NOAA's Sea Level Rise Viewer

And Marsh Resilience

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Presentation to the Chesapeake Bay Program – Climate Resiliency Workgroup
October 17, 2022

Outline

- Introduction to NOAA's Sea Level Rise Viewer
  - Overview of the viewer
  - Marsh Migration (and impact) modeling
- Marsh Resilience Analysis
  - Landscape Scale / national assessment
  - Local level assessments
- Coastal Change Analysis Program (C-CAP) Land Cover
  - High Resolution future

NOAA’s Sea Level Rise Viewer

Sea Level Rise Viewer

LAUNCH

DOWNLOAD DATA

ACCESS MAP SERVICES

GEOGRAPHY
Coastal contiguous U.S. (excludes Great Lakes), HI, and territories

PLATFORM
Web-based

LEVEL OF EFFORT
Low

NOAA Office for Coastal Management

Overview

Use this web mapping tool to visualize community-level impacts from coastal flooding or sea level rise (up to 10 feet above average high tides). Photo simulations of how future flooding might impact local landmarks are also provided, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence.

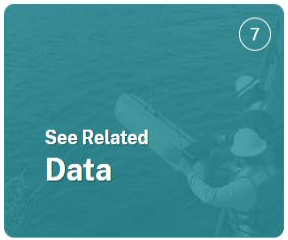
Features

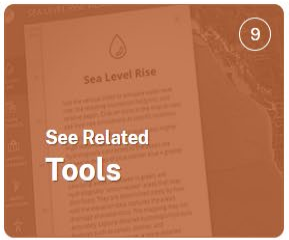
- Visualize potential impacts from sea level rise through maps and photos
- Learn about data and methods through documentation
- Share maps and links via email and social media

About the Tool

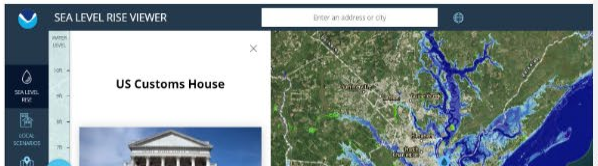
Additional Information

- + Sea Level Rise Tool FAQ
- + Mapping Methods
- + Data Updates
- + Acknowledgments
- + Story Maps
- + Publications
- + 3-D Fly-Through Scenarios





Tool **Screenshots**



Sea Level Rise Viewer

Sea Level Rise

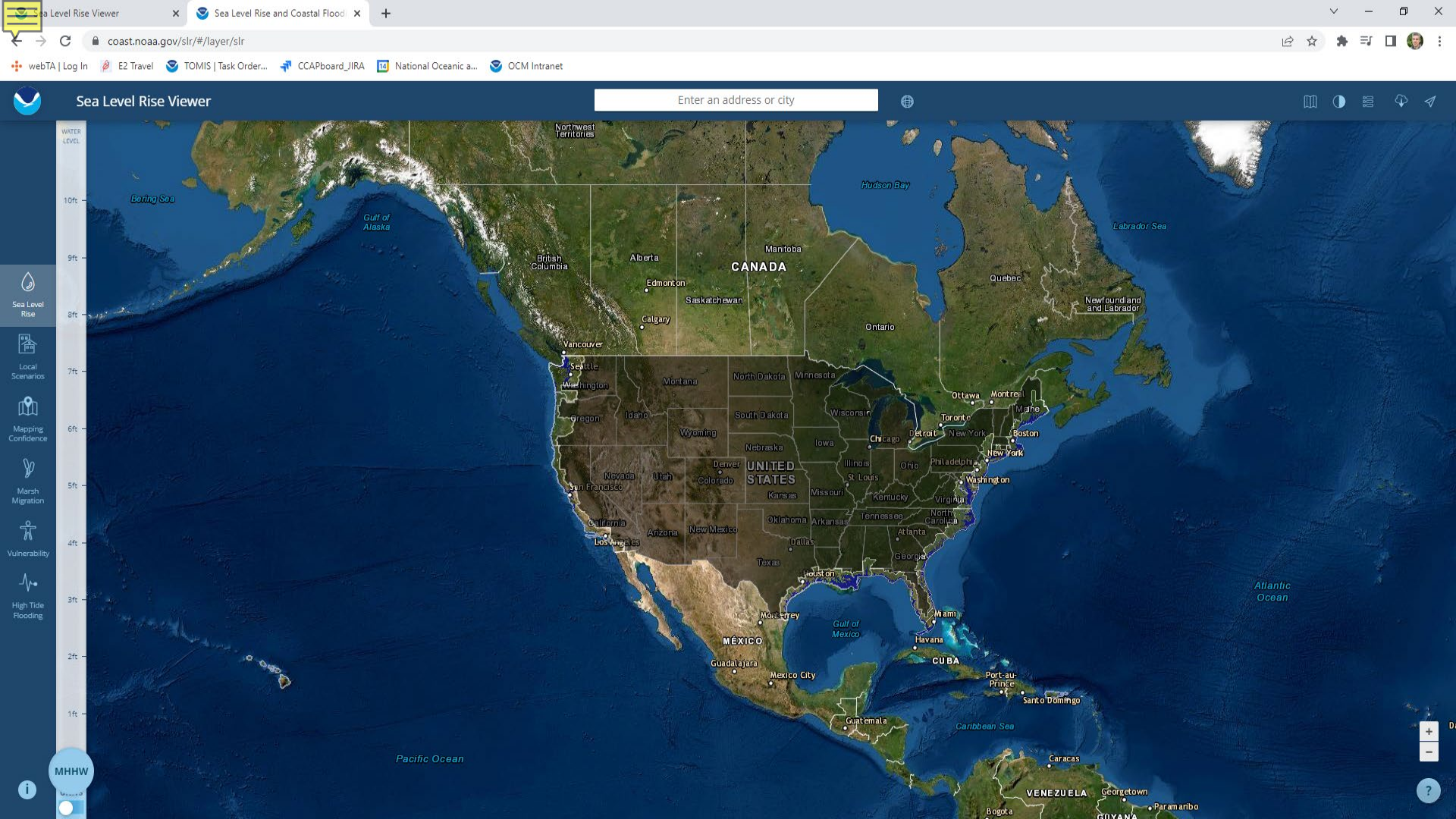
View sea level rise and potential coastal flooding impact areas and relative depth.

GET STARTED

Disclaimer

The data and maps in this tool illustrate the scale of potential flooding, not the exact location, and do not account for erosion, subsidence, or future construction. Water levels are relative to Mean Higher High Water (MHHW) (excludes wind driven tides). The data, maps, and information provided should be used only as a screening-level tool for management decisions. As with all remotely sensed data, all features should be verified with a site visit. The data and maps in this tool 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 for navigation, permitting, or other legal purposes.

DATA UPDATES


Sea Level Rise Viewer
Sea Level Rise and Coastal Flood
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webTA | Log In
E2 Travel
TOMIS | Task Order...
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National Oceanic a...
OCM Intranet
Sea Level Rise Viewer
Enter an address or city
WATER LEVEL
10ft
9ft
8ft
7ft
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4ft
3ft
2ft
1ft
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
MHHW
Northwest Territories
Hudson Bay
Bering Sea
Gulf of Alaska
Labrador Sea
British Columbia
Alberta
Manitoba
CANADA
Edmonton
Saskatchewan
Quebec
Newfoundland and Labrador
Calgary
Ontario
Vancouver
Seattle
Washington
Montana
North Dakota
Minnesota
Oregon
Idaho
South Dakota
Wisconsin
Ottawa
Montreal
Maine
Toronto
Wyoming
Detroit
New York
Boston
Chicago
Nebraska
Iowa
Denver
Illinois
Ohio
Philadelphia
Nevada
Utah
Colorado
UNITED STATES
St Louis
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San Francisco
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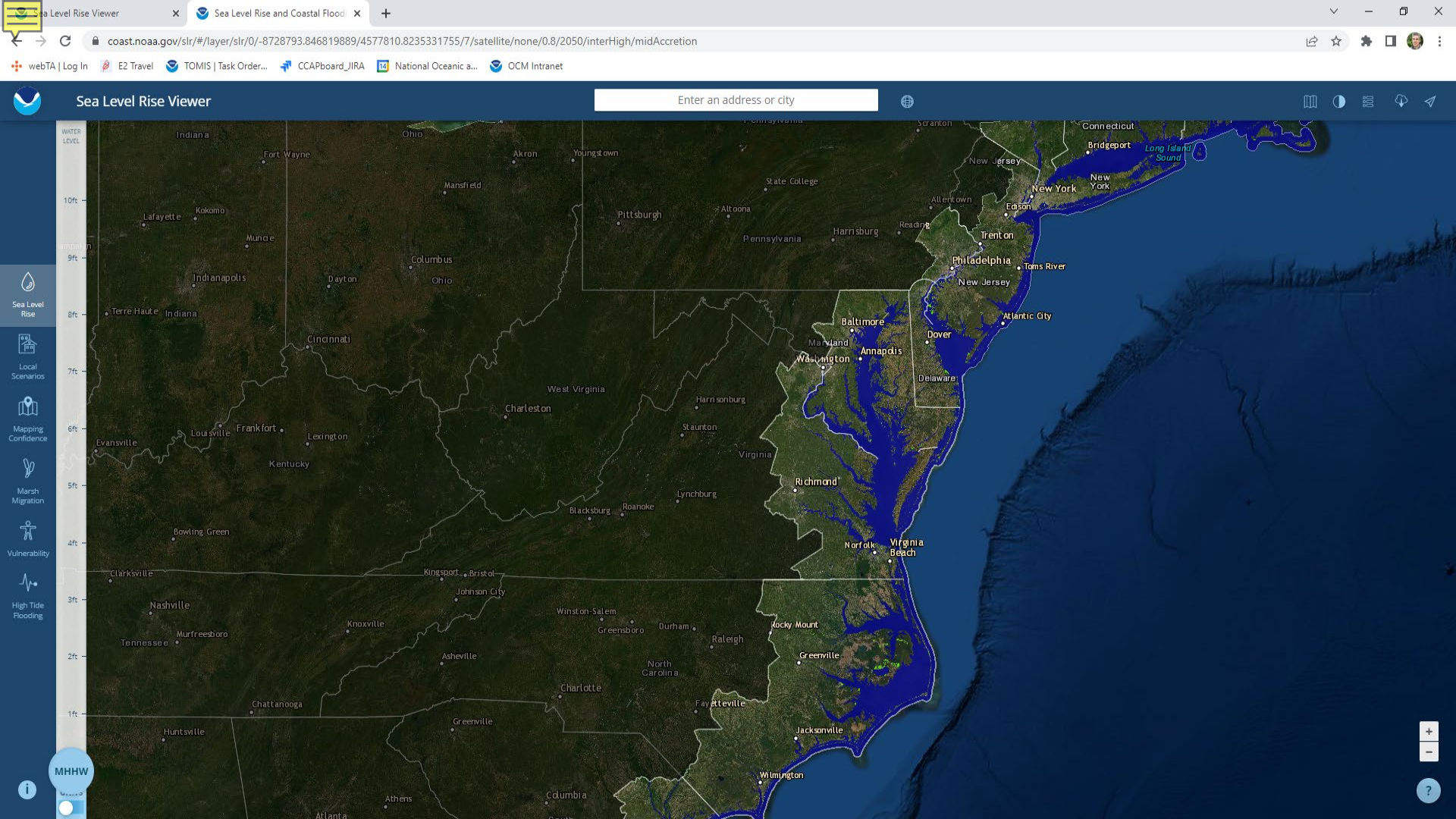
California
Oklahoma
Arkansas
Tennessee
North Carolina
Arizona
New Mexico
Atlanta
Los Angeles
Dallas
Georgia
Texas
Houston
Atlantic Ocean
Monterrey
Gulf of Mexico
Miami
MÉXICO
Havana
CUBA
Guadalajara
Mexico City
Port-au-Prince
Santo Domingo
Guatemala
Caribbean Sea
Pacific Ocean
Caracas
VENEZUELA
Georgetown
Bogota
Paramaribo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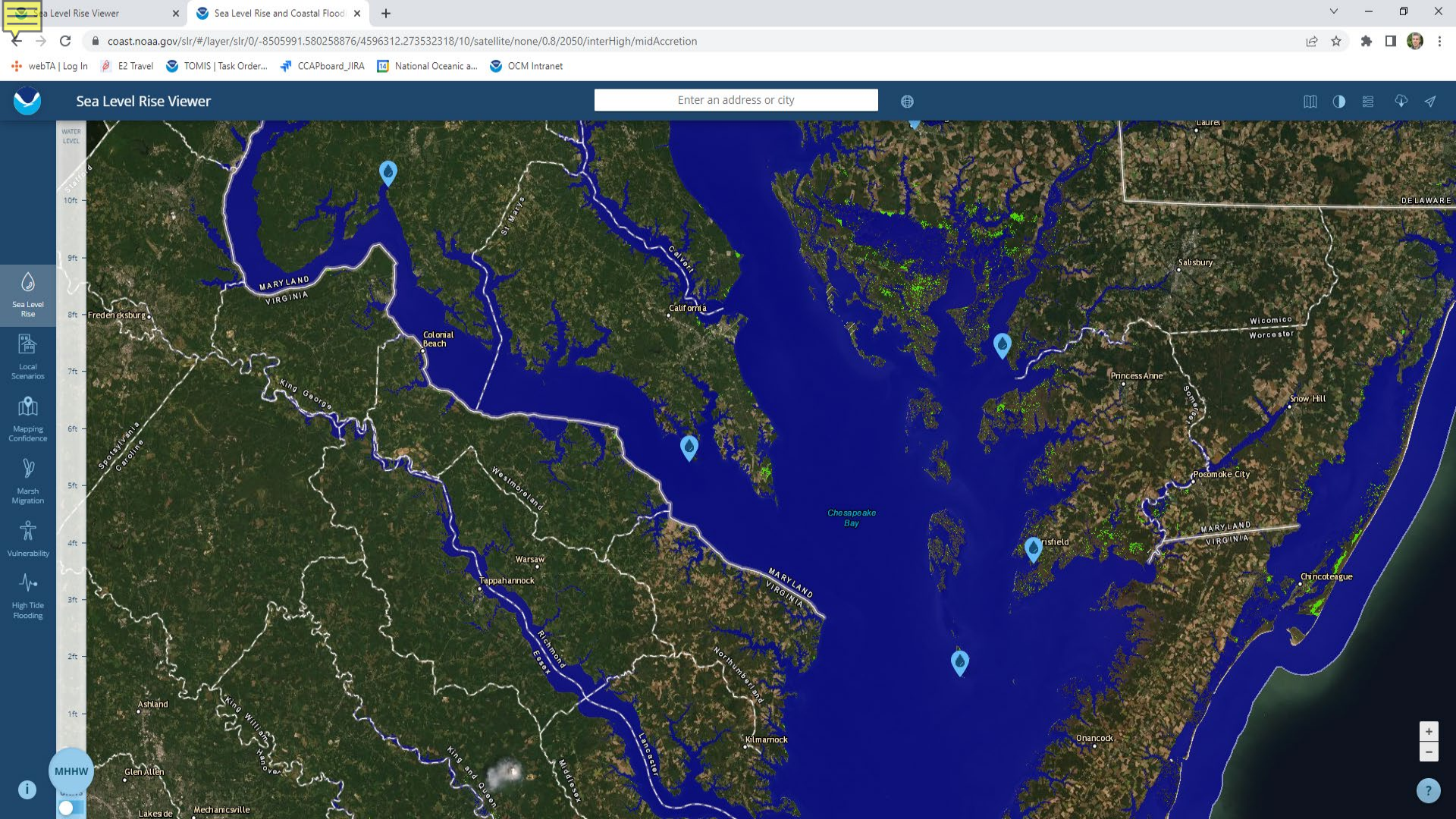
Fort Wayne
Akron
Youngstown
Mansfield
State College
Lafayette
Kokomo
Muncie
Pittsburgh
Altoona
Pennsylvania
Harrisburg
Reading
Columbus
Indianapolis
Dayton
Ohio
Terre Haute
Indiana
Cincinnati
West Virginia
Charleston
Harrisonburg
Staunton
Louisville
Frankfort
Lexington
Evansville
Kentucky
Virginia
Richmond
Lynchburg
Blacksburg
Roanoke
Bowling Green
Clarksville
Kingsport
Bristol
Johnson City
Nashville
Winston-Salem
Knoxville
Greensboro
Durham
Raleigh
Murfreesboro
Tennessee
Asheville
North Carolina
Charlotte
Chattanooga
Greenville
Huntsville
Fayetteville
Athens
Columbia
Atlanta
Scranton
Connecticut
Bridgeport
Long Island Sound
New Jersey
New York
New York
Allentown
Edison
Trenton
Philadelphia
Toms River
New Jersey
Atlantic City
Baltimore
Maryland
Annapolis
Dover
Washington
Delaware
Rocky Mount
Greenville
Norfolk
Virginia Beach
Jacksonville
Wilmington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MARYLAND
VIRGINIA
DELAWARE
Fredericksburg
Colonial Beach
California
Calvert
St Marys
King George
Spotsylvania
Caroline
Westmoreland
Warsaw
Tappahannock
Richmond
Essex
Northumberland
Lancaster
Middlesex
King and Queen
King William
Hanover
Ashland
Glen Allen
Mechanicsville
Lakeside
Kilmarnock
Onancock
Chesapeake Bay
Salisbury
Wicomico
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Chincoteague
Laurel

Sea Level Rise Viewer | Sea Level Rise and Coastal Flood

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Sea Level Rise
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MHHW

Crisfield Fire Department

Use the slider to view a simulation of sea level rise at this location.

