The Sherlock Cycle

Does the Earth have a natural climate cycle of the kind that could account for events like the Medieval Warm Period and the large global temperature increase that has been observed since the 1940s? I think it does. This letter is a summary of the reasons why I think so.

A Theory of Natural Climate Cycles

I think the Earth has a natural climate cycle in which the Sun does the warming and volcanoes the cooling. This is not an original idea: Benjamin Franklin in the 1780s was perhaps the first person to write of a link between the weather, the Sun and volcanoes. What is different here is the addition of two theoretical corollaries which change Mr. Franklin's observations on the weather into a testable theory of natural climate cycles. Both corollaries must be true if this theory is to be correct.

The First Corollary is the necessary assumption that, over the long term, the heating influence of the Sun must be equal, but opposite to, the cooling influence of volcanoes. Logically, too much of one or the other, and a cycle it would not be.

The Second Corollary is a consequence of the Law of Thermodynamics. This Law holds that the addition to the Earth of extra thermal radiation, such as occurs during the maximum years of the 11 year solar cycle, or the subtraction, or blocking, of thermal radiation as occurs following a stratospheric volcanic eruption, are strictly temporary phenomenon, and therefore cannot be the sole substance of a long term climate cycle. If volcanoes and the Sun are to be the drivers of a long term climate cycle, these two natural forces must be changing the nominally permanent contents of the atmosphere.

The significance of the Second Corollary is that because these changes to the atmosphere are permanent, they also are cumulative. This cumulative feature is the key to the climate cycle equations described in the next section.

What component of the atmosphere is being changed? I do not know, but recommend research be focused in three areas: the biological aerosols including isoprene and the monoterpenes, atmosphere electricity, and the ultrafine particulates produced by the largest volcanic explosions. These three suggestions may in the end not be right but, if this theory is correct, I have no doubt the physical secrets eventually will yield to a determined experimental inquiry.

The rest of this letter briefly describes the statistical association that exists between solar variability, volcanic eruptions and the average global temperature. Two predictions of the future global temperature are made, based on these observations.

The Testable Hypothesis

If this theory and its two corollaries are correct, then the following two equations, which form a testable hypothesis, will describe the average global temperature of the Earth:

CLIMATE CYCLE EQUATION

$$\mathrm{T}_n = \mathrm{T}_1 + \sum_1^n \mathrm{S} - \sum_1^n \Delta\mathrm{V} + \mathrm{T}_O + \sum_1^n \mathrm{T}_A \qquad (1)$$

BALANCED SLOPE EQUATION

$$m \sum_1^L \mathrm{S} = m \sum_1^L \Delta\mathrm{V} \qquad (2)$$

In Equation 1, T_n is the average global temperature at time n, T_1 is the average global temperature at time 1, $\sum_1^n \mathrm{S}$ is the sum over time of the Solar Influence, $\sum_1^n \Delta\mathrm{V}$ is the sum over time of the Absolute Volcanic Influence, T_O is the temperature influence of all other natural climate forces at time n, and $\sum_1^n \mathrm{T}_A$ is the sum over time of the accumulating temperature influence of anthropogenic activities. In words, the global temperature of today is equal to the temperature at the beginning of the period, plus all the changes made by the Sun, minus all the changes made by volcanoes, plus any current natural temperature events (like El Nino) plus all the changes made by mankind.

Equation 2 is the mathematical consequence of the First Corollary where the slopes, m, of the two straight lines that describe the accumulation of the Solar, S, and Absolute Volcanic Influence, $\Delta\mathrm{V}$, over the long term, L, will be equal.

If this theory is correct and given adequate data on solar variability and volcanic eruptions for calculating S and ΔV, it should be possible to solve the two equations. The results should track the average global temperature and be useful in predicting the future average global temperature, within the confines of our limited ability to predict future solar variability and future volcanic activity.

Testing the Hypothesis

The 3 datasets used to successfully test this hypothesis are described:

1. The International Sunspot Number as produced by the Solar Influences Data Analysis Center (SIDC), World Data Center for the Sunspot Index, at the Royal Observatory of Belgium, which has been recorded since 1700, was used as the measure of solar variability. The Monthly Mean Sunspot Numbers from February, 1755 onward (the start of Solar Cycle 1) were assumed to be correct in all respects and are referred to here as the Monthly Sunspot Count.
2. The Volcanic Eruption Record (volcano name and eruption date) and the Volcanic Explosivity Index (Newhall and Self's 1982 measure of volcano size) were adapted from the List of Large Holocene Eruptions compiled by the Smithsonian Institution, Global Volcanism Program. This list includes all known eruptions with a VEI of 4 or greater and also was assumed to be correct in all substantial ways from 1755 onward.
3. Monthly values for the average global temperature are based on satellite observations, as interpreted by the National Space Science and Technology Center, University of Alabama, Huntsville. The Global Temperature Report is available from December, 1978.

