

## Sea Level Calculator

*[coast.noaa.gov/sealevelcalculator](https://coast.noaa.gov/sealevelcalculator)*

**NOAA Center for Operational Oceanographic Products and  
Services and NOAA Office for Coastal Management**

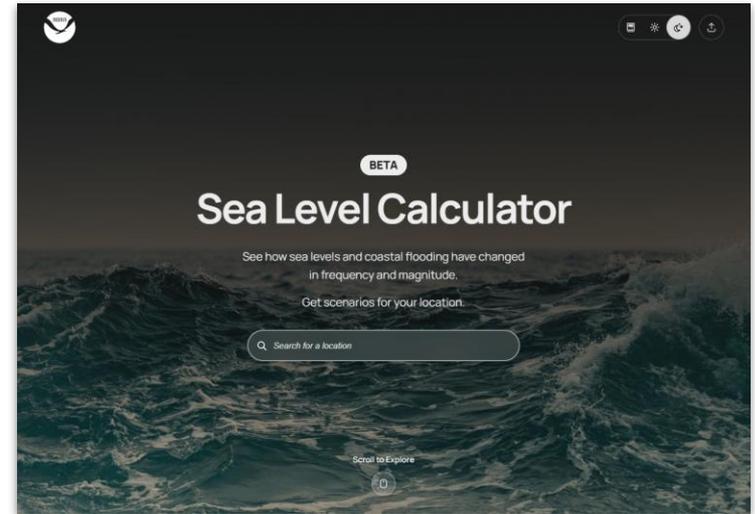
# Sea Level Calculator

## Goals

- Provide useful and actionable information on how sea level and flood frequency are changing over time and on the ground
- Integrate numerous water level data sets to provide streamlined access to NOAA's Water Level Data

## Primary Audience

- Stormwater, floodplain, and emergency managers; land use planners; public works; and engineers and more!



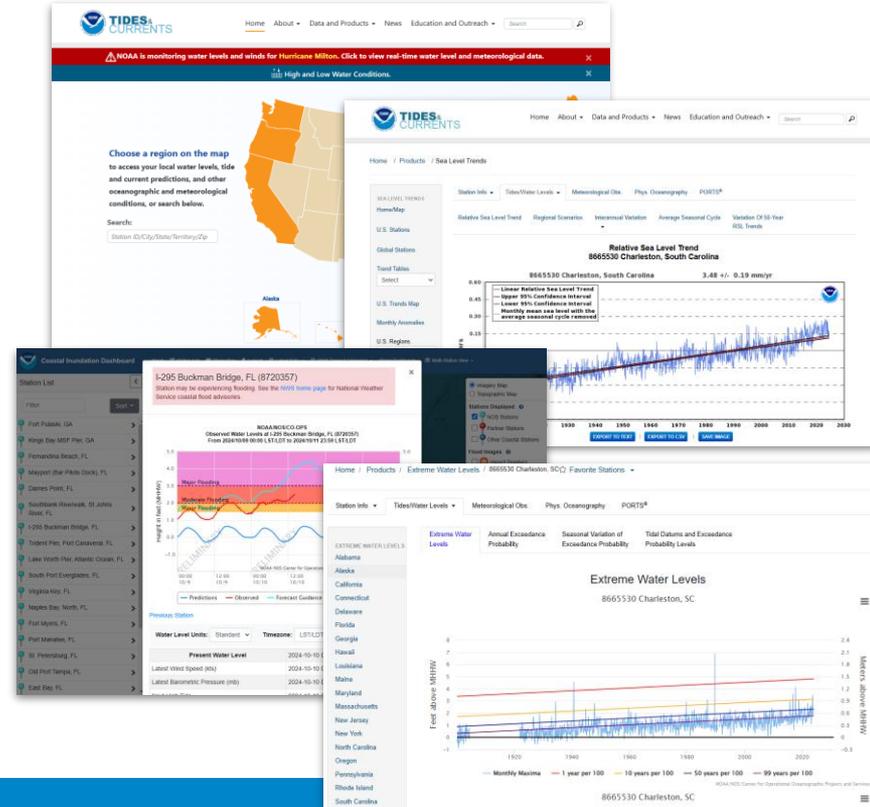
<https://coast.noaa.gov/sealevelcalculator>



# Co-development with CO-OPS

- NOAA Center for Operational Oceanographic Products and Services (CO-OPS)
- CO-OPS is the operational and authoritative source for NOAA's coastal water level data
- Integrated OCM and CO-OPS team

<https://tidesandcurrents.noaa.gov>



# Service Delivery

## Gathering Input

- Coastal Inundation Needs Assessment
- 6 use cases developed from detailed interviews with 14 diverse stakeholders
- 2 design review workshops with stakeholders to gather input on layout, accessibility, and function
- Continued engagement throughout development

## Incorporating Needs

- Allow users to set thresholds appropriate to their location and management issue
- Provide multiple types of data visualization, guidance on use



# Example Use Case: Coastal Planner

Examples: Chief Resilience Officer, City Manager, Land Use Planner

“As a **Chief Resilience Officer**, I need to know how many times flooding has happened over XX timeframe and how much it is increasing, so I can show the data to city council members to justify funding.”

“As a **Land Use Planner**, I need to define spatial areas of future flood risk to look at development of new place based policies for Sustainability planning that mitigates or minimizes flood hazards risk.”

“As a **Coastal Planner**, I need sea level rise projections and graphics in a report format, so I can develop a climate action plan or state coastal plan and guide policy. I need to develop a sea level rise strategy. I want a spatial layer data to overlay with our own GIS data.”

