GISS vs Raw Temperatures for Lebanon, Missouri

Gary Wescom, 30 December 2010

With all the concern about Global Warming, I decided to check on what the records show for my small part of the world. I live near Lebanon, Missouri. This is a small town, only recently breaking the 12,000 population number. It is also quite rural. The nearest other town large enough to have its own gas station is 15 miles away. Urban Heat Island effect should be fairly minor. Even now, the Lebanon 2W official temperature station is about a mile outside town.

I was most familiar with warming descriptions based upon GISS data. Having been an instrumentation technician in the early part of my career, I naturally was interested in looking at how the temperature data was collected and verifying that the GISS data corresponded well with what was recorded. It is not that I didn't trust the GISS information but rather it was simple due diligence to make the check. Besides, I'm retired and the weather that week was too cold for working outside.

The first step was to get the historic temperature data for Lebanon 2W. I found it available at the USHCN web site in both a daily and a monthly text format. I downloaded the daily file and wrote a small C program to convert it into a simplified comma delimited format with Excel formatted dates.

I then set about comparing the high and low temperature values from the USHCN file with those on the NCDC PDF images of the original hand written forms. I am embarrassed how easy it was to make that comparison. A few months earlier, before I realized that the text format file was available, I had already tediously manually entered the data from the PDF images for the first half of the 20th century. My hand collected data and the USHCN data matched for the dates I had manually entered and visual inspection checks against the NCDC PDF files for later years also showed a match.

Once I had validated the contents of the downloaded USHCN data, I converted it into monthly values using simple averaging. Figure 1 shows what that data looks like in an Excel line graph.

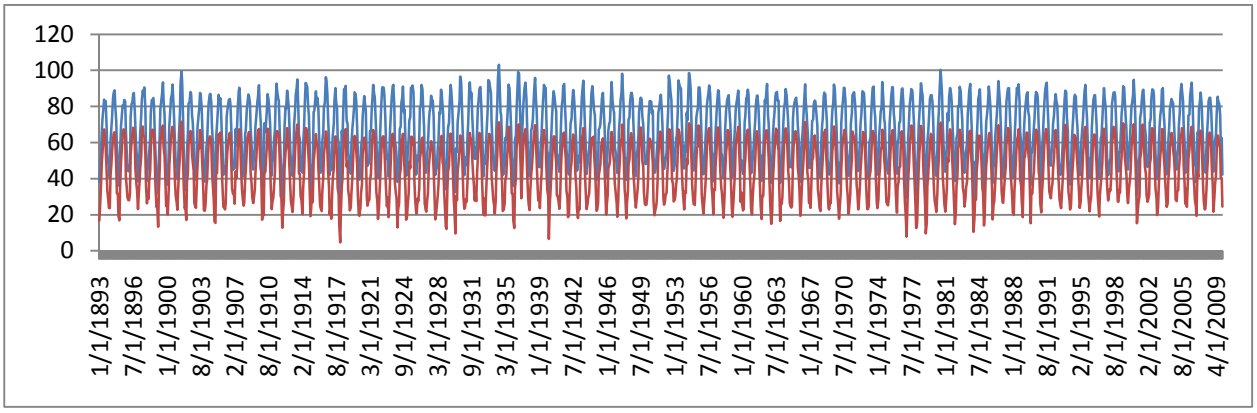

Figure 1: USHCN Lebanon 2W hi/lo (Degrees F)

However, most climate discussions prefer using the average or mean of the high and the low for each day. That is obviously not a true average temperature for each day but is more convenient to deal with

than for high and low separately. Figure 2 shows that data. As is obvious from the graph, month to month temperature variation are simply too great to notice a trend smaller than several degrees per century.

