



# An Inspection of NOAA's Global Historical Climatology NetWork Verson 3 Unadjusted Data

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## Introduction

NOAA released Version 1 of its Global Historical Climatology Network (GHCN) database in the early 1990s under the sub organization The National Climatic Data Center (NCDC.) Version 2 was released in 1997 and Version 3 was released in May of 2011. In 2015 the name of the NCDC was changed to The National Centers for Environmental Information (NCEI.) At the present time a Version 4 of the database is being developed.

This report is an inspection of the NOAA-NCEI's Version 3 (V3) of the GHCN's Unadjusted monthly temperature data, where the designation 'Unadjusted' is what has earlier been called 'Raw', that is 'as received' from the agencies/centers that collect the respective Station data. There are 7280 Stations included in the database whose locations are worldwide. NOAA-NCEI states it is the same set of Stations as for Version 2 (V2.)

Two additional inspection reports are planned, one for the Adjusted data, and another that compares the V2 data to the V3 data.

## The Nature of The Inspection

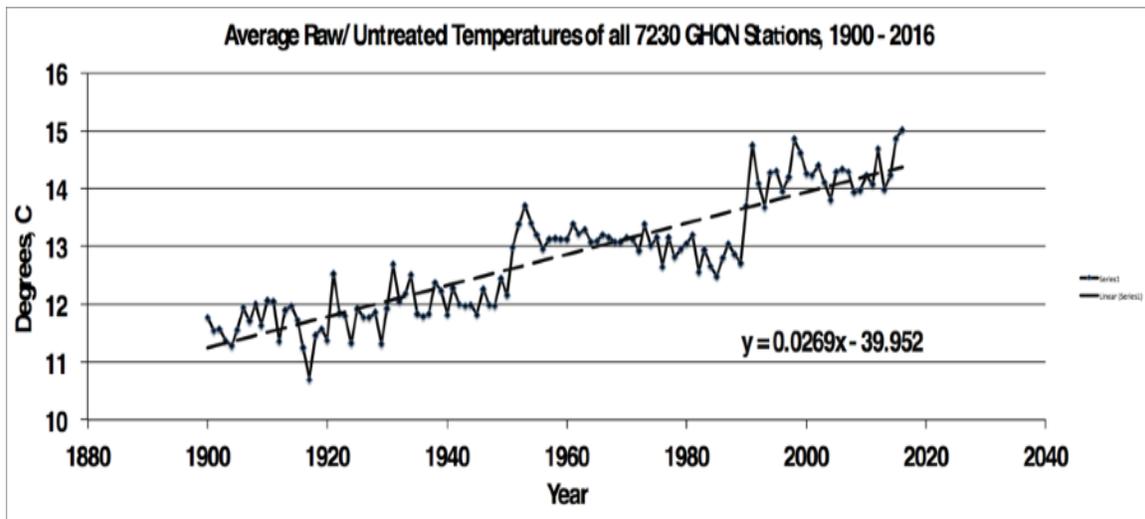
The Unadjusted data are taken as provided by NOAA-NCEI and two aspects are inspected for the 1900 – 2016 timeframe:

- 1 –The temperature trends of Rural, Suburban, and Urban Station locations are inspected as well as whether or not those locations are at Airports affects the trends.
- 2 – The effects on temperature trends by the number of years within the 1900 – 2016 timeframe Stations reported data is inspected. The number varies from as little as 10 years to as much as 117. Furthermore, for Stations in which the number of years of reporting is less than the timeframe the reporting may be early in the timeframe for some and late for others.

## Yearly Average Temperature for All Stations (Rural, Suburban, and Urban)

Sixty (60) of the 7280 Stations have no identification (Rural, Suburban, or Urban and whether or not at an Airport) of the nature of their locations. Only the 7220 that do have such identification are included in this inspection.

Figure 1 is the year-by-year average of all 7220 GHNC Stations for the 1900 – 2016 timeframe. The dashed line is a linear regression fit to the data. Its slope, the trend rate, is 2.7 degree Celsius per 100 years. This is about twice that NOAA recently determined for the last half of the Twentieth Century (Ref 1) and within the range predicted by the Intergovernmental Panel on Climate Change (Ref 2.)

