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ENVIRONMENT

Climate Heretic

Why can't we have a civil conversation about climate?

By Michael D. Lemonick

IN TRYING TO UNDERSTAND THE JUDITH CURRY PHENOMENON, it is tempting to default to one of two comfortable and familiar story lines.

For most of her career, Curry, who heads the School of Earth and Atmospheric Sciences at the Georgia Institute of Technology, has been known for her work on hurricanes, Arctic ice dynamics and other climate-related topics. But over the past year or so she has become better known for something that annoys, even infuriates, many of her scientific colleagues. Curry has been engaging actively with the climate change skeptic community, largely by participating on outsider blogs such as Climate Audit, the Air Vent and the Blackboard. Along the way, she has come to question how climatologists react to those who question the science, no matter how well established it is. Although many of the skeptics recycle critiques that have long since been disproved, others, she believes, bring up valid points—and by lumping the good with the bad, climate researchers not only miss out on a chance to improve their science, they come across to the public as haughty. "Yes, there's a lot of crankology out there," Curry says. "But not all of it is. If only 1 percent of it or 10 percent of what the skeptics say is right, that is time well spent because we have just been too encumbered by groupthink."

She reserves her harshest criticism for the Intergovernmental Panel on Climate Change (IPCC). For most climate scientists the major reports issued by the United Nations–sponsored body every five years or so constitute the consensus on climate science. Few scientists would claim the IPCC is perfect, but Curry thinks it needs thoroughgoing reform. She accuses it of "corruption." "I'm not going to just spout off and endorse the IPCC,"

IN BRIEF

If people and governments are going to take serious action to reduce carbon emissions, the time pretty much has to be now, because any delay will make efforts to stave off major changes more difficult and expensive to achieve.
In the wake of "Climategate" and attacks on policy makers, the public is more confused than ever about what to think, particularly when it comes to talk of uncertainty in climate science. Climate policy is stalled.
The public needs to understand that scientific uncertainty is not the same thing as ignorance, but rather it is a discipline for quantifying what is unknown.
Climate scientists need to do a better job of communicating uncertainty to the public and responding to criticism from outsiders.

Critic: Judith Curry has traded harsh words with many of her colleagues in climate science.

Photograph by Gregory Miller

she says, "because I think I don't have confidence in the process."

Whispered discreetly at conferences or in meeting rooms, these claims might be accepted as part of the frequently contentious process of a still evolving area of science. Stated publicly on some of the same Web sites that broke the so-called Climategate e-mails last fall, they are considered by many to be a betrayal, earning Curry epithets from her colleagues ranging from "naive" to "bizarre" to "nasty" to worse.

All of which sets up the two competing story lines, which are, on the surface at least, equally plausible. The first paints Curry as a peacemaker—someone who might be able to restore some civility to the debate and edge the public toward meaningful action. By frankly acknowledging mistakes and encouraging her colleagues to treat skeptics with respect, she hopes to bring about a meeting of the minds.

The alternative version paints her as a dupe—someone whose well-meaning efforts have only poured fuel on the fire. By this account, engaging with the skeptics is pointless because they cannot be won over. They have gone beyond the pale, taking their arguments to the public and distributing e-mails hacked from personal computer accounts rather than trying to work things out at conferences and in journal papers.

Which of these stories is more accurate would not matter much if the field of science in question was cosmology, say, or paleontology, or some other area without any actual impact on people's lives. Climate science obviously is not like that. The experts broadly agree that it will take massive changes in agriculture, energy production, and more to avert a potential disaster.

In this context, figuring out how to shape the public debate is a matter of survival. If people and governments are going to take serious action, it pretty much has to be now, because any delay will make efforts to stave off major climate change much more expensive and difficult to achieve. But the COP15 climate negotiations in Copenhagen last December ended in a watered-down policy document, with no legally binding commitments for countries to reduce greenhouse gas emissions. Following Copenhagen, the U.S. Senate was unable to pass even a modest "cap and trade" bill that would have mandated reductions. And in the wake of Climategate a year ago and widespread attacks on the IPCC and on climate science in general, the public may be more confused than ever about what to think. Is Curry making things worse or better?

