Coastal Resilience Community of Practice Meeting

Monday, April 22 – 1:00pm - 3:00pm

Purpose of the COP: Bring together diverse coastal stakeholders to focus on how ecosystem resilience can build local community resilience. We don't necessarily have to have a "thing" to work on but will take on projects as appropriate and mutually agreed on. Website: https://deq.nc.gov/coastal-resilience-cop

In attendance:

- Alisa Davis, NC Wildlife Resources Commission
- Arvin Maniktala, Moffatt & Nichol
- Brian Byfield, NC Office of Recovery & Resilience
- Charles Grisafi, NOAA Office for Coastal Management
- Claire Rapp, NC Coastal Federation
- Dawn York, Moffatt & Nichol
- Eryn Futral, N.C. Emergency Management
- Helene Wetherington, NC Office of Recovery & Resilience
- Holly White, NC Office of Recovery & Resilience
- Kelly Garvy, Lighthouse Environment Partners
- Kiera O'Donnell, Duke University
- Laura Moore, UNC Chapell Hill
- Lee Duncan, Pender County
- Mackenzie Todd, NC Division of Coastal Management
- Marae West, Sandbar Oyster Company
- Mariko Polk, NC Sea Grant
- Meg Perry, SWCA Environmental Consultants
- Mike Christenbury, NC Division of Coastal Management
- Michelle Raquet, NC Division of Water Resources
- Nicole Goddard, NC Office of Recovery & Resilience
- Patrick Barnard, USGS
- Phillip Todd, Freese & Nichols, Inc
- Rachel Love-Adrick, NC Division of Coastal Management
- Riley Lewis, Coastal Carolina Riverwatch
- Robert (Robbie) Fearn, NC Audubon
- Robin Hoffman, NC Division of Water Resources
- Sara Marschhauser, NC Audubon
- Sarah Spiegler, NC Sea Grant
- Savannah Newbern, Wetlands Watch
- Stacey Feken, Albemarle Pamlico National Estuary Partnership
- Stephen Bevington, NC Land and Water Fund
- Stu Brown, NC Division of Mitigation Services
- Tancred Miller, NC Division of Coastal Management
- Tashya Allen, NOAA Office for Coastal Management
- Whitney Jenkins, NC Coastal Reserve, NC Division of Coastal Management

Presentation: Flood Resiliency Blueprint – Stu Brown, Blueprint Program Supervisor, NC Division of Mitigation Services – **See Slides**

- Blueprint team Shrikar Nunna, DEQ legislation liaison; Marc Recktenwald, Division of Mitigation Services Director; Stu, Blueprint Program Supervisor
- Blueprint work plan partners, 150+ advisors, AECOM contractor does work with other subcontractors
- Blueprint – Core Outcomes:
    1. Reduce likelihood and extent of flooding
    2. Reduce vulnerability and impact of flooding
    3. Increase ability of community to recover
- Investment in resilience leads to better outcomes before, during, and after natural disasters, increase capacity of a community to recover from natural disasters, acute hazards
- Blueprint components
    1. Standardized statewide methodology for visualizing flooding / blueprint document
    2. Tool: online decision support tool which guides state, county, municipal, and others to identify and select flood mitigation strategies responsibly, systematically, equity and transparency
    3. Strategies: community and basin specific risk management strategies to identify and address flooding for NC communities / River Basin Action Strategies
    4. Implementation: implement blueprint and flood resiliency project and policies, legislation set up funding for implementation /
- Blueprint program is a multiphase process, now in Phase II, blueprint tool going to beta testing very soon.
    - Testing functionality while developing underlying methodology.
    - Future conditions modeling includes sea level rise, climate related changes, precipitation patterns, future development, etc.
    - Impacts on environment, see where co-benefits, population, infrastructure, economy
- One-dimensional modeling operational now, soon two-dimensional modeling in Neuse, then expand to other watersheds by end of year
- Potential examples of tool: identify types of interventions be successful, integrate resilience.
- Funding matching: identify sort of interventions want to pursue, identify where there may be funding, find ways to better access resources.
- Website: flood resilience blueprint website re https://ncfloodblueprint.com
- Q&A:
    - Laura Moore: mitigation strategies, to what extent does methodology quantify flood reduction from different strategies, how to determine effectiveness? What extent compound flooding being addressed?
        - Yes, different strategies, different time to develop
        - Working on a detention calculator, 1000 recommended actions, model future with and without unlikely for each of those, try build tools that help narrow the world, some need one off runs to test effectiveness
        - Compound flood, right now use statistical mode, different flood elevations, an area where can build out functionality, need to get two-dimensional HEK models going plus other models, do pilot study in certain area.
    - Tasha: who are you asking to review tool?
        - Beta test happening soon, then update with July release date. Testers are members of advisory groups, local municipalities, NGOs…
    - Dawn: We have developed a panel on Flood Resiliency Blueprint for the upcoming NC Beach and Inlet Waterway meeting May 9th in Emerald Isle. It will be an interesting conversation with coastal communities. https://www.ncbiwa.org/events/upcoming-events/

Presentation: Flooding, erosion, and groundwater hazards for the North Carolina coast – Patrick Barnard, U.S. Geological Survey – **See Slides**

- National effort to look at flooding, erosion, and groundwater hazards for coastal communities. Lots of groups involved including Deltares, USACE, VT, UNC/Laura Moore, NC Sea Grant/Sara Spiegler…
- High tide: Beaufort sunny day flooding
- Ocracoke and Hurricane Dorian, transportation issues, residents still recovering, symbolic what's going on across the coast, chronic and episodic events; ferry terminals, what Dorian other storms look like in 50 years, deal with what coming
- Rodanthe complex set of problems, suite of hazard projections, understand problems, good investments, promote coastal resilience
- Integrated topo bathymetric digital elevation model, objective: develop of high resolution integrated 1 meter topo bathymetric model
- Vertical land motion: VA Tech Manoochehr Shirzaei: key science partner / Cape Lookout / high rates vertical land motion as high as 4 mm/year, same as background sea level rise rate, land subsidence
- Overland flood hazards, quantify nearshore oceanographic, pluvial, fluvial drivers of coastal hazards and consequent overland flooding for the full suite of sea level rise and storm scenarios; Wilmington NC image, web tool
- Beaufort annual storm flooding over next century, scenarios show inundation, 2 m tipping point challenge for communities to sustain infrastructure and critical resources, potentially significantly impacts
- Statewide hazards, overland flood hazards/ NC population exposure to overland flooding / NC daily and annual exposure numbers increase dramatically by a factor 4-5 from today conditions to end of century.
- Groundwater table shallow, as sea level rises, groundwater table rise as well, shallower water table, emerging water table in some communities, how manage resilience community?
    - Modeling approach look at quantify water table elevation response to sea level rise
- Coastal change, how beaches respond to sea level rise? Model, shoreline, transect every 50 m along coastal, projections, autotunes model based on past behavior
- HERA / hazards reporting analytics tool, www.usgs.gov/apps/hera/floodtool.php
    - NC available now. Carteret county example / add demographics if want to look at from an Environmental Justice perspective
- Key Findings:
    - ~70% of the coastal residents could be exposed to shallow and emerging groundwater, ~480,000 coastal residents and $62 billion in property
    - Storms increase overland flooding exposure by more than 4 times over daily tidal flooding, directly impacting ~370,000 coastal residents and $68 billion in property
    - Up to 80% of beaches could be lost as shorelines migrate landward
    - High subsidence rates impact the majority of coastal residents across the region
- Future work and resources: summary publications, work with partners and stakeholders to support regional and local policy and coastal management decisions making, incorporate modeling in interdisciplinary studies that include social and economic factors
- Q&A:
    - Laura: Shows 80% of beaches lost, know there is a lot under the hood…
        - Based on low tide to back of beach, current active beach and 1m of sea level rise – 80% will no longer be there, some beaches translate landward, amplified by management practices, some beaches will drown beach, and our development is in the way as well
    - Holly: Do sea level rise maps incorporate groundwater? Is it also incorporated into sea level rise viewer? Or are these a static response, stand-alone models, not coupled with overland flooding? Is

the groundwater model a simple, not dynamic response to high tide or storms? Any thought to combined visualizations?

- Yes, piloting in some places, significant effort to do at statewide/regional level, but needed for decision making. Sea level rise models can be misleading when groundwater piece is missing. There are implications for local decision making on septic systems, etc.

Presentation: NOAA Digital Coast resources and upcoming funding opportunities – Charles Grisafi & Tashya Allen, NOAA's Office for Coastal Management – **See Slides**

- Tashya: Diving into Digital Coast: community resilience resources. As the SE and Caribbean learning services coordinator, I listen to challenges and needs, bring back to team that builds tools and resources. Matt Pendleton is our geospatial coordinator for the region.
- Charles: SE Coastal Management Specialist, connection to different coastal programs in the SE.
- Digital coast / diverse partners / including TNC and others
- Coastal Change Analysis Program (C-CAP) high resolution land cover/ 1 m land cover data
  - Whitney mentioned NC getting C-CAP for all of NC, worked with Nate Herold at NOAA, APNEP and EPA funded
- Digital coast: over 50 decision support tools, many very visual in nature, such as the Coastal Flood Exposure Mapper, Sea Level Rise Viewer
  - Local sea level rise scenarios/ update with 2022 projects, from tech report, still have 2017 projects in there
  - Marsh migration: land cover data / accretion rates, sea level rise, look at by scenario, water level, what land cover might change to based on different rates
- We offer training, in-person, online, and on-demand. For in-person trainings, we work with a local host, such as Whitney
  - Risk communication training: how to have better conversations, meet people where are, what they value, develop resources / just understand not lead to action
  - Nature based solutions: self-guided modules and in-person training where you hear from local experts
  - Webinar series: funding and financing coastal resilience
- Green infrastructure effectiveness database
- Case studies: Mackenzie/ RCPP/DCM example, https://coast.noaa.gov/digitalcoast/training/shovel-ready.html
- Explore curated list of resources in the topics section/ search for economic, nature-based solutions, risk communication
- NOAA OCM funding opportunities can be found at this link: https://coast.noaa.gov/funding/
- Q&A:
  - Laura / great overview/ curious about sea level rise viewer/ USGS vs NOAA how are resources different and similar / are we coordinating?
    - Yes! Compare tools: https://sealevel.climatecentral.org/matrix/NC.html?v=1

Round robin – members share what they are working on related to resilience

- Stacey: CCAP mapping, Scuppernong Engagement Project funded by Digital Coast Partners and a Digital Coast Case Study coming soon. Tribal project: https://apnep.nc.gov/documents/files/projects/phase-i-tribal-coastal-resilience-report. VA beach Symposium/Wetlands Watch panel: https://www.eventbrite.com/e/2024-north-landing-river-albemarle-sound-estuarine-symposium-registration-861107594997
- Kiera: I am hosting an Environmental Injustice of saltwater session in the first SALT conference: https://www.agroecologylab.com/salt-conference-2024. Please join if you can

- Holly: There is a lot of positive progress and movement with the new technical assistance available through the FEMA Community Disaster Resilience Zones (CDRZ) program through NCORR.
- Brian: NCORR hired Nicole Goddard, new outreach comms person, share sign up for the NCORR newsletter: https://mailchi.mp/2c7f1fcbb222/resiliency-updates. Launching soon NC Resilience Exchange, one stop shot tools resources. Heat exchange toolkit / released today/ aimed at local govt / template for them to convene stakeholders around extreme heat: https://www.rebuild.nc.gov/heat-action-plan-toolkit
- Laura: Our model for assessing interactions between management strategies and natural processes (and results) has just been published: A short highlight can be found here with links to the papers: https://eos.org/editor-highlights/barrier-islands-are-at-the-forefront-of-climate-change-adaptation. This model forms the basis for ongoing work with the National Park Service, Ocracoke, and the Department of Transportation; and future work planned with other communities.
- Robbie: Four pilot project, shorelines stabilization, coastal pond, just hit 90% design, off to permitting, five more projects moving forward in the next year
- Alisa: Green Growth Toolbox, Pender County workshop/ add information about resilience, teach planners how to integrate more conservation into land use planning, tools, resources, May 21, email if interested: alisa.davis@ncwildlife.org
- Mackenzie: RFP out for Phases 3 & 4 of Resilient Coastal Communities Program. Fifteen communities from 2021 a wrapping up plans. Phases 1 & 2, $6 million to spend, $2-3 million for Phases 3 & 4, due May 31. No cash in kind match. https://www.deq.nc.gov/about/divisions/coastal-management/coastal-adaptation-and-resiliency/nc-resilient-coastal-communities-program
- Claire: North Carolina Coastal Federation, Salt Marsh Action Plan for NC under final review, will launch formally soon. Also, a launch of OneMap, geospatial data. South Atlantic Salt Marsh Initiative (SASMI), first in-person partnership meeting in Savannah, GA last week, updates on state efforts. NC Salt Marsh Plan, overseen by Salt Marsh Steering Committee, a leadership team comprised of over 20 stakeholders across the coast. Working with Mackenzie, Sara, RCCP, NFWF, SECU funding to identify five underserved communities, build coastal resilience capacity, part of a larger regional effort.

Next meeting in July, Whitney will send a meeting poll

- Next meeting topics –
    - Salt marsh impacts/migration, marsh migration corridor mapping
    - SASMI – final conservation plan – Amanda (new coordinator), connection to NC stakeholders – state teams/action plans, get more info. Coastal Fed lead partner in NC
    - Coastal Carolina Riverwatch: community organizing in North River and the Lower New River Watershed Restoration Plan – Riley Lewis, White Oak Waterkeeper with the Coastal Carolina Riverwatch – later than April
        - Study on public policy students, protecting wetlands in Carteret County with public policy changes – Riley
    - Rachel Carson Reserve Living Shoreline – Dawn York & Paula Gillikin, maybe ready for April, or next quarter
    - Coastal resiliency project (wrapping in mid-May) – Joe Heard, Town of Duck – July meeting
    - UNC, ECU drone mapping of SAV. Susan Cohen/ UNC talk more about if interested – Robbie
        - Also, NERR drone mapping/monitoring of oyster reefs and salt marshes
    - Sandbar Oyster Co. project updates – Marae West
    - Fortified Roof Program through Joint Underwriters Association – Eryn Futral

North Carolina Flood Resiliency Blueprint

N.C. Coastal Resilience Community of Practice Meeting

April 22, 2024

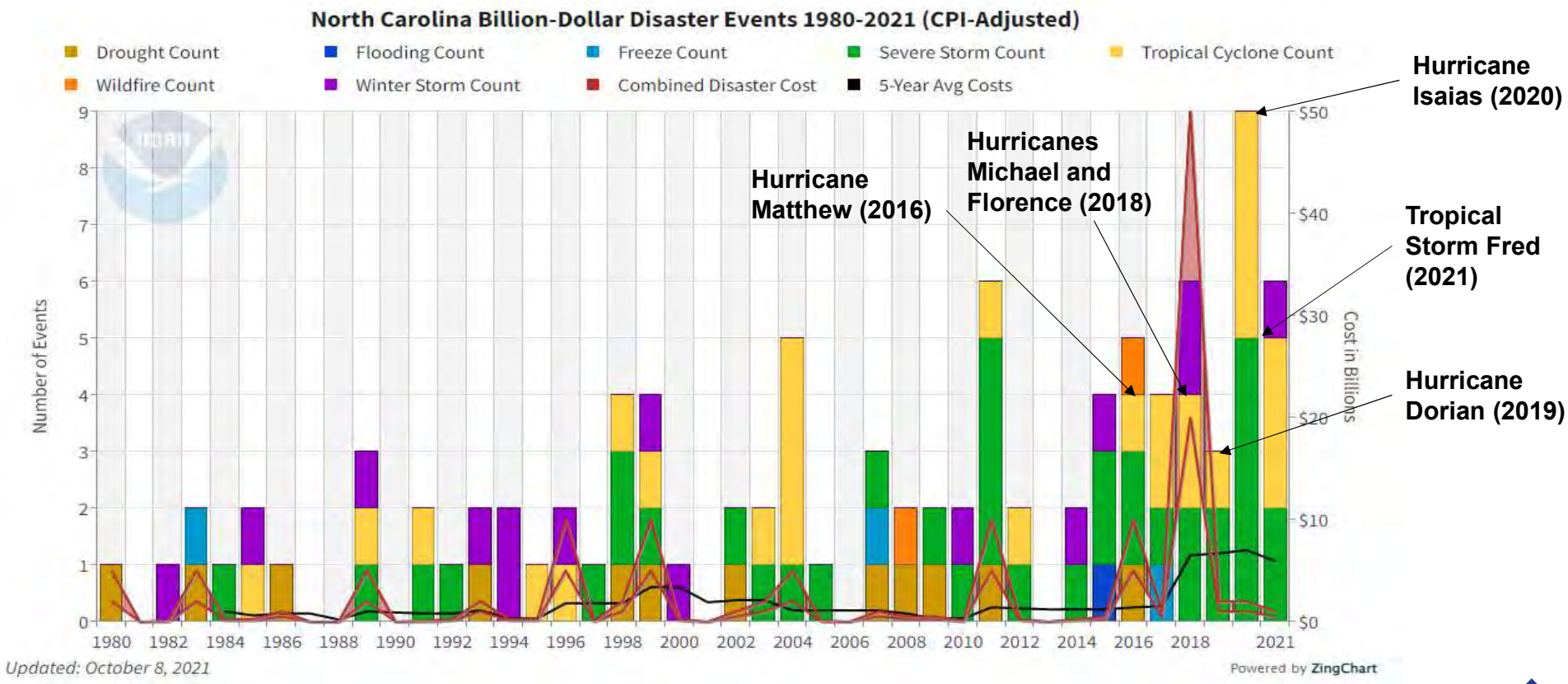
Stuart Brown, NC Dept of Environmental Quality

Agenda NC Flood Resiliency Blueprint

- Background
- Legislative Intent
- Blueprint Team
- *What is Blueprint?*
- Multiphase Blueprint Process and Status Update
- Stakeholder and Community Engagement
- Decision Support Tool Design
- Questions