The results of this successful test of the hypothesis are shown in Figure 1. Temperature values are shown as an anomaly of the average satellite temperature from 1979 to 1998. The green line, referred to here as the Sherlock Cycle, has been calculated from Equations 1 and 2, which were solved with the following values:

$$T_{2010} = T_{1979} + \sum_{1979}^{2010} a(\tanh(b(MSC - c) + 1) + 1) - \sum_{1979}^{2010} VER \times de^{VEI} \quad (3)$$

$$m\sum_{1755}^{2009} S = m\sum_{1755}^{2009} \Delta V = 0.003495°C/\text{month} \quad (4)$$

T_{1979} Calculated from the common 1755 intercept of Equation 4

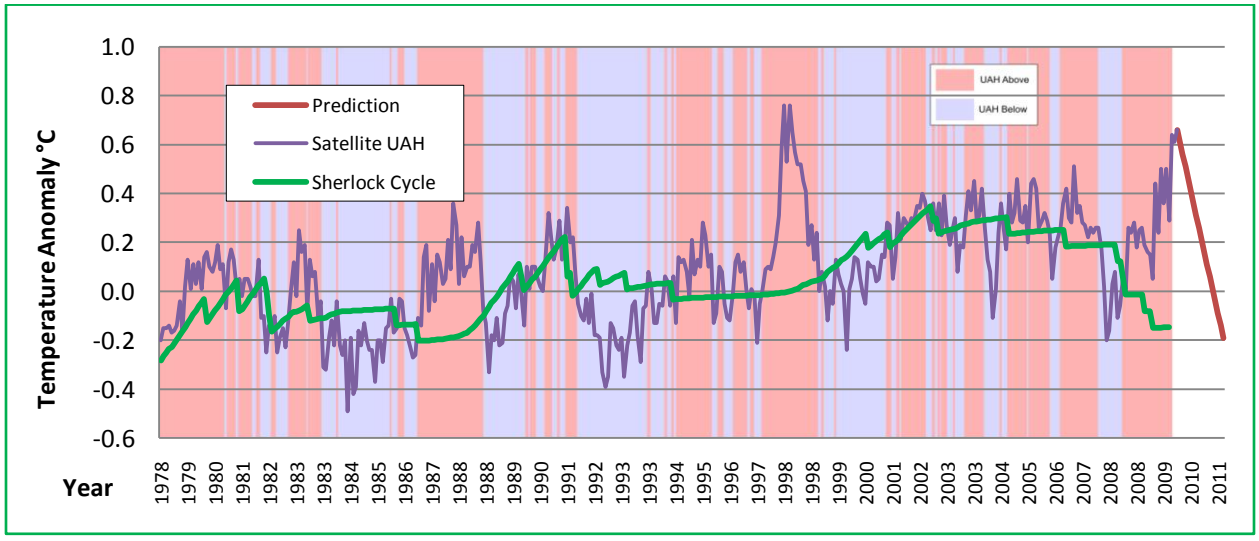
∑S: a = 0.00922, b = 0.0198, MSC = Monthly Sunspot Count, c = 152

∑ΔV: VER = Volcanic Eruption Record, d = 1.62, e = 0.010027, VEI = Volcanic Explosivity Index

Note 1: The amplitude of the Sherlock Cycle was calibrated to the satellite record using a best fit of 4th order polynomials (not shown).

Note 2: Values for T_O and $\sum_1^n T_A$ from Equation 1 are assumed to be Zero.

Figure 1 Satellite Temperatures and the Sherlock Cycle



As shown in Figure 1, and as the hypothesis predicts, the Sherlock Cycle can be calibrated to closely track the satellite measured average global temperature. The coloured bands in the background of Figure 1 identify those months when the satellite measured average global temperature was above the Sherlock Cycle (pink) or below it (blue).

