Climate Change is Dominated by Natural Phenomena

Climate Change Causes

Examination of measured data and data that has been determined using a measured proxy (the time-integral of sunspot number) reveals that climate change, as described by average global temperature (agt), whether it is called Global Warming, Global Climate Disruption or even Global Cooling, has been caused, at least primarily and probably nearly entirely, by natural phenomena. A fairly simple equation that uses measurements of these phenomena accurately (R^2 = 0.88) calculates agt over the entire period of when it has been accurately measured (since about 1895). The equation and a graph of the latest results are given below.

The equation posits that agt variation depends on three things. They are (1) the time-integral of sunspot number (this is a proxy that correlates with energy retained by the planet), (2) the effective sea surface temperature, and (3) the change in the level of carbon dioxide in the atmosphere. The equation contains coefficients that set the fraction of the total change that each of these three contributes. The coefficients are adjusted to find the best match of calculated agt to measured agt. The closeness of match is determined by the coefficient of determination, R^2. The coefficients that result in the highest possible R^2 allow determination of the fraction that each of the three phenomena contributes.

About 40% of the agt change from the calculated low in 1909 until the calculated high in 2005 correlates with variation in the time-integral of sunspot numbers. The calculation of the net energy change (in an application of the first law of thermodynamics) is trivially easy. It is simply the time-integral of sunspot numbers minus the time-integral of the energy radiated from the planet The correlation between this and the temperature run-up in the last half of the 20th century is truly astounding. The result of the calculation is shown in a graph on page 14 of the pdf made public on 4/10/2010 at http://climaterealists.com/index.php?tid=145&linkbox=true.

Svensmark discovered and reported at Phys. Rev. Lett. 85, 5004–5007 (2000) (a very brief summary is at http://prl.aps.org/abstract/PRL/v85/i23/p5004_1) that sunspot number correlates with low-altitude cloud variation. A larger sunspot number coincides with fewer low altitude clouds and therefore higher average cloud altitude. Higher average cloud altitude means lower average cloud temperature. Since clouds radiate energy from the planet, if they are colder, they radiate less energy and the planet warms. The use of the time-integral of sunspots accounts for both time and magnitude of this effect. Those who have considered only the total solar irradiation (TSI) have mistakenly discounted any connection with sunspots.

Another 40% or so of agt change is caused by change of effective sea surface temperature (ESST). About 100 times as much energy is stored in the oceans per degree of temperature change as elsewhere. A simple calculation shows that only about 3.6 meters of ocean depth is equivalent in effective heat storage capacity to everything else (land and atmosphere). The ocean has circulating currents with temperature varying slightly along the path of each current. The surface temperature depends on which part of the path happens to be at the surface at the time that the temperature is measured. For the duration that fairly accurate temperatures have been measured, ESST has been determined to have a period of 64 years and double amplitude (peak to peak) of about 1/3 degree C.

Analysis using measurements to date indicates that the remaining 20% or so may be due to added atmospheric carbon dioxide (CO_2). However, there are compelling reasons to expect that CO_2 has substantially less than even a 20% influence. A main reason is the tiny decline in R^2 (about 0.6%) that occurs when it is assumed that added atmospheric CO_2 has no influence at all. Another reason is the growing separation between the rising CO_2 and not-rising agt. From 2001 through Dec, 2010 the atmospheric CO_2 increased by 21.8% of the total increase from 1800 to 2001 while the average global temperature has not increased significantly and the average of the five reporting agencies has been declining steeply since the peak of the last El Nino in about March 2010. The 21.8% CO_2 increase is the significant measurement, not the comparatively brief time period. As the atmospheric CO_2 continues to rise in the 21st century while the agt does not, the calculated influence of CO_2 will decline.