St Marys
Calvert
California
Colonial Beach
Westmoreland
Warsaw
Tappahannock
Richmond
Essex
Northumberland
Lancaster
Middlesex
King and Queen
Kilmarnock
Chesapeake Bay
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VIRGINIA
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Current MHHW

UNITS

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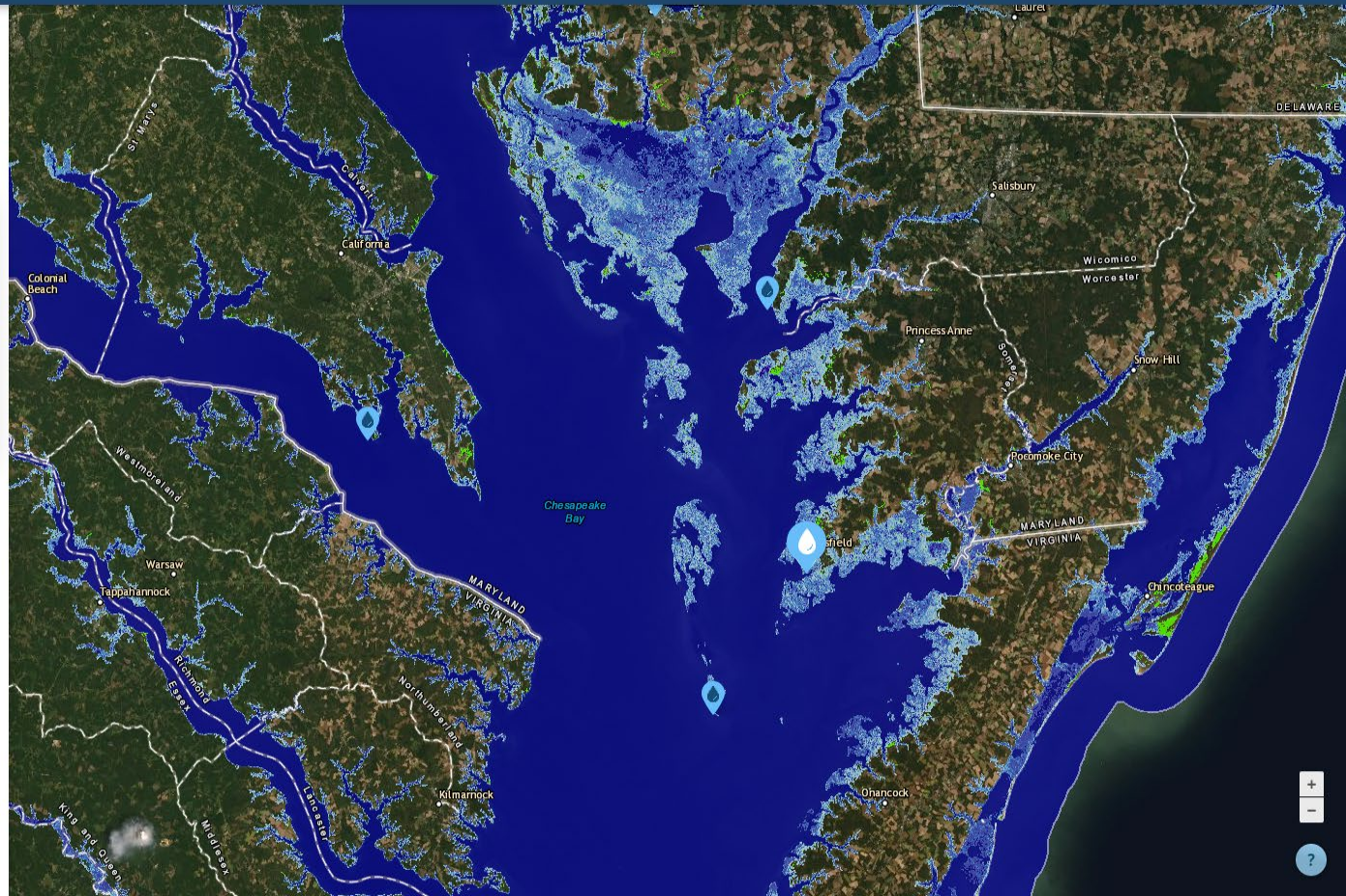

Sea Level Rise Viewer | Sea Level Rise and Coastal Flood

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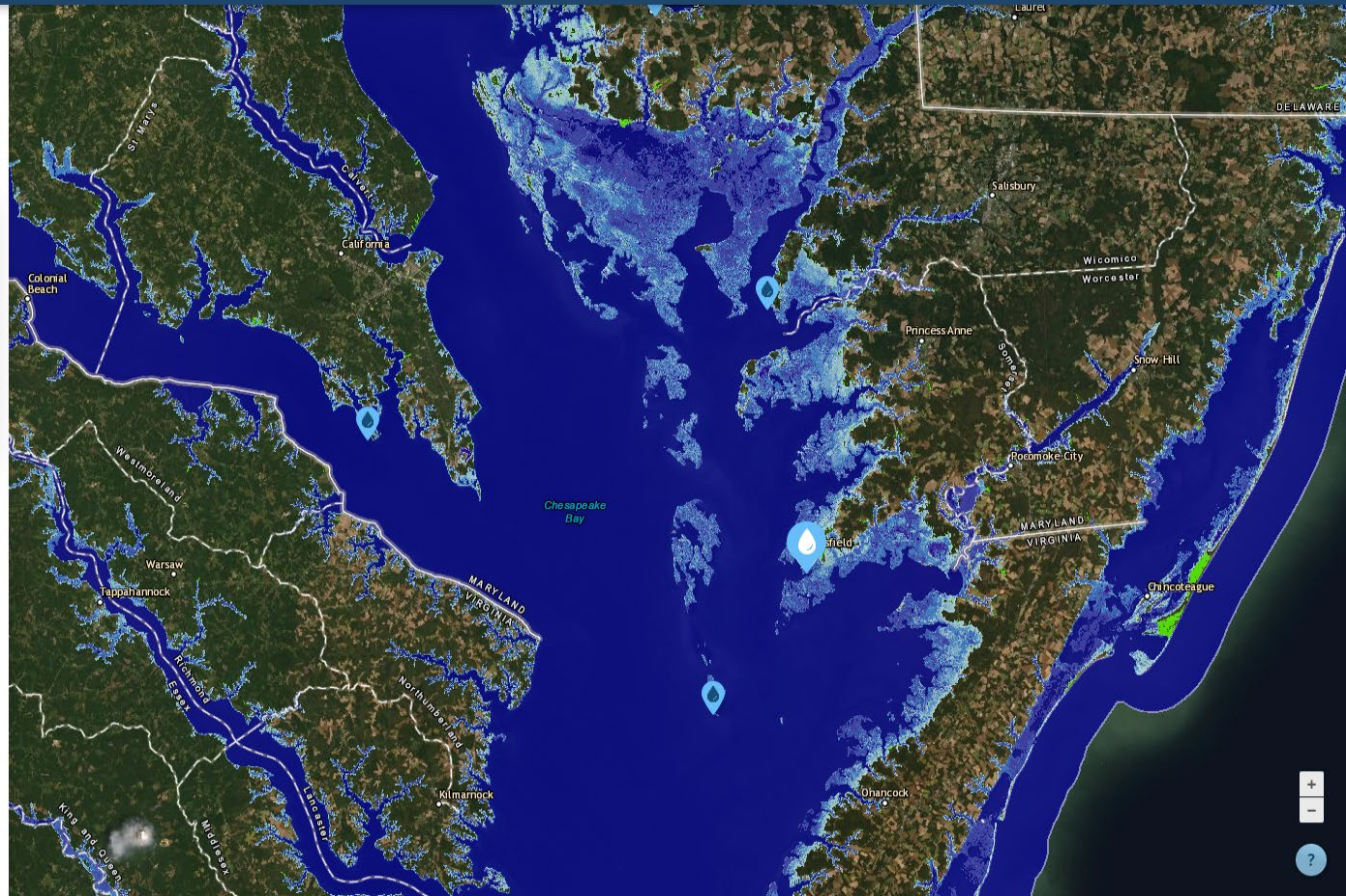

Sea Level Rise Viewer | Sea Level Rise and Coastal Flood

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Sea Level Rise

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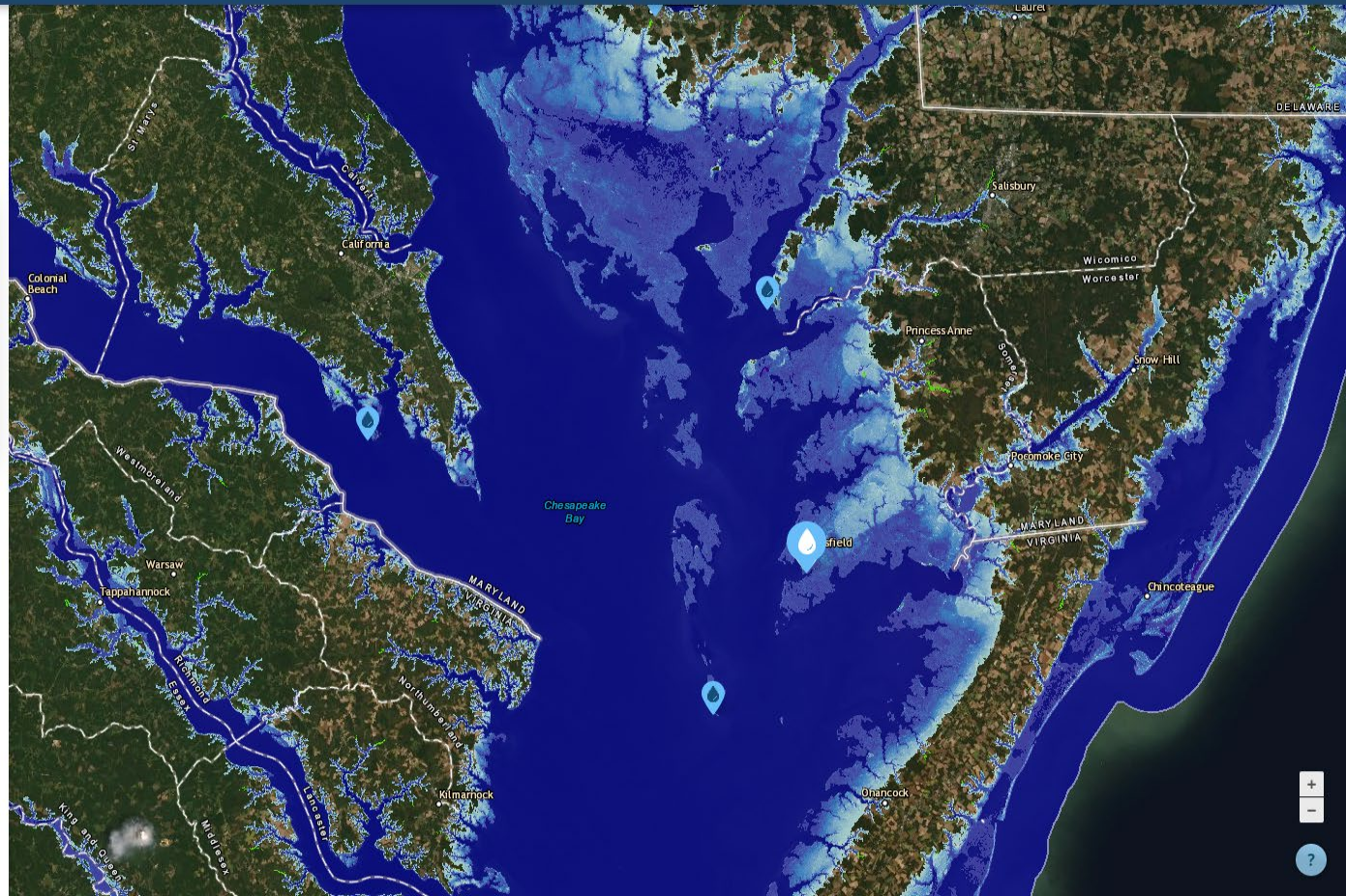

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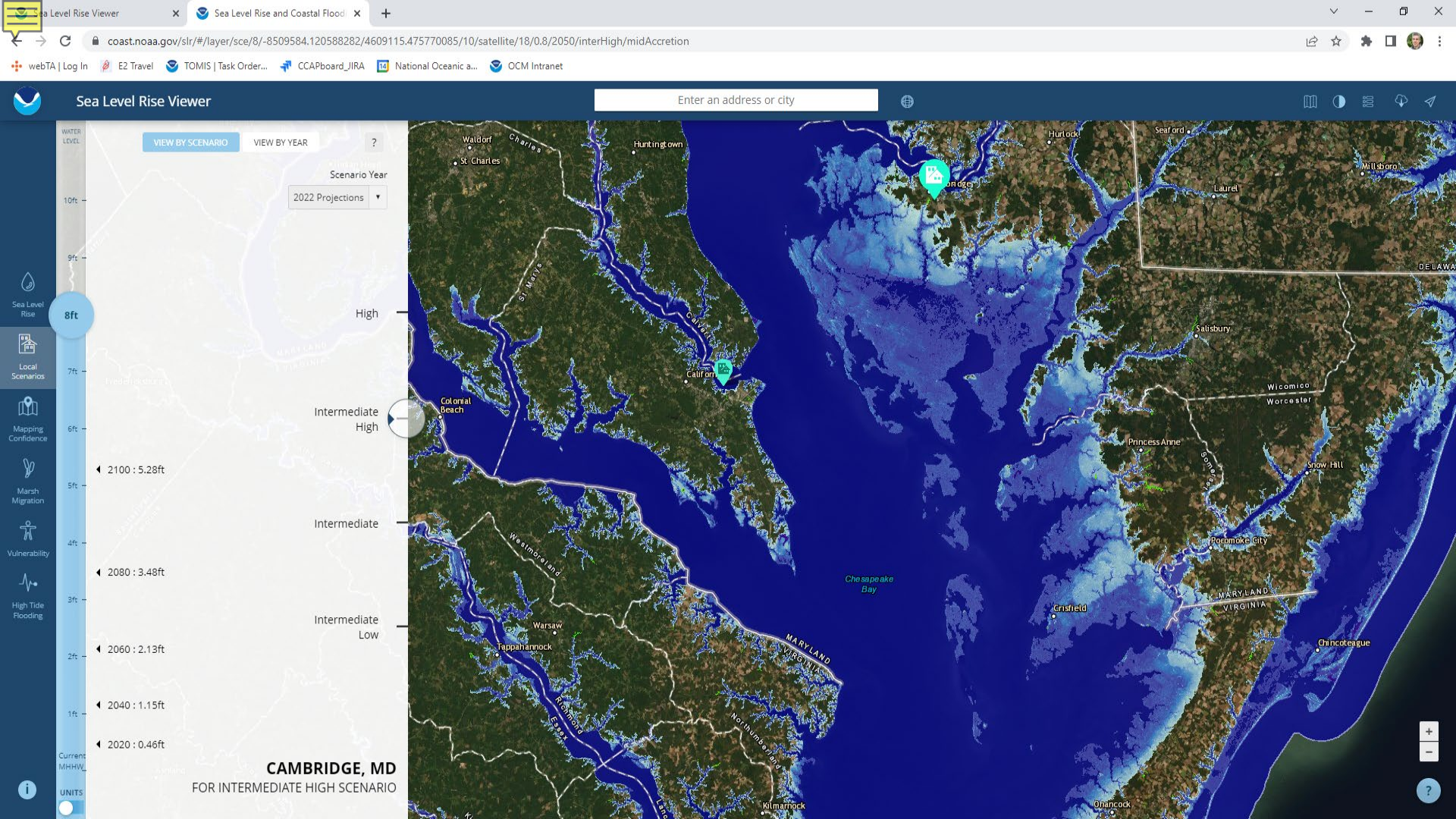
Local Scenarios

Zoom to your area of interest and click on the closest Scenario Location icon in the map.

Local sea level rise scenarios can be displayed either by year or by individual scenario.

Customize the scenarios and compare to the 1-foot water level increments (using sliders) to view potential impacts.

Local Scenarios Tutorial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VIEW BY SCENARIO
VIEW BY YEAR
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Scenario Year
2022 Projections
WATER LEVEL
10ft
9ft
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Intermediate High
2100 : 5.28ft
Intermediate
2080 : 3.48ft
Intermediate Low
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CAMBRIDGE, MD
FOR INTERMEDIATE HIGH SCENARIO
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Hurlock
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Wicomico
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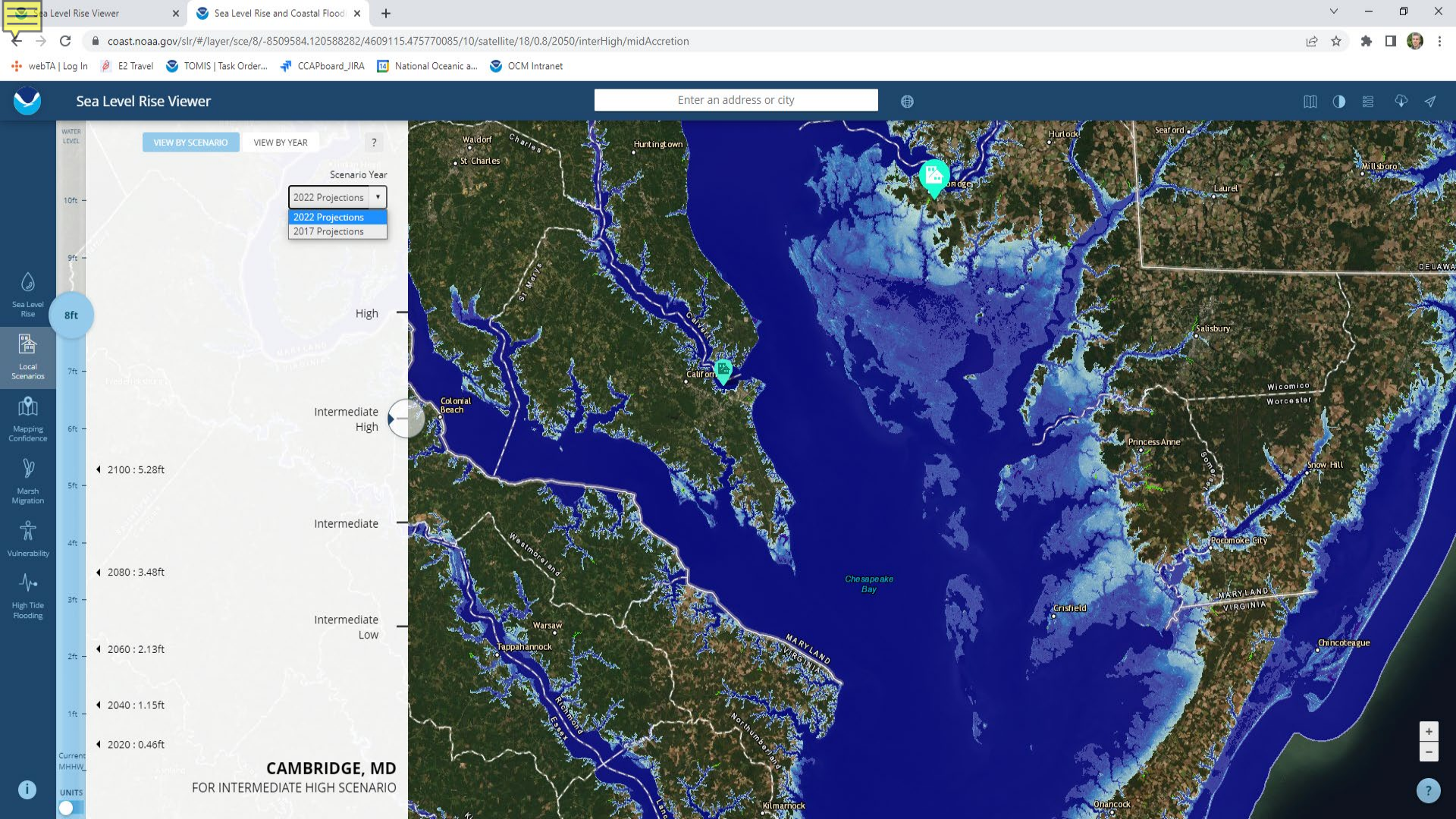
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Sea Level Rise Viewer
Enter an address or city
VIEW BY SCENARIO
VIEW BY YEAR
Scenario Year
2022 Projections
2022 Projections
2017 Projections
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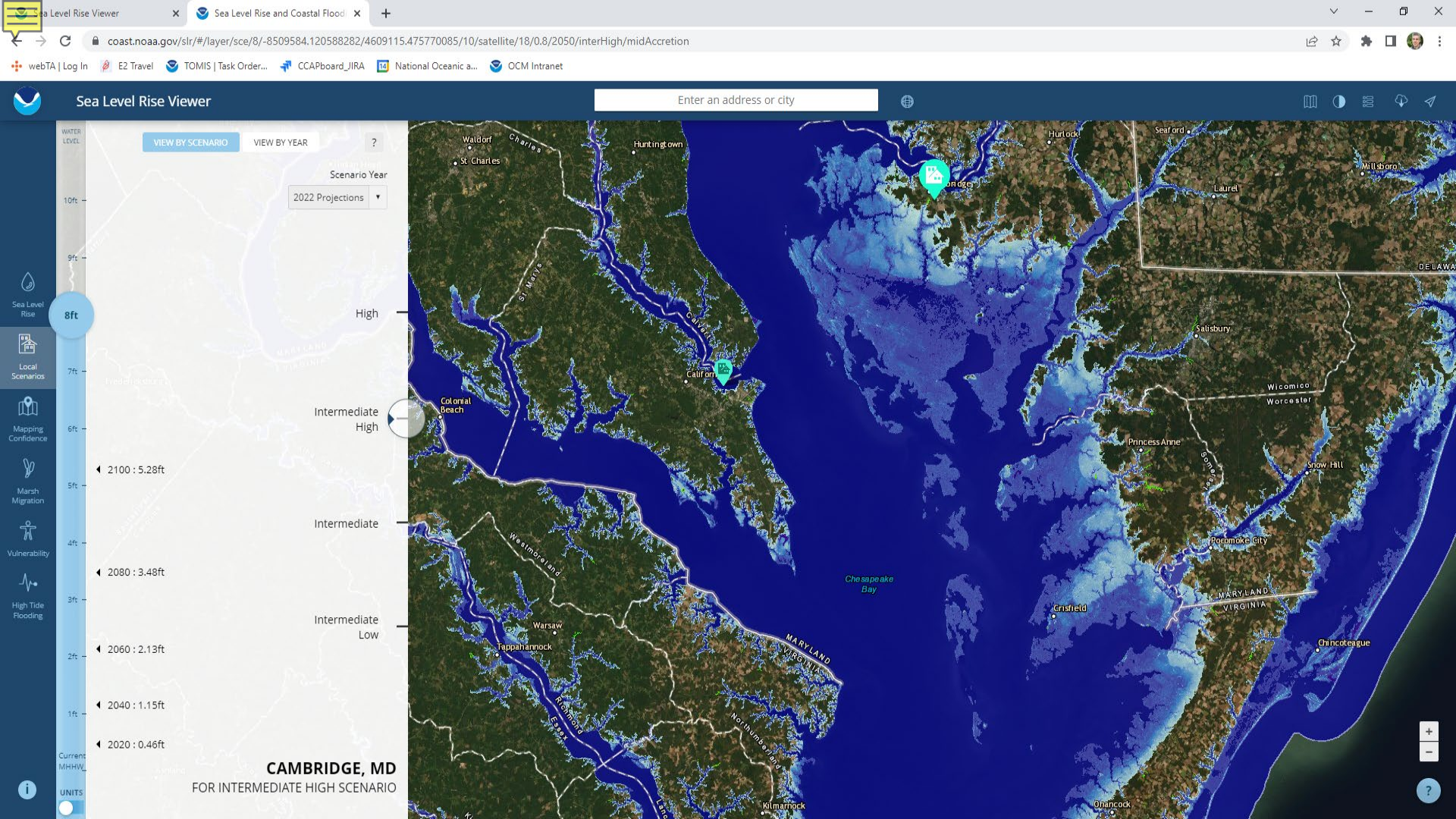
DELAWA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Sea Level Rise Viewer

