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Primary Cause of Global Warming Discovered

Reducing Global Warming is Easier than Thought

Chicago, Illinois, Wednesday, February 11, 2009: Sulfur dioxide emitted from volcanoes and from burning fossil fuel is the primary initiator of global climate change, according to Dr. Peter L. Ward, a retired U.S. Geological Survey scientist who continues to study the earth and its environment. "Carbon dioxide is a greenhouse gas compounding global warming, but it is not the initiator of climate change" according to Ward.

In a paper posted online today for the next issue of "Thin Solid Films," a physics journal published by Elsevier Press, Ward asserts that sulfur dioxide emissions regulate the ability of the atmosphere to clean itself by oxidizing pollutants.

Ward observed that the highest rates of volcanic activity in the past 46,000 years occurred at the same times as the highest rates of global warming. "When very large volcanic eruptions occur every few months", Ward says, "rapid warming follows. Too much sulfur dioxide in a short period of time causes warming."

Large eruptions today occur typically once per century. Yet by 1962, human activities were putting as much sulfur dioxide into the atmosphere every 1.7 years as one of these large eruptions. That was enough to cause world temperatures to climb at their highest rate in the 20th century.

Beginning in 1979, global efforts to reduce acid rain succeeded in decreasing human sulfur emissions 18% by 2000. The rate of increase of methane in the atmosphere began declining in 1990. By 2000 both global temperature and the concentration of methane became nearly constant and have remained so until the present. Current climate theories cannot explain these changes.

"These observations make sense," Ward said, "when you realize that sulfur dioxide is changing the oxidizing capacity of the atmosphere. A dirty atmosphere warms the earth, and a clean atmosphere cools the earth. The atmosphere cleans itself by oxidizing greenhouse gases and other pollutants, causing their molecules to become larger and therefore to fall out or be rained out of the atmosphere."

Ward explained that the primary oxidants in the atmosphere are generated by the effects of sunlight on ozone, which is in short supply. Sulfur dioxide reacts swiftly with these oxidants. "Too much sulfur dioxide uses them all up, causing methane and other pollutants to accumulate."

"By reducing acid rain, we accidentally reduced global warming," Ward said. "The problem now is that sulfur dioxide emissions are rapidly increasing again as new power plants are coming on line every week, especially in developing countries. But we know how to reduce sulfur emissions both technically and politically. It is much easier to do than reducing carbon dioxide emissions."

But what about carbon dioxide? "Prior to the 20th century," Ward said, "changes in carbon dioxide lagged behind large changes in temperature by decades to centuries. Carbon dioxide during the 20th century has been increasing and has not yet leveled off in a manner similar to methane and temperature. The concentration of carbon dioxide is not primarily influenced by oxidation. It simply increases as the temperature of the ocean increases. Carbon dioxide escapes from a warming ocean, just at it escapes from a warming soda drink."

Ward recommends an aggressive international program to minimize sulfur dioxide emissions. "We need to improve current technologies and assure their widespread and immediate implementation. Large emissions of carbon dioxide compound the problem, but reducing sulfur dioxide emissions will be far more effective in the immediate future."

Ward based his findings on data from Greenland ice cores that document the amounts of sulfur dioxide in the atmosphere during the past 100,000 years. "Recent concentrations are similar to the highest concentrations observed during the few thousand years when the world warmed suddenly while emerging from the last ice age," Ward said.

"The rapid increase in recent sulfur dioxide concentrations cannot be attributed to increased volcanic activity but correlates closely with increases in known sulfur emissions from human burning of fossil fuels. There is no doubt that man is to blame for 20th century global warming."

Ward's observation that frequent large volcanic eruptions cause warming is a major surprise, even shock, to most climatologists. They know that sulfur dioxide causes cooling for a few years after a single, major volcanic eruption such as Pinatubo in 1991. They also know that sulfur dioxide normally stays in the atmosphere for only a few weeks. Therefore, they had dismissed the possibility of other effects of sulfur dioxide. Ward argues that the rate of sulfur dioxide emissions determines whether world temperatures will be warm or cold, whether there may be prolonged drought, and whether mass extinctions will occur. The rate of sulfur dioxide emissions is the true initiator of global climate change.

"The Nobel-winning Intergovernmental Panel on Climate Change emphasizes carbon dioxide and other emissions of greenhouse gases into the atmosphere by man," says Ward. "I, on the other hand, emphasize the role of sulfur dioxide in changing the atmosphere's ability to purge itself of such greenhouse gases." Both influence the atmospheric concentration of greenhouse gases, but the implications are very different.

There are a number of ways to burn fossil fuels with less sulfur dioxide emissions and to scrub the remaining emissions from smokestacks. Removing carbon dioxide is much more difficult. "Since most cases of rapid climate change in the past were caused by sudden increases in volcanic activity," Ward says, "concerns over the climate reaching other types of proposed tipping points for sudden climate change appear less likely." By carefully managing emissions we might be able to control global temperature and humidity. But what will man do when large volcanic eruptions begin to occur again every few months?

Throughout his 27 years with the U.S. Geological Survey, Ward was concerned with the effects of geological events on human activities and human safety issues resulting from geological events. He developed a prototype global volcano surveillance network in the early 1970s. He was a leader in developing the National Earthquake Hazards Reduction Program in the late 1970s. In 1990 he wrote, produced, and published a magazine entitled "The Next Big Earthquake May Come Sooner then You Think. Are You Prepared?" A total of 3.3 million copies were distributed in 41 newspapers throughout northwestern California and by request. The magazine was printed in English, Chinese, Spanish, and Braille, and won the Public Affairs Award of the Department of Interior and the highest award of the National Association of Government Communicators. He is a national leader in developing public hazard warning systems. He has published widely on volcanoes, earthquakes, and plate tectonics.

