# *US Temperatures and Climate Factors since 1895*

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## *Introduction*

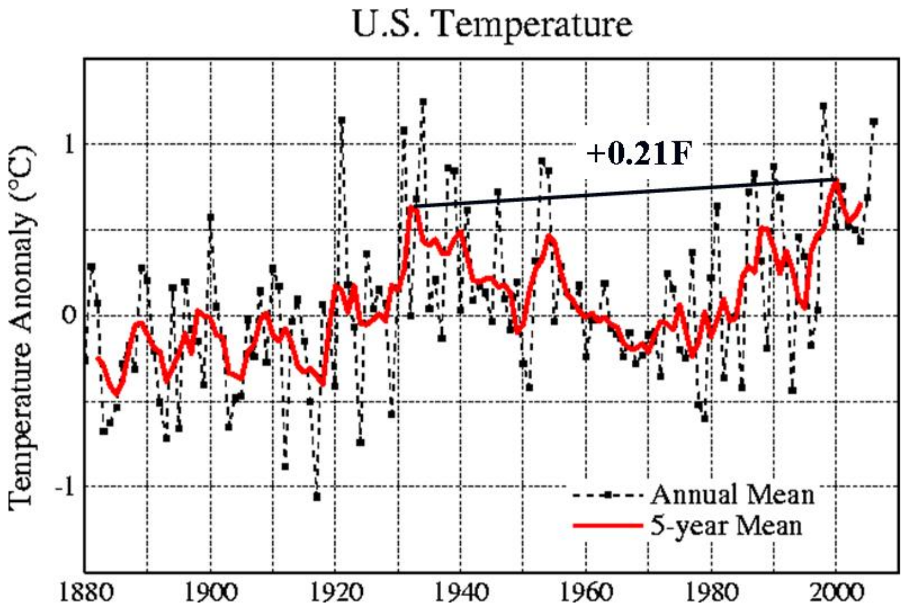
Significant problems have been identified in numerous recent peer review studies (most recent here) for the global data bases (GISS, GHCN, CRU) which may result that they may have overestimated the warming the last century by 30-50%. These issues include station dropout, missing data, siting issues and insufficient or even no adjustment for urbanization. This makes them unusable or even unreliable for trend analysis. I have preferred to work with the USHCN data from the United States which at least is stable and has much less missing data and made adjustments for changes in the time of observation, instrumentation, any documented siting changes and at least until the latest version, urbanization (Karl 1988). The work of Pielke and Watts and others have shown issues with siting still remain, but still this data set is superior to the global. USHCN Version 2 data became available in recent months which has replaced the Karl urbanization adjustment and siting adjustments with a 'change point detection algorithm' that NCDC` believes will better identify previously undocumented inhomogeneities.

In this analysis, I will look at the data trends and show how they are cyclical in nature and show little long time trends. The cycles in the temperatures correlate far better with solar and multidecadal ocean cycles.

### *USHCN Data*

The now familiar NASA plot of the US climate network since 1895 shows a cyclical pattern with a rise from 1895 to a peak near 1930 and then a decline into the 1970s before another rise with an apparent peak around 2000. Note the minor warming from the peak in 1930 to the peak in 2000 in the NASA version of the USHCN data set.