OVER TO THE DARK SIDE

CURRY'S SAGA began with a *Science* paper she co-authored in 2005, which linked an increase in powerful tropical cyclones to global warming. It earned her scathing attacks on skeptical climate blogs. They claimed there were serious problems with the hurricane statistics the paper relied on, particularly from before the 1970s, and that she and her co-authors had failed to take natural variability sufficiently into account. "We were generally aware of these problems when we wrote the paper," Curry says, "but the critics argued that these issues were much more significant than we had acknowledged."

She did not necessarily agree with the criticisms, but rather than dismissing them, as many scientists might have done, she began to engage with the critics. "The lead author on the paper, Peter J. Webster, supports me in speaking with skeptics," Curry says, "and we now have very cordial interactions with Chris Landsea (whom we were at loggerheads with in 2005/2006), and we have had discussions with Pat Michaels on this subject."

In the course of engaging with the skeptics, Curry ventured onto a blog run by Roger Pielke, Jr., a professor of environmental studies at the University of Colorado who is often critical of the climate science establishment, and onto Climate Audit, run by statistician Steve McIntyre. The latter, Curry adds, "became my blog of choice, because I found the discussions very interesting and I thought, 'Well, these are the people I want to reach rather than preaching to the converted over at [the mainstream climate science blog] RealClimate.'"

It was here that Curry began to develop respect for climate outsiders—or at least, some of them. And it made her reconsider her uncritical defense of the IPCC over the years. Curry says, "I realize I engaged in groupthink myself"—not on the hurricane paper per se but more broadly in her unquestioning acceptance of the idea that IPCC reports represent the best available thinking about climate change.

She says she always trusted the IPCC to gather and synthesize all the disparate threads in this complex and multifaceted area of science. "I had 90 to 95 percent confidence in the IPCC Working Group 1 report," she states, referring to the basic-science section of the three-part report. But even then, she harbored some doubts. In areas where she had some expertise—clouds and sea ice, for example—she felt that the report's authors were not appropriately careful. "I was actually a reviewer for the IPCC Third Assessment Report," Curry says, "on the subject of atmospheric aerosols [that is, particles such as dust and soot that affect cloud formation]. I told them that their perspective was far too simplistic and that they didn't even mention the issue of aerosol impacts on the nucleation of ice clouds. So it's not so much as finding things that were wrong, but rather ignorance that was unrecognized and confidence that was overstated." In retrospect, she laughs, "if people expert in other areas were in the same boat, then that makes me wonder."

Apparently few others felt the same way; of the many hundreds of scientists involved in that report, which came out in 2001, only a handful have claimed their views were ignored—although the Third Assessment Report could not possibly reflect any one scientist's perspective perfectly.

Still, once Curry ventured out onto the skeptic blogs, the questions she saw coming from the most technically savvy of the outsiders—including statisticians, mechanical engineers and computer modelers from industry—helped to solidify her own uneasiness. "Not to say that the IPCC science was wrong, but I no longer felt obligated in substituting the IPCC for my own personal judgment," she said in a recent interview posted on the Collide-a-Scape climate blog.

Curry began to find other examples where she thought the IPCC was "torquing the science" in various ways. For example, she says, "a senior leader at one of the big climate-modeling institutions told me that climate modelers seem to be spending 80 percent of their time on the IPCC production runs and 20 percent of their time developing better climate models." She also asserts that the IPCC has violated its own rules by accepting nonpeer-reviewed papers and assigning high-status positions to relatively untested scientists who happen to feed into the organization's "narrative" of impending doom.

