

## NORTH ATLANTIC COAST COMPREHENSIVE STUDY OVERVIEW - SESSION 2

# UNDERSTANDING WHAT'S UNDER THE HOOD

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Oct. 2020

[rpsgroup.com](http://rpsgroup.com)



# NOAA Office for Coastal Management

## Federal lead for national coastal management efforts (CZMA)

## Primary programs:

- Digital Coast
- National Coastal Zone Management Program
- National Estuarine Research Reserves
- Coral Reef Conservation Program



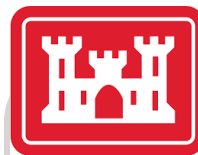
# North Atlantic Coast Comprehensive Study

The U.S. Army Corps of Engineers produced North Atlantic Coast Comprehensive Study (NACCS) in 2015 to address coastal storm and flood risk in the North Atlantic region. The study was designed to:

- Help local communities better understand changing flood risks associated with climate change
- Provide tools to prepare for future flood risks that can be customized for any coastal watershed

The Northeast Regional Ocean Council (NROC) worked with RPS to extract key model data and statistics and develop tools and services to easily work with these data.

[www.northeastoceancouncil.org/naccs](http://www.northeastoceancouncil.org/naccs)





# What to Expect

## Session 1 - NACCS overview: Informing coastal decisions in the Northeast

- A high-level overview of the NACCS and how it can be applied to coastal management in the Northeast and Mid-Atlantic.

## Session 2 - NACCS technical session: Understanding what's under the hood

- Building on *Session 1- NACCS overview* offered on Oct. 21st, this more in-depth session will explore the technical components of NACCS.
- When? Session 2 will be offered twice to provide flexibility in scheduling:
  - October 27, 2020, Tuesday | 10am - 11:30am Eastern Time
  - October 29, 2020, Thursday | 10am - 11:30am Eastern Time



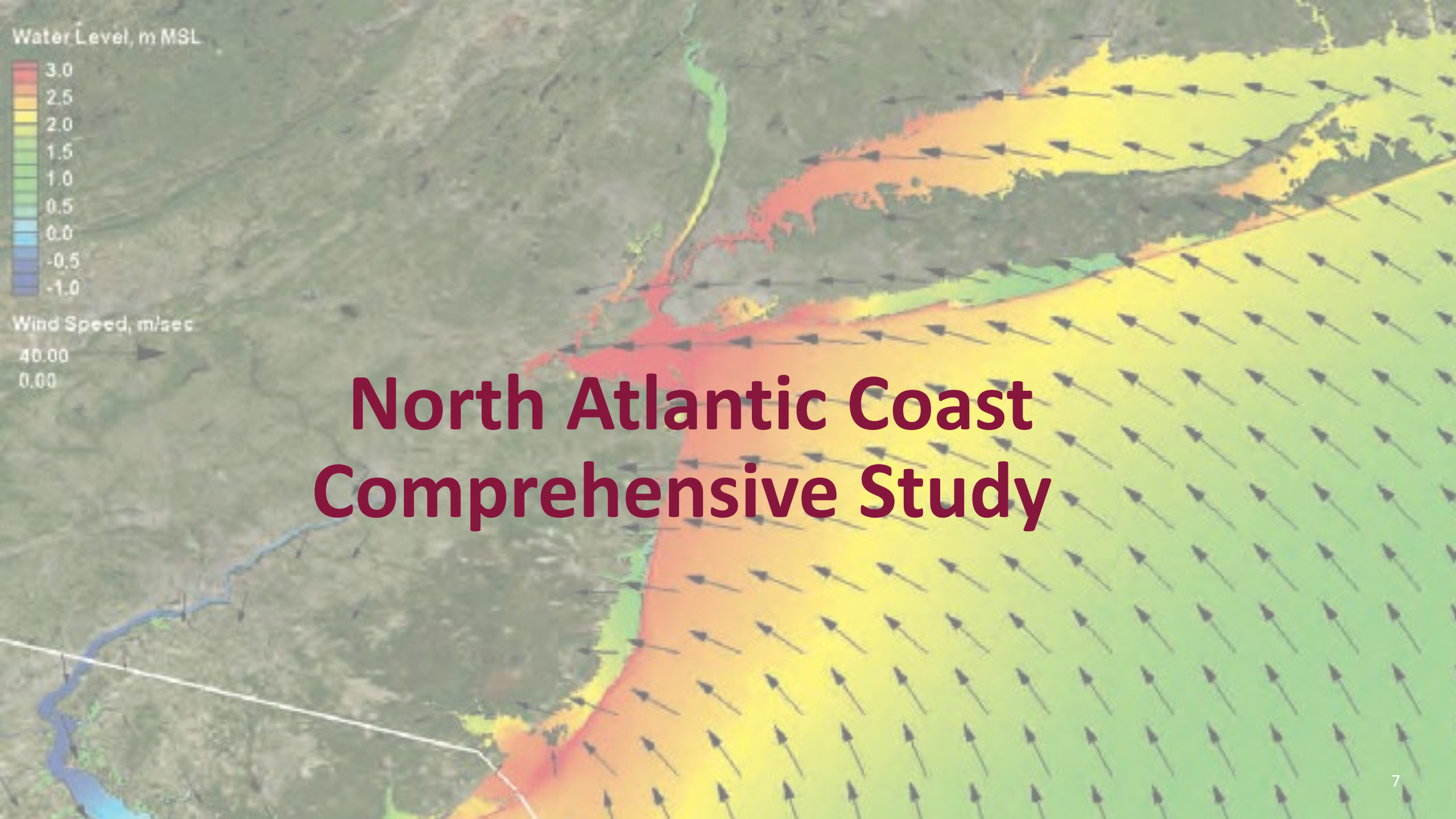
# Outline

- Introduction
- NACCS modeling overview
  - Storm basics (Synthetic tropical , historical extratropical storm)
  - Modeling approach
  - Model output
- ArcGIS GeoDatabase overview
  - How to access the results from different servers
  - Mapping the results from the geodatabase
  - Case Study

# Last Session

Discussed:

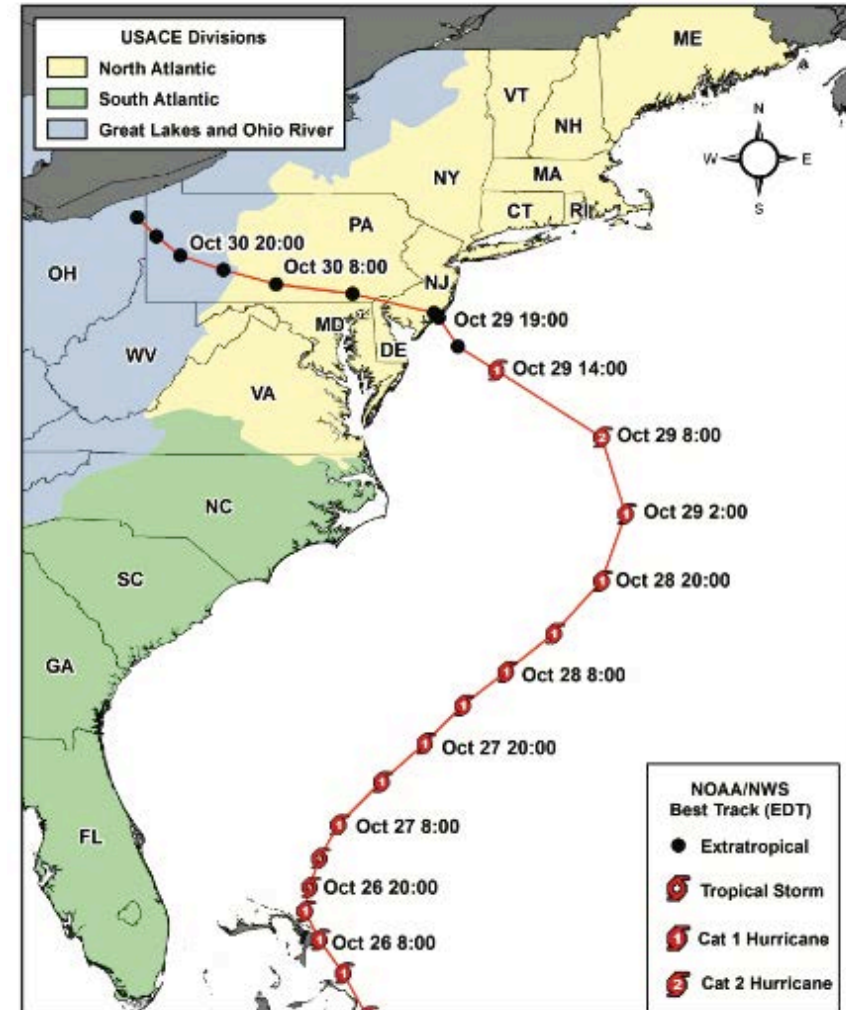
- NACCS and other coastal flooding products
  - So many maps .... most appropriately for education/awareness purposes
  - Should not be used as the sole source for specific risk management decisions.
- Use case(s) of NACCS
  - Nonlinear interaction of tide, sea level rise and storm surge
  - Limitation of bathtub approach





# NACCS


- North Atlantic Coast Comprehensive Study (NACCS) , a two-year study by the USACE
- Included atmospheric, wave and storm surge modeling for the North Atlantic region, including coastal areas of all NROC member states.
  - To provide critical information for effective flood risk management project planning, design, and performance evaluation, providing the joint probability of coastal storm environmental forcing parameters.
  - To provide tools to better prepare for future flood risks.



# Goals of NACCS

**Provide a risk management framework;  
and  
Support resilient coastal communities**

Concepts of resilience include:  
anticipate (prepare, avoid);  
resist (withstand);  
recover (bounce back); and  
adapt (evolve, transform).

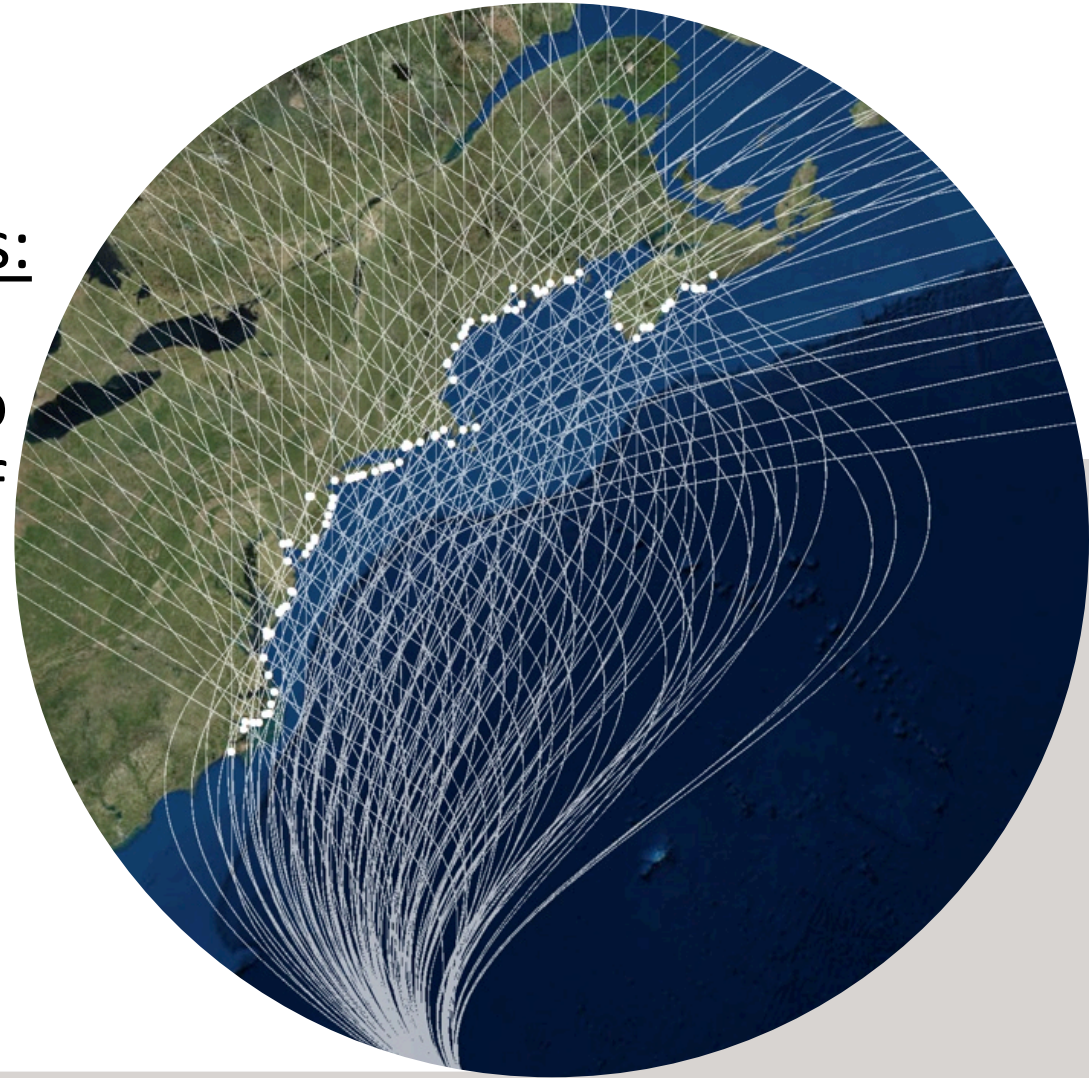


Floods are the most common and costly hazard affecting communities and the hazard that is most predictable (FEMA 2013a).



# NACCS Modeling Goals

- Wave and water level modeling study goals: simulating an efficient number of storms that covers the characteristics necessary to accurately describe the statistical nature of coastal storm response over the entire study region.
- This information is required for modern probabilistic project design and for risk assessment.

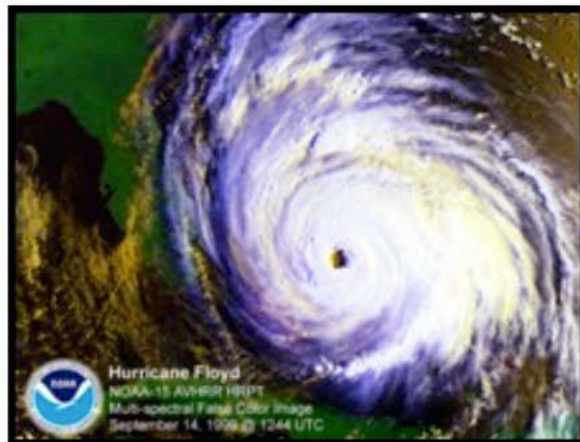




# Storms in North Atlantic

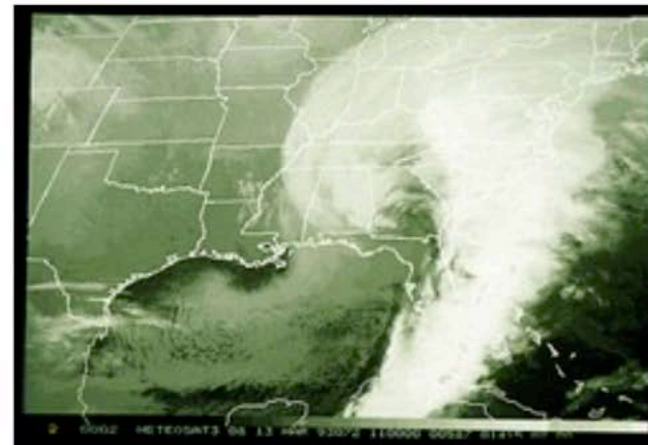
- Tropical Cyclone:

A rotating, organized, warm-core system originating over tropical or subtropical waters and has a closed surface wind circulation about a well-defined center (e.g., tropical depression, tropical storm, hurricane).



- Extratropical Cyclone:

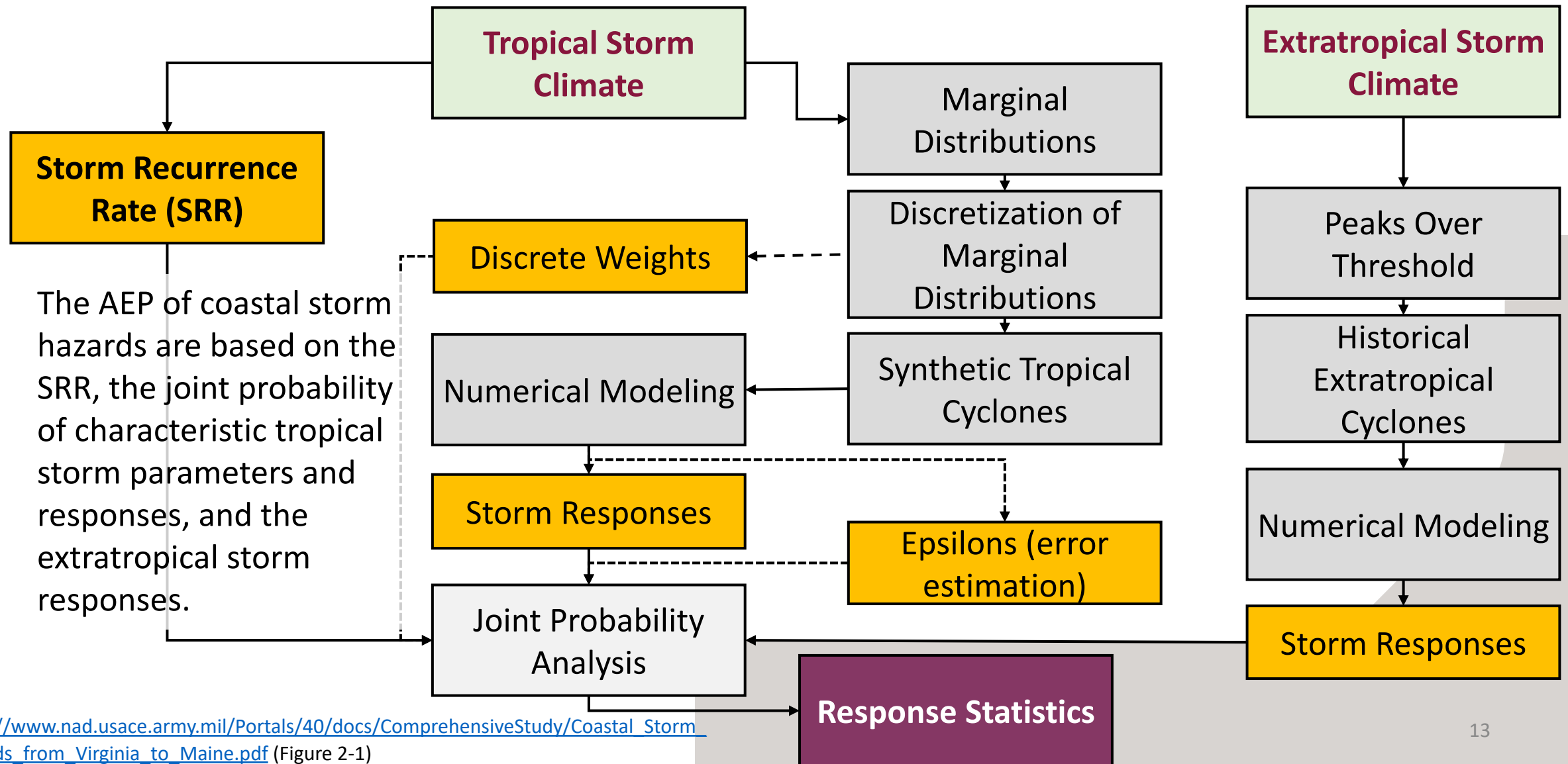
A low-pressure system that primarily relies on baroclinic processes, getting its energy from the temperature contrast between warm and cold air masses in the atmosphere (e.g., Nor'easter).



# METHODOLOGY



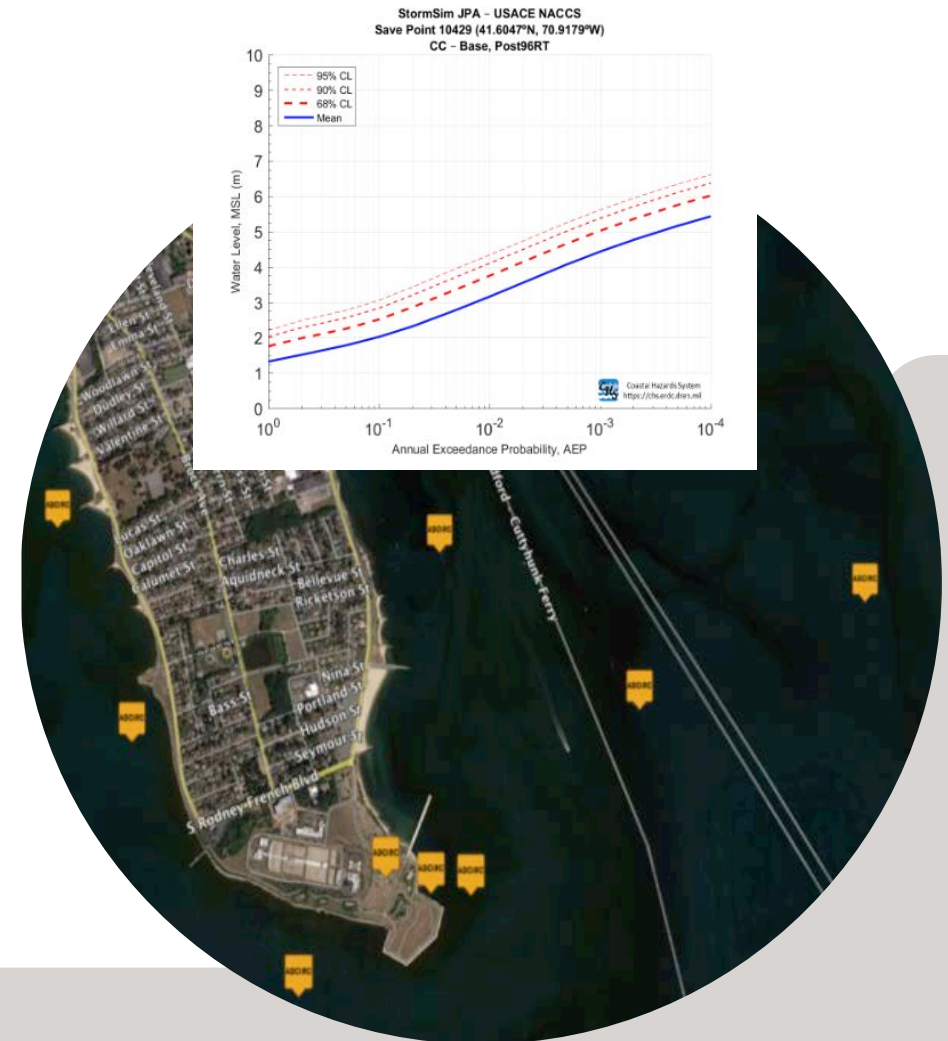
# Joint Probability Analysis of coastal storm hazards





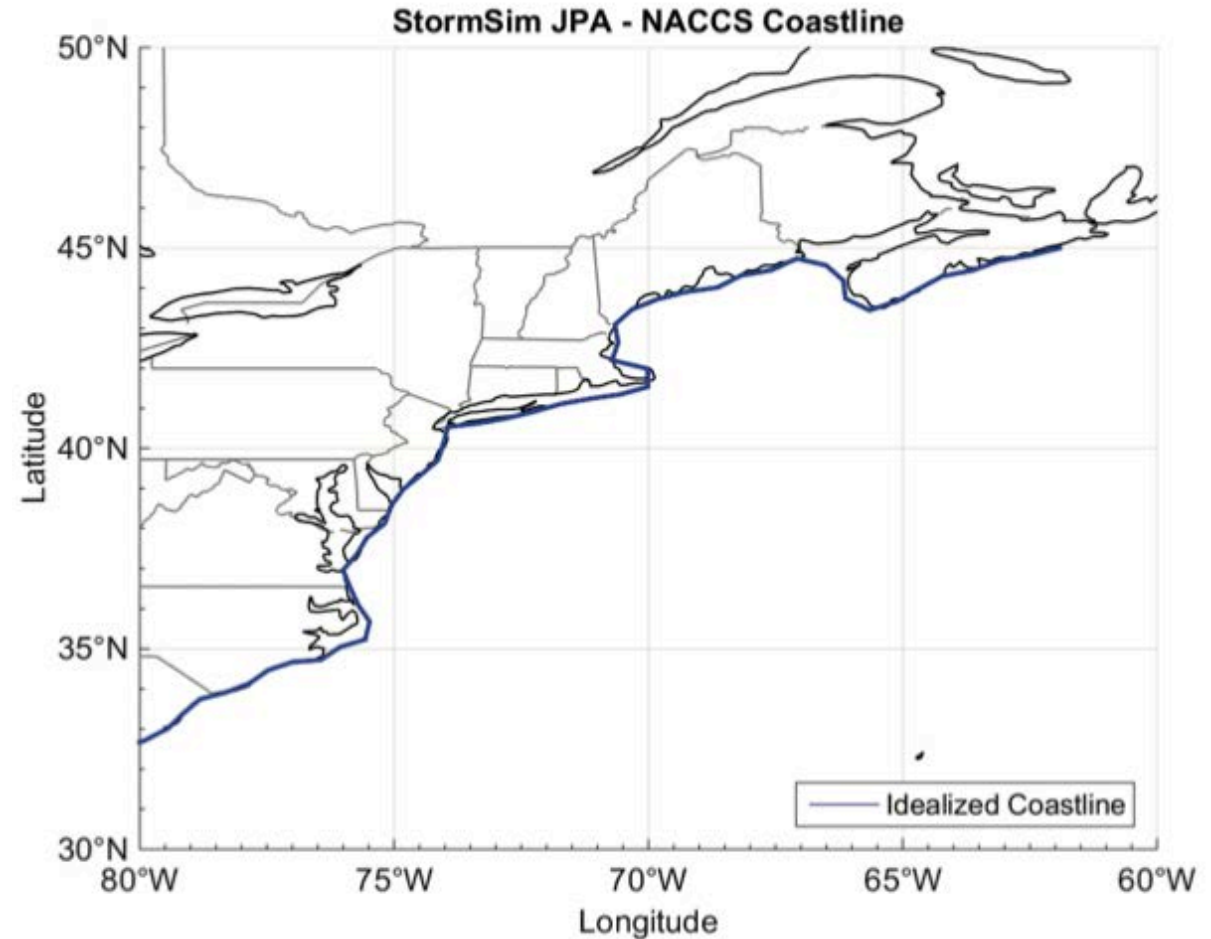
# NACCS Statistical Methodology

- Required the development of:
  - A joint probability Method (JPM) model of TC forcing parameters in order to span the parameter and probability spaces.
  - Extreme value analysis (EVA) of historical extratropical cyclones (XC) responses.
  - For both XC and TC populations, extreme storms were efficiently sampled to accurately compute extreme statistical from high-fidelity modeling results.



