



# ANNUAL HIGH TIDE FLOODING OUTLOOK

**Center for Operational Oceanographic Products and Services  
National Oceanic and Atmospheric Administration**

# 2023



NOAA's Annual High Tide Flooding Outlook (formerly the State of High Tide Flooding and Annual Outlook) is released annually in an interactive, web-based format. In 2023, NOAA began adapting the previous year's Annual High Tide Flooding Outlook into the following portable document format (PDF) to provide interested users with a free, downloadable historical archive. Data from previous years are also available to download for free from our Derived Product API (DPAPI) on [tidesandcurrents.noaa.gov](https://tidesandcurrents.noaa.gov).



# 2023 Annual High Tide Flooding Outlook

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## Overview

Above-normal tides can trigger high tide flooding, disrupting coastal communities. This flooding can occur on sunny days and in the absence of storms. More severe flooding may occur if high tides coincide with heavy rains, strong winds, or large waves. As sea levels continue to rise, our coastal communities will experience more frequent high tide flooding - a National average of 45 to 85 days per year by 2050. Predicting the frequency of high tide flooding in the future helps coastal communities plan for and mitigate flooding impacts.

The Annual High Tide Flooding Outlook provides the number of high tide flooding days predicted for the coming meteorological year (May to April). Data is supplemented with decadal projections for the year 2050, sea level rise scenarios, and high tide flood exposure maps to support long-term coastal planning. Summaries are provided for each region to account for geographical differences at the coast, and are accompanied by regional graphics to demonstrate potential high tide flooding impacts.

# National Outlook



## Regions:

- Northeast
- Southeast
- East Gulf
- West Gulf
- Southwest
- Northwest
- Caribbean
- Pacific Islands



**4 to 9  
days likely**

*High tide flooding is anticipated to continue with frequency over the next meteorological year (May 2023 – April 2024).*

## Overview:

The Nation continues to experience rapid increases in high tide flooding due to long-term effects of sea level rise. In 2022, coastal communities around the Country experienced 4 high tide flooding days on average. **This year, the Nation is predicted to experience between 4 and 9 high tide flood days.**

- In 2022, [Bar Harbor, ME](#) recorded the highest number of observed flood days, 16.
- For 2023, the flooding threshold for [Kwajalein Island, Marshall Islands](#) is predicted to be exceeded most throughout the Nation, up to 55 days.

**Note:** Pacific Island flood thresholds were adjusted on June 1, 2023 to better match on-the-ground reports of flooding. This change impacts the Annual Outlooks for the Pacific Islands compared to previous years. Adjusted flood thresholds may not be representative of flooding around Kwajalein Island. Reported flood days represent the number of observed and predicted days where water levels exceed the flood threshold at the Kwajalein station. The number of true flood days may be lower.

# Northeast Outlook



## States:

- Maine
- New Hampshire
- Massachusetts
- Rhode Island
- Connecticut
- New York  
(to Kings Point, NY)



*Caption: High tide flooding pushes water onto a walkway along the Boston waterfront near India Wharf.*

*Photo credit: My-Coast, 10/18/2016*

*Location: Near India Wharf, Boston, Massachusetts*

## Region Overview:

The Northeast continues to experience rapid increases in high tide flooding due to long-term effects of sea level rise. The region experienced 5 flood days on average in 2022. **This year, the Northeast is predicted to experience between 4 and 10 flood days.**

- In 2022, [Bar Harbor, ME](#) recorded the highest number of observed flood days, 16.
- In 2023, [Boston, MA](#) is predicted to experience the highest number of flood days, up to 18.

The northeast is routinely impacted by high tide flooding primarily due to large tidal ranges and coastal storms, which often occur during the winter and spring seasons. Offshore storms usually bring winds from the east and northeast, piling up water over a wide, shallow continental shelf. **This year, the Northeast is predicted to experience between 4 and 10 high tide flood days, representing an approximately 150% increase in flood days since the year 2000.** Boston is predicted to experience the region's highest number of flood days, up to 18. In 2022, the region experienced 5 flood days on average.



