observers in extreme environments led to some estimations or fabrications being made in place of real observations, especially in the brutal Siberian winter. See this report[61]. This was said to be true also in Canada along the DEW Line where radars were set up to detect incoming Soviet bombers during the Cold War.

McKitrick and Michaels (2004) gathered weather station records from 93 countries and regressed the spatial pattern of trends on a matrix of local climatic variables and socioeconomic indicators such as income, education, and energy use. Some of the non-climatic variables yielded significant coefficients, indicating a significant contamination of the temperature record by non-climatic influences, including poor data quality.

The two authors repeated the analysis on the IPCC gridded data covering the same locations. They found that approximately the same coefficients emerged. Though the discrepancies were smaller, many individual indicators remained significant. On this basis they were able to rule out the hypothesis that there are no significant non-climatic biases in

60 http://wattsupwiththat.com/2008/11/15/giss-noaa-ghcn-and-the-odd-russian-temperature-anomaly-its-all-pipes.

61 http://wattsupwiththat.com/2008/07/17/fabricating-temperatures-on-the-dew-line/.

the data. Both de Laat and Maurellis and McKitrick and Michaels concluded that non-climatic influences add up to a substantial warming bias in measured mean global surface temperature trends.

Ren et al. (2007), in the abstract of a paper on the urban heat-island effect in China, published in *Geophysical Research Letters*, 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."

This result, along with the previous mentioned research results, indicates a need to pay more attention to the urbanization-induced bias that appears to exist in the current surface air temperature records.

Numerous recent studies show the effects of urban anthropogenic warming on local and regional temperatures in many diverse, even remote, locations. Jáuregui, E. et al. (2005) discussed the UHI in Mexico, Torok et al. (2001) in southeast Australian cities. Block *et al*., (2004) showed effects across central Europe. Zhou *et al*. (2004) and He *et al*. (2005) across China, Velazquez-Lozada *et al*. (2006) across San Juan, Puerto Rico, and Hinkel *et al*., (2003) even in the village of Barrow, Alaska. In all cases, the warming was greatest at night and in higher latitudes, chiefly in winter.

Kalnay and Cai (2003) found regional differences in US data but overall very little change and if anything a slight decrease in daily maximum temperatures for two separate 20-year periods (1980-1999 and 1960-1979), and a slight increase in night-time readings. They found these changes consistent with both urbanization and land-use changes from irrigation and agriculture.

Fully correcting the surface temperature data for non-climatic effects reduce the estimated 1980-2002 global average temperature trend over land by about half.

Christy et al. (2006) showed that temperature trends in California's Central Valley had significant nocturnal warming and daytime cooling over the period of record. The conclusion is that, as a result of increases in irrigated land, daytime temperatures are suppressed owing to evaporative cooling and nighttime temperatures are warmed in part owing to increased heat capacity from water in soils and vegetation. Mahmood *et al.* (2006b) also found similar results for irrigated and non-irrigated areas of the Northern Great Plains.

Two Dutch meteorologists, Jos de Laat and Ahilleas Maurellis, showed in 2006 that climate models predict there should be no correlation between the spatial pattern of warming in climate data and the spatial pattern of industrial development. But they found that this correlation does exist and is statistically significant. They also concluded it adds a large upward bias to the measured global warming trend.

Ross McKitrick and Patrick Michaels in December 2007 showed a strong correlation between urbanization indicators and the "urban adjusted" temperatures, indicating that the adjustments are inadequate. Their conclusion is: "Fully correcting the surface temperature data for non-climatic effects reduce the estimated 1980-2002 global average temperature trend over land by about half."

As Pielke (2007) also notes –

> "Changnon and Kunkel (2006) examined discontinuities in the weather records for Urbana, Illinois, a site with exceptional metadata and concurrent records when important changes occurred. They identified a cooling of 0.17°C caused by a non-standard height shelter of 3 m from 1898 to 1948. After that there was a gradual warming of 0.9°C as the University of Illinois campus grew around the site from 1900 to 1983. This was followed by an immediate 0.8°C cooling when the site moved 2.2 km to a more rural setting in 1984. A 0.3°C cooling took place with a shift in 1988 to Maximum-Minimum Temperature systems, which now represent over 60% of all USHCN stations. The experience at the Urbana site reflects the kind of subtle changes described by Runnalls and Oke (2006) and underscores the challenge of making adjustments to a gradually changing site."

A 2008 paper[62] by Hadley's Jones *et al.*, has shown a considerable contamination in China, amounting to 1°C per century. This is an order of magnitude greater than the amount previously assumed (0.05-0.1 °C/century uncertainty).

In a 2009 article[63], Brian Stone of Georgia Tech wrote –

> "Across the US as a whole, approximately 50 percent of the warming that has occurred since 1950 is due to land use changes (usually in the form of clearing forest for crops or cities) rather than to the emission of greenhouse gases. Most large US cities, including Atlanta, are warming at more than twice the rate of the planet as a whole. This is a rate that is mostly attributable to land use change."

In a paper posted on SPPI here[64], Dr. Edward Long summarized his findings as follows: Both raw and adjusted data from the NCDC has been examined for a selected Contiguous U.S. set of rural and urban stations, 48 each or one per State. The raw data provides 0.13 and 0.79 °C/century temperature increase for the rural and urban environments.

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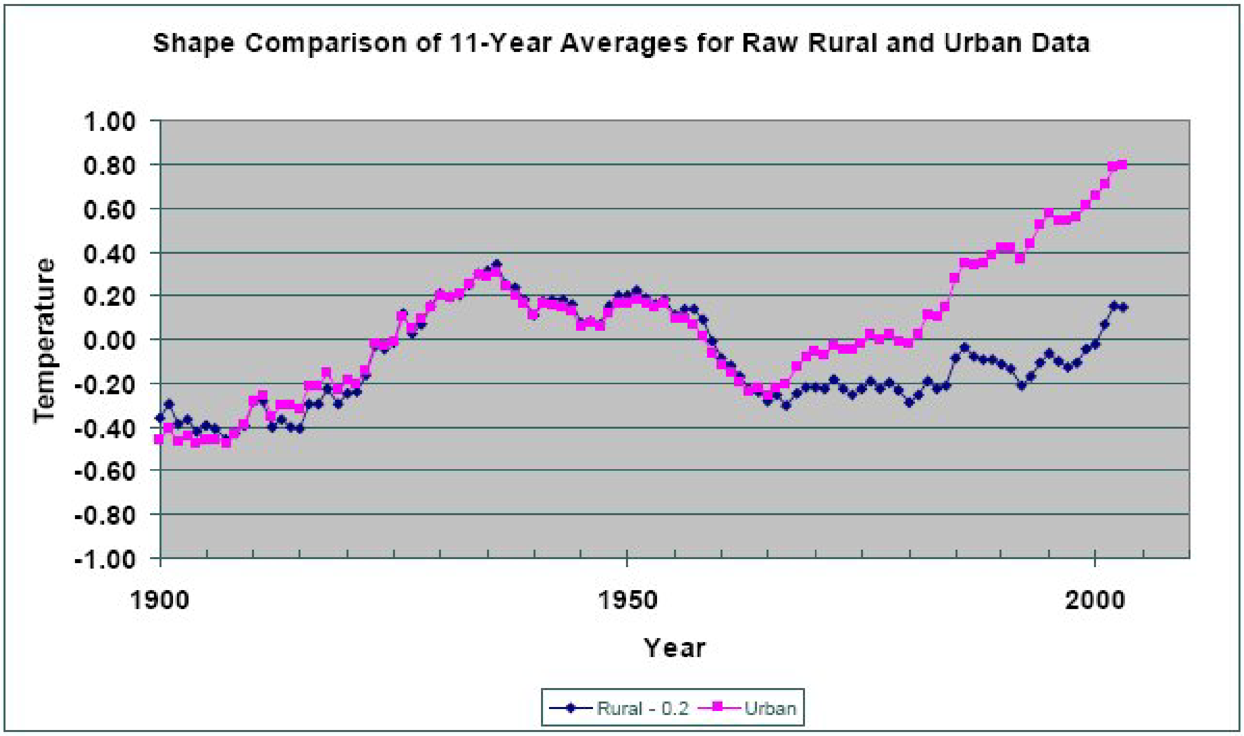
62 http://www.warwickhughes.com/blog/?p=204.

63 http://www.gatech.edu/newsroom/release.html?nid=47354.

64 http://scienceandpublicpolicy.org/images/stories/papers/originals/Rate_of_Temp_Change_Raw_and_Adjusted_NCDC_Data.pdf.



The adjusted data provides 0.64 and 0.77 °C/century respectively. The rates for the raw data appear to correspond to the historical change of rural and urban U. S. populations and indicate warming is due to urban warming. Comparison of the adjusted data for the rural set to that of the raw data shows a systematic treatment that causes the rural adjusted set's temperature rate of increase to be 5-fold more than that of the raw data. The adjusted urban data set's and raw urban data set's rates of temperature increase are the same. This suggests the consequence of the NCDC's protocol for adjusting the data is to cause historical data to take on the time-line characteristics of urban data. The consequence intended or not, is to report a false rate of temperature increase for the Contiguous U.S. See full analysis in CASE 13.

Spencer[65] (2010) has described a new method for quantifying the average Urban Heat Island (UHI) warming effect as a function of population density, using thousands of pairs of temperature measuring stations within 150 km of each other. The results supported previous work which had shown that UHI warming increases logarithmically with population, with the greatest rate of warming occurring at the lowest population densities as population density increases (see CASE 15 for more).

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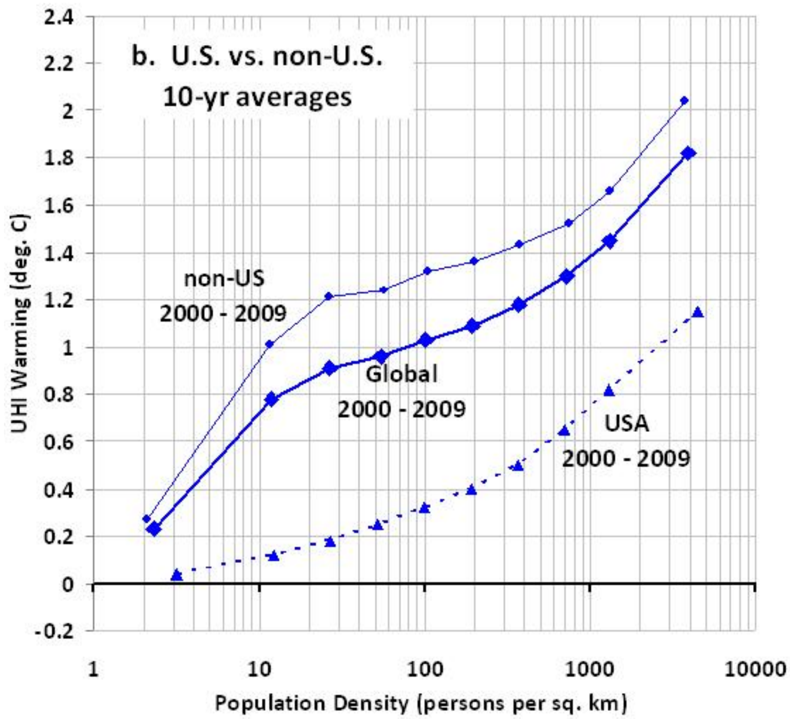
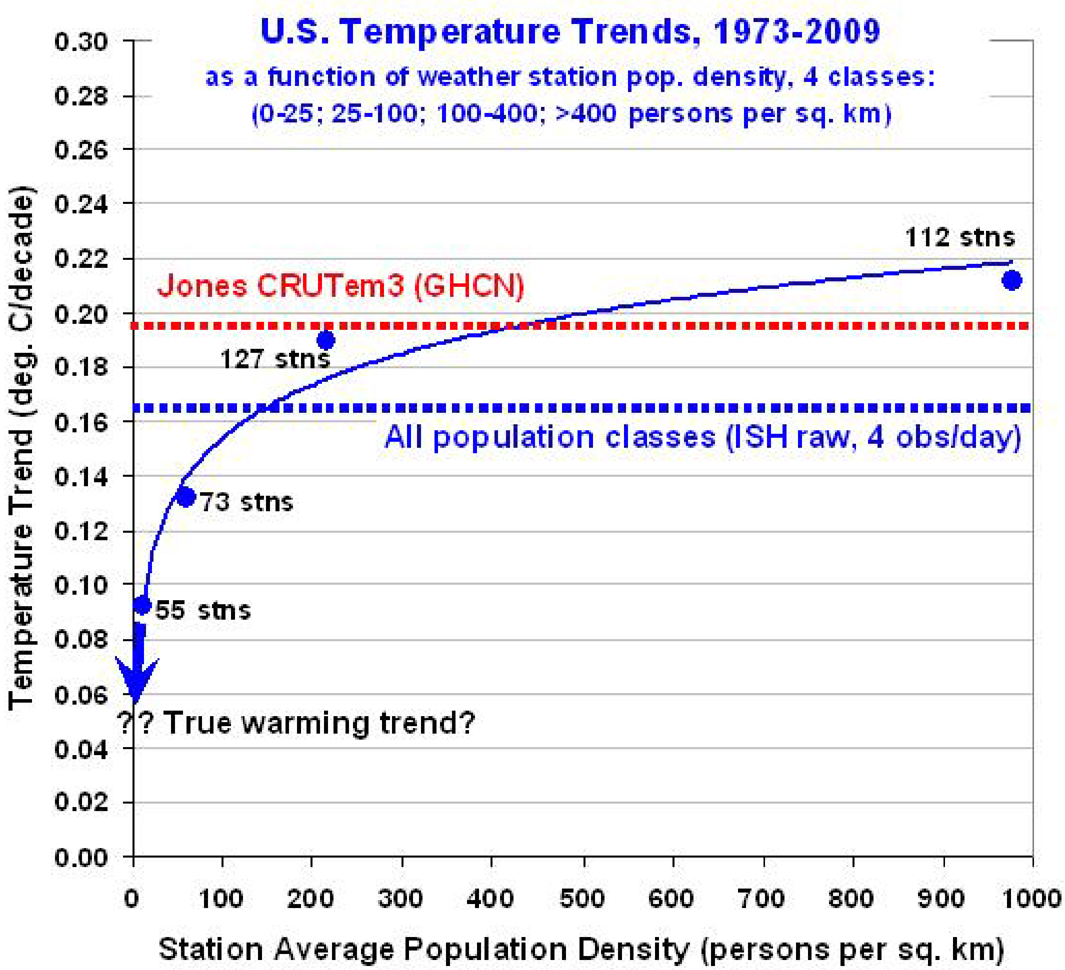
[65] http://www.drroyspencer.com/2010/03/direct-evidence-that-most-u-s-warming-since-1973-could-be-spurious/.


b. U.S. vs. non-U.S.
10-yr averages
non-US
2000 - 2009
Global
2000 - 2009
USA
2000 - 2009
UHI Warming (deg. C)
Population Density (persons per sq. km)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
1
10
100
1000
10000


U.S. Temperature Trends, 1973-2009
as a function of weather station pop. density, 4 classes:
(0-25; 25-100; 100-400; >400 persons per sq. km)
Jones CRUTem3 (GHCN)
All population classes (ISH raw, 4 obs/day)
112 stns
127 stns
73 stns
55 stns
?? True warming trend?
Temperature Trend (deg. C/decade)
Station Average Population Density (persons per sq. km)
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
100
200
300
400
500
600
700
800
900
1000

GISS Global Urban Heat-island Adjustments

Is NASA better? Steve McIntyre has taken an in-depth look at the data adjustments made to NASA's GISS global dataset. The findings are summarized very well in *Correct the Correction,* by Ken Gregory of Friends of Science –

> "NASA's Goddard Institute of Space Studies publishes a global temperature index. The temperature record is contaminated by the effects of urban development and land use changes. NASA applies an 'urbanization adjustment' to adjust the temperature histories to eliminate these effects. The resulting GISS temperature index is supposed to represent what the temperatures would have been in the absence of urbanization and land use changes. Most scientists assume that these adjustments are done correctly.
>
> "An audit by researcher Steve McIntyre reveals that NASA has made urban adjustments of temperature data in its GISS temperature record in the wrong direction. The urban adjustment is supposed to remove the effects of urbanization. Instead the NASA negative adjustments increase the urbanization effects. The result is that the surface temperature trend utilized by the International Panel on Climate Change (IPCC) is exaggerated."

"An audit by researcher Steve McIntyre reveals that NASA has made urban adjustments of temperature data in its GISS temperature record in the wrong direction."

Outside of the USA, southern Canada and northern Mexico, GISS uses population data to define rural stations –

> "We use the definition of Peterson et al 1997 for these categories: that is, rural areas have a recent population of less than 10,000, small towns between 10,000 and 50,000 and urban areas more than 50,000. These populations refer to approximately 1980."

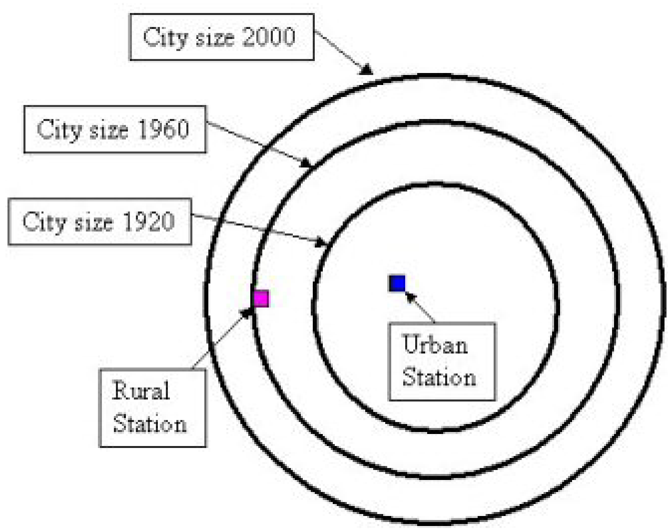
The GISS sites are defined to be "rural" if the town has a population under 10,000. Unfortunately, the GISS population data are out of date. Stations at cities with populations greatly exceeding 10,000 are incorrectly classified as rural. For example, in Peru there are 13 stations classified as rural. Of these, one station is located at a city with a population of 400,000. Five are at cities with populations from 50,000-135,000.

The GISS sites are defined to be "rural" if the town has a population under 10,000. Unfortunately, the GISS population data are out of date. Stations at cities with populations greatly exceeding 10,000 are incorrectly classified as rural.

Steve McIntyre says –

"If the supposedly 'rural' comparanda are actually 'urban' or 'small towns' within the Hansen definitions, the GISS 'adjustment' ends up being a … meaningless adjustment of one set of urban values by another set of urban values. No wonder these adjustments seem so random."

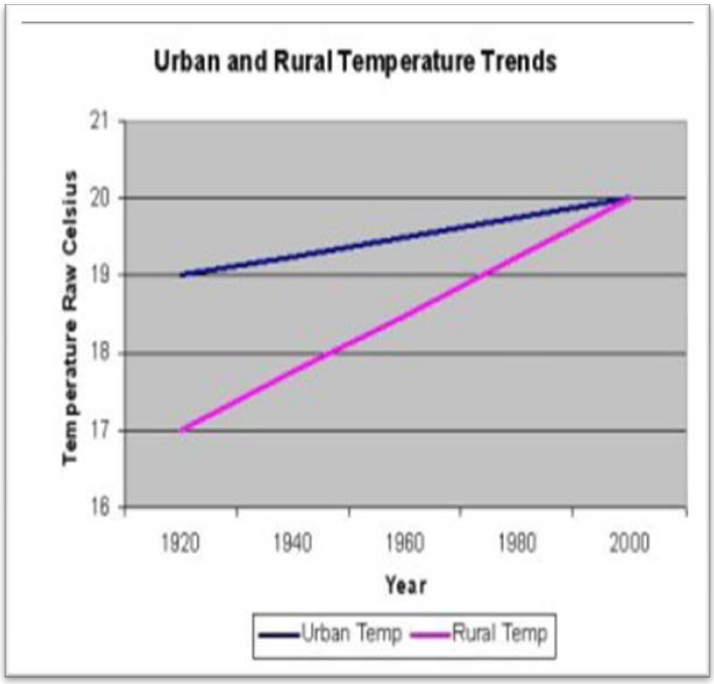
A population increase of 500 in a town of 2000 people would have a much larger effect on temperature measurements than the same increase in a city of 500,000 people. A city with a growing population generally increases its area. A temperature station inside the city would be little affected by the expansion of the suburbs. However, a temperature station located just outside a city would be greatly affected by the city expanding around the station –



A hypothetical urban station is shown in a city. A rural station is outside the city in 1920.

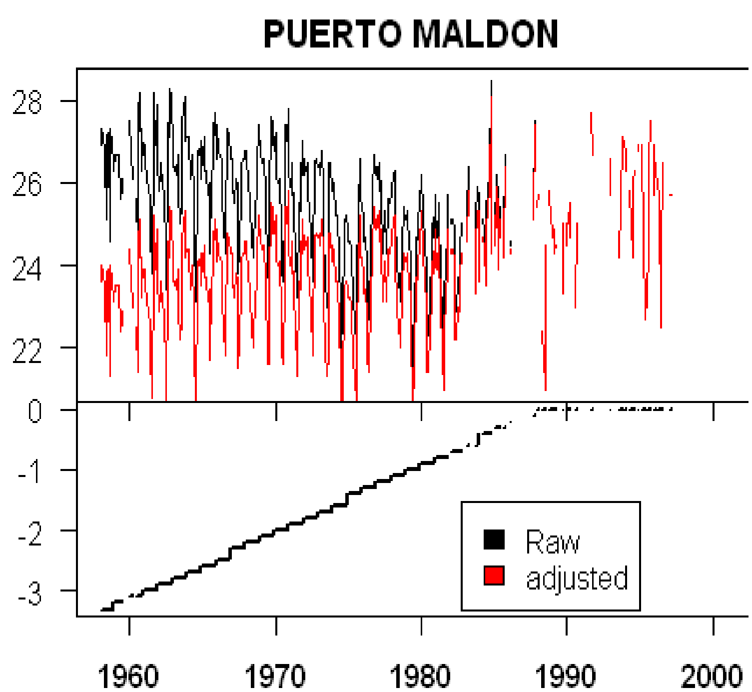
By 1960, the city has grown out to reach the rural station. The city's growth has little effect on the urban station but a much larger affect on the rural station.

By 2000 the rural station is completely surrounded by the city, so it has the same temperature as the urban station –



Now, as indicated in the graph, the unadjusted rural temperature trend is much greater than the urban station trend. According to the urban adjustment procedure, the urban station trend is increased to match the rural station trend by reducing the past temperatures.

Here is an example of an urban negative adjustment from Peru:



Note that the raw data show no warming trend, but after applying the GISS urban adjustment the adjusted data show a significant warming trend. The adjustments are applied to reduce the past temperatures by up to 3 degrees Celsius. This is a very large adjustment when compared to the total warming of the twentieth century of 0.6 Celsius estimated by the IPCC.

A proper urban correction algorithm would reduce the warming trends of both stations to make an adjusted temperature record represent what would have happened if nobody had lived near the stations.

In many examples we found increased warming trends were accomplished by "cooling" older time periods. This is what NCAR's Tom Wigley refers to as the "warm blip" in the 1940s.

In many examples we found increased warming trends were accomplished by "cooling" older time periods.

The many studies in this area convincingly show that urban "corrections" fail to correct for the effects of urbanization, but do not indicate why the corrections fail. The audit of GISS urban adjustments by Steve McIntyre answers this question.

FINAL ADJUSTMENTS – HOMOGENIZATION

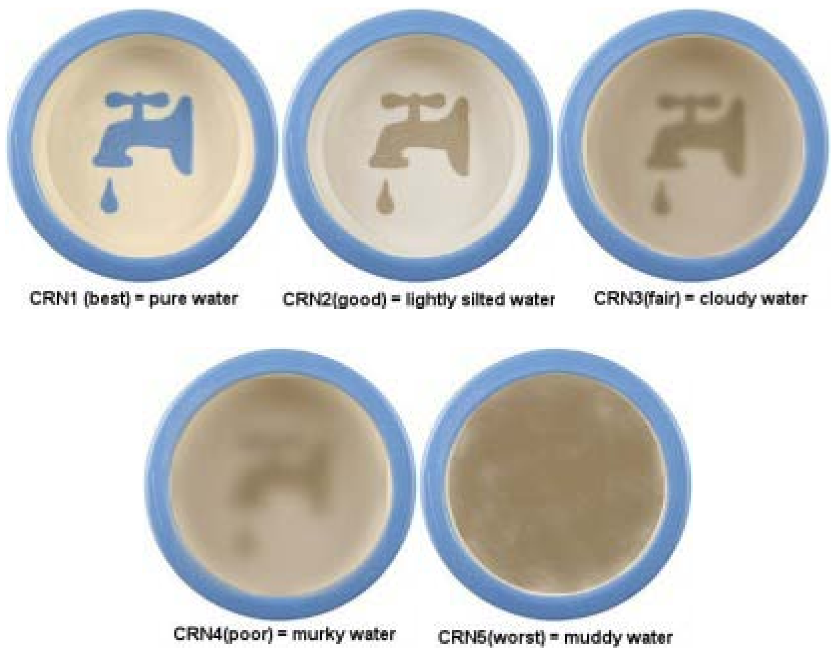
Dr., William Briggs in a 5 part series on the NOAA/NASA process of homogenization on his blog here[66] noted the following:

> "At a loosely determined geographical spot over time, the data instrumentation might have changed, the locations of instruments could be different, there could be more than one source of data, or there could be other changes. The main point is that there are lots of pieces of data that some desire to stitch together to make one whole.
>
> Why?
>
> I mean that seriously. Why stitch the data together when it is perfectly useful if it is kept separate? By stitching, you introduce error, and if you aren't careful to carry that error forward, the end result will be that you are far too certain of yourself. And that condition - unwarranted certainty - is where we find ourselves today."

[66] http://wmbriggs.com/blog/?p=1459.

It has been said by NCDC in Menne et al. *"On the reliability of the U.S. surface temperature record"* (in press) and in the June 2009[67] "Talking Points: related to *Is the U.S. Surface Temperature Record Reliable?*" that station siting errors do not matter. However, the way NCDC conducted the analysis gives a false impression because of the homogenization process used.

Here's a way to visualize the homogenization process. Think of it like measuring water pollution. Here's a simple visual table of CRN station quality ratings and what they might look like as water pollution turbidity levels, rated as 1 to 5 from best to worst turbidity:



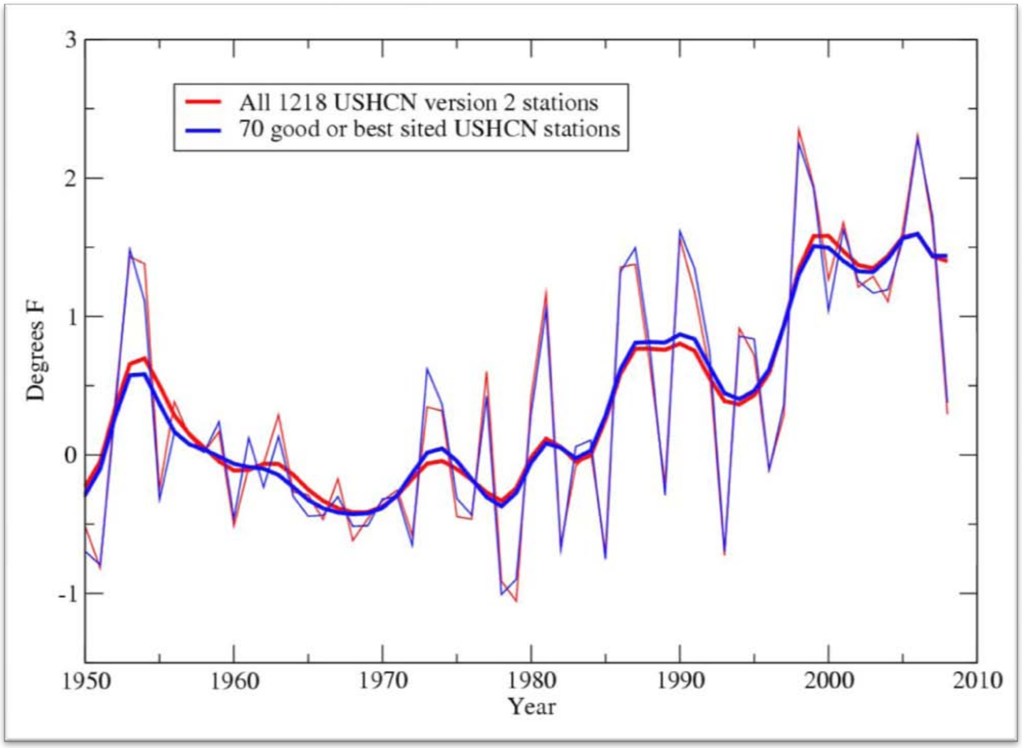
In homogenization the data is weighted against the nearby neighbors within a radius. And so a station might start out as a "1" data wise, might end up getting polluted with the data of nearby stations and end up as a new value, say weighted at "2.5". Even single stations can affect many other stations in the GISS and NOAA data homogenization methods carried out on US surface temperature data here[68] and here[69].

67 www.ncdc.noaa.gov/oa/about/response-v2.pdf.
68 http://wattsupwiththat.com/2009/07/20/and-now-the-most-influential-station-in-the-giss-record-is/.
69 http://wattsupwiththat.com/2008/09/23/adjusting-pristine-data/.

In the map above, applying a homogenization smoothing, weighting stations by distance nearby the stations with question marks, what would you imagine the values (of turbidity) of them would be? And, how close would these two values be for the east coast station in question and the west coast station in question? Each would be closer to a smoothed center average value based on the neighboring stations.

Essentially, NCDC is comparing *homogenized data* to *homogenized data*, and thus there would *not* likely be any large difference between "good" and "bad" stations in that data. All the differences have been smoothed out by homogenization (pollution) from neighboring stations!

The best way to compare the effect of siting between groups of stations is to use the "raw" data, before it has passed through the multitude of adjustments that NCDC performs. However NCDC is apparently using homogenized data. So instead of comparing apples and oranges (poor sited vs. well sited stations) they essentially just compare apples (Granny Smith vs. Golden Delicious) of which there is little visual difference beyond a slight color change.



From NCDC's "talking points" rebuttal - click for larger image.

They cite 60 years of data in the graph they present, ignoring the warmer 1930's. They also use an early and incomplete surfacestations.org dataset, that was never intended for analysis, in their rush to rebut the issues raised. However, our survey most certainly cannot account for changes to the station locations or station siting quality any further back than about 30 years. By NCDC's own admission, (see Quality Control of pre-1948 Cooperative Observer Network Data[70]) they have little or no metadata posted on station siting much further back than about 1948 on their MMS metadatabase. Clearly, siting quality is dynamic over time.

The other issue about siting that NCDC does not address is that it is a significant contributor to extreme temperature records. By NOAA's own admission in PCU6 - Unit No. 2 Factors Affecting the Accuracy and Continuity of Climate Observations[71] such siting issues as the rooftop weather station in Baltimore contributed many erroneous high temperature records, so many in fact that the station had to be closed.

NOAA wrote about the Baltimore station:

> "A combination of the rooftop and downtown urban siting explain the regular occurrence of extremely warm temperatures. Compared to nearby ground-level instruments and nearby airports and surrounding COOPs, it is clear that a strong warm bias exists, partially because of the rooftop location.

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70 http://ams.confex.com/ams/pdfpapers/68379.pdf.

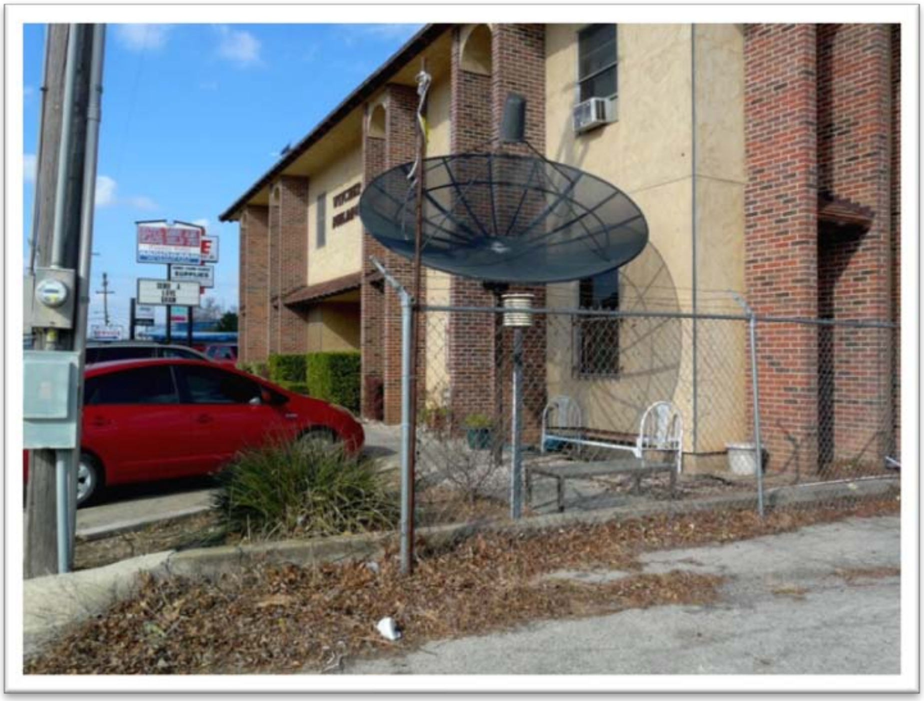
71 http://www.weather.gov/om/csd/pds/PCU6/IC6_2/tutorial1/PCU6-Unit2.pdf.

> Maximum and minimum temperatures are elevated, especially in the summer. The number of 80 plus minimum temperatures during the one-year of data overlap was 13 on the roof and zero at three surrounding LCD airports, the close by ground-based inner Baltimore harbor site, and all 10 COOPs in the same NCDC climate zone. Eighty-degree minimum are luckily, an extremely rare occurrence in the mid-Atlantic region at standard ground-based stations, urban or otherwise."

Clearly, siting does matter, and siting errors have contributed to the temperature records of the United States, and likely the world GHCN network. Catching such issues isn't always as easy as NOAA demonstrated in Baltimore.

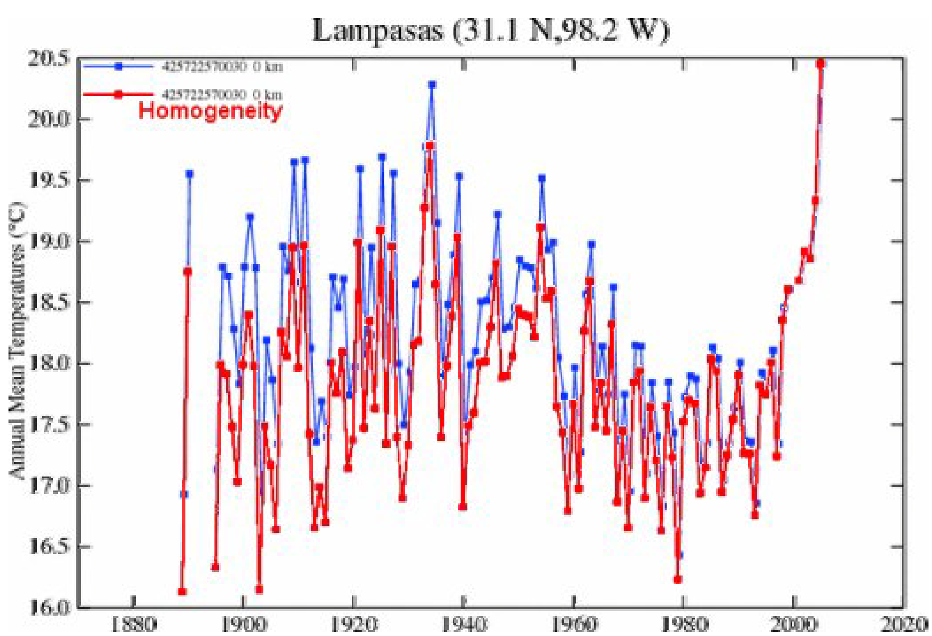
Baltimore USHCN station circa 1990's photo, courtesy NOAA.

There is even some evidence that the change point algorithm does not catch some site changes it should catch and that homogenization doesn't help. Take, for example, Lampasas, Texas, as identified by Anthony Watts.



Photograph by Julie K. Stacy, courtesy of surfacestations.org.

The site at Lampasas, TX, moved close to a building and a street from a more appropriate grassy site after 2001. Note even with the GISS "homogeneity" adjustment (red) applied to the NOAA adjusted data, this artificial warming remains although the old data (blue) is cooled to accentuate warming even further.



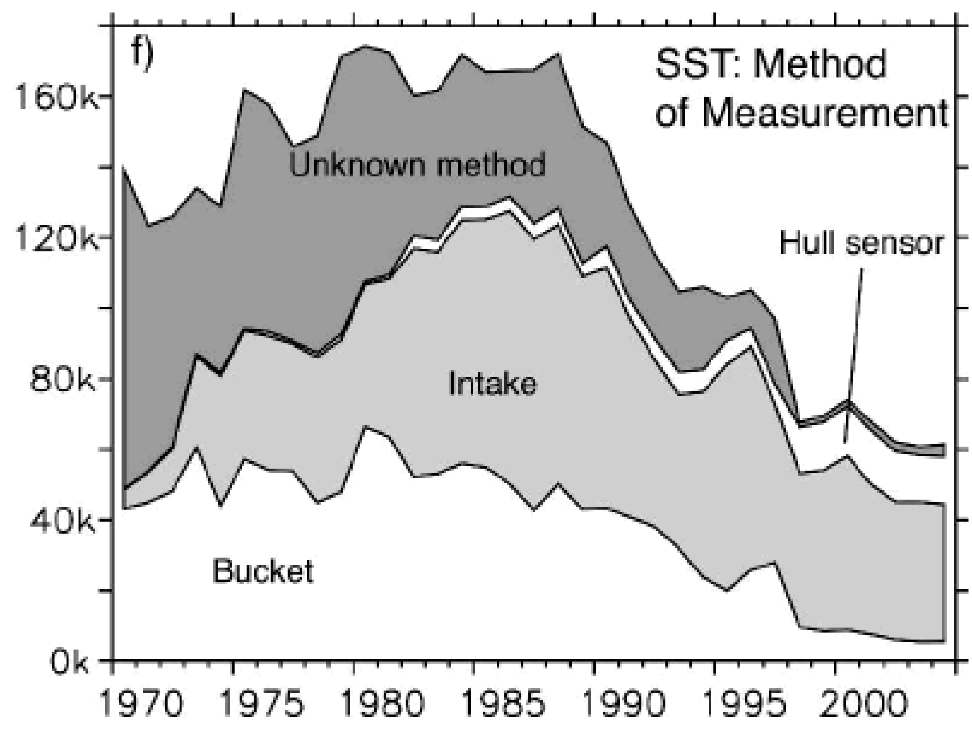
The net result is to make the recent warm cycle maximum more important relative to the earlier maximum in the 1930s, and note the sudden warm blip after the station move remains.

This final data set is then used to populate a global grid, interpolating up to 1200 km (745 miles) to grid boxes that had become now vacant by the elimination of stations.

The data is then used for estimating the global average temperature and anomaly and for initializing or validating climate models.

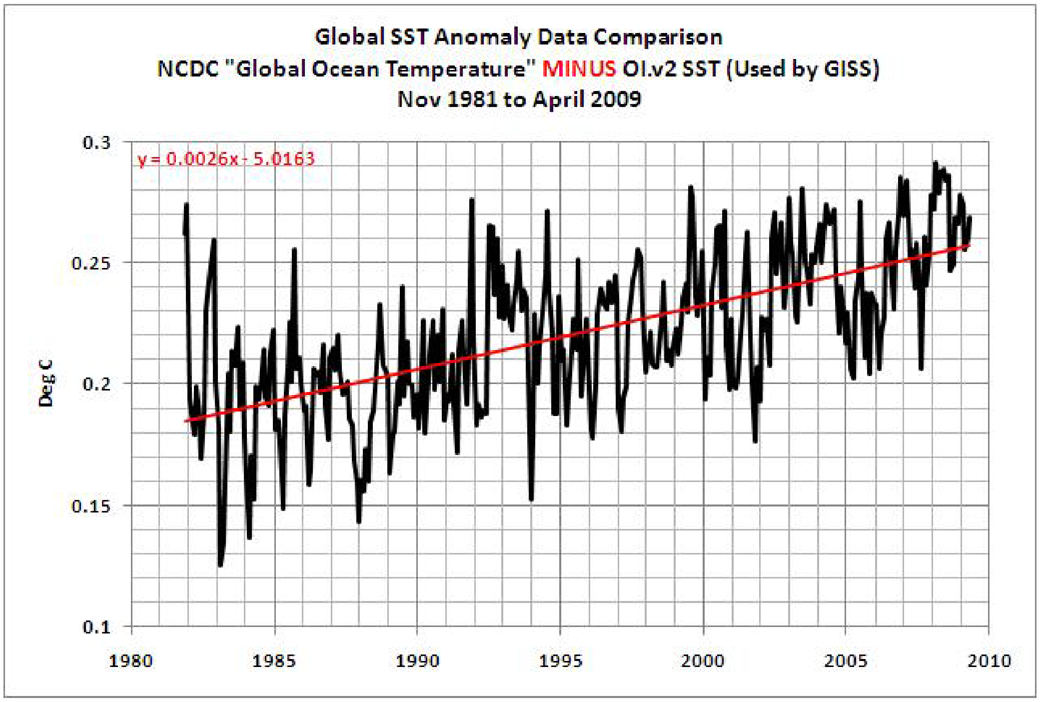
PROBLEMS WITH SEA SURFACE TEMPERATURE MEASUREMENTS

The world is 71% ocean. The Hadley Centre only trusts data from British merchant ships, mainly plying northern hemisphere routes. Hadley has virtually no data from the southern hemisphere's oceans, which cover four-fifths of the hemisphere's surface. NOAA and NASA use ship data reconstructions. The gradual change from taking water in canvas buckets to taking it from engine intakes introduces uncertainties in temperature measurement. Different sampling levels will make results slightly different. How to adjust for this introduced difference and get a reliable dataset has yet to be resolved adequately, especially since the transition occurred over many decades. The chart, taken from Kent (2007), shows how methods of ocean-temperature sampling have changed over the past 40 years –



We have reanalysis data based on reconstructions from ships, from buoys (which also have problems with changing methodology) and, in recent decades, from satellites. The oceans offer some opportunity for mischief, as the emails released by the Climategate whistle-blower showed clearly.

NOAA NCDC has their own SST anomaly dataset for their global surface temperature product, and they calculate anomalies against the base years of 1901 to 2000. GISS has used the NCDC OI.v2 SST anomaly data since December 1981, and before that they had used the Hadley Centre's HADSST data. GISS then splices the two datasets together. Bob Tisdale[72] looked at the differences between the multiple NCDC SST anomaly datasets, one of which is used by GISS.



NOAA clearly is "finding" more warming in their ocean data set than NASA (with anomalies over 0.25 greater on a consistent basis).

This report[73] analyzed climate model (Barnet et al., 2001) forecasts of ocean temperatures from 1955 to 2000 versus actual changes. It found models greatly overstated the warming especially at the surface where the actual change was just about 0.1°C over that period.

There is another data set that may better resolve this discrepancy with time, the ARGO buoys.

As detailed in the SPPI report by Dr. David Evans here[74]:

> "There has been a change in direction by the climate alarmists, as shown by their new "Synthesis Report"[75] (June 2009). They now emphasize ocean temperatures and ocean heat content, and pay scant attention to air

72 http://wattsupwiththat.com/2009/05/18/recent-differences-between-giss-and-ncdc-sst-anomaly-data-and-a-look-at-the-multiple-ncdc-sst-datasets/.

73 http://www.worldclimatereport.com/archive/previous_issues/vol6/v6n16/feature1.htm#http://www.world climatereport.com/archive/previous_issues/vol6/v6n16/feature1.htm.

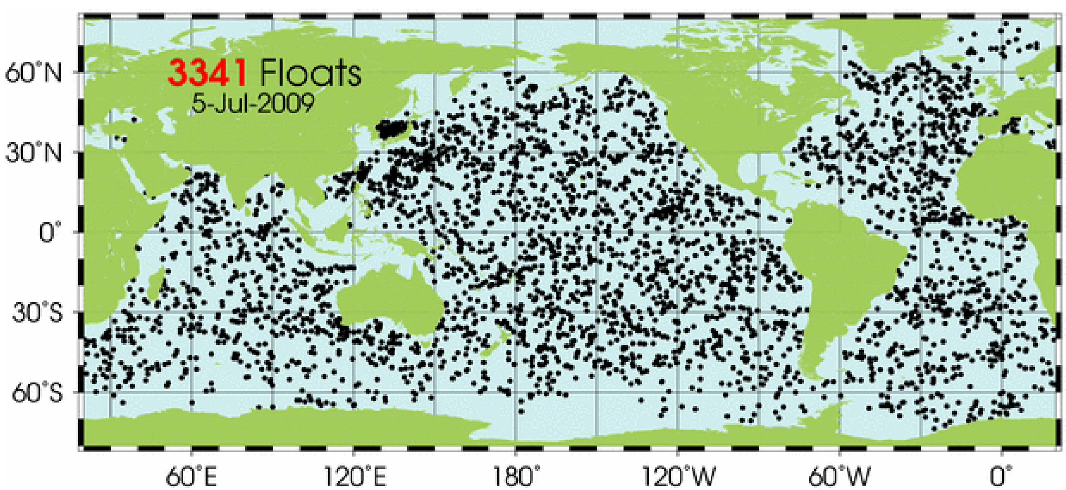
74 http://scienceandpublicpolicy.org/images/stories/papers/originals/ocean_temps.pdf.

75 http://climatecongress.ku.dk/pdf/synthesisreport/.

temperature. Their new argument is that most of the heat in the climate system (water, air, ice, and snow) is stored in the oceans, so the ocean temperature is "a better indicator of change in the climate" than the air temperature. This argument is correct (as supported by DiPuccio 2009[76] and originally suggested by Pielke Sr. in 2003 and again in 2007 on his blog, A Litmus Test for Global Warming). The problem is that ocean temperatures have only been measured adequately since mid 2003.

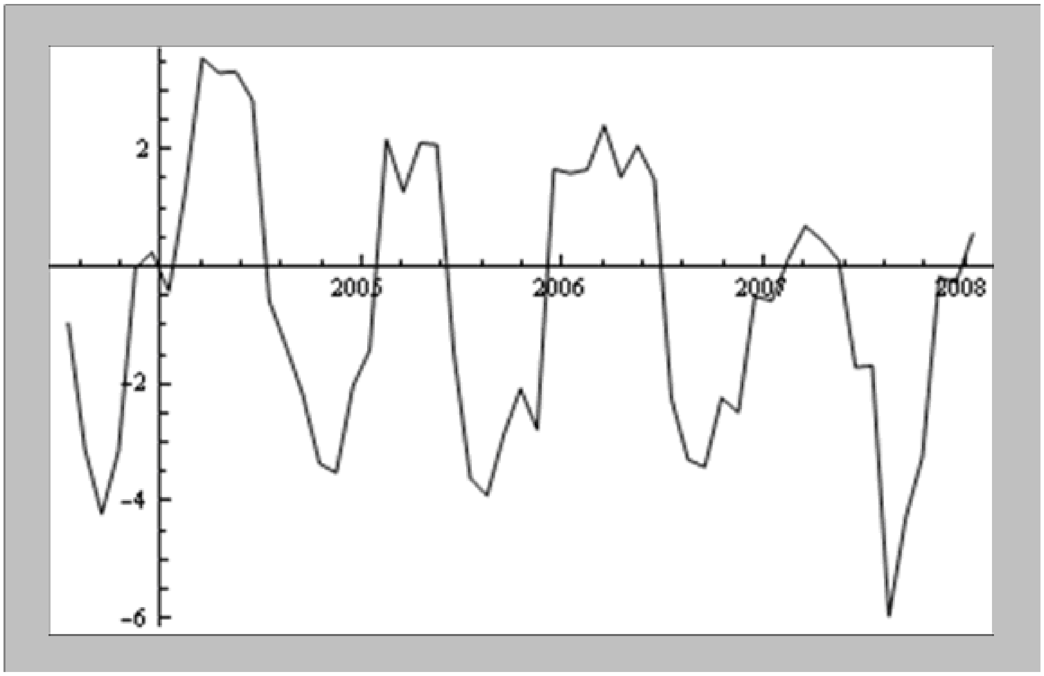
Measuring ocean temperature globally is harder than it sounds. The Argo network[77] finally overcomes many of the prior problems, but only became operational in mid-2003.

Before Argo, starting in the early 1960s, ocean temperatures were measured with bathythermographs (XBTs). They are expendable probes fired into the water by a gun, that transmit data back along a thin wire. They were nearly all launched from ships along the main commercial shipping lanes, so geographical coverage of the world's oceans was poor—for example the huge southern oceans were not monitored. XBTs do not go as deep as Argo floats, and their data is much less accurate (Met Office[78], Argo[79]).

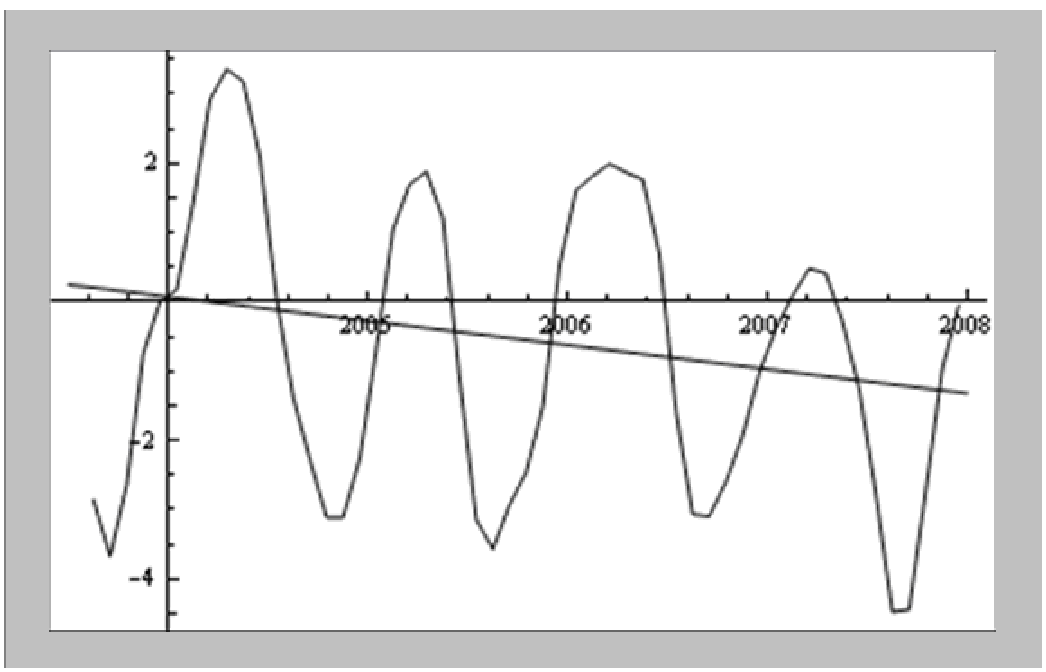


The Argo data shows that the oceans have been in a slight cooling trend since at least late-2004, and possibly as far back as mid-2003 when the Argo network started.

76 http://pielkeclimatesci.wordpress.com/2009/05/05/have-changes-in-ocean-heat-falsified-the-global-warming-hypothesis-a-guest-weblog-by-william-dipuccio/.
77 http://www.argo.ucsd.edu/About_Argo.html.
78 http://www.metoffice.gov.uk/weather/marine/observations/gathering_data/argo.html.
79 http://wwlw.argo.ucsd.edu/Novel_argo.html.



*The ocean heat content from mid 2003 to early 2008, as measured by the Argo network, for 0 – 700 meters. The unit of the vertical axis is 1022 Joules (about 0.01°C). This shows the recalibrated data, **after** the data from certain instruments with a cool bias were removed (initial Argo results showing strong cooling).*



The Argo data smoothed, with a line of best fit. The line is dropping at -0.35 x 1022 Joules per year (about 0.035°C per decade) Loehle (2009).

Josh Willis of NASA's Jet Propulsion Laboratory, in charge of the Argo data, said in March 2008 on NPR[80]: "There has been a very slight cooling, but not anything really significant".

The ocean data that the alarmists are relying on to establish their warming trends is all pre-Argo; it all comes from the old, less accurate XBTs. Now that we are measuring ocean temperatures properly, the warming trend has disappeared. And by coincidence, it disappeared just when we started measuring it properly! There is a large ocean temperature rise reported in the two years before Argo became available—might there have been a calibration problem between the old data and the Argo data? Could the old ocean temperature data have been subject to "corrections", like the GISS air temperature data?

The Argo data originally showed a strong cooling trend. Josh Willis was surprised at the results: "every body was telling me I was wrong", because it didn't agree with the climate models or satellite observations of net radiation flux. Willis decided to recalibrate the Argo data by omitting readings from some floats that seemed to be giving readings that were too cold. The Argo results shown above are for the new, current data, ***after*** those recalibrations were made.

There is a problem with data in the politicized world of climate science: alarmists have all the authority positions in climate science and own (manage) all the datasets. Datasets that contradict the alarmist theory have a habit of being recalibrated or otherwise adjusted for technical reasons, and the changes to the datasets always make them more supportive of the alarmist theory."

Also, there is NO use of the Argo buoy data in the global monthly assessments.

SUMMARY

Just as the Medieval Warm Period was an obstacle to those trying to suggest that today's temperature is exceptional, and the UN and its supporters tried to abolish it with the "hockey-stick" graph, the warmer temperatures in the 1930s and 1940s were another inconvenient fact that needed to be "fixed".

In each of the databases, the land temperatures from that period were simply adjusted downward, making it look as though the rate of warming in the 20th century was higher than it was, and making it look as though today's temperatures were unprecedented in at least 150 years.

[80] http://www.npr.org/templates/story/story.php?storyId=88520025.

Wigley[81] even went so far as to suggest that sea surface temperatures for the period should likewise be "corrected" downward by 0.15C, making the 20th-century warming trend look greater but still plausible. This is obvious data doctoring.

In the Climategate emails, Wigley also noted[82]:

> "Land warming since 1980 has been twice the ocean warming — and skeptics might claim that this proves that urban warming is real and important."

NOAA, then, is squarely in the frame. First, the unexplained major station dropout with a bias towards warmth in remaining stations and a process that increases the need to estimate data for regions where data was accessed before but not currently despite it being available and visible to all even on the internet. Next, the removal of the urbanization adjustment and lack of oversight and quality control in the siting of new instrumentation in the United States data base degrades what once was the world's best data set, USHCNv1. Then, ignoring a large body of peer review research demonstrating the importance of urbanization and land use changes NOAA chooses not to include any urban adjustment for the global data set, GHCN.

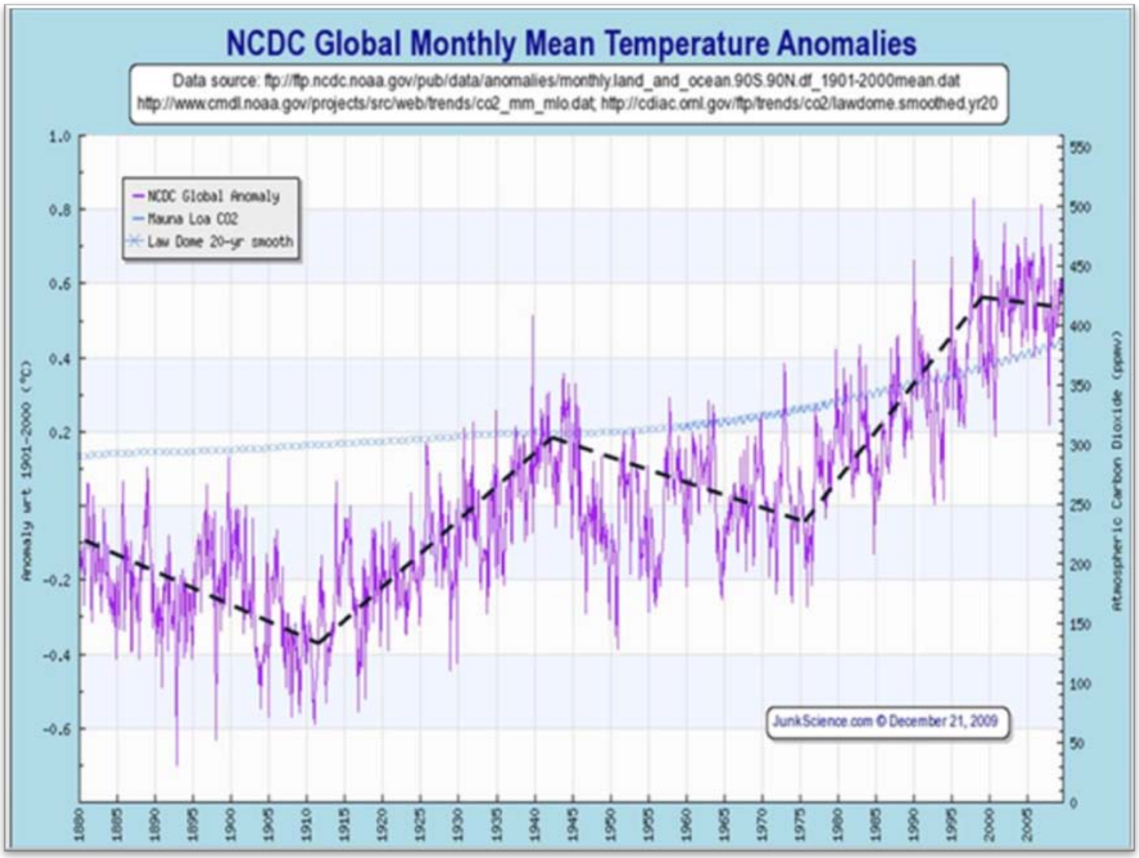
Just as the Medieval Warm Period was an obstacle to those trying to suggest that today's temperature is exceptional, and the UN and its supporters tried to abolish it with the "hockey-stick" graph, the warmer temperatures in the 1930s and 1940s were another inconvenient fact that needed to be "fixed".