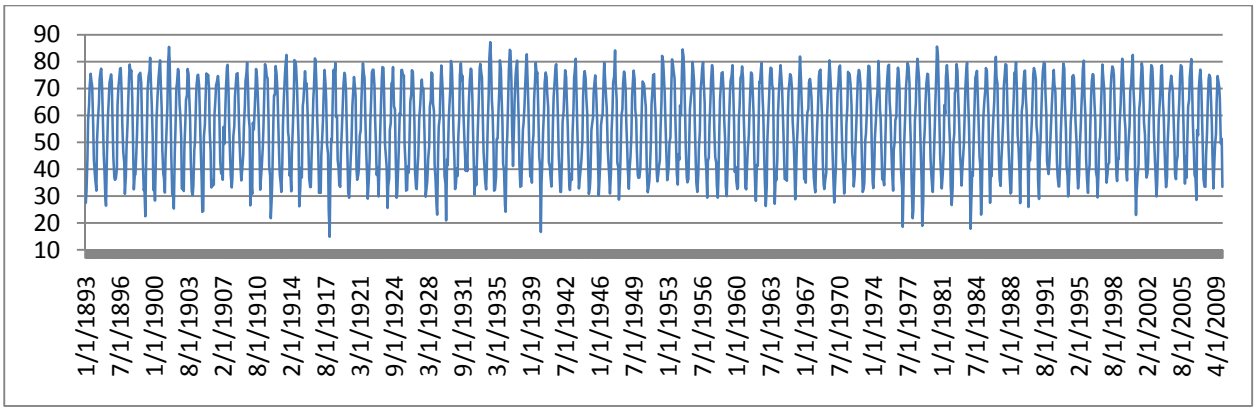

Figure 2: USHCN Lebanon 2W avg. (Degrees F)

There is one thing we do know for sure about climate temperature data is that it varies with the seasons. Removing that seasonal signal might improve our ability to notice a trend. I wrote a program in C to examine the monthly temperature values and find an average value for each of the 12 months of the year. Those values were then subtracted from their corresponding months leaving each month showing its deviation from its long term average value. In order to place these values in context, the average of all temperature values was added back in to each month. This is not a common way to show monthly temperature anomalies but it has been easier for non-technical people to visualize the meaning of the plotted data.

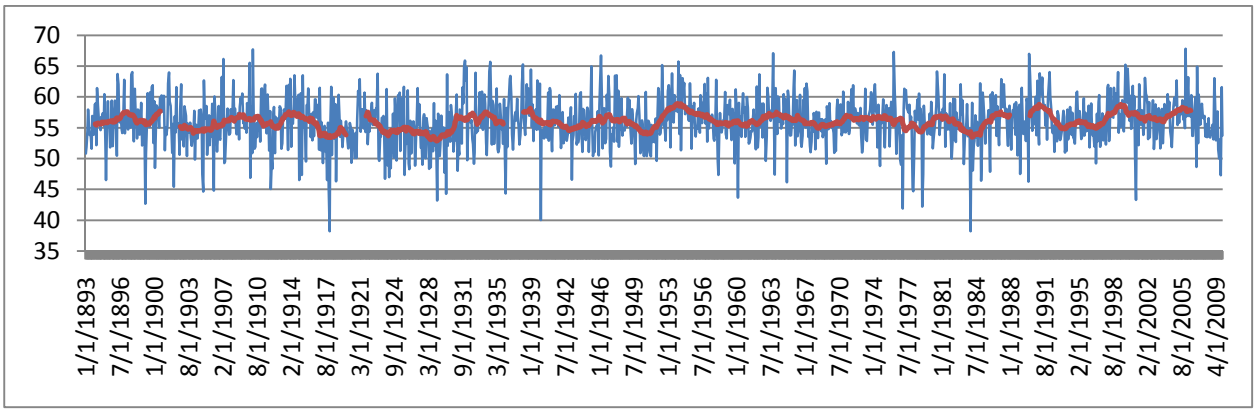

Figure 3: USHCN Lebanon 2W normalized (Degrees F)

Figure 3 shows the results of the seasonal normalization exercise. The blue line is the variation of individual months from normal, centered on the local average temperature of about 56 degrees Fahrenheit. The red line is 25 month running average. The gaps in the red line are dates when a full series of 25 months is not available for averaging. Even with breaks, the red line does give a feel for how much the annual temperature can vary from year to year. For Lebanon, Missouri, we can see that even

the 25 month running average can drift up and down by 5 or 6 degrees Fahrenheit in within a span of only 5 years.

