The Uncertainty of Carbon Dioxide – Climate Driver or Climate Rider

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The earth's climate is undergoing an episode of warming. About that fact, there is general agreement. However, the causes for the warming are topics for considerable debate. Some members of the scientific climate community are focused solely on carbon dioxide as the driver of climate change. Carbon
dioxide, as a greenhouse gas, has the property of absorbing heat radiated from the earth's surface and then re-radiating the heat into the atmosphere. But, carbon dioxide comprises only 0.035% of the atmosphere (380 ppmv). The carbon dioxide contribution to the total greenhouse effect is small, about 5%. Of that 5% only 0.28% is created by human activity. In addition, the greenhouse effect of carbon dioxide is small in comparison to water vapor which accounts for about 95% of all greenhouse heat. The atmospheric concentration of water vapor is far greater than that of carbon dioxide, commonly being on the order of 22,000 ppmv or more.

Carbon dioxide adsorbs and re-radiates heat at four wavelengths in the infrared spectrum. However, only the 15 micron wave length has much importance to climate science. Infrared radiation at this wavelength causes the molecule to resonate with a bending motion which immediately adsorbs the energy and then re-radiates it into the atmosphere at a wavelength that is 30 to 40 microns longer. The width of the adsorption band around the 15 microns is described by the Lorentz equation for a spectral half-line which states that temperature and pressure are the primary controlling factors. These characteristics serve to limit the heat trapping capacity of carbon dioxide to a fairly narrow band of the infrared spectrum.

The heat trapping capacity in terms of concentration of carbon dioxide is described by the Beer-Lambert law. It states that the amount of adsorption of infrared radiation is logarithmic and is controlled by concentration and radiative efficiency. That is, the temperature rise for a doubling of the concentration of carbon dioxide will be the same as the temperature rise from the previous concentration. Climate data suggests that present day concentrations are approaching a saturation level beyond which additional carbon dioxide will have an insignificant effect on temperature. If carbon dioxide is increased to 720 ppm over the present value of 360 ppm, it projects a temperature rise of only 1.85 degrees centigrade, which is far short of the Intergovernmental Panel on Climate Change prediction of 9 degrees centigrade.

In the context of geologic history, the case for carbon dioxide as the primary climate driver is difficult to support. The earth has under gone eight great climate cycles during the Phanerozoic. For more than 90% of the time, the earth was warmer than today. During the Ordovician, carbon dioxide volumes were eighteen times greater than today, yet glaciers existed. During the Eocene, carbon dioxide concentrations were six times higher than today yet the temperature rose while carbon dioxide values fell. Global cooling occurred during the Oligocene while carbon dioxide concentrations were increasing, and carbon dioxide values declined during the Miocene Climate Optimum.

In the more recent past, carbon dioxide volumes and global temperatures have trended in opposite directions. At the end of the 1800's, carbon dioxide was 20% lower than today, but the climate still warmed from the Little Ice Age. Most of the warming of the twentieth century occurred between 1910

and 1940 when carbon dioxide levels were building at a much lower rate than at present. Temperatures fell between 1940 and 1970 in the face of a carbon dioxide increase.

There is a convincing body of evidence that carbon dioxide follows global temperature instead of driving global temperature. Close examination of the Vostok ice core data reveals that the rise in carbon dioxide trails the temperature rise by about 800 years.

The evidence that supports carbon dioxide as a climate driver is weak. Carbon dioxide concentration levels are small. Carbon dioxide's primary heat trapping capacity is limited to narrow band of thermal radiation; historic correlations show that carbon dioxide follows climate instead of leading climate; and there are too many historic examples of divergent temperature and carbon dioxide concentration. The conclusion is that atmospheric science must look beyond carbon dioxide to find the real climate drivers.