## Practical Needs

- Charts/graphs of SLR rise rates, trajectories, SLR projections, number of HTF days, changes in flood frequency
- Data tables and reporting capability (similar to SW assess tool) to “build your own” report out.
- Links to relevant references
- Top 10 flood events, how HTF has increased
- Needed freeboard amount based on 50 years out most likely scenario (ex. 2-3 FT)

## Technical Needs

- Provide historical information
- User entered thresholds (existing NWS thresholds/NOS thresholds)
- Report out option (customized elements)
- Enter in time period (ex. 50 years) to extract scenarios (most likely).
- Links to references/resources
- Wants access to download spatial data to use in their own GIS maps



# More Use Cases

- Generate water levels for a given return period to inform **infrastructure design**
- **Compute water level(s) for a point in time** and convert to user-selected datum
- Generate a table and a map to illustrate future flooding extents at the next **county commission meeting**
- Pair **historical flood extents** with **sea level rise scenarios**
- Determining best location for **infrastructure**
- Prioritizing **conservation** efforts
- Creating community **climate action plans**
- Understanding **future flooding risks**
- Reviewing **community investment** strategies
- Prioritizing **flood reduction** strategies

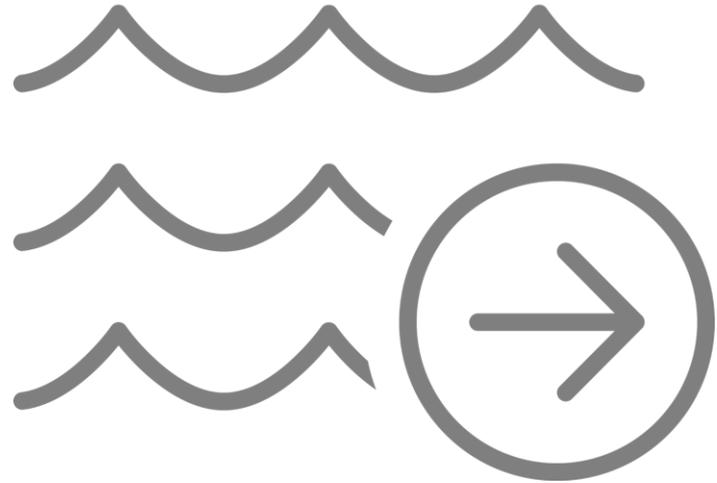


# Sea Level Calculator Quick View

## Future Sea Levels

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Explore sea level projections.  
Learn when high tide flooding  
is expected to become a daily  
occurrence.



# Sea Level Calculator Quick View

## Changes in Flood Frequency

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Determine if flood frequency has been increasing (or not!) and how these conditions may change in the future.

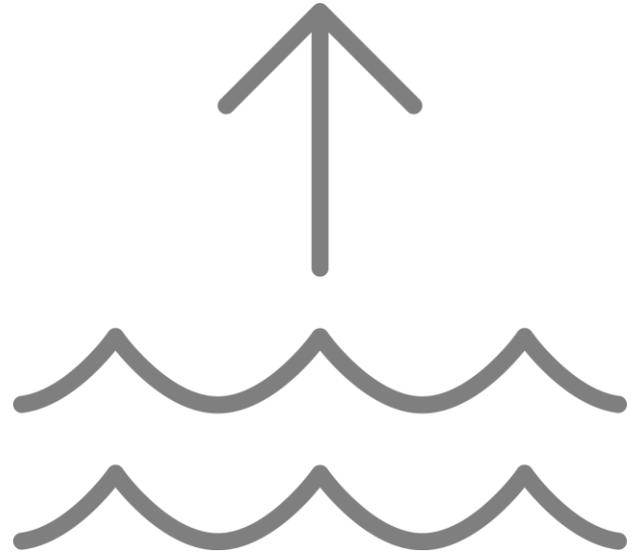


# Sea Level Calculator Quick View

## Extreme Water Levels

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View past extreme water level (Top 10) events and exceedance probability levels and how these may change over time using different sea level rise scenarios.

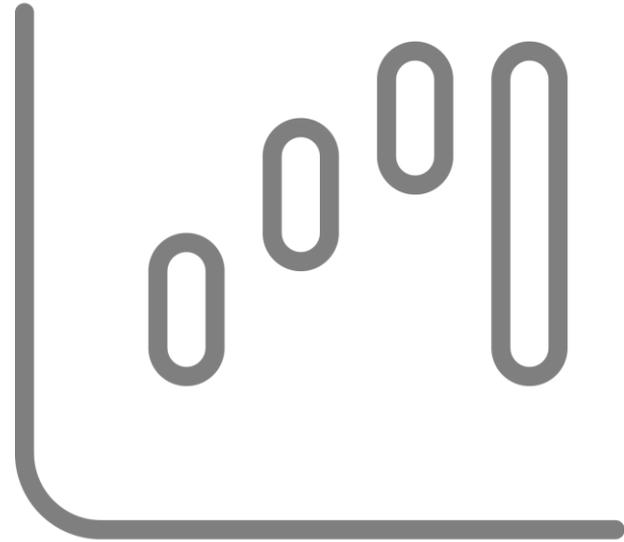


# Sea Level Calculator Quick View

## Observed Sea Level Trends

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Explore historical water levels and estimated levels for 2050. Compare trends. See how vertical land motion contributes to the equation.



# Sea Level Calculator Quick View

## Seasonal Variation

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See the ten most extreme flood events; determine which months your community is most likely to experience flooding.





# Sea Level Calculator

Explore how sea levels and coastal flooding have changed in frequency and magnitude for your chosen location. Use the latest sea level scenario projections to plan for the future.

The data, maps, and information provided should be used only as a screening-level tool for management decisions and are provided "as is," without warranty to their performance, merchantable state, or fitness for any particular purpose. The entire risk associated with the results and performance of these data is assumed by the user. This tool should be used strictly as a planning reference tool and not used for navigation, permitting, or other legal purposes.

Scroll to Explore





Search for a location



After entering a location, you can select a tide station. The number of Quick Views depends on the data available for that tide station. When choosing a tide station, consider the proximity and similarity to your area of interest and the available Quick Views at each station. Alternatively, you can select anywhere on the map if you only want to access sea level rise scenarios for that location.



### Future Sea Levels

Explore scenarios for your location.

[Watch Video →](#)



### Changes in Flood Frequency

Explore how often flooding has occurred in your area and how it may change in the future.

[Watch Video →](#)



### Extreme Water Levels

Compare past flood events to future flood probabilities.

[Watch Video →](#)



### Observed Sea Level Trends

Explore how water levels have changed over time.

[Watch Video →](#)



### Seasonal Variation

Determine when flooding and extreme events are most likely to occur throughout the year.