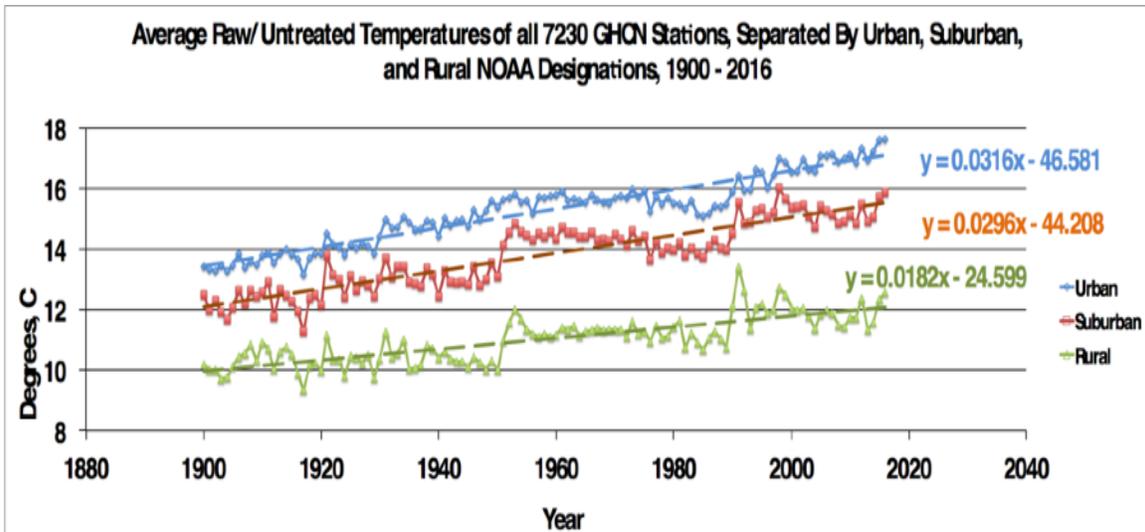


**Figure 1** – Year-by-Year average for the 7220 GHNC Stations that have identification of the nature of their locations.

A specific challenge to the reported GHNC data, albeit primarily in regards to the Adjusted data, has been that Urban Heat Island Effect (UHIE), which means an Urban site causes the temperature to be higher than it would be if the location were Rural, causes a higher trend rate of temperature. We will inspect the GHNC Raw data to determine if such an effect may exist.

## Separation of Rural, Suburban, and Urban Located Stations

Figure 2 is a plot of year-by-year temperature averages for the 1900 – 2016 timeframe for the 1947 Urban, 1401 Suburban, and 3872 Rural Stations, where such location designation is made by NOAA-NCEI.



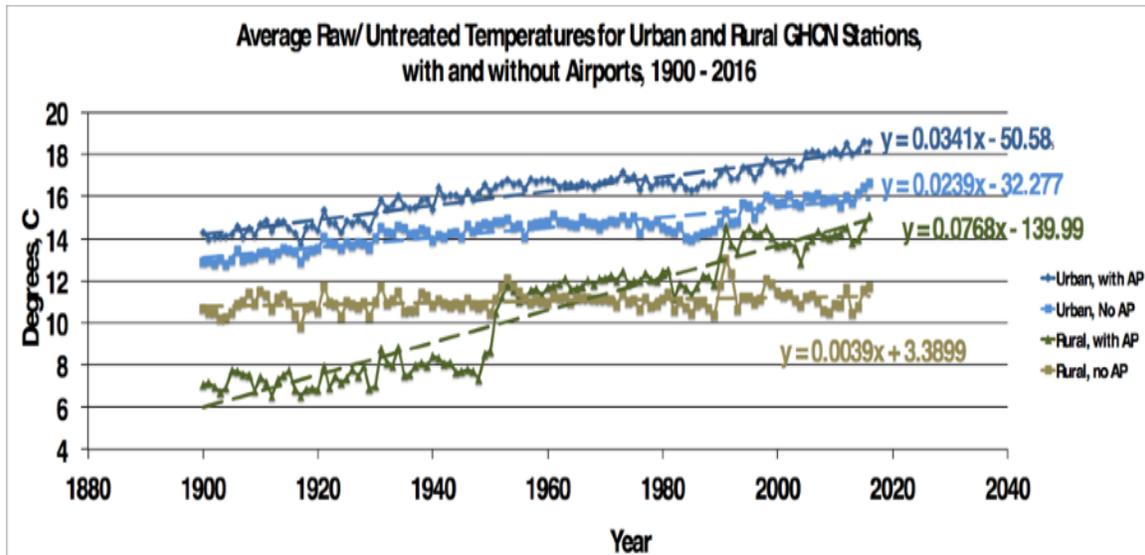
**Figure 2** – Year-by-Year average for the 1947 Urban, 1401 Suburban, and 3872 Rural GHNC Stations where such location designation is made by NCIE, NOAA.

