



This is the print version of the [Skeptical Science](http://sks.to/trace) article '[CO2 is just a trace gas](http://sks.to/trace)', which can be found at <http://sks.to/trace>.

How substances in trace amounts can cause large effects

What The Science Says:

Small amounts of very active substances can cause large effects.

Climate Myth: CO2 is just a trace gas

"We have been grossly misled to think there is tens of thousands of times as much CO2 as there is! Why has such important information been withheld from the public? If the public were aware that man-made CO2 is so incredibly small there would be very little belief in a climate disaster ..." ([Gregg Thompson](#))

CO₂ makes up 390 ppm (0.039%)* of the atmosphere, how can such a small amount be important? Saying that CO₂ is "*only a trace gas*" is like saying that arsenic is "*only*" a trace water contaminant. Small amounts of very active substances can cause large effects.

Some Examples of Important Small Amounts:

- He wasn't driving drunk, he just had a *trace* of blood alcohol; 800 ppm (0.08%) is the [limit](#) in all 50 US states, and [limits](#) are lower in most other countries).
- Don't worry about your iron deficiency, iron is *only* 4.4 ppm of your body's atoms ([Stern and Eiser, 2002](#)).
- Ireland isn't important; it's *only* 660 ppm (0.066%) of the world population.
- That ibuprofen pill can't do you any good; it's *only* 3 ppm of your body weight (200 mg in 60 kg person).
- The Earth is *insignificant*, it's *only* 3 ppm of the mass of the solar system.
- Your children can drink that water, it only contains a *trace* of arsenic (0.01 ppm is the WHO and US EPA limit).
- Ozone is *only* a *trace* gas: 0.1 ppm is the [exposure limit](#) established by the US National Institute for Occupational Safety and Health. The World Health Organization (WHO) recommends an [ozone limit](#) of 0.051 ppm.
- A few parts per million of ink can turn a bucket of water blue. The color is caused by the absorption of the yellow/red colors from sunlight, leaving the blue. Twice as much ink causes a much stronger color, even though the total amount is still only a *trace* relative to water.



"Traces" of CO₂

Although percentage is a convenient way to talk about the amount of gas in the atmosphere, it

only tells how much is there relative to everything else; percentage doesn't give an absolute amount.

For example, you have trouble breathing on top of Mount Everest even though the atmosphere still contains 21% oxygen just like at sea level. The percentage isn't important, you need a certain number of oxygen molecules with each breath, regardless of how much or little they are diluted by inert gases. At an altitude of 8000 m the whole atmosphere is diluted.

The total number of CO₂ molecules above our heads in the atmosphere is more important than their percentage in the atmosphere. If the amount of inert nitrogen gas (N₂) in the atmosphere were to be cut in half then the **percentage** of CO₂ would jump (to about 600 ppm; 0.06%) without a change in the absolute amount of CO₂ and no substantial change in the energy balance of the Earth. Adding a huge number of energy-absorbing CO₂ molecules to the atmosphere doesn't change its percent number very much, only because it's being added to a vast inert N₂ background.

We know the amount of CO₂ in the atmosphere has increased because we have measured it. We know the climate has warmed from current and historical data. The link between increasing greenhouse gases and increasing temperature is clear: just as ink makes water more colored, CO₂ makes the atmosphere more absorbing. The extra CO₂ in our atmosphere is trapping energy that would otherwise escape to space. The measured global warming matches closely with the amount of energy trapped from the greenhouse gases added to the atmosphere.



A doubling of the *trace* molecule CO₂ from 280 ppm to 560 ppm is still a *trace*, but just like with arsenic, the difference between a small *trace* and a larger *trace* is fatal.

* To convert ppm to percentage divide by 10,000.

Photo credit: <http://www.photographylogger.net/15-cool-pictures-of-ink-in-water/>

Basic rebuttal written by Sarah

Update July 2015:

Here is a related lecture-video from [Denial101x - Making Sense of Climate Science Denial](#)

[see video at [this link](#).]



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