As shown, these and other changes that have been made alter the historical record and mask cyclical changes that could be readily explained by natural factors like multidecadal ocean and solar changes (here[83]).

[81] http://www.eastangliaemails.com/emails.php?eid=1016&filename=1254108338.txt.

[82] http://www.eastangliaemails.com/emails.php?eid=1067&filename=1257546975.txt.

[83] http://icecap.us/images/uploads/ATMOSPHERIC_CIRCULATION.doc.



Is NASA in the clear? No. It works with the same GHCN/USHCN base data, (plus the SCAR data from Antarctica). To its credit, as we have shown its US data base includes an urban adjustment that is reasonable, but as Steve McIntyre showed[84] for GHCN it uses population data and adjusts temperature records for cities in a warming direction as often as they do in a cooling direction. This we have seen is due to very poor metadata from GHCN which GISS uses to match with satellite night like to define a station as urban, suburban or rural.

And their homogenization process and other non-documented final adjustments result in an increase in apparent warming, often by cooling the early record as can be seen in several case studies that follow.

NASA also constantly tampers with the data. John Goetz[85] showed that 20% of the historical record was modified 16 times in the 2½ years ending in 2007. 1998 and 1934 ping pong regularly between first and second warmest year as the fiddling with old data continues.

NASA also constantly tampers with the data.

[84] http://icecap.us/images/uploads/US_AND_GLOBAL_TEMP_ISSUES.pdf.
[85] http://wattsupwiththat.com/2008/04/08/rewriting-history-time-and-time-again/.

In 2007, NASA adjusted post 2000 data[86] when Steve McIntyre found a bug in the USHCN data down by 0.12 to 0.15C. Note how the data was adjusted up again in 2009 (USHCN V2.)

GISS Temperatures Change Yearly

	2006	2007	2008	2009
1996	-0.18	-0.16	-0.16	-0.06
1997	0.05	0.04	0.04	0.14
1998	1.24	1.24	1.24	1.31
1999	0.94	0.94	0.94	1.07
2000	0.65	0.54	0.54	0.69
2001	0.89	0.78	0.78	0.92
2002	0.67	0.55	0.55	0.69
2003	0.65	0.53	0.53	0.69
2004	0.54	0.46	0.46	0.61
2005	0.99	0.71	0.71	0.92
2006	*	1.15	1.15	1.31
2007	*	*	0.84	0.88
2008	*	*	*	0.12

E-mail messages obtained by a Freedom of Information Act request reveal that NASA concluded that its own climate findings were inferior to those maintained by both the University of East Anglia's Climatic Research Unit (CRU) -- the scandalized source of the leaked Climate-gate e-mails -- and the National Oceanic and Atmospheric Administration's National Climatic Data Center.

The e-mails from 2007 reveal that when a *USA Today* reporter asked if NASA's data "was more accurate" than other climate-change data sets, NASA's Dr. Reto A. Ruedy replied with an unequivocal no. He said[87] "the National Climatic Data Center's procedure of only using the best stations is more accurate," admitting that some of his own procedures led to less accurate readings.

"My recommendation to you is to continue using NCDC's data for the U.S. means and [East Anglia] data for the global means," Ruedy told the reporter.

86 http://data.giss.nasa.gov/gistemp/updates/200708.html.
87 http://pajamasmedia.com/files/2010/03/GISS-says-CRU-Better0001.pdf.

NOAA USHCN was observed to gradually change after 1999 before version 2 was introduced. Anecdotal evidence also suggests GHCN V2 may have varied (including the Central Park Case Study). A new version of GHCN (V3) is said to be coming in 2010.

Climategate has sparked a flurry of examinations of the global datasets not only at CRU, NASA, and NOAA, but in various countries throughout the world. Though the Hadley Centre implied their data was in agreement with other datasets and was thus trustworthy, the truth is that other data centers and the individual countries involved were forced to work with degraded data and appear to be each involved in data manipulation.

SECOND WARMEST YEAR (NASA), WARMEST DECADE EVER (NOAA) – NONSENSE!

Should you believe NOAA/NASA/HADLEY rankings for month and year? Definitively NO! Climate change is real, there are cooling and warming periods that can be shown to correlate nicely with solar and ocean cycles. You can trust in the data that shows there has been warming from 1979 to 1998, just as there was warming around 1920 to 1940. But there has been cooling from 1940 to the late 1970s and since 2001. It is the long term trend on which this cyclical pattern is superimposed that is exaggerated.

As shown, record highs in North America show the cyclical pattern but suggest the 1930s to 1940 peak was higher than the recent peak around 1998. Recent ranking was very likely exaggerated by the numerous data issues discussed. Given these data issues and the inconvenient truths in the Climategate emails, the claim that the 2000s was the warmest decade in a millennium or two is ludicrous.

These factors all lead to significant uncertainty and a tendency for overestimation of century-scale temperature trends. An obvious conclusion from all findings above and the case studies that follow is that the global data bases are seriously flawed and can no longer be trusted to assess climate trends. And, consequently, such surface data should not be used for decision making.

We enthusiastically support Roger Pielke Sr. who, after exchanges with Phil Jones over data sets, called for[88] –

> *"an inclusive assessment of the surface temperature record of CRU, GISS and NCDC. We need to focus on the science issues. This necessarily should involve all research investigators who are working on this topic, with formal assessments chaired and paneled by mutually agreed to climate scientists who do not have a vested interest in the outcome of the evaluations."*

We further suggest it should be extended to include UAH and RSS.

[88] http://wattsupwiththat.com/2010/01/14/pielke-senior-correspondence-with-phil-jones-on-klotzbach-et-al/.

Roy Spencer has suggested what was needed in this way:

> "...*independent groups doing new and independent global temperature analyses—not international committees of Nobel laureates passing down opinions on tablets of stone.*"

In addition, the reliance on the global data by both the UNIPCC and the US GCRP/CCSP requires a full investigation and audit.

CASE STUDIES IN DATA MANIPULATION

A series of case studies illustrates the scale and frequency of data manipulation. In every instance, the effect of the tampering is to make it appear as though temperature has risen faster in the instrumental record than in truth it has. This is but a sampling. By the time you read this, there probably will be many more.

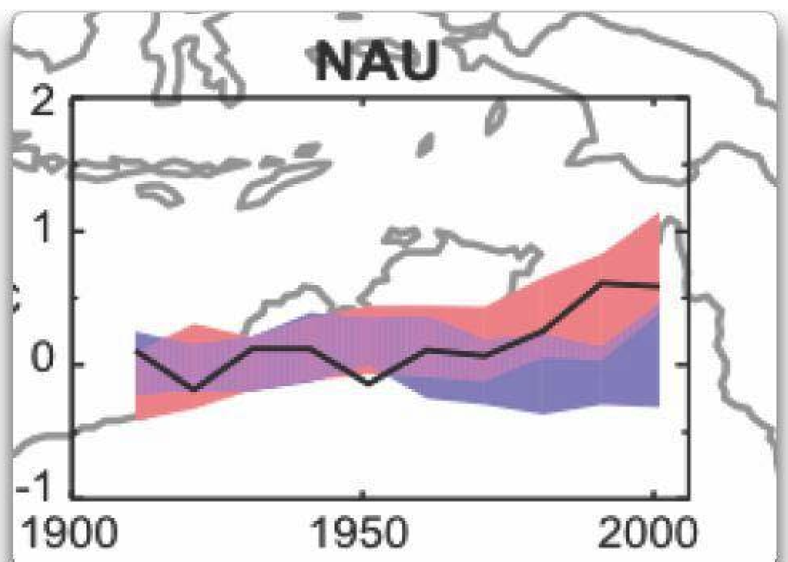
> *In every instance, the effect of the tampering is to make it appear as though temperature has risen faster in the instrumental record than in truth it has.*

CASE 1: THE SMOKING GUN AT DARWIN ZERO

by Willis Eschenbach for Watts Up With That (posted here[89])

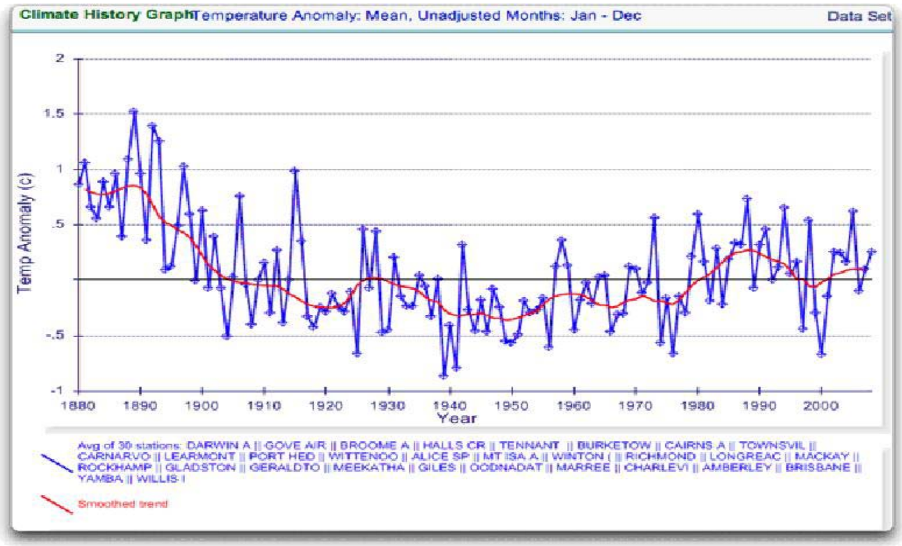
So I'm still on my multi-year quest to understand the climate data. You never know where this data chase will lead. This time, it has ended me up in Australia. NASA [GHCN] only presents 3 stations covering the period 1897-1992. What kind of data is the IPCC Australia diagram based on? If any trend it is a slight cooling. However, if a shorter period (1949-2005) is used, the temperature has increased substantially. The Australians have many stations and have published more detailed maps of changes and trends.

The folks at CRU told Wibjorn that he was just plain wrong. Here's what they said is right, the record that Wibjorn was talking about, Fig. 9.12 in the UN IPCC Fourth Assessment Report, showing Northern Australia (vertical axis is temperature anomaly in Celsius).



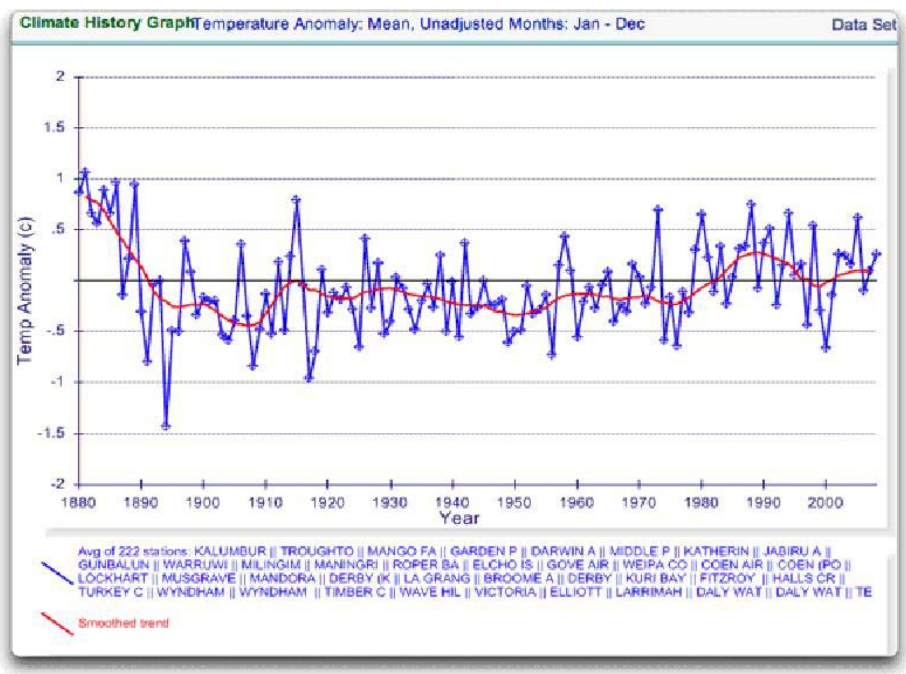
[89] http://wattsupwiththat.com/2009/12/08/the-smoking-gun-at-darwin-zero/.

Here are all 30 stations in the region as defined by the IPCC that contains temperature records that extend up to the year 2000 no matter when they started –



These graphs all use the raw GHCN data, and they show virtually no trend in temperatures in Northern Australia in 125 years.

Still no similarity with IPCC. So I looked at every station in the area. That's 222 stations. Here's that result (below, enlarged here[90]) –

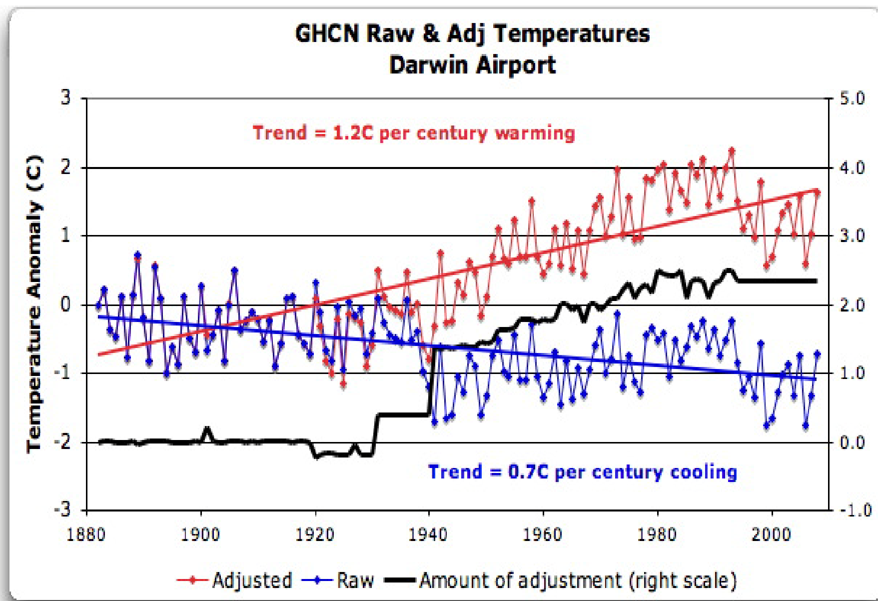


These graphs all use the raw GHCN data, and they show virtually no trend in temperatures in Northern Australia in 125 years. However, the IPCC uses the "adjusted" data. GHCN adjusts the data to remove what it calls "inhomogeneities". So, on a whim I thought I'd take a look at the first station on the list, Darwin Airport, so I could see what an inhomogeneity might look like when it was at home.

[90] http://icecap.us/images/uploads/darwin_zero4.JPG.

Then I went to look at what happens when the GHCN "adjusts" the data to remove the "inhomogeneities". Of the five raw datasets, the GHCN discards two, probably because they are short and duplicate existing longer records. The three remaining records are first "homogenized" and then averaged to give the "GHCN Adjusted" temperature record for Darwin.

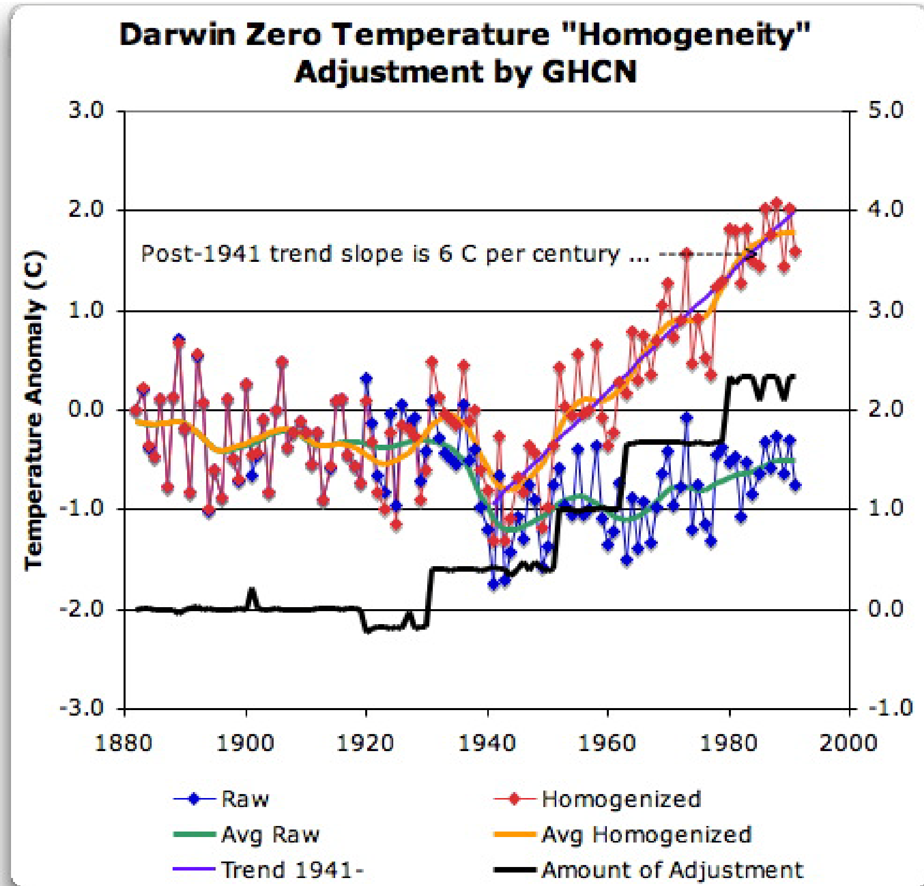
To my great surprise, here's what I found. To explain the full effect, I am showing this with both datasets starting at the same point (rather than ending at the same point as they are often shown).



Before the "adjustment" by NOAA, temperatures in Darwin were falling at 0.7 Celsius per century, but after the homogenization they were rising at 1.2 Celsius per century. The gross upward adjustment was 2 Celsius per century.

Before the "adjustment" by NOAA, temperatures in Darwin were falling at 0.7 Celsius per century, but after the homogenization they were rising at 1.2 Celsius per century. The gross upward adjustment was 2 Celsius per century.

Intrigued by the curious shape of the average of the homogenized Darwin records, I then went to see how NOAA had homogenized each of the individual station records, starting with the earliest record. Here is Station Zero at Darwin, showing the raw and the homogenized versions –



It is difficult to justify adjustment on so very large a scale. We have five different records covering Darwin from 1941 on. They all agree almost exactly. Why adjust them at all? NOAA added a huge, artificial, imaginary trend to the most recent half of the raw data. Now it looks like the IPCC diagram. Note how the magnitude of the adjustment climbs in discrete steps like a ziggurat. What's up with that? See here[91].

CASE 2: New Zealand Warms to Warming

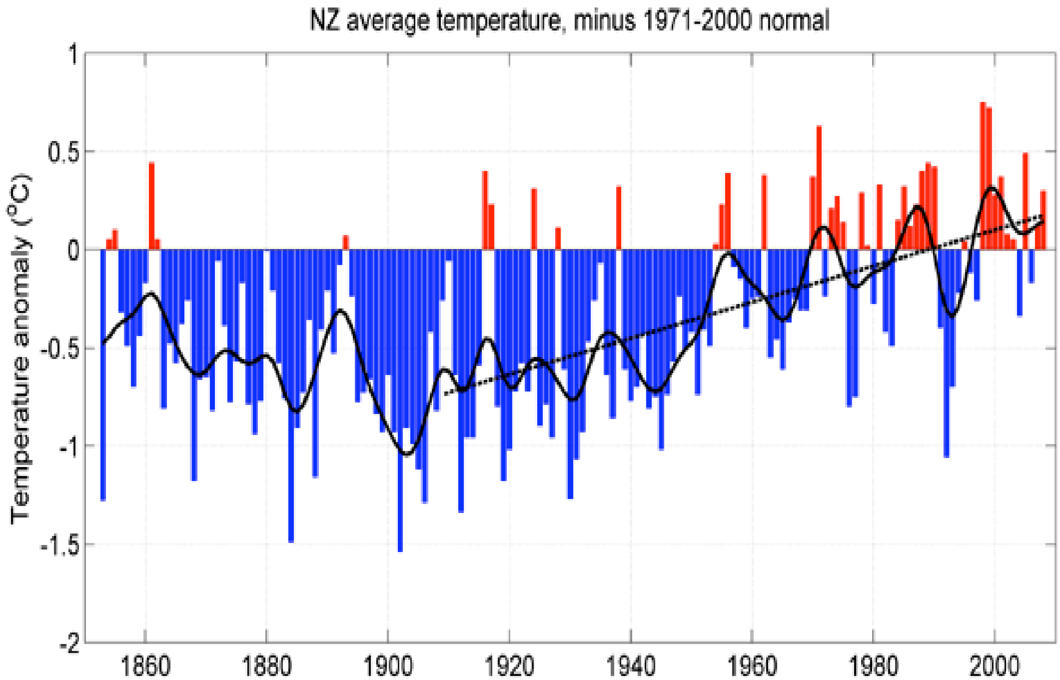
A study by the New Zealand Climate Science Coalition

There have been strident claims that New Zealand is warming. The UN's climate panel is not alone in alleging that, along with the rest of the world, New Zealand has been heating up for over 100 years.

But now, a simple check of publicly-available information proves these claims wrong. In fact, New Zealand's temperature has been remarkably stable for a century and a half. So what's going on?

[91] http://wattsupwiththat.com/2009/12/08/the-smoking-gun-at-darwin-zero/.

New Zealand's National Institute of Water & Atmospheric Research (NIWA) is responsible for New Zealand's National Climate Database. This database, available online, holds all of New Zealand's climate data, including temperature readings, since the 1850s. Anybody can go and get the data for free. That's what we did, and we made our own graph. Before we see that, let's look at the official temperature record. This is NIWA's graph of temperatures covering the last 156 years, from NIWA's website –



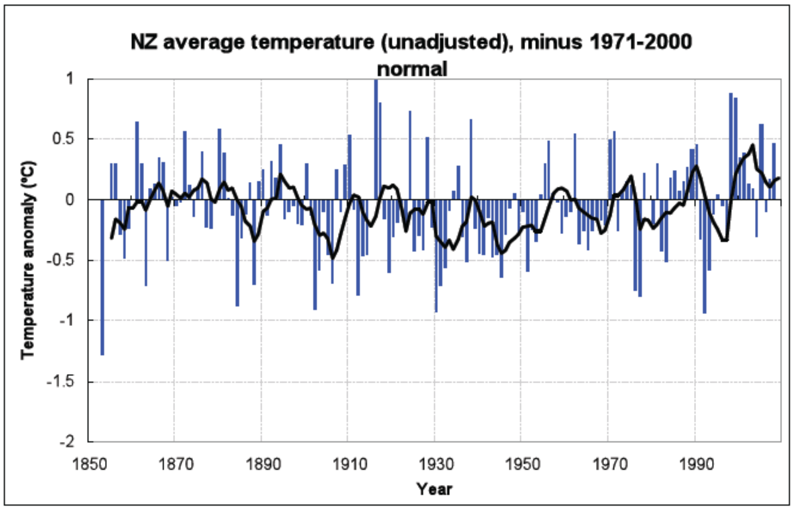
The graph shows mean annual temperature over New Zealand, from 1853 to 2008 inclusive, based on between two (from 1853) and seven (from 1908) long-term station records. The blue and red bars show annual differences from the 1971-2000 average, the solid black line is a smoothed time series, and the dotted straight line is the linear trend over 1909 to 2008 (0.92 C°/century).

This graph is the centerpiece of NIWA's temperature claims. It contributes to global temperature statistics and the IPCC reports. It is partly why our government is insisting on introducing an Emissions Trading Scheme (ETS) and participating in the climate conference in Copenhagen. But it's an illusion.

Dr Jim Salinger (who no longer works for NIWA) started this graph in the 1980s when he was at CRU (Climate Research Unit at the University of East Anglia, UK) and it has been updated with the most recent data. It's published on NIWA's website[92] and in their climate-related publications.

[92] http://www.niwa.co.nz/ourscience/climate/information-and-resources/clivar/pastclimate.

To get the original New Zealand temperature readings, you register on NIWA's web site, download what you want and make your own graph. We did that, but the result looked nothing like the official graph. Instead, we were surprised to get this:



Straight away you can see there's no slope - either up or down. The temperatures are remarkably constant way back to the 1850s. Of course, the temperature still varies from year to year, but the trend stays level - statistically insignificant at 0.06 C° per century since 1850. Putting these two graphs side by side, you can see huge differences. What is going on?

Why does NIWA's graph show strong warming, when graphing the raw data looks completely different? NIWA's graph shows warming, but the actual temperature readings show none whatsoever! Have the readings in the official NIWA graph been adjusted?

It is relatively easy to find out. We compared raw data for each station (from NIWA's web site) with the adjusted official data, which we obtained from one of Dr Salinger's colleagues. Requests for this information from Dr Salinger himself over the years, by different scientists, have long gone unanswered, but now we might discover the truth.

We were astonished to find that strong adjustments have indeed been made. About half the adjustments actually created a warming trend where none existed; the other half greatly exaggerated existing warming.

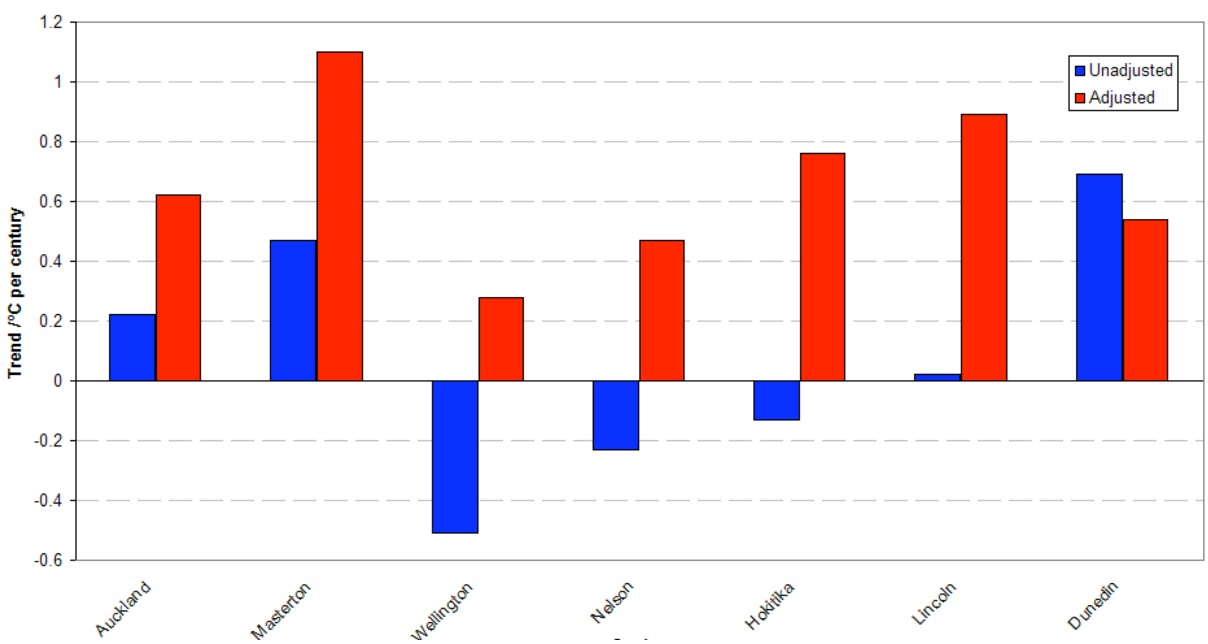
What did we find? First, the station histories are unremarkable. There are no reasons for any large corrections. But we were astonished to find that strong adjustments have indeed been made. About half the adjustments actually created a warming trend where none existed; the other half greatly exaggerated existing warming. All of the adjustments increased or even created a warming trend, with only one (Dunedin) going the other way and slightly reducing the original trend.

Station	Trend: ºC per century Unadjusted	Adjusted	Difference
Auckland	+0.22	+0.62	+0.40
Masterton	+0.47	+1.10	+0.63
Wellington	-0.51	+0.28	+0.79
Nelson	-0.23	+0.47	+0.70
Hokitika	-0.13	+0.76	+0.89
Lincoln	+0.02	+0.89	+0.87
Dunedin	+0.69	+0.54	-0.15

The shocking truth is that the oldest readings have been cranked way down and later readings artificially lifted to give a false impression of warming, as documented below. There is nothing in the station histories to warrant these adjustments. To date Dr Salinger and NIWA have not revealed why they did this.

The shocking truth is that the oldest readings have been cranked way down and later readings artificially lifted to give a false impression of warming.

The next graph shows **unadjusted** and **adjusted** temperature trends in New Zealand –



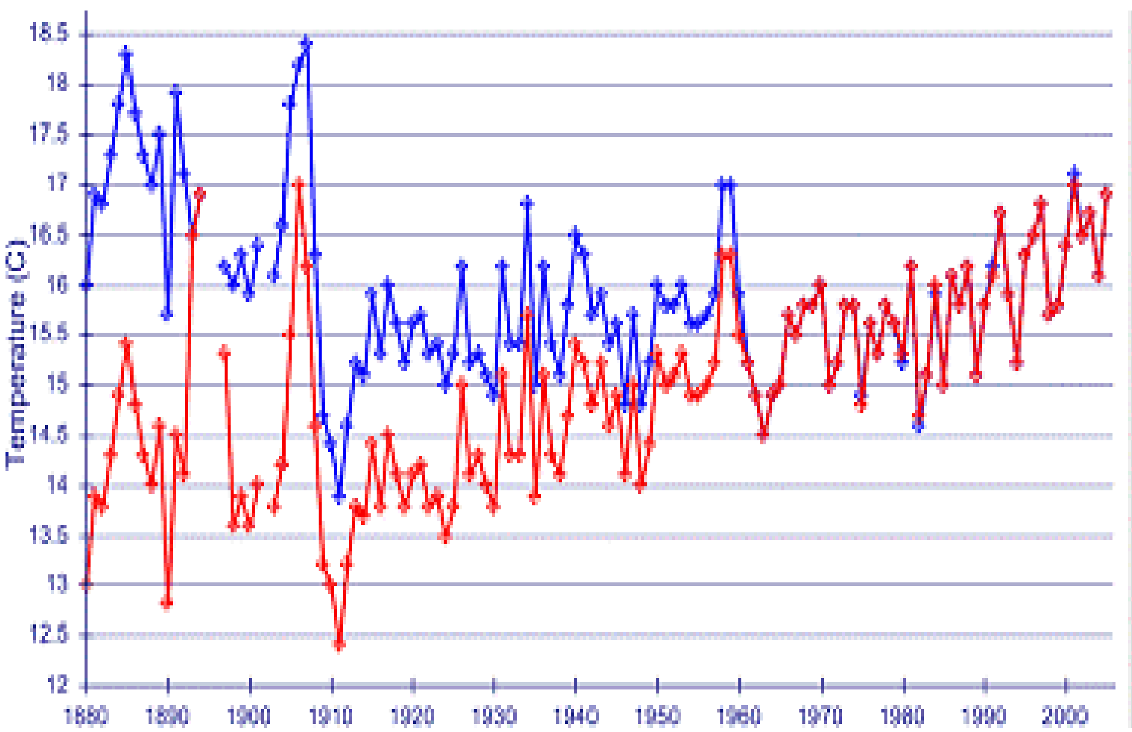
See much more of this detailed analysis here[93]. NIWA responds to the charges here[94].

CASE 3: OTHER EXAMPLES OF TEMPERATURE ADJUSTMENT

by Alan Cheetham, Global Warming Science

Temperature adjustments[95] are often made to US stations that are hard to explain but invariably increase the apparent warming. The following figure shows the closest rural station to San Francisco (Davis) and closest rural station to Seattle (Snoqualmie). In both cases a warming trend is artificially introduced to rural stations by adjusting earlier periods to make them appear cooler (blue for unadjusted, red for adjusted values) –

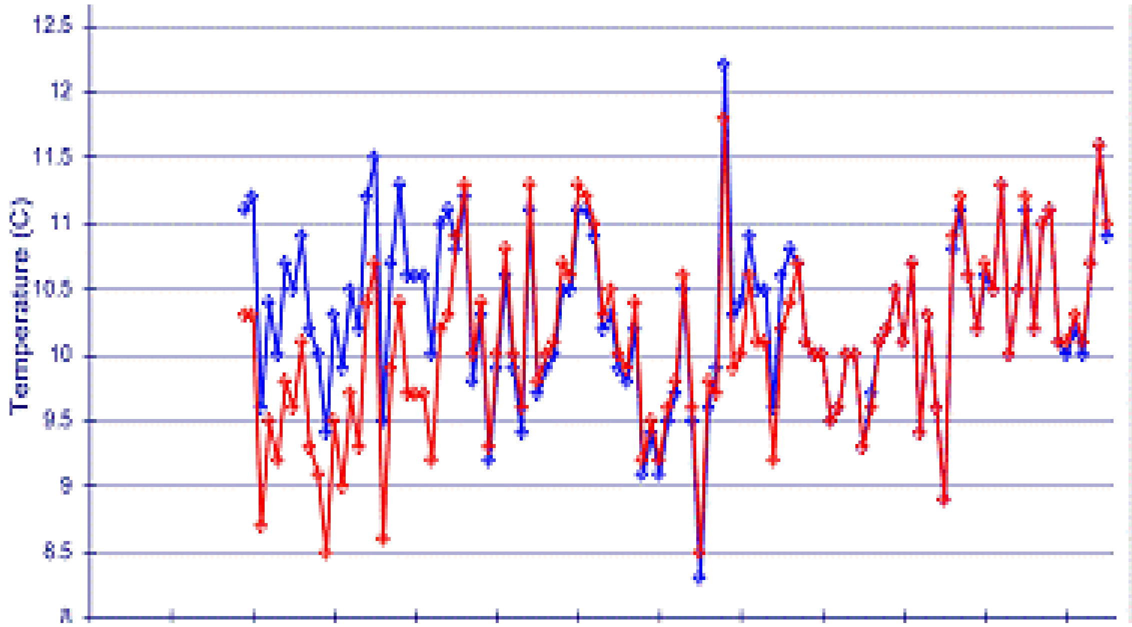
> ***In both cases a warming trend is artificially introduced to rural stations by adjusting earlier periods to make them appear cooler.***



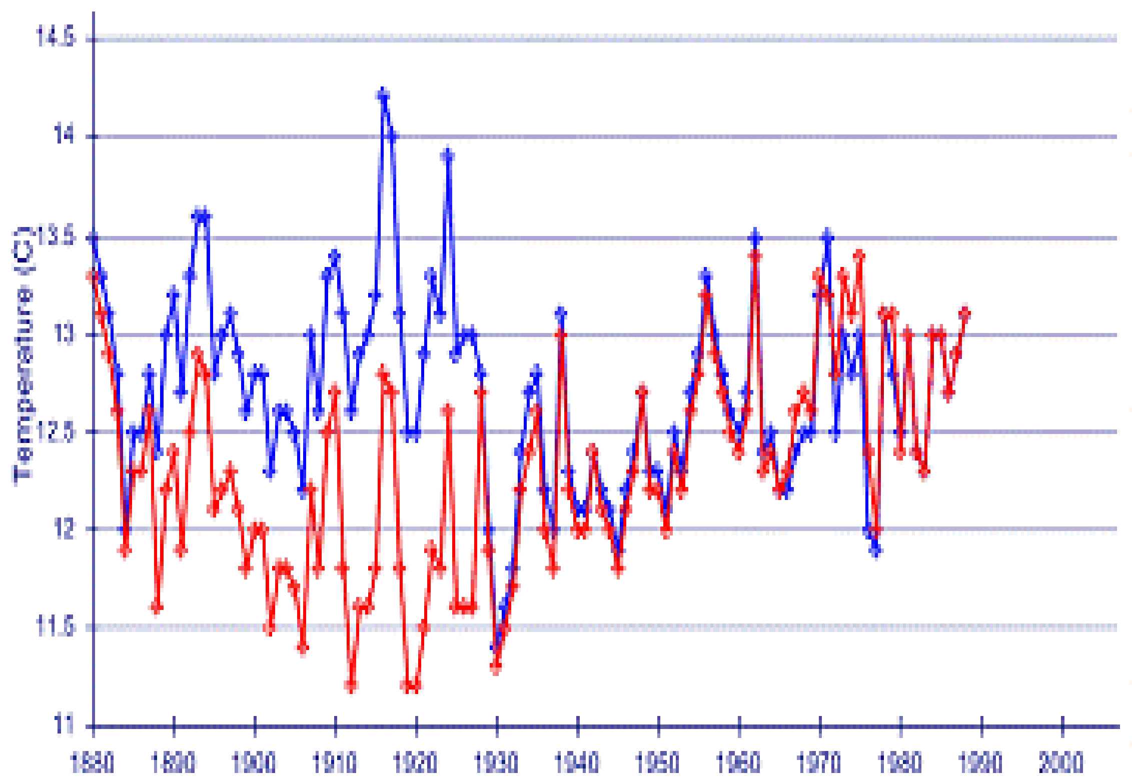
93 http://icecap.us/images/uploads/global_warming_nz_pdf.pdf.

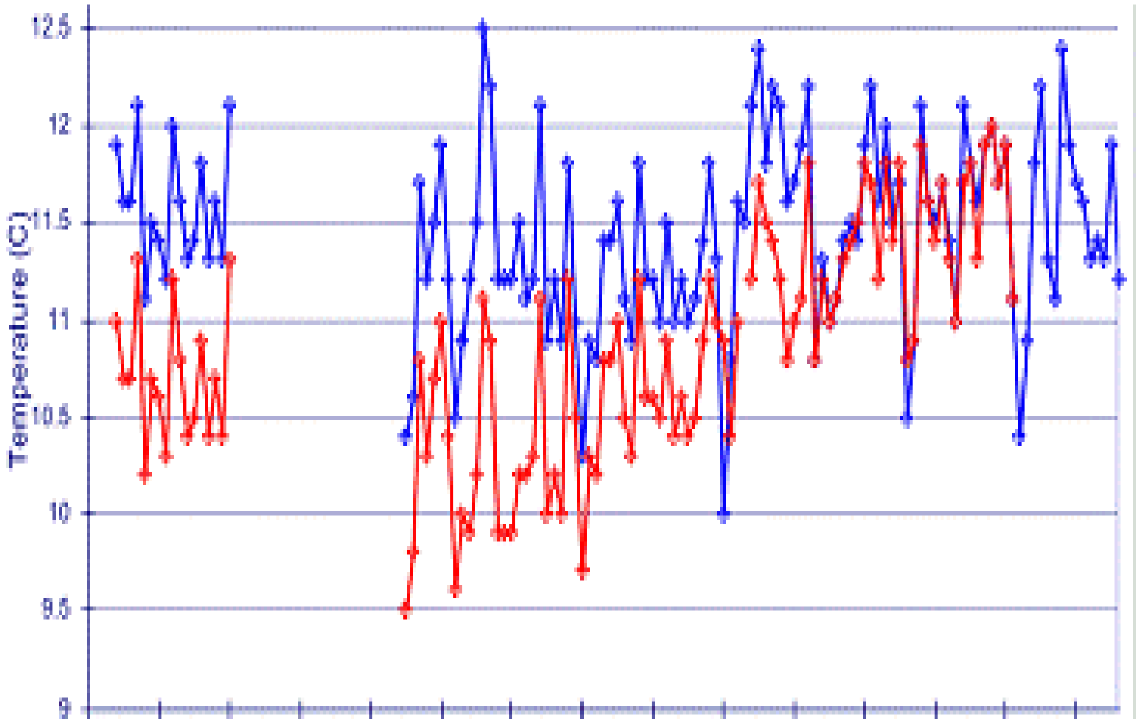
94 http://www.niwa.co.nz/our-science/climate/news/all/niwa-confirms-temperature-rise.

95 http://www.appinsys.com/GlobalWarming/GW_Part2_GlobalTempMeasure.htm.

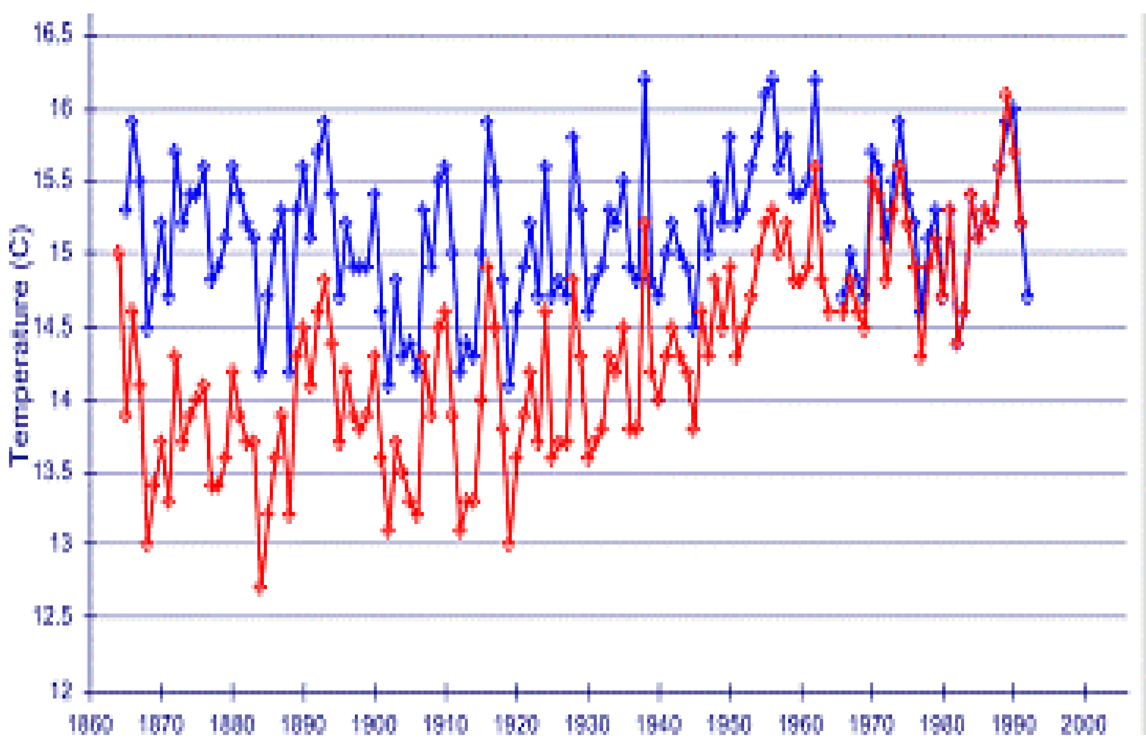


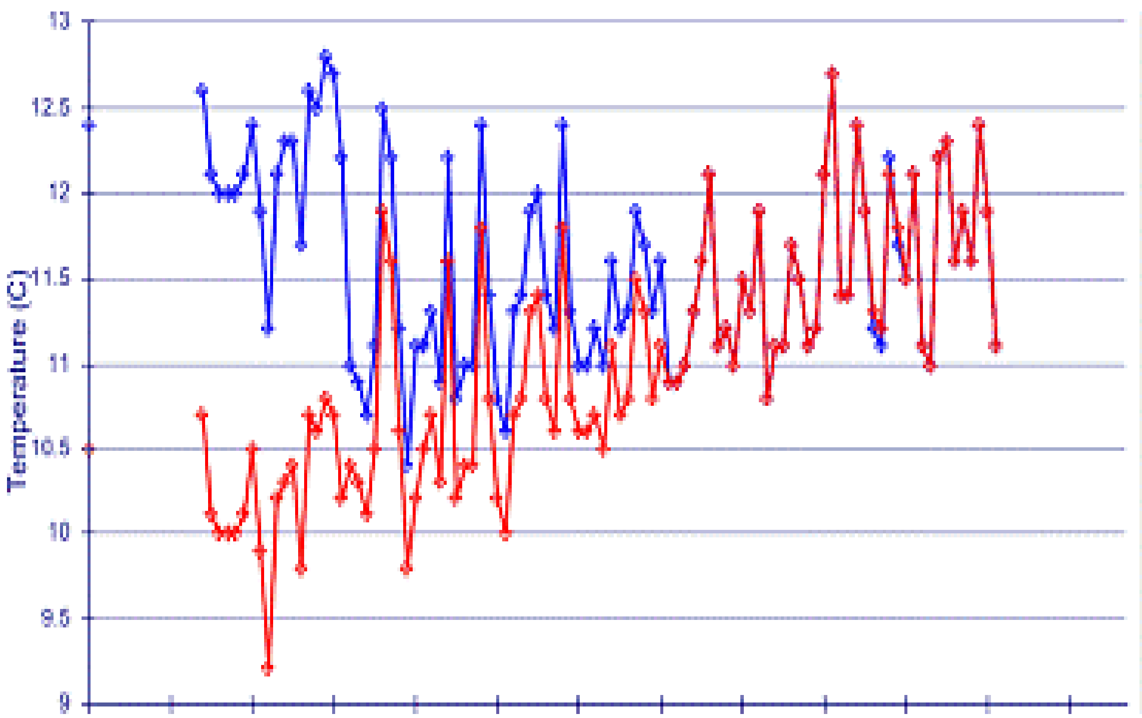
Similar adjustments can be seen here in both New Zealand and Australia. Here is a comparison of **unadjusted** and **adjusted** temperature data for Wellington (top) and Christchurch (bottom) –



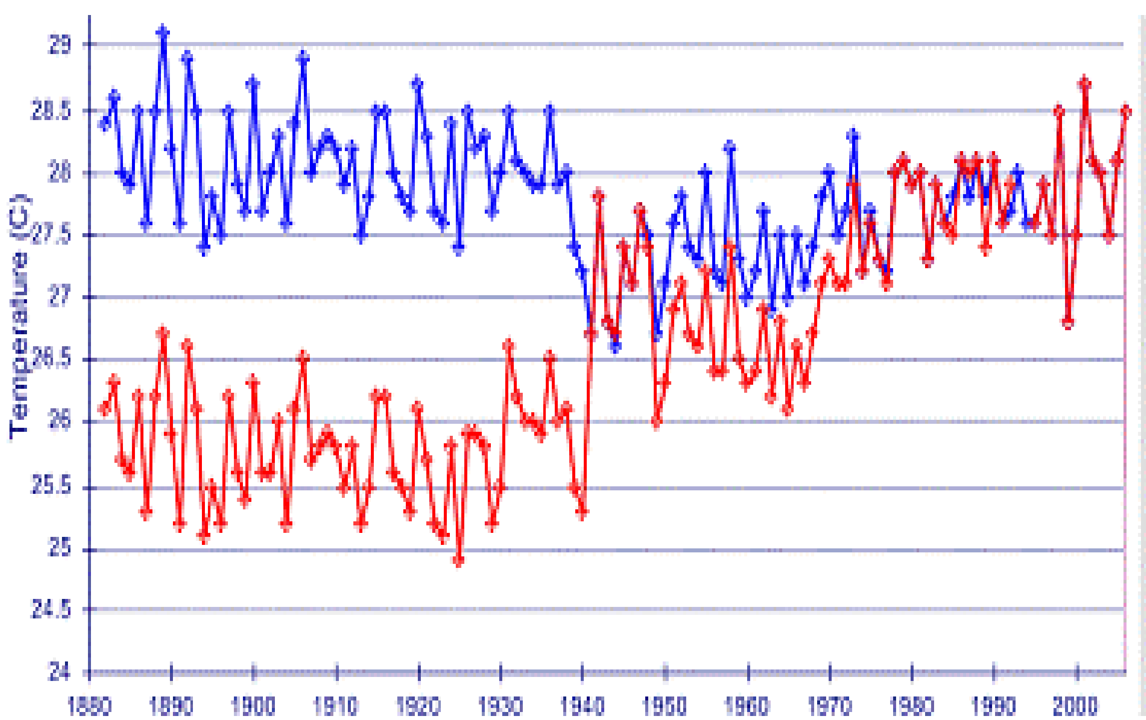


Here is a comparison of **unadjusted** and **adjusted** temperature data for Auckland (top) and Hokitika (bottom). Even the Hokitika station, listed as rural, ends up with a very significant warming trend –





The following graph is typical of the standard adjustments made to the temperature data. This is for Darwin, Australia, **unadjusted** and **adjusted**. Warming is created in the data through the adjustments, again by making earlier periods cooler –



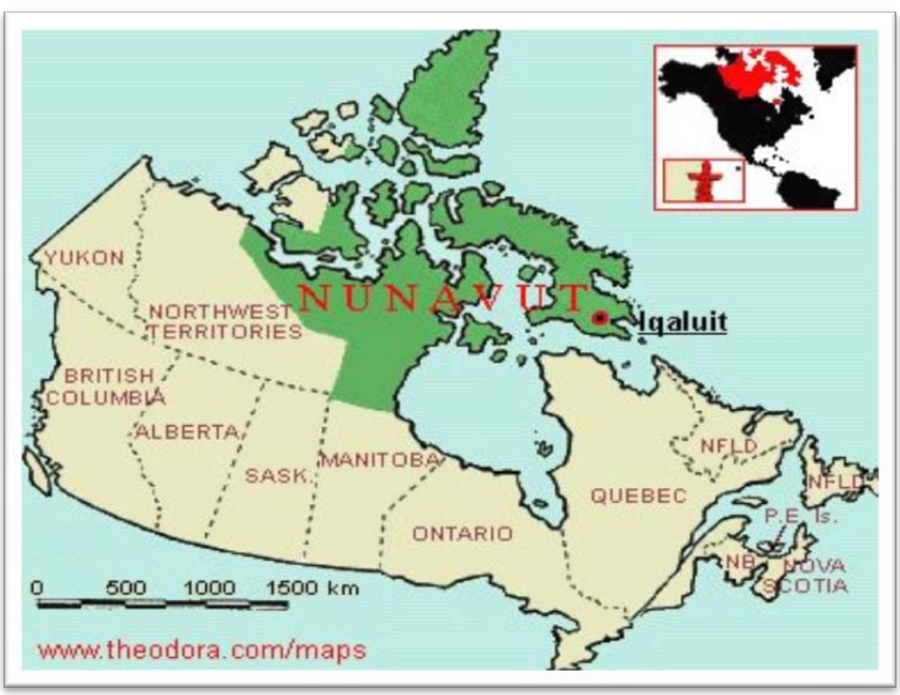
CASE 4: CANADA'S WEATHER NETWORK

by Dr. Tim Ball

Canada is the second-largest country in the world, with an area of 9,976,140 km^2. It encloses Hudson Bay, the largest inland ocean sea, with a surface area of 480,000 km^2, for a combined area of 10,456,140 km^2. There were 1088 WMO-rated stations – a density of one for every 9,610 km^2. However, density is extremely variable and the lack of density is troublesome in critical areas, the worst of which is Nunavut –

Land and Water Area, Quantity, and Density of WMO Stations

Province	Land (km^2)	Water (km^2)	Total (km^2)	WMO	Density (km^2)
Alberta	642,317	19,531	661,848	**18**	36,769
British Columbia	925,186	19,549	944,735	**107**	8,829
Manitoba	553,556	94,241	647,797	**42**	15,423
New Brunswick	71,450	1,458	72,908	**18**	4,050
Newfoundland	373,872	31,340	405,212	**18**	22,511
Northwest Terri.	1,183,085	163,021	1,346,106	**6**	56,087
Nova Scotia	53,338	1,946	55,284	**24**	2,303
Nunavut	1,936,113	157,077	2,093,190	**6**	348,865
Ontario	917,741	158,654	1,076,395	**96**	11,212
Prince Edward Is.	5,660	0	5,660	**8**	707
Quebec	1,365,128	176,928	1,542,056	**66**	23,364
Saskatchewan	591,670	59,366	651,036	**52**	12,519
Yukon	474,391	8,052	482,443	**5**	96,488



Now add the inadequate coverage for Yukon Territory, Northwest Territory, Newfoundland, and Labrador.

It is quickly apparent that coverage for most of northern Canada is totally inadequate.

The problem goes even further because there are no stations for the Arctic Basin, as the Arctic Impact Assessment Report identified, ironically using CRU data.

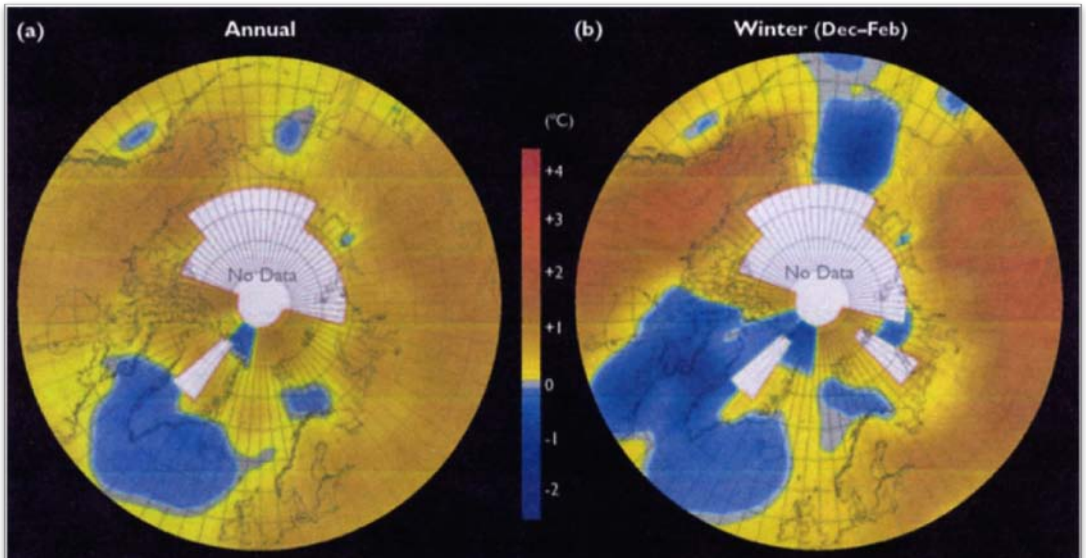


Fig. 1.3. Change in observed surface air temperature between 1954 and 2003: (a) annual mean; (b) winter (Chapman and Walsh, 2003, using data from the Climatic Research Unit, University of East Anglia, www.cru.uea.ac.uk/temperature).

This map shows the northern Canadian region with cold temperatures and Eurasia with warmer temperatures.

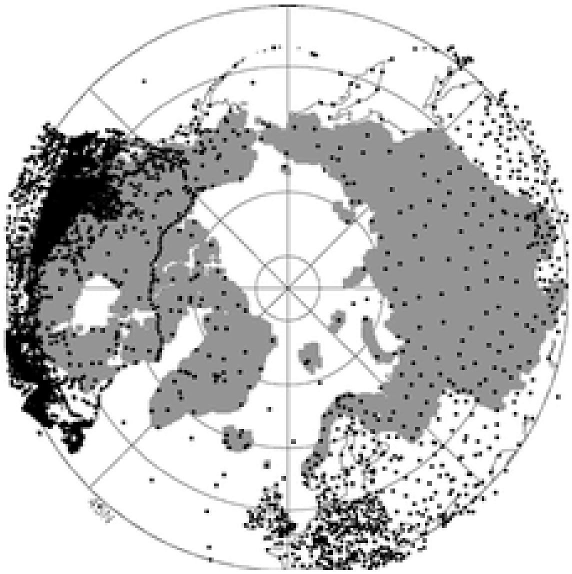
However, we now know the Eurasian pattern is distorted by the very selective stations used by NOAA and CRU.

The densities given for the Canadian provinces, which generally lie south of 60° N, are averages, but a quick look at the map of the total stations show a concentration in the southern half of each province.

For example, there are only three stations north of 55° N in Quebec. This is important because the boundary between the general surplus energy of the tropics and the deficit of the polar regions, traditionally known as the Polar Front, moves north and south within Canada in response to the general migration of the Sun.

