NATURE | NEWS

Severe weather linked more strongly to global warming

Climatologists propose different approach to detect human role in extreme events.

Jeff Tollefson

24 June 2015

Michael Heiman/Getty Images

Warmer waters and higher sea level are cited as contributors to Hurricane Sandy's destructive power.

Attempts to attribute extreme weather events to global warming have often failed because they have looked at the wrong thing, leading climatologists claim. By focusing on rising temperatures, tides and atmospheric moisture instead of chaotic and highly variable shifts in atmospheric circulation, they say, scientists may be able to better identify the human fingerprint in destructive events such as Hurricane Sandy, which devastated the US Atlantic coast in 2012.

“A small change can make a big difference,” says Kevin Trenberth, a climatologist at the National Center for Atmospheric Research in Boulder, Colorado, and lead author of a perspective paper published on 22 June in *Nature Climate Change*[1]. “That’s the thing that breaks the record and pushes you beyond previous thresholds, and that’s when the damage goes up enormously.”

Trenberth and his colleagues begin with the observation that global warming is boosting both atmospheric and sea-surface temperatures across the globe, which has increased the amount of water vapour in the atmosphere by roughly 5% since the 1950s. This has fuelled larger storms, and in the case of hurricanes and typhoons, ones that ride atop oceans that are 19 centimetres higher than they were in the early 1900s. That sea-level rise increases the height of waves and tidal surges as storms make landfall.

Yet many studies analysing extreme weather events focus on atmospheric circulation, which is inherently chaotic and highly variable. Such research has often found little evidence of major changes in the kind of storms or their frequency, but that does not mean that global warming is not having an effect, says Noah Diffenbaugh, a climatologist at Stanford University in California.

“This perspective piece is refocusing our attention on the underlying causes and on the underlying ingredients of extreme weather,” Diffenbaugh says. “That’s a really helpful message.”

Storm damage

Trenberth's team applied its methodology to multiple extreme events, including Hurricane Sandy. In that case, modellers at the European Centre for Medium-Range Weather Forecasts, which correctly forecasted the storm track a week in advance, have simulated the same storm but with cooler sea-surface temperatures. Their results suggest that the warmer sea-surface temperatures

caused by climate change increased the size and strength of the storm, boosting precipitation by 35%. Combined with higher sea levels,Trenberth suggests, that additional rainfall might have been enough to cause the flooding of subways and tunnels that occurred during the storm, adding to total damages that reached an estimated US$65 billion.

The team also challenged a 2014 study that found no connection between climate change and an intense storm system that caused flooding in Boulder, Colorado, in September 2013[2]. Although unusual atmospheric patterns were certainly the main driver, Trenberth says, the study failed to take into account anamolously warm sea surface temperatures off the west coast of Mexico, which pumped prodigious quantities of water into the atmosphere.

A co-author of that study, Martin Hoerling, counters that the type of framework proposed by Trenberth oversimplifies things. “Extreme events are not borne of high water vapour and warm oceans alone,” says Hoerling, a meteorologist with the US National Oceanic and Atmospheric Administration in Boulder, Colorado. Moreover, he says, the societally valuable challenge is to understand and forecast extreme events rather than simply attribute global warming's contribution after they happen.

Diffenbaugh co-authored a paper investigating extreme temperature trends in *Nature* on 24 June[3]. It found that the accumulation of heat in the atmosphere can account for much of the increase in extreme high temperatures, as well as an average decrease in cold extremes, across parts of North America, Europe and Asia. But his team's results suggest that atmospheric circulation has also played a part. The team did not attempt to determine whether these weather changes are caused by to global warming or any other factor.

The *Nature* analysis confirms some basic theories about how climate change is affecting temperature extremes, “but will do little to settle or alleviate the differences,” says Judah Cohen, an atmospheric scientist at Atmospheric and Environmental Research, a private research firm in Lexington, Massachusetts. In particular, Cohen says the *Nature* paper does not resolve persistent questions about whether rapid warming that is occurring in the Arctic could affect weather patterns farther afield, perhaps contributing to the kind of winter storms that have pummelled the northeastern United States in recent years.

Trenberth fears that climate scientists have bogged down in endless, and perhaps futile, arguments about complex weather phenomena. “The climate community has been arguing at cross purposes,” he says. “Our paper provides a framework for giving some answers.”

Nature | doi:10.1038/nature.2015.17828

References

1. Trenberth, K. E., Fasullo, J. T. & Shepherd, T. G. *Nature Clim. Change* http://dx.doi.org/10.1038/nclimate2657 (2015).
2. Herring, S. C., Hoerling, M. P., Peterson, T. C. & Stott, P. A. *Bull. Amer. Meteor. Soc.* **95**, S1–S104 (2014).
3. Horton, D. E. *et al*. *Nature* http://dx.doi.org/10.1038/nature14550 (2015).