Enter an address or city

VIEW BY SCENARIO | VIEW BY YEAR | ?

Scenario Year: 2022 Projections

WATER LEVEL

10ft
9ft
8ft
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6ft
5ft
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1ft
Current MHHW

High

Intermediate High

2100 : 5.28ft

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UNITS

Sea Level Rise | Local Scenarios | Mapping Confidence | Marsh Migration | Vulnerability | High Tide Flooding

CAMBRIDGE, MD
FOR INTERMEDIATE HIGH SCENARIO

Waldorf | St. Charles | Charles | Huntingtown | Hurlock | Seaford | Millsboro | Laurel | Salisbury | Wicomico | Worcester | Princess Anne | Somerset | Snow Hill | Pocomoke City | Crisfield | Chincoteague | Colonial Beach | St. Marys | Calvert | Westmoreland | Warsaw | Tappahannock | Richmond | Essex | Northumberland | Kilmarnock | Onancock | Chesapeake Bay | MARYLAND | VIRGINIA | DELAWA

Sea Level Rise Viewer | Sea Level Rise and Coastal Flood

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Sea Level Rise Viewer

Enter an address or city

NET SEA LEVEL

10ft
9.5ft
9ft
8.5ft
8ft
7.5ft
7ft
6.5ft
6ft
5.5ft
5ft
4.5ft
4ft
3.5ft
3ft
2.5ft
2ft
1.5ft
1ft
0.5ft
MHHW

Sea Level Rise
Local Scenarios
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Marsh Migration

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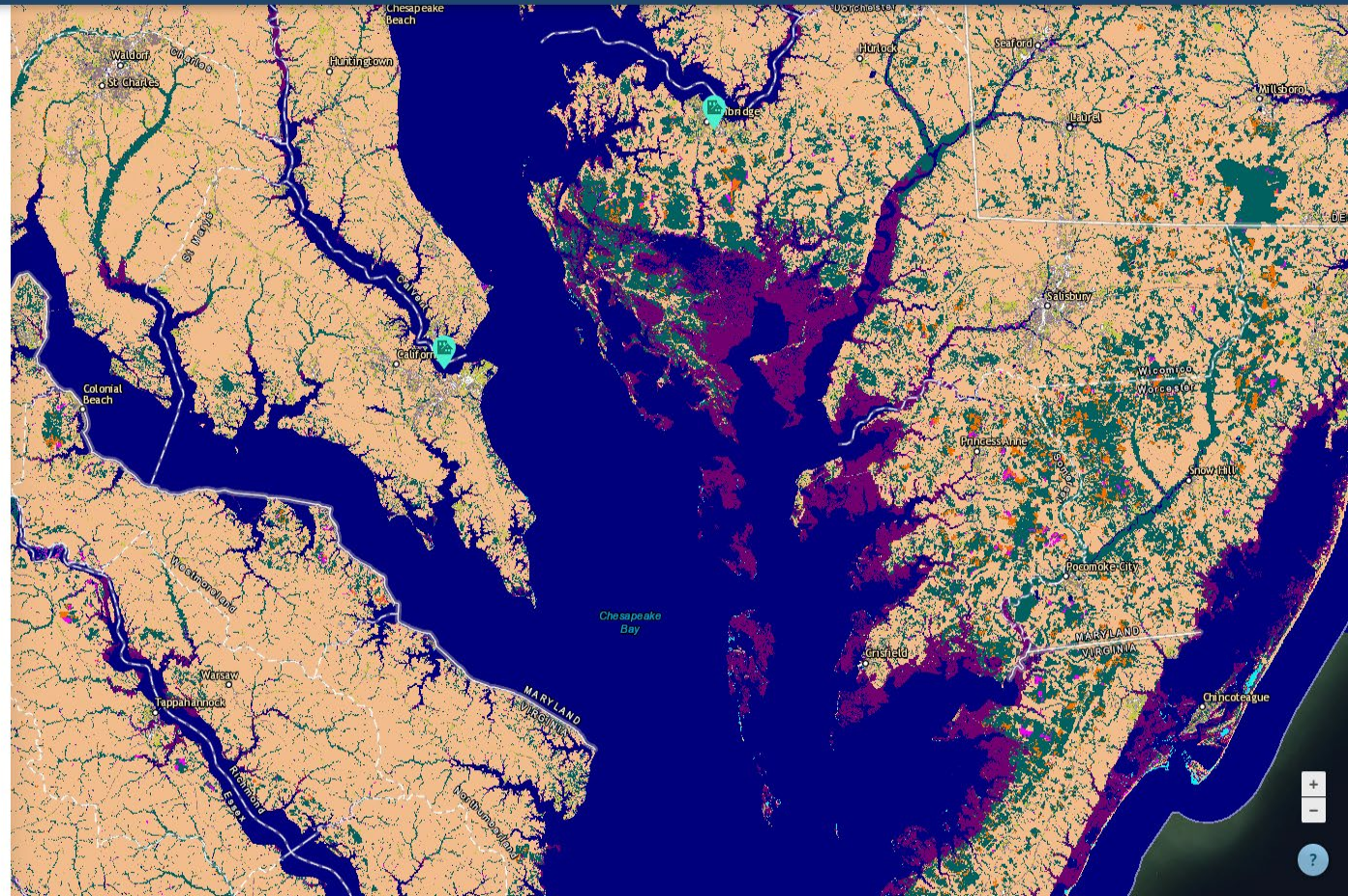
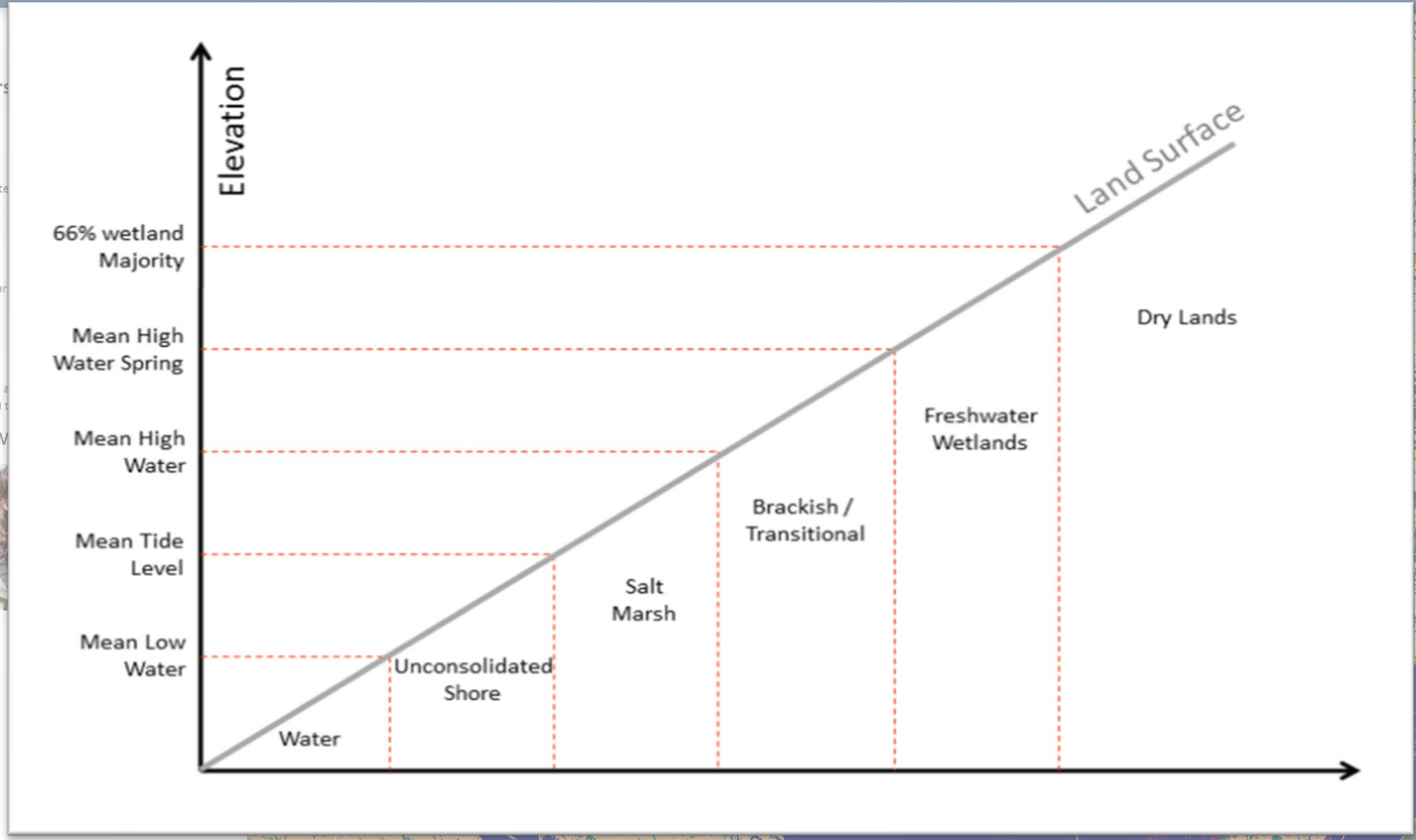
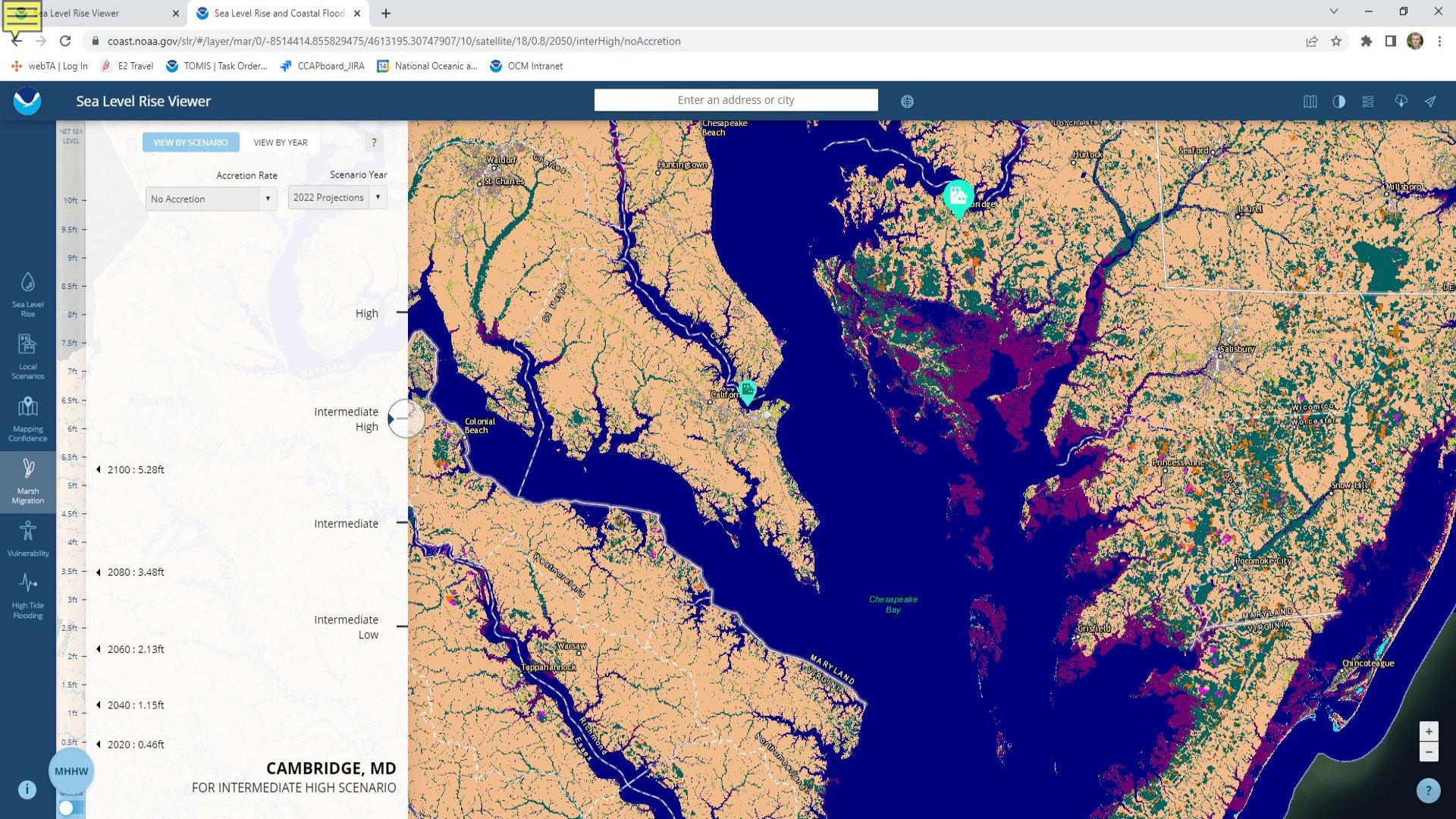
Marsh Migration Tutorial




