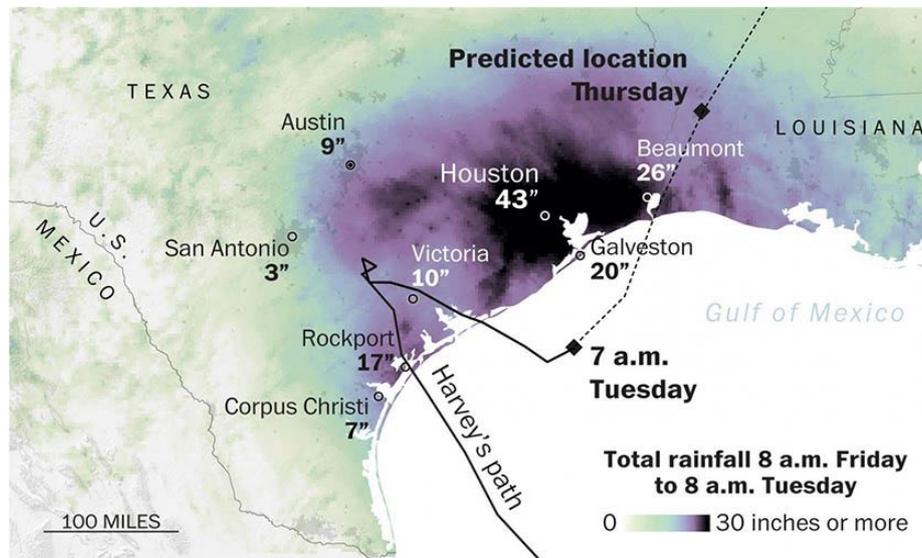


# Harvey marks the most extreme rain event in U.S. history

By Jason Samenow August 29 at 4:07 PM

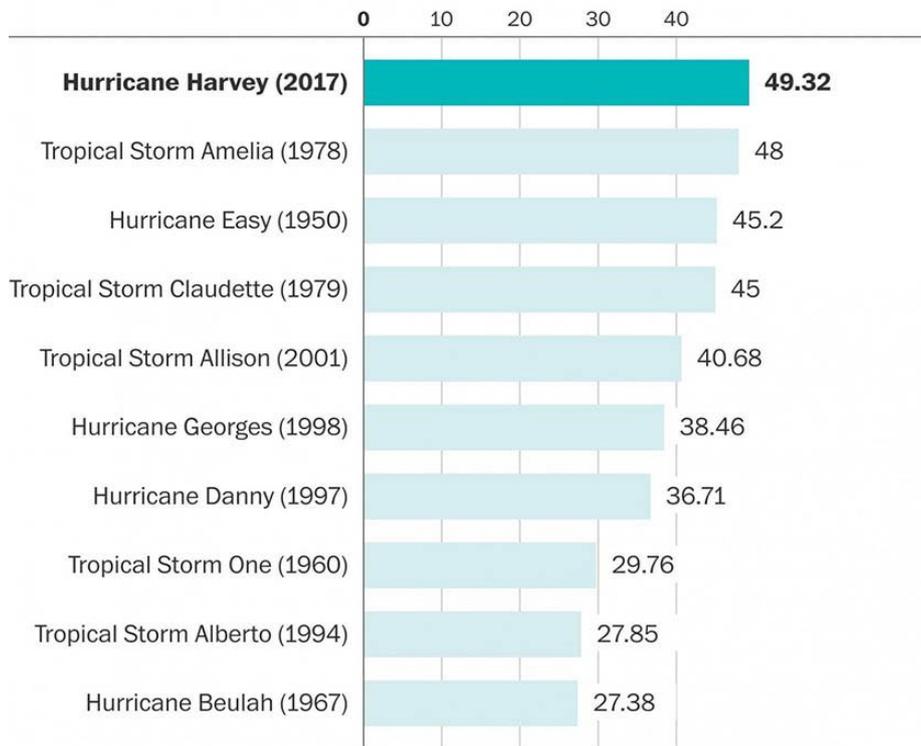


The rain from Harvey is in a class of its own. The storm has unloaded over 50 inches of rain east of Houston, the greatest amount ever recorded in the Lower 48 states from a single storm. And it's still raining.

John Nielsen-Gammon, Texas state climatologist, said a rain gauge in Mont Belvieu, about 40 miles east of Houston, had registered 51.9 inches of rain through late Tuesday afternoon. This total exceeds the previous record of 48 inches set during tropical cyclone Amelia in Medina, Texas in 1978.

## Wettest storms in U.S. history

With around 50 inches of total rainfall through Tuesday, Hurricane Harvey is now the rainiest tropical storm in the Lower 48.



