



By Jeff Berardelli
August 29, 2020

Climate change may make extreme hurricane rainfall 5 times more likely, study says

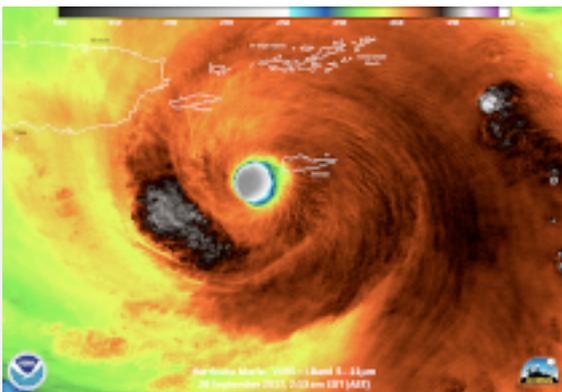
Before *Hurricane Laura* battered Louisiana¹, it drenched the Dominican Republic, Haiti and Cuba with deadly rainfall, killing at least 23 people outside the U.S.

Because of their mountainous terrain and vulnerability to flash flooding and landslides, the Caribbean islands are particularly susceptible to a warming climate, which causes tropical systems to get considerably wetter.

According to a new study², "considerably" may mean a 5 times greater likelihood of extreme hurricane rainfall in a warmer world.

"The findings are alarming and illustrate the urgent need to tackle global warming to reduce the likelihood of extreme rainfall events and their catastrophic consequences, particularly for poorer countries which take many years to recover," said lead author of the study, Emily Vosper, a researcher at the University of Bristol.

A 2019 study³ showed *Hurricane Maria*⁴ produced the single largest maximum rainfall event since 1956 in Puerto Rico. Using a statistical analysis, that study found the probability of extreme rainfall of Maria's maximum magnitude has increased by a factor of almost five due to human-caused climate change.



Hurricane Maria approaches Puerto Rico in 2017 NOAA/CIMSS

This new study took a different approach than the 2019 study by using computer model simulations, instead of a purely statistical analysis, to answer the question of what would happen to Caribbean hurricanes in a warmer world.

Researchers generated thousands of hurricane simulations from four global climate models in three different climates. The three climate scenarios were: present-day conditions, 1.5 degrees Celsius of warming above pre-industrial temperature levels, and 2 degrees Celsius of warming above

¹ <https://www.cbsnews.com/news/hurricane-laura-louisiana-coastline-power-outages/>

² <https://iopscience.iop.org/article/10.1088/1748-9326/ab9794>

³ <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019GL082077>

⁴ <https://www.cbsnews.com/news/hurricane-maria-death-toll-puerto-rico-2975-killed-by-storm-study-finds/>