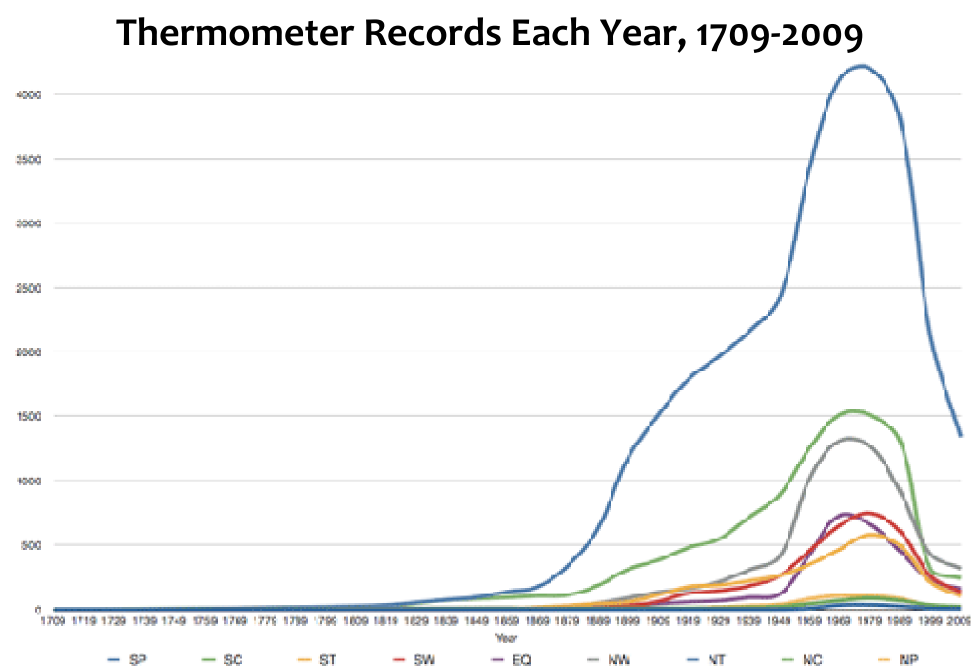
Its mean summer position is approximately 65° N, so the year-round area of deficit has virtually no weather stations.

The next diagram, with caption, comes from Rawlins and Wilmott (2003).



Locations of the monthly air-temperature station records for all Arctic stations (left) and for those Arctic stations with data from 1961–1990 (right). The light grey shading delineates the Pan-Arctic drainage basin. The map projection is Lambert's Azimuthal Equal Area (original caption). Source is [here](#)[96].

E.M. Smith has done a [detailed analysis](#)[97] of this limitation summarized in this diagram –



Smith's caption says: "*That next to the top green line is the Northern Cold band. The area we are talking about here. From 50N to 70N latitude. We see the thermometer count rise from the 1700s until a sudden Great Dying as the Thermometer Langoliers take their toll.*"

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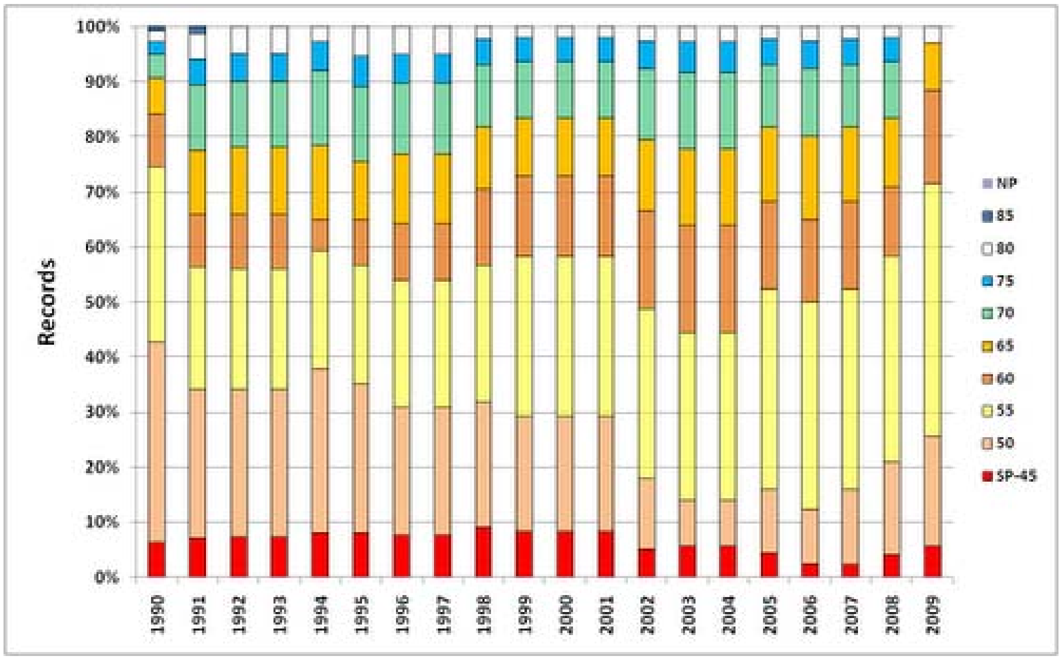
96 http://www.bioone.org/doi/abs/10.1657/1523-0430(2003)035%5b0530:WATCOT%5d2.0.CO;2?cookieSet=1&journalCode=aare.

97 http://chiefio.wordpress.com/2009/10/27/ghcn-up-north-blame-canada-comrade/.

Smith also shows a graph showing changing coverage north of 55° N from 1990-2009:



Smith's comments are: "Here we see that three northern bands have been gutted entirely. There are now NO thermometers (as of 2009) in the 65-70, 70-75, and 80-85 bands. 1992 saw the 80-85 band die. 2009, the others. Due to the general slaughter of thermometers, that 75-80 band is ONE thermometer.

That's right: one thermometer for everything north of Latitude 65°. Who needs Northwest Territories, Yukon Territories, or Baffin Island anyway?

Two factors led to the decline in stations from 950 in 1945 to 210 today: first, the decision that satellites would reduce the need for surface stations; secondly, the shift from a weather service as mandated by law to a climate change agency. The Auditor General reported $6.8 billion spent on climate change between 1998 and 2005. The lack of stations was an immediate problem aggravated by the replacement in many cases with Automatic Weather Observing Stations (AWOS). When NavCanada was formed in 1997 to take over airports, they became responsible for the weather stations. They refused to accept the AWOS stations as unreliable, which triggered a parliamentary investigation by Senator Pat Carney.

The 210 are the stations considered for producing global average annual temperature. The number of weather stations in Canada has reduced significantly since 1945 but coverage was always inadequate. There are very few stations with records over 60 years in length. Most of them are in southern regions, that is south of 55° N, and are located near large cities. The urban heat island effect is especially pronounced in Canadian cities because of the cold temperatures. Studies in Winnipeg, Montreal, Hamilton and Vancouver all show considerable differences between urban and surrounding rural areas, especially in winter. The lack of records for the sub-polar and polar regions is especially problematic because most agencies agree this is where global temperatures changes are detected first.

If we add the inadequacy of the records for Eurasia, it is reasonable to say that we are ignorant of weather and climate north of 55° N in the Northern Hemisphere.

The number of stations in Canada is inadequate at any time to determine the actual temperature or how it has changed. It is certainly inadequate to serve as the basis for the grids that form the basis of computer models. If we add the inadequacy of the records for Eurasia, it is reasonable to say that we are ignorant of weather and climate north of 55° N in the Northern Hemisphere. A more complete analysis is here[98].

CASE 5: NO WARMING TREND IN THE 351-YEAR CENTRAL ENGLAND TEMPERATURE RECORD

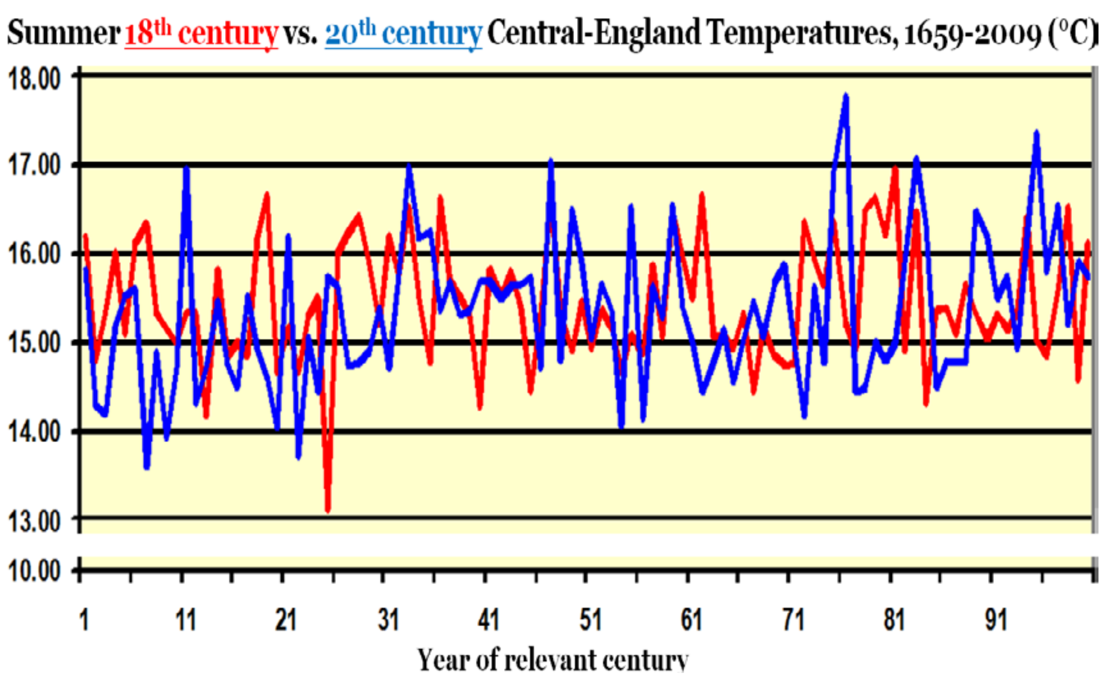
by the Carbon Sense Coalition (here[99])

The Central England Temperature record, starting in 1659 and maintained by the UK Met Office, is the longest unbroken instrumental temperature record in the world.

Temperature data are averaged for a number of weather stations representative of central England.

A Scottish chemist, Dr. Wilson Flood, has collected and analyzed the 351-year Central England temperature record.

Here is the comparison of the 18th Century with the 20th Century:



98 http://icecap.us/images/uploads/Canada.pdf.

99 http://carbon-sense.com/2009/10/01/british-record/.

Wilson Flood comments:

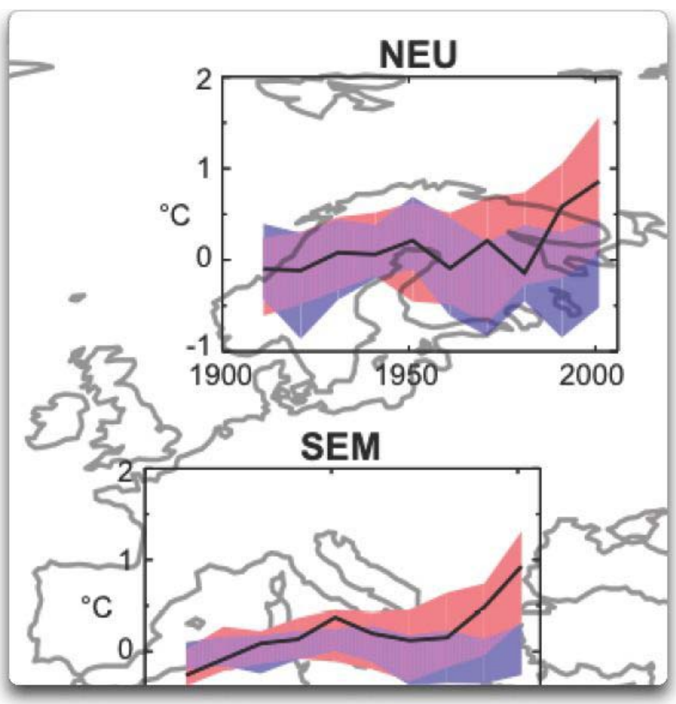
> "Far from being warmer due to assumed global warming, comparison of actual temperature data shows that UK summers in the 20th century were cooler than those of two centuries previously."

> "Summers in the second half of the 20th century were warmer than those in the first half and it could be argued that this was a global warming signal. However, the average CET summer temperature in the 18th century was 15.46 deg C while that for the 20th century was 15.35 deg C. Far from being warmer due to assumed global warming, comparison of actual temperature data shows that UK summers in the 20th century were cooler than those of two centuries previously."

CASE 6: KARLEN ON NON-REPLICABILITY OF IPCC CRU-BASED NORDIC DATA

by Willis Eschenbach on wattsupwiththat.com

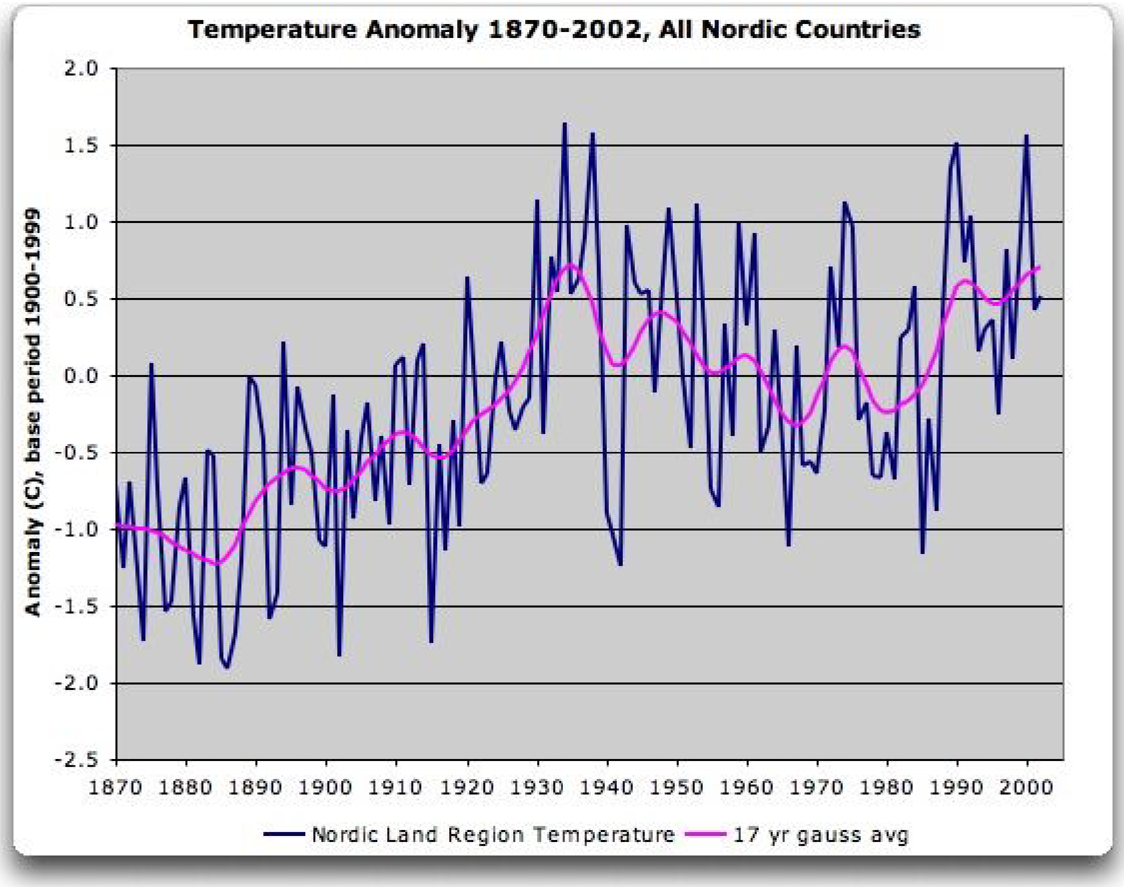
Professor Karlen attempts to reconstruct the Nordic temperature. In his analysis, I find an increase from the early 1900s to ~1935, a downtrend to the mid 1970s and another increase to about the same temperature level as in the late 1930s (below, enlarged here[100]).



A distinct warming to a temperature about 0.5 deg C above the 1940 level is reported in the IPCC diagrams (above). I have been searching for this recent increase, which is very

[100] http://icecap.us/images/uploads/wrgb4.jpg.

important for the discussion about a possible human influence on climate, but I have failed to find any subsequent warming compared with the late 1930s (below, enlarged here[101]).

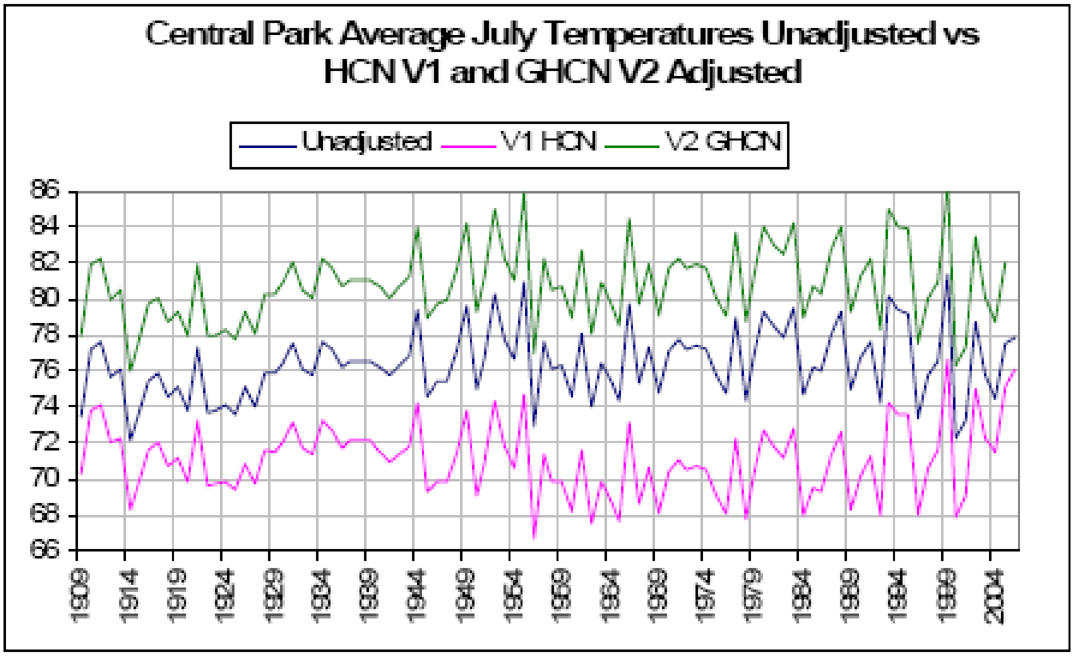


See much more here[102].

CASE 7: CENTRAL PARK – HISTORY A MYSTERY

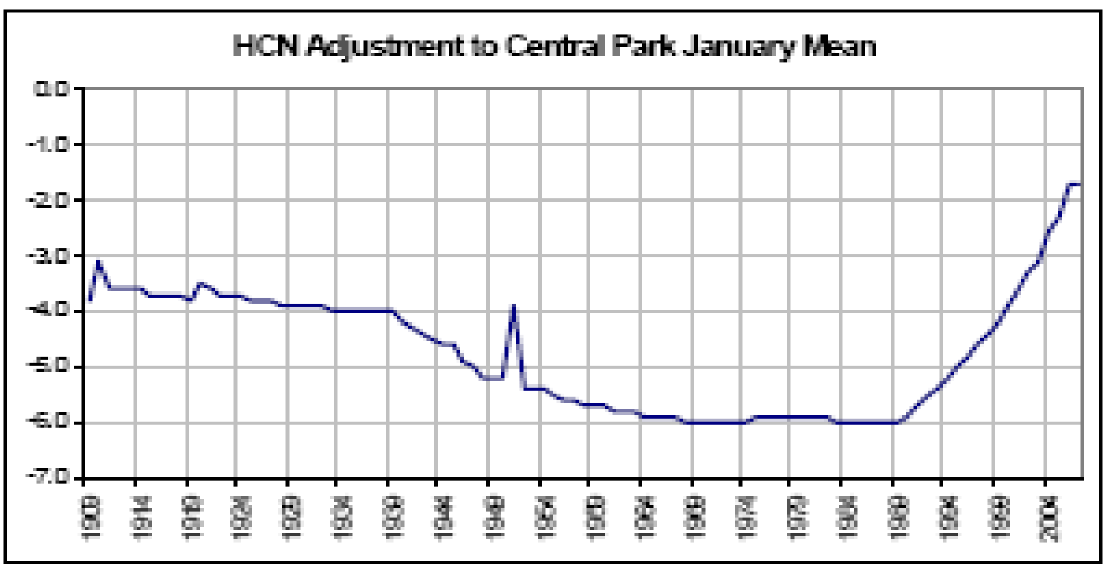
In this analysis[103], see how Central Park data was manipulated in inconsistent ways. The original US Historical Climate Network (USHCN: blue) data showed a cooling when adjusted for urban heat island effect (pink). The global version of Central Park (GHCN again: green) inexplicably warmed Central Park by 4 F° –

101 http://icecap.us/images/uploads/wrgb3.jpg.
102 http://wattsupwiththat.com/2009/11/29/when-results-go-bad/.
103 http://icecap.us/images/uploads/Central_Park_Temperatures_Two.pdf.

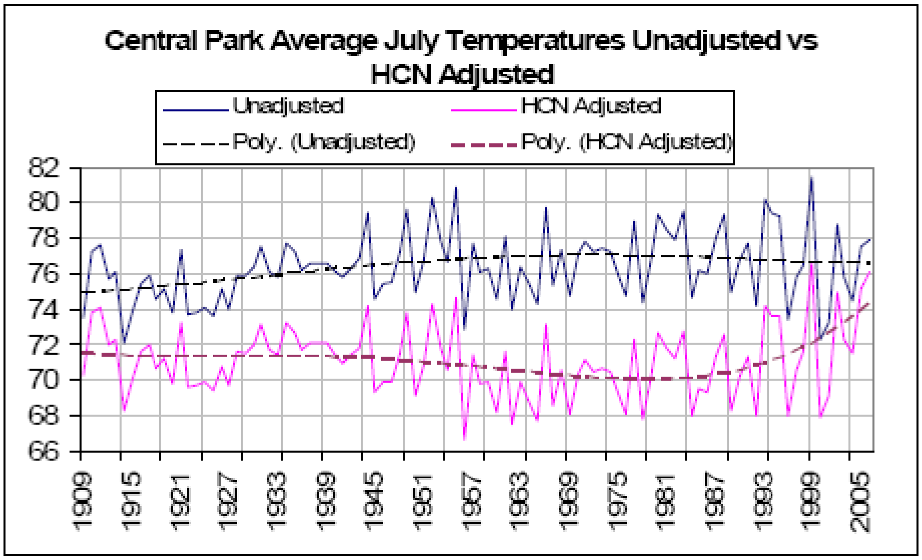


Raw observed Central Park mean July temperatures (blue), HCN v.1 (pink), and GHCN v.2 (green), 1909-2009.

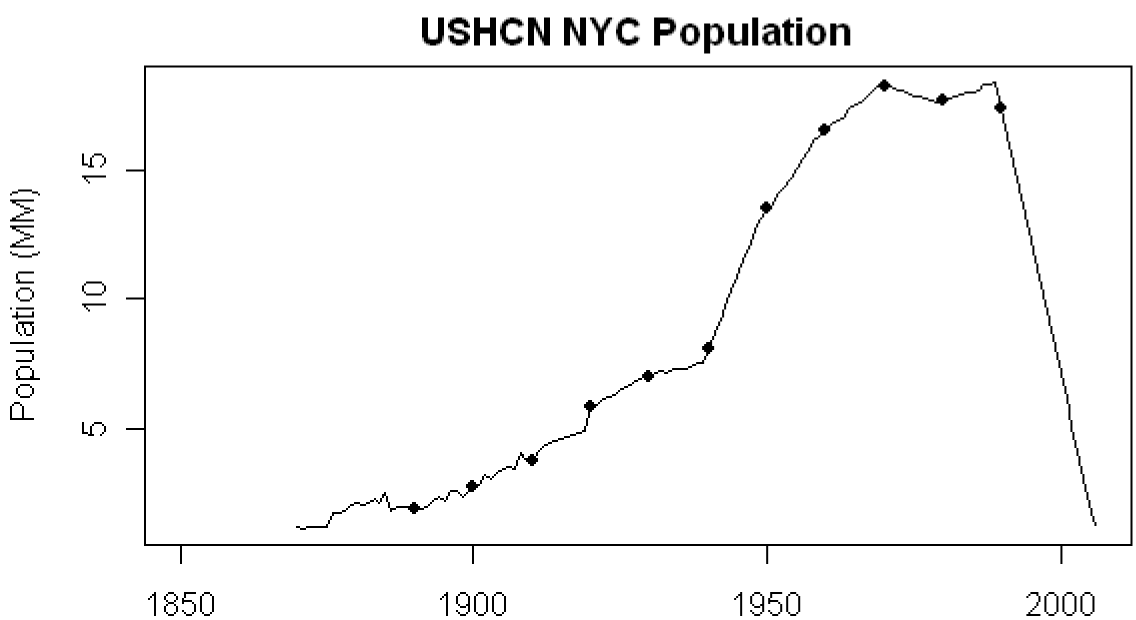
The difference between the two US-adjusted and global-adjusted databases, both produced by NCDC, reached an unbelievable 11F for the month of July, and 7F annually. Gradually, and without notice, NOAA began slowly backing off the urban heat island adjustment in the USHCN data in 1999 and eliminated it entirely in 2007 –



The USHCN version 1 had an urban adjustment (Karl 1988) when it was introduced in 1990. The cooling was as 7F for July and 6F for January. Notice however as some state climatologists noticed, the annual adjustments began to diminish in 1999 and in version 2 of USHCN disappeared altogether.

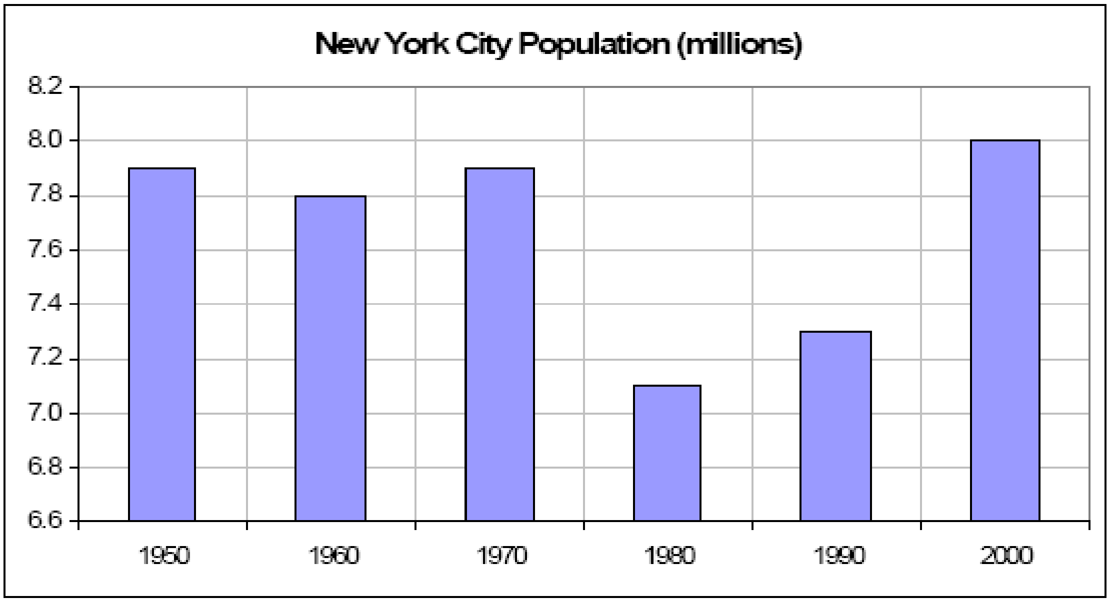


This led Steve McIntyre [here](http://climateaudit.org/2007/07/05/central-park-will-the-real-slim-shady-please-stand-up/)[104] to quip "If one reverse engineers this adjustment to calculate the New York City population used in the USHCN urban adjustment, the results are, in Per's words, 'gobsmacking' (utterly astounding, even by climate science standards." This was because, it could only be explained by a massive depopulation of New York City.



Shown clearly not the case.

[104] http://climateaudit.org/2007/07/05/central-park-will-the-real-slim-shady-please-stand-up/.



The story doesn't end there. The same NCDC maintains a global data base of station data used for climate change assessment called GHCN Version 2 of GHCN contains some of the same adjustments except for the Karl urban adjustment. Central Park is one of the GHCN sites. Note in the top graph above, it mysteriously warms not cools New York's Central Park by 4F.

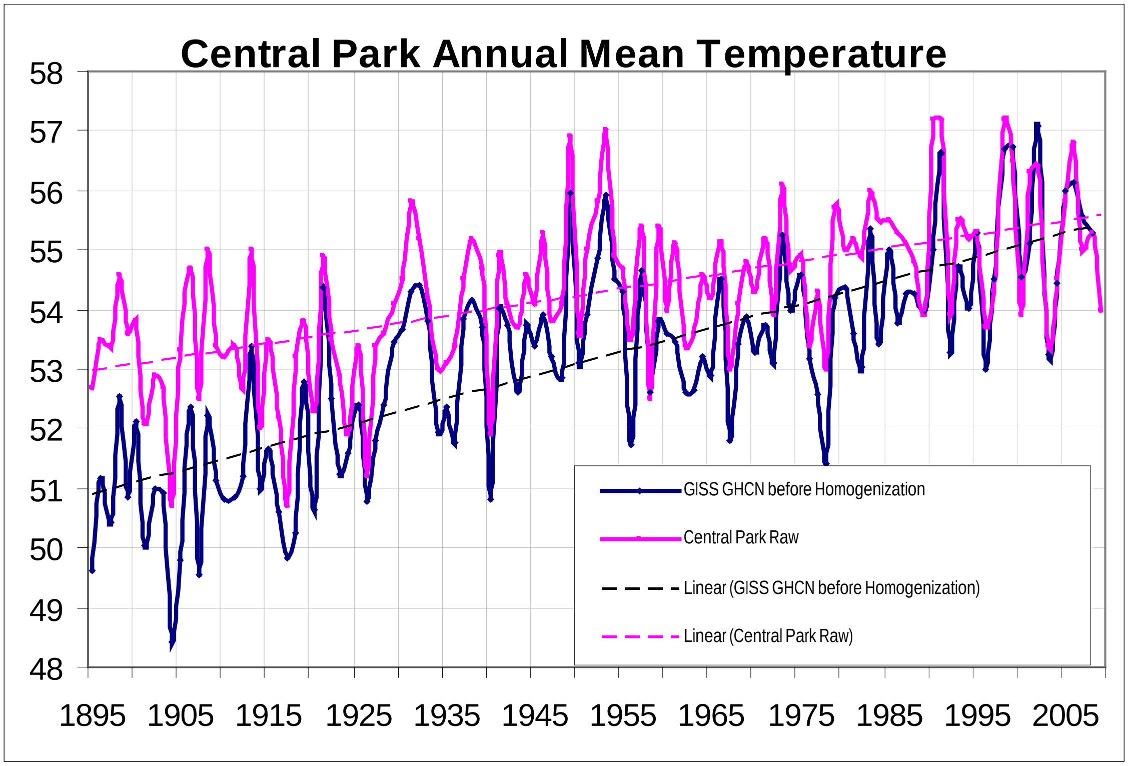
GISS USES GHCN AS UNADJUSTED DATA BEFORE HOMOGENIZATION

GISS recently eliminated GHCN with USHCN adjustments as one of the data access options here[105]. *"We no longer include data adjusted by GHCN" as an option,* implying they start with GHCN 'unadjusted' before they work their own homogenization and other magical wonders.

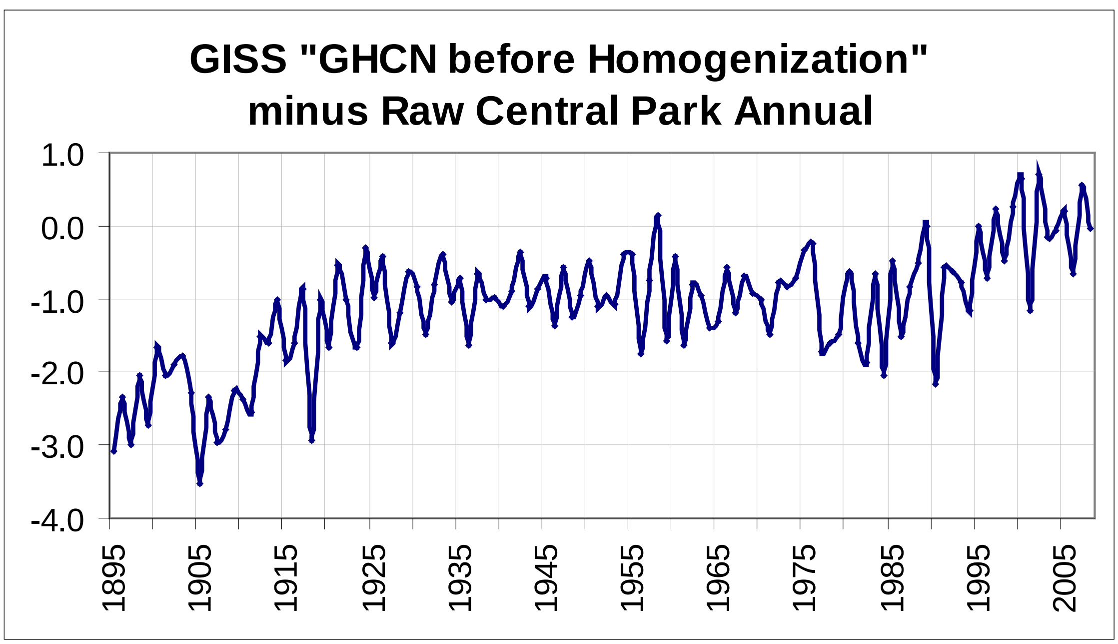
I downloaded what GISS describes as Central Park data before homogenization and "after combining sources at the same location" from GISS and did a comparison with the raw annual mean data downloaded from the NWS New York City Office web site here[106].

We found that the two data sets were not the same. For some unknown reason, Central Park was colder in the unadjusted data sets in the early record as much as 3F than the raw observation records. The difference gradually diminished so, currently the changes are small (2008 was the same). Some recent years the 'unadjusted' adjustments were inexplicably positive.

[105] http://data.giss.nasa.gov/gistemp/station_data/.
[106] http://www.erh.noaa.gov/okx/climate/records/monthannualtemp.html.



The difference is shown below.

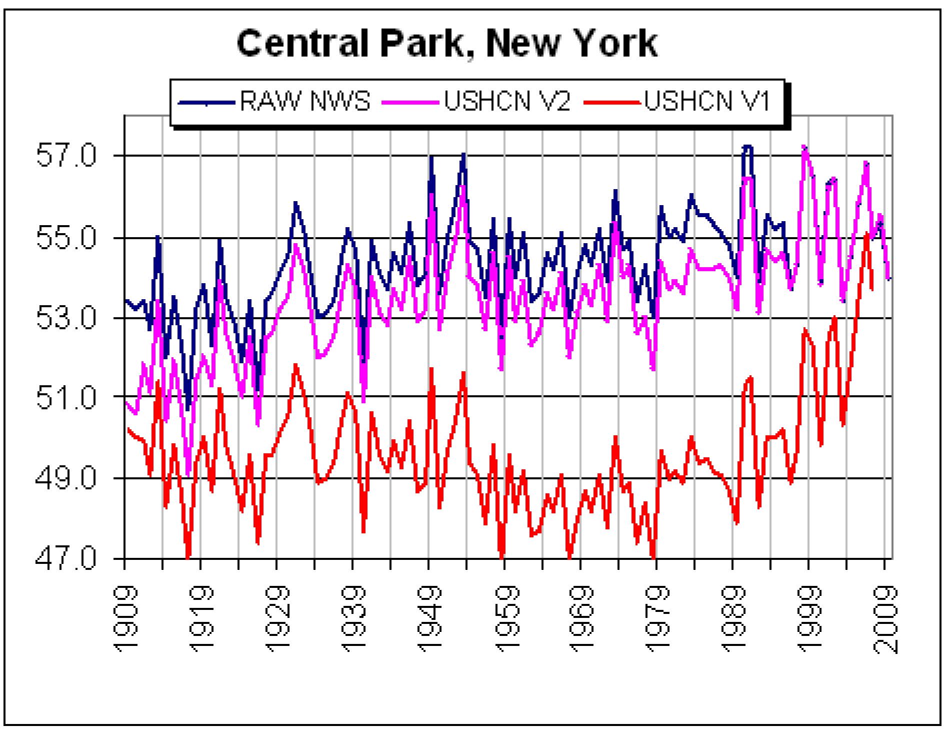


Thus in the implied unadjusted data, the warming (due to urbanization) is somehow increased from 2.5 to 4.5F.

E.M. Smith downloaded the latest iteration of GHCN Central Park directly from NOAA and found it had found its way back closer to the raw data. So the data at GISS is some other source, perhaps an earlier version of the GHCN with USHCN adjustments. He notes there are many iterations of the data sets available from CRU, NOAA and NASA. The differences between them is much greater than the changes over time calling into question our ability to accurately assess climate trends. See his discussion here[107].

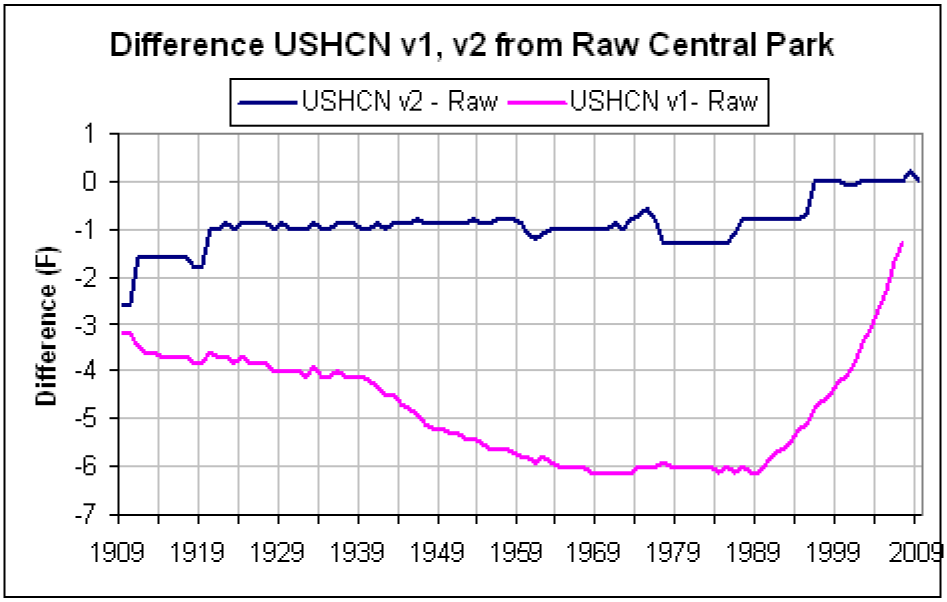
There are many iterations of the data sets available from CRU, NOAA and NASA. The differences between them is much greater than the changes over time calling into question our ability to accurately assess climate trends.

We followed this up with a comparison of the raw with the USHCN version 1 and the newly available USHCNv2. Here is the plot of USHCN versions 1 and 2 together with raw original observations for Central Park.



And the differences between the raw and USCHN v1 and v2 .

[107] http://chiefio.wordpress.com/2010/01/13/ghcn-does-unadjusted-mean-cooked/.



The most obvious feature that jumps out from the chart is the cooling (UHI) that peaked at just over 6 degrees in the 1980s, then inexplicably diminished after 1999 slowly and disappeared in 2007 when version 2 was issued. For version 2, a reduction of 2.6F from the raw for the first two years (1909-1910) gradually diminishes to zero in recent years.

Obviously adjustments here as in the many other locations are enhancing warming.

CASE 8: WOULD YOU LIKE YOUR DATA HOMOGENIZED, OR PASTEURIZED?

by Basil Copeland on wattsupwiththat.com

The hits just keep on coming. About the same time that Willis Eschenbach revealed "The Smoking Gun at Darwin Zero," the UK's Met Office released a "subset" of the HadCRUT3 dataset used to monitor global temperatures. I grabbed a copy of "the subset[108]" and then began looking for a location near me in central Arkansas that had a long and generally complete station record that I could compare to a "homogenized" set of data for the same station from the GISTemp dataset[109].

I quickly, and more or less randomly, decided to take a closer look at the data for Nashville, TN. In the HadCRUT3 subset, this is "72730" in the folder "72." A direct link to the homogenized GISTemp data used is here. After transforming the row data to column data (see the end of the post for a "bleg" about this), the first thing I did was plot the differences between the two series.

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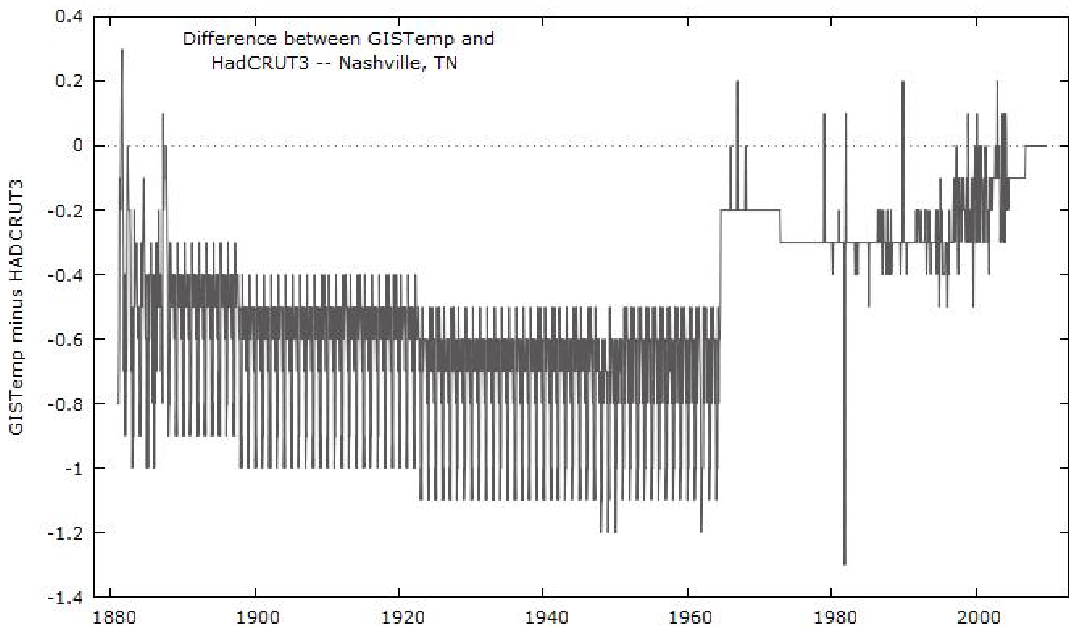
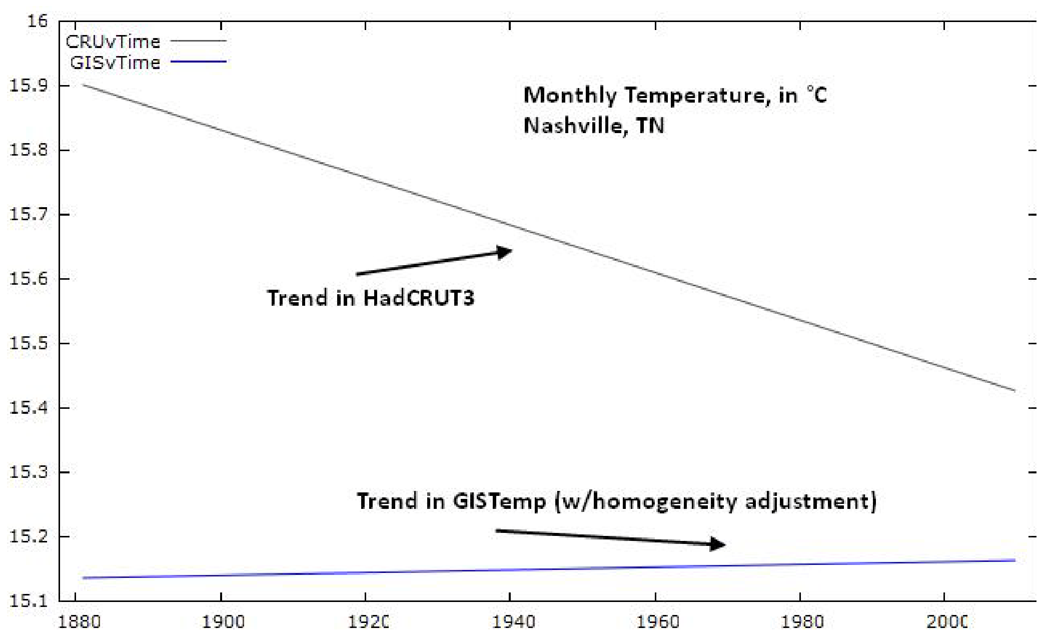
108 http://www.metoffice.gov.uk/climatechange/science/monitoring/subsets.html.

109 http://data.giss.nasa.gov/gistemp/station_data/.



The GISTemp homogeneity adjustment looks a little hockey-stickish, and induces an upward trend by reducing older historical temperatures more than recent historical temperatures. This has the effect of turning what is a negative trend in the HadCRUT3 data into a positive trend in the GISTemp version –



So what would appear to be a general cooling trend over the past ~130 years at this location when using the unadjusted HadCRUT3 data becomes a warming trend when the homogeneity "adjustment" is supplied.

"There is nothing to see here, move along." I do not buy that. Whether or not the homogeneity adjustment is warranted, it has an effect that calls into question just how much the earth has in fact warmed over the past 120-150 years (the period covered, roughly, by GISTemp and HadCRUT3). There has to be a better, more "robust" way of measuring temperature trends, that is not so sensitive that it turns negative trends into positive trends (which we've seen it do twice now, first with Darwin Zero, and now here with Nashville). I believe there is.

Whether or not the homogeneity adjustment is warranted, it has an effect that calls into question just how much the earth has in fact warmed over the past 120-150 years.

In a recent series of posts, here[110], here,[111] and with Anthony here[112], I've been promoting a method of analyzing temperature data that reveals the full range of natural climate variability. Metaphorically, this strikes me as trying to make a case for "pasteurizing" the data, rather than "homogenizing" it. In homogenization, the object is to "mix things up" so that it is "the same throughout." When milk is homogenized[113], this prevents the cream from rising to the top, thus preventing us from seeing the "natural variability" that is in milk. But with temperature data, I want very much to see the natural variability in the data. And I cannot see that with linear trends fitted through homogenized data. It may be a hokey analogy, but I want my data pasteurized – as clean as it can be – but not homogenized so that I cannot see the true and full range of natural climate variability. See full post here[114].

See this post on GISS Raw Station Data Before and After Homogenization[115] for an eye-opening view into blatant data manipulation and truncation.

CASE 9: Climate Data Analysis of Existing Weather Stations in the Central Alaska Network (CAKN) (PDF)[116]

Prepared for National Park Service, Central Alaska Inventory and Monitoring Network by Richard A. Keen, Ph.D.

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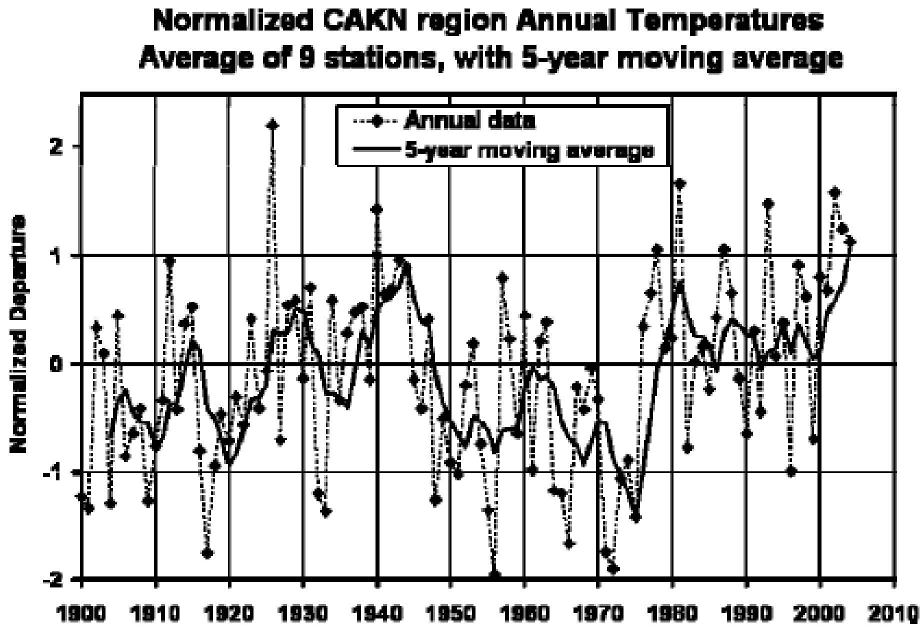
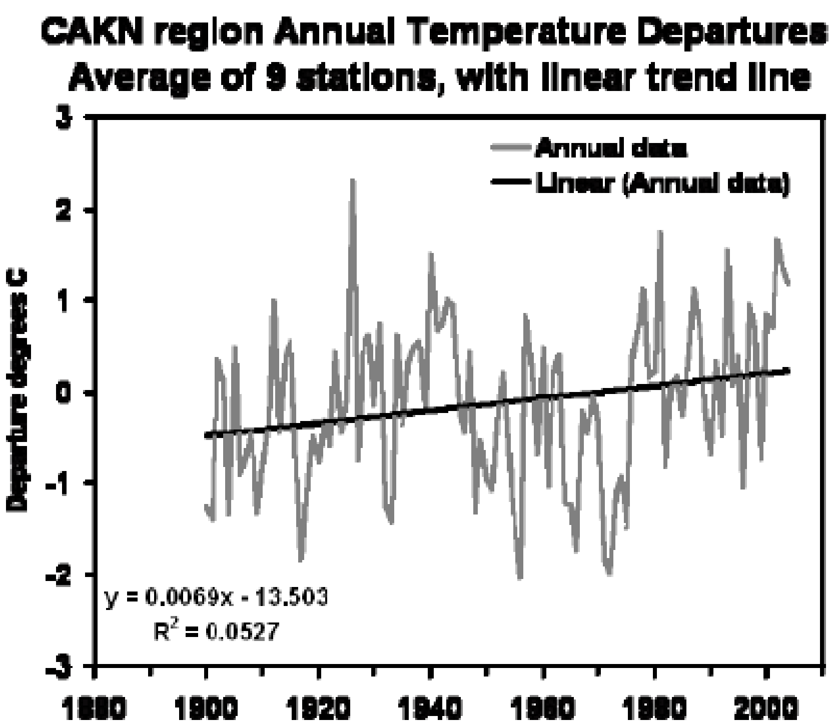
[110] http://wattsupwiththat.com/2009/08/12/is-global-temperature-a-random-walk/.
[111] http://wattsupwiththat.com/2009/11/30/what-do-we-really-know-about-climate-change/.
[112] http://wattsupwiththat.com/2009/05/23/evidence-of-a-lunisolar-influence-on-decadal-and-bidecadal-oscillations-in-globally-averaged-temperature-trends/.
[113] http://en.wikipedia.org/wiki/Homogenization_%28chemistry%29.
[114] http://wattsupwiththat.com/2009/12/11/would-you-like-your-temperature-data-homogenized-or-pasteurized/#more-14026.
[115] http://wattsupwiththat.com/2009/12/11/giss-raw-station-data-before-and-after/.
[116] http://science.nature.nps.gov/im/units/cakn/Documents/2008reports/CAKN_Climate_Data_%20Analysis_%20Keen_2008.pdf.

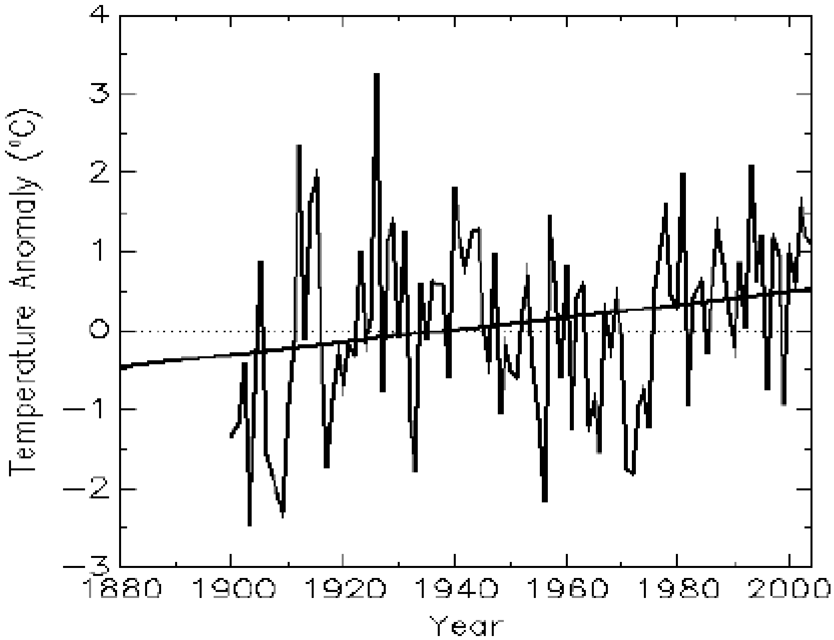


The next three figures show the annual normalized departures converted to degrees C, for comparison with annual temperatures for the grid area 60 to 65 North, 140 to 155 West, from the global temperature data sets of the Global Historical Climate Network (GHCN) and Jones et al.

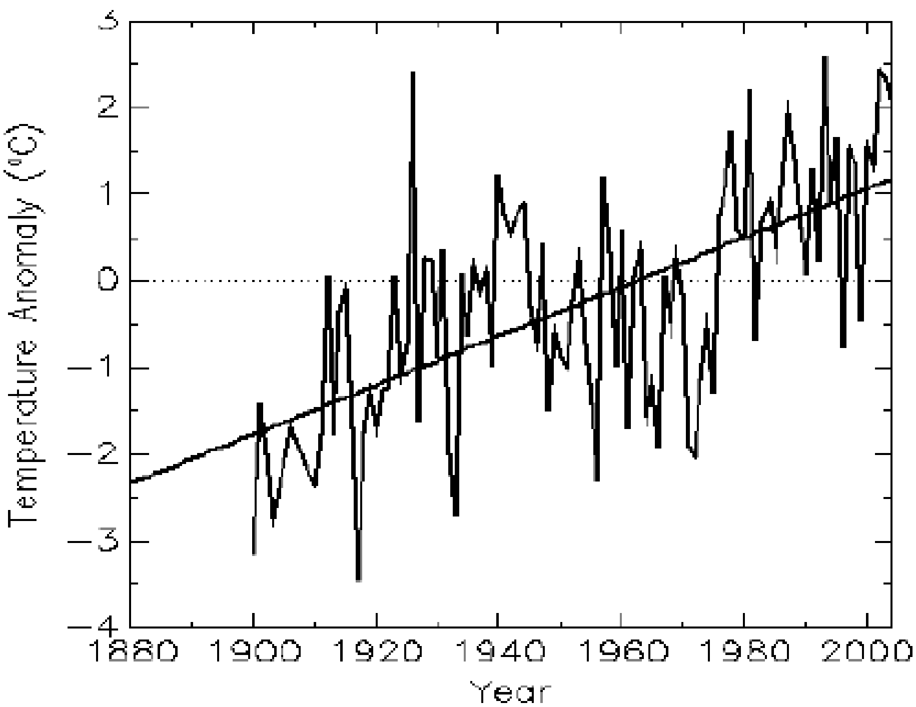
105 year record of regional Annual Average Temperature, degrees C.



105 year record of regional Annual Average Temperature, degrees C, from Jones et al.



105 year record of regional Annual Average Temperature, degrees C, from GHCN.



The annual temperatures in this study are very similar to those of Jones et al., the largest difference being due to the normalizations procedure used in this study. The GHCN time series differs most dramatically, most likely because of a different selection and/or weighting of stations and because of a series of adjustments made to the GHCN data. The trends computed from the three time series are:

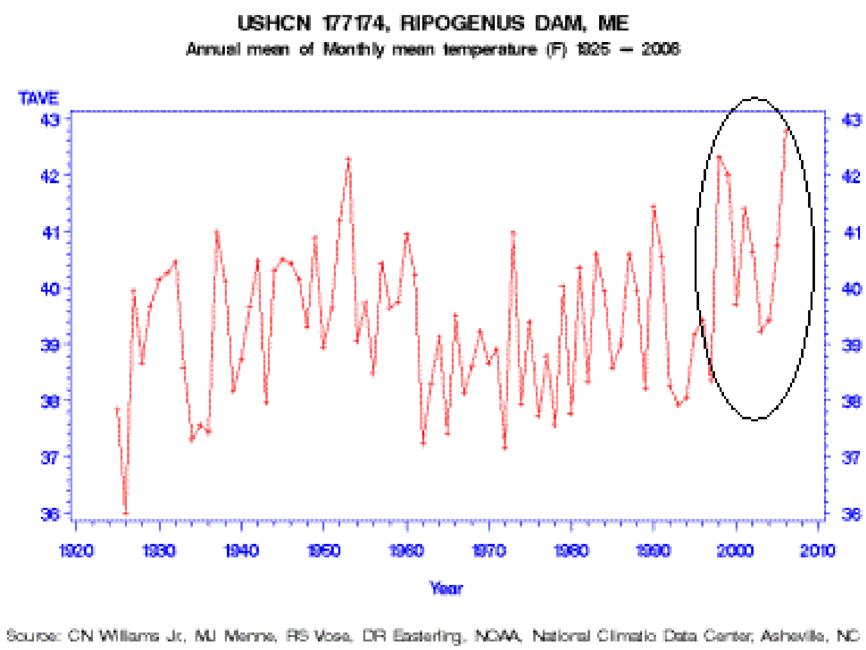
This Study 0.69 C/century
Jones et al. 0.79 C/century
GHCN 2.83 C/century.

