



Burning question. It is plausible that global warming made recent Australian bushfires more likely, but researchers can't say for sure.

the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colorado.

But climate researchers aren't giving up on turning extreme weather events into moments of teachable science. September's mammoth international assessment from the Intergovernmental Panel on Climate Change (IPCC) (*Science*, 4 October, p. 23) details current understanding—such as it is—of extreme weather's links to climate change, and describes new methods for gauging those links. With more effort, climate scientists could one day answer the “Is this climate change?” question on the spot.

CLIMATE CHANGE

In the Hot Seat

Scientists pressed on global warming's link to weather disasters are scrambling to grasp the teachable moment without going beyond their meager understanding

Many climate scientists winced earlier this year when a well-meaning nonscientist tried to use extreme weather to argue that global warming is real. “We can choose to believe that Superstorm Sandy, and the most severe drought in decades, and the worst wildfires some states have ever seen were all just a freak coincidence. Or we can choose to believe in the overwhelming judgment of science—and act before it's too late.”

That was President Barack Obama in his State of the Union address. The fact is, there is little or no evidence that global warming steered Sandy into New Jersey or made the storm any stronger. And scientists haven't even tried yet to link climate change with particular fires.

Representative Lamar Smith (R-TX), one of the president's political opponents, got it just as wrong in a recent newspaper editorial titled “Extreme weather isn't linked to climate change.” In fact, it is, sometimes. Climate models have securely linked several heat waves to global warming, which can increase the odds of extreme heat many fold.

For climate scientists, extreme weather is risky territory. There

is no question that global warming is real, but the science linking any one hurricane, drought, or flood to climate change is shaky, at best. And yet politicians, the public, and the rare scientist inevitably seize on vivid, easy-to-grasp weather events to make their points about abstract, long-term climate. Add in the loud voices of climate activists like Al Gore and 350.org's Bill McKibben, and the climate change discourse is “as much politics as scientific evidence,” says climate scientist Martin Hoerling of



Ha, ha. Grandchildren of global-warming skeptic Senator James Inhofe and their parents built a mocking igloo after a 2010 snowstorm battered Washington, D.C.

Where's the science?

For better or worse, extreme weather is persuading Americans to take global warming seriously. In March and September 2012, for example, climate and media researcher Anthony Leiserowitz of Yale University with his Yale and George Mason University colleagues surveyed more than 1000 Americans (<http://tinyurl.com/l697t4o>). In September, 74% of those polled agreed that “global warming is affecting weather in the United States.” That was up by 5% from March, after a summer of record drought, high temperatures, and powerful storms. And substantial majorities

said global warming had worsened every one of six recent extreme weather events in the United States—from high temperatures to forest fires to a blustery “derecho.”

The public perception is that “we live on a new planet of extreme weather,” notes communication researcher Matthew Nisbet of American University in Washington, D.C. “That's a very engaging narrative.”

But it is one that makes many mainstream climate scientists uneasy. As summarized in a full-page table in the IPCC report, their confidence linking the observed global warming to extreme weather does not

extend much further. There “very likely” have been fewer cold and more frequent hot days and nights since 1950, the report concludes, and humans “very likely” contributed to the changes. In a physically straightforward next step, the report finds that heat waves have become more frequent, longer, or both. And heavy precipitation events have become more frequent because warmer air can hold and then release more moisture.

But when it comes to the role of human-induced change in phenomena that are more than one step removed from a simple warming, the IPCC typically has “low confidence.” That goes for droughts (down from medium confidence in the 2007 assessment), floods, and tropical storms. Wildfires aren’t even considered, for good cause. It’s plausible that a warming climate plays a role in fires in places like the western United States and Australia, says wildfire researcher Max Moritz of the University of California, Berkeley. But “fire is a couple steps removed from temperature or precipitation, and our records are short. So detecting a trend is tough and attributing an event to climate change is really, really tough. We have to be very careful.”

Wrong messengers

Links between extreme weather and climate change are not only often scientifically suspect, they may also be a risky strategy for persuading the public to take climate change seriously. “What disturbs me is assigning anything that comes along to global warming,” says professor emeritus of meteorology John M. Wallace of the University of Washington, Seattle. “That may work in the short run, but I don’t think that kind of conversion has staying power.” Indeed, surveys coming out on the 1-year anniversary of Hurricane Sandy’s landfall (29 October) show the concerns about hurricanes that spiked in the wake of the disaster have nearly faded away.

And “there’s a little bit of ‘live by the sword, die by the sword’” in making the connection, Leiserowitz says. A steady stream of extreme weather events makes for a steady media drumbeat on climate change, but that stream can falter. The current Atlantic hurricane season looks to be a near no-show with just two short-lived, minimal hurricanes

(Category 1) so far with a month to go in the season and nothing stirring in the tropical Atlantic. And no major hurricane (Category 3 to 5) has struck the U.S. coast since 2005. (Sandy may have been a “super” storm, but it wasn’t a major hurricane.)

When the weather turns cold, it becomes a cudgel for climate skeptics. The “Snowmageddon” that hit Washington, D.C., in February 2010 with 70 centimeters of snow brought out a less-than-playful taunt from conservative U.S. Senator James Inhofe. His grandchildren

Try, try again

As long as reporters and the public insist on blurring climate change and run-of-the-mill weather, however, experts must manage as best they can. At the nonprofit Climate Central in Princeton, New Jersey, scientists and journalists work with the public’s go-to people on weather: local TV meteorologists. “In these moments [of extreme weather], people have questions, we provide the context,” says Climate Central’s chief climatologist, Heidi Cullen. “Sometimes it’s a little bit messy, but we try to be really, really careful. We educate people about the scientific method itself.”

Climate scientists are also working on developing better talking points. “I talk about the risk,” says climate scientist Peter Stott of the U.K. Met Office’s Hadley Centre in Exeter. “Sometimes it has been quite successful. People understand there’s always been extreme weather.” By consulting climate records and modeling extreme events with and without added greenhouse gases, scientists can talk about how much global warming has increased the chances of extreme events—without blaming any one event on warming. For example, a NOAA and U.K. Met Office study published in the July 2012 *Bulletin of the American Meteorological Society* found that heat waves like the one that scorched Texas in 2011 are now 20 times as likely to occur as they were 50 years ago given the same conditions in the tropical Pacific that favor them.

That message came a year after the heat waves—fast for a meteorological study, but too slow to influence public perceptions. But Myles Allen thinks modelers can forge links between global warming and particular extreme weather much faster. Allen, a climate scientist at the University of Oxford in the United Kingdom, says models used to forecast the next season’s climate could be adapted to calculate the probability of a range of extreme events. “It wouldn’t be all that difficult, though it would require substantial funding,” Allen says, “but we should do it.” Then, when the first reporter calls in the midst of the next heat wave, there might be a firmer answer to that nagging perennial question.

—RICHARD A. KERR

Global warming had a role here ...



... But not here



It depends. Global warming boosted the chances for heat and dryness in Texas in 2011 (top), according to published studies, but it had nothing to do with upping the 2011 rains in Thailand (bottom).

and their parents built a much-photographed igloo with a sign reading “Al Gore’s New Home.” Actually, Inhofe’s taunt was baseless; global warming favors heavier precipitation, both wet and white.

Indeed, the whole field of extreme weather is a minefield for scientists. “Extreme events are the last place you want to look to document the human effect” of climate change, notes science policy scholar Roger Pielke Jr., of the University of Colorado, Boulder. Uncertainties and unknowns are so abundant in the field that “I’ve advocated for a long time that extreme events should not be part of the public dialogue,” he says.