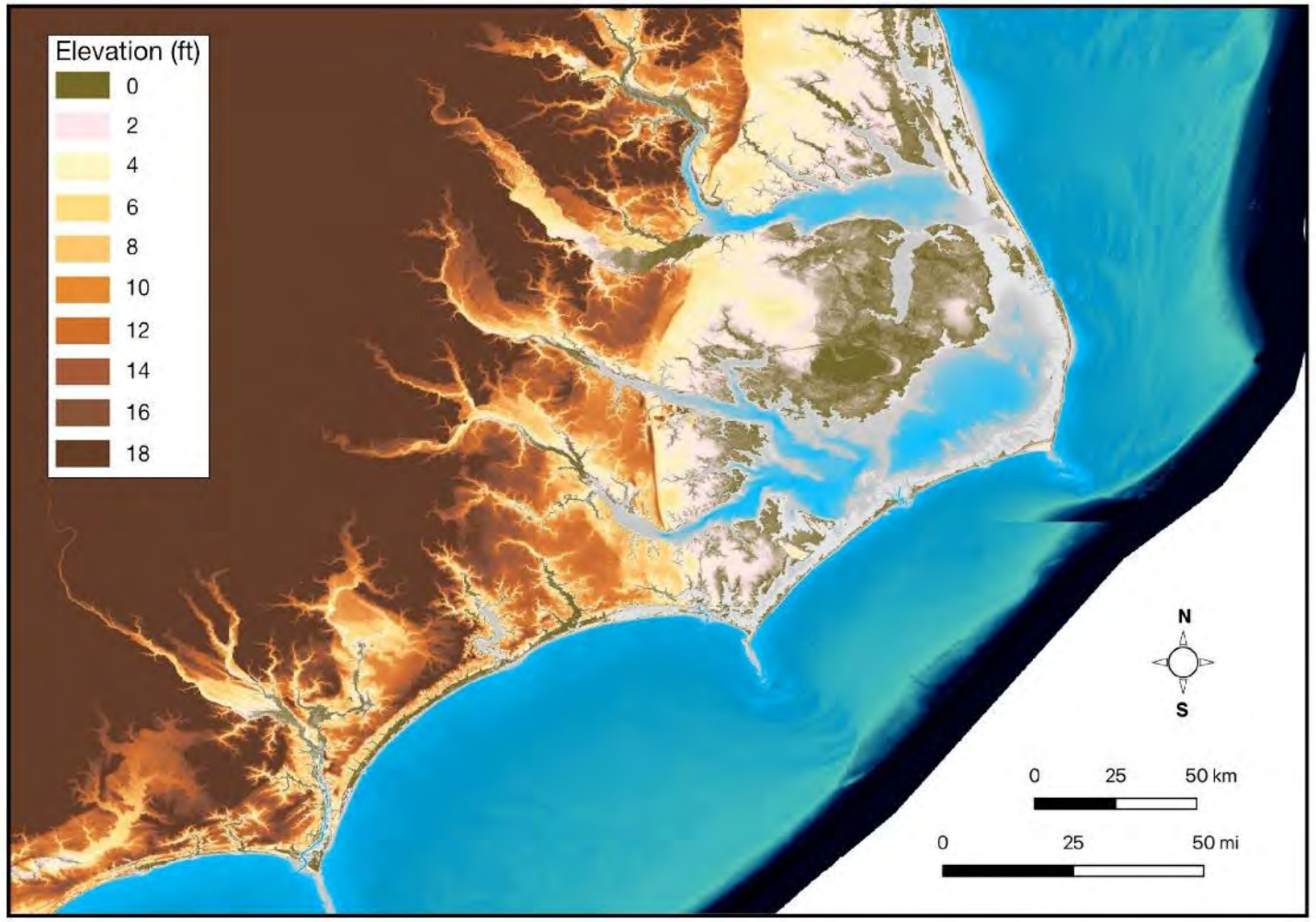
Barrier Islands

Naturally-dynamic Landforms

Reide Corbett

Dean of Integrated Coastal Programs
East Carolina University
Executive Director, Coastal Studies Institute



ECU

Coastal Studies Institute
A Multi-Institutional Research Partnership

Agenda for today

- **Barrier Evolution**
  - *The past is a window into the future*.
- **Modern processes**
  - *Drivers of change…for better or worse change is happening!*
- **Implications of these coastal hazards**
  - *How will the system change?*
  - *How can we respond?*

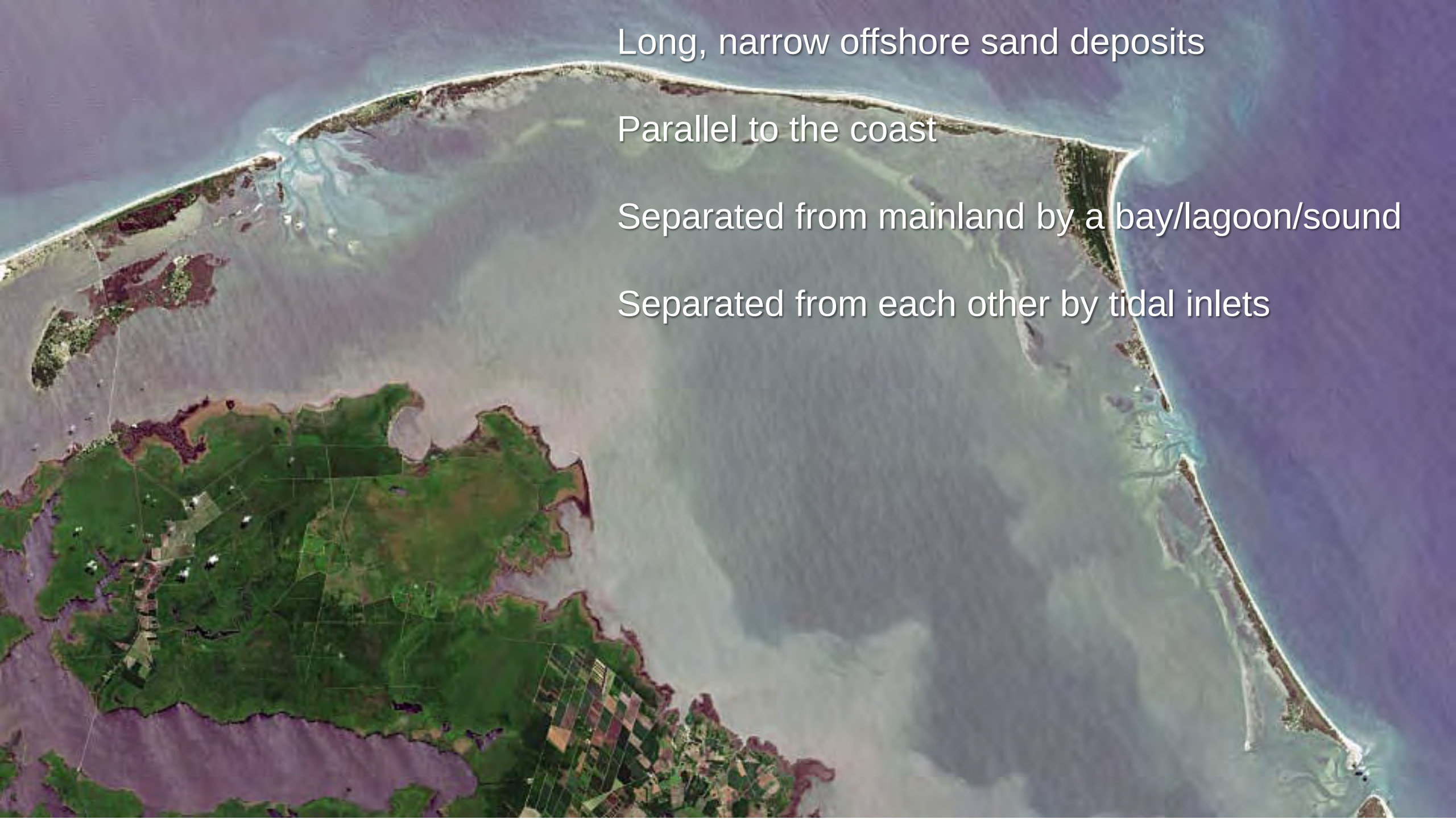
2149 barrier islands worldwide (10-15% of global coastlines; 25% of US coastlines)

