Comparing BEST data with USHCN data for Lebanon, Missouri

Gary Wescom, October, 2011

The Berkeley Earth Surface Temperature (BEST) group has recently release a preliminary set of temperature data. This is the output of months of work by experts in climate and data analysis. I was interested in how it might compare with the previous work done by the US Historical Climate Network (USHCN). I had already collected data for the nearest USHCN site for Lebanon, Missouri, leb2w, identified as site 136146. It's a handy site because it has a continuous record from the 1890s to the present. My examination of that data was described in this document:
http://climate.n0gw.net/GISS%20vs%20Raw.pdf

(N0GW in the URL above is my FCC issued amateur radio call sign. The last two letters are my initials.)

So… The first step was to dig the 1437 leb2w site monthly entries out of the 15 million line long BEST data.txt file. An Excel plot of that BEST site data is shown in **Figure 1**. The plot was a little surprising as it appears to be a low pass filtered version of raw data. Supplying low pass filtered data as a final output could be problematic if not performed correctly. Sample aliasing and filter ringing can introduce artifacts. I'll assume the folks at BEST are familiar enough with signal processing concepts to have avoided that class of problem.

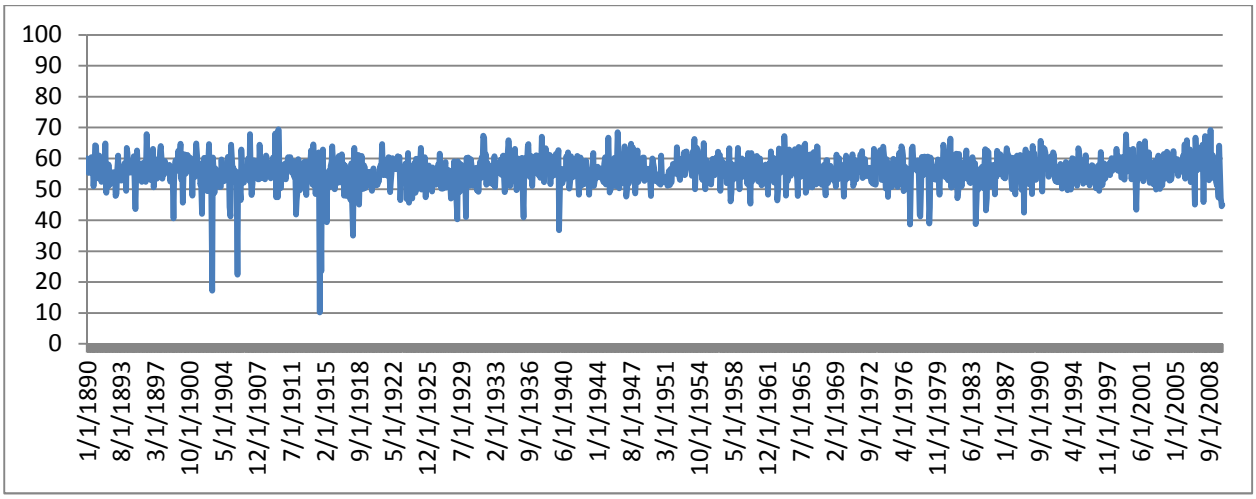

Figure 1: BEST leb2w monthly average

While the BEST data appears to average near the correct long term temperature average of around 56 degrees Fahrenheit for Lebanon, Missouri, there are some interesting analysis artifacts added to the record. I can assure you that the average temperature for month of July, 1914, was not actually 10.153 degrees Fahrenheit. (-12.1 degrees Celsius)

The **Figure 2** plot shows the USHCN raw temperature data. This is a digitized version of the data actually written by leb2w observers. As noted in the GISS vs Raw analysis mentioned above, I had previously validated the contents of the USHCN raw data values against the image scans of the original leb2w

paper temperature reporting forms. You will, no doubt, notice no monthly values that reach as low as 10 degrees Fahrenheit that might cause a low pass filter to produce that BEST July, 1914, anomaly.