Elevation
Land Surface
66% wetland Majority
Mean High Water Spring
Mean High Water
Mean Tide Level
Mean Low Water
Water
Unconsolidated Shore
Salt Marsh
Brackish / Transitional
Freshwater Wetlands
Dry Lands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Sea Level Rise and Coastal Flood
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webTA | Log In
E2 Travel
TOMIS | Task Order...
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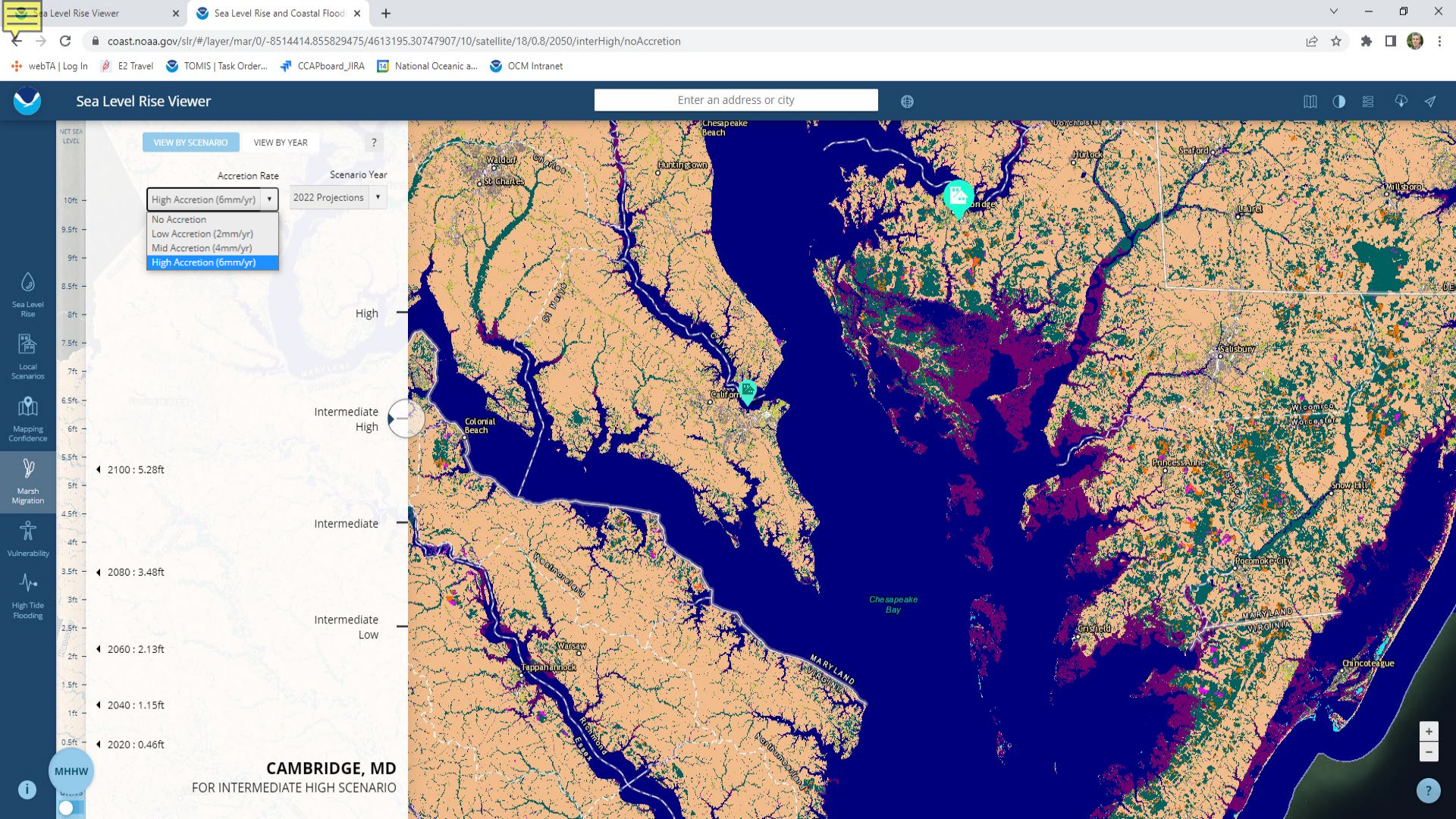
National Oceanic a...
OCM Intranet
Sea Level Rise Viewer
Enter an address or city
VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
No Accretion
Scenario Year
2022 Projections
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
High
Intermediate High
2100 : 5.28ft
Intermediate
2080 : 3.48ft
Intermediate Low
2060 : 2.13ft
2040 : 1.15ft
2020 : 0.46ft
MHHW
CAMBRIDGE, MD
FOR INTERMEDIATE HIGH SCENARIO
Chesapeake Beach
Waldorf
St Charles
Huntingtown
Hurlock
Seaford
Laurel
Salisbury
Colonial Beach
Princess Anne
Snow Hill
Crisfield
Chincoteague
Chesapeake Bay
MARYLAND
VIRGINIA
Tappahannock
Warsaw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Sea Level Rise and Coastal Flood
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webTA | Log In
E2 Travel
TOMIS | Task Order...
CCAPboard_JIRA
National Oceanic a...
OCM Intranet
Sea Level Rise Viewer
Enter an address or city
VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
Scenario Year
High Accretion (6mm/yr)
2022 Projections
No Accretion
Low Accretion (2mm/yr)
Mid Accretion (4mm/yr)
High Accretion (6mm/yr)
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
High
Intermediate High
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Intermediate
2080 : 3.48ft
Intermediate Low
2060 : 2.13ft
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MARYLAND
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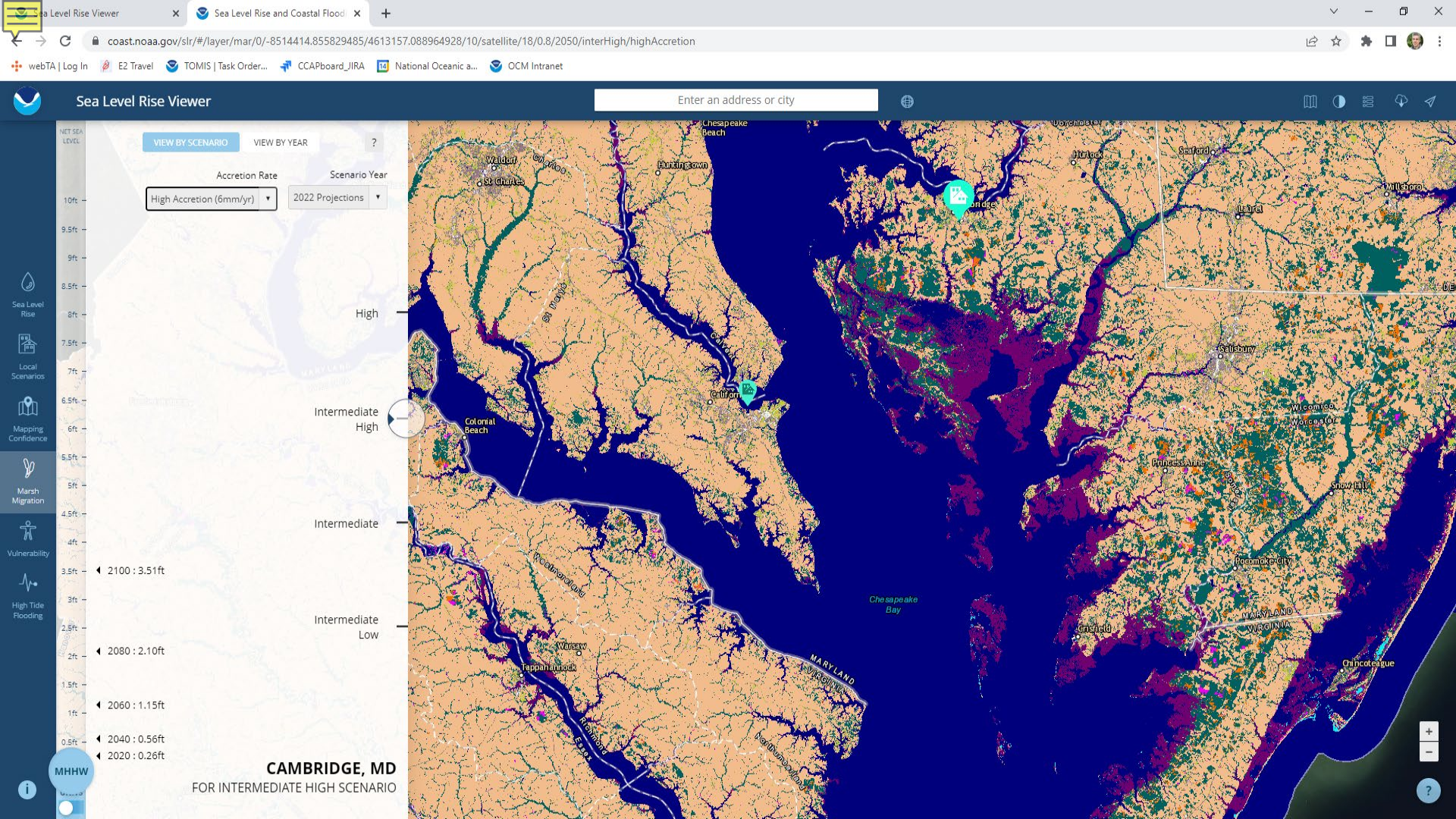
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Sea Level Rise and Coastal Flood
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OCM Intranet
Sea Level Rise Viewer
Enter an address or city
VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
High Accretion (6mm/yr)
Scenario Year
2022 Projections
NET SEA LEVEL
10ft
9.5ft
9ft
8.5ft
8ft
7.5ft
7ft
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1ft
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High
Intermediate High
Intermediate
2100 : 3.51ft
Intermediate Low
2080 : 2.10ft
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2020 : 0.26ft
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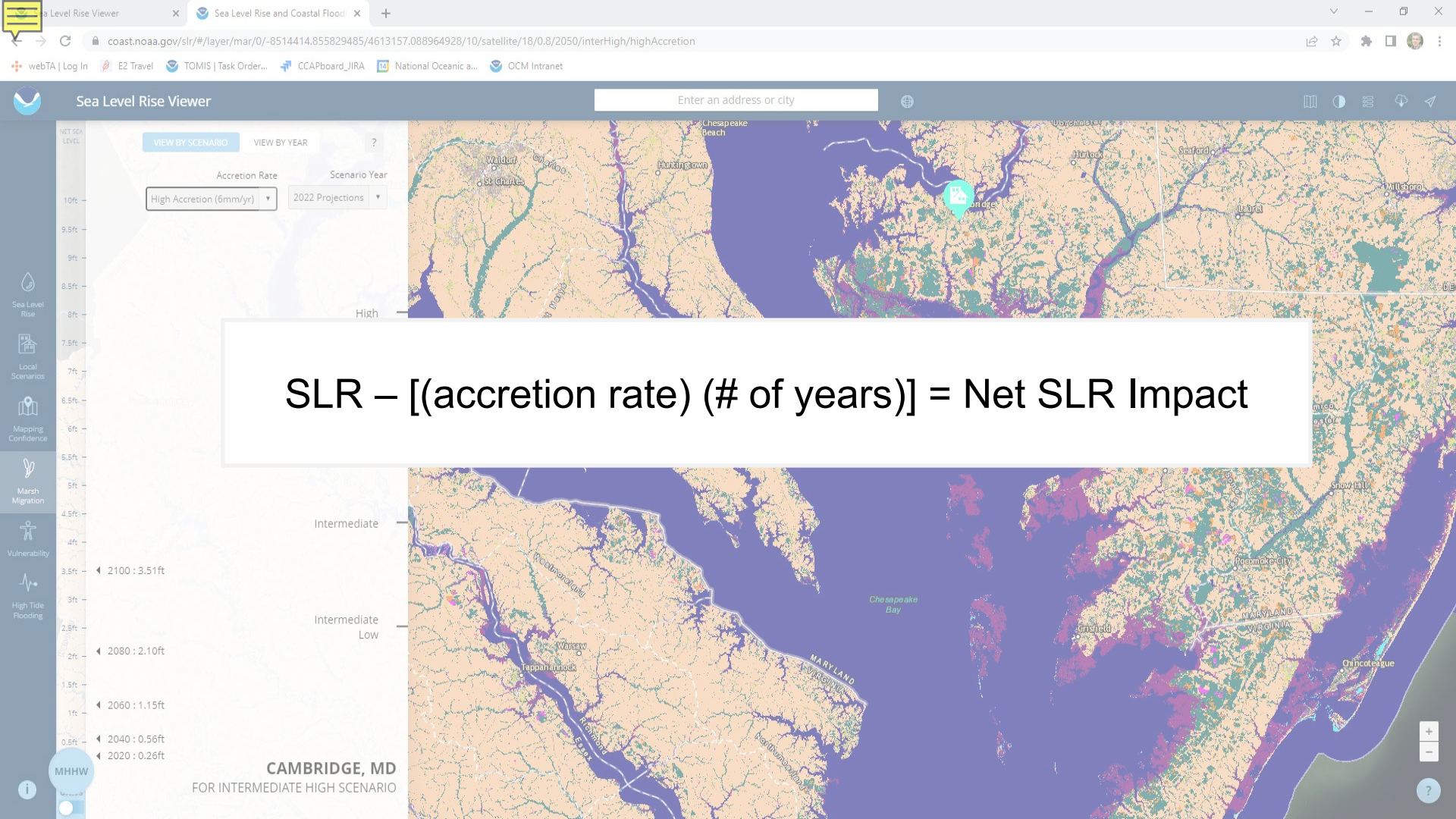
Warsaw


Sea Level Rise Viewer
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Accretion Rate
High Accretion (6mm/yr)
Scenario Year
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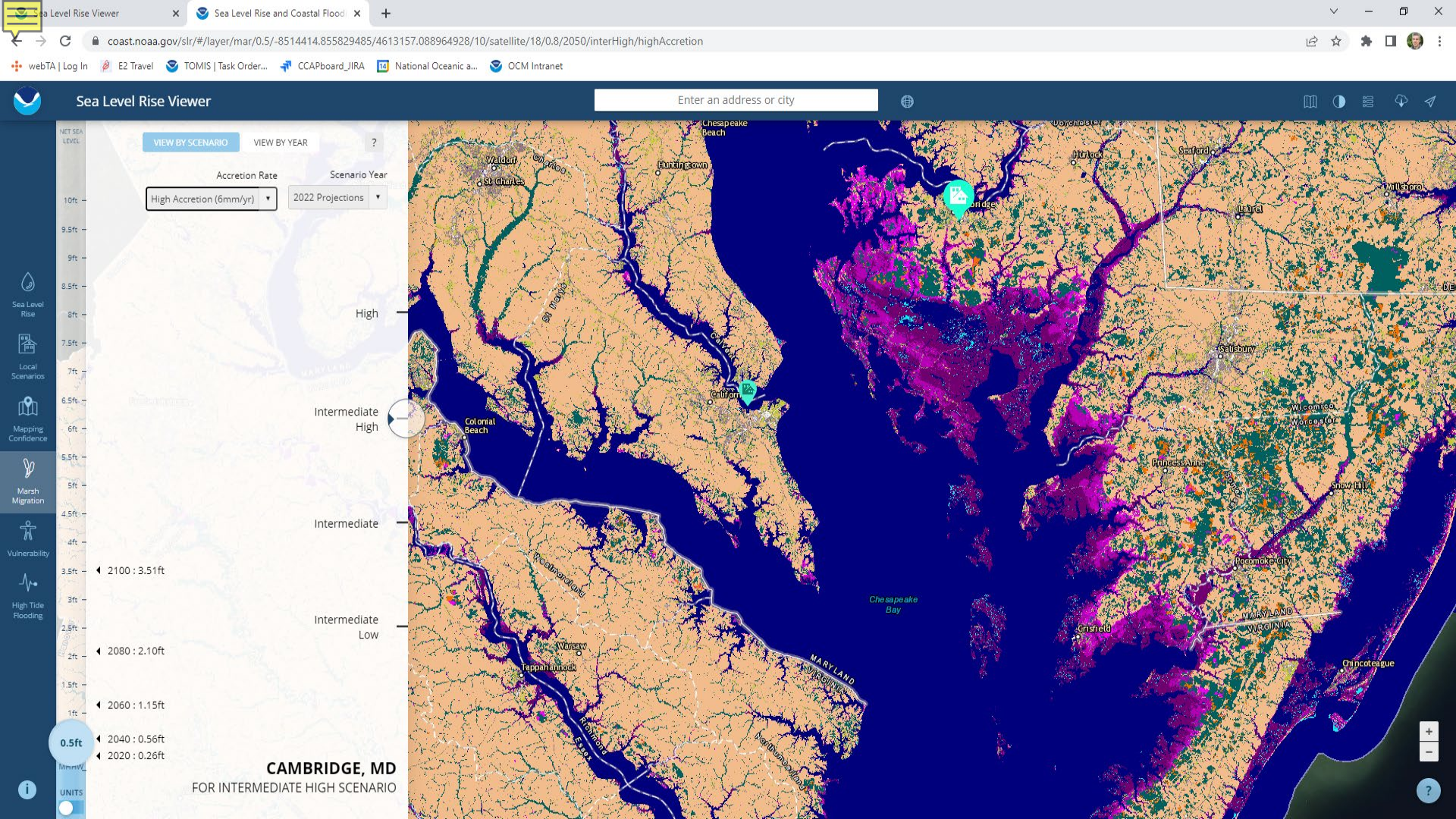
2020 : 0.26ft
MHHW
CAMBRIDGE, MD
FOR INTERMEDIATE HIGH SCENARIO
SLR – [(accretion rate) (# of years)] = Net SLR Impact


Sea Level Rise Viewer
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Accretion Rate
High Accretion (6mm/yr)
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2022 Projections
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10ft
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Sea Level Rise
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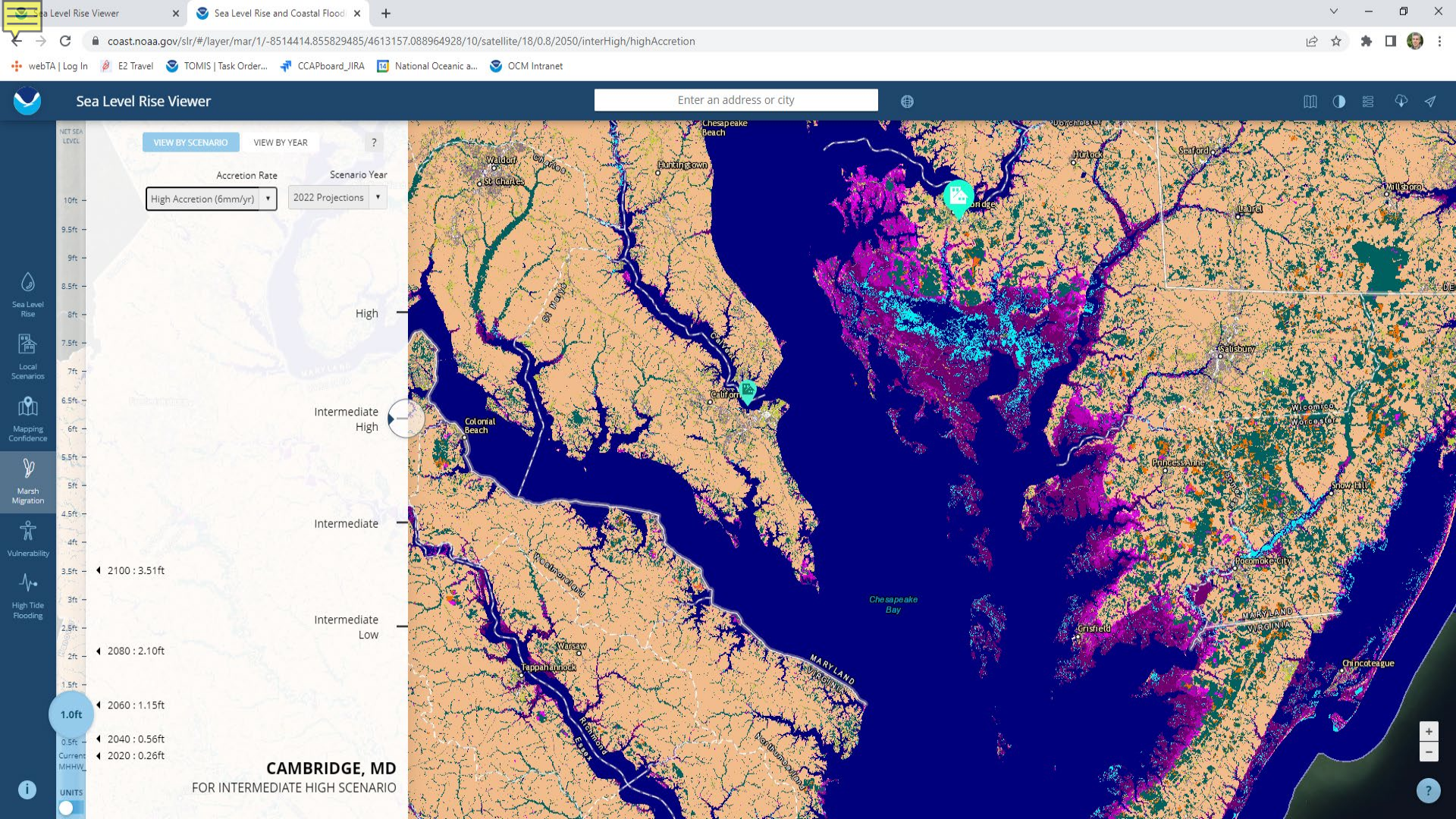
Chesapeake Beach
Waldorf
St Charles
Huntingtown
Hurlock
Seaford
Dorchester
Laurel
Salisbury
Colonial Beach
Princess Anne
Snow Hill
Roanoke City
Crisfield
Chincoteague
Tappahannock
Warsaw
Chesapeake Bay
MARYLAND
VIRGINIA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High Accretion (6mm/yr)
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9.5ft
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3ft
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2ft
1.5ft
1.0ft
0.5ft
Current MHHW
UNITS
High
Intermediate High
Intermediate
Intermediate Low
2100 : 3.51ft
2080 : 2.10ft
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2040 : 0.56ft
2020 : 0.26ft
CAMBRIDGE, MD
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Sea Level Rise
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Marsh Migration
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Chesapeake Beach
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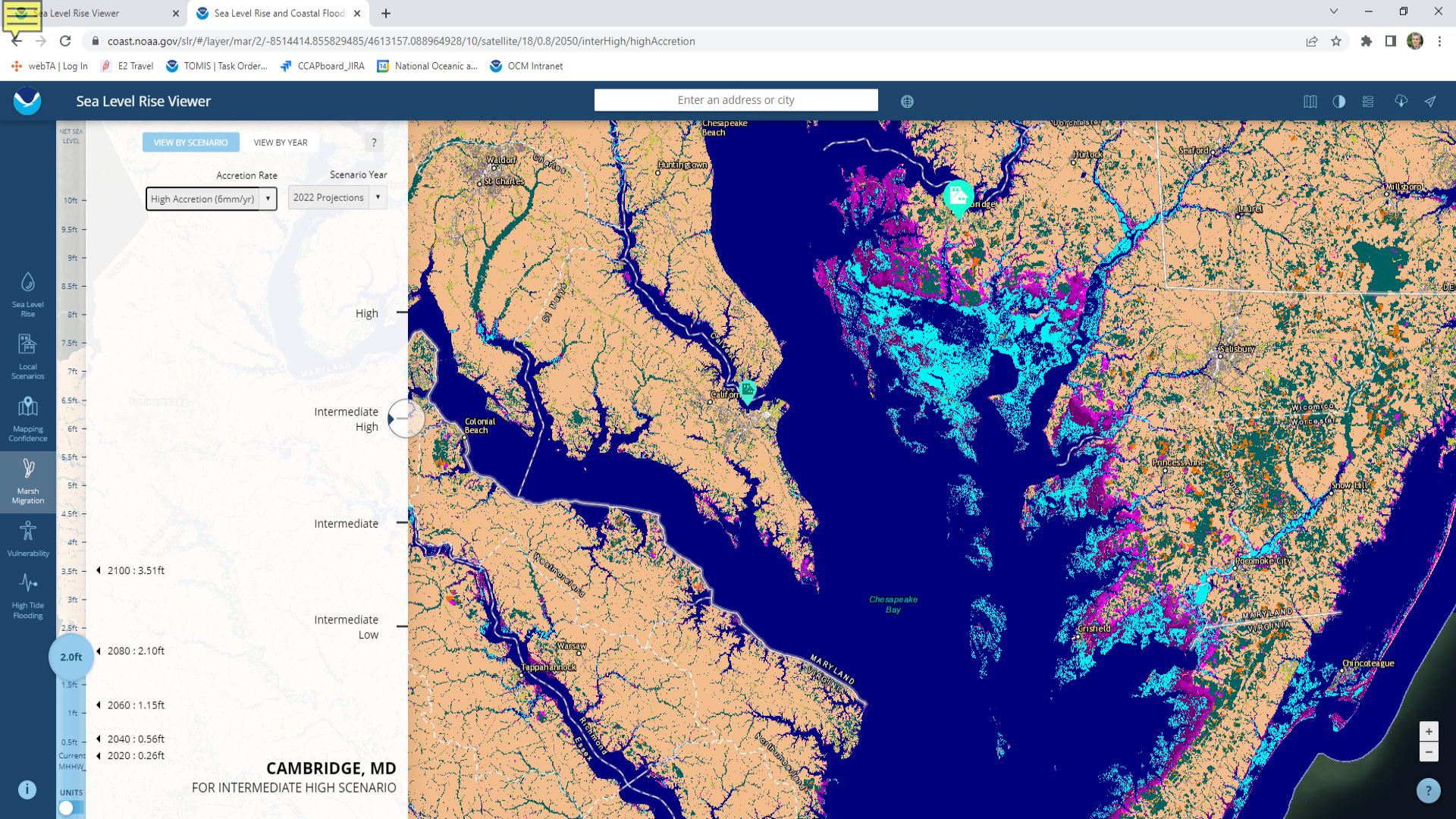
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Accretion Rate
High Accretion (6mm/yr)
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2022 Projections
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Marsh Migration
Vulnerability
High Tide Flooding
High
Intermediate High
Intermediate
Intermediate Low
2100 : 3.51ft
2080 : 2.10ft
2060 : 1.15ft
2040 : 0.56ft
2020 : 0.26ft
2.0ft
CAMBRIDGE, MD
FOR INTERMEDIATE HIGH SCENARIO
UNITS
Chesapeake Beach
Waldorf
St Charles
Huntingtown
Colonial Beach
Cambridge
Hurlock
Seaford
Laurel
Millsboro
Salisbury
Princess Anne
Snow Hill
Pocomoke City
Crisfield
Chincoteague
Chesapeake Bay
Tappahannock
Warsaw
Westmoreland
Richmond
Essex
Northumberland
MARYLAND
VIRGINIA

