Ross McKitrick: All those warming-climate predictions suddenly have a big, new problem

Junk Science Week: Looking at the Equilibrium Climate Sensitivity measurements, it might not get as hot some people seem to think

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Greenhouse gas emissions may not have as big an impact on the climate as has been claimed, writes Ross McKitrick.*Getty Images*

One of the most important numbers in the world goes by the catchy title of Equilibrium Climate Sensitivity, or ECS. It is a measure of how much the climate responds to greenhouse gases. More formally, it is defined as the increase, in degrees Celsius, of average temperatures around the world, after doubling the amount of carbon dioxide in the atmosphere and allowing the atmosphere and the oceans to adjust fully to the change. The reason it's important is that it is the ultimate justification for governmental policies to fight climate change. The United Nations Intergovernmental Panel on Climate Change (IPCC) says ECS is likely between 1.5 and 4.5

degrees Celsius, but it can’t be more precise than that. Which is too bad, because an enormous amount of public policy depends on its value. People who study the impacts of global warming have found that if ECS is low — say, less than two — then the impacts of global warming on the economy will be mostly small and, in many places, mildly beneficial. If it is very low, for instance around one, it means greenhouse gas emissions are simply not worth doing anything about. But if ECS is high — say, around four degrees or more — then climate change is probably a big problem. We may not be able to stop it, but we’d better get ready to adapt to it.
So, somebody, somewhere, ought to measure ECS. As it turns out, a lot of people have been trying, and what they have found has enormous policy implications.

To understand why, we first need to delve into the methodology a bit. There are two ways scientists try to estimate ECS. The first is to use a climate model, double the modeled CO2 concentration from the pre-industrial level, and let it run until temperatures stabilize a few hundred years into the future. This approach, called the model-based method, depends for its accuracy on the validity of the climate model, and since models differ quite a bit from one another, it yields a wide range of possible answers. A well-known statistical distribution derived from modeling studies summarizes the uncertainties in this method. It shows that ECS is probably between two and 4.5 degrees, possibly as low as 1.5 but not lower, and possibly as high as nine degrees. This range of potential warming is very influential on economic analyses of the costs of climate change.
The second method is to use long-term historical data on temperatures, solar activity, carbon-dioxide emissions and

atmospheric chemistry to estimate ECS using a simple statistical model derived by applying the law of conservation of energy to the planetary atmosphere. This is called the Energy Balance method. It relies on some extrapolation to satisfy the definition of ECS but has the advantage of taking account of the available data showing how the actual atmosphere has behaved over the past 150 years.

The surprising thing is that the Energy Balance estimates are very low compared to model-based estimates. The accompanying chart compares the model-based range to ECS estimates from a dozen Energy Balance studies over the past decade. Clearly these two methods give differing answers, and the question of which one is more accurate is important.

Climate modelers have put forward two explanations for the discrepancy. One is called the “emergent constraint” approach. The idea is that models yield a range of ECS values, and while we can’t measure ECS directly, the models also yield estimates of a lot of other things that we can measure (such as the reflectivity of cloud tops), so we could compare those other measures to the data, and when we do, sometimes the models with high ECS values also yield measures of secondary things that fit the data better than models with low ECS values.

This argument has been a bit of a tough sell, since the correlations involved are often weak, and it doesn’t explain why the Energy Balance results are so low.
The second approach is based on so-called “forcing efficacies,” which is the concept that climate forcings, such as

greenhouse gases and aerosol pollutants, differ in their effectiveness over time and space, and if these variations are taken into account the Energy Balance sensitivity estimates may come out higher. This, too, has been a controversial suggestion.

