How natural factors control temperature changes short and long term

By Joseph D’Aleo, CCM

BACKRGOUND

The IPCC AR4 chapter explaining the patterns of climate variability through global teleconnections and defining the circulation indices including the short term and decadal scale oscillations in the Pacific, and Atlantic. It noted that the decadal variability in the Pacific (the Pacific Decadal Oscillation or PDO) is likely due to oceanic processes. Extratropical ocean influences are likely to play a role as changes in the ocean gyre evolve and heat anomalies are subducted and reemerge. The Atlantic Multidecadal Oscillation (AMO) is thought to be due to changes in the strength of the thermohaline circulation. In the end the multidecadal cycles were not reproduced in the climate models used to drive future projections.

The IPCC AR4 discussed at length the varied research on the direct solar irradiance variance and the uncertainties related to indirect solar influences through variance through the solar cycles of ultraviolet and solar wind/geomagnetic activity. They admit that ultraviolet radiation by warming through ozone chemistry and geomagnetic activity through the reduction of cosmic rays and through that low clouds could have an effect on climate but in the end chose to ignore the indirect effect.

For the total solar forcing, in the end the AR4 chose to ignore the considerable recent peer review in favor of Wang et al. (2005) who used an untested flux transport model with variable meridional flow hypothesis and reduced the net long term variance of direct solar irradiance since the mini-ice age around 1750 by up to a factor of 7. This may ultimately prove to be AR4’s version of the AR3’s “hockey stick” debacle.

INTRODUCTION

ENSO and the longer term mulitdecadal cycles in the oceans play the key role in US and global temperatures interannually and on a decadal scale. With volcanism, these ocean cycles and the solar cycles (which are in sync with and likely drive these ocean cycles) can help explain virtually of the changes we have observed in anomalies and in extremes and in the regimes of events over the decades.

The EPA does not find empirical evidence 'compelling', preferring to trust long term climate models and theory over facts.

*"Claims that ENSO, **PDO**, AMO, and other known modes of internal climate variability can explain all or most of the changes in climate that have occurred over the past century are <u>inconsistent with the assessment literature, and commenters did not provide compelling evidence that the assessment literature has reached fundamentally flawed conclusions</u>."*

And yet now the alarmists are cheering a paper in Nature that explains why the world stopped warming 15 - 17 years ago – ENSO and the PDO. I will show you why the EPA was wrong.

HOW NATURAL FACTORS DRIVE THE GLOBAL TEMPERATURES

In the following graph in which all the global surface station data sets (HADCRUT3, **NCDC**, GISS) *and satellite (UAH, RSS) are plotted. Years with El Nino invariable show warming and La Ninas* cooling. In addition strong volcanism in the early 1980s (El Chichon and Mt. St. Helens) and early 1990s (Pinatubo and Cerro Hudson) are reflected with major cooling for several years.

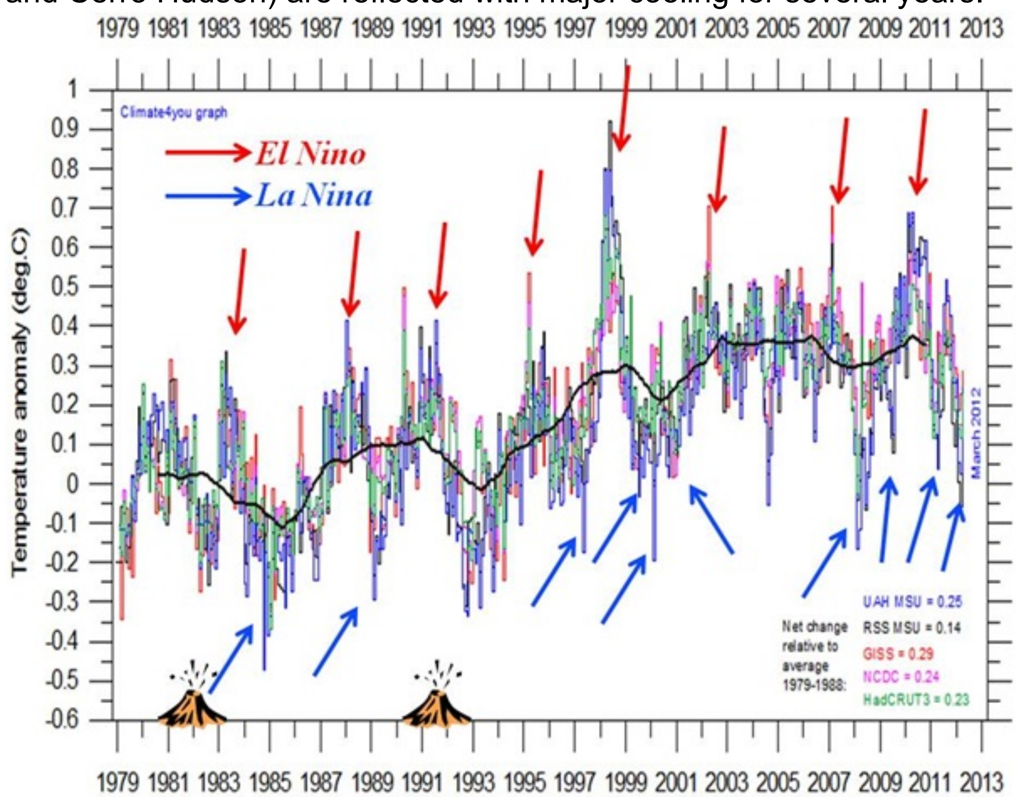
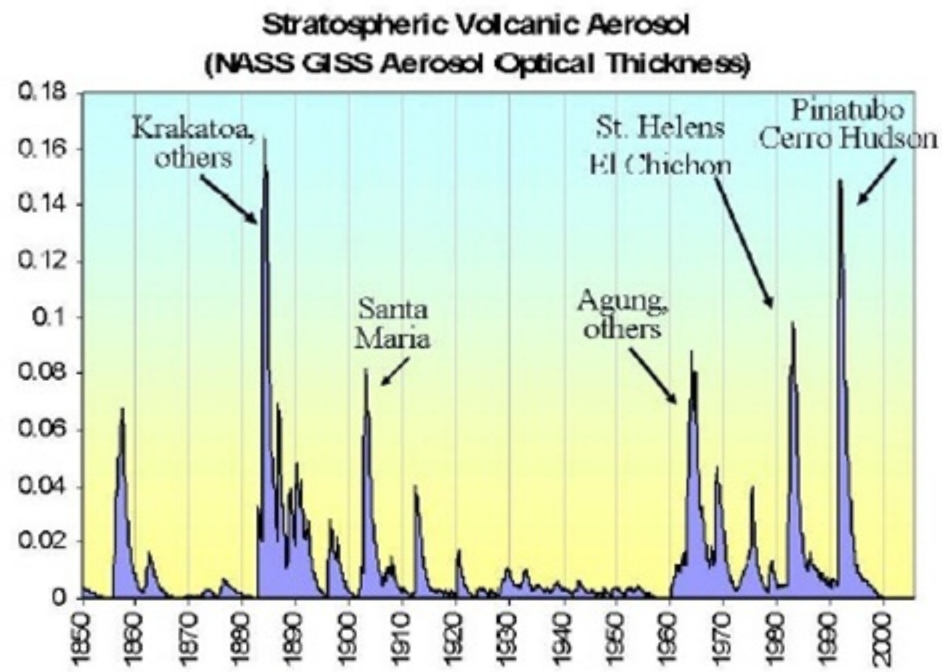