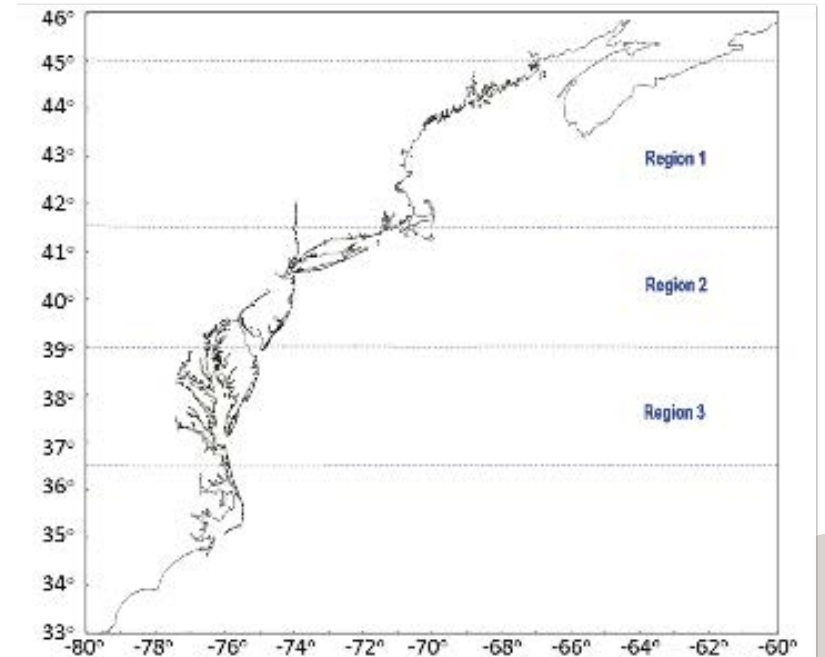
# Tropical Cyclones

- The joint probability method with optimal sampling (JPM-OS) considers all possible combinations of TC meteorological parameters ;
- Synthetic TCs based on parameters for storms that impacted the region from Virginia to Maine:
  - track location ( $x_0$ ),
  - heading direction ( $\theta$ ),
  - central pressure deficit ( $\Delta p$ ),
  - radius of maximum winds ( $R_{max}$  or  $RMW$ ), and
  - translational speed ( $V_f$ ).
- Optimal sampling of the joint distributions of these parameters : 1,050 unique TCs.



# Tropical Cyclones

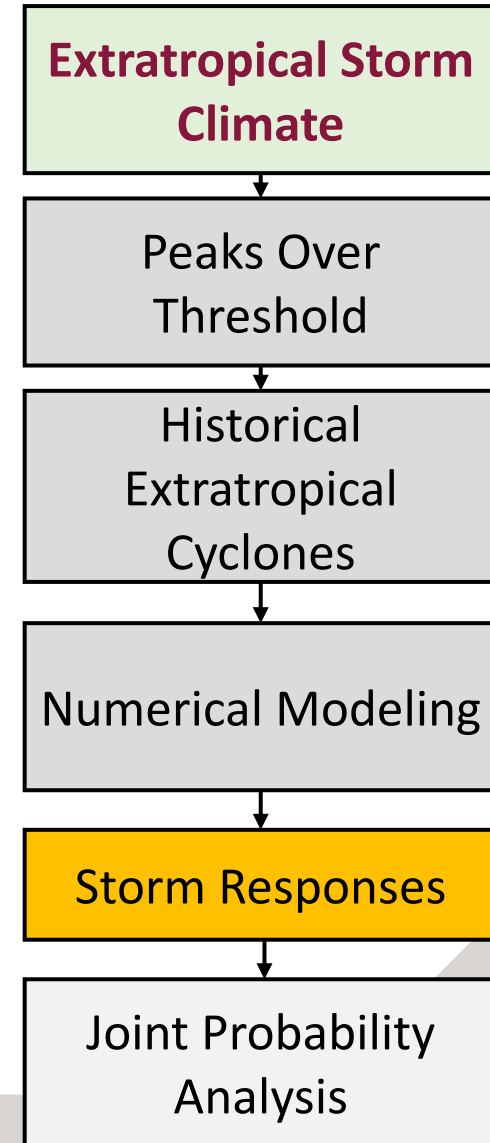
- These storm parameters: inputs to wind model and pressure fields (planetary boundary layer (PBL))
- The JPM was critical to the storm selection process because storms are synthesized from the discrete joint probability distribution.
- The parameter ranges exceed the historical record but reasonably represent extreme potential storms.



Tropical Cyclone Parameters	NACCS Subregion 3	NACCS Subregion 2	NACCS Subregion 1
$\theta$	-60°, -40°, -20°, 0°, +20°, +40°	-60°, -40°, -20°, 0°, +20°, +40°	-60°, -40°, -20°, 0°, +20°, +40°
$\Delta p$	From 28 to 98 hPa at 5 hPa intervals	From 28 to 88 hPa at 5 hPa intervals	From 28 to 78 hPa at 5 hPa intervals
$R_{max}$	From 25 to 145 km, median of 54 km	From 25 to 158 km, median of 62 km	From 26 to 174 km, median of 74 km
$V_r$	From 12 to 59 km/h, median of 27 km	From 14 to 88 km, median of 45 km	From 16 to 83 km, median of 49 km
Holland $B$	From 0.45 to 1.32	From 0.56 to 1.35	From 0.66 to 1.37

# Extratropical Cyclones

- Using observation screening:  
Storm surge and meteorological measurements (1938–2013) => 250 extratropical storms
- Using the peaks-over-threshold (POT) technique for largest water level values => reduced to an optimal amount of 100 historical XCs.

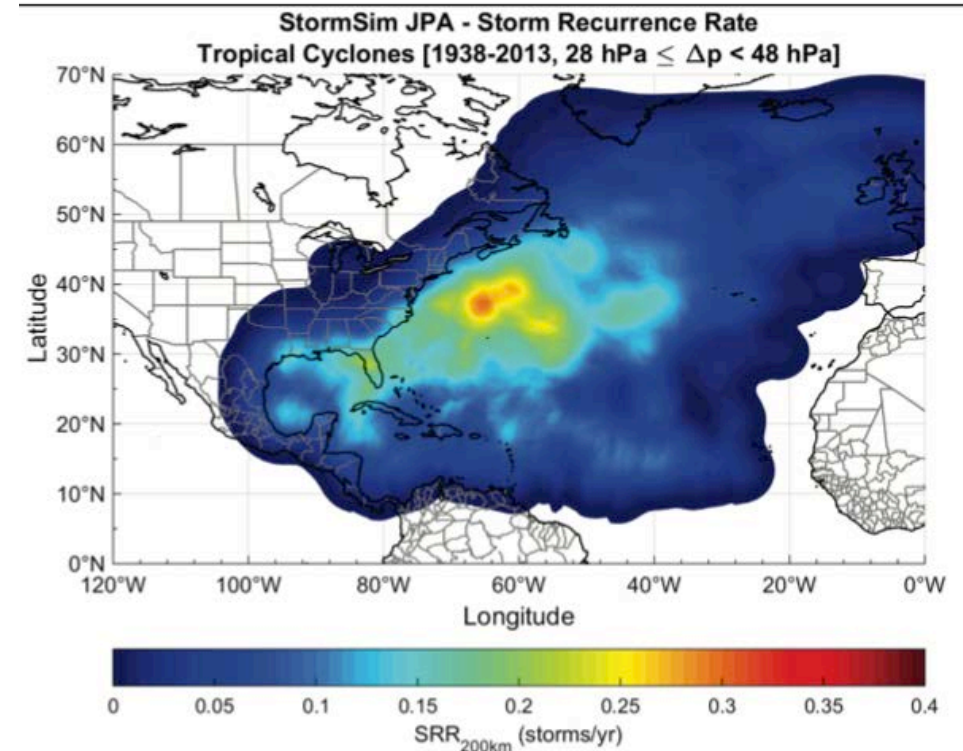


# Spatially Varying Storm Recurrence Rate (SRR)

- To efficiently sample historical storms and to compute the spatial variation of storms, Gaussian kernel function (GKF) is used.

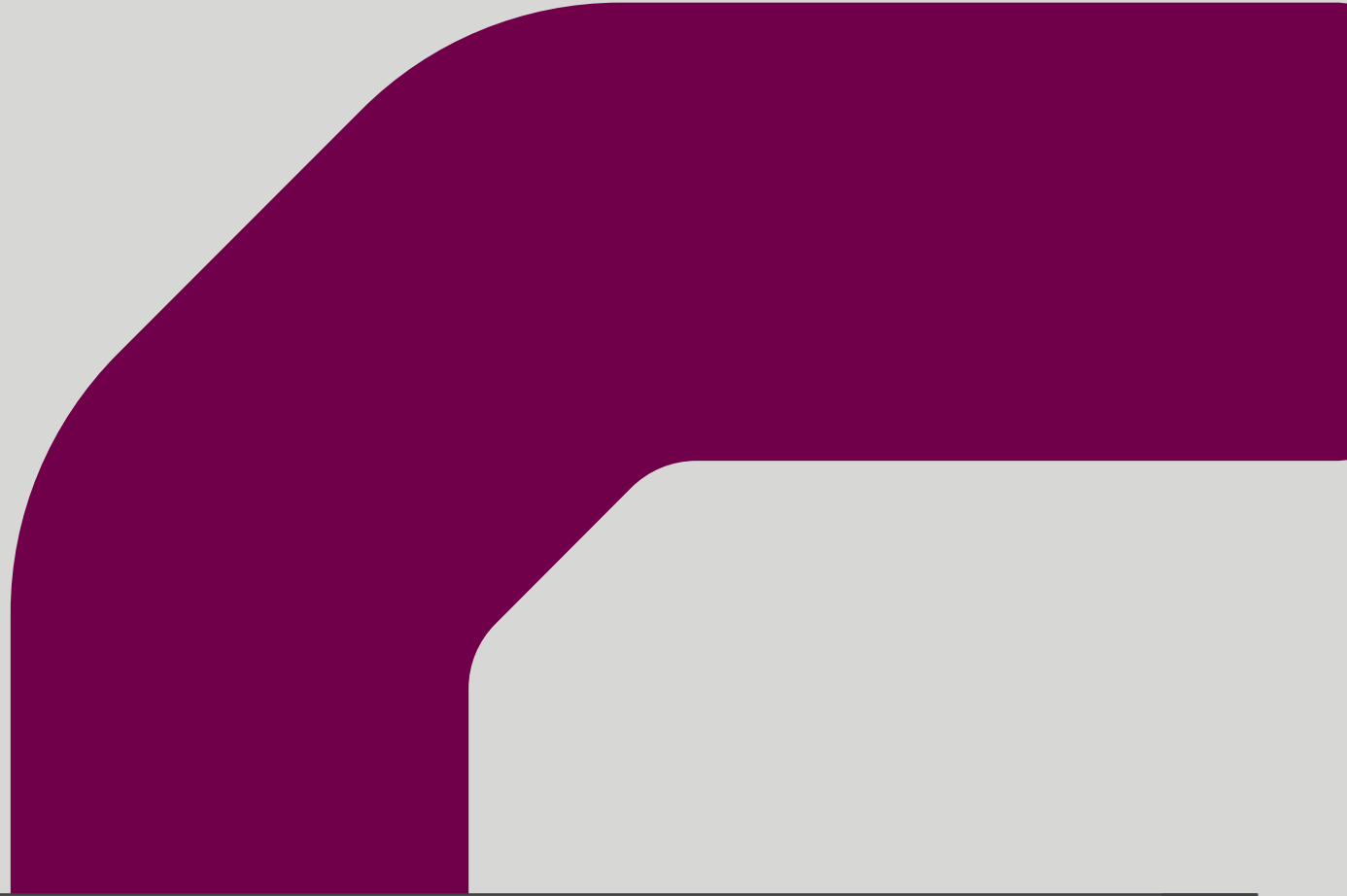
Gaussian kernel function (GKF):

- establishing a grid of nodes where estimates of the SRR are sought.
- All storms within this gridded space can be counted at any given node, but the weight assigned to each storm decreases with increasing distance from storm to node (PDF)



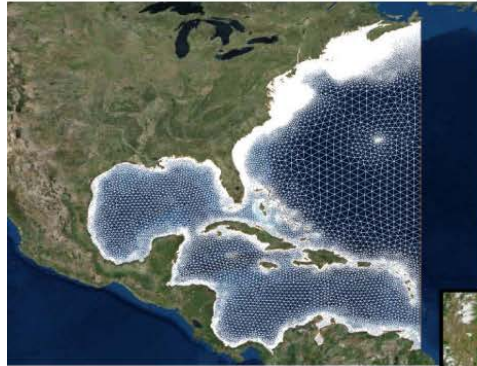


# MODELING APPROACH

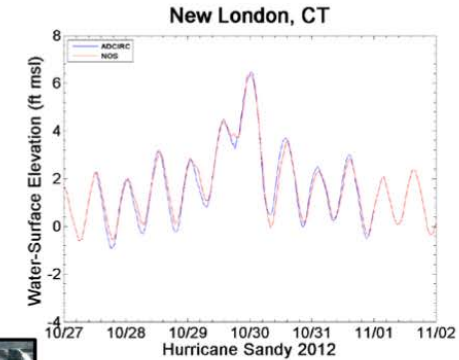


# NACCS

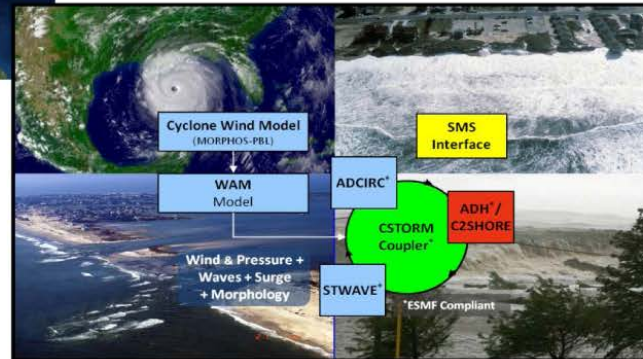
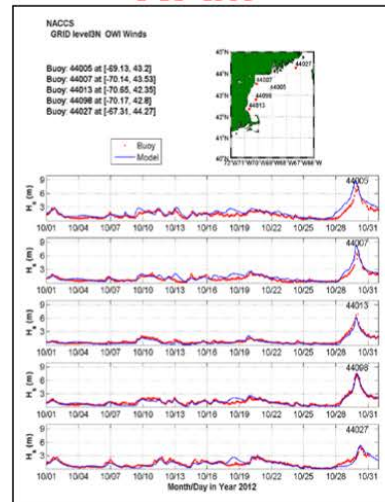
## ADCIRC



## CSTORM-MS High Fidelity Modeling



## WAM



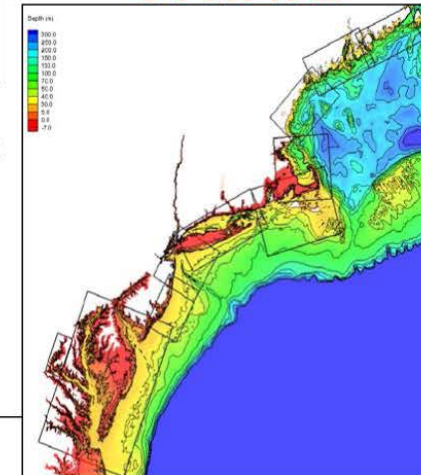
CSTORM-MS: Coastal **STORM** Modeling System

WAM: **WA**ve Prediction **M**odel

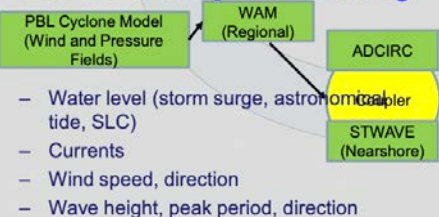
STWAVE: **ST**eady-State Spectral **WA**ve model

ADCIRC: **AD**vance **CIRC**ulation Model

## STWAVE



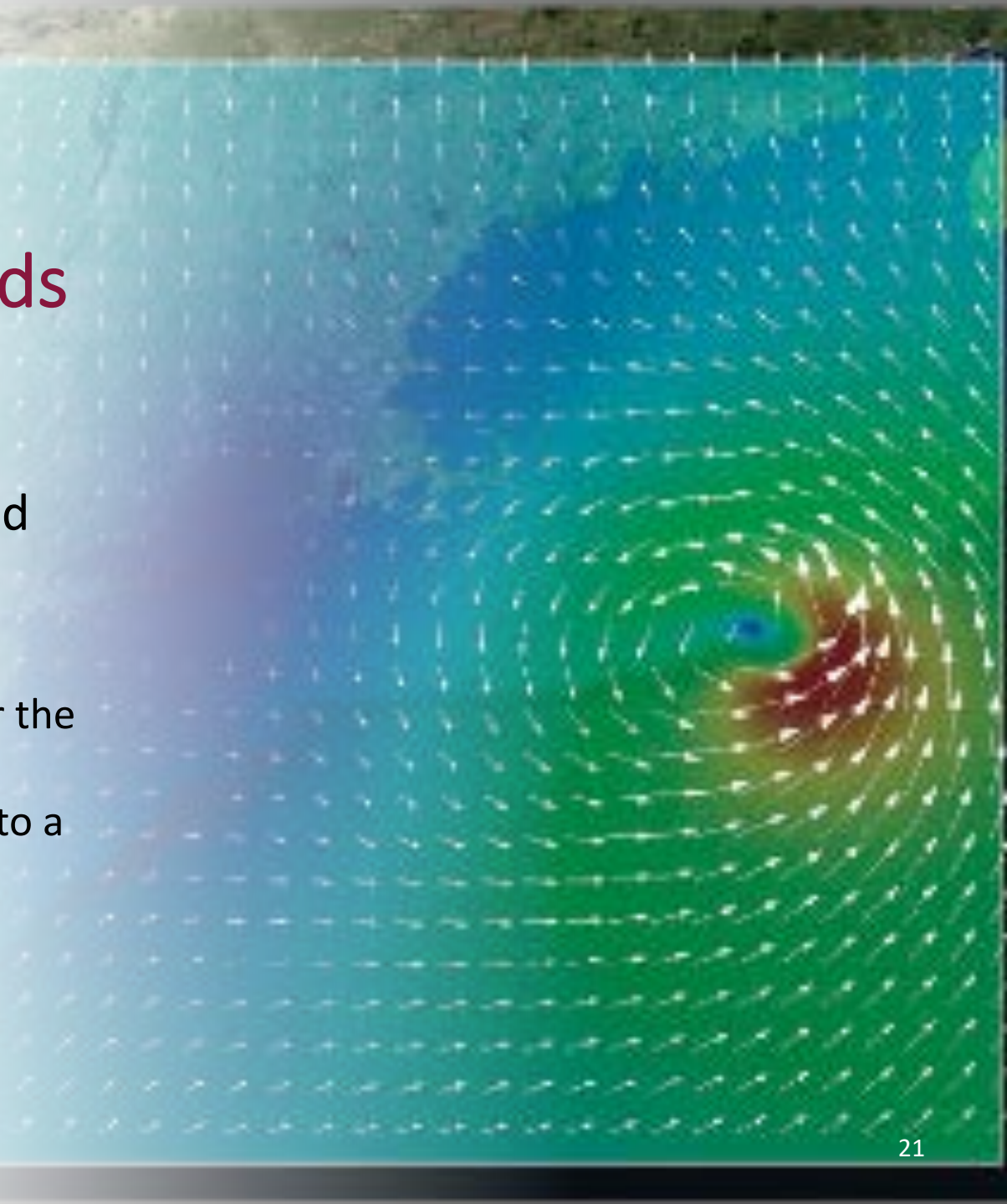
### Climate and Hydro Modeling



# XC and TC wind and pressure fields

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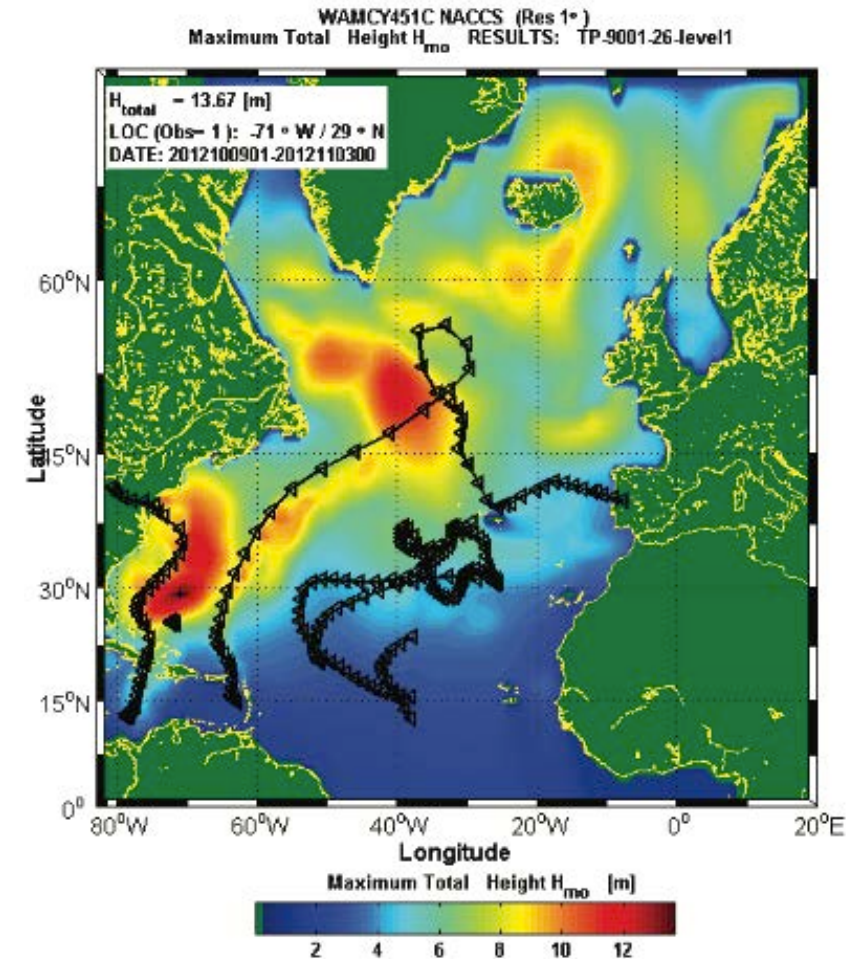
- Planetary Boundary Layer (PBL) model was used for generation of wind and pressure fields.
- Oceanweather Inc. (OWI):
  - generated extratropical wind and pressure fields for the 100 historical XC events
  - expanded the landfall parameters of the 1050 TC into a full track time history to drive the model





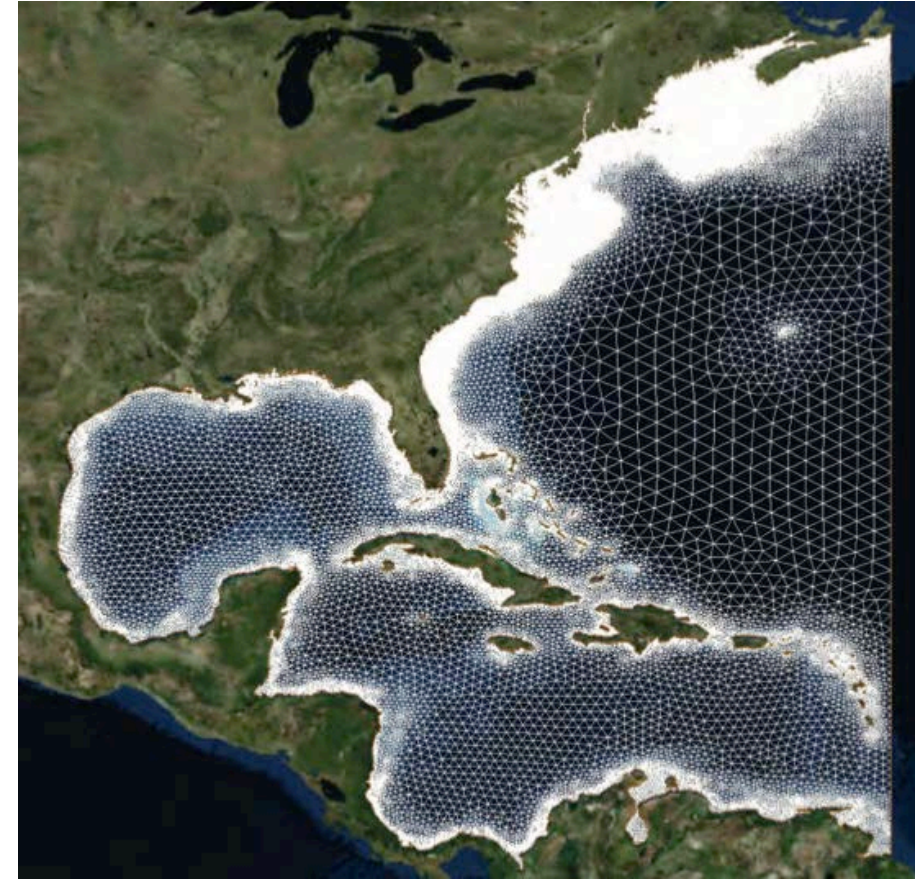
# Offshore Wave Generation

- WAM: simulation of the 100 extratropical and 1050 synthetic tropical storm events
  - to provide offshore deep water wave boundary conditions for the nearshore steady-state wave model STWAVE.
  - Accounting for all wave energy, swell energy in the presence of a high-frequency wind-sea component will be unaffected in the decay stages of a primary storm as energy is transmitted to the coast.