300 ring the Atlantic and Gulf coasts of the US

Low-lying

Ecologically diverse and important

Protect mainland from waves and surge



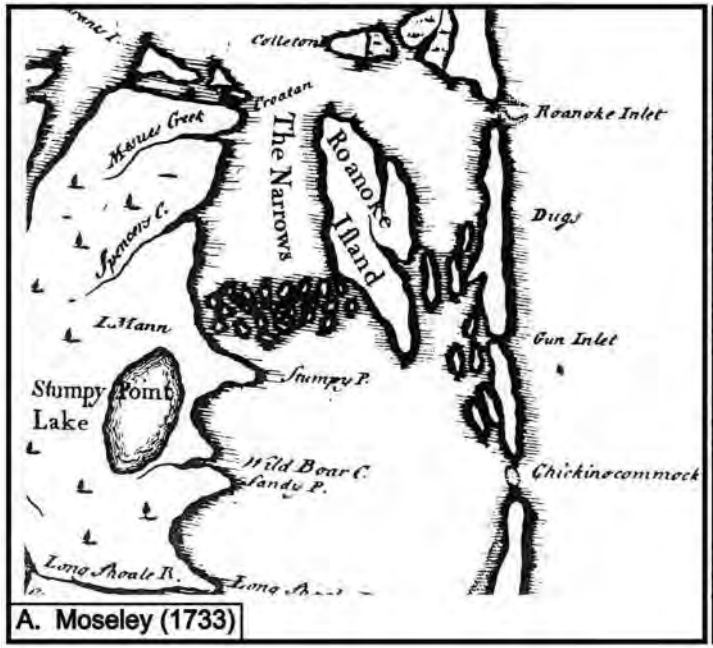
Long, narrow offshore sand deposits

Parallel to the coast

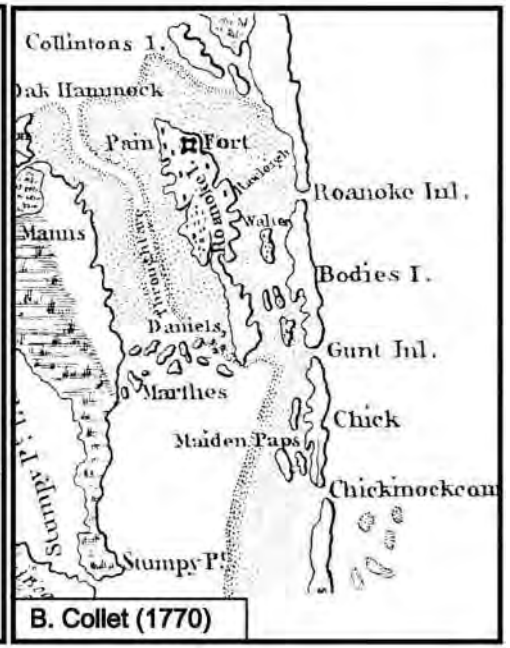
Separated from mainland by a bay/lagoon/sound

Separated from each other by tidal inlets

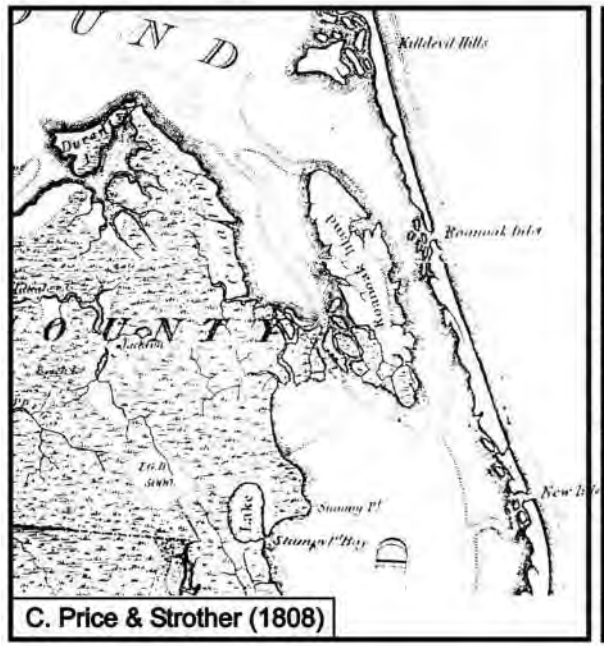
Change along the NC coast is NOT a new concept…



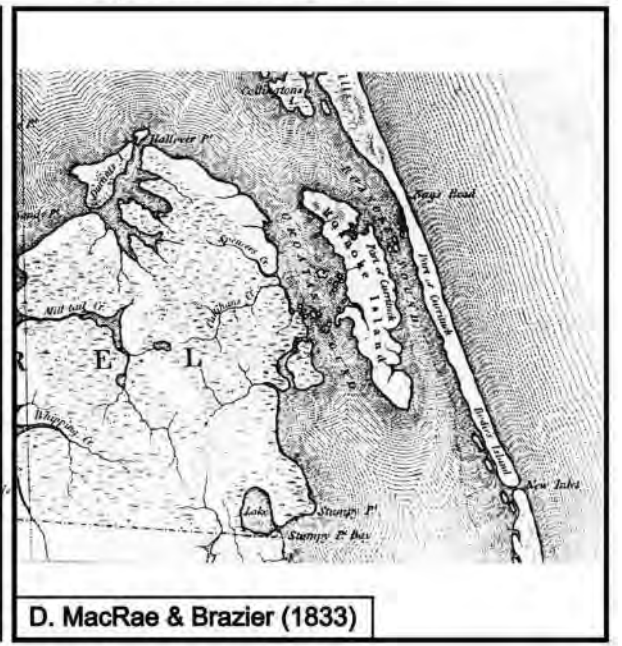
A. Moseley (1733)



B. Collet (1770)



C. Price & Strother (1808)



D. MacRae & Brazier (1833)

…but we need to remember that it is a different coastal environment today!

