Some Thoughts on Climate Change

by John P. Bluemle

In 1999, I co-authored a paper with Joseph Sabel (U.S. Coast Guard) and Wibjörn Karlén (University of Stockholm) for the Journal *Environmental Geosciences*. We pointed out that innumerable world-wide changes in climate have occurred through geologic time, some gradual, some rapid. Many of these changes have far exceeded those predicted by even the most pessimistic forecasters of future global warming. Our study indicated that the current trend of climate change is no greater in rate or magnitude, and probably less in both, than many changes that have occurred in the past.

If humans are not the cause of climate change, what is? Wibjörn Karlén published a paper recently in the Royal Swedish Academy of Sciences titled *"Global Temperature Forced by Solar Irradiation and Greenhouse Gases?"* He concluded that changes in solar irradiation (the amount of heat from the sun) have been the dominant cause of changes in climate we are currently seeing (Fig. 1). Karlén pointed out that the increase in annual global temperature since the mid-1800s and to approximately 1980, can be correlated with solar irradiation. Further, he noted that the temperature and irradiation show breakpoints in the gradient at the same time before about 1980; e.g. a low point about 1910, a maximum between 1940 and 1950, a decrease through 1974, and an increase between 1975 and the early 1980s.

Karlén also makes the following observation: *"In addition, the increase in greenhouse gas concentrations correlate with the temperature increase. However, because the increase in CO_2 is small until after World War II, CO_2 cannot explain the distinct warming during the first half of the 1900s or the changes before this event. Human release of greenhouse gases can, of course, still have contributed to the temperature increase."*

An article similar to Karlén's appeared on the Internet in *Science* Online (week of November 19, 2001) quoting work by paleo-oceanographer Gerard Bond of the Lamont-Doherty Observatory www.sciencexpress.org). Bond and his colleagues reported that the climate of the northern Atlantic has warmed and cooled nine times in the last 12,000 years, in step with the waxing and waning of the sun. The data of Bond *et al.*, along with numerous other paleoclimate researchers, are so convincing that solar variability is now considered to be the leading hypothesis to explain the roughly 1500-year oscillation of climate seen since the last Ice Age, including the Little Ice Age.

According to David Jenkins (personal communication via e-mail), based on the cyclicity of the past millennia, the earth would be expected to continue to warm even if CO_2 levels held constant. Atmospheric physics is quite clear that increasing CO_2 concentration increases temperature. The best way to demonstrate this is to model the temperature of the atmosphere with all CO_2 removed. It is VERY cold. Then, increase CO_2 by small increments and plot the graph of temperature increase. It is very rapid initially and then flattens out. Doubling CO_2 from today's concentration, holding all other parameters constant, has a "negligible" effect. Changes

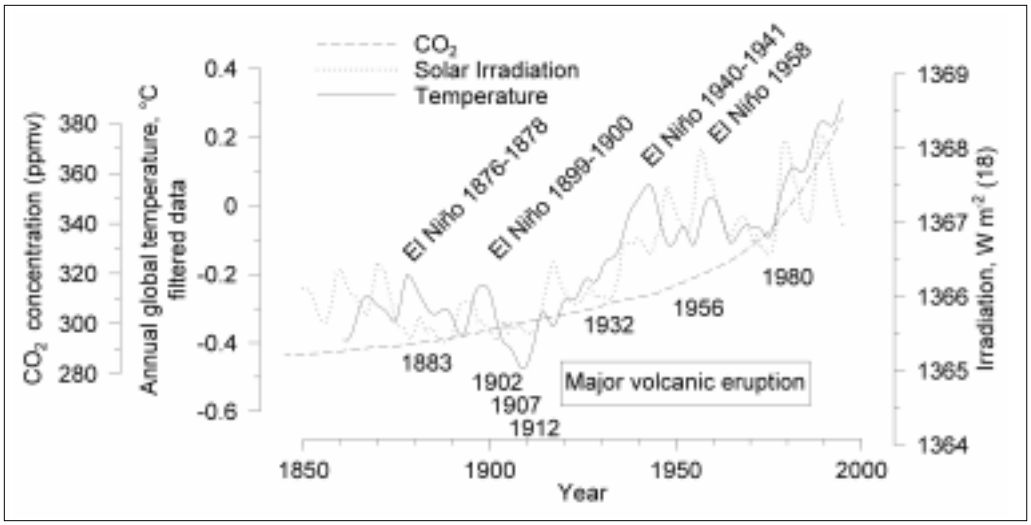

Figure 1. This chart (from Karlén, 2001) shows how global temperatures (solid line), as well as both solar irradiation (dotted line) and the atmospheric concentration of carbon dioxide (dashed line) have increased since the mid-1800s. Major volcanic eruptions are noted. Both irradiation and global temperatures show distinct changes in gradient in the beginning of the 1900s, around 1950 and about 1970, but CO_2 shows only a gradual gradient increasing with time. For global temperature, an 11-year binomial filter was used in drawing the trace.

in other parameters, like water vapor, have a greater impact and lead to the temperature ranges (and uncertainties) inherent in the computer modeling.