My next step was to download the GISS version of the Lebanon 2W monthly data. Again, a small C program was created to translate the GISS text format into a simplified Excel comma delimited file. In this case, however, GISS records had been converted to Celsius. It was necessary to convert them back to Fahrenheit for direct comparison with the USHCN raw data. Figure 4 shows the GISS monthly plot.

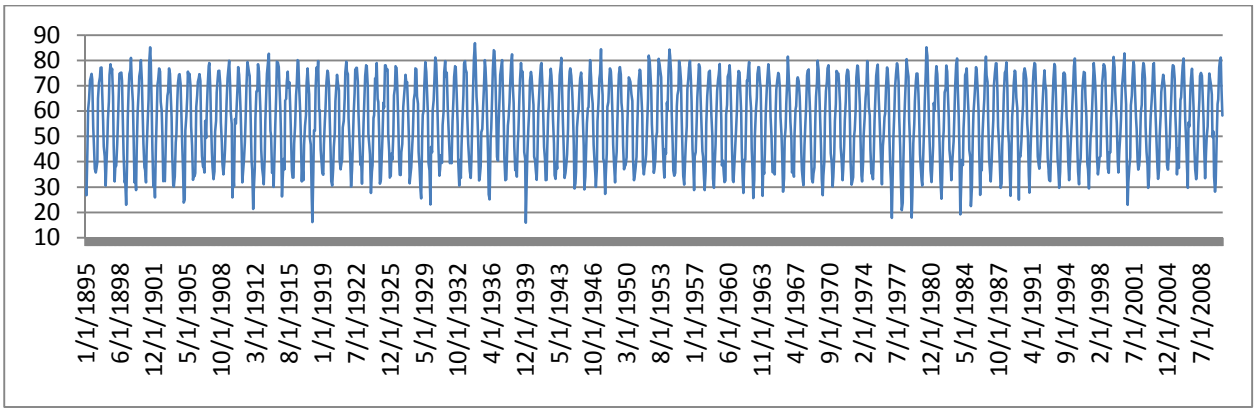

Figure 4: GISS Lebanon 2W avg. (Degrees F)

The next step was to compare the USHCN data which I had verified against the hand written historical records with the GISS data. A simple C program was created to perform this operation. Figure 5 shows the results.

Figure 5 shows the result of subtracting USHCN data from GISS data. The blue line is the monthly difference. The red line again is a running 25 month average. No estimation for missing values in either data set was performed. Missing values simply show as gaps. That there is some small noisy difference between the sets of temperatures can be attributed to rounding errors in conversion between Fahrenheit and Celsius and back. The visible cyclic annual signal in the plot is not something that would be expected for rounding errors however.

There is something very interesting about Figure 5. As can be seen, those adjustments to GISS data are substantial. Why anyone might think they are necessary is a puzzle. The history of this small town certainly does not show any reason for expecting errors these corrections suggest.