[Watch Video →](#)





Search for a location



### Gridded Data

Select a grid section anywhere on the map if you only want to access **Sea Level Rise Scenarios** for that location.



### Access Data

Access data used in the Calculator.

**Calculator Data** →

Real-time data is available through NOAA CO-OPS.

**Real-time Data** →

### Interagency Collaboration

The Interagency Task Force on Sea Level Change, formed under the U.S. Global Change Research Program, is a forum for federal agencies contributing to and applying sea level science to coordinate and address national needs. The Task Force (DOD, DHS, EPA, NASA, NOAA, USACE, USAID, and USGS) recently launched an interagency sea level science platform – [sealevel.globalchange.gov](https://sealevel.globalchange.gov) – to provide federally supported sea level science including educational information on causes, impacts, and solutions, as well as data from **Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines** (the 2022 Sea Level Rise Technical Report).

This Calculator complements the content on the interagency platform by providing additional historical and seasonal data, as well as geospatial mapping functionality and the ability to set user-defined thresholds and customize datums, units, and vertical land motion rates.

Version one of the Calculator incorporates coastal water level data from NOAA, NASA, and the 2022 Sea Level Rise Technical Report. Data from additional agencies participating in the task force may be incorporated in future versions as interagency collaborations grow and research efforts are ready to transition to applications.

Development of the Calculator and the interagency platform took place over the past two years. While close coordination has been ongoing, it was not feasible to bring both online in a fully integrated manner. As a result, version one of the calculator is hosted within NOAA's Digital Coast platform.





🔍 Search for a location



# Frequently Asked Questions

We are here to help! Get answers, tips and tricks from the experts.

Is there a glossary of terms and definitions to reference?



Why is this called a calculator?



Where does the data come from?



Can I use the Sea Level Calculator to project future sea level rise?



How can I report a problem or bug?



# Enter location



## Sea Level Calculator

Explore how sea levels and coastal flooding have changed in frequency and magnitude for your chosen location. Use the latest sea level scenario projections to plan for the future.

A search input field with a magnifying glass icon on the left and a close 'x' icon on the right. Below the input field is a dropdown menu with a dark background and white text. The first item is "Beaufort, NC" with a blue location pin icon and a mouse cursor hovering over it. Below it are two other items: "Beaufort County, SC, USA" and "Beaufort County, NC, USA".