CASE 10: WHEN STATIONS CLOSE BUT DATA APPEARS

For (these) stations that are missing periods or some stations that are now closed, surrounding stations data are used. One example is Ripogenus Dam in Maine.

Surveys of the United States Historic Climate Network (USHCN) temperature stations in Maine for Anthony Watts surface station evaluation project determined that every one of the stations in Maine was subject to microclimate or urbanization biases. One station especially surprised 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!



Part of the USHCN data is created by a computer program called "filnet" (essentially homogenization) 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 closed station from surrounding stations, which in this case as we noted were all subject to microclimate and urban bias. Those existing stations are no longer adjusted for the urban heat island effect so neither is the temperature for the "closed" station. Note the rise in temperatures after this best sited, truly rural station in Maine was closed.

CASE 11: Skewed Science

by Phil Green, Financial Post

A French scientist's temperature data show results different from the official climate science. Why was he stonewalled? The Climategate emails detail efforts to deny access to global temperature data.

The global average temperature is calculated by climatologists at the Climatic Research Unit at the University of East Anglia. The temperature graph the CRU produces from its monthly averages is the main indicator of global temperature change used by the Intergovernmental Panel on Climate Change, and it shows a steady increase in global lower-atmosphere temperature over the 20th century. Similar graphs for regions of the world, such as Europe and North America, show the same trend. This is consistent with increasing industrialization, growing use of fossil fuels, and rising atmospheric concentrations of carbon dioxide.

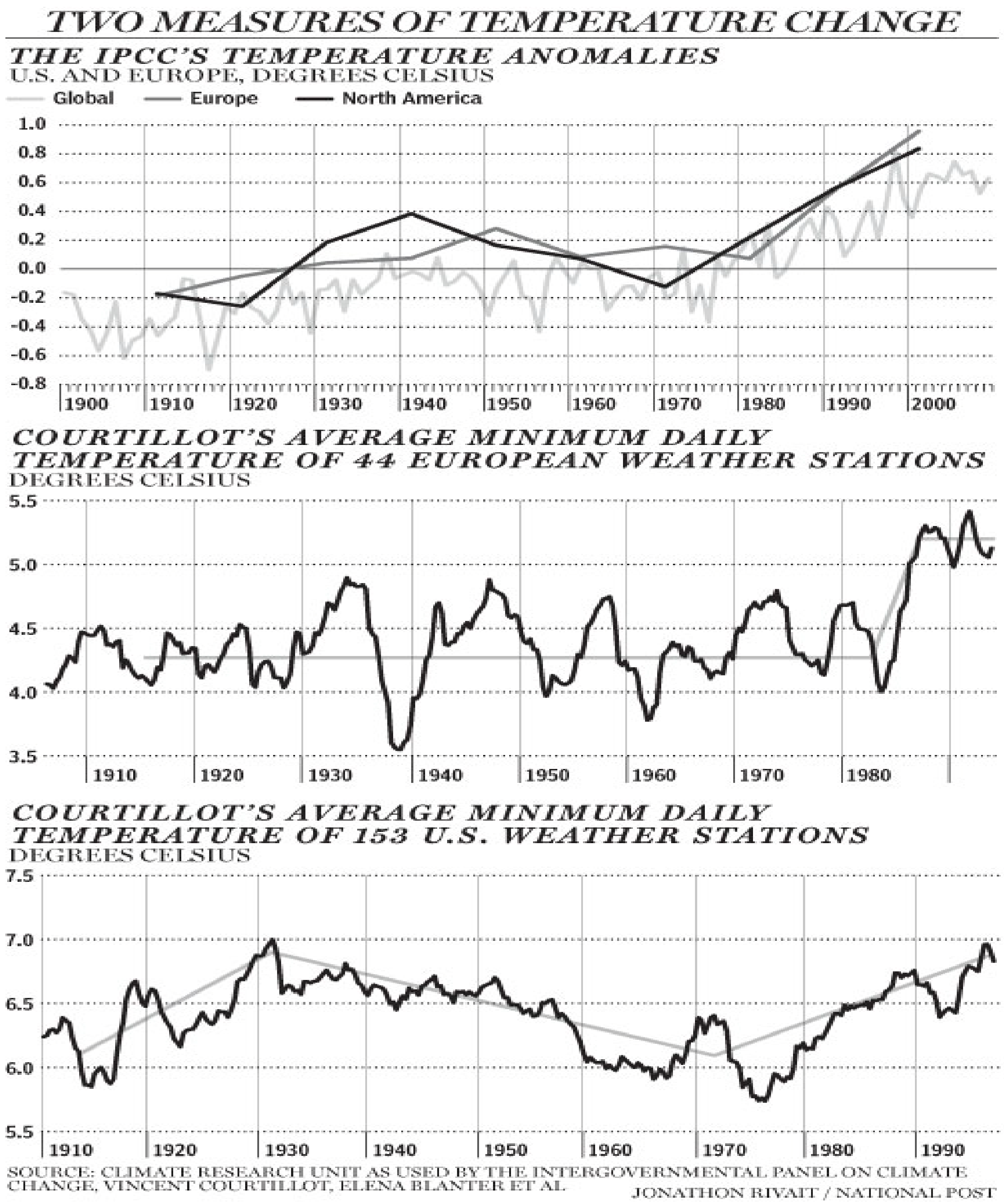
The Climategate emails detail efforts to deny access to global temperature data.

It took the CRU workers decades to assemble millions of temperature measurements from around the globe. The earliest measurements they gathered came from the mid-19th century, when mariners threw buckets over the side of their square-riggers and hauled them up to measure water temperature. Meteorologists increasingly started recording temperatures regularly on land around the same time. Today they collect measurements electronically from national meteorological services and ocean-going ships.

Millions of measurements, global coverage, consistently rising temperatures, case closed. The Earth is warming. Except for one problem. CRU's average temperature data doesn't jibe with that of Vincent Courtillot, a French geo-magneticist, director of the Institut de Physique du Globe in Paris, and a former scientific advisor to the French Cabinet. Last year he and three colleagues plotted an average temperature chart for Europe that shows a surprisingly different trend. Aside from a

Courtillot asked Phil Jones, the scientist who runs the CRU database, for his raw data, telling him (according to one of the 'Climategate' emails that surfaced following the recent hacking of CRU's computer systems), "There may be some quite important information in the daily values which is likely lost on monthly averaging." Jones refused Courtillot's request for data.

very cold spell in 1940, temperatures were flat for most of the 20th century, showing no warming while fossil fuel use grew. Then in 1987 they shot up by about 1 C and have not shown any warming since. This pattern cannot be explained by rising carbon dioxide concentrations, unless some critical threshold was reached in 1987; nor can it be explained by climate models.



Courtillot and Jean-Louis Le Mouel, a French geo-magneticist, and three Russian colleagues first came into climate research as outsiders four years ago. The Earth's magnetic field responds to changes in solar output, so geomagnetic measurements are good indicators of solar activity. They thought it would be interesting to compare solar activity with climatic temperature measurements.

Their first step was to assemble a database of temperature measurements and plot temperature charts. To do that, they needed raw temperature measurements that had not been averaged or adjusted in any way. Courtillot asked Phil Jones, the scientist who runs the CRU database, for his raw data, telling him (according to one of the 'Climategate' emails that surfaced following the recent hacking of CRU's computer systems), "There may be some quite important information in the daily values which is likely lost on monthly averaging." Jones refused Courtillot's request for data, saying that CRU had "signed agreements with national meteorological services saying they would not pass the raw data onto third parties." (Interestingly, in another of the CRU emails, Jones said something very different: "I took a decision not to release our [meteorological] station data, mainly because of McIntyre," referring to Canadian Steve McIntyre, who helped uncover the flaws in the hockey stick graph.)

Courtillot and his colleagues were forced to turn to other sources of temperature measurements. They found 44 European weather stations that had long series of daily minimum temperatures that covered most of the 20th century, with few or no gaps. They removed annual seasonal trends for each series with a three-year running average of daily minimum temperatures. Finally they averaged all the European series for each day of the 20th century.

The decision to consider the 1961-1990 period as 'normal' was CRUs. Had CRU chosen a different period under consideration, the IPCC graph would have shown less warming ... Parker advised Jones not to select a different period, saying "anomalies will seem less positive than before if we change to newer normals, so the impression of global warming will be muted."

CRU, in contrast, calculates average temperatures by month – rather than daily – over individual grid boxes on the Earth's surface that are 5 degrees of latitude by 5 degrees of longitude, from 1850 to the present. First it makes hundreds of adjustments to the raw data, which sometimes require educated guesses, to try to correct for such things as changes in the type and location of thermometers. It also combines air temperatures and water temperatures from the sea. It uses fancy statistical techniques to fill in gaps of missing data in grid boxes with few or no temperature measurements. CRU then adjusts the averages to show changes in temperature since 1961-1990.

CRU calls the 1961-1990 the "normal" period and the average temperature of this period it calls the "normal." It subtracts the normal from each monthly average and calls these the monthly "anomalies." A positive anomaly means a temperature was warmer than CRU's normal period. Finally CRU averages the grid box anomalies over regions such as Europe or over the entire surface of the globe for each month to get the European or global monthly average anomaly. You see the result in the IPCC graph nearby, which shows rising temperatures.

The decision to consider the 1961-1990 period as 'normal' was CRUs. Had CRU chosen a different period under consideration, the IPCC graph would have shown less warming, as discussed in one of the Climategate emails, from David Parker of the UK meteorological office. In it, Parker advised Jones not to select a different period, saying "anomalies will seem less positive than before if we change to newer normals, so the impression of global warming will be muted." That's hardly a compelling scientific justification!

In addition to calculating temperature averages for Europe, Courtillot and his colleagues calculated temperature averages for the United States. Once again, their method yielded more refined averages that were not a close match with the coarser CRU temperature averages. The warmest period was in 1930, slightly above the temperatures at the end of the 20th century. This was followed by 30 years of cooling, then another 30 years of warming.

Courtillot's calculations show the importance of making climate data freely available to all scientists to calculate global average temperature according to the best science. Phil Jones, in response to the email hacking, said that CRU's global temperature series show the same results as "completely independent groups of scientists." Yet CRU would not share its data with independent scientists such as Courtillot and McIntyre, and Courtillot's series are clearly different. Read more here[117].

As Ronald Coase, the Nobel Laureate, when the Nobel was a meaningful prize well deserved, suggested "The data has indeed been tortured and it has confessed."

CASE 12: NASA: "Hide This After Jim Checks It"

by Steve McIntyre, on ClimateAudit.org

This post by Steve McIntyre on his Climate Audit blog was given in response to NASA GISS's James Hansen comments to the early press release on the data issues on the KUSI website. It speaks to the 'quality control' efforts of the GISS team. It appears they indeed do practice quality control but not quality assurance, which is what a data center really should provide.

> "NASA has not been involved in any manipulation of climate data used in the annual GISS global temperature analysis. The analysis utilizes three independent data sources provided by other agencies. Quality control checks are regularly performed on that data. The analysis methodology as well as updates to the analysis are publicly available on our website. The agency is confident of the quality of this data and stands by previous scientifically based conclusions regarding global temperatures."

[117] http://network.nationalpost.com/np/blogs/fpcomment/archive/2009/11/26/skewed-science.aspx#ixzz0Y6KcQceK.

The word "hide" has obviously attracted a lot of attention lately – "hide the decline" even occasioning its own song.

Today I'd like to discuss the following remarkable instructions by a NASA employee in the recently disclosed NASA emails (available at Judicial Watch):

> *Robert please move to the CU site and **hide this after Jim checks it**. Darnell please send it out to Jim's email list. Jim said **if I don't want to** you should do…*

What is that they are planning to "hide"? And why would they be "hiding" it in the first place? And why would Hansen think that one of his employees wouldn't "want" to send something out to Jim's email list?

In order to forestall claims that I've shown these words "out of context", I've done a careful review of the events leading up to this email.

The context is the Hansen Y2K controversy in August 2007. On August 3 (10:46 am Eastern), I had published a post entitled Hansen's Y2K Error[118] in which I observed a previously unreported "Y2K error" in GISS USHCN conclusively disproved efforts by Eli Rabett (for example, here[119]) and Tamino to discredit Anthony Watts' surface stations project on the basis that NASA software could "fix" inhomogeneous station data. I observed in this post:

> *The input version [for the Detroit Lakes example shown] switches from the USHCN adjusted/TOBS version to the USHCN raw version (without time-of-observation adjustment). This imparts an upward discontinuity of 1 deg C in wintertime and 0.8 deg C annually. I checked the monthly data and determined that the discontinuity occurred on January 2000 – and, to that extent, appears to be a Y2K problem. I presume that this is a programming error.*

This post was the result of a lengthy process of cross-comparing different versions of station data in order to try to figure out the precise provenance of GISS data – a procedure reasonably described as "reverse engineering".

Within a few hours (13:21 Eastern), NASA blogger Gavin Schmidt, like the eye of Saruman ever alert to the smallest rustling in the blogosphere, noticed the CA post and immediately notified NASA employee Reto Ruedy :

> *If you didn't see it: www.climateaudit.org/?p=1854. There is something curious here, why does GISS raw go back to USHCN unadjusted in 2000? Shouldn't it have stayed with USHCN + TOBS? Gavin. PS if this is all as it should be, we need to make clear the reasons very quickly. Otherwise the myth of the "Hansen Y2K error" will be all around the place and once it's out, it won't go away.*

118 http://www.climateaudit.org/?p=1854.
119 http://rabett.blogspot.com/2007/08/its-not-watt-you-think-tony-watts.html.

Ruedy quickly realized that there was indeed a problem and suggested to Gavin that they could adjust the USHCN data prior to 2000 to match the post-2000 GHCN version. Gavin wondered whether it might make sense to adjust the post-2000 GHCN data (a logical suggestion – one that I made independently – but one that wasn't followed).

On August 4, I sent an email to Hansen notifying him of the problem.

> *In your calculation of the GISS "raw" version of USHCN series, it appears to me that, for series after January 2000, you use the USHCN raw version whereas in the immediately prior period you used USHCN time-of-observation or adjusted version. In some cases, this introduces a seemingly unjustified step in January 2000.*
>
> *I am unaware of any mention of this change in procedure in any published methodological descriptions and am puzzled as to its rationale. Can you clarify this for me?*
>
> *In addition, could you provide me with any documentation (additional to already published material) providing information on the calculation of GISS raw and adjusted series from USHCN versions, including relevant source code. Thank you for your attention, Stephen McIntyre*

The emails now show a steady stream of discussions by and between NASA employees.

On Monday morning (Aug 6), Ruedy described me to Hansen as follows:

> *Steve is the person who appointed himself auditor of all web sites and organizations that have to do with global warming in order to debunk this "hoax". He is maintaining a blog – a website called climateaudit.org , a site containing among justified concerns (caveats that we stress in all our papers) obvious fabrications and vicious attacks … I expect only a minor effect since the offsets average out to ~0 over all USHCN stations"*

On Monday evening August 6 (23:19 Eastern), I published my own first estimate of the impact of the error in the post Quantifying the Hansen Y2K Error[120]. I showed a bimodal distribution of the step discontinuities and that the distribution was not symmetric. I estimated that there would be an upward step at January 2000 of about 0.18-0.19 deg C (not a bad estimate as things turn out),

> *The step in January 2000 is clearly visible and results in an erroneous upward step of about 0.18-0.19 deg C. in the average of all unlit stations. I presume that a corresponding error would be carried forward into the final GISS estimate of US lower 48 temperature and that this widely used estimate would be incorrect by a corresponding amount. The 2000s are warm in this record with or without this erroneous step, but this is a non-negligible error relative to (say) the amounts contested in the satellite record disputes.*

[120] http://climateaudit.org/2007/08/06/quantifying-the-hansen-y2k-error/.

The next morning (Aug 7), Ruedy sent Hansen and Gavin a draft reply to my email. He reported a US error of 0.15 deg C (a bit lower than my estimate the previous night.) The draft reply satirized the idea (then being promulgated by Rabett and Tamino) that GISS software could "fix" defects in surface data:

> *I had no idea what code you are referring to until I learned from your article "Hansen's Y2K Error (which should really be Reto's Y2K error) that GISS is in possession of some magical software that is able to "fix" the defects in surface data. No wonder you would like to get your hands on that – so would I. Unfortunately your source totally misled you in that respect. I'm a little amazed that you uncritically present it as a fact given that a large part of your web site is devoted to convincingly prove that such software cannot possibly exist.*

Gavin suggested a pared down reply which Ruedy agreed to, replying:

> *Any attempts to teach or outsmart Steve are counterproductive and a total waste of time.*

Let's just say that I disagree that the "teaching" part would be "counterproductive and a total waste of time". After a number of exchanges, Hansen weighed in, with Ruedy seizing on Hansen's suggestions as a means to "ignore" Climate Audit even though we now know that the blog was the original source of their knowledge of the error:

> *Jim, thanks – with your suggested change, we totally ignore his blogs.*

The nuance here is that they would (for a very short time) acknowledge me *personally* without acknowledging the blog – even though it turns out that they learned of the problem from the blog. (A few weeks later, they deleted the acknowledgement.) Late in the afternoon, Ruedy replied to me by email (which I noted that evening in an update here[121].)

Through the two days, NASA employees were busy re-calculating the adjusted USHCN network, discussing this passim in August 7 emails. Instead of adjusting the post-2000 GHCN values, they adjusted the pre-2000 USHCN values. This led to changes in literally millions of individual values in their database.

Early in the morning of August 8, CA readers began to become aware of the wholesale changes – see comments in the Quantifying[122] thread.

Reader Mikel was the first[123] to observe changes in the US history. Jerry Brennan was the first to notice changes in individual station data, and shortly afterwards confirmed[124] "completely new" pre-2000 numbers in a spot check of three stations:

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[121] http://climateaudit.org/2007/08/06/quantifying-the-hansen-y2k-error/.
[122] http://climateaudit.org/2007/08/06/quantifying-the-hansen-y2k-error/.
[123] http://climateaudit.org/2007/08/06/quantifying-the-hansen-y2k-error/#comment-98188.
[124] http://climateaudit.org/2007/08/06/quantifying-the-hansen-y2k-error/#comment-98192.

> *I looked at three of the stations that I checked a few days ago, and all three have completely new pre 2000 numbers in the GISS "raw" files.*

Following Jerry Brennan's lead, I also checked some stations, also confirming[125] massive changes to pre-2000 values:

> *#45. I checked Hopewell and I agree. Jeez, they've been crazy busy the last couple of days. I'm not sure what they're doing but they're really going at it fast. IF Hopewell VA is typical, they'll have changed all the GISS raw and GISS adjusted versions in the U.S. before 2000.*
>
> *I think that they are trying to do things too fast without thinking it through. If this is what they've done (and I'm not sure yet), the pre-2000 GISS raw (which was fairly stable) has been changed into pre-adjusted versions that now don't track to original sources, whatever those sources were.*
>
> *My, my…*
>
> *If it were me in their shoes, I'd have kept the pre-2000 data intact and adjusting the post-2000 data. Far too many changes in what they're doing. But it will take a couple of days to assess the situation.*

A bit later, I observe[126]:

> *Here's something interesting. If you compare "old" Hopewell VA numbers (fortunately preserved due to my much criticized "scraping" of GISS data) to the "new" Hopewell VA numbers, the GISS "raw" data for say June 1934 or June 1935 has gone up by 0.7 deg C, while the GISS "adjusted" data has gone up by only 0.1 deg C. So in some cases, their "UHI" adjustment as applied offsets what was a programming error. Makes you wonder about the validity of the UHI adjustment. BTW as Jerry previewed, their US data set is now a total mess. Everything's been written over prior to 2000.*

In the early afternoon of August 8 (14:51 Eastern), I wrote a short post[127] on changes in the "leaderboard". This short and simple post attracted a lot of attention and infuriated Hansen:

[125] http://climateaudit.org/2007/08/06/quantifying-the-hansen-y2k-error/#comment-98193.
[126] http://climateaudit.org/2007/08/06/quantifying-the-hansen-y2k-error/#comment-98196.
[127] http://climateaudit.org/2007/08/08/a-new-leaderboard-at-the-us-open/.

> *There has been some turmoil yesterday on the leaderboard of the U.S. (Temperature) Open and there is a new leader.*
>
> *A little unexpectedly, 1998 had a late bogey and 1934 had a late birdie. (I thought that they were both in the clubhouse since the turmoil seemed to be in the 2000s.) In any event, the new leader atop the U.S. Open is 1934.*
>
> *2006 had a couple of late bogeys and fell to 4th place, behind even 1921. I think that there's a little air in the 2006 numbers even within GISS procedures as the other post-2000 lost about 0.15 strokes through late bogeys, while it lost only 0.10 strokes. It is faltering and it might yet fall behind 1931 into 5th place.*
>
> *Four of the top 10 are now from the 1930s: 1934, 1931, 1938 and 1939, while only 3 of the top 10 are from the last 10 years (1998, 2006, 1999). Several years (2000, 2002, 2003, 2004) fell well down the leaderboard, behind even 1900. (World rankings are calculated separately.) Note: For the new leaderboard see http://data.giss.nasa.gov/gistemp/graphs/Fig.D.txt. The old data has been erased; by sheer chance, I had the old data active in my R-session but I can't give a link to it.)*

As events proved out, Hansen didn't need Saruman to bring the matter to his attention. It's interesting in retrospect to review the ripples from the blog to NASA as a media exercise – as the story spread first through specialist blogs, then into the media, at which point Hansen paid attention.

The first blog coverage appears to be on August 8 by Anthony[128] – then a fledgling blog, a long way from being #2 at Wikio.

The next day (Aug 9), it got mentioned at realclimate, where Gavin dismissed[129] the point as insignificant and, despite Climate Audit's obvious priority in identifying the spliced data sets, falsely credited GISS themselves with pinning down the precise error:

> *Once notified of the problem, GISS investigated immediately, **found the error**, and added an extra step to the analysis to remove any jump at the transition*

At 10:30, Noel Sheppard at Newsbusters posted[130] on the story, restricting the point (as I had done) to the US, rather than global, temperatures. An hour later, the story was reported at dailytech.com here[131], where it was also noted that the effect on global temperatures was minor, but the effect on the US was noticeable. Both stories commented adversely on NASA's changing the data without an explicit change notice.

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128 http://www.norcalblogs.com/watts/2007/08/1998_no_longer_the_hottest_yea.html.

129 http://www.realclimate.org/index.php/archives/2007/08/the-co2-problem-in-6-easy-steps/comment-page-3/#comment-45781.

130 http://newsbusters.org/blogs/noel-sheppard/2007/08/09/did-media-or-nasa-withhold-climate-history-data-changes-public.

131 http://www.dailytech.com/article.aspx?newsid=8383.

In the early afternoon (14:28), Andy Revkin asked Schmidt and/or Hansen about the story, again noting the restriction to the US:

> *"you probably noticed the Mcintyre et al depiction of GISS annual temp estimates for US over time. Were the revisions published yet or are they updated in databases alone? Also are you doing same for global mean temp or is this specific issue related to US?"*

An hour later, Gavin had drafted a reply, which he forwarded to Ruedy. Ruedy quickly responded that the issue was a "red herring" because the values in their 2001 (!) paper were unaffected, as the data used in the paper ended in 1999 before the splice:

> *"none of the figures in our latest (2001) paper were affected since it was written in 2000 and only data up to 1999 was used for the figures in that paper… a red herring"*

Around 6 pm Aug 9, a citizen emailed Hansen directly asking for a comment. Hansen forwarded the email to Ruedy and Gavin. Around 7 pm, Ruedy suggested to Gavin that the inquiry either be "ignored" or that they "set matters straight" at RealClimate:

> *"Jim gets many of these kinds of responses – a change whose effect we described as well within the margin of error has become an "astonishing change"…. I guess the best thing is to ignore it and – if at all –* ***set matters straight in a place like RealClimate.***

At 19:12, Gavin replied tersely, agreeing that the matter should be dealt with at RealClimate (which he did in a post the next day):

> *Agreed.*

Later in the evening, Hansen, apparently never bothering to read what I'd actually written on the topic, sent an email to Revkin calling the incident a "tempest inside somebody's teapot dome" – a phrase that Hansen seemed to like as he re-used it , fuming:

> *This seems to be a tempest inside somebody's teapot dome… It is unclear why anyone would try to make something out of this, perhaps a light not on upstairs? Or perhaps this is coming from one of the old contrarians? They can't seem to get over the fact that the real world has proven them full of malarkey! You would think that they would be ready to crawl under a rock by now.*

On August 10, the story gets covered in a few more places. The New York Times Opinionator reported on the dailytech column around 9 a.m. A reporter from the National Post in Canada inquires at to several NASA employees, referring to Anthony Watts' post of two days earlier.

At 10:23 Hansen complained that he is being "besieged" by emails (either the FOI is incomplete or, in Hansen-world, a few inquiries constitute a siege) and decided to "do something":

> *I am being besieged by emails and calls about this, so we need to do something promptly as there will be stories written today for publication tomorrow… By the way, Makiko, do you remember if we ever make any statement about how different years ranked for the U.S. temperatures? There are several demands that we issue a press release correcting our wrong results and declaring that 1934 is now the warmest year on record in the US and also that 4 of the 10 warmest years were in the 1930s and only 3 in the last 10 years.*

In the late morning, Ruedy answered Leslie McCarthy (apparently the PR person) sycophantically describing Hansen's tirade to Revkin as answering in the "clearest and most beautiful way", before making various accusations against me:

> *Andy Revkin asked the same question and Jim's answer below says it all in the clearest and most beautiful way… The blog you attached is a prime example of what gives bloggers a really bad name; somebody with no idea what he is talking about is spouting absolute nonsense, making no distinction between what is essential (the facts he conveniently omits) and what is pure noise (which he is concentrating on exclusively). ..*
>
> *He finds it astounding that the years 1934 and 1998 reversed ranks, not remembering that the corrections only affected years 2000-2006, hence there is no possible connection there. By speaking of warmest year (rather than warmest year in the US time record), he successfully deceived people like Mark Taylor."*

Just before noon Aug 10, Hansen again complains about being "besieged", but this time with a knot in his stomach as he's just been told that the earlier results have been "thrown away", making a before and after comparison impossible. Hansen pleads for his subordinates to retrace their steps or they will "never live this down" and sensibly recommends that they save their results at least once a year in the future:

> *I am being besieged by these… The appropriate response is to show the curves for U.S. and global temperatures before and after McIntyre's correction.* ***Makiko doubts that his is possible because the earlier result has been 'thrown away'. We will never live this down if we give such a statement****. It must be possible to reconstruct the "before" result. Unfortunately this needs to be done soon as there are various writers with deadlines this afternoon. .. By the way, I think that we should save the results of the analyses at least once a year, so we will have a record of how they change.*

An hour later, Ruedy told Hansen, much to his relief, that the data had not been thrown out and that they could do the desired comparison. So Hansen started writing what became his "Lights On Upstairs" jeremiad.

Meanwhile, Gavin was responding to inquiries from Stewart Gaffin about the Opinionator piece, which recapped the dailytech article that stated that I had " "reverse engineered" the data to find NASA's algorithm, discovered that a Y2K bug had played havoc with some of the numbers and notified the space agency." Gavin disparaged my role in the matter, again attributing the precise diagnosis to NASA (though it was me who had spotted the change in data sets) and denying that I had had to do "reverse engineering" to figure out the problem – even though that was precisely what I had had to do (in the form of patient comparison of multiple versions of different data sets):

> *The opinionator piece is mostly made up… The issue is that McIntyre noticed an odd jump in some US stations at the switch between 1999 and 2000. He sent a letter pointing out the jump, the GISTEMP people looked into it, saw the problem and fixed it in less than a day. No "reverse engineering". Nobody 'always puzzled by the gaps' and no havoc.*

Meanwhile, Hansen had finished his draft Lights Out Upstairs editorial and circulated it to his staff at 15:54, noting that it still "needs the figures and links".

Concurrently, Sato sent a note to Hansen reminding him that 1934 and 1998 had changed places (this is covered more thoroughly in a later Sato memo) and that earlier in the year (January), 1998 was in first place.

> *Let's try to remember what statements we made about US temperature. … (3) In January 2007, I showed on my "Some Extra" page which most people don't look at: 1834 1.23, 1998 1.24 and 2006 1.23.*

She added that, while NASA didn't usually publicize US rankings, NOAA did (e.g. their January 2007 press release[132] (which was headlined "NOAA REPORTS 2006 WARMEST YEAR ON RECORD FOR U.S." and which was very much in the air at the time).

In response to Hansen's attempt to restrict attention to global trends, Revkin reminded Hansen that USA temperature trends had been frequently used in advocacy (and thus the point could not be dismissed quite as easily as Hansen wanted):

> *Given that quite a few folks (Gore and some enviros particularly) have often used the USA temp trends in arguments for action (string of record years) it's hard for me to ignore the reanalysis of those annual temps – even though my own focus remains global mean temps. …happy to discuss by phone til 6 pm or so.*

During the next few hours, Hansen's subordinates worked busily to get Lights Out Upstairs ready for showtime. At 16:04, Schmunk checked with Hansen on which precise 2001 reference he wanted to link to. At 16:18, Sato asked whether the figures were too large or too small. At 16:26, Sato confirmed to Schmunk that a fresh version had been sent to Hansen and asked Schmunk about links. At 16:29, Hansen sent out a revised version for comment to Schmunk, Ruedy, Sato and Darrell Cain. At 16:35, Ruedy notified Sato of a few typos. At 16:43, Schmunk advised Sato on pdf linking style. At 16:50, Sato sent minor edits to Hansen. At 17:09, Hansen reverted with two small changes. At around 17:30, Sato sent a final version to Schmunk, Hansen and Cain, telling Schmunk to move the essay to CU (Hansen's

[132] http://www.noaanews.noaa.gov/stories2007/s2772.htm.

"personal" site) and "hide" it at the NASA site and telling Darnell Cain that he had to send it out to Hansen's email list:

> *Jim, please check if everything is fine. Robert, please move to the CU site and hide this after Jim checks it. Darnell, please send it out to Jim's email list. Jim said if I don't want to, you should do, but it is not a matter of what I WANT TO or NOT WANT TO. I don't know how to.*

Within a couple of minutes of Sato asking Schmunk to "hide" the Lights Out Upstairs editorial on the NASA website, Gavin Schmidt (at 17:33), in accordance with his agreement with Ruedy the previous day, used RealClimate as a vehicle to set "matters straight" about Hansen's Y2K error (see here[133]) once again trivializing the issue. For my own take on the significance of the incident, see my contemporary editorial here[134] where I argued:

> *My own view has been that matter is certainly not the triviality that Gavin Schmidt would have you believe, but neither is it any magic bullet. I think that the point is significant for reasons that have mostly eluded commentators on both sides.*

Back to the Lights Out Upstairs editorial. At 17:55, Schmunk reverted to Sato and the others with slightly edited doc and PDF versions. At 18:10, Schmunk notified Darnell Cain that the PDF was going up at Hansen's personal (CU) website. At 18:22, Hansen thanked the NASA team for their help in disseminating "A Lights On Upstairs[135]":

> *Thanks to all of you for the rush job! I think that it is very clear.*

At 18:27, A Light on Upstairs? was online at Hansen's personal website here[136]. Despite Sato's notice to Hansen that 1998 had ranked first in NASA rankings earlier that year, Hansen stated that they had ranked 1934 first in their 2001 paper and falsely and stubbornly asserted that it ranked first both "before and after" the Y2K correction:

> *our prior analysis had 1934 as the warmest year in the U.S. (see the 2001 paper above), and it continues to be the warmest year, **both before and after the correction to post 2000 temperatures.***

Hansen then complained once again about being "besieged" – this time by "rants" and not by "emails" and, apparently proud of his bon mots about "tempest inside someone's teapot dome" and a "light not being on upstairs", included these phrases in his jeremiad:

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[133] http://www.realclimate.org/index.php/archives/2007/08/1934-and-all-that/.
[134] http://climateaudit.org/2007/08/11/does-hansens-error-matter/.
[135] http://www.columbia.edu/~jeh1/mailings/2007/20070810_LightUpstairs.pdf.
[136] http://www.columbia.edu/~jeh1/mailings/2007/20070810_LightUpstairs.pdf.

> *Somehow the flaw in 2001-2007 U.S. data was advertised on the internet and for two days I have been besieged by rants that I have wronged the President, that I must "step down", or that I must "vanish". Hmm, I am not very good at magic tricks.*
>
> *My apologies if the quick response that I sent to Andy Revkin and several other journalists, including the suggestion that it was a tempest inside somebody's teapot dome, and that perhaps a light was not on upstairs, was immoderate. It was not ad hominem, though.*

So why did Sato want to "hide" A Lights On Upstairs? at the NASA website. And why did Hansen think that Sato might not want to distribute the Lights On email for him? And, after NASA employees had worked all afternoon on Lights Out Upstairs, why did Hansen post Lights Out Upstairs at his "personal" website rather than at the NASA GISS website?

Obviously we don't *know* the answers. But it's not hard to speculate on why Hansen chose to publish the article at his "personal" website. NASA has policies and regulations on the dissemination of NASA information – see a CA discussion from late 2007 here[137]). Would Lights Out Upstairs – with its whiny and juvenile tone – comply with NASA peer review procedures? Seems pretty unlikely to me. And I'm sure that Hansen was as aware of this as anyone.

The most plausible explanation for Sato wanting to "hide" Lights Out was presumably to avoid the article being deemed to require NASA peer as required for all NASA work product, a classification that Hansen seems to want to avoid in this case.

For some reason, Hansen seemed to have thought that Sato didn't "want" to send out the email for him and had already instructed Darrell Cain to send out the email if Sato didn't "want" to. We don't know why Hansen thought this about Sato. Perhaps she didn't think that it was appropriate for a NASA employee to be providing personal services to her boss (something not encouraged in NASA codes of conduct). Or maybe it was something very mundane.

Exactly why Hansen asked NASA employees to send an editorial being published on his "personal" webpage to his "personal" email list is also unclear. Perhaps Hansen was either unable or unwilling to do anything quite so menial as sending his work product to his "personal" email list. Maybe he was delivering insulation materials to a poor family. Maybe he was planting a tree.

In any event, the emails show that either Lights Out Upstairs was NASA work product (and not personal) or that NASA employees were diverted from NASA business to provide personal services for their boss. Something to keep in mind when contemplating the ongoing conundrum of how Gavin Schmidt operates RealClimate on his "personal time" – which elastically includes NASA working hours.

[137] http://climateaudit.org/2007/12/28/nasa-evasion-of-quality-control-procedures/.

Postscript: *On August 13, NASA headquarters sent an inquiry to NASA GISS about the Y2K controversy, then in its second wind. Even though the matter was 10 days old, there was no assessment at the NASA GISS website. Instead of publishing an assessment at the NASA website – the logical place, Hansen and Schmidt responded in off-balance sheet venues: Hansen at his "personal" website and Gavin, in accordance with his agreement with Ruedy, at RealClimate. So instead of being able to refer NASA headquarters to a clear and professional assessment at the NASA website, Hansen's answer was:*

> *"Send them Lights On Upstairs."*

See Steve's post and comments here[138].

CASE 13: CONTIGUOUS U.S. TEMP TRENDS USING NCDC RAW AND ADJUSTED DATA FOR ONE-PER-STATE RURAL AND URBAN STATION SETS

by Edward R. Long, Ph.D.

INTRODUCTION

The Goddard Institute for Space science (GISS), the National Climatic Data Center (NCDC), and centers processing satellite data, such as the University of Alabama at Huntsville (UAH), have published temperature and rate of temperature change for the Contiguous United States, or 'Lower 48'. A summary of the rate of temperature change reported by GISS (Ref 1) and NCDC (Ref 2) are provided in Table I. UAH's data began in 1979.

Table I – Rate of Temperature Change for the Contiguous 48

	Temperature Change/Century	
	°C	°F
Contiguous 48, GISS (Ref 1)	0.55	0.95
Contiguous 48, NCDC (Ref 2)	0.69	1.25

Both GISS and NCDC have been criticized for their station selections and the protocols they use for adjusting raw data, (Ref 3 - 6). GISS, over a 10-year period has modified their data by progressively lowering temperature values for far-back dates and raising those in the more recent past (Ref 3). These changes have caused their 2000 reporting of a 0.35 °C/century in 2000 to increase to 0.44 °C/century in 2009, a 26-percent increase. NCDC's protocols for adjusting raw data for missing dates, use of urban locations, relocations, etc. has led to an increase in the rate of temperature change for the Contiguous U. S., for the period from 1940 to 2007, from a 0.1 °C/century for the raw data to a 0.6 °C/century, for the adjusted data (Ref 4). Whether or not these changes are intentional, or the consequence of a questionable protocol, has been and continues to be, discussed. This paper does not intend to add to the speculation of which but rather to determine the rate of change for the Contiguous U.S. from the two NCDC data sets, raw and adjusted, from meteorological stations, based on a rural and an urban stations locations, and comment on the result.

[138] http://climateaudit.org/2010/01/23/nasa-hide-this-after-jim-checks-it/#more-9903.

Grid Layout of the United States and Station Selection Criteria

One criteria common to most station selections or sampling is to use a 5-deg latitudinal x 5-deg longitudinal grid. NCDC's (NOAA) for the Contiguous U. S. is shown in Figure 1 (Ref 7), although NCDC concludes a 2.5-deg x 3.5-deg grid is preferable in terms of station density average and that all interior grid boxes have more than one station. The 2.5-deg by 3.5 deg grid box is shown in Figure 2.

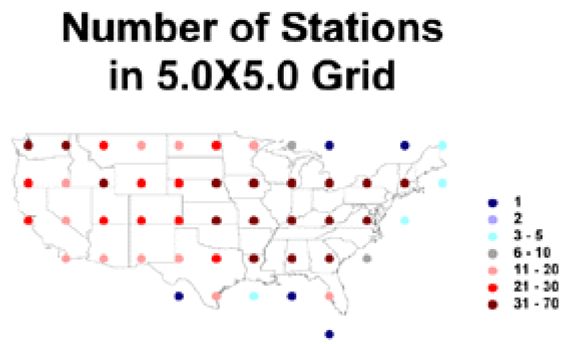

Figure 1 – NCDC contiguous 48 grid 5-deg x 5-deg division and station population for each grid box.

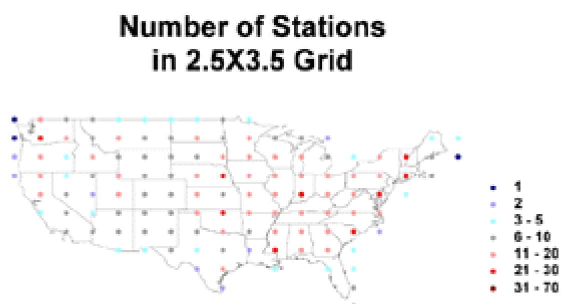

Figure 2 – NCDC contiguous 48 grid 2.5-deg x 3.5-deg division and station population for each grid box.

Ref 7 states the assumption '… stations in the same latitude bands tend to share a more similar climate." Another assumption is that "… averaging station anomalies within regions of similar size (grid boxes) and then calculating the average of all the grid box averages, a more representative region-wide anomaly can be calculated. This makes grid box averaging superior to simply taking the average of all stations in the domain." While these assumptions in themselves can be argued to be reasonable, the problem would seem to be the methodologies engendered in treatment for a mix of urban and rural locations. Ref 4 suggests that the 'adjustment' protocol appears to accent to a warming effect rather than eliminate it. This, if correct, leaves serious doubt for whether the rate of increase in temperature found from the adjusted data is due to natural warming trends or warming because of another reason, such as erroneous consideration of the effects of urban warming.

Figure 3 is an alternate view of a 5-deg by 5-deg grid division of the Contiguous U. S. The state boundaries are included and suggest, with the exception of the North Eastern portion, an alternate approach would be to select an equal number of stations per State. To make such an approach simple we elected to select one station per State. Two sets of 48 stations have been chosen from a posted list of the stations employed by the NCDC, Ref 8. The first set consists of stations with 'rural' locations. In the context of this paper, 'rural' means a station whose location is with no more than one dwelling in its vicinity or at the outer boundary of a small community whose population does not exceed a small multiple of a thousand residents. The second set consists of stations with 'urban' locations. In the context of this paper, 'urban' means a station at the site of a sizeable airport, an industrial area within a city, or near the center of a well-populated city with industrial activity. The number 48 is about half in number of the 114 stations anticipated for NOAA-NCDC's U. S. Climate Reference Network (USCRN) (Ref 9) , which is a network apart from those now used by NCDC and GISS and whose installations began after 1999. Thus the statistics according to the number of sampled stations should similar. The two sets of stations, rural and urban, are provided in Tables II and III respectively.

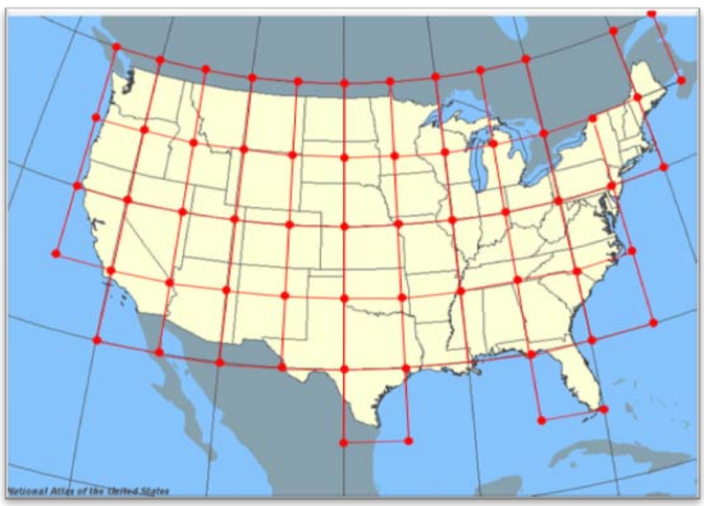

Figure 3 – A 5-deg grid overlay of Contiguous 48 map, including State boundaries.

No knowledge is assumed regarding the conditions at the station sites, such as those made recently for classifying the actual conditions of existing stations, Ref 10. Also, no consideration was given for the duration of service. Even so, with few exceptions, the beginning dates were in the late 1890's and the stations are, for the most part, still in service.

For each set, rates of temperature increase were determined for both the raw and adjusted data. An argument can be made that since the raw data set has some missing years, for most of the stations, and since the missing years are not coupled from one station to another, nor did all of the stations begin in 1895 and continue through 2008, the period of this study, the set is not adequate. But an equally good argument can be made that adjusted set of data is no more valid. The adjusted set is based on 'filling-in-of-missing-values' of one station set using the data of another station that is at a near-by distance.

Table II – Station Set 1, Rural Locations

Station Number	Latitude	Longitude	Elevation	State	Name
13816	31.87	-86.2542	132	AL	HIGHLAND HOME
21248	36.1533	-109.5394	1709.9	AZ	CANYON DE CHELLY
35512	35.5125	-93.8683	253	AR	OZARK 2
49855	37.75	-119.5897	1224.7	CA	YOSEMITE PARK HQ
58204	37.9492	-107.8733	2643.2	CO	TELLURIDE 4WNW
62658	41.95	-73.3667	167.6	CT	FALLS VILLAGE
73595	38.8161	-75.5761	13.7	DE	GREENWOOD 2NE
85275	30.4517	-83.4119	36.6	FL	MADISON
90586	30.8228	-84.6175	57.9	GA	BAINBRIDGE INTL PAPER
103143	46.0931	-115.5356	475.5	ID	FENN RS
110187	37.4814	-89.2344	195.1	IL	ANNA 2 NNE
120676	40.6683	-84.9305	265.2	IN	BERNE WWTP
130112	41.0656	-92.7867	268.2	IA	ALBIA 3 NNE
143527	38.8586	-99.3358	612.6	KS	HAYS 1 S
150381	36.8825	-83.8819	301.8	KY	BARBOURVILLE
160205	30.7094	-90.525	51.8	LA	AMITE
170100	44.3739	-68.2592	143.3	ME	ACADIA NP
182523	38.8833	-75.8	14.9	MD	DENTON 2 E
190535	42.4833	-71.2833	48.8	MA	BEDFORD
201439	46.5192	-87.9858	487.4	MI	CHAMPION VAN RIPER PK
211630	46.7047	-92.5253	385.6	MN	CLOQUET
221094	31.5447	-90.4581	132.6	MS	BROOKHAVEN CITY
230856	39.3447	-91.1711	270.4	MO	BOWLING GREEN 1 E
241552	47.2194	-111.71	1024.1	MT	CASCADE 5 S
253715	42.5119	-102.6944	1159.8	NE	HAY SPRINGS 12 S
264950	39.4136	-114.7733	1911.1	NV	MCGILL
272999	45.0875	-71.2872	506	NH	FIRST CONNECTICUT LAKE
281582	41.0347	-74.4233	231.6	NJ	CHARLOTTEBURG RSVR
294369	35.7783	-106.6872	1908.7	NM	JEMEZ SPRINGS
300183	42.3017	-77.9889	440.4	NY	ANGELICA
314055	35.0536	-83.1892	1170.4	NC	HIGHLANDS
323287	46.1581	-98.4	437.4	ND	FULLERTON 1 ESE
331541	41.0517	-81.9361	359.7	OH	CHIPPEWA LAKE
340179	34.5903	-99.3344	420.6	OK	ALTUS IRIG RSCH STN
351897	43.7917	-123.0275	181.4	OR	COTTAGE GROVE 1 NNE
362537	39.805	-77.2292	164.6	PA	EISENHOWER NHS
374266	41.4906	-71.5414	34.7	RI	KINGSTON
381588	34.7319	-79.8833	42.7	SC	CHERAW
390043	43.4892	-99.0631	512.1	SD	ACADEMY 2NE
405187	35.4139	-86.8086	239.9	TN	LEWISBURG EXP STN
410639	28.4575	-97.7061	77.7	TX	BEEVILLE 5 NE
420086	37.4403	-112.4819	2145.8	UT	ALTON
431360	43.9833	-72.45	243.8	VT	CHELSEA
449263	38.9036	-78.485	205.7	VA	WOODSTOCK 2 NE
454764	46.7492	-121.812	841.9	WA	LONGMIRE RAINIER NPS
468384	38.8008	-81.3619	287.4	WV	SPENCER
475932	44.3589	-88.7189	243.8	WI	NEW LONDON
487388	44.7764	-108.7592	1332	WY	POWELL FLD STN

Table III – Station Set 2, Urban Locations

Station Number	Latitude	Longitude	Elevation	State	Name
18024	33.4164	-86.135	136.6	AL	TALLADEGA
28815	32.2292	-110.9536	742.2	AZ	TUCSON WFO
35754	34.2256	-92.0189	65.5	AR	PINE BLUFF
46719	34.1483	-118.1447	263.3	CA	PASADENA
55722	38.4858	-107.8792	1764.5	CO	MONTROSE #2
63207	41.3506	-72.0394	12.2	CT	GROTON
76410	39.6694	-75.7514	27.4	DE	NEWARK UNIV FARM
86997	30.4781	-87.1869	34.1	FL	PENSACOLA RGNL AP
97847	32.13	-81.21	14	GA	SAVANNAH INTL AP
104670	42.7325	-114.5192	1140	ID	JEROME
110338	41.7806	-88.3092	201.2	IL	AURORA
126001	37.9286	-87.8956	108.8	IN	MT VERNON
131402	43.0775	-92.6714	309.1	IA	CHARLES CITY
144588	39.3256	-94.9189	265.2	KS	LEAVENWORTH
150909	36.9647	-86.4239	160.9	KY	BOWLING GREEN RGNL AP
160549	30.5372	-91.1469	19.5	LA	BATON ROUGE METRO AP
172426	44.9067	-66.9919	25.9	ME	EASTPORT
185718	39.2811	-76.61	6.1	MD	MD SCI CTR BALTIMORE
195246	41.6333	-70.9333	21.3	MA	NEW BEDFORD
205650	42.6083	-82.8183	176.8	MI	MT CLEMENS ANG BASE
215435	44.8831	-93.2289	265.8	MN	MINNEAPOLIS/ST PAUL AP
221865	31.2503	-89.8361	45.7	MS	COLUMBIA
234271	38.585	-92.1825	204.2	MO	JEFFERSON CITY WTP
247286	47.315	-114.0983	883.9	MT	SAINT IGNATIUS
250622	40.2994	-96.75	395.3	NE	BEATRICE 1N
266779	39.4839	-119.7711	1344.2	NV	RENO AP
273850	43.7031	-72.2847	183.8	NH	HANOVER
280325	39.3792	-74.4242	3	NJ	ATLANTIC CITY
297610	33.3075	-104.5083	1112.2	NM	ROSWELL IND AP
301012	42.9408	-78.7358	214.9	NY	BUFFALO NIAGARA INTL
317615	35.6836	-80.4822	213.4	NC	SALISBURY
323207	46.05	-100.6667	510.5	ND	FT YATES 4 SW
338534	40.8333	-83.2833	260.3	OH	UPPER SANDUSKY
344204	34.9894	-99.0525	474.3	OK	HOBART MUNI AP
350328	46.1569	-123.8825	2.7	OR	ASTORIA AP PORT OF
368449	40.7933	-77.8672	356.6	PA	STATE COLLEGE
376698	41.7219	-71.4325	15.5	RI	PROVIDENCE WSO AP
381944	33.9831	-81.0167	73.8	SC	COLUMBIA UNIV OF SC
398932	44.9047	-97.1494	532.8	SD	WATERTOWN RGNL AP
401790	36.5467	-87.3567	116.4	TN	CLARKSVILLE WWTP
412015	27.7742	-97.5122	13.4	TX	CORPUS CHRISTI AP
425826	41.0428	-111.6722	1551.4	UT	MORGAN POWER & LIGHT
431081	44.4681	-73.1503	100.6	VT	BURLINGTON WSO AP
446139	36.9033	-76.1922	9.1	VA	NORFOLK INTL AP
457458	47.65	-122.3	5.8	WA	SEATTLE URBAN SITE
465707	39.4019	-77.9844	162.8	WV	MARTINSBURG E WV RGNL
475474	43.0719	-88.0294	221.3	WI	MILWAUKEE MT MARY COL
487845	41.5942	-109.0653	2055	WY	ROCK SPRINGS AP

This is based on the assumption that within a certain latitude band stations along an East-West line experience the same climate and that within a grid unit the set of stations are somehow related in a manner that their temperature characteristics are interchangeable to an extent understood from averaging and distribution within the grid and/or latitude. There are examples of stations within a small geographical distribution that refute this assumption. Thus the adjusted set is, on the whole no better than the raw set. Furthermore, as will be seen in the discussion of the data, the raw set has characteristics that argue it to be as valid, if not more so, than the adjusted set, especially in that it suffers no human bias.

RESULTS AND DISCUSSION

Raw NCDC Data –

Figure 4 is a plot of the annual average and 11-year average temperature anomalies for the rural station set's raw data. The reference period is inclusive for the interval 1961 - 1990, that used by the NCDC. Figure 5 is a like plot for the urban set. The slopes of the linear regression fits are 0.13 and 0.79 °C/century for the respective sets.

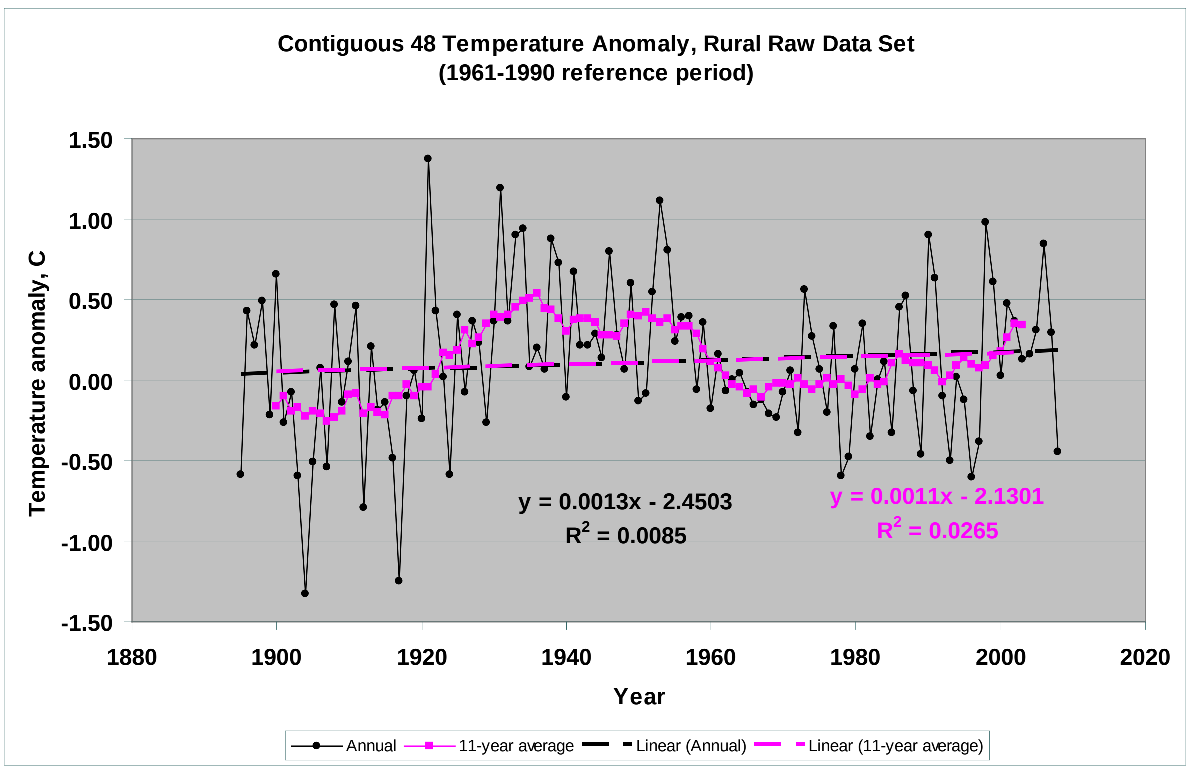

Figure 4 – Annual and 11-year average temperature anomaly for rural raw data set for the contiguous 48 States.

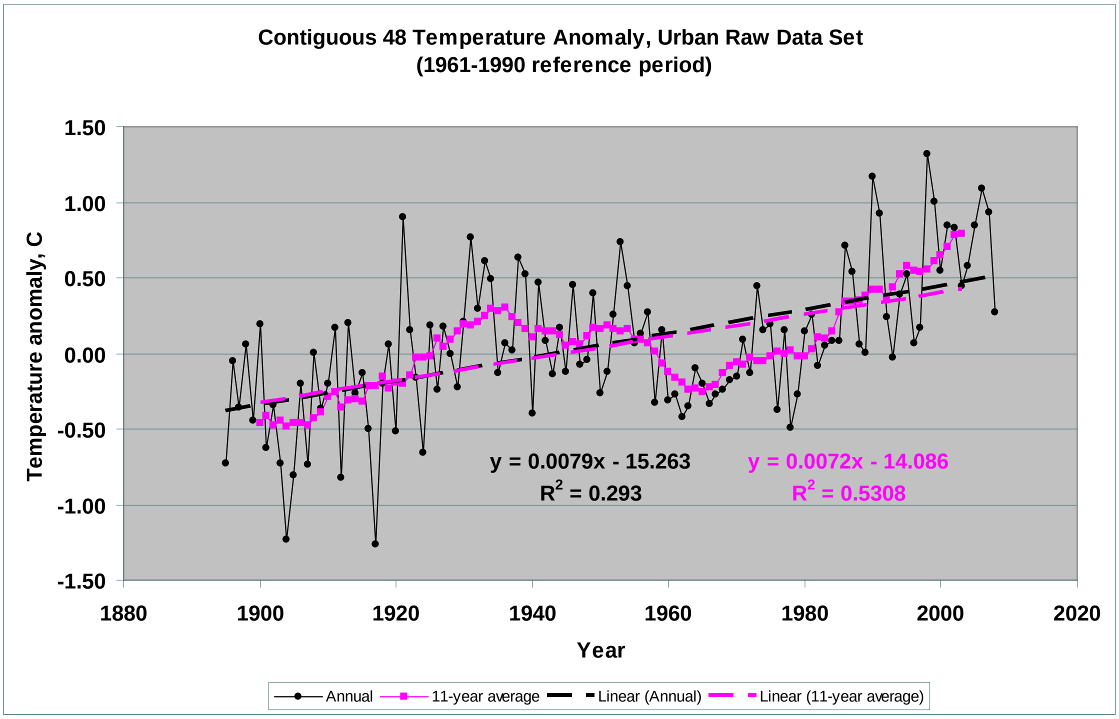

Figure 5 – Annual and 11-year average temperature anomaly for urban raw data set for the contiguous 48 States.

A logical question presents itself from the onset: 'Are these two sets of raw data reasonable representations of the time span?' The answer is 'yes', based on several observations:

- The raw data is that measured at the time, so, simply stated, those were the temperatures.

- The two sets' year-to-year trends are strikingly similar with those for the rural being larger. This is what might be thought of an urban dampening effect on the rural excursions, a dome created by the urban environment separating the urban environment from the surrounding countryside.

- The long-term trends are similar up to about 1965 (see Figure 6). The divergence of the two sets for later dates is the cause of the overall linear fit's slope being larger for the urban data.

While there may be more than one explanation for the departure of the rural and urban trends in Figure 6, one is the size and location of the Contiguous U. S. population. Figure 7 is the rural and urban populations for the time span. The size and the rate of growth of the urban portion of the population dramatically increased during the 1950-1960 period, and continued at a rate of growth twice that before the period, while the rural population has remained approximately constant, Ref 11. The urban growth was likely due to a combination of the 'baby boom' and the 'migration to the city'.