Figure 1: Plot of monthly global temperatures from UAH, RSS, GISS, NCDC and HadCRUT3. Also indicated are El Nino years (red arrows), La Nina years (blue arrows) and major volcanism

NASA maintains a global data base of stratospheric volcanic aerosols (Aerosol Optical Thickness) for modeling purposes. You can see the clustering of activity in the late 1800s into the early 1900s, in the 1960s, 1980s and 1990s.



Volcanic aerosols in the high atmosphere block solar radiation and increase cloud cover leading to widespread cooling, especially significant in summer

Figure 2: Global stratospheric aerosol loading as estimated by the Aerosol Optical Thickness by Sato of NASA GISS. Notice the tendency for clustering of major eruptional activity in the later 1800s, 1960s and early 1980s and 1990s. Current levels are near or at the low of the entire record.

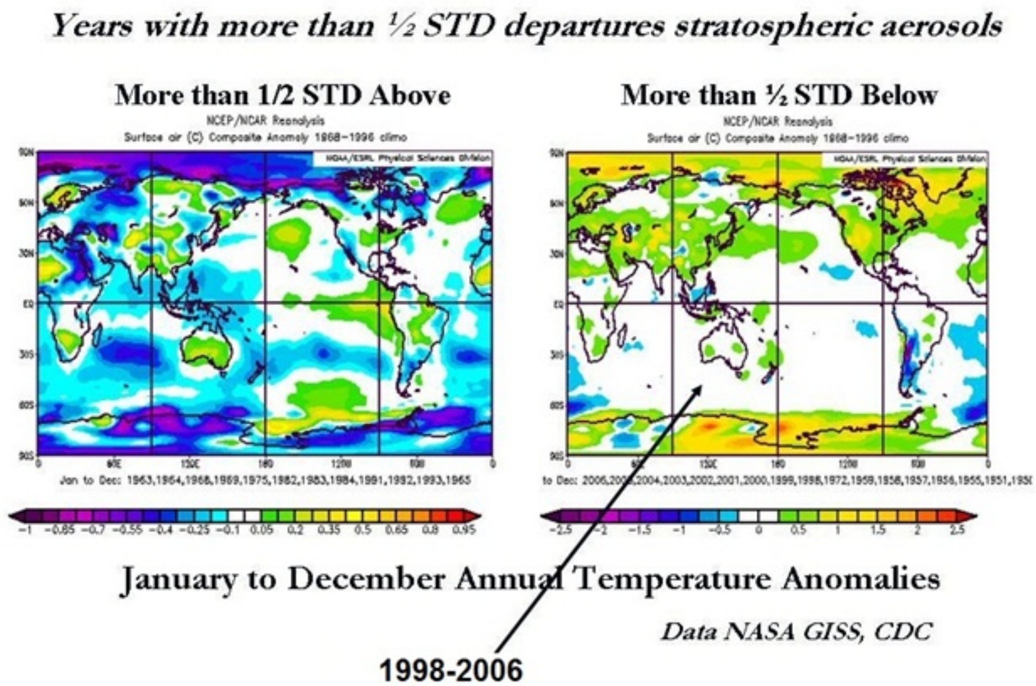


Figure 3: The years with high AOTs are shown to be cold globally, especially in the polar regions and low AOTS, general warmth including the polar regions.

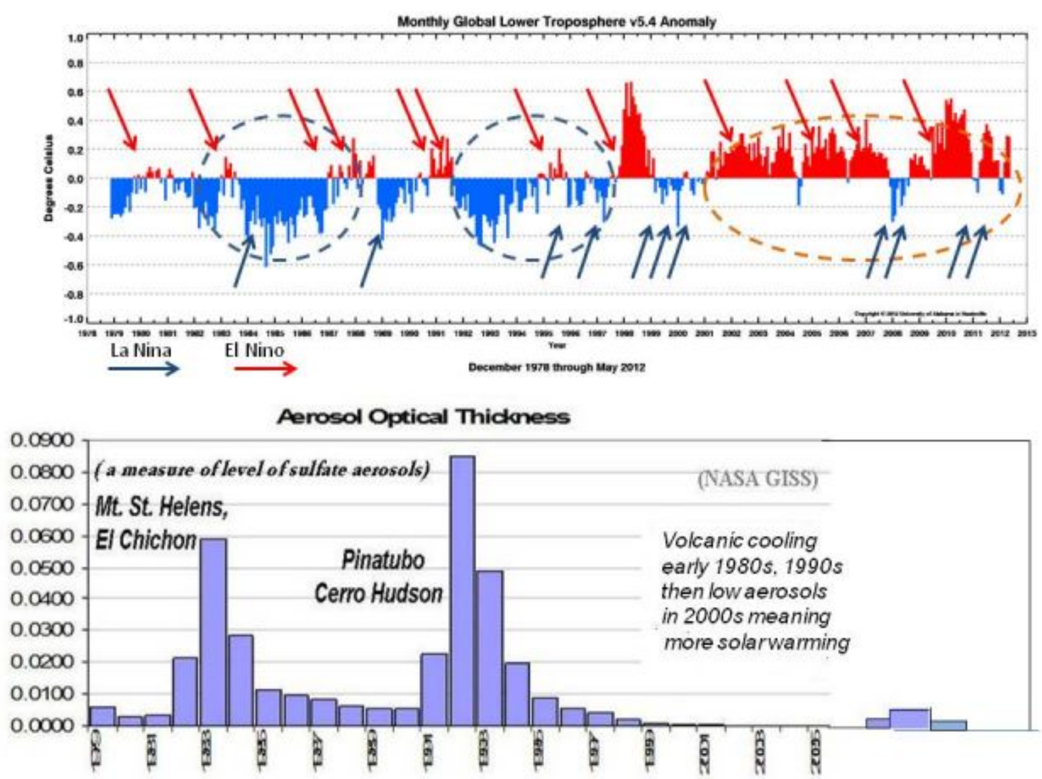


Figure 4: You can see the effect on lower tropospheric temperatures of high aerosol counts after major eruptions in the early to mid 1980s and 1990s. Also

note the low aerosol levels of the late 1990s and 2000s that allowed more sunshine through and accentuated the warming

So we see how both volcanism and ENSO play a role in temperatures globally. Mantua et al. (1997) found the "Pacific Decadal Oscillation" (PDO) is a long-lived El Nino-like pattern of Pacific climate variability. While the two climate oscillations have similar spatial climate fingerprints, they have very different behavior in time.