Temperature Measurements

Measured average global temperature (agt) anomalies for 2010 (and for January, 2011) obtained from the five reporting agencies are now available on the web. Anomalies are the difference between the measured temperature and a reference temperature (reference temperatures are usually the average for some time period and differ slightly between agencies). Current web sites for the data are:

NOAA (National Oceanic and Atmospheric Administration)
ftp://ftp.ncdc.noaa.gov/pub/data/anomalies/monthly.land_ocean.90S.90N.df_1901-2000mean.dat
and/or http://www.ncdc.noaa.gov/oa/climate/research/2009/perspectives.html

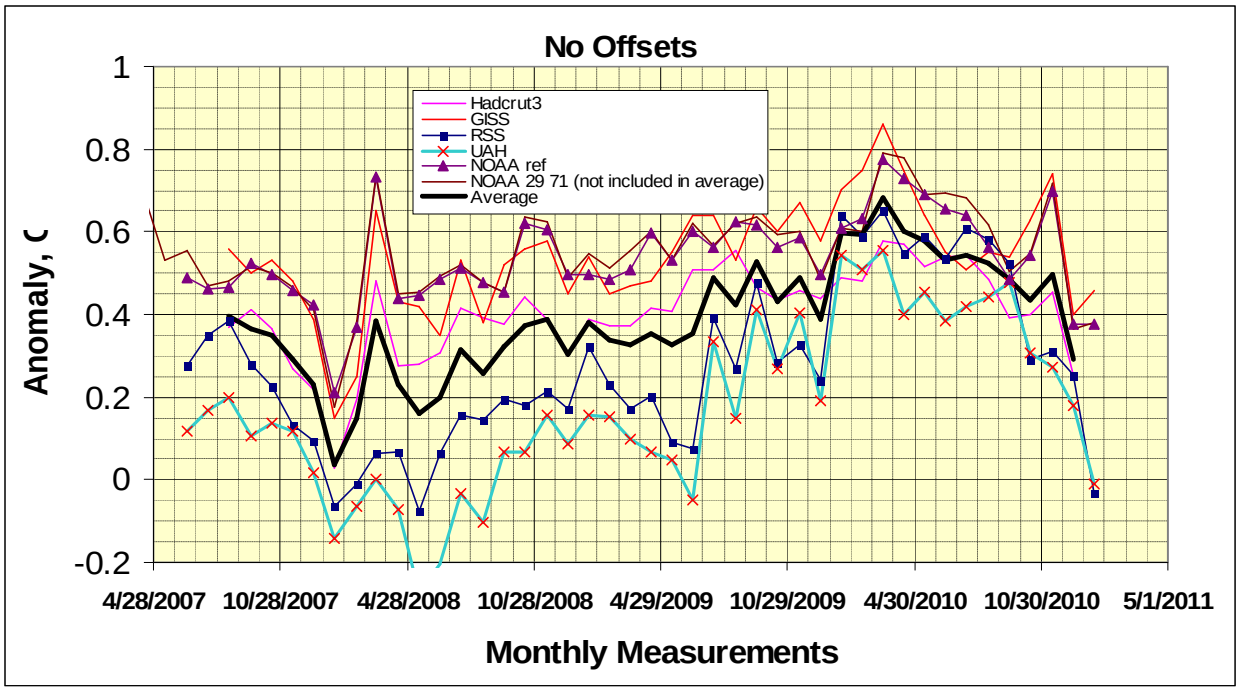
UAH (University of Alabama at Huntsville)
http://vortex.nsstc.uah.edu/data/msu/t2lt/uahncdc.lt

RSS (Remote Sensing Systems)
http://www1.ncdc.noaa.gov/pub/data/cmb/temp-and-precip/upper-air/rss_monthly_msu_amsu_channel_tlt_anomalies_land_and_ocean.txt

