



## Central Coast Climate Science Education

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Misperception 4: Volcanoes produce more CO<sub>2</sub> than human activities do.

### Response:

One of the frustrations of trying to communicate factual information about human-caused climate change is the steady flow of misinformation that circulates over talk radio and the Internet. Some of these peak in terms of the frequency with which they are repeated and then fade away, only to be replaced with new bits of misinformation.

However, there is one that has been around for several years and it is somewhat curious that it has persisted. I recently received material describing this bit of misinformation in response to a column I wrote for our local newspaper, recently overheard it being repeated in idle chitchat at a carwash and heard it yet again when I was on a local radio talk show. So, I have decided to respond to it in this “Misperception” series. The misinformation is this: that volcanoes produce more CO<sub>2</sub> than do human activities (primarily associated with fossil fuel burning.)

A prominent source of this misinformation seems to be from an Australian mining geologist, Dr. Ian Plimer. This bit of misinformation is curious for two reasons: First, it is not only just a little bit wrong, it is wildly incorrect and easily refuted by climate scientists. Second, when even geologists who have no training or expertise in volcanism are first told that this claim is wildly wrong, they are frequently surprised. Why is this? I think the reason relates to the awesome power and spectacle of a major volcanic eruption:



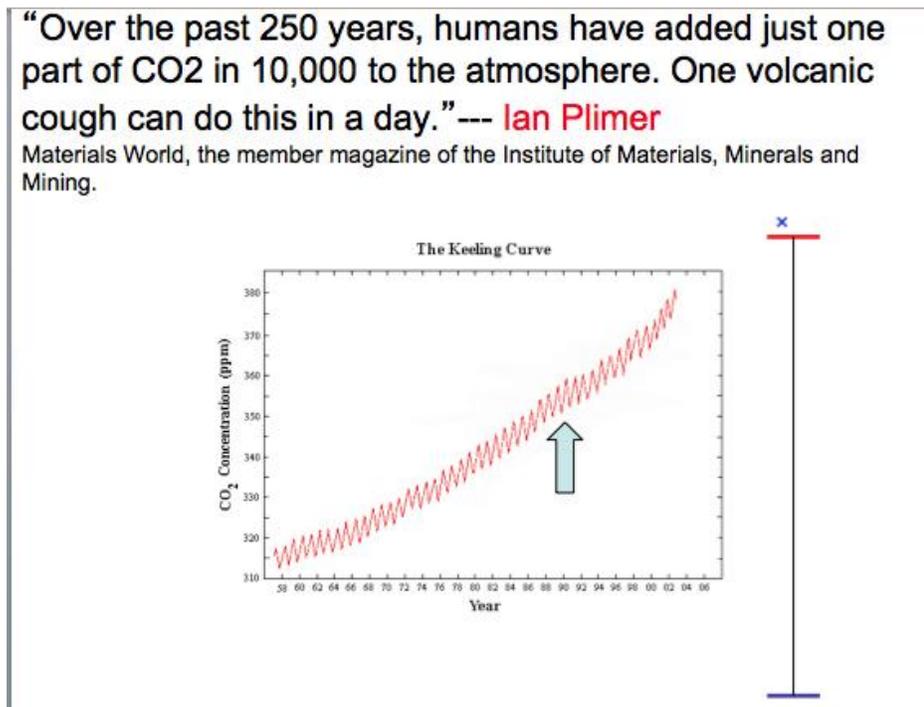
1991 Mount Pinatubo eruption in the Philippines

Admittedly, such an eruption is very impressive—but what we are seeing in that picture is volcanic ash—solid particles, not gas. Of course gases are also emitted, among them water vapor, carbon dioxide and sulphur dioxide. The question is how much carbon dioxide is emitted in a large eruption like Mt. Pinatubo, and more generally, how much is emitted averaged over many decades by all the volcanoes in the world, both on land and under the ocean.

Here is what Dr. Plimer claims concerning the eruption of Mt. Pinatubo:

*“When Mt. Pinatubo erupted in the Philippines in 1991, it spewed out more greenhouse gases into the atmosphere than the entire human race had emitted in all its years on Earth.”*

Basically, the same claim is made in the picture below, accompanied by a plot that immediately shows the absurdity of this claim:



First of all, the quote is, to put it in its most charitable light, seriously misleading: The one “part” (molecule) of CO<sub>2</sub>, the greenhouse gas that plays the dominant role in major climate changes, is being compared in the quote above to the 8000 molecules of Nitrogen and 2000 molecules of Oxygen, neither of which have anything to do with the greenhouse effect. (See Misperception #1).

