

## What is CO<sub>2</sub> - friend or foe?

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Carbon and CO<sub>2</sub> (carbon dioxide) are fundamental for all life on Earth. CO<sub>2</sub> is a colorless, odorless, non-toxic gas. CO<sub>2</sub> is product of our breathing, and is used in numerous common applications like fire extinguishers, baking soda, carbonated drinks, life jackets, cooling agent, etc. Plants' photosynthesis consume CO<sub>2</sub> from the air when the plants make their carbohydrates, which bring the CO<sub>2</sub> back to the air again when the plants rot or are being burned.

On wet basis the Earth's atmosphere consists by mass of ~73.5% nitrogen, ~22.5% oxygen, ~2.7% water, and ~1.25% argon. CO<sub>2</sub> in air is in minimal amount, ~0.05% by mass, and with minimal capacity (~2%) to influence the "Greenhouse Effect" compared to water vapor (≤98%; Raval, A. & Ramanathan, V. 1989: Observational determination of the greenhouse effect. *Nature* 342, 758-761). This is valid for a cloud-free atmosphere. If we compare with the capability of the clouds to regulate the "Greenhouse Effect" (by retention of heat or reflection of solar radiation), which is +/- 20-30%, the effect of atmospheric CO<sub>2</sub> is negligible for the Earth's climate.

The assumptions made by the IPCC (Intergovernmental Panel on Climate Change) are that solar heat input has always been constant; the Earth was in perfect balance; atmospheric CO<sub>2</sub> has always been constant; Man started from 1750 (industrial revolution) to burn fossil fuels whose CO<sub>2</sub> has accumulated in the air; this extra CO<sub>2</sub> must increase the heat absorbed in the atmosphere and this is catastrophic. The asserted proofs are: Selected ice cores show flat CO<sub>2</sub> contents and recent rise vs. time; selected trees show similar patterns in their tree rings; selected surface temperatures show a rising trend (except 1940-1975); hence CO<sub>2</sub> must have a long lifetime in air.

The IPCC's temperature curve (the so-called "hockey stick" curve) must be in error, because the Mediaeval warm period (= the "Climate Optimum") and the Little Ice Age both are absent from their curve, on which the IPCC bases its future projections and recommended mitigations.

All measurements of solar luminosity and <sup>14</sup>C isotopes show that there is at present an increasing solar radiation which gives a warmer climate (Willson, R.C & Hudson, H.S. 1991: The Sun's luminosity over a complete solar cycle. *Nature* 351, 42-44; and Coffey, H.E., Erwin, E.H. & Hanchett, C.D.: Solar databases for global change models. [www.nglc.noaa.gov/stp/SOLAR/solarda3.html](http://www.nglc.noaa.gov/stp/SOLAR/solarda3.html)). Warmer climate was previously perceived as an *optimum climate* and not catastrophic.

The atmospheric CO<sub>2</sub> constitutes a miniscule reservoir compared to the vast CO<sub>2</sub> reservoirs in the oceans, the sediments, the rest of the Earth's crust, and in the Earth's mantle. Without the Earth's sediments, the partial pressure of CO<sub>2</sub> in the air alone would be 40-60 atmospheres. Atmospheric CO<sub>2</sub> dissolves, hydrolyses, and protolyses in the ocean water, and combines with calcium and precipitates solid calcium carbonate, forming sediments. CO<sub>2</sub> partitioning between air and water is governed by Henry's Law, resulting in some 50 times more CO<sub>2</sub> in water than in air at equilibrium. The ocean's carbonate system will buffer the ocean's pH to a value around 8. Together with other mineral buffers they add up to an almost infinite pH buffer capacity (Stumm, W. & Morgan, J.J. 1970: *Aquatic Chemistry*. Wiley, 583 pp.). Hence to double the amount of atmospheric CO<sub>2</sub> would require the addition of much more than is now present therein (Mason, B. 1966: Principles of Geochemistry, 3rd ed. Wiley, 329 pp.). There is not enough fossil fuels available for a doubling of CO<sub>2</sub> in air through anthropogenic burning of fossil fuels (Jaworowski, Z., Segalstad, T.V. & Hisdal, V. 1992: Atmospheric CO<sub>2</sub> and global warming: a critical review, 2nd rev. ed. *Norsk Polarinstitutt Meddelelser [Norwegian Polar Institute Memoirs]* 119, 76 pp.).

Analysis of the carbon isotopes in the air's CO<sub>2</sub> is the only way to directly measure the amount of fossil-fuel-generated CO<sub>2</sub> in the atmosphere. The C-isotopes constitute the absolute proof that human influence on the "Greenhouse Effect" is minimal (maximum 4%). Anthropogenic CO<sub>2</sub> amounts to ≤4% of the ~2% of the "Greenhouse Effect", hence an influence of less than 1 permil of the Earth's total natural "Greenhouse Effect" (some 0.03°C of the total ~33°C).

Mass balance calculations of the <sup>13</sup>C/<sup>12</sup>C isotopes confirm a multitude of other measurements that the effective lifetime of atmospheric CO<sub>2</sub> is ~5 years, and that ~134 GT C (gigatonnes of carbon; 18% of total) of air CO<sub>2</sub> is exchanged each year between the air and other reservoirs, mainly the ocean; far more than the ~7 GT C annually released to the air from fossil fuel burning.