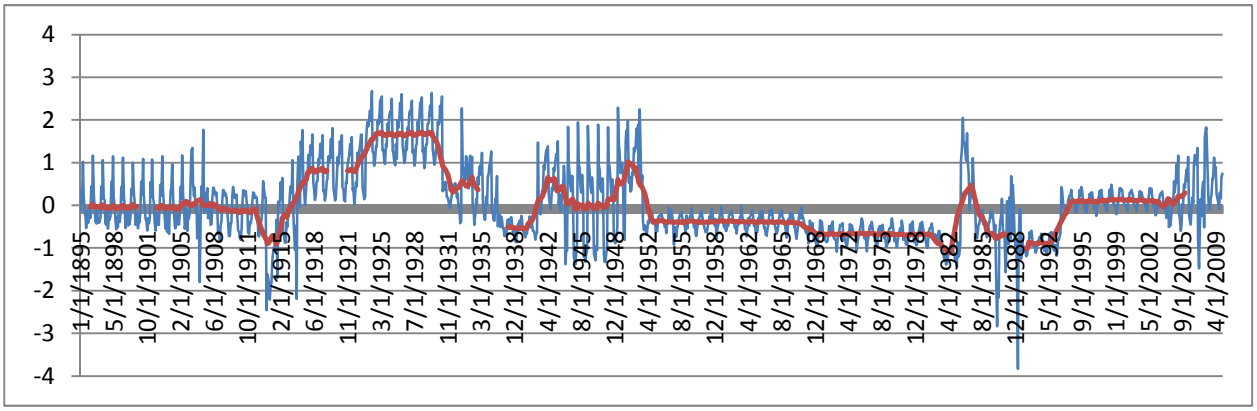

Figure 5: GISS monthly minus USHCN daily (Degrees F)

The corrections applied to the GISS monthly data exceed the claimed temperature trend for the last century by a large margin. That does not give me confidence in that claimed trend. The GISS data is described as "Raw GHCN data + USHCN corrections." Of course, I was curious about those temperature 'corrections'? I looked a little further. USHCN has both daily and monthly data files available.

There are three sets of temperatures in the USHCN monthly data file. There are Raw, Time of Observation corrected (TOBS), and Corrected temperatures for each month.

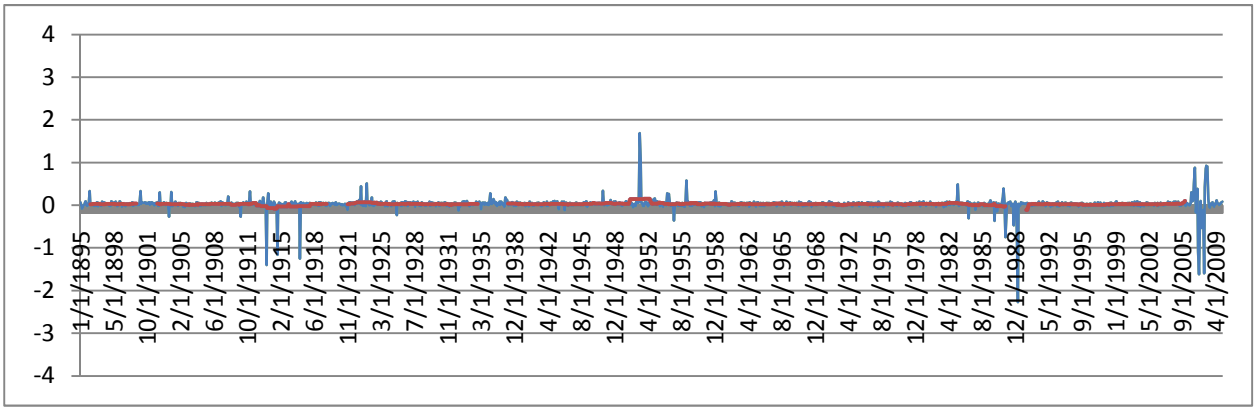

Figure 6: USHCN monthly Raw minus USHCN daily (Degrees F)

Examining figure 6 shows that the USHCN raw monthly data calculations match the simple arithmetic averaged daily means created from the USHCN daily data file. Next I checked USHCN daily data against the TOBS corrected temperatures.