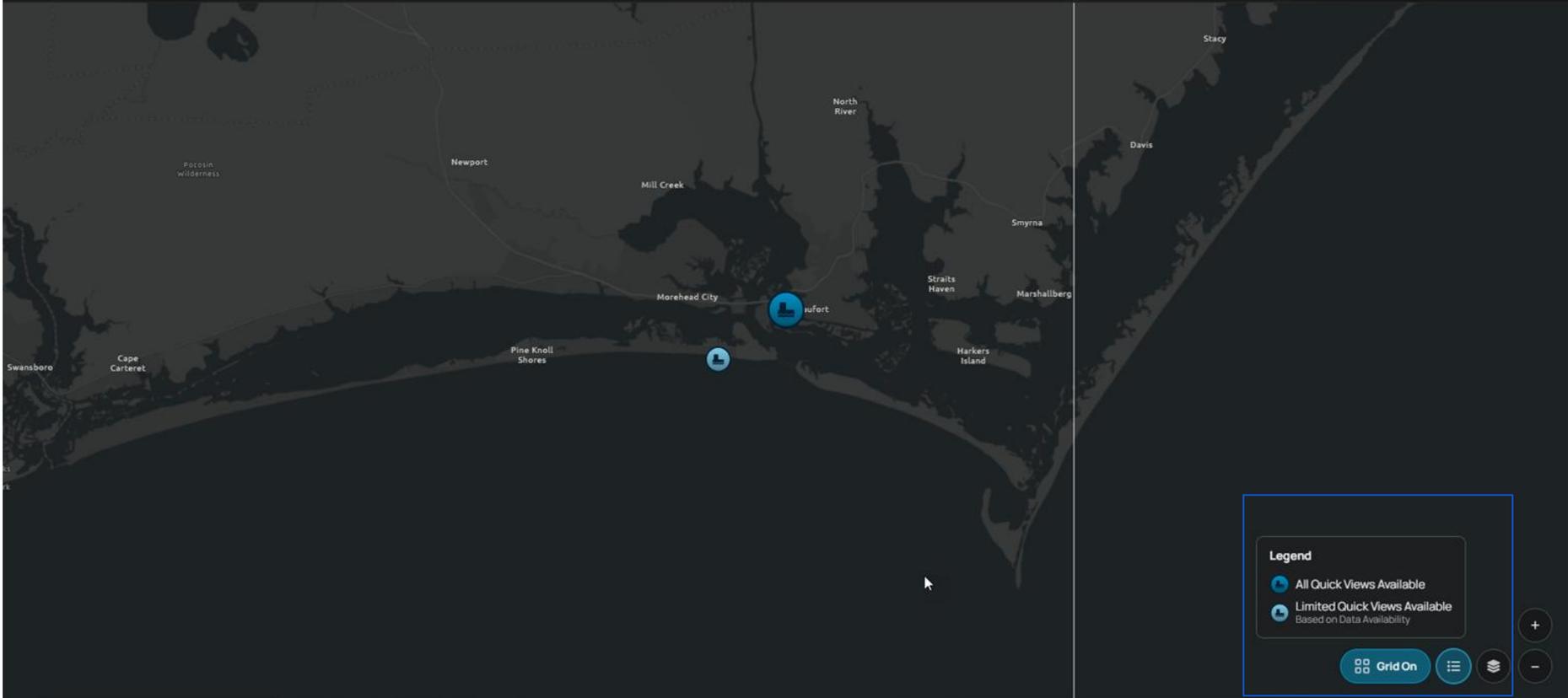
Scroll to Explore





Sea Level Calculator

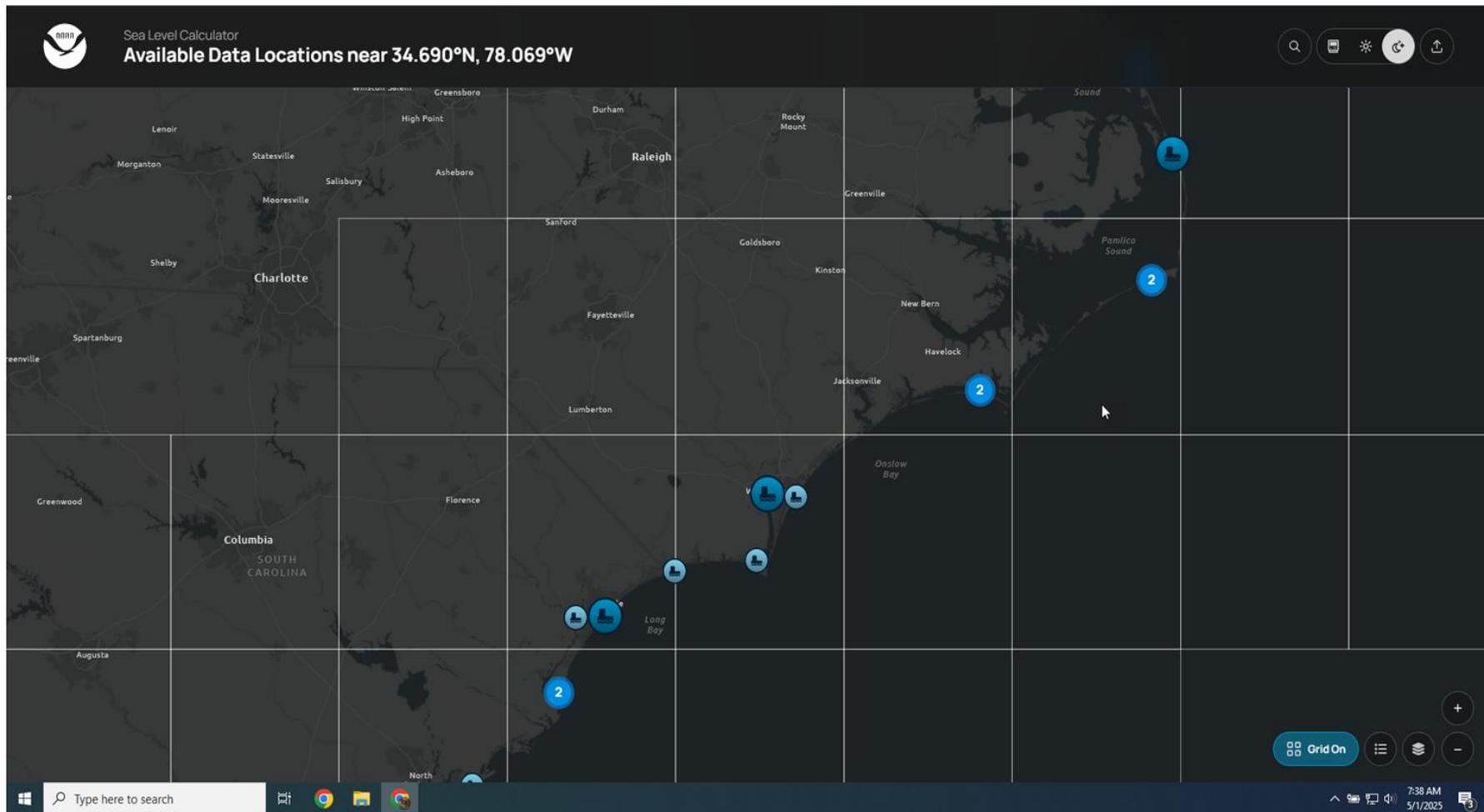
## Available Data Locations near 34.717°N, 76.671°W

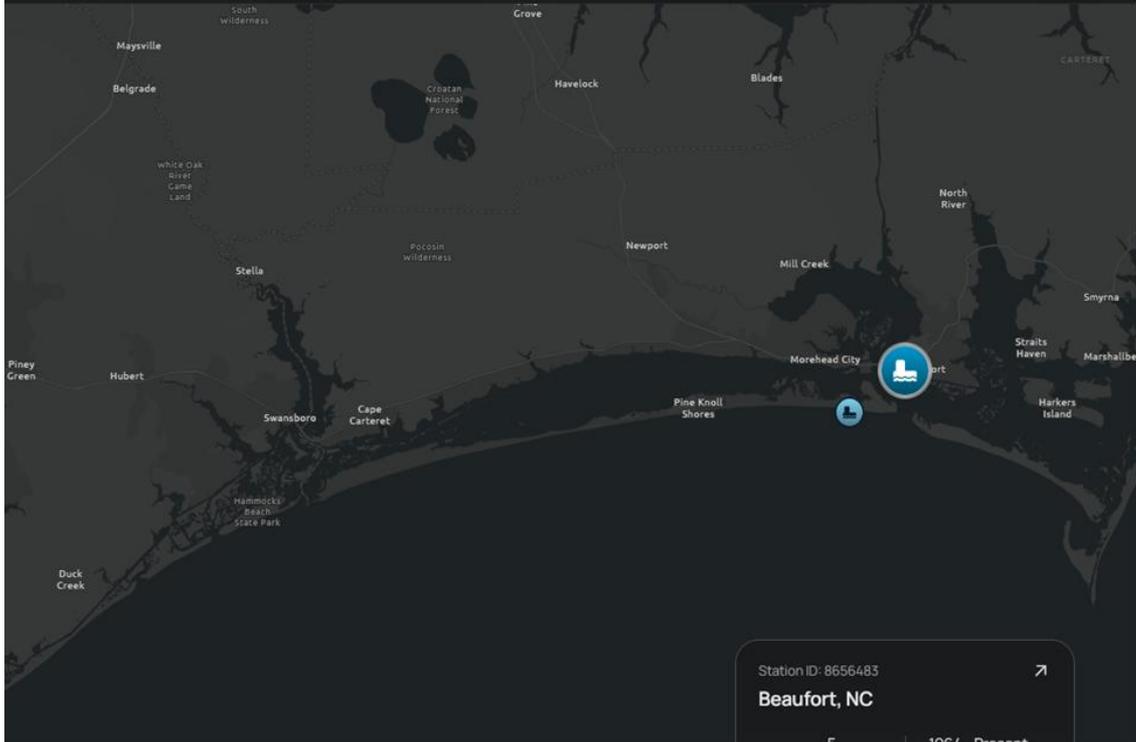


- Legend**
-  All Quick Views Available
  -  Limited Quick Views Available  
Based on Data Availability



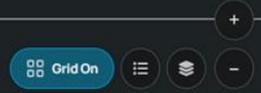
# Zoom out - See system of tide gages and grid turns on





Station ID: 8656483 [↗](#)  
**Beaufort, NC**  
5 Quick Views | 1964 - Present  
Period of Record

- Beaufort has 5 quick views
- see period of record





Video



### Future Sea Levels

Explore scenarios for your location.