# Storm Surge Modeling

- ADvanced CIRCulation (ADCIRC) model to simulate the surge and circulation response to the storms:
- high resolution in areas of complex shoreline configuration and bathymetry.
- **3.1 million computational nodes**
- **6.2 million elements**
- The largest elements: in the Caribbean Sea, 40km nodal spacing
- The smallest elements nodal spacing: 10 m.
- Flooding and drying of these areas during storms, extracting the 20 m topographic contour

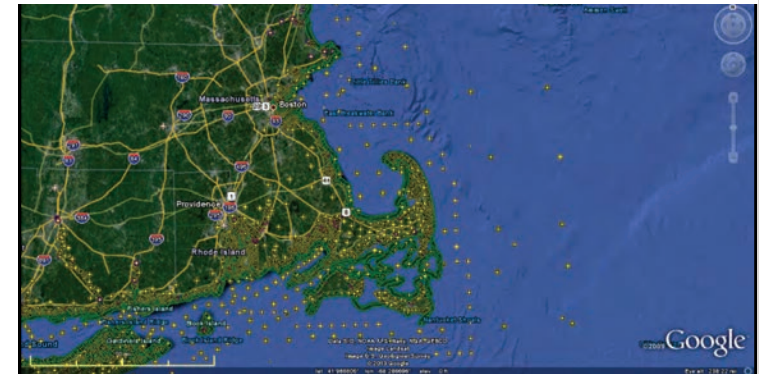
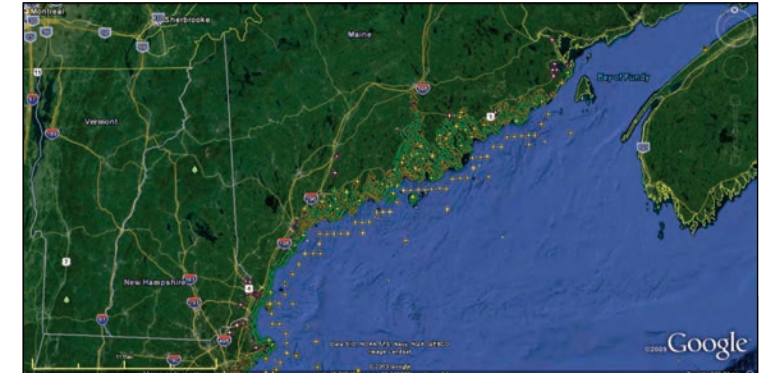




# ADCIRC high-frequency Model Output

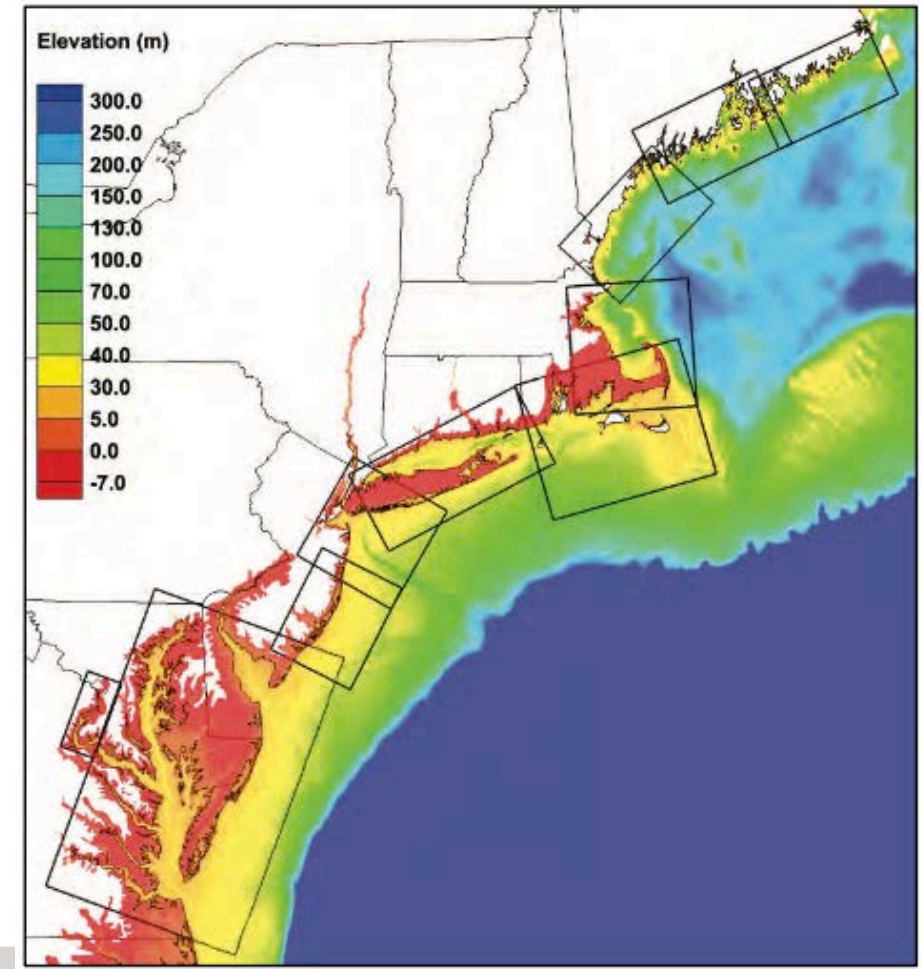
Save-point locations :

- provide useful information at District project sites
- can be applied as boundary forcing conditions for local refined numerical models
- are more easily accessible than the global solutions.
- provide frequent nearshore time-series information for a smaller subset of points
- the total number of save points: ~19k.



# Nearshore Wave Modeling

- State spectral WAVE (STWAVE): simulates nearshore wave transformation, between the offshore and the shoreline (typically depths of less than 40 m)
- Ten STWAVE grids, *tightly* two-way coupled with ADCIRC , to represent the underlying physical processes of the storm events.
- ADCIRC passes water elevations and wind fields to multiple instances of STWAVE. Upon completion, STWAVE passes wave radiation stress gradients to ADCIRC to drive wave-induced water level changes (e.g., wave set- up and setdown).



# NACCS Scenarios

The combination of parameter variations resulted in a total of 1050 tropical storms, and 100 extratropical storms.

1) base condition, was modeled on mean sea level with wave effects but without astronomical tides or long-term sea level change.

2) the same base condition as described in the first set but with each storm modeled on a unique randomly selected tide phase.

3) the same as the second set except that it was modeled with a static water level adjustment of 1.0 m to simulate a potential future global sea level rise (GSLR) scenario.

4) linear superposition of 96 randomly selected tide phases to the base condition set.

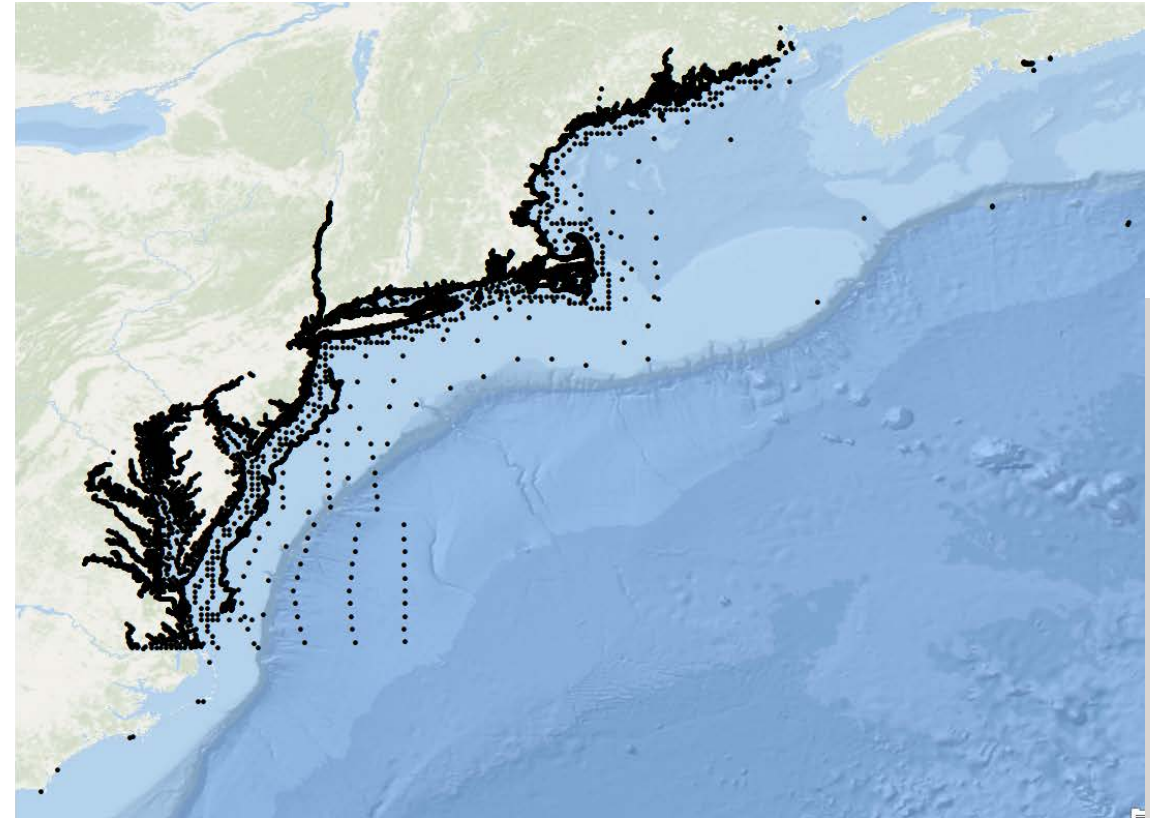


# OUTPUTS

# Output of SavePoints

Storm surge, wave heights, and extremal statistics estimated in from the Joint Probability Analysis:

- Mean water level and significant wave height at 1-yr through 10,000-yr return periods
- 95<sup>th</sup> percentile confidence level water level and significant wave height at 1-yr through 10,000-yr return periods
- 98<sup>th</sup> percentile confidence level water level and significant wave height at 1-yr through 10,000-yr return periods
- Peak (or maximum) water level and wave height from all storm events



# Storm Response Statistical Analysis

- The NACCS JPA model was built based on the historical storm climatology of both TCs and XCs.
- These model save point locations were chosen to ensure optimal coverage of the study region. The joint probabilities of these responses were computed for separate and combined TC and XC statistical families.
- The statistical analysis of the response of the 1150 simulated storms was conducted at nearly 19,000 save point locations to produce response statistics including annual exceedance probability (AEP) and average recurrence interval (ARI).
- In addition, epistemic uncertainty was quantified and represented as confidence levels (CLs).



# Annual Recurrence Interval

- **Recurrence interval** (also called return period or reliability level) is on average how often a given event is expected to occur over a given duration.
- **Annual exceedance probability (AEP)** is the probability that a given event will be equaled or exceeded in any given year.

Decision makers *often* value events with a low probability of occurrence (high reliabilities) for flood protection.

Region/Country	Return period (year)	Reliability level	AEP (%)
The Netherlands	250 – 10,000	1 in 250 – 1 in 10,000	0.4 – 0.01
USA	100 & 500	1 in 100 & 1 in 500	1 & 0.2
Japan	100 – 200	1 in 100 – 1 in 200	1 – 0.5
The United Kingdom	30 – 200	1 in 30 – 1 in 200	3.3 – 0.5
Vietnam	50	1 in 50	2

# Confidence Levels

**Confidence levels (CL)** provide information regarding the reliability or certainty/uncertainty of an unknown value.

A 95<sup>th</sup> percentile confidence level has a 95% probability that the calculated confidence level value encompasses the true value.

Example:

95% CL 100-yr water level = 3.14 m

95% certain that the true 100-yr water level does not exceed 3.14 m

$$CL = \bar{x} + z \frac{\sigma}{\sqrt{n}}$$

$\bar{x}$  = sample mean

$\sigma$  = standard deviation of the sample

$n$  = sample size

$z$  = Z value

Confidence Level (%)	Z-Score
95	1.645
98	2.0

NACCS\_SavePoint\_9137.txt - Notepad

File

Edit

Format

View

Help

NACCS Save Point ID:

9137

Latitude:

41.293900

Longitude:

-71.556900

Depth (NAVD88):

41.0007 meters

Conversion factor (NAVD88 to MSL):

-0.1040

	Water Level (m)		Wave Height (m)	
ARI* (yrs)	Mean	Upper 95% CI	Mean	Upper 95% CI
1	1.08	1.79	4.19	5.41
2	1.25	1.99	5.18	6.40
5	1.49	2.20	6.30	7.46
10	1.66	2.38	7.05	8.19
20	1.82	2.59	7.71	8.84
50	2.05	2.88	8.58	9.70
100	2.25	3.14	9.14	10.26
200	2.49	3.43	9.65	10.78
500	2.86	3.79	10.22	11.35
1,000	3.12	4.05	10.57	11.70
2,000	3.36	4.30	10.89	12.04
5,000	3.64	4.58	11.36	12.56
10,000	3.84	4.77	11.88	13.13

\*ARI = Annual Recurrence Interval

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100%

Windows (CRLF)

UTF-8

# NACCS Outputs

- Compute probabilities of coastal storm parameters

## Output

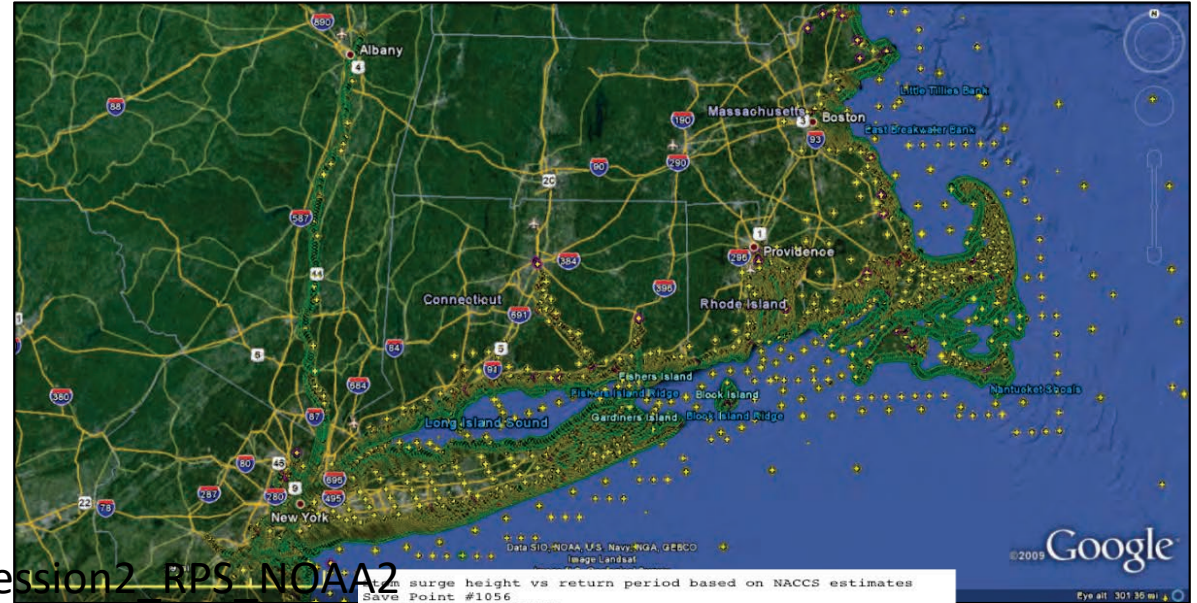
- Data at Save Points (not full grid)
- 1-10,000 year return periods:

### ADCIRC model save points

- Storm recurrence rates
- Peak water levels from
  - 1050 Tropical Cyclone simulations (synthetic)
  - 100 Extra Tropical simulations (historical)
- Water level return periods with associated confidence intervals

### STWAVE model save points

- Peak wave heights from STWAVE

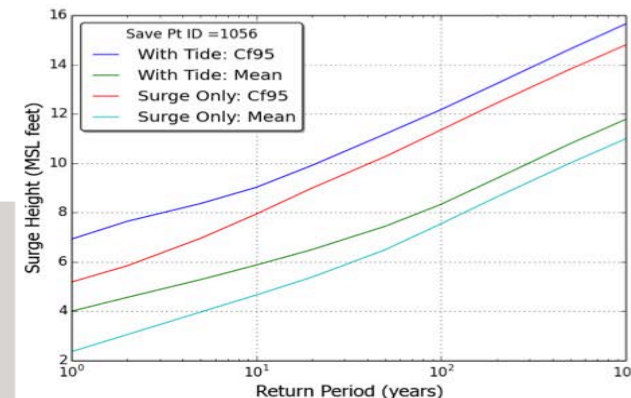


NACCS\_session2\_RPS\_NOAA2

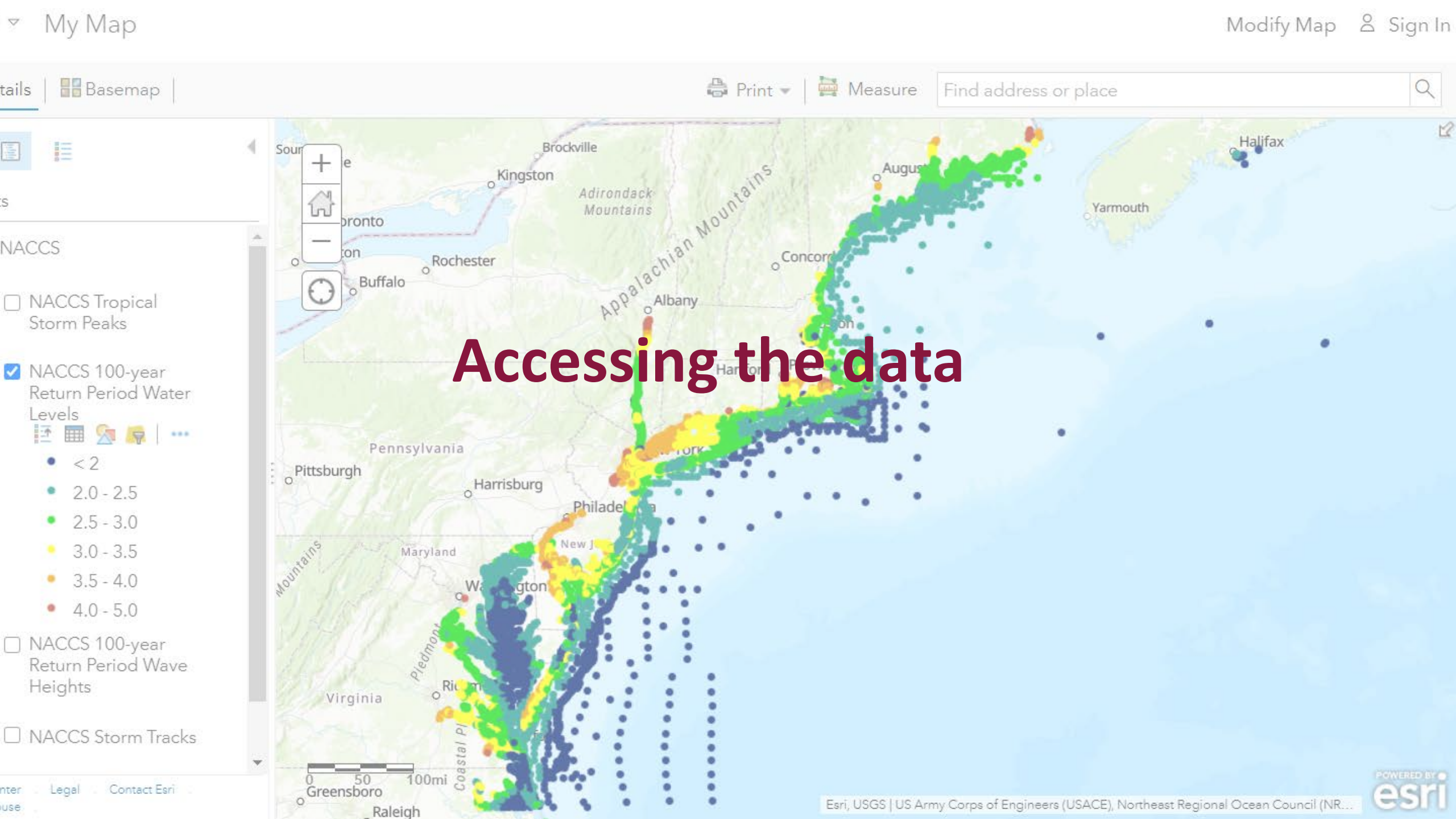
Storm surge height vs return period based on NACCS estimates

Save Point #1056  
Latitude 41.44474  
Longitude -71.34537

Return Period (yrs)	Surge Only		With Tide	
	Mean	Upper 95% Confidence	Mean	Upper 95% Confidence
1	0.72 (m)	2.4 (ft)	1.22 (m)	4.0 (ft)
2	0.93	3.1	1.39	4.6
5	1.21	4.0	1.61	5.3
10	1.42	4.7	1.79	5.9
20	1.64	5.4	1.98	6.5
50	1.98	6.5	2.27	7.4
100	2.30	7.5	2.54	8.3
200	2.63	8.6	2.86	9.4
500	3.05	10.0	3.29	10.8
1000	3.35	11.0	3.59	11.8
2000	3.63	11.9	3.89	12.8
5000	3.96	13.0	4.24	13.9
10000	4.19	13.7	4.49	14.7





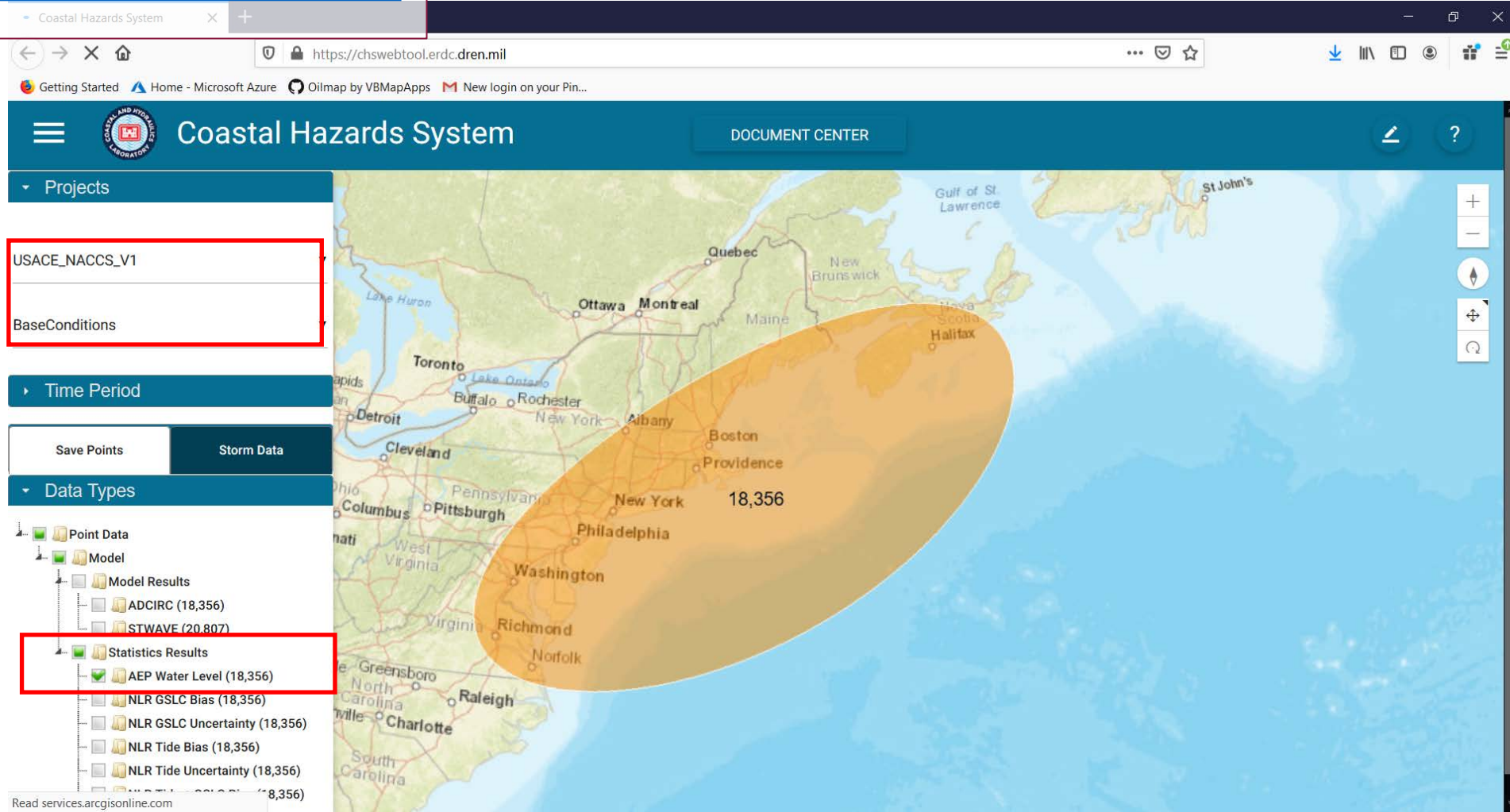




# USACE COASTAL HAZARDS SYSTEM PORTAL

Full dataset:

<https://chswbtool.erdc.dren.mil/>



# USACE COASTAL HAZARDS SYSTEM PORTAL

Coastal Hazards System

← → ↺ ↻

https://chswebtool.erdc.dren.mil

Getting Started Home - Microsoft Azure Oilmap by VBMapApps New login on your Pin...

Coastal and Hydraulics Laboratory

Coastal Hazards System

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↶

SUBMIT

CLEAR ?