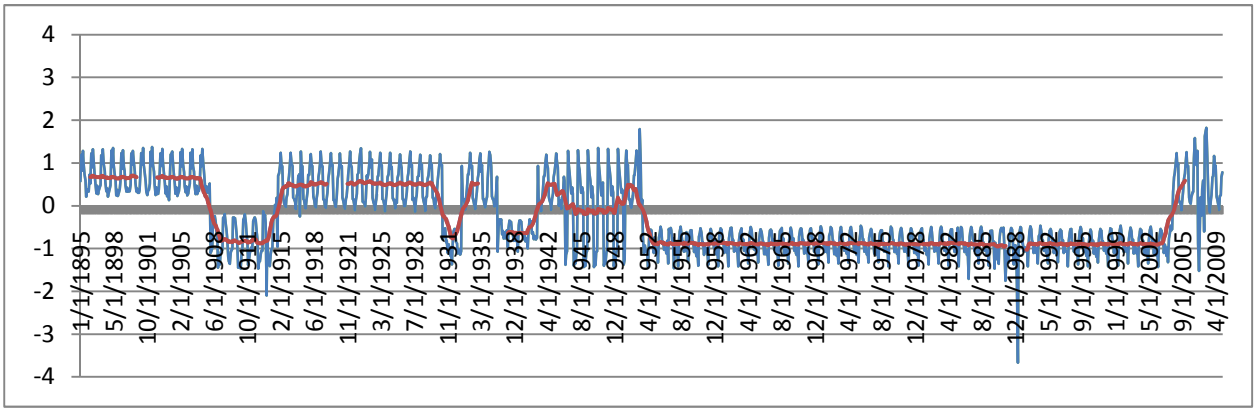

Figure 7: USHCN monthly TOBS corrected minus USHCN daily (Degrees F)

Comparing figure 7 shows that some the Time of Observation adjustments are fairly substantial, nominally averaging about plus and minus 0.7 degrees Fahrenheit. Peak-to-peak adjustments appear to be between 2 and 3 degrees Fahrenheit. While the change in the sign of the adjustments appear to match up with shifts between morning and evening observation, why such large corrections are needed is not immediately obvious from the description given by the USHCN documents. The correction values appear to be estimated based upon other sites for which hourly data could be compared with minimum and maximum temperatures that would have been read at different times of the day. Whatever the source, those corrections are quite large.

Next, I compared USHCN daily data with the USHCN final monthly temperature values.

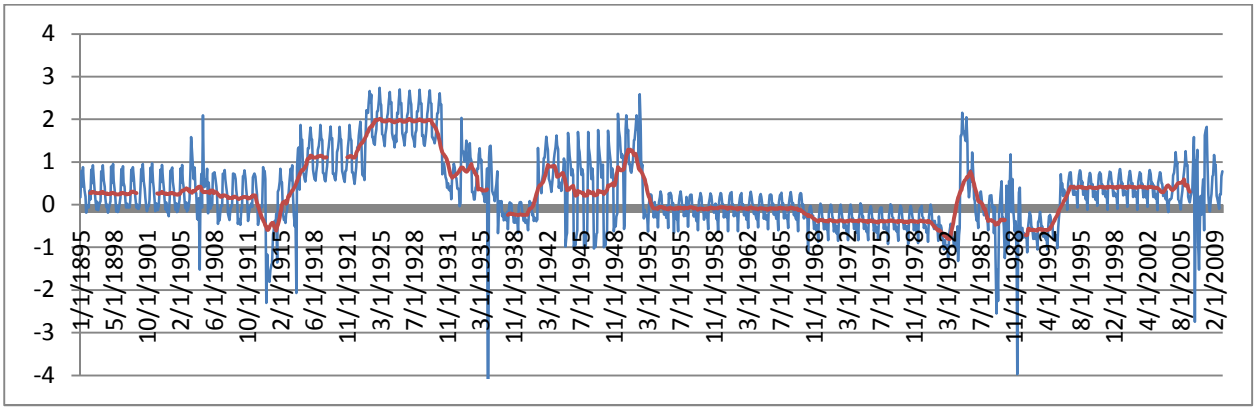

Figure 8: USHCN monthly minus USHCN daily (Degrees F)

Since Figures 7 and 8 differ quite noticeably, I was interested to see what correction was applied to transform the TOBS temperatures into the final temperature set. Figure 9 shows those additional corrections. The kinds of corrections shown do not make sense from a site historical perspective. The steps in the adjustments shown in Figure 9 do not correspond with changes in temperature monitoring site. They also do not correspond with any changes to the City of Lebanon, Missouri or surrounding countryside.

