Global Warming and Natural Forcing Factors

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Abstract: It is almost common place in the Engineering society to believe that Global Warming is a *man-made* effect. However, a closer review of the related literature provides equally sound *natural* alternatives that may cause the same effect. This paper offers a review of important factors that affect the Global Climate.

The Intergovernmental Panel on Climate Change (IPCC) declares that the observed Global Warming since the beginning of the Industrial era is a man-made effect. IPCC bases its estimates on numerical models that lack adequate knowledge of fundamental related factors and estimates that for a doubling of atmospheric CO2, the global temperature is most likely to rise by about 3°C.

Other branches of science offer the following views: (a) Scientifically it was shown that the earth climate is affected by various cyclic changes, called Milankovitch cycles, that are related to the earth's orbit. (b) Physical observations on other planets confirm that the atmospheric CO2 partial pressure influences in a specific log-log relation the surface air temperature. (c) A lot of individual but prominent scientists arrived at the conclusion that at the most, *doubling* the atmospheric CO2 from its pre-industrial level, will only cause an increase in atmospheric temperature by 1 K and not 3 K. (d) Carbon at present and near-future concentrations, is still not in the range of a pollutant. On the contrary plants benefit because of this increase.

Turning our interest into the sun, we find that comparison of past and present solar cycles suggests cyclicity, indicating that similar global temperatures will occur. Additionally the cosmic ray hypothesis, being investigated by *DNSI* and others, suggests that periods with low solar activity result to a lower global mean temperature.

Concluding, all the above show that in the case when there is no sound scientific understanding of physical phenomena, no sound and absolute conclusions should be drawn.

Keywords: Global Warming, CO2, Milankovitch cycles, solar cycles, cosmic ray hypothesis.

1. Introduction

It is a fact that global temperature has increased by about 0.7°C over the last century. The scientific community has assumed that the reason for this is the release of greenhouse gases coming mostly from the burning of fossil fuels, the clearing of land and the manufacture of cement. According to IPCC, the observed increase in globally averaged temperatures since the mid-20th century is 'very likely' to have occurred due to the increase of the greenhouse effect. The greenhouse effect is the phenomenon where water vapor, carbon dioxide (CO_2), methane and other atmospheric gases absorb outgoing infrared radiation resulting in the raising of the temperature. In its turn, CO_2 is essentially blamed to be the main factor causing the greenhouse effect because it is the most important anthropogenic greenhouse gas (IPCC, 2007a). The concentration of CO_2 in the atmosphere has increased by about 35% from its pre-industrial values, with all the resulting consequences.

But the above is not a proven fact. There are other factors – besides the greenhouse gases – that affect the global temperature, like changes in the galactic environment, solar activity, cloud cover, ocean circulation and so forth.

For the past 4.5 billion years the earth has been traveling through galactic space. The global climate has changed drastically through time with variations between ice-free and glaciated climates. One reason for this may be the change of the galactic environment and the activity of the sun. The geological record of the past 510 million years shows four alternations between "hothouse" and "icehouse" conditions during the Phanerozoic aeon, which can be attributed to four encounters with the spiral arms of the Milky Way with every encounter causing an icehouse episode (Svensmark, 2012). On a smaller scale we would observe that the temperature always fluctuates, showing warm and cold episodes without the need of intervention from mankind. As is well demonstrated with the analysis of the Vostok ice cores (Florides and Christodoulides, 2009) the temperature may fluctuate with differences of as much as 12 K in a time-span of about 100–125 thousand years. This is normally due to the angle and distance of the earth to the sun.

Additionally, the sun as the energy source of our planetary system undoubtedly affects the earth's life conditions. The sun emits all kinds of electromagnetic radiation like infrared radiation, visible light, ultraviolet rays, microwaves, X-rays, gamma rays and so forth. The sun also emits particle radiation, consisting mostly of protons and electrons comprising the solar wind. The earth is protected against the solar wind by its magnetic field that prevents the particle radiation from reaching the surface. But how much do we really know about the sun activity and its effect on the earth's climate? The truth is that there is still low scientific understanding of the solar irradiance (one of many features of the sun that may affect the global climate) (IPCC, 2007b) and this is due to the lack of experimental data. Some more insight on this can be found in Florides et al. (2010), where the factors that affect the sun radiation reaching the earth on long time scales are presented extensively.