▼ Projects

USACE\_NACCS\_V1

BaseConditions

▶ Time Period

Save Points

Storm Data

▼ Data Types

Point Data

Model

- Model Results
  - ADCIRC (18,356)
  - STWAVE (20,807)
- Statistics Results
  - ☒ AEP Water Level (18,356)
  - ☐ NLR GSLC Bias (18,356)
  - ☐ NLR GSLC Uncertainty (18,356)
  - ☐ NLR Tide Bias (18,356)
  - ☐ NLR Tide Uncertainty (18,356)
  - ☐ NLR Tide + GSLC Bias (18,356)

Rochester

Dover

Maine

Portland

Hampden

Amesbury

Haverhill

Newburyport

Ipswich

Sturbridge

Peabody

+

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No legend

The logo for RPS, consisting of the letters 'rps' in a stylized, lowercase, purple font.

# USACE COASTAL HAZARDS SYSTEM PORTAL

Coastal Hazards System

Model ResultsObservationsAEP ResultsNLR Results

Annual Exceedance Probability

Display AEPDownload

Save Point ID	Results	Region/Simulation	Project	Latitude	Longitude
<input type="checkbox"/>	8968 AEP	BaseConditions	USACE_NACCS_V1	43.0774	-70.7201
<input type="checkbox"/>	7229 AEP	BaseConditions	USACE_NACCS_V1	43.0833	-70.7333
<input type="checkbox"/>	8965 AEP	BaseConditions	USACE_NACCS_V1	43.0862	-70.7601
<input type="checkbox"/>	7392 AEP	BaseConditions	USACE_NACCS_V1	43.0733	-70.7183
<input type="checkbox"/>	7049 AEP	BaseConditions	USACE_NACCS_V1	43.0717	-70.7117
<input checked="" type="checkbox"/>	7390 AEP	BaseConditions	USACE_NACCS_V1	43.0783	-70.7517
<input type="checkbox"/>	8966 AEP	BaseConditions	USACE_NACCS_V1	43.0795	-70.7478
<input type="checkbox"/>	7230 AEP	BaseConditions	USACE_NACCS_V1	43.0795	-70.7433
<input type="checkbox"/>	18967 AEP	BaseConditions	USACE_NACCS_V1	43.0739	-70.7376
<input type="checkbox"/>	7391 AEP	BaseConditions	USACE_NACCS_V1	43.0733	-70.7118
<input type="checkbox"/>	7231 AEP	BaseConditions	USACE_NACCS_V1	43.0817	-70.745

Projects

USACE\_NACCS\_V1

BaseConditions

Time Period

Save PointsStorm Data

Data Types

Point Data

Model

Model Results

ADCIRC (18,356)

STWAVE (20,807)

Statistics Results

AEP Water Level (18,356)

NLR GSLC Bias (18,356)

NLR GSLC Uncertainty (18,356)

NLR Tide Bias (18,356)

NLR Tide Uncertainty (18,356)

NLR Tide + GSLC Bias (18,356)

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# USACE COASTAL HAZARDS SYSTEM PORTAL

Coastal Hazards System

https://chswebtool.erdc.dren.mil

Getting Started Home - Microsoft Azure Oilmap by VBMapApps New login on your Pin...

Coastal Hazards System

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Projects

USACE\_NACCS\_V1

BaseConditions

Time Period

Save Points

Storm Data

Data Types

Point Data

Model

Model Results

ADCIRC (18,356)

STWAVE (20,807)

Statistics Results

AEP Water Level (18,356)

NLR GSLC Bias (18,356)

NLR GSLC Uncertainty (18,356)

NLR Tide Bias (18,356)

NLR Tide Uncertainty (18,356)

NLR Tide + GSLC Bias (18,356)

Model Results

Observations

AEP Results

NLR Results

AEP Filter: 

LOAD RECORDS

Save Points → AEP

Display Selected Statistics Values Back

Save Point ID	Data Type ID	Data Type	Parameters	Units	
<input type="checkbox"/>	7390	1	NACCS_CC_SimB_Post0_Stat_WL_AEP	Confidence Limit 84 for AEP	m
<input type="checkbox"/>	7390	1	NACCS_CC_SimB_Post0_Stat_WL_AEP	Confidence Limit 90 for AEP	m
<input type="checkbox"/>	7390	1	NACCS_CC_SimB_Post0_Stat_WL_AEP	Confidence Limit 95 for AEP	m
<input type="checkbox"/>	7390	1	NACCS_CC_SimB_Post0_Stat_WL_AEP	Confidence Limit 98 for AEP	m
<input type="checkbox"/>	7390	1	NACCS_CC_SimB_Post0_Stat_WL_AEP	Expected Value AEP	m

No legend





# USACE COASTAL HAZARDS SYSTEM PORTAL

Coastal Hazards System

Model ResultsObservationsAEP ResultsNLR Results

Values → AEP

Save Data

Point ID	Type ID	Data Type	Parameter	Units	Values
7390	1	NACCS_CC_SimB_Post0_Stat_WL_AEP	Confidence Limit 84 for AEP	m	1.24650200867221 1.55969292122703 1.87563805212522 2.05695303714699 2.20269379305643 2.35281466284956 2.4479297754714 2.59230184663445 2.92341203699928 3.22374871648007 3.56999800867654 3.98890858275366 4.24643747606768

Projects

USACE\_NACCS\_V1

BaseConditions

Time Period

Save PointsStorm Data

Data Types

Point Data

Model

Model Results

ADCIRC (18,356)

STWAVE (20,807)

Statistics Results

AEP Water Level (18,356)

NLR GSLC Bias (18,356)

NLR GSLC Uncertainty (18,356)

NLR Tide Bias (18,356)

NLR Tide Uncertainty (18,356)

NLR Tide + GSLC Bias (18,356)

DOCUMENT CENTER

+

?

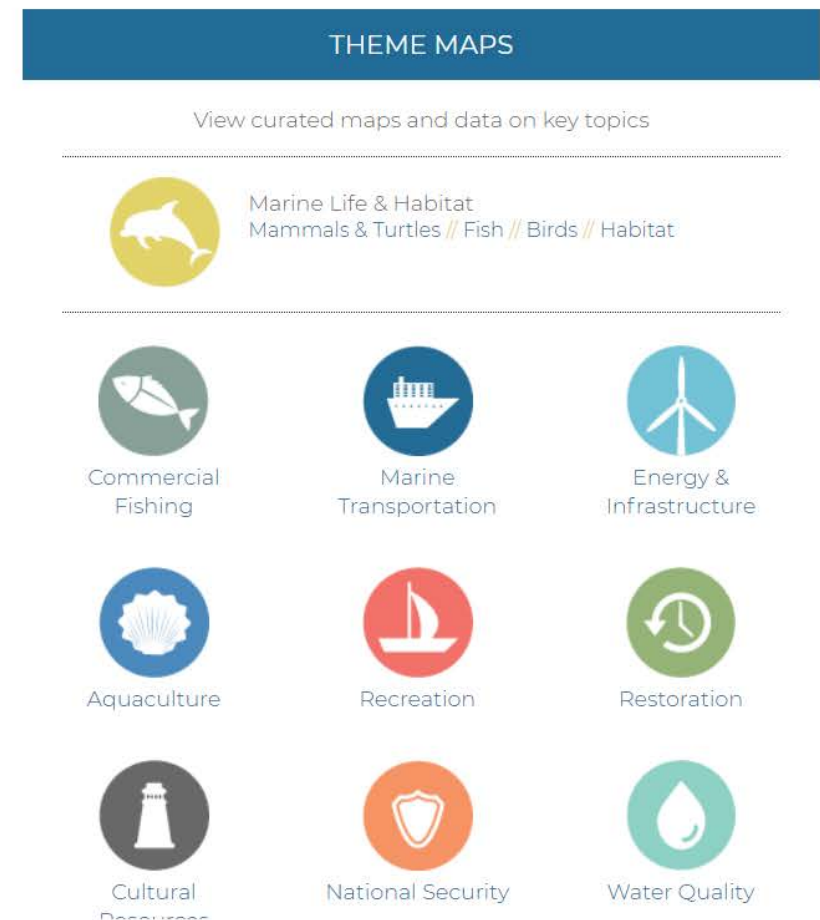
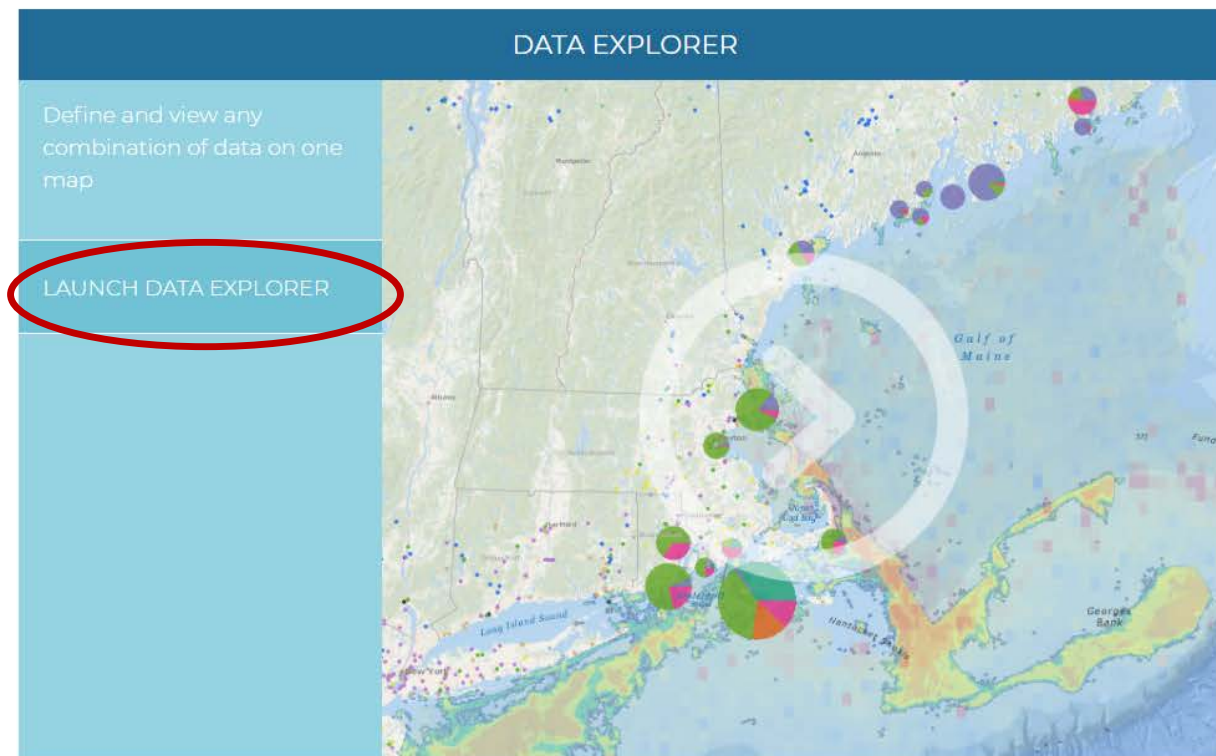
No legend



# NORTHEAST OCEAN DATA, DATA EXPLORER

Dataset: [northeastoceandata.org](https://www.northeastoceandata.org/)

<https://www.northeastoceandata.org/>





# NORTHEAST OCEAN DATA, DATA EXPLORER

NORTHEAST OCEAN DATA

HOME WHAT'S NEW? CURRENT ISSUES THEME MAPS DATA EXPLORER DOWNLOAD ABOUT

## DATA EXPLORER

Turn all Layers Off



All Layers

Active Layers (1)

Keyword Search

✓ Physical Oceanography

☐ Ocean Observing  
Buoys and Stations

☐ Contours - Mean  
Annual Offshore  
Wind Speed (m/s)

☒ NACCS Tropical  
Storm Peak Water  
Levels (meters)

☐ NACCS 100-year  
Return Period  
Water Levels  
(meters)

☐ NACCS 100-year  
Return Period Wave  
Heights (meters)

☐ NACCS Storm  
Tracks

➤ Bathymetry & Imagery

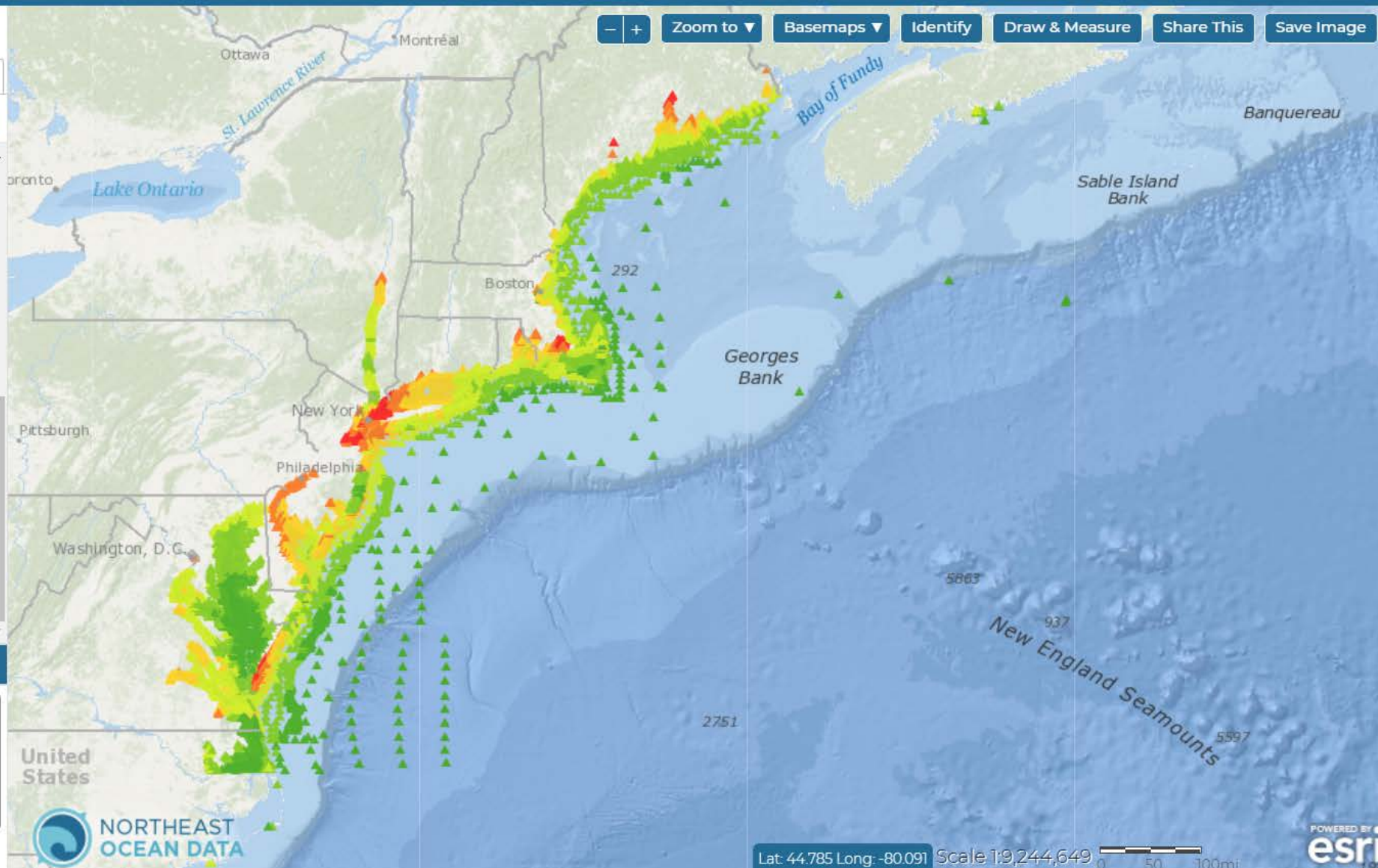
➤ Demography and Economy

Legend >

NACCS Tropical Storm Peak Water Levels  
(meters)

▲ < 3

▲ 3 - 4

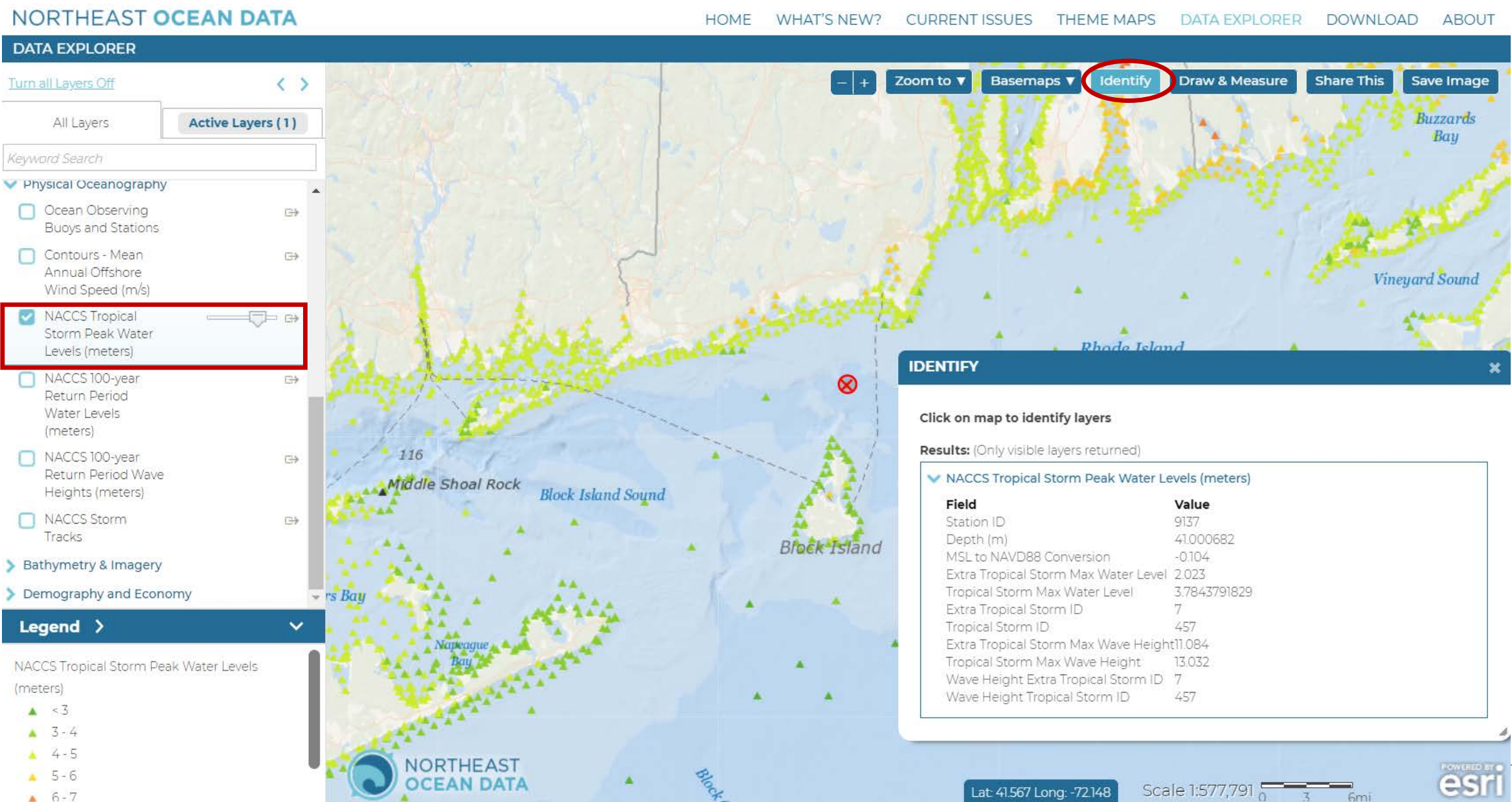


NORTHEAST  
OCEAN DATA

Lat: 44.785 Long: -80.091 Scale 1:9,244,649 0 50 100mi

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esri

# NORTHEAST OCEAN DATA, DATA EXPLORER





# NORTHEAST OCEAN DATA, DATA EXPLORER

## NORTHEAST OCEAN DATA

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### DATA EXPLORER

Turn all Layers Off



All Layers

Active Layers (1)

Keyword Search

#### Physical Oceanography

☐ Ocean Observing  
Buoys and Stations

☐ Contours - Mean  
Annual Offshore  
Wind Speed (m/s)

☐ NACCS Tropical  
Storm Peak Water  
Levels (meters)

☒ NACCS 100-year  
Return Period  
Water Levels  
(meters)

☐ NACCS 100-year  
Return Period Wave  
Heights (meters)

☐ NACCS Storm  
Tracks

#### Bathymetry & Imagery

#### Demography and Economy

### Legend

NACCS 100-year Return Period Water Levels  
(meters)

- < 2
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0



Zoom to

Basemaps

Identify

Draw & Measure

Share This

Save Image

### IDENTIFY

Click on map to identify layers

Results: (Only visible layers returned)

#### NACCS 100-year Return Period Water Levels (meters)

Field	Value
Station ID	9137
Depth (m)	41.000682
MSL to NAVD88 Conversion	-0.104
Water Level ARI 1yr	1.0771294007535672
Water Level ARI 2yr	1.2530672263239735
Water Level ARI 5yr	1.4856553395632877
Water Level ARI 10yr	1.655547748390331
Water Level ARI 20yr	1.8214340803178892
Water Level ARI 50yr	2.048032251254438
Water Level ARI 100yr	2.2475535664624946
Water Level ARI 200yr	2.4947368068131928
Water Level ARI 500yr	2.8581121338967295
Water Level ARI 1000yr	3.119378716204528
Water Level ARI 2000yr	3.3605677542764782
Water Level ARI 5000yr	3.644648426065448
Water Level ARI 10000yr	3.8364215032059663



Lat: 41.045 Long: -72.275

Scale 1:577,791

0 3 6mi

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# NORTHEAST OCEAN DATA, DATA EXPLORER

NORTHEAST OCEAN DATA

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DATA EXPLORER

Turn all Layers Off



All Layers

Active Layers (1)

Keyword Search

## Physical Oceanography

☐ Ocean Observing  
Buoys and Stations

☐ Contours - Mean  
Annual Offshore  
Wind Speed (m/s)

☐ NACCS Tropical  
Storm Peak Water  
Levels (meters)

☐ NACCS 100-year  
Return Period  
Wave Levels  
(meters)

☒ NACCS 100-year  
Return Period Wave  
Heights (meters)

☐ NACCS Storm  
Tracks

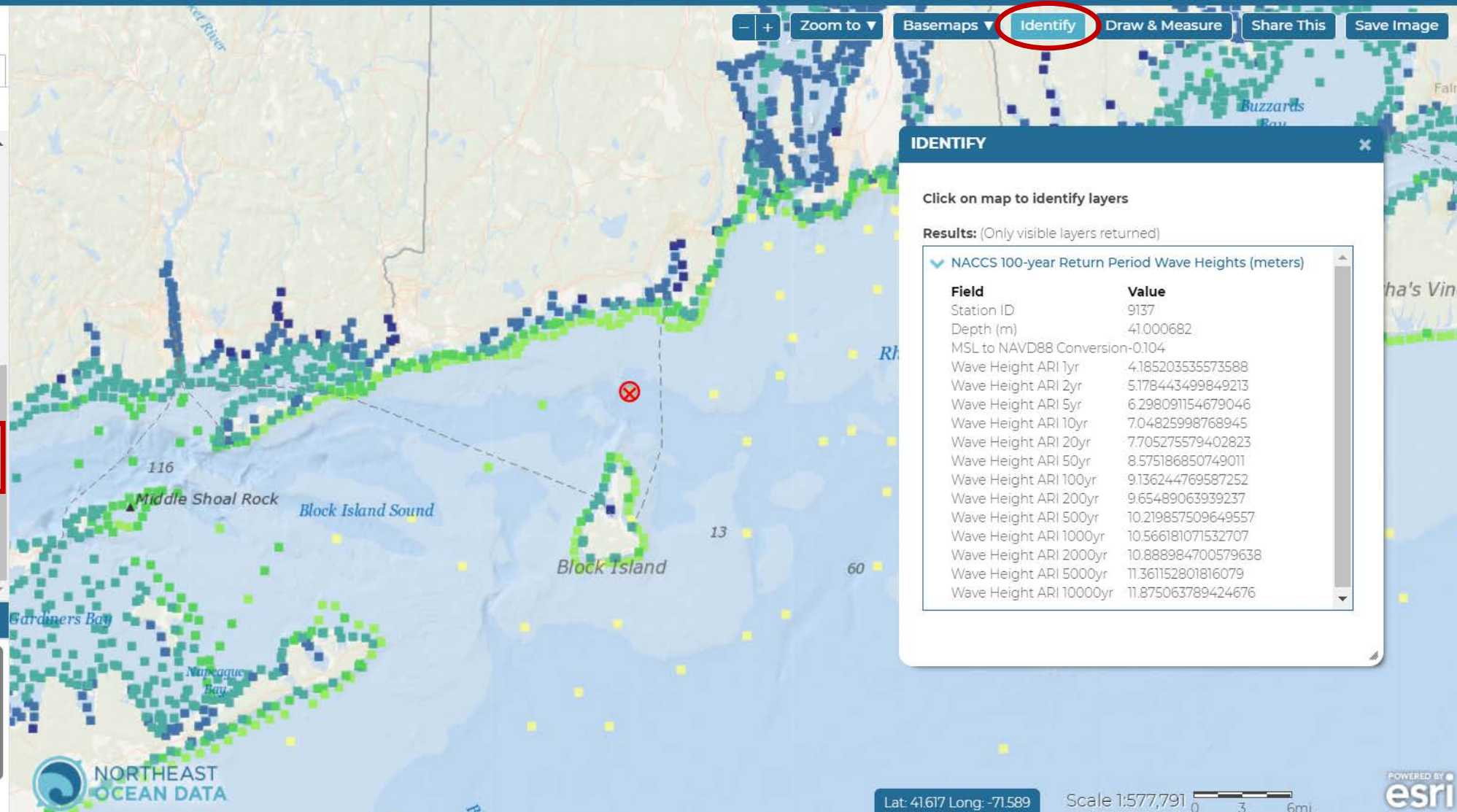
## Bathymetry & Imagery

## Demography and Economy

Legend

NACCS 100-year Return Period Wave Heights  
(meters)

- < 1
- 1 - 2
- 2 - 4
- 4 - 6
- 6 - 8



Zoom to

Basemaps

Identify

Draw & Measure

Share This

Save Image

## IDENTIFY

Click on map to identify layers

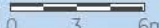
Results: (Only visible layers returned)