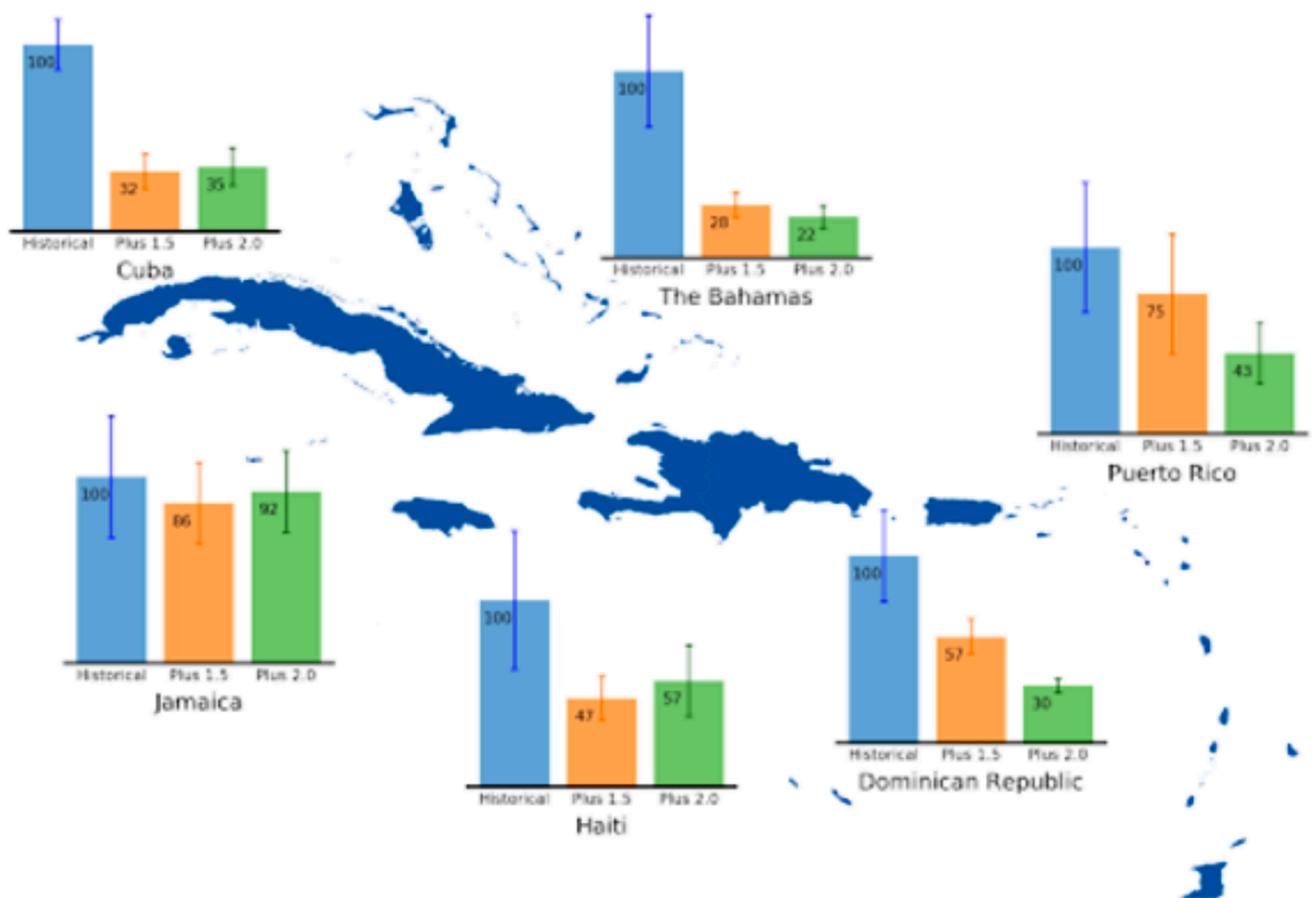
pre-industrial temperature levels. The 1.5°C and 2°C scenarios were chosen because they are the warming goals that the *Paris Climate Agreement*⁵ endeavors to stay below.

The results of the study show that in a 2°C warmer world, an event of similar size and location to Maria would be more than twice as likely, occurring once every 43 years rather than once every 100 years.

For the Bahamas, the findings are even more dramatic, with a once-in-100-year storm becoming 4 to 5 times more likely in a 2°C scenario.

In the Dominican Republic, a 100-year extreme hurricane rainfall in the present climate is projected to occur greater than three times more often – once every 30 years – in a 2°C warmer world. But under the more ambitious goal of limiting warming to 1.5°C, extreme hurricane rainfall events in the Dominican Republic would occur roughly once every 57 years – half as often as compared to the 2°C warming scenario.

Projected Return Period of 100-year Caribbean Hurricanes



Comparison of the return period of extreme hurricane rainfall in the Caribbean and Bahamas using historical contrasting historical conditions with future warming scenarios.

VOSPER ET AL

Comparison of the return period of extreme hurricane rainfall in the Caribbean and Bahamas using historical contrasting historical conditions with future warming scenarios. - Vosper Et al

⁵ <https://www.cbsnews.com/news/paris-climate-agreement-what-you-need-to-know/>

Vosper, the researcher, sees this as proof that taking efforts to limit climate change can make a real difference:

"By focusing efforts to stabilise global warming to the more ambitious 1.5°C goal, we could dramatically reduce the likelihood of extreme hurricane rainfall events in the area."