Prediction 1

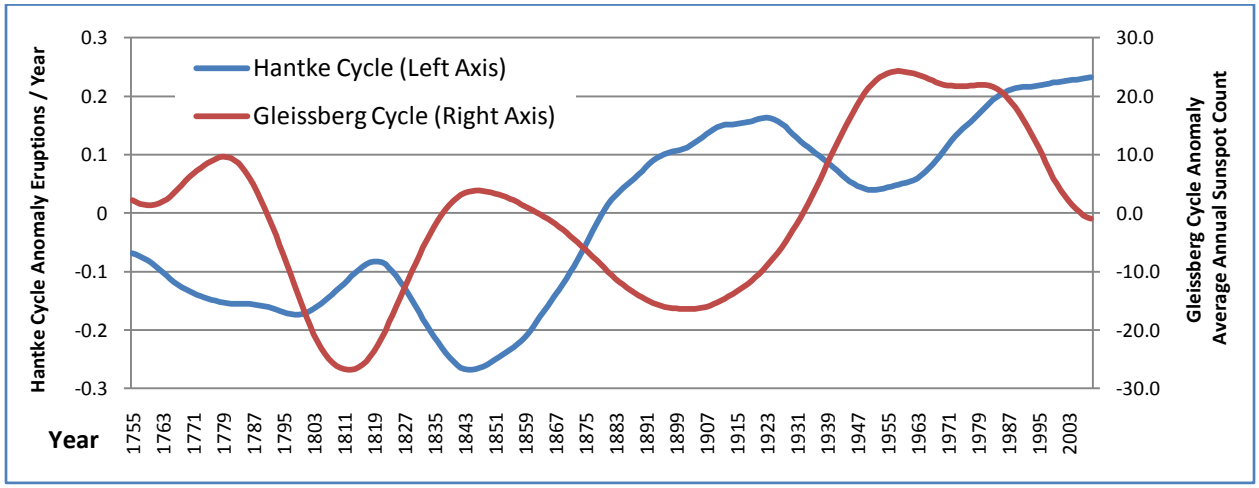
Figure 1 also shows the first of two temperature predictions made in this letter: as we emerge from the current El Nino event, the satellite measured, average global temperature anomaly is predicted to drop below -0.2°C on or about August, 2011. All of the global warming of the last 30 years will be gone, and as discussed in the final section of this letter, the average global temperature is not likely to increase any time soon.

Volcanoes and the Sun

The First Corollary states that over the long term, the heating influence of the Sun is equal, but opposite to, the cooling influence of volcanoes. If this corollary is correct, and if there is a long term pattern in the variability of the Sun, which there is, then there may be a similar, complimentary pattern in the volcanic eruption record. Observational data from the last 255 years shows there is a correlation. This phenomenon is shown graphically in Figure 2.

M. N. Gleissberg in 1939 observed a long-periodic fluctuation in sunspots in an approximate 80 year cycle that now bears his name. The Gleissberg Cycle shown in Figure 2 has been calculated by passing the average annual sunspot count three times through a 21 year running average filter. The values are shown as an anomaly from the 255 year series annual average count of 52.1 sunspots.

Figure 2 The Gleissberg and Hantke Cycles



The 141 large stratospheric volcanic eruptions that have occurred since 1755 show a similar, but mostly opposite pattern, referred to here as the Hantke Cycle - Gustav Hantke was a pioneer in the systematic recording of volcanic eruption events. The Hantke Cycle shown in Figure 2 was calculated by passing the annual count of stratospheric eruptions three times through a 21 year running average filter. The values are shown as an anomaly from the series average of 0.553 eruptions per year

Although the interaction of the variable magnetic field of the Sun with the magnetic field generated by the Earth's molten core is an elementary fact of nature, I never imagined the significance of this relationship could be so clearly visible, using even the crudest of measurements, as has been done here. I remain astonished by the simple clarity of Figure 2.

Data in Figure 2 from the last 30 years show we are in a time of high volcanic activity, while solar variability is headed to the low part of the Gleissberg cycle.