Two main characteristics distinguish PDO from El Nino/Southern Oscillation (ENSO): (1) 20th century PDO "events" persisted for 20-to-30 years, while typical ENSO events persisted for 6e18 months; (2) the climatic fingerprints of the PDO are most visible in the North Pacific/North American sector, while secondary signatures exist in the tropics while the opposite is true for ENSO.

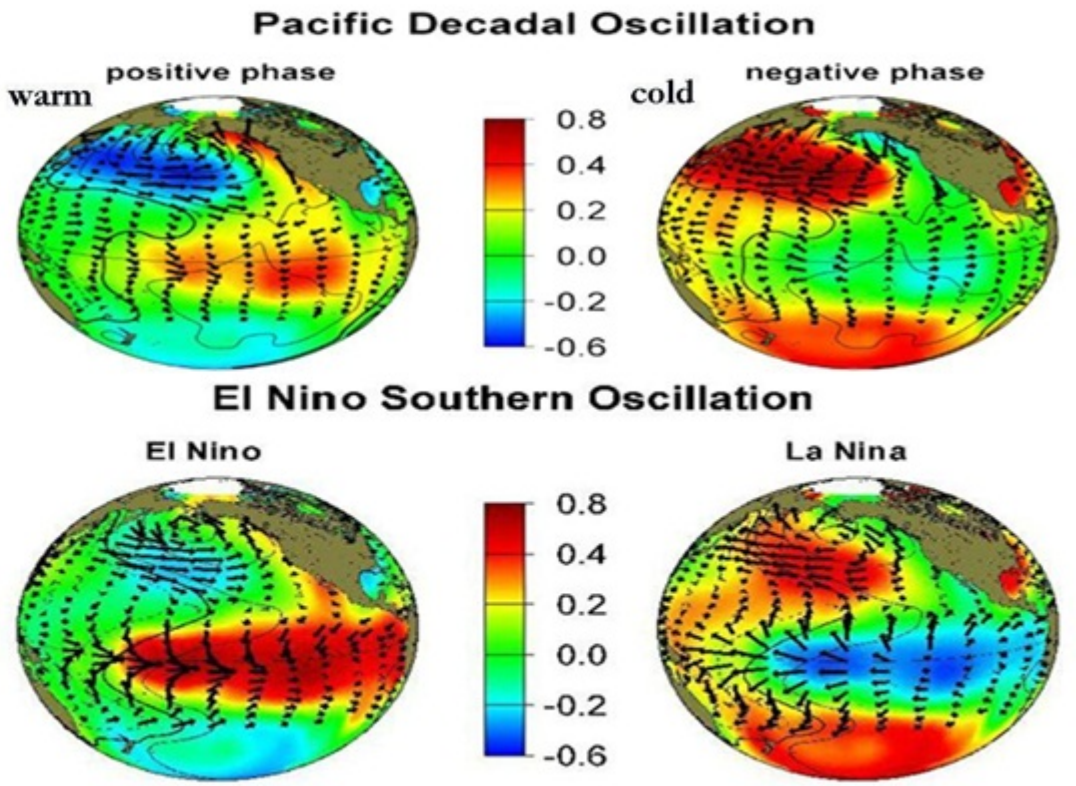


Figure 5: The sea surface temperature patterns for the warm and cold PDO and El Nino and La Nina. Note the similarity of the warm PDO and El Nino and cold PDO and La Nina

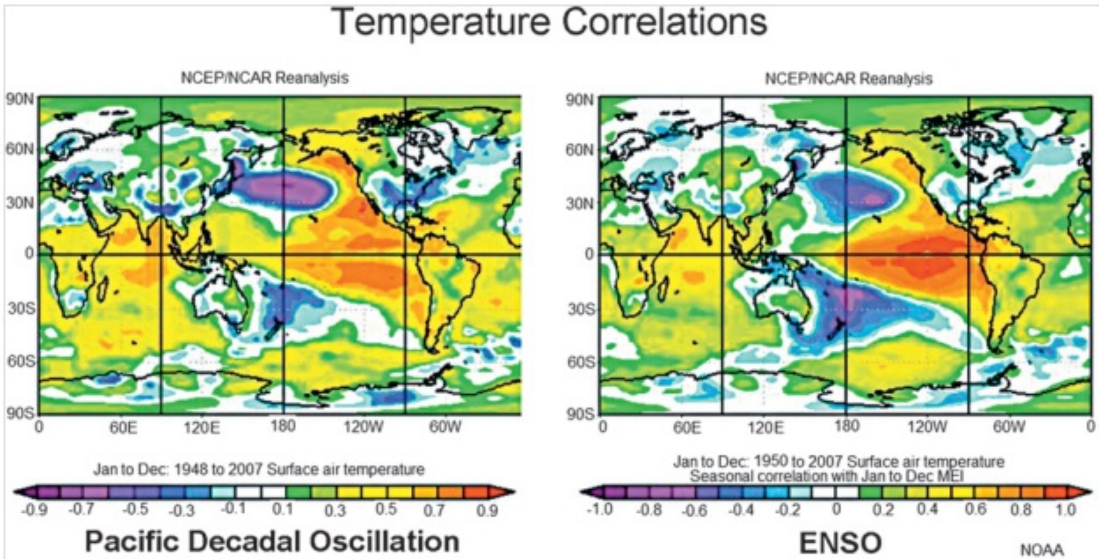


Figure 6: The correlations (NOAA CDC PSD Reanalysis) for annual temperature anomalies versus the positive PDO and El Nino. The opposite thermal pattern is true for both the negative PDO and La Nina

A study by Gershunov and Barnett (1998) showed that the PDO has a modulating effect on the climate patterns resulting from ENSO. The climate signal of El Nino is likely to be stronger when the PDO is highly positive; conversely the climate signal of La Nina will be stronger when the PDO is highly negative. See the PDO annual plot from 1900 below. It shows a cycle of roughly 60 years (55years).

