On the Validity of NOAA, NASA and Hadley CRU Global Average Surface Temperature Data
&
The Validity of EPA's CO_2 Endangerment Finding

Abridged Research Report

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ABSTRACT

The objective of this research was to test the hypothesis that Global Average Surface Temperature (GAST) data, produced by NOAA, NASA, and HADLEY, are sufficiently credible estimates of global average temperatures such that they can be relied upon for climate modeling and policy analysis purposes. The relevance of this research is that the validity of all three of the so- called Lines of Evidence in EPA's GHG/CO_2 Endangerment Finding require GAST data to be a valid representation of reality.

In this research report, the most important surface data adjustment issues are identified and past changes in the previously reported historical data are quantified. It was found that each new version of GAST has nearly always exhibited a steeper warming linear trend over its entire history. And, it was nearly always accomplished by systematically removing the previously existing cyclical temperature pattern. This was true for all three entities providing GAST data measurement, NOAA, NASA and Hadley CRU.

As a result, this research sought to validate the current estimates of GAST using the best available relevant data. This included the best documented and understood data sets from the U.S. and elsewhere as well as global data from satellites that provide far more extensive global coverage and are not contaminated by bad siting and urbanization impacts. Satellite data integrity also benefits from having cross checks with Balloon data.

The conclusive findings of this research are that the three GAST data sets are not a valid representation of reality. In fact, the magnitude of their historical data adjustments, that removed their cyclical temperature patterns, are totally inconsistent with published and credible U.S. and other temperature data. Thus, it is impossible to conclude from the three published GAST data sets that recent years have been the warmest ever –despite current claims of record setting warming.

Finally, since GAST data set validity is a necessary condition for EPA's GHG/CO_2 Endangerment Finding, it too is invalidated by these research findings.

PREFACE

This research report stands on the back of a great deal of highly relevant previous research by the authors and many others.

This previous research includes:
On the Existence of a "Tropical Hot Spot" & The Validity of EPA's CO_2 Endangerment Finding, Abridged Research Report, Second Edition, Dr. James P. Wallace III, Dr. John R. Christy, Joseph S. D'Aleo, CCM, AMS Fellow April 2017, see page 58 re data manipulation of HadCRUT4.
https://thsresearch.files.wordpress.com/2017/04/ef-data-research-report-second-editionfinal041717-1.pdf

Climate4you update April 2017
http://www.climate4you.com/Text/Climate4you_April_2017.pdf
http://www.climate4you.com/, Global Temperatures, Temporal stability of global temperature measurements

A Critical Look at Surface Temperature Records, Joseph D'Aleo, CCM, AMS Fellow
https://thsresearch.files.wordpress.com/2017/05/chap3-published-in-elsevier.pdf

A Critical Review of Global Surface Temperature Data Products
Ross McKitrick, Ph.D., Professor of Economics, University of Guelph Guelph Ontario Canada, August 5, 2010
https://notalotofpeopleknowthat.wordpress.com/2017/06/13/serious-quality-problems-in-the-surface-temperature-data-sets-ross-mckittrick/

However, while the research listed above dealt with some of the issues covered herein, it typically did so in a different context. For example, this research focuses not on whether or not specific types of surface temperature data adjustments are appropriate, but rather on testing the hypothesis that Global Average Surface Temperature (GAST) data, produced by NOAA, NASA, and HADLEY, are sufficiently credible estimates of global average temperatures such that they can be relied upon at all, that is validated, for climate modeling and policy analysis purposes.

I. RELEVANCE OF THIS RESEARCH

The assumption that Global Average Surface Temperature Data is valid is critical to all Three Lines of Evidence in EPA's GHG/CO_2 Endangerment Finding. This may be easily seen by reviewing each Line of Evidence.

Stated simply, first, the Tropical Hot Spot (THS) is claimed to be a fingerprint or signature of atmospheric and Global Average Surface Temperatures (GAST) warming caused by increasing GHG/CO_2 concentrations[1].

Second, higher atmospheric CO_2 and other GHG concentrations are claimed to have been the primary cause of the claimed record setting GAST over the past 50 plus years.

Third, climate models are said to be valid for policy analysis purposes, that is, their predictions of the impact of rising CO_2 levels on future GAST levels are said to be credible. Thus, GAST is the critical variable in all the climate models EPA has relied upon. These are the climate models that EPA relied upon in its policy analysis supporting, for example, its Clean Power Plan --recently put on hold by a Supreme Court stay. These climate models were also critical to the Social Cost of Carbon estimates EPA had used to justify a multitude of regulations across U.S. Government agencies.

Clearly, if GAST data is not valid, neither is the Endangerment Finding.

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[1] See http://icecap.us/images/uploads/ImportanceoftheHotSpot_093016_.pdf See also U.S. Climate Change Science Program, Synthesis and Assessment Product 1.1, Temperature Trends in the Lower Atmosphere - Understanding and Reconciling Differences, Chapter 1, p. 18-19, https://www.gfdl.noaa.gov/bibliography/related_files/vr0603.pdf

II. OBJECTIVE OF THE RESEARCH

Although global warming from 1979 to 1998 is well supported in all surface and tropospheric temperature data sets, major questions exist regarding the validity of the 1900 to date surface temperature data as officially reported. Climategate and follow-on investigations suggest that Global Average Surface Temperature data may be seriously compromised. (See http://www.climate4you.com/Text/Climate4you_April_2017.pdf)

Hence, the objective of this research was to: *Test the hypothesis that Global Average Surface Temperature (GAST) data, produced by NOAA, NASA, and HADLEY, are sufficiently credible estimates of global average temperatures such that they can be relied upon for climate modeling and policy analysis purposes.*

The three terrestrial datasets provided by the institutions – NOAA's National Climatic Data Center (NCDC), NASA's Goddard Institute for Space Studies (GISS/ GISTEMP), and the University of East Anglia's Climatic Research Unit (CRU)/Hadley Center – all depend on data supplied by surface stations administered and data disseminated by NOAA under the management of the National Climatic Data Center (NCDC) in Asheville, North Carolina.

This Global Historical Climatology Network (GHCN) is the most commonly cited source of raw, or unadjusted, global surface temperature data over the last 100 plus years. Hadley CRU's Phil Jones stated that "Almost all the station data we have in the CRU archive is exactly the same as in the GHCN archive used by the NOAA National Climatic Data Center". Source: https://www.barrasso.senate.gov/public/index.cfm/2010/3/post-b5fb5b46-a699-6acb-e43d-c14a42133346

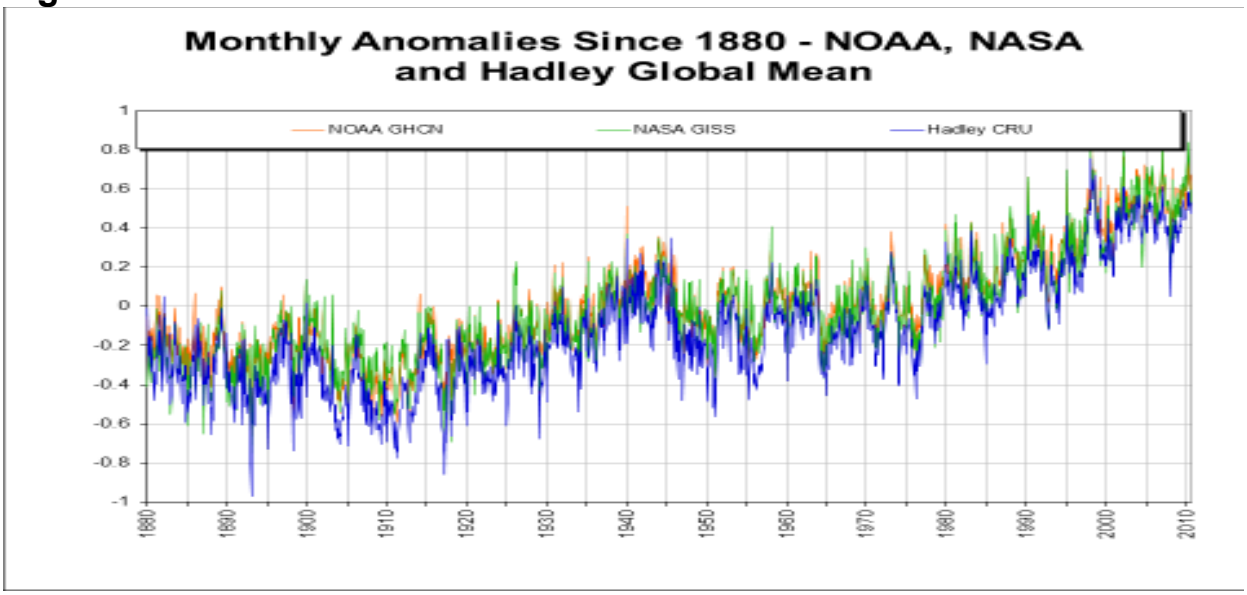
NASA writes "The current analysis uses surface air temperatures measurements from the following datasets: the unadjusted data of the Global Historical Climatology Network (Peterson and Vose, 1997 and 1998), United States Historical Climatology Network (USHCN) data, and SCAR (Scientific Committee on Antarctic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

It is not surprising that there is good agreement between NOAA, NASA and Hadley on past temperatures given that they all largely use the same raw data. The "best estimate" that has been reported is that 90 – 95% of the raw data is the same in each of the data sets (Pielke). Steve McIntyre's analysis showed 95.6% concordance between GHCN and Hadley CRU.

Dr. Roger Pielke Sr. 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…"*

Thus the fact that today, all three of these entities' Global Average Surface Temperature data portray the same basic pattern over the last 100 plus years cannot be taken as further evidence as to their individual credibility. See Figure II-1. Their data gathering and analysis efforts are clearly not independent. Moreover, accurately measuring Global Average Surface Temperature involves avoiding, and when that is not possible overcoming, numerous challenges. After the raw data with all its issues are collected, adjustments are made. Such adjustments are necessary not only for current period raw data but also possibly for previously reported historical data.

Figure II-1



Source: NOAA GHCN, NASA GISS & Hadley CRU

III. HISTORICAL TEMPERATURE DATA ADJUSTMENT

The adjustment of raw surface temperature data is clearly necessary to overcome numerous challenges. Perhaps the biggest challenge results from local factors. The earth's population has increased from 1 billion to over 7 billion since 1900 so that the surface temperature data suffers significant contamination by urbanization and other local factors such as land-use/ land-cover changes. These are typically called Urban Heat Island impacts. Also well documented are surprisingly poor instrument siting that subjects the surface temperature measurement instruments to heat sources that can significantly bias the results.

Moreover, even as some efforts increased to more accurately calculate GAST so as to better ascertain the degree of climate change, the geographic distribution and "reliability" of the data inexplicably worsened. There was a major station dropout (75% of the stations), which occurred suddenly around 1990. And, the remaining stations are disproportionally urban with 49% at airports. For more detail, see
thsresearch.files.wordpress.com/…/uncertainties-final1.pdf

Regarding data reliability, at about the same time, there was a significant increase in missing monthly data in the stations that remained in all countries. Up to 90% of stations in Africa and South America have missing months requiring infilling. Missing data and spikes have also been observed in the US data set. Changes in technology introduced new discrepancies through instrument biases and forced related changes in siting. In addition, over the past 100 plus years, the daily time of observation varied from location to location and often changed over time, which has a varying effect on calendar day highs and lows and for which appropriate adjustments to raw data must be made.

There are also large uncertainties in ocean temperatures, no small issue, as oceans cover 71% of the Earth's surface. Major questions persist about how much and when to adjust for changing coverage as well as measurement techniques from buckets to ship engine water intake, to moored and drifting buoys, and now ARGO diving buoys.