Sea Level Rise Viewer

Enter an address or city

VIEW BY SCENARIO | VIEW BY YEAR

Accretion Rate: High Accretion (6mm/yr)

Scenario Year: 2022 Projections

NET SEA LEVEL

10ft
9.5ft
9ft
8.5ft
8ft
7.5ft
7ft
6.5ft
6ft
5.5ft
5ft
4.5ft
4ft
3.5ft
3ft
2.5ft
2ft
1.5ft
1ft
0.5ft
Current MHHW

High

Intermediate High

Intermediate

Intermediate Low

3.5ft — 2100 : 3.51ft

2080 : 2.10ft

2060 : 1.15ft

2040 : 0.56ft

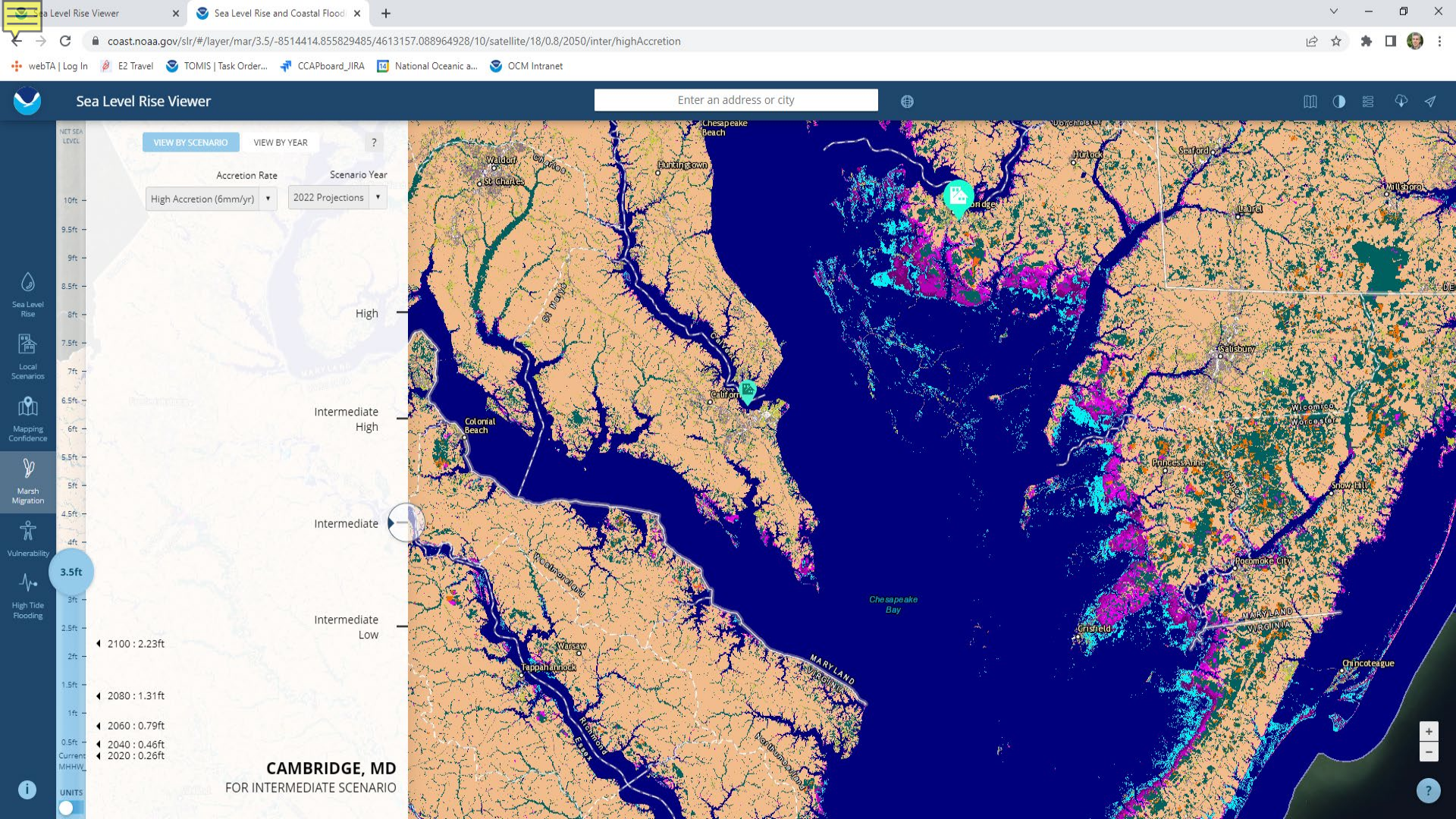
2020 : 0.26ft

UNITS

Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding

CAMBRIDGE, MD
FOR INTERMEDIATE HIGH SCENARIO

Chesapeake Beach
Huntingtown
Waldorf
St Charles
Hurlock
Seaford
Hillsboro
Laurel
Salisbury
Colonial Beach
Princess Anne
Snow Hill
Roanoke City
Chesapeake Bay
MARYLAND
VIRGINIA
Crisfield
Chincoteague
Tappahannock
Warsaw
Rappahannock
Essex
Northumberland


Sea Level Rise Viewer
Sea Level Rise and Coastal Flood
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webTA | Log In
E2 Travel
TOMIS | Task Order...
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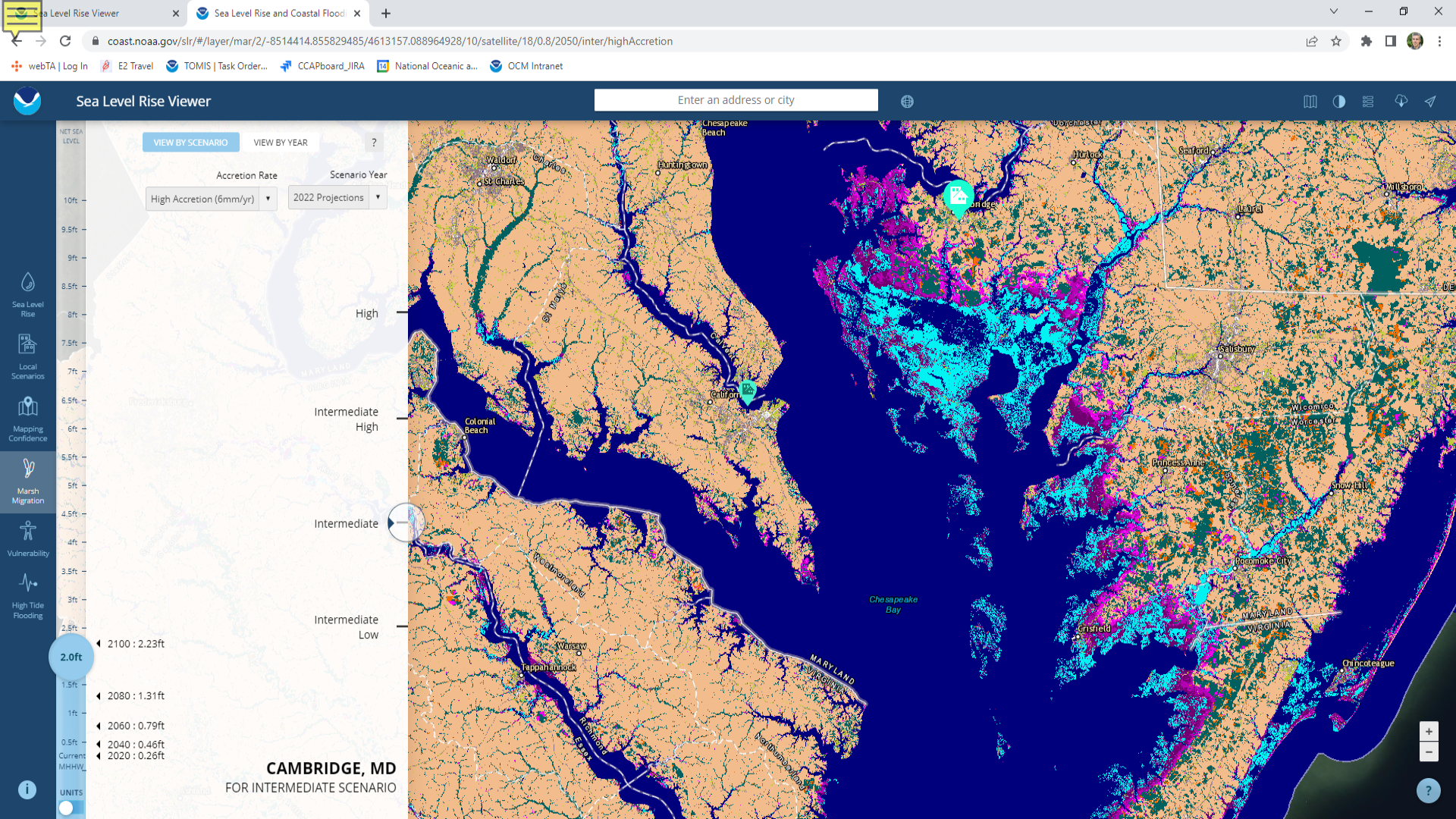
National Oceanic a...
OCM Intranet
Sea Level Rise Viewer
Enter an address or city
VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
High Accretion (6mm/yr)
Scenario Year
2022 Projections
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
High
Intermediate High
Intermediate
Intermediate Low
3.5ft
2100 : 2.23ft
2080 : 1.31ft
2060 : 0.79ft
2040 : 0.46ft
2020 : 0.26ft
CAMBRIDGE, MD
FOR INTERMEDIATE SCENARIO
Chesapeake Bay
MARYLAND
VIRGINIA


Sea Level Rise Viewer
Sea Level Rise and Coastal Flood
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OCM Intranet
Sea Level Rise Viewer
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VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
High Accretion (6mm/yr)
Scenario Year
2022 Projections
NET SEA LEVEL
10ft
9.5ft
9ft
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4ft
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1.5ft
1ft
0.5ft
Current MHHW
High
Intermediate High
Intermediate
Intermediate Low
2100 : 2.23ft
2080 : 1.31ft
2060 : 0.79ft
2040 : 0.46ft
2020 : 0.26ft
UNITS
CAMBRIDGE, MD
FOR INTERMEDIATE SCENARIO
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
Chesapeake Beach
Huntingtown
Waldorf
St Charles
Hurlock
Seaford
Laurel
Salisbury
Colonial Beach
Princess Anne
Snow Hill
Roanoke City
Crisfield
Chincoteague
Chesapeake Bay
MARYLAND
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Tappahannock
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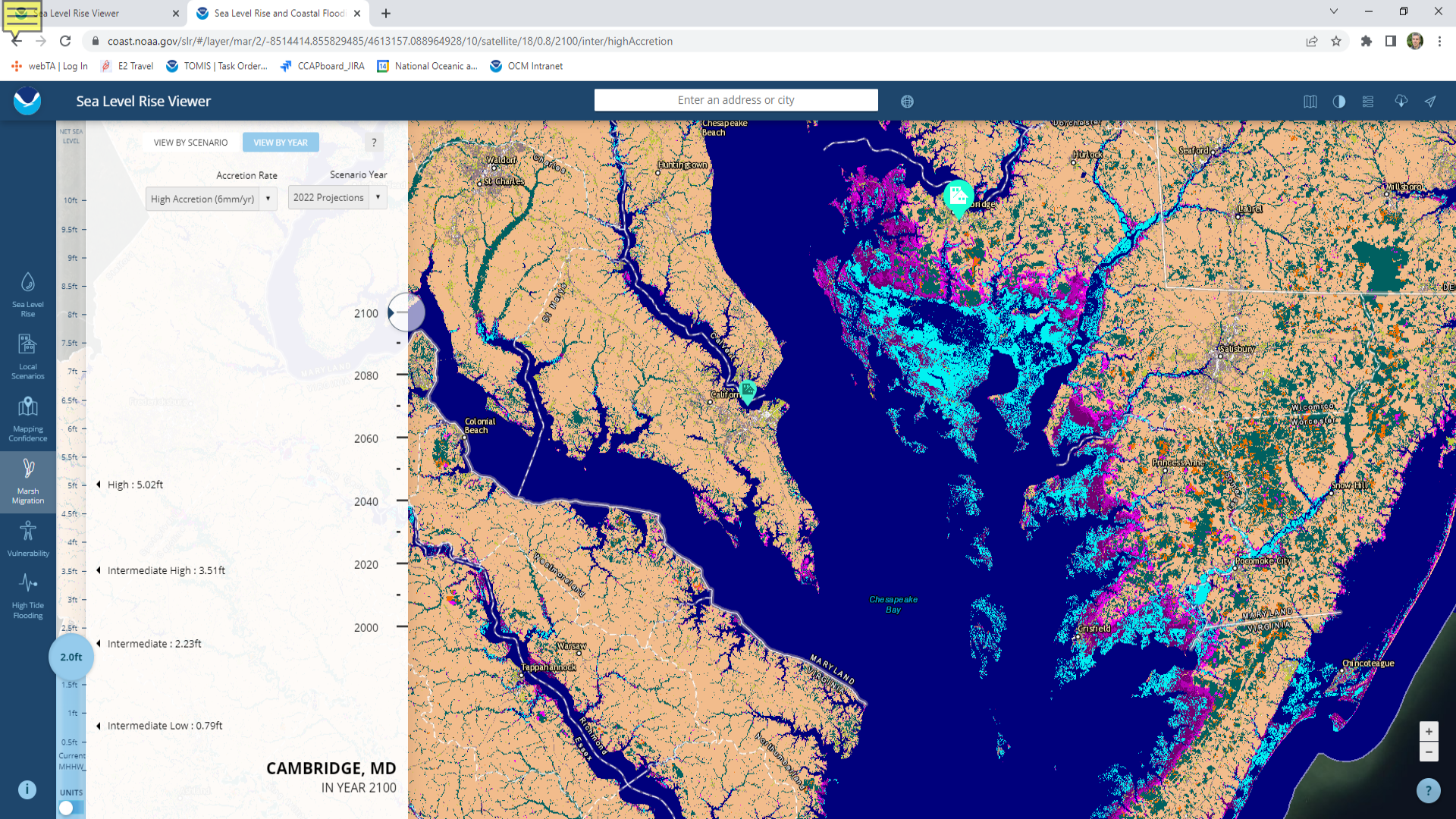
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E2 Travel
TOMIS | Task Order...
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OCM Intranet
Sea Level Rise Viewer
Enter an address or city
NET SEA LEVEL
VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
High Accretion (6mm/yr)
Scenario Year
2022 Projections
10ft
9.5ft
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1ft
0.5ft
Current MHHW
UNITS
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
2100
2080
2060
2040
2020
2000
High : 5.02ft
Intermediate High : 3.51ft
Intermediate : 2.23ft
Intermediate Low : 0.79ft
CAMBRIDGE, MD
IN YEAR 2100
Chesapeake Beach
Waldorf
St Charles
Huntingtown
Hurlock
Seaford
Millsboro
Laurel
Salisbury
Wicomico
Worcester
Princess Anne
Snow Hill
Pocomoke City
Crisfield
Chincoteague
Colonial Beach
Chesapeake Bay
Westmoreland
Warsaw
Tappahannock
Richmond
Essex
Northumberland
MARYLAND
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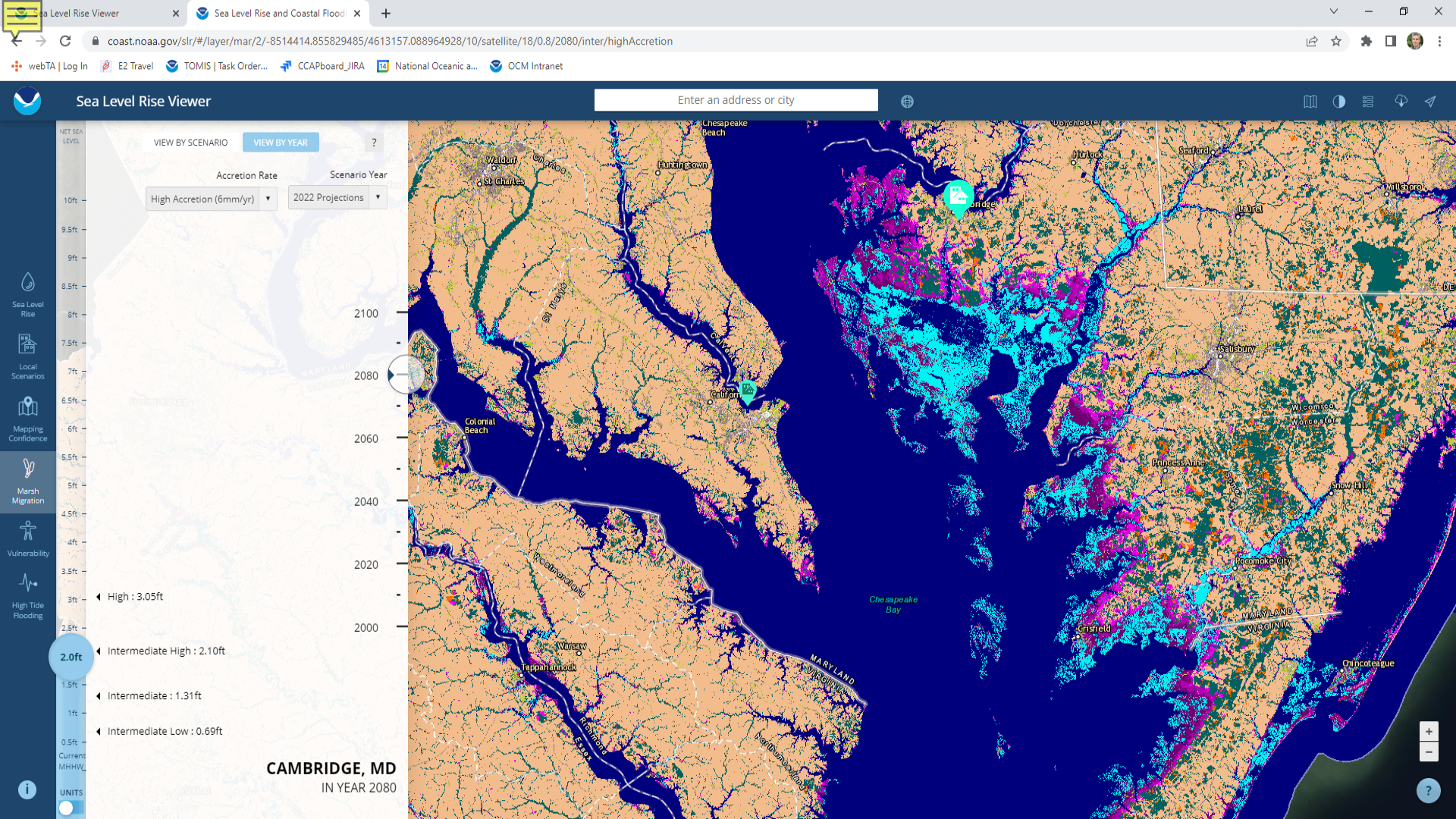
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Enter an address or city
VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
High Accretion (6mm/yr)
Scenario Year
2022 Projections
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
2100
2080
2060
2040
2020
2000
High : 3.05ft
Intermediate High : 2.10ft
Intermediate : 1.31ft
Intermediate Low : 0.69ft
2.0ft
CAMBRIDGE, MD
IN YEAR 2080
UNITS
Chesapeake Beach
Waldorf
St Charles
Huntingtown
Hurlock
Seaford
Millsboro
Laurel
Salisbury
Colonial Beach
Princess Anne
Snow Hill
Pocomoke City
Chesapeake Bay
Crisfield
Chincoteague
Warsaw
Tappahannock
MARYLAND
VIRGINIA