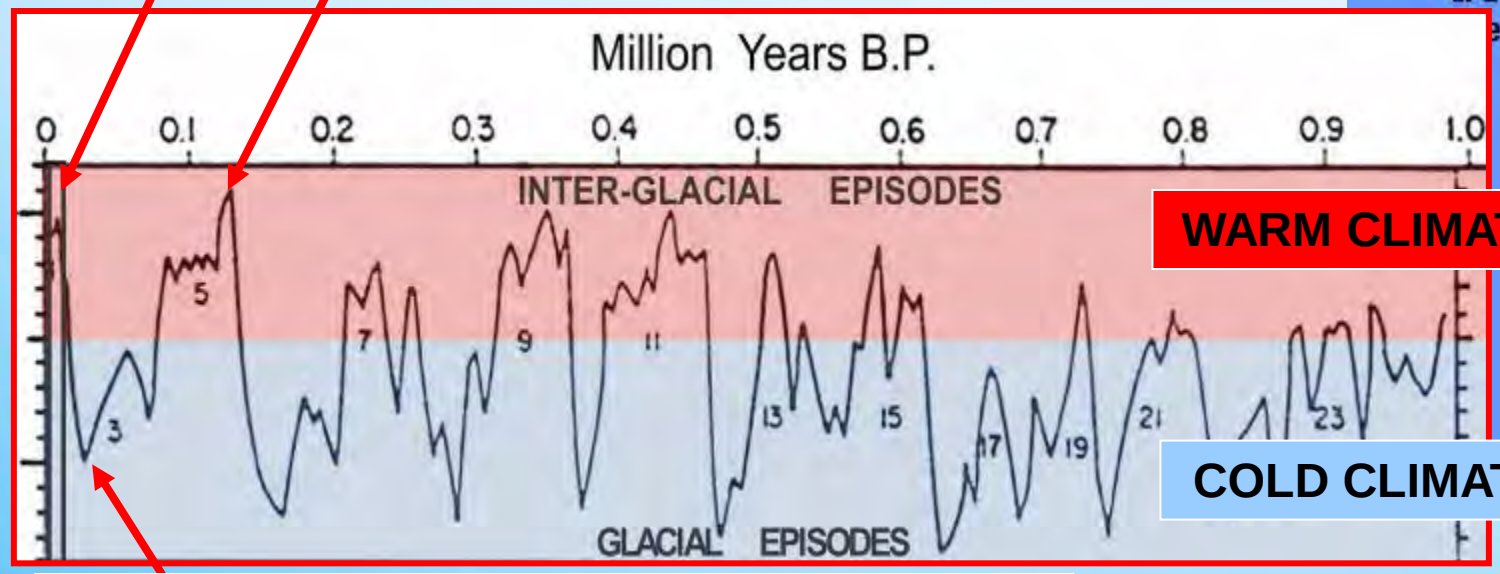
North Rodanthe, NC

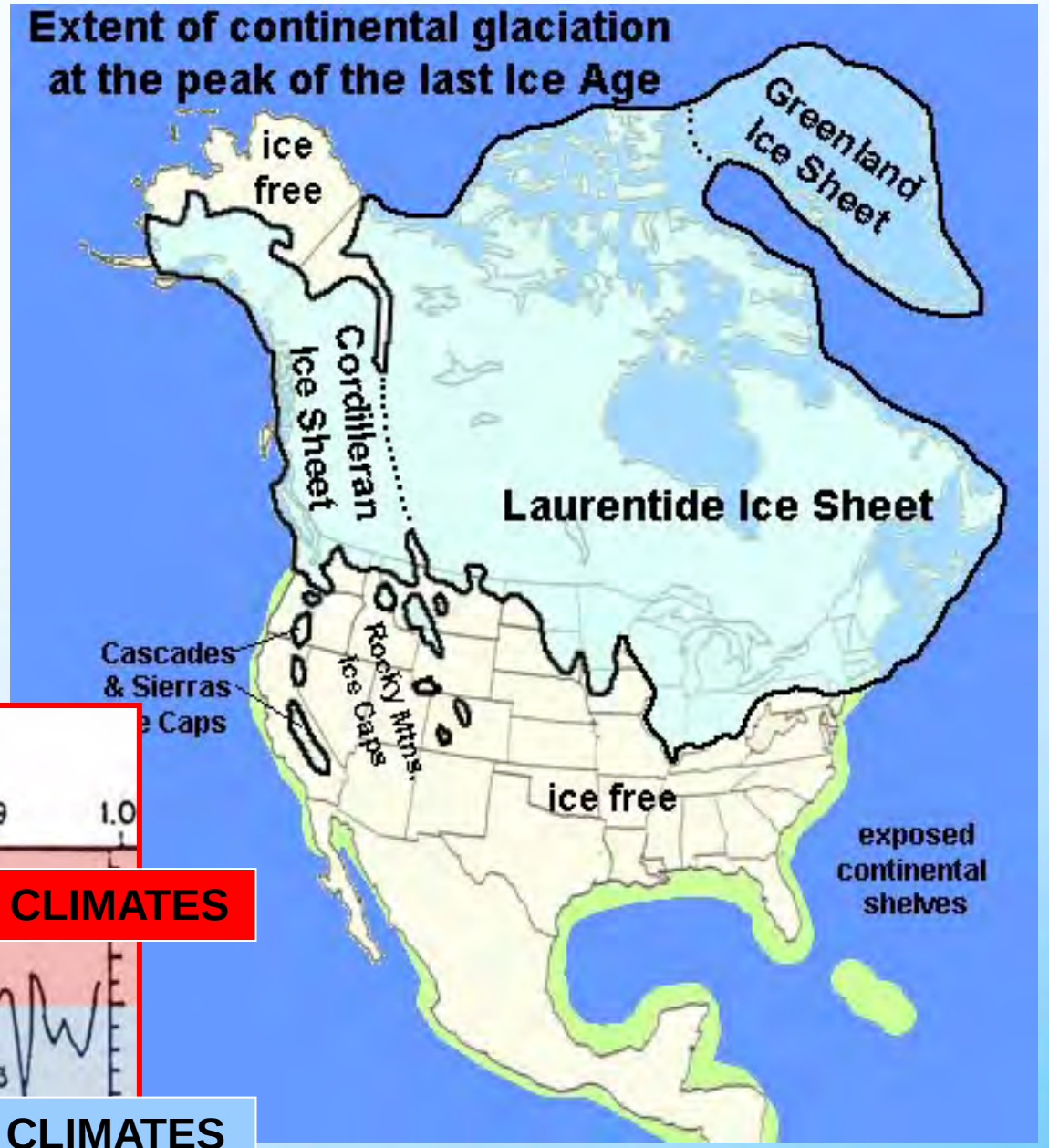
…but we need to remember that it is a different coastal environment today!

