

Climate change tripled the odds of the record-shattering rainfall from Hurricane Harvey

On August 25, 2017, Hurricane Harvey made landfall near Corpus Christi, Texas as a Category 4 storm. Stalling over south-east Texas, Harvey unloaded a relentless torrent of rainfall that led to catastrophic flooding in Houston and the surrounding area. Unprecedented rainfall totals were observed including 51.89 inches at Cedar Bayou, and more than 30 inches of rain falling across the larger region. Emergency responders and civilian volunteers undertook over 120,000 rescues, and over 100,000 homes were flooded.

New science to study the role of climate change in extreme weather events

According to an [independent report](#) by the National Academies of Sciences, Engineering, and Medicine, it is now possible for scientists to determine the role of climate change in extreme weather events. An [international coalition of scientists](#), the World Weather Attribution partnership, undertook such an extreme event attribution to study the role of climate change in driving the rainfall during Hurricane Harvey. This study confirms that heavy rainfall events are increasing across the Gulf Coast region because of human interference with the climate system and this has serious implications for how we plan for them now and in the future.

Climate change raised the odds of an extremely rare event

Scientists found that the chances of a storm like Hurricane Harvey have tripled since the early 1900s due to climate change. In today's climate the likelihood of such extreme rainfall in Houston is at least 1-9,000 years – still extremely rare. Taking a disaster management lens, the chance of seeing this much rain *anywhere* over the entire Gulf Coast region is less than once every 100 years. Although an event like Hurricane Harvey is still



September 6, 2017. Port Aransas, Texas. Red Cross volunteers, from left, Nurse Minnie, mental-health worker Julie, and Nurse Carol, go street-to-street in Port Aransas, which was hit hard by Hurricane Harvey. Photo: Chuck Haupt/American Red Cross

rare in today's climate it would have been significantly less likely to occur in the 1900s before the climate started to warm.

Emergency response systems need to adapt

Even though Hurricane Harvey was a very rare event, less extreme events have also left residents of Houston flooded in the past including Tropical Storm Allison (2001), Hurricane Ike (2008), the Memorial Day floods (2015), and Tax Day floods (2016). The likelihood of these flood events is also increasing and



September 3, 2017. Victoria, Texas. Red Cross volunteer Charlie Magee of Laramie, Wyoming, hands out hot meals out of an Emergency Response Vehicle. Charlie was helped by the Red Cross when his home was affected by a tornado which motivated him to join the organization a year ago. He said, "The Red Cross symbol means help and that is why I'm here." Photo: Chuck Haupt/American Red Cross

disaster managers are responding to emergency flooding situations more frequently now, than in the past. As climate change continues, these extreme events will be more common in the future and will become the new normal. Emergency response systems also need to adapt to be prepared for more unprecedented storms in the future.

Incorporate changing risks in Houston's recovery, and planning in the Gulf Coast region

The impacts of Harvey were not a result of the rainfall alone, but also determined by the exposure and vulnerability of people and systems.¹ Changes to vulnerability and exposure have a significant effect on how

impactful extreme rainfall events are and Hurricane Harvey recovery efforts provide an important opportunity to positively influence these factors.

Although no water-management system can be expected to withstand an event as rare as Hurricane Harvey, other extreme events are also becoming more common and provide a strong impetus for risk-informed policies and plans which incorporate changing trends in climate risk, vulnerability and exposure. This includes, for example, improvements to water-management infrastructure, and updating the standard for the tolerable level of flood risk in Houston based on the "new normal".

In the Gulf Coast region, managing changing risks includes updating disaster management scenarios, promoting sustainable urban growth policies and advocating for climate-smart planning efforts to keep pace with future increases in extreme rainfall risks. It may also mean revisiting current flood zones and ensuring that those that are likely to be affected by flooding in the future are aware and have the appropriate flood insurance.

In the future, more intense extreme rainfall events are likely to stretch emergency-management resources. Deliberate efforts today aimed at reducing disaster risk can help avoid future disasters and build long-term resilience.

International commitment – the Paris Agreement

The past is no longer a good indicator for current or future flood risks. In today's climate, global temperatures are about 1.8°F (1°C) higher than pre-industrial temperatures due to global warming. Looking to the future, the Paris Agreement sets a global target to limit warming to 3.6°F (2°C). If this target is met, storms like Hurricane Harvey will *further* increase by about a factor of three. If this target is not met, the increase in frequency and intensity could be much higher. This means disaster managers need to start expecting and preparing for these types of events to happen more frequently in the Gulf Coast region.

¹ Exposure is the presence of people, their livelihoods, infrastructure, and economic and social assets in places that could be affected by extreme events, such as rainfall, while vulnerability indicates the propensity or predisposition for those people or assets to be affected.