# NASA GISS US DATA

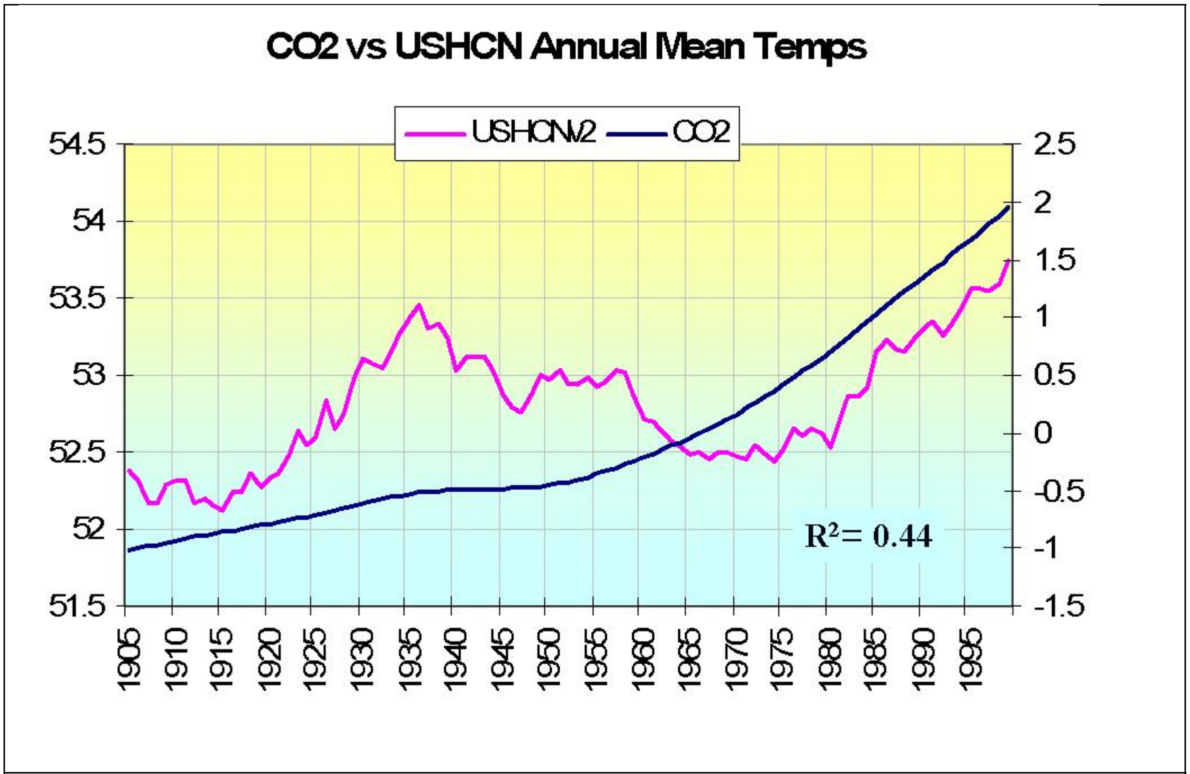



The short term fluctuations are driven by factors such as ENSO and volcanic eruptions. The longer term cycles are mainly driven by cycles in the sun and oceans although changes in the last half century have been increasingly blamed on anthropogenic factors.

Let's look at the three factors mentioned and how well they correlate with the USHCN version 2 observed temperatures. For each, I will do an 11 year running mean to eliminate any influence of the 11 year solar cycle. Except for temperatures and CO2 values, the plotted values are units of STD positive and negative for that factor.

***USHCN AND CARBON DIOXIDE***

I first took the CDIAC annual mean carbon dioxide estimates since 1895 and plotted that against the annual USHCN. For a correlation, I got an r-squared of 0.44. The correlation was best after 1915 to the mid 1930s and from 1980 to the late 1990s.




***A comparison of the 11 year running mean of the USHCN version 2 annual mean temperatures with the running mean of CO2 from CDIAC (standardized values). An r-squared of 0.44 was found.***

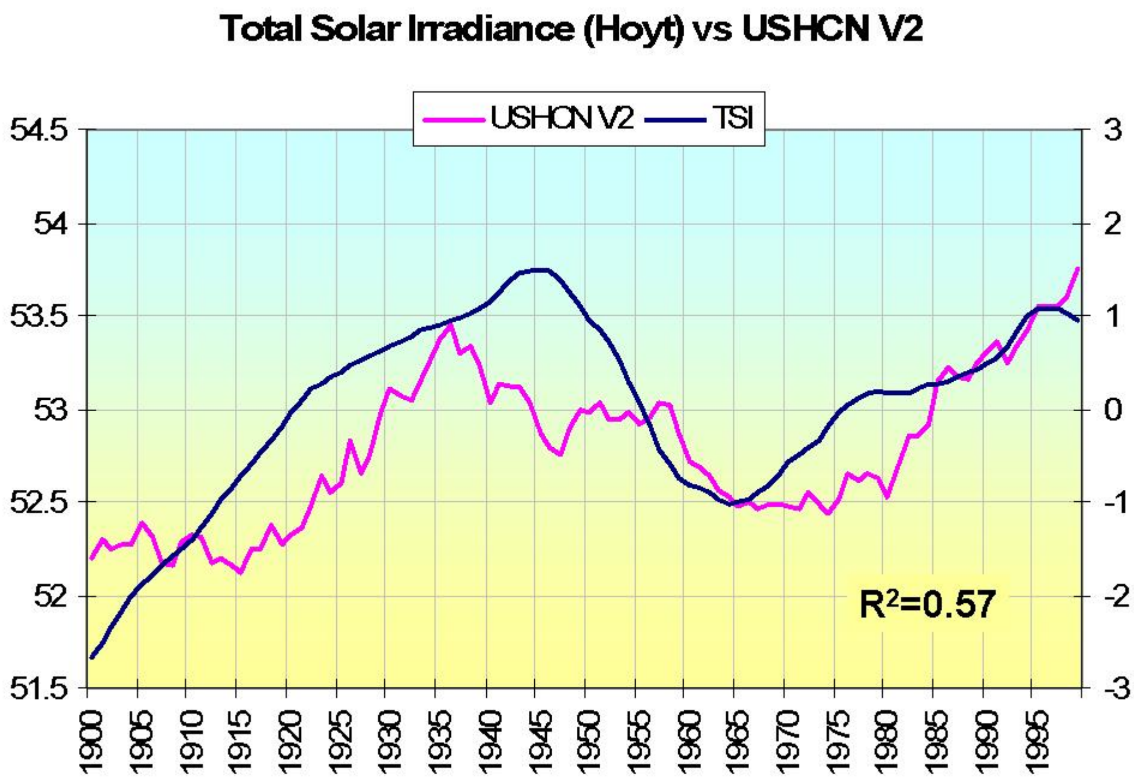
***USHCN AND SOLAR***

The sun influences the climate in direct and indirect ways. A more active sun is a brighter slightly hotter sun and when the sun is hotter the earth is a little hotter. This small effect is magnified by other more indirect solar influences. When the sun is more active although its brightness (mainly visible light) only increases by 0.1%, the ultraviolet radiation increases by 6-8% and the even shorter wavelengths by a factor of two or more. These UV rays create and destroy ozone in the high atmosphere, both of which are exothermic effects and produce heat. Work by Labitzke and Shindell at NASA GISS have shown this to be important. Shindell showed how this factor may have been responsible for the little ice age.