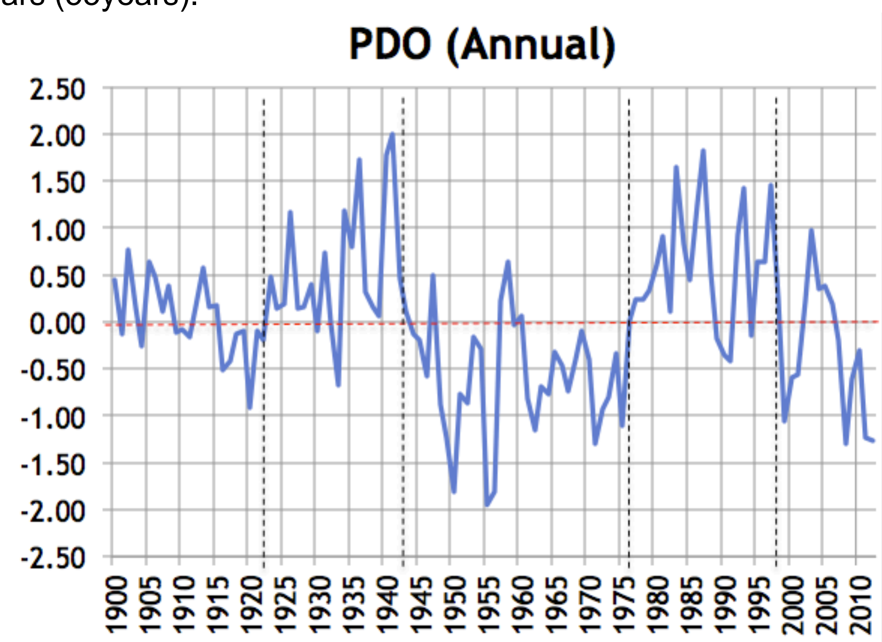


Figure 7 Annual PDO since 1900 (source CDC) after Mantua. Note the regimes with a positive PDO 1922 to 1945 and 1977 to 1998 and negative 1946 to 1976 and after 1998.

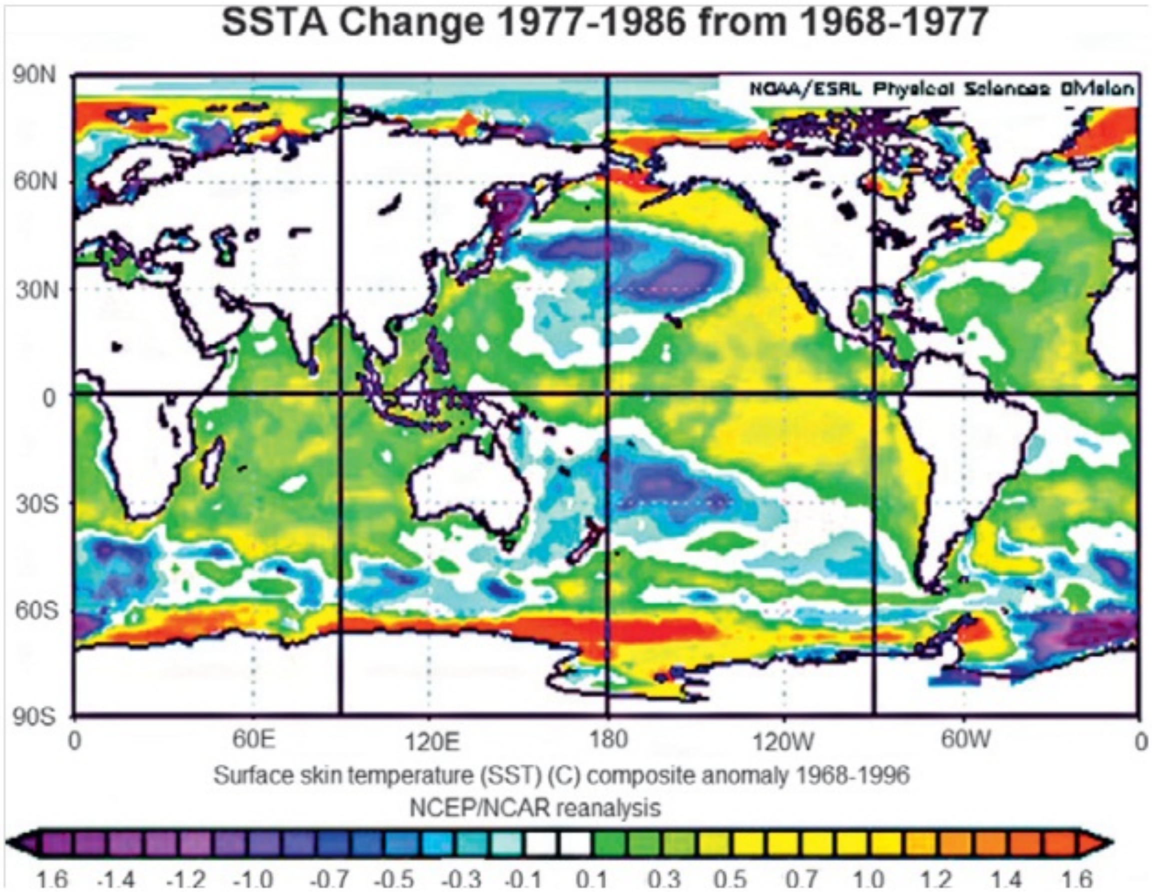


Figure 8: The Great Pacific Climate Shift in 1977 can be seen by examining the changes from the prior decade to the following decade of sea surface temperature patterns. Note the development of the classic +PDO signal