# Mid-Atlantic Outlook



## States:

- New York (from the Battery, NY)
- New Jersey
- Pennsylvania
- Delaware
- Maryland
- Virginia
- North Carolina



**Caption:** Cars driving along Long Neck Road between Rehoboth Bay and Indian River Bay encountered flooding due to a simultaneous above normal high tide and new moon, which was exacerbated by multiple rounds of rain and onshore winds.

**Photo credit:** Driscoll Drones, 2/25/2020

**Location:** Long Neck Road, Millsboro, Delaware



## Region Overview:

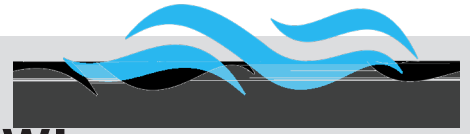
The Mid-Atlantic continues to experience rapid increases in high tide flooding due to long-term effects of high rates of relative sea level rise, which are primarily due to land subsidence, global sea level rise, and regional oceanographic effects. The Mid-Atlantic experienced 8 flood days on average in 2022. **This year, the Mid-Atlantic is predicted to experience between 9 and 14 high tide flood days.** Increased flood frequencies are associated with El Niño conditions that contribute to an increase in storm activity in the region.

- In 2022, [Wachapreague, VA](#) recorded the highest number of flood days, 12.
- In 2023, [Sewells Point, VA](#) is predicted to experience the highest number of flood days, up to 19.

The Mid-Atlantic is routinely impacted by high tide flooding throughout the year due to its low lying coastal lands, wide/shallow continental shelf, and exposure to coastal storms. Coastal flooding in this region is predominantly weather driven, including both tropical systems coming up the coast from the south, and non-tropical offshore storms bringing winds and ocean currents from the east and northeast. This year, the Mid-Atlantic is predicted to experience the most high tide flooding due to the effects of El Niño conditions, which flattens the atmospheric jet stream over the southern United States in the winter and spring, increasing the frequency of storms in the south, many of which move up the coast producing storm surge. **Though the frequency of high tide flooding varies year to year, the Mid-Atlantic is predicted to experience an 300% increase in flood days since the year 2000.**



# Southeast Outlook



## States:

- South Carolina
- Georgia
- Florida (east coast)



***Caption:** Cars travel through high water on E. Bay St in front of Sanders-Clyde Elementary School in Charleston, SC. The high tide flooding was due to a perigean spring tide.*

***Photo credit:** Sean Bath, 9/11/2024*

***Location:** Charleston, South Carolina*

## Region Overview:

The Southeast continues to experience rapid increases in high tide flooding due to long-term effects of sea level rise. The recent, rapid rise in relative sea levels is caused by global sea level rise and regional oceanographic effects. The region experienced 6 flood days on average in 2022. **This year, the Southeast is predicted to experience between 4 and 8 high tide flood days.**

- In 2022, [Trident Pier, FL](#) recorded the highest number of flood days, 16.
- In 2023, [Trident Pier, FL](#) is predicted to experience the highest number of flood days, up to 16.

This region of the U.S. is largely composed of low-lying areas prone to minor flooding. Coupled with land subsidence and global sea level rise, high tide flooding events have been observed more frequently over the past few decades. Due to relatively infrequent storm activity and a narrow continental shelf (limiting the depth of storm surge), major flooding events are usually only associated with Atlantic hurricanes and strong tropical storm systems. This year, the southeast is predicted to experience more flood days than in 2022. Northern parts of this region are sensitive to El Niño conditions that contribute to an increase in coastal storm activity, however, El Niño conditions are also associated with suppressed tropical storm development, decreasing the likelihood of major flood events. **Overall, the southeast is predicted to experience approximately 300% increase in flood days since the year 2000, predominantly driven by sea level rise.**



# East Gulf Outlook



## States:

- Florida (west coast)
- Alabama
- Mississippi



*Caption: High tide flooding impacting a residential area in coastal Alabama.*

*Photo credit: NOAA, 7/14/2021*

*Location: Dauphin Island, Alabama*

## Region Overview:

The Eastern Gulf Coast continues to experience rapid increases in high tide flooding due to long-term effects of sea level rise. The recent, rapid rise in relative sea levels is caused by land subsidence, global sea level rise, and regional oceanographic effects. **The region experienced 2 flood days on average in 2022. This year, the Eastern Gulf Coast is predicted to experience between 2 and 6 high tide flood days.**

- In 2022, [Cedar Key, FL](#) recorded the highest number of flood days, 5.
- In 2023, [Bay Waveland Yacht Club, MS](#) is predicted to experience the highest number of flood days, up to 17.