Climate skeptics have seized on Curry's statements to cast doubt on the basic science of climate change. So it is important to emphasize that nothing she encountered led her to question the science; she still has no doubt that the planet is warming,

that human-generated greenhouse gases, including carbon dioxide, are in large part to blame, or that the plausible worst-case scenario could be catastrophic. She does not believe that the Climategate e-mails are evidence of fraud or that the IPCC is some kind of grand international conspiracy. What she does believe is that the mainstream climate science community has moved beyond the ivory tower into a type of fortress mentality, in which insiders can do no wrong and outsiders are forbidden entry.

UNCERTAINTY AND SCIENCE

CURRY IS NOT ALONE in criticizing the IPCC and individual climate scientists; in the wake of Climategate, an error about glacial melting in an IPCC report, and accusations of conflicts of interest involving IPCC chair Rajendra K. Pachauri, bodies ranging from the U.N. to the British government to individual universities on both sides of the Atlantic launched investigations. None found evidence of fraudulent science—including, most important, a probe by the InterAcademy Council (IAC)—a network of the U.S. National Academies of Science and its counterparts around the world. Although it found no major errors or distortions, it reported that the IPCC's procedures have failed to change adequately with the times and that in some cases the body has not enforced its own standards rigorously.

Stripped of incendiary words, the central issue that concerns Curry also happens to be the key problem in translating climate science into climate policy. The public at large wants to know whether or not climate is warming, by how much and when, and they want to know how bad the effects are going to be. But the answers scientists give in papers and at conferences come couched in a seemingly vague language of confidence intervals and probabilities. The politically charged nature of the issue seems to have made some scientists reluctant to even mention anything to the public about "uncertainty" for fear that the likes of Oklahoma's Senator James "greatest hoax ever perpetrated on the American people" Inhofe and other politically motivated skeptics will continue to use the word as a blunt instrument against the whole enterprise of climate science—that because the scientists do not know everything, they know nothing.

The uncertainty lies in both the data about past climate and the models that project future climate. Curry asserts that scientists haven't adequately dealt with the uncertainty in their calculations and don't even know with precision what's arguably the most basic number in the field: the climate forcing from CO_2—that is, the amount of warming a doubling of CO_2 alone would cause without any amplifying or mitigating effects from melting ice, increased water vapor or any of a dozen other factors.

Things get worse, she argues, when you try to add in those feedbacks to project likely temperature increases over the next century, because the feedbacks are rife with uncertainty as well: "There's a whole host of unknown unknowns that we don't even know how to quantify but that should be factored into our confidence level." One example she cites is the "hockey stick" chart showing that current temperatures are the warmest in hundreds of years. If you are going to say that this year or that decade is the hottest, you had better have a good idea of what temperatures have actually been over those hundreds of years—and Curry, along with many skeptics, does not think we have as good a handle on that as the scientific community believes.

Many climate scientists find these complaints unfair. They say the IPCC has been upfront about uncertainties all along—

SOURCES: THE IPCC THIRD ASSESSMENT REPORT, 2001 (*temperature graph*); THE IPCC THIRD ASSESSMENT REPORT, SUMMARY FOR POLICY MAKERS, 2007; "KINEMATIC CONSTRAINTS ON GLACIER CONTRIBUTIONS TO 21ST-CENTURY SEA-LEVEL RISE," BY W. T. PFEFFER ET AL., IN *SCIENCE*, VOL. 321; 2008 (*projected sea level*)