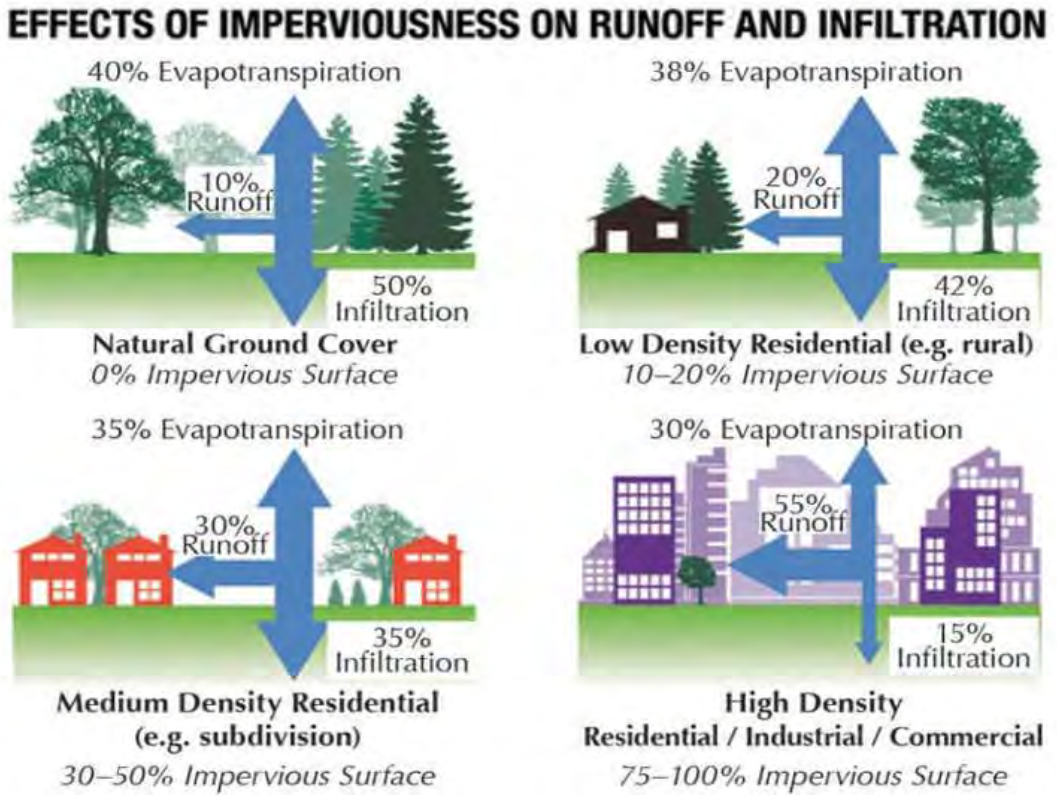
Background

Billion-Dollar Disaster Events



North Carolina population growth 1990-2035

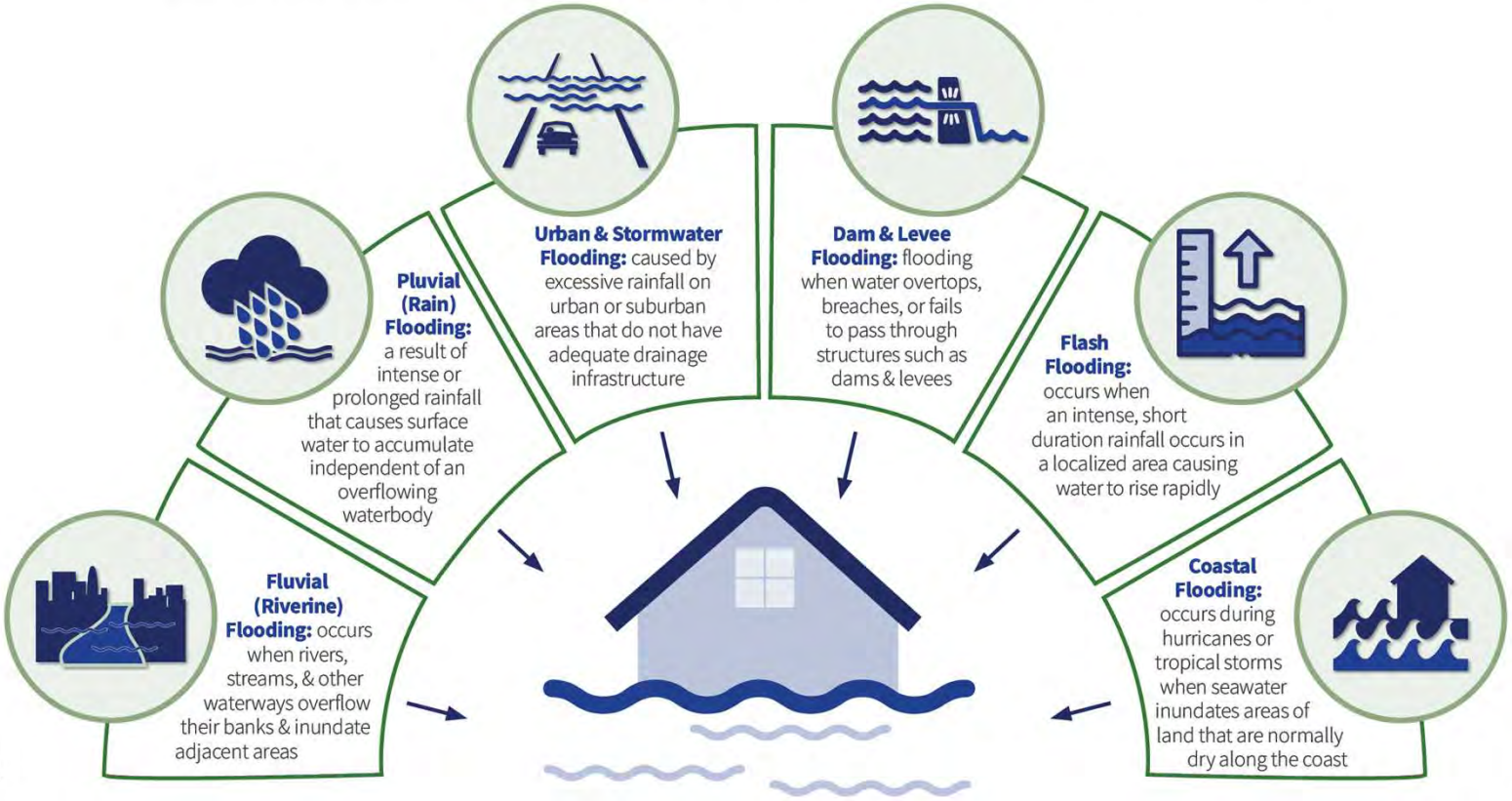
Source: US Census Bureau, NCOSBM



Source: The Watershed Institute

FLOOD HAZARD TYPES

There are many types and sources of flooding that create negative impacts to human safety, structures, infrastructure, and the environment. These sources of flooding may occur independently, but often occur concurrently with each other (compound flooding). Often, brick and mortar structures are a primary focus; however, impacts can include infrastructure, agricultural areas, natural resources, indirect economic impacts or anything else that could be negatively impacted by flooding. Different types of categorized flood hazards include:



Legislative Intent

S.L. 2021-180 Sec 5.9(c) Requirements (1 of 3)

- Contract with an organization to **develop a statewide Flood Resiliency Blueprint** for major watersheds impacted by flooding, including, among others, the Cape Fear River and the Neuse River Basins
- Shall form the **backbone of a State flood planning process** that **increases community resiliency to flooding**
- Should **reduce the cost and complexity for local government** in developing decision support tools and implementation of flood risk reduction projects
- Shall be a resource for **riverine and stream management** to reduce flooding
- Should support the establishment and furtherance of local government **stormwater** maintenance programs

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S.L. 2021-180 Sec 5.9(c) Requirements (2 of 3)

- Shall **identify the major watersheds affected by flooding and direct these funds** toward the activities which are central to the creation of an actionable blueprint, namely
  - Flood risk assessment
  - Identification of data gaps
  - Recommendations to reduce flood risk for each target watershed
- Shall ensure the blueprint **incorporates**
  - Local knowledge
  - Community goals
  - Projections of future flood risk
  - Best available science and **hydrologic modeling** to **create a decision tool for flood mitigation investments and strategies from local watersheds up to whole river basins**.
- Lead to a prioritized set of projects and funding strategies that can be **implemented by state agencies, local governments, and regional resource managers**.

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S.L. 2021-180 Sec 5.9(c) Requirements (3 of 3)

- DMS and the organization selected are encouraged to **examine examples from other states** such as the Louisiana Coastal Master Plan or the flood resiliency planning processes in South Carolina and Virginia.
- The organization shall send all necessary information to DMS on the implementation of the blueprint upon request by DMS.
- The organization shall submit an initial **draft of the blueprint** to DMS **no later than December 31, 2023.**
- **DMS shall report by July 1, 2022, and annually thereafter** to the Joint Legislative Commission on Governmental Operations and the Fiscal Research Division on the implementation of this subsection.

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S.L. 2021-180 Sec 5.9(c) Requirements

"...A successful blueprint should ultimately lead to a prioritized set of projects and funding strategies that the State can implement."

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NORTH CAROLINA
Department of Environmental Quality

Blueprint Team

DEQ Core Blueprint Team

Shrikar Nunna
Director of Legislative Affairs
Department of Environmental Quality, Secretary's Office

Marc Recktenwald
Director
Department of Environmental Quality, Division of Mitigation Services

NOW HIRING

Stuart (Stu) Brown
Flood Resiliency Blueprint Program Supervisor
Department of Environmental Quality, Division of Mitigation Services

Six Time-limited Blueprint Project Managers

Blueprint Development Team Structure

Leadership		
DEQ Executive Leadership	**DEQ Core Advisory Group**	**Principal Advisory Group**
Work with the Core Advisory Group to decide on recommendations	*Determine whether to implement recommendations provided by the TAGs, including technical requirements, policies, economics, environmental and human health, and project funding*	*Provide advisory input and feedback on the policy, process, engagement, modeling, tools, and support utilized*

Seven Technical Advisory Groups						
Government		**Environmental**		**Social**		**Regional**
Governance	**Partnership/ Funding**	**Hazard Identification**	**Vulnerability/ Risk/ Impact**	**Resilience/ Mitigation/ Reduction**	**Tool Development/ Acceptance**	**Neuse Regional Advisory Council**

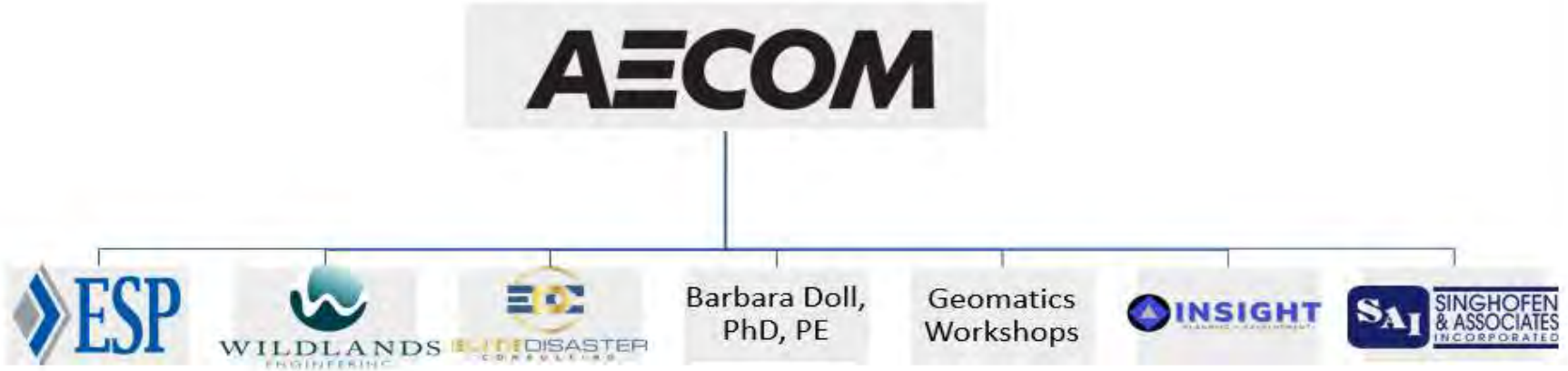
Critical to providing advisory input and feedback

Blueprint Work Plan Partners

150 + Advisors

15

Phase I & II Vendor Team



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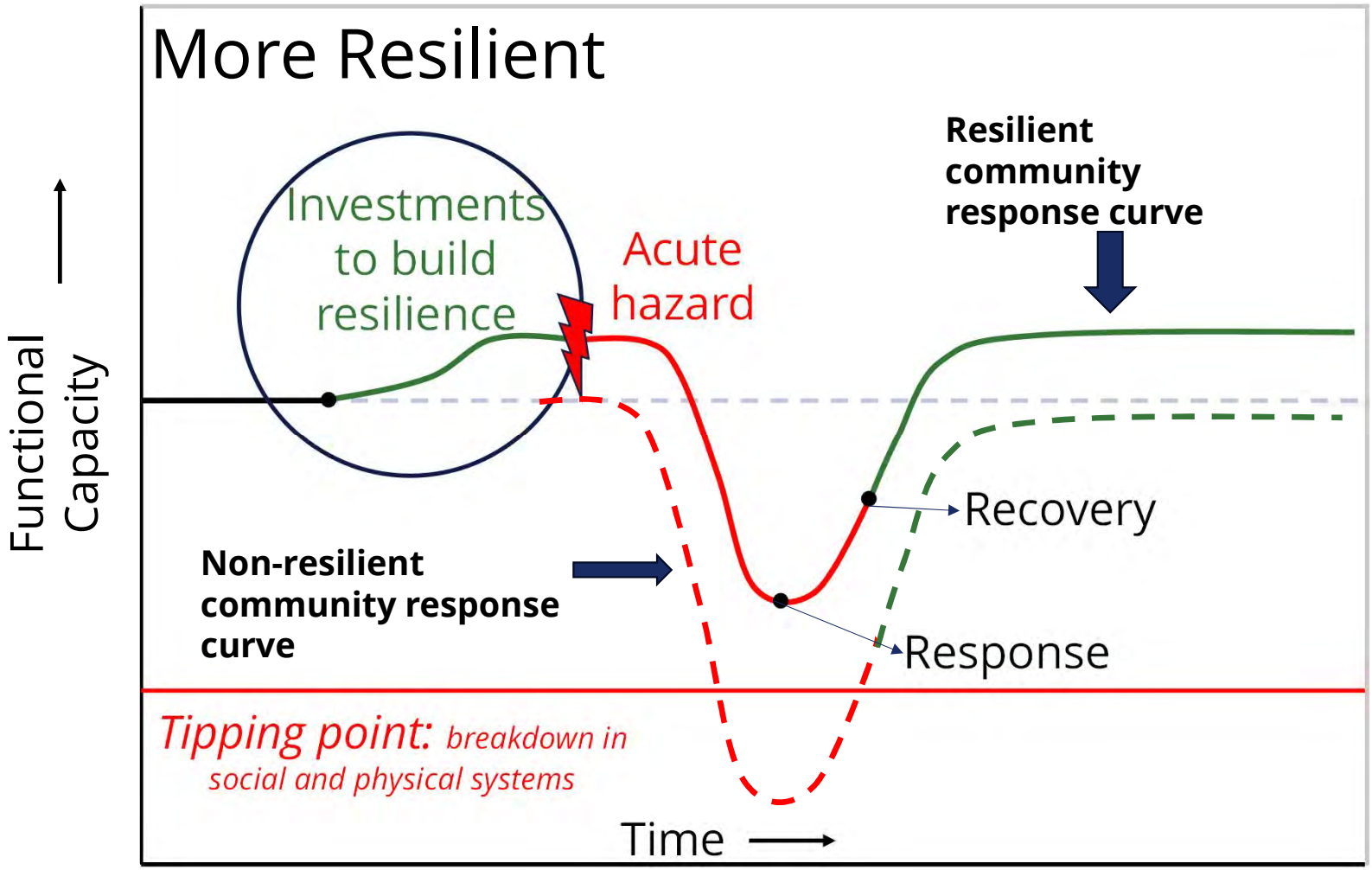
What is Blueprint?

Purpose and Goals

Blueprint – Core Outcomes

The three core high level goals that all actions are evaluated against:

1. Reduce likelihood and extent of flooding
2. Reduce vulnerability and impact
3. Increase community ability to recover



- **Investment in resilience, leads to better outcomes before, during and after natural disasters.**
- **What is a community's "Capacity" to recover from flood hazards?**

Blueprint Components

Blueprint Program - Multiphase Process

- **Phase I** *(2022 - 2023)*
  - Research and evaluation
  - Gap analysis
  - Recommendations and decisions (Programmatic, Policy, Tools, Approaches, Needs)
  - Implementation roadmap and manual
  - Blueprint Workflow
  - Neuse River Basin Actin Strategy (Pilot)
  - Draft Blueprint **by December 31, 2023**
  - **Version I of Blueprint document is complete**
  - **20 of 29 documents are currently available on the website**
- **Phase II** *(2023 - 2024)*
  - Develop online decision support tool (Blueprint Tool)
  - Refine Blueprint and Neuse Action Strategy (including additional modeling)
  - Begin implementation
- **Phase III** *(2024 - 2025)*
  - Develop Action Strategies for five prioritized areas
  - Refine of Decision Support Tool
  - Continue Blueprint implementation
  - Implement $96 million worth of resiliency projects in prioritized areas
- **Phase IV** (2025 +)
  - Statewide Expansion of Strategies/Decision Support Tool (pending additional funding)
  - Ongoing implementation and refinement of the Blueprint Program

Phase I

Phase I:

Develop Draft Blueprint and Draft Neuse Basin Flood Resiliency Action Strategy

Task 1:

Stakeholder Outreach/ Facilitation.

Literature review, Data collection inventory, Review of existing statewide planning efforts,

Review of governance schemes from select peer states

Task 2:

Gap Analysis.

Statewide data inventory

Gap analysis of data, Modeling,

Resources necessary to develop the Blueprint and Action Strategies

Task 3:

Recommendations /Decision Framework.

Develop recommendations to support the Draft Blueprint and Action Strategies.

Task 4:

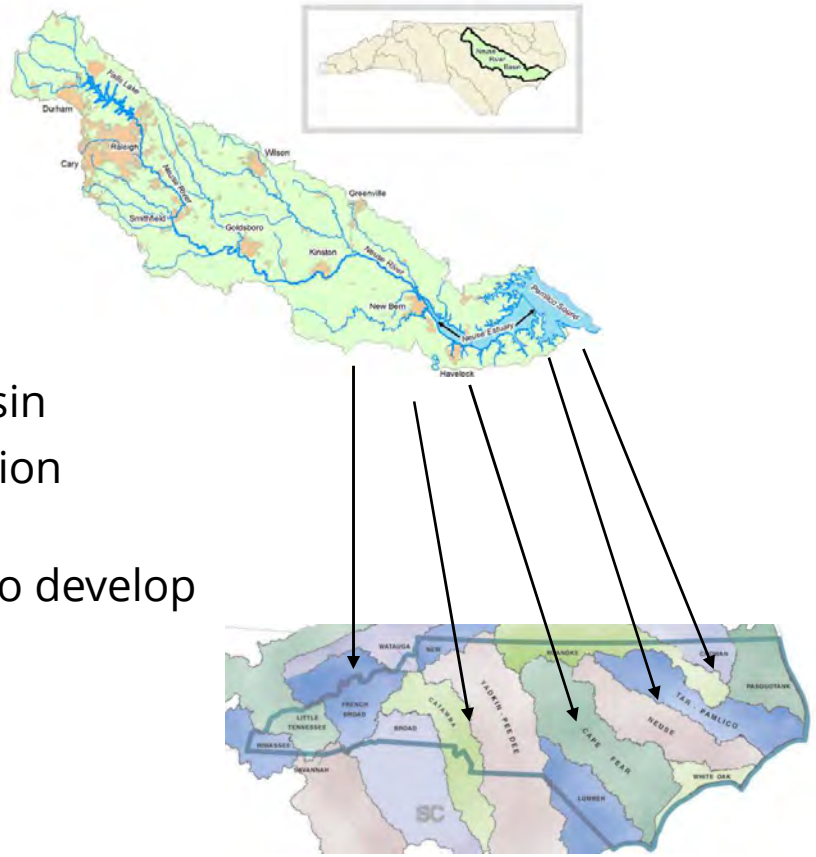
Develop a Draft Blueprint and Pilot Action Strategy.

Includes developing the requirements needed for an online decision support tool.

Decisions Now & Strategic Future

River Basin Action Strategies (RBAS)

- Considering NC basins have different
  - flood exposure,
  - data and modeling needs,
  - capacity and/or values;
  - unique stakeholders and governments for each basin
- Develop preliminary RBAS to identify best flood mitigation strategies based on initial data and engagement
- Identify and prioritize basin data and modeling needs to develop final river basin action strategy
- Fill in gaps and analyze results
- Complete Action Strategy



Blueprint Workflow

Draft Blueprint Program

- "Connective tissue" for resilience efforts
- Recognize, support, leverage, and advance resilience efforts at the basin scale
- Identify and fill data gaps
- Close capacity gaps
- Implement resiliency actions

Proposed, Interim Approach to Approving Critical Decisions

- Need for decisions in a timely manner for continued progress, implementation
- NCDEQ is decision authority, in the interim
- Blueprint Principal Advisory Group

Draft Blueprint Workflow is Dynamic

- General guide, not stringent
- Engagement of communities, stakeholders, etc. is critical
- Collaborate with key partners
- "Manual" on the specific steps is under development
- Basin Advisory Groups

Blueprint Action Strategy Workflow

- Gather, generate and update data

Step 1. Actionable Data, Modeling, Analysis

- Formal kickoff with communities and stakeholders

Step 2. Initiate Community Engagement and Discovery

- Start using the Flood Resiliency Blueprint Tool

Step 3. Flood Risk Planning and Analysis

- Refine action data

Step 4. Action Review, Creation, and Adjustment

- Review, sort, and rank actions

Step 5. Action Analysis and Ranking

- Create Basin Action Strategy

Step 6. Flood Resiliency Blueprint Basin Action Strategy

- Increase resilience at the basin scale

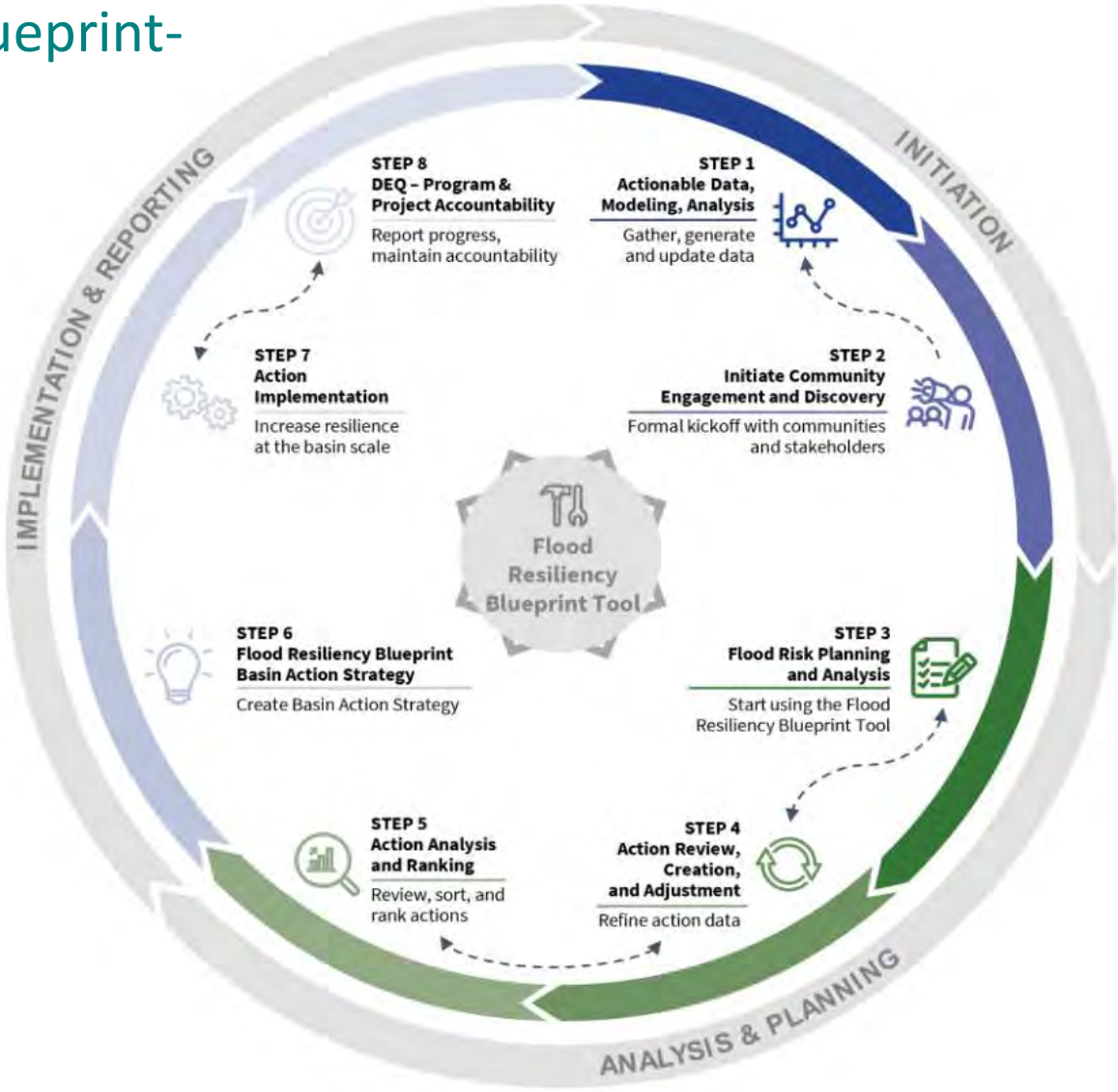
Step 7. Action Implementation

- Report progress, maintain accountability

Step 8. NCDEQ – Program & Project Accountability

North Carolina Flood Resiliency Blueprint-
Differentiators

- **Future Conditions Modeling**
- Detail Profiles *(hazard, community, actions, funding)*
- Quantifiable Metrics
- Impacts (*population, environment, structures, infrastructure, economy)*
- Mitigation / Resilience Action Exploration
- ROI / Added Value
- Prioritization of Actions – Ranking
- **Matching Sources of Funding**