These considerations support a thesis that the raw data, even though having missing dates, provides an accurate assessment that nature itself warmed little for the period and the 'warming' is a consequence of urban heating.

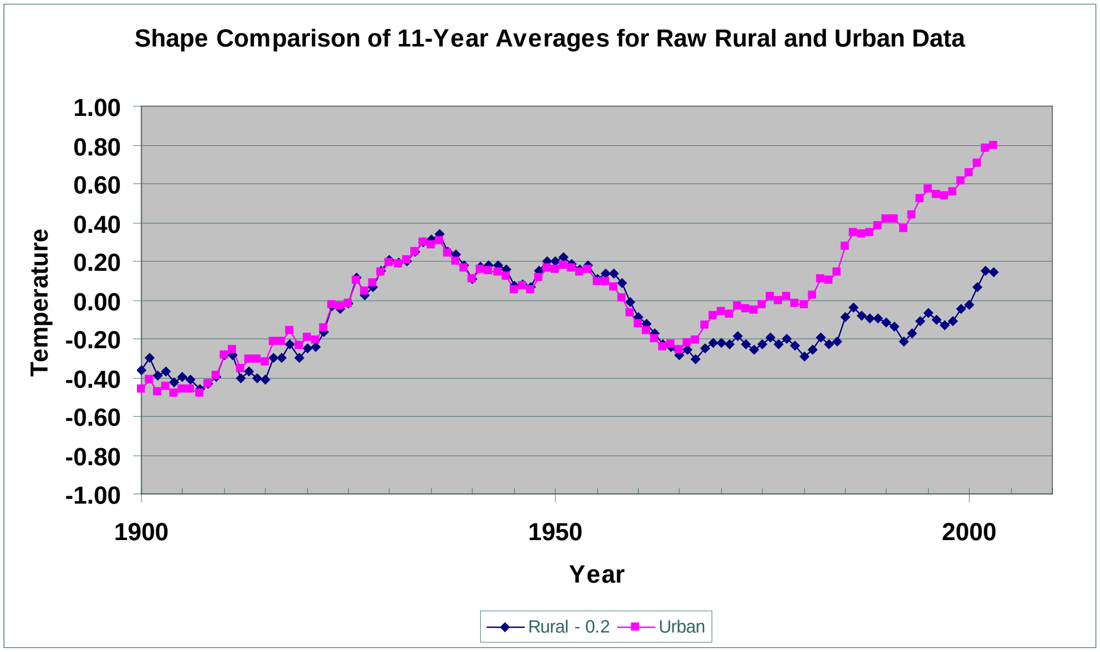

Figure 6 – Comparison of 11-averages of the raw rural and urban temperatures. The rural data is offset by a factor of '-0.2', due to the smaller value of its average, compared to that for the urban, for the 1961-1990 period.

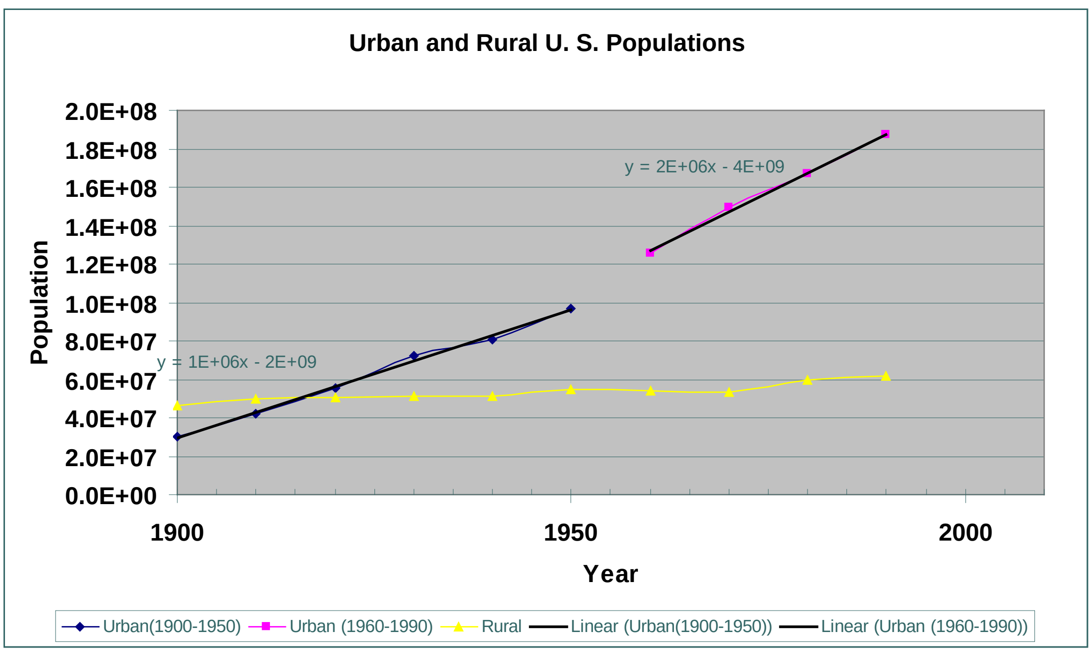

Figure 7 – Urban and rural U.S. populations. The urban is divided into two groups in order to determine the first-order fits for the two periods.

Adjusted NCDC Data –

Figure 8 is a plot of the annual average and 11-year average temperature anomalies for the rural station set's adjusted data, for the Contiguous U. S. The reference period is inclusive for the interval 1961 - 1990, that used by the NCDC.

Figure 9 is a similar plot for the urban set's adjusted data. The linear regression fits are 0.64 and 0.77 ^{o}C/century for the respective sets.

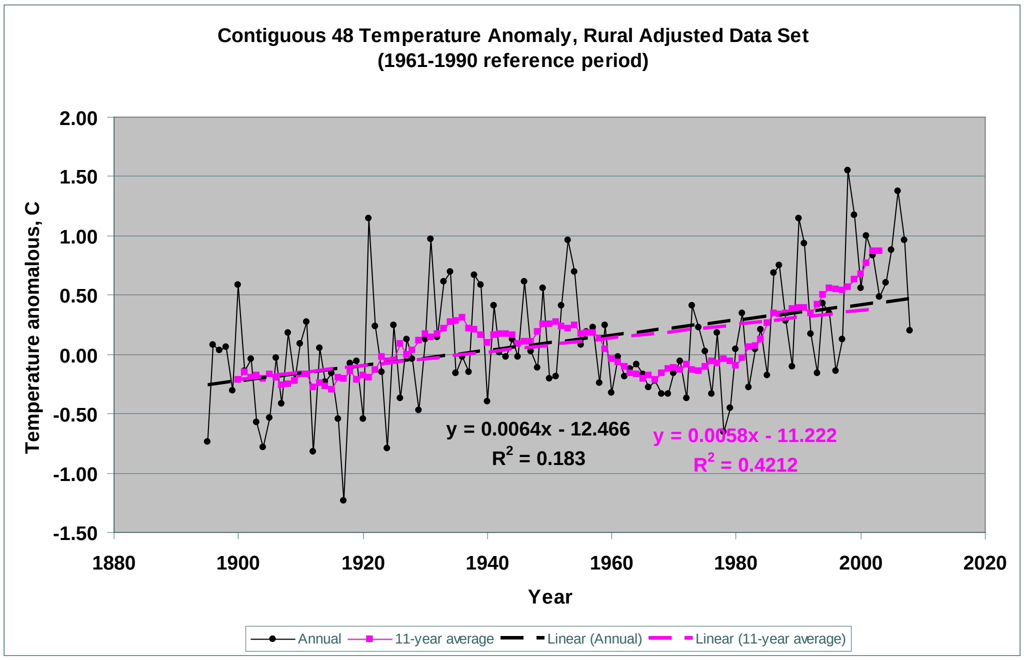

Figure 8 – Annual and 11-year average temperature anomaly for rural adjusted data set for the contiguous 48 States.

Thus, the adjustments to the data have increased the rural rate of increase by a factor of 5 and slightly decreased the urban rate, from that of the raw data. NCDC provides a description of its protocols, Ref 12. The NCDC states, "Then we created global temperature time series from the rural only stations and compared that to our full dataset. The result was that the two showed almost identical time series (actually the rural showed a little bit more warming) so there apparently was no lingering urban heat island bias in the adjusted GHCN dataset." No doubt this is the case as can be observed from Figures 8 and 9. But, this is after they 'adjusted' the raw data for rural and urban environments which, as would be expected, were different. So the 'adjustments' eradicated the difference and hid urban heating. The consequence is the five-fold increase in the rural temperature rate of increase and a slight decrease in the rate of increase of the urban temperature. Indeed as the NCDC stated, and is shown in Figure 10, there is little difference in the adjusted rural and urban trends. But, what is striking is the magnitude of the changes that had to be made to the raw rural data in order to arrive at its adjusted values. This is shown in Figure 11.

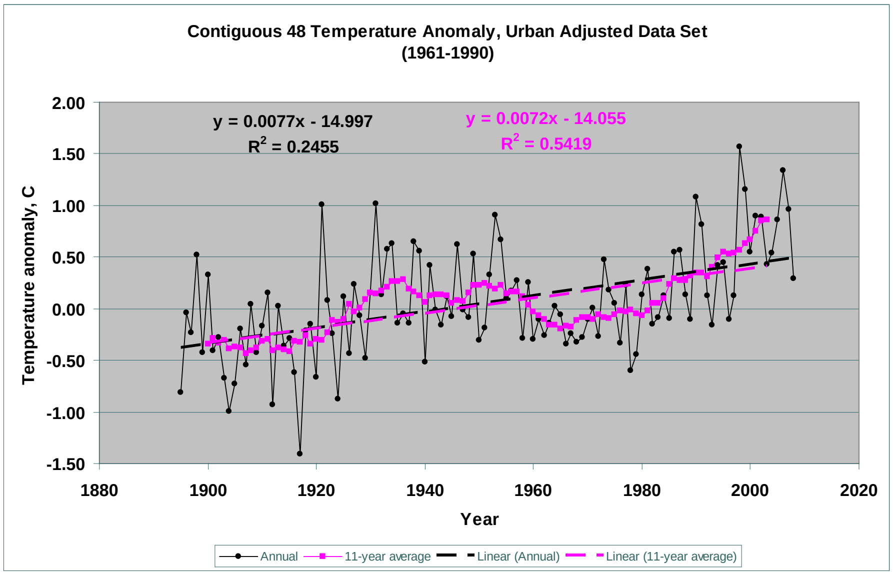

Figure 9 – Annual and 11-year average temperature anomaly for urban adjusted data set for the contiguous 48 States.

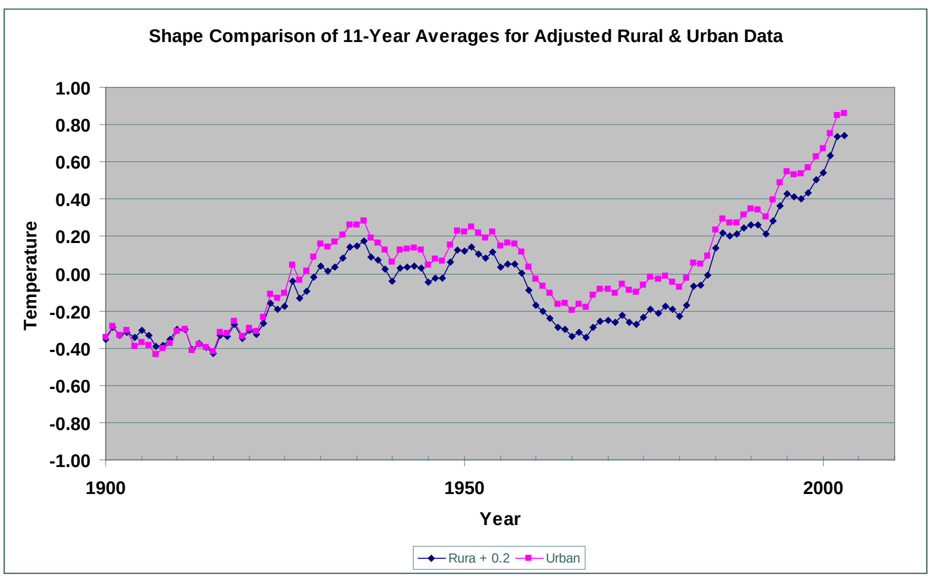

Figure 10 – Comparison of 11-averages of the adjusted rural and urban temperatures. The rural data is offset by a factor of '+ 0.2', due to the larger value of its average, compared to that for the urban, for the 1961-1990 period.

The content in Figure 11 was determined as follows: In the raw data station sets, rural and urban, most all of the individual stations have years, one or more, for which there were no data (blanks) – in this case we are concerned with the raw rural data. These same years were then also to blanks in the adjusted rural data set and this revised adjusted set was averaged for each year. The values in Figure 11 are the differences of these two rural data sets, the raw and the revised adjusted. In other words, these are the results of the NCDC's adjustments of the raw data for which there were values. To state differently, the NCDC has taken liberty to alter the actual rural measured values. Thus the adjusted rural values are a systematic increase from the raw values, more and more back into time and a decrease for the more current years. At the same time the urban temperatures were little, or not, adjusted from their raw values. The results is an implication of warming that has not occurred in nature, but indeed has occurred in urban surroundings as people gathered more into cities and cities grew in size and became more industrial nature. So, in recognizing this aspect, one has to say there has been warming due to man, but it is an urban warming. The temperatures due to nature itself, at least within the Contiguous U. S., have increased at a non-significant rate and do not appear to have any correspondence to the presence or lack of presence of carbon dioxide.

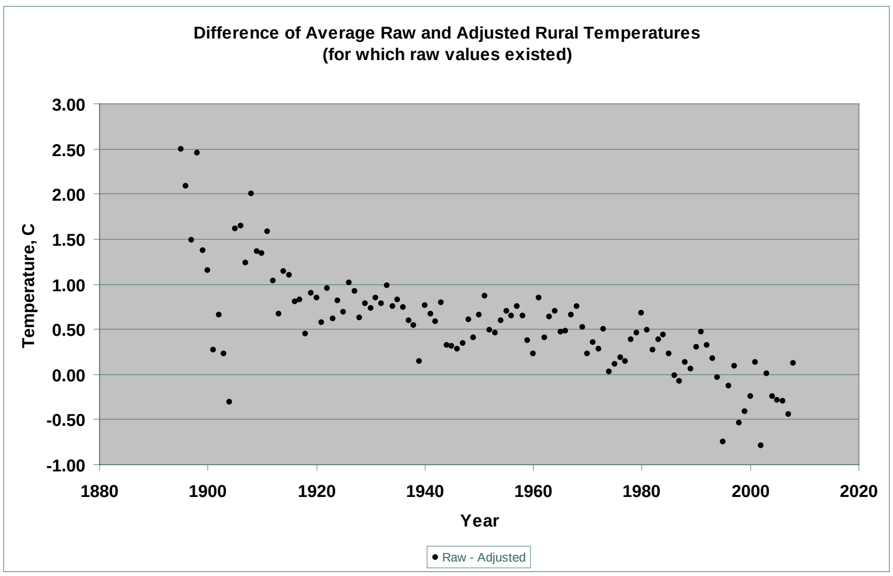

Figure 11 – Differences of rural raw and adjusted average data for raw values existed.

SUMMARY

Both raw and adjusted data from the NCDC has been examined for a selected Contiguous U. S. set of rural and urban stations, 48 each or one per State. The raw data provides 0.13 and 0.79 ^{o}C/century temperature increase for the rural and urban environments. The adjusted data provides 0.64 and 0.77 ^{o}C/century respectively. The rates for the raw data appear to correspond to the historical change of rural and urban U. S. populations and indicate warming is due to urban warming. Comparison of the adjusted data for the rural set to that of the raw data shows a systematic treatment that causes the rural adjusted set's temperature rate of increase to be 5-fold more than that of the raw data. The adjusted urban data set's and raw urban data set's rates of temperature increase are the same. This suggests the consequence of the NCDC's protocol for adjusting the data is to cause historical data to take on the time-line characteristics of urban data. The consequence intended or not, is to report a false rate of temperature increase for the Contiguous U. S.

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CASE 14: CONTRIBUTION OF USHCN AND GISS BIAS IN LONG-TERM TEMP RECORDS FOR A WELL-SITED RURAL WEATHER STATION

by David W. Schnare, Esq. Ph.D.

When Phil Jones suggested that if folks didn't like his surface temperature reconstructions, then perhaps they should do their own, he was right. The SPPI analysis of rural versus urban trends demonstrates the nature of the overall problem. It does not, however, go into sufficient detail. A close examination of the data suggests three areas needing address. Two involve the adjustments made by NCDC (NOAA) and by GISS (NASA). Each made their own adjustments and typically these are serial, the GISS done on top of the NCDC. The third problem is organic to the raw data and has been highlighted by Anthony Watts in his Surface Stations project. That involves the "micro-climate" biases in the raw data.

As Watts points out, while there are far too many biased weather station locations, there remain some properly sited ones. Examination of the data representing those stations provides a clean basis by which to demonstrate the peculiarities in the adjustments made by NCDC and GISS.

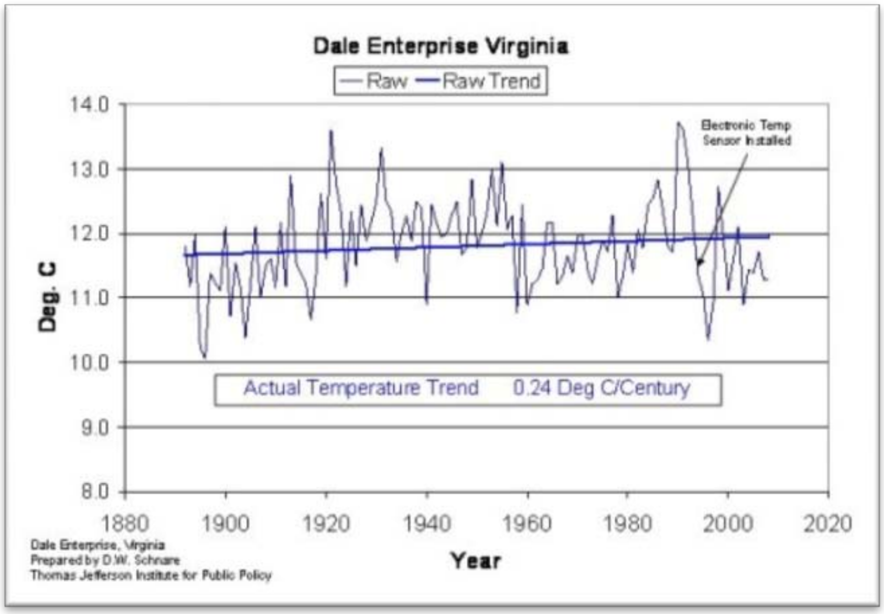
One such station is Dale Enterprise, Virginia. The Weather Bureau has reported raw observations and summary monthly and annual data from this station since 1891 through the present, a 119 year record. From 1892 to 2008, there are only 9 months of missing data during this 1,404 month period, a missing data rate of less than 0.64 percent. The analysis below interpolates for this missing data by using an average of the 10 years surrounding the missing value, rather than basing any back-filling from other sites. This correction method minimizes the inherent uncertainties associated with other sites for which there is not micro-climate guarantee of unbiased data.

The site itself is in a field on a farm, well away from buildings or hard surfaces. The original thermometer remains at the site as a back-up to the electronic temperature sensor that was installed in 1994.

The Dale Enterprise station site is situated in the rolling hills east of the Shenandoah Valley, more than a mile from the nearest suburban style subdivision and over three miles from the center of the nearest "urban" development, Harrisonburg, Virginia, a town of 44,000 population.

Other than the shift to an electronic sensor in 1994, and the need to fill in the 9 months of missing reports, there is no reason to adjust the raw temperature data as reported by the Weather Bureau.

Here is a plot of the raw data from the Dale Enterprise station.



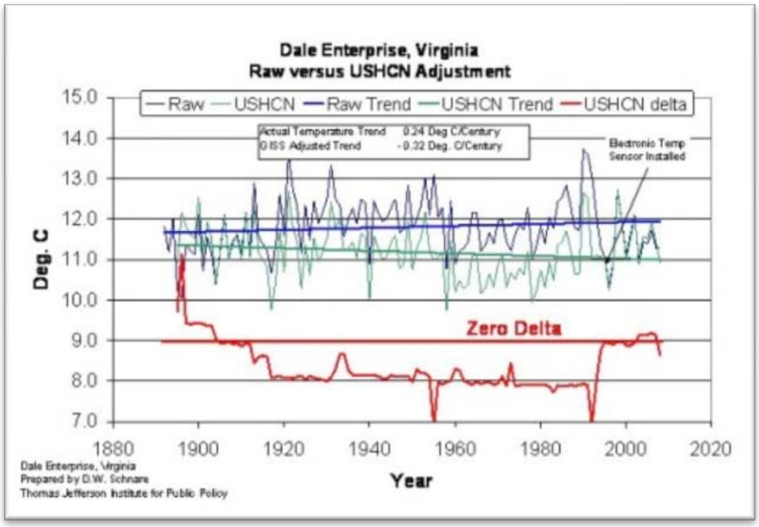
There may be a step-wise drop in reported temperature in the post-1994 period. Virginia does not provide other rural stations that operated electronic sensors over a meaningful period before and after the equipment change at Dale Enterprise, nor is there publically available data comparing the thermometer and electronic sensor data for this station. Comparison with urban stations introduces a potentially large warm bias over the 20 year period from 1984 to 2004. This is especially true in Virginia as must such urban sites are typically at airports where aircraft equipment in use and the pace of operations changed dramatically over this period.

Notably, neither NCDC nor GISS adjusts for this equipment change. Thus, any bias due to the 1994 equipment change remains in the record for the original data as well as the NCDC and GISS adjusted data.

THE NCDC ADJUSTMENT

Although many have focused on the changes GISS made from the NCDC data, the NCDC "homogenization" is equally interesting, and as shown in this example, far more difficult to understand.

NCDC takes the originally reported data and adjusts it into a data set that becomes a part of the United States Historical Climatology Network (USHCN). Most researchers, including GISS and the East Anglia University Climate Research Center (CRU) begin with the USHCN data set. Figure 2 documents the changes NCDC made to the original observations and suggests why, perhaps, one ought begin with the original data.



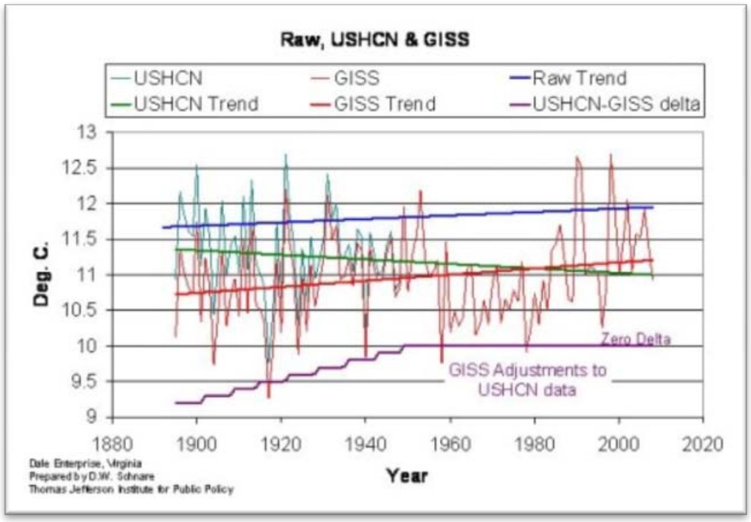
The red line in the graph shows the changes made in the original data. Considering the location of the Dale Enterprise station and the lack of micro-climate bias, one has to wonder why NCDC would make any adjustment whatever. The shape of the red delta line indicates these are not adjustments made for purposes of correcting missing data, or for any obvious other bias. Indeed, with the exception of 1998 and 1999, NCDC adjusts the original data in every year! [Note, when a 62 year old Ph.D. scientist uses an exclamation point, their statement is rather to be taken with some extraordinary attention.]

This graphic makes clear the need to "push the reset button" on the USHCN. Based on this station, alone, one can argue the USHCN data set is inappropriate for use as a starting point for other investigators, and fails to earn the self-applied moniker as a "high quality data set."

THE GISS ADJUSTMENT

GISS states that their adjustments reflect corrections for the urban heat island bias in station records. In theory, they adjust stations based on the night time luminosity of the area within which the station is located. This broad-brush approach appears to have failed with regard to the Dale Enterprise station. There is no credible basis for adjusting station data with no micro-climate bias conditions and located on a farm more than a mile from the nearest suburban community, more than three miles from a town and more than 80 miles from a population center of greater than 50,000, the standard definition of a city. Harrisonburg, the nearest town, has a single large industrial operation, a quarry, and is home to a medium sized (but hard drinking) university (James Madison University). Without question, the students at JMU have never learned to turn the lights out at night. Based on personal experience, I'm not sure most of them even go to bed at night. This raises the potential for a luminosity error we might call the "hard drinking, hard partying, college kids" bias. Whether it is possible to correct for that in the luminosity calculations I leave to others. In any case, the layout of the town is traditional small town America, dominated by single family homes and two and three story buildings. The true urban core of the town is approximately six square blocks and other than the grain tower, there are fewer than ten buildings taller than five stories. Even within this "urban core" there are numerous parks. The rest of the town is quarter-acre and half-acre residential, except for the University, which has copious pervious open ground (for when the student union and the bars are closed).

Despite the lack of a basis for suggesting the Dale Enterprise weather station is biased by urban heat island conditions, GISS has adjusted the station data as shown below. Note, this is an adjustment to the USHCN data set. I show this adjustment as it discloses the basic nature of the adjustments, rather than their effect on the actual temperature data.



While only the USHCN and GISS data are plotted, the graph includes the (blue) trend line of the unadjusted actual temperatures.

The GISS adjustments to the USHCN data at Dale Enterprise follow a well recognized pattern. GISS pulls the early part of the record down and mimics the most recent USHCN records, thus imposing an artificial warming bias. Comparison of the trend lines is somewhat difficult to see in the graphic. The trends for the original data, the USHCN data and the GISS data are: 0.24, -0.32, and 0.43 degrees C. per Century, respectively.

If one presumes the USHCN data reflect a “high quality data set”, then the GISS adjustment does more than produce a faster rate of warming, it actually reverses the sign of the trend of this “high quality” data. Notably, compared to the true temperature record, the GISS trend doubles the actual observed warming.

This data presentation constitutes only the beginning analysis of Virginia temperature records. The Center for Environmental Stewardship of the Thomas Jefferson Institute for Public Policy plans to examine the entire data record for rural Virginia in order to identify which rural stations can serve as the basis for estimating long-term temperature trends, whether local or global. Only a similar effort nationwide can produce a true “high quality” data set upon which the scientific community can rely, whether for use in modeling or to assess the contribution of human activities to climate change.

CASE 15: COSTA RICAN WARMING: A STEP ARTIFACT?

by Boballab[139] *(here*[140]*)*

Now this is interesting.

San Jose, Juan Santamar and Puentarenas Costa Rica according to GISS sets the latitude for those stations at exactly 10N, and not a fraction of that. That means that it falls on the boundary between 2 grid boxes in their gridded datasets. Box One is centered on 9 N / 85 W and Box Two is centered on 11 N / 85 W. What makes that interesting is that the amount of infill for each box is determined by the radius from the center of the box not from any of the temperature stations in that box. So it will be interesting to see how close the trend for actual data from stations like San Jose match to the trend of the 250km infill GISS anomalies. I am going to try and make a visual layout of what the boxes look like and with Long/Lat's and where the temperature stations lie in relation to everything:

```
88/14-----------86/14-----------84/14-----------82/14
  |     87/13     |     85/13     |     83/13     |
88/12-----------86/12-----------84/12-----------82/12
  |     87/11     |     85/11     |     83/11     |
88/10-----------86/10-------|||--84/10-----------82/10
  |     87/09     |     85/09     |     83/09     |
88/08-----------86/08-----------84/08-----------82/08
  |     87/07     |     85/07     |     83/07     |
88/06-----------86/06-----------84/04-----------82/06
```

Ok there you go a bunch of grid boxes and the amazing thing according to GISS is that data from the box centered on 87W/09N can be used to determine what the "real temperature trend" in the box centered on 83W/09N is.

In the cases of San Jose, Juan Santamar and Puntarenas they all sit right on the line going between 86/10 and 84/10 (as shown by the three vertical lines). So by looking at the trends for the boxes they overlap and comparing them to the trends for those stations it will give us a good idea how much of those trends is infill from other boxes and how much is from the stations in the boxes. Remember for this comparison the data was turned back to 250km infill from the center point, normally it is 1200km infill.

First let's look in Figure 1 the trends for the two boxes based on the yearly anomalies from 1942-2009, Jan-Dec:

[139] http://boballab.wordpress.com/about/.

[140] http://boballab.wordpress.com/2010/03/16/costa-rican-warming-a-step-artifact/.

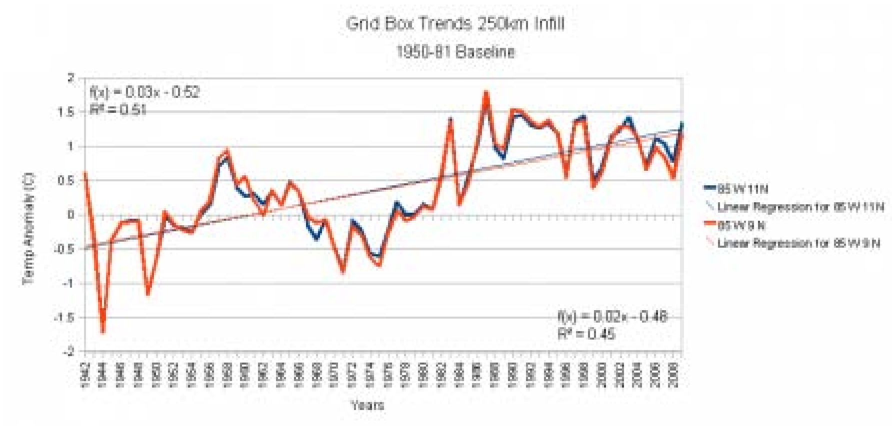


Figure 1

Now as you can see according to the anomalies from 1942 to 2009 the trend is warming of about 1.7° C. Now in Figure 2 we will see the graph of the absolute temperatures for these 3 stations:

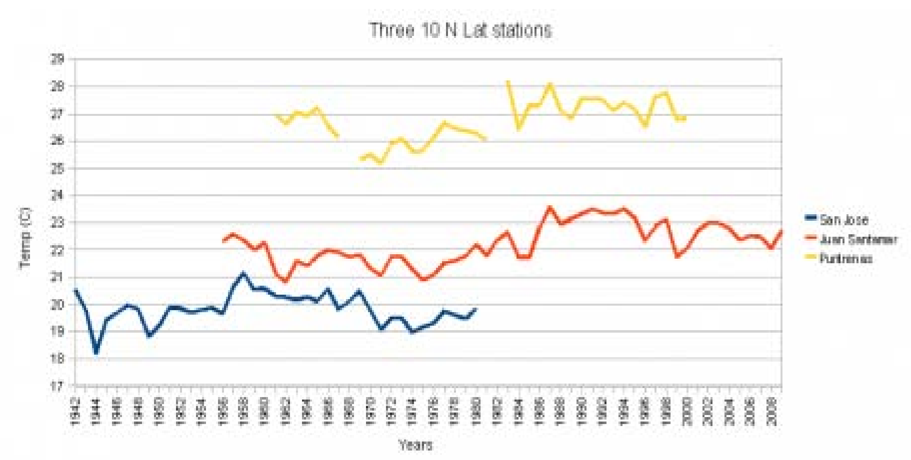


Figure 2

Notice that in the overlap period of the 3 stations that they are at different absolute temperatures. Matter of fact the trend for San Jose during its time of coverage is < -.1° C, for Juan Santamar we have a trend of 1.35° C and for Puntarenas 1.2° C.

So with 2 of the stations showing a warming trend but .35° C and .5° C less than the grid and with 1 station showing basically a flat trend does that mean most of the difference is due to infilling?

Not necessarily, first let's just do a simple average of the anomalies of those three stations and compare that to the grid trends. The Anomalies are based on taking each station's data and subtracting out the average for the baseline period of just that stations data, then averaging those anomalies and that gives us what is seen in Figure 3:

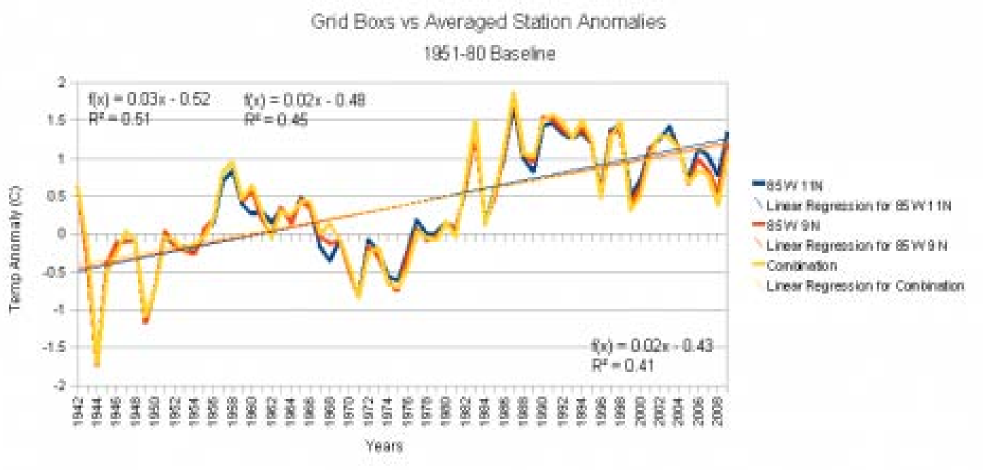


Figure 3

Now as you can see that gives a pretty good fit with a combined station anomaly trend of 1.6° C over that time period. Now some might ask about geographical weighting of the data and when you look at the Lat/Long of each station you will see that there is very little difference. All three are set at 10° N Lat and they run at 84.1°, 84.2° and 84.8° W Long. So these stations are not that far apart in the horizontal sense but they are different in elevation. San Jose according to the GHCN station list (which seems to have gone MIA from the NCDC GHCN ftp server) is at 1141 meters, Juan Santamar is at 939 meters and Puntarenas is at 3 meters. So when you go back to the graph in Figure 2 you see that as you get lower in elevation the temperature starts rising, but it doesn't seem that GISS weights for elevation (at least they do not have any indication of such in their station list, there is no elevation listed).

Now what else is different between the three? Well according to GHCN San Jose and Juan Santamar are both classified as tropical and Puntarenas as water (that means it's down by the beach). According to GHCN San Jose is Urban and GISS has a pop of over 390,000, while the other two are classified by GHCN as S and GISS has pops of 33,000 and 26,000 for them today. So we started out with one thermometer up in the mountains in a city that grew over time, we added in another thermometer in 1956 at a little lower elevation with a smaller population and then added a third in 1961 much further down in elevation. We then lose the original thermometer in 1980, then lose the one down by the beach in 2000, leaving the one small town thermometer (which might be the international airport for San Jose the capital see: http://en.wikipedia.org/wiki/Juan_Santamar%C3%ADa_International_Airport). This lets us break down everything into separate time periods based on when we added and lost thermometers and see what the trends were for each one and compare it to the averaged trend line for those same periods.

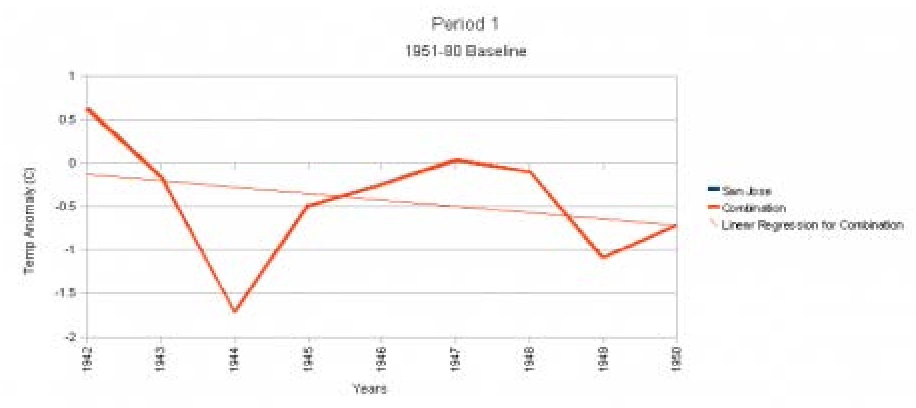


Figure 4

As can be seen in Figure 4, period 1 covers the years 1942 thru 1950 and there is only one thermometer for that period. Also shown is that there is a cooling trend of about -.6° C over that period. Also note the big drop in temperature right after the start of the graph. That big drop is going to play a big part in the 1.6° C warming trend we saw in Figure 3.

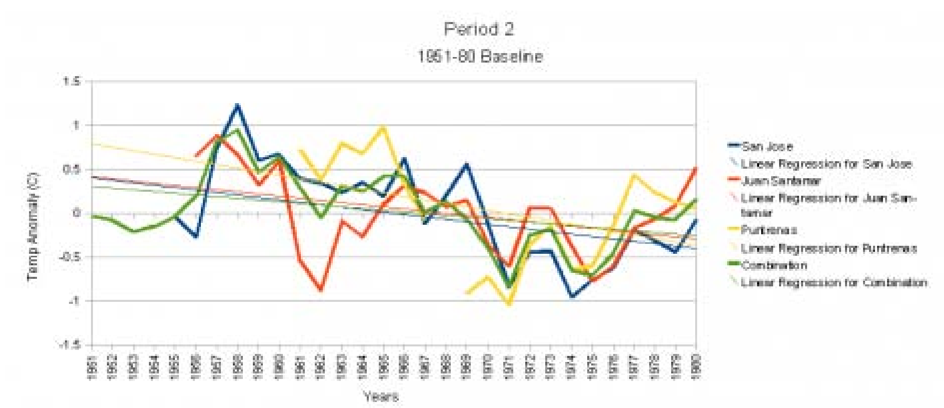


Figure 5

Now here in period 2, which covers the baseline years of 1951-80, we gained two new thermometers while still retaining the original one, however 1980 is the final year for our original thermometer. What that means is that it help shaped the combined/Grid box baseline and is what the other two thermometers are compared to in the future. Also note that all trends are cooling at that point including the combined at slightly over -.5° C.

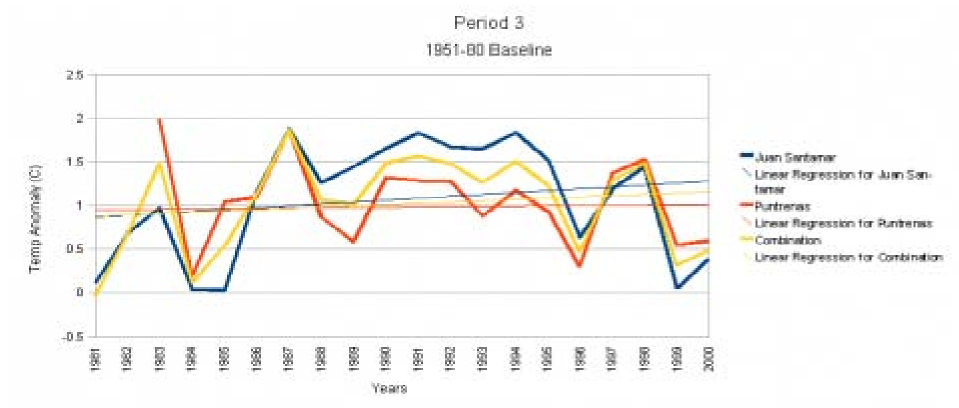


Figure 6

Now here in period 3 we just have two small towns that have thermometers, one at higher elevation and one down by the beach (http://en.wikipedia.org/wiki/Puntarenas). The one down by the water basically has a flat trend during this period with barely a small amount of warming. The higher elevation one is of much more interest, it has a warming trend of .4° C over that period. What makes it interesting is that the temperature at that station jumped up very quickly in 1985, then remained basically flat after 87 until 95 and then dropped back down. What this produced in the combined is a slight warming trend just under .2° C.

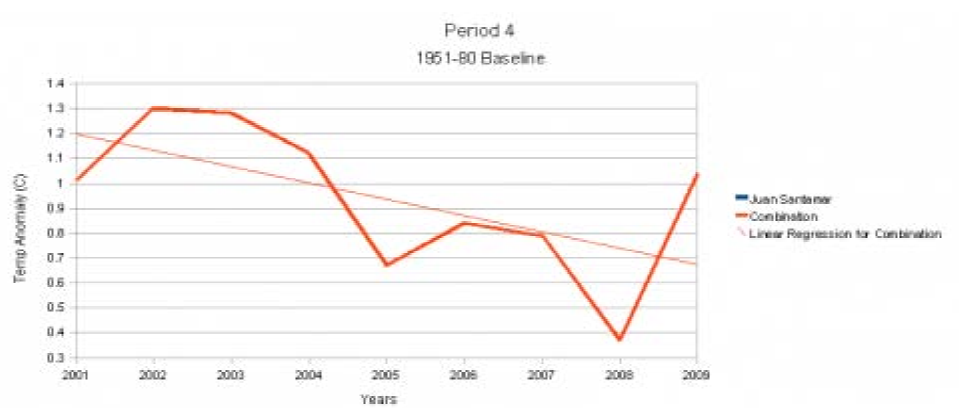


Figure 7

Now here in Period 4 we are back down to just one thermometer and it's in a small town at a higher elevation (which might be the 2nd busiest airport in Central America) and we see a cooling trend of just over -.5° C for that period.

Now I broke that record up into 4 periods, 2 of which have just one station each, one is the baseline period where we introduced 2 into the record and ended our original and the last period is a long stable period of just two stations. Now of those 4 periods we had 3 with cooling trends and only 1 with a slight warming trend. What you see if you go back and look at Figure 2 is that from 1941-80 you had a big dip in temperatures followed by some warming, then another dip of temperatures. From 1981-2009 you see a jump in temperatures followed by a flat trend since then, however the anomalies all stay above the baseline where before 1980 you had those dips below the baseline, that is what gives you the warming there, the comparison of those big dips prior to the baseline and the large jump after the baseline. You will be able to see this in the following three graphs:

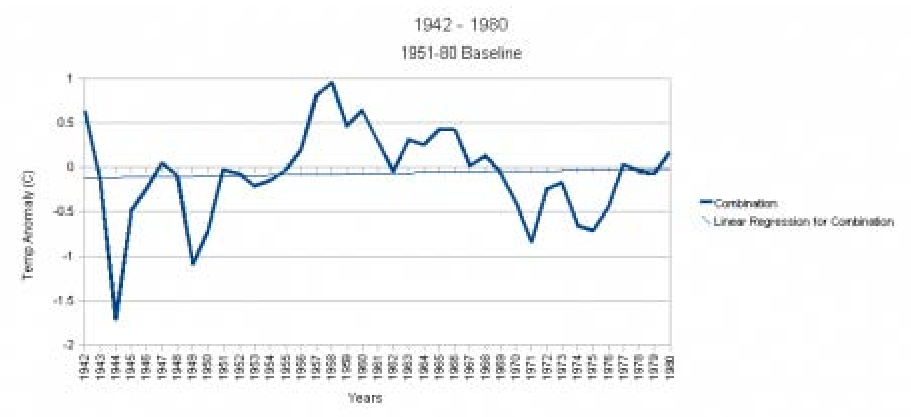


Figure 8

Here we see a slight warming trend of just under .1° C for the period 1942-1980.

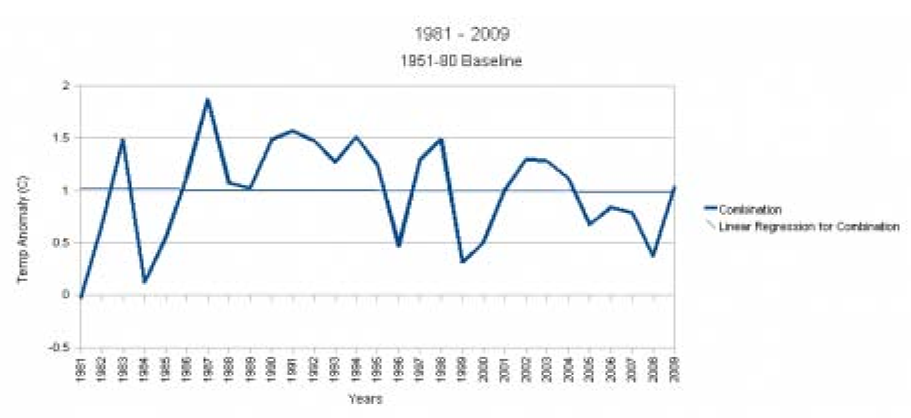


Figure 9

Here you see a trend that is for almost all intents and purposes flat for 1981-2009, but is about 1.1° C higher than the trend in Figure 8.

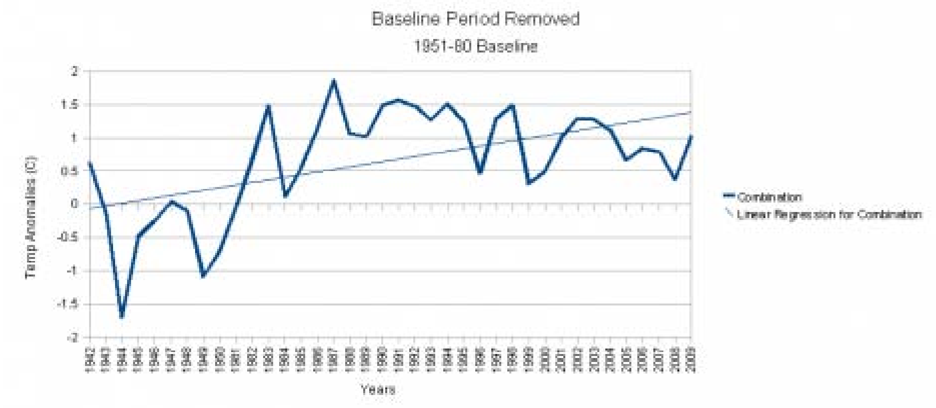


Figure 10

Now in Figure 10 I took out the baseline years and just glued the period 1981-2009 to the end of 1950 and you can see you get a warming trend of about 1.5° C. That shows that you are basically comparing the anomalies of the two newer thermometers against the anomalies of the original thermometer, which is an apples to oranges comparison and giving you a nice big 1.5° C warming trend, where if you look at the one thermometer that runs from 1956 thru 2009 you only get a 1.35°.

Now let's see what GISS says the trend should be for our 2 selected boxes:

First 1200km infill
48 50 -85.00 9.00 1.2232
48 51 -85.00 11.00 1.1963

These numbers are what I get from the GISS trend map for 1942-2009, Jan to Dec years, in those two boxes. To make GISS trend and Anomaly maps go here: http://data.giss.nasa.gov/gistemp/maps/ . You can download the trend/anomaly for each grid box from the map page.

250km Infill
48 50 -85.00 9.00 1.6586
48 51 -85.00 11.00 1.7351

As we added in more thermometers the trend dropped by about .5° C but, as I think I have shown above, the "trend" for those grids is not based on a warming trend over that entire period but a step function right when you lost the original thermometer. The result causes an apples-to-oranges comparison of the 2 post Baseline thermometers to the original one pre Baseline. So to me the "warming" trend we see is more a case of change in instruments then what's really going on there. When you had periods of instrument stability you had mostly flat trends and when you didn't it was just in the one station you had a big step jump that got the warming trend.

CASE 16: DIRECT EVIDENCE THAT MOST U.S. WARMING SINCE 1973 COULD BE SPURIOUS

by Roy W. Spencer, Ph. D.

INTRODUCTION

My last few posts have described a new method[141] for quantifying the average Urban Heat Island (UHI) warming effect as a function of population density, using thousands of pairs of temperature measuring stations within 150 km of each other. The results supported previous work which had shown that UHI warming increases logarithmically with population, with the greatest rate of warming occurring at the lowest population densities as population density increases.

But how does this help us determine whether global warming trends have been spuriously inflated by such effects remaining in the leading surface temperature datasets, like those produced by Phil Jones (CRU) and Jim Hansen (NASA/GISS)?

While my quantifying the UHI effect is an interesting exercise, the existence of such an effect *spatially* (with distance between stations) does not necessarily prove that there has been a spurious warming in the thermometer measurements at those stations *over time*. The reason why it doesn't is that, to the extent that the population density of each thermometer site does not change over time, then various levels of UHI contamination at different thermometer sites would probably have little influence on long-term temperature trends. Urbanized locations would indeed be warmer on average, but "global warming" would affect them in about the same way as the more rural locations.

This hypothetical situation seems unlikely, though, since population does indeed increase over time. If we had sufficient truly-rural stations to rely on, we could just throw all the other UHI-contaminated data away. Unfortunately, there are very few long-term records from thermometers that have not experienced some sort of change in their exposure…usually the addition of manmade structures and surfaces that lead to spurious warming.

Thus, we are forced to use data from sites with at least some level of UHI contamination. So the question becomes, *how does one adjust for such effects?*

As the provider of the officially-blessed GHCN temperature dataset that both Hansen and Jones depend upon, NOAA has chosen a rather painstaking approach where the long-term temperature records from individual thermometer sites have undergone homogeneity "corrections" to their data, mainly based upon (presumably spurious) abrupt temperature changes over time. The coming and going of some stations over the years further complicates the construction of temperature records back 100 years or more.

All of these problems (among others) have led to a hodgepodge of complex adjustments.

[141] http://www.drroyspencer.com/2010/03/the-global-average-urban-heat-island-effect-in-2000-estimated-from-station-temperatures-and-population-density-data/.

A SIMPLER TECHNIQUE TO LOOK FOR SPURIOUS WARMING

I like simplicity of analysis — whenever possible, anyway. Complexity in data analysis should only be added when it is required to elucidate something that is not obvious from a simpler analysis. And it turns out that a simple analysis of publicly available raw (not adjusted) temperature data from NOAA/NCDC, combined with high-resolution population density data for those temperature monitoring sites, shows clear evidence of UHI warming contaminating the GHCN data for the United States.

I will restrict the analysis to 1973 and later since (1) this is the primary period of warming allegedly due to anthropogenic greenhouse gas emissions; (2) the period having the largest number of monitoring sites has been since 1973; and (3) a relatively short 37-year record maximizes the number of continuously operating stations, avoiding the need to handle transitions as older stations stop operating and newer ones are added.

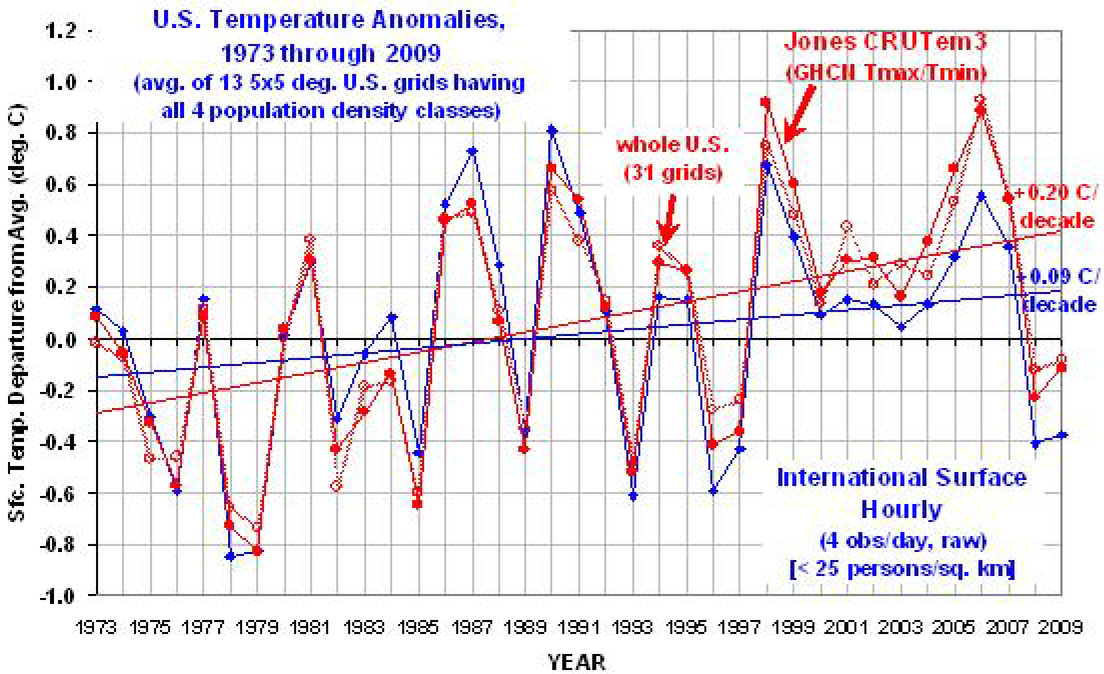
Similar to my previous posts, for each U.S. station I average together four temperature measurements per day (00, 06, 12, and 18 UTC) to get a daily average temperature (GHCN uses daily max/min data). There must be at least 20 days of such data for a monthly average to be computed. I then include only those stations having at least 90% complete monthly data from 1973 through 2009. Annual cycles in temperature and anomalies are computed from each station separately.

I then compute multi-station average anomalies in 5×5 deg. latitude/longitude boxes, and then compare the temperature trends for the represented regions to those in the CRUTem3 (Phil Jones') dataset for the same regions. But to determine whether the CRUTem3 dataset has any spurious trends, I further divide my averages into 4 population density classes: 0 to 25; 25 to 100; 100 to 400; and greater than 400 persons per sq. km. The population density data is at a nominal 1 km resolution, available for 1990 and 2000… I use the 2000 data.

All of these restrictions then result in 24 to 26 5-deg grid boxes over the U.S. having all population classes represented over the 37-year period of record. In comparison, the entire U.S. covers about 40 grid boxes in the CRUTem3 dataset. While the following results are therefore for a regional subset (at least 60%) of the U.S., we will see that the CRUTem3 temperature variations for the entire U.S. do not change substantially when all 40 grids are included in the CRUTem3 averaging.

EVIDENCE OF A LARGE SPURIOUS WARMING TREND IN THE U.S. GHCN DATA

The following chart shows yearly area-averaged temperature anomalies from 1973 through 2009 for the 24 to 26 5-deg. grid squares over the U.S. having all four population classes represented (as well as a CRUTem3 average temperature measurement). All anomalies have been recomputed relative to the 30-year period, 1973-2002.



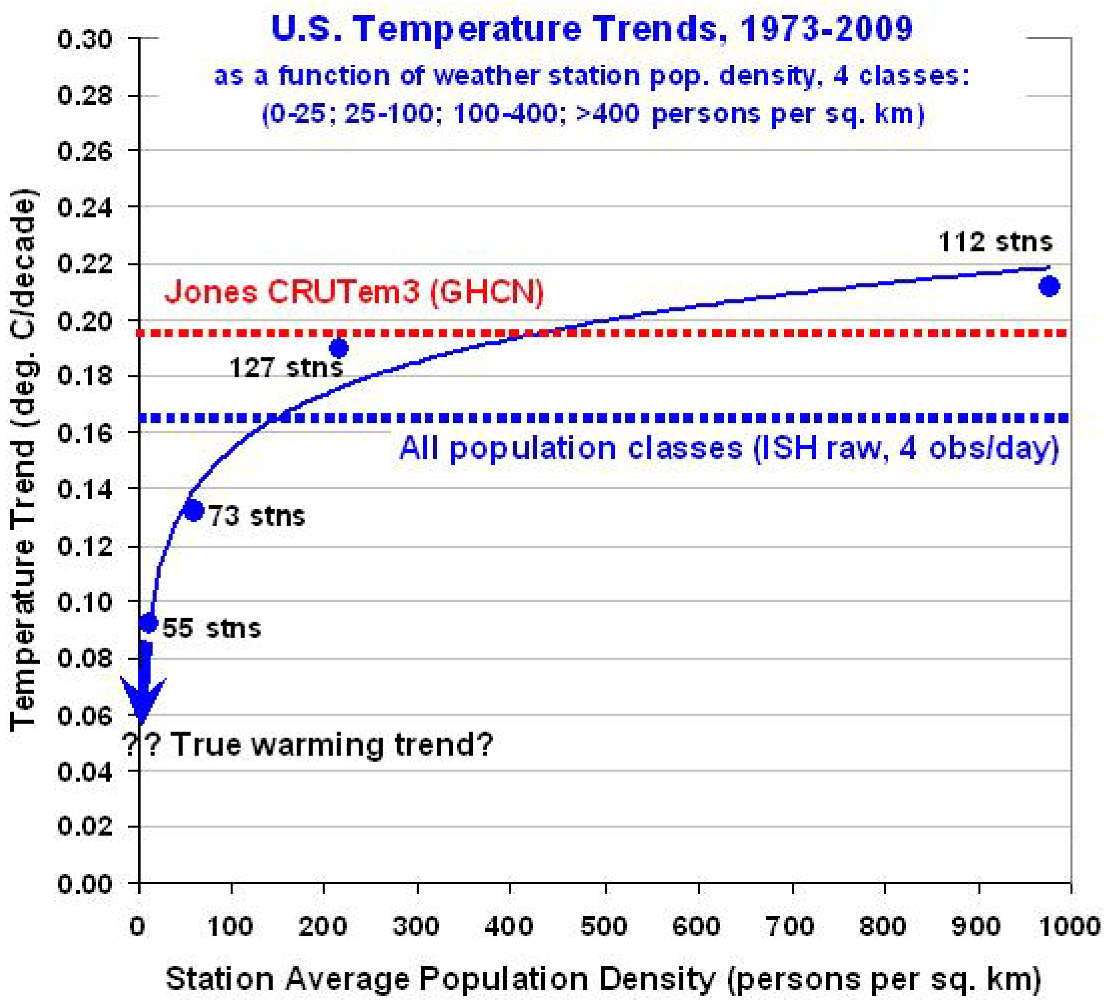
The heavy red line is from the CRUTem3 dataset, and so might be considered one of the "official" estimates. The heavy blue curve is the lowest population class. (The other 3 population classes clutter the figure too much to show, but we will soon see those results in a more useful form.)