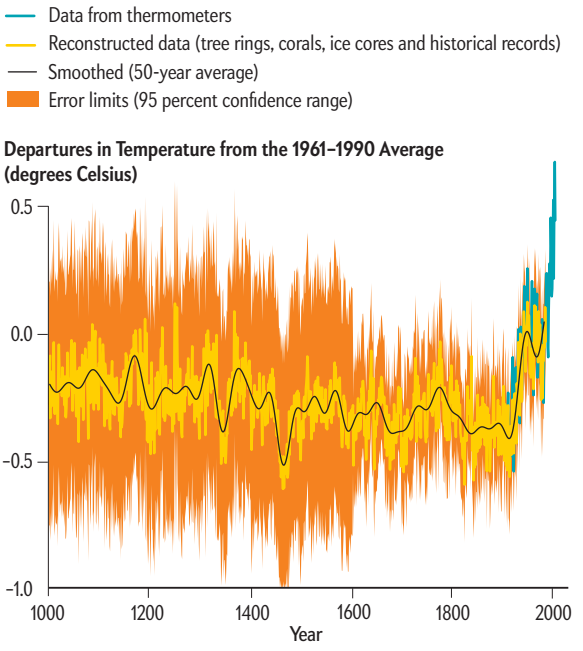
BEHIND THE NUMBERS

Making Sense of Trends

Some big questions in climate science are problematic because the answers often depend in part on proxy measurements or incomplete data. Scientists routinely spell out the extent of their uncertainty, but the very fact of uncertainty often leads to public confusion over the validity of the results. The graphics below illustrate two examples of data sets that have elicited controversy.

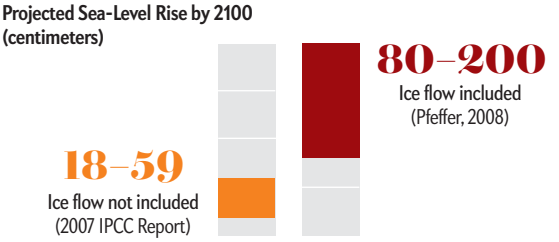
Reconstructing the Past

The IPCC's Third Assessment Report, published in 2001, includes a graph of temperature going back 1,000 years, rising steeply in recent decades, known as the hockey stick. Error bars (*orange*) are greater for the values calculated for the distant past because temperature measurements in that period were not available; instead scientists derived them from proxies such as tree rings, coral growth, ice hole bores and other data. (The yellow indicates the actual data plot.) The likelihood of true temperature falling between the error bars is considered to be 95 percent.



Predicting the Future

When the IPCC issued its Fourth Assessment Report in 2007, it included an estimate for future sea-level rise, which, because of a lack of data about ice dynamics, excluded this particular factor. The IPCC gave a range within which levels were "likely" to rise (with likely defined as 66 percent probability). Subsequently, scientists came up with revised estimates, based on new data, that more than doubled the projected sea-level rise.



that the reports explicitly cite areas where knowledge is lacking. It would be scientifically irresponsible to give flat answers to questions such as "How much will it warm?" or "How much will sea level rise?" Instead the experts give ranges and confidence intervals and the like. More important, other scientists part ways with Curry over how significant those uncertainties are to the final calculation. Yes, the most basic number in climate science is not known with absolute precision, agreed Stanford University's Stephen H. Schneider in a conversation shortly before he died in July. But it is only uncertain by a few percent, which simply is not enough to skew the projections significantly. Other effects, such as whether clouds will accelerate or retard warming, are much less certain—but here people like Schneider point out that the lack of precision is laid out by the IPCC. (Schneider was the one who persuaded the IPCC to systematize its discussion of uncertainty a decade ago.) For that reason, Curry's charges are misleading, her critics say. "We've seen a lot of strawmen from Judy lately," Schneider said. "It is frankly shocking to see such a good scientist take that kind of a turn to sloppy thinking. I have no explanation for it."

The sloppiness is not one-sided, however. While the IAC panel came out of its investigation with respect for the IPCC overall, it had issues with how the organization deals with uncertainty. "We looked very carefully at the question of how they communicate the level of uncertainty to policy makers," says Harold Shapiro, a former president of Princeton University and head of the IAC panel. "We found it was a mix. Sometimes they do it well, sometimes not so well. There were statements made where they expressed high confidence in a conclusion where there was very little evidence, and sometimes there were statements made that could not be falsified." A statement that cannot be proven false is generally not considered to be scientific.

In at least one respect, however, Curry is in harmony with her colleagues. The public needs to understand that in science un-

POLICY

How to Cope with an Uncertain Fate

It's time to abandon the fantasy that all nations must first agree on a master climate plan

BY M. GRANGER MORGAN

People make decisions in the face of irreducible uncertainty all the time. We choose where to go to college, what job to take, whom to marry, and whether to have children—all with limited and uncertain information. Governments do the same thing. They subsidize transportation networks, change regulatory policies, implement social programs, declare war and sue for peace, even though they can't know for certain how things will work out.