The paper is organized as follows. In section 2 the effect of the greenhouse phenomenon and CO_2 on global climate is discussed through IPCC's formula for calculating the radiative forcing for CO_2 is presented. Then in sections 3–7 follows the views of other branches of science like physics, biology, cosmology and astronomy, with particular attention given to the sun as a climate factor.

2. The IPCC theory and assumptions

IPCC (200b) reports that climate has changed in some defined statistical sense and assumes that the reason for that is anthropogenic forcing. As it states, traditional approaches with controlled experimentation with the earth's climate system is not possible. Therefore, in order to establish the most likely causes for the detected change with some defined level of confidence; IPCC uses computer model simulations that demonstrate that the detected change is not consistent with alternative physically plausible explanations of recent climate change that exclude important anthropogenic forcing. The results of the computer simulations are that anthropogenic CO_2 emissions to the atmosphere are the main reason for the observed warming and that doubling the amount of CO_2 in the atmosphere will increase the temperature by about 1.5–4.5°C. A similar result is mentioned in IPCC (2007a), where the equilibrium global mean warming for a doubling of atmospheric CO_2, is likely to lie in the range 2–4.5°C, with a most likely value of about 3°C.

Lets us now observe how the IPCC prediction through modelling reflects reality in the passing of years. R. Spencer (2013) presents a comparison of 44 climate models versus the UAH and RSS satellite observations for global lower tropospheric temperature variations, for the period 1979–2012 from the satellites, and for 1975–2025 for the models (Figure 1). The black line in the plot is the 44-model average, and it approximately represents what the IPCC uses for its official best estimate of projected warming. Obviously, there is a substantial disconnect between the models and observations for this statistic. Therefore, the observations do not support the IPCC best estimates of warming. The reasons for the disagreement are not obvious for the moment although there are a few suggestions.

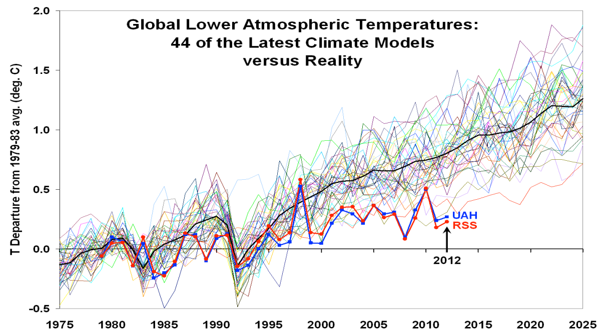

Figure 1. Comparison of IPCC prediction through modeling versus the UAH and RSS satellite observations for global lower tropospheric temperature variations.

3. Earth's orbit and variations in climate

Astronomers have linked the earth climate to various changes related with the earth orbit around the sun and the amount of energy that the earth receives. These orbital processes are thought to be the most significant drivers of ice ages according to the theory of Milankovitch. The Milankovitch cycles were recently observed and confirmed in the Antarctica Dome C ice-core samples recording the climate variability over the past 800000 years (Jouzel et al., 2007).

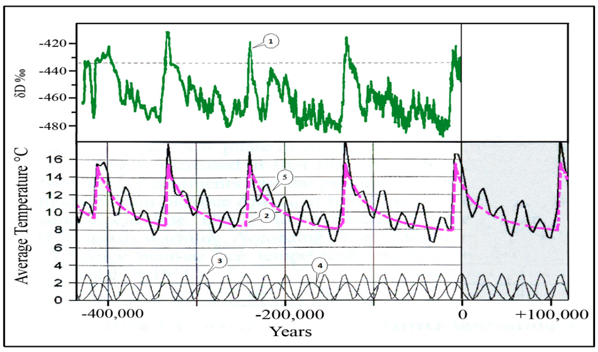

Figure 2. Temperature deviations with respect to time presenting the combined effect of the attraction of the Earth by the Moon and the Sun and the main harmonic components of the Milankovitch cycles compared to the Vostok isotope temperature measurements (redrawn from Sorokhtin et al. (2007). (1) Vostok isotope temperature measurements, (2) Earth temperature change due to the attraction of the Earth by the Moon and the Sun, (3)–(4) Temperature change due to the main harmonic components of the Milankovitch cycles, (5) Resulting temperature change.