The slopes of the respective linear regression fits, trend rates, for the Urban, Suburban, and Rural locations are 3.2, 3.0, and 1.8 degrees C per century. Perhaps the significant comment is that for the Urban environment the temperature trend rate is 1.74 times that of the Rural. This comparison of temperature trend rates suggests there is a sound basis for an UHIE.

Since NOAA-NCEI also designates whether or not the Urban, Suburban, and Rural Stations are at Airports that aspect should also be considered.

### **At or Not At Airports**

Figure 3 plots the year-by-year temperature averages for the 1900 – 2016 timeframe for the GHNC Urban and Rural Stations, at and not at Airports. The Suburban Stations are not included because they are not necessary for observing the effects of whether or not a Station is located at an Airport. According to NOAA-NCEI 908 Urban Stations are at Airports and 1029 are not while 969 Rural Stations are at Airports and 2883 are not.



**Figure 3** – Year-by-Year for GHNC Urban and Rural Stations, with and without Airports

Figure 3 demonstrates an unintentional, but fundamental, problem with NOAA-NCEI's determination of whether or not a GHNC Station is at an Airport. The problem is that the determination is based on whether or not Stations were located at Airports when the V3 (V2 ?) model came into being. At some point in time prior to the existence of V2 or V3 it is likely, if not entirely certain, that a majority of these Stations were not at Airports because the respective Airport did not exist at those Station locations, or Stations changed their locations to that of an Airport. So the temperature data for Rural GHNC Stations designated by NOAA-NCEI to be at Airports is at the very least misrepresentative.

There is still another problem with the data for Rural Stations designated to be at Airports. At about the year 1950 a large portion of the Rural Stations designated to be at Airports stopped reporting data. Moreover, at about 1950 an entirely new set of Rural Stations said to be at Airports began reporting data. The issue is exacerbated in that the set of Rural Stations prior to 1950 reported data that was about 2 degrees less than those reporting after 1950. Thus there is a reasonable assumption that in terms of accuracy confidence can only be had for temperature trend rate for Rural Stations at Airports after 1950. The slope for the associated linear regression fit for 1950 – 2016 is 5.4 degrees C per century.

The GHNC Stations NOAA-NCEI has designated as NOT being at an Airport have a much better continuity from 1900 up to and including 2016. So it is more reasonable to assume the data in Figure 3 for 'Rural, no AP' can be viewed with some confidence. That being the case then the temperature trend rate in Rural areas, without man-caused heat surroundings such as Airports, has been 0.39 degrees C per century. (For the time frame 1950 – 2016 the trend rate is -0.1 degree C per century.) This is far less than that advertised by NOAA-NCEI or the IPCC.

## **The Effect of GHNC Station Continuity for 1900 – 2016**

An inspection of the GHNC data indicates that the number of years Stations have reported data during the 1900 – 2016 timeframe varies from zero (0) years to every year of the timeframe (117.) Moreover, the set of Stations reporting data for a particular year can vary very significantly from year to year. The consequence is that the average temperature from year to year may be different not because the 'global' temperature has changed but rather that the set of Stations changes from year to year.

In this section the effect of requiring Stations to have reported data for more than 25, 50, and 75 percent and for 100 % of the 117 years is inspected. Herein this percentage is called 'Extent,' i.e. Extents of > 25, > 50, > 75, and =100 %.

The numbers of GHNC Rural and Urban Stations, at and not at Airports, for the Extents are summarized in the following table.

|     | Number of Stations |        |        |        |         |
|-----|--------------------|--------|--------|--------|---------|
|     | All                | > 25 % | > 50 % | > 75 % | = 100 % |
| R-A | 969                | 661    | 346    | 134    | 34      |
| R-x | 2903               | 2119   | 1266   | 792    | 243     |
| U-A | 908                | 728    | 476    | 207    | 106     |
| U-x | 1099               | 853    | 533    | 305    | 44      |

Figure 4 (U, x) and Figure 4 (U, A), are the respective data for the 1900 – 2016 timeframe for GHNC Urban Stations not at and at Airports.