These ocean measurement issues may be the most significant limit to the accuracy in assessing GAST.

Former GISS Chief Scientist James Hansen called establishing a GAST "elusive" and stating that *"This can only be done with the help of computer models, the same models that are used to create the daily weather forecasts. We may start out the model with the few observed data that are available and fill in the rest with guesses (also called extrapolations) and then let the model run long enough so that the initial guesses no longer matter, but not too long in order to avoid that the inaccuracies of the model become relevant. - - - -"* Source: https://data.giss.nasa.gov/gistemp/faq/abs_temp.html

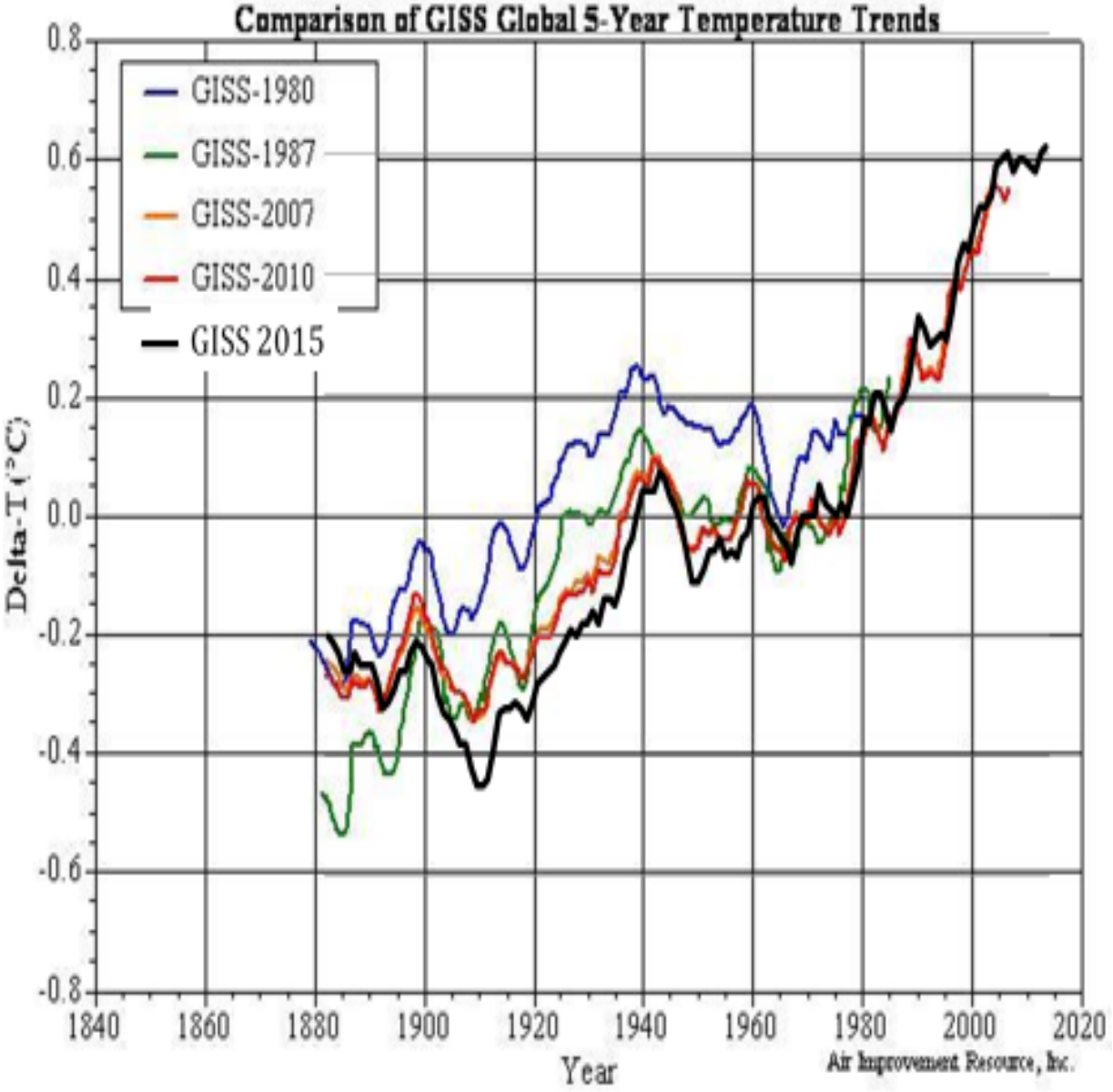
All of these challenges notwithstanding, calculation of GAST requires that, after the raw data are collected, some adjustments clearly must be made. For example, both Time of Observations and Urban Heat Island adjustments have been shown clearly to be necessary. It has been argued elsewhere that the *"adequacy"* of adjustments to historical GAST data has not been sufficient "to remove warming biases. *The overall conclusion of this report is that there are serious quality problems in the surface temperature data sets that call into question whether the global temperature history, especially over land, can be considered both continuous and precise. Users should be aware of these limitations, especially in policy-sensitive applications."* Source: https://notalotofpeopleknowthat.wordpress.com/2017/06/13/serious-quality-problems-in-the-surface-temperature-data-sets-ross-mckittrick/

In this report, the focus is on the changes that the three entities actually made to their previously reported historical data. The notion that some adjustments to historical data may have been needed is not challenged here. The basic question addressed is whether or not the *current depictions of the trend cycle patterns of GAST* data by NOAA, NASA and Hadley CRU are valid in light of other highly credible counter indications.

IV. ADJUSTMENTS TO HISTORICAL GAST DATA

In this section, the changes to historical GAST temperature data sets are shown. Figure IV-1 below shows NASA's GAST depictions over time. Focusing solely here on the period through 1980, the shift from a cyclical pattern to a more aggressive upward sloping linear trend pattern is obvious. Whether or not the GAST trend beyond 1980 is credible will be even more specifically dealt with in Section VI below.

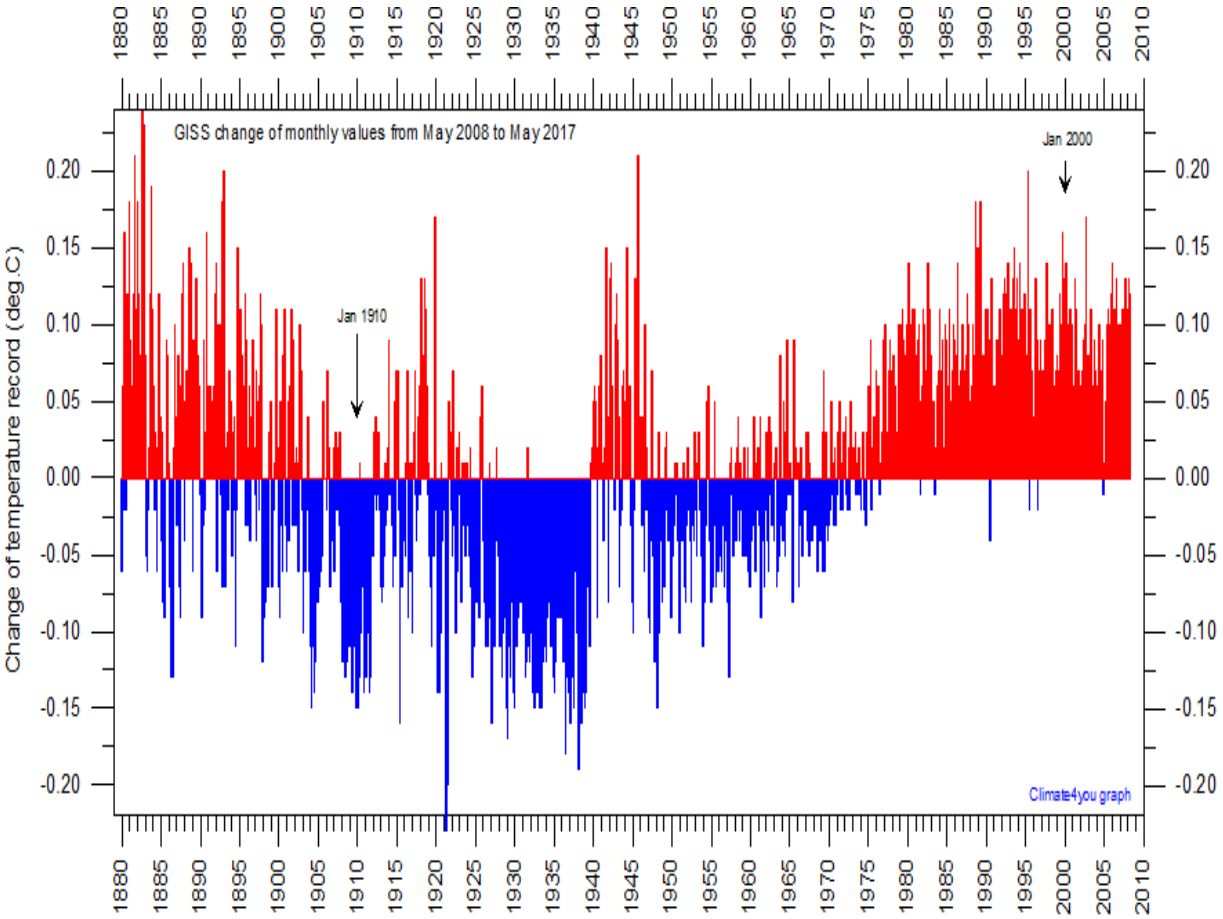
Figure IV-1



Source: GISS, and Air Improvement Resource, Inc.

In Figure IV-2 below is shown the net changes made to the historical data between May 17, 2008 and May 15, 2017. The changes made by NASA clearly removed the bulk of cyclical pattern from 1900 to 1980 in the original 1980 depiction of GAST (shown in blue) in Figure IV-1 above.