Video



### Changes in Flood Frequency

Explore how often flooding has occurred in your area and how it may change in the future.

Video



### Extreme Water Levels

Compare past flood events to future flood probabilities.

Video



### Observed Sea Level Trends

Explore how water levels have changed over time.

Video



### Seasonal Variation

Determine when flooding and extreme events are most likely to occur throughout the year.

# Future Sea Levels for Beaufort, NC



Sea Level Calculator

## Future Sea Levels for Beaufort, NC

[View station data](#)



Quick Views

Video



MSL Datum

Standard Units

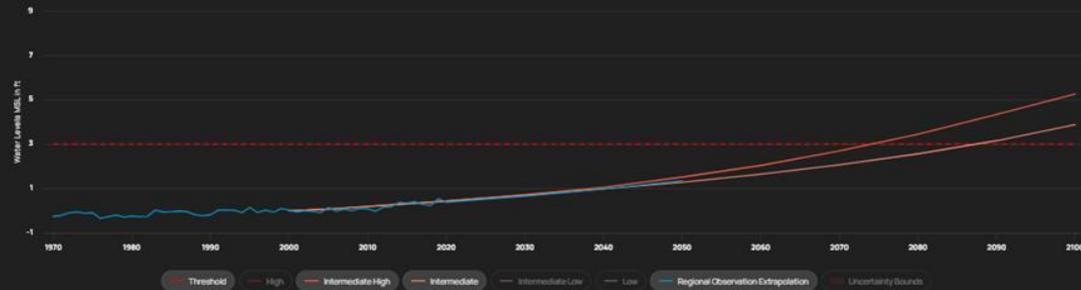
3.00 Threshold (ft)

0.065 VLM (ft) per year

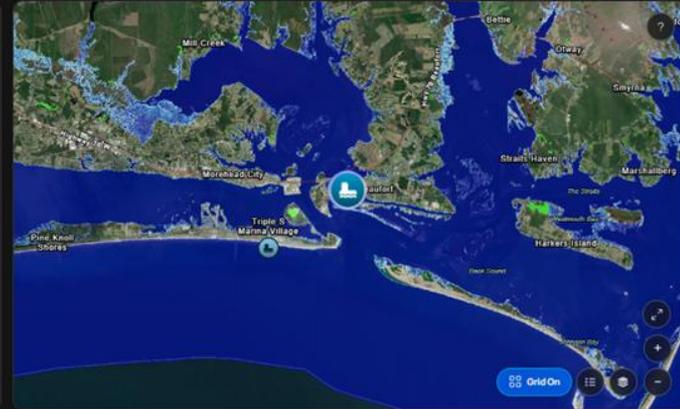
2040 Decade

2000 Reference Year

### Sea Level Rise Projections



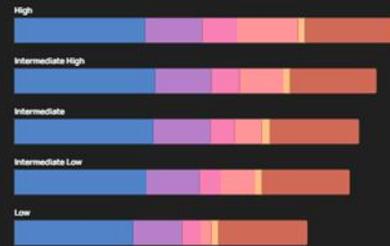
Observational and model-based data are plotted together to show past and future sea levels. The Southeast regional trajectory, based on local tide-gauge observations from 1970 to 2020, is extrapolated to 2050. Median values of model-based scenario projections are shown as solid lines, while the shaded regions represent likely ranges of 17-85 percent uncertainty. Comparing the extrapolated, observed data to the modelled scenarios help suggest which scenario is closest to your real world conditions. All data in the plot are permanently referenced to mean sea level, however values are displayed according to the user-selected datum. Map layers are referenced to MHHW but are being converted to the user-selected datum as well. Mean sea level is the default datum being displayed.



### Year 3.00 ft MSL is Exceeded

Scenario	Average Sea Level	Average High Tide
High	2067	2042
Int. High	2075	2043
Intermediate	2088	2047
Int. Low	>2100	2051
Low	>2100	2058

### Regional Contributions to Sea Level Rise in 2040



### Sea Level Rise Projections by Decade Since 2000 in MSL

Scenario	2030	2040	2050	2060	2070	2080	2090	2100
High	0.72	1.12	1.67	2.40	3.35	4.46	5.61	6.86
Int. High	0.72	1.05	1.51	2.03	2.69	3.44	4.33	5.25
Intermediate	0.69	0.98	1.28	1.64	2.07	2.56	3.15	3.87
Int. Low	0.66	0.92	1.15	1.41	1.64	1.90	2.13	2.36
Low	0.59	0.82	1.02	1.21	1.38	1.48	1.61	1.74

# Changes in Flood Frequency



Sea Level Calculator

## Changes in Flood Frequency for Beaufort, NC

[View station data](#)

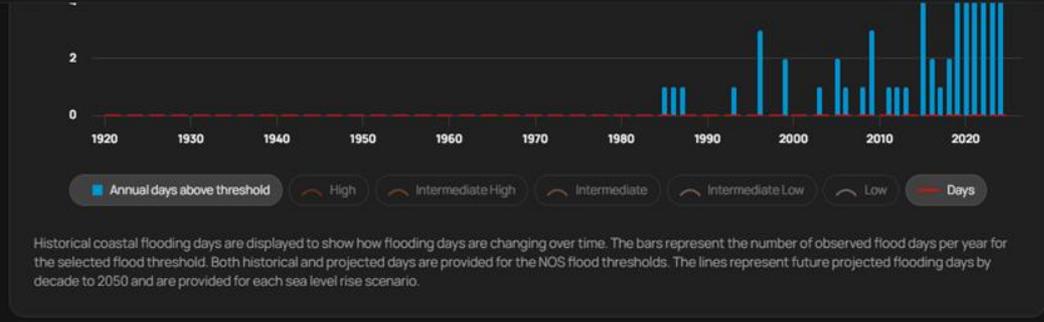
Quick Views Video Print Fullscreen Share Refresh