Buxton, NC

Changes to the System

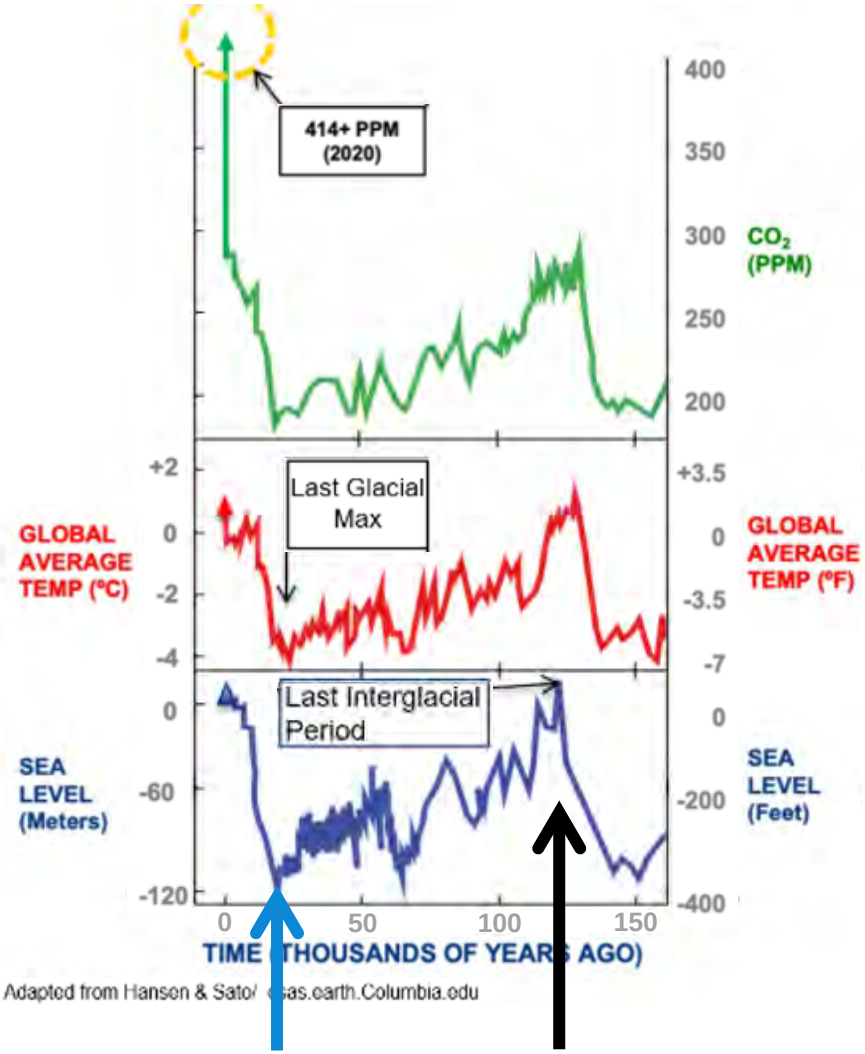
Geologic Timescales





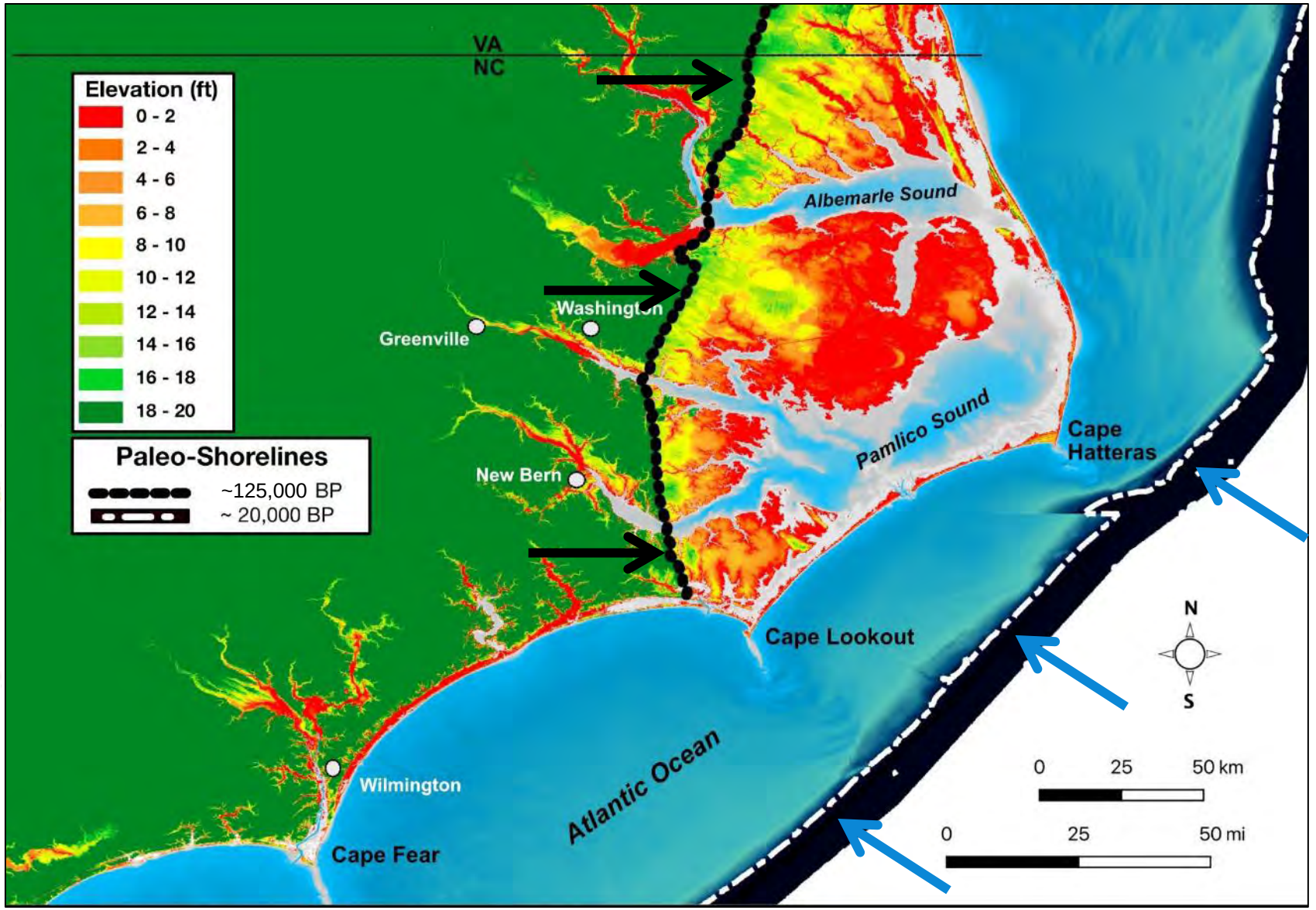
SHACKLETON & OPDYKE (1973)