Figure IV-2



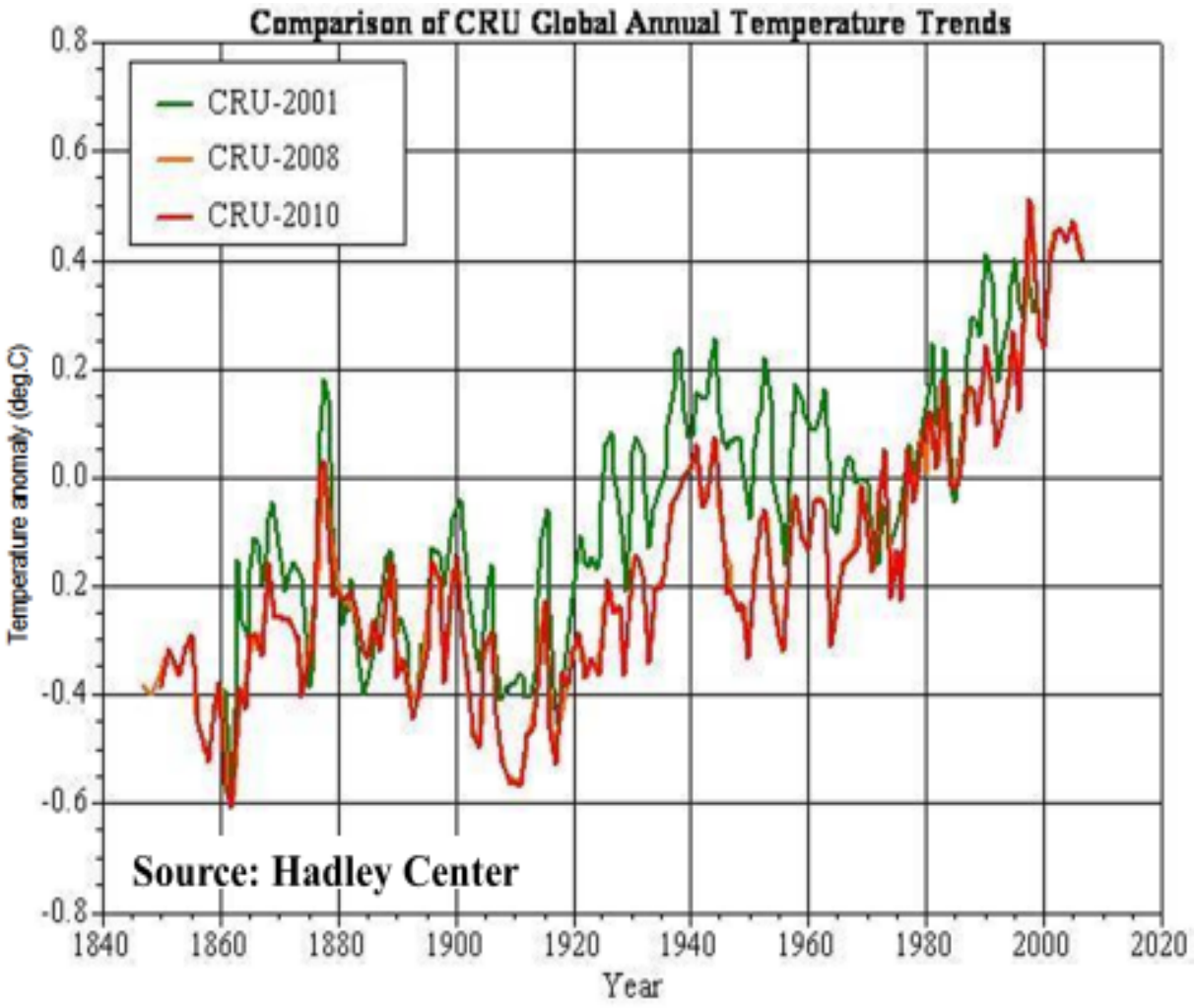
Maturity diagram showing net change since 17 May 2008 in the global monthly surface air temperature record prepared by the Goddard Institute for Space Studies (GISS), at Columbia University, New York City, USA. This temperature estimate extends back to January 1880. Last diagram update 15 May 2017.

Source: Climate4you update April 2017
http://www.climate4you.com/Text/Climate4you_April_2017.pdf
http://www.climate4you.com/, Global Temperatures, Temporal stability of global temperature measurements

To accomplish this result, in Figure IV-2 above, it is can be seen that the historical data changes made between May 17, 2008 and May 15, 2017 focused on reducing newly reported temperature data in the 1930s and increasing newly reported data beyond 1975. Such changes would serve to increase the slope of the linear trend in NASA's GAST data over entire period.

Figure IV-3 below shows the changes made by Hadley CRU from 2001 to 2010. Here again the changes as recently as between 2001 and 2010 served to dampen the earlier cyclical pattern.

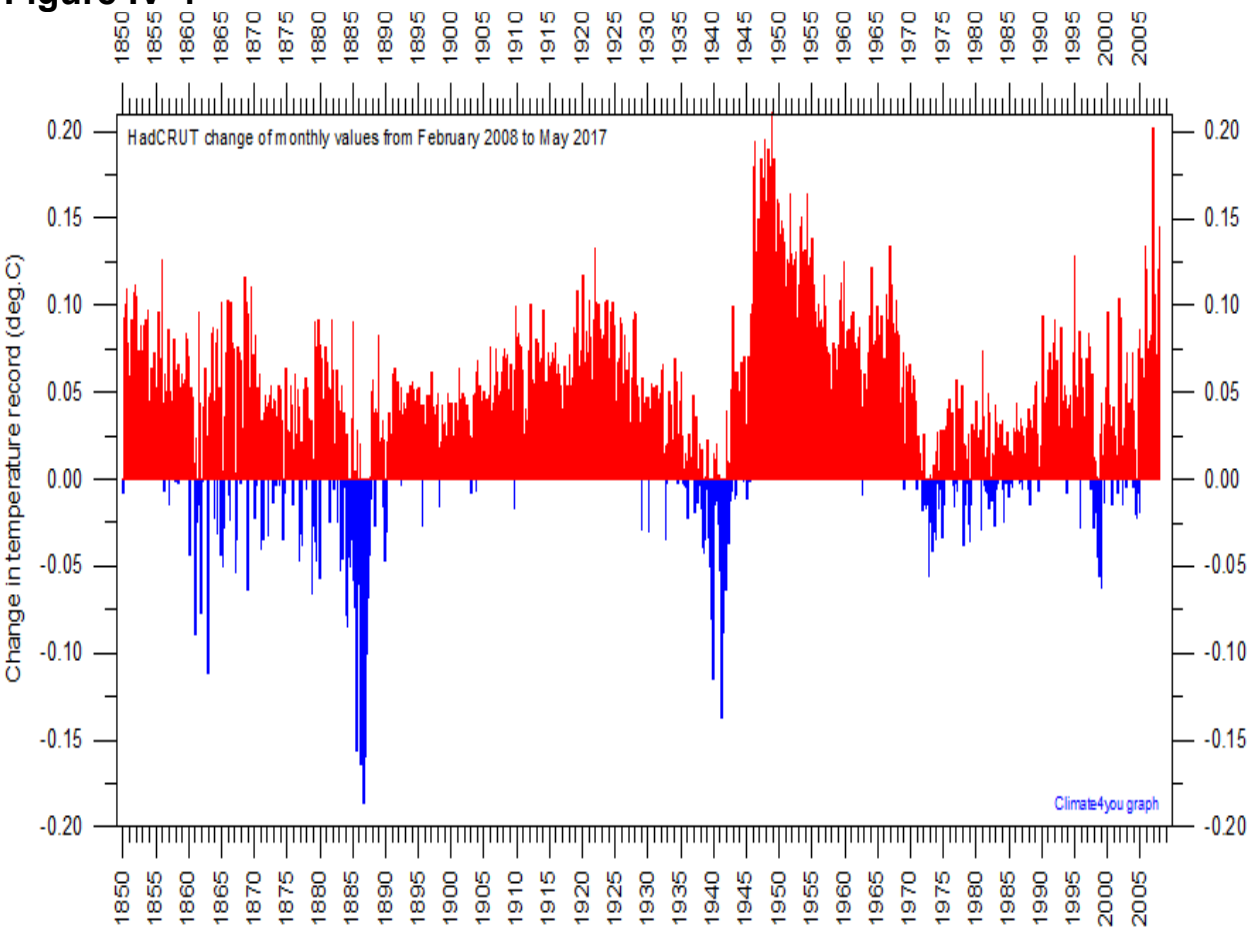
Figure IV-3



Source: Hadley CRU

Then, as shown in Figure IV-4, between February 2008 and May 2017, the vast bulk of the changes have served to raise temperatures, with particular emphasis on the 1950s and 60s, as compared to the February 2008 reported Hadley GAST data. A look back at the 2008 depiction in Figure IV-3 suggests why such 1950-60 increases might have been made. Note also why the targeted reduction around 1940 might have been made to the reported February 2008 data.

Figure IV-4

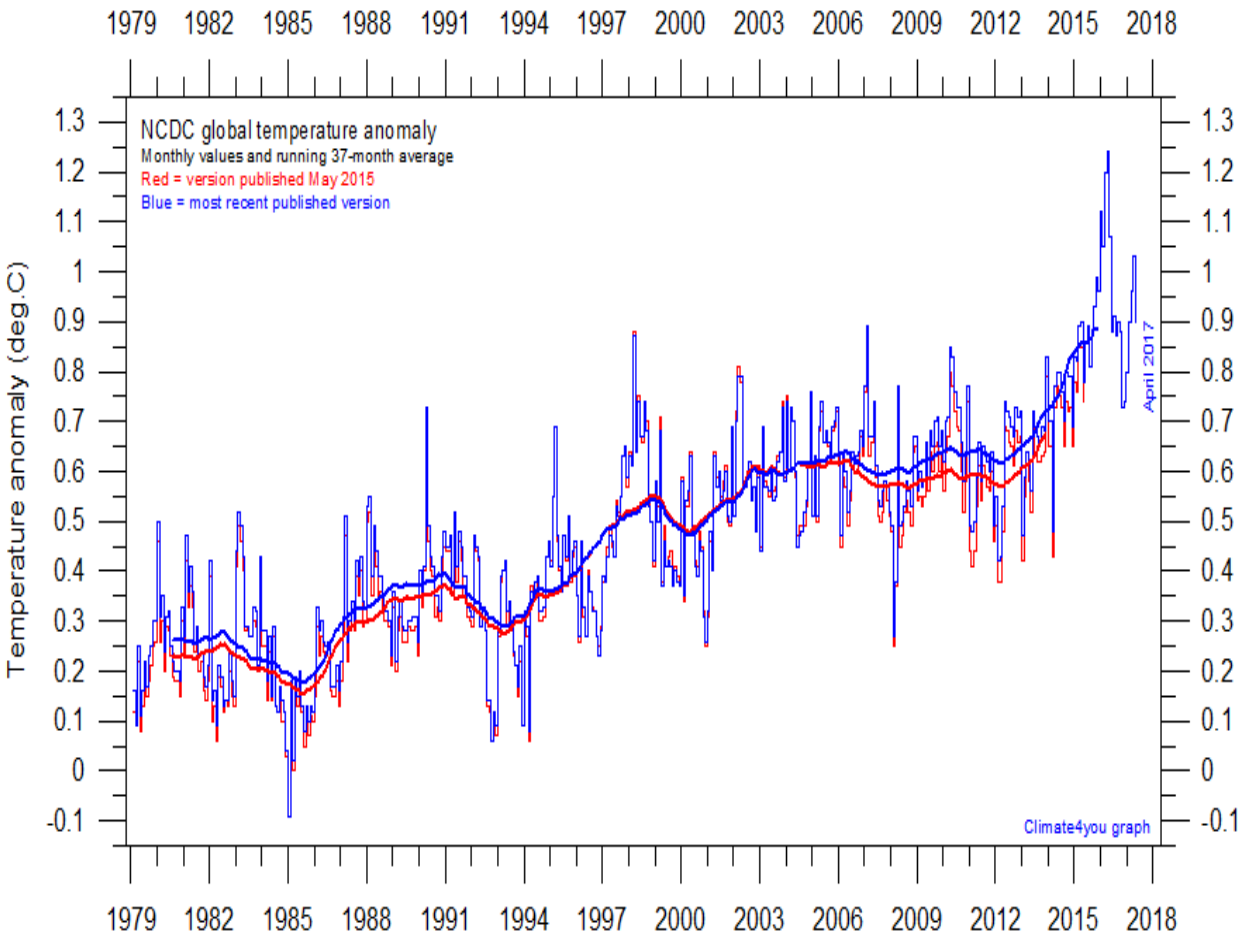


Maturity diagram showing net change since 25 February 2008 in the global monthly surface air temperature record prepared by the Hadley Centre for Climate Prediction and Research and the University of East Anglia's Climatic Research Unit (CRU), UK. This temperature estimate extends back to January 1850. Last diagram update: 3 May 2017.

Source: http://www.climate4you.com/, Global Temperatures, Temporal stability of global temperature measurements

As shown in Figure IV-5 below, as recently as the May 18, 2017 release, NOAA again made significant changes to their historical data reported only two years previously in May 2015.