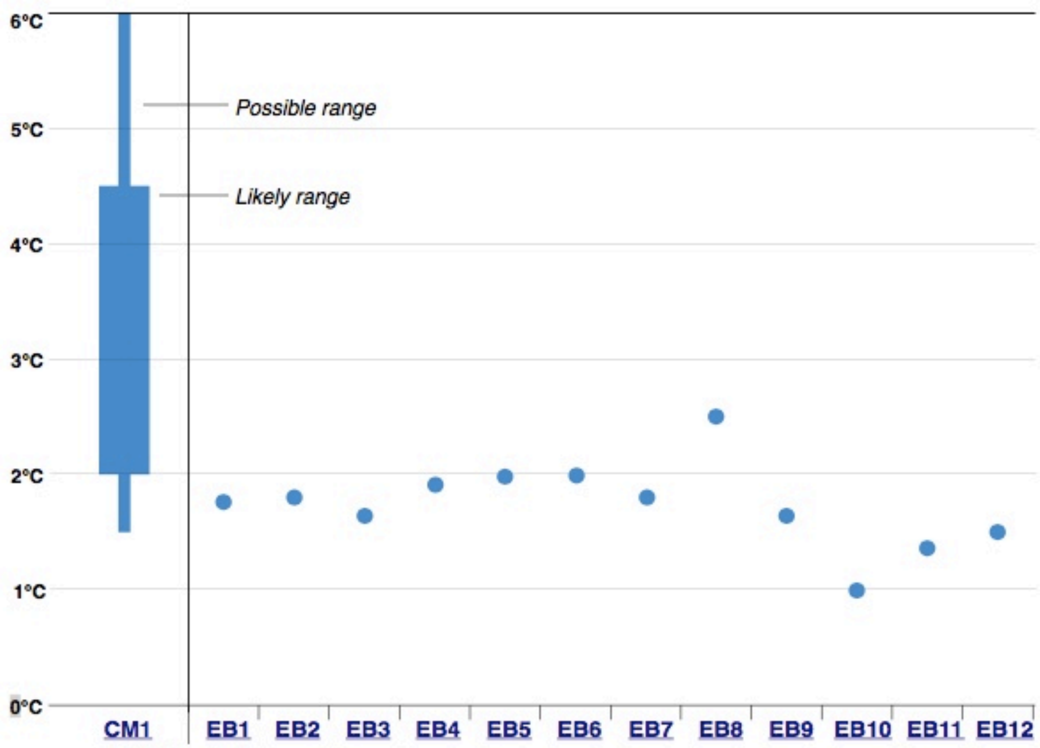
A recent Energy Balance ECS estimate was just published in the Journal of Climate by Nicholas Lewis and Judith Curry. There are several features that make their study especially valuable. First, they rely on IPCC estimates of greenhouse gases, solar changes and other climate forcings, so they can't be accused of putting a finger on the scale by their choice of data. Second, they take into account the efficacy issue and discuss it at length. They also take into account recent debates about how surface temperatures should or shouldn't be measured, and how to deal with areas like the Arctic where data are sparse. Third, they compute their estimates over a variety of start and end dates to check that their ECS estimate is not dependent on the relative warming hiatus of the past two decades.

It looks like the climate models we have been using for decades need to be revised

Their ECS estimate is 1.5 degrees, with a probability range between 1.05 and 2.45 degrees. If the study was a one-time outlier we might be able to ignore it. But it is part of a long list of studies from independent teams (as this graphic shows), using a variety of methods that take account of critical challenges, all of which conclude that climate models exhibit too much sensitivity to greenhouse gases.

<u>CLIMATE MODELS VS. CLIMATE HISTORY</u>

Two methods of measuring Equilibrium Climate Sensitivity to rising greenhouse gasses: IPCC climate models (CM) vs Energy Balance Method (EB)—in degrees Celsius.



SOURCES: CM1:ROE-BAKER 2007. EB1: ALDRIN ET AL 2012. EB2: RING ET AL 2012. EB3: LEWIS 2013. EB4: OTTO ET AL 2013. EB5. MASTERS 2014. EB6: LOEHLE 2014. EB7:SKELE ET AL 2014. EB8: JOHANNSEN ET AL 2015. EB9: LEWIS & CURRY 2015. EB 10: BATES 2016. EB11:CHRISTY & MCNIDER 2017. EB12: LEWIS & CURRY 2018.

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Policy-makers need to pay attention, because this debate directly impacts the carbon-tax discussion.

The Environmental Protection Agency uses social cost of carbon models that rely on the model-based ECS estimates. Last year, two colleagues and I published a study in which we took an earlier Lewis and Curry ECS estimate and plugged it into two of those models. The result was that the estimated economic damages of greenhouse gas emissions fell by between 40 and 80 per cent, and in the case of one model the damages had a 40 per cent probability of being negative for the next few decades — that is, they would be beneficial changes. The new Lewis and Curry ECS estimate is even lower than their old one, so if we re-did the same study we would find even lower social costs of carbon.

If ECS is as low as the Energy Balance literature suggests, it means that the climate models we have been using for decades run too hot and need to be revised. It also means that greenhouse gas emissions do not have as big an impact on the climate as has been claimed, and the case for costly policy measures to reduce carbon-dioxide emissions is much weaker than governments have told us. For a science that was supposedly “settled” back in the early 1990s, we sure have a lot left to learn.

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