NC Online Flood Resiliency Blueprint Decision Support Tool (Blueprint Tool)

Blueprint Tool

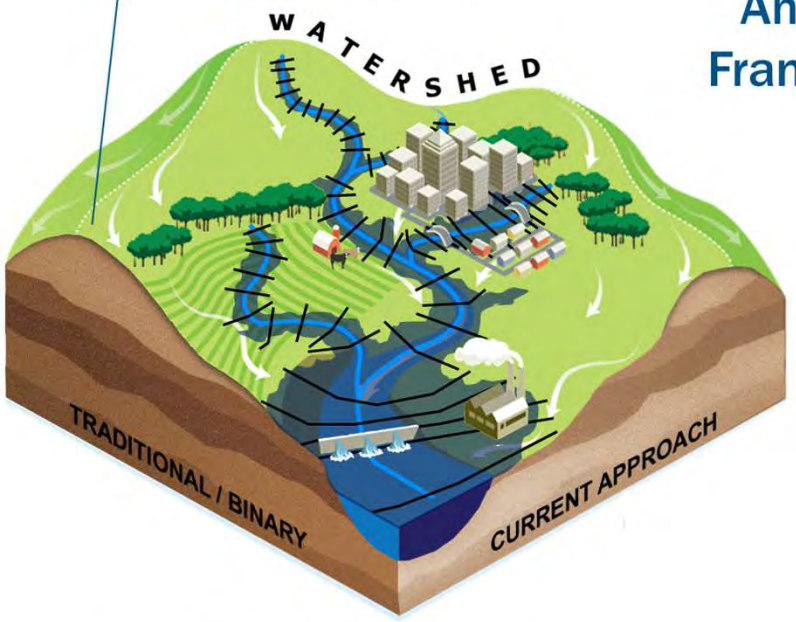
- Expands on existing tools with new data and methodologies
- Integrates forecasted changes
- Allows for integration of future data and logic generated through multiple sources
- Is scalable (catchment to statewide)
- **Is dynamic** and improves as data and methodologies improve

NC FRIS

DATA DEVELOPMENT

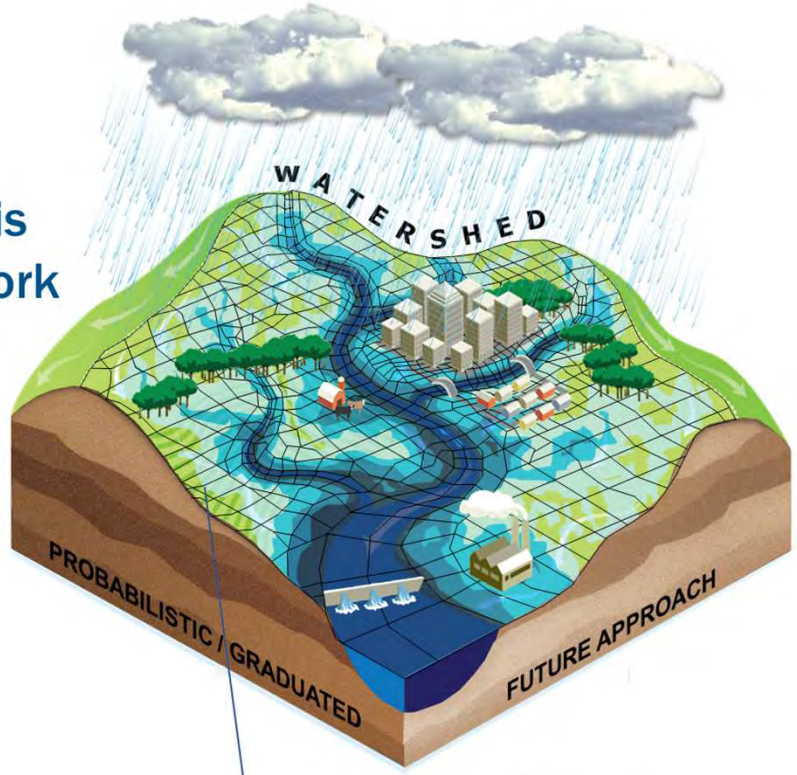
H&H Modeling Considerations

- 1D Modeling
- Fluvial flooding only
- Event-based analyses



Inland/Riverine Flooding Examples

Analysis Framework



- 2D Modeling
- Fluvial and pluvial flooding
- Probabilistic analyses

Initial Blueprint Tool

The Decision Support Tool will assist with:

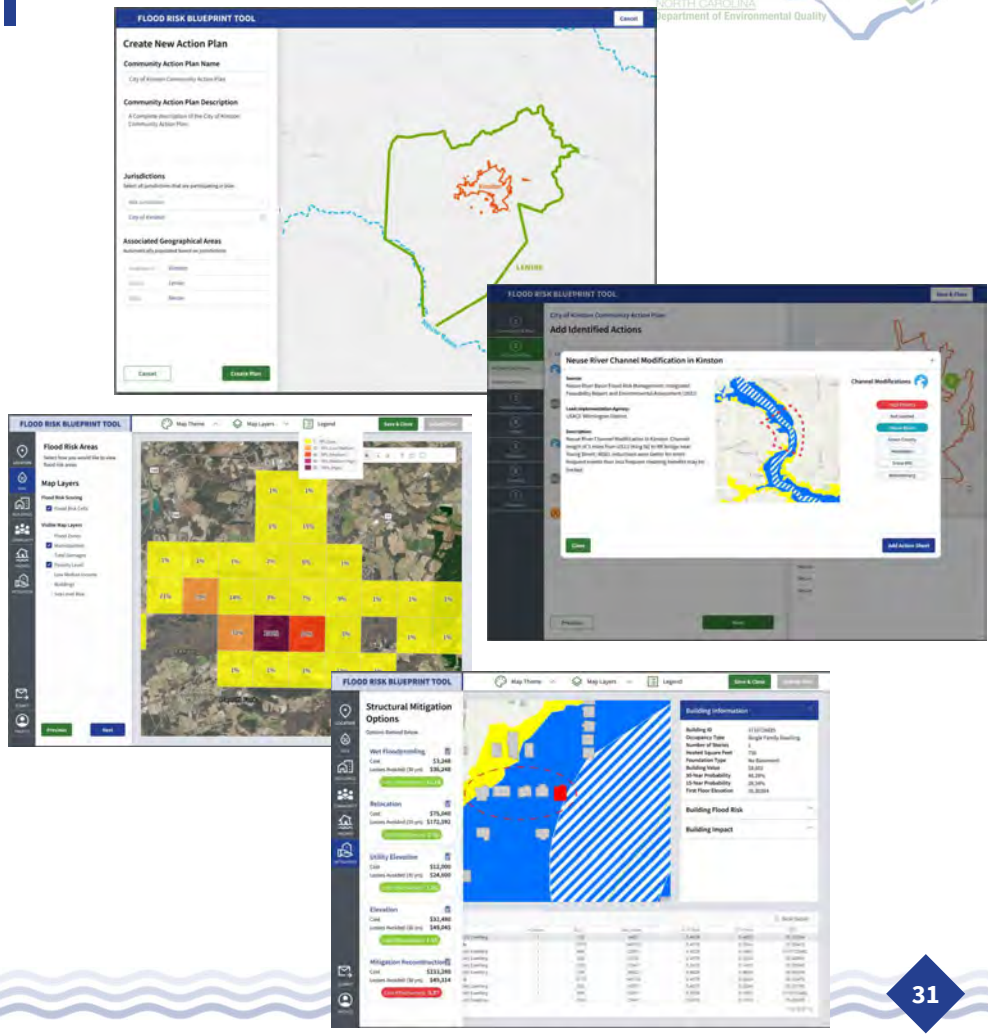
- Multi-level, multi-variant mitigation planning
- Prioritization, including factors such as:
  - Social vulnerability
  - Local desire/tolerance
  - Nature-based solutions
  - Traditional mitigation solutions
  - Benefit-Cost Ratio
- Mitigation project management

Progress on the Decision Support Tool has begun with:

- User roles and workflows, Storyboards, and Wireframes are in review

Potential examples of Tool

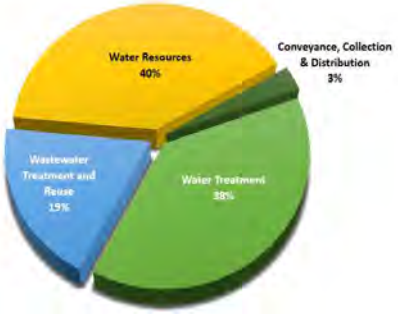
- These are Mockups of potential interface types that could be used for the tool.
- Visualization of risk
- Showing how plans would be created
- An understanding of projects, including data available
- Mitigation actions and their ranking
- Funding sources link to project type
- Track program accountability



Blueprint – Strategic Funding ID and Matching

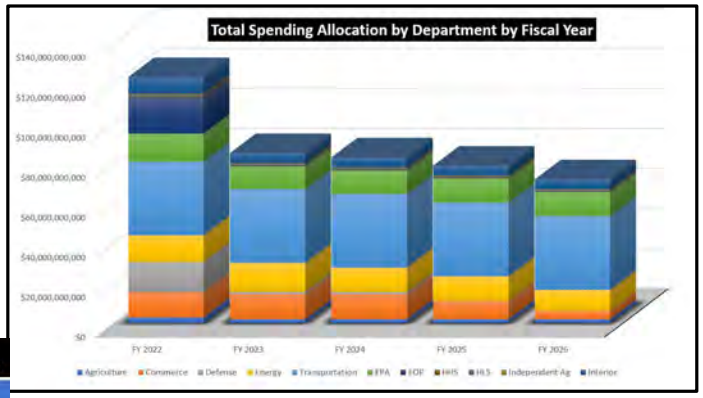
Annual Federal Appropriations and Authorization Acts
Infrastructure Investment and Jobs Act / BIL
Inflation Reduction Act
Water Resources Development Act (Biennial Authorization)
Energy and Water Development
Interior-Environment
Homeland Security
Agriculture, Rural Development, Food and Drug Administration, and Related Agencies
Commerce-Justice-Science
Farm System Reform Act of 2023

Water BL Markets	Opportunities	Total Allocation
Water Treatment	7	$35,086,349,500
Wastewater Treatment and Reuse	12	$17,349,810,000
Water Resources	97	$36,756,881,660
Conveyance, Collection & Distribution	9	$2,732,530,000



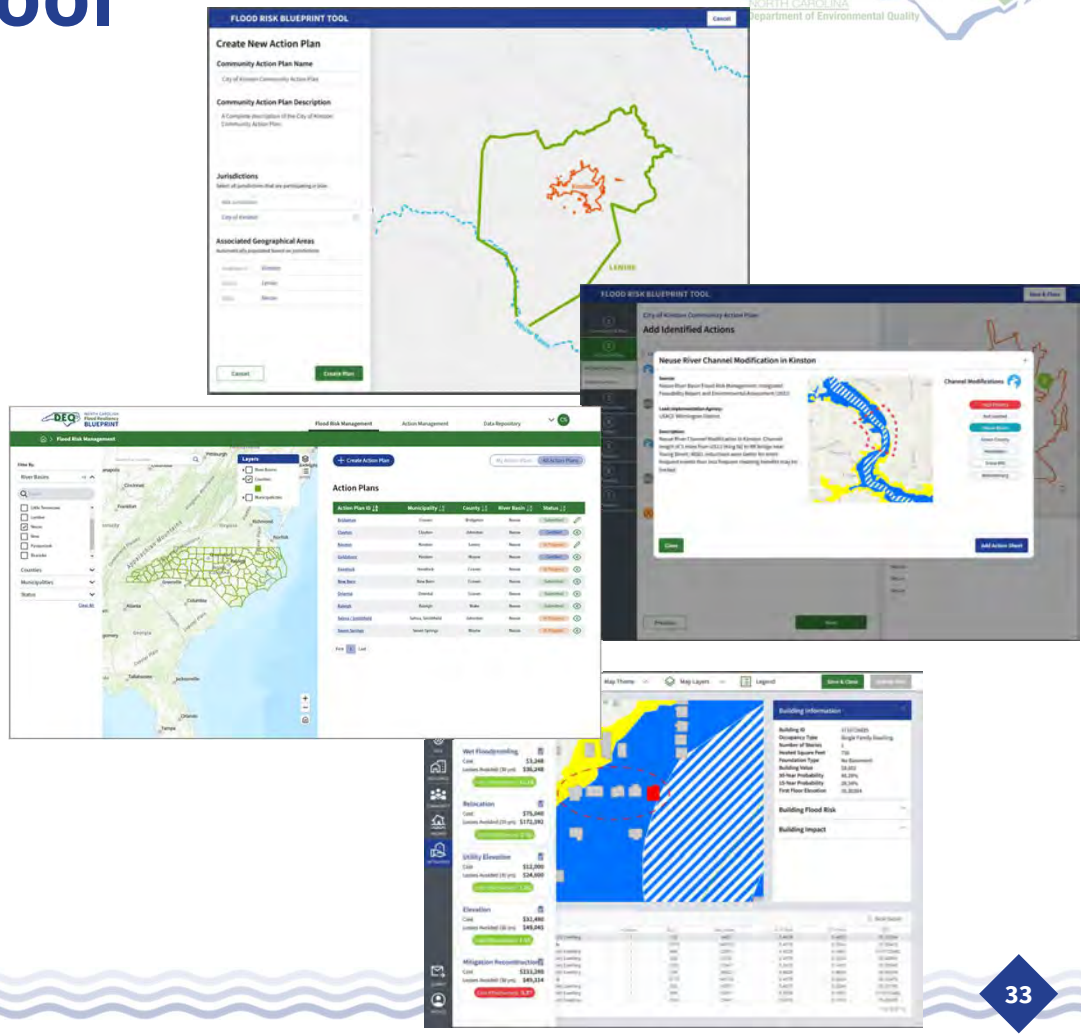
WR Sub-Markets	No. of Opportunities	Total Allocation	Federal	Non-Federal
Ecosystem Restoration	8	$1.6 B	$1.3 B	$242 M
Ports and Harbors	3	$2.7 B	$500 M	$2.2 B
Dams & Levees	28	$12.6 B	$9.8 B	$2.8 B
Flood Risk Management	21	$12.4 B	$7.45 B	$4.9 B
Rivers and Waterways	2	$3.5 B	$3.5 B	$0
Watershed Management	35	$3.9 B	$3.6 B	$272 M

Departments	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026
Agriculture	$2,681,124,790	$1,815,102,415	$1,815,102,415	$1,815,102,415	$1,815,102,415
Commerce	$12,726,927,667	$12,554,984,000	$12,554,983,000	$9,174,427,667	$4,201,677,667
Defense	$15,009,000,000	$1,050,000,000	$1,000,000,000	$0	$0
Energy	$13,222,130,000	$14,493,580,000	$12,158,292,500	$12,182,870,625	$10,410,267,656
Transportation	$36,815,600,000	$36,815,600,000	$36,815,600,000	$36,815,600,000	$36,815,600,000
EPA	$13,995,800,000	$11,220,800,000	$11,622,800,000	$12,022,800,000	$12,022,800,000
EOP	$17,639,658,000	$650,000	$650,000	$650,000	$400,000
HHS	$800,000	$800,000	$800,000	$800,000	$800,000
HLS	$1,882,100,000	$1,618,100,000	$1,518,100,000	$1,318,100,000	$1,218,100,000
Independent Ag	$350,000,000	$200,000,000	$200,000,000	$200,000,000	$200,000,000
Interior	$8,346,123,000	$4,969,458,340	$4,969,458,340	$4,969,458,340	$4,969,458,340
Total	$122,669,263,457	$84,739,074,755	$82,655,786,255	$78,499,809,047	$71,654,206,078



Potential examples of Tool

- Mockups of potential interface types that could be used for the tool.
- Showing how plans would be created
- An understanding of projects including data available
- Visualization of risk
- Mitigation actions and their ranking.



Application Modules

Introductory Module

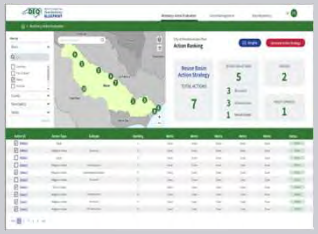
- Login & Homepage
- Community Flood Risk
- Community Profile

Flood Risk Management Module

- Create a draft action Plan
- Identify Flood Risk areas
- View Impacts
- Add existing resiliency Actions
- Define new resiliency actions
- Save actions
- Action plan summary
- View all action plans

Resiliency Action Evaluation Module

- Action summary and Ranking



Action Management Module

- Action overview
- Action management dashboard

Data Repository

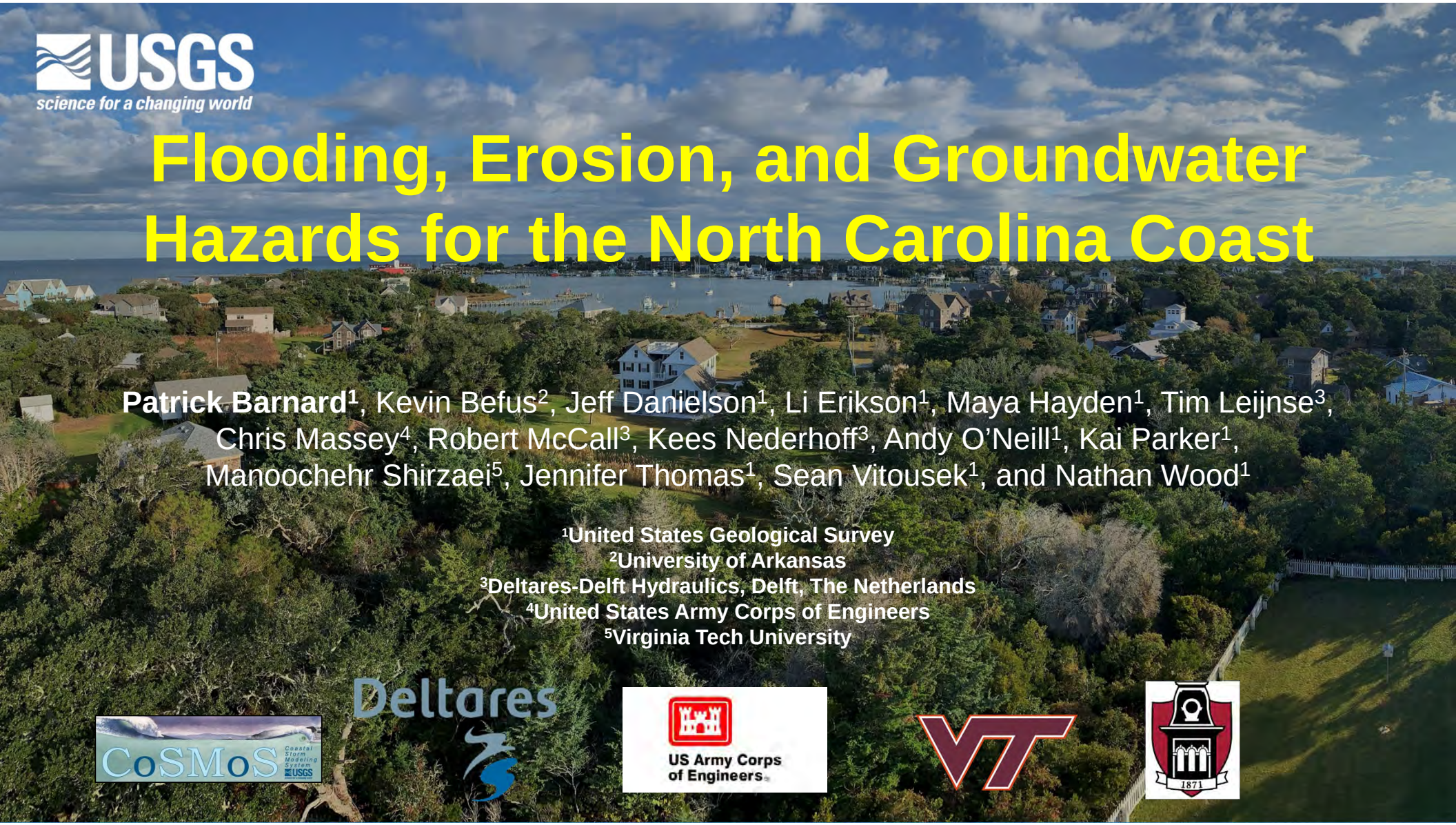
- Download spatial data in various formats.
- Search technical documents
- View or download the documents.
- NCDEQ manages documents in the Data Repository.