MHHW  
Datum

Standard  
Units

NOS Minor  
1.781  
Threshold (ft)  
adjusted to  
MHHW

0  
Days



### NOS-Derived Thresholds

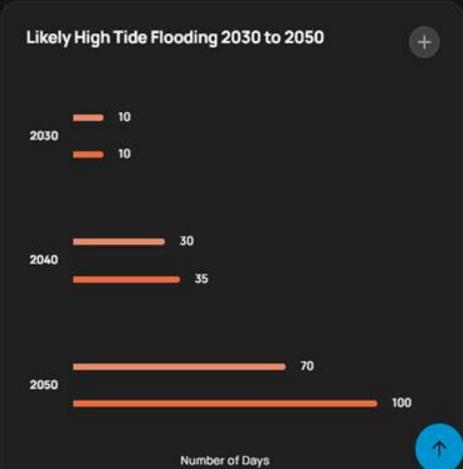
- 1.781 ft  
Minor
- 2.730 ft  
Moderate
- 3.980 ft  
Major
- Above MHHW

### Average Historic Flooding Days

Decade	Flooding Days per Year
2020-2024	7.6
2010-2019	2.1
2000-2009	0.8
1990-1999	0.6
1980-1989	0.3
1970-1979	
1960-1969	

### Projected High Tide Flooding Days

Scenario	2030	2040	2050	2060	2070	2080
High	10	40	125	275	355	365
Int. High	10	35	100	215	325	360
Intermediate	10	30	70	135	235	320
Int. Low	10	25	50	95	150	215
Low	8	20	35	65	95	125



# Extreme Water Levels



Sea Level Calculator

## Extreme Water Levels for Beaufort, NC

[View station data](#)

Quick Views Video [Icons]

MHHW Datum

Standard Units

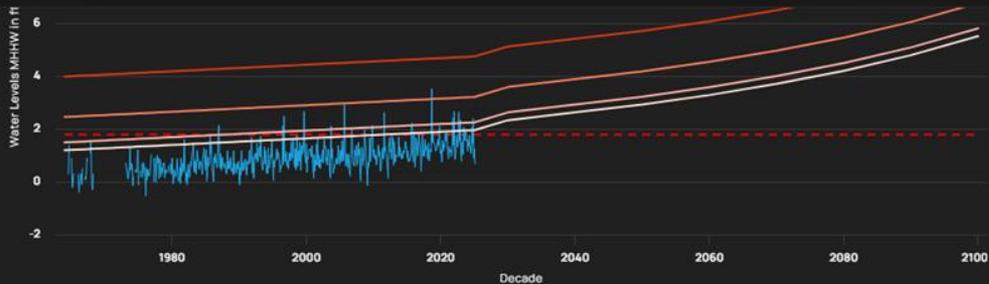
NOS Minor 1781 Threshold (ft) adjusted to MHHW

2050 Decade

2022 Tec... Data Source

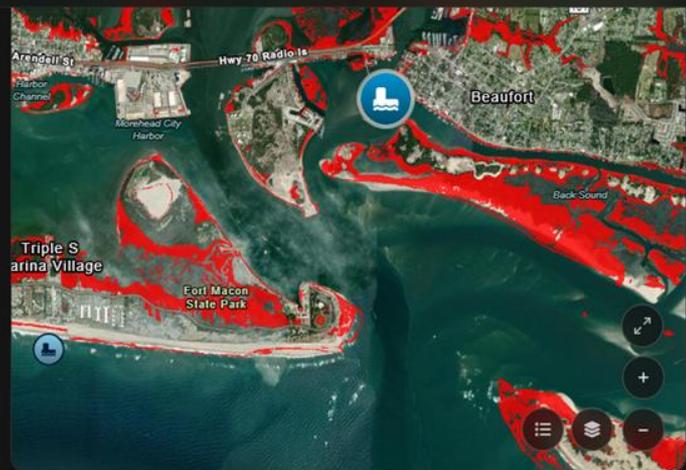
Intermed... Scenario

2000 Reference Year



Threshold Max Water Level 0.02 events/year level 0.1 events/year level 0.5 events/year level 1.0 events/year level

Historical and projected extreme water levels are displayed together. Using monthly maximum water level values (blue line), historical and projected extreme water level statistics are calculated and displayed as curves. For future time frames, the extreme water levels follow the user-selected sea level rise scenario projections. For historical time frames, the extreme water levels follow the station's mean sea level linear trend where available and the regional mean sea level trend if not. Use this graph to plan for future inundation potential, which differs from historical and current extreme likelihoods.



### Top 10 Events by Water Level (MHHW ft)

Event	Source	Height	Date
Hurricane Florence	Observed Peak Water Level	3.65 ft	September 14, 2018
Hurricane Ione	Observed Peak Water Level	3.29 ft	September 19, 1955
Hurricane Hazel	Observed Peak Water Level	3.29 ft	October 15, 1954
Hurricane Ophelia	Observed Peak Water Level	3.01 ft	September 14, 2005
Hurricane Floyd	Observed Peak Water Level	2.88 ft	September 16, 1999

### Average Event Frequency Levels in 2050 under the Intermediate Scenario



# Observed sea level trends and how those are projected to change



Sea Level Calculator

## Observed Sea Level Trends for Beaufort, NC

[View station data](#)