Sea Level Rise Viewer

Enter an address or city

VIEW BY SCENARIO | VIEW BY YEAR

Accretion Rate: High Accretion (6mm/yr)

Scenario Year: 2022 Projections

NET SEA LEVEL

10ft
9.5ft
9ft
8.5ft
8ft
7.5ft
7ft
6.5ft
6ft
5.5ft
5ft
4.5ft
4ft
3.5ft
3ft
2.5ft
2.0ft
1.5ft
1ft
0.5ft
Current MHHW

2100
2080
2060
2040
2020
2000

- High : 1.44ft
- Intermediate High : 1.15ft
- Intermediate : 0.79ft
- Intermediate Low : 0.56ft

UNITS

CAMBRIDGE, MD
IN YEAR 2060

Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding

Chesapeake Bay
MARYLAND
VIRGINIA

Sea Level Rise Viewer

LAUNCH

DOWNLOAD DATA

ACCESS MAP SERVICES

GEOGRAPHY
Coastal contiguous U.S. (excludes Great Lakes), HI, and territories

PLATFORM
Web-based

LEVEL OF EFFORT
Low

NOAA Office for Coastal Management

Overview

Use this web mapping tool to visualize community-level impacts from coastal flooding or sea level rise (up to 10 feet above average high tides). Photo simulations of how future flooding might impact local landmarks are also provided, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence.

Features

- Visualize potential impacts from sea level rise through maps and photos
- Learn about data and methods through documentation
- Share maps and links via email and social media

About the Tool

Sea Level Rise Data Download

Go to SLR Viewer | Go to Digital Coast | Go to Map Services | Go to Data Update History | Go to Marsh Data Download

Filter by States or Counties

- Alabama
- American Samoa
- CNMI
- California

Del Norte ,Humboldt, Mendocino, Trinity
Sea Level Rise | Sea Level Rise Depth | Mapping Confidence | DEM | Flood Frequency

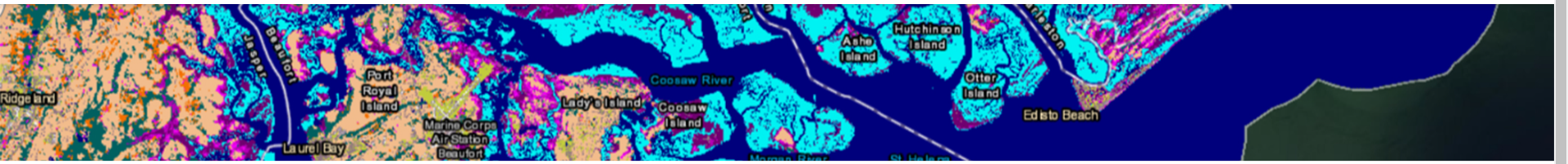
Los Angeles, San Luis Obispo, Santa Barbara, Ventura
Sea Level Rise | Sea Level Rise Depth | Mapping Confidence | DEM | Flood Frequency

Alameda, Contra Costa, Marin, Monterey, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, Sonoma
Sea Level Rise | Sea Level Rise Depth | Mapping Confidence | DEM | Flood Frequency

Orange, San Diego
Sea Level Rise | Sea Level Rise Depth | Mapping Confidence | DEM | Flood Frequency

Channel Islands
Sea Level Rise | Sea Level Rise Depth | Mapping Confidence | DEM | Flood Frequency

- Connecticut
- Delaware



Sea Level Rise Wetland Impacts and Migration

DOWNLOAD DATA

NOAA Office for Coastal Management

AREA OF COVERAGE
Coastal contiguous U.S. (excludes Great Lakes), HI, and territories

DATA FORMAT(S)
Raster img

RESOLUTION
Varies from 2 to 10 meter

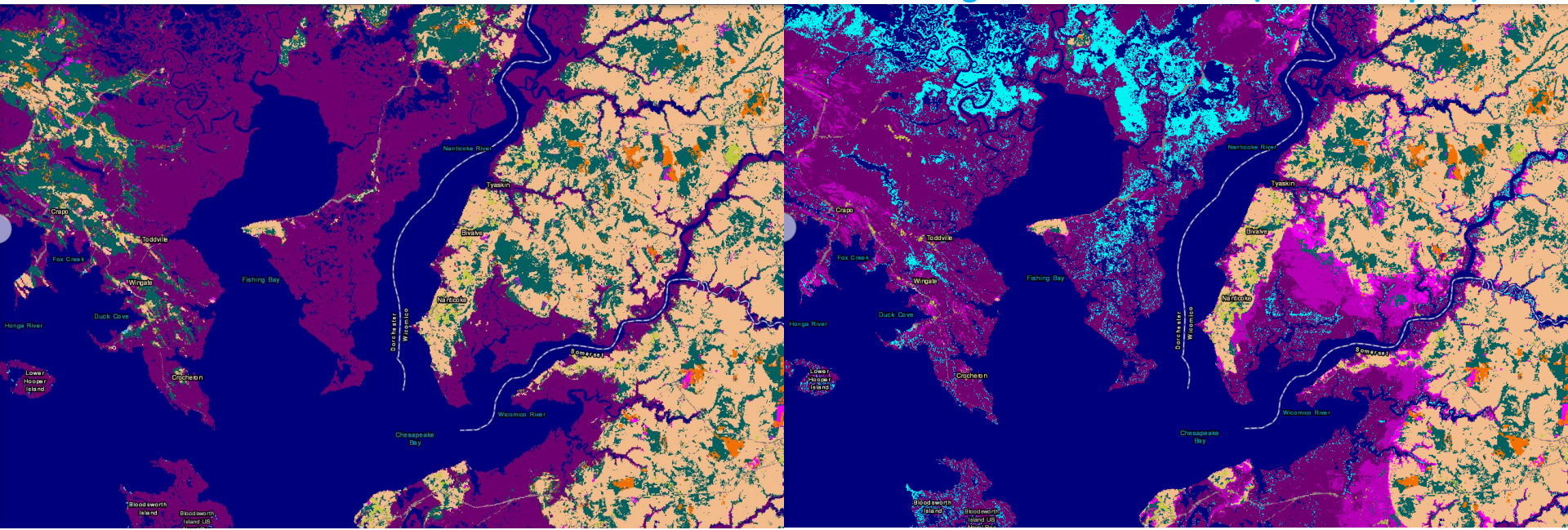
Overview

These data illustrate multiple impacts to, and the possible future condition of, coastal wetlands in the face of potential sea level rise scenarios. This information uses the best available elevation and land cover data, along with user-chosen sea level rise scenarios, to estimate the losses, changes, and potential future migration of coastal wetlands. This information helps direct conservation, restoration, and monitoring responses.

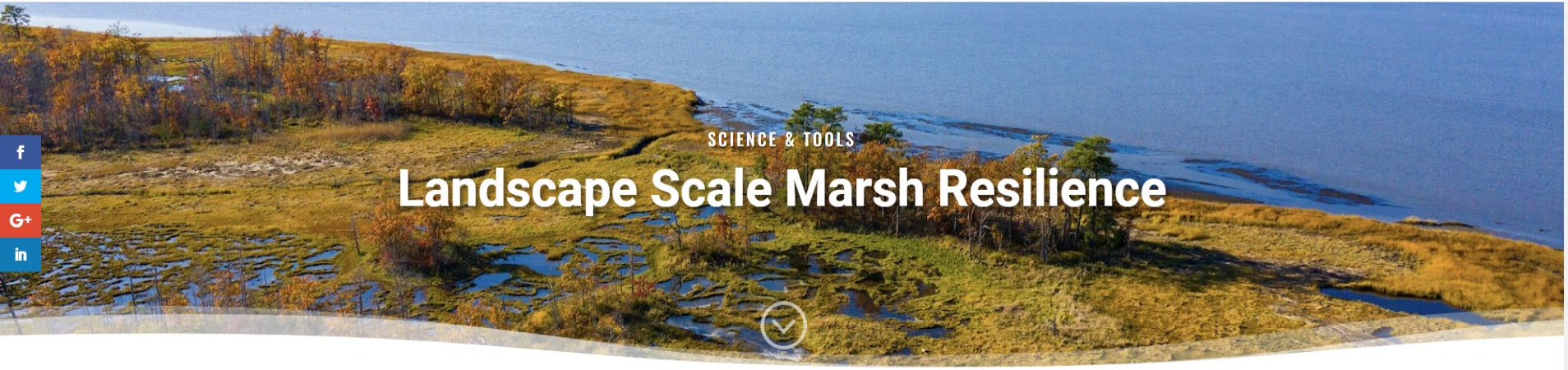
Direct Comparison of Data Layers

2016 Land Cover

2060 Intermediate High
with high rate of accretion (1ft Net Impact)



Marsh Resilience Analysis



SCIENCE & TOOLS

Landscape Scale Marsh Resilience

Squeezed between rising seas and landward development, many of our nation's tidal marshes are in danger of disappearing. Deciding how to protect them requires the ability to conduct "apples to apples" comparisons of marsh condition across broad landscapes. This innovative

- FINAL REPORT
- PRESENTATION
- RESERVE-SCALE RANKINGS
- RESILIENCE-BASED MANAGEMENT OPTIONS

National Marsh Resilience Metrics

	Group	Metric	+/-	Explanation
Current Condition	Marsh Configuration	Area to edge ratio	+	more core and less edge represents less exposure
		Unvegetated edge ratio	-	more unvegetated edge represents more risk
	Land Cover/Use	% impervious	-	more impervious can negatively impact runoff/habitat
		% natural	+	more natural areas can absorb runoff/protect habitat
		% agricultural	-	more agriculture can negatively impact runoff/habitat
Vulnerability	Erosion	Soil erodibility	-	high erosion potential represents greater risk of loss
	Tides	Tidal range	+	a larger tidal range represents more resilience
		% marsh below MHHW	-	more marsh below MHHW represents more risk with SLR
		% marsh below MTL	-	more marsh below MTL represents more risk with SLR
Adaptive Capacity	Shoreline	Hardened shoreline	-	more hardened shoreline represents more impediments to migration
		Shoreline complexity	+	the more complex the shoreline the more protection it provides
	Migration Ability	Marsh migration space	+	more migration space represents a larger potential future area for marsh to move into
		Wetland "connectedness"	+	marshes that are more connected in the future are more resilient

Landscape Scale Study of Marsh Resilience to Sea Level Rise

The Big Picture of Marsh Resilience

Squeezed between rising seas and landward development, many of our nation's tidal marshes are in danger of disappearing. Deciding how to protect them requires the ability to conduct "apples to apples" comparisons of marsh conditions across broad landscapes. This innovative assessment ranks marsh resilience according to metrics of current marsh conditions, vulnerability to sea level rise, and potential for adaptation.

Led by the National Estuarine Research Reserve System and the NOAA Office for Coastal Management, this study can help inform marsh restoration and conservation planning, identify marshes with particular characteristics across large areas, target fieldwork, and strengthen experimental design. It also can be used as a screening tool for national and regional work or be replicated with finer-scale data to create higher-resolution products.

Nationally Significant and Locally Relevant

The marsh resilience assessment was conducted with nationally standardized data sets for coastal areas of the lower 48 United States, not including the Great Lakes. The analysis systematically ranked resilience at multiple scales. It offers standardized comparisons of resilience across "marsh units" with broadly similar land use, land cover, and hydrology characteristics. Marsh resilience scores are summarized at the watershed scale (HUC-12 units).

Marsh Data

Marsh land-cover classes from

Landscape Scale Marsh Resilienc | Tidal Marsh Resilience to Sea Lev | Salt Marsh Resilience to Sea Leve
experience.arcgis.com/experience/25037478b4634bb2bf421f443ac47541/page/Page-1/?views=Current-Condition
webTA | Log In | E2 Travel | TOMIS | Task Order... | CCAPboard_JIRA | National Oceanic a... | OCM Intranet

Study Findings

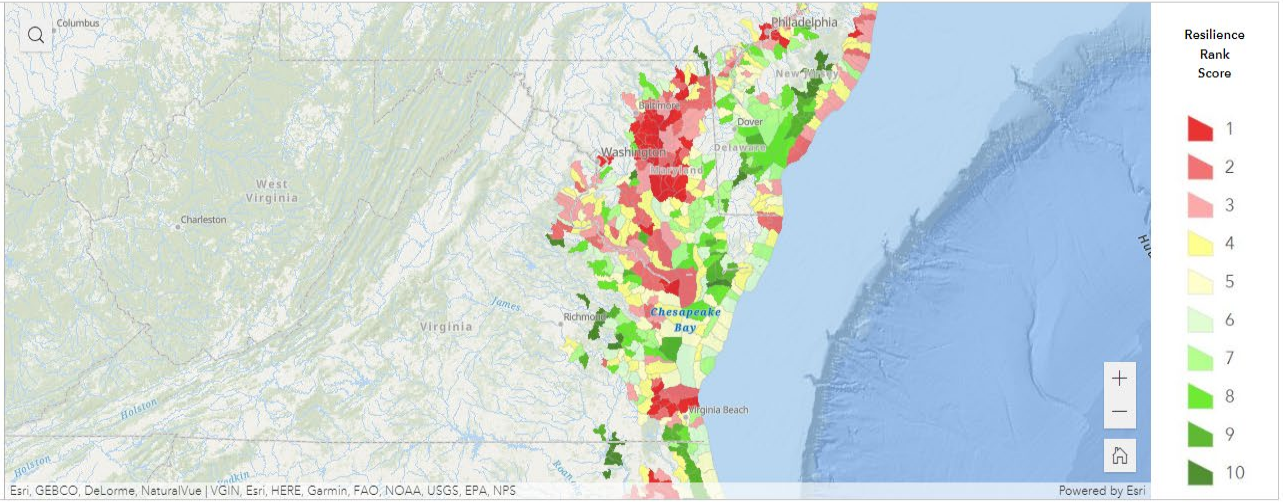
Tidal marsh resilience to sea level rise was calculated using 13 GIS-based metrics related to **current marsh conditions**, **vulnerability to sea level rise**, and **adaptive capacity**. Values for each metric were scored based on a quantile distribution (10 categories), and then combined. Results were summarized to the watershed scale (HUC-12 units). The analysis includes all watersheds (from the National Watershed Boundary Dataset) that contained estuarine marsh (as derived from NOAA's Coastal Change Analysis Program 2016 land cover) in the contiguous United States (not including the Great Lakes).

One can view, analyze, and compare marsh resilience in three ways: overall resilience, resilience by category, or resilience by individual metric.

Overall Resilience Rankings

The map seen here highlights the overall score for each marsh unit. Resilience scores range from 1 (red) for least resilient to 10 (green) for most resilient.

The study found that overall marsh resilience varies by region, with the Southeast having the most resilient marshes, and the Northeast having the least. Marshes were most resilient in Georgia and least resilient in New York. Different factors, explored in the study report, contributed to the resilience of each region's marshes.