### NACCS 100-year Return Period Wave Heights (meters)

Field	Value
Station ID	9137
Depth (m)	41.000682
MSL to NAVD88 Conversion	-0.104
Wave Height ARI 1yr	4.185203535573588
Wave Height ARI 2yr	5.178443499849213
Wave Height ARI 5yr	6.298091154679046
Wave Height ARI 10yr	7.04825998768945
Wave Height ARI 20yr	7.705275579402823
Wave Height ARI 50yr	8.575186850749011
Wave Height ARI 100yr	9.136244769587252
Wave Height ARI 200yr	9.65489063939237
Wave Height ARI 500yr	10.219857509649557
Wave Height ARI 1000yr	10.566181071532707
Wave Height ARI 2000yr	10.888984700579638
Wave Height ARI 5000yr	11.361152801816079
Wave Height ARI 10000yr	11.875063789424676

Lat: 41.617 Long: -71.589

Scale 1:577,791



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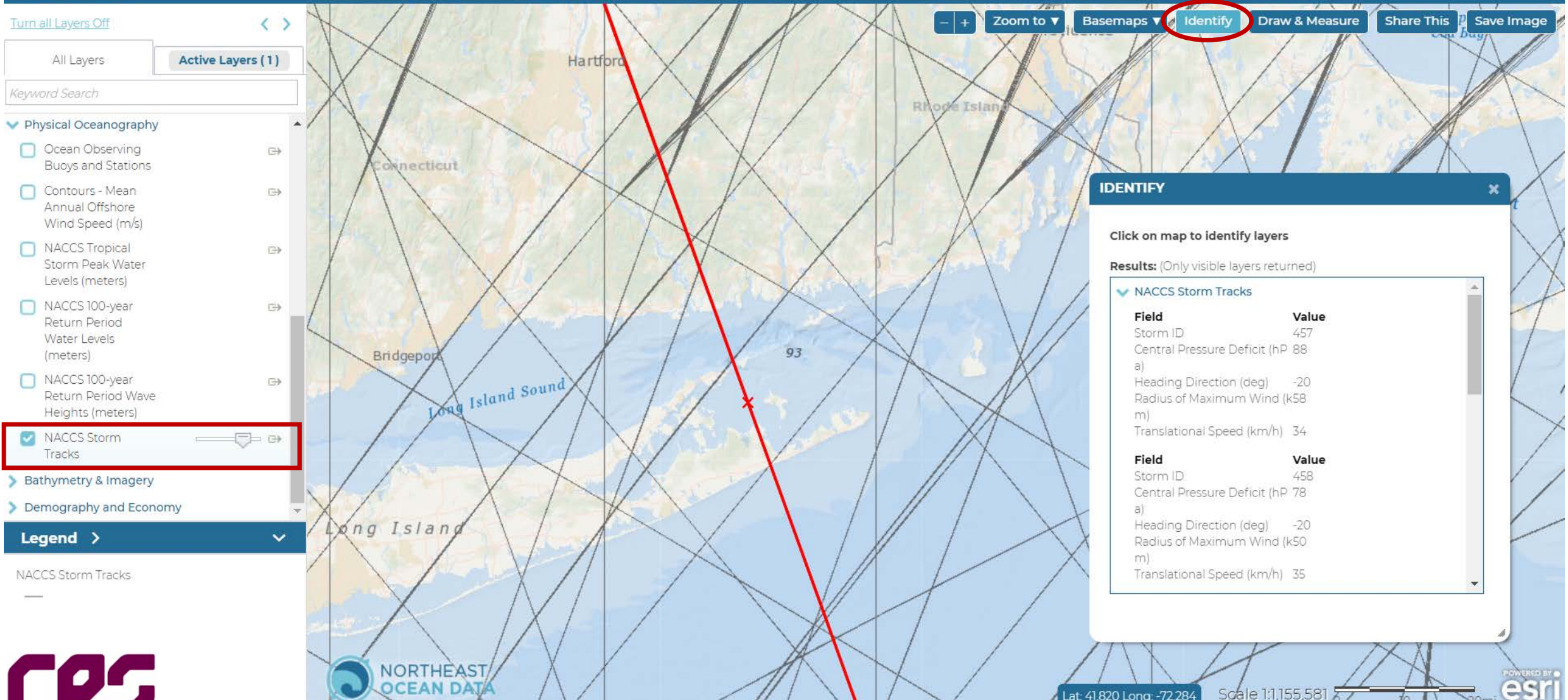


# NORTHEAST OCEAN DATA, DATA EXPLORER

NORTHEAST OCEAN DATA

HOME WHAT'S NEW? CURRENT ISSUES THEME MAPS DATA EXPLORER DOWNLOADS ABOUT

DATA EXPLORER



# NACCSapi

## Dataset:

<http://52.73.191.103:3000/>

## Output format: JSON/GEOJSON

Supply a bounding box of lat.,  
lon. (xmin,ymin,xmax,ymax):

- EX: <http://52.73.191.103:3000/points?bbox=-67%2C44%2C-66%2C45>

Supply a savepoint ID to find:

- EX: <http://52.73.191.103:3000/points/160>

Supply a storm ID to find lat., Lon. of storm track:

- EX: <http://52.73.191.103:3000/storms/800>



Download  
API Blueprint

INTRODUCTION

Useful Links

JSON and JSONP Formatting

Status Codes

REFERENCE

NACCS

## NACCSapi

INTRODUCTION

NACCSapi is a simple REST API allowing consumers to view US Army Corps of Engineers' North Atlantic Coast Comprehensive Study (NACCS) storm and save point data.

### Useful Links

- Coastal Hazards System
- North Atlantic Coast Comprehensive Study Report

### JSON and JSONP Formatting

NACCSapi only supports a single format, JSON/GeoJSON. JSONP is also supported by adding a callback parameter to your request.

### Status Codes

A full table of status codes will be added during development

< > ↺ ⚠ Not secure | 52.73.191.

```
{
  "ari": {
    "hs": {
      "c195": [
        4.284791410751952,
        4.8183699260129655,
        5.0738041436542,
        5.233671359449066,
        5.355428045560015,
        5.464823633890457,
        5.532641131089286,
        5.60018791021468,
        5.63691945057449,
        5.664705788198957,
        5.692492125823425,
        5.729223666183235,
        5.757010003807703
      ],
      "c198": [
        4.617436019662394,
        5.154188617146605,
        5.434642071289945,
        5.598369948956604,
        5.709240159743746,
        5.828043741119517,
        5.884201849679709,
        5.9403599582399,
        6.006873877542793,
        6.033319418127023,
        6.059764958711251,
        6.094724061794028,
        6.121169602378257
      ],
      "mean": [
        3.106406621339403,
        3.532655425096768,
        3.8140133720358915,
        3.9707522241882174,
        4.084405584124864,
        4.210948371671753,
        4.263592332362431,
        4.316236293053109,
        4.385827823716262,
        4.435384244874337,
        4.483803283007068,
        4.547809769842149,
        4.596228807974881
      ],
      "tsid": [

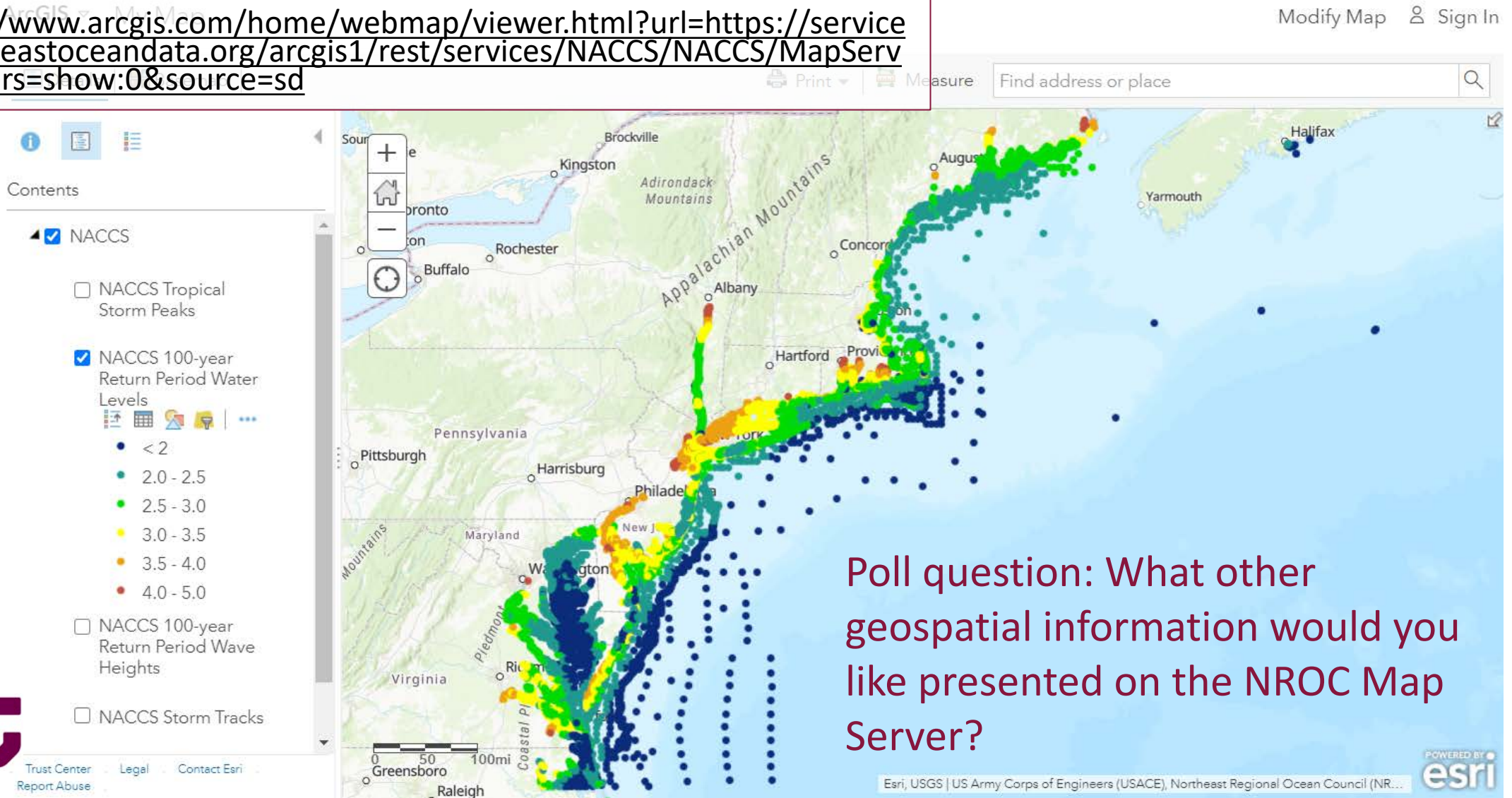
```



# NROC ARCGIS MAP SERVER

## Dataset:

<https://www.arcgis.com/home/webmap/viewer.html?url=https://services.northeastoceandata.org/arcgis1/rest/services/NACCS/NACCS/MapServer?layers=show:0&source=sd>



Poll question: What other geospatial information would you like presented on the NROC Map Server?

ArcGIS ▾ My Map

Details | Basemap

Print Measure

Find address or place

[About](#) [Content](#) [Legend](#)

 NACCS



  $< 3$

3-4

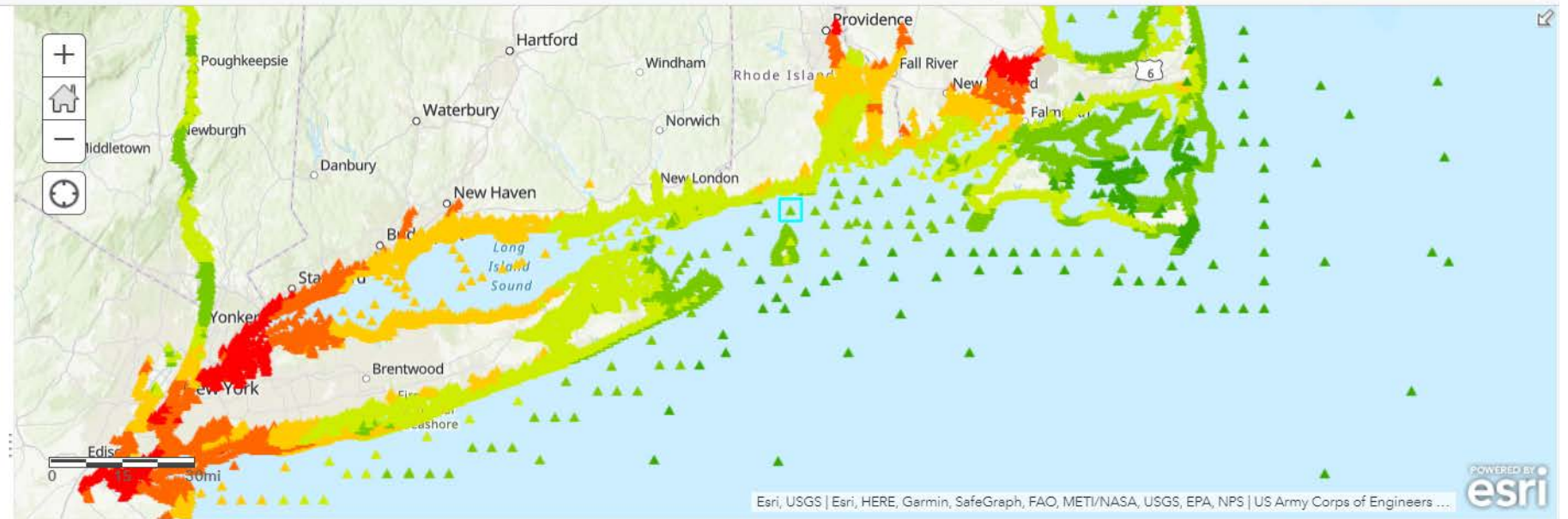
4-5

5-6

4 7

☐ NACCS Storm Tracks

►  Topographic



NACCS Tropical Storm Peak Water Levels (meters) (Features: 16326, Selected: 1)

Station ID	Depth (m)	MSL to NAVD88 Conversion	Extra Tropical Storm Max Water Level	Tropical Storm Max Water Level	Extra Tropical Storm ID	Tropical Storm ID	Extra Tropical Storm Depth (m)	Tropical Storm Depth (m)
1	6.93		3.62	4.65	41	570		
2	5.52	-0.04	3.43	4.54	41	815		
3	9.98		3.40	4.42	41	815		
4	10.03	-0.04	2.75	4.09	41	809	5.63	
5	9.70	-0.04	2.73	4.14	41	809	4.29	
6	3.70	-0.05	2.78	5.04	41	809	5.80	

[gal](#) [Contact Esri](#) [Report Abuse](#)



Modify Map  Sign In



# NROC ARCGIS MAP SERVER

ArcGIS My Map

Modify Map Sign In

DetailsBasemap

AboutContentLegend

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☐ NACCS Tropical Storm Peak Water Levels (meters)

☐ NACCS 100-year Return Period Water Levels (meters)

☒ NACCS 100-year Return Period Wave Heights (meters)

< 1

1 - 2

2 - 4

4 - 6

6 - 8

8 - 15

☐ NACCS Storm Tracks

☒ Topographic

PrintMeasureFind address or place

015

Esri, USGS | Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS | US Army Corps of Engineers ...

POWERED BY esri

NACCS 100-year Return Period Wave Heights (meters) (Features: 16326, Selected: 1)

Station ID	Depth (m)	MSL to NAVD88 Conversion	Wave Height ARI 1yr	Wave Height ARI 2yr	Wave Height ARI 5yr	Wave Height ARI 10yr	Wave Height ARI 25yr	Wave Height ARI 50yr
1	6.93							
2	5.52	-0.04						
3	9.98							
4	10.03	-0.04	1.06	1.28	1.49	1.61	1.67	
5	9.70	-0.04	1.11	1.35	1.52	1.63	1.71	
6	3.70	-0.05	0.74	0.84	0.94	1.01	1.05	
7	7.44	-0.06	3.81	4.97	5.28	5.44	5.54	
8	16.24	-0.08	1.10	1.58	2.00	2.25	2.43	

Show Selected Records

Center on Selection

Clear Selection

Show/Hide Columns

Filter

rps

Contact EsriReport Abuse



# NROC ARCGIS MAP SERVER

Details | Basemap

About | Content | Legend

Contents

☒ NACCS

☐ NACCS Tropical Storm Peak Water Levels (meters)

☐ NACCS 100-year Return Period Water Levels (meters)

☐ NACCS 100-year Return Period Wave Heights (meters)

☒ NACCS Storm Tracks

☐ Topographic

+

Home

−

Clock

15

30mi

Esri, USGS | Esri, HERE, Garmin, FAO, METI/NASA, USGS, EPA, NPS | US Army Corps of Engineers (USACE), N...

esri

NACCS - NACCS Storm Tracks (Features: 1050, Selected: 6)

Storm ID	Central Pressure Deficit (hPa)	Heading Direction (deg)	Radius of Maximum Wind (km)	
1	88.00	-60.00	39.00	18
2	78.00	-60.00	108.00	29
3	68.00	-60.00	62.00	42
4	58.00	-60.00	47.00	32.00
5	48.00	-60.00	64.00	12.00

# Additional ways to access the GIS data

1. Download the geodatabase and open in ArcGIS Desktop or ArcGIS Pro
2. Access the 4 map services (just a subset of the data – not the full geodatabase):
  - a) Connecting to the Northeast Ocean Data Portal GIS Server:
    - Connect through ArcGIS Desktop or Pro as a “user” (no credentials are required), need the URL  
(<https://services.northeastoceandata.org/arcgis1>)
  - b) Using ArcGIS Online can add map services to an ArcGIS Online Map

Poll question: Which software do you use to present coastal flooding geospatial datasets?



A map of the North Atlantic region, including parts of North America, Europe, and Greenland. The map is overlaid with a geodatabase of data points. The points are color-coded: green, yellow, and orange. They are distributed along the coastlines and in the open ocean. A blue rectangular box highlights a specific area in the central North Atlantic. The text "NROC ArcGIS Geodatabase" is overlaid on the map in a large, bold, dark red font.

# NROC ArcGIS Geodatabase

# Downloading the Geodatabase

## Website:

<https://www.northeastoceancouncil.org/naccs/>

## Dataset:

<http://www.northeastoceandata.org/files/metadata/NACCS/NACCS.zip>

- Annual recurrence interval statistics for storm surge and wave height

The database system is designed to connect easily to a range of web portals and online viewers hosted by NROC states:

- The final database and API (<http://docs.naccs.apiary.io/#>) are hosted by the Northeast Regional Association of Coastal Ocean Observing Systems (NERACOOS).
- Web services hosted by Northeast Ocean Data allow ArcGIS users to access the NACCS data.

### For More Information:

- USACE North Atlantic Coast Comprehensive Study Website
- USACE NACCS Main Report
- [USACE Report – NACCS Coastal Storm Model Simulations: Waves and Water Levels](#)
- Presentation by RPS ASA at NROC Meeting (February 2017)
- Geodatabase object relationship diagram

### Download:

- Metadata
- ArcGIS file geodatabase

### ArcGIS Services:

<http://50.19.218.171/arcgis1/rest/services/NACCS/NACCS/MapServer>

### NACCS API:

<http://docs.naccs.apiary.io/#>

### Links to the NACCS Maps:

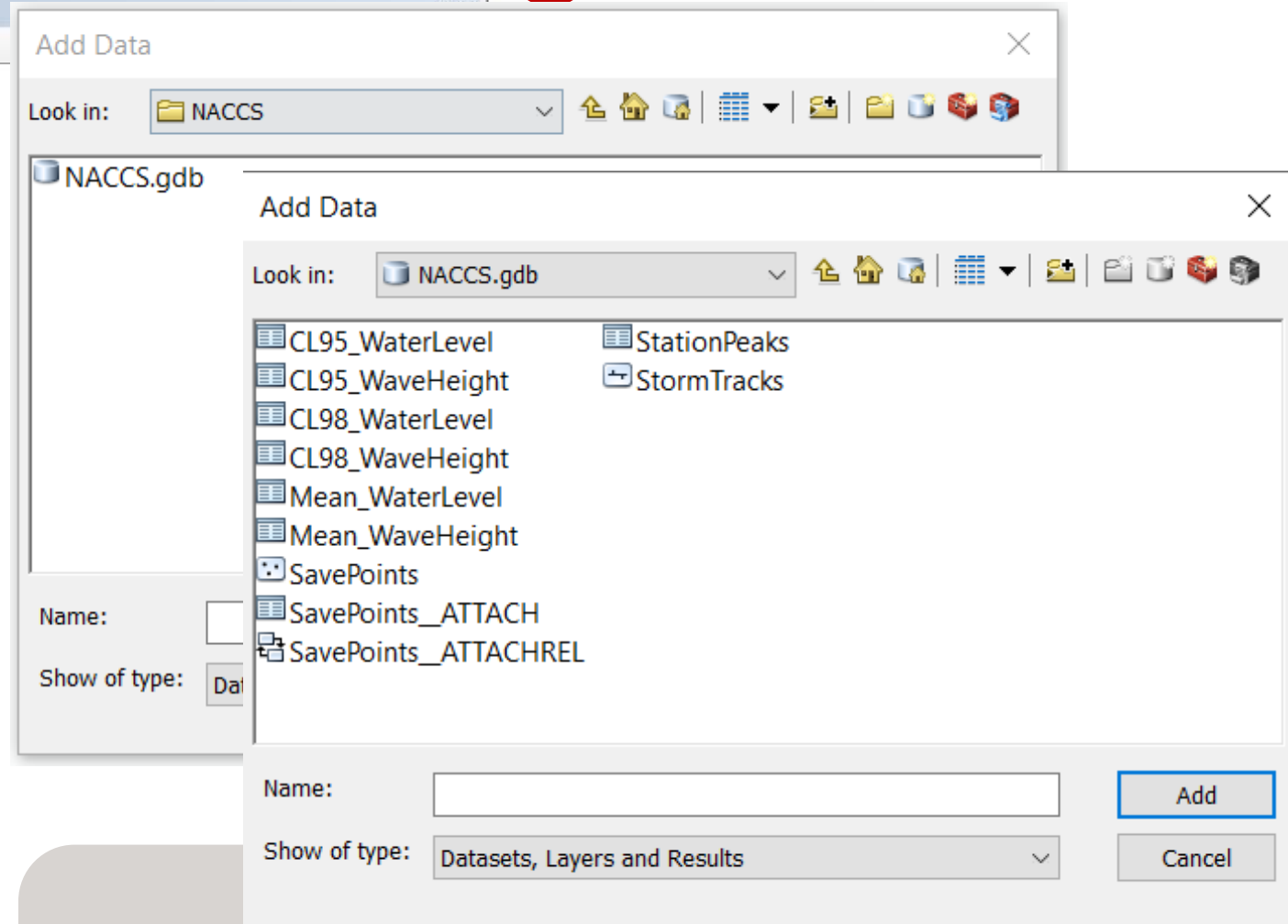
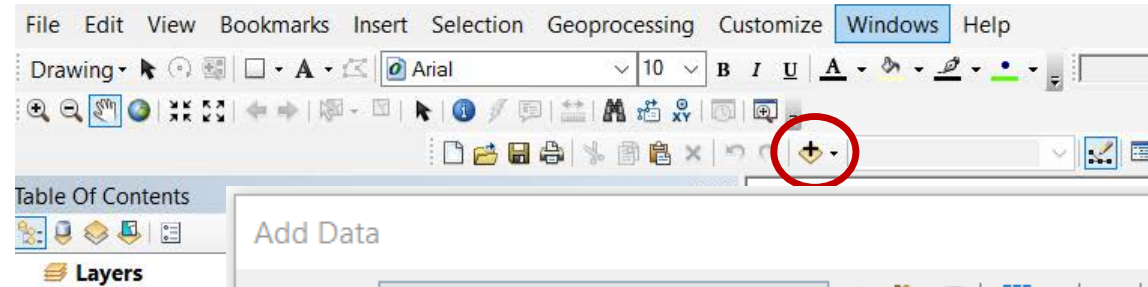
Maximum Predicted Water Levels





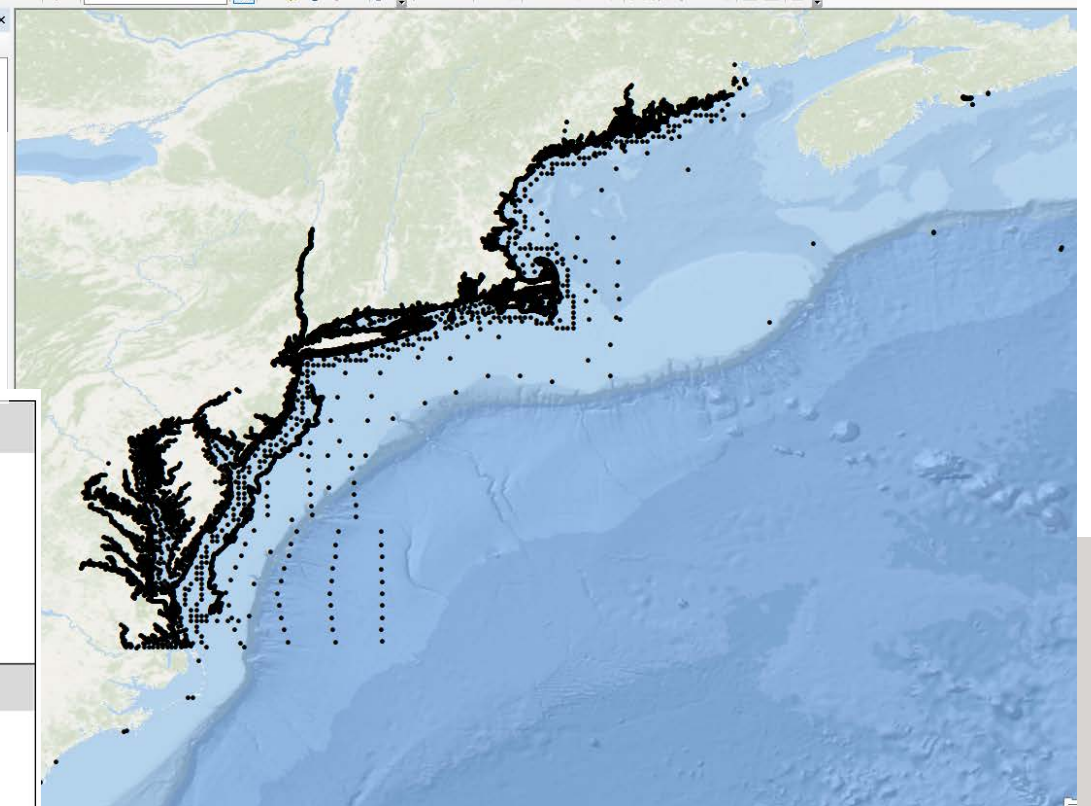
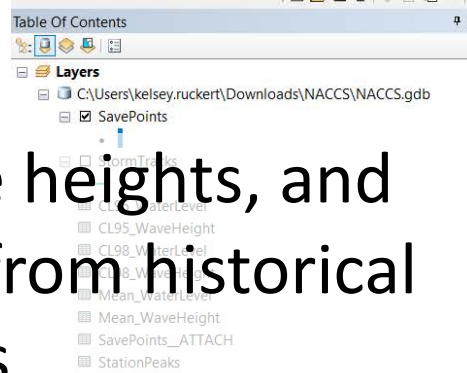
# Opening the data in ArcMAP

1. Open ArcMap under ArcGIS and choose **New Maps > Blank Map**.
2. Load the layers using the **Add Data** button from the Toolbar



# SavePoints Layer

Points of storm surge, wave heights, and extremal statistics derived from historical and simulated storm events.