This region of coast is routinely impacted by severe weather that often contributes to flood events, with extreme flooding usually caused by Atlantic hurricanes. Coupled with land subsidence and sea level rise, high tide flooding is even more frequent and impactful. Predictions for the region vary year to year due to large-scale weather and ocean current patterns. **Overall, the eastern Gulf is predicted to experience nearly 200% increase in flood days since the year 2000, largely driven by sea level rise.**



# West Gulf Outlook



## States:

- Louisiana
- Texas



*Caption: Persistently elevated water levels in West Bay cause high tide street flooding on Galveston Island around Jamaica Beach.*

*Photo credit: Sheri Cortez, 6/25/2020*

*Location: Jamaica Beach, Texas*



## Region Overview:

The Western Gulf Coast continues to experience rapid increases in high tide flooding due to long-term effects of sea level rise. Recent rises in relative sea levels are caused by land subsidence, global sea level rise, and regional oceanographic effects. The region experienced 2 flood days on average in 2022, an anomalously low year compared to previous years. This year, the western Gulf Coast is predicted to experience between 7 and 14 high tide flood days. Increased flood frequencies at some locations are associated with El Niño conditions that contribute to an increase in storm activity in the southern United States. However, El Niño conditions are also associated with suppressed tropical storm development, decreasing the likelihood of major coastal flood events.

- In 2022, [Eagle Point, TX](#) recorded the highest number of flood days, 12.
- In 2023, [Galveston Pier, TX](#) is predicted to experience the highest number of flood days, up to 13.

The western Gulf is a region frequently impacted by high tide flooding due to high rates of land subsidence, with extreme coastal flooding occurring during Atlantic hurricanes. This year, the western Gulf is an area predicted to experience the most high tide flooding due to the effects of El Niño. **Though predictions vary year to year, compared to the year 2000, the Western Gulf has experienced approximately 350% increase in high tide flooding days, largely driven by sea level rise.**



# Southwest Outlook



## States:

- California



**Caption:** Aerial photo of the king tide at Manzanita Junction, Mill Valley. Water levels were higher than normal due to a perigean spring tide.

**Photo credit:** California Coastal Commission, 12/4/2021

**Location:** Manzanita Junction, Mill Valley, California



## Region Overview:

The Southwest continues to experience modest increases in high tide flooding due to long-term effects of sea level rise. Recent rises in relative sea levels are caused by global sea level change and regional oceanographic effects. This region experienced significant variation in 2022, on the order of less than 1 flood day as a whole, however Humboldt Bay (North Spit) and San Diego experienced 12 and 10 days, respectively. This year, the southwest is predicted to experience between 1 and 5 high tide flood days.

- In 2022, [Humboldt Bay, CA \(North Spit\)](#) recorded the highest number of flood days, 12.
- In 2023, [Humboldt Bay, CA \(North Spit\)](#) is predicted to experience the highest number of flood days up to 14.

High tide flooding outlooks vary by region to account for differences in the coastline that contribute to flood events. In general, the narrow continental shelf and relatively infrequent coastal storms systems limit the frequency of significant flood events although this region can experience damaging flood levels from high waves. Increased flood frequencies in this region are highly dependent upon El Niño conditions, which brings warmer water to the coast and contributes to higher sea levels, increasing the likelihood for minor, frequent flooding. El Niño also favors tropical storm development in the central and eastern Pacific Ocean, increasing the likelihood for major flooding events. The higher sea levels allow for very high tides, such as king tides, to inundate a larger extent and have larger impact. **Overall the southwest Pacific is predicted to experience almost a 100% increase in flood days since the year 2000, driven largely by the forecasted strong El Niño, compared to minimal increases under neutral conditions.**

# Northwest Outlook



## States:

- Washington
- Oregon
- California (northern)



## Region Overview:

The Northwest continues to experience modest increases in high tide flooding due to long-term effects of sea level rise. The region experienced 8 flood days as a whole, ranging between 3 and 15 days in 2022. This year, the region is predicted to experience between 4 and 11 high tide flood days. The Northwest experienced the second highest regional average of flood days in 2022.