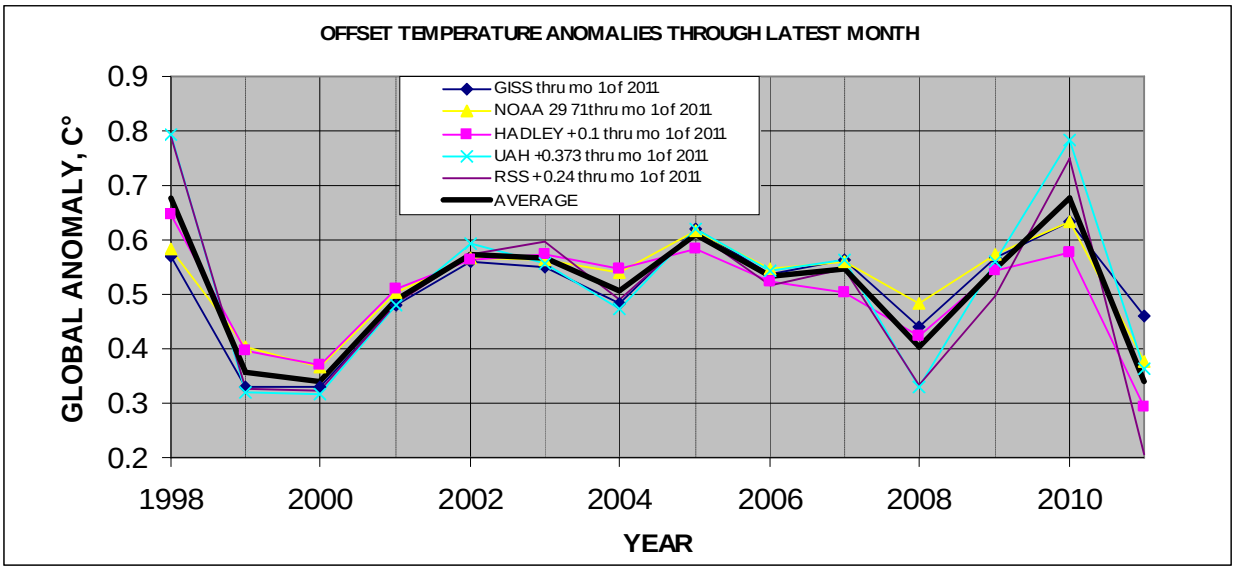
HADcrut3 (Met office Hadley Centre, UK)
http://www.cru.uea.ac.uk/cru/data/temperature/hadcrut3gl.txt

GISS (Goddard Institute of Space Studies)
http://data.giss.nasa.gov/gistemp/tabledata/GLB.Ts+dSST.txt

Recent data reported by these agencies and their arithmetic average are graphed by month below (NOAA ref is from the ftp web site and NOAA 2971 is 29% of the land value added to 71% of the ocean value from the http website). This graph shows the peak of the latest El Nino in March 2010 and the decline since then.