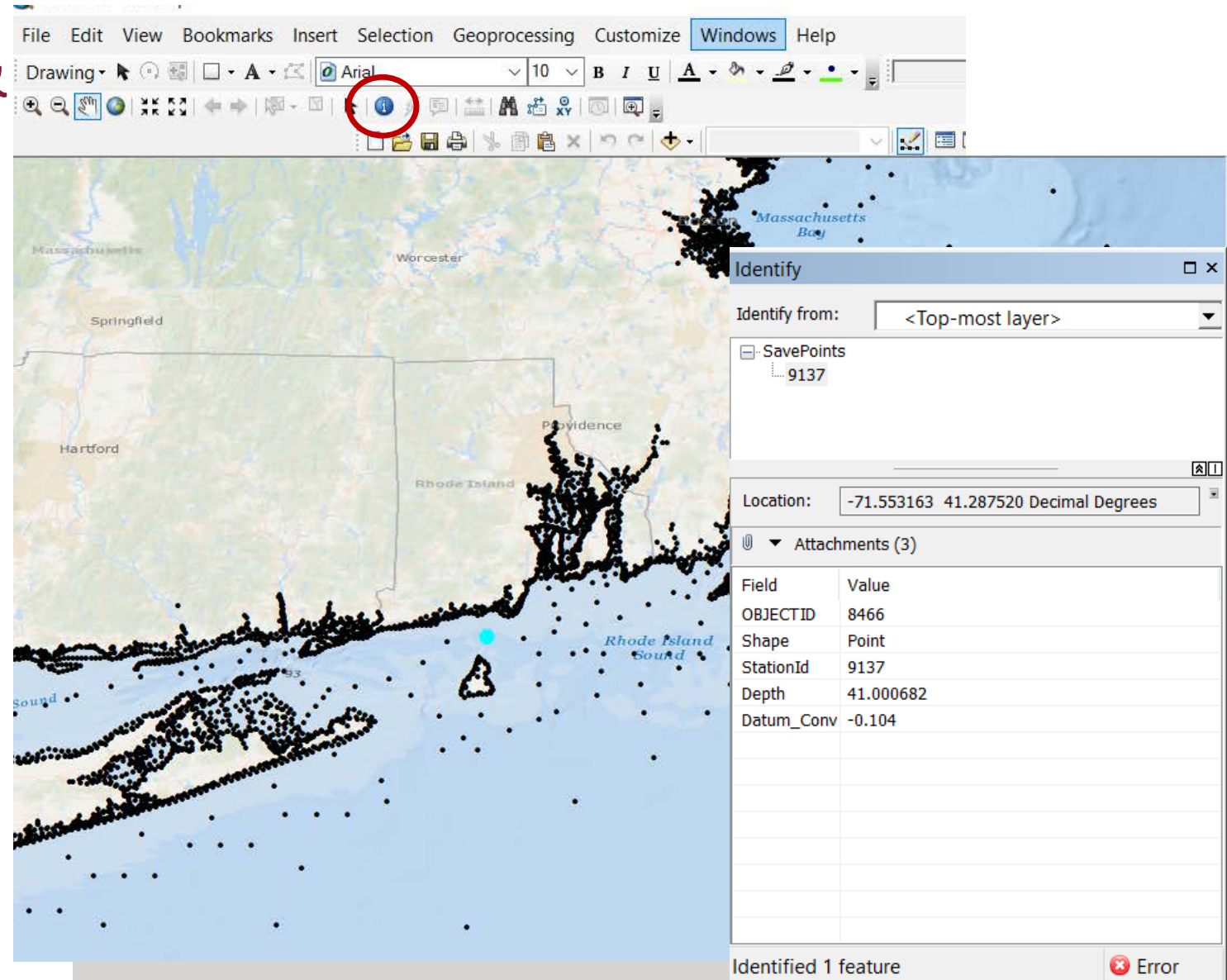
## Feature Class Name: SavePoints

**Feature Type:** Point  
**Description:** NACCS save point locations  
**Total Number of Unique Features:** 16,326  
**Data Status:** Complete

Line	Name	Definition	Type	Size
1	OBJECTID	Uniquely identifies a feature	OBJECTID	*
2	Shape	Geometric representation of the feature	geometry	*
3	StationId	NACCS identifier	long	6
4	Depth	Depth of seafloor at save point location	double	12, 6
5	Datum_Conv	Value used to convert from Mean Sea Level datum to NAVD88	double	12, 6
6	(attachment)	Text file with all water level and wave height data	.txt	*
7	(attachment)	Plot of water level by return period with confidence intervals and peak	.png	*
8	(attachment)	Plot of wave height by return period with confidence intervals and peak	.png	*

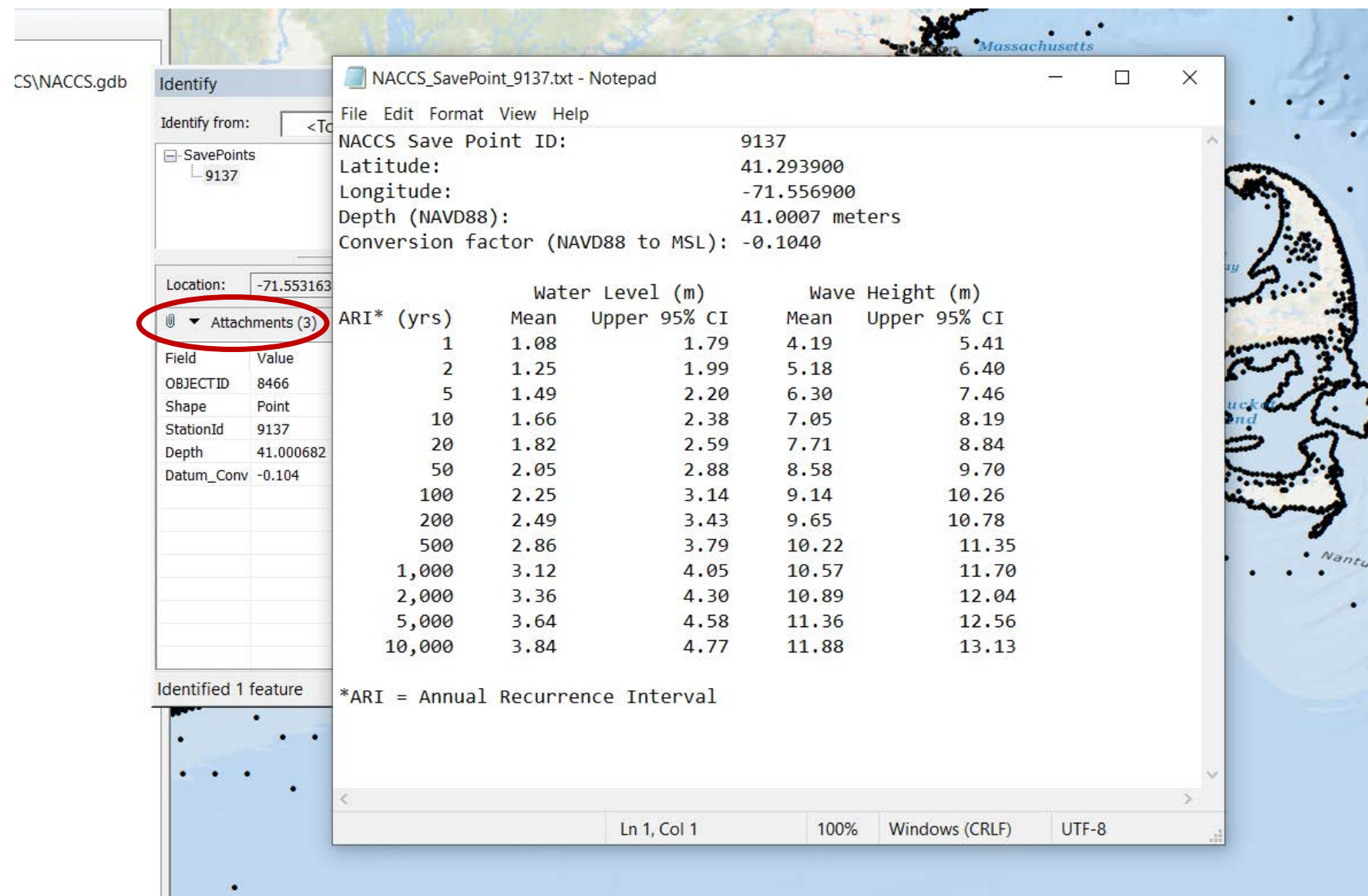
# Example: SavePoint between Block Island & mainland Rhode Island

1. Select the **Identify** button from the Toolbar.
2. Click a point on a map.

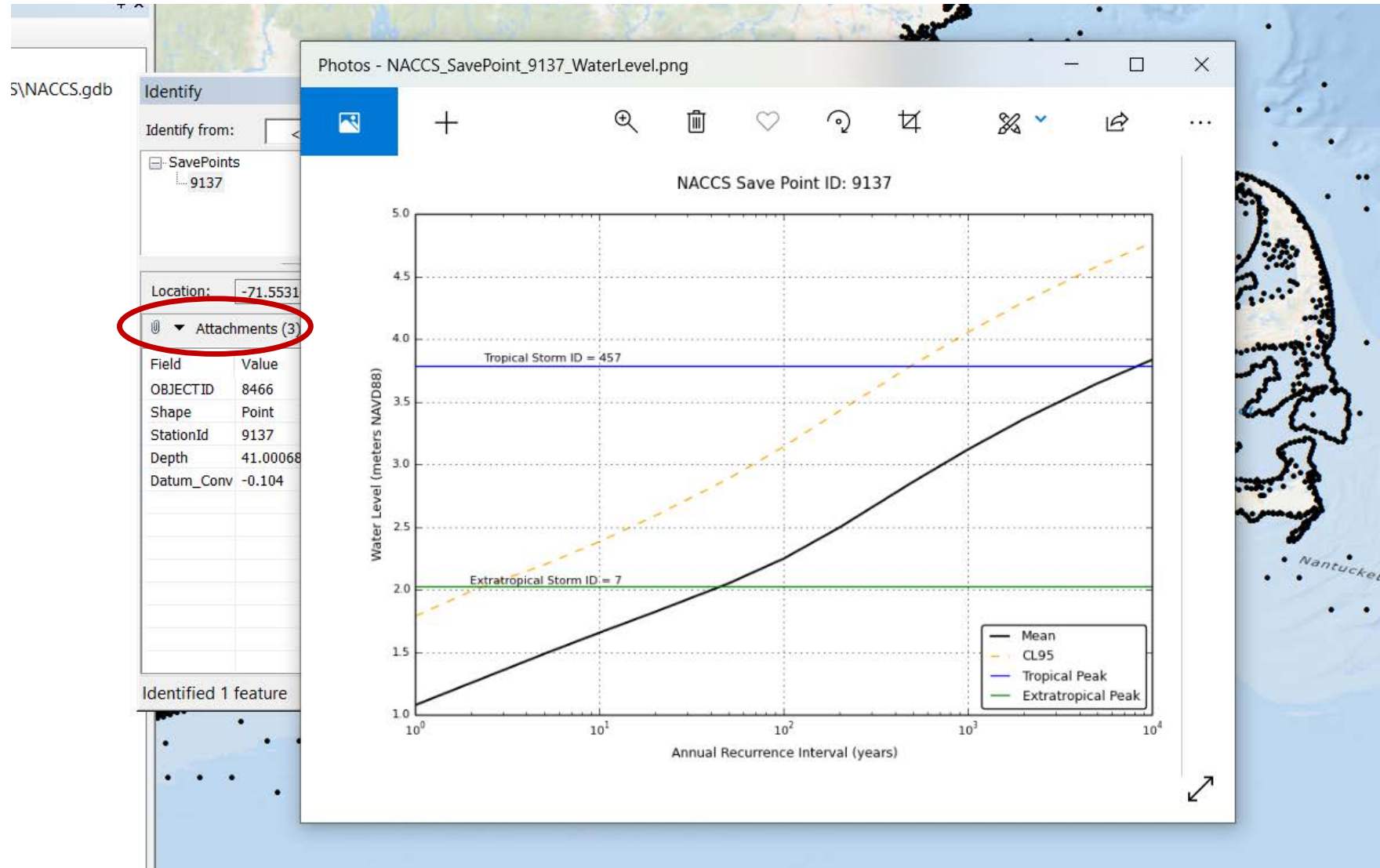




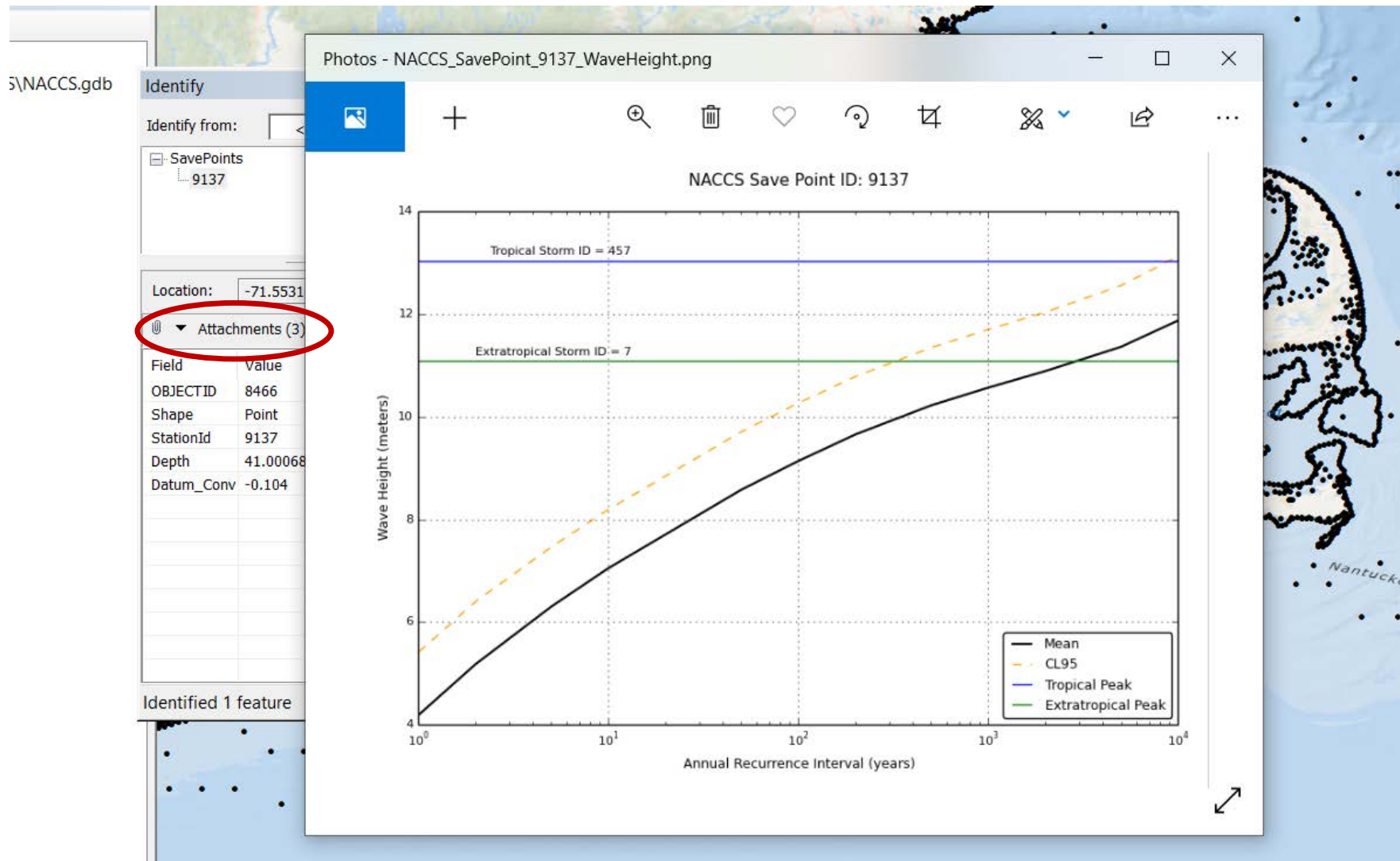
# Water Level and Wave Height Annual Recurrence Intervals at 9137



# Annual Recurrence Interval plot of Water Level at 9137



# Annual Recurrence Interval plot of Wave Height at 9137





# Parsing the data tables

1. Right click the table and select **Open**

2. In the popup table, click the **Table Options** button and select **Select by Attributes**

3. Create a query setting the **StationId = 9137**, click **Apply**, and click on **Show selected records**

The screenshot shows a software interface with a 'Table Of Contents' pane on the left, a main table window, and a 'Select by Attributes' dialog box.

**Table Of Contents:**

- Layers
  - C:\Users\kelsey.ruckert\Downl...
    - SavePoints
    - StormTracks
    - CL95\_WaterLevel
    - CL95\_WaveHeight
    - CL98\_WaterLevel
    - CL98\_WaveHeight
    - Mean\_WaterLevel
    - Mean\_WaveHeight
    - SavePoints\_ATTACH
    - StationPeaks
  - World Ocean Reference
  - World Ocean Base

# Parsing the data tables

1. Right click the table and select **Open**

2. In the popup table, click the **Table** icon and select **Select by Attributes**

3. Create a query setting the **StationId = 9137**, click **Apply**, and click on **Show selected records**

The screenshot shows a GIS application interface. On the left, the 'Layers' panel lists several data layers, including 'CL95\_WaterLevel', 'CL95\_WaveHeight', 'CL98\_WaterLevel', 'CL98\_WaveHeight', and 'Mean\_WaterLevel'. A red box highlights these layers. In the center, a table titled 'StationPeaks' is displayed. The table has columns: OBJECTID \*, StationId \*, ETS\_WaterLevel, TS\_WaterLevel, ETS\_WL\_ID, TS\_WL\_ID, ETS\_WaveHeight, TS\_WaveHeight, ETS\_WV\_ID, and TS\_WV\_ID. The first row is highlighted in blue. A red circle highlights the 'Table' icon in the top toolbar. On the right, the 'Select by Attributes' dialog box is open. It contains a text area with the query 'StationId = 9137'. Below the text area are buttons for 'Clear', 'Verify', 'Help', 'Load...', 'Save...', 'Apply', and 'Close'. A red circle highlights the 'Show selected records' button at the bottom of the dialog box.

OBJECTID *	StationId *	ETS_WaterLevel	TS_WaterLevel	ETS_WL_ID	TS_WL_ID	ETS_WaveHeight	TS_WaveHeight	ETS_WV_ID	TS_WV_ID
8466	9137	2.023	3.784379	7	457	11.084	13.032	7	457

# Parsing the data tables

1. Right click the table and select **Open**

2. In the popup table, click the  
select **Select by Attributes**

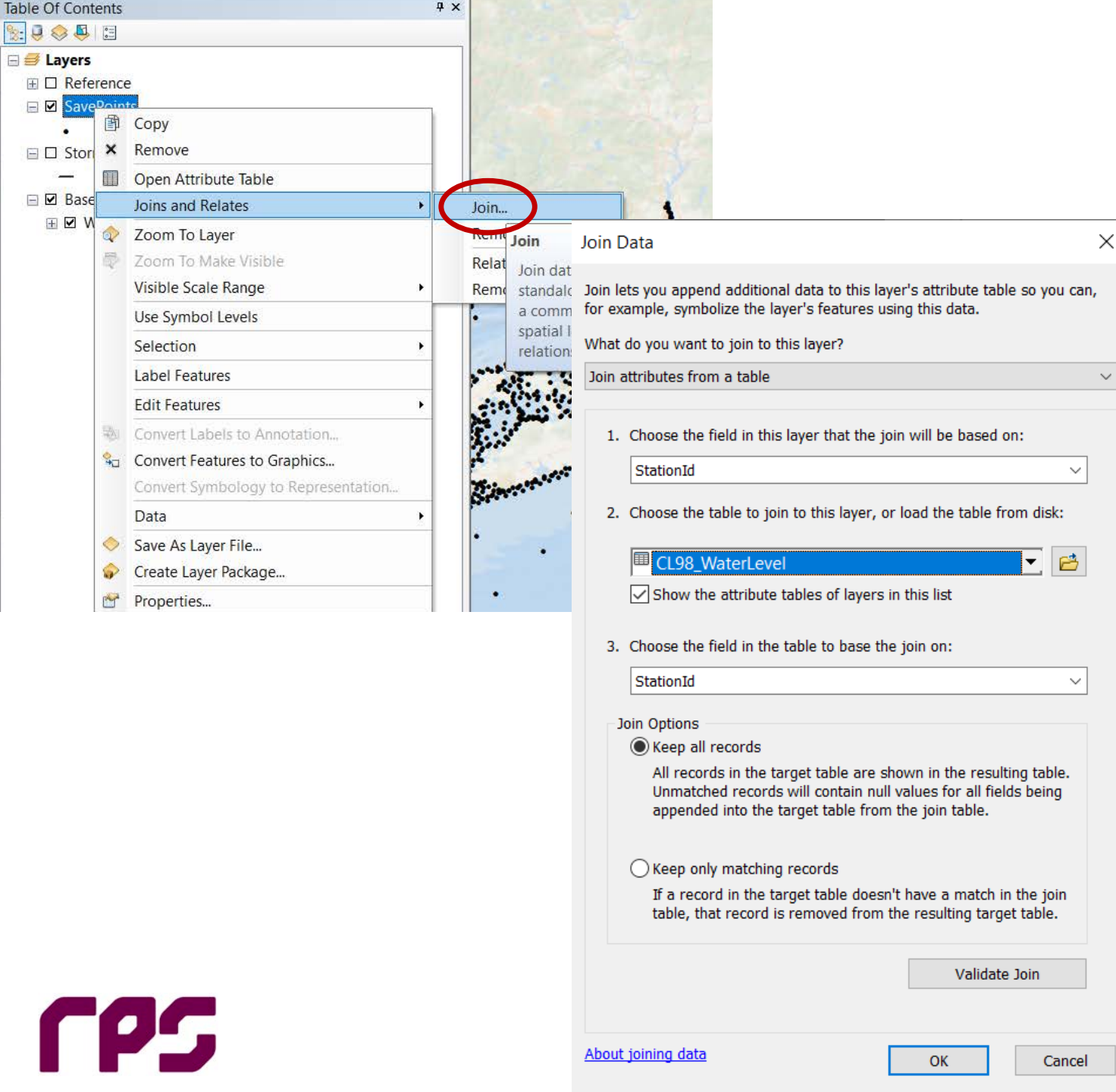
3. Create a query setting the  
**StationId = 9137**, click  
**Apply**, and click on **Show**  
selected records

The screenshot shows a GIS application interface. At the top, a 'Table Of Contents' pane lists layers: 'C:\Users\kelsey.ruckert\Download\StormTracks', 'CL98\_WaveHeight', and 'Mean\_WaterLevel'. The 'CL98\_WaveHeight' layer is selected. Below it, a table titled 'CL98\_WaveHeight' is displayed with columns: OBJECTID \*, StationId, WH\_ARI\_1, WH\_ARI\_2, WH\_ARI\_5, WH\_ARI\_10, WH\_ARI\_20, WH\_ARI\_50, WH\_ARI\_100, WH\_ARI\_200, WH\_ARI\_500, WH\_ARI\_1000, WH\_ARI\_2000, WH\_ARI\_5000, WH\_ARI\_10000. The first row shows OBJECTID 8466 and StationId 9137. To the right, a 'StationPeaks' table is partially visible. A query window is open, showing a query: 'SELECT \* FROM StationPeaks WHERE: StationId = 9137'. The 'Apply' button is highlighted. At the bottom, a status bar indicates '1 out of 16326 Selected'.