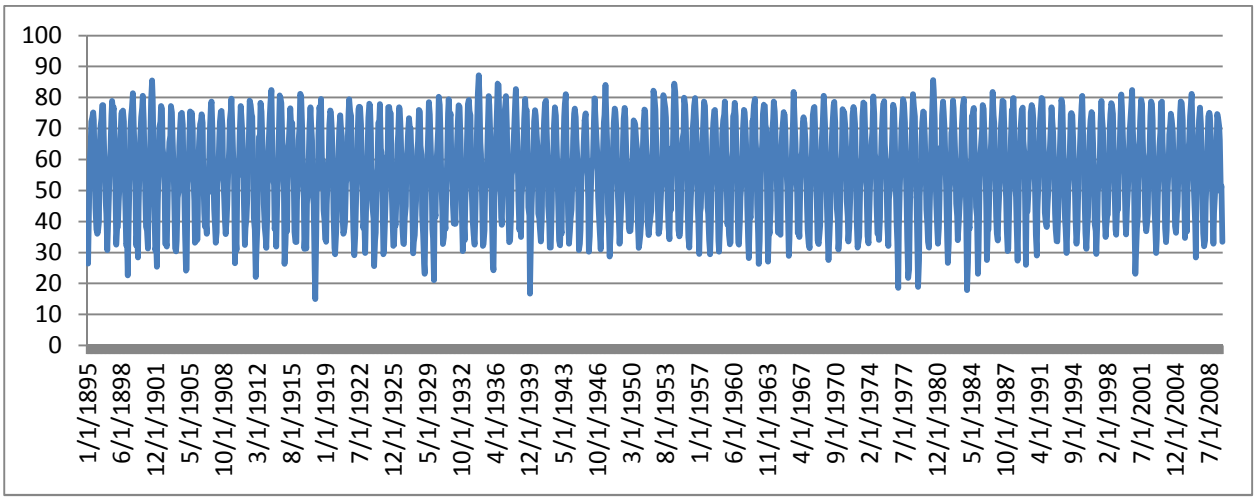

Figure 2: USHCN Leb2w monthly mean of raw data.

My favorite way narrowing the vertical plot of a temperature series like this is to seasonally normalize each month's data. That is, calculate the average of each month, subtract the corresponding average from each month, and add back the average temperature for all months. That last step shifts the anomaly plot to place it in context with the overall site climate. This scheme of presenting anomaly data seems to be more understandable to non-technical folks. It also has the advantage of not destroying trend information in the data set. It merely removes the annual season signal without distorting long term trend info. That plot is shown in **Figure 3**.