When the sun is more active there are more flares and eruptive activity that causes rapid increases in the solar winds, causing ionization storms in the earth's atmosphere with resultant heating. Also importantly an active sun causes the earth's magnetic shield to diffuse more cosmic rays from reaching into our atmosphere. Since these rays have a low water cloud formation enhancing effect (recently confirmed in the laboratory), an active sun usually means less low clouds and thus warmer temperatures. In all these cases, a more active sun brings warming.

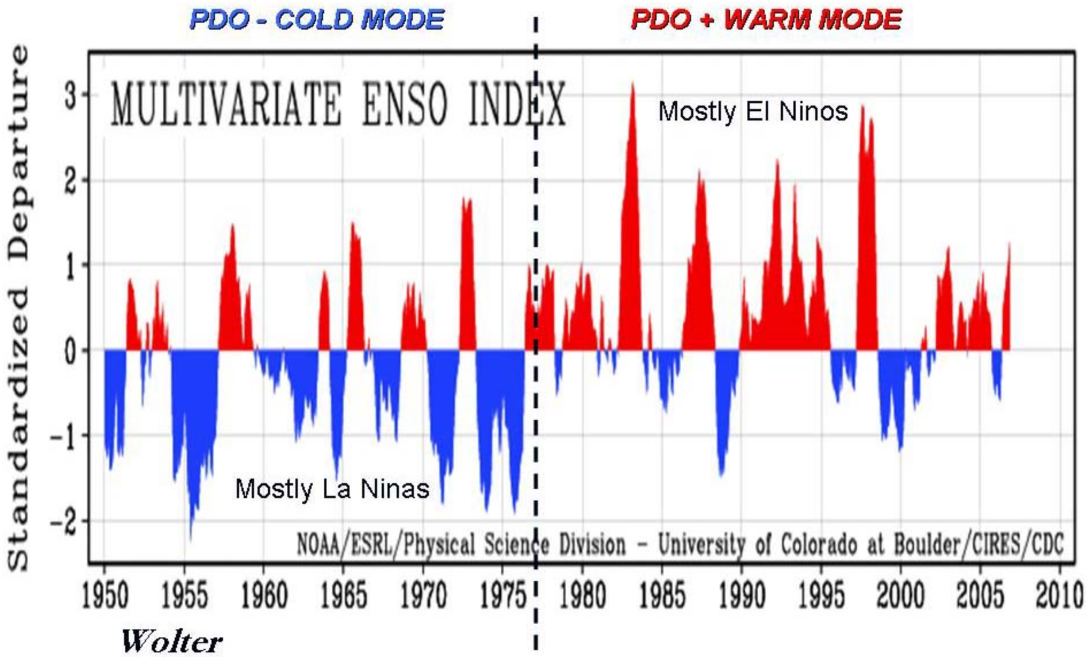
Scafetta and West (2007) have suggested that the total solar irradiance (TSI) is a good proxy for the total solar effect which may be responsible for at least 50% of the warming since 1900.

I took the TSI from Hoyt Schatten (data provided by Doug Hoyt through 2004) and compared to the USHCN data (smoothing the data for 11 years to eliminate the 11 year solar cycle. The Hoyt-Schatten TSI series uses five historical proxies of solar irradiance, including sunspot cycle amplitude, sunspot cycle length, solar equatorial rotation rate, fraction of penumbral spots, and decay rate of the 11-year sunspot cycle. I found a correlation strength (r-squared) of 0.57.