Figure IV-5

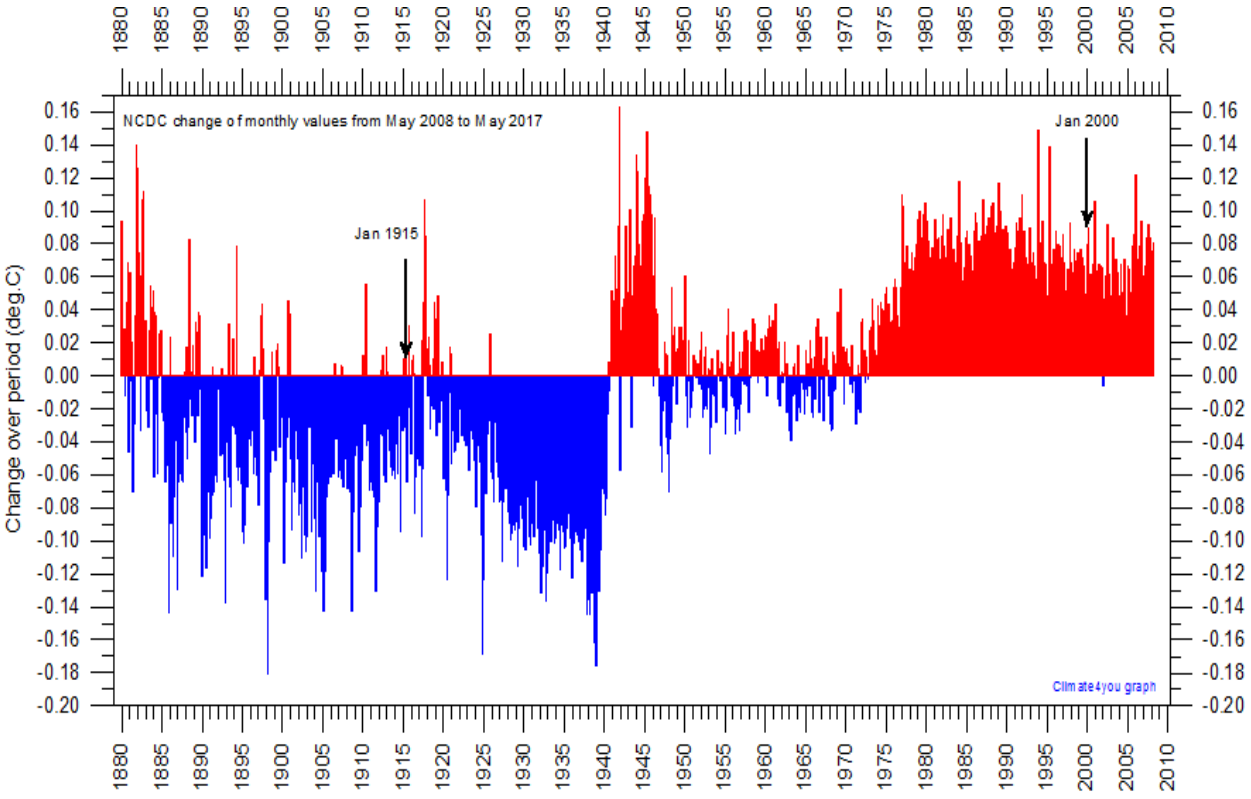


Global monthly average surface air temperature since 1979 according to the National Climatic Data Center (NCDC), USA. This time series is calculated using land surface data from the Global Historical Climatology Network (Version 2) and sea surface temperature anomalies from the United Kingdom MOHSST data set and the NCEP Optimum Interpolated SSTs (Version3; note version change on May 2, 2011). The thick line is the simple running 37 month average, nearly corresponding to a running 3 yr average. Base period: 1880-2016. Last month shown: April 2017. Last diagram update: 18 May 2017.

Source: Climate4you update April 2017
http://www.climate4you.com/Text/Climate4you_April_2017.pdf

In Figure IV-6 below, it can be seen that NOAA's historical data changes made between May 17, 2008 and May 18, 2017 served to rotate the GAST trend so as to be more steeply upward sloped. **In fact, to quote from the Climate4you author of the graph: "*The net result of the adjustments made are becoming substantial, and adjustments since May 2006 occasionally exceeds 0.1°C. Before 1945 global temperatures are generally changed toward lower values, and toward higher values after 1945, resulting in a more pronounced 20th century warming (about 0.15°C) compared to the NCDC temperature record published in May 2008. Last diagram update: 18 May 2017.*"**

Figure IV-6



Maturity diagram showing net change since 17 May 2008 in the global monthly surface air temperature record prepared by the National Climatic Data Center (NCDC), USA.

Source: Climate4you update April 2017
http://www.climate4you.com/, Global Temperatures, Temporal stability of global temperature measurements

V. GAST DATA VALIDATION

Clearly the historical GAST data adjustments that have been made have been dramatic and invariably have been favorable to Climate Alarmists' views regarding Global Warming. The question now is whether the latest versions of GAST data by NOAA, NASA and Hadley are credible for policy analysis, or even climate modeling, purposes.

As has been clearly shown in Section IV above, the consequences of the changes made to previously reported historical versions of GAST data have been to virtually eliminate the previously existing cyclical nature of their previously reported trend cycle patterns. The notion that there was a 1930 and 40s warm period followed by a mid-1970 cool period now gets lost in the noise so to speak. In this section, particularly credible country-specific data will be used to test the validity of the now almost nonexistence of this cyclical pattern in the current versions of GAST[2].

Clearly, if the historical data adjustments that were made to the GAST data <u>inappropriately</u> removed this cyclical pattern, then all three of the current versions of GAST must be considered invalid.

Beginning with the U.S., a number of charts showing the aforementioned cyclical pattern in available U.S. city data is immediately informative. See Figures V-1 to V-4 and note the 1930s and 40s warming and 1970s cooling cyclical pattern in literally all of them.

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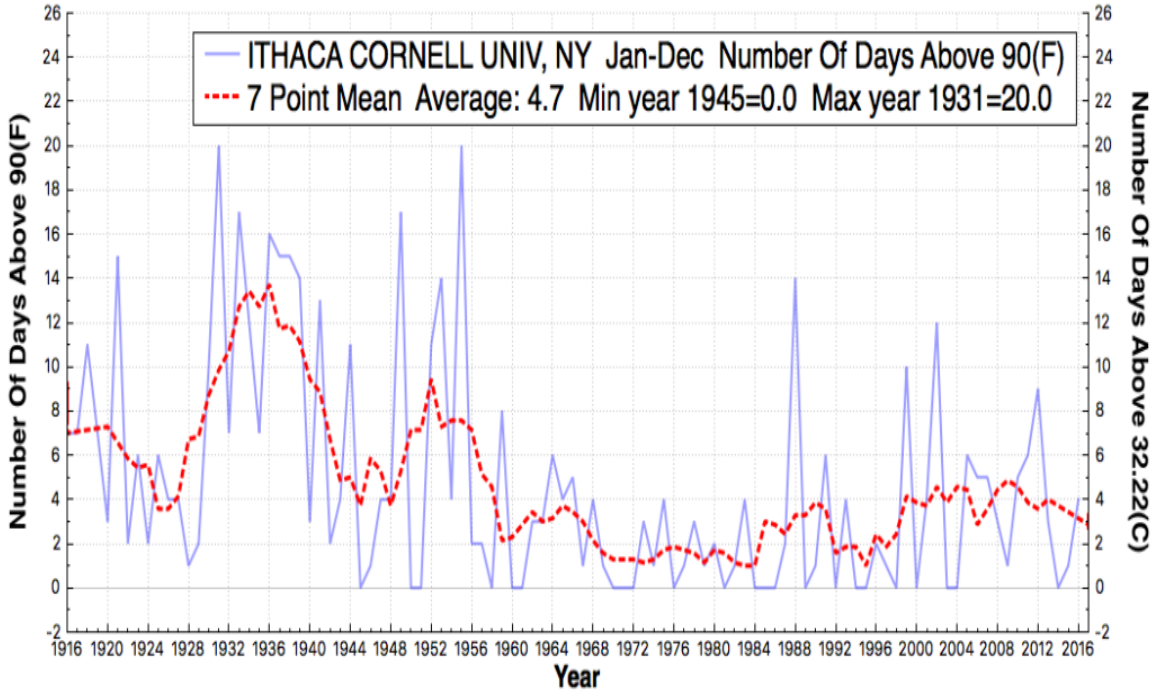
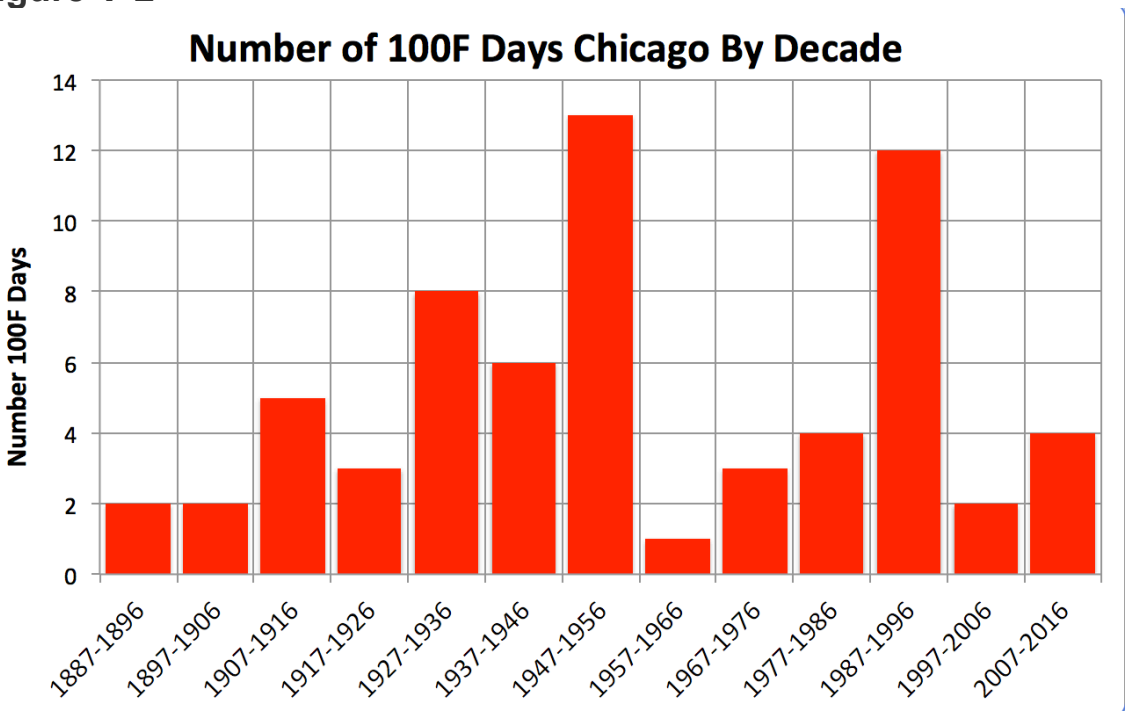
[2] Nearly all of the temperature data shown in this Section should be thought of as "raw" data; but the data presented focus on daily maximums, rather than daily averages –maximums are far less affected by UHI impacts over time. As discussed in Section III above, such UHI adjustments are critical in that without them, all other things equal, the data would show positive linear trends due solely to the UHI impacts. However, for the purposes of this analysis, if all the raw temperature data show a strong cyclical pattern, say, with peaks in the 30s & 40s and troughs in the 1970s, such findings must be considered robust in that such cycles would be even more significant relative to the linear trend lines in properly UHI adjusted raw data.