If carbon dioxide were causing warming, the most basic laws of physics require that it be seen first in satellite data in the lower troposphere (the lower 7 to 10 miles of the Earth's atmosphere – the zone below the stratosphere). This is not what we are seeing. In any case, while it is logical to assume that the addition of carbon dioxide will affect climate, the amount of anthropogenic (human-caused) change is so small that it likely cannot be identified because it is masked by the much larger natural variability we experience. Up to now at least, there is absolutely no evidence of any discernable human effect on global climate.

Regarding the use of computers to model the climate, it should be pointed out that computer models are not information. They are scientists' ideas set to mathematical "music." Real information is what we can actually measure, and what we are measuring does not indicate a significant human contribution to present climate change.

Climate is constantly changing in all directions and all parameters (becoming warmer, cooler, wetter, drier, etc.) and at all scales. The short-term prognosis is that the global climate will trend toward warming for perhaps the next 200 to 300 years. However, it is also possible that this warming trend will be interrupted by a major long-term cold snap sometime before that time. We know that the earth's temperature has been cooling for the past 8,000 years. I reported in this newsletter in 1978 that when the Arctic Ocean thaws, it is likely that the next Ice Age will start – that is, a thawed Arctic Ocean will provide a huge source of water that will trigger greatly increased evaporation and precipitation in the north polar regions, resulting in the growth of continental glaciers, as has happened several times over the past three million years or so. Further, the thickness of the ice over the north polar region has become much thinner over the past century. I still think the "thawed Arctic Ocean = growth of continental glaciers" is a reasonable hypothesis, but it is not a proven fact.

In closing, I've reproduced a diagram (Fig. 2) that appeared in a new book (Gerhard et al., 2001). The diagram shows the various factors that drive climate and the scale at which they operate.

References

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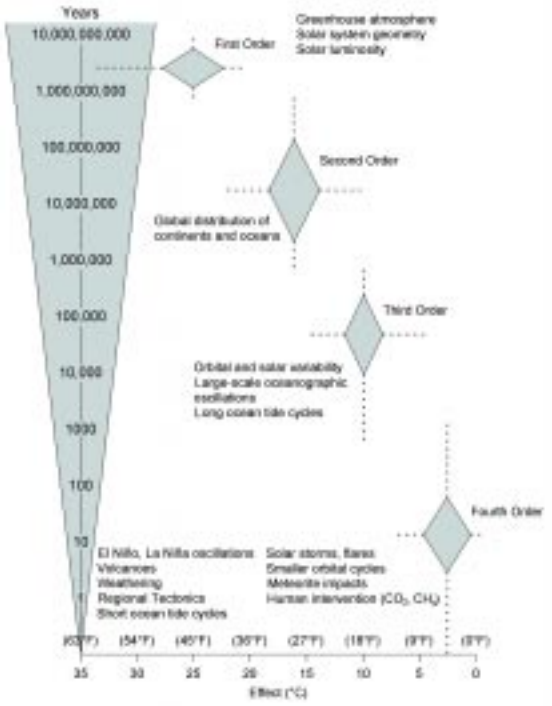

Figure 2. This chart (from Gerhard et al., 2001) shows the relative significance of the various processes that affect climate. That is (starting at the top), factors such as the geometry of the solar system and overall luminosity of the sun are "first order" climate drivers, which operate on very long-term time scales (billions of years). They include such things as distance from the sun and the geometry of the solar system and can result in temperature changes of, perhaps, 20 to 35 degrees Celsius. "Second order" climate drivers, which operate on time scales of tens of millions of years, include such things as the global distribution of the continents (thus, we are currently locked into a cycle of repeated glaciation, and will be as long as the Antarctic continent remains over the south polar region). The second order drivers result in temperature changes of 10 to 25 degrees Celsius. "Third order" climate drivers, such as large-scale changes in ocean circulation, operate on time scales of tens of thousands of years and result in global temperature changes of 5 to 15 degrees Celsius. There are many "fourth order" drivers that can cause small temperature changes (up to 10^0 C) over short periods of time. They include such things as volcanic eruptions, El Nino and La Nina Oscillations, solar storms and flares, and human intervention.

Note that human intervention, which may or may not be a factor, is in the same category as some other natural climate drivers. Diamond shapes are interpreted and literature-documented ranges of values; dots indicate possible ranges of values.