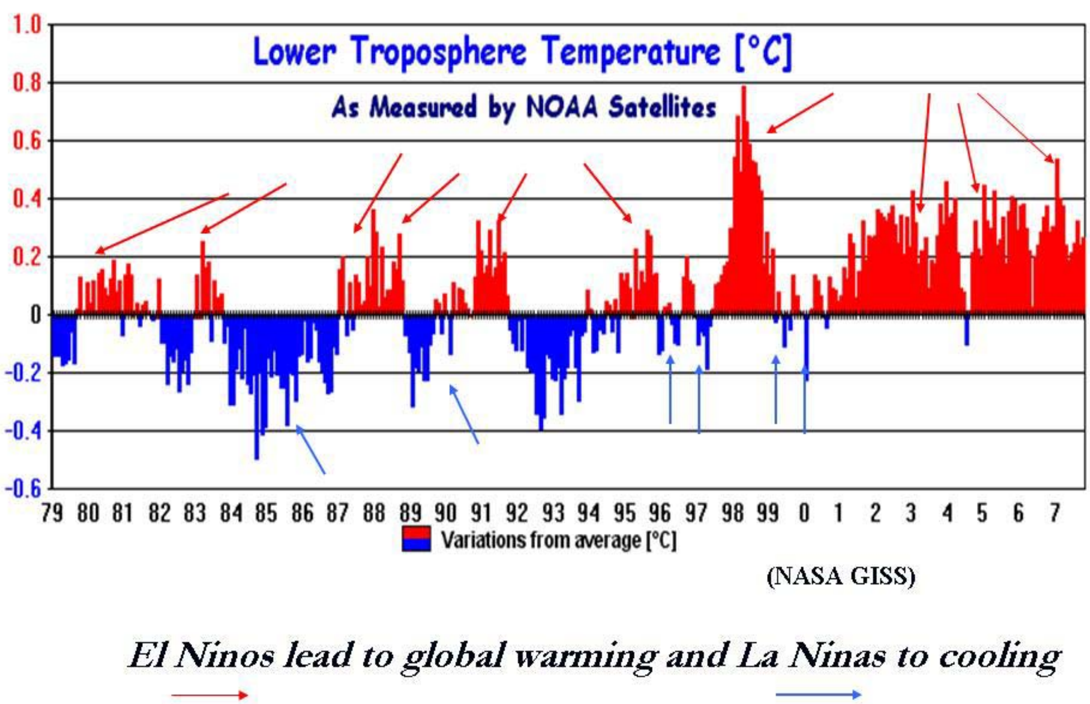



### *USHCN AND OCEAN MULITDECADAL CYCLES*

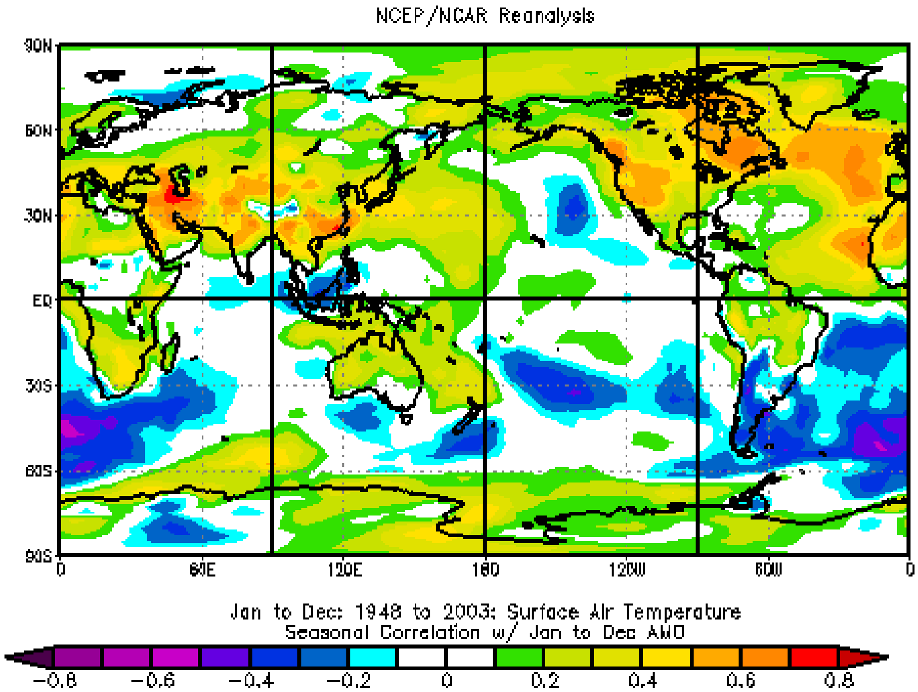
We know both the Pacific and Atlantic undergo multidecadal cycles the order of 50 to 70 years. In the Pacific this cycle is called the Pacific Decadal Oscillation. A warm Pacific (positive PDO Index) as we found from 1922 to 1947 and again 1977 to 1997 has been found to be accompanied by more El Ninos, while a cool Pacific more La Ninas (in both cases a frequency difference of close to a factor of 2).




Since El Ninos have been shown to lead to global warming and La Ninas global cooling (seen below on the UAH MSS), this should have an affect on annual mean temperature trends in North America.