Although many details of climate science are uncertain, we know much more about how the climate system will respond to a dramatic increase in atmospheric carbon dioxide than we know about many of the choices we face in private life and in policy. Human actions over the past couple of centuries have placed our planet at great risk. If we do not act soon to change our energy systems and reduce emissions of greenhouse gases, later this century our children and grandchildren will witness profound changes to the planet's ecosystems and regional climates that may put at risk the livelihood and lives of billions of people in the developing world. The people who do climate science and assessment should be more careful and open in their communication with the public, but uncertainty about the science is not what is preventing progress on policy.

The first thing we should do is put aside the idea that all nations must agree before any of them can get serious about reducing carbon emissions. Otherwise we are likely to face decades of delay. We should continue to work on international agreements but focus more on getting individual nations and regions to take action. We should develop international strategies to coalesce different kinds of emission-control regimes into larger agreements and develop strategies for getting laggards onboard either through moral suasion or through policies such as high tariffs on imports from noncomplying regions.

We also need to end the us-versus-them mind-set. Yes, the developed world has benefited from a few hundred years of development based on unconstrained emissions of greenhouse gases. But have you been to Brazil, China or India lately? All their aircraft, cell phones, automobiles and computers are also the consequence of those years of development. The developed nations, because they can afford to, have an obligation to take the lead in controlling emissions. Yet responsibility is not as clear-cut as many think. Millions of well-to-do people in the developing world leave carbon footprints that are as large as anyone's. They should not get a free ride.

Finally, we need to help people understand the basics. In a study my colleagues and I published in the journal *Risk Analysis* more than 15 years ago and replicated just this year, we found that many Americans do not understand the difference between climate and weather and that a majority still do not identify burning coal, oil and natural gas as the primary cause of climate change. Education will not be easy, because lobby groups continue to spend millions of dollars every year to protect their short-term economic interests by keeping the public confused. "Climategate" has been used to prolong this confusion.

It took decades to overcome the doubt that lobbyists cast on the link between cigarettes and cancer. If we don't act soon to reduce carbon emissions dramatically, a few more decades may commit us to a course that could lead to global catastrophe. We're not certain about that, of course. But the risk is real, and the odds are not in our favor.

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GETTY IMAGES

certainty is not the same thing as ignorance; rather it is a discipline for quantifying what is unknown. Curry has sought to begin a conversation on one of the most important and difficult issues in climate policy: the extent to which science can say something valid despite gaps in knowledge. "If we can't talk the language of probability theory and probability distributions," says Chris E. Forest, a statistician at Pennsylvania State University, "we have to resort to concepts like odds, rolls of the dice, roulette wheels." And because climate is complex, he adds, the terms "likely" and "very likely" in the IPCC reports represent lots of wheels or lots of dice rolling at once, all interacting with one another. When scientists translate statistical jargon into comprehensible language, they necessarily oversimplify it, giving the impression of glossing over nuance. The public gets cartoon versions of climate theories, which are easily refuted.

A crucial lesson for the public is that uncertainty cuts both ways. When science is uncertain, it means that things could turn out to be much rosier than projections would indicate. It also means things could turn out to be much worse. Sea-level-rise projections are a case in point. Glaciologists can easily estimate how quickly the thick blankets of ice covering Greenland and Antarctica should melt as temperatures rise and how much that extra water should raise sea level. Warming, though, could also affect the rate at which glaciers flow from the ice sheets down to the sea to dump icebergs, which raises sea level independently. Predicting the latter effect is tougher. In fact, Curry says, "we don't know how to quantify it, so we don't even include it in our models. But it's out there, and we know it probably has an impact."