Hawaii mountain peaks have reported larger rainfall totals.

Source: National Weather Service

CAPITAL WEATHER GANG

All rainfall totals from this storm are still preliminary and require review. But, if verified, this amount breaks not only the Texas state rainfall record but also the record for the remaining Lower 48 states.

*[What the flooding and rescues of Hurricane Harvey look like, in videos]*

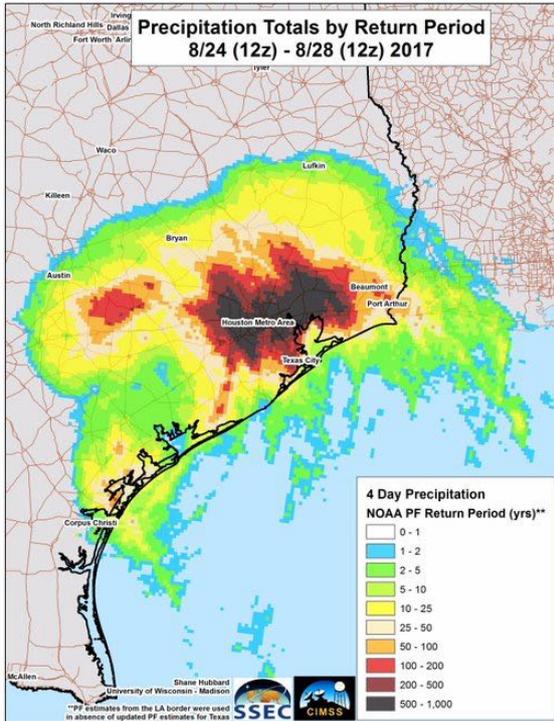
Hawaii has logged isolated reports of greater amounts at high elevations from tropical systems, but the footprint from Harvey in Southeast Texas is much larger. It has produced at least three feet of rain over most of the Houston region, affecting more than 5 million people.

“The 3-to-4 day rainfall totals of greater than 40 inches (possible 50 inches in locations surrounding Santa Fe and Dickinson) are simply mind-blowing that has led to the largest flood in Houston-Galveston history,” the National Weather Service office serving Houston wrote.

From the perspective of the amount of volume unloaded in the United States from a single storm, Harvey has no rival.

Nielsen-Gammon found Harvey's total rainfall concentrated over a 20,000-square-mile area represents nearly 19 times the daily discharge of the Mississippi River, by far the most of any tropical system ever recorded.

The Space Science and Engineering Center at the University of Wisconsin at Madison determined that many areas of Southeast Texas have received rain that is expected to come around only once every 1,000 years (or having a 0.1 percent probability of occurrence), assuming a stationary climate.



**UW-Madison SSEC**

@UWSSEC

4 day rain total with nearly entire metro area exceeding the 1% annual chance rainfall event (100 yr) and some areas near the 0.1% (1000 yr)

6:31 AM - Aug 29, 2017

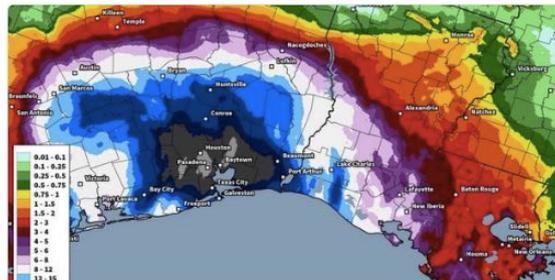
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This is truly an epic storm.



**Harvey marks the most extreme rain event in U.S. history**

A Texas location has received over 49 inches, the most ever from a tropical system in the Lower 48,

[washingtonpost.com](http://washingtonpost.com)

## Hurricane Harvey: The link to climate change



**Matt McGrath**  
Environment correspondent



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image caption

The intensity of rain in the Houston area is being linked to rising global temperatures

**When it comes to the causes of Hurricane Harvey, climate change is not a smoking gun.**

However, there are a few spent cartridge cases marked global warming in the immediate vicinity.

Hurricanes are complex, naturally occurring beasts - extremely difficult to predict, with or without the backdrop of rising global temperatures.

The scientific reality of attributing a role to climate change in worsening the impact of hurricanes is also hard to tease out simply because these are fairly rare events and there is not a huge amount of historical data.

But there are some things that we can say with a good deal of certainty.

There's a well-established physical law, the Clausius-Clapeyron equation, that says that a hotter atmosphere holds more moisture.

For every extra degree Celsius in warming, the atmosphere can hold 7% more water. This tends to make rainfall events even more extreme when they occur.