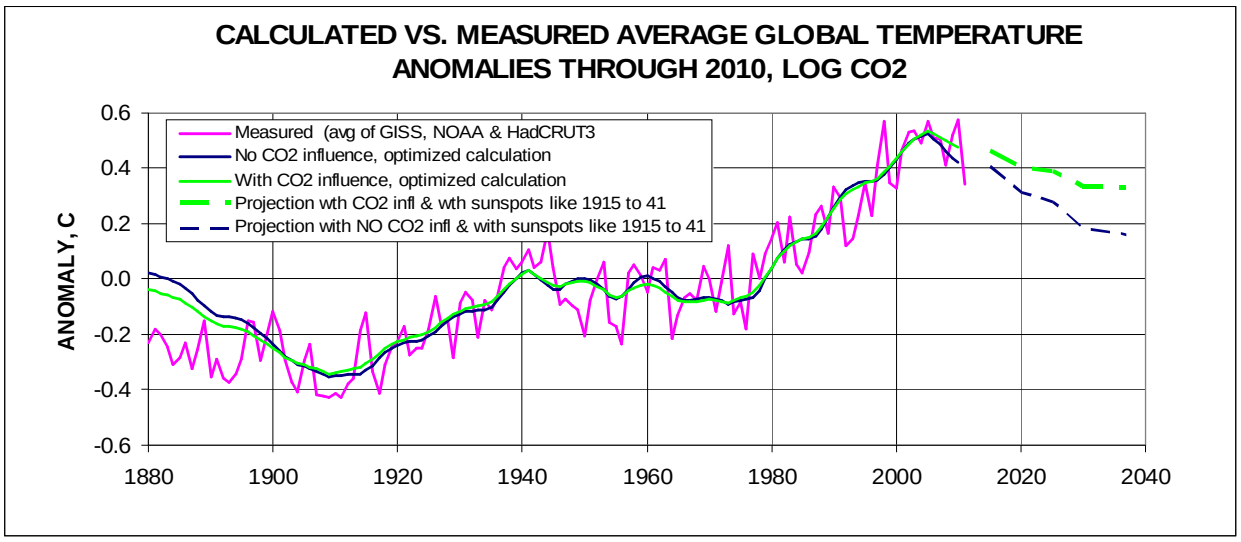


Data for the five agencies and their arithmetic average since the peak of the previous El Nino in 1998 are graphed next. This shows the essentially flat temperatures for the last several years. The peak temperature and comparatively large differences between the agencies (associated with an El Nino) in 2010 are seen to be the same as the peak and large differences (also associated with an El Nino) in 1998. Offsets (equivalent to change in reference temperature) are applied as noted to show the usual close match in temperature trajectory between agencies. This graph shows the high average temperature for 2010 and the steep decline to the values for January 2011 (2011 values will change as data for more months becomes available). The decline since March 2010 is leading to a La Nina and expected lower average global temperature for 2011.

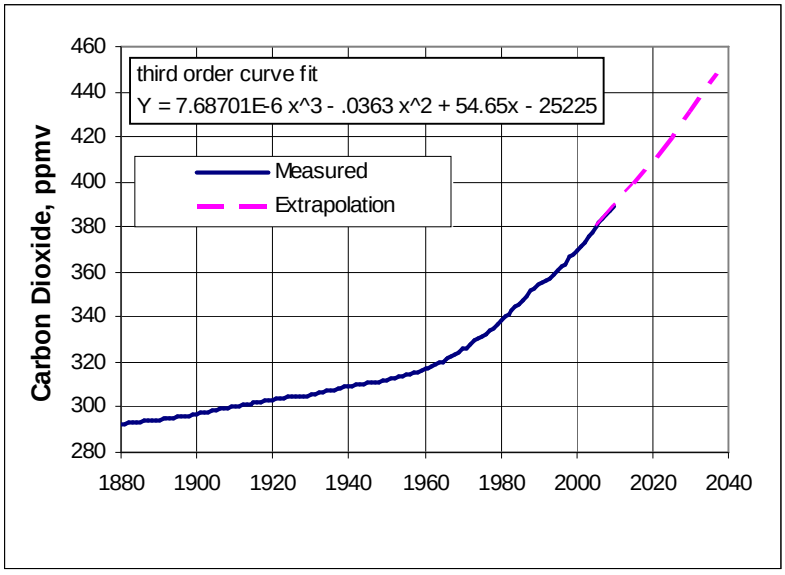


Calculations

The next graph shows the average temperature anomaly for the three agencies that report that far back. The average of GISS, NOAA and Hadley measured data since 1880 (only the value for January was available for 2011) are plotted along with calculated (prior to the present) and predicted values.



The calculated values for temperature anomaly if there is CO_2 influence use the logarithmic decline in influence of added increments of CO_2. Projected values use the cubic extrapolation of CO_2 level as shown here and sunspot activity estimated to be similar to that following 1914 which was the last time that the sun was as quiet for as long as it has been lately. The projected values, if it is assumed that there is no influence from CO_2, use the same estimated future sunspot activity.



This work follows the method used in the pdfs at http://climaterealists.com/index.php?tid=145&linkbox=true (see especially the pdfs made public on 4/10/10 and 6/27/10) but replacing the linear effect of CO_2 with the logarithmic decline of effect of added increments. The improved equation is as follows:

$$\text{anom}(Y) = \frac{\left(\sum_{i=1}^{Y} N(i)\right) - \sum_{i=1}^{Y} 6.52\cdot 10^{-9}\cdot T(i)^4}{b} - a + \text{ESST}(c, Y) + d\cdot\ln\left(\frac{\text{CO2}(Y)}{\text{CO2start}}\right)$$

Where:

anom(Y) = calculated anomaly in year Y,
N(i) = average daily Brussels International sunspot number in year i,
Y = number of years that have passed,
T(i) = agt of year i in °K,
ESST(c,Y) = ESST in year Y calculated using an ESST range (magnitude) of c,
CO2(Y) = ppmv CO_2 in year Y
CO2start = ppmv CO_2 in 1880
a, b, c, and d are factors to be determined.

