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The Scientific Case Against Catastrophic Global Warming and the Kyoto Protocol

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Climate Is Always Changing

The only constant about climate is change. For as long as Earth has existed, natural climate changes have occurred and will continue. Change occurs at many scales, from gradual variation over millions of years, to rapid climate shifts in a decade or less. The question is how to distinguish between natural climate variation and possible change caused by human activity.

During the past two million years, the Earth has been as ice-age cold as it has ever been, experiencing more than 30 glaciations. In the past 800,000 years, the pattern has been approximately 100,000 years of extensive glaciation, interspersed with warmer interglacials of around 15,000 years. By studying climate changes through these previous cycles, we surmise that the next ice age is less than 5000 years ahead. At that time, large portions of North America will be buried under kilometers of ice.

Greenhouse Gases and Climate

The greenhouse effect has an important influence on the climate of the Earth. The temperature of the Earth is primarily maintained by the transport of energy by atmospheric circulation and ocean currents and the balance between the flux of incoming solar radiation and the amount of outgoing infrared radiation back to space. Greenhouse gases, clouds and aerosols in the atmosphere trap some of the reflected radiation from the surface, causing a natural greenhouse effect that makes the planet habitable. Without this natural greenhouse effect, the global ambient temperature would be substantially colder.

Atmospheric greenhouse gases comprise less than 0.1 percent of the air. These gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), as well as the most important one, water vapor (H_2O).

Water vapor is the principal greenhouse gas, comprising 99% of greenhouse gases in the atmosphere. The amount of water vapor has the most significant influence on global temperature of any greenhouse gas, followed by the warming effect of water in all its phases in clouds.

Despite the rhetoric of the Kyoto Protocol, CO_2 is at most a minor contributor to global climate change. The proportion of CO_2 in the atmosphere has varied significantly over geologic time. Through most of the last 500 million years atmospheric CO_2 content has been higher – up to 18 times higher – than at present. Strikingly, the atmospheric concentration of CO_2 was more than ten times higher than today's value during the Ordovician glaciation, around 440 million years ago. CO_2 is simply a minor driver in the many factors that influence climate.

The percentages of CO_2 in the atmosphere above the Antarctic Ice Cap for the last 150,000 years have been measured in air bubbles enclosed in ice cores. Over this interval, CO_2 levels have closely paralleled temperatures. However, detailed analysis of CO_2 concentrations indicates that CO_2 levels often rose and peaked several hundred years after temperature. These results further emphasize that climate change drives major changes in CO_2, not the reverse. Temperature change affects the carbon cycle, which then produces fluctuations in atmospheric CO_2 concentration.

During the last 300 years, atmospheric CO_2 concentrations have risen from 275 parts per million (ppmv) to around 360 ppmv, a 30% increase. Most of the increase has been recent, caused by fossil fuel burning and deforestation. As discussed below, the increase in atmospheric CO_2 content, while clearly linked to post-WWII industrialization, cannot be closely linked to global surface warming trends.

Computer models that predict catastrophic human-induced global warming have consistently failed to accurately reproduce past and present climate changes, so their predictions of future climate changes are highly suspect. These models incorrectly assume that increased CO_2 concentration is a major driver of atmospheric warming, and also assume large positive feedbacks arising from increased CO_2 concentration, for which there is no scientific evidence. Without these speculated positive feedbacks, even a doubling of CO_2 concentration would lead to a theoretical warming of only approximately $1^{o}C$.

Kyoto is ineffective

Computer simulations of climate have yielded wide-ranging forecasts of future temperature increases from rising atmospheric CO_2 concentrations, based on projections of future energy use. The United Nations' Intergovernmental Panel on Climate Change (IPCC) has compiled these simulations. The middle range forecast of future warming, based on expected growth in fossil fuel use without any curbs, is for a $1^{o}C$ increase between now and 2050. The Kyoto Protocol would reduce that increase by an insignificant $0.06^{o}C$. If increased atmospheric concentrations of CO_2 were a major problem, then as many as 40 Kyoto-type emission cuts would be required to stop the predicted human-made warming.