Figures V -1



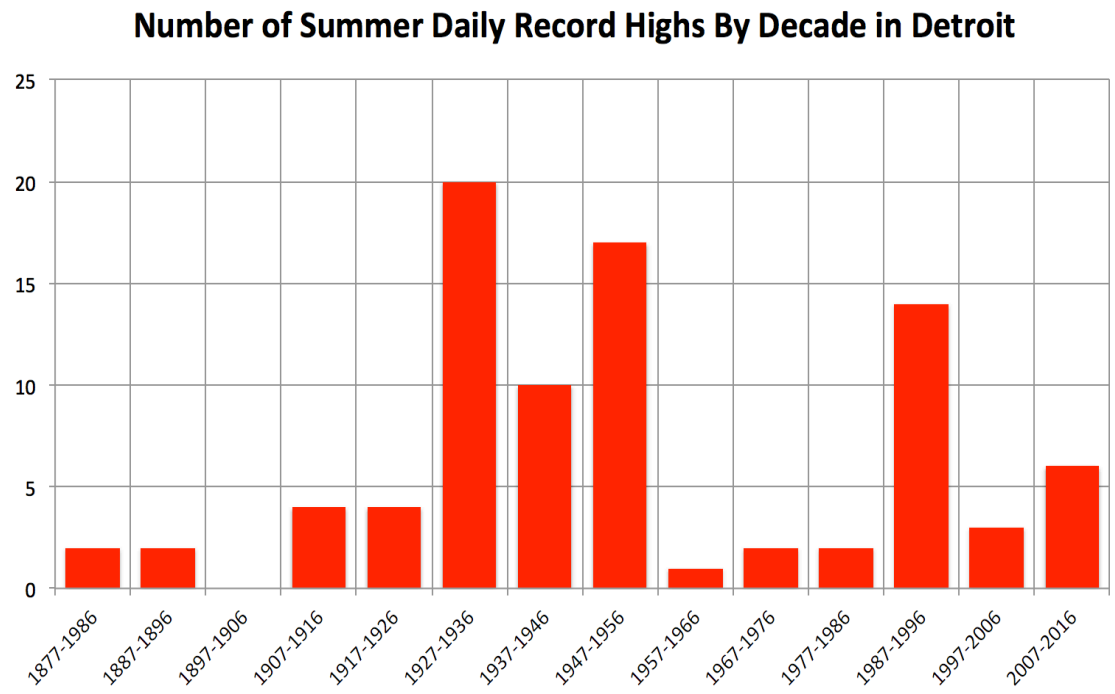
Source: NERCC

Figure V-2



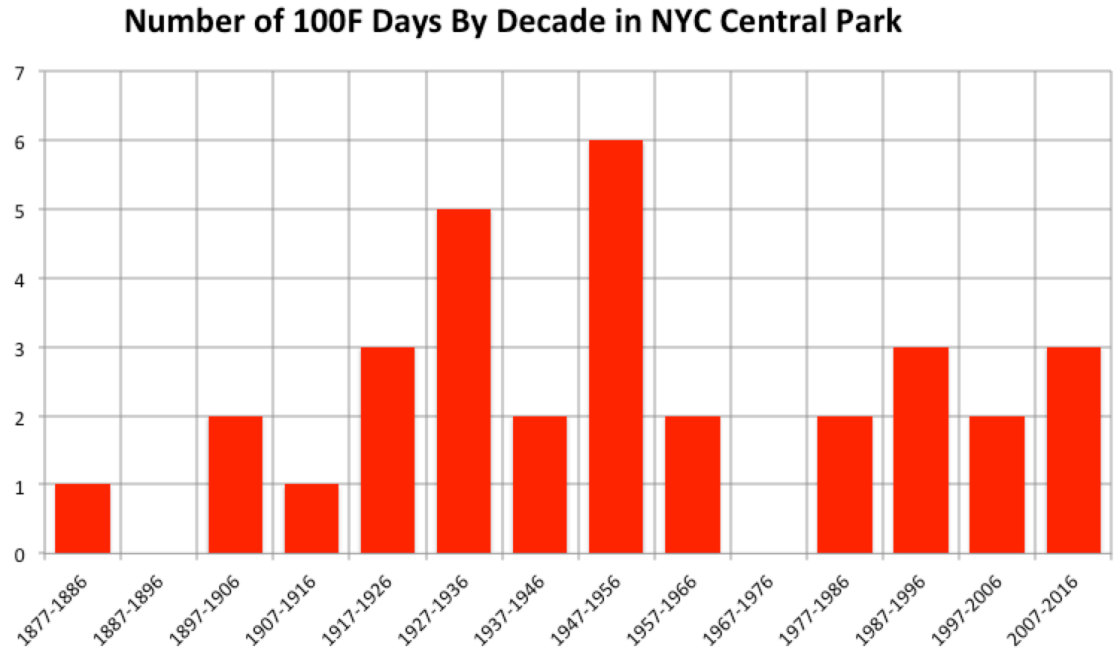
Source: NOAA NWS

Figure V-3



Source: NOAA NWS

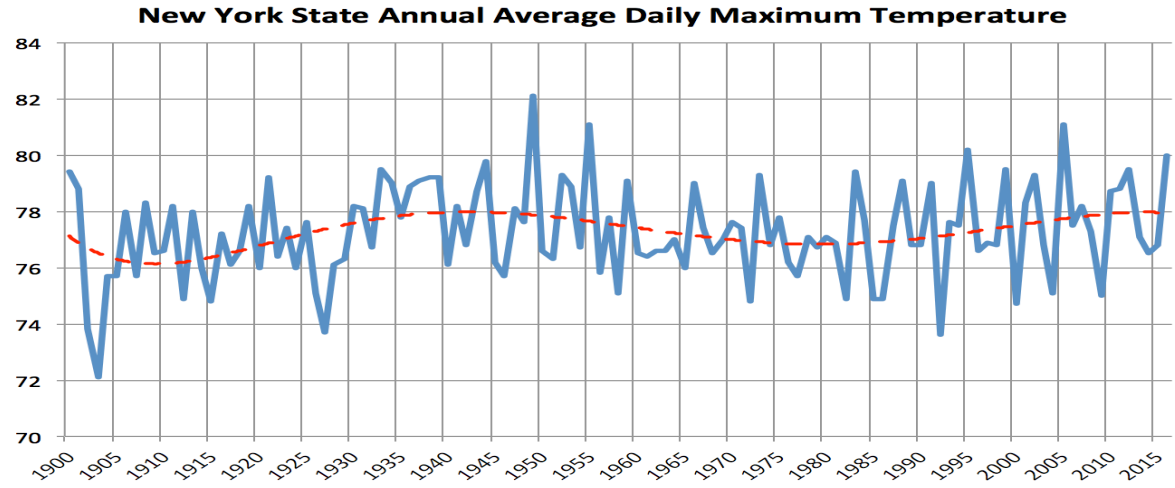
Figure V-4



Source: NOAA NWS

The aforementioned cyclical pattern is also obvious in the New York State data shown in Figure V-5 below. Maximum temperatures are shown since they do not reflect the urban heat island contamination evident in the minimum temperatures because the atmosphere tends to be better mixed during the day.

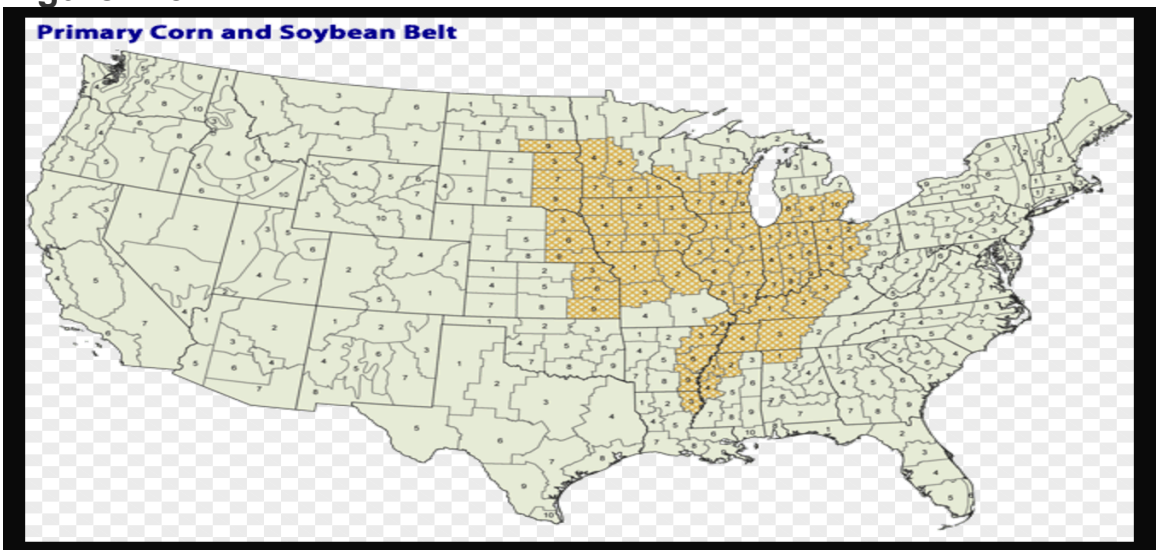
Figure V-5



Source: NOAA Climate at a Glance

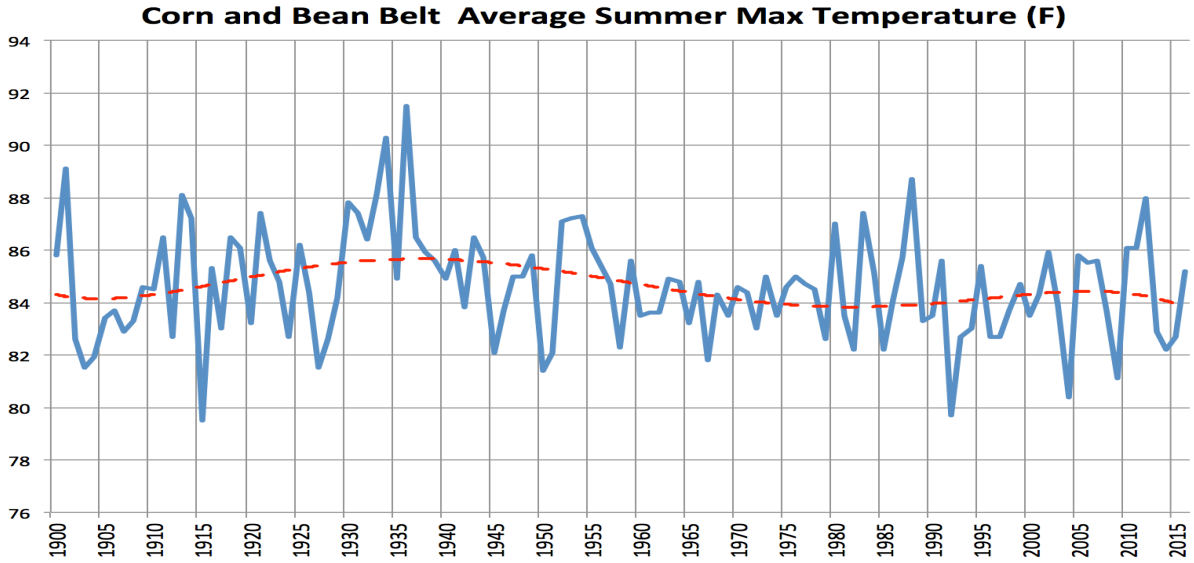
Across the "Corn and Bean Belt" defined in Figure V-6, the same cyclical pattern is also shown in Figure V-7.