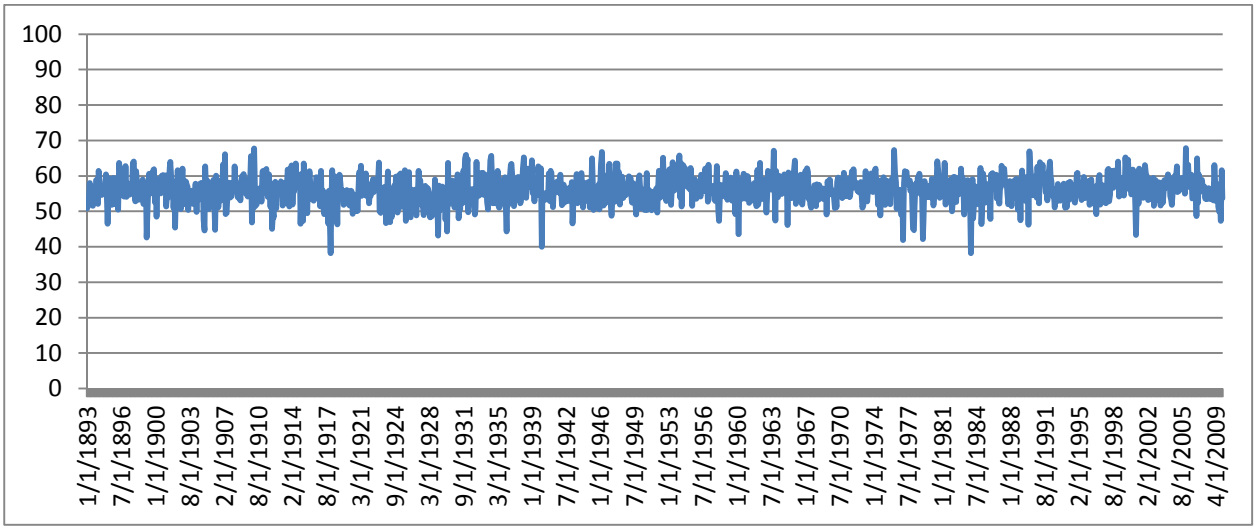

Figure 3: USHCN leb2w raw monthly mean seasonal normalized

Figure 1 and **Figure 2** are very similar in appearance except for some anomalous negative temperature spikes in the **Figure 1** BEST data. Comparing the two graphically seemed a good next step.

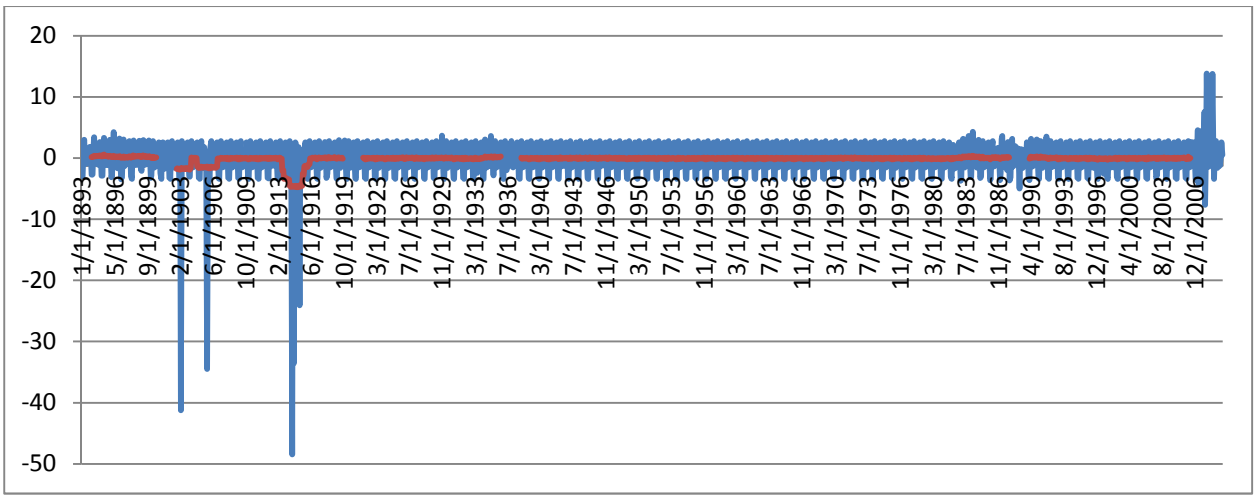

Figure 4: Subtracting USHCN raw normalized from BEST average.

Figure 4 plots the difference between the normalized USHCN raw data from the BEST data. The red line is a simple 25 month running average for reference. Blanks in the red line are periods where a full 25 months of data is not available. Notice that the red line closely tracks zero difference. **Figure 5** shows the **Figure 4** information expanded so only the area out to plus and minus 5 degrees Fahrenheit are show.