It should be noted that most scientists feel the ambitious goal of 1.5°C is **not** attainable and that we are more likely headed for close to **3°C** of warming, especially if we do not take bold measures.

Vosper said there are various potential reasons why a warmer climate has a higher propensity for extreme hurricane rainfall. Her simulations reveal that there were more hurricanes in the 1.5° and 2° degree warming scenarios compared to current conditions. She believes this one of the factors contributing to the increase in extreme rainfall risk.

While there is still some debate in the climate community about whether hurricane numbers will in fact increase, there are various aspects of hurricanes in a warmer climate that are commonly accepted. The most straightforward is the *Clausius Clapeyron equation*, which dictates that for every 1°C temperature increase, the air can hold 7% more water. Vosper said that part of the increase in extreme rain events in her study can also be attributed to that.

Dr. Kevin Trenberth, who was not involved in the study, agrees. As a distinguished senior scientist at the *National Center for Atmospheric Research*, he specializes in the energy flows, ocean heat and tropical cyclones. He said Clausius Clapeyron plays a role, but it's so much more. With higher sea surface temperatures and more upper ocean heat content there is more potential energy to fuel storms, which grow through moisture evaporated from the oceans.

Trenberth described the Earth as an interconnected system trying to equalize the imbalance caused by excess human heating.

"We expect more activity as the system, the atmosphere and ocean, try to get rid of the extra heat," said Trenberth. "Hurricanes play a major role in this: a role of such storms is to pump heat out of the oceans, into the atmosphere, and disperse it to where it can radiate to space."

Trenberth said increased activity is manifested in several ways: more storms, bigger storms, more intense storms, longer lasting storms, and heavier rainfalls.

"We expect more intense, bigger and longer lasting storms," said Trenberth, but on the subject of "more frequent storms" he believes it is possible there may actually be fewer in the future. "That's because one big storm can play the role of 4 or more smaller storms in moving heat and striving for energy balance", said Trenberth.

But the following key point is perhaps the most important of all in explaining why a warmer climate means more extreme hurricane rainfalls. As Trenberth discusses, in hurricanes the air spirals into a storm from about 4 times the radius of the visible storm. So the moisture flowing into the storm, that feeds it, is converging from a much larger area.

As a result

"the Clausius Clapeyron effect is magnified and the net rainfall increase is more like 20 to 30% rather than the 7% per degree Celsius of warming," said Trenberth.

A 20% to 30% increase in hurricane rainfall per degree Celsius of warming in itself is substantial. However, most scientists agree our climate will likely warm by at least 2 to 3 degrees Celsius, yielding an even more magnified effect on extreme rainfall. This is concerning for U.S. cities which reside in *Hurricane Alley* and the especially vulnerable Caribbean islands.

It takes at least six years⁶ for even the richest of the Caribbean countries to rebuild after a major hurricane hits, stalling economic growth. Vosper said her team's research shows residents should be concerned about the impacts of hurricanes in the future and that governments should be stepping up planning.

And that's exactly what island communities all over the world are working on. As the environment program officer for the *New York Community Trust* and with his Puerto Rican and Cuban roots, Arturo Garcia-Costas⁷ is concerned about their future.

That's why, with the help of the *New York Community Trust*, Garcia-Costas is working with a program called *Climate Strong Islands*. After the devastation of hurricanes Maria and Irma in 2017, last February in Puerto Rico more than 65 organizations from Guam to Maine signed onto the *Climate Strong Islands Declaration*⁸ calling for action. The overarching goal is collaboration to make island communities more resilient, sustainable, and self sufficient.

"We are on the path to a much hotter, wetter world, and the 20th century systems and the infrastructure we have in place are just not ready for it," said Garcia-Costas. "Storms are regularly overwhelming aging sewer systems and electrical grids. We need new thinking for new challenges."

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⁶ <https://www.bristol.ac.uk/news/2020/august/hurricanes.html#:~:text=It takes at least six,to financial and time constraints.>

⁷ <https://www.nycommunitytrust.org/newsroom/staff/arturo-garcia-costas/>

⁸ <https://oceanfdn.org/the-climate-strong-islands-declaration/>