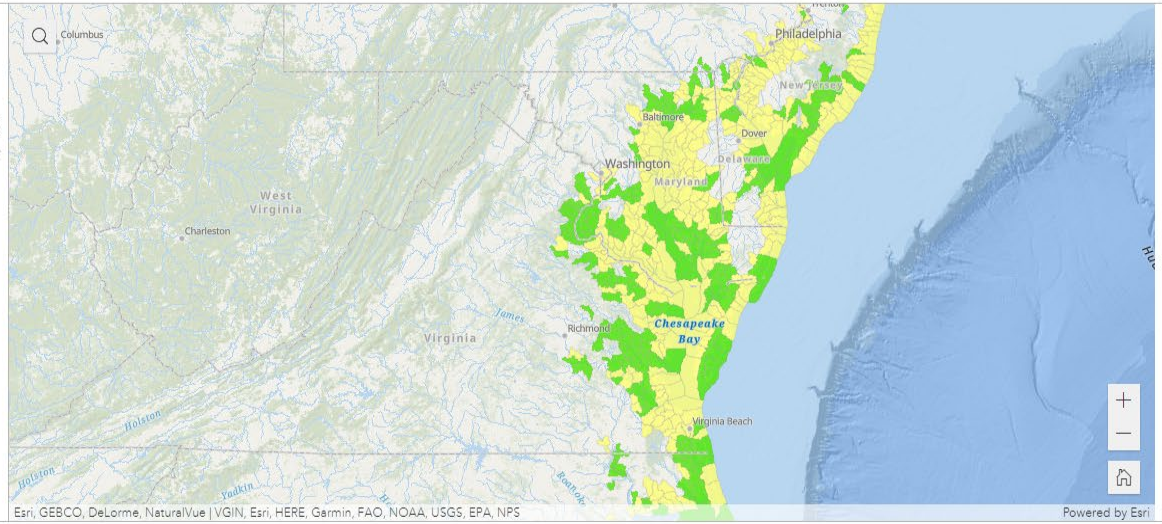


Current Condition Factors

This resilience category includes metrics that represent characteristics of individual marsh features as well as land cover and land uses within the surrounding watershed. In this map you can use the buttons (below) to change the maps to see marsh unit rankings for each metric and more explanation of the metrics.

Current Conditions Factor High/Low

This map highlights the overall current condition rating. This rating includes factors associated with the marsh configuration (size and shape) as well as the landscape surrounding those marshes. This information is related to these features as they exist today (potential future changes are not considered here).



Current Condition | Edge-Core Ratio | Unvegetated Ratio | % Impervious Cover | % Natural Area | % Agriculture

Vulnerability Factors

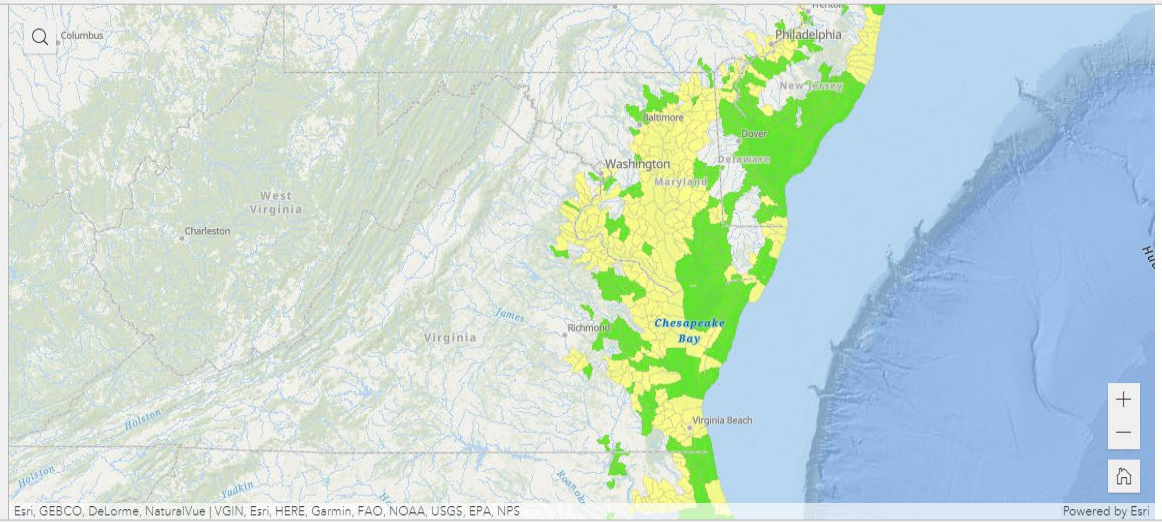
Landscape Scale Marsh Resilienc | Tidal Marsh Resilience to Sea Lev | Salt Marsh Resilience to Sea Leve
experience.arcgis.com/experience/25037478b4634bb2bf421f443ac47541/page/Page-1/?views=Current-Condition
webTA | Log In | E2 Travel | TOMIS | Task Order... | CCAPboard_JIRA | National Oceanic a... | OCM Intranet

Vulnerability Factors

This resilience category includes metrics that represent possible current and future factors related to vulnerabilities of marsh features. In this map you can use the buttons (below) to change the maps to see marsh unit rankings for each metric and more explanation of the metrics.

Vulnerability Factor High/Low

This map highlights the overall vulnerability rating. This rating includes factors associated with the erosion potential, tide range, and the current distribution of marshes within that tidal range. This information is related to these features as they exist today (potential future changes are not considered here).



Vulnerability | Erodibility | Tidal Range | % Below MHHW | % Below MTL

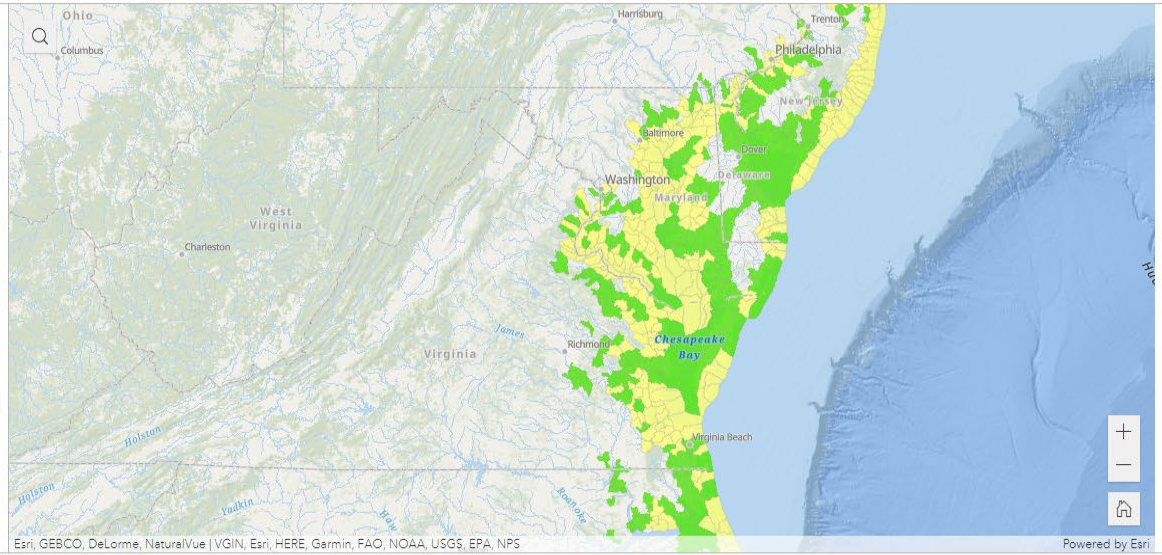
Landscape Scale Marsh Resilienc | Tidal Marsh Resilience to Sea Lev | Salt Marsh Resilience to Sea Leve
experience.arcgis.com/experience/25037478b4634bb2bf421f443ac47541/page/Page-1/?views=Current-Condition
webTA | Log In | E2 Travel | TOMIS | Task Order... | CCAPboard_JIRA | National Oceanic a... | OCM Intranet

Adaptive Capacity Factors

Adaptive capacity factors include metrics that represent characteristics of individual marshes that highlight the potential for that marsh to adapt to future sea level conditions. In this map you can use the buttons (below) to change the maps to see marsh unit rankings for each metric and more explanation of the metrics.

Adaptive Capacity Factor High/Low

This map highlights the overall adaptive capacity rating. This rating includes factors associated with the shoreline configuration and hardened structures, as well as the space available for migration and the potential configuration of that future marsh area. Shoreline information is related to these features as they exist today (potential future changes are not considered here), while predictions of marsh migration are based on modeling done within NOAA Sea Level Rise Viewer.



Adaptive Capacity | % Hardened Shoreline | Shoreline Sinuosity | Marsh Migration Space | Future Marsh Connectedness

Landscape Scale Marsh Resilienc | Tidal Marsh Resilience to Sea Lev | Salt Marsh Resilience to Sea Leve
experience.arcgis.com/experience/25037478b4634bb2bf421f443ac47541/page/Page-1/?views=Current-Condition
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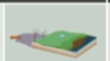
Applying the Data

This analysis and its findings can be used to advance understanding of the forces that drive tidal marsh resilience, and to support a range of efforts to manage and protect these precious resources for the future. Wetland managers can use data from this analysis to determine which marshes need help and what kind of help they may need.

Data for Marsh Management

Resilience rankings can inform where and how to invest in marsh management. This table summarizes eight management options, each informed by how well the unit's marshes ranked in the resilience categories (current conditions, vulnerability to relative sea level rise, and adaptive capacity). Options are considered from an ecological, rather than socioeconomic, perspective.

Note: Green text indicates a positive condition, red reflects a negative one. (Click the chart below to enlarge, or click here for a more detailed version of this chart.)

Marsh Resilience Category			Interpretation		Management Options
Current condition	Vulnerability to sea level rise	Adaptive capacity			
High	Low	High	A marsh in good condition that will migrate inland naturally over the long-term.		Land protection or policy: Fee or conservation easement purchase of marsh or migration space. Managed relocation of structures in marsh or migration space.
High	High	High	A marsh in good condition that will adapt if it can out-pace current vulnerability to sea level rise.		Adaptation (sediment): Increase sediment supply to current marsh footprint though strategies like thin layer sediment placement and removal of barriers to hydrologic flow within the marsh.
High	Low	Low	A marsh in good condition that cannot maintain current footprint long-term without active management.		Adaptation (migration and land protection): Remove infrastructure or topographical barriers to inland migration. Protect marsh's current footprint.
High	High	Low	A marsh in good condition but also vulnerable to sea level rise and cannot maintain current footprint without active management.		Phased adaptation: Implement thin layer sediment placement, but only if barriers to inland migration are removed.
Low	High	Low	A marsh in poor condition marsh that will not persist in the future.		Test innovative science or abandon marsh: Limit investment in land protection or restoration activities as effectiveness will be relatively short-term.
Low	Low	Low	A marsh in poor condition not currently vulnerable to sea level rise, but cannot maintain current footprint without intervention.		Phased management (restore then adapt): Apply proven restoration techniques within current marsh footprint—e.g., invasive species management—but only if removal of barriers to migration are planned.
Low	High	High	A marsh in poor condition that has potential to migrate inland naturally, if it can out-pace sea level rise.		Phased management (restore then adapt): Apply proven restoration techniques within current marsh footprint that ideally also increase sediment supply to marsh, e.g. ditch remediation, tidal crossing restoration.
Low	Low	High	A marsh in poor condition that is not currently vulnerable to sea level rise and has potential to migrate inland naturally.		Restoration: Decrease current stressors to marsh e.g., *Phragmites* or invasive crab control. Mitigate water quality issues in surrounding watershed, e.g., reduce fertilizer application in residential and agricultural areas.

Marsh Resilience Category			Interpretation		Management Options
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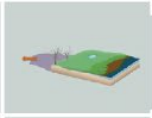
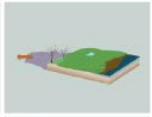
High	Low	High	A marsh in good condition that will migrate inland naturally over the long-term.		Land protection or policy: Fee or conservation easement purchase of marsh or migration space. Managed relocation of structures in marsh or migration space.
High	High	High	A marsh in good condition that will adapt if it can out-pace current vulnerability to sea level rise.		Adaptation (sediment): Increase sediment supply to current marsh footprint though strategies like thin layer sediment placement and removal of barriers to hydrologic flow within the marsh.
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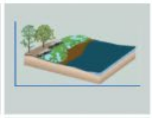
Low	High	Low	A marsh in poor condition marsh that will not persist in the future.		Test innovative science or abandon marsh: Limit investment in land protection or restoration activities as effectiveness will be relatively short-term.
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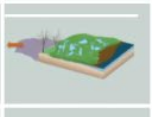
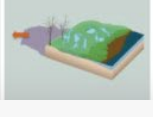
Low	High	High	A marsh in poor condition that has potential to migrate inland naturally, if it can out-pace sea level rise.		Phased management (restore then adapt): Apply proven restoration techniques within current marsh footprint that ideally also increase sediment supply to marsh, e.g. ditch remediation, tidal crossing restoration.
Low	Low	High	A marsh in poor condition that is not currently vulnerable to sea level rise and has potential to migrate inland naturally.		Restoration: Decrease current stressors to marsh e.g., *Phragmites* or invasive crab control. Mitigate water quality issues in surrounding watershed, e.g., reduce fertilizer application in residential and agricultural areas.

Landscape Scale Marsh Resilienc | Tidal Marsh Resilience to Sea Lev | Salt Marsh Resilience to Sea Leve
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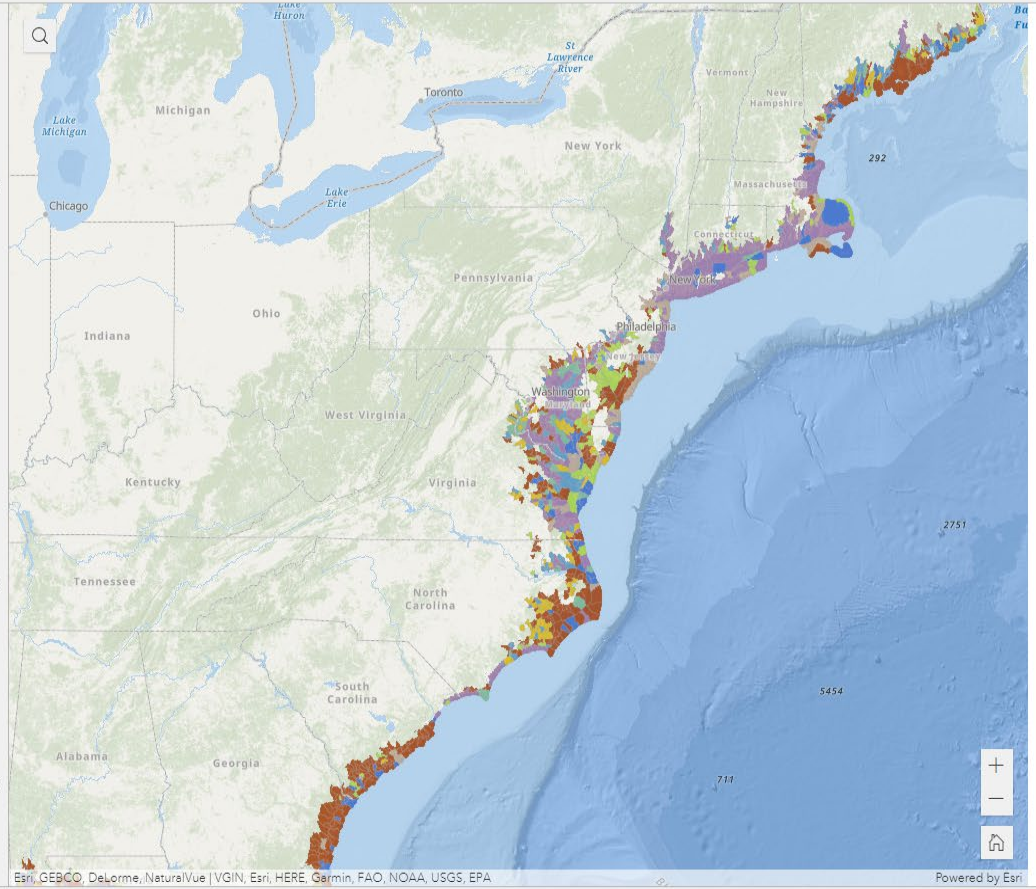
webTA | Log In | E2 Travel | TOMIS | Task Order... | CCAPboard_JIRA | National Oceanic a... | OCM Intranet

Mapping Management Options

This map shows each watershed mapped with the management option (from the table above) that fits the resilience category rankings. Using graphics like these, one can identify which marshes to protect, as they are likely to persist in place, which ones might be good candidates for restoration, and which ones require significant investment to save.

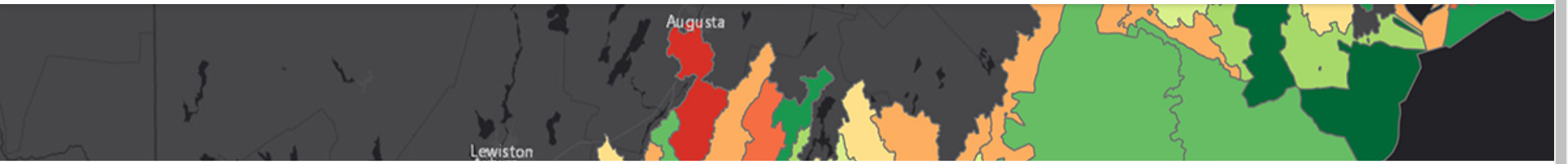
For example, marshes that have a high current condition score and are likely to persist are the best candidates for conservation and migration.

Comparing categories and individual metrics of resilience also can help scientists and practitioners identify the appropriate techniques to use for restoration. For example, marshes with high vulnerability to sea level rise and strong potential for migration may be good candidates for experimental restoration techniques like thin layer placement.



Management Options

- Adaptation (sediment)
- Adaptation (migration and land protection)
- Phased adaptation
- Test innovative science or abandon marsh
- Phased management (restore, migrate)
- Phased management (restore, sediment)
- Restoration



Tidal Marsh Resilience to Sea Level Rise

NOAA Office for Coastal Management, National Estuarine Research Reserve System

AREA OF COVERAGE
Coastal watersheds containing tidal marsh nation-wide

DATA FORMAT(S)
ESRI geodatabase

RESOLUTION
12-digit watersheds

DOWNLOAD DATA

Datasets 1

- 2010 NOAA Salt Marsh Resilience

Overview

Tidal marshes are valuable natural infrastructure with many benefits. This geodatabase ranks the resilience of tidal marshes using metrics associated with current marsh conditions, vulnerability to sea level rise, and potential for adaptation. These landscape-scale rankings can be used to identify marsh areas that are the most vulnerable or adaptable to rising seas—critical information for efforts to conserve, restore, or study tidal marshes around the country. This information can be used nationally, regionally, or at the state scale.

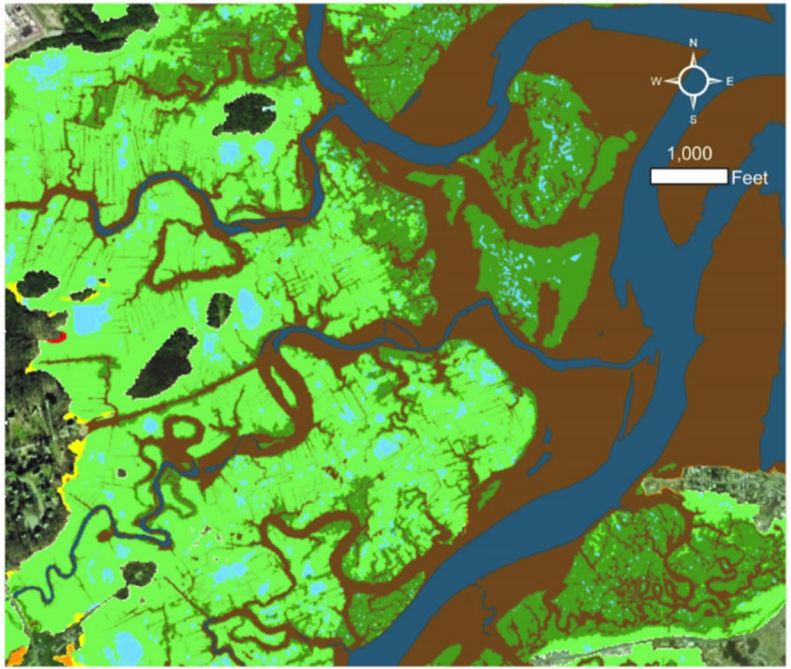
Creating a Comprehensive Plan for Resilient Salt Marshes in New Hampshire

Issue

Salt marshes provide communities with important benefits, such as fisheries habitat, water filtration, flood control, and carbon sequestration. Understanding where salt marshes are, how they are changing, and what might happen to them as sea levels rise and coastal development encroaches is critical to protecting the valuable services they provide to people and wildlife. Moderate-resolution maps and models do not provide the information resource managers need to make the informed parcel-level decisions to ensure their survival.