Significantly, the warming trend in the lowest population class is only 47% of the CRUTem3 trend, a factor of two difference.

Also interesting is that in the CRUTem3 data, 1998 and 2006 would be the two warmest years during this period of record. But in the lowest population class data, the two warmest years are 1987 and 1990. When the CRUTem3 data for the whole U.S. are analyzed (the lighter red line) the two warmest years are swapped, 2006 is 1st and then 1998 2nd.

From looking at the warmest years in the CRUTem3 data, one gets the impression that each new high-temperature year supersedes the previous one in intensity. But the low-population stations show just the opposite: the intensity of the warmest years is actually *decreasing* over time.

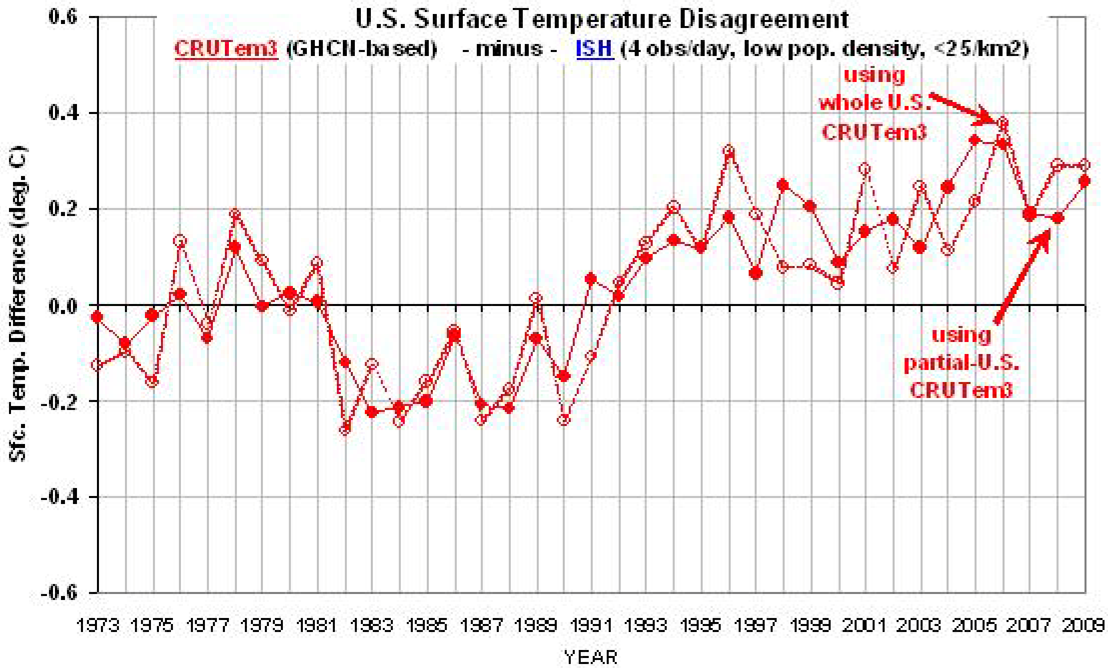
To get a better idea of how the calculated warming trend depends upon population density for all 4 classes, the following graph shows – just like the spatial UHI effect on temperatures I have previously reported on – that the warming trend goes down nonlinearly as population density of the stations decrease. In fact, extrapolation of these results to zero population density might produce little warming at all!



This is a very significant result. It suggests the possibility that there has been essentially *no* warming in the U.S. since the 1970s.

Also, note that the highest population class actually exhibits slightly *more* warming than that seen in the CRUTem3 dataset. This provides additional confidence that the effects demonstrated here are real.

Finally, the next graph shows the difference between the lowest population density class results seen in the first graph above. This provides a better idea of which years contribute to the large difference in warming trends.



Taken together, I believe these results provide powerful and direct evidence that the GHCN data still has a substantial spurious warming component, at least for the period (since 1973) and region (U.S.) addressed here.

There is a clear need for new, independent analyses of the global temperature data…the raw data, that is. As I have mentioned before, we need independent groups doing new and independent global temperature analyses — not international committees of Nobel laureates passing down opinions on tablets of stone.

But, as always, the analysis presented above is meant more for stimulating thought and discussion, and does not equal a peer-reviewed paper. Caveat emptor.

CASE 17: HUMAN FINGERPRINT IN SEA TEMPS?

by World Climate Report

In the ongoing battle to persuade the world that global warming is real and is a problem, advocates are waging a two-pronged attack. And each prong is heavily based on global climate models that have accounted for the largest portion of the research dollars "invested" in this issue.

Not long ago, theirs was but a simple one-pronged attack: *Climate models say the world will warm [x] degrees* (insert your favorite large number here)—implying that the time for action to combat the forthcoming tragedy had long passed. But so-called global warming "skeptics" (i.e., people who base their arguments on data rather than *speculation* [e.g., climate models]) cried foul when these self-same models proved incapable of reproducing observed climate variations. Forecasting is always the easy part, it's the verification that's the bane of TV weathercaster and climate modeler alike.

Enter Prong No. 2: fingerprint detection. Though everyone agrees that climate has a lot of inherent variability that serves to screw up comparisons with models, it nevertheless should be possible to detect the impact of human activities (from greenhouse gases)—the so-called human "fingerprint"—on global climate. Take a model, add a slow greenhouse-gas buildup over time, and compare the resulting pattern of temperature change with the observations. If they match up, then presto! The observed changes are *caused* by greenhouse gases. (Of course, no self-respecting scientist would say "caused," but a journalism major is happy to veer off in that direction.) Most importantly, model forecasts of the future can now be trusted, since they have successfully reproduced past observations.

Quite a story.

This context explains the hype and hoopla surrounding a 2001 study in *Science* by Scripps Institute of Oceanography scientist Tim Barnett and two colleagues. Barnett used the existing approach for fingerprint detection of air temperatures over land and applied it to the world's oceans using a newly compiled data set that shows changes in water temperatures to a depth of 3,000 meters. Barnett ran a climate model and compared the observed changes since 1995 with the changes in ocean temperatures produced by the model that forced increasing greenhouse gases and sulfate aerosols.

Before we show you the results, here's a very important aside that in reality is more of a main course. No matter how complex a climate model is—no matter how many layers it has, how complex the parameterizations of cloud processes are, or how many soil moisture or sea-ice feedbacks exist—when the model is forced by increasing carbon dioxide, it will warm, and usually in a linear fashion. Sulfates are merely added to lower the future warming rate to a value that's not inherently ludicrous, but rather merely ridiculous. The models can do nothing *but* produce a warming. They have no choice. More greenhouse gases equals more warming, period.

But for some reason, our real global climate, which apparently hasn't been paying attention to the P. R. from the modeling community, sometimes cools. If this cooling happens for a decade or more (like the surface air temperatures did from end of World War II until the mid-1970s), well, the model is screwed. It simply can't produce a cooling with all those nasty greenhouse gases in the atmosphere. So, for the fingerprinting to work, other things have to be added to the model that can generate a cooling. These can be anything from volcanic expulsions to changes in solar energy to outright cheating (by pre-specifying observed ocean temperatures rather than modeling them, for example, which was the approach of NASA's rocket scientists).

Figure 1 shows model-predicted values of oceanic heat content, averaged from the ocean surface down to 3,000 meters, from 1955 to 2000, compared with the observations. Here, the observed values are highly smoothed (they simply use the mean value for each 10-year period), because otherwise they would not appear to match the model output. Do you think the two lines match? Well, as usual, the model produces a warming ocean, but in every ocean basin except the South Atlantic, the oceans actually cooled between the mid-1970s and mid-1980s. To get around that, error bars are added to the model forecasts (though *not* to the observations)—showing, according to the authors, "an unexpectedly close correspondence between the observed heat-content change and the average of the same quantity from the five model realizations."

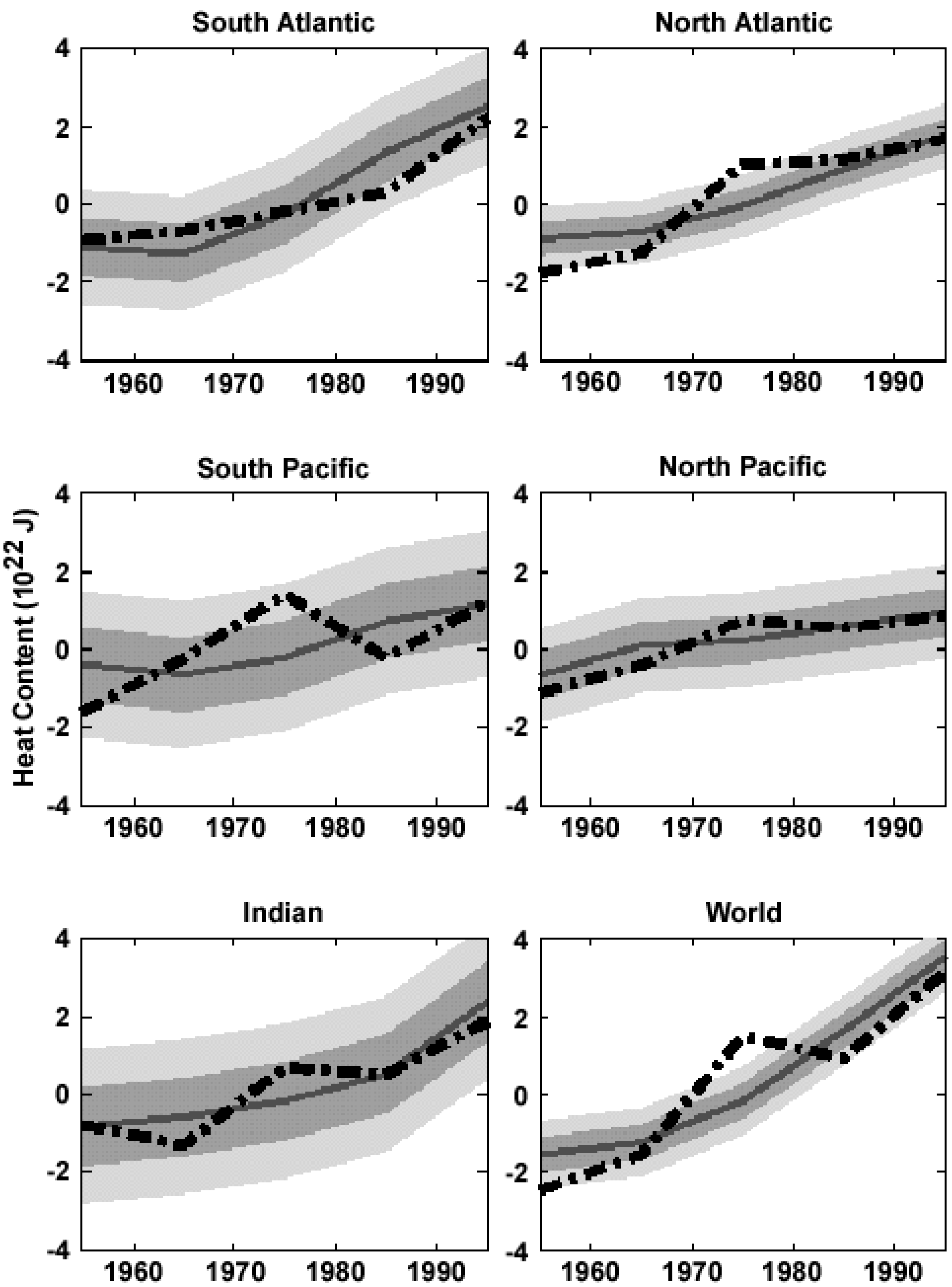


Figure 1. Modeled (shaded region) vs. observed (dotted line) oceanic heat content, averaged from the ocean surface down to 3000 meters, 1995 to 2000.

And now on to the fingerprint detection. In Figure 2, we reproduce the modeled and observed ocean temperatures at depth (down to 2,000 meters) over time. Do they match up? The answer depends of how far away you are from your computer screen right now. If you're looking at this graph with one eye shut from across the room, then you'd better sell your beach house now, because global warming is coming with a vengeance. But step up closer, and let's look at these data a little more carefully.

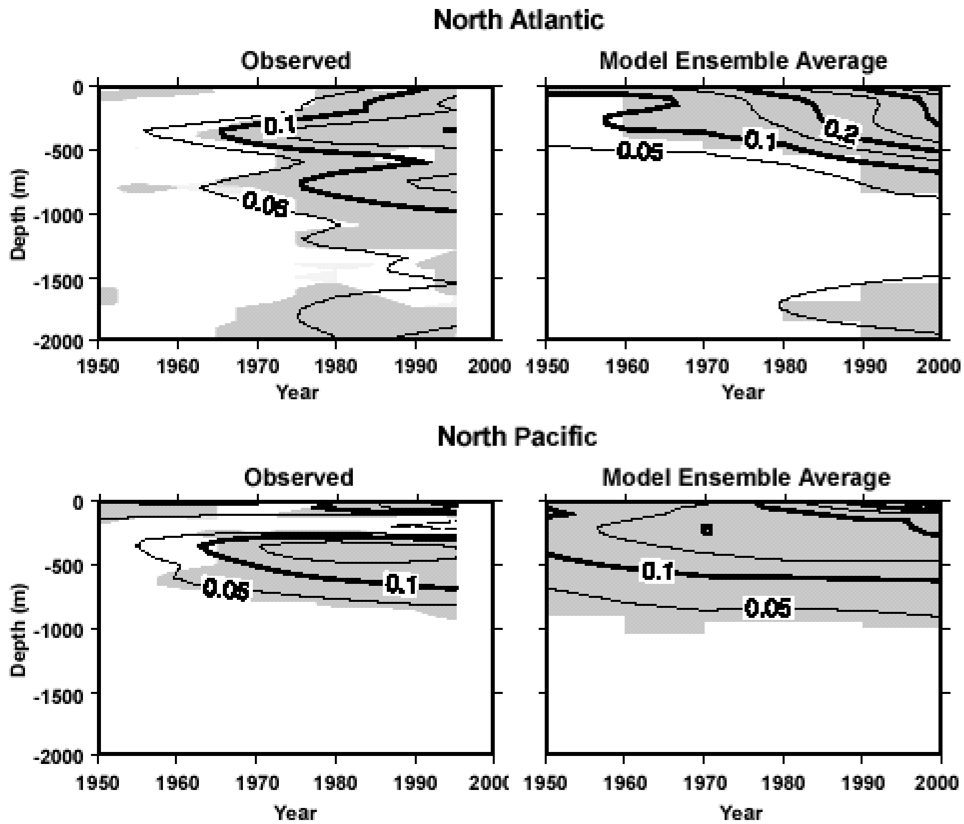


Figure 2. Modeled and observed ocean temperatures at depth (down to 2,000 meters) over time.

We plotted the observations and model predictions of temperature anomalies at depth at the end of the record (about 1995) for the North Atlantic and North Pacific Oceans (Figure 3). The model essentially produces a huge surface warming that weakens the deeper you go into the abyss. But yet again, nature seems to be operating under a different set of physics. That is one lousy forecast, especially at the surface. If, however, you want the temperature 2000 meters below the surface, where temperatures seem to be unaffected by greenhouse gases, then the model does a fantastic job.

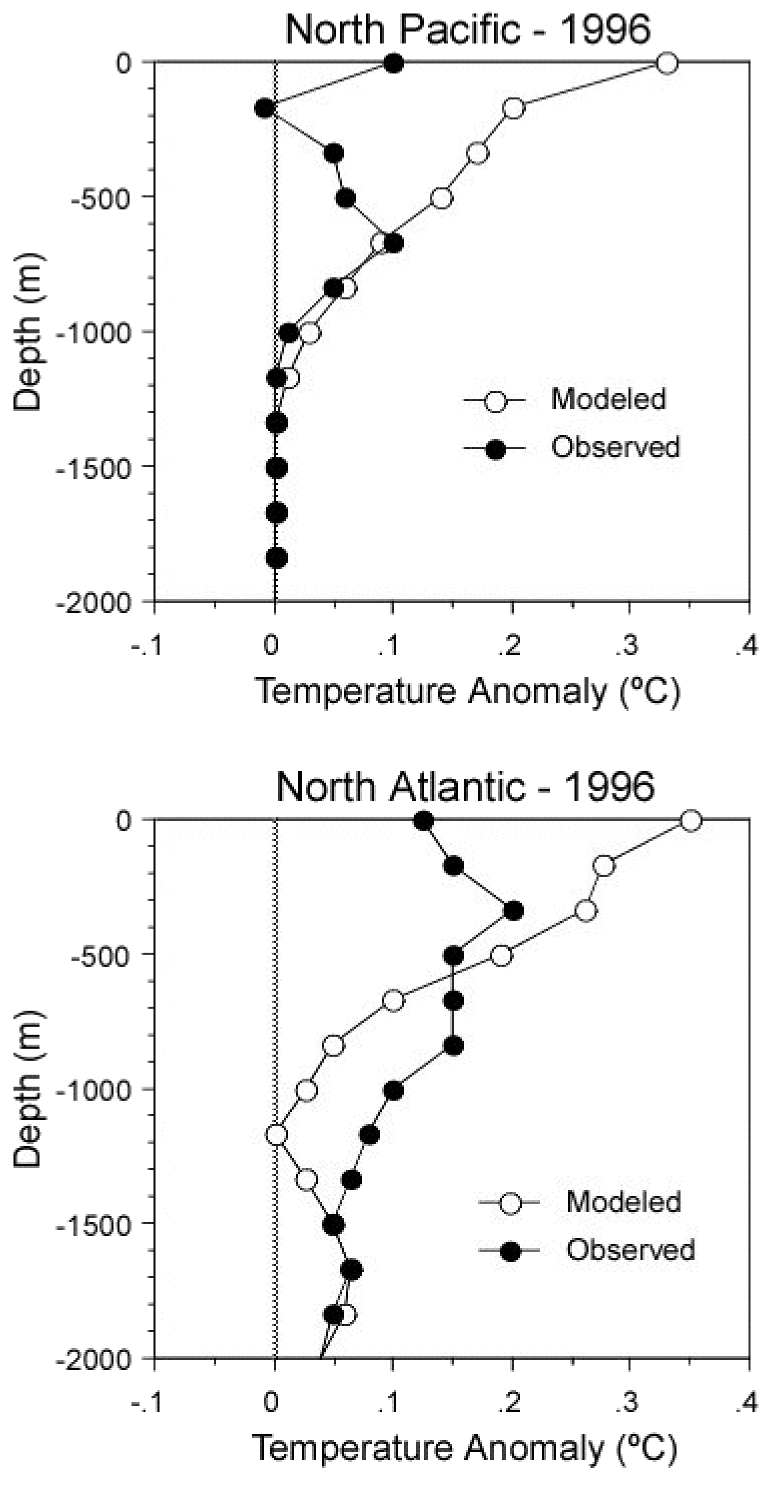


Figure 3. Modeled and observed temperature anomalies at depth (down to 2,000 meters) at the end of the record (about 1995) for the North Atlantic and North Pacific Oceans.

But wait a second. Look again at Figure 1. At the end of the record, the models and observations seem to match perfectly. How is that possible, given Figure 3? To demonstrate, quickly estimate the average of the following numbers:

0.35, 0.30, 0.25, 0.15, 0.10, 0.5, 0.3, 0.1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.

And now the following row:

0.12, 0.13, 0.2, 0.12, 0.12, 0.12, 0.1, 0.07, 0.06., 0.05, 0.05, 0.05, 0.04, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.

If you said the two averages were both pretty darned close to zero, you win a new slide rule! And that's also essentially what Figure 1 shows. In the top layers of the ocean, where all the temperature variations are taking place, the model does in fact do a lousy job. But since the averages are taken over a layer that extends down to 3000 meters, most of which includes no variation, then the model is now excellent because the important fluctuations are averaged out. (This situation is not unlike the unforgettable brouhaha over Benjamin Santer's claim that he first detected the human-induced greenhouse warming fingerprint in the atmosphere in 1996: The surface and lower atmosphere temperatures don't really match, but he used a statistic that depended heavily on strong cooling of the stratosphere for confirmation).

What we are seeing with the Barnett paper is more of the same. We have claims that a general circulation model can reproduce ocean temperatures when, in reality, it cannot. We have evidence of a human fingerprint in ocean temperature patterns that arises only when the data are substantially smoothed. And we have a press corps that's even more convinced of the certainty of significant human-induced global warming. In fact, however, evidence for the human global warming fingerprint remains elusive.

Reference

Barnett, T.P., D.W. Pierce, and R. Schnur, 2001. Detection of anthropogenic climate change in the world's oceans, *Science,* **292**, 270–274.

CASE 18: Thermal Hammer

by Jeff Id

Ok, today is the day that tAV, the repeatedly alleged EVIL denialist blog, lucky unwitting recipient of the biggest scientific scandal of the last hundred years, hosting the proprietor who has been snipped from every advocate website, who will now present a global gridded temperature from the RAW-ish GHCN data, having a higher trend than the believers will publish. However, it is to my knowledge a more correct representation of the actual data.

To perform this feat of magic, we'll use Roman's hammer, so popular it has been immortalized in a t-shirt.

Roman's hammer, is a simple method for the combination of temperature time series. Remember different thermometers can experience two primary effects. Offset of temperature due to altitude or proximity to water etc. and different levels of seasonal variance, proximity to water, dryness of air, etc.. The "hammer" method takes care of both seasonal variation and offsetting values to provide the best match between series. A second and independent improvement from Roman's recent work means that we no longer need to calculate anomaly in order to solve for global temperature trend.

The steps are simple.

- ✓ Load data.
- ✓ Sort temperature series into their own 5×5 gridcells 72lon by 36 lat.
- ✓ Create individual series from the GHCN inventory file by simple averaging of station ID's with multiple series representing the same instrument.
- ✓ Gather all series for each gridcell and hammer them together.
- ✓ Average NH an SH individually and combine — not sure if this makes sense but it copies HadCrut.

I've changed the renown "getstation" algorithm for this post, it has a new value called "version". Since multiple instruments which sometimes have the same WMO number are mixed in with multiple copies of the same instrument (How sloppy is that?!) they use an additional digit. Considering the crew, team or whatever, wants literally trillions of dollars to limit CO_2, they can certainly spend the small time required to document and record "actual" temperature stations by their own ID. In this post, the algorithm sorts out which stations are nearby vs same instrument. Multiple series are placed in columns and averaged using a row mean and placed in a single output timeseries.

I'll put the whole code at a different link but here is the getsinglestation function:
[view source]

```
getsinglestation=function(staid=60360, version=0)
{
   staraw=NA
   #raw data
   smask= (ghmean[,2]==staid)
   mask= ghmean[smask,3]==version
   data=ghmean[smask,][mask,
]
```

```
noser= levels(factor(data[,4]))

for(j in noser)
{
   mask2=data[,4]==j
   startyear=min(data[mask2,5])
   endyear=max(data[mask2,5])
   subd=data[mask2,6:17]
   index=(data[mask2,5]-startyear)+1
   dat=array(NA,dim=c(12,(endyear-startyear)+1))
   for(k in 1:length(index))
   {
      dat[,index[k]]=as.numeric(subd[k,])
   }
   dim(dat)=c(length(dat),1)

   dat[dat==-9999]=NA
   dat=dat/10
   rawd=ts(dat,start=startyear,deltat=1/12)
   if(max(time(rawd))>=2011)
   {
      print ("error series")
      rawd=NA
   }

   if(!is.ts(staraw))
   {
      staraw=rawd
   }else{
      staraw=ts.union(staraw,rawd)
   }
}
if(!is.null(ncol(staraw)))
{
   allraw=ts(rowMeans(staraw,na.rm=TRUE),start=time(staraw)[1],freq=12)
}else{
   allraw=staraw
```

```
  }

  allraw
}
```

The main loop of the software is worth discussing a bit. In the code below tinv is the inventory values for each temp station It contains lat, lon, and a variety of station metadata. Before the loop, an array is created to which gridded cell each station is assigned to.
view source

```
##assign stations to gridcells
gridval=array(NA,dim=c(stationnum,2))
gridval[,1]=as.integer((tinv[,5]+90)/5)+1  #lat
gridval[,2]=as.integer((tinv[,6]+180)/5)+1  #lon
```

Over the last couple of months, the algorithm keeps getting simpler, which of course makes the engineer in me happier with each revision.   It starts where “ii” is gridded longitude in 5 degree increments and “jj” is latitude also each 5 degrees.

I’ve added a number of comments to the code for this post. view source

```
gridtem=array(NA,dim=c(36,72,211*12))

for(ii in 1:72)
{
  for(jj in 1:36)
  {
    maska=gridval[,2]==ii  #mask all stations where longitude doesn't match
    maskb=gridval[,1]==jj  #mask all stations where latitude doesn't match
    maskc= maska & maskb   #combine lon and lat masks to get all stations where both match
    sta=NA                ##initialize to non TS
    for(i in (1:stationnum)[maskc])
    {
      rawsta = getsinglestation(tinv[i,2],tinv[i,3])

      if(!is.ts(sta)) #add stations to multicolumn timeseries
      {
        sta=rawsta          #first station
      }else{
```

```
            ts.union(sta,rawsta)  #other columns
        }
      }

      if(is.ts(sta))          #if at least one time series exists
      {

        sta=window(sta,start=1800)                #trim any pre-1800 data
        index=as.integer((((time(sta)-1800)*12+.002)+1)  #calculate time index for insertion into array
        if(!is.null(ncol(sta)))                     #is station more than one column
        {
          gridtem[jj,ii,index]=temp.combine(sta)$temps    #more than one column, use Roman's algorithm
        }else{
            gridtem[jj,ii,index]=sta                      #a single column, just assign the data
        }
        print(jj)                                #progress debug
        tit=paste("ii=",ii,"jj=",jj)
        plot(ts(gridtem[jj,ii,],start=1800,freq=12),main=tit)   #debug plot
      }
   }
   print ("COLUMN")       #progress debug
   print(ii)       #progress debug
}
```

That's it. Pretty simple, just gather it into gridcells and if there is more than one temp station per gridcell, use the Roman Hammer to smack them into place. Ok Jeff, we've waited for two weeks, enough scribbling of nonsense, what are the results.

Remember Roman's temperature combinations allow different offsets for linear trend by month, yet a single trend for the whole dataset. The offsets are required to align anomalies with each other and represent a substantial improvement over typical global instrumental temperature series.

The algorithm above is called with the following lines. view source

```
rgl=gridtem                               #move gridded temperature to different variable
dim(rgl)=c(36*72,2532)                    #restructure grid into 36*72 individual series
rgl=t(rgl)                                #transform rows and columns so each year is a row
```

```
rgl=ts(rgl,start=1800,deltat=1/12)                    #make time series
mask=!is.na(colMeans(rgl,na.rm=TRUE))                 #create mask for empty columns (empty gridcells)
wt=rep(weight,72)                                     #apply area weighting to gridcells
maskb=array(FALSE,dim=c(36,72))
maskb[1:18,]=TRUE                                     #create mask by hemisphere
dim(maskb)=(36*72)
maskc=mask & maskb                                    #combine hemisphere mask with empty gridcell mask
nh=temp.combine(rgl[,maskc],wt[maskc])$temps          #use Roman's method to combine all gridcell series in the hemisphere
maskc=mask & !maskb                                   #invert hemisphere mask and redo for sh
sh=temp.combine(rgl[,maskc],wt[maskc])$temps

glt=(nh+sh)/2                                         #take global average
```

It's pretty sweet how simple things are getting. There is of course still the possibility (an in my case probability) of error but as the code has been gone over again and again, the differences created by any mistakes are becoming small.
Northern hemisphere trend.

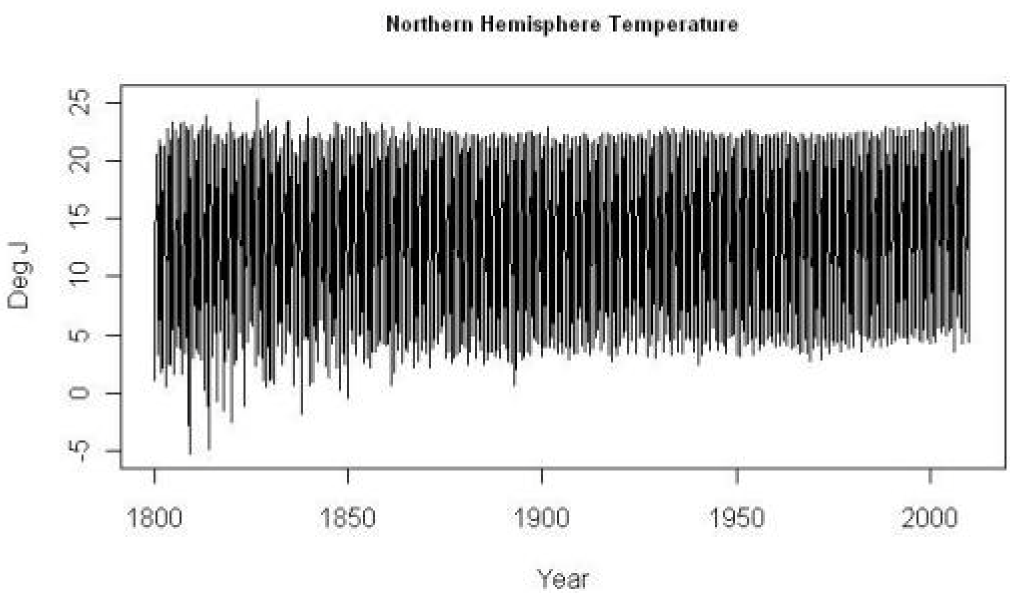


Figure 1 – Northern hemisphere temperatures.

I bet you've never seen a semi-global temperature plot that looks like that! It happens to be in Degrees J, which have equal increments to degrees C but the true value has some offset. Think of it as Degrees C, except that nobody knows where zero really is.
The Southern hemisphere is in Figure 2.

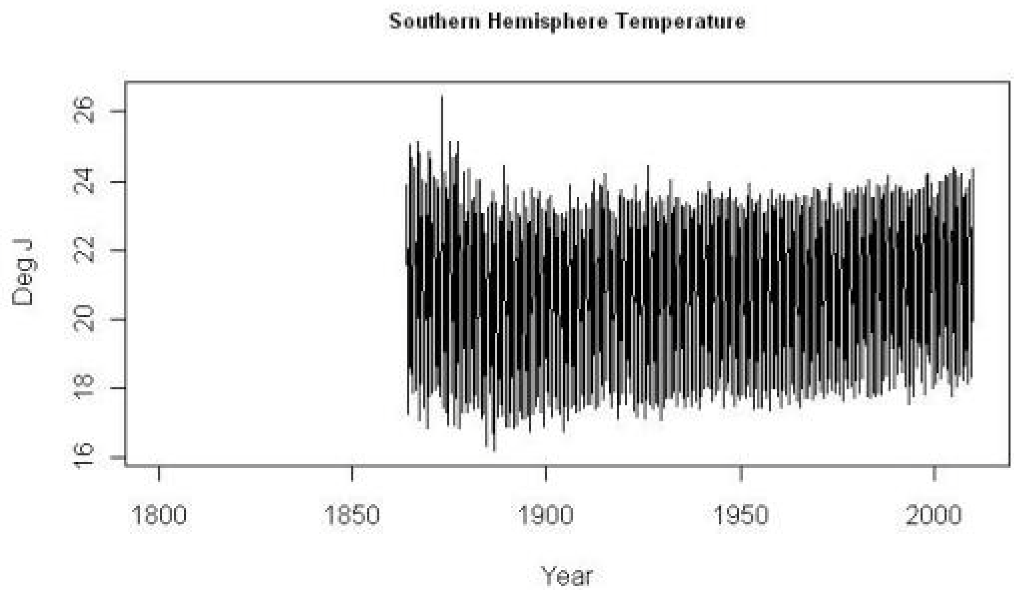


Figure 2 – Southern hemisphere temperatures.

Pretty unique looking. It's a simple matter to combine the two series, yup I used the hammer again. [view source](#)

```
1 glt=temp.combine(un)$temps
```

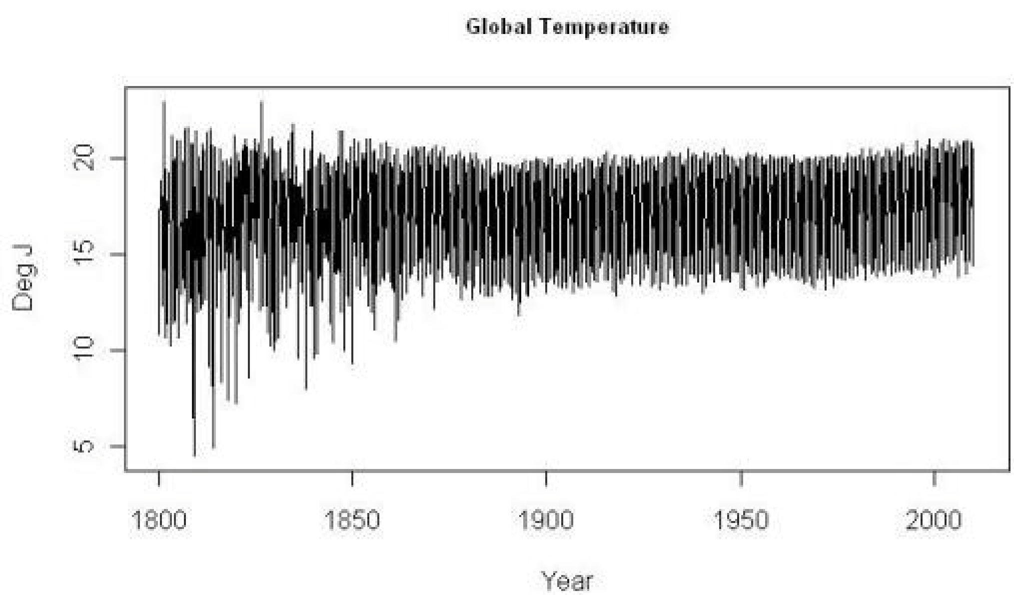


Figure 3 – Global temperatures.

Ok, so that told us nothing, except that we've now been able to calculate global temperature in degrees J. The variation in actual value seems fairly small.

Trend is what we care about though.

Using Roman's true anomaly methods, I get the following plot.

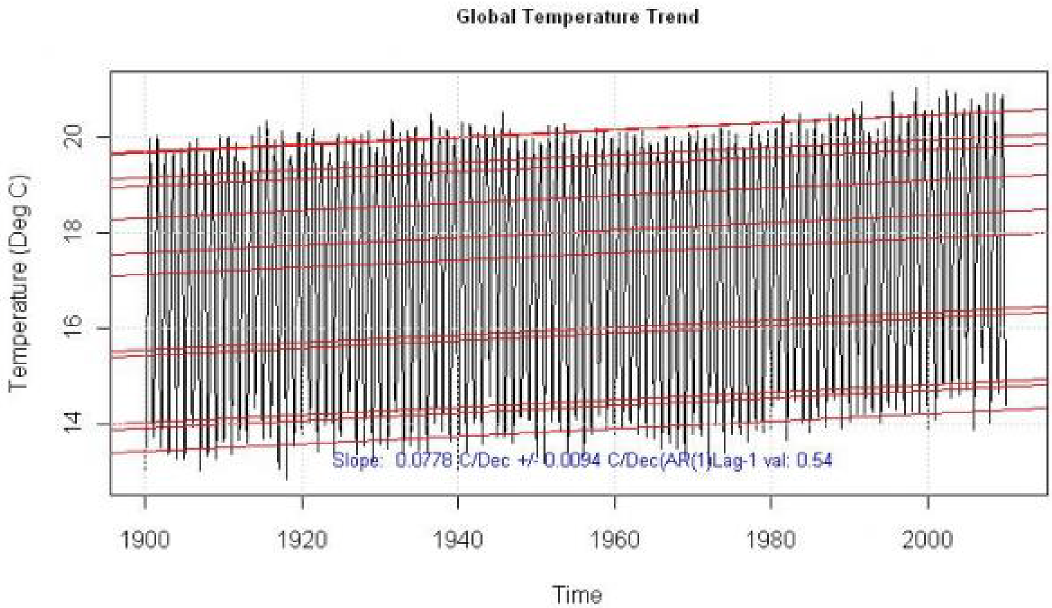


Figure 4 – Global temperature trend with true slope.

This method really is different from the less accurate yet standard anomaly trend of climate science. Globally, 0.079 C/Decade since 1900. Of course this is just GHCN data, so the trend could be created by UHI and such.

Below is a corrected anomaly trend.

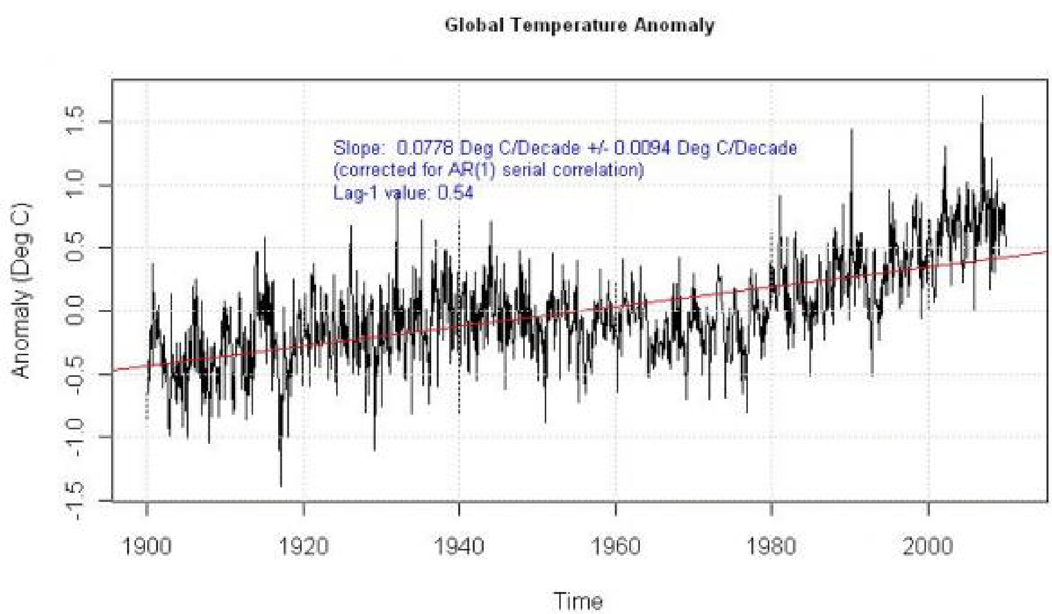


Figure 4 – Global temperature trend by anomaly.

Below that is the same plot as Fig 4 with HadCrut overlaid. The anomaly for this post is calculated using my adaptation of Roman's trend for anomaly calculation.

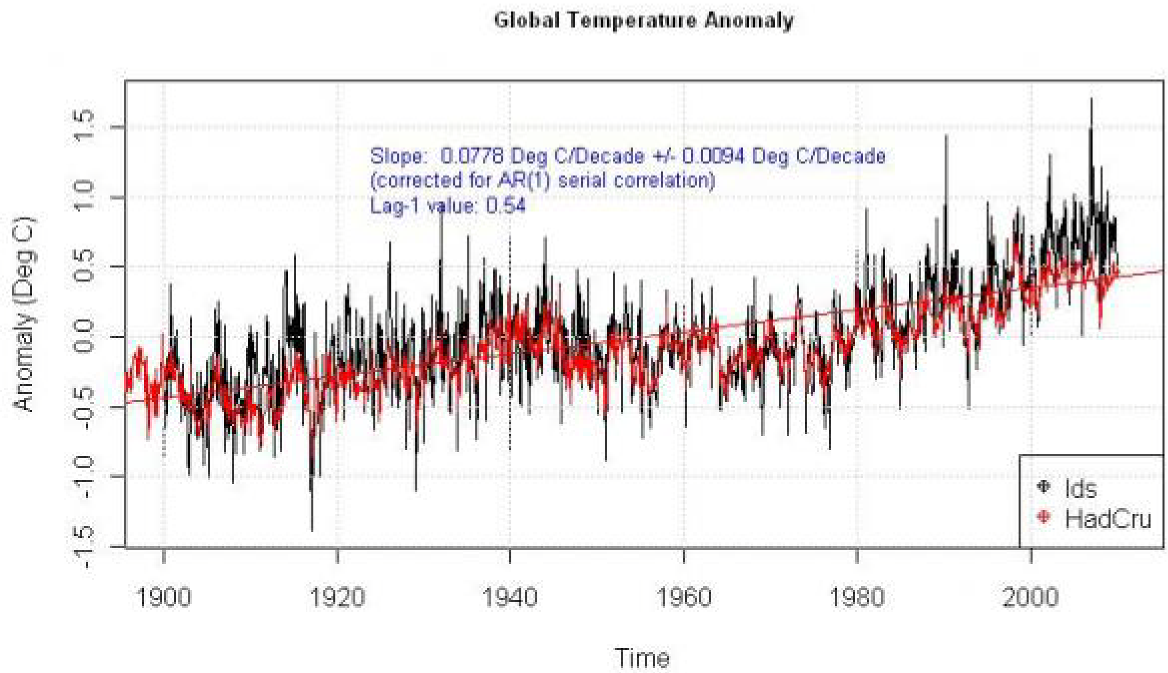


Figure 5 – Global temperatures plus HadCrut.

Now look at that match. CRU has slightly too low a historic value WRT GHCN 1935 and before, but in the alleged anthropogenic global warming era, GHCN has a much higher trend. I call it Id's but it's really primarily Roman's work which has been shaped into this post. There are better methods for area combination than gridded and we should play with those in time, but there is a lot of information in the above graph. As a last minute add on, Bob Tisdale has a post which is a fantastic match to this result.

First the obvious, a skeptic, denialist, anti-science blog published a greater trend than Phil Climategate Jones. What IS up with that?

From climategate, we learned that Phil flinched away from review of at least one technical math oriented paper. My own guess is that he just hadn't considered an offset method for aligning anomalies just hoping the steps would come out in the wash. In reality, when there is an upslope in the true signal, the steps created from starting and stopping of *anomaly* temperature series, always reduce the trend.

We discussed that in this post Anomaly Aversion.

The hemispheres tell an interesting story.

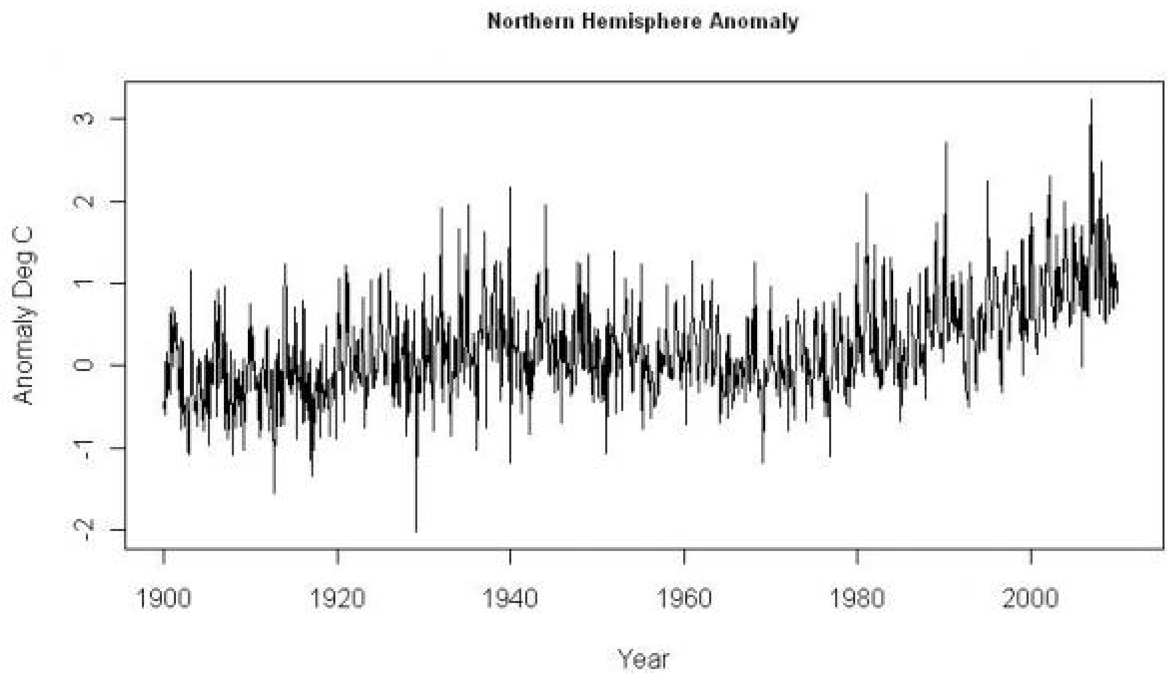


Figure 6 – Northern hemisphere temp anomaly.

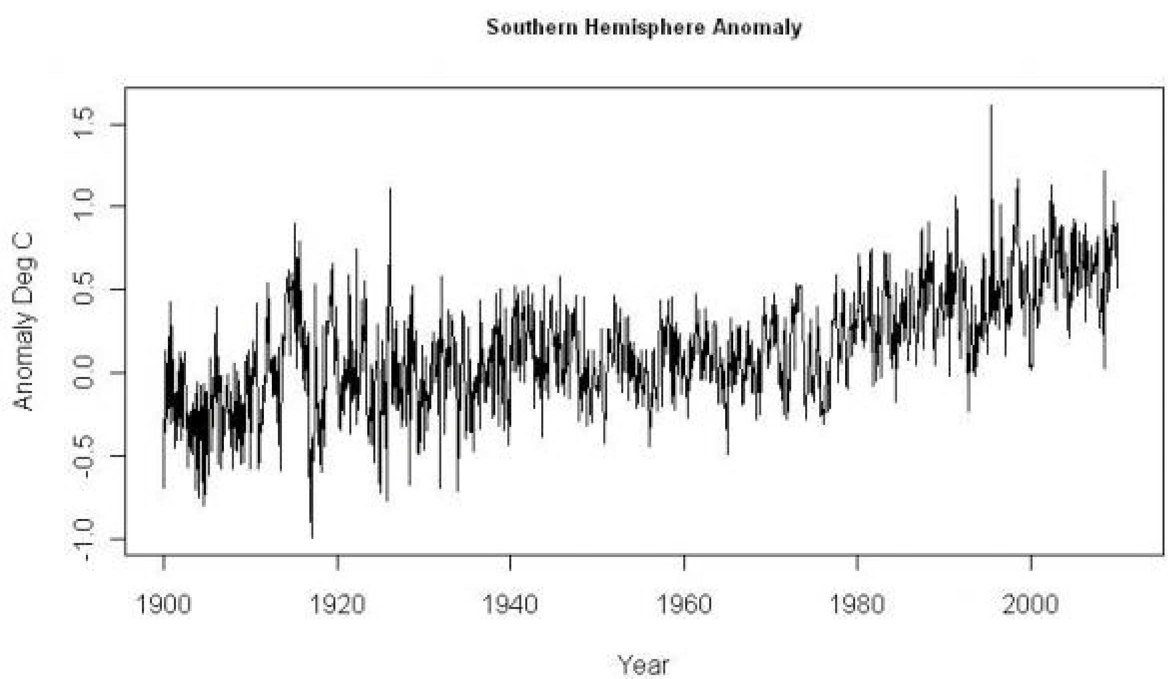


Figure 6 – Southern hemisphere temperature anomaly.

Check out the difference between the two hemispheres of GHCN.

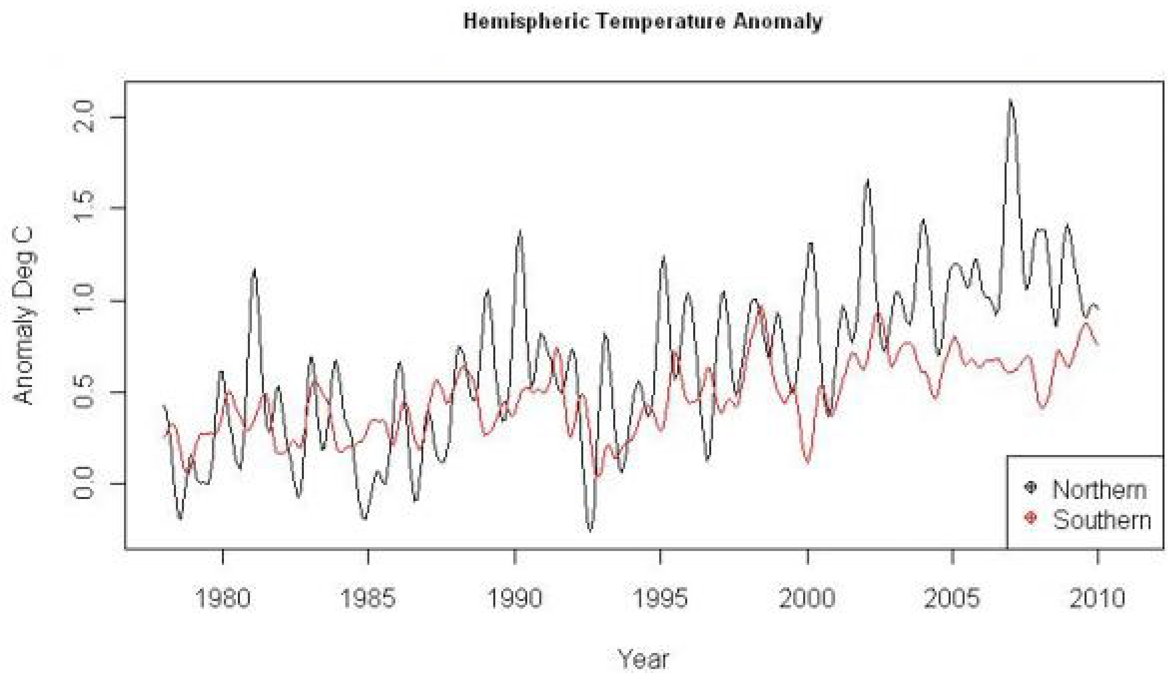


Figure 7 – Both hemispheres. Filtered 11 year Gaussian.

Note the delta in the most recent data.

There are a lot of details in this next plot which others may not see. Many of you are more experienced and knowledgeable with respect to temp trend than I, but running the algorithm makes a difference in understanding the quality of the data. Visually, as each dataset is plotted by anomaly, I see a general upslope in most data. There are plenty of blue series which go against the trend though, which brings the question of data quality into focus.

Below is a global plot since 1978. The deep red points are gridcells with such unreasonable temperature trends that they cannot be accepted. There are far more deep red than deep blue. So far though, this algorithm is still a bit of a black box beast. I've not explored the reasons for individual extremes in gridcells and we are looking for small temp trends.

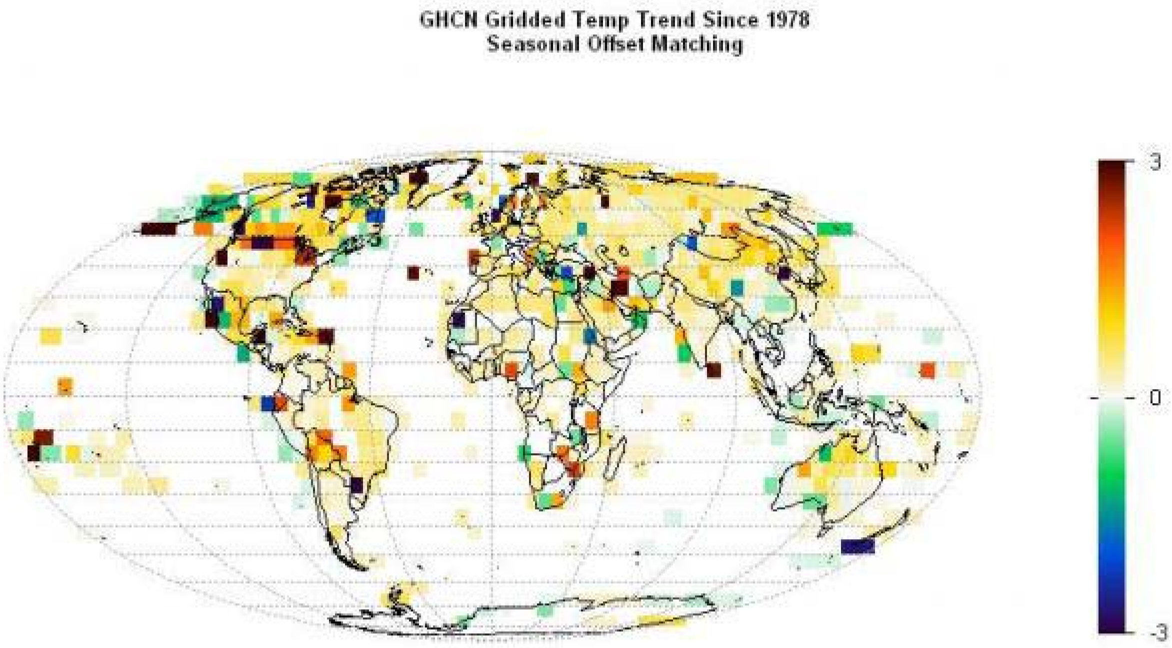


Figure 8 – Temperature trends since 1978.

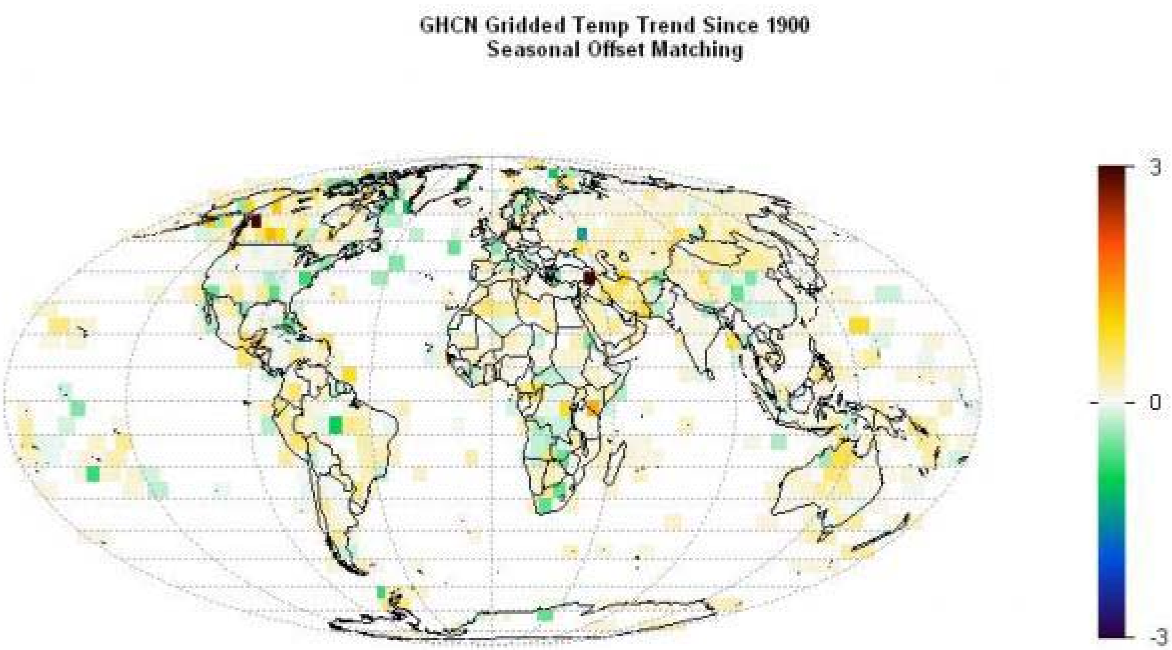


Figure 9 – Temperature since 1900.

This post has been worked on for literally weeks, I've looked at so many plots my head spins. There is a lot of unwritten detail here. Consider the amazing evenness in Russian temp stations. Enough so that it will be difficult to ever question Siberia as was done prior to climategate.

There are high trends from GHCN, so high in fact that anyone who questions Phil Climategate Jones temp trends will need to show some evidence. Certainly Phil is an ass, but it no longer seems to me that he has 'directly' exaggerated temp trends one bit. Also, the elimination of temp stations has certainly reduced the quality of data, however, despite E.M. Smiths work, we don't know which way the bias runs. We need the actual data for that.

Several skeptics will dislike this post. They are wrong, in my humble opinion. While winning the public "policy" battle outright, places pressure for a simple unified message, the data is the data and the math is the math. We're stuck with it, and this result. In my opinion, it is a better method. Remember though, nothing in this post discusses the quality of the raw data. I've got a lot of information on data quality, for the coming days. In the meantime, consider what would cause such a huge difference in trend between the northern and southern hemispheres.

