North Carolina Coastal Resilience Community of Practice Meeting
Tuesday, December 14, 2021 – 1:00pm - 3:00pm
Via Webex

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

Agenda
Welcome & Introductions. Attendees:

- Sam Burdick, Town of Beaufort, Town Planner
- Cayla Cothron, NC Sea Grant, Climate Resilience Specialist
- Lora Eddy, NC Chapter The Nature Conservancy Albemarle-Pamlico Sounds Office, Community Resilience Specialist
- Stacey Feken, Albemarle Pamlico National Estuary Partnership, Policy & Engagement Manager
- Eryn Futral, NC Floodplain Management Program, Eastern Branch Planner for NFIP
- Joe Heard, Town of Duck
- Whitney Jenkins, Coastal Reserve & DCM
- Rachel Love-Adrick, DCM District Planner
- Brooke Massa, WRC Habitat Conservation Division, Conservation Biologist
- Tancred Miller, DCM
- Amanda Ohlensehlen, City of New Bern, Community and Economic Development Manager
- Charlan Owens, DCM District Planner
- Gloria Putnam, NC Sea Grant
- Grace Roskar, NC Coastal Reserve & DCM, Natural Resources Resilience Specialist
- Sarah Spiegler, NC Sea Grant, Coastal Resilience Specialist
- Mackenzie Todd, DCM
- Holly White, Town of Nags Head
- Lisa Williams, Mideast Commission, Disaster Recovery Coordinator

Guests:

- Jane Harrison, Coastal Economics Specialist, NC Sea Grant
- Charlie Humphries, ECU
- Patrick Barnard, USGS, Coastal Hazards Program, Research Geologist
- Steve Bevington, NCDCR Land & Water Stewardship Program
- Karl Dudman, PhD student, UK / University of Oxford/coastal resilience NC State Climate office host during field work
- Kirsten Ullman, Watershed Planner, NCDEQ Division of Mitigation Service

1:15pm **Climate Change and Onsite Wastewater Treatment Systems in the Coastal Carolinas – Jane Harrison, NC Sea Grant**

Wastewater Infrastructure Tipping Points: Climate adaptation for onsite systems in the Coastal Carolinas

https://ncseagrant.ncsu.edu/program-areas/sustainable-communities/climate-change-and-onsite-wastewater-treatment-systems-in-the-coastal-carolinas/

- Interdisciplinary long term research project funded by NOAA SARP / COCA program

- Better understand climate adaptation options for wastewater infrastructure, septic systems, onsite, number of options can be used when centralized treatment not available
  interdisciplinary group:
- Focus efforts: Town of Nags Head and City of Folly Beach
- Climate adaption is an ongoing quest for the coastal Carolinas, includes NC & SC, inland communities, coastal plain, and barrier islands
- Specifically interested in onsite WW treatment: septic systems: out of sight, out of mind?
    - Drainfield, soil layers, treat waste, eventually comes out and goes into streams and lakes, well water, etc.
    - Almost half of residents in the Carolinas rely on onsite systems in both states, may never think about whether or not functioning
- Challenges: storm surge, sea level rise, heavy rainfall = failing septic systems and untreated waste
- Melissa Smith UNCW scientific illustrator drew diagram / groundwater level, surface water level rising SLR, soil layer critically important for processing contaminants, create smaller level of separation, smaller area for soil to treat contaminants
- Lauren Vorhees NC Sea Grant conduct interviews with septic installers and operations, learn how climate and weather influence their onsite systems installation, selection, and functions
- Coastal plain, piedmont, interview ~ 20 septic installers and health regulators that permit the systems, local and state, SC done on state level so not as many local
- Regulators do not consider weather and climate in system selection and permitting. What factors are considered? Vertical separation distance, soil morphology, lot size and number of bedrooms, drainage rates, horizontal setbacks to water, topography of the lot, strength of wastewater (how much is coming out of a residential structure)
- Evaluate sites with a snapshot, one visit, no seasonality,
- Are aware climate change could impact how sites are, rising seawater and hurricanes, can impact soil conditions, the depth of the GW table, and mean high water mark, but future conditions not in rule book to consider
- Current regulation for drain field depth do not provide a buffer for rising GW tables
- Inspections of conventional systems are rare. Usually problem if a bad smell, issues onsite, obvious problem, someone complains
- Communication with property owners about septic systems is limed and inconsistent
- Once system permitted no direct communication from septic installer/ not seeking information unless a problem
- Installers, heavy rain, wet soils, king tides can cause a system to malfunction
- Asked installers about diff scenarios: Ask about dry conditions + heavy rain, wet soils + heavy rain, wet soils + king tide, etc.
- Site variable determine functionality drainage, soil type, elevation and groundwater height determine septic system functionality in heavy rainfall, graph of diff variable
- Adaption by septic installers is happening by some, private installers. Asked if taking any adaptation measures into consideration, over half said yes:
    - Raising septic tanks and drain fields / raise height vertical separation distance
    - More conservative installation measurements, increase tank capacity,
    - Recommend advanced systems: pretreatment drip irrigation, modified e.g. hamper system, pressure systems, etc.
    - Easy solution disruptive weather events let system dry out avoid use for a few days or pump system
    - Advance systems may have benefits but cost prohibitive/ cost b/w $25K-30K, conventional less than $10K
- Charlie: another study question: how do onsite WW systems compare to package treatment plants and municipal sewer with respect to nutrient and bacteria treatment

- Monitoring locations: Nags head, Wanchese, Cove City, Vanceboro, New Bern, Greenville, NC, Folly Beach, SC
- System monitoring: wells installed near drain field trenches for groundwater collection/characterization, 8 systems (5 new, 3 existing)/install monitoring wells between drain field trenches/ analyze nitrogen, phosphorus, E. coli, physical and chemical parameters
- Package plant/centralized sewer monitoring collect influent and effluent samples, same parameters as on site: pH, DO, temperature, nitrogen, phosphorus, E. coli
- Onsite system nitrogen treatment
- Septic N treatment: See high variability in nitrogen removal in septic systems / look at WW and GW /average concentrations 46% lower in GW than WW in septic tank,
- Package plant and municipal sewer plant nitrogen treatment: 0.5 MGD cut off for package vs. municipal sewer
- MWS: 73-86% TDN treatment / vs WW TDN/37%reduction in average in nitrogen concentrations, effective
- Also evaluate phosphorus treatment, at most part systems effective in removing phosphorus, average 76% / ones with GW in trenches less effective than those with good separation
- Package plant and municipal sewer plant phosphate treatment: huge range, WW influent 4-6 P
- Average 74% phosphorus reductions for municipal sewer vs. PTP less
- Bacteria treatment / no treatment beyond dilution and dispersion, all technologies effective at reducing bacteria / UV chlorination
- Preliminary findings summary:
    - Municipal sewer most efficient for N treatment
    - Onsite system most efficient for P treatment
    - All system effective at E. coli treatment
    - Separation distance to GW very important for onsite system function
    - Efficiency reduced as GW gets closer to trench bottoms
- ?? depth? Maintain 1-2 ft separation distance, anything less get worse over time especially in coastal areas / less than 3 feet
- Partners: Nags head has septic health initiative/ looking at ways to support residents/may have examples to help other communities as gather results
- https://www.nagsheadnc.gov/280/Septic-Health-Initiative-Water-Quality

Future coastal hazard assessment in the SE due to SLR and storms – Patrick Barnard, USGS (see PPT below)

- Large effort by USGS across entire SE / Norfolk down to Miami/ try address nationwide in consistent way/ been done in CA, umbrella of coastal storm modeling system/ worked with SACS USACE, VA Tech, Univ Arkansas GW program, coastal and marine hazard program USGS
- Why SE Atlantic? 14 million residents in coastal counties / includes some of most vulnerable communities in the country including Norfolk, Wilmington, Charleston, Savannah, and Miami
    - **See pic of slide Hurricane impacts annual threat / also SLR
- The latest science: past six years warmest on record, not matter which agency data you look at
    - Global surface temperature had increased faster since 1970 than in any other 50 yr period over the last 2000 years
    - Rate of SLR has tripled since 1971
    - Any investment will pay off down road!
- Seeing impacts today: Florence, Matthew, Dorian, more impacts in future, higher probability of increased flooding, flood levels of Ocracoke {pic of Sara showing water levels from various storms}

- Adaptation and resilience / rebuilding in communities like Ocracoke and other/ adapt to present and future, elevating structure, not just private home, infrastructure: ferry terminals, ecosystem vulnerability, other impacts
- No freeboard, seeing flooding today just in high tide events / downtown Beaufort
- Future coastal hazards: overview:
    - Assess coastal hazards associated with SLR and storms for the 21st central from VA beach to Miami, looked at diff SLR scenarios, key products 1 m topo-bathy DEM, flooding extent, depth *see slide*
    - Integrated topo bathymetric digital elevation model (TBDEM): objective development of high resolution integrates d1 meter topobathy *see slide*
    - Vertical land motion: determine rate along southeast coastline at management relevant resolution
    - Overland flood hazards assessment of flood risk over entire coastal zone looking at future conditions
    - Beaufort: annual storm flooding/ potential flood risk SLR scenarios 2 m upper end projection (not likely) 3m far end of probability distribution but may take 100-200 years think strategically how protect communities for risk that will occur eventually
    - GW hazards/ what are critical depths, this why asking Jane/Charlie/ Objective: quantify water table elevation response to SLR
    - 1 m SLR scenario water table at the surface, today right at surface not a lot of freeboard for water table today/not just overland flood flooding coming up from below
    - Coastal Change: predict future coastal change based on the SLR scenarios and total water level projections CoSMoS-COAST; look at projected wave conditions, utilize Landsat satellite records, coastal erosion hazards, integrate SLR, cross shore long shore transport / example from Avon been in news lately for beach renourishment
    - Socioeconomic exposure: determine assets exposed to coastal flooding, erosion and GW shoaling for the full suite of SLR and storm scenarios: exposure mapping based on community boundaries and data from us census, dept of homeland security, county assessor's office, been way to communicate value of acting / pilots in CA shown helpful
    - Serving up results: USGS data releases, USGS coastal change hazards portal, HERA: hazard exposure reporting and analytics tool
    - How has approach been used? Built out on west coast for a decade: {see slide for more}
        - Dozens of cities & counties use to update local coastal programs for hazard mitigation and climate adaptation
        - Caltrans transport vulnerability
        - Legislature use to justify $4 billion investment in climate adaption
        - Integrate into state climate change guidance
        - Willing to chat more, want to be useful and meaningful if opportunities to influence planning and policy
    - Future: support community resilience and environmental justice / product delivery March 2022/virtual reality video for Ocracoke / NPS in 2022/ tons of links for more information
    - Please reach out anytime: pbarnard@usgs.gov and happy to provide further briefings to your agency or stakeholders if useful
    - Capitola Virtual Reality Video:
        - Video with voice over in 360 (when viewed on phone or tablet):
            - YouTube: https://youtu.be/WY_uGQivUd8
            - Vimeo: https://vimeo.com/434811381
        - Video without voice over:
            - Standard: https://vimeo.com/435199239/e24f61c94b
            - 360: https://vimeo.com/435199262/5a2987b645