Sorokhtin et al. (2007) studied the temperature deviations with respect to time and presented the combined effect of the attraction of the Earth by the Moon and the Sun and the main harmonic components of the Milankovitch cycles. Their work could be used for forecasting the climatic changes in the future considering a best fit of theoretical to experimental data. Such a fit is presented in Figure 2, where one observes that there were periods of climatic cooling of about 8–10°C. After the formation of thick ice covers, a rapid warming – by the same 8–10°C – occurred degrading the glaciers completely in a few thousand years. Their forecast is that in the future we should expect a significant cooling.

4. Physical observation

Physical observations and measured data are of great importance in estimating the global warming produced by the rising levels of greenhouse gases. Idso (1988) presented a comparison for the CO2 greenhouse effect on Mars, Earth and Venus by plotting the CO2 warming vs. the CO2 atmospheric partial pressure on a log-log scale (see Figure 3). He mentions that considering the consistency of all empirical data, atmospheric CO2 fluctuations influence surface air temperature largely, independently of atmospheric moisture conditions, because water vapor quantities are practically non-existent on Mars, "medium" on Earth and large on Venus (in an absolute sense). Hence, the long-espoused claim of a many-fold amplification of direct CO2 effects by a positive water vapor feedback mechanism would appear to be rebuffed by the analysis.

As a result, Idso's final conclusion is that the scientific consensus on the strength of the CO2 greenhouse effect, as expressed in past reports of the U.S. National Research Council, is likely to be in error by nearly a full order of magnitude. Based on the comparative planetary climatology relationship of Figure 4, a 300–600 ppmv doubling of earth's atmospheric CO2 concentration should only warm the planet by about 0.4°C.

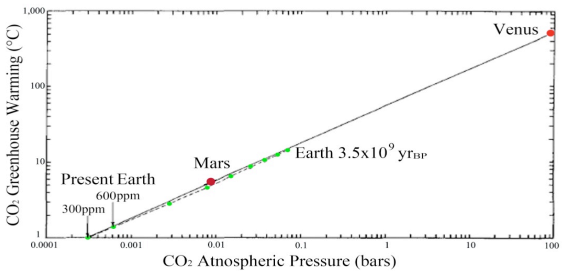

Figure 3. Comparative planetary climate relationship for Mars, Earth and Venus based on the greenhouse warming of Mars and Venus, which are produced by their atmospheric partial pressures of CO2 (solid line). Also shown is the almost identical relationship derived from standard considerations related to the Earth's paleoclimatic record and the first early Sun paradox (dashed line) (redrawn from Idso, 1988).

A lot of individual but outstanding scientists examined the matter from different angles. Archibald (2008), presents an interesting comparison of estimates of the effect that CO2 would have if its concentration in the atmosphere doubles to 600 ppmv, and concludes that the models of the IPCC apply an enormous amount of compounding water vapor feedback and, at their worst, the IPCC models take 1°C of heating and turn it into 6.4°C (see Figure 4).

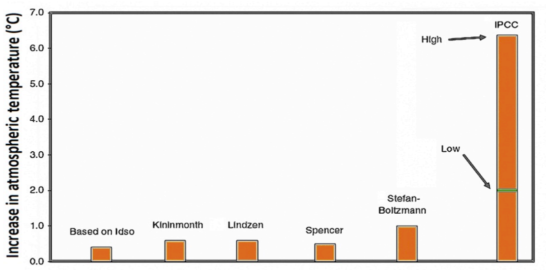

Figure 4. Archibald's (2008) comparison of estimates for doubling the atmospheric CO2 from its pre-industrial level.

Idso derived an estimate of climate sensitivity from nature observations. Kininmonth estimates a 0.6°C and this is based on water vapor amplification but also includes the strong damping effect of surface evaporation. Lindzen's estimation is based on water vapor and negative cloud feedback. Spencer examined the data from the Aqua satellite and performed simple model analysis. Finally, the Stefan-Boltzmann figure of 1°C is based on the Stefan-Boltzmann equation without the application of feedbacks and as Archibald comments everybody agrees with this figure when no feedbacks are involved.

