Here's how climate change is fueling Hurricane Florence

A novel forecast looks at the size and fury of the storm with and without human-caused warming

BY **CAROLYN GRAMLING** 6:56PM, SEPTEMBER 13, 2018

FLORENCE'S FURY Hurricane Florence, as seen from the International Space Station on September 12, was so big two days before it was expected to roar ashore along the North Carolina coast that astronauts 400 kilometers above the storm had to use a super wide-angle lens to capture all of it.

NASA

Even as Hurricane Florence bears down on the Carolinas, bringing fierce winds and heavy rains, one team of scientists has undertaken a different kind of forecast: Understanding the influence of human-caused climate change on a storm that hasn't made landfall yet.

Real-time storm forecasts continuously update as new data become available. But what would happen if, from a single starting point — in this case, the state of the atmosphere on September 11 — Florence roared ahead in two parallel worlds: one with and one without the influence of human-caused climate change?

Florence would be bigger in today's world than if it occurred in a world with no human-caused warming, climate modeler Kevin Reed of Stony Brook University in New York and colleagues conclude in a study posted on the university's website September 12. And thanks to warmer sea surface temperatures and more available moisture in the air, it would dump 50 percent more rain on some parts of the Carolinas.

The goal of such climate change attribution studies is to determine whether — and by how much — human-driven climate change might have caused a particular extreme event, such as a hurricane, a heat wave or a flood. It's an increasingly high-profile area of research, particularly after three studies last year found that a trio of extreme events in 2016 simply could not have happened without climate change (*SN: 1/20/18, p. 6*).

Until now, such studies have been conducted only when the event is long over. Reed and his colleagues got a jump on that question, conducting the first attribution study for an extreme event that is still in progress. It's not yet clear what role such real-time attribution studies might play in society; they could aid emergency planning, policy making and even climate-related litigation.

In the meantime, what this study reveals is that "dangerous climate change is here now," says study coauthor Michael Wehner, a climate scientist at Lawrence Berkeley National Laboratory in California. "The chances and magnitude of dangerous extreme weather have already been significantly increased."

Reed talked with *Science News* about what a forecast attribution study is, how the new study suggests climate change may have altered Florence's rainfall and size, and the future of real-time attribution. His responses are edited for space and clarity.

***SN*: We've heard many times that scientists can't say whether or not a particular storm was caused by climate change. How is this different?**

Reed: We're not making a statement about whether this storm is more likely due to climate change; that's not something we can do. We're doing forecasts of an existing storm, looking at the impacts of climate change on this storm that's already

occurring.

***SN*: OK, so how does that work?**

Reed: It's actually relatively simple. What we did was basically take a model that's traditionally used for climate forecasting and changed it to operate like a weather model. We started with the state of the atmosphere as it was on September 11. We run a set of weather forecasts, or ensembles, [that forecast out to] seven days. Then we go back to those initial conditions and remove the signature of climate change.

***SN*: You describe doing that as "a counterfactual forecast of Hurricane Florence if it were to occur in a world without human-induced global warming." How do you create that world?**

Reed: We use climate simulations created by an international project called C20C+ that model the climate with and without human-created greenhouse gases over the last 100-plus years. That creates a climate change signal that we can remove from our initial conditions of the forecast.

***SN*: So you ran these two scenarios to see how climate change has changed Florence's fate. What did you find?**

Reed: We see increased rainfall. In the areas of heaviest precipitation, for example, the ensembles with the climate change signal show that rainfall is heavier by more than 50 percent, compared with the simulations without climate change.

HARVEY'S WAKE Slow-moving Hurricane Harvey, which made landfall near Houston in August 2017 (outskirts of the city shown), dumped record amounts of rain across southeastern Texas. Researchers say Harvey's extreme rainfall is likely linked to climate change.

U.S. ARMY NATIONAL GUARD PHOTO COURTESY OF SC-HART

We also looked at the size of the storm. The forecasted diameter of Florence is about 80 kilometers wider than without climate change. That means that higher winds are being felt by a larger area. The size of the storm is important for things like storm surge: A larger storm can produce larger storm surge, as more winds push more water toward the shore.

***SN*: The forecasts for Florence have changed a lot since you set your initial conditions on September 11. The projected track has moved southward, and we now think the storm will stall over the Carolinas. What does that mean for your results?**

Reed: Yeah, [the stalling] wasn't a thing a few days ago. So the forecasts are less accurate than they would have been with more recent data. But to see the signal of climate change in what happened to the storm, we basically just wanted to compare apples to apples. That's the essence of what we're doing here: running this attribution study along with the forecasts.

***SN*: Are you updating it as you go?**

Reed: We are going in and doing additional runs every day with new conditions. We won't really be able to do an in-depth analysis until the storm is done. It's very experimental right now, but we're getting ideas for how it can be applied in the future.

***SN*: Doing a climate attribution study for an event while it's still happening and before the data are all in seems potentially pretty controversial — have you gotten pushback from other scientists?**

Reed: [Laughs] Yes, other scientists have reached out to ask about how we set up things, and everybody has their opinions of how we do these types of things. We think we've done it right, but we put it out there and everybody has their chance to say. It's the scientific process.

Editor's note: This story was updated September 14, 2018, to clarify the study's conclusions.

Citations

K.A. Reed *et al.* The human influence on Hurricane Florence. Posted online September 12, 2018, Stony Brook University website.

Further Reading

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C. Gramling. These weather events turned extreme thanks to human-driven climate change. *Science News*. Vol. 193, January 20, 2018, p. 6.

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