In Figure 4 (U, x), Urban Stations not at Airports, the trends suggest there is little effect of Extents up to and including >50 %. The temperature trend is an increase of 2.4 degrees C per century. For an Extent of > 75 % the temperature trend in an increase of 1.5 degrees C per century. Though a challenge may be made to the use of only Stations with Extents > 75 %, 305 Stations out of a total of 1099 or 28 %, a rebuttal may be "if the matter is 'global' then why would any portion of the globe be significantly different than any other portion, if indeed the matter is 'global.'"

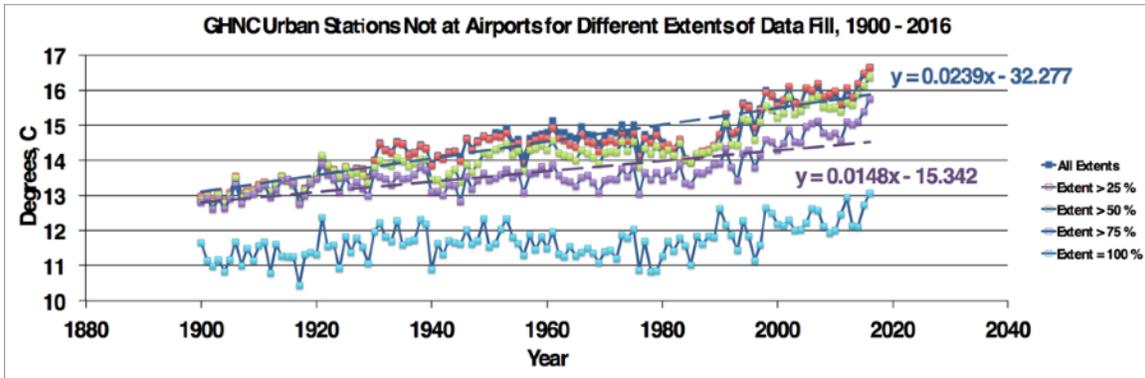


Figure 4 (U, x) – Temperature averages for Urban Stations not at Airports

Figure 4 (U,A) is a plot of data for GHNC Urban Stations located at Airports. For Extents All, > 25 %, and > 50 % the temperature trend is an increase of 3.5 degrees C per century. For > 75 %, or 23 % of the total GHNC Stations at an Airport, the trend rate is 1.1 degree C per century. So for GNHC Urban Stations, both at and not at Airports, the trend rate is an increase that is significantly less for the >75 % Extent. As in previous section, that discussed the inspection of Stations at and not at Airports, the problem for the smaller Extents perhaps is that Stations with smaller number of years of data promote a larger temperature trend rate rather than any actual global change in temperature because the short and irregular report periods are disruptive on the averages. The matter may be one of data set ‘quality.’

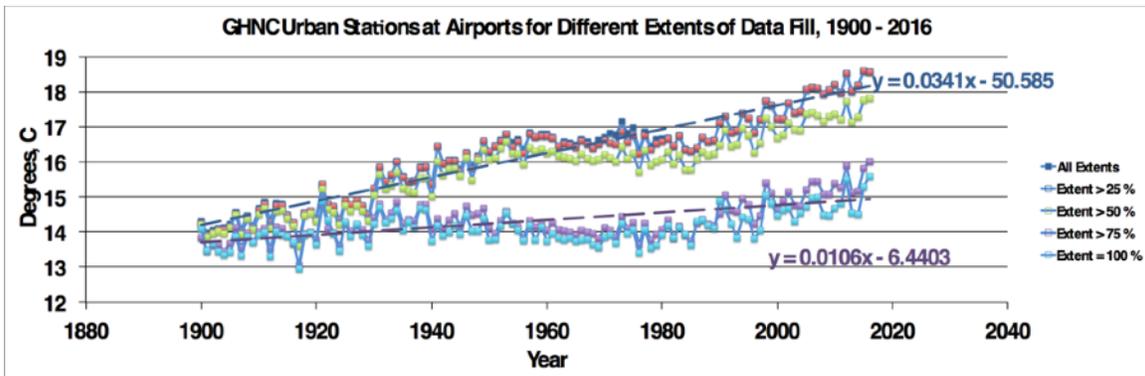


Figure 4 (U, A) – Temperature averages for Urban Stations at Airports

Figure 4 (R, x) are the data for GHNC Rural Stations that are not at Airports. In the preceding section of this report a plausible assumption was that it is likely these Stations have never been at an Airport. For the All, >25 %, > 50 % Extents the trends are much the same, a value of 0.39 degrees C per century. This is the same temperature trend rate found in the prior section. For < 75 % the rate of change is 0.06 degrees C per century.