**All content and functionality are subject to further refinement as part of Phase II*

NC Flood Resiliency Blueprint Status of process

Website

- The Flood Resiliency Blueprint Website is available.
- https://ncfloodblueprint.com/
- Version 1 of Blueprint Tool July 5th



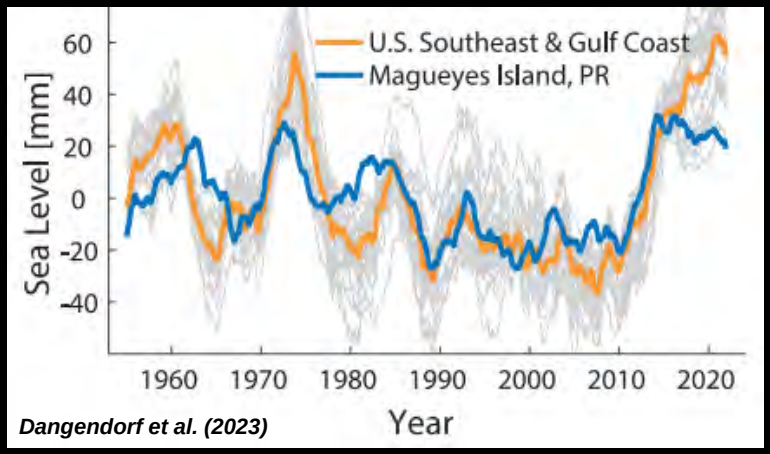
Flooding, Erosion, and Groundwater Hazards for the North Carolina Coast

Patrick Barnard[1], Kevin Befus[2], Jeff Danielson[1], Li Erikson[1], Maya Hayden[1], Tim Leijnse[3], Chris Massey[4], Robert McCall[3], Kees Nederhoff[3], Andy O'Neill[1], Kai Parker[1], Manoochehr Shirzaei[5], Jennifer Thomas[1], Sean Vitousek[1], and Nathan Wood[1]

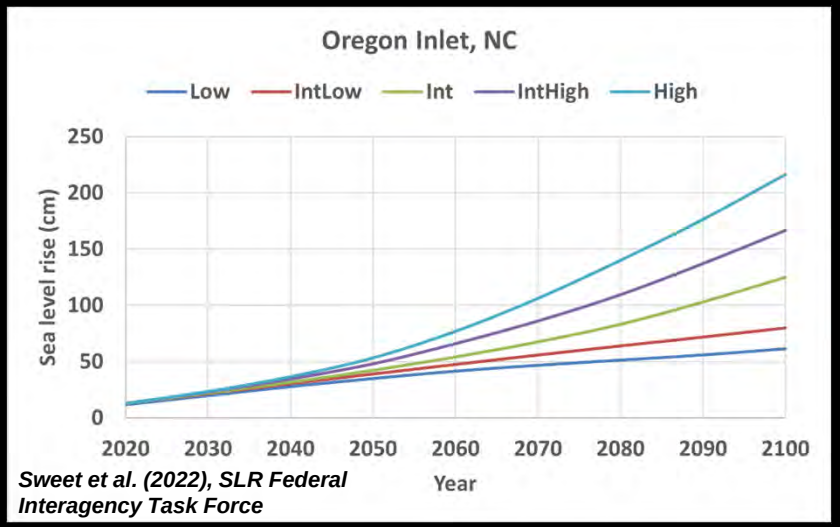
[1]United States Geological Survey
[2]University of Arkansas
[3]Deltares-Delft Hydraulics, Delft, The Netherlands
[4]United States Army Corps of Engineers
[5]Virginia Tech University

Sea Level Rise in North Carolina

- North of Cape Hatteras has been a hotspot for decades, with SLR increasing ~4 times faster than the global average from 1970-2009
- South of Cape Hatteras, rates of > 10 mm/yr have been observed at the majority of tide gauges from 2010-2021
- Intermediate SLR projection of 0.43 m (1.4 ft) by 2050 and 1.25 m (4.1 ft) by 2100 per Sweet et al. (2022)
- Under the higher scenarios, 2 m (6.6 feet) of SLR would be reached in the first half of the 22nd century



Dangendorf et al. (2023)



Sweet et al. (2022), SLR Federal Interagency Task Force

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Future Coastal Hazards - Overview

Objective: Assess coastal hazards associated with SLR and storms for the 21st century from Virginia Beach to Miami

Scenarios

- Sea-level rise (n=7): 0, +0.25, +0.5, +1.0, +1.5, +2.0, and +3.0 m
- Storms (n=4): daily, annual, 20- and 100-yr

Key Products

- 1 m topo-bathy DEM
- Vertical land motion
- Flooding extent, depth and uncertainty
- Long-term and storm-related beach erosion
- Groundwater hazards
- Socioeconomic exposure
- Web tools: CCH web portal, HERA

Funding

- Appropriations for Disaster Relief Act of 2019 [H.R. 2157]
- National Park Service

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Wilmington, Hurricane Florence, 2018
Jim Lo Scalzo, EPA

Beaufort, NC, November 2022

Ocracoke, NC, Hurricane Dorian, September 2019 (Julia Wall, The News and Observer)

Ocracoke, NC, November 2022

Ocracoke, NC, November 2022


DORIAN
MATTHEW
OCTOBER 9
2016
ALEX Aug 3, 2004
High Tide Line, Hurricane GLORIA
Sept. 1985
ISABEL 9/18/03
GUSTAV 9/1/02
EARL 9/3/10


Ocracoke, NC, November 2022
OCRACOKE
whiskey
DORIAN
2019
MATTHEW
2016
ALEX
2004

Rodanthe, NC, Hurricane Irene, August 30, 2011

Integrated Topobathymetric Digital Elevation Model

Objective: Development of a high-resolution integrated 1-meter topobathymetric digital elevation model (TBDEM) to support projections of coastal flooding, erosion, and groundwater hazards.

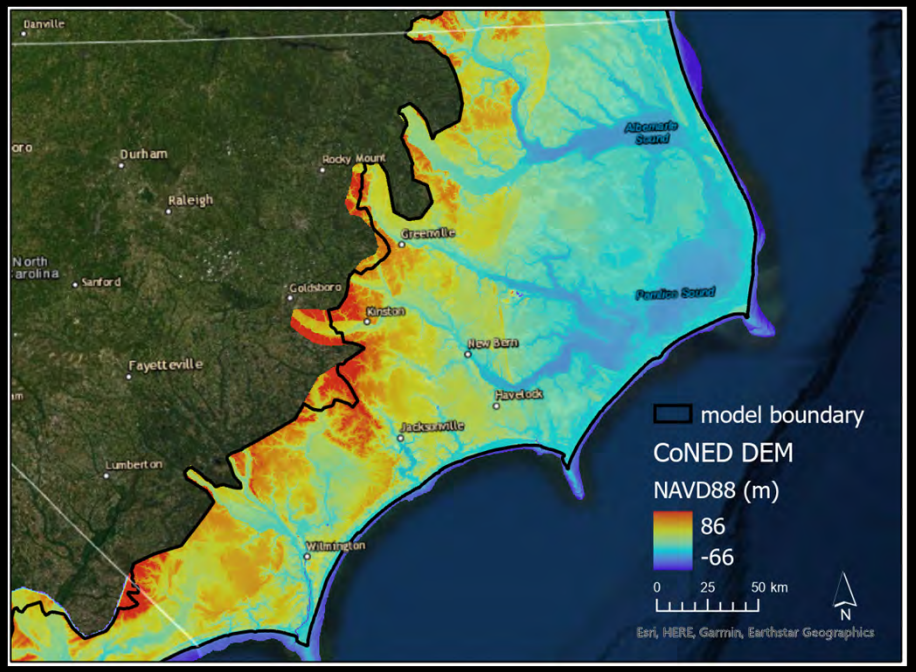
Approach Highlights

- Integrated TBDEM compilation based on best available pre- and post-Hurricane Florence/Dorian topography and bathymetry geospatial data

Products

- Integrated TBDEM for the coastal zone

Tyler, D., Cushing, W.M., Danielson, J.J., Poppenga, S., Beverly, S.D., and Shogib, R., 2022. Topobathymetric Model of the Coastal Carolinas, 1851 to 2020: U.S. Geological Survey data release, https://doi.org/10.5066/P9MPA8K0



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www.usgs.gov/core-science-systems/eros/coned

Vertical Land Motion

Objective:

- Determine the rate of Vertical Land Motion (VLM) along the coastline at management relevant resolution.

Approach Highlight:

- Across a ~100 km wide swath of land along the coast, perform an advanced multitemporal InSAR analysis of large datasets obtained by ALOS and Sentinel1 satellites

Products:

- VLM rates for entire coast at ~100 m resolution

Key Science Partner: Manoochehr Shirzaei (Virginia Tech)

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Overland Flood Hazards

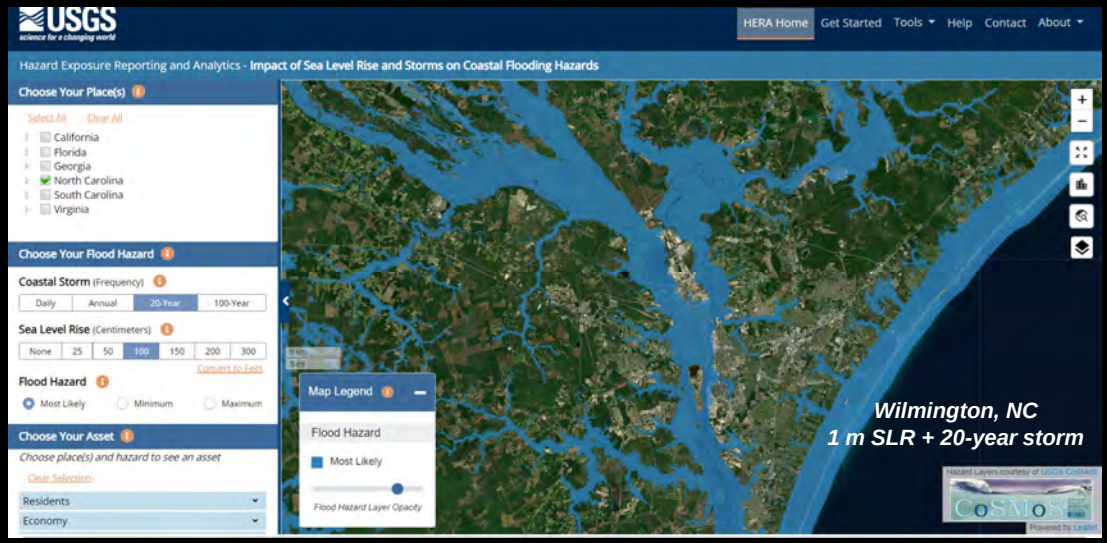
Objective: Quantify nearshore oceanographic, pluvial, and fluvial drivers of coastal hazards and consequent overland flooding for the full suite of sea level rise and storm scenarios.

Approach Highlights

- Dynamically downscaled future conditions using the latest generation of climate change models (CMIP6)

Products

- Projected (future) time-series of nearshore waves and storm-tides; joint occurrences of hurricanes and non-hurricane events with precipitation and fluvial discharges; flood hazard maps (extent, depth, duration)



Key Science Partners: Deltares, USACE/ERDC

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US Army Corps of Engineers

www.usgs.gov/cosmos

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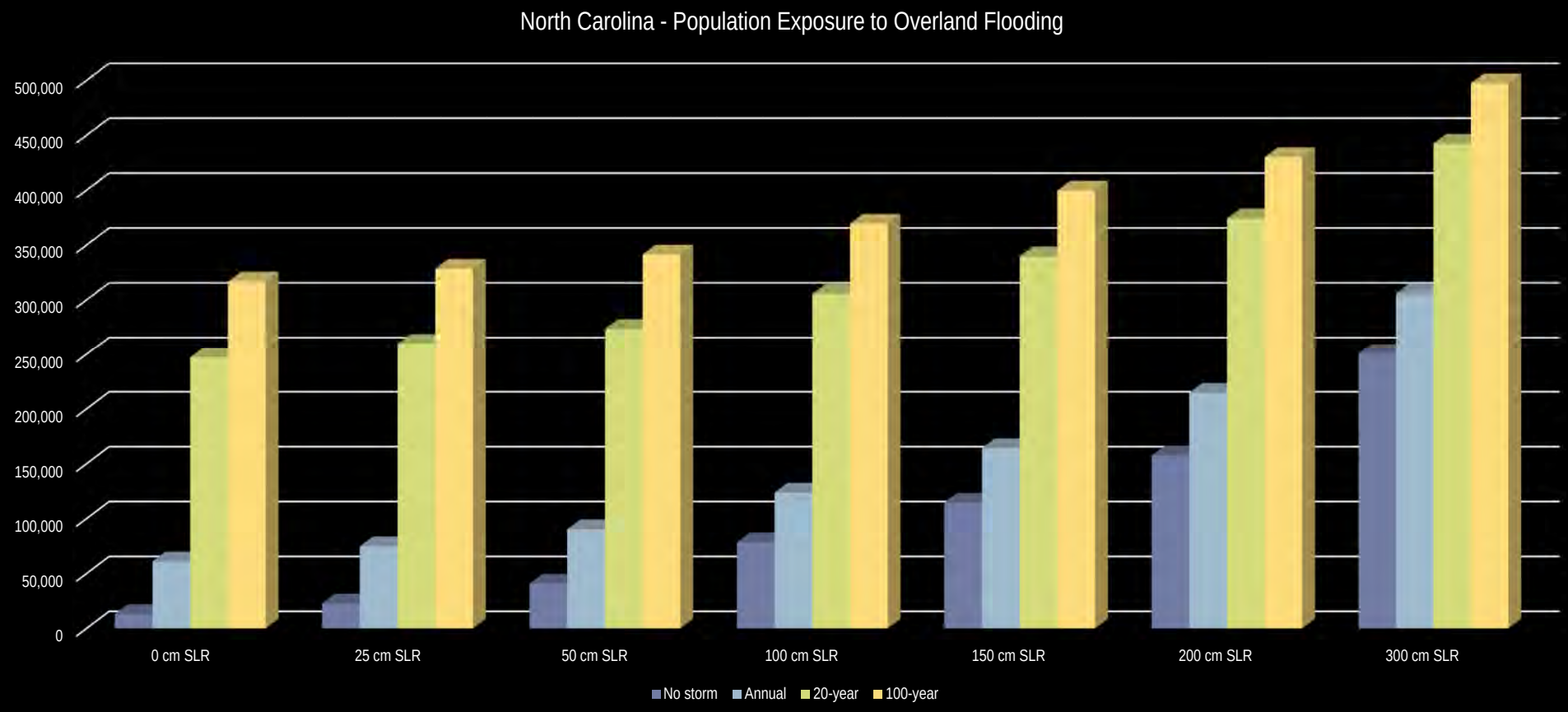
Beaufort – Annual Storm Flooding

Overland Flood Hazards



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US Army Corps of Engineers

www.usgs.gov/cosmos

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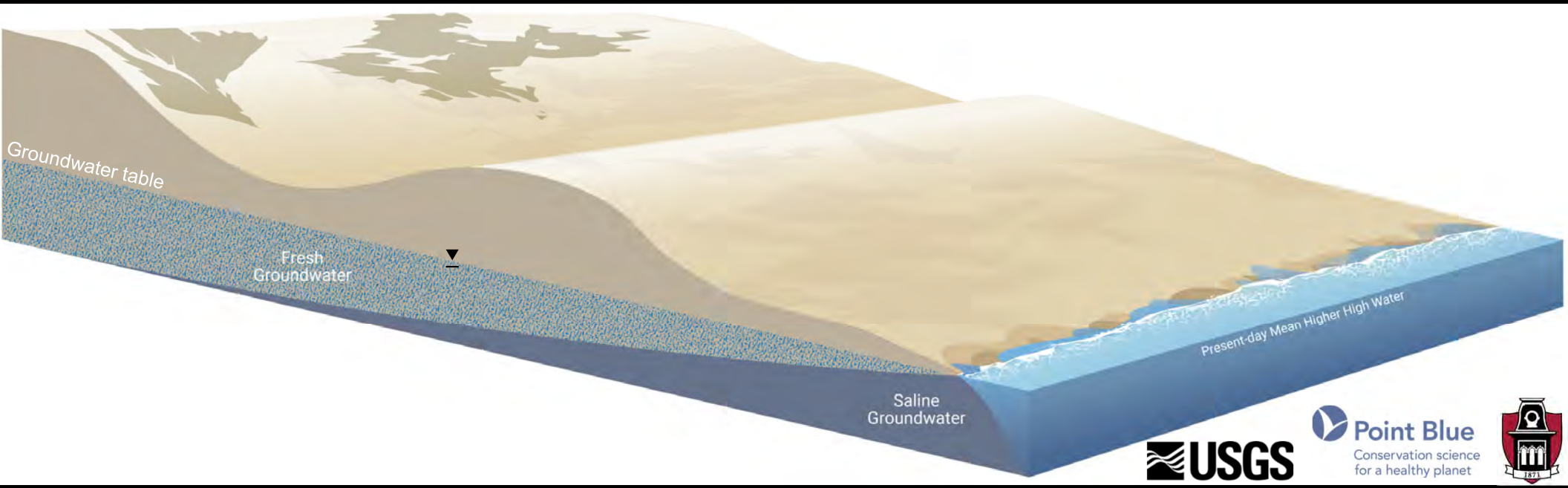
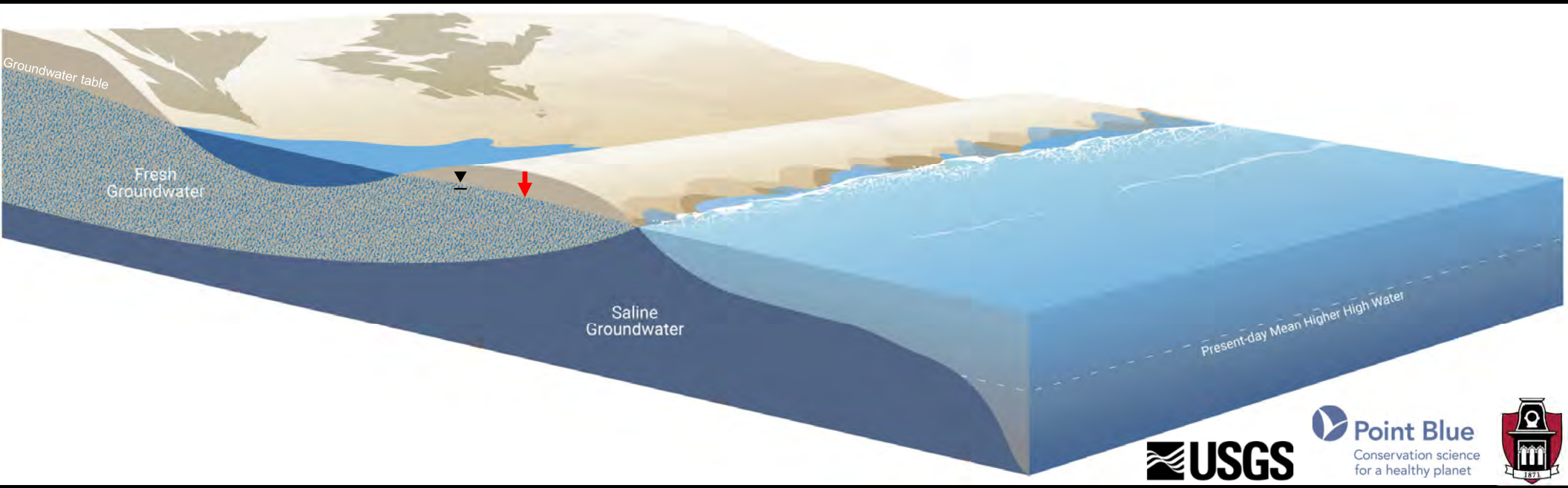
How sea level rise affects the groundwater table



USGS

CoSMoS

How sea level rise affects the groundwater table



USGS

Point Blue
Conservation science for a healthy planet

USGS

CoSMoS

Groundwater Hazards

Objective: Quantify water table elevation response to sea-level rise.