OBJECTID *	StationId	WL_ARI_1	WL_ARI_2	WL_ARI_5	WL_ARI_10	WL_ARI_20	WL_ARI_50	WL_ARI_100	WL_ARI_200	WL_ARI_500	WL_ARI_1000	WL_ARI_2000	WL_ARI_5000	WL_ARI_10000
8466	9137	1.968136	2.185146	2.396582	2.584116	2.800589	3.112046	3.374578	3.659095	4.027734	4.289195	4.53018	4.814504	5.006381

OBJECTID *	StationId	WH_ARI_1	WH_ARI_2	WH_ARI_5	WH_ARI_10	WH_ARI_20	WH_ARI_50	WH_ARI_100	WH_ARI_200	WH_ARI_500	WH_ARI_1000	WH_ARI_2000	WH_ARI_5000	WH_ARI_10000
8466	9137	5.775214	6.743754	7.788907	8.517414	9.165739	10.026838	10.585942	11.104038	11.66872	12.02403	12.364627	12.898822	13.485484





# Joins and Relates

1. Right click **SavePoints**, select **Joins and Relates**, and select **Join**

2. In the popup table, select **StationId** as the field to be joined by and select the **CL98\_WaterLevel** or another table to join to SavePoints

3. Choose whether to keep all records or only matching records and click **OK**

# Joins and Relates

Table Of Contents

- Layers
  - Reference
  - SavePoints

Drawing

Editor

1:1,000,000

46%

Identify

Identify from: <Top-most layer>

SavePoints

9137

Location: -71.559003 41.290638 Decimal Degrees

Field	Value
OBJECTID	8466
Shape	Point
StationId	9137
Depth	41.000682
Datum_Conv	-0.104
OBJECTID	8466
StationId	9137
WL_ARI_1	1.968136
WL_ARI_2	2.185146
WL_ARI_5	2.396582
WL_ARI_10	2.584116
WL_ARI_20	2.800589
WL_ARI_50	3.112046
WL_ARI_100	3.374578
WL_ARI_200	3.659095
WL_ARI_500	4.027734
WL_ARI_1000	4.289195
WL_ARI_2000	4.53018
WL_ARI_5000	4.814504
WL_ARI_10000	5.006381

Table

SavePoints

OBJECTID *	Shape *	StationId	Depth	Datum_Conv	OBJECTID *	StationId *	WL_ARI_1	WL_ARI_2	WL_ARI_5	WL_ARI_10	WL_ARI_20	WL_ARI_50
8466	Point	9137	41.000682	-0.104	8466	9137	1.968136	2.185146	2.396582	2.584116	2.800589	3.112046

(1 out of 16326 Selected)

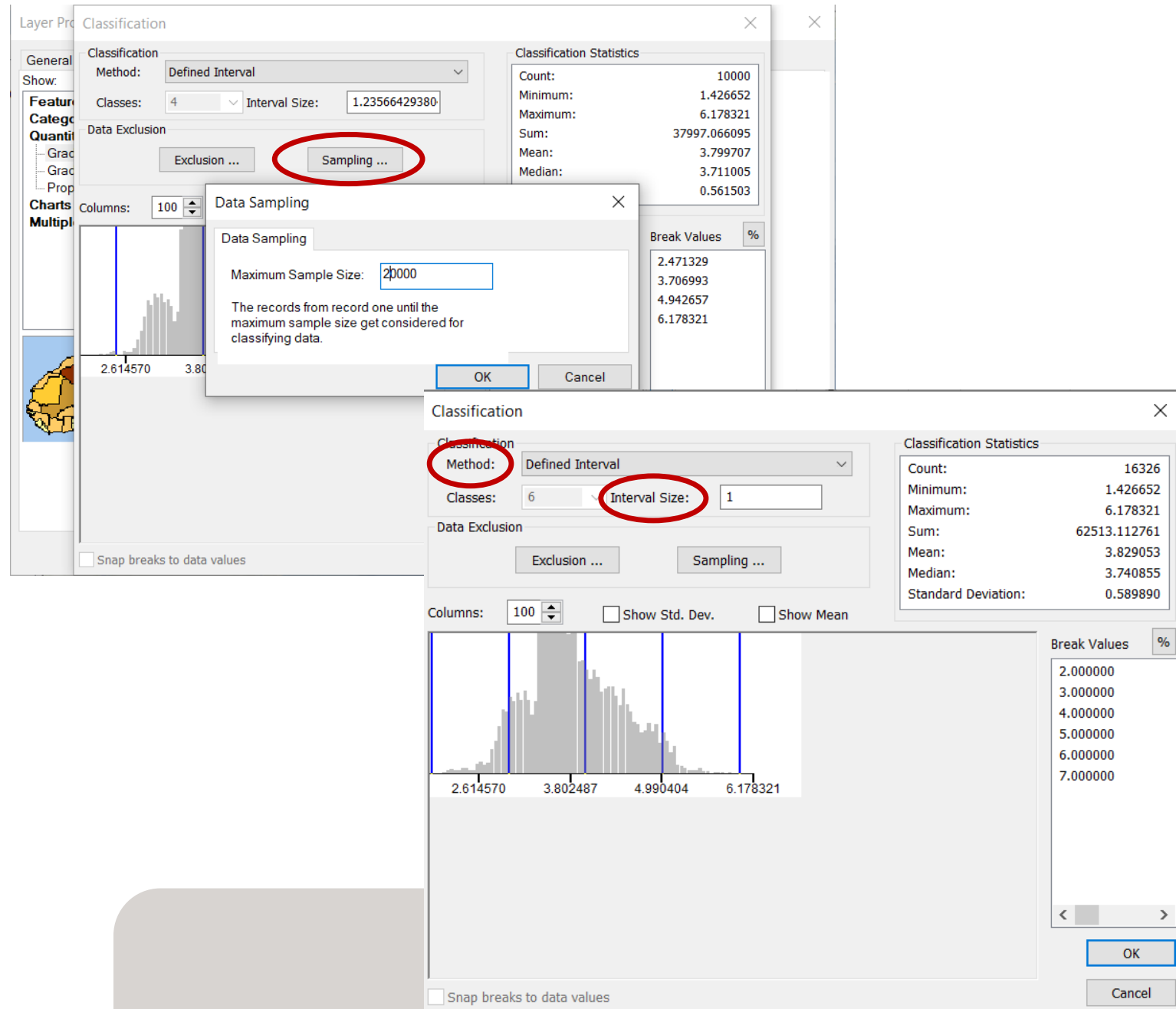
SavePoints

OK Cancel

# Display 100-yr values across all SavePoints

## Example: 98% 100-yr water levels

1. In the Classification popup, click **Sampling...** and increase the maximum sample size to greater than the amount of points (e.g., 20000)
2. Set the **Method** to Defined Interval, specify the **Interval Size**, and click **OK**

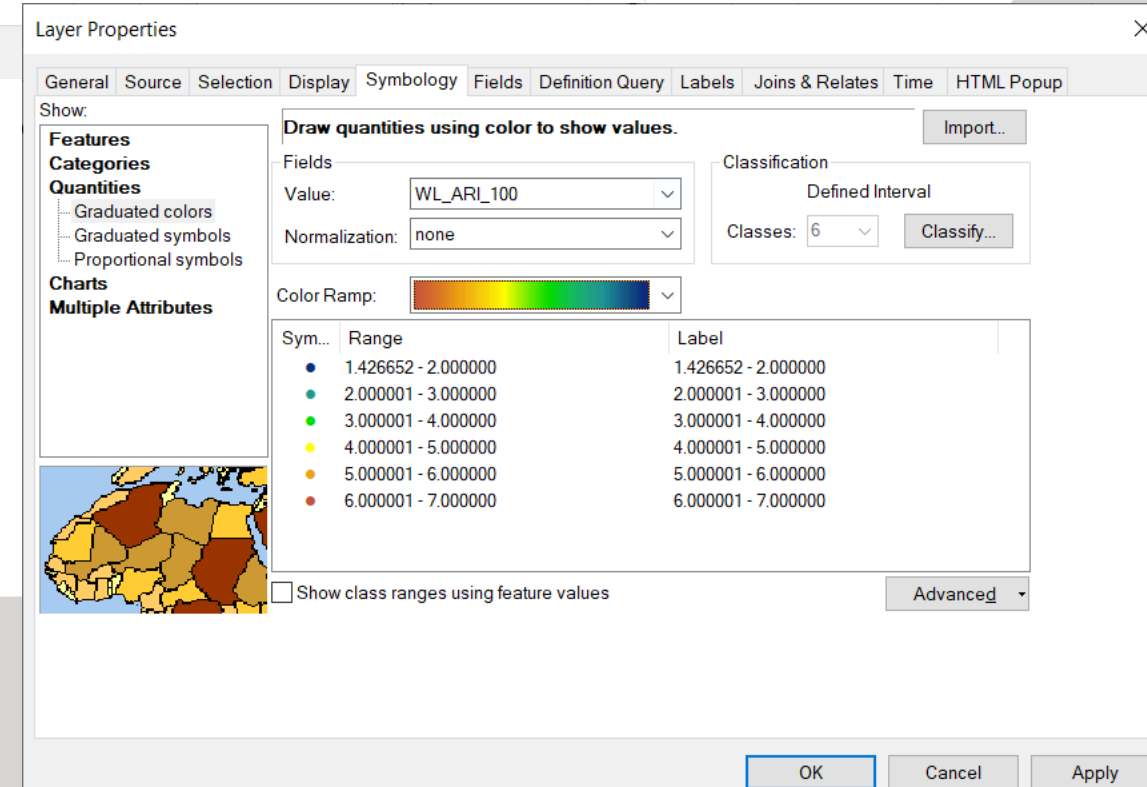
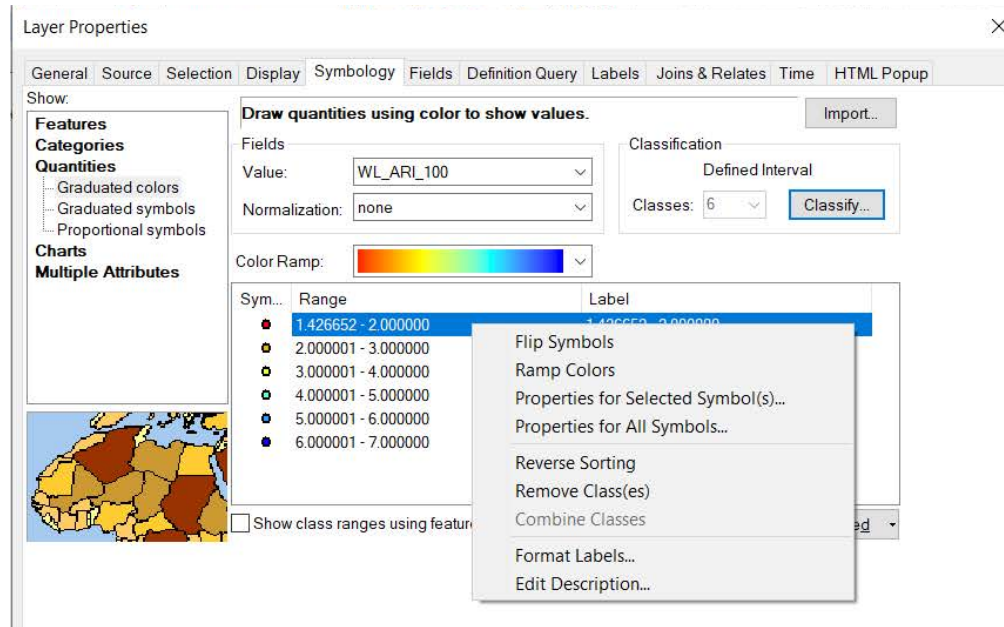


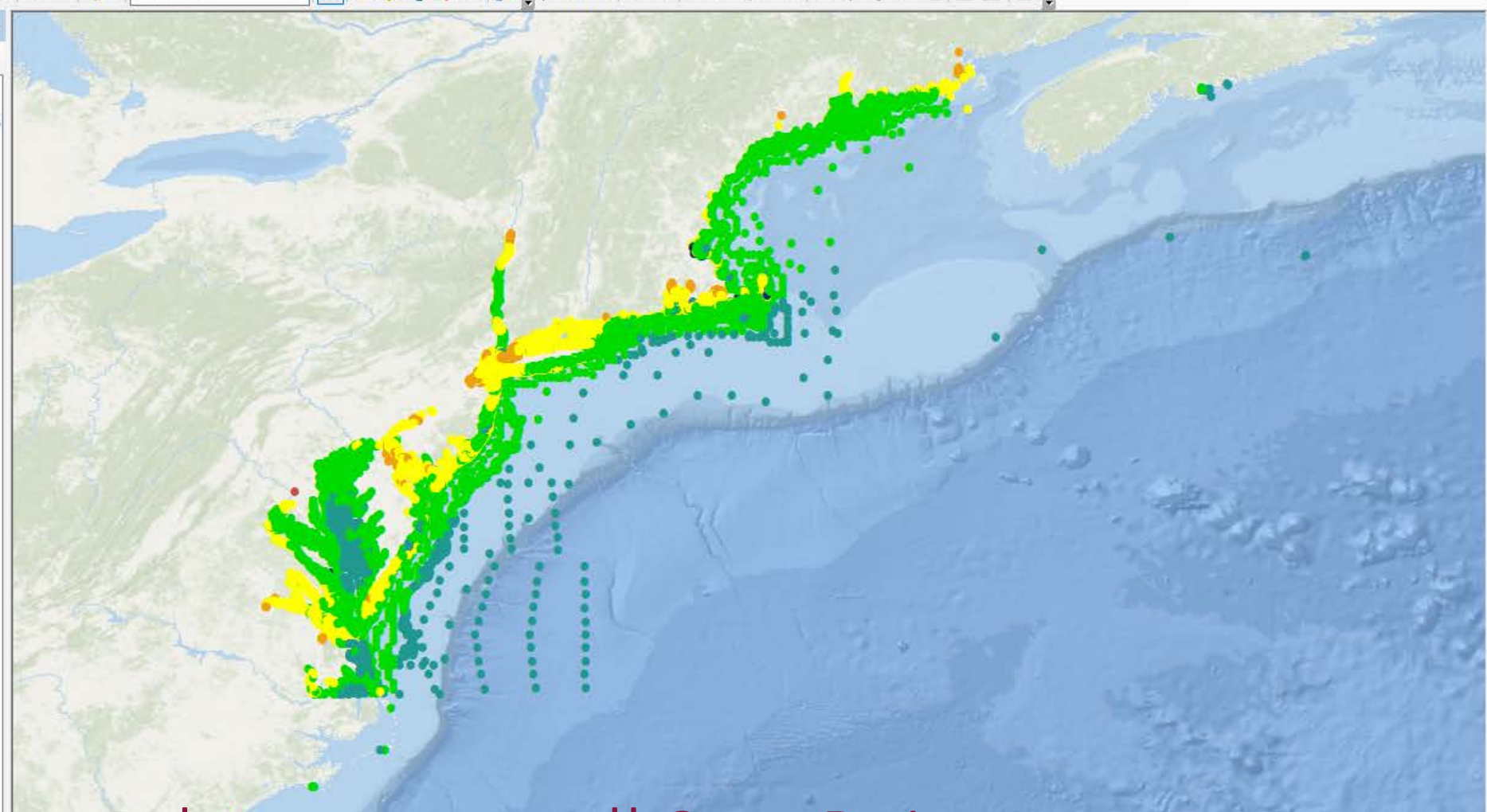
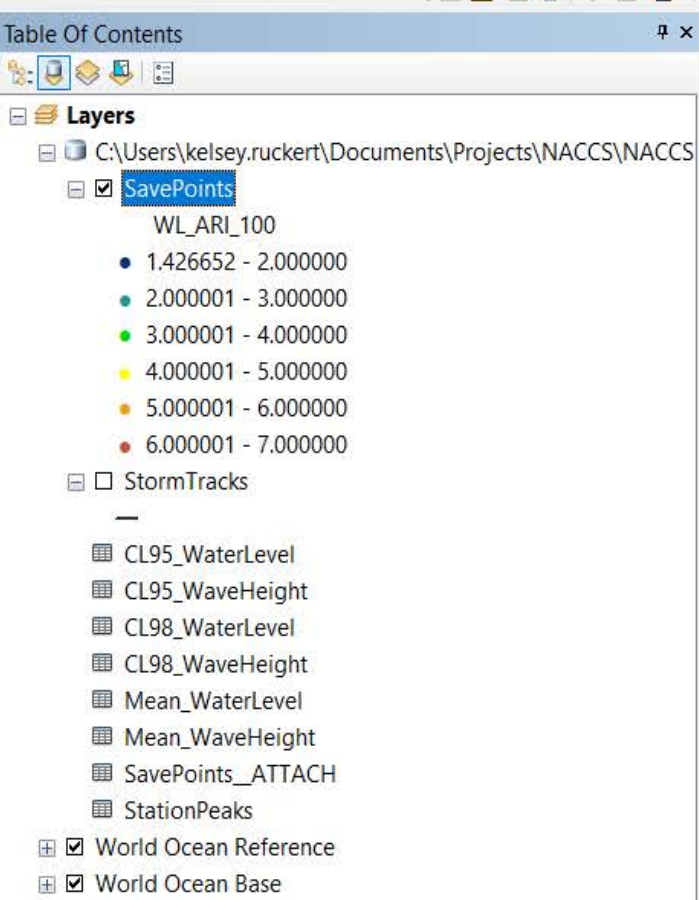


# Display 100-yr values across all SavePoints

## Example: 98% 100-yr water levels

1. Right clicking a range value will show a drop-down menu that can be used to modify symbols and colors
2. Click **OK** once satisfied with the ranges and styling



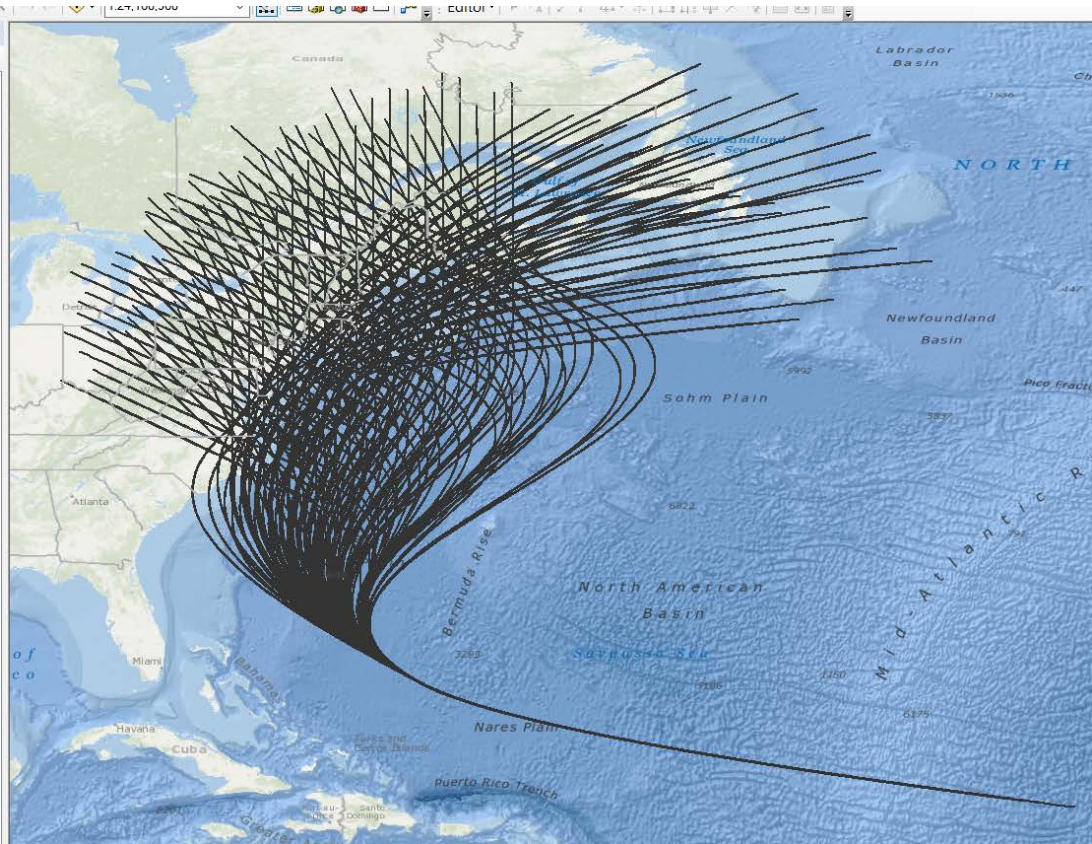
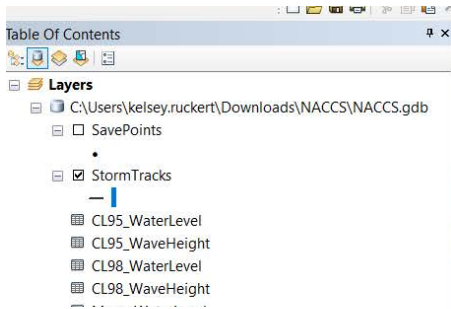


Display 100-yr values across all SavePoints:  
98% 100-yr water levels



# StormTracks Layer

Feature Class Name: StormTracks				
Feature Type:		Polyline		
Description:		Synthetic tropical storm tracks		
Total Number of Unique Features:		1,050		
Data Status:		Complete		
Line	Name	Definition	Type	Size
1	OBJECTID	Uniquely identifies a feature	OBJECTID	*
2	Shape	Geometric representation of the feature	geometry	*
3	StormId	Original numerical storm identifier from source material	long	6
4	C_Pressure	Central Pressure Deficit (hPa) - difference between the central pressure of the storm and peripheral barometric pressure (controls the intensity of hurricanes)	double	8, 1
5	Heading	Heading Direction - track direction (degrees clockwise from north) at the point of landfall	double	6, 1
6	Radius_Max_Wind	Radius of Maximum Wind – distance (km) from the center of a tropical cyclone to the location of the cyclone's maximum winds (generally found at the inner edge of the eyewall)	double	8, 1
7	Ref_Lat	Reference Latitude (deg) – latitude of storm landfall point (for landfalling storms) or latitude where the storm exits the impact region (for bypassing storms)	double	6, 2
8	Ref_Lon	Reference Longitude (deg) - longitude of storm landfall point (for landfalling storms) or longitude where the storm exits the impact region (for bypassing storms)	double	6, 2
9	Trans_Speed	Translational Speed - storm forward speed (km/h) as it approaches the coast	double	6, 1

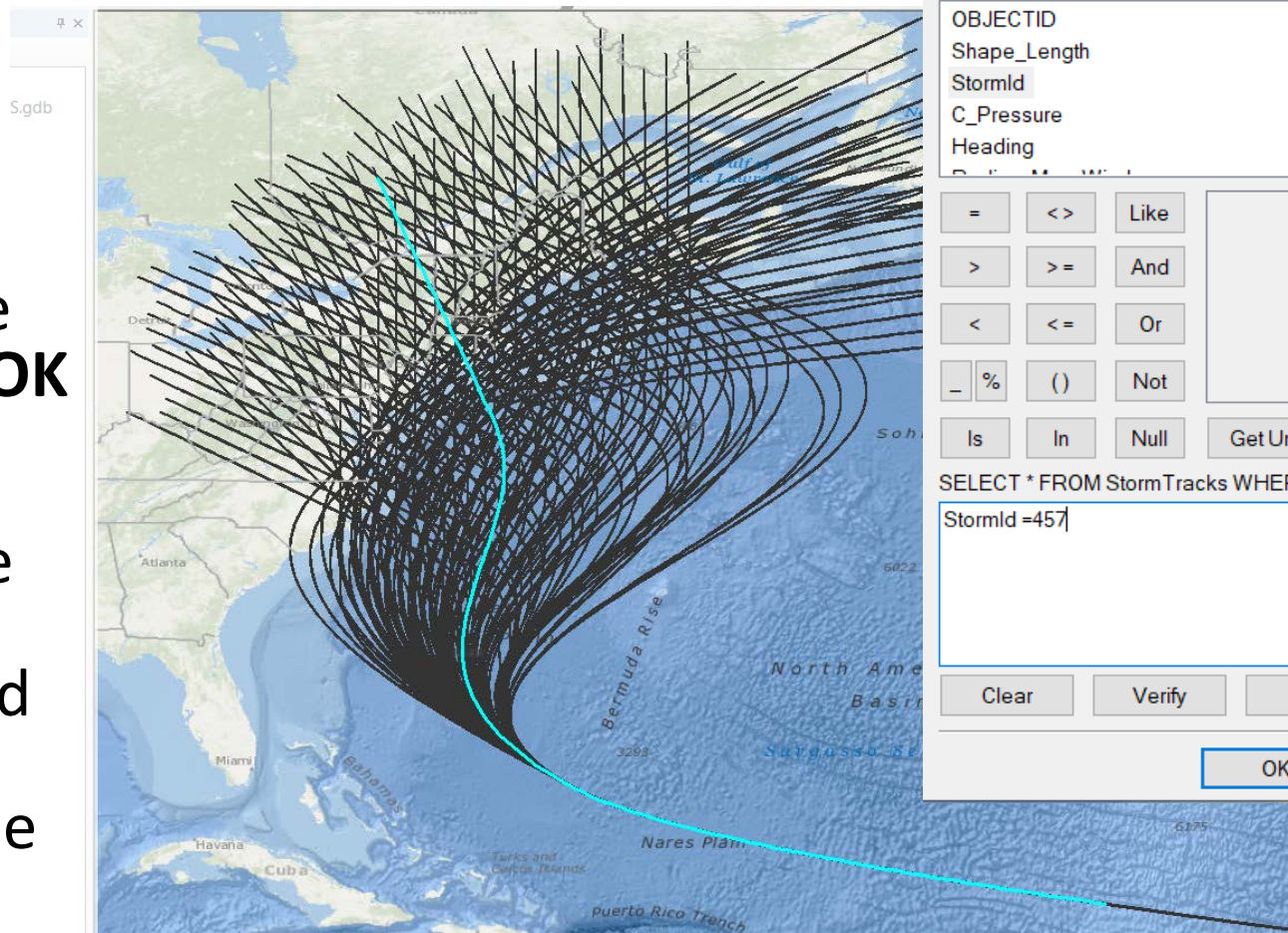


A set of simulated storm events from which storm surge, wave heights, and extremal statistics were derived.



