Explained: Climate sensitivity

March 19 2010, by David L. Chandler

Graphic: Christine Daniloff

Climate sensitivity is the term used by the Intergovernmental Panel on Climate Change (IPCC) to express the relationship between the human-caused emissions that add to the Earth's greenhouse effect -- carbon dioxide and a variety of other greenhouse gases -- and the temperature changes that will result from these emissions.

Specifically, the term is defined as how much the average global surface temperature will increase if there is a doubling of greenhouse gases (expressed as carbon dioxide equivalents) in the air, once the planet has had a chance to settle into a new equilibrium after the increase occurs. In other words, it’s a direct measure of how the Earth’s climate will respond to that doubling.

That value, according to the most recent IPCC report, is 3 degrees Celsius, with a range of uncertainty from 2 to 4.5 degrees.

This sensitivity depends primarily on all the different feedback effects, both positive and negative, that either amplify or diminish the greenhouse effect. There are three primary feedback effects — clouds, sea ice and water vapor; these, combined with other feedback effects, produce the greatest uncertainties in predicting the planet's future climate.

With no feedback effects at all, the change would be just 1 degree Celsius, climate scientists agree. Virtually all of the controversies over climate science hinge on just how strong the various feedbacks may be — and on whether scientists may have failed to account for some of them.

Clouds are a good example. Clouds can have either a positive or negative feedback effect, depending on their altitude and the size of their water droplets. Overall, most scientists expect this net effect to be positive, but there are large uncertainties.

"There is still lots of uncertainty in what the climate sensitivity is," says Andrei Sokolov, a research scientist in MIT's Center for Global Change Science, who has been doing research on climate sensitivity for many years. "Feedback is what's driving things," he says.

It is important to note that climate sensitivity is figured on the basis of an overall doubling, compared to pre-industrial levels, of carbon dioxide and other greenhouse gases. But the temperature change given by this definition of climate sensitivity is only part of the story. The actual increase might be greater in the long run because greenhouse gas levels in the atmosphere could more than double without strong policies to control emissions. But in the short run, the actual warming could be less

than suggested by the climate sensitivity, since due to the thermal inertia of the ocean, it may take some time after a doubling of the concentration is reached before the climate reaches a new equilibrium.

This is the second part of an "Explained" on climate change. Part one *dealt with radiative forcing.*

Provided by Massachusetts Institute of Technology

Citation: Explained: Climate sensitivity (2010, March 19) retrieved 13 March 2024 from https://phys.org/news/2010-03-climate-sensitivity.html