To prove the reliability of future forecasts, computer simulations need verification by testing past, well-documented temperature fluctuations. New investment in technology, especially that of space-based instrumentation, has helped address the issue of observed response of the climate to increased greenhouse gas concentrations. Two tests of the reliability of the computer simulations are the past decades of surface temperature and lower troposphere change.

Record of surface temperature

The Earth has been much warmer and colder in the past, before we started burning fossil fuels. From about 900 to 1300 AD, during the Medieval Warm Period, the Earth was warmer than it is today. In the 20th Century the global average surface temperature rose about $0.6^{o}C$, as measured by thermometry, after a five hundred year cool period called the Little Ice Age. Only the 20th Century warming trend *may* have a human component attributable to fossil fuel use, which increased sharply after 1940.

A closer look at the 20th century temperature record shows three distinct trends: First, a warming trend of about $0.5^{o}C$ began in the late 19th century and peaked around 1940. Next, temperature decreased from 1940 until the late 1970's. Then a third warming trend occurred from 1976 to 1986, after which the trend flattens.

Because about 80% of the CO_2 from human activities was added to the air *after* 1940, the early 20th Century warming trend should be largely natural. The cooling from 1940 to the late 1970's, when CO_2 concentrations were rapidly increasing, also tends to contradict the theory that CO_2 is a major driver of global temperature.

Even if one arbitrarily assumed that all of the late 20^{th} century warming was caused by increased concentrations of industrially produced greenhouse gases, this would amount to at most $0.1^{o}C$ warming per decade - the maximum amount of the surface-warming trend seen since the late 1970's. This surface warming would suggest a temperature trend of about $1^{o}C$ per century, which is less than that predicted by the computer simulations, but it is unlikely that even this recent trend in surface warming is primarily attributable to human-made greenhouse gases.

Record of lower troposphere temperature

Computer simulations of climate, in which atmospheric greenhouse gas concentrations increase due to human activities, predict detectable warming not only near the surface but also in the layer of air above the surface, the lower troposphere, which rises in altitude from roughly two to eight kilometers. Records from NASA's Microwave Sounder Units aboard satellites extend back 22 years and cover most of the globe (Figure 1). The satellite-derived record is validated independently by measurements from NOAA balloon radiosonde instruments, and those records extend back 45 years. Both records show that the temperature of the lower troposphere does vary as a result of natural factors, e.g., the strong El Niño warming pulse of 1997-98 is obvious. However, no meaningful human warming trend, as forecast by the computer simulations, can be found.

Although the radiosonde record lacks the dense spatial coverage from satellites, it does extend back to 1957, a period that includes the recent rapid rise in atmospheric CO_2 concentration. The radiosonde record shows no linear warming trend in global average temperature prior or subsequent to a dramatic shift in 1976-77. That warming, known as the Great Pacific Climate Shift of 1976 - 1977, is not attributable to human causes but is a natural shift in the Pacific that occurs every 20 to 30 years.

When compared to the observed response of the climate system, the computer simulations all have forecast warming trends much steeper over the last several decades than measured. The forecasts exaggerate to some degree the warming at the surface, and profoundly in the lower troposphere

Natural climate variability: The Sun's influence

Given the lack of a meaningful observed warming trend in the lower troposphere, computer model results say that most of the surface warming in recent decades is not caused by a human-made enhanced greenhouse effect. However, the 20th Century temperature pattern does show a strong correlation to energy output of the Sun (Figure 2). Although the causes of the changing Sun's particle, magnetic and energy outputs are uncertain, as are the responses of the climate to the Sun's various changes, the correlation is pronounced. It explains especially well the warming trend up to 1940, which cannot have much human contribution, and the cooling trend from 1940 to the late 1970's. Increased solar activity, not increased atmospheric CO_2, can also be the primary cause of the warming trend since the late 1970's.

Conclusion

Based on analysis of ancient and recent temperature and atmospheric data, increased atmospheric concentrations of CO_2 are not a cause of significant global warming. Contrary to forecasts by computer simulations, there is no evidence of catastrophic global warming due to burning of fossil fuels. The magnitude of human-caused warming is especially constrained by the observed temperature trends of the lower troposphere. There is strong evidence that natural variation in the Sun's activity is a much more significant driver of temperature than human-made greenhouse gases.