Another element that we can mention with some confidence is the temperature of the seas.

"The waters of the Gulf of Mexico are about 1.5 degrees warmer above what they were from 1980-2010," Sir Brian Hoskins from the Grantham Institute for Climate Change told BBC Radio 4's Today programme.

"That is very significant because it means the potential for a stronger storm is there, and the contribution of global warming to the warmer waters in the Gulf, it's almost inevitable that there was a contribution to that."

Researchers are also quite confident in linking the intensity of the rainfall that is still falling in the Houston area to climate change.

"This is the type of event, in terms of the extreme rainfall, that we would expect to see more of in a warming climate," Dr Friederike Otto from the University of Oxford told BBC News.

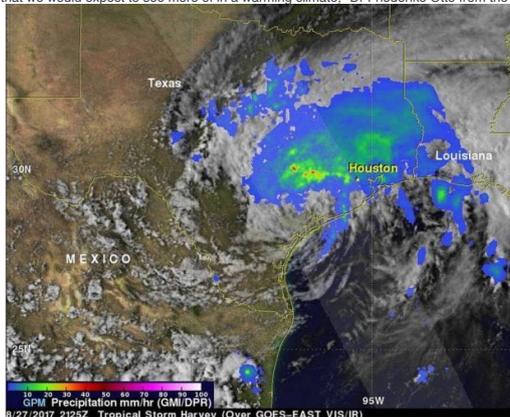


image caption

The view from Nasa of Hurricane Harvey over the Houston area

**Analysis - Roger Harrabin, Environment analyst**

Environmental lawyers are questioning whether events like Harvey should still be referred to as "Acts of God" or "Natural Disasters" as they are made worse by emissions from fossil fuels.

In a comment paper in the journal Nature Geoscience, they say legal action may be taken against countries that don't contribute to the global effort to cut emissions.

Lawsuits seeking to apportion responsibility for climatic events have generally failed in the past.

But lawyers from the firms Client Earth in London and Earth and Water Law in Washington say that's likely to change.

They believe a new branch of knowledge called attribution science will allow the courts to decide with reasonable confidence that individual events have been exacerbated by manmade climate change.

They believe in future governments and firms risk being successfully sued if they don't cut their emissions.

"For the intensity of the rainfall (over Houston), it is very reasonable to assume there is a signal from climate change in that intensity."

One big question, though, is the persistence of the storm over the Texas area. This has been key to the scale of the downpour and the amount of flooding that has been seen so far.

Some researchers believe that climate is playing a role here too.

Prof Stefan Rahmstorf from the Potsdam Institute for Climate Impact Research says that a general slowdown in atmospheric circulation in mid-latitudes is a possible follow-on from a changing climate elsewhere in the world.

"This is a consequence of the disproportionately strong warming in the Arctic; it can make weather systems move less and stay longer in a given location - which can significantly enhance the impacts of rainfall extremes, just like we're sadly witnessing in Houston."

However, slow-moving storms over Texas have appeared before. Tropical storms Claudette in 1979 and Allison in 2001 had huge rainfall impacts as they settled in place over the state for long periods.

Other scientists think that attributing the slowly meandering nature of this storm to climate change is a step too far.

"I don't think we should speculate on these more difficult and complex links like melting in the Arctic without looking into these effects in a dedicated study," said Dr Otto.



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image caption

The number of people seeking help has stretched the emergency services to the limit

Experts say that in looking at a storm like Harvey, the impact of climate change is not simply about higher temperatures in the atmosphere and in the seas - it is also linked to changes in atmospheric circulation patterns.

Sometimes, the temperature and circulation changes brought about by warming can cancel each other out. Other times they can make the impacts worse. Understanding the full picture will be difficult and expensive.

"For hurricanes, we would ask the question as to what are the possible hurricane developments in the world we live in and compare that to the possible hurricane developments in a world without climate change," said Dr Otto.

"These high-resolution models are very expensive to run over and over again so that you can simulate possible weather rather than tracks of hurricanes."

Other researchers say that we are looking at the issue entirely the wrong way.

Regardless of the human impact on climate change, indirectly making Harvey worse - they believe the real human contribution to the catastrophe is far more simple and straightforward.

"The hurricane is just a storm, it is not the disaster," said Dr Ilan Kelman, at the Institute for Risk and Disaster Reduction and Institute for Global Health at University College London.

"The disaster is the fact that Houston population has increased by 40% since 1990. The disaster is the fact that many people were too poor to afford insurance or evacuate.

"Climate change did not make people build along a vulnerable coastline so the disaster itself is our choice and is not linked to climate change."