Figure V-6



Source: NOAA Climate at a Glance

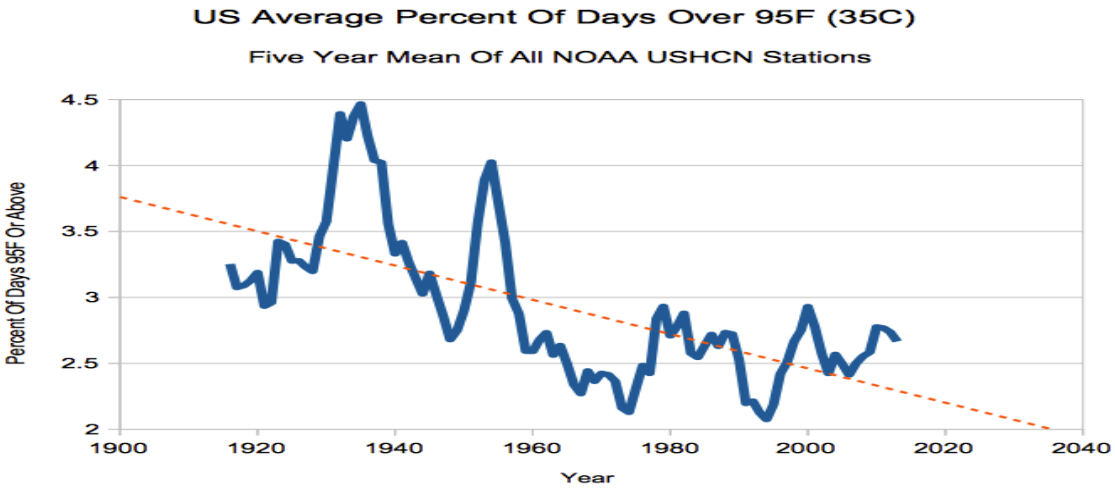
Figure V-7



Source: NOAA Climate at a Glance

Nationally, as shown in Figure V- 8, the percent of hot days has also plummeted, which is inconsistent with a rising GAST trend pattern over the period 1900 to date.

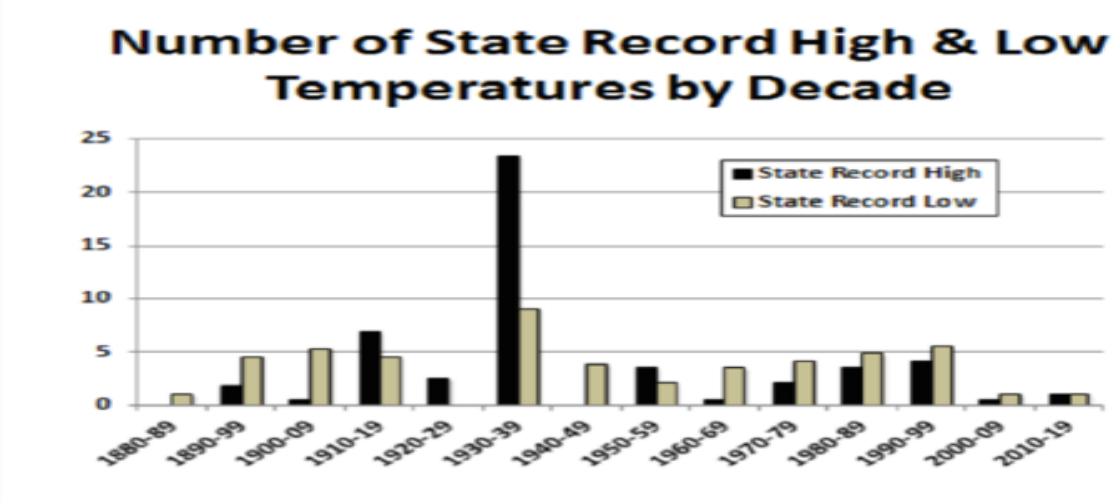
Figure V-8



Source: NOAA USHCN

This fact is borne out by Figure V-9 below, which implies that roughly 70% of the state **current** high temperature records were set prior to 1940. And, that over the last 5 full decades, there were more cold records set than hot.

Figure V-9

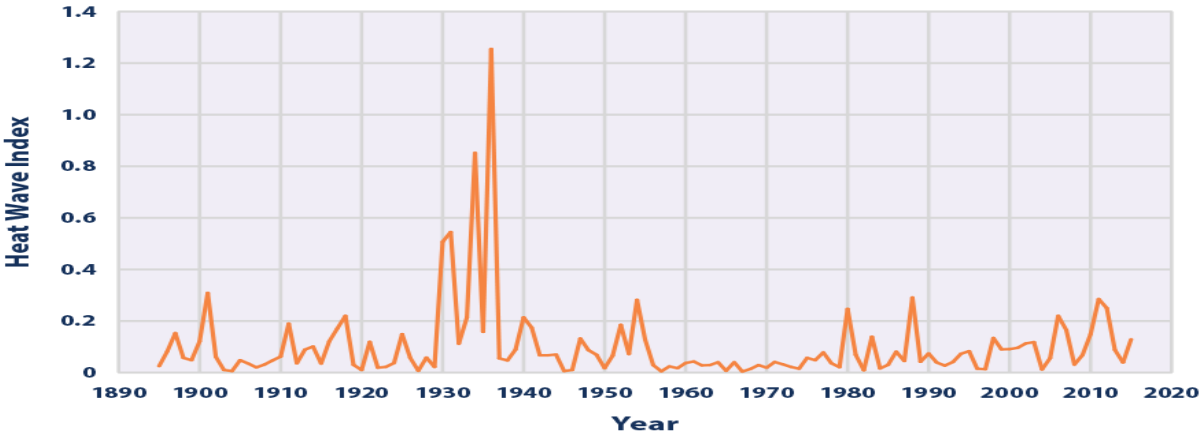


Source: NOAA NATIONAL CLIMATIC DATA CTR., State Climate Extremes Committee, Records, https://www.ncdc.noaa.gov/extremes/scec/records

The final proof that the U.S. surface temperature trend pattern reflected in GAST should contain this particular cyclical behavior is given in Figure IV-10 showing the U.S. Annual Heat Wave Index. These data cover the lower 48 states.

Figure V-10

U.S. Annual Heat Wave Index, 1895–2015

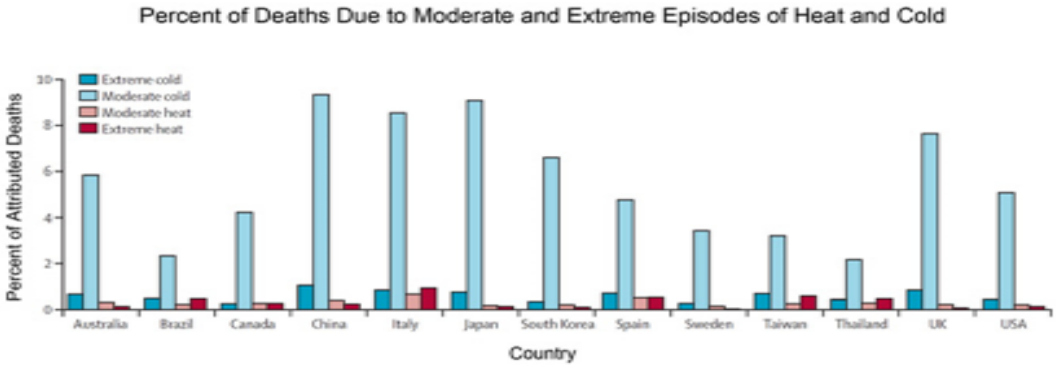


Source: https://www.epa.gov/climate-indicators/climate-change-indicators-high-and-low-temperatures Heat waves are defined as warm spells of 4 days in duration with mean temperature exceeding the threshold for a 1 in 10 year event (Kunkel et al, 1999) using a log transformation.

Incidentally, Figure IV-11 below shows cold to be far more dangerous than hot weather.

Figure V-11

Fraction of all-cause mortality attributable to moderate and extreme hot and cold temperature by country. Extreme and moderate high and low temperatures were defined with the minimum mortality temperature and the 2.5 and 97.5th percentiles of temperature distribution as cutoffs. (Source: Gasparrini et al., 2015).

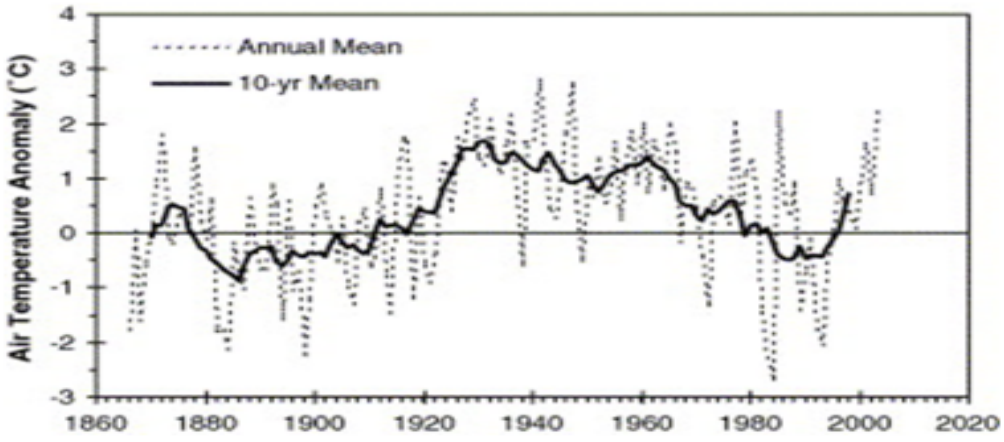


Source: Gasparrini et al, 2015

Of course, it could be that only the U.S. data exhibits this cyclic pattern and that other regions in, say in the Northern Hemisphere do not. But this is not the case, as shown in Figures V-12 to V14.

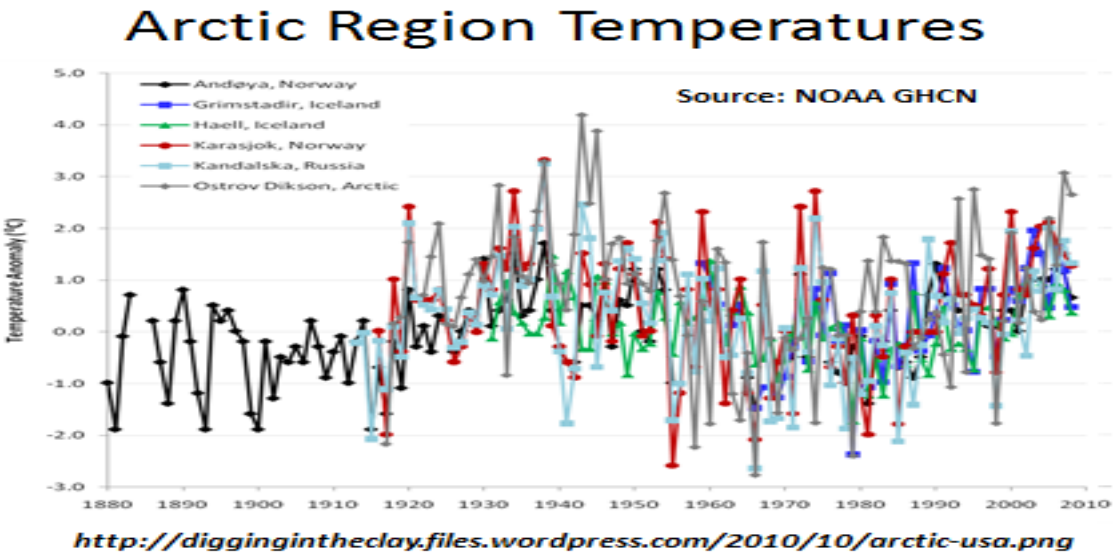
Figures V-12

The annual and 10-year running mean of the air temperatures at Nuuk in West Greenland.