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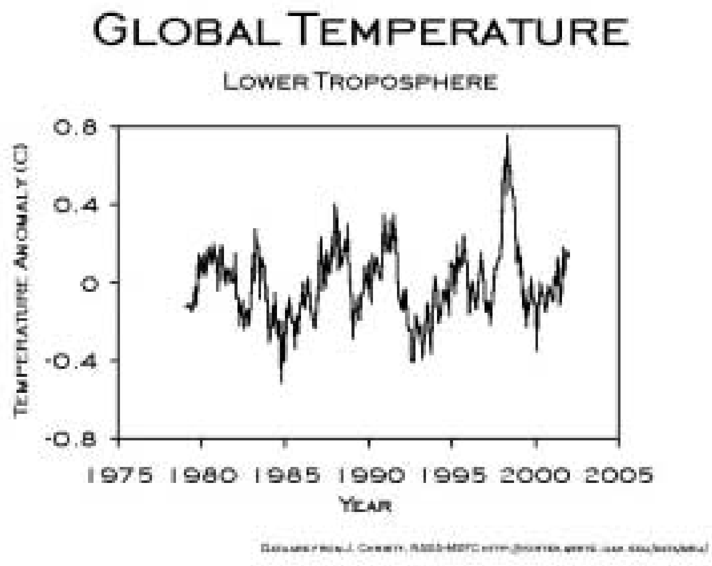

Figure 1 -- Monthly averaged temperatures sampled nearly globally for the lower troposphere (roughly two to eight kilometers altitude) from Microwave Sounder Unit (MSU) instruments onboard NASA satellites. The large spike of warmth resulted from the temporary natural warming of the Pacific Ocean by the 1997 - 1998 El Niño event.

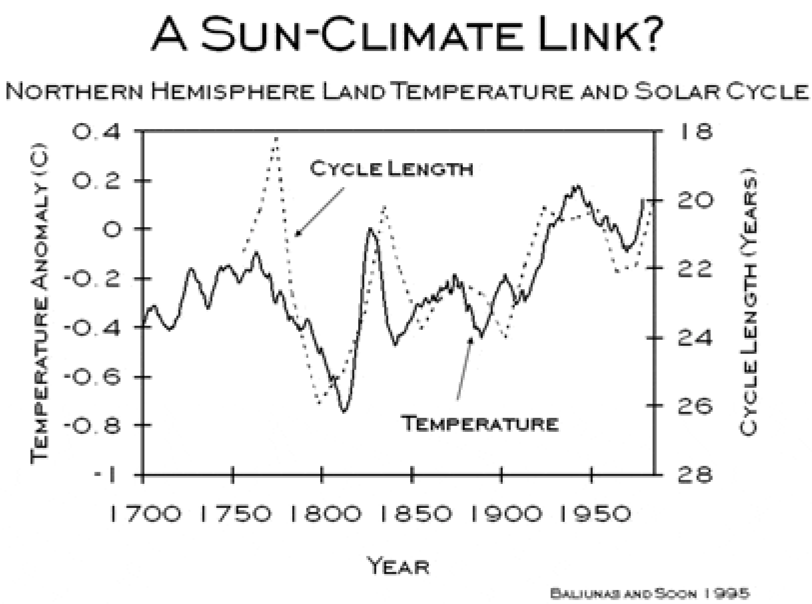

Figure 2 -- Changes in the Sun's magnetism (as evidenced by the changing length of the 22-year, or Hale Polarity Cycle, dotted line) and changes in smoothed Northern Hemisphere land temperature through 1986 (solid line) are closely correlated. The Sun's shorter magnetic cycles are more intense, suggesting periods of a brighter Sun, then a fainter Sun during longer cycles. The record of reconstructed Northern Hemisphere land temperature substitutes for global temperature, which is unavailable back to 1700 (S. Baliunas and W. Soon, 1995, *Astrophysical Journal*, 450, 896).