



RESEARCH BRIEF

Photo courtesy of the U.S. Coast Guard

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Extreme Precipitation Changes Contribute to Increases in U.S. Flood Damages

Extreme precipitation has increased across the United States because of climate change, leading to higher flooding costs.

Background

Climate change has caused more intense extreme precipitation events, with further increases in extreme precipitation anticipated due to continued global warming. These heavy precipitation events can lead to flooding, which is one of the nation's costliest natural hazards, causing billions of dollars in damage each year. The total cost of flood-related damages has been growing over time, with average global disaster losses increasing from around \$50 billion a year in the 1980s to \$200 billion a year in the 2010s.

Understanding how changes in precipitation impact the cost of flooding is a necessary component of evaluating the costs of climate change. To date, the financial impact of changes in extreme precipitation has been poorly understood. This question has been challenging to answer because many socioeconomic factors also impact the cost of flooding. For example, development in flood-prone areas and increases in property values could each increase the cost of flooding. Previous studies have argued that changes in

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- ▶ **Increases in precipitation over the past century have led to higher flooding costs in the U.S.** Extreme precipitation events, which cause the largest damages, have been increasing most rapidly, even in some regions where average precipitation has not changed.
- ▶ **Historical precipitation changes have contributed approximately one-third (36%) of the cost of flood damages over the period 1988-2017.** Estimates of the cumulative impact of precipitation change total \$73 billion of the \$200 billion analyzed in this study.
- ▶ **Future global warming is very likely to cause further increases in extreme precipitation and flooding, but a low-emissions scenario consistent with the UN Paris Agreement would likely reduce damages from flooding relative to the current global warming trajectory.**
- ▶ **Analyzing historical rain and flood damage data regionally allows for better quantification of climate change costs.** Accurate quantification of these costs is critical for decisions about the value of greenhouse gas mitigation, as well as climate adaptation and resilience.
- ▶ **The researcher's empirical framework to quantify climate-change-driven losses can be applied to other sectors.** These sectors include labor productivity, agricultural losses and wildfires.



socioeconomic factors could explain most of the recent increases in flooding losses. As a result, there has been high uncertainty in national and international assessments of whether or not climate change has increased recent flood costs. However, many of these studies focused only the national scale, despite the fact that floods occur on local or regional scales.

To understand the impact of precipitation changes on flood damages, Stanford researchers examined historical flood damages and precipitation at a higher resolution. By analyzing 30 years of monthly flood damages in each of the lower 48 states, the researchers were able to separate the effects of precipitation change from other simultaneous changes that affected the costs of flooding. Through this observational framework, researchers were able to quantify the contribution of historical precipitation changes to recent increases in flood damages. They also analyzed the extent to which human-caused climate change contributed to precipitation changes in the past as well as into the future, including changes in different levels of precipitation intensity.



Photo courtesy of Petty Officer Jaclyn Young



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This brief is based on “**Contribution of historical precipitation change to US flood damages**” by Davenport et al., published in the *Proceedings of the National Academy of Sciences* 118(4), e2017524118.

FOR MORE INFORMATION

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