    - Eryn: had community ask about using my coast tool / how utilize citizen observations? Patrick said anecdotally rely on citizen science, also use in models, reason why went to Ocracoke, observations of

water levels what folks seeing on the ground, if not pass sniff test what see in backyard no trust in moving forward

- Elizabeth: asked about virtual reality video purpose? Patrick said to raise awareness impacts of climate change, poster child like Ocracoke, work with NPS on broader education piece on climate risk and flooding, try immerse people in science get sense of what future actually looks like / did pilot work in CA effective to get people to understand / vs. just looking at a map / also working on companion in Miami, innovative outreach techniques communicate in effective way

Break

NC Sea Grant Climate Resilience Advisory Group Discussion – Cayla Cothron

Climate resilience extension program development presentation

- New position in NC Sea grant/utilize this group in an advisory capacity/explore ideas and opportunities for collaboration
- FL: BS env studies FSU, MURP Colorado Denver, worked as community planner western US as private sector consultant and local government: Logan Simpson, associate long range planner City of ?
- Role at NC Sea Grant / transition legacy sentinel sites work into extension
- Risk communication project focused on improving practices to engage historically underserved and underrepresented communities
- Develop and expand programming into climate resilience (focus today)
- Guiding principles at NC Sea grant align with mission and priorities
    - Cover broader spectrum of current & future anticipated impacts of climate change
    - Prioritize holistic resilience for all
    - *see slides*
- Current Activities:
    - research and information gathering
    - Informal interviews, engaging, building network
    - Participating in state resilient communities program and RISE RCPP and NCOR
- Issues from needs assessment s to date:
    - short and long term climate impacts and non-climate stressors
    - Proactive vs. reactive disaster recovery and resilience
    - Sustaining long-term momentum toward resilience
    - Limited capacity and resources at the local level

<u>Opportunity Areas:</u>

- Data & Resources:
    - Improve understanding of what's available and how to choose the appropriate and most useful information
    - Increase accessibility and application at the community scale
    - Incorporate future conditions for long term planning
- Building long term resilience
    - Facilitate an integrated approach to resilience
    - Improve local and regional coordination
    - Support community planning efforts that provide a framework for proactive disaster recovery (ex: coordinated community efforts for floodplain buyouts)
- Implementation
    - Connect tools and strategies to needs for different scales, risks, and conditions
    - Inform frameworks to aid in implementation / Build in metrics in monitoring / quantitative and qualitative to evaluate success
    - Identify opportunities for future research

    - Infrastructure / update design standards
- Education and outreach
    - Strengthen equity in outreach and community engagement
    - Facilitate translation of climate information tailored to the local context: meet people where they are, what care about in communities'/land use, housing, economic viability jobs, infrastructure
    - Improve community capacity to strengthen and sustain participation and engagement: equip community members with information they need to understand and participate, best practices/ where gaps and barriers are, bring people to table that haven't been invited
- Target audiences
    - Local/county governments
    - Regional governments / COGs
    - Planning and engineering consultants
    - Community stakeholders: property owners, tenants, local organizations, (informal)
    - Nonprofit and community based organizations (formal
    - Others?
- Contact: Thanks for your time, everyone! Please feel to reach out anytime, and always happy to talk more: Cayla Cothron, Climate Resilience Extension Associate at NC Sea Grant, cayla_cothron@ncsu.edu, 386-690-1116 (best number to reach me in times of COVID).

- Discussion?
    - Joe Heard: recommend property owners, not just homeowners, but NGOs/state/federal government/ TNC etc. large landowners
    - Tancred: end users: being a presence, being in communities, being a trusted partner, impartial, non-political, invest time and resources critical/ folks are trying to understand what vulnerabilities, just one more anxiety producing thing/relationships becoming more and more important/ help move conversation forward
    - Sarah: folks asking how Sarah and Cayla roles similar and different/ background different: import out there and trusted source of information, Sara only one person, critical to have someone that knew communities and current communities to go with Patrick USGS / encourage reach out to both
    - Cayla happy to talk more
    - Whitney: plan to have standing agenda item give Cayla feedback

2:40pm Round robin – members share what they are working on related to resilience

- Whitney: NOAA Nature based workshop in January/ Holly & talk about estuarine shoreline management & Swansboro sign up soon, 11 spaces left:
  Nature-Based Solutions for Coastal Hazards 101 - Virtual: https://deq.nc.gov/about/divisions/coastal-management/nc-coastal-reserve/coastal-training-program/scheduled-workshops#nature-based-solutions-for-coastal-hazards-101---virtual

- Jacob {not at meeting/update via Whitney}: CHPP unanimously approved by all 3 commissions/lead resilience clearinghouse steering committee/ coordinate parallel efforts decrease redundancies / app to USCA for 1-year position to help with tech assistance and coordination

- Amanda: {missed update?}

- Brook: starting doing Green Growth Toolbox (GGT) webinars/ 1 hour webinars every few weeks/ AICP and landscape architect credits. Sign up here if you're interested: https://www.ncwildlife.org/Conserving/Programs/Green-Growth-Toolbox/Training-Workshops

- Cat: Currituck Sound Coalition released marsh conservation plan for Currituck sound culmination of 1.5 yrs. of meetings Link to plan; NWF grant received
    - NFWF and NOAA National Coastal Resilience Fund grant for marsh restoration in Currituck Sound: https://nc.audubon.org/press-release/national-grant-will-fund-audubon%E2%80%99s-marsh-restoration-project-currituck-sound
    - Currituck Sound Coalition Marsh Conservation Plan (link to plan in article): https://www.wunc.org/environment/2021-12-13/plan-save-currituck-sound-marshes-protection-climate-change-outer-banks

- Elizabeth: 1-year survey Ocracoke impacts of Dorian/ household/ Dare, Hyde Carteret county mainland/ flesh out economic exposure from social science perspective

- Eryn: potential changes to NFIP program encourage folks to consider making statement / how NFIP better promote and minimize impacts to endangered species, / link:
  FEMA Extends Comment Period and Schedules Additional Public Meeting About Minimum Floodplain Management Standards: https://www.regulations.gov/document/FEMA-2021-0024-0001

- Gloria: civic engagement could use in smaller communities Cayla questions: focus areas / community participating/ how drive momentum how gather peers/ participate in public meetings/navigate government, etc. could be improved on the ground / understand planning and decision making

- Grace: continue habitat resilience plan for Rachel Carson reserve/ narrow on the ground interventions reaching out to partners/

- Joe: look forward get projects on the ground, next year budget/living shoreline north of Duck village funded through BRIC and NFWS, Dare county tourist board, other sources as well. Also look at shoreline stabilization project town hall town park property / on the ground "in the water" observe along public boardwalk

- Karl: research: based out of the State Climate Office in Raleigh / project includes a coastal focus, looking how different stakeholders, residents, people working in resilience collaborate on resilience when climate change not easy discussion to have / Craven and ? county / email in chat happy to chat more kedudman@ncsu.ed

- Lisa: Mideast five counties, work all 5 counties currently end of what rest of us doing, communities already being affected by flooding/ elevation projects, acquisition / relocation, take proceeds from acquisition re-invest in affordable housing out of flood risk / 22 duplex rental units torn down, where are they going to go / help owner reinvest / affordable housing /heavily involved in mitigation work

- Lora: comments to NFIP call for info and comments on minimum floodplain standards as well as endangered species act / The Federal Emergency Management Agency (FEMA) recently published a Request for Information (RFI) as they seek to update the National Flood Insurance Program (NFIP)'s Minimum Floodplain Management Standards.
  https://www.federalregister.gov/documents/2021/10/12/2021-22152/request-for-information-on-the-national-flood-insurance-programs-floodplain-management-standards-for

    - TNC moving along on partnership with USFWS at Great Dismal Swamp hydrologic restoration / idea to ditch and drain swamp / water control structures / alleviate downstream peak flows Pasquotank River / good project for nature and downstream communities

- Recent budget 1.5 M CCAP / SWCD /remind all of us small flood projects great program provide state funds, bioretention, Stormwater wetlands/ $75% of cost match http://www.ncagr.gov/SWC/costshareprograms/CCAP/BMPs.html

- Mackenzie: $540 NFWF national coastal /more recently identified through state budget continue expand program RCPP / RFP for phase 3 of programs / prioritize projects that communities identify in phase 2

- Sam: work wrap up CAMA combined land use plan comp land plan with resilience elements in it / include resilience strategy include in RCPP as appendix to CAMA LU plan, amendment / supporting document / keep working through RCPP getting started on risk and vulnerability assessment/ first public meeting next month on 27th, send out invite/

- Sarah: no updates, work closely with Mackenzie and Tancred on RCPP community action team meetings / NCORR programs stakeholder teams putting together now RISE

- Steve Bevington: as mentioned in beginning, NCDCR Land & Water Stewardship Program received funding for next two years to develop a program to help people capture water and precent flooding / all of eastern NC; may be of interest to this group, not sure if looking for 1-2 huge projects or few smaller projects, up to board, will meet mid-January to begin process. contact him to discuss more: steve.bevington@ncdcr.gov