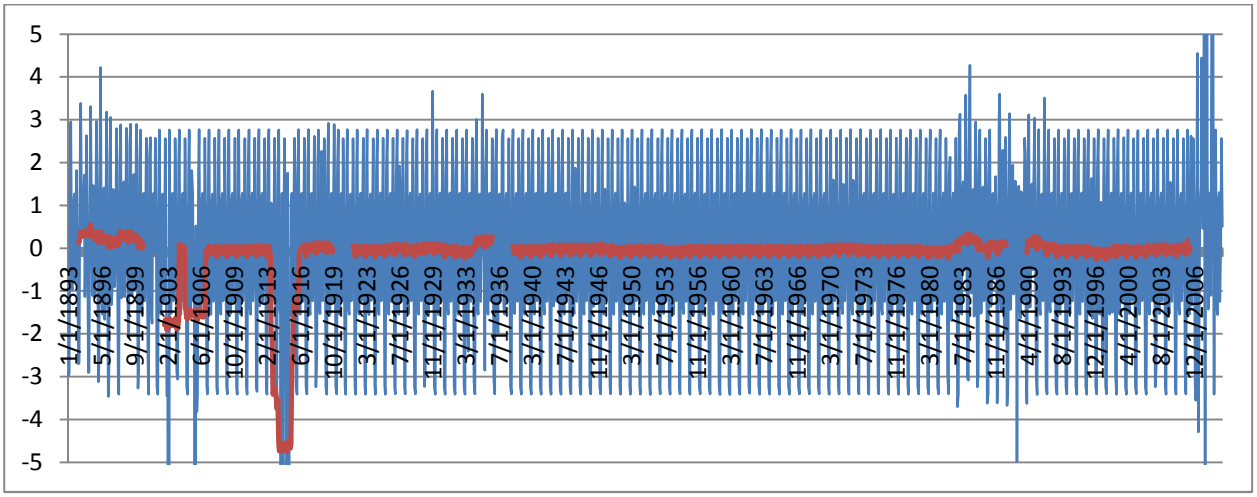

Figure 5: Figure 4 info expanded vertically

The vertical pattern in **Figure 5** is seasonal. I've stretched it out horizontally for clarity in **Figure 6**. That figure shows the BEST data for the years 1995 through 2005. This span was convenient since it there is no missing data during that period.

What else did I spot as I was digging through this data? The slope of the BEST data plot across the entire time period covered by that data is 1.14 degrees Fahrenheit per century temperature rise. For comparison, the slope of the raw USHCN data for its span was 1.06 degrees rise. While both of these rates of temperature rise seem reasonable, keep in mind that the original data was collected at a resolution of one degree Fahrenheit, sometimes in the dark by the light of a kerosene lantern while it was snowing. Hundredth or even tenths of a degree are not really meaningful.