Process

NOAA and the Great Bay National Estuarine Research Reserve partnered to develop a high-resolution map of salt marsh habitats throughout New Hampshire. Other partners included the New Hampshire Coastal Program, University of New Hampshire, and New Hampshire Fish and Game Department. The developers followed salt marsh mapping methods developed by NOAA's Office for Coastal Management that use high-resolution imagery, lidar data, and field data to identify habitat types and mixed species areas, from the tidal creeks to the upland edges of the salt marshes. The habitat data were combined with high-resolution land cover, shoreline, sea level rise, and other data sets to conduct a statewide salt marsh resilience assessment that examined current conditions, vulnerability, and



Brackish Marsh
High Marsh
Low Marsh
Mud Flat
Open Water
Panne/Pool
Phragmites Spp.
Recently Flooded Forest
Terrestrial Border
Wrack

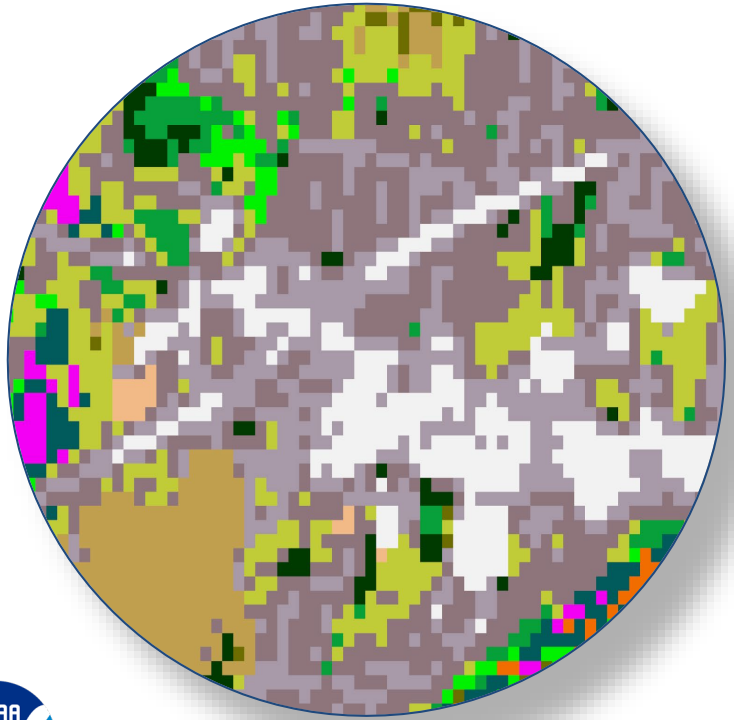
Coastal Change Analysis Program

Coastal Change Analysis Program (C-CAP)

- FGDC National Geospatial Data Asset
- Coastal expression of the NLCD
- Regional Products at 30-meter
  - Updated every 5 years (1996 – 2016)
  - Back as far as 1975 in some locations
  - 2021 update planned (2023 release)
- High Resolution Products at 1-meter
  - Historically expensive to produce
  - Faster, cheaper, better now possible
  - 2021 national buildout (by 2025)

Comparison of Resolutions

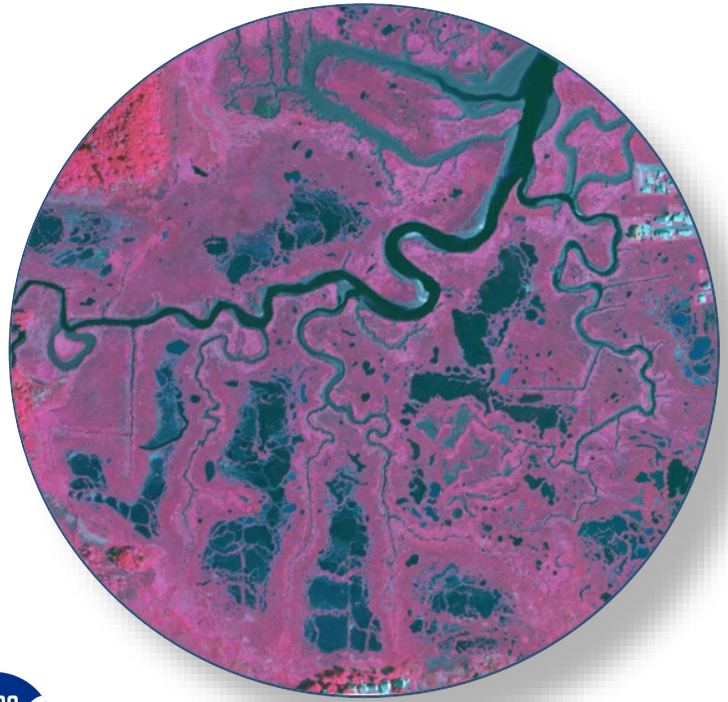
REGIONAL (30 METER)



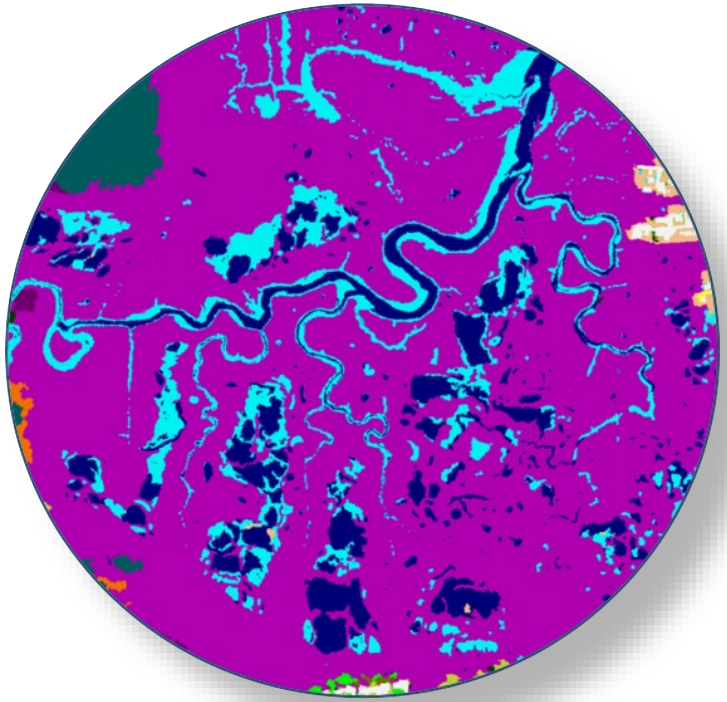
LOCAL (1 METER)

High Resolution Land Cover

ORTHOIMAGE

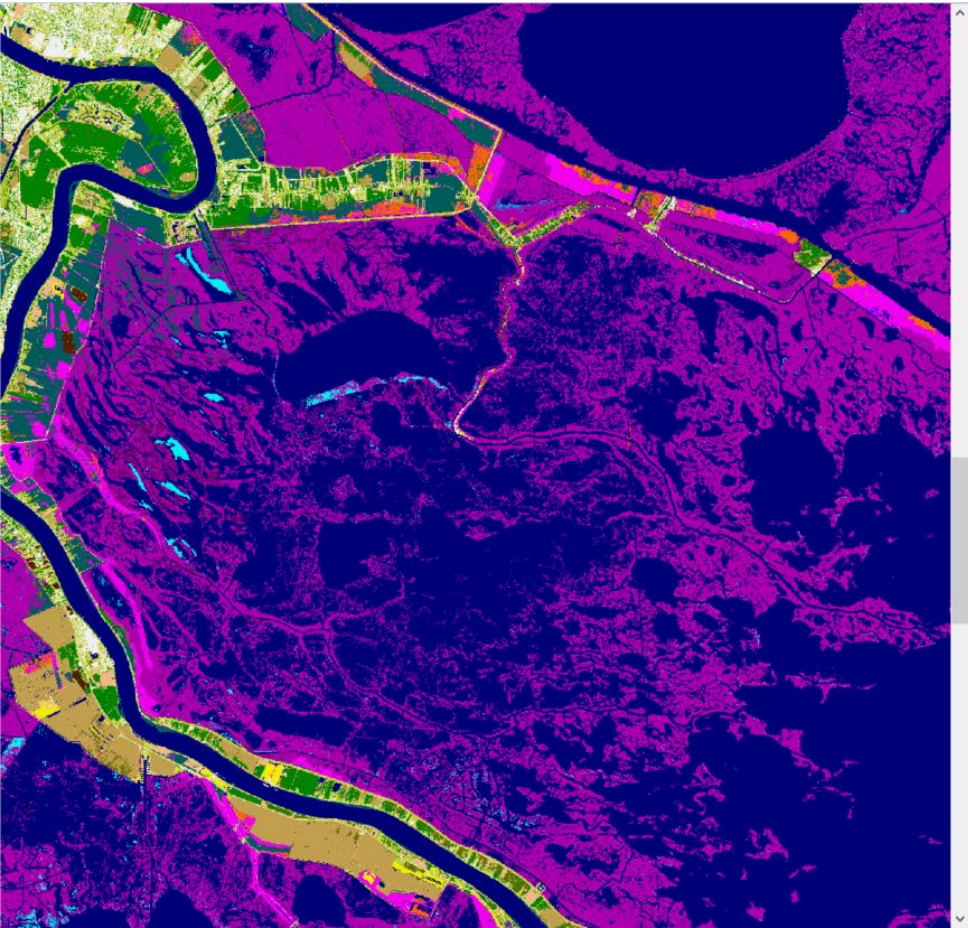


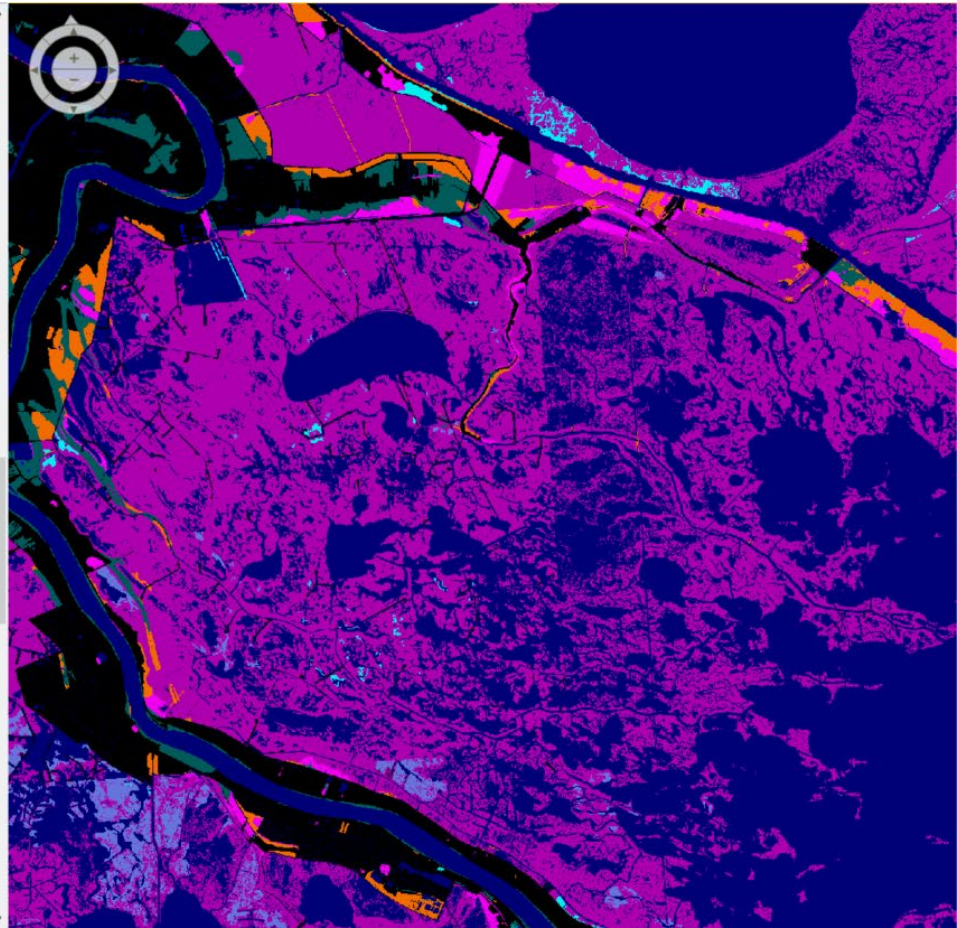
LAND COVER



1-meter 2017 C-CAP

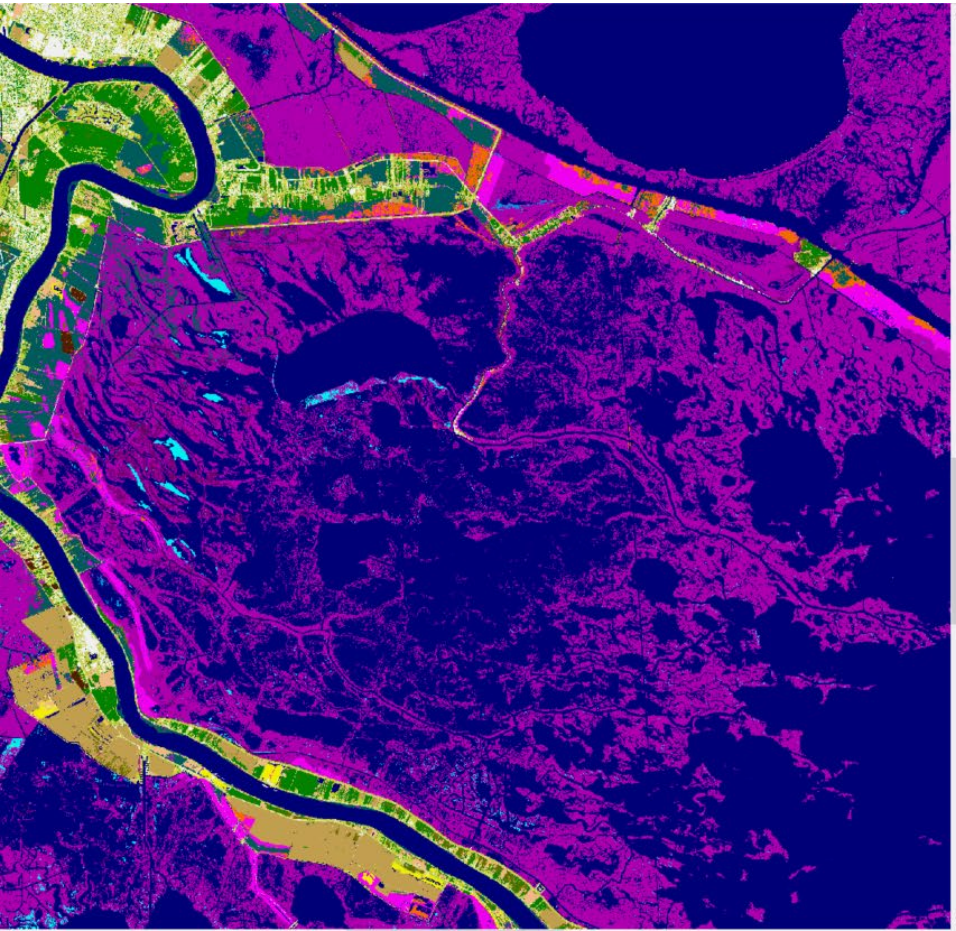
National Wetland Inventory

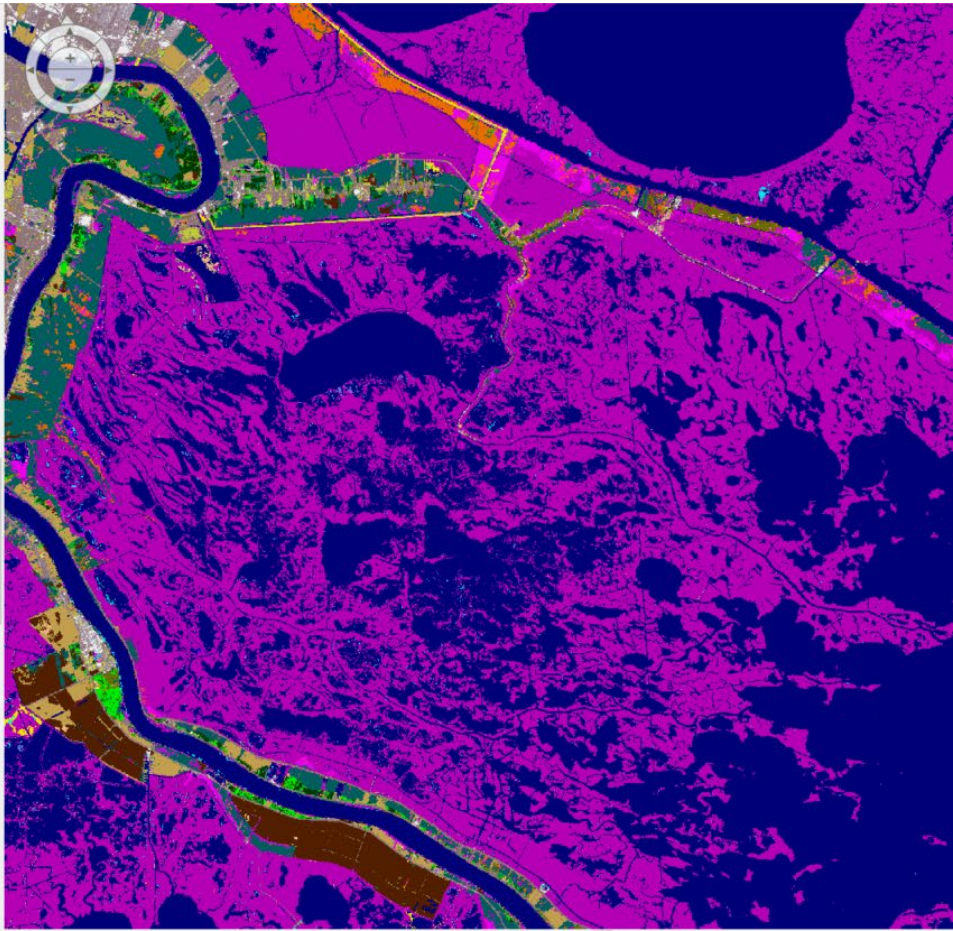




1-meter 2017 C-CAP

30-meter 2016 C-CAP





Upcoming High Resolution Mapping

Phase 1 Geographies

Questions?

Nate Herold
Physical Scientist
nate.herold@noaa.gov

Visit us on the Digital Coast at:
coast.noaa.gov/digitalcoast/topics/coastal-land-cover.html