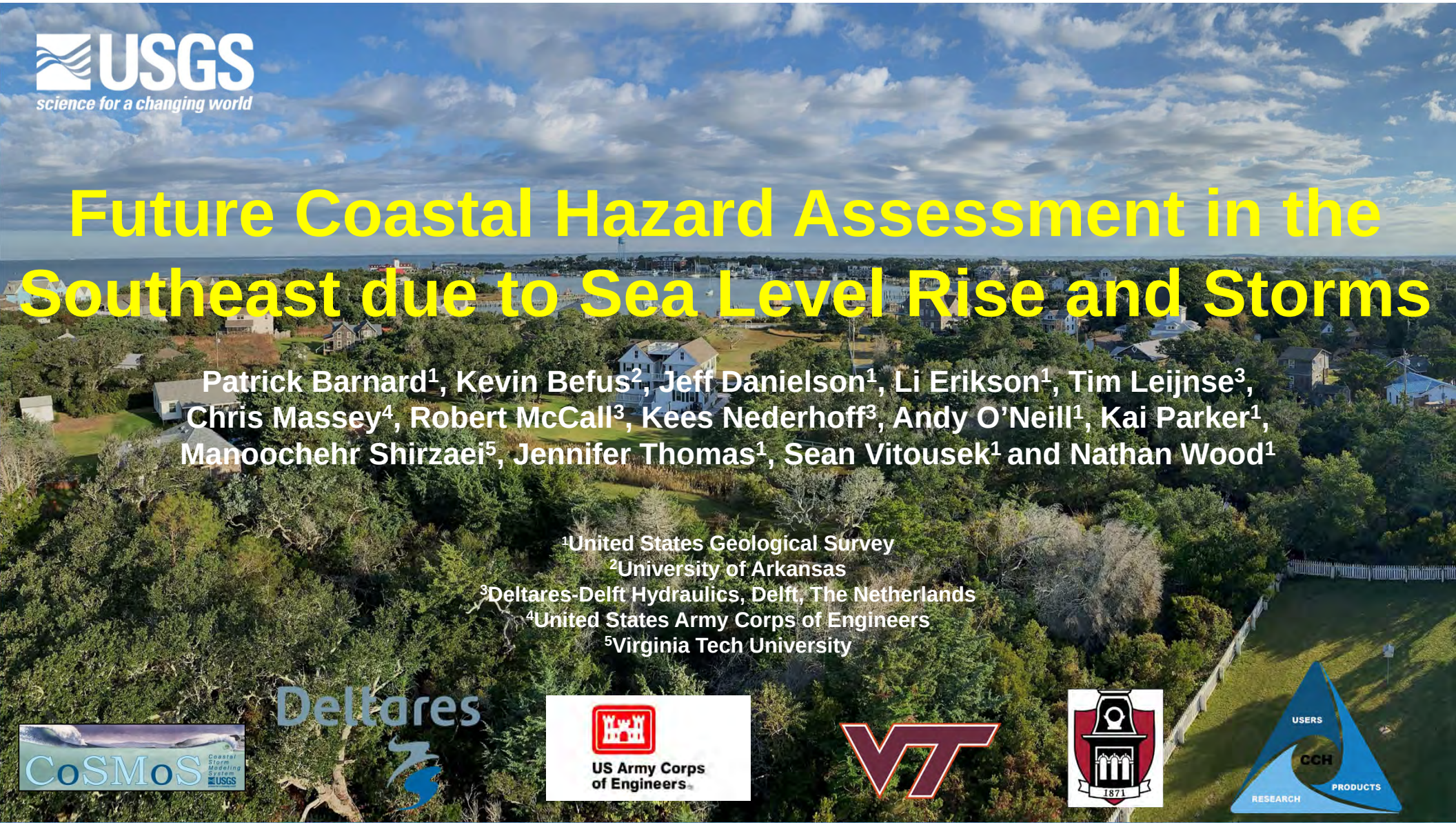
- Karl Dudman, PhD student, UK / University of Oxford/coastal resilience NC State Climate office host during field work

- Kirsten Ullman, Watershed Planner, NCDEQ Division of Mitigation Service, tasked with developing a flood resilience blueprint for the state, try to wrap head around all things resilience

Next meeting:

- In March – Whitney will send a meeting poll
- Next meeting topics –
  - Climate Central tools, Dan Rizza drizza@climatecentral.org (Sarah)
  - Cam McNutt from DWR and/or a basin planner (Forest/Nora/Robin working on coastal watersheds) working on the Watershed Action Plans / TMDL plans / basin plans come and talk and get ideas about integrating resilience into coastal WQ and basin planning (Stacey)
  - DEEPP project at UNC (Dynamics of Extreme Events, People, and Places) (Grace)
- Other agenda item ideas?

Meeting adjourned



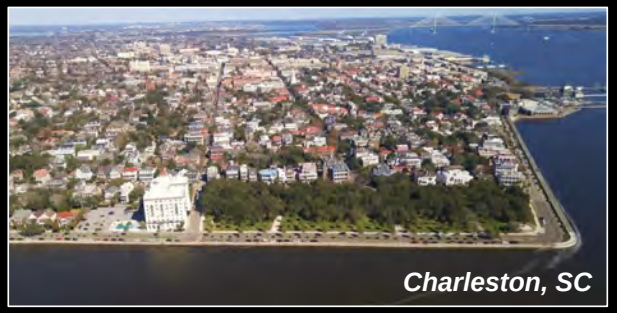
Future Coastal Hazard Assessment in the Southeast due to Sea Level Rise and Storms

Patrick Barnard[1], Kevin Befus[2], Jeff Danielson[1], Li Erikson[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

Why the Southeast Atlantic?

- 14 million residents in coastal counties
- Includes some of the most vulnerable communities in the country, including Norfolk, Wilmington, Charleston, Savannah and Miami
- VA, NC, SC and FL (1.5 M) each have over 100,000 residents at risk of SLR inundation by the end of 21st century (52% of CONUS population)
- Hurricane impacts are an annual threat
- No assessment of future coastal hazards across all five states that considers sea level rise, storms and erosion (~3x risk)
- <u>SLR will likely cause 'once-in-a-lifetime' coastal flooding events to occur annually by 2050, and every day by 2100</u>


Charleston, SC


Miami, FL

Wilmington, NC

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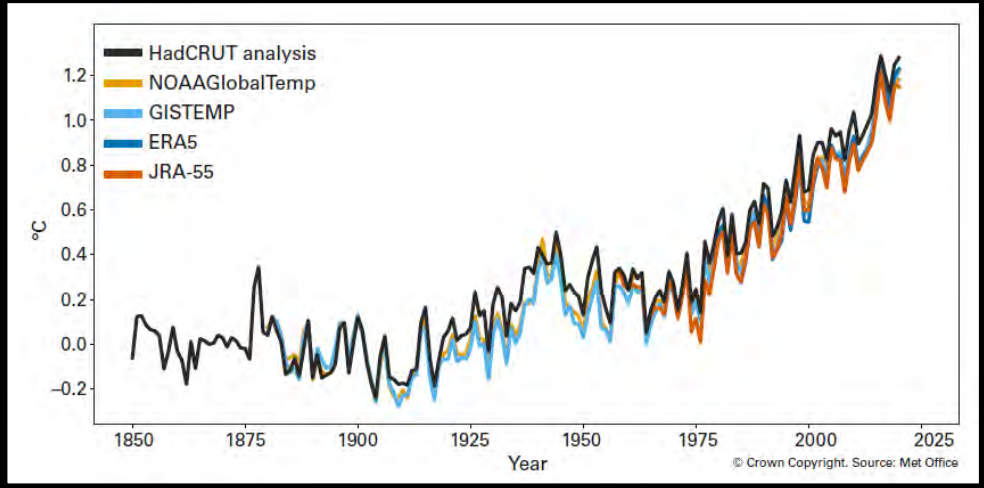
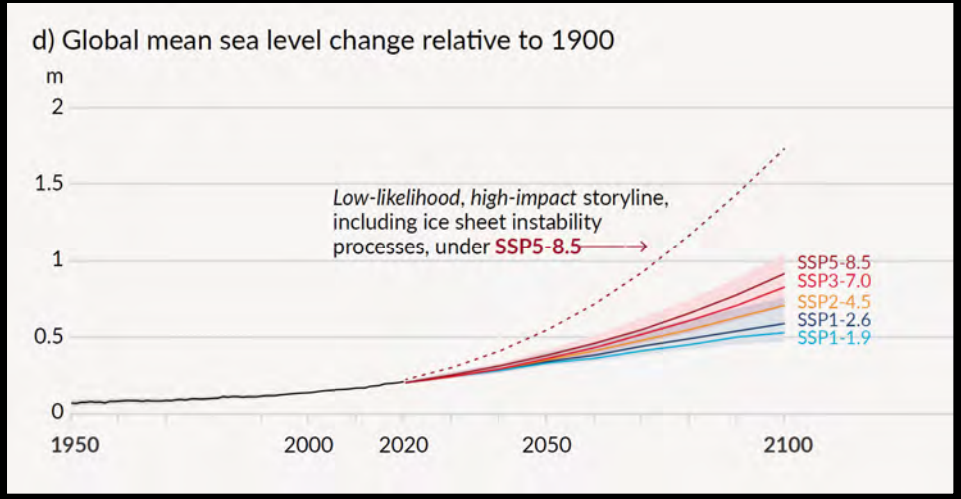
The Latest Science

- **The past six years have been the six warmest years on record (WMO)**
- **“Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years” (AR6)**
- **The rate of sea level rise has ~tripled since 1971, currently 3.7 mm/yr (AR6)**
- **“Global mean sea level has risen faster since 1900 than over any preceding century in at least the last 3000 years” (AR6)**
- **“Sea level is committed to rise for centuries to millennia due to continuing deep ocean warming and ice sheet melt, and will remain elevated for thousands of years” (AR6)**

Sources: *World Meteorological Organization, State of the Global Climate 2020 (2021).*

IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (In Press).





Ocean Isle Beach, Hurricane Matthew, 2016

Wilmington, Hurricane Florence, 2018

Jim Lo Scalzo, EPA

Ocracoke, Hurricane Dorian, 2019

Ocracoke, Hurricane Dorian, 2019


MATTHEW
High Tide Line, Hurricane GLORIA
Sept. 1985


OCRACOKE
whiskey
DORIAN
2019
MATTHEW
2016
ALEX
2004


OPEN


439


STOP
NO ONE
ALLOWED
BEYOND THIS
POINT


OCRACOKE
SEAFOOD
COMPANY
OCRACOKE
SEAFOOD
COMPANY


SOUTHERN ROCK
THE GENERAL STORE
MEZCALITO


MEZCALITO
RETIREMENT
SALE
RETIREMENT
SALE

Future Coastal Hazards - Overview

Proposal 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
- 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])
- USGS Coastal and Marine Hazards and Resources Program
- National Park Service

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Integrated Topobathymetric Digital Elevation Model

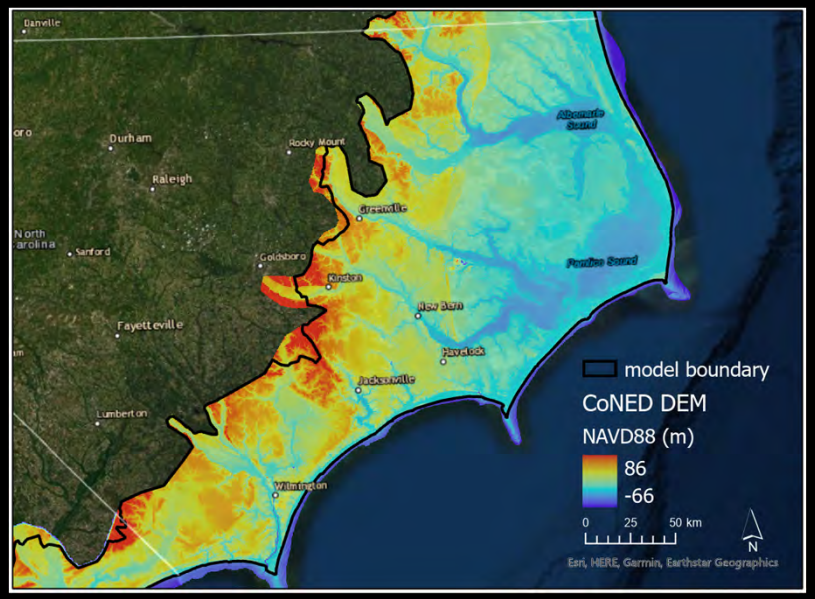
Objective: Development of a high-resolution integrated 1-meter topobathymetric digital elevation model (TBDEM) to support projections of coastal flooding, erosion, and groundwater hazards.