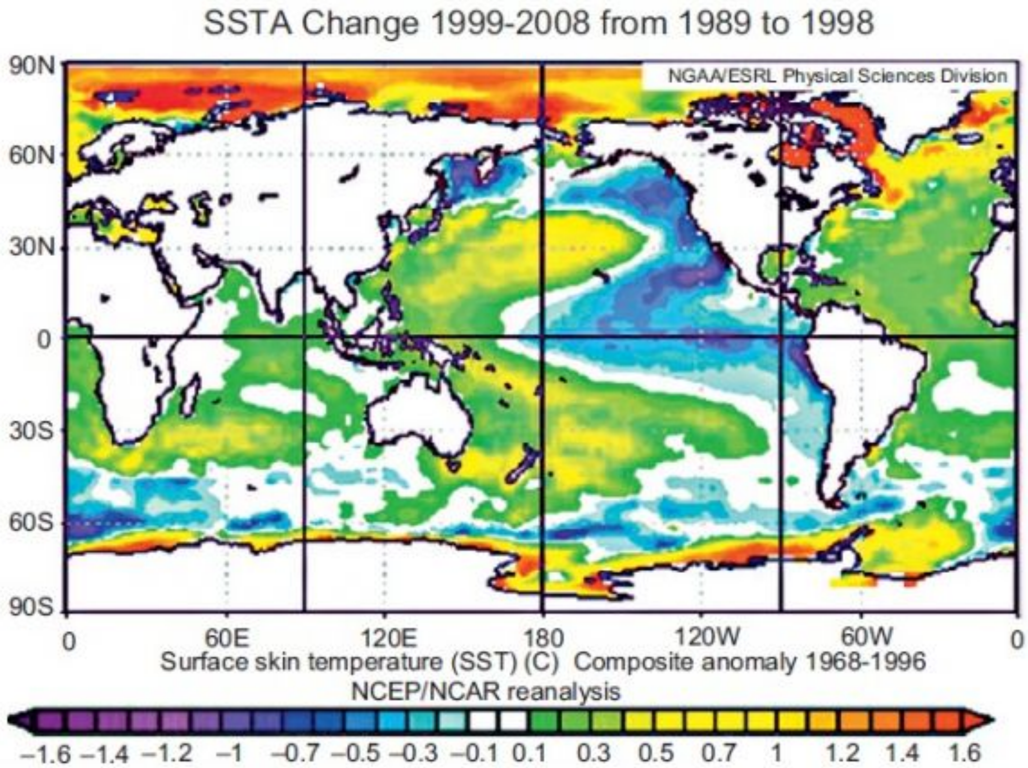
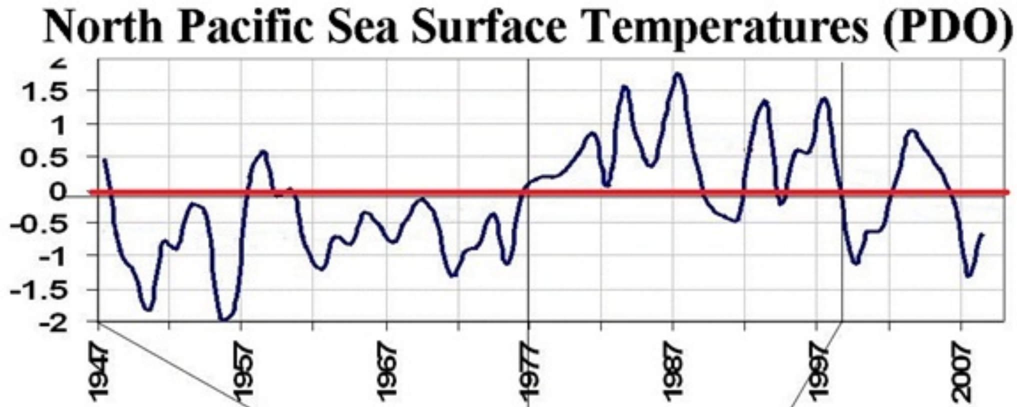


Figure 9: In 1998 after the super El Nino, the PDO flipped back to the cold mode as seen by the change from the decade before the decade after. Note the classic –PDO horseshoe pattern.

A study by Gershunov and Barnett (1998) showed that the PDO has a modulating effect on the climate patterns resulting from ENSO. The climate signal of El Nino is likely to be stronger when the PDO is highly positive; conversely the climate signal of La Nina will be stronger when the PDO is highly negative. We find the El Ninos tend to be MORE FREQUENT, STRONGER and LAST LONGER when the PDO is positive and the La Ninas tend to be MORE FREQUENT, STRONGER and LAST LONGER when the PDO is negative.



PDO	Cold	Warm	Cold
	1947-1977	1978-1998	1999-2012
El Nino	7	10	3
La Nina	14	3	7

NOAA CDC

Figure 10: See the frequency of El Nino is more than three time greater in the warm (positive) PDO and La Ninas more than two times stronger during the cold (negative) PDO

ENSO Duration in Months		
	El Nino	La Nina
Positive PDO	21	12
Negative PDO	13	20

Figure 11: El Ninos tend to last nearly twice as long during the warm (positive) PDO than the negative and La Ninas almost twice as long during the cold (negative) PDO

Thus during the positive (warm PDO) decades, El Ninos dominate and because they produce a global warming, the trend should be positive. During the negative (cold PDO) decades, La Ninas dominate and the trend should be down. You can see that in the USHCN data.

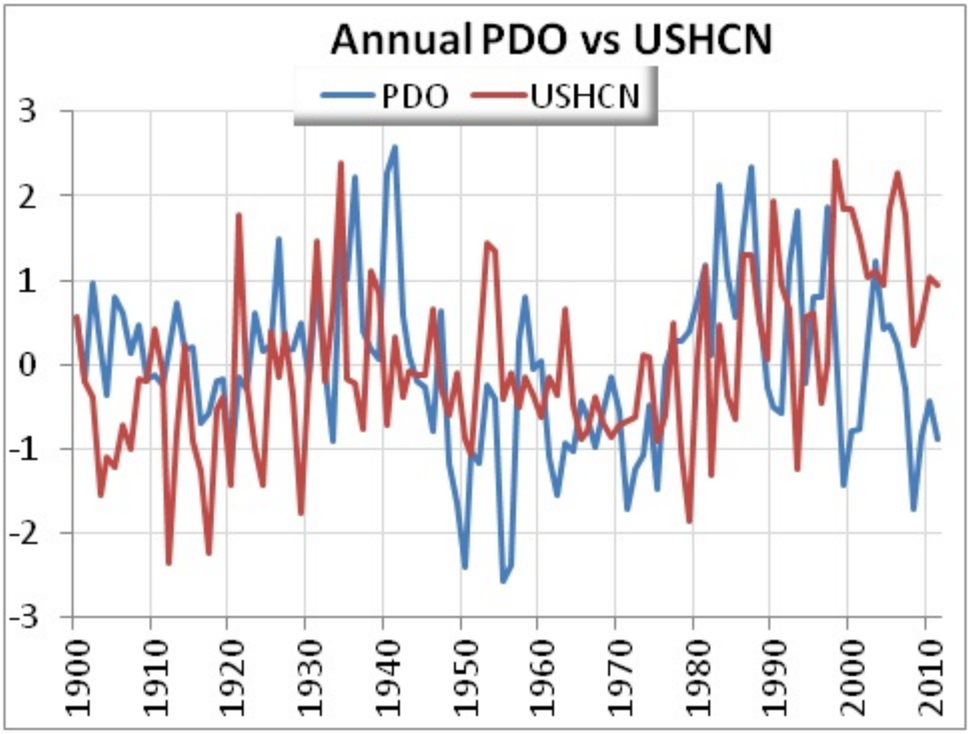


Figure 12: Annual PDO versus USHCN annual temperature anomalies (STD)

That trending is seen in the data with a tendency for cooling from the 1940s to late 1970s during the cold mode of the PDO, warming from 1977 to 1998 with the warm PDO and dominance of El Ninos and then leveling off as PDO began decline.

AMPLIFICATION BY ATLANTIC MULTIDECADAL OSCILLATION

The Atlantic also undergoes a multidecadal cycle with a period of about 70 years. The AMO is a measure of standardized sea surface temperature anomalies in the Atlantic from 0 to 70N.

