This is the print version of the Skeptical Science article 'Humans are too insignificant to affect global climate', which can be found at http://sks.to/significant.

Are humans too insignificant to affect global climate?

What The Science Says:
Atmospheric CO2 levels are rising by 15 gigatonnes per year. Humans are emitting 26 gigatonnes of CO2 into the atmosphere. Humans are dramatically altering the composition of our climate.

Climate Myth: Humans are too insignificant to affect global climate
To suggest that humanity is capable of impacting and disturbing forces of such magnitude is reflective of a self-centred arrogance that is mind numbing. Humanity is a subset of Nature. Nature is not a subset of humanity. We have travelled full circle. We are back in the mindset that prevailed when Society's leaders dictated what people in Copernicus' days may or may not think. The Earth is once again flat. (source: Financial Sense University)

Are humans too insignificant to affect global climate? After all, our planet is a big place. Isn't it arrogant to claim puny little humans could make a dent in such a huge climate? However, whether human activity might affect climate is not a question of arrogance. It's merely a question of numbers. In particular, there are two numbers to consider.

Atmospheric CO2 is rising by 15 Gigatonnes per year

The first on-site continuous measurements of atmospheric CO2 were implemented by Charles Keeling in 1958 at Mauna Loa, Hawaii. This station provides the longest continuous record of atmospheric CO2. Currently, atmospheric CO2 levels are being measured at hundreds of monitoring stations across the globe. For periods before 1958, levels of atmospheric CO2 are determined from analyses of air bubbles trapped in polar ice cores.

What we observe is that in pre-industrial times over the last 10,000 years, CO2 was relatively stable at around 275 to 285 ppm. Over the last 250 years, atmospheric CO2 levels have increased by about 100ppm. Currently, the amount of CO2 in the atmosphere is increasing by 15 gigatonnes every year.

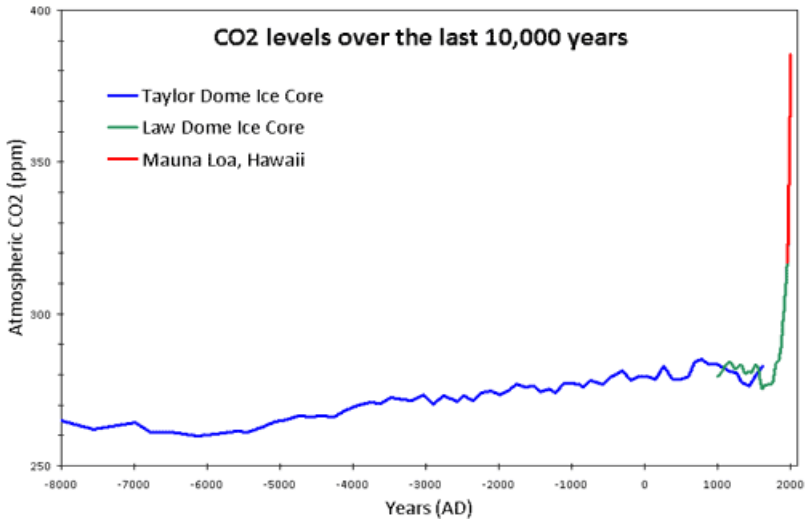

Figure Figure 1: CO2 levels (parts per million) over the past 10,000 years. Blue line derived from ice cores obtained at Taylor Dome, Antarctica (NOAA). Green line derived from ice cores obtained at Law Dome, East Antarctica (CDIAC). Red line from direct measurements at Mauna Loa, Hawaii (NOAA).

Humans are emitting 26 Gigatonnes of CO2 per year

Global CO2 emissions are derived from international energy statistics, tabulating coal, brown coal, peat, and crude oil production by nation and year. This means we can calculate how much CO2 we're emitting not only in recent years, using United Nations data, but also estimate fossil fuel CO2 emissions back to 1751 using historical energy statistics. What we've found is fossil fuel and cement emissions have continued to increase, climbing to the current rate of 26 Gigatonnes of CO2 per year.