5. CO2 concentration and life

One must ask if human life is in danger if atmospheric CO2 continues to increase the way it already increased during the 20th century. The answer is absolutely not. In an indoor air test we can find CO2 levels as high as 600 ppm, which is typical of indoor air and is considered an acceptable and safe level (InspectAPedia, 2012). But what about plants? The IPCC (2007c) mentions that increased CO2 concentrations can fertilize plants by stimulating photosynthesis, which (as various models suggest) has contributed to increased vegetation cover and leaf area over the 20th century.

The full extent of the beneficial effect that CO2 has on plant life can be found in a website maintained by CO2 Science (CSCDGC, 2012), where an expanding archive of the results of peer-reviewed scientific studies that report the growth responses of plants to atmospheric CO2 enrichment can be found. Results from thousands of scientific articles are tabulated according to two types of growth response: dry weight and photosynthesis. The results indicate that the mean percentage increase in yield for some important species, for a 300 ppm increase in atmospheric CO2 concentration is remarkable. For instance barley has an increase in dry weight by 40%, soybeans by 46%, citrus 30-60% and potatoes by 30%.

6. Solar cycle predictions and the effect of planetary systems

So-called solar cycles are periodic phenomena characterizing the activity of the sun. Badalyan et al. (2001) predicted from the coronal emission line intensities of the second half of 1999 a low cycle 24 with the maximal Wolf-number not exceeding 50 (similar to cycles 5–6) and the epoch of maximum at 2010–2011. The Wolf-number is also known as the International sunspot number (ISSN) and their prediction is based on the observation that cyclic variations in the Wolf-numbers follow the green-line variations with a delay of about 10 years. Thus, as they mention, their results infer that we are on the eve of a deep minimum of solar activity similar to that at the beginning of the 19th century. Contrary to the above, the forecast of a team led by Mausumi Dikpata of NCAR (NASA-Science, 2012) has predicted that cycle 24, would peak in 2011 or 2012, and would be intense. The prediction was based on the observed behavior of the conveyor belt. From May 2006 NASA solar physicist David Hathaway predicted also that solar cycle 24 would be intense with cycle 25, peaking around the year 2022. Cycle 25, could be one of the weakest in centuries.

In October 2006 an Official Solar Cycle 24 Prediction Panel was assembled by NOAA, NASA, ISES and other US and International representatives. The panel met to begin deliberations towards achieving a consensus prediction for the maximum amplitude and timing of solar cycle 24. The panel consisted of voting members and issued a preliminary prediction in the spring of 2007 and also updates in later stages (NASA-OSCPP, 2012). There were more than 30 wide ranging predictions, both published and submitted directly to the panel, which were considered. In March 2007 the deliberations of the panel supported two possible peak amplitudes for the smoothed ISSN, 140 ± 20 and 90 ± 10. For the large cycle case (ISSN = 140) the panel agreed that solar maximum would occur near October 2011 and for the small cycle (ISSN = 90) the prediction was for August 2012.

The most recent NASA prediction of solar cycle 24, after three years into cycle 24, gives a smoothed sunspot number maximum of about 60 in the spring of 2013. The current predicted size makes this the smallest sunspot cycle in about 100 years (NASA-Solar Science, 2012).

Now after the passage of time we may check how well we understand the sun and its activity by observing its performance for the past years. The very good similarity of sunspot numbers of cycles 1–5 to the recent cycles 20–24 (see Figure 5), show the presence of a 200-year cycle but no one can still be sure that this is not a coincidence. It is obvious that the sun is not well-understood and also that there are large and small sun cycles for which we have not yet a complete set of scientific data to compare.

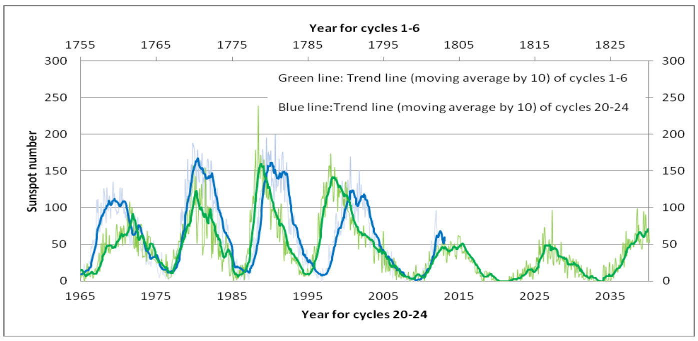

Figure 5. Green line showing cycles 1–6 lasting for about 70 years (1755–1825) compared to cycles 20–24 for the years 1965 till today, showing good similarity and suggesting that cycle 24 and 25 will cause cooling of global temperature.