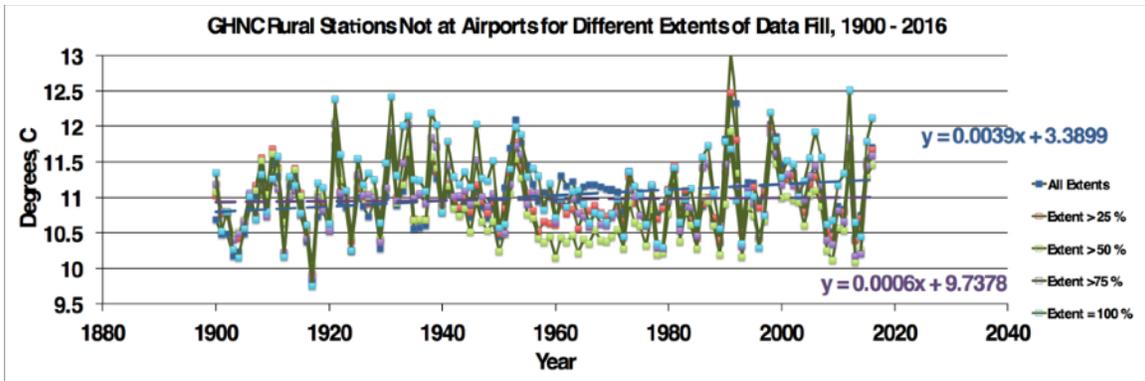


Figure 4 (R, x) – Temperature averages for Rural Stations not at Airports

Finally there are the GHNC Rural Stations at Airports. For the Extents of All, >25 %, and > 50 % there is a discontinuity at about the year 1950. The assessment for why this is the case is the same as in the prior section of this inspection report. For an Extent > 75 % there is no discontinuity and the trend rate is 1.14 degrees per century. The comparison of this trend rate to that for GHNC Stations not at an Airport and with Extents > 75 % (0.06 degrees C per century) does suggest being located at an Airport causes the rate of change to be much larger and possibly suggests a false high indication of actual temperature trends.

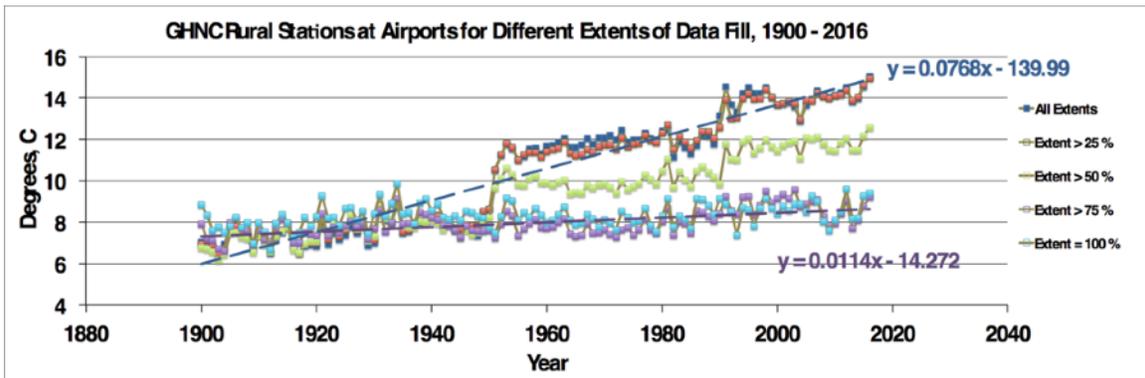


Figure 4 (R, A) - Temperature averages for Rural Stations at Airports

## Summary

What the reader draws from this data inspection is left to the reader. Whether not the data set of the entire 7220 GHNC Station set is somewhat suspect in that for many (or much) of the Stations the data are for only short periods of time and often without overlap, thus causing disruption in the over all temperature trends, is a legitimate question of data quality. The rate of temperature trends for larger Extents appears to be much less than that which NCEI, NOAA and the IPCC reports based on the entire set of 7280 GHNC Stations.

## **References**

1 - Possible artifacts of data biases in the recent global surface warming hiatus , <http://science.sciencemag.org/content/348/6242/1469.full>

2 - IPCC Predictions: Then Versus Now, <http://www.climatecentral.org/news/ipcc-predictions-then-versus-now-15340>