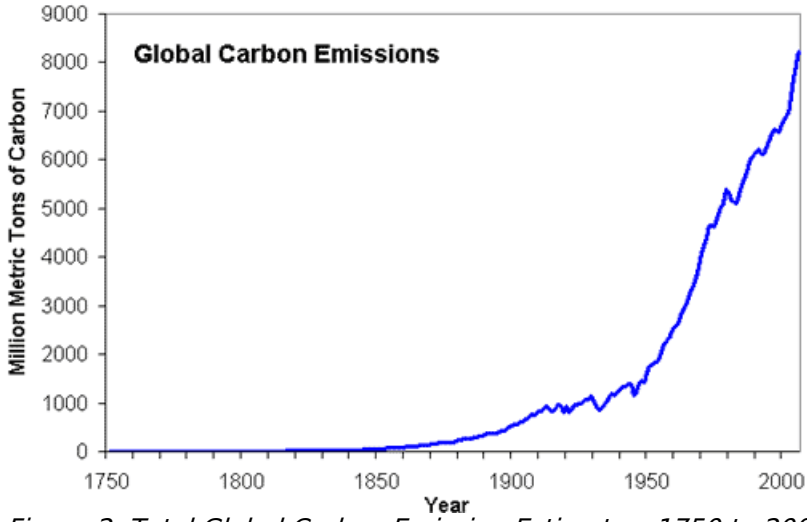

Figure 2: Total Global Carbon Emission Estimates, 1750 to 2006 (CDIAC).

In other words, humans are emitting nearly twice as much CO2 than what ends up staying there. Nature is reducing our impact on climate by absorbing a large chunk of our CO2 emissions. The amount of human CO2 left in the air, called the "airborne fraction", has hovered around 55% since 1958.

Detecting the human signature in atmospheric CO2

Further confirmation that rising CO2 levels are due to human activity come by analysing the types of CO2 found in the air. The carbon atom has several different isotopes (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 fossil fuels, the C13/C12 should be falling. Indeed this is what is occuring (Ghosh 2003) and the trend correlates with the trend in global emissions.

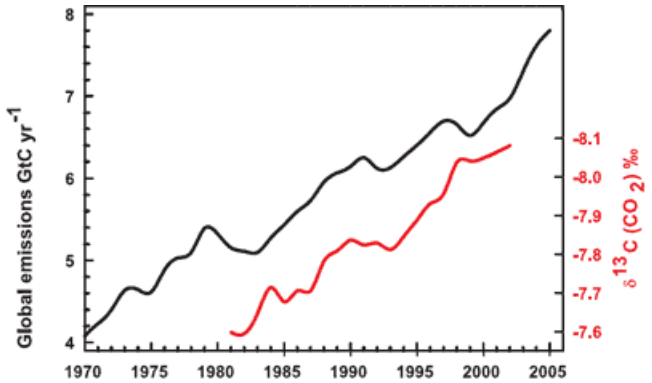

Figure 3: Annual global CO2 emissions from fossil fuel burning and cement manufacture in GtC yr–1 (black), annual averages of the 13C/12C ratio measured in atmospheric CO2 at Mauna Loa from 1981 to 2002 (red). (IPCC AR4)

So we see that humans have indeed changed the composition of our atmosphere in dramatic ways. If anyone could be accused of arrogance, you might say it's more arrogant to think we can pollute without consequences.

Intermediate rebuttal written by John Cook

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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Skeptical Science explains the science of global warming and examines climate misinformation through the lens of peer-reviewed research. The website won the Australian Museum 2011 Eureka Prize for the Advancement of Climate Change Knowledge. Members of the Skeptical Science team have authored peer-reviewed papers, a college textbook on climate change and the book Climate Change Denial: Heads in the Sand. Skeptical Science content has been used in university courses, textbooks, government reports on climate change, television documentaries and numerous books.

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