North Carolina's Shorelines of the PAST

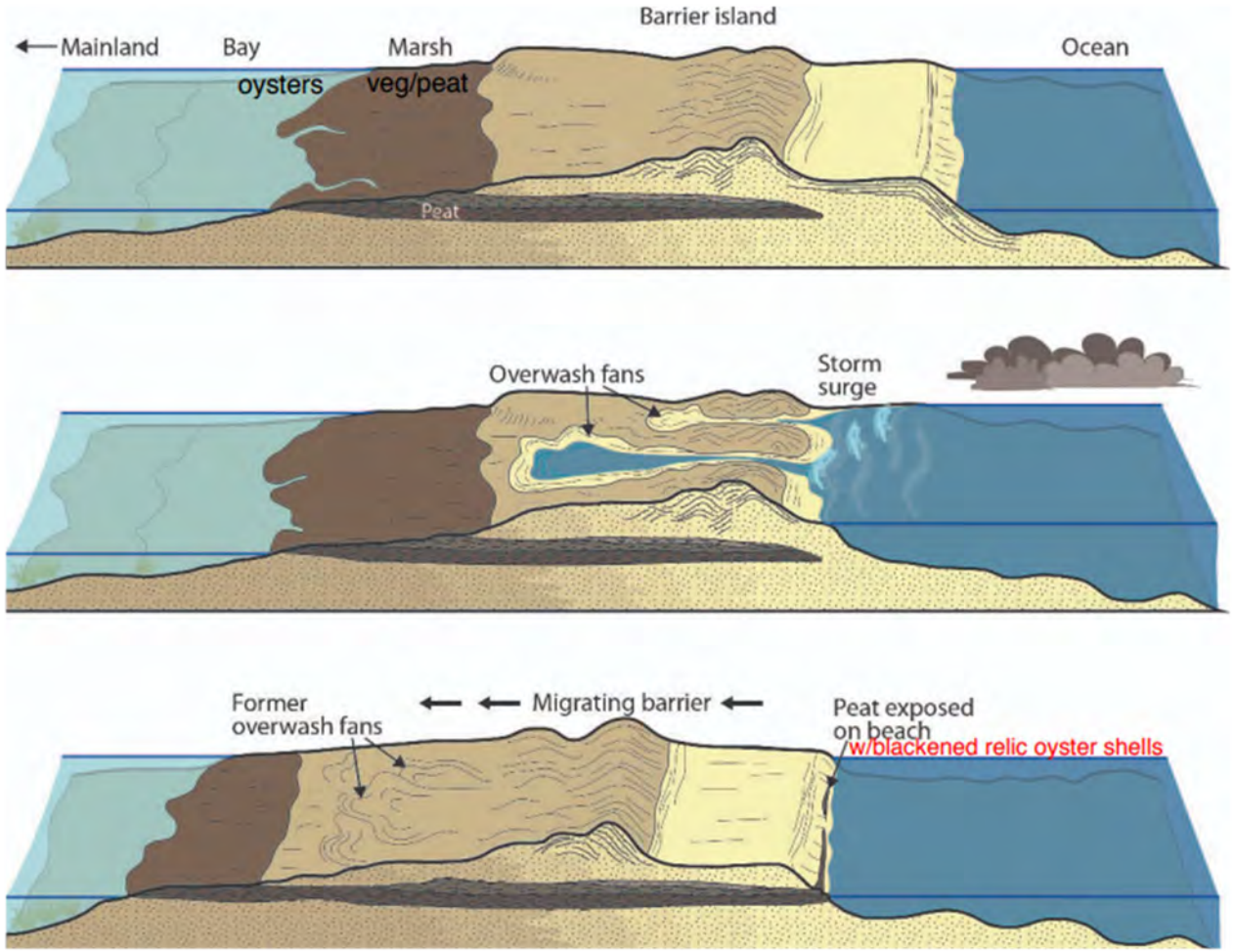


Glacial

Interglacial



Barrier islands build new land, keep pace with sea-level rise through storm overwash



- Overwash: landward directed flux of water and sand during storms
- Over decades the barrier island marches landward

Couplings across the landscape affect the state of the barrier system

Humans alter couplings across barrier systems

How do you think humans alter these ecomorphodynamic feedbacks?

USGS 2023-5034: https://doi.org/10.3133/sir20235034

Limit overwash delivery to the barrier interior and marsh (development as overwash filter)

Longshore Transport

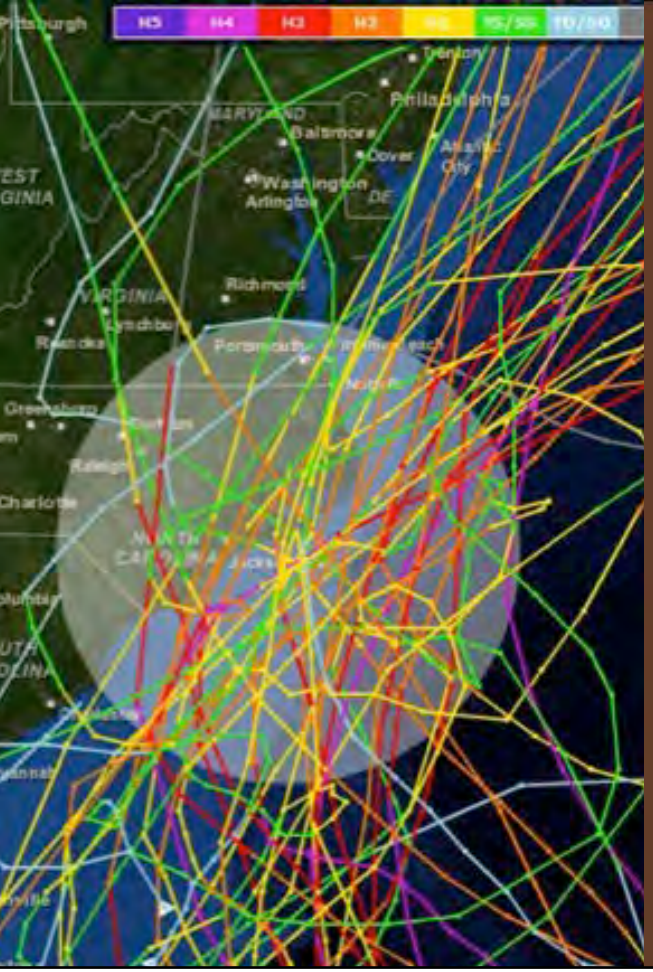
Alter patterns of alongshore sediment transport