The scientifically relevant statement is that since the onset of the industrial revolution humans have increased the amount of heat-trapping CO<sub>2</sub> in the atmosphere from about 280 parts per million to a value of, as of November 2013, 397—an increase of over 40%. (See for example: <http://keelingcurve.ucsd.edu/> and the “full record” and “1700-present” displays).

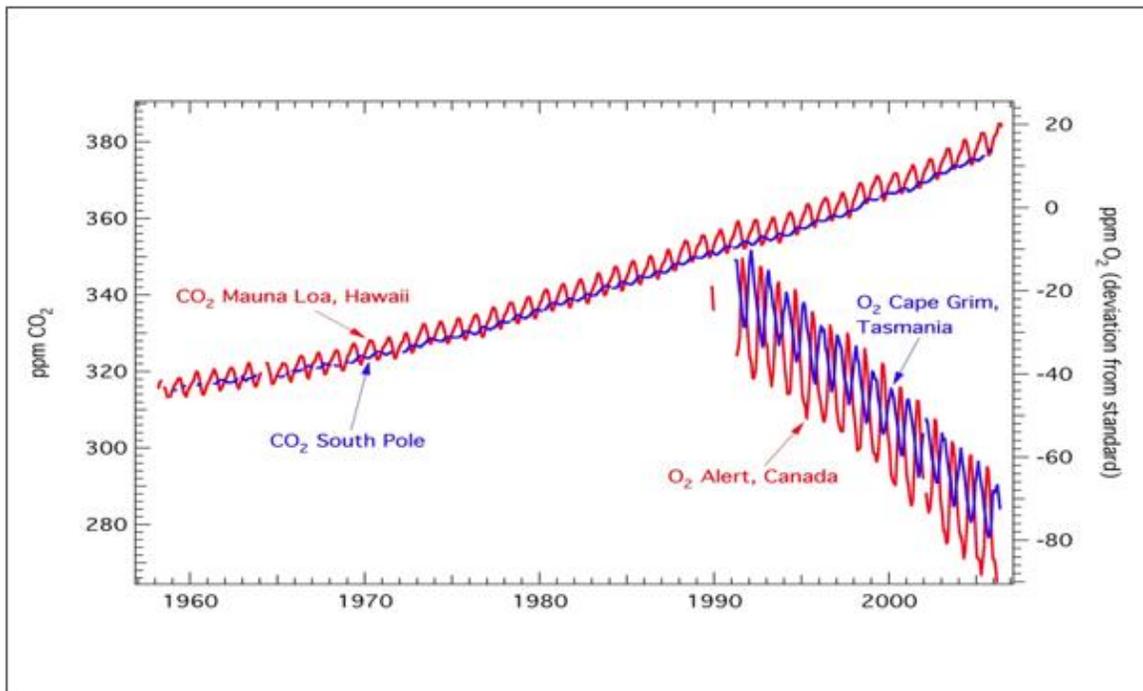
The plot above—the wavy red curve—shows the rise in the amount of CO<sub>2</sub> starting in 1958 when direct, extremely accurate measurements began. Prior to that, ice core records (see Tutorial #7) show that the level prior to the industrial revolution was about 280 parts per million. This level is represented by the short horizontal blue line on the lower right part of the

graph. The curve shown above ended in about 2003, but since then, as noted above, the amount of CO<sub>2</sub> has continued to rise to the level represented by the short horizontal red line at the upper right part of the graph. The length of the black vertical line connecting the blue and red lines thus represents increase in carbon dioxide since the industrial revolution.