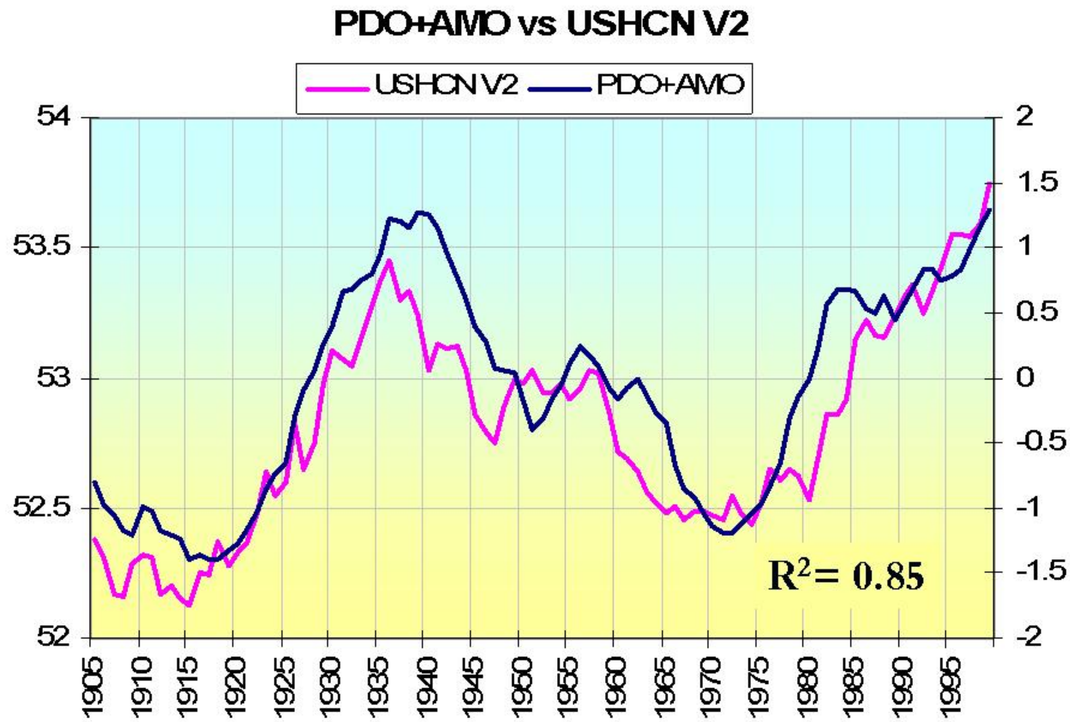

A similar mulitidecadal cycle exists in the Atlantic known as the Atlantic Multidecadal Oscillation (AMO). When the Atlantic is in its warm mode there tends to be more tropical activity and on average above normal temperatures on an annual basis across the northern hemispheric continents.