The factor 'b' is the effective thermal capacitance. It relates the net effective energy in the numerator to a temperature anomaly.

Incorporation of the log decline of the influence of added increments of CO_2 results in a tiny increase of accuracy. R^2 for linear through 2009 is 0.879481 while R^2 for log decline through 2010 is 0.884103. If it is assumed that CO_2 has no influence, then R^2 is 0.878868. The coefficients that result in these correlations are as follows:

Assessment	End year	Offset, a	Energy devisor, b	ESST magnitude, c	CO_2 change multiplier, d	R^2
Best correlation	2009	0.365	5710	0.337	0.00251 for linear influence	0.879481
Best correlation	2010	0.372	5900	0.343	0.898 for log influence	0.884103
No CO_2 influence	2010	0.361	3886	0.3854	0	0.878868

The result for assumed linear influence of CO_2 uses the form of the equation presented in the pdf made public 6/27/10 at http://climaterealists.com/index.php?tid=145&linkbox=true.

Comments on the method
Note that some have mistakenly perceived this approach as traditional curve fitting using polynomials or the Fourier Technique. The form of the equation is derived from rational consideration of the physics as described in the section titled 'Anomaly Calculation (an engineering analysis) of the pdf made public on 4/10/10 at http://climaterealists.com/index.php?tid=145&linkbox=true. The factors are optimized to determine the portion of influence that each physical phenomenon contributes. The excellent correlation, which matches the up and down average global temperature trends for over a century, demonstrates that the hypothesis that the energy change of the planet varies directly with the time-integral of sunspot number is verified.

However, as discussed previously, the predictive ability of the equation depends on the sun and ESST both continuing to act as they have for more than a century. The qualitative contribution of ESST results primarily from observation of agt over the 20th century. This is reinforced by observation of reported values for PDO, AMO and nino3.4. Although ESST is the net effect of multiple ocean current activity, no explicit cause is identified. Thus the multiple currents may be independent and just happened to align for over a century in a way that produced the observed agt-time trajectory. If they are indeed independent then the alignment will eventually fade, the as-defined ESST influence (amplitude) will decline and the description of ESST may need to be revised. Given the excellent correlation between calculated and measured agt for over a century, however, the derived amplitude and cycle length should be good approximations of the trend for decades.

For the projections, solar activity was assumed to be similar to that following about 1914. The solar experts are currently projecting that Solar Cycle 24 will be somewhat less active than the circa post 1914 Solar Cycles 15 and 16 so the temperature trend may decline even more steeply than the lower of the two projections on the above graph. A lower limit for the temperature decline rate (no sunspots and no CO_2 influence) is shown in the pdf made public on 6/26/10 at http://climaterealists.com/index.php?tid=145&linkbox=true .

Following is a summary description of the development of the coefficient X in the equation on page 13 of the 4/10/10 pdf (thanks to Viscount Monckton for asking). Since the planet's average global temperature hasn't changed much for centuries, the two factors on the right side of the equation must be about equal. The average sunspot number since 1700 is about 50, the energy radiated from the planet is about 342*0.7 = 239.4 (for the units used) and the earth's effective emissivity is about 0.61 (http://en.wikipedia.org/wiki/Global_climate_model). Thus, as a place to start, X should be about 50/239.4 times the Stephan-Boltzmann constant times 0.61.

50/239.4*5.67E-8 *0.61 = 7.2E-9

With this plugged into the equation, a plausible graph is produced with a dramatic change observed to take place in about 1940. In EXCEL, 7.2E-9 was placed in a cell and the cell (value for X) called by the equation which produced a graph. The graph was observed as the value for X was varied. X was adjusted until the net energy from 1700 to about 1940 exhibited a fairly level trend. This occurs when X is 6.519E-9 (unbeknownst to me at the time, cell formatting rounded it to 6.52E-9). If an average sunspot number of 6.52/7.2*50 = 45.28 had been used, no adjustment would have been needed. Interestingly, the average sunspot number from 1700 to 1940 is 44.