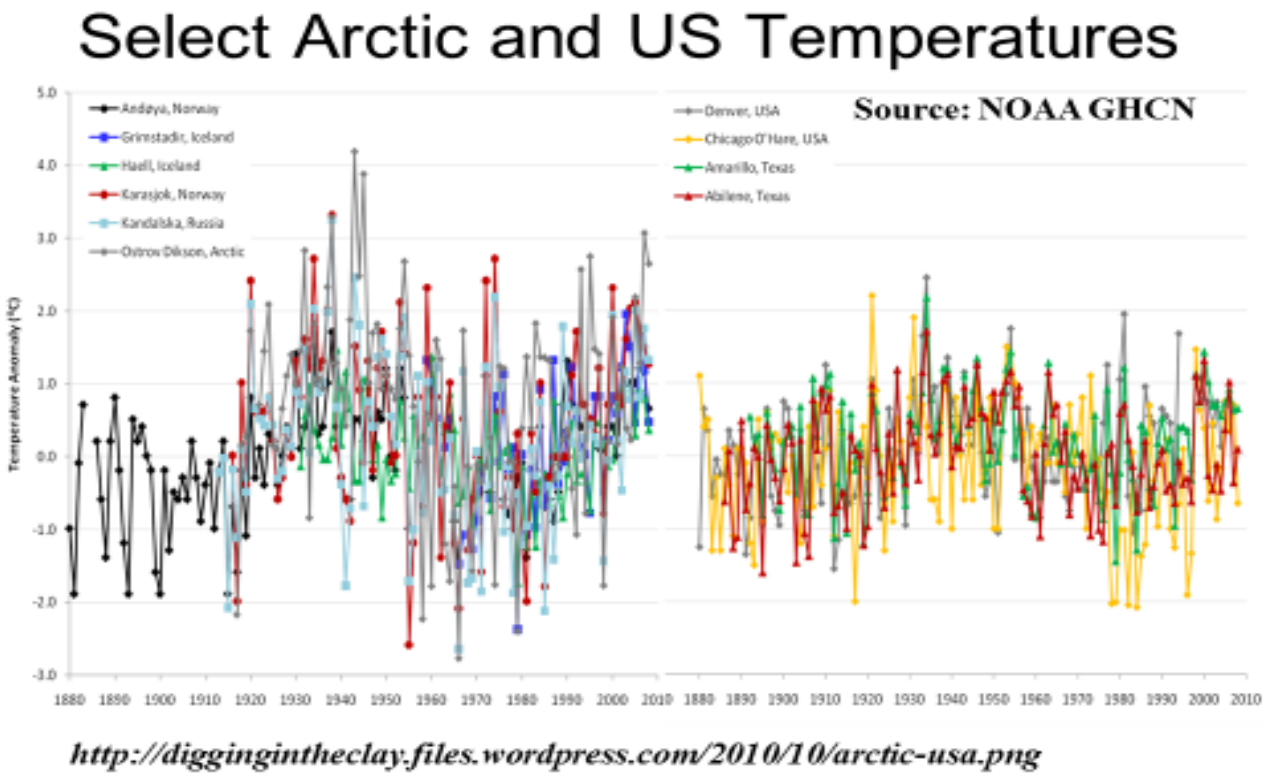
Source: NASA GISS

Figures V-13



It is telling that, in fact, the Arctic city cyclical trend pattern is similar to that of the selected U.S. cities as shown in Figure V-14 below.

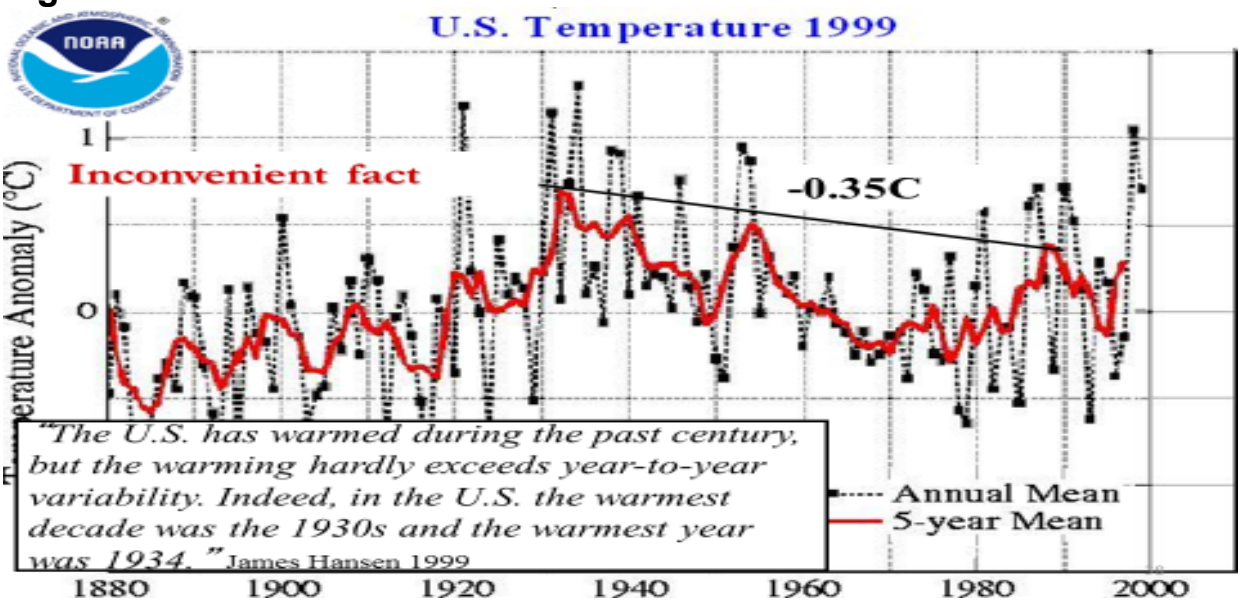
Figure V-14



Source: NOAA GHCN

Thus, it seems that beyond any doubt, the U.S. data reflected in the Global Average Surface Temperature data calculation should contain the cyclical patterns shown above. In fact, as shown below in Figure V-15, as of 1999, in NOAA data, it did!

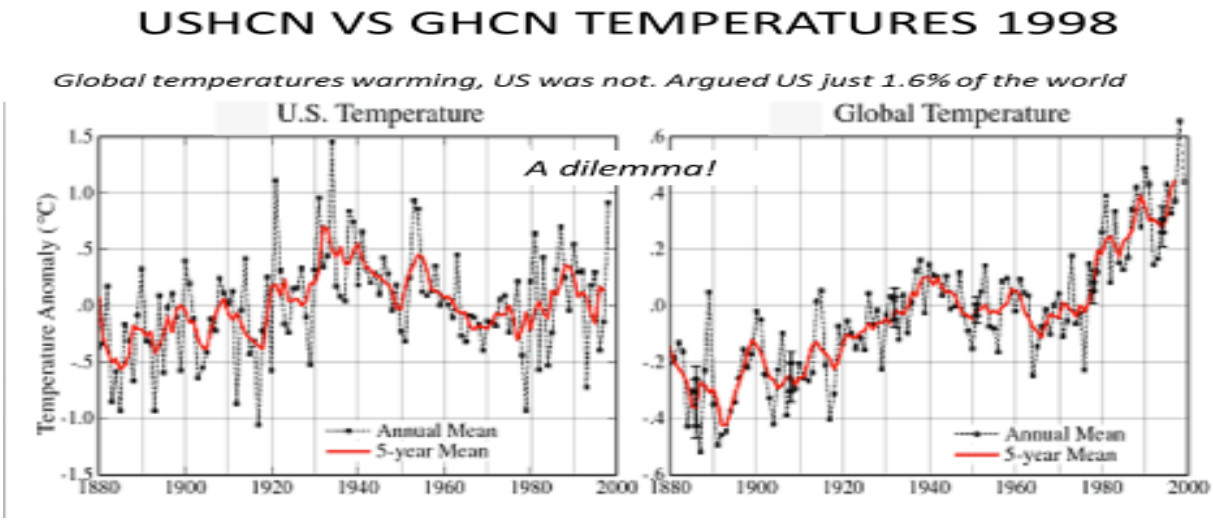
Figure V-15



Source: USHCN

However, as shown in Figure V-16 below, this caused a dilemma for those believing the global warming crisis was real. **G**AST data showed record warming, while the U.S. data did not.

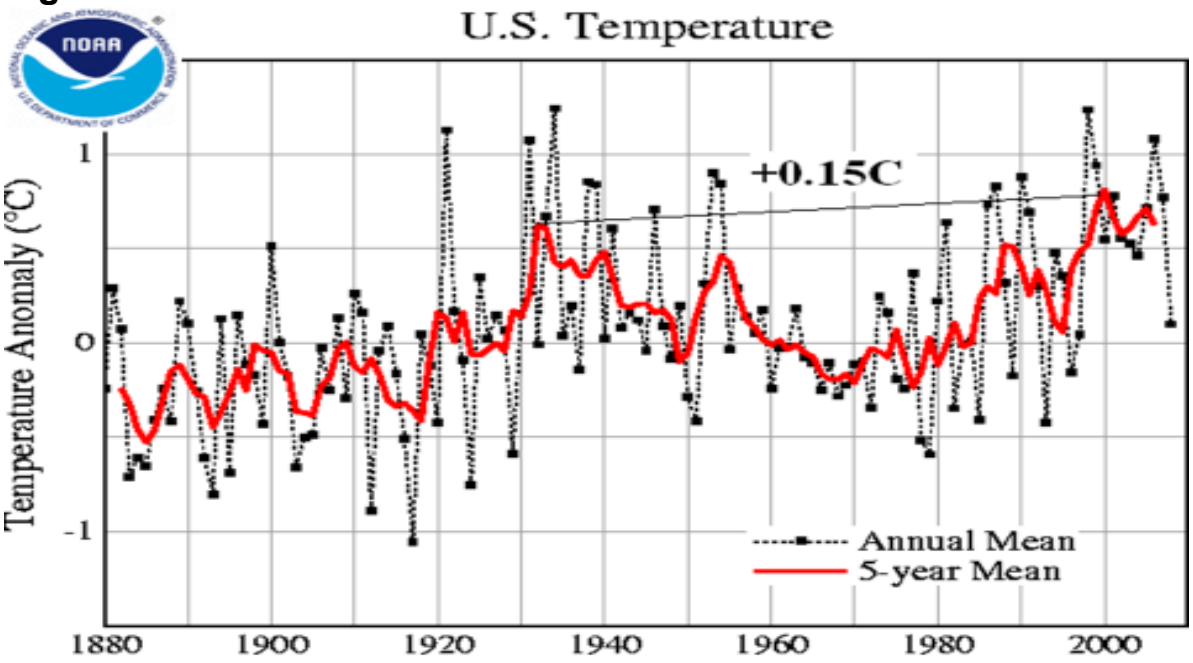
Figure V-16



Source: USHCN, GHCN

The solution: the U.S. historical data was adjusted as shown in Figure V-17.