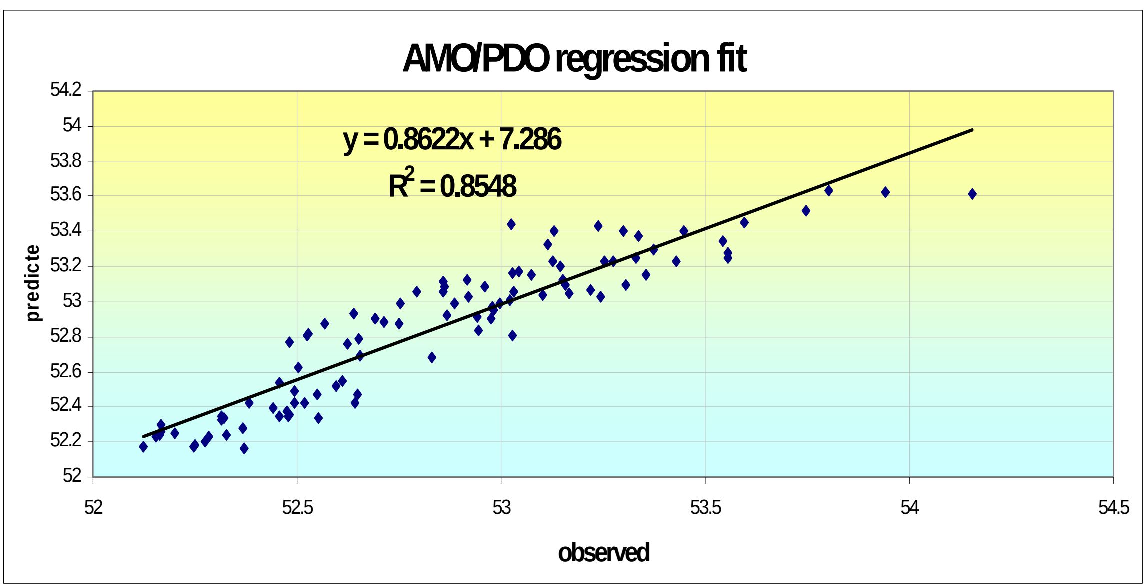

*Correlation from CDC of Annual Temperatures with AMO*

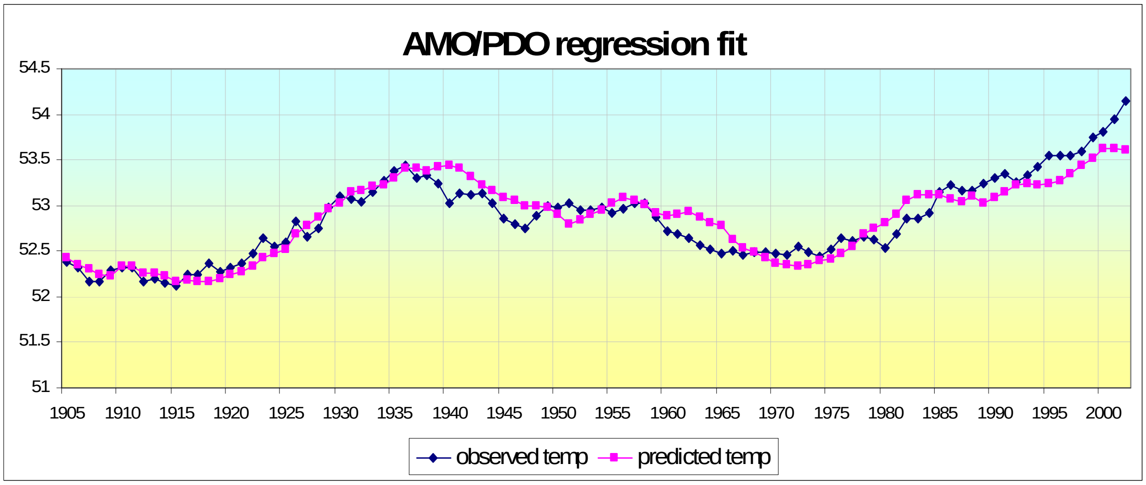
Since the warm modes of the PDO and AMO both favor warming and their cold modes cooling, I thought the combination of the two may provide a useful index of ocean induced warming for the hemisphere (and US). I standardized the two data bases and did a multiple regression analysis with the USHCN data, again using a 11 point smoothing as with the CO2 and TSI.

This was the best correlation with the highest value of r-squared (0.85).



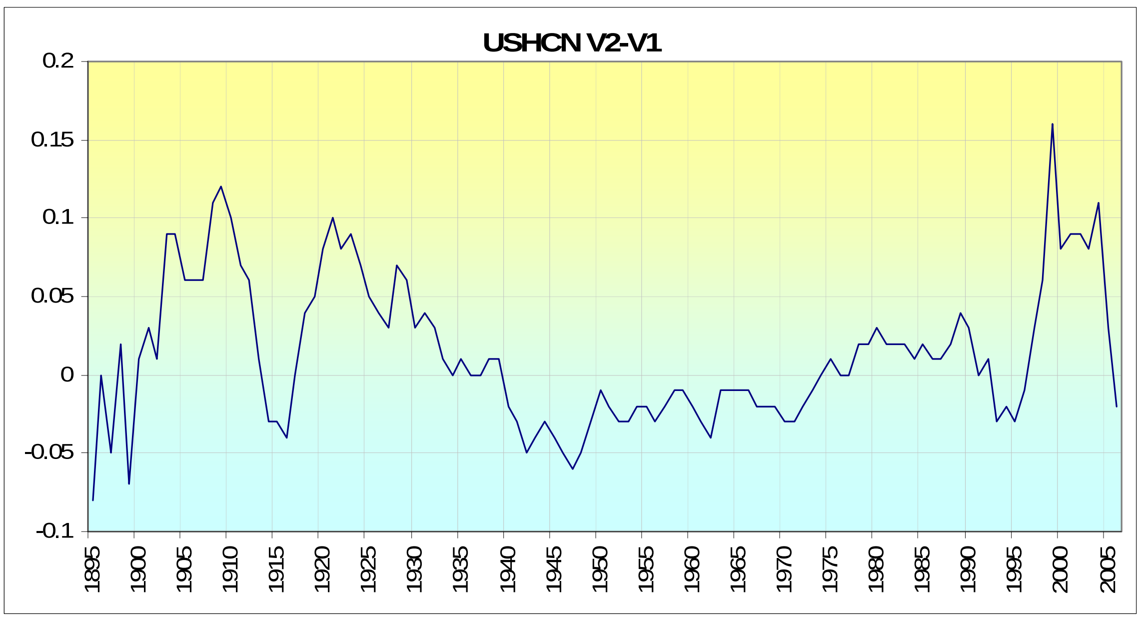

I did a multiple regression analysis with the USHCN.