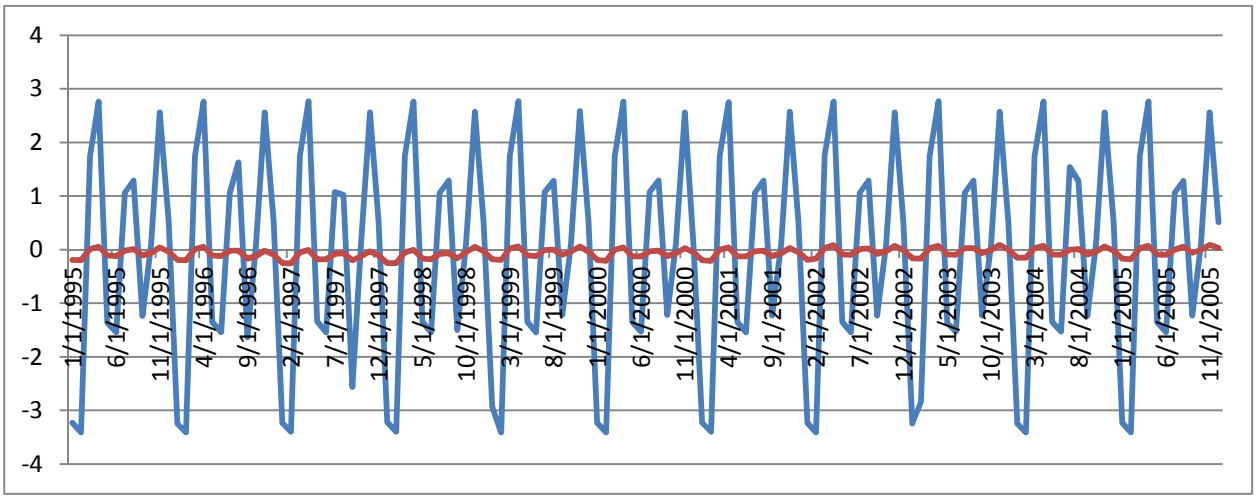

Figure 6: Figure 5 info expanded, showing 1995 through 2005

What does this all tell us? It tells us not very much actually. The BEST data for leb2w appears to be simply low pass filtered raw temperature values with some strange large 30, 40, and 50 degree Fahrenheit hiccups added. Some anomalous data values are normal when dealing with real world data. Unexpected glitches occur. However, 10 degrees Fahrenheit average for July in the American Midwest is not reasonable. The BEST documents indicate that outliers such as this are caught and fixed. In this case, silly errors were added to the data. That does not bode well for the reliability of the BEST data processing algorithms.

Next, neither the USHCN raw data nor the new BEST data for leb2w show a temperature trend of any significant consequence over the time span of the data supplied. That does not mean however that the temperature profile is constant over that period.

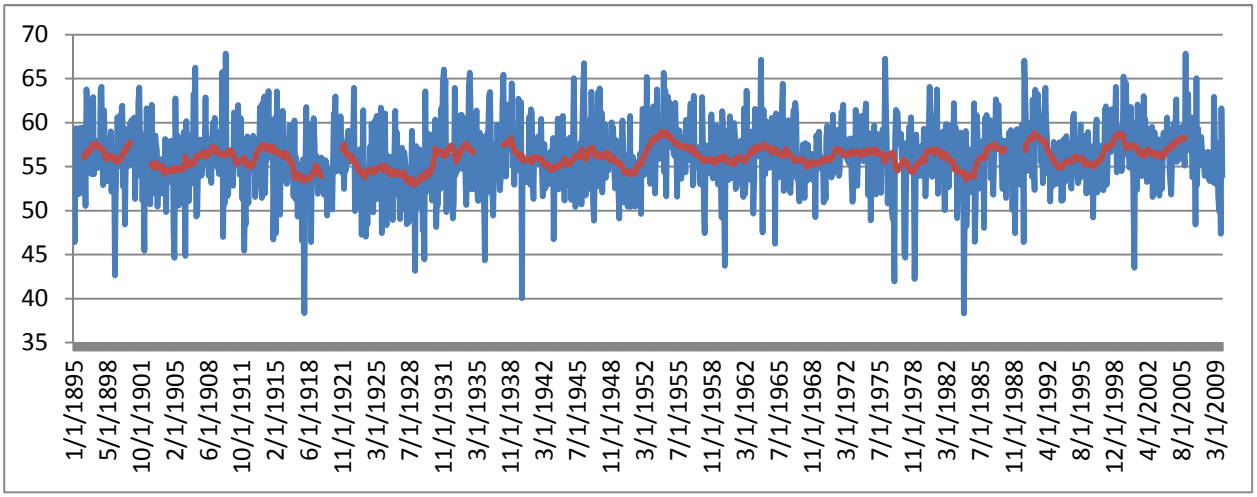

Figure 7: USHCN raw seasonally normalized temperatures

Figure 7 shows a vertically expanded version of **Figure 3** above. Notice that the red 25 month average plot drifts up and down randomly over a span of over 5 degrees Fahrenheit. That should help place in context the significance of a one degree per century rise in average temperature.

Files available for reference:

BEST Leb2w site extract: http://climate.n0gw.net/136146.txt

BEST Leb2w Excel CSV: http://climate.n0gw.net/136146.csv

Comments from BEST data.txt: http://climate.n0gw.net/comments.txt

USHCN leb2w: http://climate.n0gw.net/USHCN_leb2w_monthly.csv

USHCN leb2w raw mean: http://climate.n0gw.net/USHCN_leb2w_raw_mean.csv

USHCN leb2w raw normalized: http://climate.n0gw.net/USHCN_leb2w_raw_norm.csv

Sample Software: http://climate.n0gw.net/software.zip