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Ward's paper "Sulfur Dioxide Initiates Global Climate Change in Four Ways" is available online (doi:10.1016/j.tsf.2009.01.005) and will appear in the upcoming issue of *Thin Solid Films*, Volume 517, Issue 11, a physics journal published by Elsevier (www.sciencedirect.com/science/journal/00406090). Related information is found on Ward's website (www.tetontectonics.org/Climate.html).

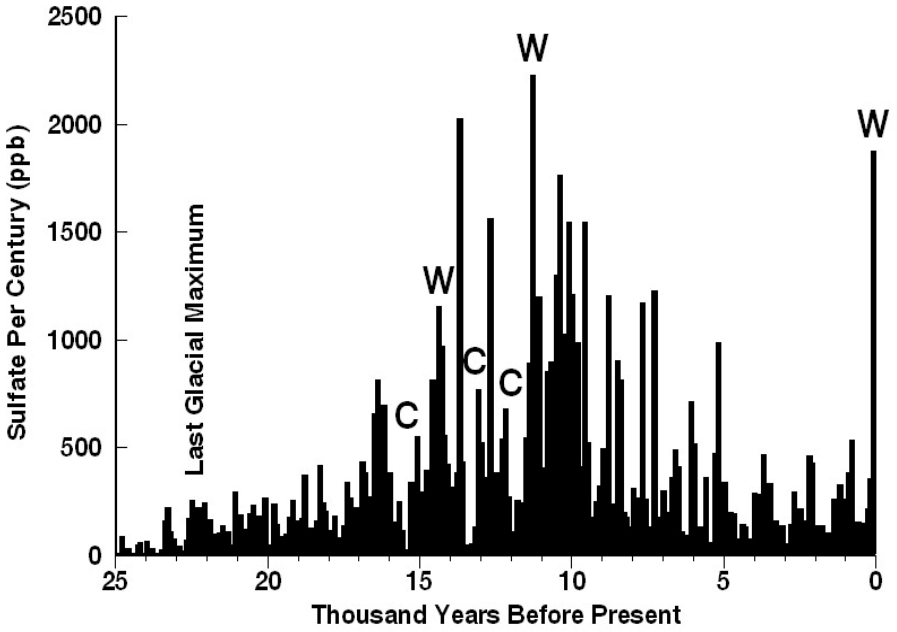

Figure 1: Volcanic sulfate measured in the ice layers of Greenland has its highest concentrations during times when global warming was greatest (W) at the end of the last ice age and is lowest when re-glaciation occurred (C).

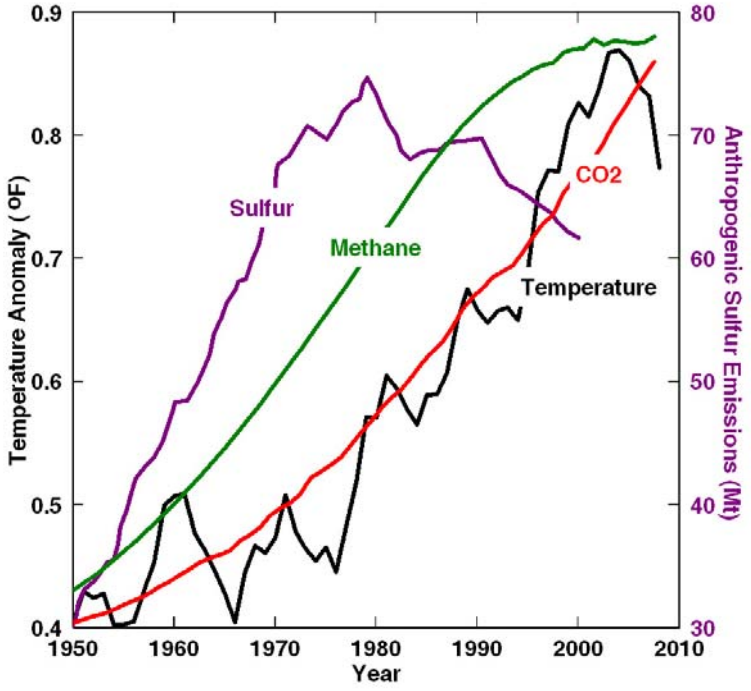

Figure 2: Human emissions of sulfur began to decrease around 1980 through efforts to reduce acid rain. The rate of increase of the concentration of methane began to decrease by 1990. Methane and temperature became relatively constant soon after 2000. It took 20 years to increase the oxidizing capacity of the atmosphere enough to reverse the increase in temperature. CO_2 continues to increase due to emissions by man and a time lag to respond to temperature change.

Table 1: The Four Cardinal Rates of SO_2.

	Rate of SO_2 Emission	**Eruption Rate**	**Effect**	**Cause**
I	**Low**	No large volcanic eruptions for decades	Cooling and decadal droughts	Lack of significant SO_2 allows the oxidizing capacity of atmosphere to be restored, purging all greenhouse gases and pollutants, reducing the insulating capacity of the atmosphere and inhibiting rain.
II	**Moderate**	One large volcanic eruption (Volcano Explosivity Index ≥ 6) every few decades or longer	Cooling for a few years	Erupted SO_2 forms sulfuric acid layer in the lower stratosphere, reflecting heat from the sun typically for three years. Eruptions spaced a few years to decades apart cool the earth incrementally into ice ages.
III	**High**	More than one large volcanic eruption each year for decades	Global warming	Erupted SO_2 uses up the oxidizing capacity of the atmosphere causing greenhouse gases and other pollutants to accumulate.
IV	**Extreme**	More than 100,000 large flood basaltic eruptions in less than one million years	Extreme global warming and mass extinctions	Erupted SO_2 causes extreme global warming and acid rain over tens of thousands of years.