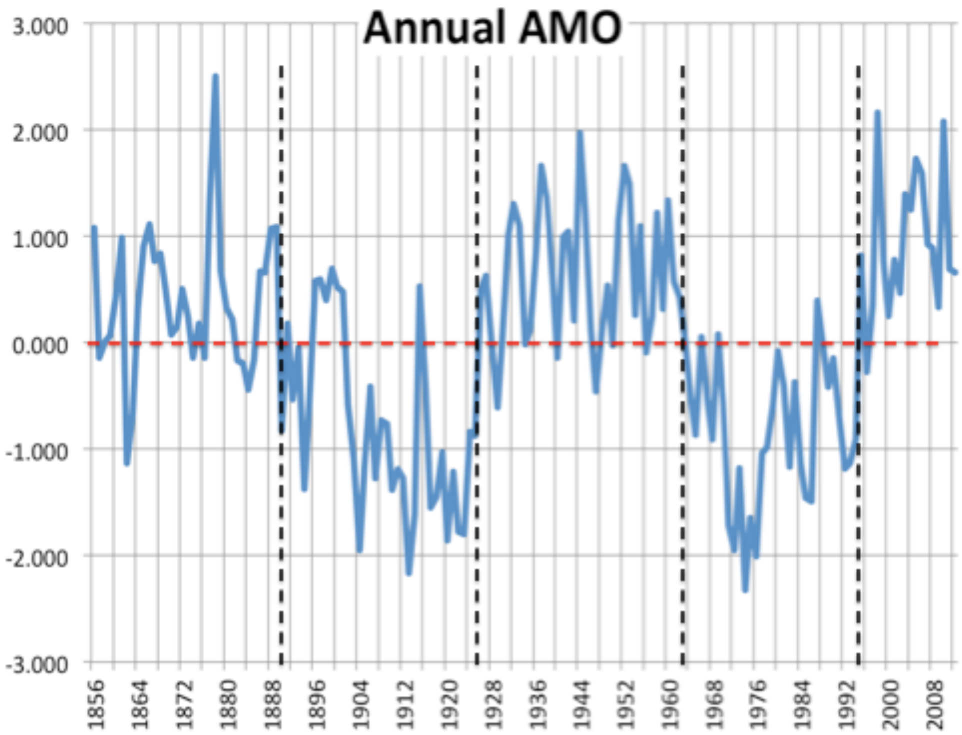


Figure 13: Annual AMO (CDC): Cold regimes are seen 1913 to around 1946 and from 1965 to 1994. The warm modes are seen before 1913, 1945 to 1965 and after 1995

SSTA Change from 1985 to 1994 to 1995-2004

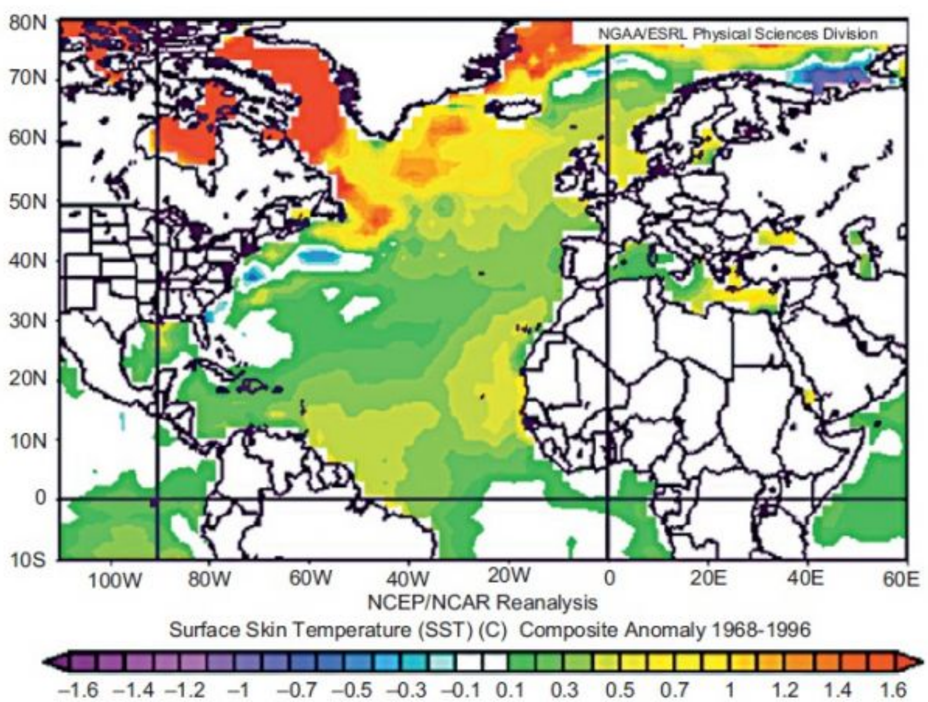


Figure 14: In 1995 the Atlantic shifted from the cold mode where the North

Atlantic and tropical Atlantic are colder than average with a warm belt in between to the opposite 'tripole' with warmth in the North and tropical Atlantic with relative cool water in between

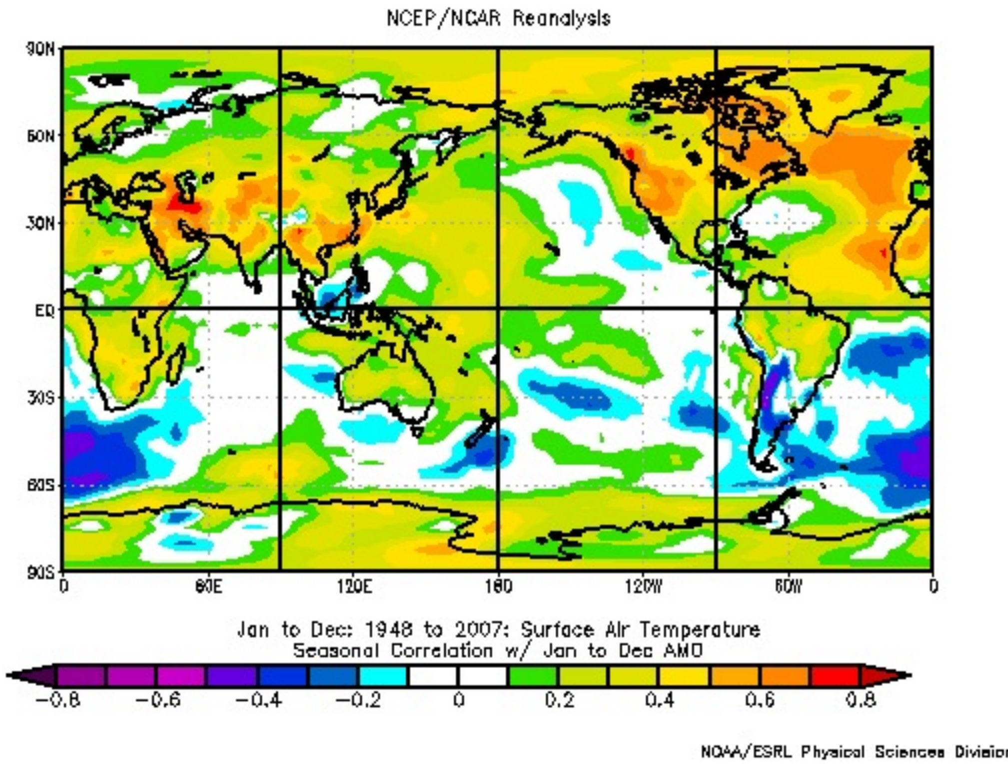


Figure 15: The positive AMO is characterized by warm temperatures in most of the Northern Hemisphere including the polar regions

Thus when both the Atlantic and Pacific are in their warm mode, warming is to be expected and when cold, cooler intervals. We see that in the annual patterns. Here we chose the USHCN v1 which we think was the best data set – most stable with UHI adjustment. Note how V2, by removing the urban heat island adjustment, has increased temperatures in the last few years.