Approach Highlights

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

Products

- Develop an integrated TBDEM for the coastal zones of Virginia, North Carolina, South Carolina, Georgia and Florida



Key Staff: Jeff Danielson (Earth Resources Observation & Science [EROS] Center)

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

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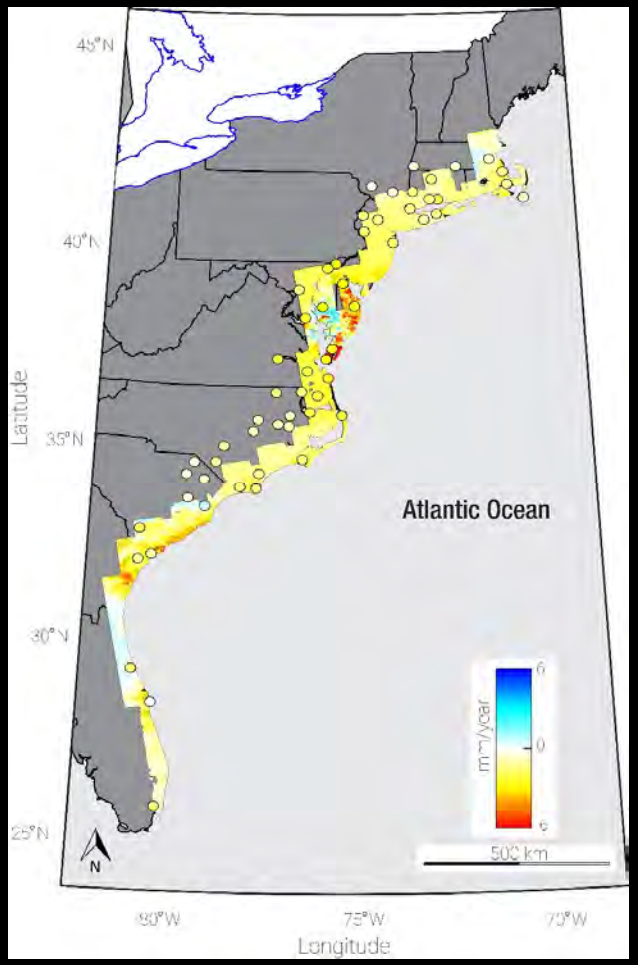
Vertical Land Motion



Objective:

- Determine the rate of Vertical Land Motion (VLM) along the Southeast 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)

Ocracoke
25 cm SLR + annual storm

Key Staff and Science Partners: Li Erikson, Kai Parker, Jenny Thomas and Deltares team; USACE/ERDC for hurricanes

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CoSMoS Coastal Storm Modeling System USGS

US Army Corps of Engineers

www.usgs.gov/cosmos

Beaufort – Annual Storm Flooding

Groundwater Hazards

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

Approach Highlights

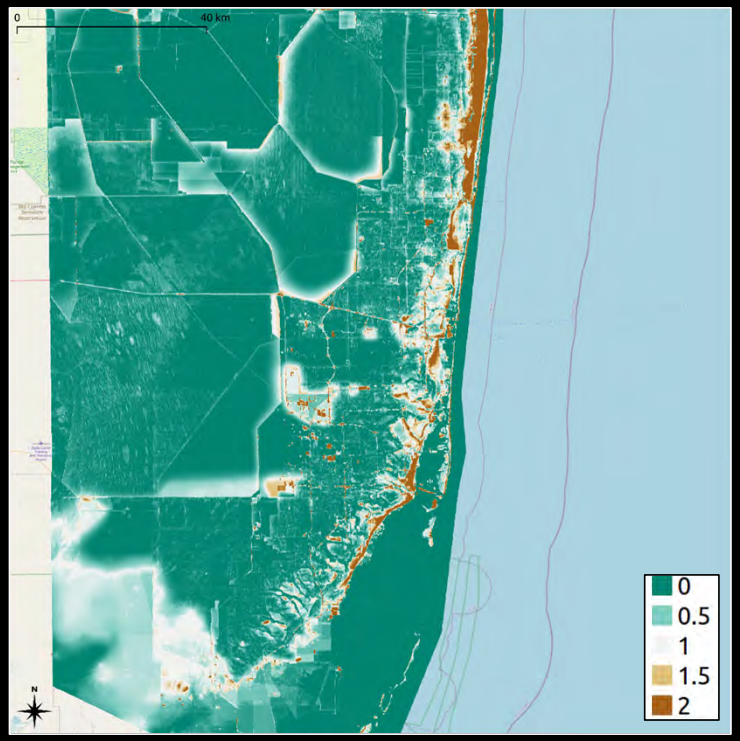
- Overlapping numerical models of steady-state groundwater flow for each sea-level rise scenario
- Leverages transmissivity/K-values from Befus et al. (2017) and Zell and Sanford (2020)

Products

- Continuous output datasets and maps of groundwater emergence and shoaling

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

Depth to Water Table – 1 m SLR



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CoSMoS Coastal Storm Modeling System USGS

www.usgs.gov/cosmos

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Coastal Change

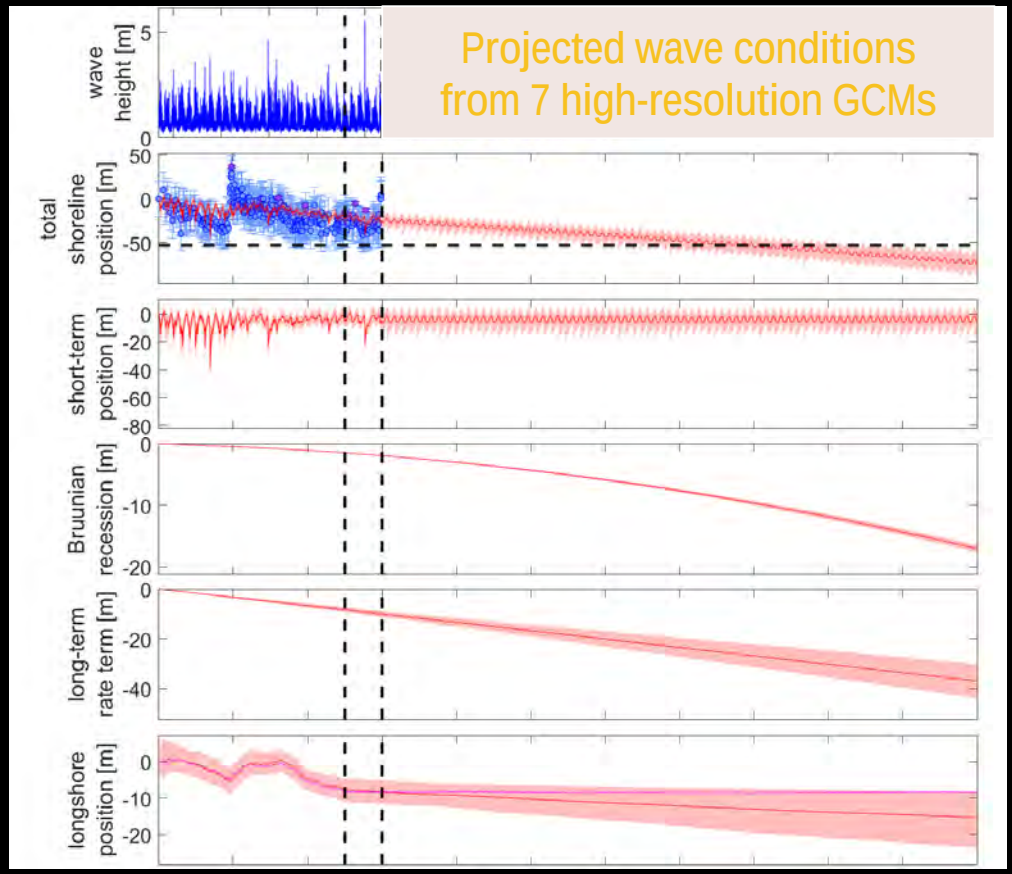
Objective: Predict future coastal change based on the SLR scenarios and total water level projections (CoSMoS-COAST).