Approach Highlights

- Overlapping numerical models of steady-state groundwater flow for each sea level rise scenario
- Leverages transmissivity/K-values from Befus et al. (2017) and Zell and Sanford (2020)

Products

- Continuous output datasets and maps of groundwater emergence and shoaling

Key Staff: Kevin Befus (University of Arkansas), Cliff Voss (WMA, Emeritus)

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www.usgs.gov/cosmos

1871

Coastal Change

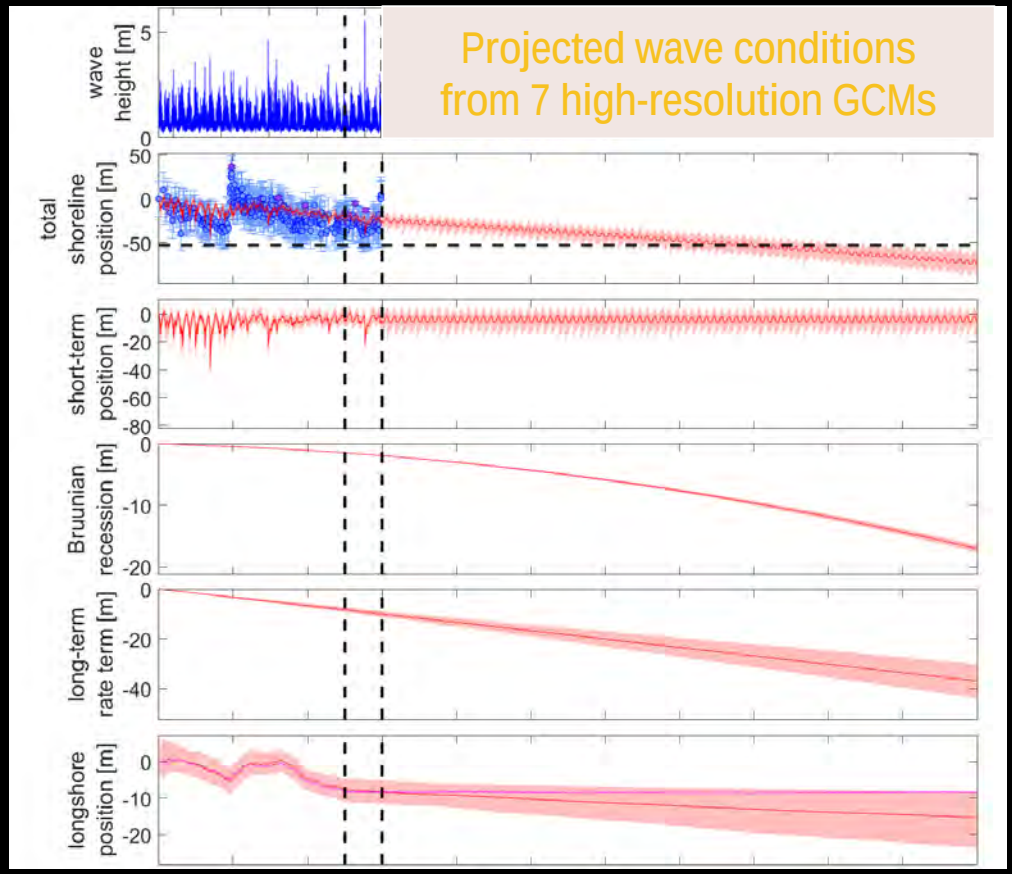
Objective: Predict future position of the shoreline based on SLR scenarios and total water level projections (CoSMoS-COAST).

Approach Highlights

- Auto-tunes model parameters along 50-m spaced transects to best fit historical, satellite-derived shoreline data
- Projects coastal erosion hazards incorporating SLR, cross-shore and longshore transport, and sediment supply

Products

- Erosion hazard maps for daily and storm conditions



Key Staff: Sean Vitousek

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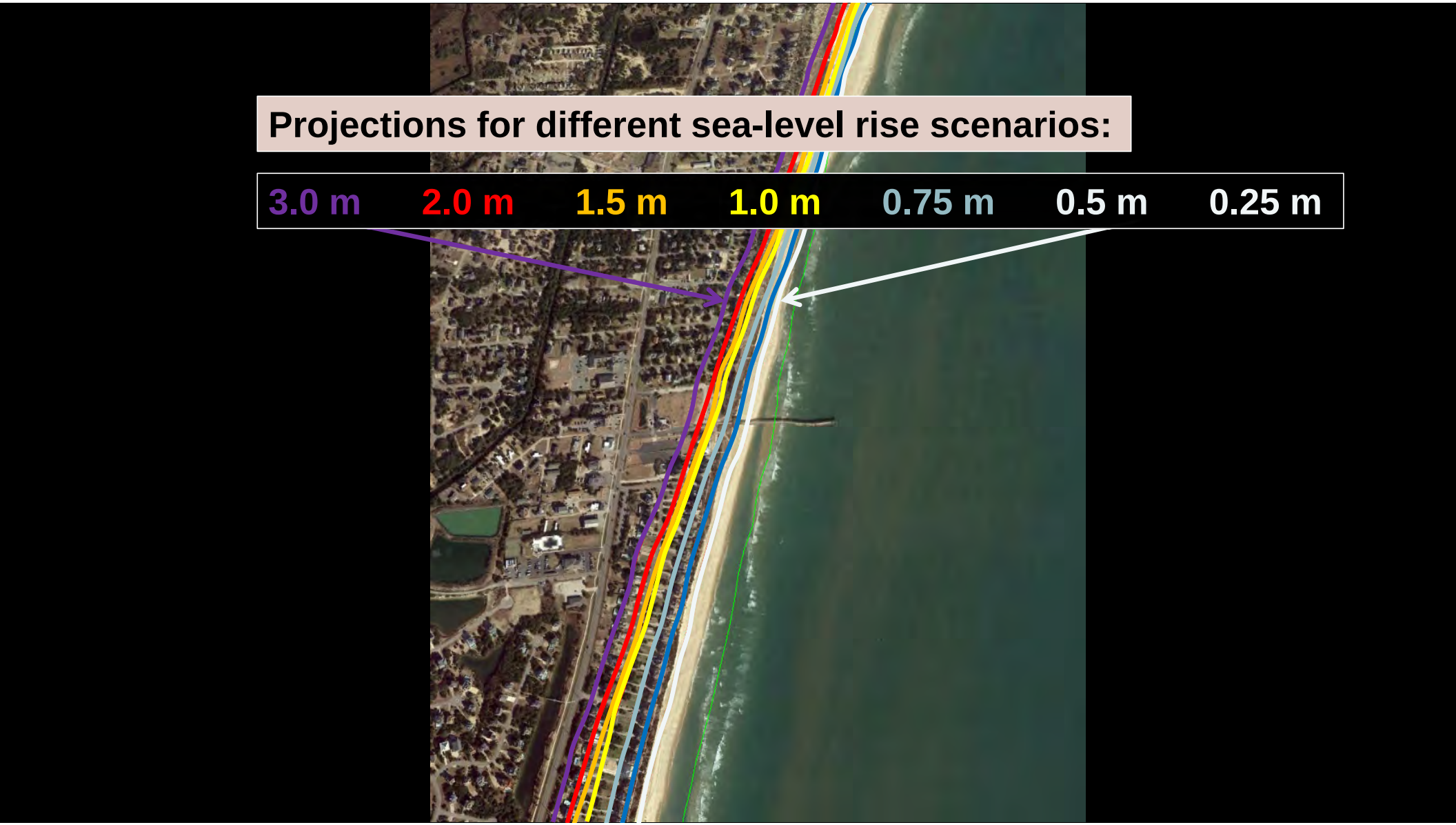

Projections for different sea-level rise scenarios:
3.0 m
2.0 m
1.5 m
1.0 m
0.75 m
0.5 m
0.25 m

Socioeconomic Exposure

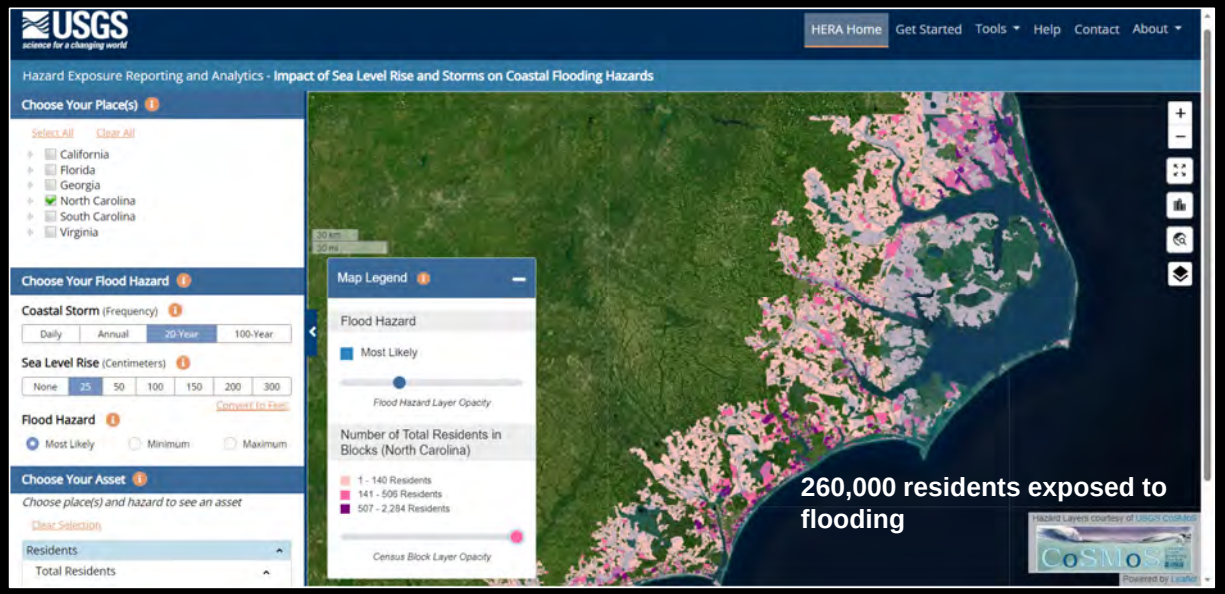
Objective: Determine the assets exposed to coastal flooding, erosion, and rising groundwater for the full suite of sea level rise and storm scenarios.

Approach Highlights

- Exposure mapping based on community boundaries and data from the U.S. Census, Department of Homeland Security, County Assessors Offices, etc.

Products

- Hazard Exposure Reporting and Analytics (HERA) tool



Key Staff: Nate Wood (Western Geographic Science Center)

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www.usgs.gov/apps/hera

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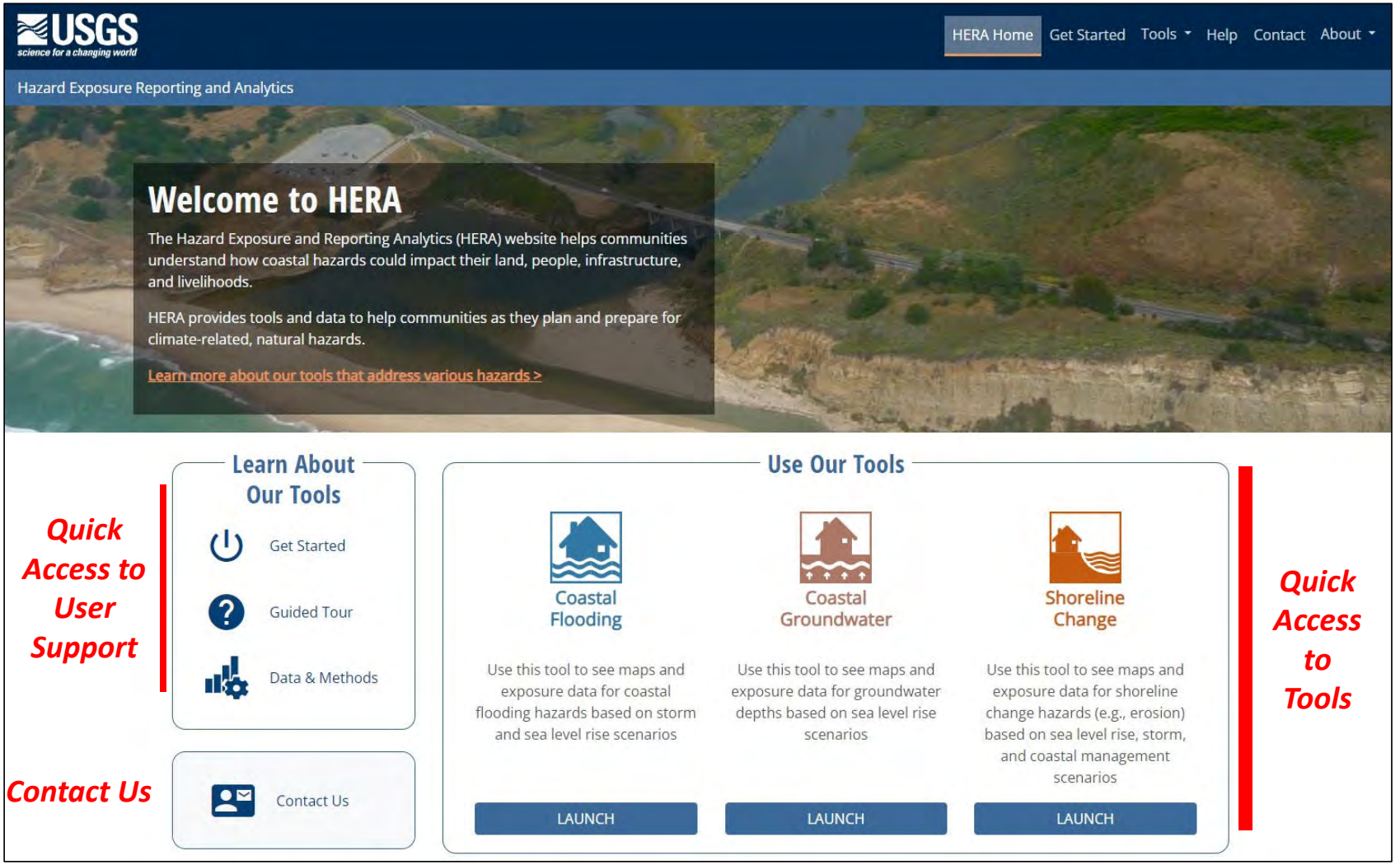
HERA Main Page Overview https://www.usgs.gov/apps/hera/



Supporting content and tool access

Quick Access to User Support

Contact Us

Quick Access to Tools

Overview of Coastal Flooding Tool

https://www.usgs.gov/apps/hera/floodTool.php

Coastal Flooding

Availability:

- California coast and San Francisco Bay except for Del Norte, Humboldt, and Mendocino Counties
- Eastern FL, GA, SC, NA, VA

Storm Scenarios:

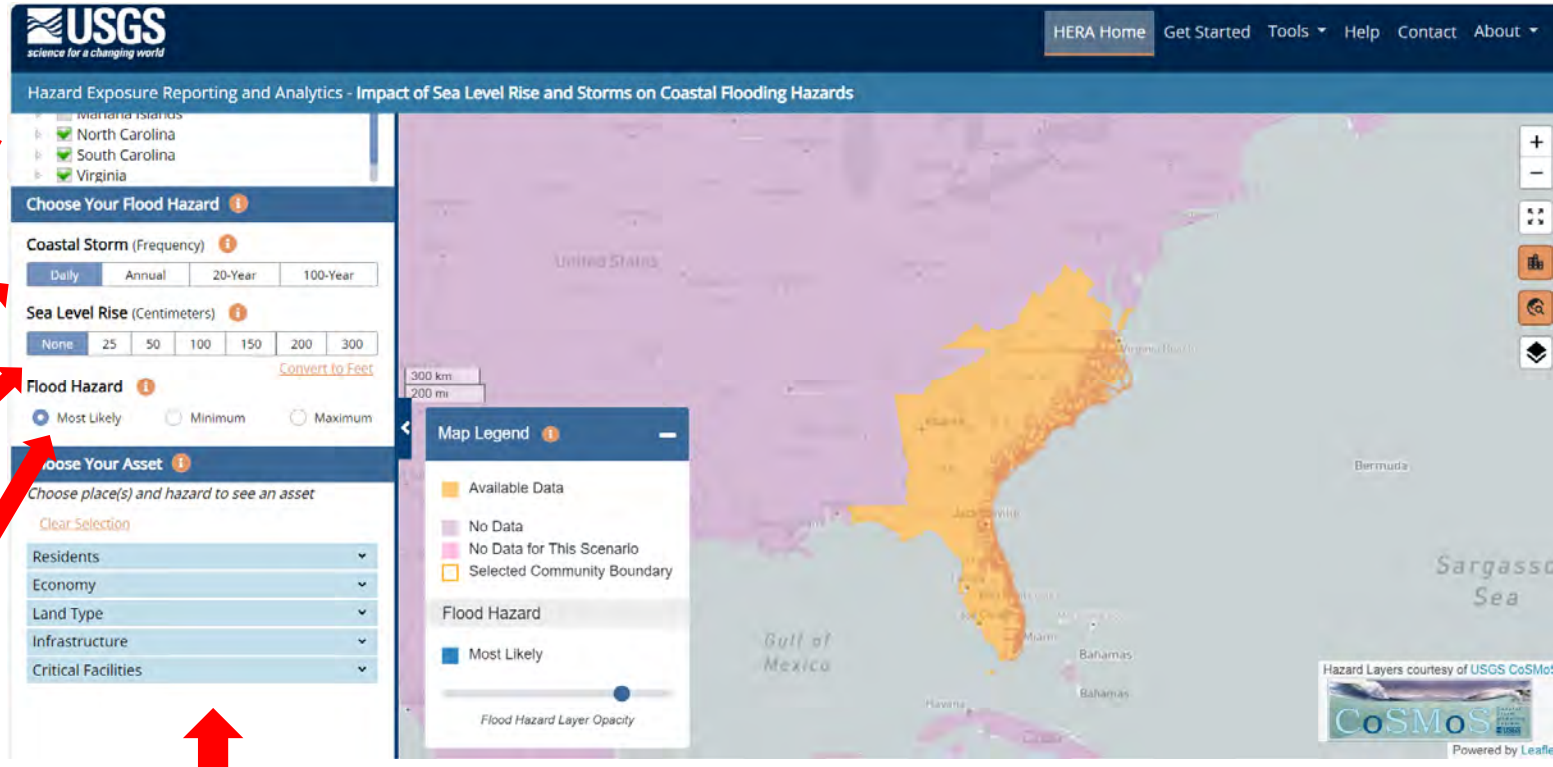
daily, annual, 20-yr, 100-yr

Sea level rise scenarios:

None, 25, 50, 75, 100, 150, 200, 300 (cm)