# Extracting the tropical peak storm from StormTracks

1. Click on **Selection** from the Toolbar and **Select By Attributes...**
2. In the popup, select StormTracks as the Layer, create a query setting the **StormId = 457**, and click **OK**
3. Right click the layer in the Table of Contents, select **Open Attribute Table**, and click on **Show selected records** in the popup table



Select By Attributes

Layer: ☒ StormTracks  
☐ Only show selectable layers in this list

Method: Create a new selection

OBJECTID  
Shape\_Length  
StormId  
C\_Pressure  
Heading

= <> Like  
> >= And  
< <= Or  
\_ % ( ) Not  
Is In Null Get Unique Values Go To:

SELECT \* FROM StormTracks WHERE:  
StormId=457

Clear Verify Help Load... Save...  
OK Apply Close

StormTracks										
	OBJECTID *	Shape *	Shape_Length	StormId	C_Pressure	Heading	Radius_Max_Wind	Ref_Lat	Ref_Lon	Trans_Speed
▶	457	Polyline	46.371855	457	88	-20	58	40.96	-72.12	34





# Case Study: Prescott Park, NH

Prescott Park - Master Plan - Project Area (includes highlighted parcels)

# Prescott Park (downtown Portsmouth, NH)

**Purpose:** Identify areas of Prescott Park that are vulnerable to flooding

- access to the Piscataqua River
- open space and outdoor arts venue
- 10+ acres of waterfront property

**Method:** Bathtub modeling approach

- Variety of storm and SLR scenarios



# Prescott Park - Approach

- NROC NACCS database was investigated for this study:
  - **Base Conditions + 96 Random Tides**
  - Nearest NACCS save point (#7390) used.
- Both the mean and the 95<sup>th</sup> percentile were investigated.
- A scenario of no SLR (present conditions) and SLR of 2 ft were used in this study.



# Prescott Park – Accessing the data

## ***Base Conditions + 96 Random Tide Phases (NROC ArcGIS geodatabase)***

Table Properties

General Source Display Fields Definition Query Joins & Relates Time

Definition Query:

StationId =7390

Query Builder...

OK Cancel Apply

Mean_WaterLevel											
OBJECTID *	StationId *	WL_ARI 1	WL_ARI 2	WL_ARI 5	WL_ARI 10	WL_ARI 20	WL_ARI 50	WL_ARI 100	WL_ARI 200	WL_ARI 500	WL
7040	7390	1.94642	2.18362	2.44934	2.630612	2.791454	2.97892	3.105952	3.226326	3.394379	

# Prescott Park – 8 scenarios

ID	SLR		Storm Water Level	Base + 96 Random Tide Phases			
				Mean Confidence Level		95 <sup>th</sup> Percentile Confidence Level	
				NACCS Water Level (ft. NAVD88)	Water Level + RSLR (ft. NAVD88)	NACCS Water Level – 95 <sup>th</sup> % (ft. NAVD88)	Water Level + RSL (ft. NAVD88)
1	Present Day	0 ft.	10-yr	8.6	<b>8.6</b>	10.8	<b>10.8</b>
2	Present Day	0 ft.	100-yr	10.2	<b>10.2</b>	12.5	<b>12.5</b>
3	Year 2050 <b>high</b> SLR	2 ft.	10-yr	8.6	<b>10.6</b>	10.8	<b>12.8</b>
4	Year 2050 <b>high</b> SLR	2 ft.	100-yr	10.2	<b>12.2</b>	12.5	<b>14.5</b>



# Prescott Park – Results

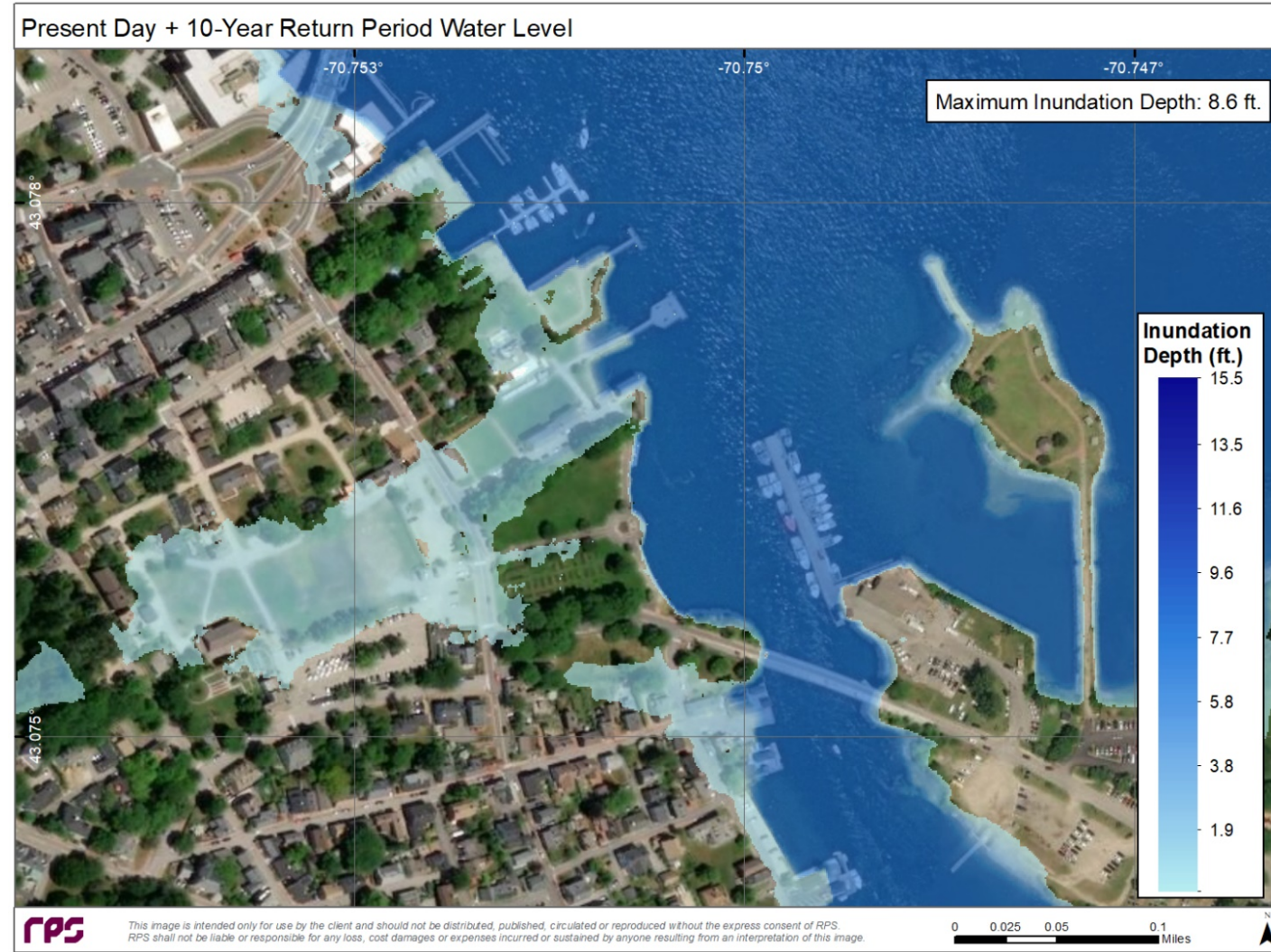
Created a series of figures corresponding to each of the eight scenarios

Figures illustrate the predicted extent and depth (in feet) of inundation in and around Prescott Park for each scenario.

All figures were created with the same color scale for consistency with the maximum inundation depth for each scenario noted in the upper right corner.



## ***Base + 96 Random Tide Phases Mean Confidence Level***



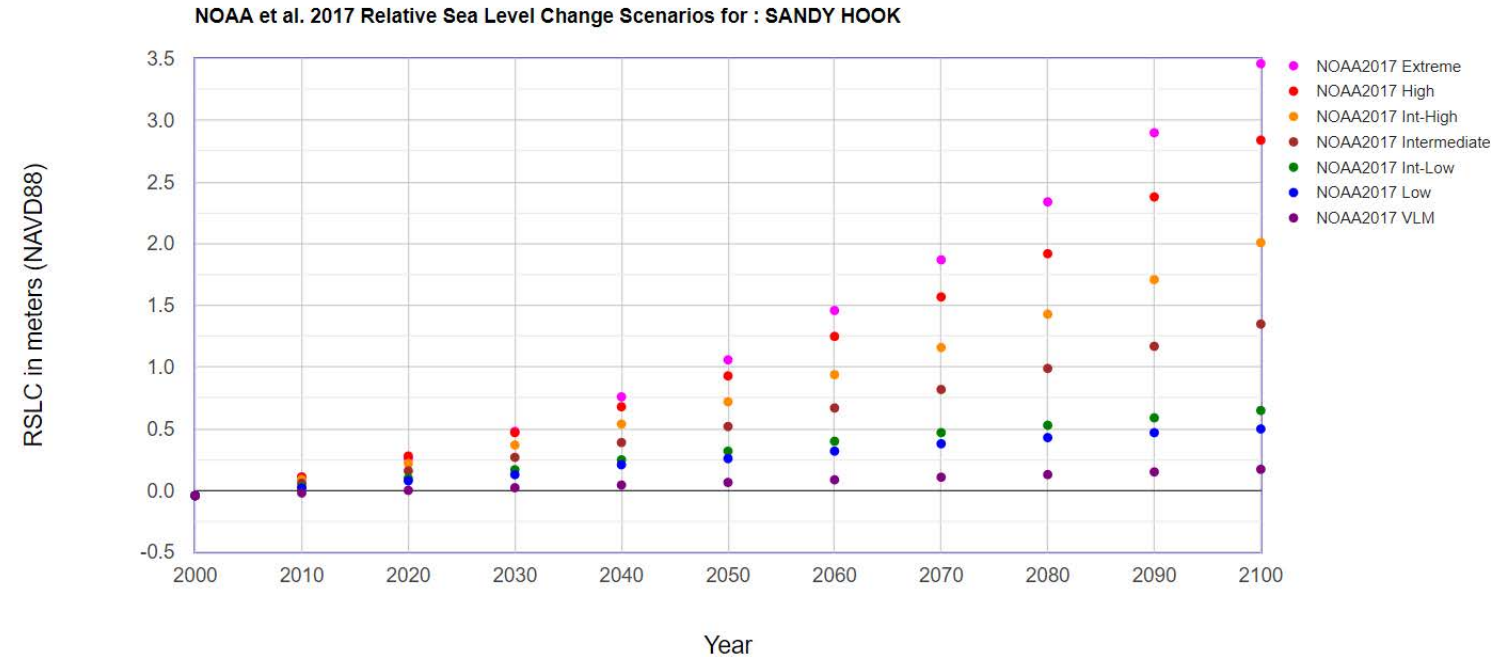


The bathtub  
approach:  
Creating an  
inundation map  
surrounding  
Rockaway park, NY



# Datasets

- Topobathy Digital Elevation Model (DEM)
  - Coastal National Elevation Database (CoNed)
    - Hurricane Sandy Region (New Jersey and Delaware)
  - New England
- NROC NACCS geodatabase
  - Mean 100-year water level
- Sweet et al., 2017 relative sea-level change (RSLC) at Sandy Hook tide station
  - Intermediate scenario in the year 2050 (**0.52 m** relative to 1992)

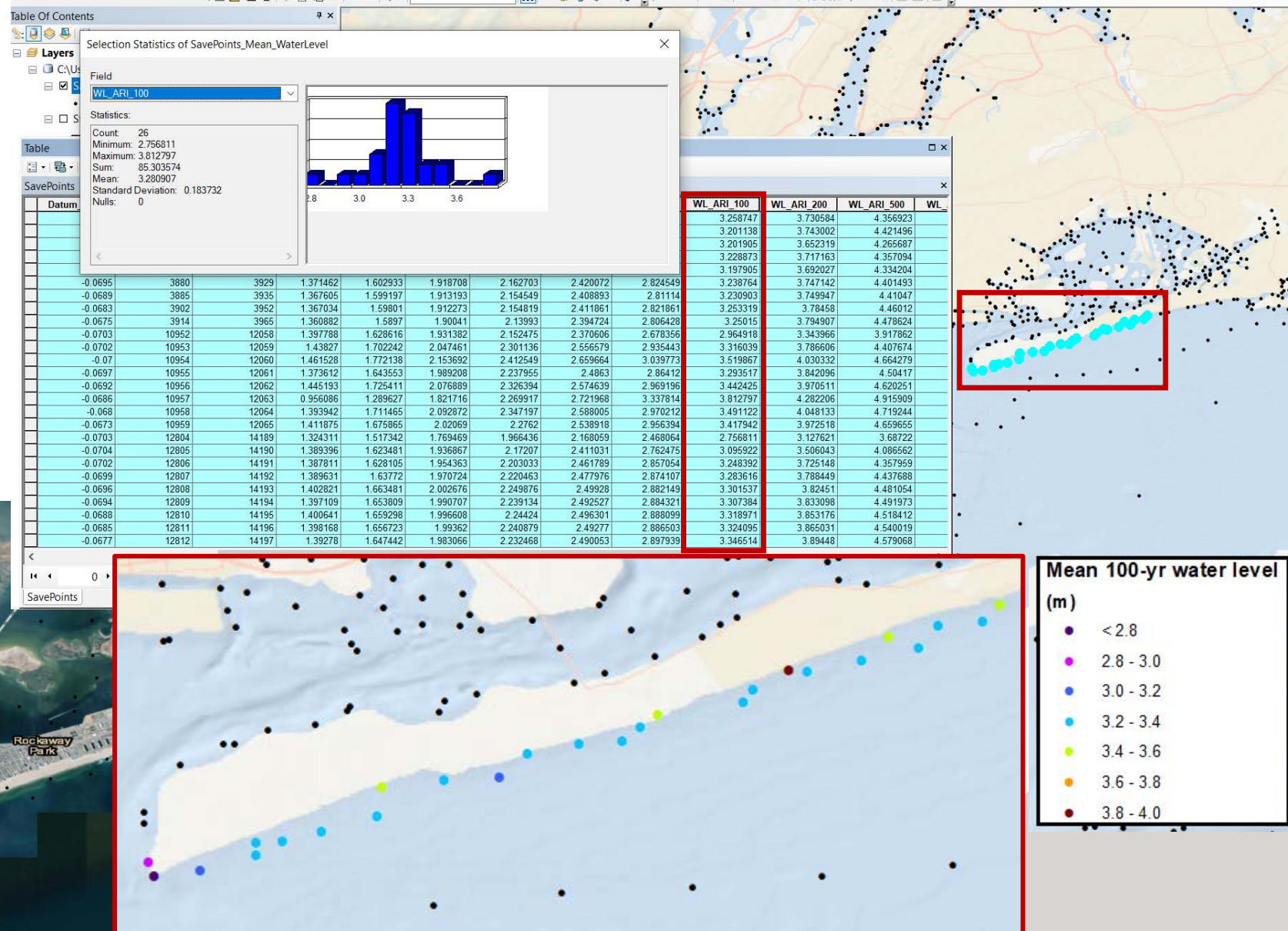




# Selection of NROC NACCS Mean 100-year water level

SavePoints along  
Rockaway Park:

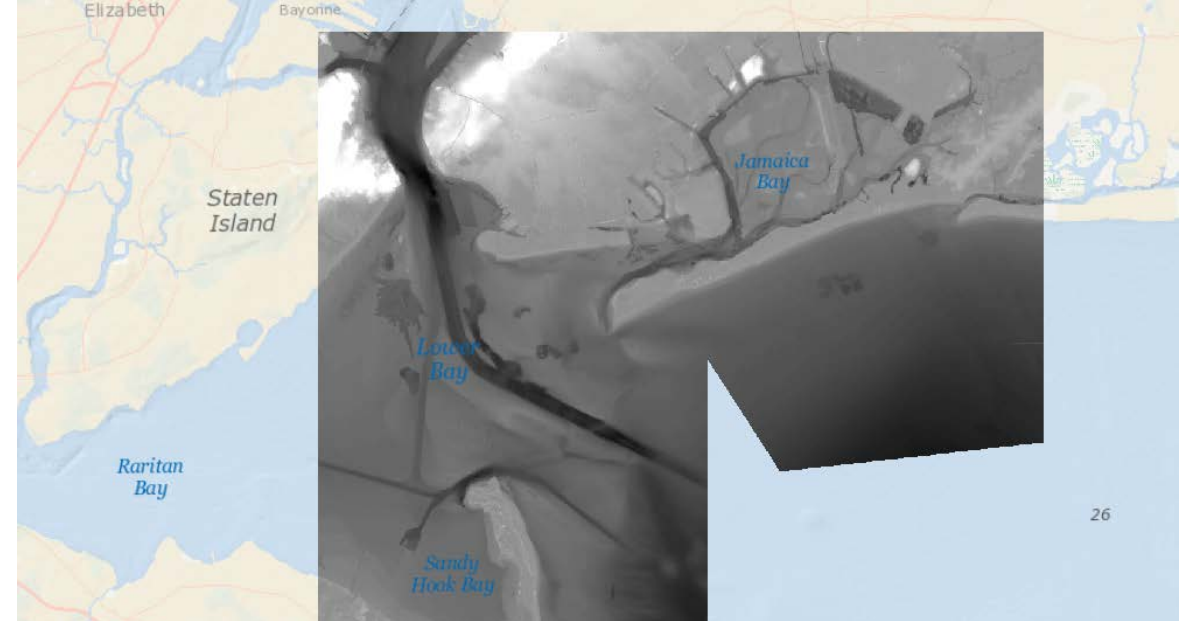
- 2.8 – 3.8 m with a mean of 3.3 m
- ID 14196: Mean 100-yr WL: **3.32 m**



# Reclassify values

NACCS 100-year water level + RSLC in 2050 = 3.84 m

Old values	New values
-32.945377 - 0	1
0 - 3.84	2
3.841 - 114.010956	3
NoData	NoData



26

Reclassify

Input raster  
NENJ\_DEM

Reclass field  
VALUE

Reclassification

Old values	New values
-32.945377 - 0	1
0 - 3.84	2
3.84 - 114.010956	3
NoData	NoData

Classify...  
Unique  
Add Entry  
Delete Entries

Load... Save... Reverse New Values Precision...

Output raster  
C:\Users\kelsey.ruckert\Downloads\CoNED\_New\_England\_New\_Jersey\_Delaware\_Mm34Vtgu92YvGaW1

☐ Change missing values to NoData (optional)

OK Cancel Environments... << Hide Help

# Extract Elevation Ranges

Using the Spatial Analyst extract tools you can extract the specific elevation ranges with the **Extract by Attributes** tool. The resulting raster can be used as a mask to clip the original DEM with the **Extract by Mask** tool.



**Extract by Attributes**

Input raster: re\_0baseslr

Where clause: "VALUE" = 2

Output raster: C:\Users\kelsey.ruckert\Downloads\CoNED\_New\_England\_New\_Jersey\_Delaware\_Mm34Vtgu92YvGaW1

OK Cancel Environments... << Hide Help

**Extract by Mask**

Input raster: NENJ\_DEM

Input raster or feature mask data: Ex\_BaseSLR

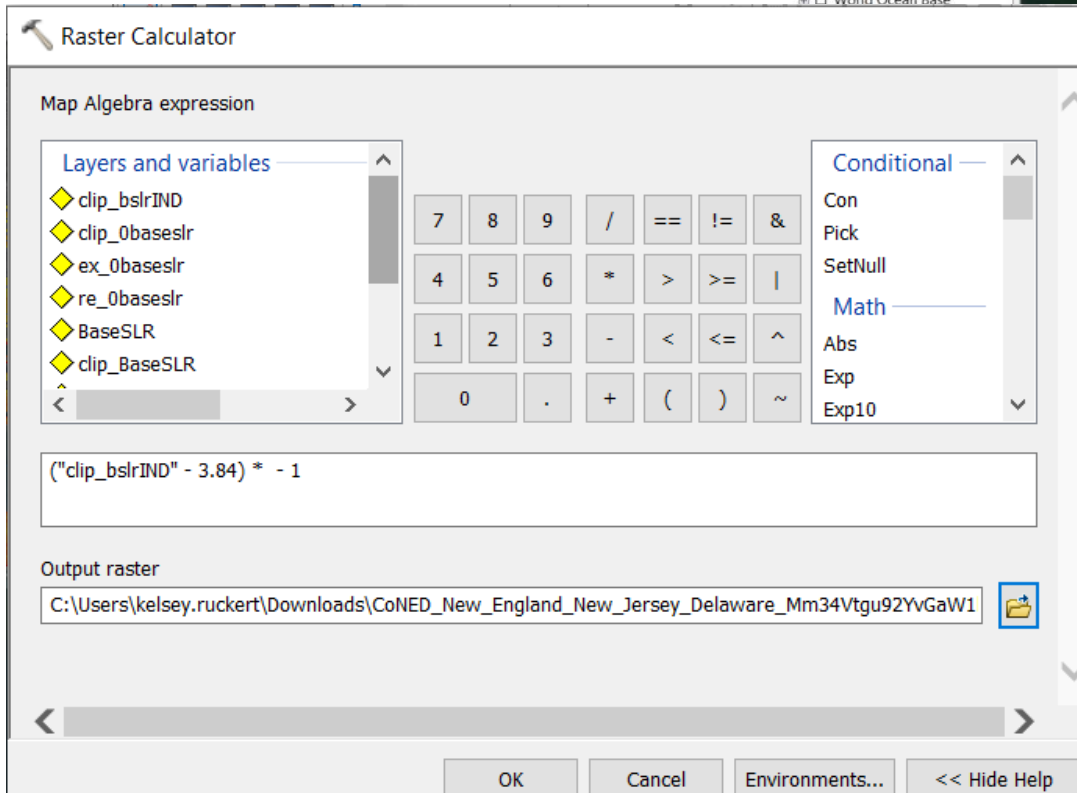
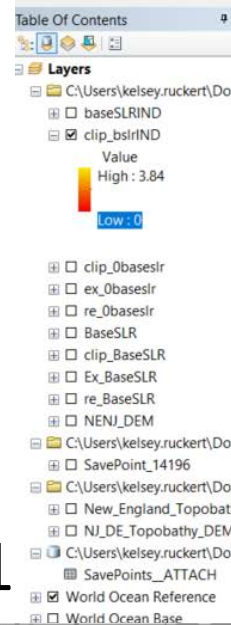
Output raster: C:\Users\kelsey.ruckert\Downloads\CoNED\_New\_England\_New\_Jersey\_Delaware\_Mm34Vtgu92YvGaW1

OK Cancel Environments... << Hide Help

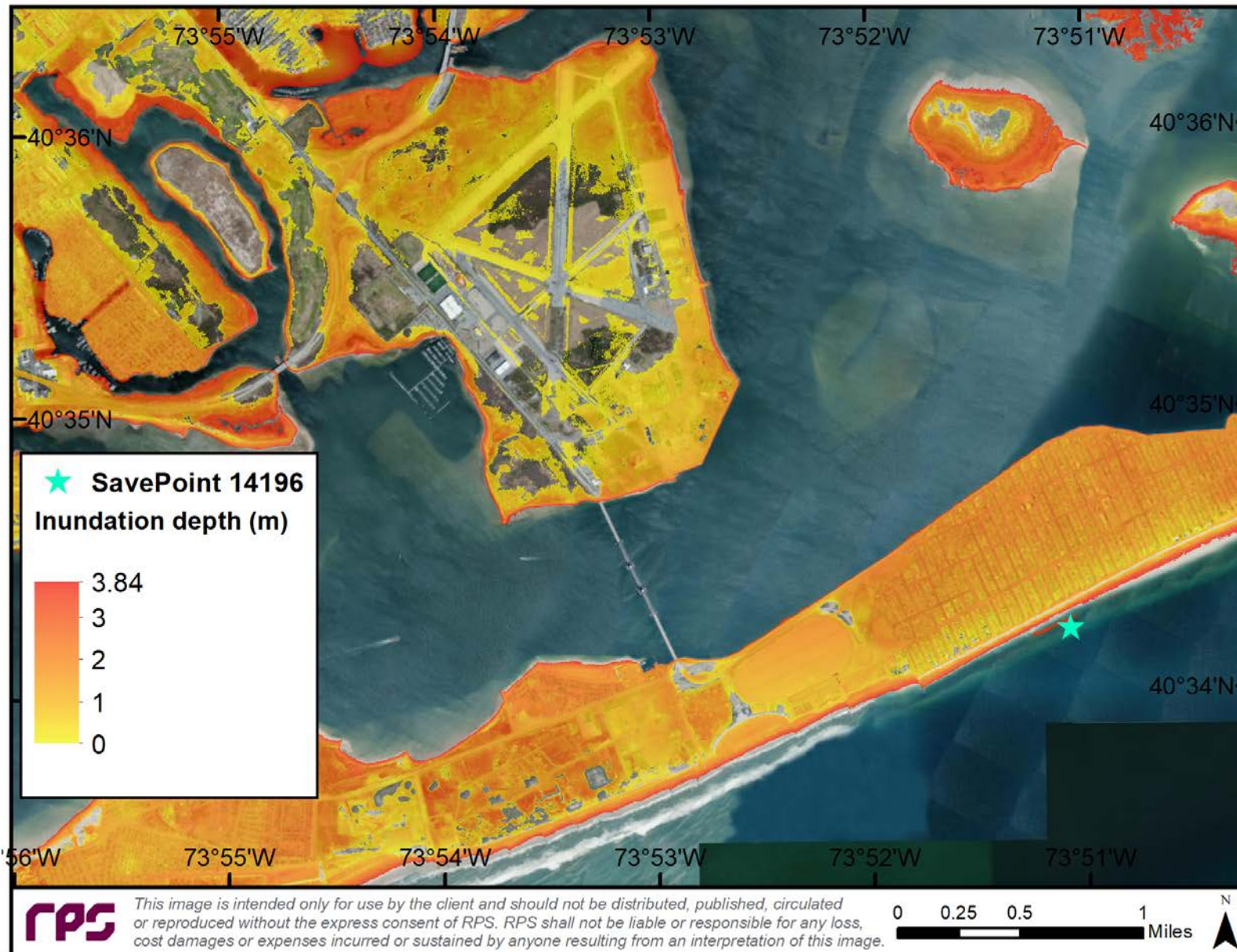


# Convert elevation to inundation

To convert the raster to inundation depth, use the **Raster Calculator** to subtract the clipped raster by the flood level (3.84 m) and multiply by -1



# Predicted extent and depth of inundation from 100-yr + SLR



# Final Note

Locations to access the data:

- USACE Coastal Hazards System Portal
- Northeast Ocean Data, Data Explorer
- NACCSapi
- NROC ArcGIS Server
- NROC ArcGIS geodatabase



THANK YOU!

Questions?

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[tayebbeh.tajallibakhsh@rpsgroup.com](mailto:tayebbeh.tajallibakhsh@rpsgroup.com)