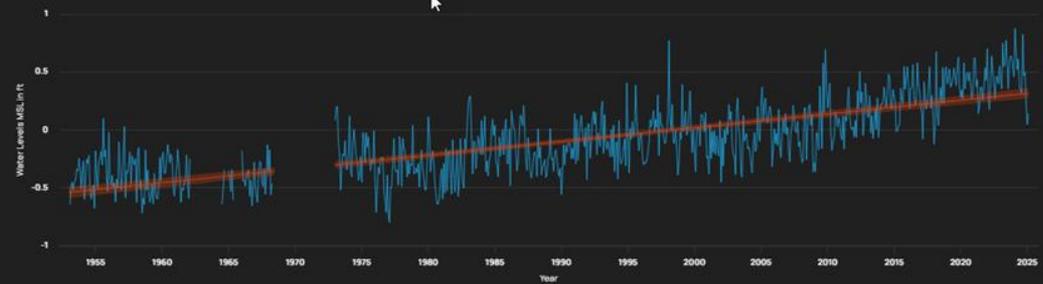
Quick Views Video

MSL Datum

Standard Units

2000 Reference Year

### Sea Level Trends



- Monthly Mean Sea Level
- 83rd Percentile Observations Based Trajectory
- 17th Percentile Observations Based Trajectory
- Median Observations Based Trajectory
- Regional Observations
- Linear Relative Sea Level Trend

The blue represents the monthly sea levels over the station's period of record. The Southeast regional trajectory is shown as a solid green line. This is based on local tide gauge observations from 1970 to 2020 and is extrapolated to 2050. Dashed green lines represent the likely range of the regional trajectory. A linear fit to the observations from the tide gauge over its entire period of record is shown as a red line. Note: The linear fit may not capture more recent increases in the rate of sea level rise and thus may underestimate the present rate.



### Station Trends

Long-Term Sea Level Change (1964 - 2025)

0.72 ft Amount      0.14 in/yr Rate

Contribution of Vertical Land Motion (1964 - 2025)

0.33 ft Amount      0.065 in/yr Rate

### Regional Trends

Sea Level Change in Southeast (1993-2020)

0.46 ft Amount      0.20 in/yr Rate

Sea Level Change in Southeast (2020 - 2050)

0.96\* ft Amount      0.38\* in/yr Rate

\* based on extrapolation

### Global Trends

Global Mean Sea Level Change (1993 - 2020)

0.29 ft Amount      0.13 in/yr Rate

# Seasonal Variations - how flooding fluctuates throughout the year



Sea Level Calculator

## Seasonal Variation for Beaufort, NC

[View station data](#)

Quick Views Video

MHW

Default

Standard

Units

0

Days

NOS Minor

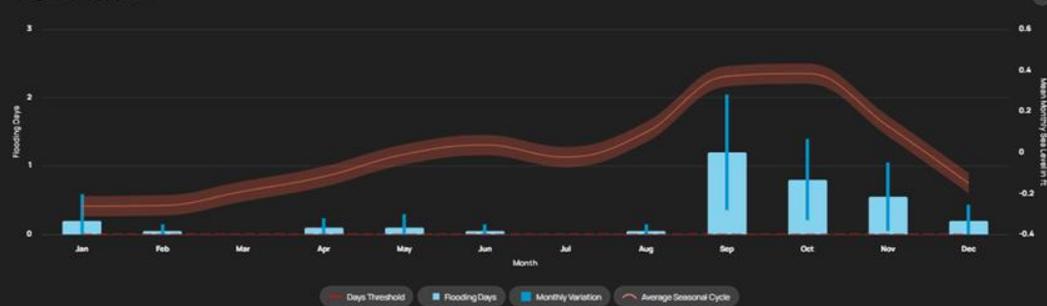
1.781

Threshold (ft)

adjusted to

MHW

### Average Flood Days by Month



Historical observations reveal how flooding fluctuates throughout the year. The solid line shows mean sea level per month, which is often linked to minor flooding in tidally influenced areas. The bars represent the average number of days per month that hourly water levels exceeded the flood threshold and includes minor flooding and extreme weather events. Bringing these datasets together depicts seasonal flooding distribution. As climate change progresses, seasonal cycles could change, leading to shifts in flood timing and frequency. Rising sea levels mean more frequent flood days. Monitoring mean sea level and flood days together provides valuable insights for anticipating and adapting to these changes.



### Months With Most High Tide Flooding Days

September  
24 Days (2005 - 2024)

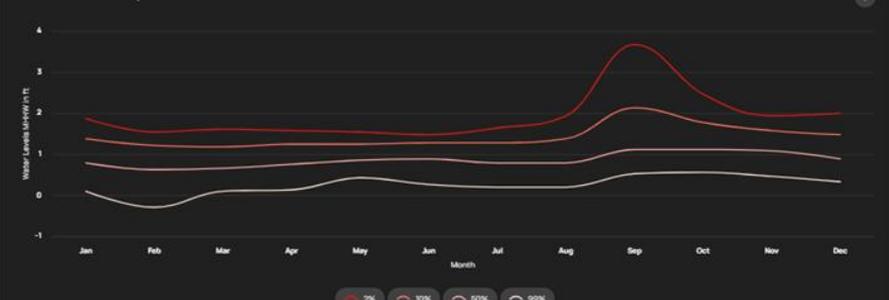
### Highest Mean Sea Level Occurs In

September, October  
0.38 ft MSL

### Top 10 Events by Month (MHW ft)

Event	Source	Height	Date
Above Normal Tides & Coastal Low Pressure	Observed Peak Water Level	2.85 ft	January 3, 2022
Hurricane Irene	Observed Peak Water Level	2.74 ft	August 27, 2011
Hurricane Florence	Observed Peak Water Level	3.75 ft	September 14, 2018
Hurricane Ione	Observed Peak Water Level	3.39 ft	September 19, 1955
Hurricane Ophelia	Observed Peak Water Level	3.11 ft	September 14, 2005
Hurricane Floyd	Observed Peak Water Level	2.90 ft	September 16, 1999
Hurricane Donna	Observed Peak Water Level	2.89 ft	September 12, 1960
Hurricane Ian	Observed Peak Water Level	2.84 ft	September 30, 2022
Hurricane Fran	Observed Peak Water Level	2.62 ft	September 6, 1996
Hurricane Hazel	Observed Peak Water Level	3.39 ft	October 15, 1954

### Extreme Water Levels By Month



# Quick Reference



## NOAA'S SEA LEVEL CALCULATOR PUTTING THIS TOOL TO GOOD USE

The powerful calculator delivers comprehensive local sea level data, visuals, and projections. Decades of observational data, combined with advanced modeling techniques, make this all-inclusive approach possible.