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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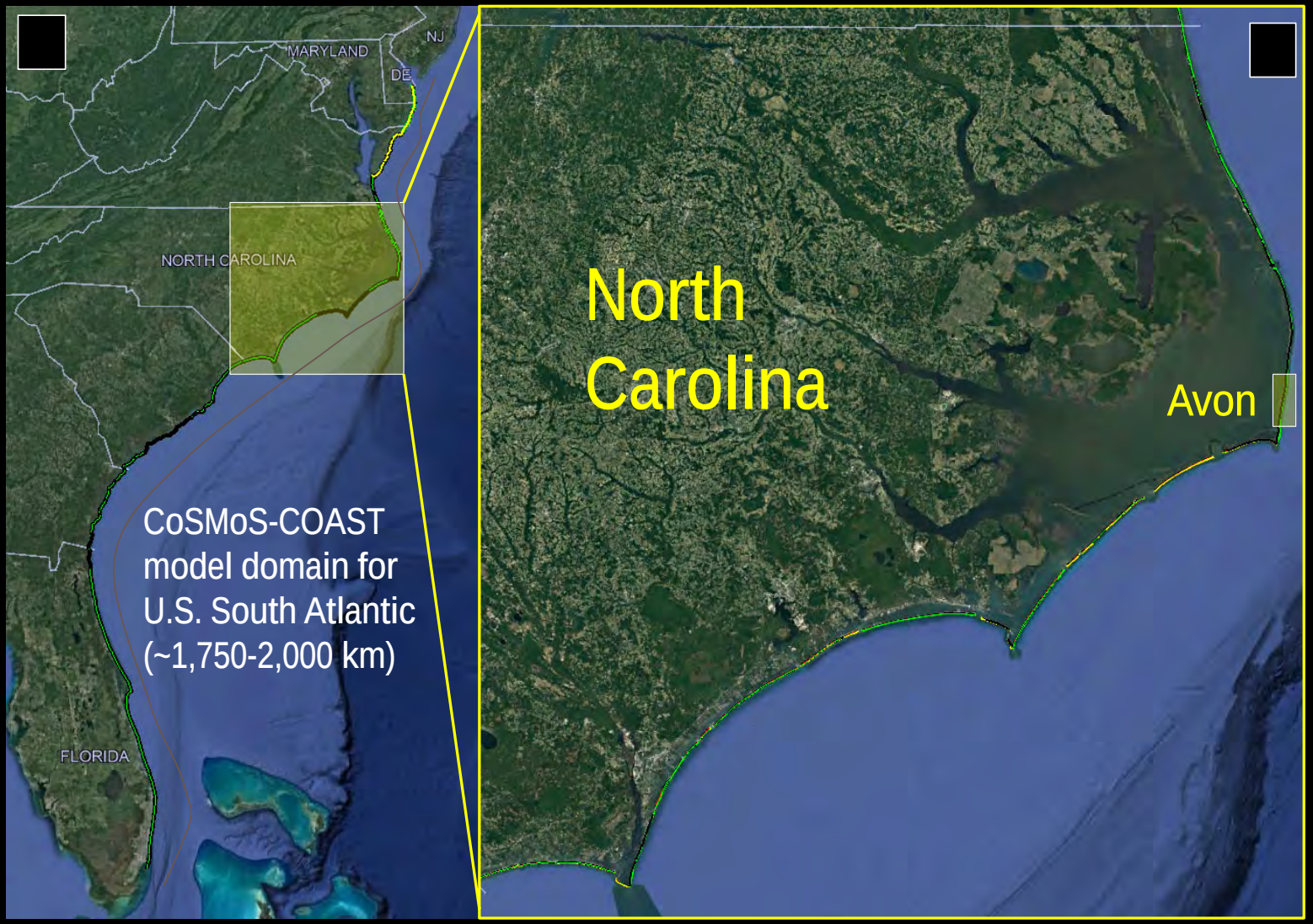
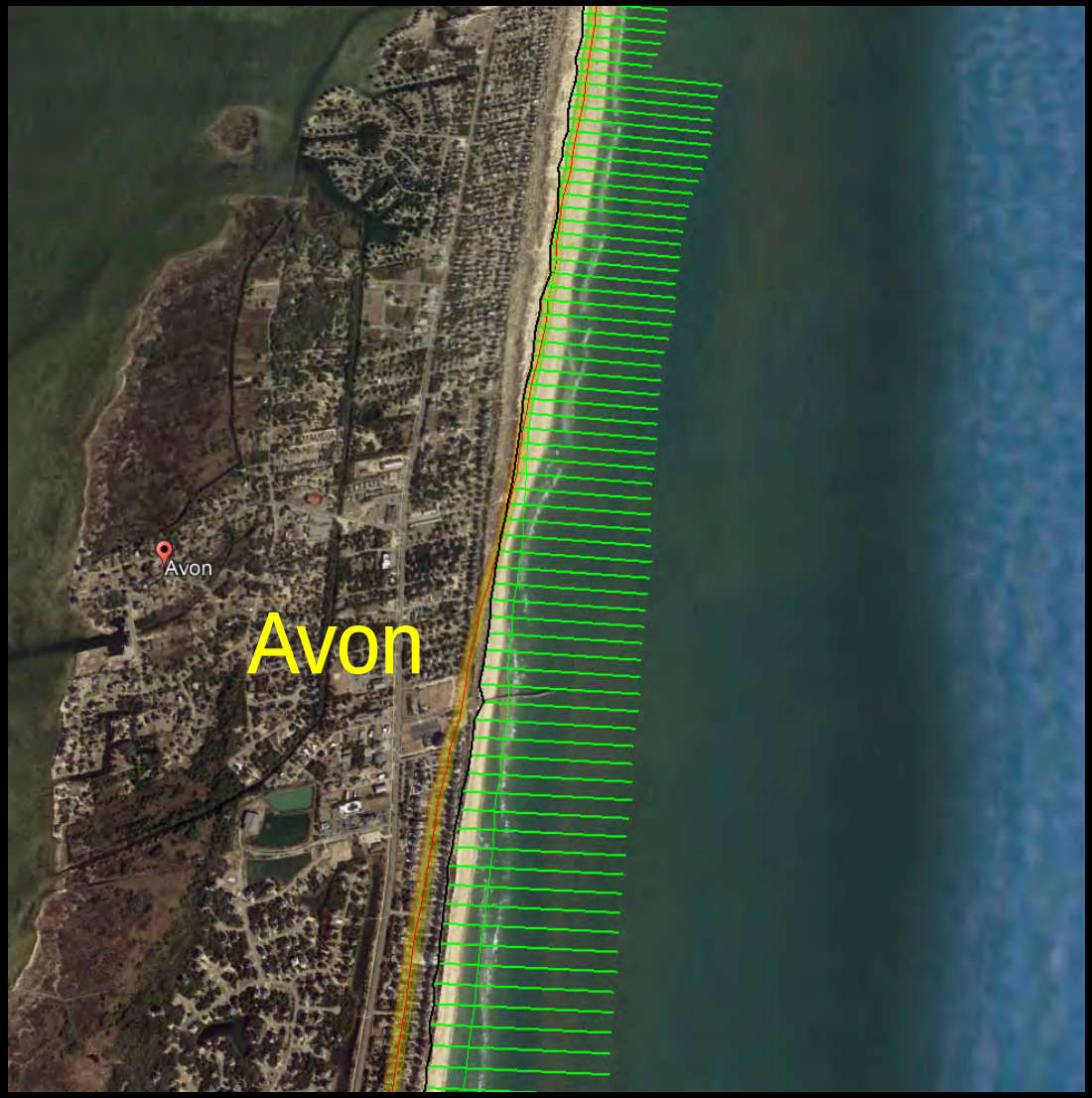
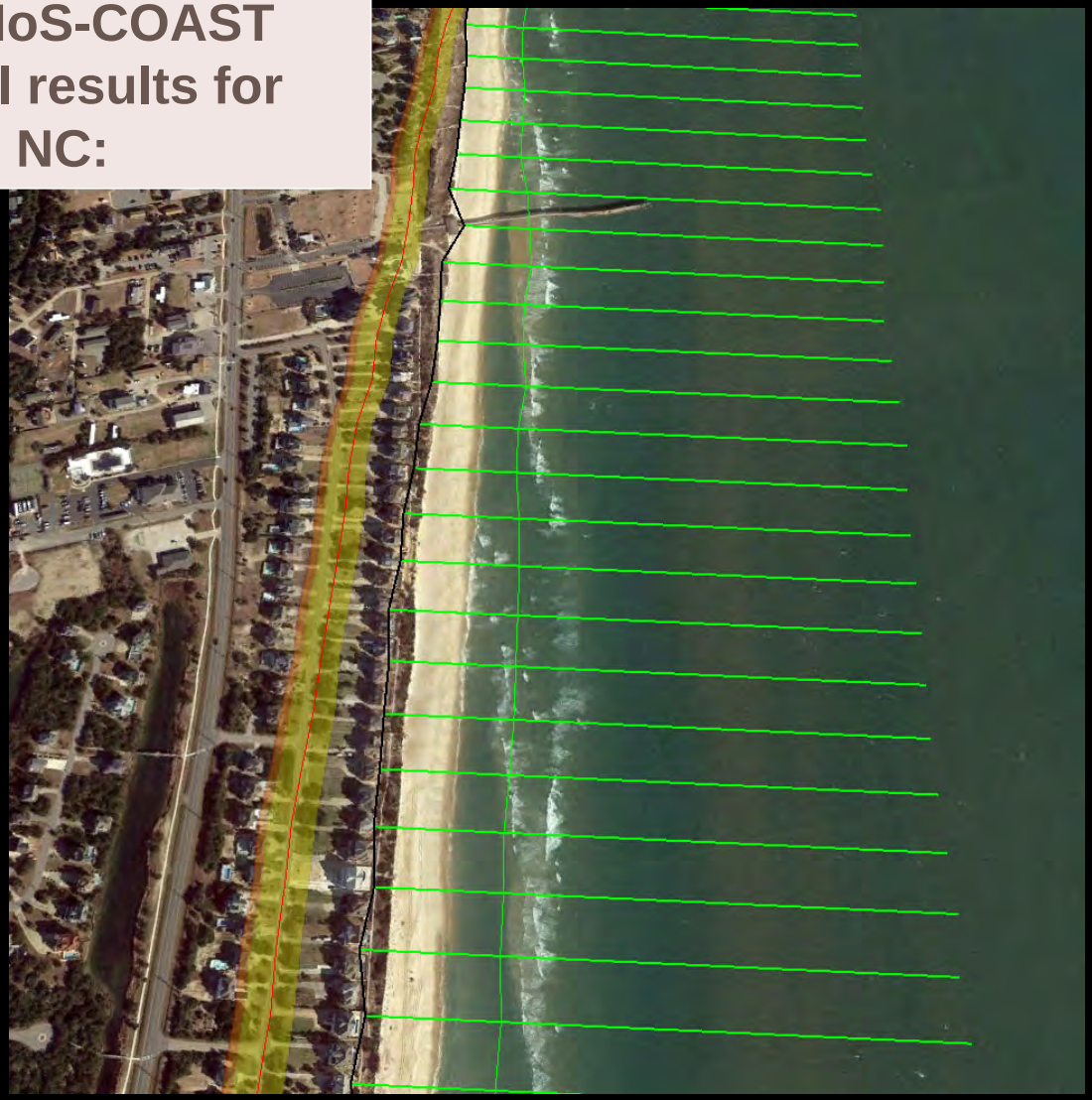
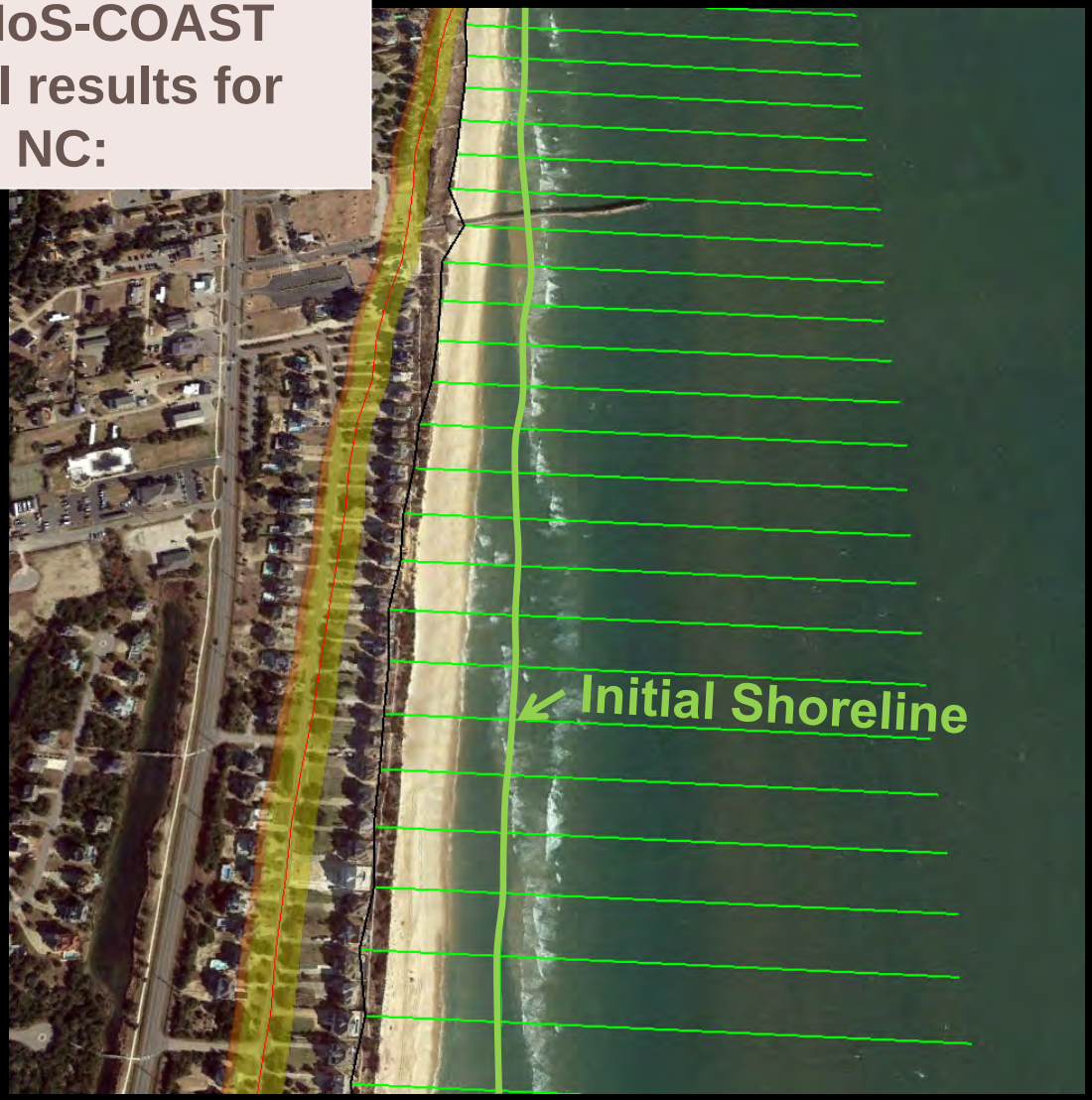