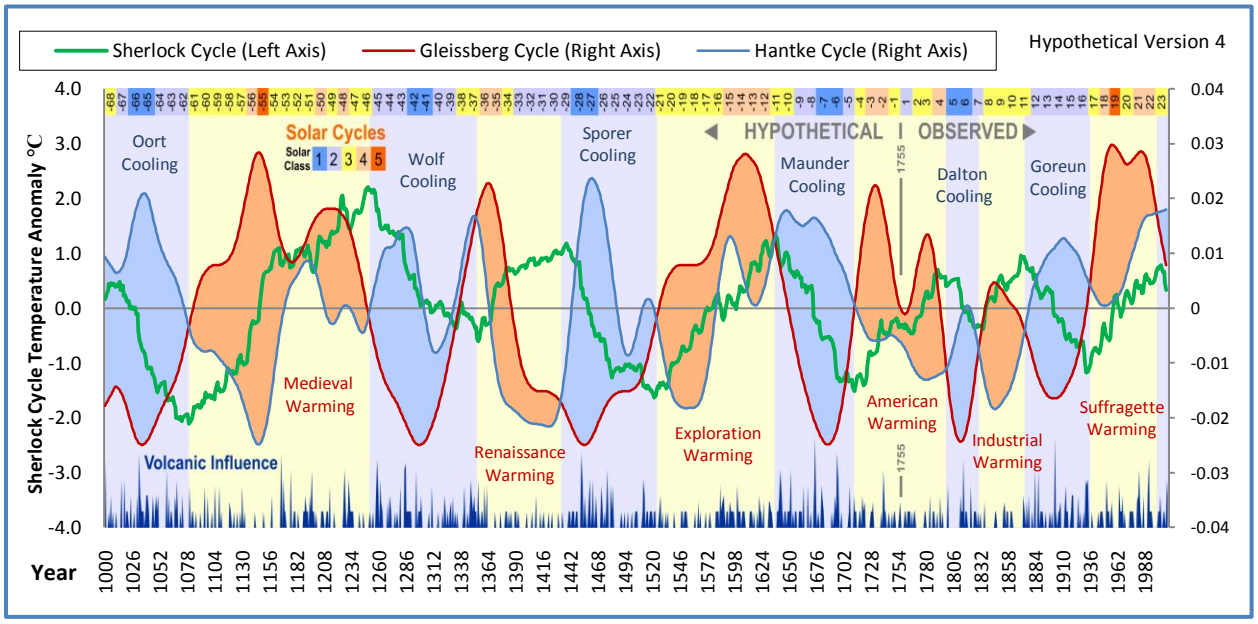
An abbreviated description of the impact of these two related natural phenomenon on the history and future of the global climate is the subject of the next section.

The Medieval Warm Period?

To address this question a Monthly Sunspot Count and a Volcanic Eruption Record for the years 1000 AD to 1754 were reconstructed from available proxy and observational records. As noted elsewhere, this task is fraught with ambiguity and is at best difficult, if not actually impossible. The reconstruction used here is a work in progress, can be fairly described as part artistic and part scientific, and therefore is referred to as Hypothetical.

The results of the 755 year Hypothetical reconstruction, combined with the 255 year observational record, are shown in Figure 3. The 23 known and the 68 Hypothetical solar cycles are shown in the bar at the top of Figure 3. Solar Class is a 5 category classification of the solar cycle from weak (1) to strong (5). The Volcanic Eruption Record is illustrated at the bottom of Figure 3. The annual Absolute Volcanic Influence ranges from 0 to 0.388°C (scale not shown). The Gleissberg Cycle (red) and the Hantke Cycle (blue) have been calculated here as a 3 pass, 21 year running average of the annual Solar Influence, S and the Absolute Volcanic Influence, ΔV, respectively. Values of these two natural phenomena are shown on the right axis as an anomaly from the common series average of 0.043°C per year.

Figure 3 Sherlock Cycle Periods



The Sherlock Cycle is again shown in green with the temperature values this time shown as an anomaly from the 1010 year series average. Twelve Sherlock Cycle Periods have been identified. The Cooling Periods are named after famous scholars of solar and climate science and the Warming Periods after contemporary historic events. The start and end times of the Sherlock Cycle Periods, identified by colour and name in Figure 3, are defined by the intersections of the two lines identified as the Gleissberg and Hantke Cycles.

The Sherlock Cycle has an amplitude of approximately 2°C in the observed portion of Figure 3. The amplitude increases to about 4°C in the Hypothetical portion.

In Figure 3 the Medieval Warming is the warmest period of the last 1010 years. The temperature of today is not in any obvious way abnormal.

Prediction 2

As shown in Figure 3, the Suffragette Warming ended in 1999 and we have now entered an as yet unnamed period of global cooling. Based on current knowledge, this climate cooling will last anywhere from 12 to 100 or more years. So to be as specific as possible, it is predicted there will be no more sustained global warming until the two lines describing the Gleissberg Cycle and the Hantke Cycle, as calculated in Figure 3, intersect once again.

The Anthropogenic Influence on the Global Temperature

One notable result of this work is that since the Sherlock Cycle, as calculated here, accounts for all of the global climate variability of the last 31 years, it seems fair to conclude that the Anthropogenic Influence - the $\sum_1^n T_A$ from Equation 1 - on the average global temperature is zero, or in a worst case scenario, near zero. I think the 1950's era carbon dioxide hypothesis of runaway global warming is false.

Final Comment

It is understood this theory and the conclusions reached are at odds with current thinking, but if the two temperature predictions made in this letter prove accurate, this alternative explanation for the cause of climate change, an explanation that leaves the production of plant food off the hook, is sure to gain considerable currency.

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4 June 2010, Winnipeg

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