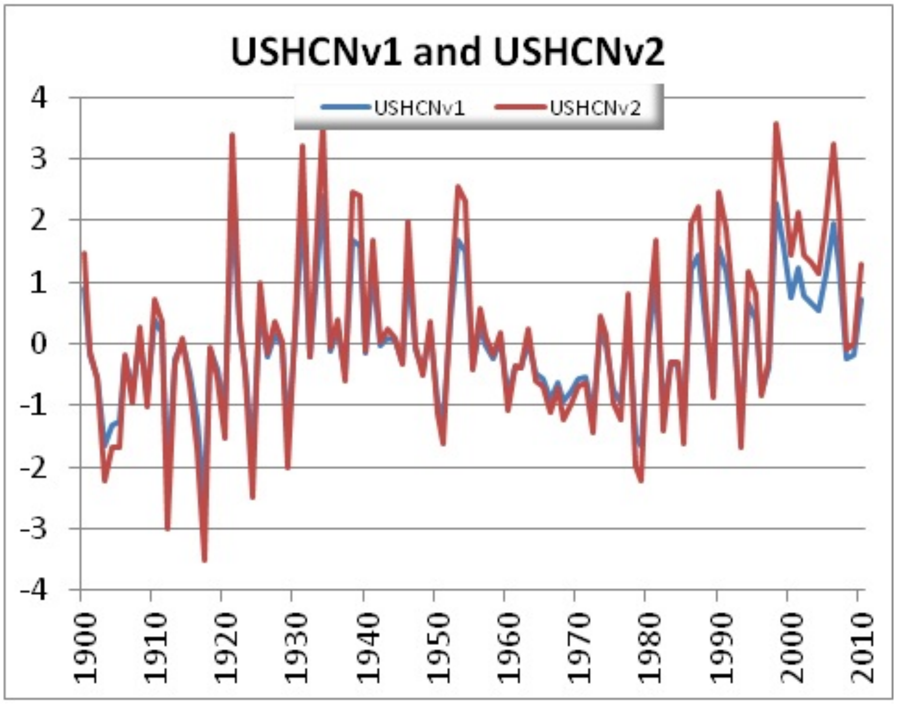


Figure 16: USHCNv1 versus USHCN v2 (NCDC)

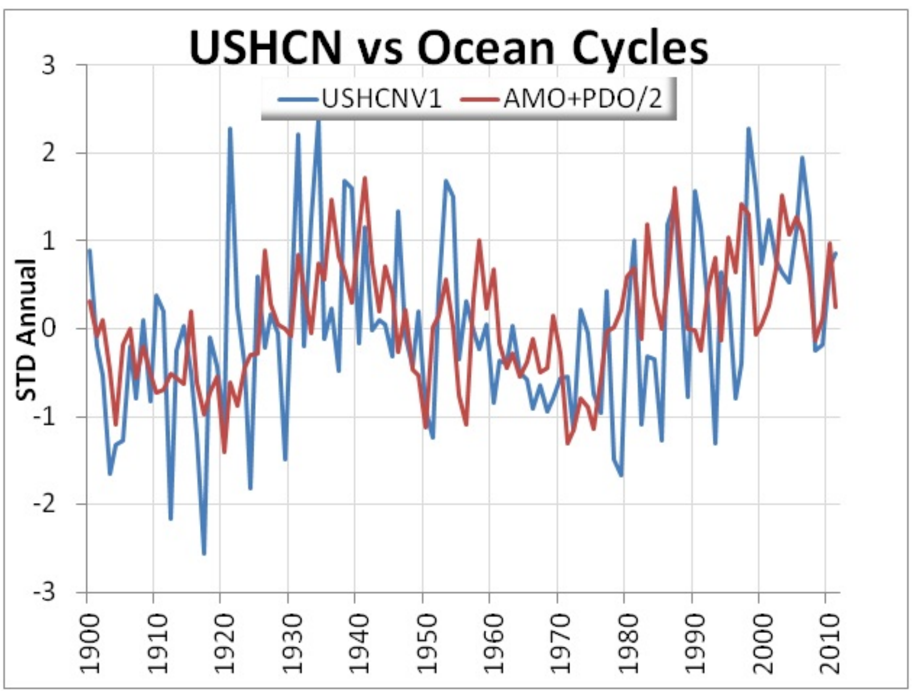


Figure 17: A plot of the average of the AMO+PDO versus the USHCN v1 data. Note the tight fit of the ocean anomalies with the temperatures even with the year-to-year variability.

We smoothed the data to see this pattern more clearly (11 point matching the average solar cycle). The r- squared is 0.78. BTW, the r-squared for version 2 was 0.77.

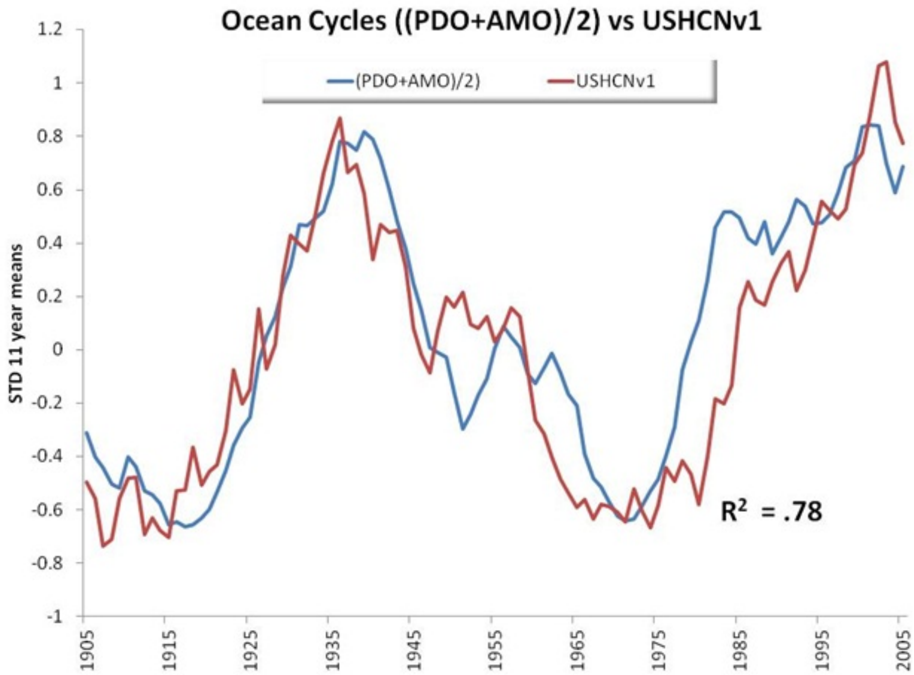


Figure 18: A plot of the smoothed (11 year) average of the AMO+PDO versus the smoothed USHCN v1 data. R squared value is 0.78

We know that smoothing increasing the r and r squared. But we did the same for the CO2 versus the USHCN smoothed in the same way.