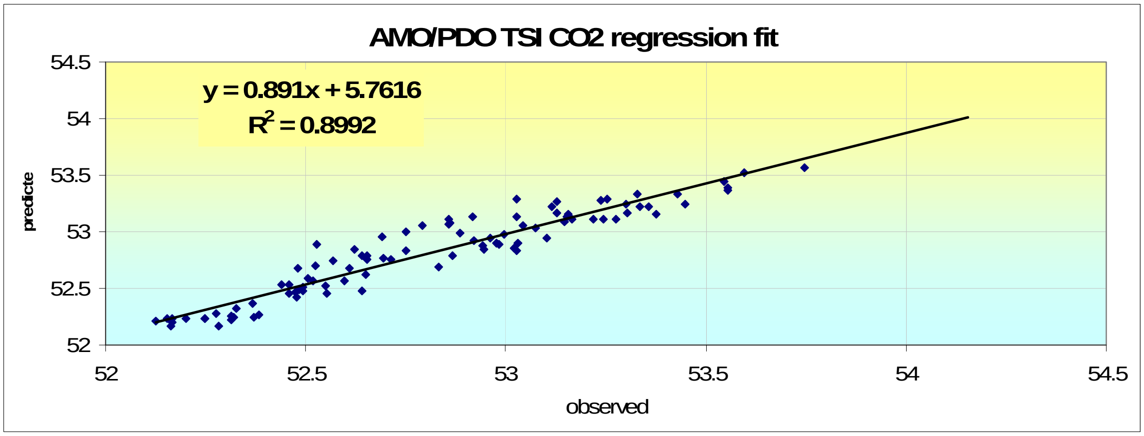


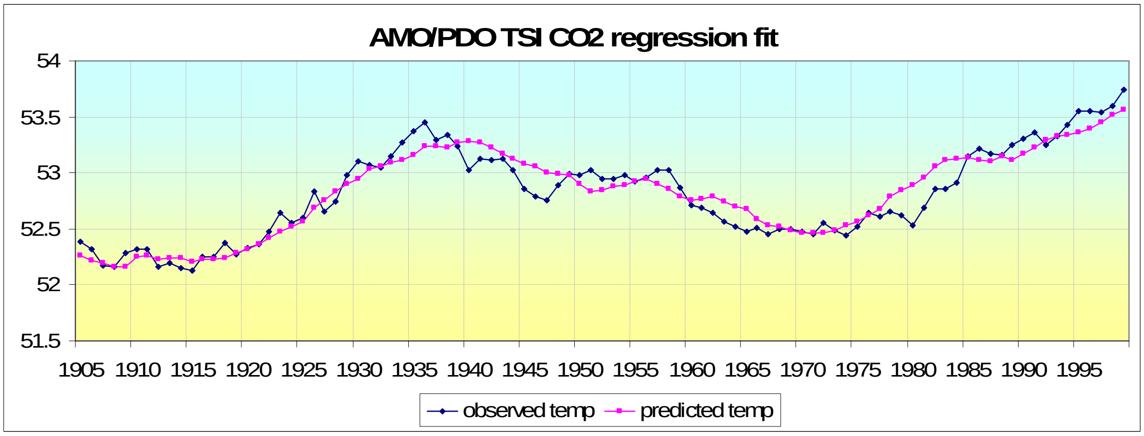

Note this data plot started in 1905 because the PDO was only available from 1900. The divergence post 2000 was either (1) greenhouse warming finally kicking in or (2) an issue with the new USHCN version 2 data.

The plot of the difference between version 1 and version 2 suggests the latter as the likely cause. Note the adjustment up of the 1999-2005 temperatures by as much as 0.15F (unexplained).




When I added the TSI and CO2, the total correlation improved from 0.85 to 0.89.



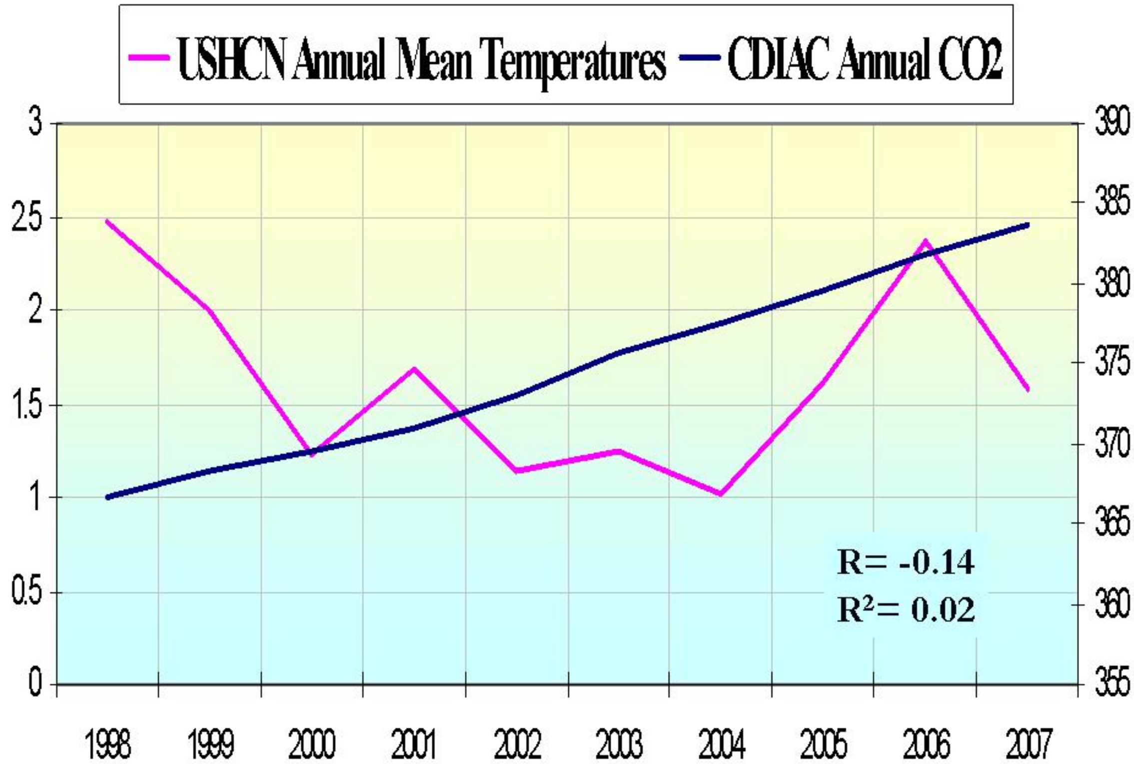




Given the rapid decline of the PDO and AMO this past year and the continued low solar Activity, the regression suggests 2008 will end up coldest since 1996 (perhaps even 1993).