Hazard zones:

most likely, minimum, maximum



Assets of interest

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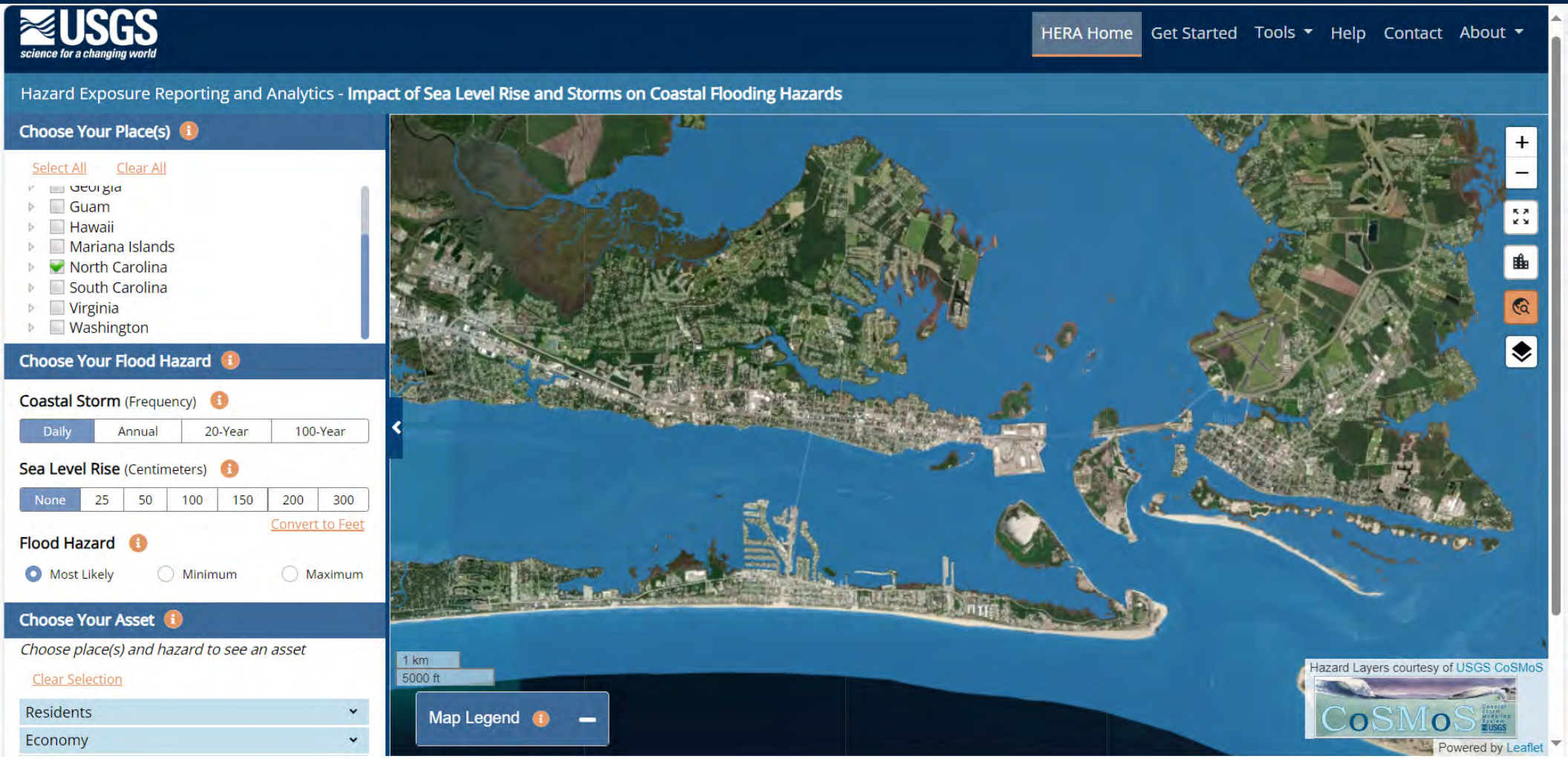
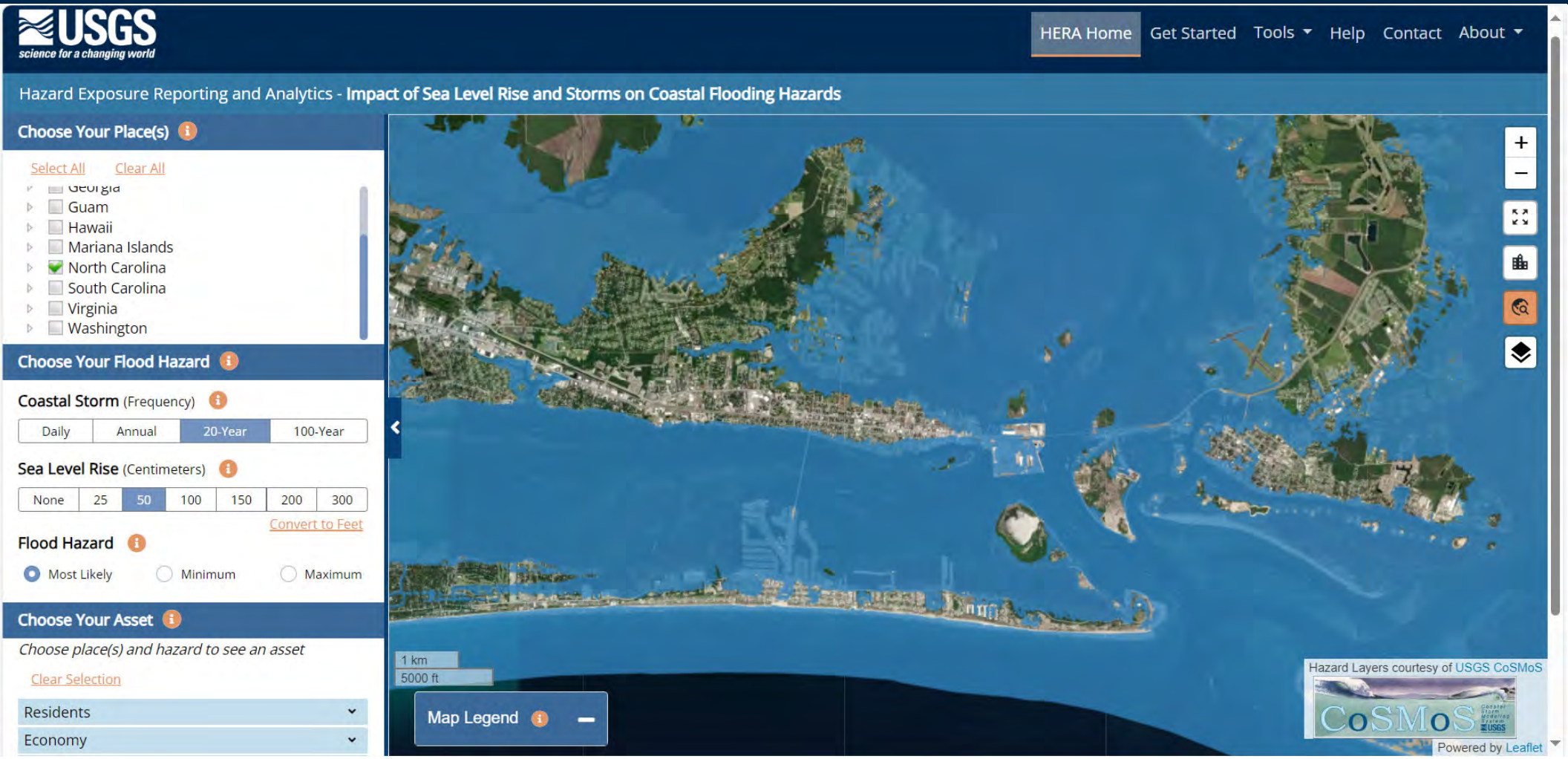
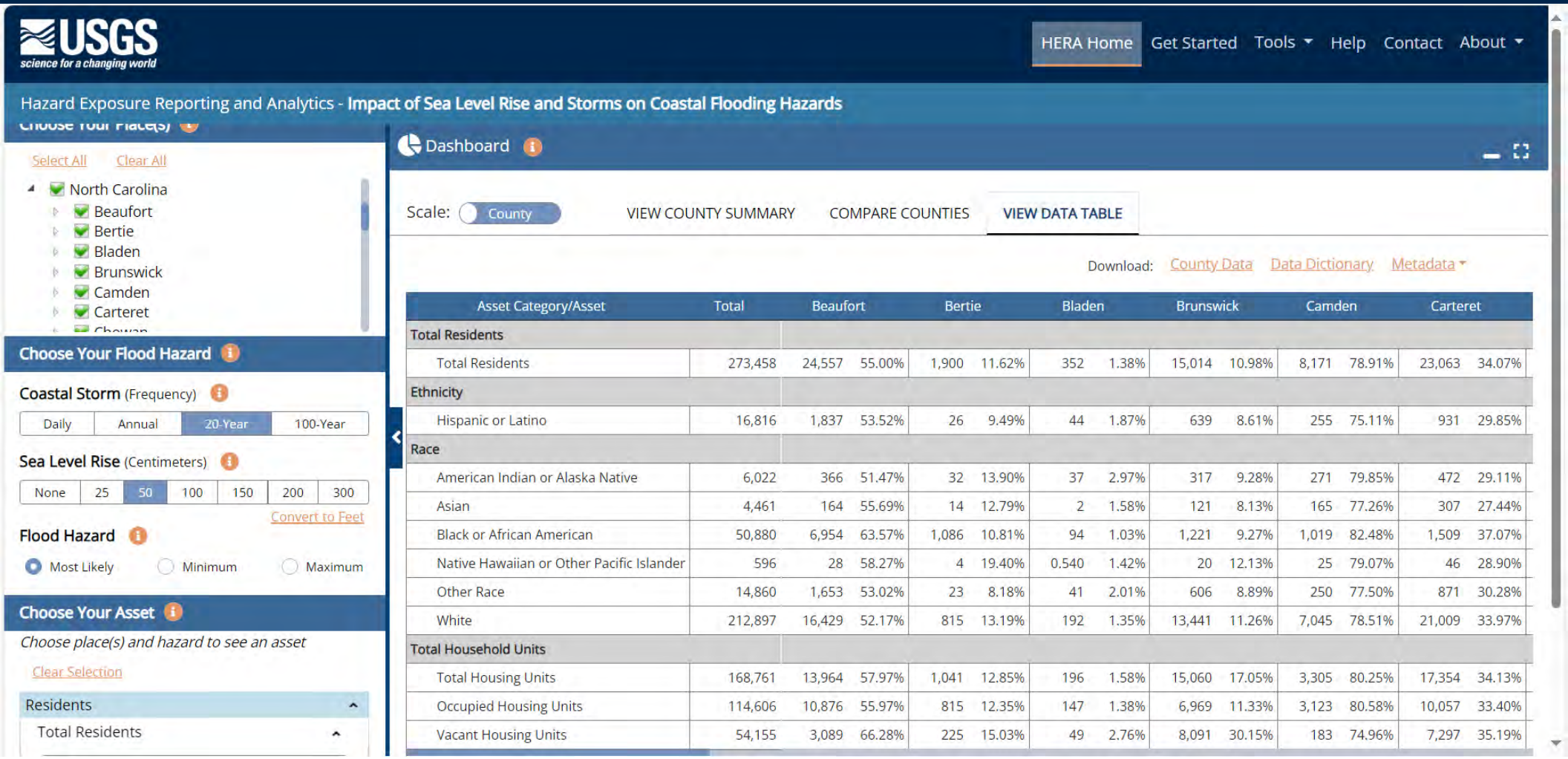
Exposure Dashboard – Flood Viewer



Exposure Dashboard – Flood Viewer



Exposure Dashboard – View Place or County Summary



Asset Category/Asset	Total	Beaufort		Bertie		Bladen		Brunswick		Camden		Carteret	
Total Residents													
Total Residents	273,458	24,557	55.00%	1,900	11.62%	352	1.38%	15,014	10.98%	8,171	78.91%	23,063	34.07%
Ethnicity													
Hispanic or Latino	16,816	1,837	53.52%	26	9.49%	44	1.87%	639	8.61%	255	75.11%	931	29.85%
Race													
American Indian or Alaska Native	6,022	366	51.47%	32	13.90%	37	2.97%	317	9.28%	271	79.85%	472	29.11%
Asian	4,461	164	55.69%	14	12.79%	2	1.58%	121	8.13%	165	77.26%	307	27.44%
Black or African American	50,880	6,954	63.57%	1,086	10.81%	94	1.03%	1,221	9.27%	1,019	82.48%	1,509	37.07%
Native Hawaiian or Other Pacific Islander	596	28	58.27%	4	19.40%	0.540	1.42%	20	12.13%	25	79.07%	46	28.90%
Other Race	14,860	1,653	53.02%	23	8.18%	41	2.01%	606	8.89%	250	77.50%	871	30.28%
White	212,897	16,429	52.17%	815	13.19%	192	1.35%	13,441	11.26%	7,045	78.51%	21,009	33.97%
Total Household Units													
Total Housing Units	168,761	13,964	57.97%	1,041	12.85%	196	1.58%	15,060	17.05%	3,305	80.25%	17,354	34.13%
Occupied Housing Units	114,606	10,876	55.97%	815	12.35%	147	1.38%	6,969	11.33%	3,123	80.58%	10,057	33.40%
Vacant Housing Units	54,155	3,089	66.28%	225	15.03%	49	2.76%	8,091	30.15%	183	74.96%	7,297	35.19%

Key Findings for North Carolina (3 ft of SLR)

- ~70% of the coastal residents could be exposed to shallow and emerging groundwater, ~480,000 coastal residents and $62 billion in property
- Storms increase overland flooding exposure by more than 4 times over daily tidal flooding, directly impacting ~370,000 coastal residents and $68 billion in property
- Up to 80% of beaches could be lost as shorelines migrate landward
- High subsidence rates impact the majority of coastal residents across the region

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Future Work and Resources

- Summary publications
- Work with partners and stakeholders to support regional and local policy and coastal management decision-making (training, technical assistance)
- Incorporate modeling in interdisciplinary studies that include social and economic factors

- USGS data release

Barnard et al., 2023. Future coastal hazards along the U.S. North and South Carolina coasts: U.S. Geological Survey data release: doi.org/10.5066/P9W91314

- Journal publications

Nederhoff et al., Large-scale dynamic modeling of coastal compound flooding due to extratropical storms, hurricanes, and sea level rise: a study for Atlantic Southeastern US coast. *Coastal Engineering*, available on Earth ArXiv: doi.org/10.31223/X56H26

Parker et al., 2023. Relative contributions of water-level components along the US Southeast Atlantic Coast from a regional-scale water-level hindcast. *Natural Hazards*, 30 pp., doi.org/10.1007/s11069-023-05939-6

- Hazard Exposure Reporting and Analytics (HERA) tool: *usgs.gov/apps/hera*

USGS science for a changing world

Contacts: Maya Hayden, *mkhayden@usgs.gov*
Patrick Barnard, *pbarnard@usgs.gov*

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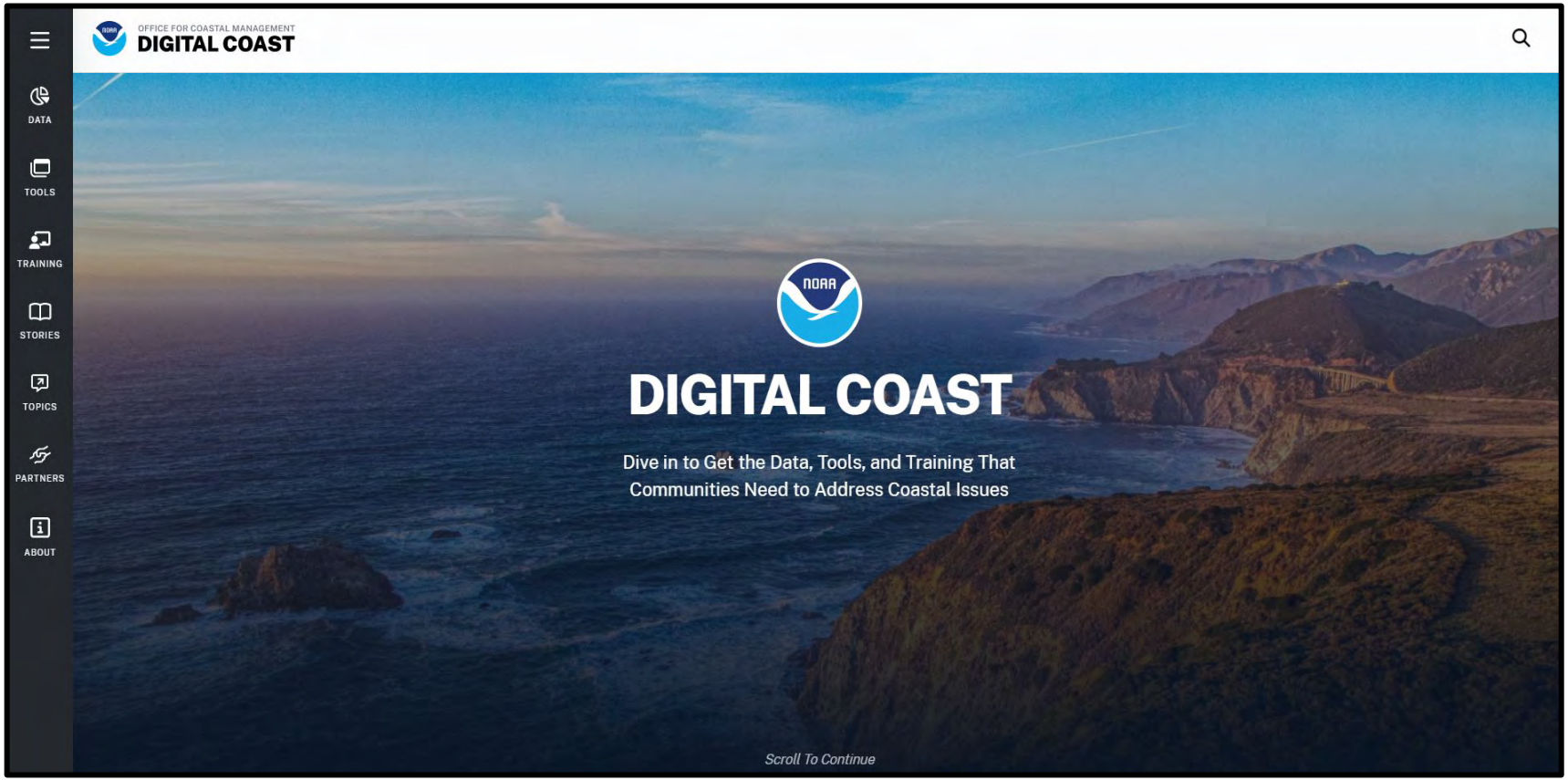
Diving into the Digital Coast - Community Resilience Resources

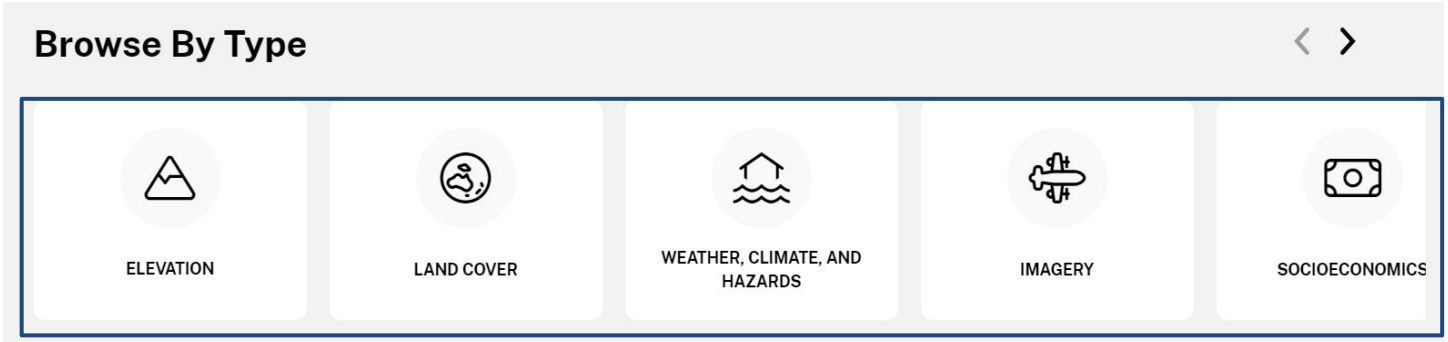
NOAA Office for Coastal Management

Charles Grisafi - Southeast Coastal Management Specialist
Tashya Allen - Southeast and Caribbean Learning Services Coordinator
Matt Pendleton - Southeast and Caribbean Geospatial Coordinator


OFFICE FOR COASTAL MANAGEMENT
DIGITAL COAST
DATA
TOOLS
TRAINING
STORIES
TOPICS
PARTNERS
ABOUT
DIGITAL COAST
Dive in to Get the Data, Tools, and Training That Communities Need to Address Coastal Issues
Scroll To Continue

Digital Coast: Data

- Over 80 terabytes of high-resolution elevation data, land cover data, and orthoimagery
- 350+ web mapping services
- Linkages to over 40 national-level coastal data sets



coast.noaa.gov/digitalcoast/data/home.html

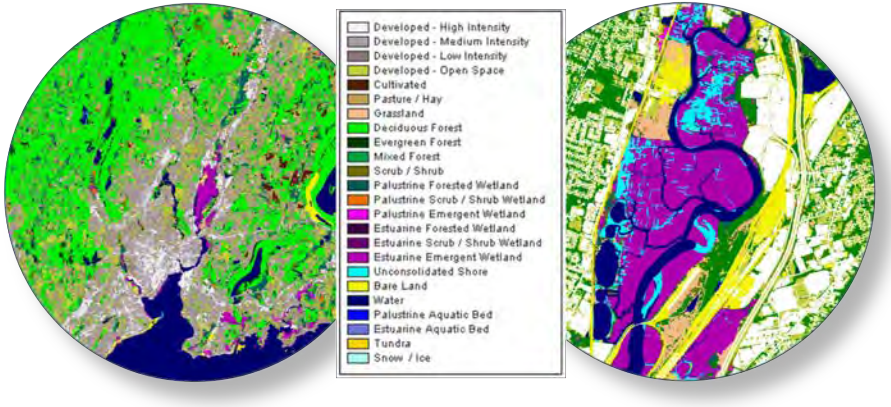
C-CAP High-Resolution Land Cover

Data currently available:

- Impervious surface
- Water
- Canopy

Comparison of Resolutions

REGIONAL (30-METER) LOCAL (1-METER)