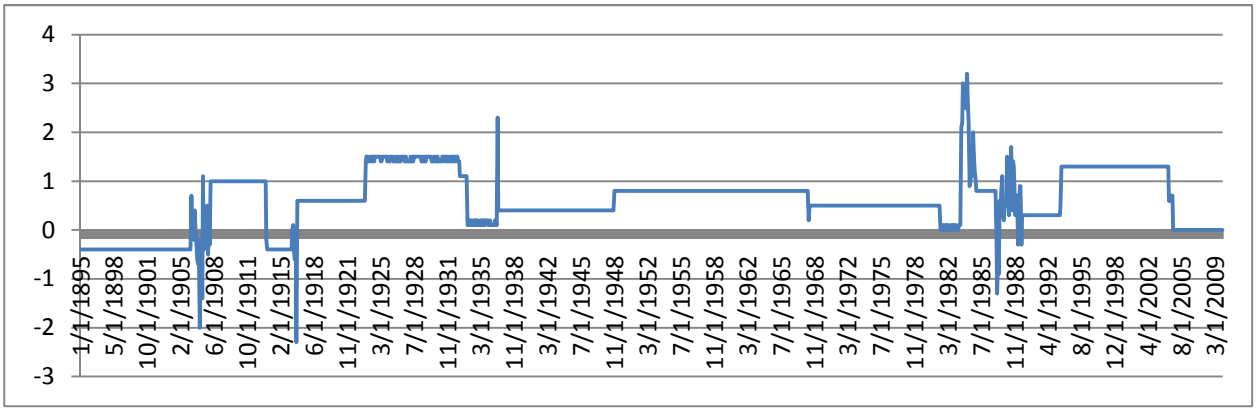

Figure 9: USHCN final minus TOBS corrections (Degrees F)

Since Figure 8 appears to visually match Figure 5 reasonably well, I thought the GISS data and the USHCN data were basically the same with some possible minor rounding errors. The obvious next step is to actually compare GISS monthly and USHCN monthly temperatures to verify they match.

Figure 10 shows that the GISS monthly data and the USHCN data match except for a small fixed offset. The GISS temperature data averages 0.3 degrees Fahrenheit lower than the USHCN temperature data.

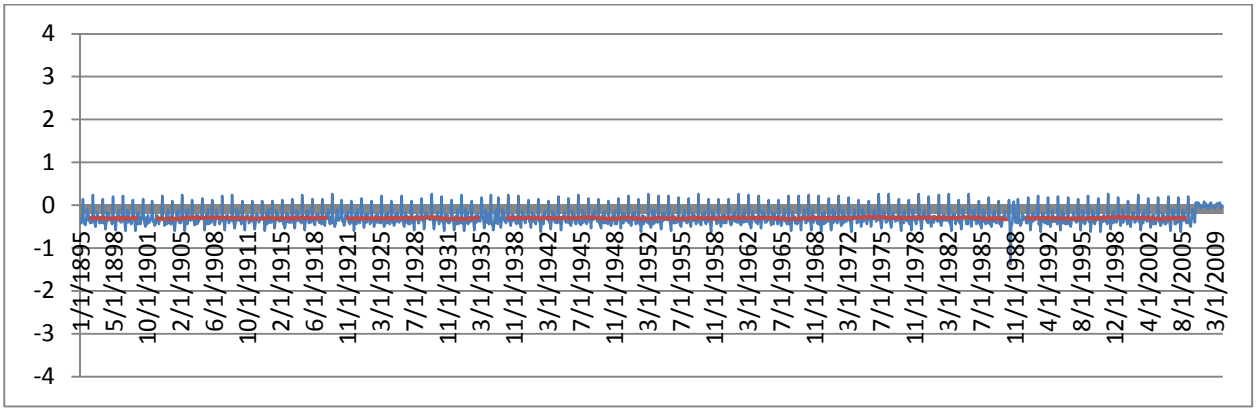

Figure 10: GISS monthly minus USHCN monthly (Degrees F)

Conclusion

This simple set of file comparisons grew from a curiosity about possible long term temperature trend near where I live. I chose to start with the rawest temperature data set possible, the hand written monthly temperature history. That led me to validating the digitized version of that data. Upon examining that data, I found no trend that would be recognizable in human perceived daily temperatures. Additional data analysis showed that the various official adjustments to the temperature records are themselves much larger than any claimed temperature trend, and those adjustments appear to be based upon estimates, not measurements.