One observation that can explain the above similarity in the solar cycles, is the cyclicity that is observed in the planets position in space in their orbits around the sun. Sharp (2010) studied the gravitational effects of Jupiter, Saturn, Uranus and Neptune using detailed angular momentum (AM) graphs. The AM perturbations were measured and quantified. It was found that the AM perturbation and modulation is a direct product of the outer gas giants (Uranus and Neptune). Their conclusion was that the link between solar activity and planetary influence via a discrepancy found in solar/planet AM along with current AM perturbations, indicate solar cycles 24–25 will be heavily reduced in sunspot activity resembling a similar pattern to solar cycles 5–6 during the Dalton Minimum (1790–1830).

7. Cosmic rays

In the 1990s Svensmark and Friis-Christensen presented a new astronomical cause for climate change: the cosmic ray hypothesis. Cosmic radiation comprises mainly protons 92%, and alpha particles 6%, with very high energy. When the ray particles reach the atmosphere, they cause ionization in its upper layers and many of the particles are absorbed or lose their energy colliding with other particles in the atmosphere. The earth is shielded from the cosmic rays because the rays are deflected by the earth magnetic field. Also since the solar wind expands the magnetic field of the sun more of these rays are reflected away of the earth when the solar wind is stronger. According to the cosmic ray hypothesis, periods with low solar activity allow more cosmic radiation to reach the earth. The theory suggests that ions and radicals produced in the atmosphere by cosmic rays influence aerosol production and thereby cloud properties. More cosmic rays in the atmosphere will produce more low clouds, and finally a lower global mean temperature will result because of this. In examining the above-mentioned hypothesis the Danish National Space Center (Marsh et al., 2006), identified that UV and GCR present a striking correlation with the global coverage of low clouds, over the nearly two and a half solar cycles they examined. Currently, the National Space Institute of Denmark (DNSI, 2007) has been investigating the above hypothesis. The reported variation of cloud cover was approximately 2% over the course of a sunspot cycle but this would result in a comparable global warming to that presently attributed to human activity. DNSI assumes that ions and radicals produced in the atmosphere by cosmic rays could influence aerosol production and since aerosols work as precursors for the formation of cloud droplets, this is an indication that cosmic rays influence cloud formation. DNSI in cooperation with the European Organization for Nuclear Research, CERN and other organizations, are currently performing experiments to check and understand the role of cosmic rays in the formation of clouds (CERN-CLOUD, 2010).

8. Conclusions

In the recent decades the increase in atmospheric CO2 concentration has been heavily blamed for the observed increase in global temperature, although it is common knowledge that it is the sun that mainly powers the climate of the earth. IPCC used models to prove this with the effect of basic parameters of the climate system still not well known. The extraction of conclusions from such models, which are derived without any sound theoretical background, becomes merely a form of data curve fitting by “manipulating” the parameters and have no rigorous scientific value.

Physical observations on other planets confirm that independently of atmospheric moisture conditions, the atmospheric CO2 partial pressure influences in a specific log-log relation the surface air temperature. Independent studies examining the matter from different angles point at the conclusion that at the most, doubling the atmospheric CO2 from its pre-industrial level will cause an increase in atmospheric temperature by 1°C as opposed to IPCC's mean estimate of 3°C.

The earth climate is affected by various cyclic changes related with the earth orbit around the sun and the amount of energy the earth receives. Referring to the sun, we can emphasize a cyclicity in its behavior with a further understanding of its behavior being rudimental. Empirical data show that this cyclicity is caused by the relevant position of the planets. Solar activity may affect the climate on earth not only directly but indirectly as well. The cosmic ray hypothesis suggests that periods with low solar activity allow more cosmic radiation to reach the earth. Cosmic rays influence aerosol production and thereby cloud formation. More cosmic rays in the atmosphere will produce more low clouds, and finally a lower global mean temperature will result because of this.

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