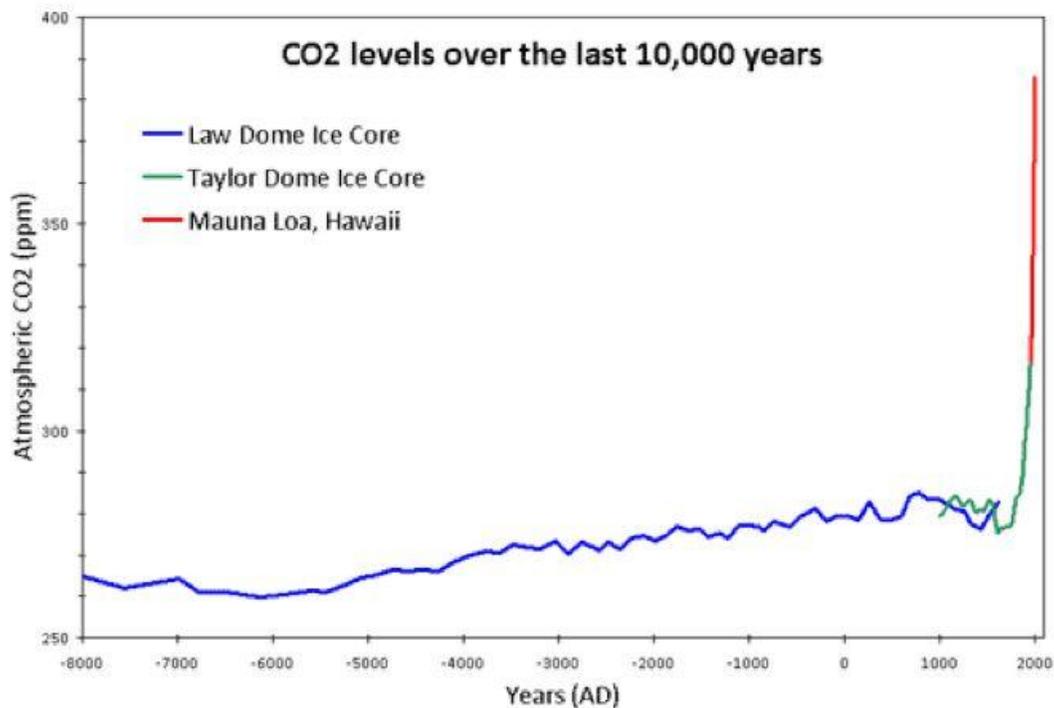
There is powerful evidence, discussed below, that this increase is due to human activities. So if Plimer were correct, the eruption of Pinatubo in 1991—marked by the pale blue arrow—should have caused a sudden jump in the wavy red line at that point at least as great as the length of the vertical line. No jump at all can be seen. In fact the discrepancy is even worse than this, since the amount of CO<sub>2</sub> produced by human consumption of fossil fuels can be tracked since we know the amount of coal, oil and natural gas consumed and the amount of CO<sub>2</sub> produced when these fossil fuels are burned. And, this amount is actually about twice the increase of the CO<sub>2</sub> in the atmosphere, since the ocean and biosphere have absorbed about half of the human generated CO<sub>2</sub>. (See Tutorial #6 on the Carbon Cycle, especially page 4). So much for the “one volcanic cough” claim.

What about the total amount of CO<sub>2</sub> produced by all volcanoes, both land and oceanic? There are geologists who specialize in volcanism who actually measure emitted gases from surface volcanoes and hot spots and trenches in the ocean floor. *They publish their results and do not merely make claims*: Thus, other scientists can see how they arrived at them and try to check them. In other words, they submit their work to the normal scientific practice of “peer review”. Their estimates of the fraction of CO<sub>2</sub> emitted by all volcanoes over many decades compared to the human-generated emissions over the same period range from about 0.5% to a little over 1% with the average ratio being about 1/130. In other words, the typical total emission per year from all volcanic activity is matched by human-generated emissions in only about 3 days.

There are other lines of evidence that volcanoes play only a very minor role compared to fossil fuel consumption in enriching CO<sub>2</sub> to the atmosphere: When fossil fuels are burned, the carbon in the fuel reacts with the oxygen in the atmosphere, using up two atoms of oxygen for every carbon atom. Thus, we might expect a decrease in the amount of oxygen in the atmosphere to accompany the increase of carbon in the atmosphere in the form of carbon dioxide. In fact this is observed as shown in the following graph. Of course the percentage change in the oxygen content of the atmosphere is very tiny because there are so many more oxygen molecules than carbon dioxide molecules.



Finally, while individual eruptions occur from time to time, the rate at which overall volcanic activity changes by a significant amount varies by a very small amount on time scales of decades. The graph below, based on both the direct measurements and ice core records mentioned above, shows how the concentration has varied over the last 10,000 years.



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Does any responsible scientist (or for that matter any responsible person) really believe that the amount of volcanic activity suddenly decided to spike just at the time that human consumption of fossil fuels skyrocketed?

I do not know whether Dr. Plimer's claims are made from a lack of understanding of the scientific data, or are intentional misrepresentations to discredit very solid peer-reviewed climate science, based on his ideological opposition to the necessity of somehow limiting the emission of greenhouse gases. Only he can say. But, it is unfortunate, destructive and a disservice to the general public's limited scientific understanding of a very complex subject.

What is even more unfortunate is the readiness of so many in the media and general public to uncritically accept and propagate misinformation of this sort. There are many available sources from which to obtain the results of peer-reviewed analysis from highly-respected and long-established climate scientists who have shown volcanic eruptions to be of no significant importance in the increase of greenhouse gases.