Anyway, the global temp trend, from this data since 1978 is:

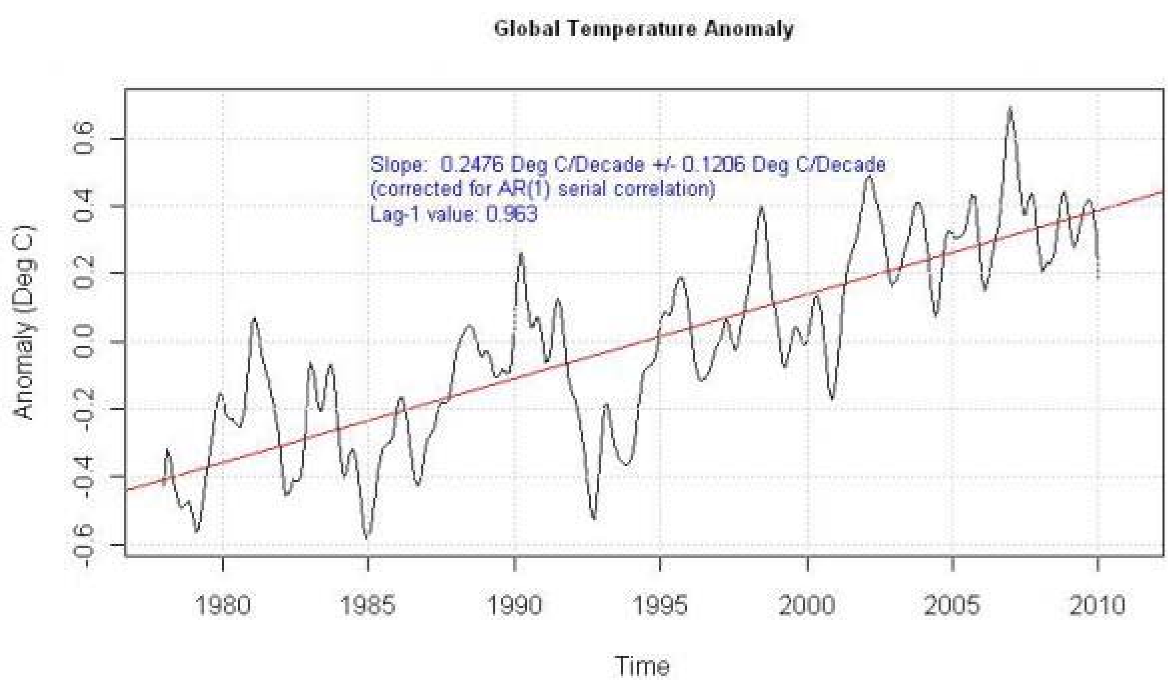


Figure 10 – Global temperatures as calculated from GHCN.

CASE 19: GISSCAPADES

by Willis Eschenbach

Inspired by this thread on the lack of data in the Arctic Ocean, I looked into how GISS creates data when there is no data.

GISS is the Goddard Institute for Space Studies, a part of NASA. The Director of GISS is Dr. James Hansen. Dr. Hansen is an impartial scientist who thinks people who don't believe in his apocalyptic visions of the future should be put on trial for "high crimes against humanity". GISS produces a surface temperature record called GISTEMP. Here is their record of the temperature anomaly for Dec-Jan-Feb 2010 :

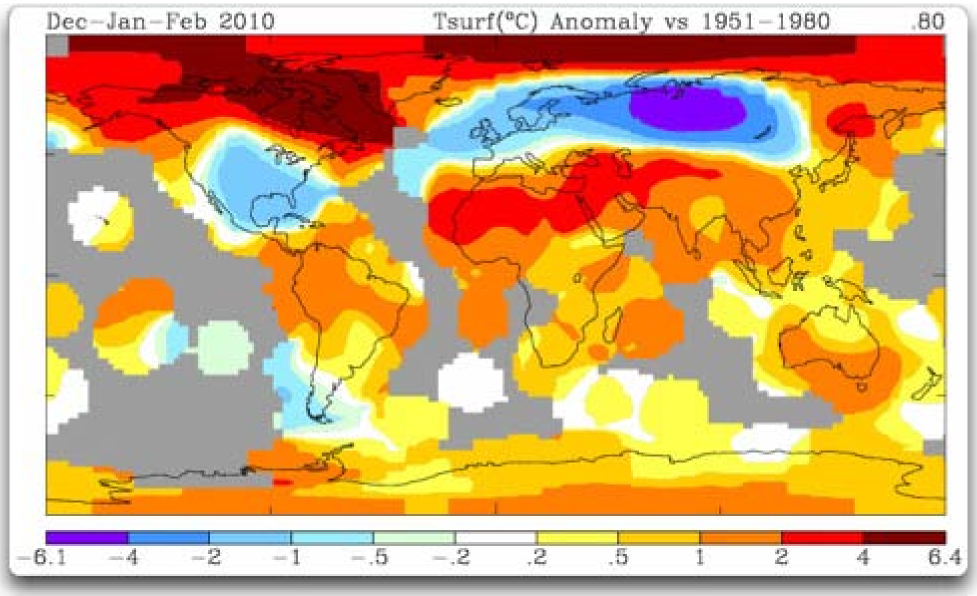


Figure 1. *GISS temperature anomalies DJF 2010. Grey areas are where there is no temperature data.*

Now, what's wrong with this picture?

The oddity about the picture is that we are given temperature data where none exists. We have very little temperature data for the Arctic Ocean, for example. Yet the GISS map shows radical heating in the Arctic Ocean. How do they do that?

The procedure is one that is laid out in a 1987 paper by Hansen and Lebedeff In that paper, they note that annual temperature changes are well correlated over a large distance, out to 1200 kilometres (~750 miles).

("Correlation" is a mathematical measure of the similarity of two datasets. It's value ranges from zero, meaning not similar at all, to plus or minus one, indicating totally similar. A negative value means they are similar, but when one goes up the other goes down.)

Based on Hansen and Lebedeff's finding of a good correlation (+0.5 or greater) out to 1200 km from a given temperature station, GISS show us the presumed temperature trends within 1200 km of the coastline stations and 1200 km of the island stations. Areas outside of this are shown in gray. This 1200 km. radius allows them to show the "temperature trend" of the entire Arctic Ocean, as shown in Figure 1. This gets around the problem of the very poor coverage in the Arctic Ocean. Here is a small part of the problem, the coverage of the section of the Arctic Ocean north of 80° North:

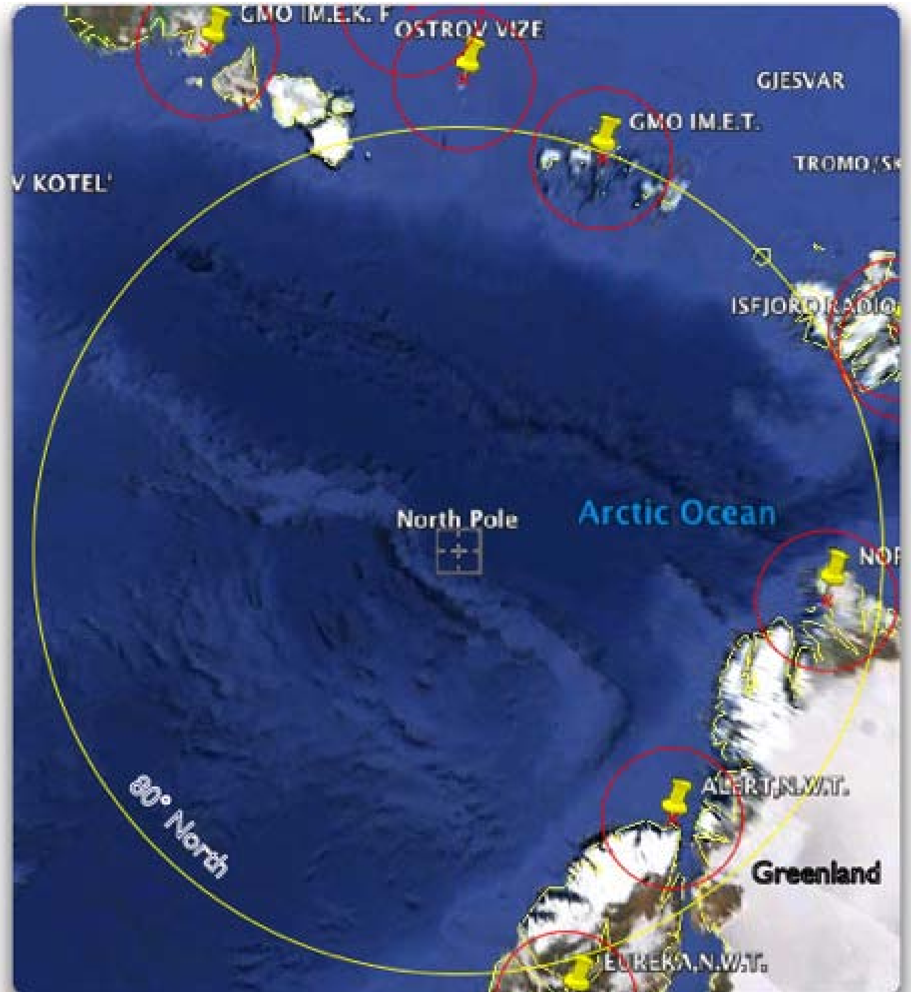


Figure 2. *Temperature stations around 80° north. Circles around the stations are 250 km (~ 150 miles) in diameter. Note that the circle at 80°N is about 1200 km in radius, the size out to which Hansen says we can extrapolate temperature trends.*

Can we really assume that a single station could be representative of such a large area? Look at Fig.1, despite the lack of data, trends are given for all of the Arctic Ocean. Here is a bigger view, showing the entire Arctic Ocean.

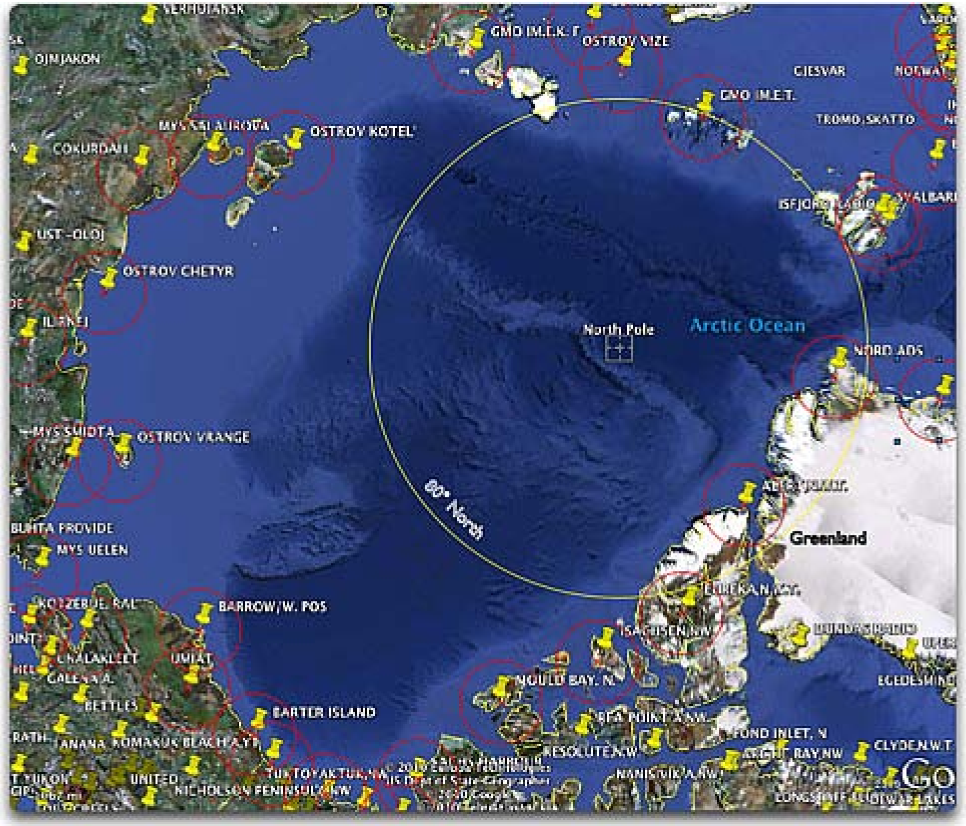


Figure 3. *Temperature stations around the Arctic Ocean. Circles around the stations are 250 km (~ 150 miles) in diameter. Note that the area of the Arctic Ocean is about three times the area of the state of Alaska.*

What Drs. Hansen and Lebedeff didn't notice in 1987, and no one seems to have noticed since then, is that there is a big problem with their finding about the correlation of widely separated stations. This is shown by the following graph:

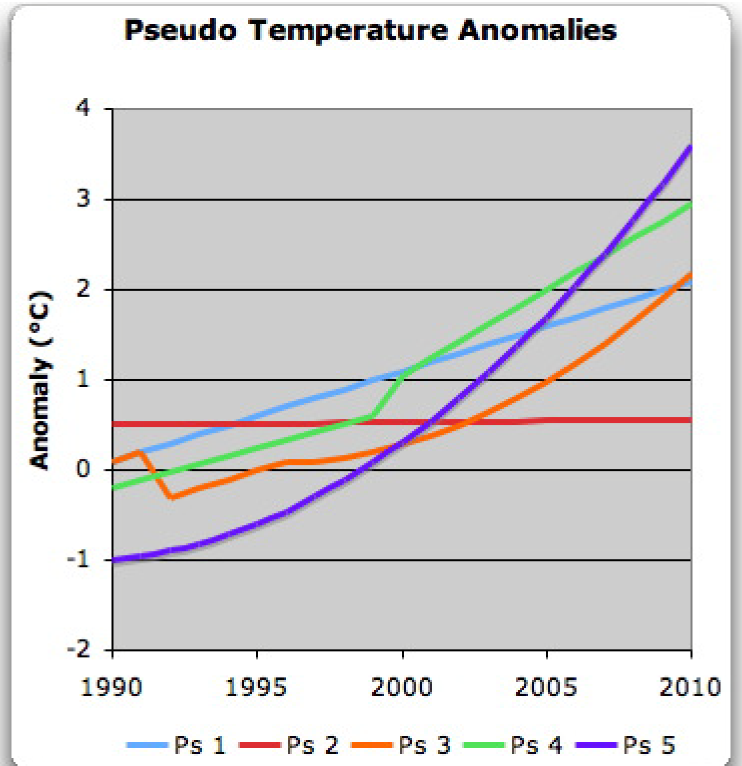


Figure 4. *Five pseudo temperature records. Note the differences in the shapes of the records, and the differences in the trends of the records.*

Curiously, these pseudo temperature records, despite their obvious differences, are all very similar in one way — correlation. The correlation between each pseudo temperature record and every other pseudo temperature records is above 90%.

Correlation of Pseudo Temperatures

	Year	*Ps 1*	*Ps 2*	*Ps 3*	*Ps 4*	*Ps 5*
Year	1					
Ps 1	1	1				
Ps 2	1	1	1			
Ps 3	0.91	0.91	0.91	1		
Ps 4	0.99	0.99	0.99	0.95	1	
Ps 5	0.97	0.97	0.97	0.98	0.99	1

Figure 5. *Correlation between the pseudo temperature datasets shown in Figure 3.*

The inescapable conclusion from this is that ***high correlations between datasets do not mean that their trends are similar.***

OK, I can hear you thinking, "Yea, right, for some imaginary short 20 year pseudo temperature datasets you can find some wild data that will have different trends. But what about real 50-year long temperature datasets like Hansen and Lebedeff used?"

Glad you asked … here are nineteen fifty-year long temperature datasets from Alaska. All of them have a correlation with Anchorage greater than 0.5 (max 0.94, min 0.51, avg .075). These are their trends:

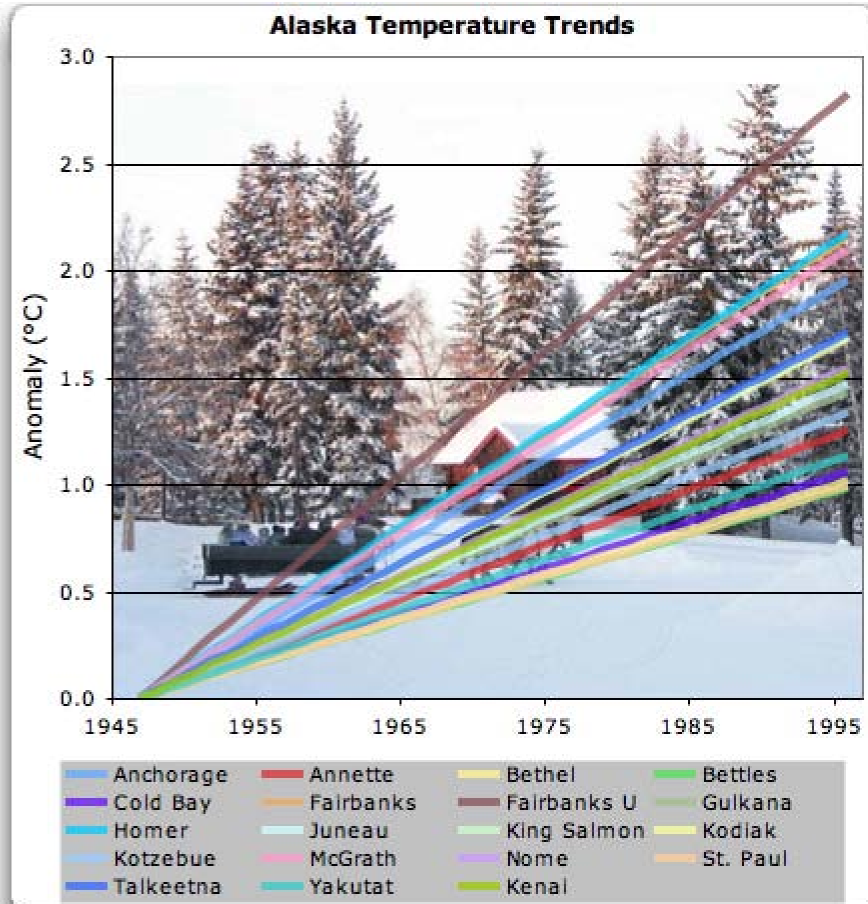


Figure 6. *Temperature trends of Alaskan stations. Photo is of Pioneer Park, Fairbanks.*

As you can see, the trends range from about one degree in fifty years to nearly three degrees in fifty years. Despite this huge ~ 300% range in trends, all of them have a good correlation (greater than +0.5) with Anchorage. This clearly shows that ***good correlation between temperature datasets means nothing about their corresponding trends.***

Finally, as far as I know, this extrapolation procedure is unique to James Hansen and GISTEMP. It is not used by the other creators of global or regional datasets, such as CRU, NCDC, or USHCN. As Kevin Trenberth stated in the CRU emails regarding the discrepancy between GISTEMP and the other datasets (emphasis mine):

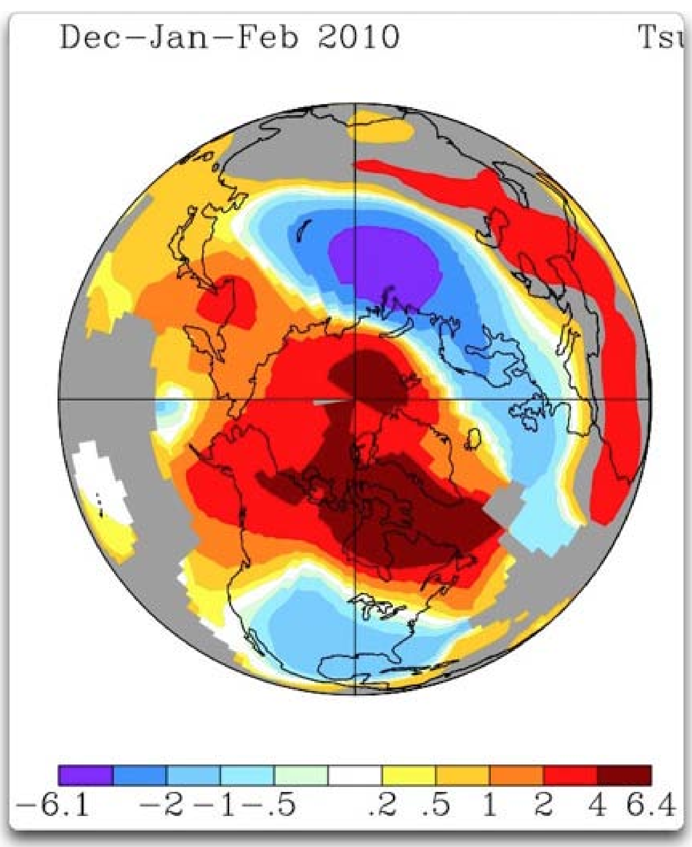
My understanding is that the biggest source of this discrepancy [between global temperature datasets] is the way the Arctic is analyzed. We know that the sea ice was at record low values, 22% lower than the previous low in 2005. Some sea temperatures and air temperatures were as much as 7C above normal. But most places there is no conventional data. In NASA [GISTEMP] they extrapolate and ***build in the high temperatures in the Arctic****. In the other records they do not. They use only the data available and the rest is missing.*

No data available? No problem, just build in some high temperatures …

Conclusion?

Hansen and Lebedeff were correct that the annual temperature datasets of widely separated temperature stations tend to be well correlated. However, they were incorrect in thinking that this applies to the trends of the well correlated temperature datasets. Their trends may not be similar at all. As a result, extrapolating trends out to 1200 km from a given temperature station is an invalid procedure which does not have any mathematical foundation.

[Update 1] Fred N. pointed out below that GISS shows a polar view of the same data. Note the claimed coverage of the entirety of the Arctic Ocean. Thanks.



CASE 20: A REVIEW OF THE UNITED STATES HISTORICAL CLIMATOLOGY NETWORK VERSION 2: ADJUSTED TEMPERATURE RECORD FOR PENNSYLVANIA, U.S.A.

by Jennifer M. Cohen, PhD.

ABSTRACT

This report compares the raw with the United States Historical Climatology Network Version 2 (USHCN V2) adjusted temperature records for the twenty-four USHCN listed temperature stations in the state of Pennsylvania. Averaging over the twenty-four stations the raw data yielded a small linear decline with temperatures trending -0.1 ± 0.1 °C/century, while the U.S. Historical Climatology Network (USCHN) Version 2 adjusted data revealed an increase of 0.7 ± 0.1 °C/century. Over the twelve year period 1998-2009 a drop in temperature was observed in both data sets with a raw trend of -0.75 ± 0.1 °C/decade and an adjusted trend of -0.65 ± 0.1 °C/decade.

INTRODUCTION

The USHCN Version 2 (USHCN V2) temperature record adjustment scheme is designed to "reduce uncertainty in temperature trends for the United States".[1] Raw data are subjected to checks for inconsistencies, such as a daily maximum that is lower than the minimum and errors or a temperature reading that is impossibly high or low.

"Time of observation" corrections are introduced which can change the overall temperature trend over time when compared to the raw record. Menne, et al estimate that this yields an increase in the maximum temperature trend of 0.15°C per century and an increase in the minimum trend of 0.22°C per century. Hence, we anticipate an average increase of about 0.185°C per century to be added to whatever trend is found in the average temperature[2] raw data. This is consistent with the USCHN Version 1 (USHCN V1) adjustment method.

An adjustment for updating from liquid in glass (LiG) to the current electronic thermometers results in a further rise in the temperature trend. Temperature stations were updated beginning in the early 1980s. Most were equipped with the electronic versions in the mid-80s, but 10% of the stations were updated after 1994.

Approximately 0.52°C is added to the raw maximum reading while 0.37°C is subtracted from the minimum to account for the electronic readings. Therefore, recent average temperatures are increased by about 0.075°C to account for the new equipment which is about 0.025°C higher than USHCN V1. We will consider temperature records from 1895 through 2009 and compute temperature trends over a century. This adjustment is expected to add something in the neighborhood of 0.075°C per century to whatever trend is seen in the raw data.

Menne, et al combine documented and undocumented changes made after the TOB adjustments in giving their changes to the temperature trends. Their estimate of raising the maximum temperature trend by 0.31°C per century, while leaving the minimum temperature trend unchanged, includes the LiG to electronic switchover. These combined changes serve to elevate the average temperature trend by about 0.155°C per century. Thus, roughly 0.08°C per century is added to the trend due to factors other than switching from LiG to electronic measurement.

Summarizing, we anticipate an upward shift in the average temperature trend of about 0.34°C per century. This includes the TOB adjustment increase of 0.185°C per century, an increase of 0.075°C per century during the LiG to electronic measurement switchover, and a 0.08°C per century increase for other documented and undocumented changes.

An important feature of this update involves dropping the Version 1 correction for the Urban Heat Island (UHI) effect in favor of an algorithm that detects undocumented change points.[3] This technique should spot sudden shifts such as undocumented station location and equipment changes. It is less clear how it detects the much slower change in the size of a population center.

The checks and adjustments leave the casual observer to wonder how the raw temperature trends compare with those of the final USHCN V2 product where they live. This survey addresses that question for the state of Pennsylvania.[4]

CALCULATIONS

The temperature records are those available through the online USHCN database.[5] Information for the twenty-four temperature stations has been entered into Table I. Their locations within Pennsylvania are shown in Fig. 1. Nine of the twenty-four stations had records that ended prior to February of 2010.

Data were converted from Fahrenheit to Celsius for this review. No changes were made in the data.

Linear least squares was employed to find the best straight line fit through the data. Our interest is not in the precise average temperature for a given year, but in the temperature trend or slope of the line.

Individual results for both the raw and USHCN V2 adjusted temperature records are plotted in Figs. 2-5 for the 24 stations. The temperature trends are labeled on each of the graphs. Color codes were assigned for the raw and adjusted trends to create the comparison maps of Fig. 6.

Averages of the trends were taken over the twenty-four stations. The raw and USHCN V2 adjusted temperature trends are depicted in Fig. 7. The raw temperature records show a decrease with temperatures trending at a rate of -0.1 ± 0.1 °C/century and the USHCN V2 records reveal an increase of 0.7 ± 0.1 °C/century.

Adjustments have resulted in an increase of about 0.8 °C/century. This was higher than the 0.34°C per century we had initially anticipated. Since the introduction of the electronic temperature stations likely took place prior to 1995, a second round of data analysis was initiated. This should eliminate or nearly eliminate the LiG to electronic thermometer correction in the temperature trend.

Consider the records for the years from 1998 to 2009, a period during which there may have been a temperature drop. We first eliminate the nine stations for which temperature records have ended (see Table I). Since there are a mere 12 years of data, the two stations that reported fewer than 10 annual averages (Eisenhower/Natl Hist Site reported 8 readings and West Chester 2 NW had 9 annual averages) were disregarded. The locations of the remaining temperature stations are shown in Fig. 8.

Linear regression was used to determine the best fit linear trend. The sampling error makes it impossible to detect the LiG to electronic thermometer 0.075°C uniform shift. However, in this case the temperature trend itself is of interest. During the 1998-2009 time period, a trend toward cooler temperatures was observed for stations in rural, small town, and urban locations as shown in the Fig. 8 plot.

CONCLUSIONS

In the state of Pennsylvania the raw temperature record reveals no significant change in temperature over the period from 1895 to 2009. The USHCN V2 adjusted temperature record shows an increase of less than a degree Celsius over those years. A cooling trend is observed in the raw and USHCN V2 records for the past 12 years.

In both the short and longer term cases the USHCN V2 adjusted data yielded trends that were roughly 1°C per century higher than those found in the raw temperature records.

---

1 M. J. Menne, C. N. Williams Jr., and R. S. Vose, 2009: The U.S. Historical Climatology Network Monthly Temperature Data, Version 2. *BAMS*, **70**, 993-1007. [http://www1.ncdc.noaa.gov/pub/data/ushcn/v2/monthly/menne-etal2009.pdf.]

2 The average daily temperature is the average of the maximum and minimum temperatures, $T_{ave} = (T_{max}+T_{min})/2$.

3 M. J. Menne and C. N. Williams Jr., 2009: Homogenization of Temperature Series via Pairwise Comparisons. *J. Climate*, **22**, 1700-1717. [http://www1.ncdc.noaa.gov/pub/data/ushcn/v2/monthly/menne-williams2009.pdf.]

4 With an area of 46,055 square miles (119,283 km^2) Pennsylvania covers less than a quarter of one-thousandth (2.3×10^{-4}) of the Earth's surface area of about 200,000,000 square miles (5.1×10^8 km^2) .

5 Data was downloaded from the National Climatic Data Center (NCDC) at the National Oceanic and Atmospheric Administration (NOAA) site. [http://www1.ncdc.noaa.gov/pub/data/ushcn/v2/monthly/].

Label	Station #	Lat. (°)	Long. (°)	Alt (m)	Name	Classification	Raw Record Final Month
A	360106	40.65	-75.45	119	ALLENTOWN LEHIGH VALLEY INTL A	URBAN	Current
B	361354	39.94	-77.64	195	CHAMBERSBURG 1 ESE	SMALL TOWN	10/2009
C	362537	39.81	-77.23	165	EISENHOWER/NATL HIST SITE	RURAL	Current
D	362682	42.08	-80.18	223	ERIE/WSO AP	URBAN	Current
E	363028	41.40	-79.83	302	FRANKLIN	RURAL	Current
F	363526	41.42	-80.37	345	GREENVILLE 2 NE	RURAL	1/1997
G	364385	40.33	-78.92	370	JOHNSTOWN	SMALL TOWN	7/1993
H	364896	40.33	-76.47	137	LEBANON 2 W	SMALL TOWN	Current
I	365915	41.87	-75.85	433	MONTROSE	[RURAL]	5/2009
J	366233	41.02	-80.36	252	NEW CASTLE 1 N	SMALL TOWN	10/2009
K	366689	40.80	-75.62	125	PALMERTON	RURAL	12/1997
L	367029	41.73	-75.45	548	PLEASANT MOUNT 1 W	[RURAL]	Current
M	367322	40.43	-75.93	110	READING 4 NNW	URBAN	3/2008
N	367477	41.42	-78.75	415	RIDGWAY	RURAL	Current
O	367931	40.78	-76.86	133	SELINSGROVE	RURAL	Current
P	368449	40.79	-77.87	357	STATE COLLEGE	SMALL TOWN	Current
Q	368596	41.01	-75.19	140	STROUDSBURG	RURAL	9/2009
R	368905	41.75	-76.44	229	TOWANDA 1 ESE	RURAL	Current
S	369050	39.92	-79.72	291	UNIONTOWN 1 NE	SMALL TOWN	11/2009
T	369298	41.85	-79.15	369	WARREN	SMALL TOWN	Current
U	369408	41.70	-77.39	554	WELLSBORO 4 SW	RURAL	Current
V	369464	39.97	-75.64	114	WEST CHESTER 2 NW	SMALL TOWN	Current
W	369728	41.24	-76.92	159	WILLIAMSPORT/WSO AP	SMALL TOWN	Current
X	369933	39.92	-76.75	119	YORK 3 SSW PUMP STN	SMALL TOWN	Current

Table I. Temperature station identification, location, and surroundings. Classifications in square brackets were determined from satellite images. The letter labels correspond to the map in Fig. 1.

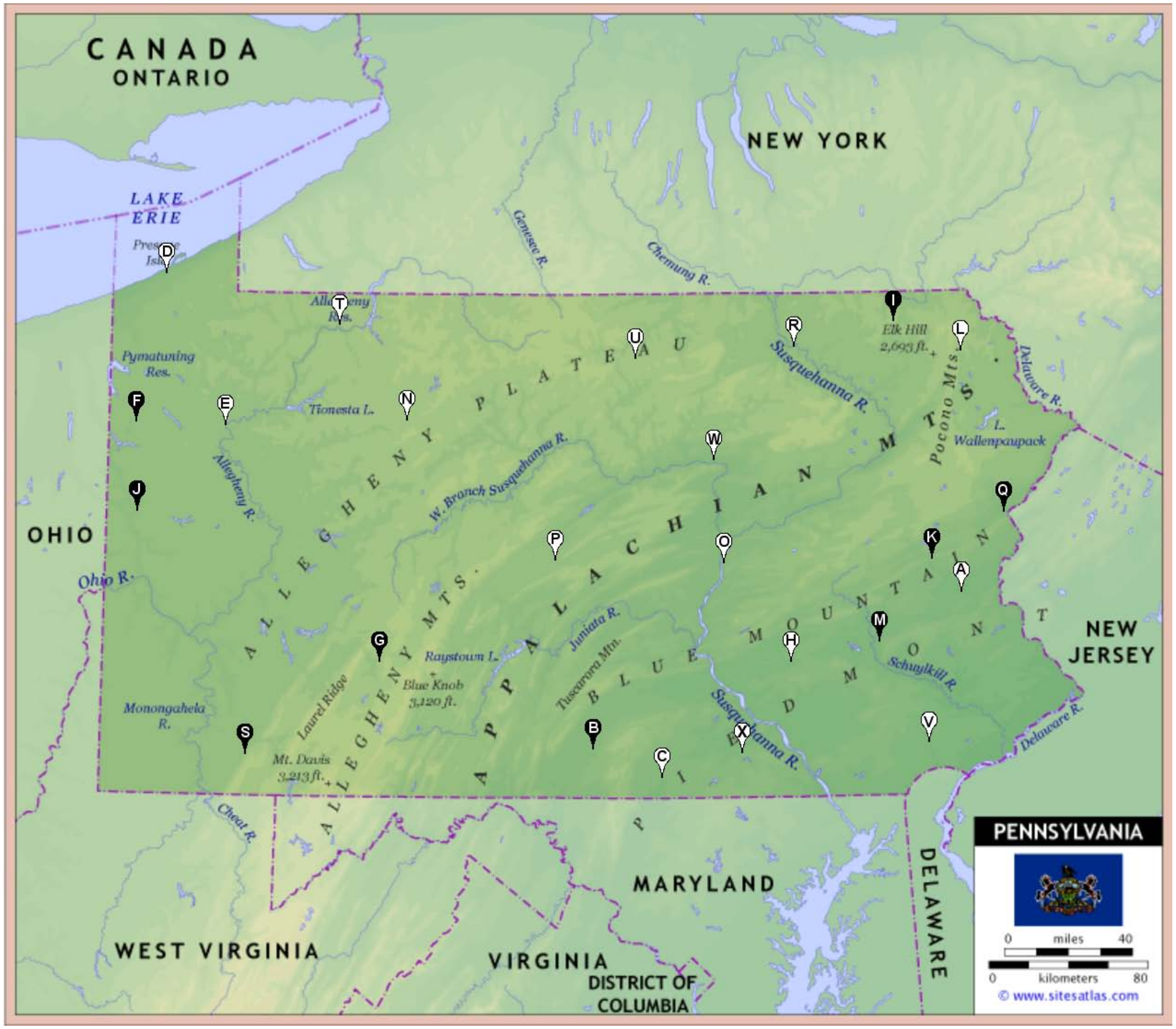


Fig. 1. Locations of the twenty-four temperature stations in Pennsylvania. Those stations that have current records are white with black labels, those whose records have lapsed are black with white labels. Letter labels are defined in Table I.

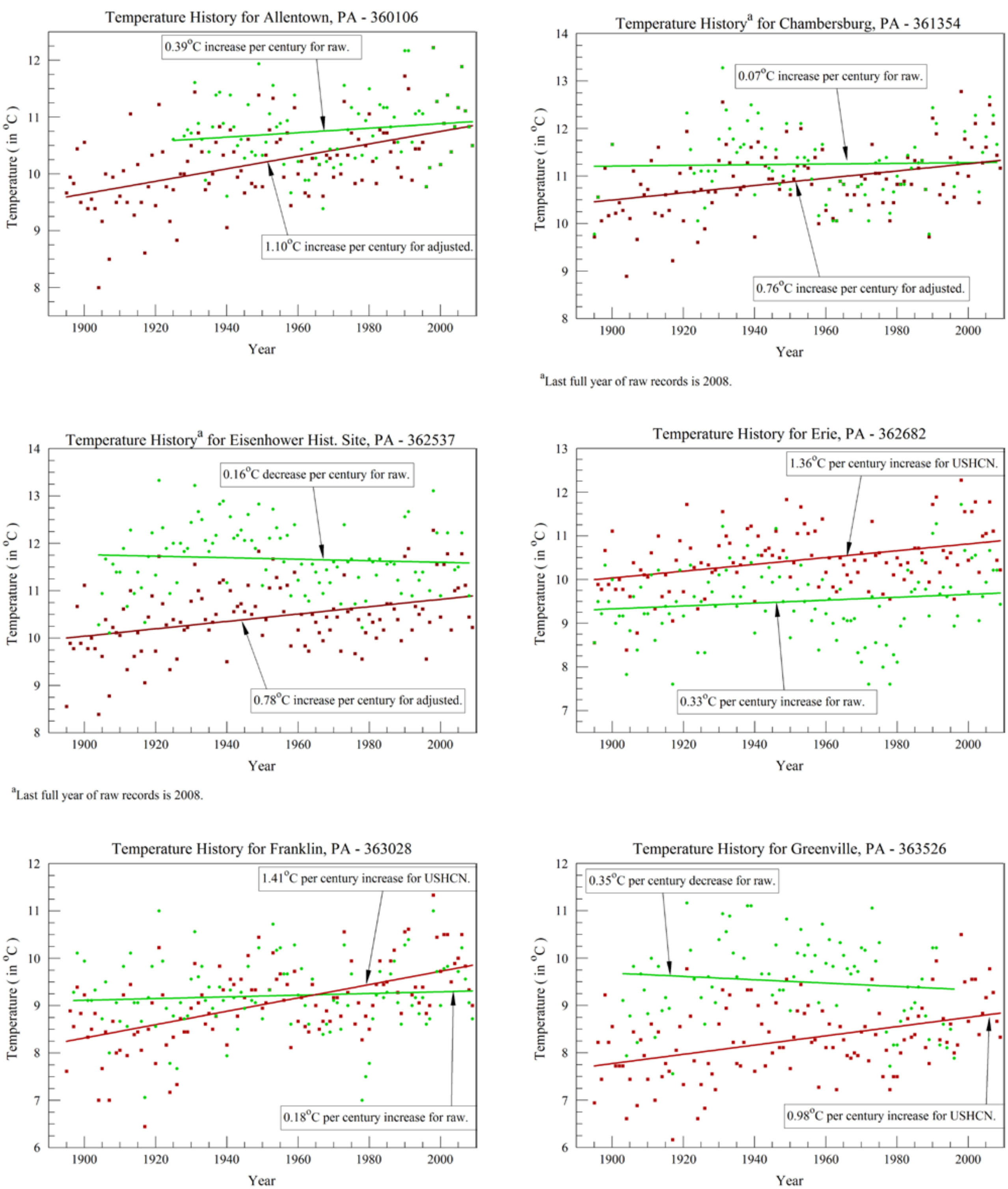


Fig. 2. Average yearly temperature in degrees Celsius versus year for stations A-F. Raw data points appear as green circles, USHCN V2 adjusted data are plotted as red squares. Linear averages for the raw and adjusted data are the green and red lines, respectively.

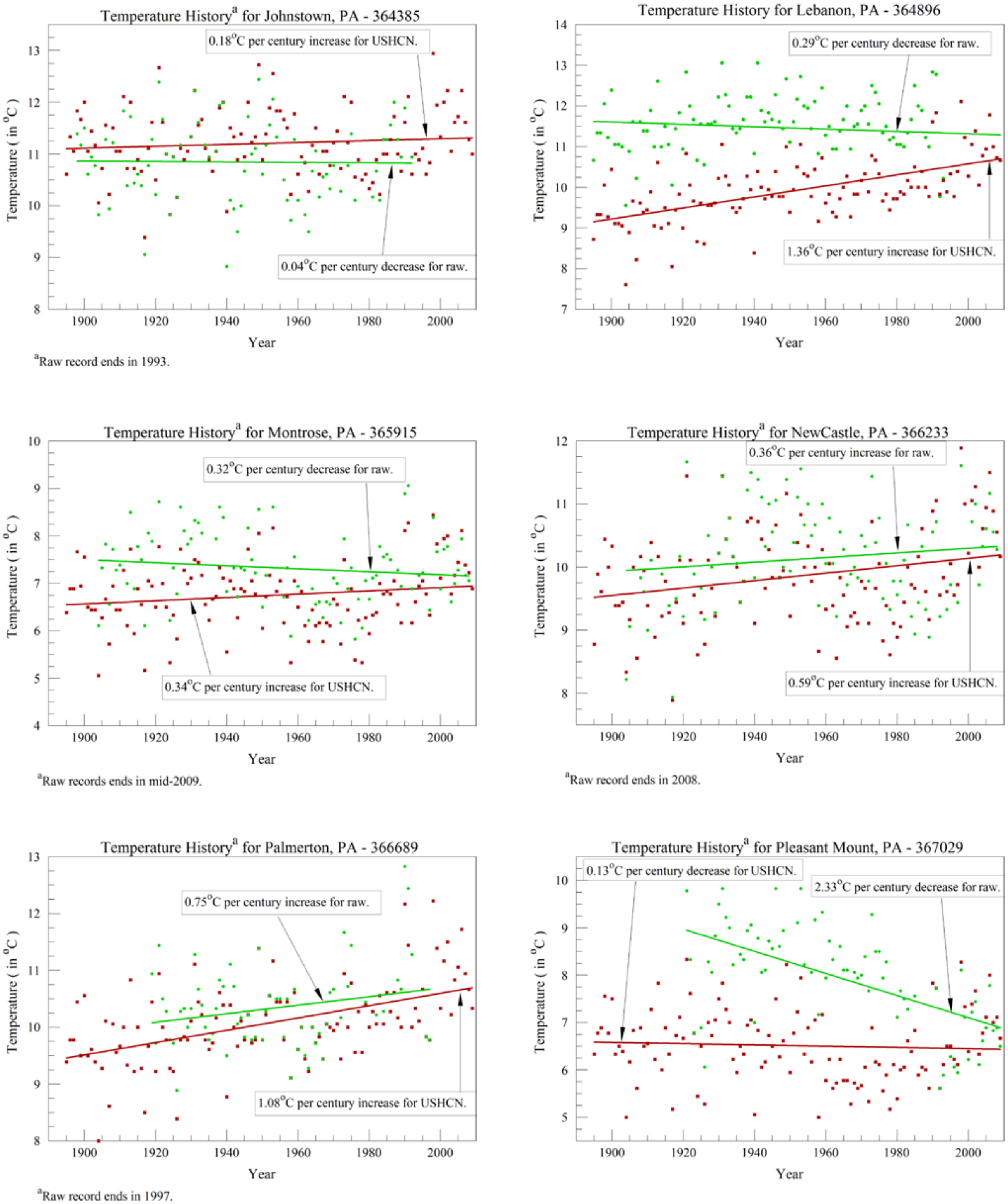


Fig.3. Average yearly temperature in degrees Celsius versus year for stations G-L. Raw data points appear as green circles, USHCN V2 adjusted data are plotted as red squares. Linear averages for the raw and adjusted data are the green and red lines, respectively.

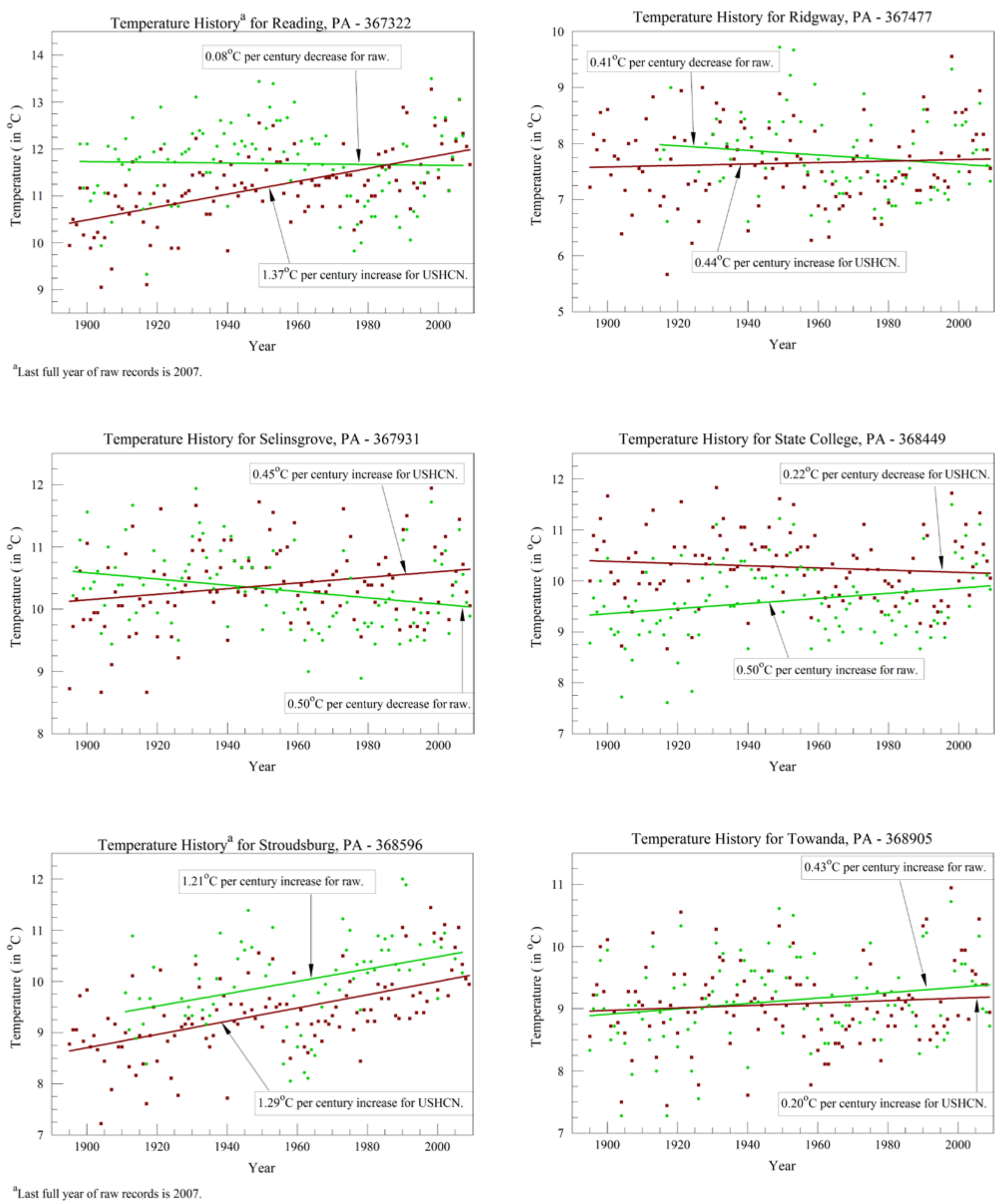


Fig. 4. Average yearly temperature in degrees Celsius versus year for stations M-R. Raw data points appear as green circles, USHCN V2 adjusted data are plotted as red squares. Linear averages for the raw and adjusted data are the green and red lines, respectively.

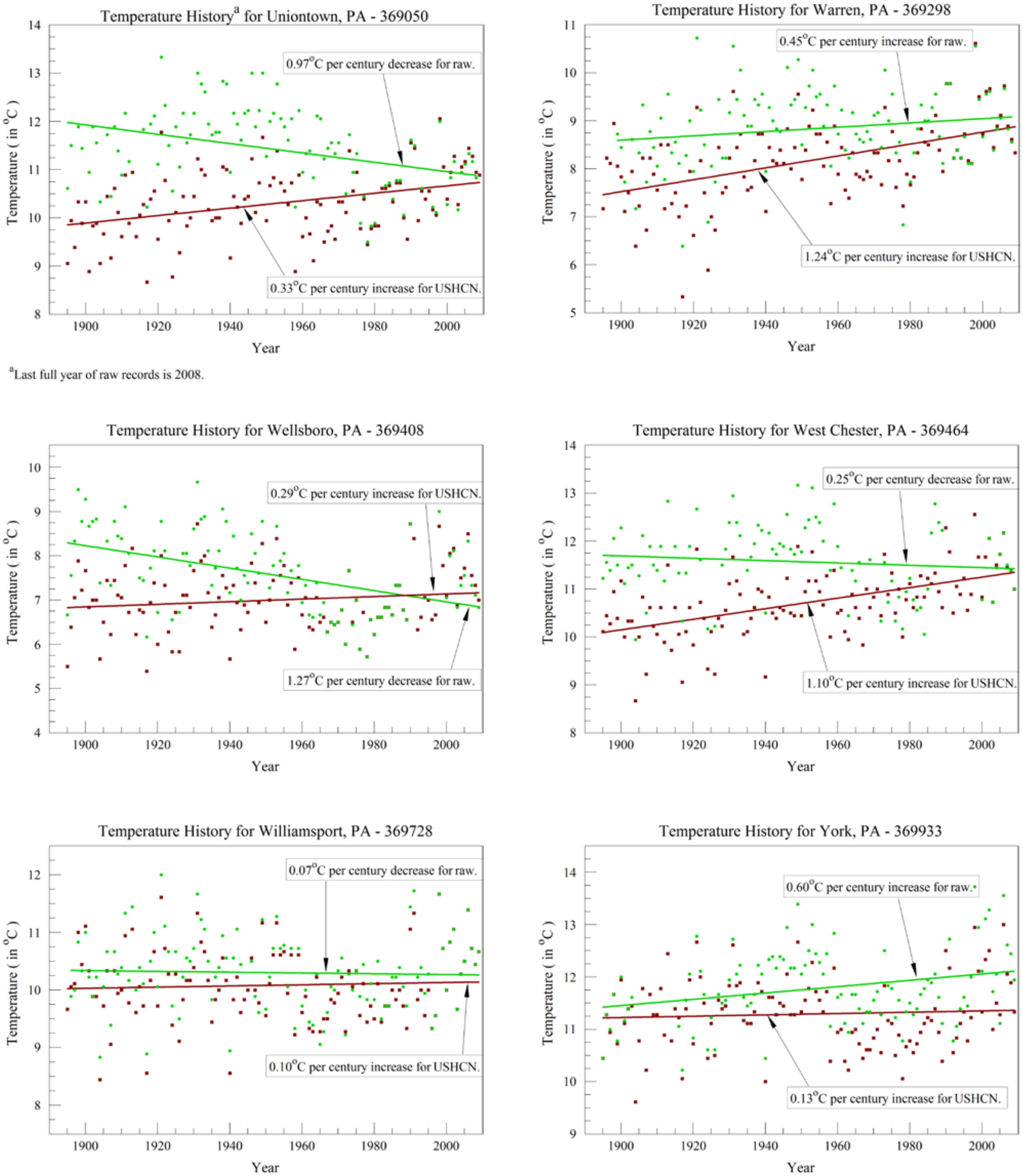


Fig. 5. Average yearly temperature in degrees Celsius versus year for stations S-X. Raw data points appear as green circles, USHCN V2 adjusted data are plotted as red squares. Linear averages for the raw and adjusted data are the green and red lines, respectively.

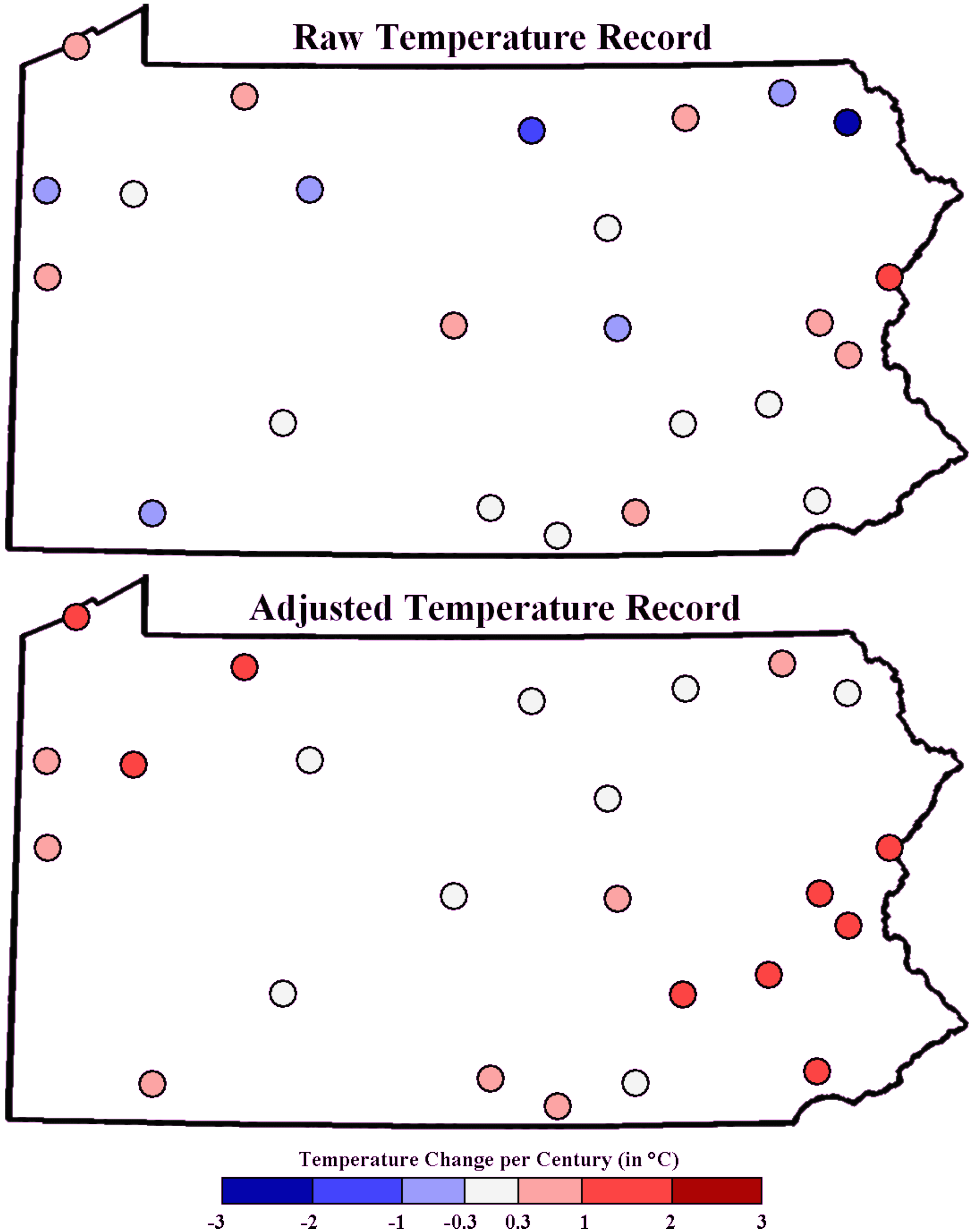


Fig. 6. Temperature trends for the Pennsylvanian temperature stations. Raw data was used for the top map, the USHCN V2 adjusted data for the bottom map.

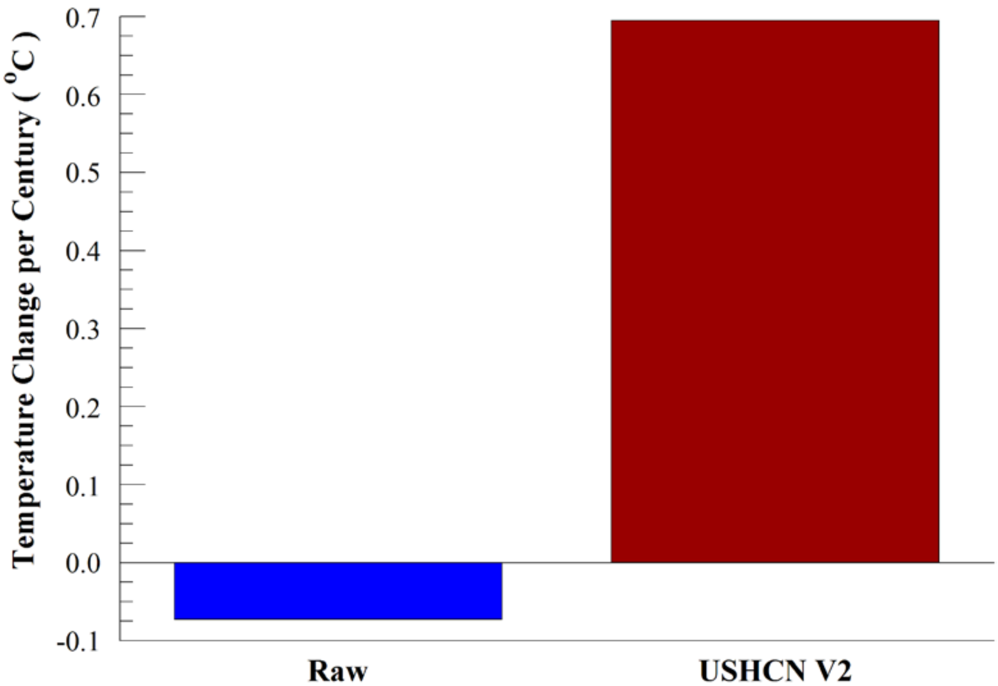


Fig. 7. Overall temperature trend for the twenty-four Pennsylvanian temperature stations calculated using the raw temperature data in blue and the USHCN V2 adjusted record in red.