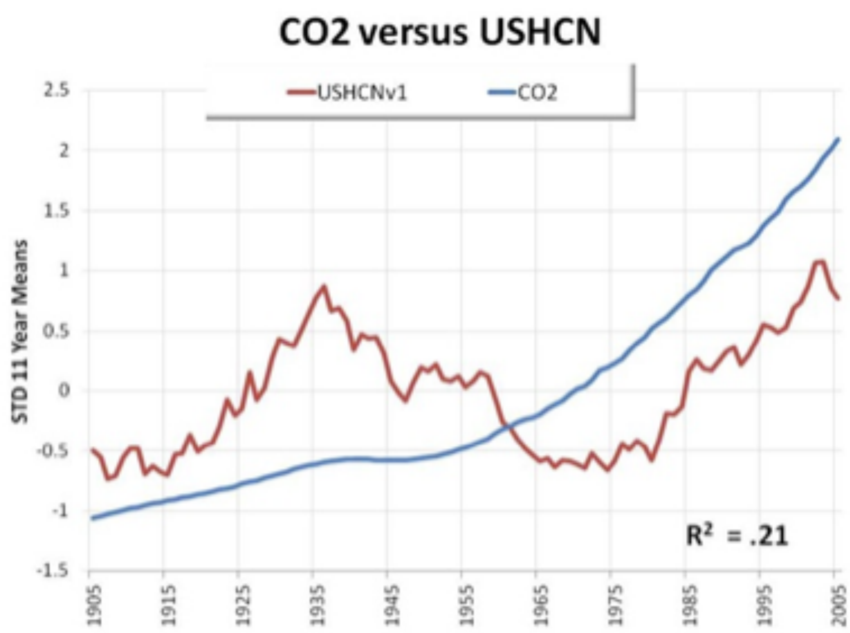


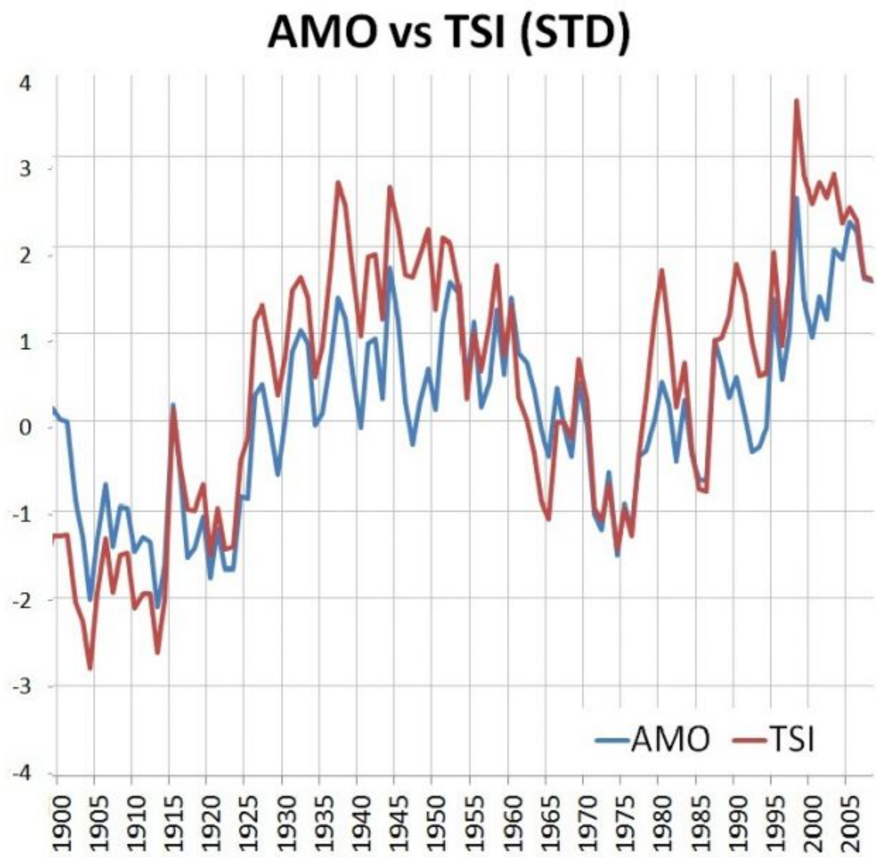
Figure 19: A plot of the smoothed (11 year) average of the CO2 (ESRL) versus the USHCNv1. R squared is 0.21.

The EPA technical support document proclaimed

"Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. Climate model simulations suggest natural forcing alone (e.g., changes in solar irradiance) cannot explain the observed warming."

That is because they only bothered to look at the brightness changes and solar irradiance/brightness changes only 0.1 to 0.15% in the 11 year cycle and perhaps 0.4% since the Little ice Age. They have ignored all the other solar factors like ultraviolet which can change 8-10% in the 11 year cycle and X-rays 100%. Nor did they consider the geomagnetic changes or the solar wind induced changes in cosmic rays which can alter low cloud cover (and albedo or reflectivity) by 1 or 2%. Low clouds reflect sunshine. A quiet sun means less warming from radiation amplified by more cloudiness. Duke's Nicola Scafetta found evidence for 60 year cycles in many data sets. The AMO and **PDO** are about 60-70 year cycles.

This chart comparing the AMO and the total solar irradiance computed by Hoyt/Schatten and Willson using multiple solar components and calibrated to the recent ACRIMSAT satellites is rather convincing for me. It shows a very tight tracking of the AMO (and not shown AMO+PDO) with TSI since 1900.



SUMMARY

We have shown that the ENSO and volcanic aerosols can explain short term fluctuations of global temperatures. Longer term changes the last century are best correlated with the ocean cycles in the Pacific and Atlantic and solar cycles and only poorly correlated with CO2 and only because the period of record begins in a cold period and ends at the end of a warm one. The data, counter to the EPA claims, provides very compelling evidence that the combination of the ENSO, PDO and AMO play a key role in observed changes in temperature since 1900.

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