

Past climate change due to natural feedbacks

The Bethlehem Gadfly Climate Action Plan, Environment, Environmental Advisory Council, Serious Issues, Uncategorized September 27, 2019

(The latest in a series of posts relating to the environment, Bethlehem's Climate Action Plan, and Bethlehem's Environmental Advisory Council)

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Gadfly:

The reason why the terminology changed from “global warming” to “climate change” has nothing to do with the science. Rather, Republican pollster Frank Luntz, based on focus groups, determined that “climate change” was less threatening politically than “global warming.” What we are experiencing now is, in fact, global warming. That does not mean there is warming at every location on the earth or that every year is warmer than the preceding year (as there is interannual variability due to things like ENSO), but that on average, global temperatures over climatic timescales of 15-30 years or so continue to increase.

What past climate change tells us is that almost every major climate change in earth's history is either caused by or amplified by changing levels of greenhouse gases (carbon dioxide or methane). When greenhouse gas levels go up, the world warms; when they go down, the world cools. Glacial/interglacial cycles were amplified by changing CO₂ levels, the warm Eocene (55 million years ago) saw an outburst of methane, the warm Cretaceous (100 million years ago) had high CO₂

levels, snowball earth was caused by fluctuating CO₂, and even the early earth, when the sun was less bright than today, was warmed by high CO₂ and methane levels. Obviously, in these cases, the elevated greenhouse gases were not caused by humans but by natural feedbacks. But we know what effect adding greenhouse gases has on the climate! And today it is humans who are adding these greenhouse gases to the atmosphere.

CO₂ levels have fluctuated between 200 and 280 ppm between glacial/interglacial cycles over the last million years. In the year 1860, they were at 280 ppm. Today, they are at 400 ppm, and still rising. There is no question as to why they have risen – it is due to human activity that began with the Industrial Revolution – burning of fossil fuels (as well as cement production). There is also no question that based on current socioeconomic trends, CO₂ levels will continue to increase, with reasonable projections above 700 ppm by the year 2100. So, we have not yet even doubled CO₂ concentrations since 1860, but will surely do so in coming decades. Global temperatures have already risen 1°C, but with even greater increases in atmospheric CO₂, they will rise even further (projected another 2-4°C by 2100).

It is so important to understand attribution – why climate changes at different times. The Little Ice age was a relatively minor cooling event that probably was due to an extended 80-year period without sunspots, known as the Maunder Minimum, as well as relatively larger number of volcanic eruptions. Changes in sunspots normally have very little effect on the climate as there is an 11-year sunspot cycle, so only when sunspots shut off for a century or so would they have a discernible effect on the climate. That is not the case now. Differences in radiation between maximum and minimum sunspots in the cycle are simply too small to account for the warming we have witnessed. In fact, while the lower part of the atmosphere, the troposphere, has warmed, the stratosphere has cooled. That is a unique greenhouse warming signature that would not have occurred if the warming were due to the sun, as greenhouse gases are essentially keeping the heat near the surface.

So, yes, climate has changed in the past. But we have a pretty good understanding of why past climate change occurred, and the larger ones all involved changing greenhouse gases due to natural feedbacks. Climate is changing now, and humans are the primary culprit. We know what we need to do in order to slow it down – reduce the amount of greenhouse gases we put into the atmosphere. How, or if, we choose to do so is up to us.

Ben

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