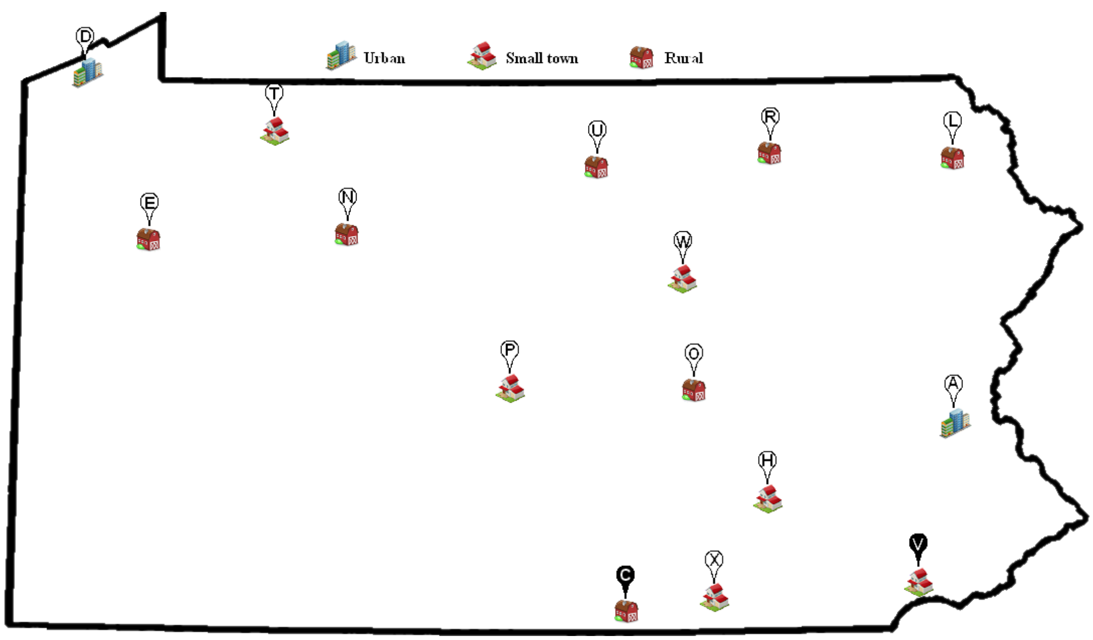


Fig. 8. Stations with current temperature records. The 1998-2009 trends were determined using data from these stations. Eisenhower/Natl Hist Site "C" and West Chester 2 NW "V" were excluded because they had fewer than 10 years of annual average raw temperatures during this period. Additional information on these stations can be found in Table I.

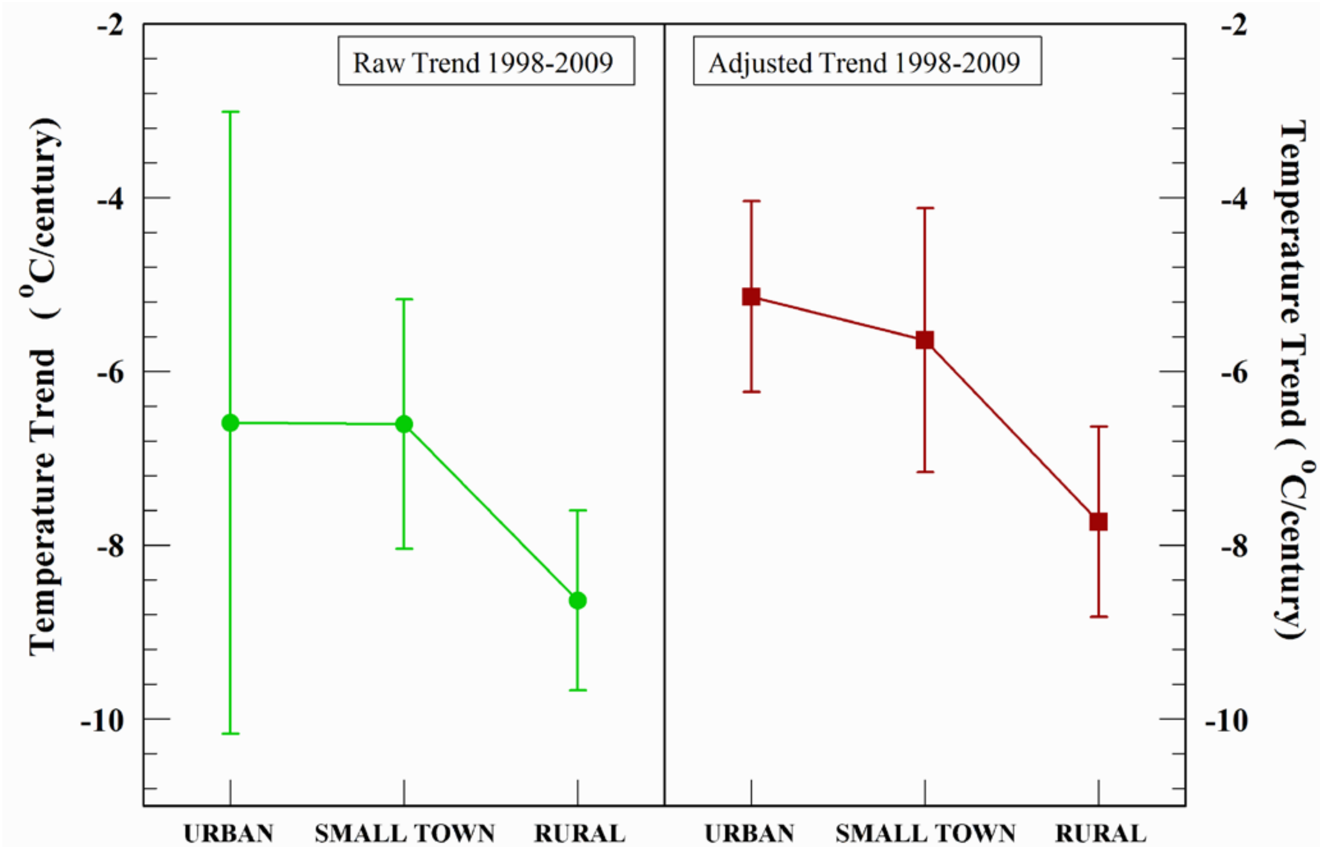


Fig. 9. 1998-2009 temperature trends. Average trends were determined for the urban, small town, and rural locations as shown in Fig. 8 above and identified in Table I.

CASE 21: An Inspection of the Urban Heat Island Effect and NCDC's Temperature Adjustments for the State of Utah

by Edward R. Long, Ph.D.

Introduction

Earlier this year, 2010, the subject of Urban Heat Island Effect (UHIE) was rekindled by a paper discussing Contiguous U.S. temperature trends (Ref 1). Since then additional studies have been presented (Ref 2 & 3). This is not to say this thin gathering of studies has addressed the subject more clearly or thoroughly than others. There have been earlier reports, some much earlier, (Ref 4 & 5). The existence of UHIE is well established for even the EPA acknowledges its existence (Ref 6 & 7). The heat of the matter, perhaps a pun intended, is whether or not there is an associated climate warming effect. Some argue that the impact is none (Ref 8 - 10). Yet, it has been demonstrated that UHIE is embedded in the global warming analysis claiming significant warming (Ref 11). Indeed, the crux of the Contiguous U.S. temperature trend study (Ref 1) was that UHIE does exist and because of the questionable temperature adjustment protocols used by NOAA's NCDC the effect leads to the conclusion of a falsely-large warming for the "Lower 48".

The Contiguous U. S. investigation (Ref 1) engendered a request for a similar study of the State of Utah. Given that Utah shares a common boundary with Colorado the contents herein may be of interest in conjunction with the one made for two cities in Colorado (Ref 2). The contents herein also provide an appraisal of the effect of NOAA's National Climatic data Center's (NCDC's) 'adjustments' of raw temperature data that suggest, as did the Contiguous U. S. study, something is wanting in the NCDC's adjustment protocol.

METEOROLOGICAL STATION SELECTION AND LOCATIONS

The set of data the NCDC uses for their analysis of the Contiguous U.S. includes 40 Utah Stations (Ref 11). These are a subset of a larger number of approximately 276 stations within the state (Ref 12). No explanation is given for why this particular subset and for the purposes of this paper none is necessary. The NCDC set is used here because both *Raw* and *Adjusted* NCDC data are provided. *Raw* is the recorded data, for the period from 1895 to 2008. *Adjusted* data are that derived by the NCDC from the Raw data using a massaging protocol meant to take into account measurement aspects such as change in the time of day temperatures are recorded, changes of station location, and urban growth. This protocol is discussed at the NCDC web site (Ref 13 and 14).

The stations used for this study are a subset of the 40 Utah NCDC locations. They were selected using the following steps:

1. First, each of the 40 stations was "flown over" using a latitude/longitude map service that provides overhead photographic images of the surface. From this visual information, each station's general urban/rural surrounding was determined, that is, inside or outside a city or town, and residential or industrial. [No consideration was made for the specific conditions of a location, such as discussed at www.Surface Stations.org.]

2. Second, five stations were selected because they appeared to be inside large cities, six that appeared to be inside medium cities, and four rural, completely apart human settlement. [Those were the only stations inside large- or medium-sized cities and completely apart from human settlement.]

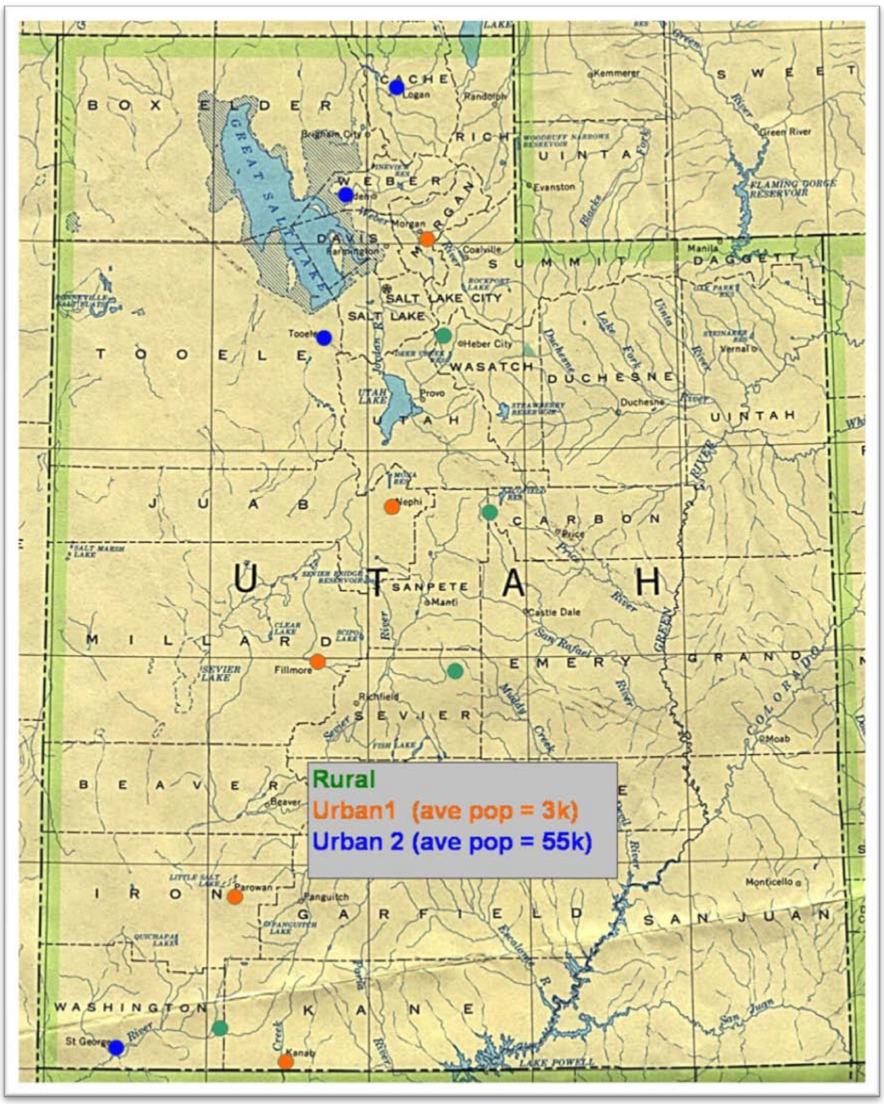
3. Third, the respective cities/towns were identified and their populations determined. This led to the discard of one 'large' city location because the city's population was far less than the other four, and of one 'medium' size because its population was far less than the other five.

Meta data for the stations used are provided in Table 1; and a map, Figure 1, provides a picture of their state-wide locations. Perhaps an argument could be made that one or more stations should have been included for the most western or eastern portions of Utah. But in the computer "fly over" there were only 4 other locations inside cities/towns, and these were communities from 200 to 400 people. To have included this as a fourth group would have presented some ambiguity for *rural* and *urban*. No check was made for their locations within Utah.

Table 1
Meta data for selected NCDC meteorological stations

Type	Station #	Latitude	Longitude	Elevation	Name	Population	Ave Population
Rural1	427909	40.5453	-111.5042	1831.8	SNAKE CREEK	0	0
	429717	37.2083	-112.9842	1234.4	ZION NP	0	
	427729	39.6847	-111.2047	2655.4	SCOFIELD-SKY	0	
	427559	38.9139	-111.4161	2304.3	SALINA 24 E	0	
Urban1	422828	38.9664	-112.3278	1560.6	FILLMORE	2,253	3,150
	426686	37.8497	-112.8278	1828.8	PAROWAN PWR	2,565	
	425826	41.0428	-111.6722	1551.4	MORGAN POWER	2,635	
	424508	37.0286	-112.5367	1493.5	KANAB	3,564	
	426135	39.7122	-111.8319	1563	NEPHI	4,733	
Urban2	428771	40.5278	-112.2975	1546.6	TOOELE	30,120	55,684
	425186	41.7456	-111.8033	1460	LOGAN UTAH S	42670	
	427516	37.1069	-113.5611	844.3	ST GEORGE	72,718	
	426404	41.2442	-111.9464	1325.9	OGDEN PIONEE	77,226	

Figure 1



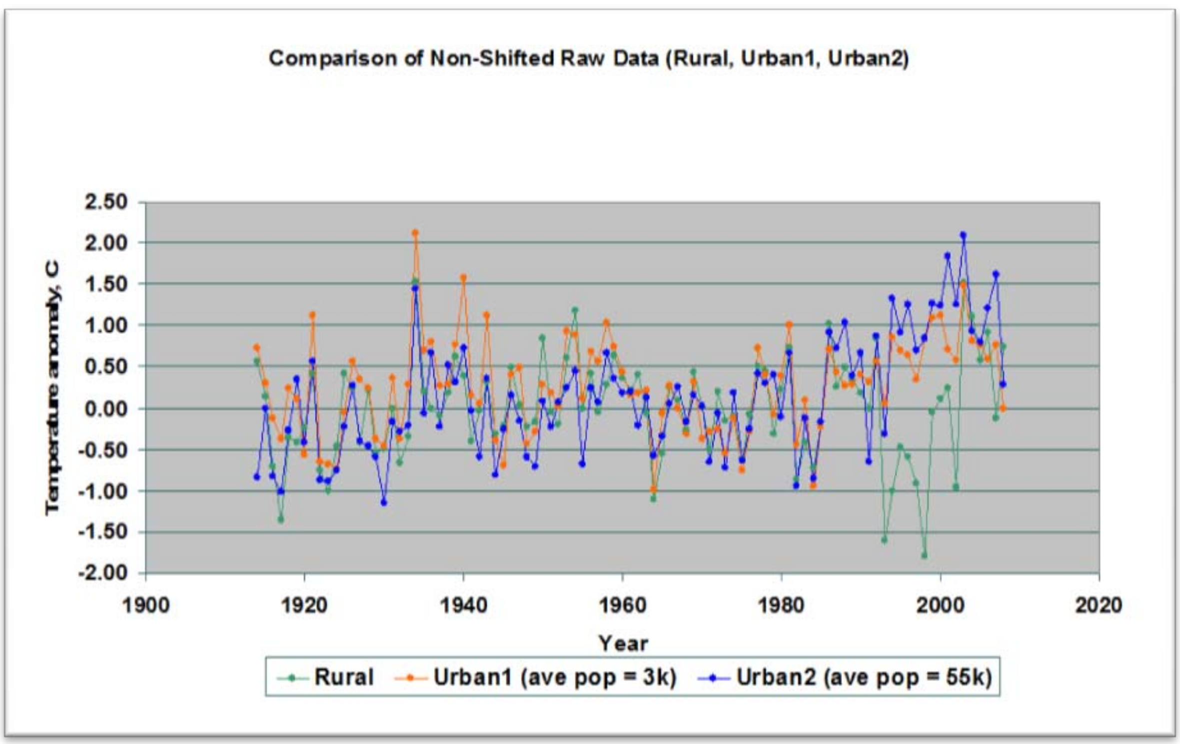
Map of Utah showing locations of selected Rural, Urban1, and Urban2 meteorological stations.

Results and Discussion

Raw Data

Raw data are those annual temperatures averaged from the monthly values, which in turn have been averaged from daily readings, for the respective meteorological stations. Here we gathered the Raw data into a spreadsheet and grouped them into their respective sets, Rural, Urban1, and Urban2. For each station within a set, the 'reference' average for the period inclusive of the span 1961-1990 was determined. This average was then subtracted from the temperatures for that station to provide the amount each year digressed from the reference average, or, if you will, the 'temperature anomalies'. For each set (Rural, Urban1, and Urban2), these stations anomalies were averaged for each year. The consequence of this practice of averages is shown in Figure 2. The earliest date in Figure 2 is 1914 because the Rural data values are sparse for earlier years, except for one of the four stations. Rather than engage a discussion for the merit of the overweighting, the earlier dates with that of the one station the years from 1985 to 1913 are not included. One suspect in the plotted data is the values for the Rural from the early 1990s forward. The abrupt decrease at about 1993 is due to one rural station whose values were much less than they were earlier years. A 'flag' of this aberration is noted, but the data is included because of what appears later in this report when the Adjusted data are discussed.

Figure 2



Temperature anomalies for Raw Rural, Urban1, and Urban2 NCDC data.

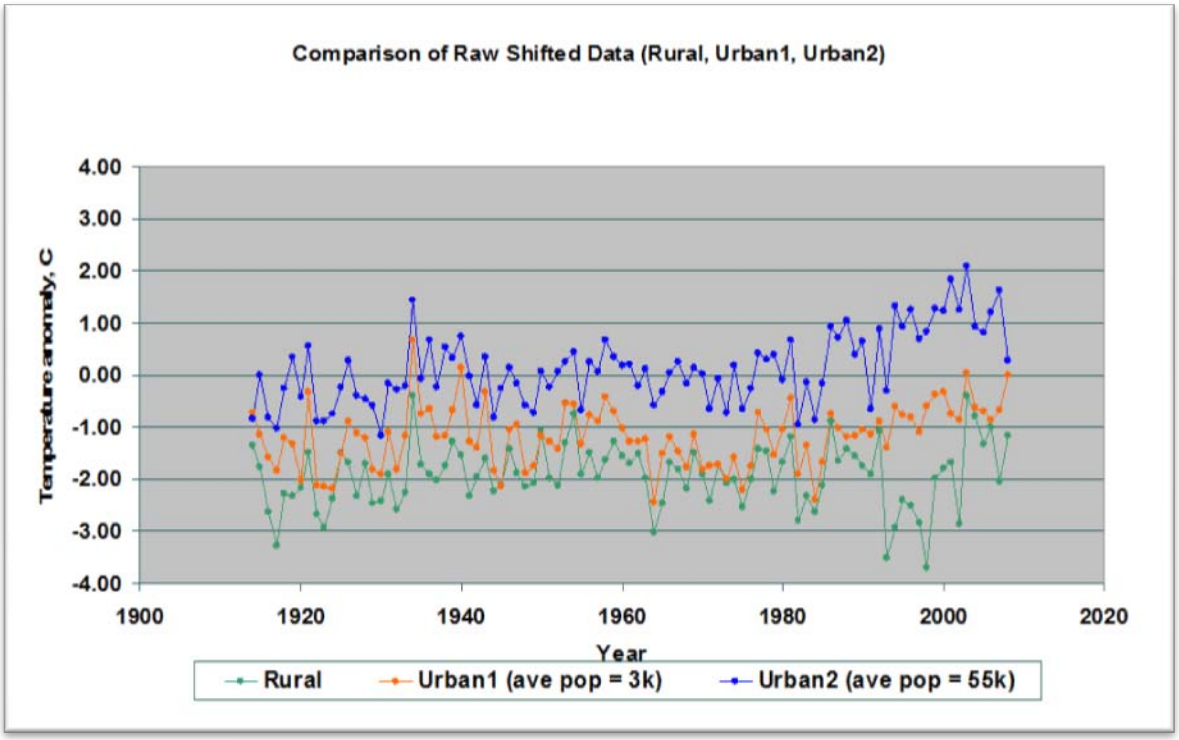
In Figure 2, each set is independent of the other. Consequently only the slopes of Rural, Urban1, and Urban2 can be commented. These respectively are 0.19, 0.46, and 1.43 ^{o}C/century, where the average for the two urban values is 0.95 ^{o}C/century. These are not unlike the rural and urban values, 0.13 and 0.79 ^{o}C/century respectively, found for raw Contiguous U.S. NCDC data (Ref 1). [An argument could be made that since there are years for which no value exists the average of the rates of change for the member stations within a set is perhaps more appropriate. Had there been no years for which there were missing values the two averages would be the same.]

The rate of increase due to nature alone, Rural, is significantly less than that of either Urban set. Hence man does indeed have an effect on temperature in urban areas, but little or none in the rural area. This substantiates the assertion there is a local-warming effect (UHIE). The data values also suggest the extent of the UHIE on local warming is in some manner proportional to the size of the urban area. And in reply to the denial that UHIE has an effect on global warming (Ref 8-10), at least Utah warming, consider that the Rural rate alone is 0.19 ^{o}C/century, whereas including the urban rates leads to 0.69 ^{o}C/century, in this case a simple average. This average rate is the same as the NCDC adjusted value (Ref 1), the latter being one of the bases on which advocates of man-made global warming proclaim anthropogenic CO_2 is the cause of such warming. [The use of averages of temperature change, as employed here and by the NCDC, may not be appropriate for quantifying warming. Some argue that the values for Rural and Urban, weighted for respective portions of the land, should be used. But this too may not be appropriate. In fact, the use of averages of rates of temperature change for any large area, State, country, or global may not be appropriate, whereas heat and rates of heat change may. But the use of averages in the discussion of temperature and climate has been used by many authors for many years and we perpetuate that practice here.]

A more insightful view of the temperature anomaly data may be had by taking into account the differences of the Set Average Ref Temperatures (SARTs). SART is determined by averaging the reference period (1961-1990) temperature averages of the stations within the set. These SARTs are, respectively for the Raw Rural, Urban1, and Urban2 sets, 27.35, 27.81, and 29.26 ^{o}C. Figure 3 is the same data in Figure 2, but accordingly shifted,-1.91 (=27.35-29.26), -1.45 (=27.81-29.26), and 0.0 (=29.26-29.26)^{o}C, with respect to the Urban2 average temperature.

The trends of the individual sets are more evident. Rural and Urban1 sets are shifted about the same. One could suppose from this that there is a more pronounced UHIE for the larger urban locations (i.e., its SART is significantly larger than that of the other two). Even without the abrupt 1993 decrease and subsequent lower values to about 2001, the Rural set seems to have a smaller rate of increase than the Urban1 after the early 1970s. This suggests some relationship between rate of change and population. However, the value of such a proportionality of temperature to the size of the size, or density, of a populated location isn't evident from this small amount of data. This proportionality has been considered elsewhere (Ref 3), but possibly such an understanding is in its infancy. [A note should be made that during the first half of the 1900s the Urban1 temperatures increased and then decreased. The same is not true for the Urban2 data.]

FIGURE 3



Temperature anomalies for Raw Rural, Urban1, and Urban2 NCDC data. Rural and Urban1 data are shifted with respect to Urban2 by the amounts of the differences of the average reference period (1961-1990) temperatures, (27.35-29.29) and (27.81-29.26) °C.

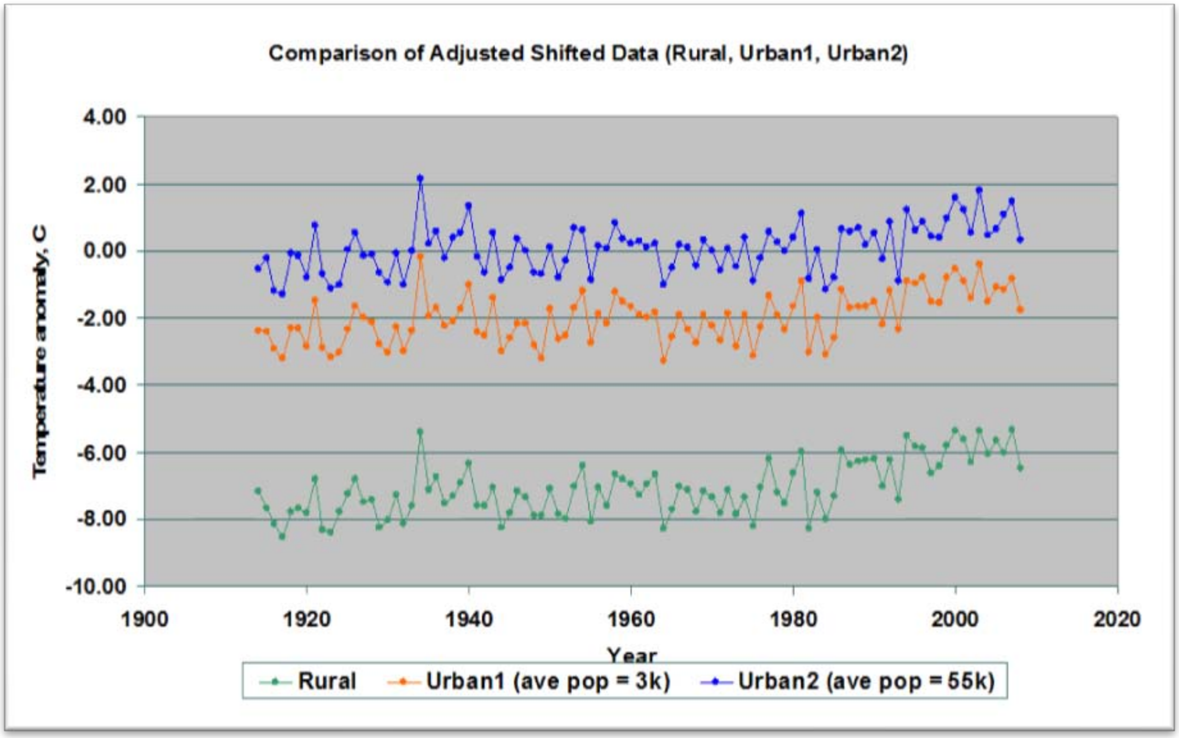
ADJUSTED DATA

Adjusted data are those annual temperatures generated by NOAA's NCDC from the Raw data using protocols said to account for changes in time of temperature measurements, station locations, and other factors (Ref 13-14). The Adjusted data were gathered into a spreadsheet and treated like that for the Raw data.

The consequence is shown in Figure 4 in which, like in Figure 3, the values of the Rural and Urban1 anomalies have been shifted relative to those of Urban2 by the differences of their SART values. The SART values for these adjusted data respectively are 22.39, 27.39, and 29.51 °C for Rural, Urban1, and Urban2.

The first to be noticed is the extent of the shift for the Adjusted Rural set. Its Adjusted SART is almost 5 °C lower (=22.39-27.35) than that for its Raw SART. "Ah," you say, "indeed the NCDC has taken into account that rural temperatures are lower." Possibly, you are correct. But it is also possible they had another line of reasoning which is obscured within their adjustment protocol or this was a fortuitous consequence. The Urban1 set's Adjusted SART is 0.42 °C lower (27.81-27.39) and the Urban2 set's is 0.25 °C higher (29.51-29.26) than their respective Raw SARTs.

FIGURE 4



Temperature anomalies for Adjusted Rural, Urban1, and Urban2 NCDC data. Rural and Urban1 data are shifted with respect to Urban2 by the amounts of the differences of the average reference period (1961-1990) temperatures.

But this consideration of averages aside, the striking aspects of the data in Figure 4 are:

- The shapes of the Rural, Urban1, and Urban2 seta are almost identical. The NCDC's adjustment protocol eliminated the abrupt early-1990s decrease for the Rural set. To comment on how they were able to do this would require a degree of speculation concerning their adjustment protocol, quite possibly equivalent to that the NCDC may have employed in arriving at their protocol. The sets, aside from the differences in their SARTs, have been homogenized to look the same.

- Slopes of the Adjusted Rural, Urban1, and Urban2 sets respectively are 1.04, 1.30, 1.14 ^{o}C/century. Thus, the Rural value has increased a factor of more than 5 and Urban1's by a factor of 2.8 while that of Urban2 is 80 percent of the Raw value. The rates of increase are summarized in Table 2. Little more need be said other than a mystery exists, as in the case for the Contiguous U.S. study (Ref 1), for how a flaw-free adjustment protocol could have produced changes, such as these, from those for the NCDC raw data.

TABLE 2 – RATES OF TEMPERATURE CHANGE FOR RAW AND ADJUSTED RURAL, URBAN1, AND URBAN2 NCDC DATA SETS.

Rate of Change, °C/Century			
	Rural	Urban1	Urban2
Raw	0.19	0.46	1.43
Adjusted	1.04	1.30	1.14

CONCLUDING REMARKS

The rates of change for Utah rural station set and urban sets, using Raw NCDC data, are similar to those for the Contiguous U.S. (Ref 1). The rates of change for the Adjusted NCDC data are just as curious as are those for the Contiguous U.S. Comparison of the rate of change of temperatures for the Rural set to that for the Urban ones, using NCDC Raw Data, indicates a pronounced Urban Island Heating Effect (UHIE) which, when Rural and Urban data are combined, as the NCDC does, leads to a significantly higher rate of temperature increase or climate warming. The rates of change of temperatures for the Adjusted NCDC data for the same Rural and Urban station sets are not distinct from one another. The rate for the set of Rural locations is raised from 0.19, for the Raw, to 1.04 °C/century for the Adjusted, while that of the large Urban locations is lowered from 1.43 to 1.14 °C/century. Thus it would seem the NCDC protocols for adjusting raw temperature data suffer a want for considerable questioning.

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11. ftp://ftp.ncdc.noaa.gov/pub/data/ushcn/v2/monthly/.
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13. http://www.ncdc.noaa.gov/cmb-faq/temperature-monitoring.html.
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CASE 22: MORE GUNSMOKE, THIS TIME IN NEPAL

by Willis Eschenbach

> *Note to Readers: This is an important post, as Willis demonstrates that NASA GISS has taken a cooling trend and converted it into a warming trend for the one GHCN station in Nepal which covers the Himalayas. I offer NASA GISS, either via Jim Hansen or Gavin Schmidt, rebuttal opportunity to this issue on WUWT anytime. — Anthony*

I read the excellent and interesting guest post by Marc Hendrickx about the IPCC and the Himalayas. My first big surprise was the size of the claimed warming. He cites IPCC Table 10.2 which says:

Nepal: 0.09°C per year in Himalayas and 0.04°C in Terai region, more in winter.

Well, my bad number detector started ringing like crazy. A warming of nine degrees C (16°F) per century in the mountains, four degrees C per century in the lowlands? … I don't think so. Those numbers are far too big. I know of no place on earth that is warming in general at 9°C per century.

Marc also quotes the IPCC source paper as saying:

The Kathmandu record, the longest in Nepal (1921–94), shows features similar to temperature trends in the Northern Hemisphere, suggesting links between regional trends and global scale phenomena.

Being cursed with a nagging, infernal curiosity, I thought I'd take a look at the Kathmandu temperature record. Foolish me …

I started by looking at where Nepal is located. It starts at the northern edge of the Indian plains, at the foothills of the Himalayas, and goes up to the crest:

Figure 1. *Nepal (yellow outline). Yellow pins show all GHCN (Global Historical Climate Network) surface temperature stations.*

So, that was my second surprise – a whole dang country, and only one single solitary GHCN temperature station. Hmmmm … as Marc shows, the paper cited by the IPCC gives the records of a dozen stations in Nepal. So why does GHCN only use Kathmandu in Nepal? But I digress.

Resolving not to be distracted by that, I went to the GISS dataset. I selected "Raw GHCN data + USHCN corrections" in the dropdown menu. (Kathmandu is outside the US, so in this case there are no USHCN corrections.) Typed in "Kathmandu", and started the search. Figure 2 shows the result:

GISS Surface Temperature Analysis

Station List Search

Click a station's name to obtain a plot for that station.

Click the "(*)" next to a station name to obtain a list of stations near that location.

	Station Name	Lat	Lon	ID	Pop.	Years
(*)	Kathmandu Air	27.7 N	85.4 E	217444540000	354,000	1961 - 1980
(*)	Kathmandu Air	27.7 N	85.4 E	217444540001	354,000	1951 - 1991
(*)	Kathmandu Air	27.7 N	85.4 E	217444540002	354,000	1987 - 2010

Figure 2. *Kathmandu Air(port) Metadata.*

This shows there are three records for Kathmandu Air (Airport), which looks promising. Also, it looks like there is an overlap between the records, which seems good. (There is no sign, however, of a record that is "the longest in Nepal (1921–94)". The earliest date is 1951, and the latest is 2010. But again I digress.)

Clicking on the top Kathmandu Air link (on the GISS website, not on the graphic above) brings up the following GISS-generated graph:

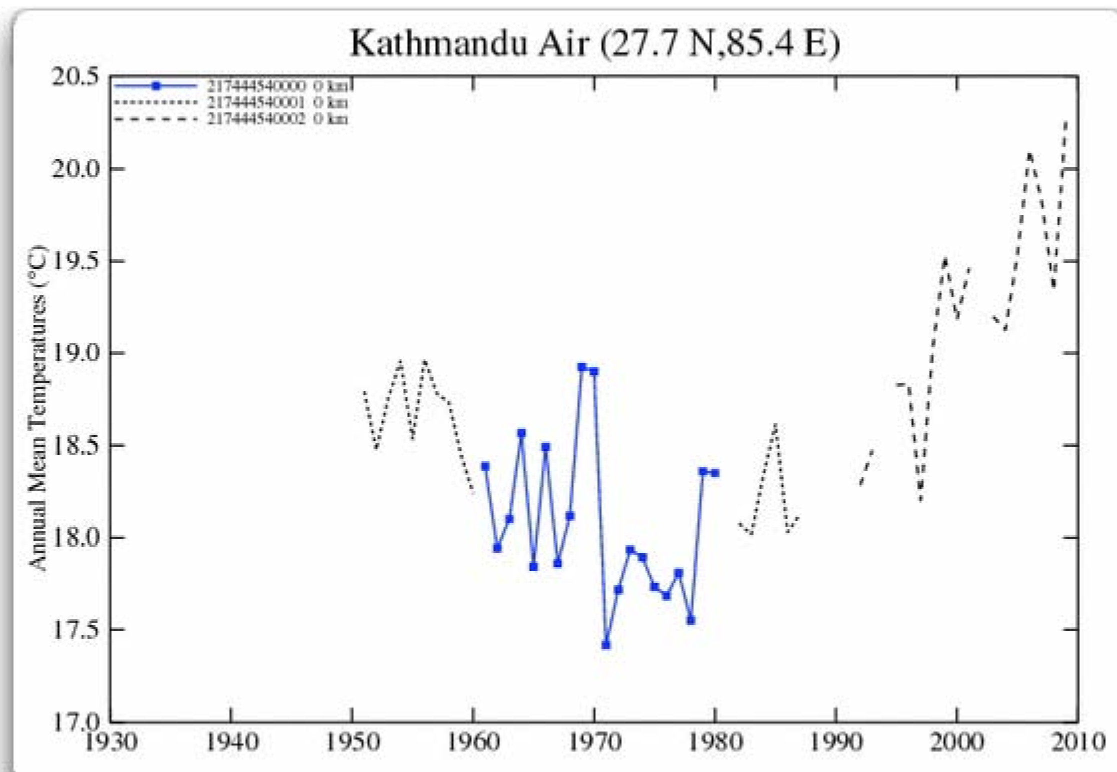

Figure 3. *Kathmandu Air. Three records are shown, as dotted, dashed, and blue.*

Here's an oddity. We have three records, each for different periods. And there is not a single year of overlap in the bunch. Not one.

Now, people think that I mine or search for these odd stations. Not so, I am simply curious about what I read, and this is not an atypical temperature record. Most are somewhat strange. Gaps and breaks in a given record often render large parts of the record unusable. GISS uses a cutoff of 20 years of consecutive data. As a result, the final GISS record for Kathmandu, rather than going from 1951-2009, goes from 1961 to 1980. Fair enough, these are all debatable choices, including the minimum record length cutoff size. In any case, the real problem with Kathmandu is not the record length. It is the lack of overlap which prevents the creation of a continuous record. This means that the apparent overall trend may not be real. It may simply be an artefact of e.g. different thermometers, or different locations. In this case, GISS has side-stepped the question by selecting only one record (shown in blue) for the final record.

How can we get to the graph of this final GISS record including all of their homogeneity adjustments? Well, we could go back to the same GISS website where we started and select a different dataset. However, here's a trick to go directly from the raw data you are looking at to the final GISS homogenized dataset. Near the end of the URL of the raw GISS dataset under discussion you find the following:

… &data_set=0& …

GISS has three datasets. The raw data is dataset 0. The data "after combining records at the same location" is dataset 1. The final data "after cleaning/homogeneity adjustment" is dataset 2.

So to get the final adjusted result, all you have to do is to change the "0" in the URL to a "2", viz:

… &data_set=2& …

Figure 3 shows the outcome of making that change:

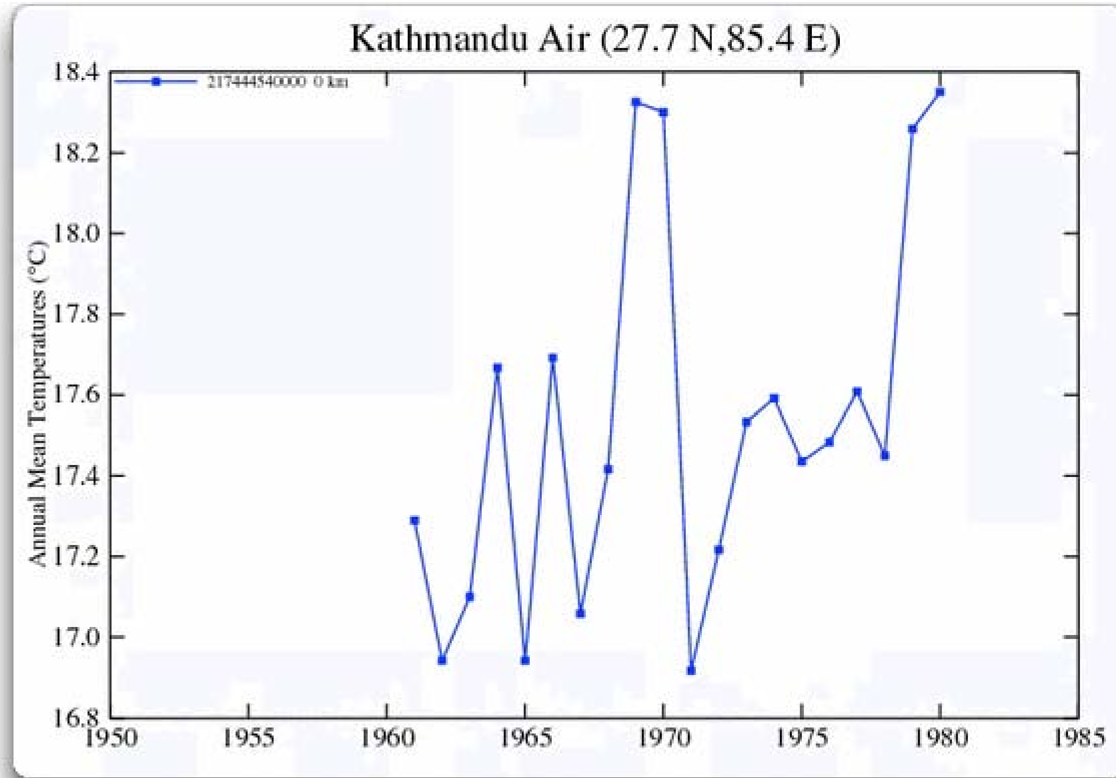

Figure 3. *Final GISS record for Kathmandu. The scale has been changed in both the X and Y axes. Note that they have discarded all segments of the record which are shorter than twenty years in length.*

And that, dear friends, was my third big surprise. Take a close look at those two records, the adjusted and unadjusted …

As you no doubt observe, one is trending somewhat downwards, while the second is trending distinctly upwards. Hmmm … so, of course, I downloaded the GISS data (from the bottom of the same web page). Here is what they have done:

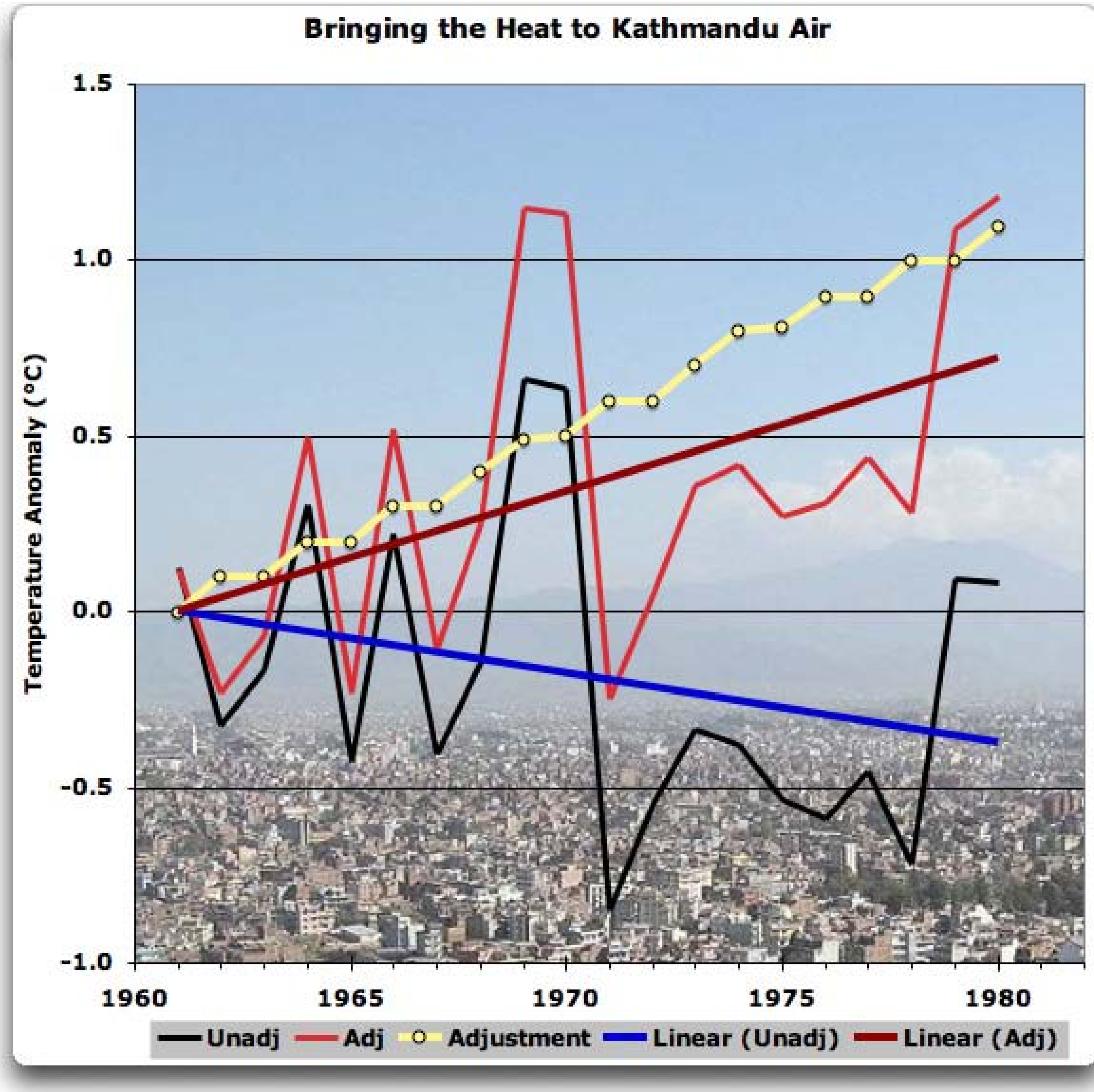

Figure 4. *GISS Kathmandu Airport Annual Temperatures, Adjusted and Unadjusted, 1961–80. Yellow line shows the amount of the GISS homogeneity adjustment in each year. Photo is of Kathmandu looking towards the mountains.*

GISS has made a straight-line adjustment of 1.1°C in twenty years, or 5.5°C per century. They have changed a cooling trend to a strong warming trend … I'm sorry, but I see absolutely no scientific basis for that massive adjustment. I don't care if it was done by a human using their best judgment, done by a computer algorithm utilizing comparison temperatures in India and China, or done by monkeys with typewriters. I don't buy that adjustment, it is without scientific foundation or credible physical explanation.

At best that is shoddy quality control of an off-the-rails computer algorithm. At worst, the aforesaid monkeys were having a really bad hair day. Either way I say adjusting the Kathmandu temperature record in that manner has no scientific underpinnings at all. We have one stinking record for the whole country of Nepal, which shows cooling. GISS homogenizes the data and claims it wasn't really cooling at all, it really was warming, and warming at four degrees per century at that … hmmm, four degrees per century, where have I heard that before …

What conceivable scientific argument supports that, supports adding that linear 5.5°C/century trend to the data? What physical phenomena is it supposed to be correcting for? What error does it claim to be fixing?

Finally, does this "make a difference"? In the global average temperature, no – it is only one GHCN/GISS datapoint among many. But for the average temperature of Nepal, absolutely – it is the only GHCN/GISS datapoint. So it is quite important to the folks in Nepal … and infinitely misleading to them.

And when it is cited as one of the fastest warming places on the planet, it makes a difference there as well. And when the IPCC puts it in their Assessment Report, it makes a difference there.

Once again we see huge adjustments made to individual temperature records without reason or justification. This means simply that until GISS are able to demonstrate a sound scientific foundation for their capricious and arbitrary adjustments, we cannot trust the final GISS dataset. Their algorithm obviously has significant problems that lead to the type of wildly unreasonable results seen above and in other temperature datasets, and they are not catching them. Pending a complete examination, we cannot know what other errors the GISS dataset might contain.

[UPDATE] John Goetz pointed out that the likely source of the spurious trend is temperatures in Tingri (see Fig. 1, way back in the high mountains at the upper right at almost 6,000 metres elevation in the tundra) and GISS step 2. GISS says:

… in step 2, the urban and peri-urban (i.e., other than rural) stations are adjusted so that their long-term trend matches that of the mean of neighboring rural stations.

It seems John is right, Tingri is the likely problem. Or to be more accurate, their method is the problem. GISS uses a different method than GHCN to average stations for step 2.

The method of "first differences" is used by GHCN. GISS instead uses the "reference station" method described in the same citation. In my opinion, the reference station method is inferior to the first difference method.

The reference station here is likely Dumka, it is the longest of the nearby stations. Unlike Tingri, Dumka is at an elevation of 250 metres in the plains of West Bengal … hmmm. This should be interesting.

In the reference station method, Tingri gets adjusted up or down until the average temperatures match during the time of the overlap. Then Tingri and Dumka are averaged together. However, let's take it a step at a time. First, I like to look at the actual underlying data, shown in Fig. 5.

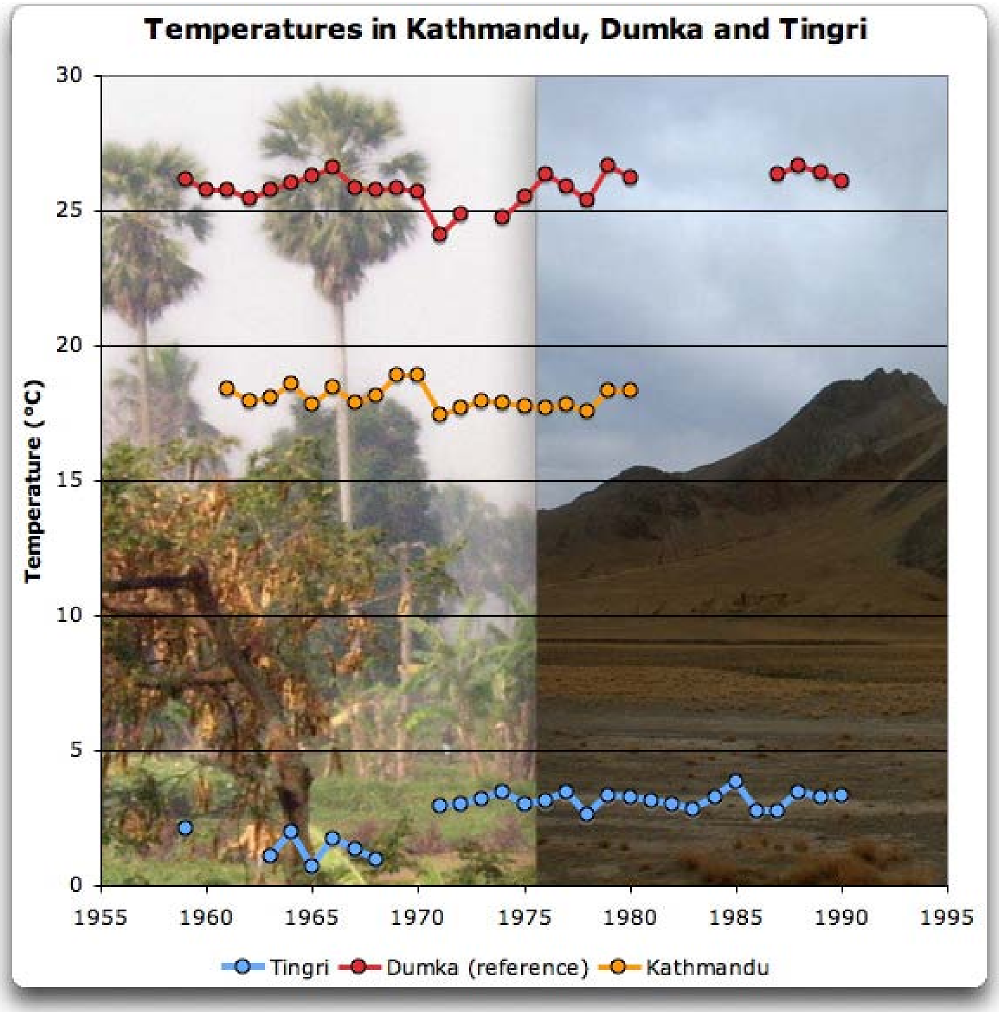

Figure 5. *Temperatures in Dumka (India) and Tingri (China). Left photo is Dumka on the lowland plains of West Bengal. Right photo is Tingri in the Himalayan mountains.*

So the brilliant plan is, we're going to use the average of the temperature anomalies in Dumka and Tingri to adjust the temperature in Katmandu, at 1,300 metres in the foothills?

Makes sense, I suppose. The average of mountains and plains is foothills, isn't it? … but I digress.

The problem arises from the big jump in the Tingri data around 1970. Using the reference station method, that big jump gets wrapped into the average used to adjust the Kathmandu data. And over the period of Tingri/Kathmandu overlap (1963-1980), because of the big jump the "trend" of the Tingri data is a jaw-dropping 15°C per century. Once that is in the mix, all bets are off.

Obviously, there is some kind of problem with the Tingri data. The first difference method takes care of that kind of problem, by ignoring the gaps and dealing only with the actual data. You could do the same with the reference station method, but only if you treat the sections of the Tingri data as separate stations. However, it appears that the GISS implementation of the algorithm has not done that …

Nor is this helped by the distance-weighting algorithm. That weights the temperatures based on how far away the station is. The problem is that Tingri is much nearer to Kathmandu (197 km) than Dumka (425 km). So any weighting algorithm will only make the situation worse.

Finally, does anyone else think that averaging high mountain tundra temperature anomalies with lowland plains anomalies, in order to adjust foothills anomalies, is a method that might work but that it definitely would take careful watching and strict quality control?

[UPDATE 2] Lars Kamel pointed below to the CRU data. If we take all of the available CRU (originally GHCN) data, we get the following trend for Kathmandu.

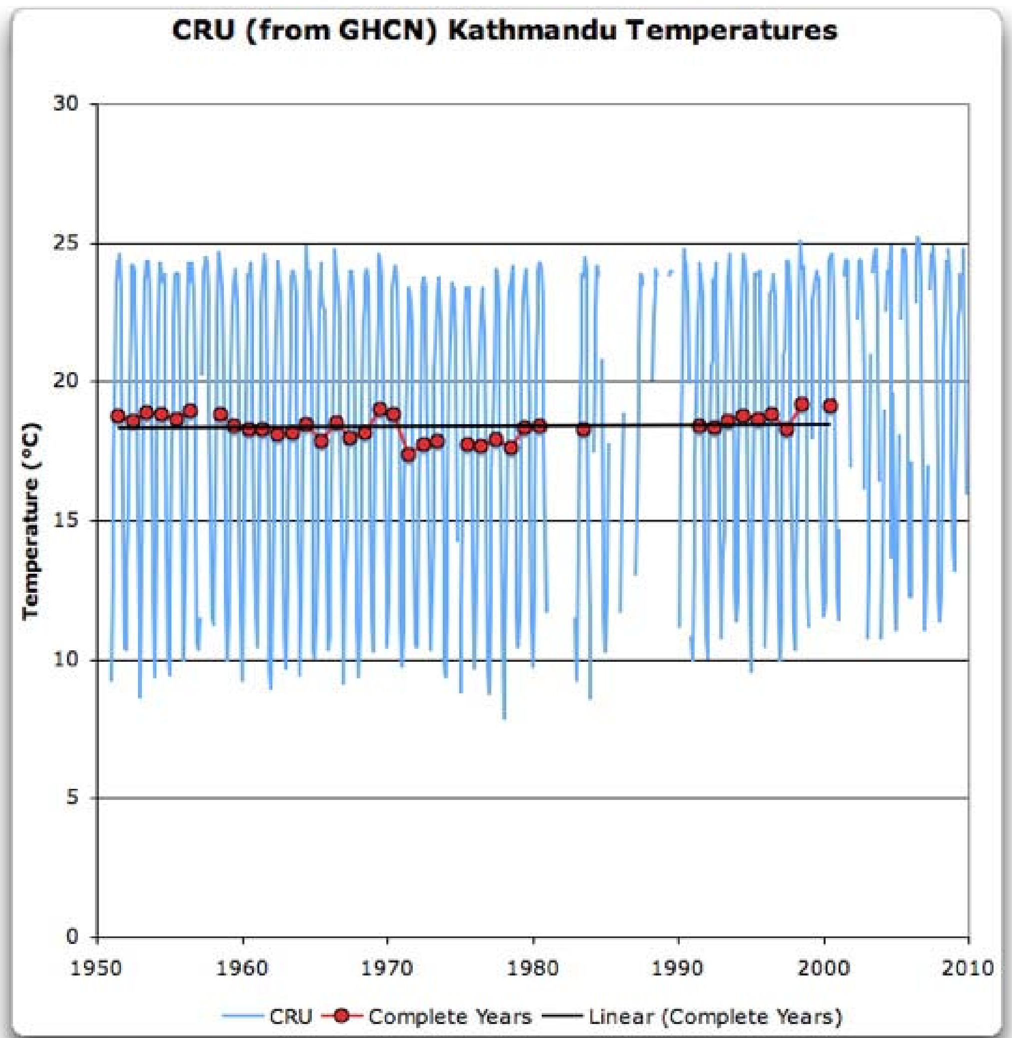

Figure 6. *CRU monthly and annual temperature data for Kathmandu. Red circles show those years with 12 months of data.*

You can see the lack of a trend in the 1950-2000 data. Went down slightly 1950-1975, went up slightly 1975-2000. Gosh.

[UPDATE 3] Steve McIntyre reminded me below of his fascinating 2008 analysis of the numbers and locations of GISS adjustments that go up, down, and sideways. His post is here, and is well worth reading.

[UPDATE 4] Zeke Hausfather has an interesting post on Kathmandu here, with lots of good information.

Source: http://wattsupwiththat.com/2010/08/11/more-gunsmoke-this-time-in-nepal/.

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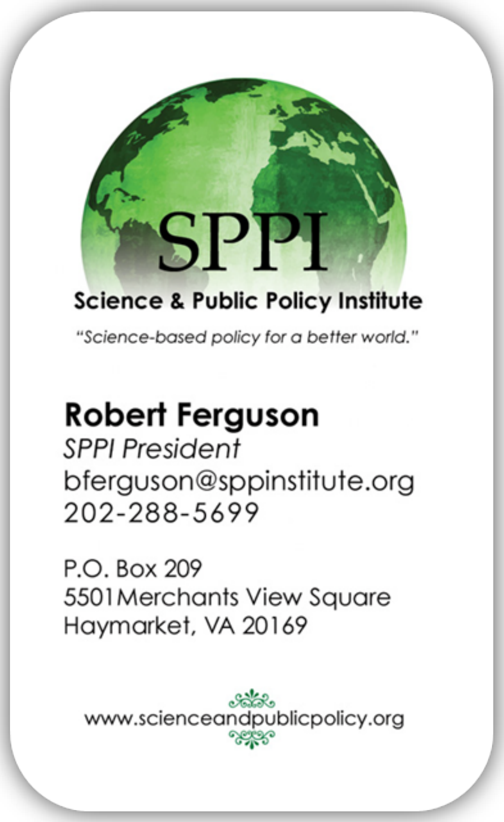

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