Notable factors are the holistic information this technical tool contains and the way the information is provided. The "Quick Views," listed below, let users explore various sea level change components in one convenient platform. Quick Views provide essential information for undertaking many decision-making processes, examples of which are provided in this document.

1. Future Sea Levels
2. Changes in Flood Frequency
3. Extreme Water Levels
4. Observed Sea Level Trends
5. Seasonal Variation

### QUICK VIEW: FUTURE SEA LEVELS

Customize thresholds and datums, visualize inundation, and compare observation-based trajectories with model-based projections. All of this is made possible through the tool's interactive graphs, tables, and maps, and the foundational data obtained from the [2022 Interagency Sea Level Rise Technical Report](#).

#### How You Can Use It

- **Resilience Officer:** Demonstrate when critical thresholds will be crossed to justify resilience funding.
- **Civil Engineer:** Utilize scenarios to calculate freeboard heights for infrastructure projects, refine elevation requirements, and incorporate customized datums to align with various project needs.
- **Natural Resource Manager:** Use decadal projections to prioritize habitat conservation and restoration efforts.
- **Engagement Professional:** Craft educational materials using the tool's visuals; draw on videos and descriptions within the tool to explain complex data.

### QUICK VIEW: CHANGES IN FLOOD FREQUENCY

Combine historical flooding data with future projections to illustrate how minor, moderate, and major flood events will evolve under various sea level rise scenarios. Input custom flooding day thresholds and visualize how these compare to projected conditions.

#### How You Can Use It

- **City Manager:** Use projected flood frequencies to illustrate funding needs for drainage improvements, including adding backflow preventers, pumps, or bioswales.
- **Floodplain Manager:** Combine historical flooding data and future projections to recommend zoning changes and secure funding for flood control infrastructure.
- **Public Works Manager:** Prioritize drainage improvements based on decadal flood frequency projections to address high-risk areas.

NOAA Center for Operational Oceanographic Products and Services  
NOAA Office for Coastal Management

#### SEA LEVEL CALCULATOR

[coast.noaa.gov/digitalcoast/tools/sea-level-calculator.html](https://coast.noaa.gov/digitalcoast/tools/sea-level-calculator.html)



### QUICK VIEW: EXTREME WATER LEVELS

Access probabilities for extreme water levels, including projections developed using the various user-selected sea level rise scenarios. Review top historical flood events and compare them to future probabilities.

#### How You Can Use It

- **Structural Engineer:** Use extreme water level probabilities to set safe building elevations to prepare structures for current and future flooding.
- **Emergency Manager:** Review historical flood events to assess emergency services needed and use future probabilities to plan updated procedures and evacuation routes.
- **Planners and Public Works Managers:** Plan for high-risk events by comparing historical context to future flood probabilities and allocating resources effectively.

### QUICK VIEW: OBSERVED SEA LEVEL TRENDS

Examine historical sea level trends with tide gauge and satellite data. Explore regional extrapolations to project future conditions. See how rates of rise have evolved over time, helping ground community planning in a historical context.

#### How You Can Use It

- **Land Use Planner:** Influence zoning policies by demonstrating historical sea level change and potential future acceleration.
- **Engineer:** Fine-tune elevation requirements for developments by assessing local trends against regional and global data.
- **Engagement Professional:** Build community trust by using local sea level trends to explain risks and justify planning priorities.

### QUICK VIEW: SEASONAL VARIATION

Anticipate risk periods and plan for infrastructure maintenance, road closings, and public safety measures by using the monthly flooding and extreme events data.

#### How You Can Use It

- **Natural Resource Manager:** Plan seasonal trail closures and maintenance schedules to protect habitats during high-risk periods.
- **Public Works Manager:** Schedule maintenance strategically to address recurring seasonal flooding issues.
- **Floodplain Manager:** Educate residents and local governments about seasonal flood risks to improve preparedness efforts.

### SEA LEVEL CALCULATOR

[coast.noaa.gov/digitalcoast/tools/sea-level-calculator.html](https://coast.noaa.gov/digitalcoast/tools/sea-level-calculator.html)

NOAA OFFICE FOR COASTAL MANAGEMENT  
NOAA CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES

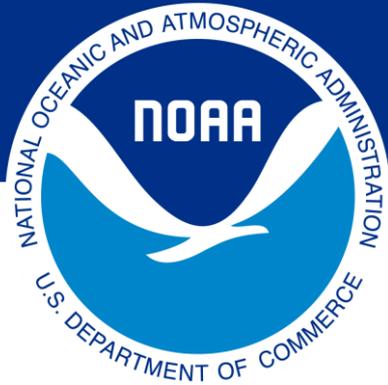
[coast.noaa.gov/data/digitalcoast/pdf/slc-uses.pdf](https://coast.noaa.gov/data/digitalcoast/pdf/slc-uses.pdf)



# Up Next...

- Updated text and tool tips
- Provides entry into the tool via map-focused screen, with user help modal.
- Updated User Settings location (moved to the top of the quick views) for better usability.
- **New Menu button which includes learning resources, frequently asked questions, access to data, and a glossary.**
- Updated tool tips on charts and graphs, linked tool tips and added units.
- **Ability to download all data for a quick view as a tabbed excel file.**
- Integrated USGS elevation grid into the map to allow a user to view land elevations and set a point based customized threshold.
- Improved extreme water levels quick view for smoother transition from historical to projected water levels.
- **Added station observation extrapolations in addition to regional extrapolations and ability to compare the two.**
- **Added subject matter expert-led deep dive videos for each Quick View.**
- Improved map legends including adding user selected threshold and which map layer is being displayed.
- **Fully automated the source station data generation, so that the application can be updated automatically when new stations and data sources are available.**
- **Implemented a more mobile friendly design**





# Sea Level Calculator

*[coast.noaa.gov/digitalcoast/tools/sea-level-calculator.html](https://coast.noaa.gov/digitalcoast/tools/sea-level-calculator.html)*

Southeast and Caribbean Geospatial Coordinator *[Matt.Pendleton@noaa.gov](mailto:Matt.Pendleton@noaa.gov)*