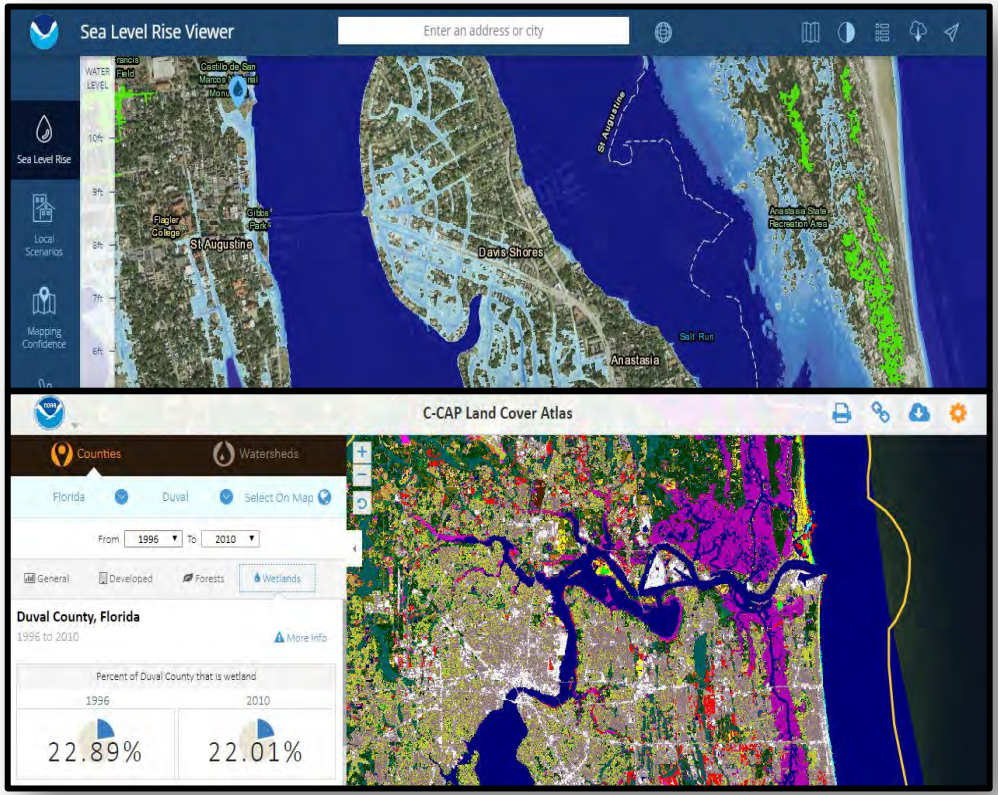
coast.noaa.gov/digitalcoast/data/ccaphighres.html

Phase One Geographies

Digital Coast: Tools

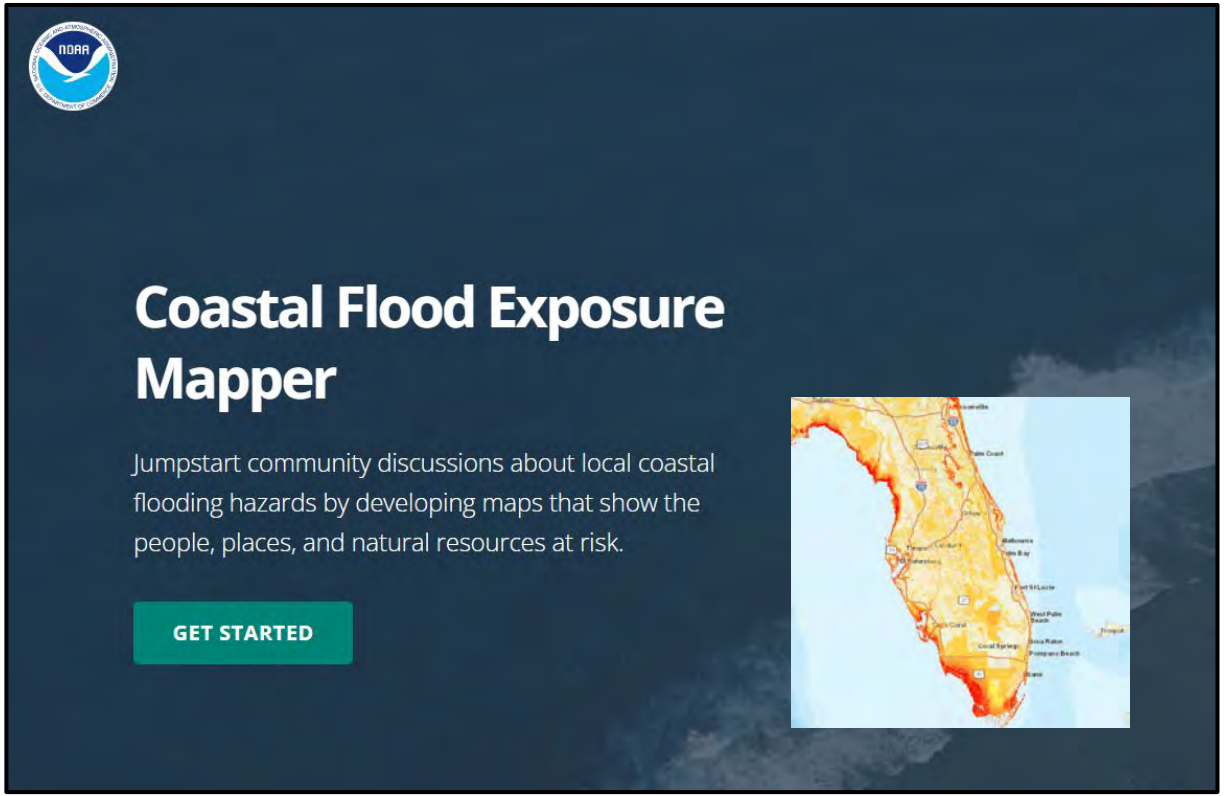
- An inventory of over 50 decision-support and information visualization tools
- Many provide visualization and analysis capabilities without need for GIS software

coast.noaa.gov/digitalcoast/tools/home.html

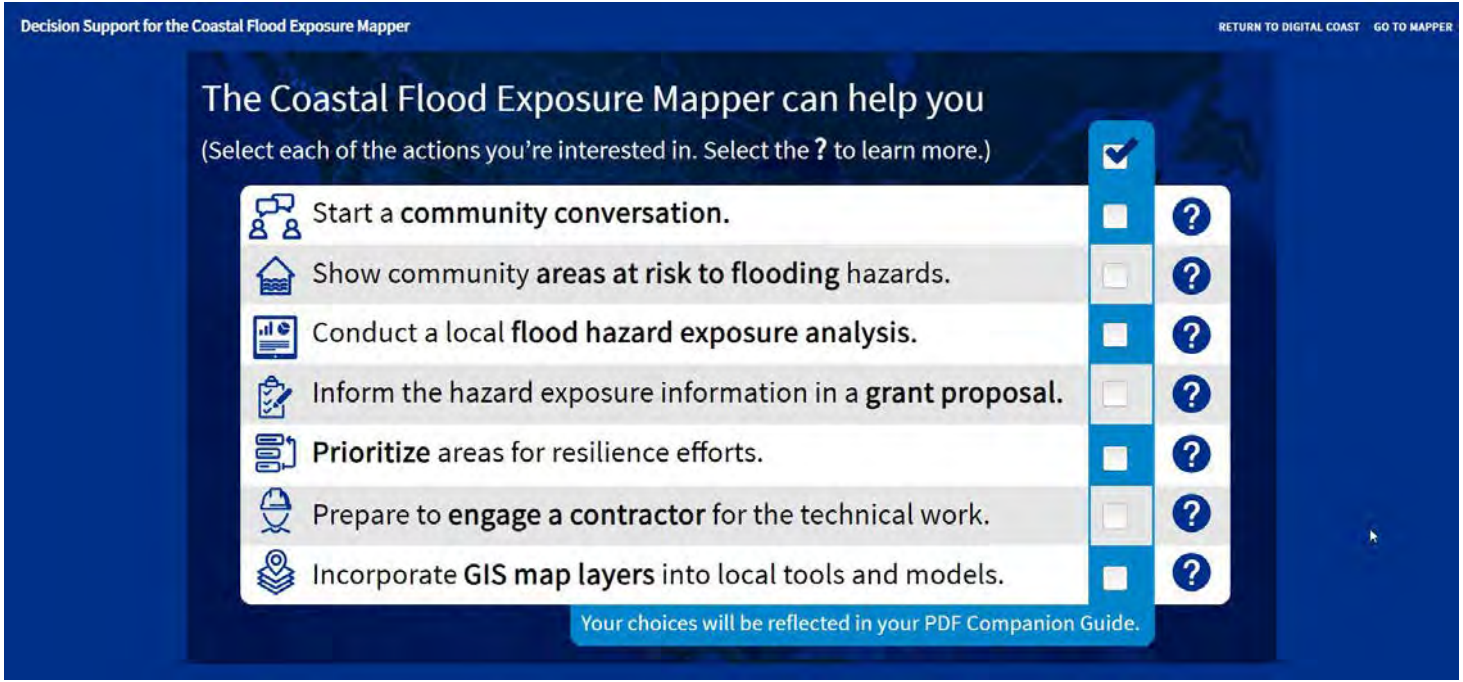


Tools: Coastal Flood Exposure Mapper

- Screening-level
- National data, locally relevant
- Hazards overlay
- Conversation or process starter

