

The Impacts of High-Tide Flooding

Overview

As the climate changes and sea levels rise, coastal communities are threatened not only by extreme weather events, but by increasingly frequent high-tide flooding. These floods typically last just a few hours and usually result in no major property damage, so it is hard to measure their impacts. Because estimating impacts is critical to informing effective responses, a Stanford-led study investigates the patterns and effects of high-tide flooding in downtown Annapolis, Maryland. The researchers' novel approach involves analyzing a range of evidence, such as social media, photographs, videos, and parking transactions.



Photo: Amy McGovern

Key Points for Policymakers

- ▶ Recurrent high-tide flooding led to 3,000 fewer visits to downtown Annapolis in 2017, corresponding to approximately \$86,000 - \$172,000 in lost revenue.
- ▶ Without adaptive measures, one foot of additional sea level rise is projected to cause a 24% decrease in visitors to downtown Annapolis. Possible adaptations include changes in business or customer behavior, such as incentivizing customers to come at flood-free times. Adaptation may also include changes in infrastructure, such as new drainage pumps to reduce flooding or new walkways that improve customer access during floods.
- ▶ Interviews with local businesses and government yielded diverse perspectives on flood frequency and effects, as well as preferred responses. Responses to high-tide flooding will influence community resilience to extreme events and adaptation to a changing climate.
- ▶ High-tide flooding can lead to different types of impacts, including increased travel time, missed work hours, and damage to infrastructure. Exploring the full range of impacts is key to a more comprehensive understanding of the local impacts of sea level rise and better investments in adaptation responses.

Background

Recurrent coastal flooding has greatly increased in frequency across the United States and is projected to accelerate as sea levels rise. According to a [recent report from the National Oceanographic and Atmospheric Administration](#), coastal communities such as Miami, Florida, and Norfolk, Virginia, are experiencing record numbers of high-tide or ‘sunny-day’ floods. Across 27 locations in the United States, the [number of coastal flood days has risen from an average of 2.1 days per year during 1956-1960 to 11.8 during 2006-2010](#). This flooding disrupts daily life and economic activity and poses risks to built infrastructure. In [Norfolk](#), for example, a key naval base is threatened, now often inaccessible due to flooded roads. Miami Beach [has installed pumps and initiated plans to raise streets](#) to combat the inundation. Impacts are particularly acute in cities such as Annapolis, where [sea levels are rising much faster than the global average](#). Annapolis had 63 flood days in 2017.

Measuring the full economic and social impacts of these floods provides a clearer sense of the needs and potential for responses. Relevant choices include the amount of financial investment to address flooding, as well as the specific infrastructure, policy, or behavior adjustment measures to deploy. Adaptation strategies go far beyond traditional engineering investments. Possible solutions include improved [building codes, early warning systems, and relocation](#).

Understanding the consequences of high-tide flooding also informs analysis of the societal costs of climate change. Further evaluations could include looking at how people perceive and respond to high-tide flooding and how it shapes their daily lives and employment. Analysis of the risks and the potential of different responses is essential to keeping communities vibrant and people safe as seas rise.

About the Authors

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This brief is based on the study “*High-tide flooding disrupts local economic activity*” by Miyuki Hino, Samanthe Tiver Belanger, Christopher B. Field, Alexander R. Davies, and Katharine J. Mach published in the journal *Science Advances*.

