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Back to previous page

Climate scientists grapple with uncertainty (though not the kind you think)

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You'll often hear climate skeptics say "The science isn't settled." And, to an extent, this is true — though not in the way they're implying. There are lots of things climatologists know with a high degree of confidence: that the Earth is warming, that human activity is a major culprit. But, as scientists will readily concede, there are still plenty of aspects of the climate system subject to fervent debate, especially the scale of the risks involved in heating the planet. That's not necessarily comforting. Uncertainty, after all, can easily mean things might be much *worse* than we thought.

Reuters

Increasingly, many scientists are puzzling over how best to present what they know and don't know to a broader audience. It's not as easy as it sounds. What do you do when there's a small but real chance that global warming could lead to a catastrophe? How do you talk about that in a way that's useful to policymakers? "This is something we've struggled with a lot over the years," says Michael Oppenheimer, a professor of geosciences at Princeton University. And as the world's climatologists get started on the next big assessment of climate science — due in 2013 — figuring out how to talk about what they're unsure of has taken on renewed urgency.

Here's an example of why this matters. The Intergovernmental Panel on Climate Change's 2007 report had a section on future sea-level rise. At the time, there was still debate over how quickly ice caps in Greenland and Antarctica would melt as the poles warmed. (Roughly speaking, it was unclear whether the melting ice sheets would largely stay in place and drip water into the oceans or whether big chunks would slide off into the sea.) So the IPCC models explicitly left out estimates of "future rapid dynamical changes in ice flow" and forecast that sea levels would rise just 18 to 59 centimeters by 2100, largely caused by thermal expansion of the oceans.

In a sense, this was "accurate," representing what the broad scientific community could say with high levels of confidence. The report even added a caveat: "Larger rises cannot be excluded, but understanding of these effects is too limited to assess their likelihood." In another sense, though, the IPCC was acting too conservatively, giving an overly rosy picture of the rising oceans. In the years since the 2007 report, researchers have learned more about the dynamics of ice sheets and are converging on the view that we're facing at least a one-meter rise by century's end if emissions aren't tamed.

Even as the sea-level picture comes into focus, Oppenheimer notes that there are other fuzzy areas likely to

bedevil the next IPCC report. It's notoriously difficult to predict how much carbon dioxide the world will emit in decades ahead. (The IPCC lays out several emissions scenarios but doesn't assign probabilities.) Feedbacks in the carbon cycle are another grey area. There's been concern that warming oceans could thaw out methane hydrates on the sea floor, kicking up even more heat-trapping methane into the air, warming the planet further. Or see Justin Gillis's New York Times dispatch about the debates over forest die-offs.

"There are a lot of things that could turn out to be important, but that we don't even have a way to deal with the likelihood," explains Oppenheimer. "If you leave it out entirely, that's not good — then governments won't be aware of it. But if you don't quantify it, policymakers could draw conclusions that aren't justified." He adds that there are some precedents for communicating hard-to-quantify risks: The defense establishment, for one, does it when talking about terrorism.

Indeed, a climate assessment that traffics only in the most likely scenarios may prove misleading. Harvard economist Marty Weitzman has argued that climate projections often have large ranges, and the worst-case scenarios at the tail end can be *really* awful. Just pulling out one example: A 2010 paper in the Proceedings of the National Academy of Sciences concluded that there's a roughly 5 percent chance that rising temperatures could render vast regions of the planet — like the Eastern United States or most of India — utterly uninhabitable. How should we think about "fat tail" risks like that?

To that end, Oppenheimer and Wesleyan's Gary Yohe have co-edited a special issue of the journal *Climatic Change*, which features a slew of ideas for communicating scientific uncertainty. In one article, for instance, Princeton's Robert Socolow argues that the IPCC should make low-probability, high-consequence outcomes more vivid and be clearer about areas where there's vigorous dispute among scientists. Another paper argues that the IPCC's reliance on terms such as "likely" and "very likely" to characterize the state of knowledge can be slippery and misinterpreted. MIT's John Sterman suggests that climate experts should be aware of psychological biases that make it difficult for people to grasp concepts like feedback effects. Still others, such as Richard Tol, argue that the IPCC has become hidebound and slow to innovate.

To some extent, translating rapidly moving research into actionable policy terms is still outside many scientists' comfort zones. "If we had all the time in the world to study this, it would be no big deal, it'd just be some arcane scientific debate," says Oppenheimer. "But because there's a policy context, there's an added urgency in getting it right." What's more, there's always the worry that emphasizing uncertainty could be overhyped by deniers and skeptics who want to argue that there's no problem at all. But Oppenheimer says that that's a risk worth taking. "My personal view," he says, "is that you have to be direct and honest about these things."

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