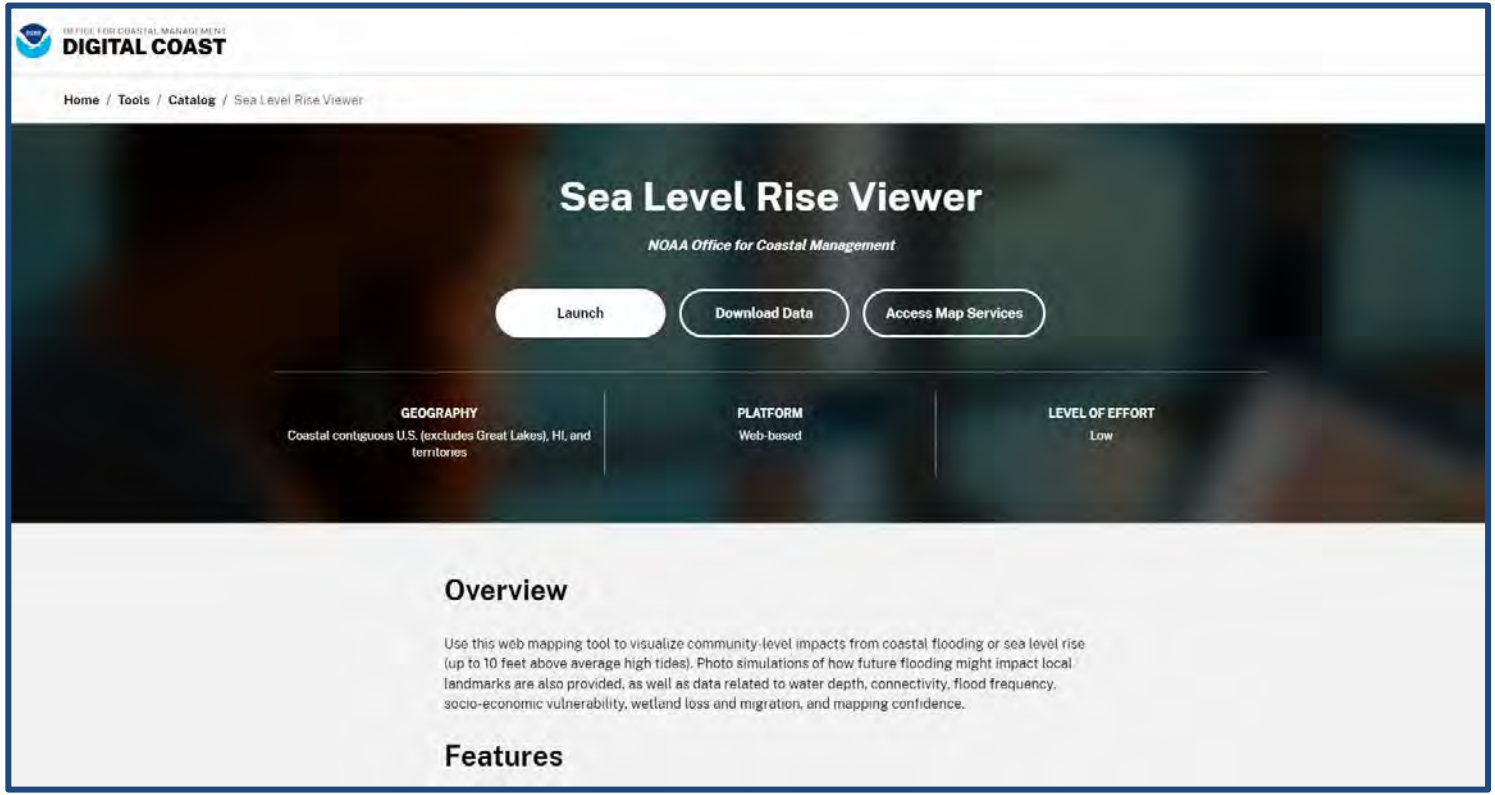


Coastal Flood Exposure Mapper

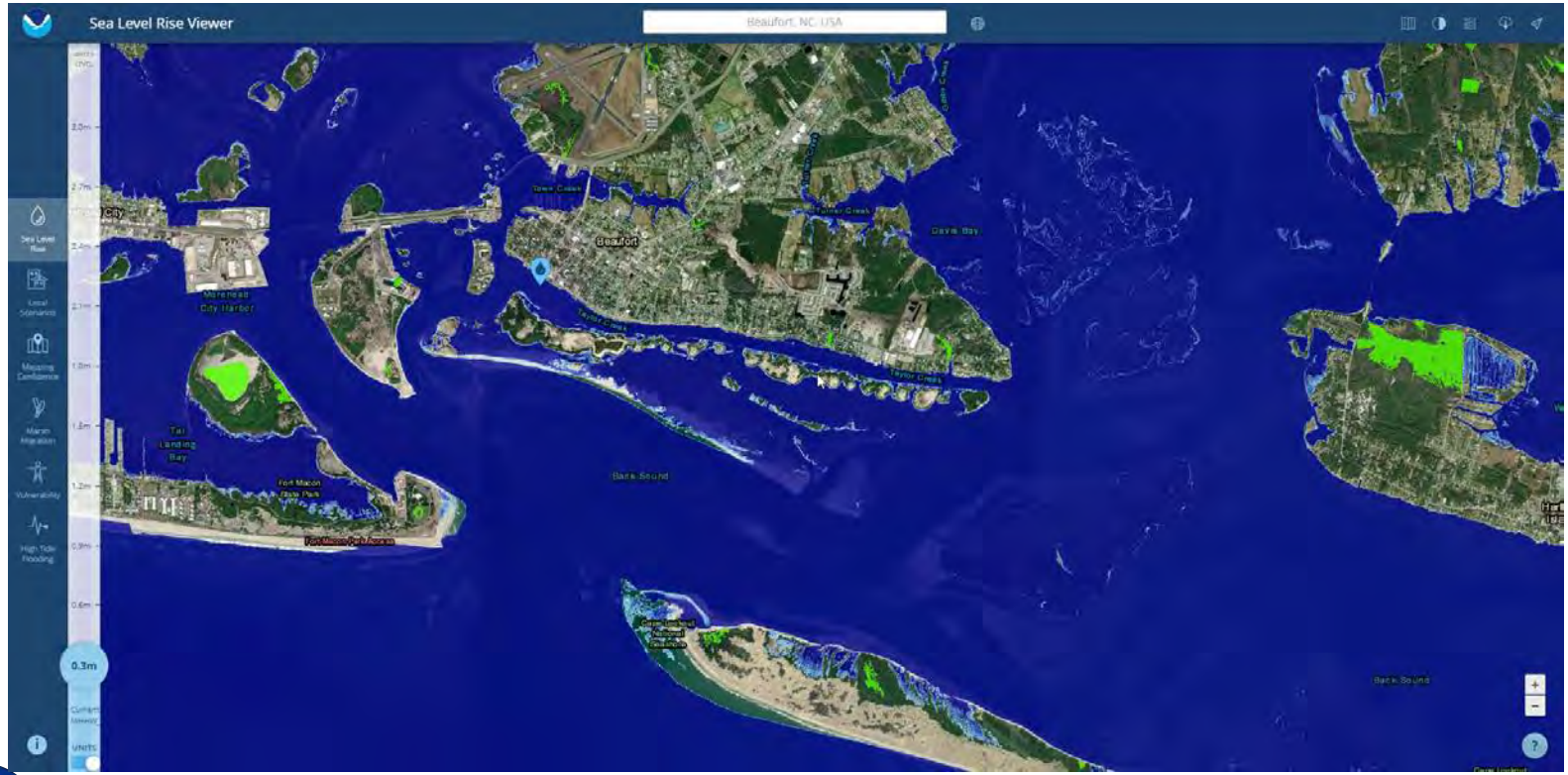


Coastal Flood Exposure Mapper

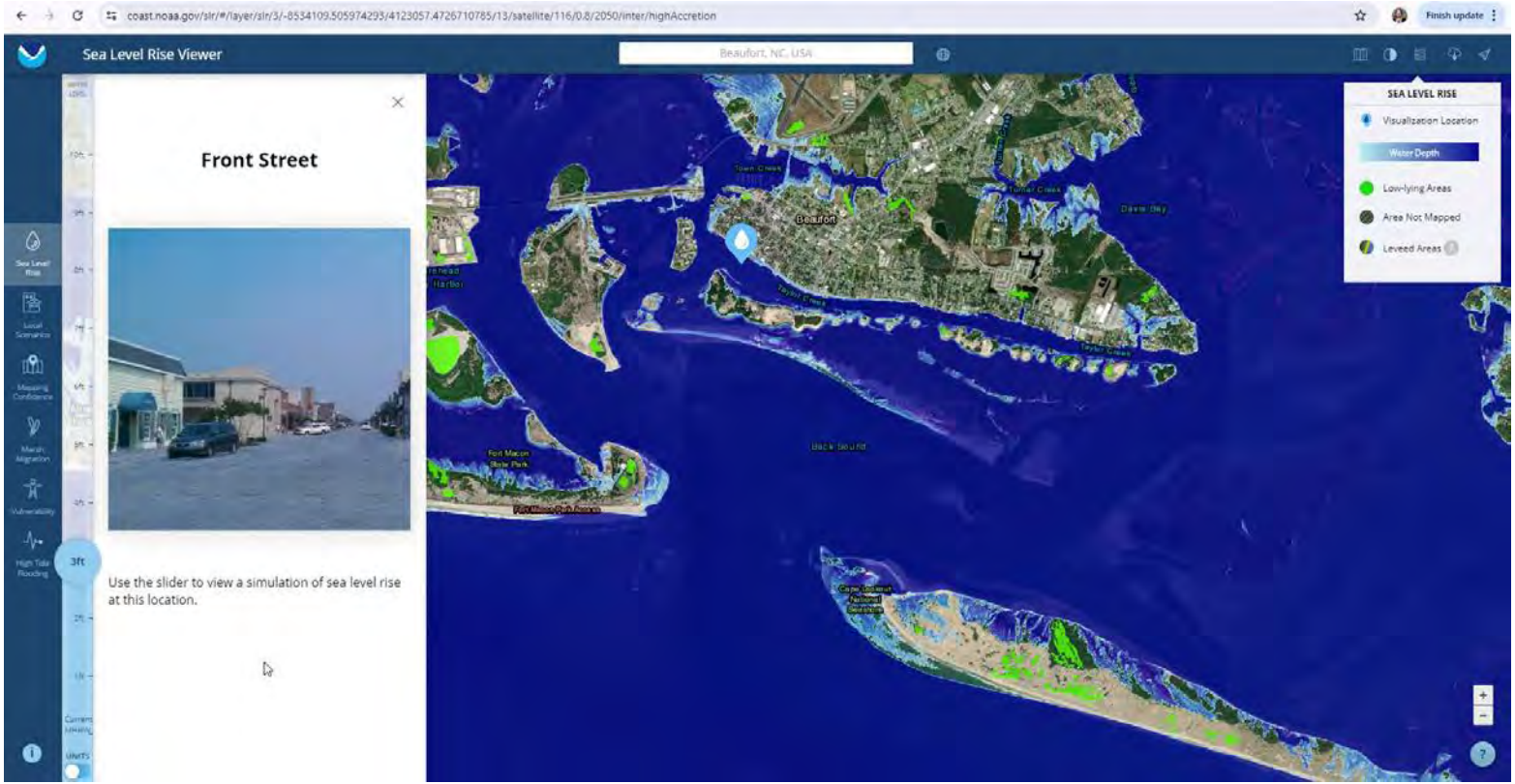
Tools: Sea Level Rise Viewer



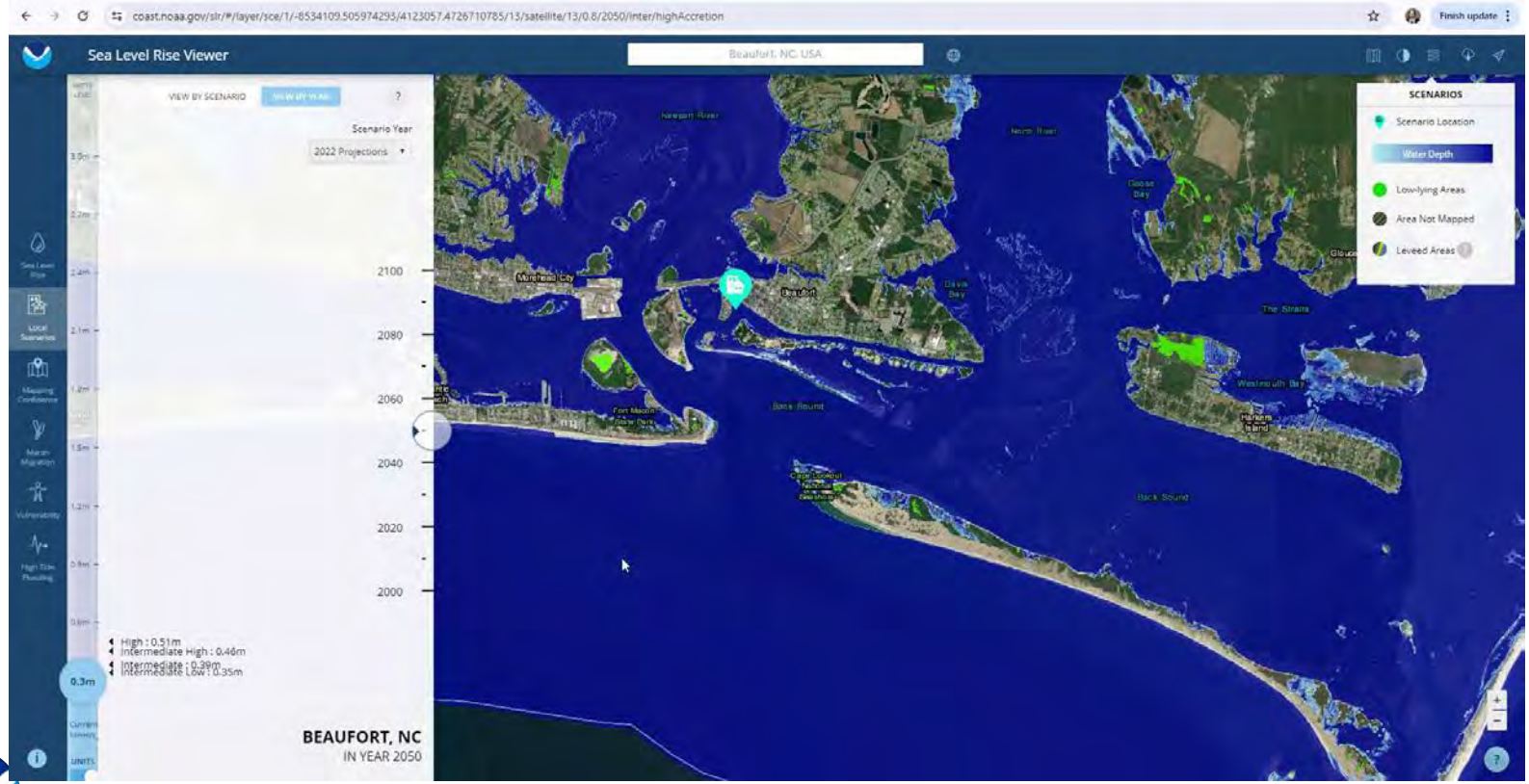
Sea Level Rise Viewer



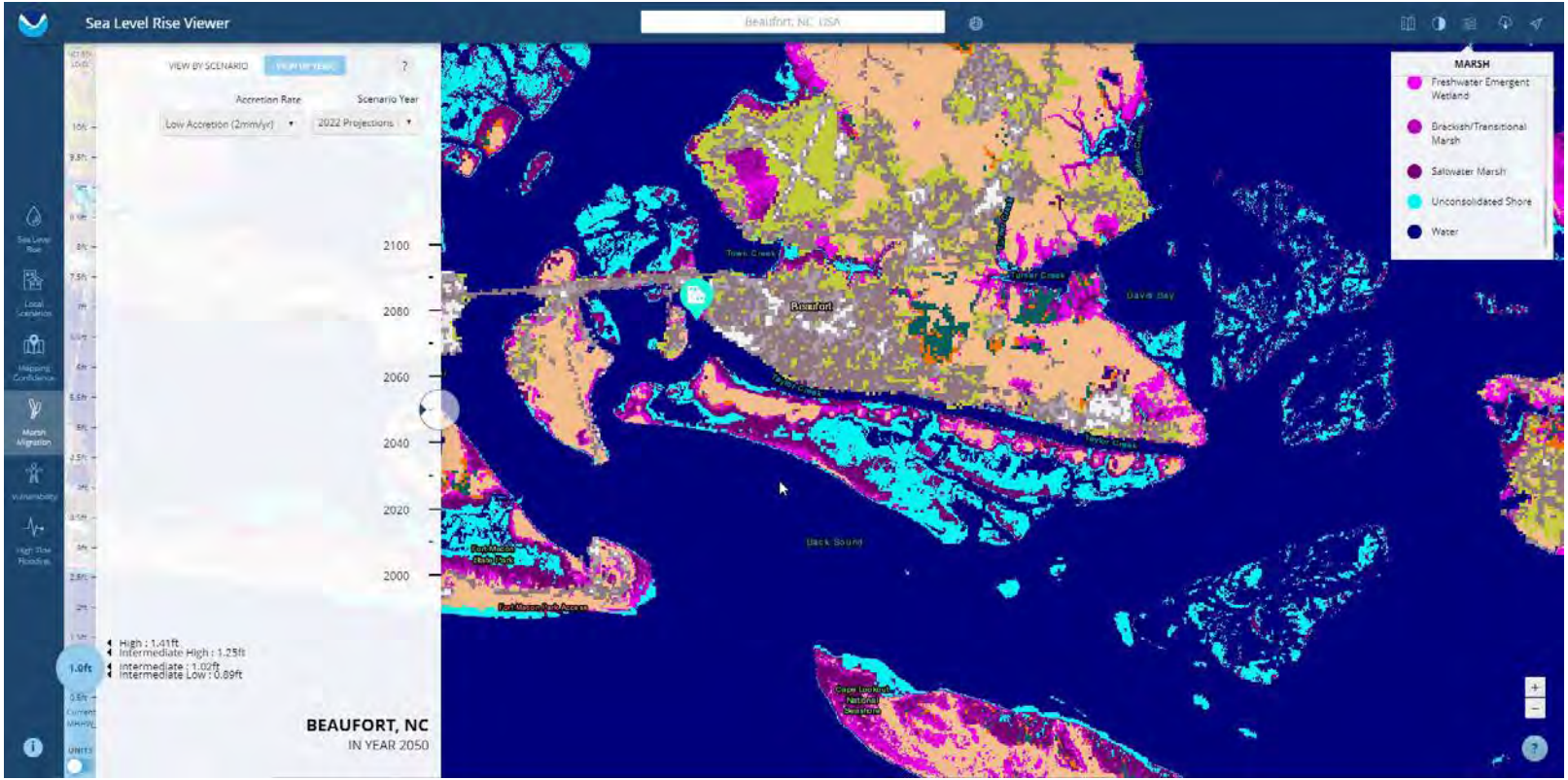
Visualizations



Local SLR Scenarios



Marsh Migration

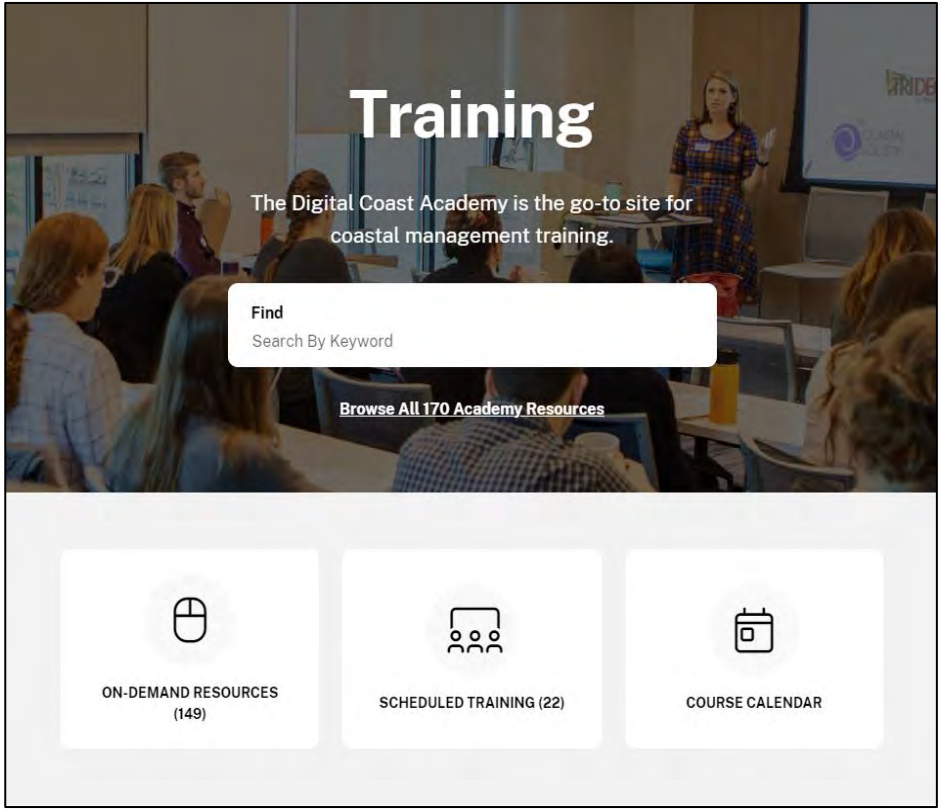


Digital Coast: Training

Classroom and online instructor-led

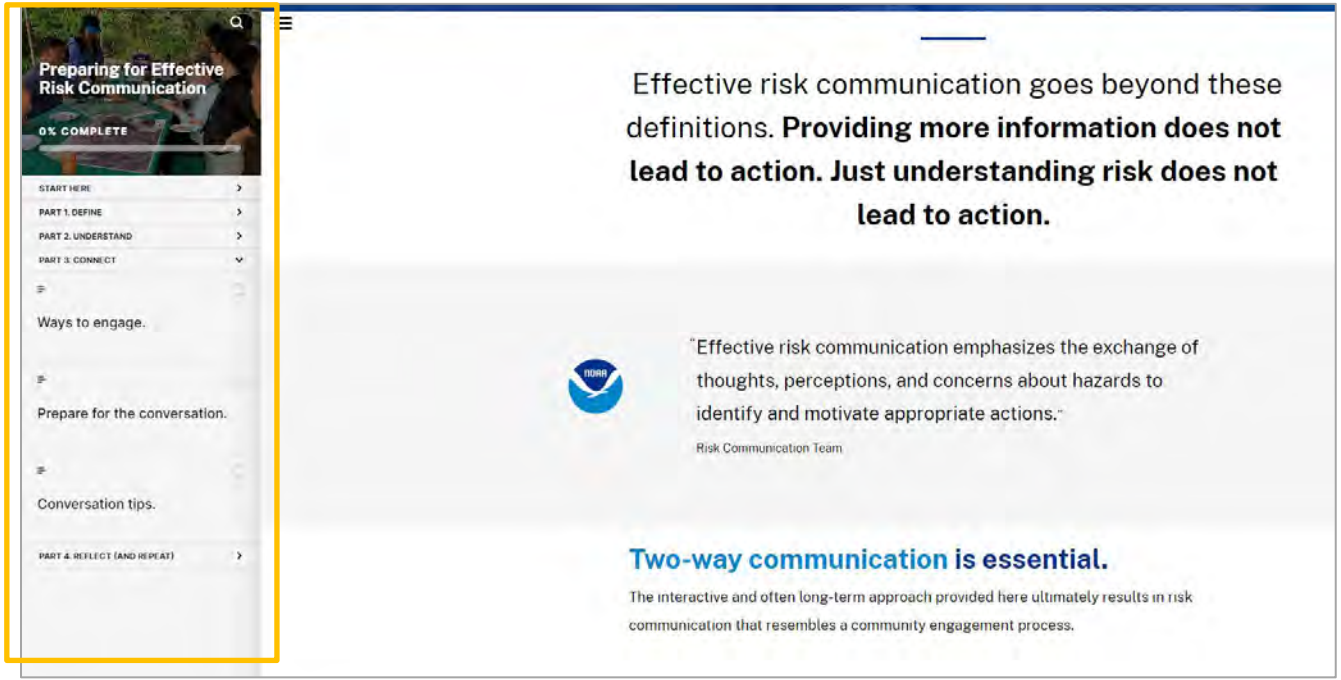
On-demand products

- Self-guided
- Case studies
- Publications
- Quick references
- Videos
- Webinars



Training

Preparing for Effective Risk Communication



Trainings

Risk Communication

Seven Best Practices for Risk Communication - 90 minute webinar

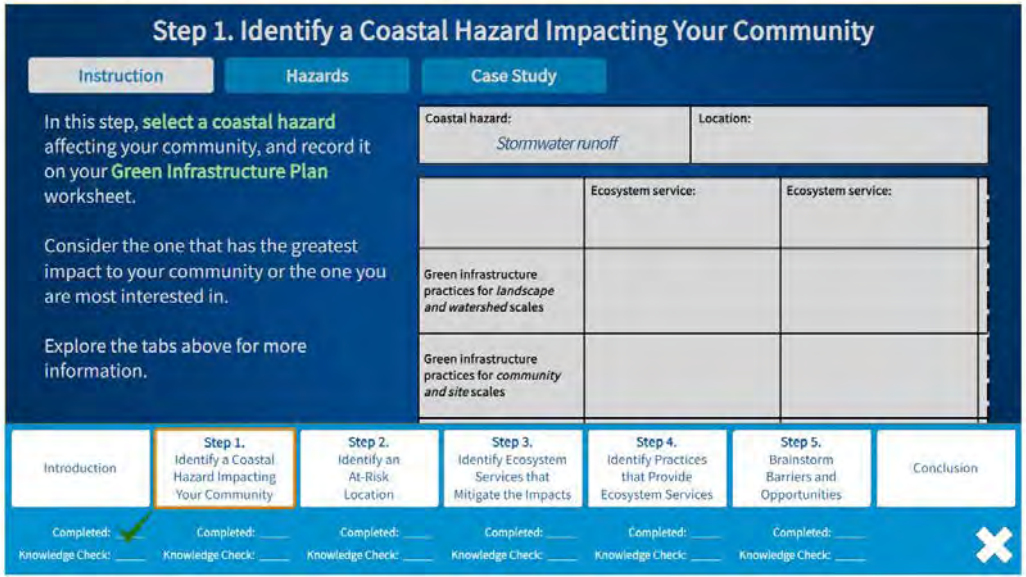
Building Risk Communication Skills - 1 day in person

coast.noaa.gov/digitalcoast/topics/risk-communication.html

Disponible en Español

Self Guided Resource

Nature-Based Solutions: The Basics



coast.noaa.gov/digitalcoast/training/nbs-basics.html

Training

Nature-Based Solutions for Coastal Hazards

- Develop a nature-based solutions strategy
- Hear from local experts using nature-based solutions

coast.noaa.gov/digitalcoast/training/green.html

Webinar Series

Funding and Financing Coastal Resilience

coast.noaa.gov/digitalcoast/training/funding-webinars.html

Green Infrastructure Effectiveness Database

Summary provides:

- Key findings
- Measures of hazard mitigation effectiveness
- Measures of co-benefits (*if applicable*)

coast.noaa.gov/digitalcoast/training/gi-database.html

Case Studies

Learn how the North Carolina Division of Coastal Management is helping communities build their resilience to coastal flood hazards through an incentive-based program that provides planning and funding for nature-based projects.

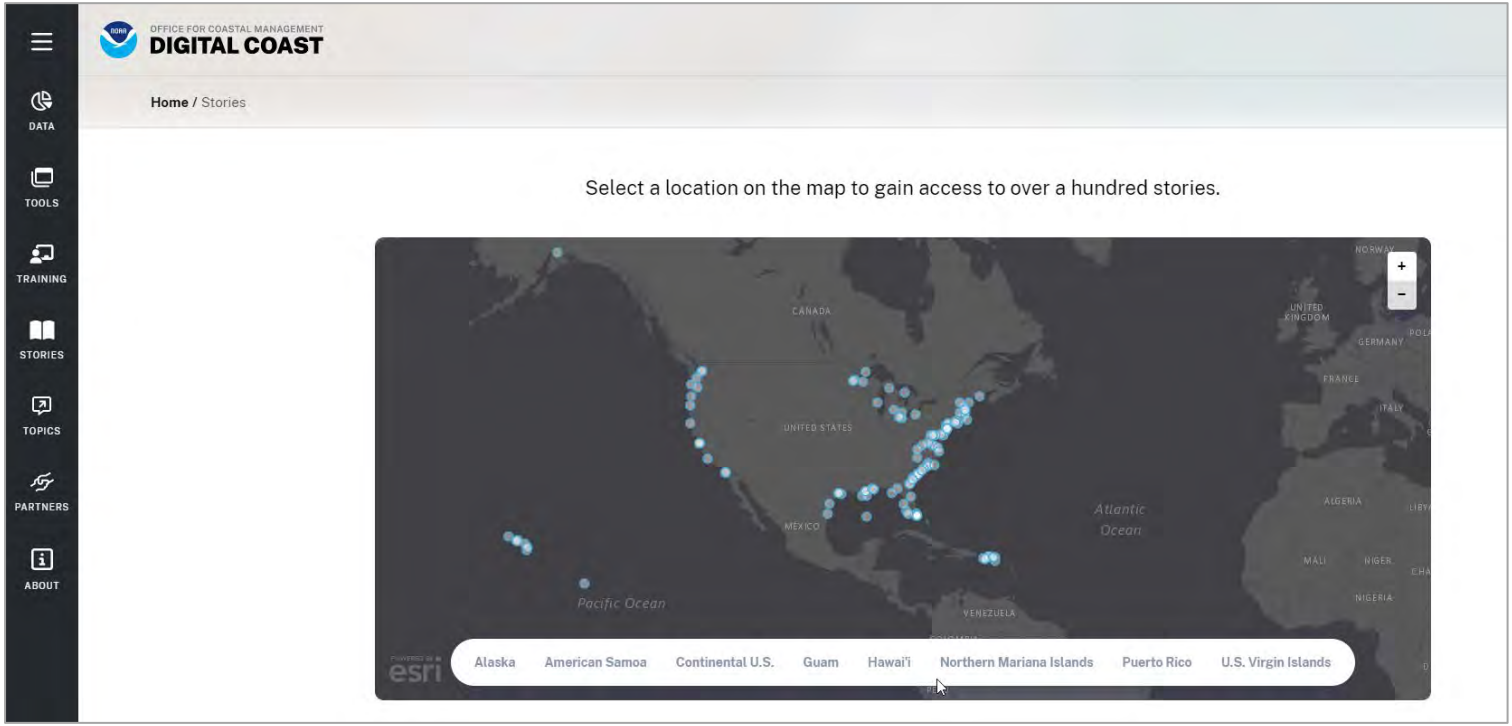
> "Having a resilience strategy helps to provide clarity of purpose, attract funding, and provide a more direct path to implementation."

Mackenzie Todd

Coastal Resilience Specialist
North Carolina Division of Coastal Management

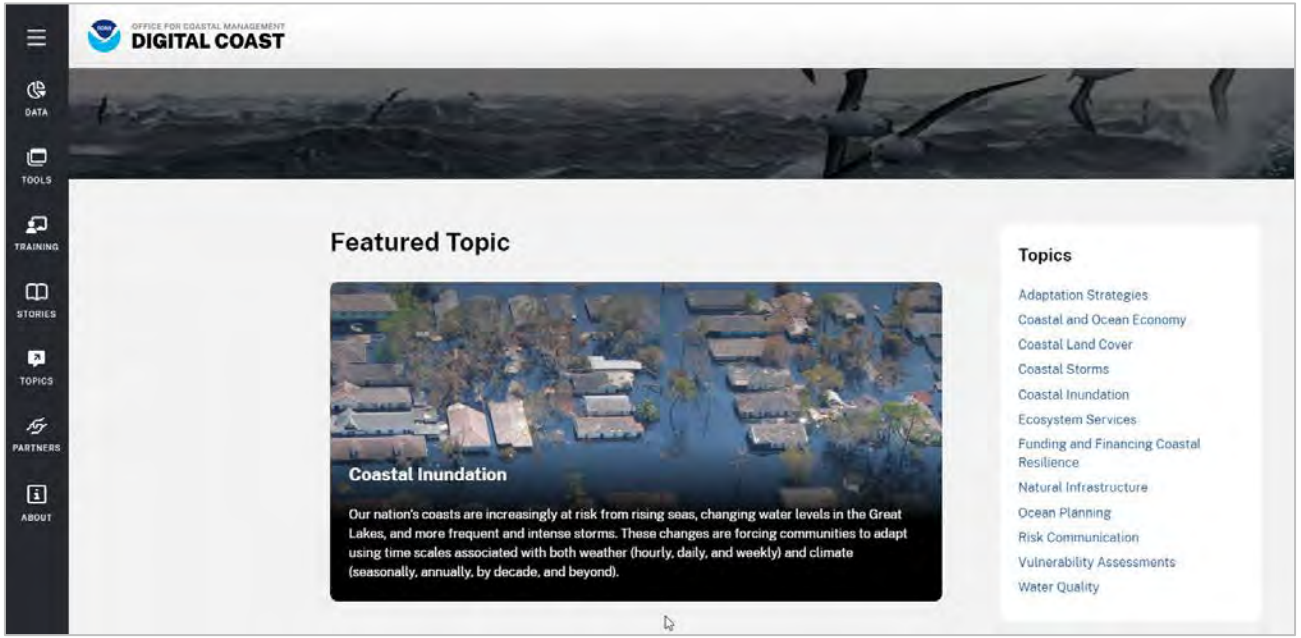
coast.noaa.gov/digitalcoast/training/shovel-ready.html

Learn how others are using the Digital Coast



coast.noaa.gov/digitalcoast/stories/home.html

Explore curated list of resources in the Topics section



coast.noaa.gov/digitalcoast/topics/

Thank You!
Please reach out

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Digital Coast *coast.noaa.gov/digitalcoast/*