- In 2022, [Friday Harbor, WA](#) recorded the highest number of flood days, 15.
- In 2023, [Toke Point, WA](#) is predicted to experience the highest number of flood days, up to 23.

Flooding in the Pacific Northwest is less tidally driven and more often the result of extreme weather events and ocean currents, where the wide, shallow continental shelf can amplify storm surge, often flooding low-lying areas. Year to year variations in high tide flood frequency in this region is highly associated with El Niño conditions, which brings warmer water to the coast, contributing to higher sea levels. The higher sea levels allow for very high tides, such as king tides, to inundate a larger extent and have larger impact. **Overall, the Pacific Northwest is predicted to experience approximately a 150% increase in flood days since the year 2000, driven largely by the forecasted strong El Niño, compared to minimal change over neutral ENSO conditions.**

*Caption: Minor high tide flooding blocks roadway on Camano Island.*

*Photo credit: My-Coast, 12/30/2022*

*Location: Camano Island, Washington*



# Caribbean Outlook



## Locations:

- Puerto Rico
- U.S. Virgin Islands



## Region Overview:

The Caribbean does not show a long-term trend in high tide flooding days. This region experienced less than 1 flood day on average in 2022. This year, the Caribbean is **predicted to experience very few flood days, less than 1 day on average.**

- In 2022, [Magueyes Island, PR](#) recorded the highest number of flood days, 2.
- In 2023, [Magueyes Island, PR](#) is predicted to experience the highest number of flood days, up to 1.

Flooding in the Caribbean Islands is less tidally driven and more often the result of waves and weather events. For this reason, minor flooding thresholds for the region are typically higher than average high tides. However, this does not preclude flooding that might occur at slightly lower heights, or flooding driven by extreme weather events, like hurricanes.

# Pacific Islands Outlook



## Locations:

- Hawaii
- Guam
- American Samoa
- Wake Island
- Kwajalein, Marshall Islands



*Caption: The intersection of Kilihau street and Kakoi street is flooded with water during high tide. Above normal water levels were due to a perigeen spring tide and swells from Hurricane Erick.*

*Photo credit: king-tide@hawaii.edu, 8/1/2019*

*Location: Mapunaou-na, Hawaii*



## Region Overview:

The Pacific Islands continue to experience rapid increases in high tide flooding due to long-term effects of sea level rise. Recent rises in relative sea levels are caused by global sea level rise and regional oceanographic effects. The region experienced 2 flood days on average in 2022. It also experienced the highest increase in average regional flood days in 2022. This year, the region is **predicted to experience between 4 and 16 high tide flood days.**

- In 2022, the flood threshold for [Kwajalein Island, Marshall Islands](#) exceeded the highest number of days, 76.
- In 2023, the flood threshold for [Kwajalein Island, Marshall Islands](#) is predicted to exceed the highest number of days, up to 55 days; less than previous years as this station experiences more frequent flooding during La Niña conditions than El Niño conditions.

**This year, NOAA updated its minor high tide flooding thresholds for the Pacific to be more representative of high tide flooding events experienced by communities. Overall, the Pacific Islands are predicted to experience almost 200% increase in flood days since the year 2000.** On average, Kwajalein Island experiences a greater number of flood days compared to other stations in the region due to regionally higher water marks. El Niño favors tropical storm development in the central and eastern Pacific Ocean, increasing the likelihood for major flooding events. Throughout the region, flood levels are often influenced by other wave or weather related events.

**Note:** Pacific Island flood thresholds were adjusted on June 1, 2023 to better match on-the-ground reports of flooding. This change impacts the Annual Outlooks for the Pacific Islands compared to previous years. Adjusted flood thresholds may not be representative of flooding around Kwajalein Island. Reported flood days represent the number of observed and predicted days where water levels exceed the flood threshold at the Kwajalein station. The number of true flood days may be lower.