



This is the print version of the [Skeptical Science](#) article '[CO2 emissions do not correlate with CO2 concentration](#)', which can be found at <http://sks.to/co2conc>.

Comparing CO₂ emissions to CO₂ levels

What The Science Says:

When CO₂ emissions are compared directly to CO₂ levels, there is a strong correlation in the long term trends. This is independently confirmed by carbon isotopes which find the falling ratio of C13/C12 correlates well with fossil fuel emissions.

Climate Myth: CO₂ emissions do not correlate with CO₂ concentration

'It is easily demonstrated that there is no correlation between CO₂ emissions and atmospheric CO₂ concentration. Over the three years from 1979 to 1982 when CO₂ emissions were decreasing due to the rapid increase in the price of oil that drastically reduced consumption, there was no change in the rate of increase in atmospheric concentration of CO₂ proving that humans were not the primary source for the increase in concentration.' ([Laurence Gould](#))

To directly compare CO₂ emissions to atmospheric CO₂ levels, both sets of data can be converted to gigatonnes of CO₂. The CO₂ emissions data is typically expressed in gigatonnes carbon (GtC). One gigatonne is equal to one billion tonnes. This means they've only included the carbon element of the carbon dioxide molecule. The atomic mass of carbon is 12, while the atomic mass of CO₂ is 44. Therefore, to convert from gigatonnes carbon to gigatonnes of carbon dioxide, you simply multiply 44 over 12. In other words, 1 gigatonne of carbon equals 3.67 gigatonnes of carbon dioxide.

Atmospheric CO₂ levels are expressed in parts per million by volume (ppm). To convert from ppm to gigatonne of carbon, the conversion tables of the [Carbon Dioxide Information Analysis Center](#) advise that 1 part per million of atmospheric CO₂ is equivalent to 2.13 Gigatonnes Carbon. Using our 44 over 12 rule, this means 1ppm = 7.8 Gigatonnes of Carbon Dioxide in the atmosphere.

[Note that the conversion is different for Gigatonnes of Carbon Dioxide *emissions*, because natural sinks (ocean and biosphere) absorb approximately 55% of human emissions, so the "airborne fraction" added to the atmosphere is about 45%. This means 1ppm = 17.3 Gigatonnes of Carbon Dioxide emissions.]

The two time series can both be plotted together expressed as gigatonnes of carbon dioxide:

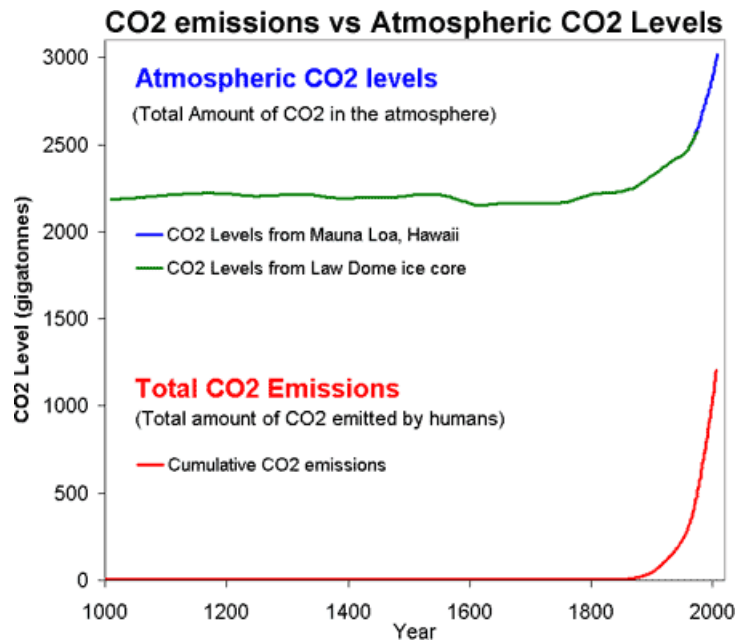


Figure 1: CO₂ levels (Green Line - [Law Dome, East Antarctica](#) and Blue line - [Mauna Loa, Hawaii](#)) and Cumulative CO₂ emissions in gigatonnes of CO₂ (Red Line - [CDIAC](#)).

So putting it all together, Figure 1 is a plot of the total amount of CO₂ in the atmosphere (top) versus the total amount of CO₂ humans have emitted into the atmosphere (bottom). Several features jump out. Firstly, the similar shape of the curves (dare I say hockey stick shaped). We have correlation but do we have causality?

It isn't too much of a stretch to imagine the amount of CO₂ we put into the atmosphere might have a causality link with the amount of CO₂ that remains in the atmosphere. Nevertheless, further confirmation comes by analysing the types of CO₂ found in the air. The carbon atom has several different isotopes (eg - different number of neutrons). Carbon 12 has 6 neutrons, carbon 13 has 7 neutrons. Plants have a lower C13/C12 ratio than in the atmosphere. If rising atmospheric CO₂ comes from fossil fuels, the C13/C12 should be falling. Indeed this is what is occurring ([Ghosh 2003](#)) and the trend correlates with the trend in global emissions.

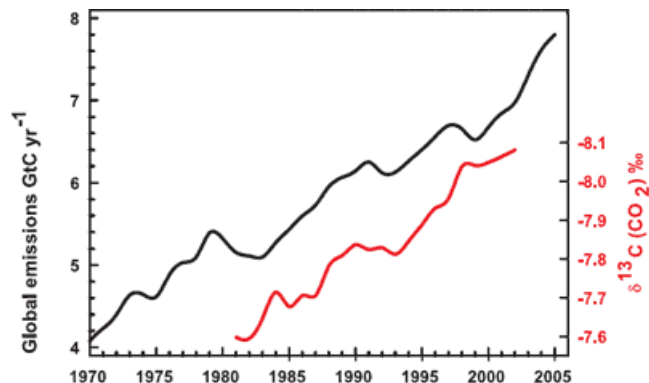


Figure 3: Annual global CO₂ emissions from fossil fuel burning and cement manufacture in GtC yr⁻¹ (black), annual averages of the ¹³C/¹²C ratio measured in atmospheric CO₂ at Mauna Loa from 1981 to 2002 (red). ([IPCC AR4](#))

This rebuttal was updated by Kyle Pressler in September 2021 to replace broken links. The updates are a result of [our call for help](#) published in May 2021.



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