MARYLAND
NJ
DE
NORTH CAROLINA
FLORIDA
CoSMoS-COAST
model domain for
U.S. South Atlantic
(~1,750-2,000 km)
North
Carolina
Avon


Avon
Avon

CoSMoS-COAST model results for Avon, NC:



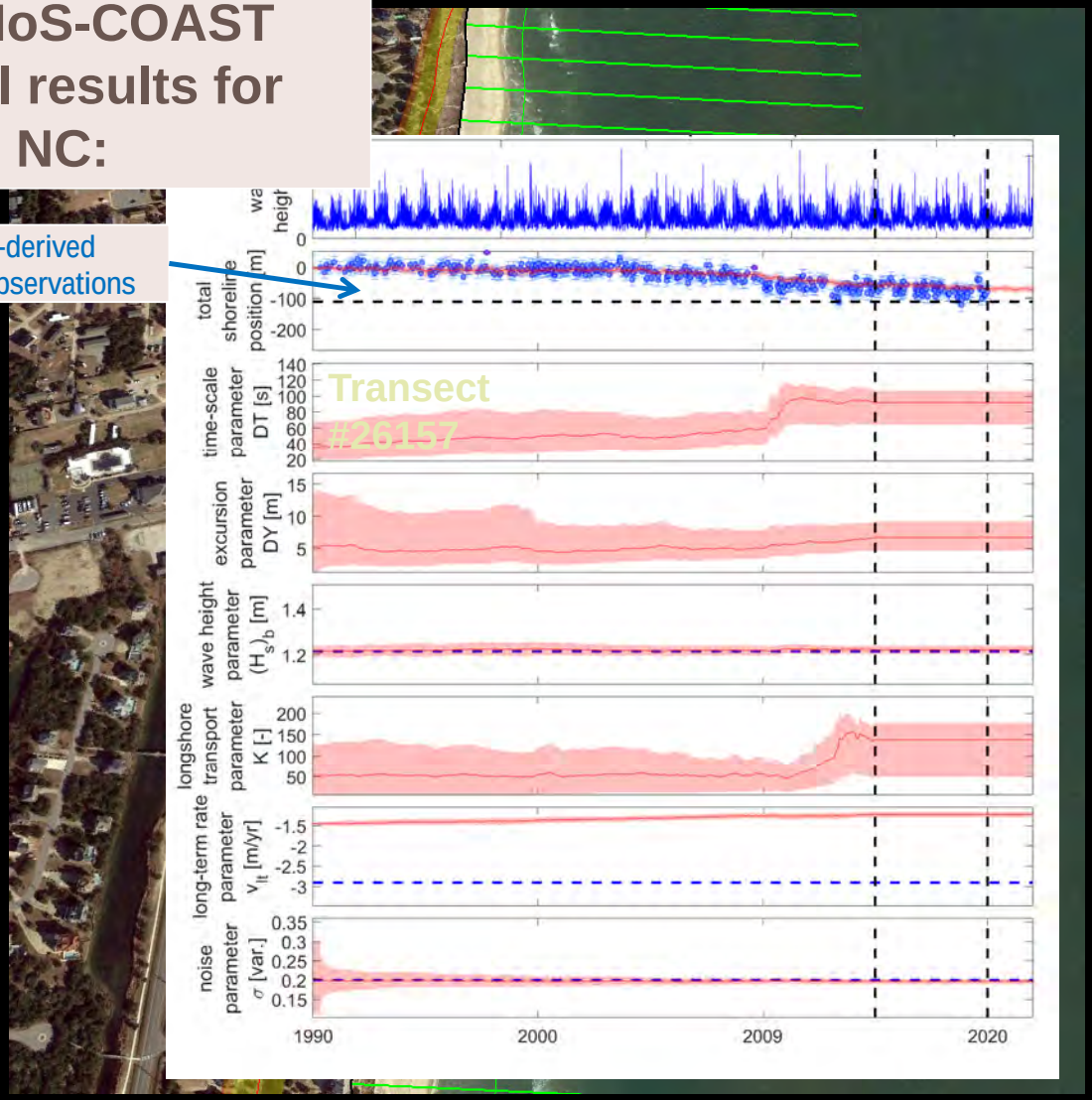
CoSMoS-COAST model results for Avon, NC:



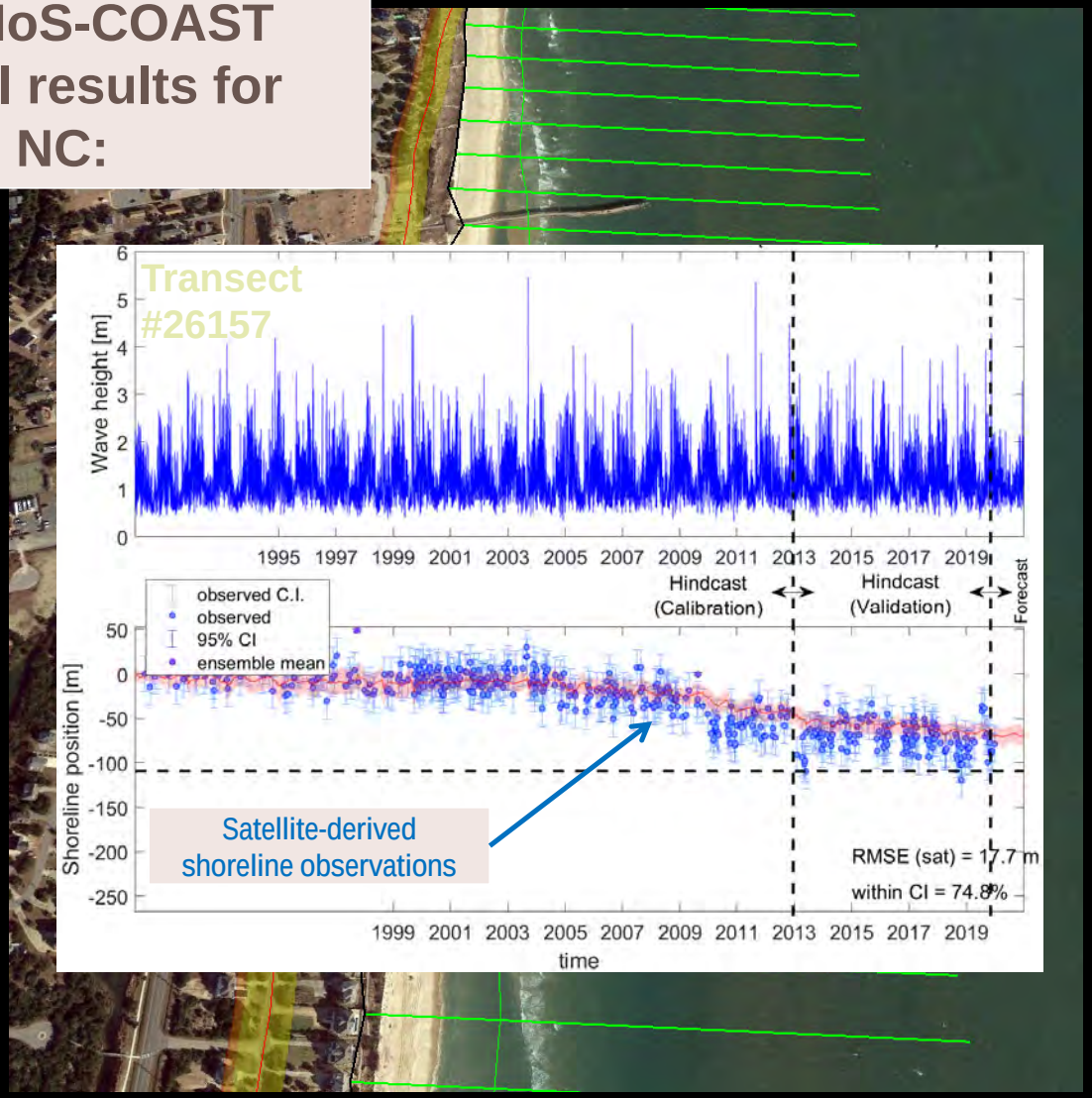
CoSMoS-COAST model results for Avon, NC:

CoSMoS-COAST model results for Avon, NC:

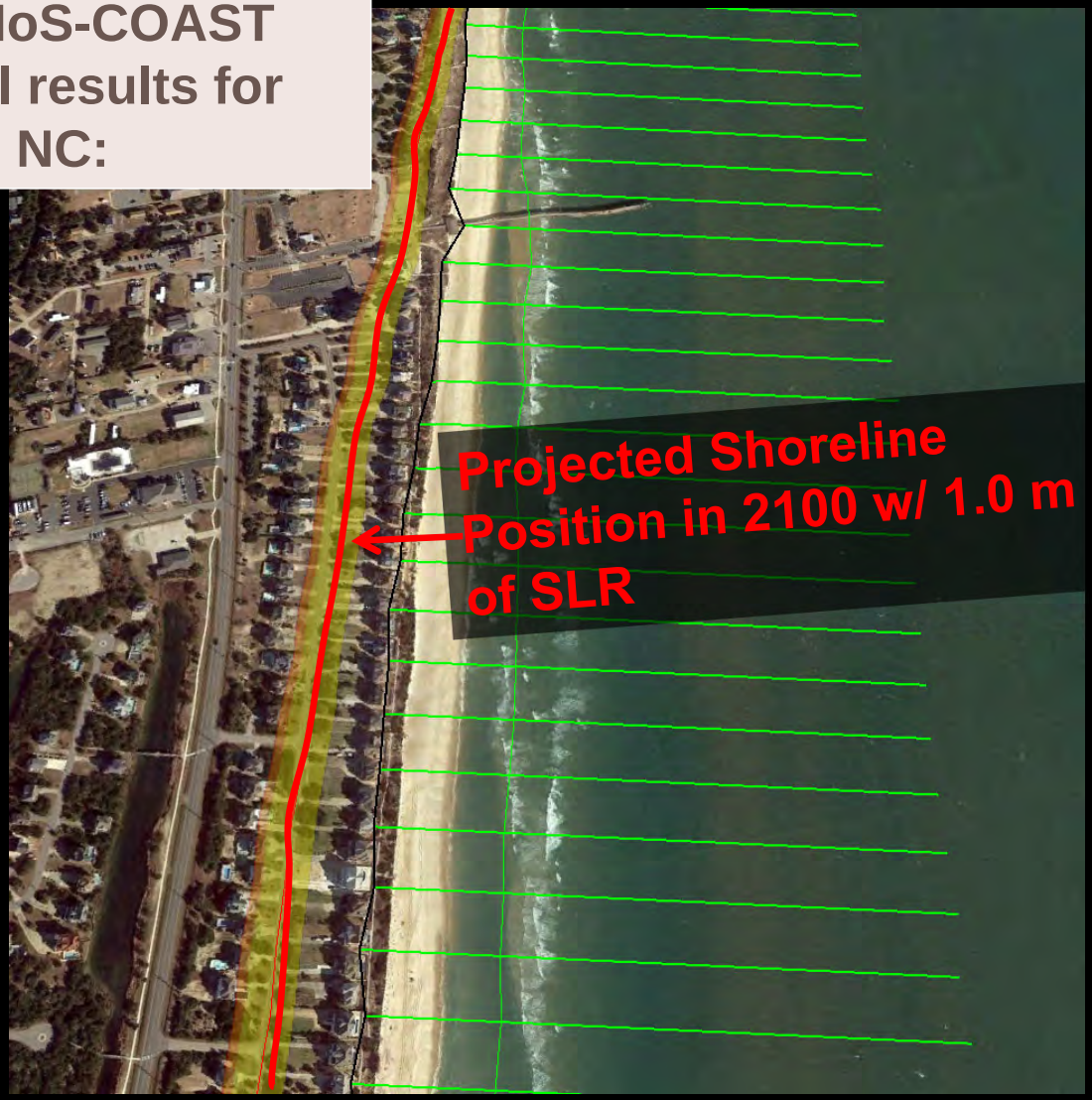
Satellite-derived shoreline observations



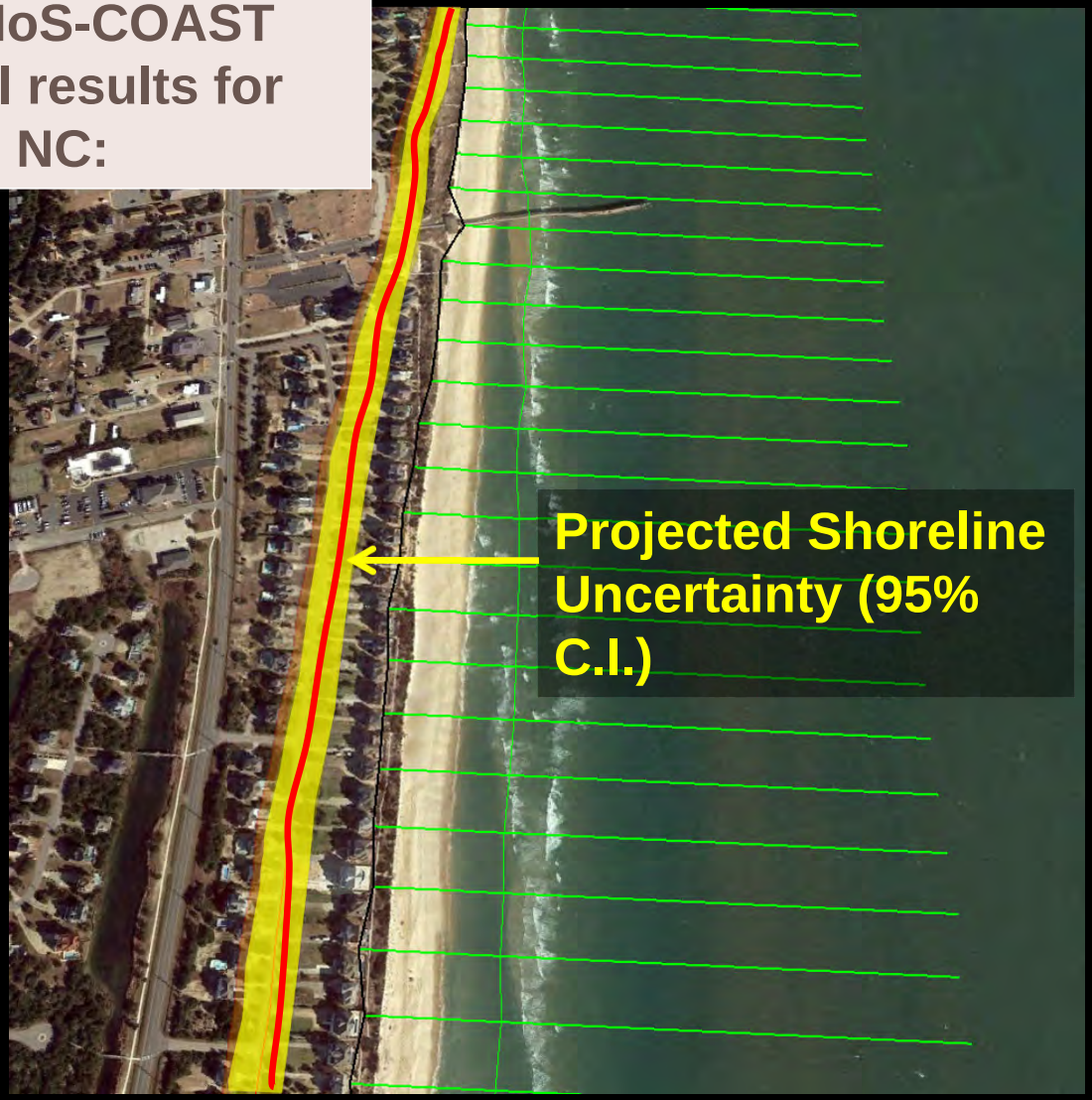
CoSMoS-COAST model results for Avon, NC:



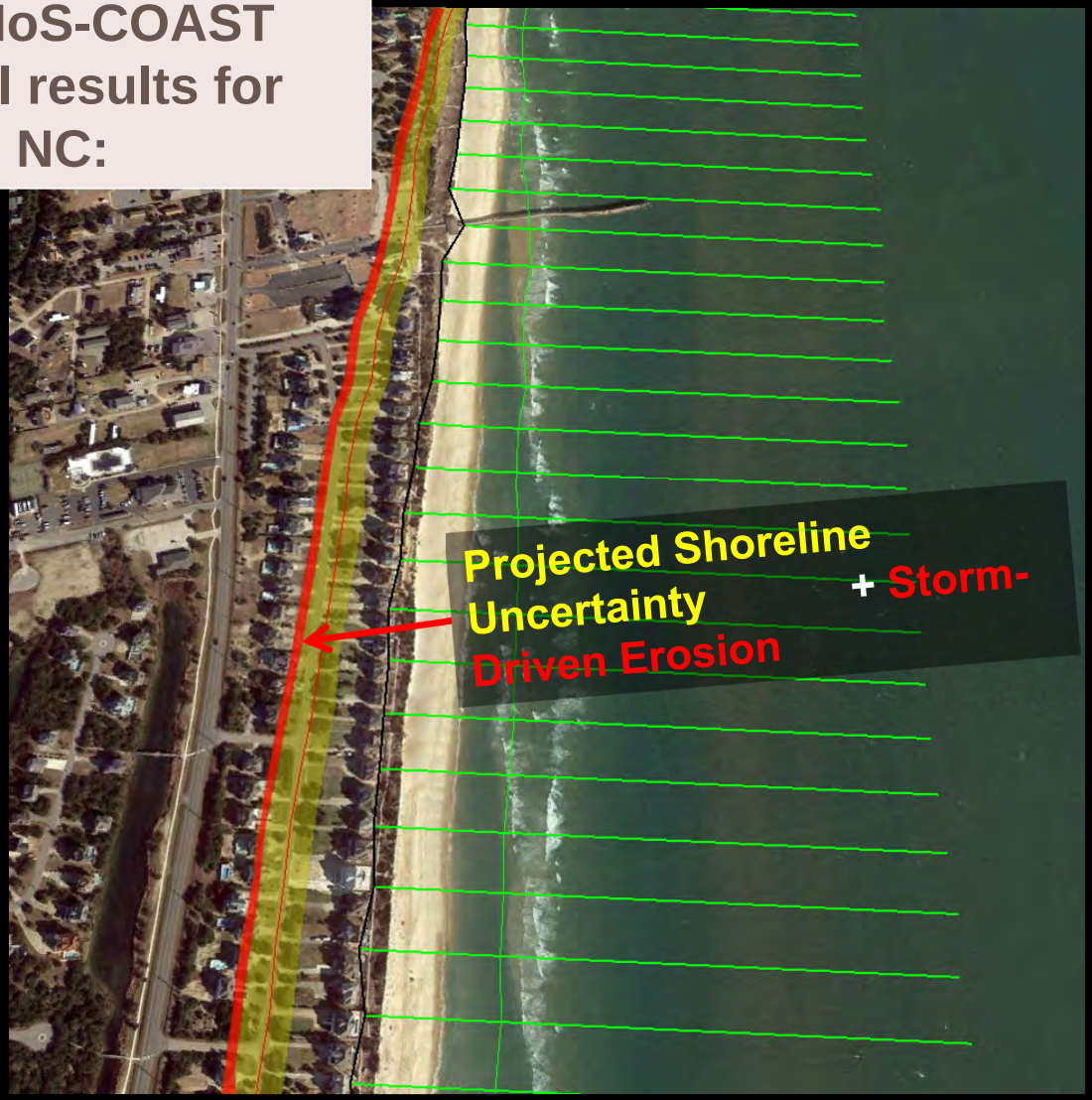
CoSMoS-COAST model results for Avon, NC:

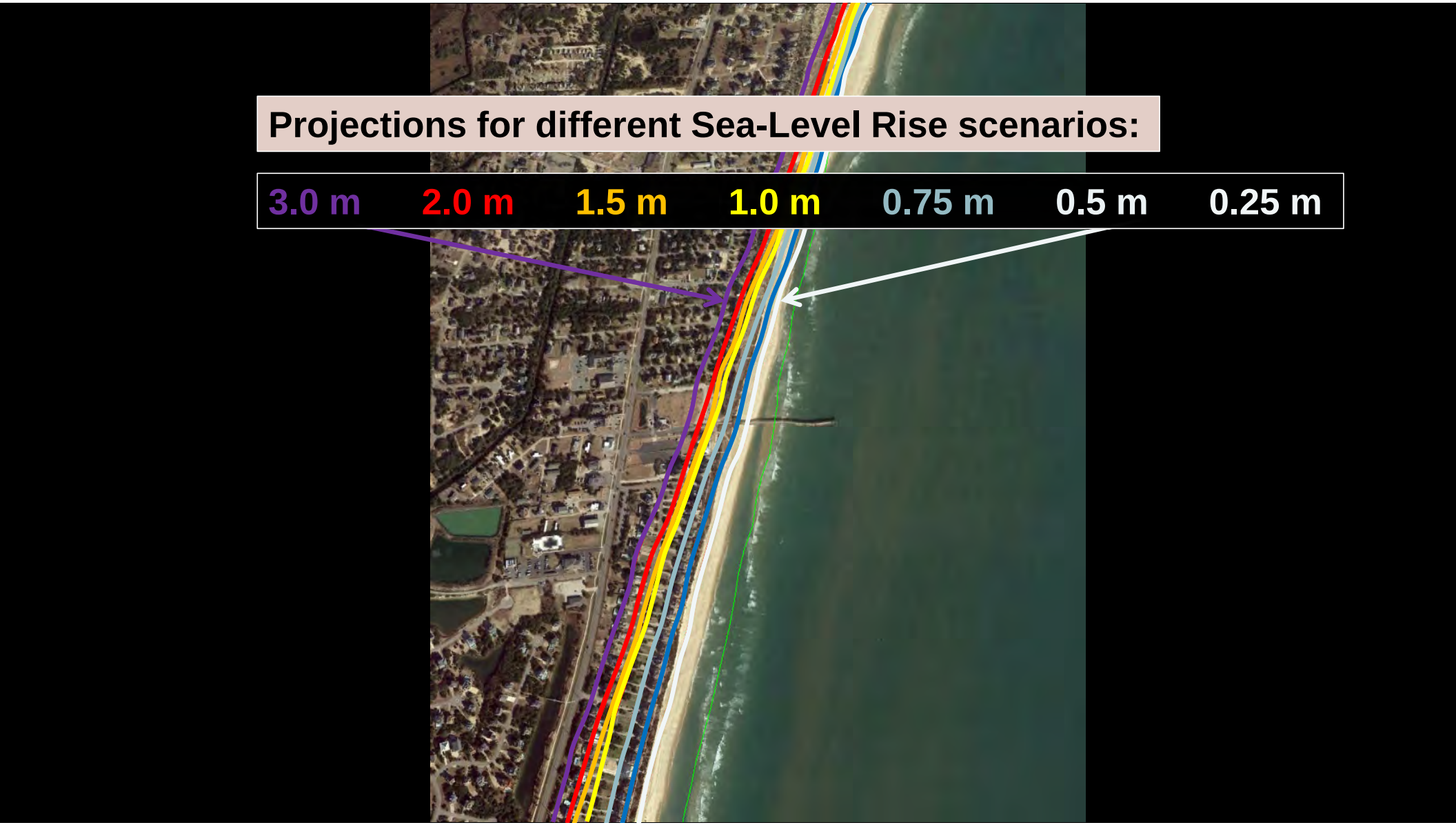


CoSMoS-COAST model results for Avon, NC:



CoSMoS-COAST model results for Avon, NC:



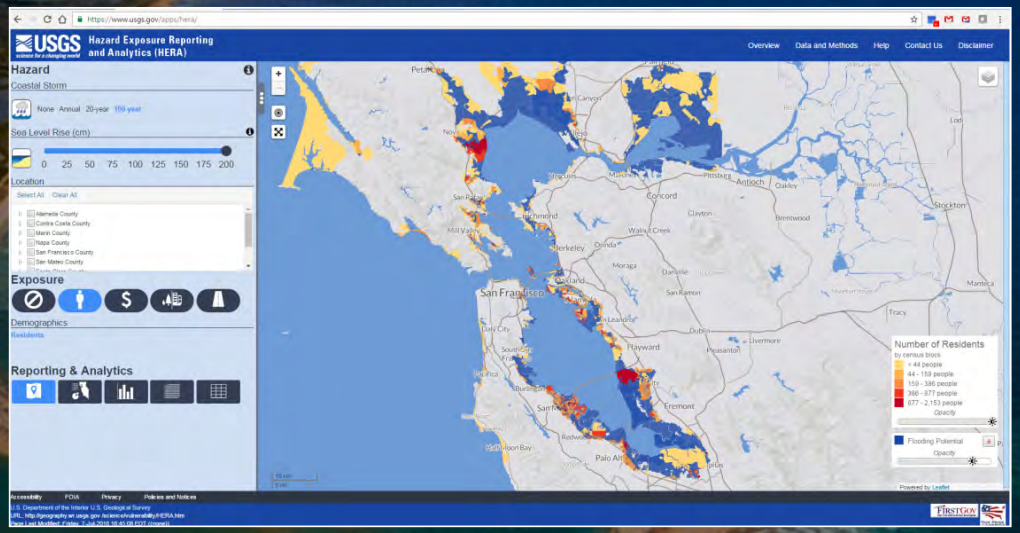

Projections for different Sea-Level Rise scenarios:
3.0 m
2.0 m
1.5 m
1.0 m
0.75 m
0.5 m
0.25 m

Socioeconomic Exposure

Objective: Determine the assets exposed to coastal flooding, erosion and groundwater shoaling 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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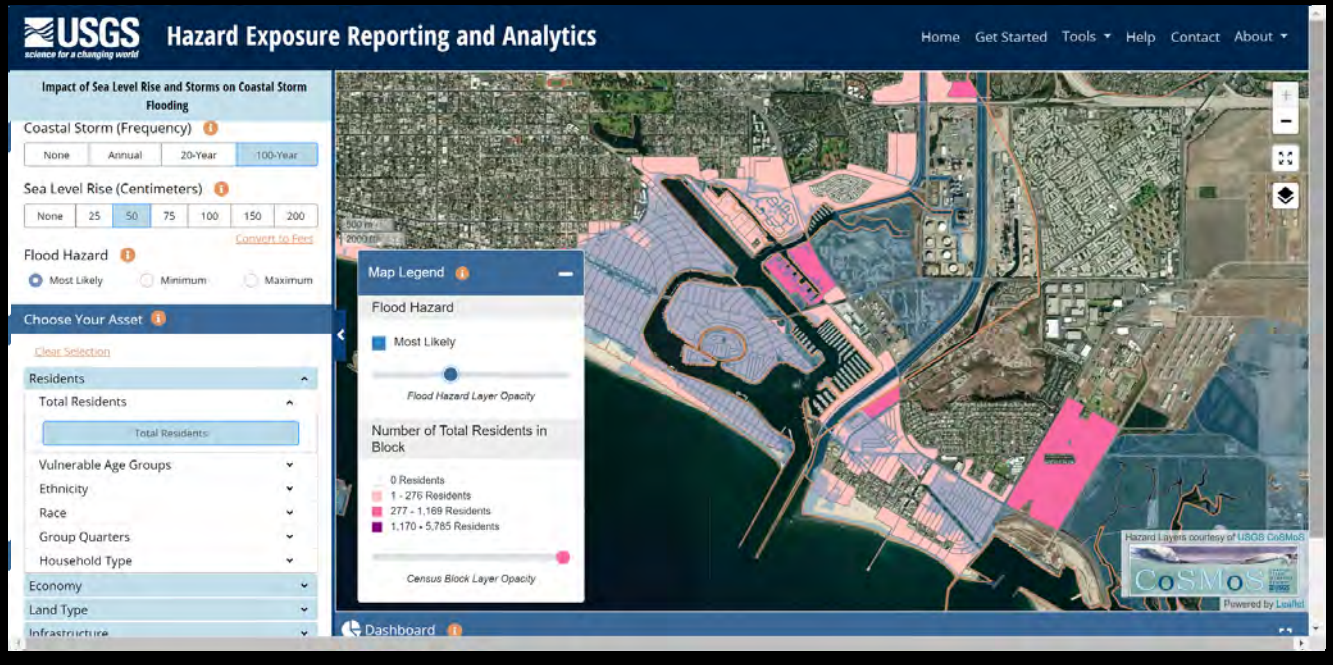
Serving up the Results

- USGS data releases
- USGS Coastal Change Hazards Portal:

https://marine.usgs.gov/coastalchangehazardsportal/

- Hazard Exposure Reporting and Analytics (HERA) tool:

www.usgs.gov/apps/hera



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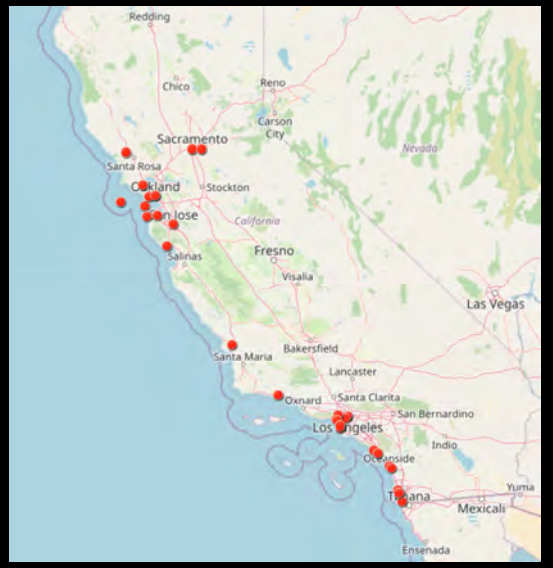
How has this approach been used?

- Dozens of cities and counties for updating their Local Coastal Programs (LCPs) for hazard mitigation and climate adaptation
- Caltrans (annual budget = $13.9 billion) to assess the vulnerability of transportation infrastructure across the state
- California Coastal Commission to evaluate coastal construction permits
- Integrated into state climate change guidance
- Evaluate siting of a power plant by the California Energy Commission
- Port of San Diego to evaluate infrastructure and resource risk
- California State Legislature justify a $3.7 billion investment in climate adaptation



Sea Grant
University of Southern California

Caltrans

ADAPTLA

Tijuana River
National Estuarine Research Reserve

SEA CHANGE
SAN MATEO COUNTY

CoSMoS
Coastal Storm Modeling System
USGS

The Future

- Product delivery March 2022
- Work with partners and stakeholders to support regional and local policy and coastal management decision-making
- Support community resilience and environmental justice
- Virtual Reality video for Ocracoke/NPS coming in 2022

Where can I get more information?

- USGS Disaster Recovery Activities: www.usgs.gov/natural-hazards/usgs-supplemental-disaster-recovery-activities
- USGS Coastal Change Hazards Portal: https://marine.usgs.gov/coastalchangehazardsportal/
- Coastal Storm Modeling System (CoSMoS): www.usgs.gov/cosmos/
- Hazard Exposure Reporting and Analytics (HERA) tool: www.usgs.gov/apps/hera/
- Coastal National Elevation Dataset (CoNED): https://topotools.cr.usgs.gov/topobathy_viewer/

Contact: Patrick Barnard, *pbarnard@usgs.gov*

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