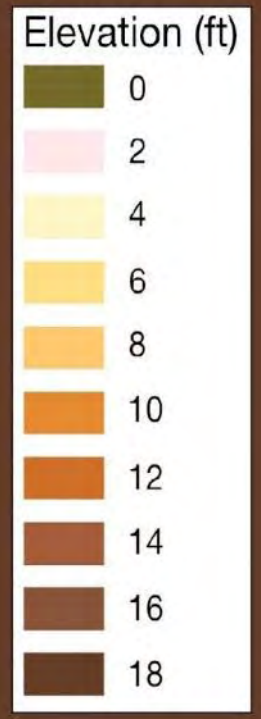
Washover

Keep shorelines at fixed cross-shore positions through beach nourishment

Remove overwash from roadways/properties

What is the future of NC's barriers?





- **Human's modify natural processes**
- **Very low lying**
- **Dynamic setting**
  - **Changing river outputs**
  - **Storms**
  - **Sea-level rise**

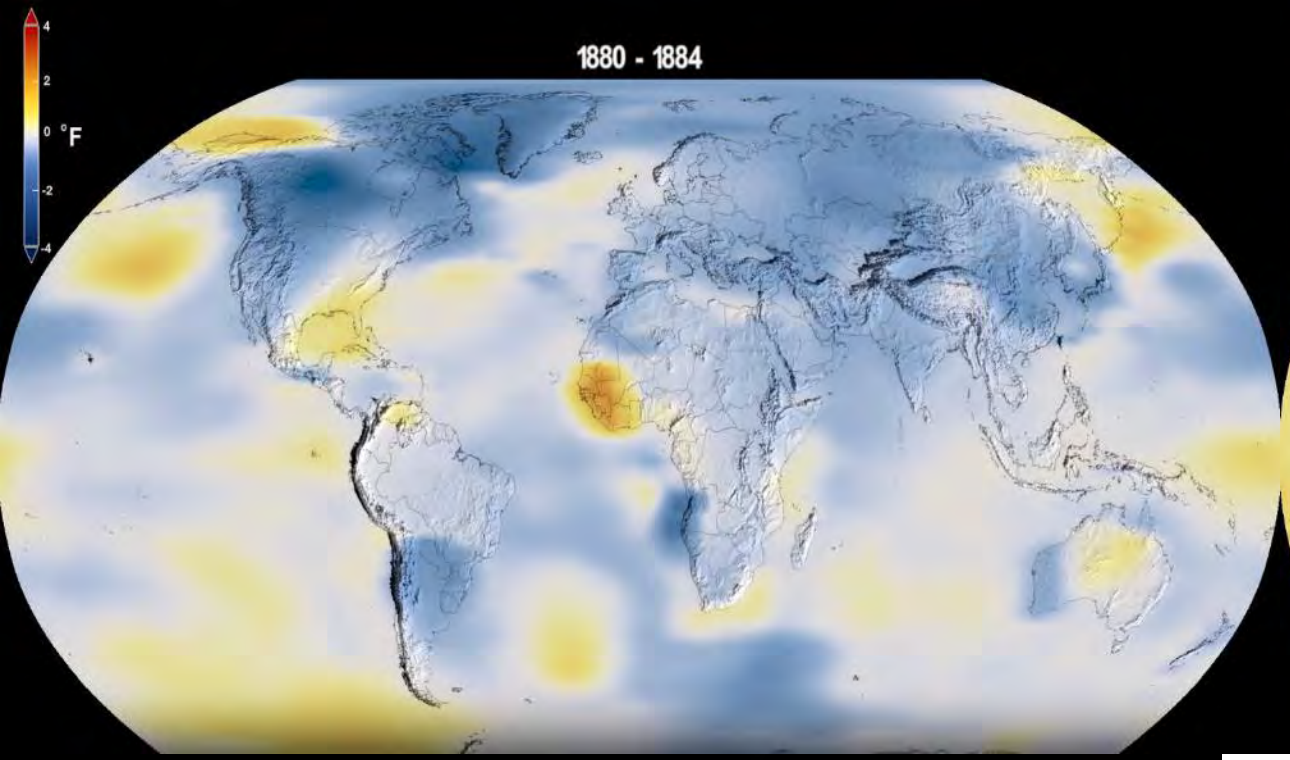
N

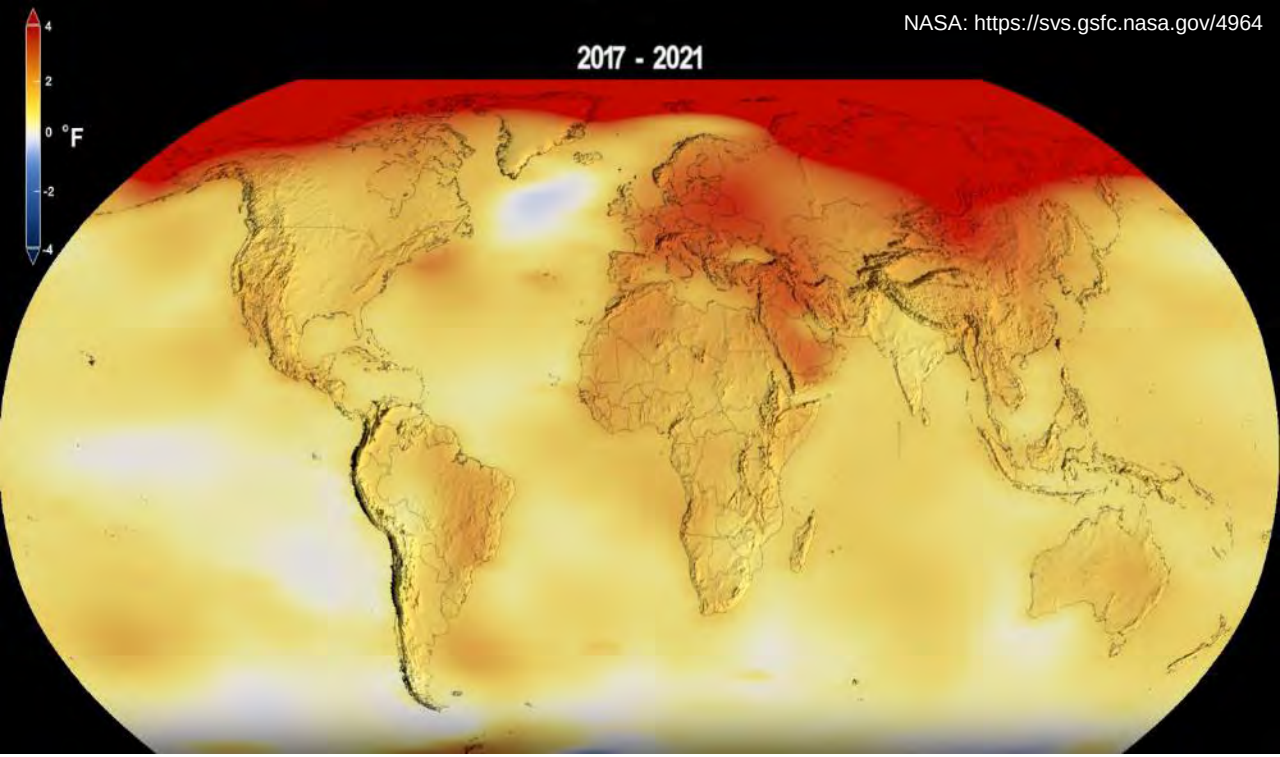
S

0 25 50 km

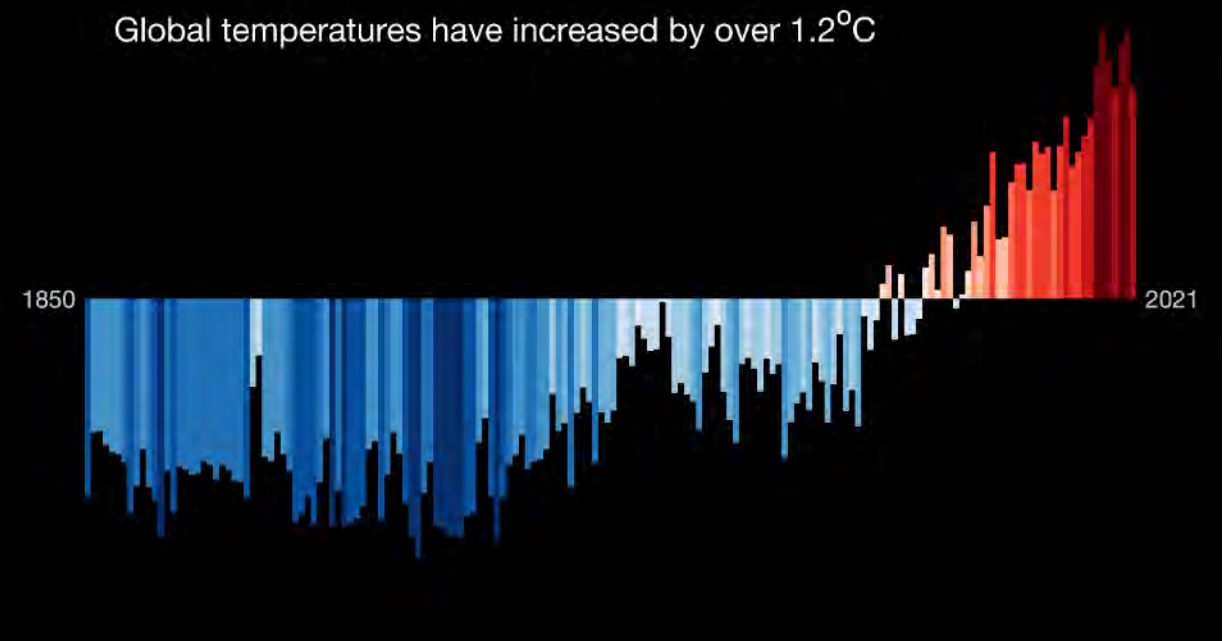
0 25 50 mi

NASA: https://svs.gsfc.nasa.gov/4964





"Normal" temperatures are calculated over the 30-year baseline period 1951-1980



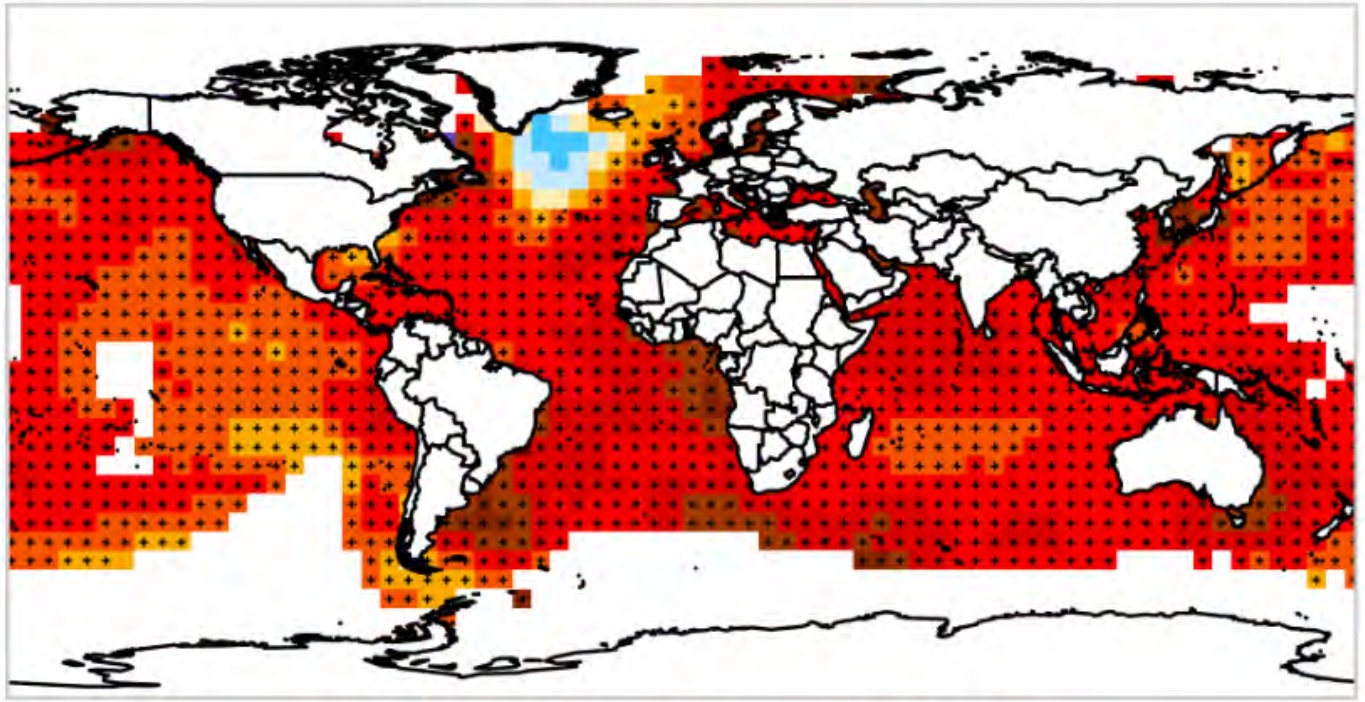
Global temperatures are a significant driver of change across our planet.