Figure V-17



Source: USHCN

Some feel that "The Fix" to USHCNv2 temperature data shown in Figure V-17 above involved removing, or at the very least improperly adjusting for, the quite real and significant UHI impacts.[3]

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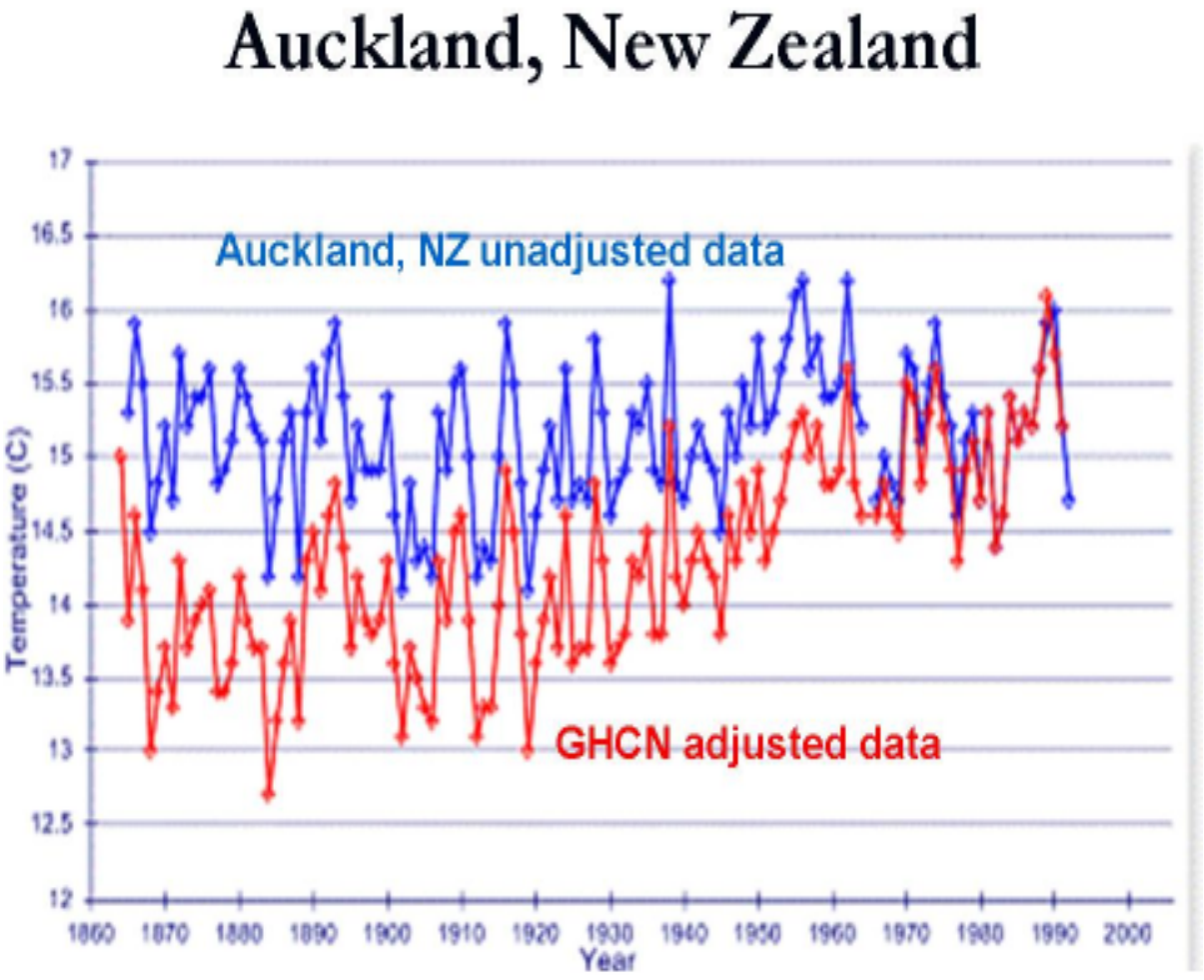
[3] Regarding the importance of proper UHI adjustment, NOAA's Tom Karl et al stated: - - - - *"trends of surface air temperature computed predominantly from [urban] station data are likely to have a serious warm bias… The average difference between trends [urban siting vs. rural] amounts to an annual warming rate of 0.34°C/decade. … The reason why the warming rate is considerably higher [may be] that the rate may have increased after the 1950s, commensurate with the large recent growth in and around airports. …. Our results and those of others show that the urban growth inhomogeneity is serious and must be taken into account when assessing the reliability of temperature records." See Karl et al, 1986 and 1988. See also: A Critical Review of Global Surface Temperature Data Products*
https://notalotofpeopleknowthat.wordpress.com/2017/06/13/serious-quality-problems-in-the-surface-temperature-data-sets-ross-mckittrick/

Finally, the Southern Hemisphere temperatures have been less cyclical than temperatures in Northern Hemisphere. So, typically, in the Southern Hemisphere, there was no significant cycle to remove, and the raw data were simply adjusted to have a far more aggressive rising trend. An example of this is illustrated in Figure V-19 below.

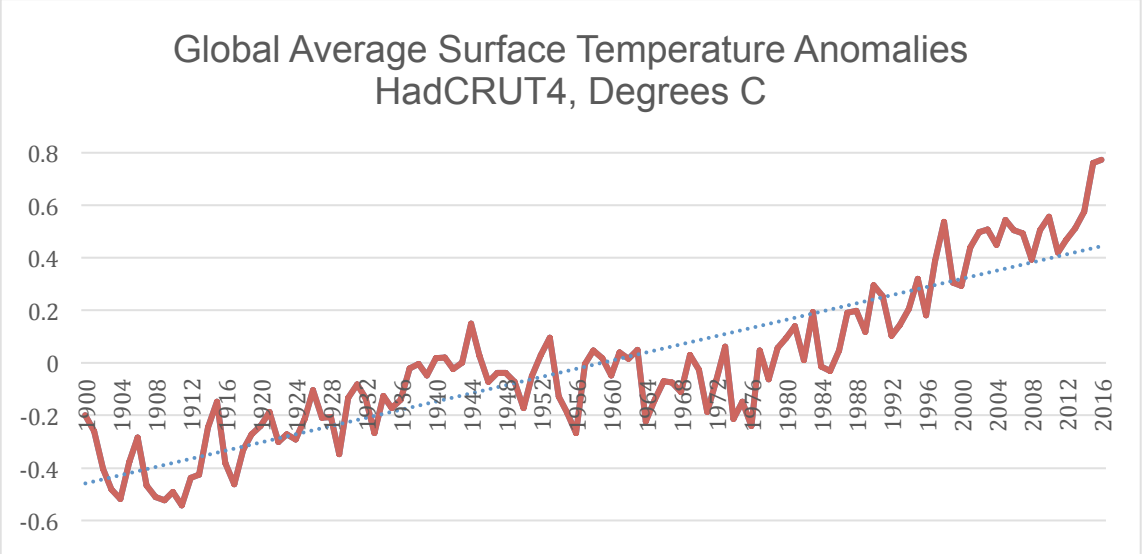
Figure V-19



Source: NOAA GHCN

The analysis above raises grave doubts that any of the GAST data sets are a credible representation of reality. The significant cyclical pattern in the earlier reported data has very nearly been "adjusted" out. As shown in Figure V-20, the cycle is now just noise around a linear trend line in the Hadley GAST data.

Figure V-20



Source:
http://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/download.html

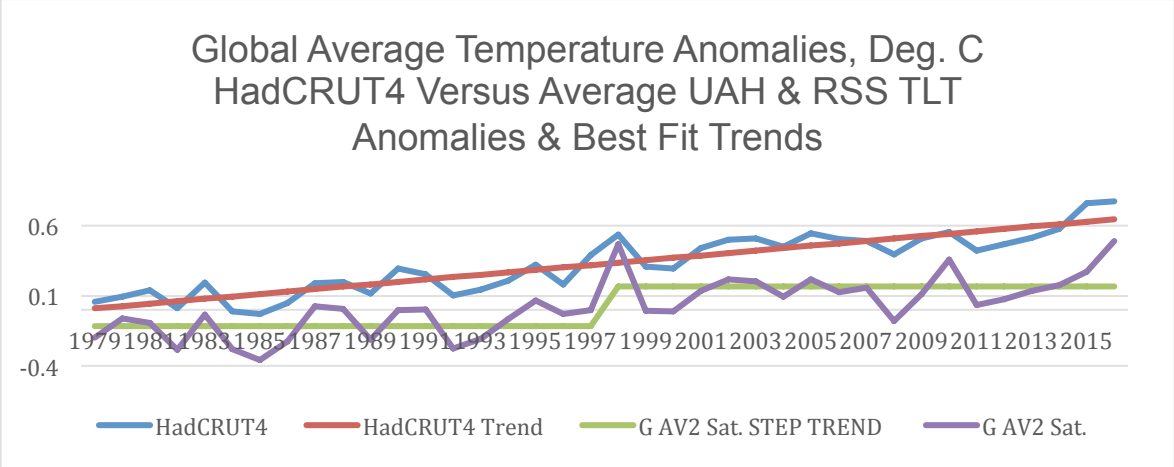
Furthermore, beginning in 1977, now the steepening of the upward sloping trend in this GAST data is very dramatic, if real.

VI. GLOBAL AVERAGE TEMPERATURE: SURFACE Vs SATELLITE

This Section deals with whether or not GAST data are credible over the period 1979 to date. Given the non-scientific nature of the surface temperature data adjustment process that has been documented above, there is absolutely no reason to believe that the GAST Trend from 1979 to date is credible. However, in 1979 satellite data became available and can be used to validate the GAST Trend since then.

Figure VI-1 below shows the Hadley CRUT4 temperature data and its steeply upward sloping linear Trend line versus the Average of UAH & RSS Lower Troposphere Satellite Temperature data and its 1998 Step Trend line. Comparing the two very different trend lines, the question is which best represents the actual trend in global average temperature. They could both be wrong, but only one can be correct. And based on the analysis contained herein, surely it is the one that shows a nearly 20 year pause. Only the satellite data have a sufficiently regular and global spatial coverage to claim a temperature measurement unencumbered by UHI and other complicating issues.

Figure VI-1



Source:
http://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/download.html
http://data.remss.com/msu/monthly_time_series/RSS_Monthly_MSU_AMSU_Channel_TLT_Anomalies_Land_and_Ocean_v03_3.txt
http://www.nsstc.uah.edu/data/msu/v6.0/tlt/uahncdc_lt_6.0.txt
The “Best Fit Trend” is that having the highest Adjusted R Square.

VII. SUMMARY & CONCLUSIONS

In this research report, the most important surface data adjustment issues are identified and past changes in the previously reported historical GAST data are quantified. While the notion that some "adjustments" to historical data might need to be made is not challenged, logically it would be expected that such historical temperature data adjustments would sometimes raise these temperatures, and sometimes lower them. This situation would mean that the impact of such adjustments on the temperature trend line slope is uncertain. However, each new version of GAST has nearly always exhibited a steeper warming linear trend over its entire history.

That was accomplished by systematically removing the previously existing cyclical temperature pattern. This was true for all three entities providing GAST data measurement, NOAA, NASA and Hadley CRU.

As a result, this research sought to validate the current estimates of GAST using the best available relevant data. This included the best documented and understood data sets from the U.S. and elsewhere as well as global data from satellites that provide far more extensive global coverage and are not contaminated by bad siting and urbanization impacts. Satellite data integrity also benefits from having cross checks between UAH and RSS as well as with Balloon data.

The conclusive findings of this research are that the three GAST data sets are not a valid representation of reality. In fact, the magnitude of their historical data adjustments, that removed their cyclical temperature patterns, are **totally inconsistent** with published and credible U.S. and other temperature data. Thus, it is impossible to conclude from the three published GAST data sets that recent years have been the warmest ever –despite current claims of record setting warming.

Finally, since GAST data set validity is a necessary condition for EPA's GHG/CO_2 Endangerment Finding, it too is invalidated by these research findings.