Rather than sweeping that uncertainty about ice sheets under the rug, as Curry's overall critique might lead one to assume, the IPCC's 2007 Fourth Assessment Report flags this uncertainty. Specifically, the report projects 0.18 to 0.59 meter of sea-level rise by the end of the century but explicitly excludes possible increases in ice flow. The reason, as the report explains, is that while such increases are likely, there was insufficient information at the time to estimate what they might be. Since the report came out, new research has given a better sense of what might happen with ice dynamics (although the authors caution that considerable uncertainty remains about the projections). It turns out that the original projections may have been too benign [*see box on page 81*].

The same could be true for other aspects of climate. "The plausible worst-case scenario could be worse than anything we're looking at right now," Curry says. The rise in temperature from a doubling of CO_2 "could be one degree. It could be 10 degrees. Let's just put it out there and develop policy options for all the scenarios and do a cost-benefit analysis for all of them, and then you start to get the things that make sense."

DOING DAMAGE

THERE IS NO QUESTION Curry has caused a stir; she is frequently cited by some of the harshest skeptics around, including Marc Morano, the former aide to Senator Inhofe and founder of the Climate Depot skeptic blog. It is not just the skeptics: Andrew C. Revkin, the *New York Times*'s longtime environment reporter has treated her with great respect on his Dot Earth blog more than once. So has Keith Kloor, who runs the militantly even-handed Collide-a-Scape blog.

What scientists worry is that such exposure means Curry has the power to do damage to a consensus on climate change that has been building for the past 20 years. They see little point in trying to win over skeptics, even if they could be won over. Says Gavin A. Schmidt, a climate scientist at the NASA Goddard Institute for Space Studies in New York City and proprietor of the RealClimate blog: "Science is not a political campaign. We're not trying to be everyone's best friend, kiss everyone's baby."

Uncertainty cuts both ways. When science is uncertain, it means things could turn out to be much rosier than projections indicate. It also means things could turn out much worse.

To Curry, the damage comes not from the skeptics' critiques themselves, most of which are questionable, but from the scientific community's responses to them—much as deaths from virulent flu come not from the virus but from the immune system's violent overreaction. Curry remarks that she has been a victim of this herself, spurned by her colleagues for her outreach efforts (although she adds that she has not been damaged professionally and continues to publish). "She's been hugely criticized by the climate science community," McIntyre says, "for not maintaining the fatwa [against talking to outsiders]."

Some disinterested commentators agree. One is S. Alexander Haslam, an expert in organizational psychology at the University of Exeter in England. The climate community, he says, is engaging in classic black sheep syndrome: members of a group may be annoyed by public criticism from outsiders, but they reserve their greatest anger for insiders who side with outsiders. By treating Curry as a pariah, Haslam says, scientists are only enhancing her reputation as some kind of renegade who speaks truth to power. Even if she is substantially wrong, it is not in the interests of climate scientists to treat Curry as merely an annoyance or a distraction. "I think her criticisms are damaging," Haslam says. "But in a way, that's a consequence of failing to acknowledge that all science has these political dynamics."

In a sense, the two competing storylines about Judith Curry—peacemaker or dupe?—are both true. Climate scientists feel embattled by a politically motivated witch hunt, and in that charged environment, what Curry has tried to do naturally feels like treason—especially since the skeptics have latched onto her as proof they have been right all along. But Curry and the skeptics have their own cause for grievance. They feel they have all been lumped together as crackpots, no matter how worthy their arguments. The whole thing has become a political potboiler, and what might be the normal insider debates over the minutiae of data, methodology and conclusions have gotten shrill. It is perhaps unreasonable to expect everyone to stop sniping at one another, but given the high stakes, it is crucial to focus on the science itself and not the noise. SA

MORE TO EXPLORE

The Intergovernmental Panel on Climate Change makes its four assessment reports available in their entirety on its Web site: **www.ipcc.ch**

RealClimate.org bills itself as "a commentary site on climate science by working climate scientists for the interested public and journalists." Gavin A. Schmidt is one of the moderators.

Climate Audit.org is a skeptic's blog run by Steve McIntyre, an amateur climatologist.

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