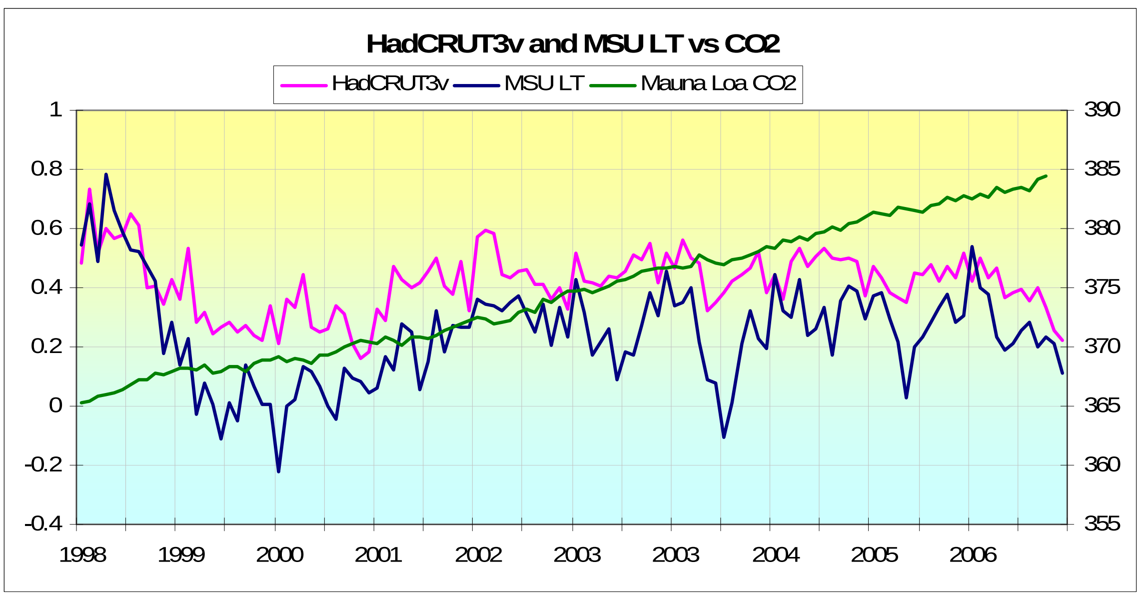
***THE LAST DECADE***

Since temperatures have stabilized in the last decade, I looked at the correlation of the CO2 with HCSN data. Greenhouse theory and models predict an accelerated warming with the increasing carbon dioxide.

Instead, a negative correlation between USHCN and CO2 was found in the last decade with an R or Pearson Coefficient of -0.14, yielding an r-squared of 0.02.




To ensure that was not just an artifact of the United States data, I did a similar correlation of the CO2 with the CRU global and MSU lower tropospheric monthlies over the same period. I found a similar non existent correlation of just 0.02 for CRU and 0.01 for the MSU over troposphere.



***SUMMARY***

USHCN temperatures show a cyclical behavior over the past 112 years with peak warming about 1930 and 2000. The temperature trends correlate with a number of factors. I examined them here. I found the correlation strengths to be as follows

| Factor | Years | Correlation (Pearson Coefficient) | Correlation Strength (R-squared) |
|---|---|---|---|
| Carbon Dioxide | 1895-2007 | 0.66 | 0.43 |
| Total Solar Irradiance | 1900-2004 | 0.76 | 0.57 |
| Ocean Warming Index (PDO and AMO) | 1900-2007 | 0.92 | 0.85 |
| Carbon Dioxide Last Decade | 1998-2007 | -0.14 | 0.02 |

Clearly the US annual temperatures over the last century have correlated far better with cycles in the oceans and sun than carbon dioxide. The correlation with carbon dioxide seems to have vanished or even reversed in the last decade.

Given the recent cooling of the Pacific and Atlantic and rapid decline in solar activity, we might anticipate given these correlations, temperatures to accelerate downwards shortly.

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## *Data Sources:*

AMO: CDC

PDO: JISAO

SOLAR TSI: Data provided by Doug Hoyt as calculated by Hoyt Schatten. The Hoyt-Schatten TSI series uses five historical proxies of solar irradiance, including sunspot cycle amplitude, sunspot cycle length, solar equatorial rotation rate, fraction of penumbral spots, and decay rate of the 11-year sunspot cycle.

USHCSN 2 TEMPS: NCDC Climate at a Glance

CDIAC CO2: CDIAC