Global temperatures have and are *rising*!

Melting Glaciers

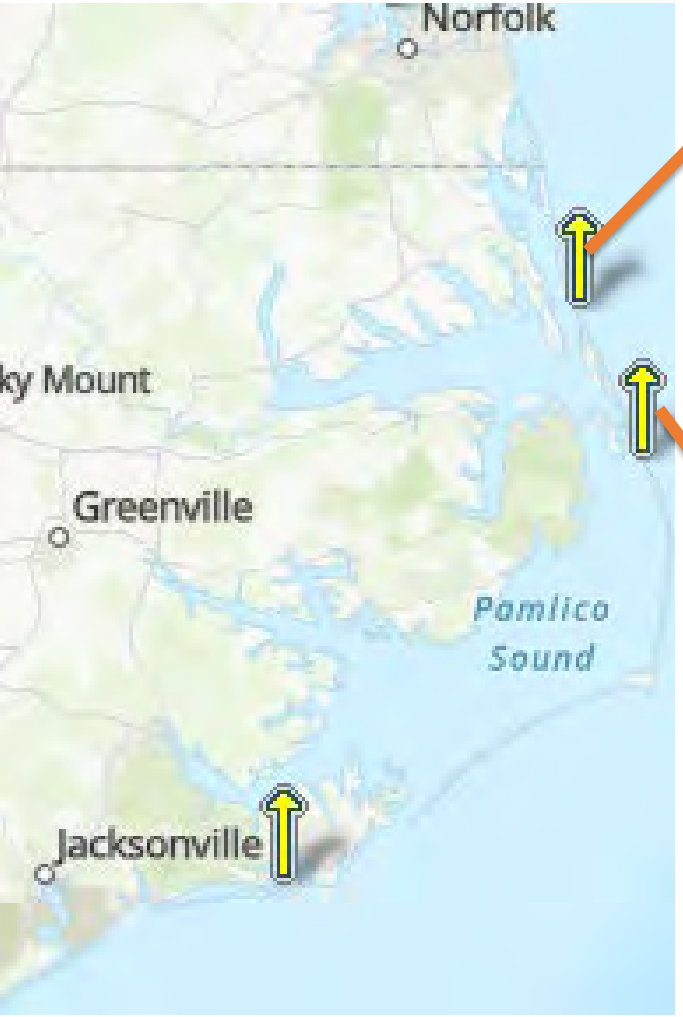
Muir Glacier, Alaska, 1941 and 2004

Rising Ocean Temperatures

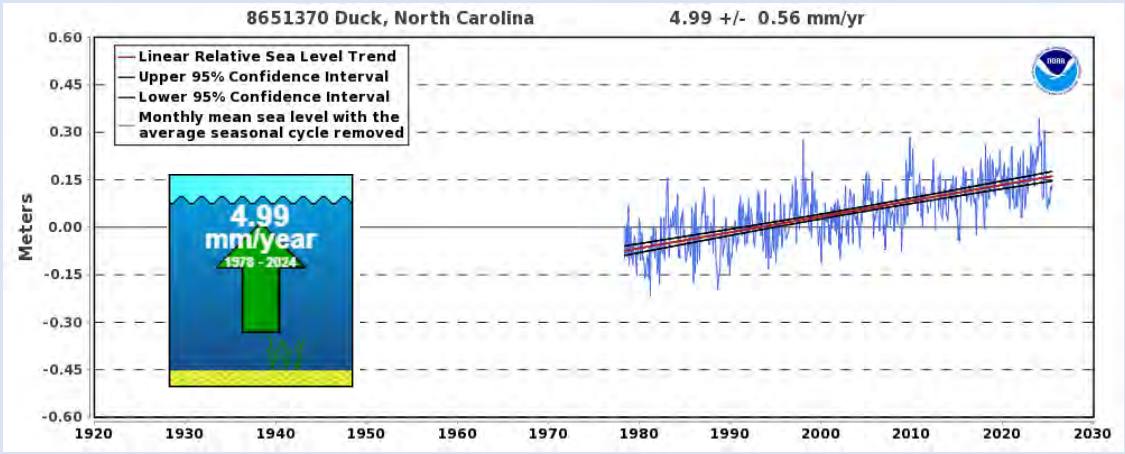


Data source: IPCC, 2013; NOAA, 2021

Relative Sea Level on the Outer Banks

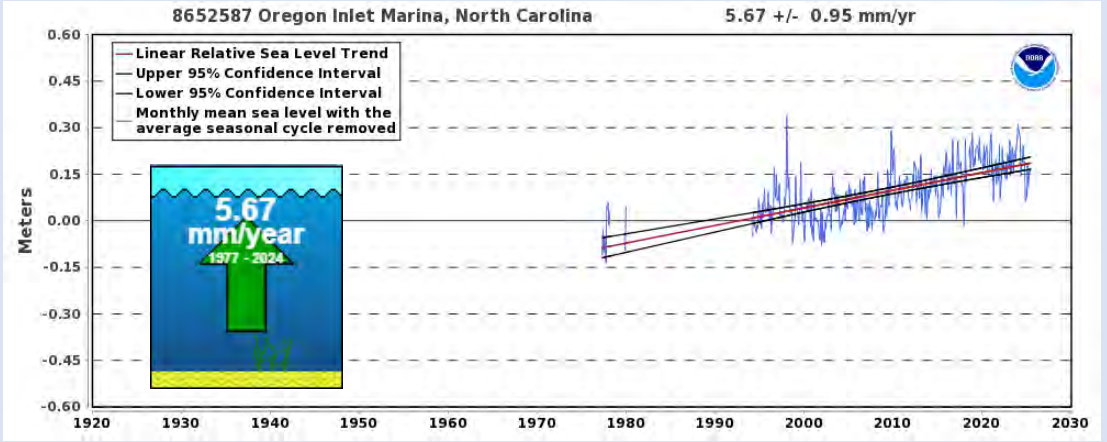


Duck, NC



"The relative sea level trend is 4.99 mm/year with a 95% confidence interval of +/- 0.56 mm/year based on monthly mean sea level data from 1978 to 2024 which is equivalent to a change of 1.64 feet in 100 years."

Oregon Inlet, NC



"The relative sea level trend is 5.67 mm/year with a 95% confidence interval of +/- 0.95 mm/year based on monthly mean sea level data from 1977 to 2024 which is equivalent to a change of 1.86 feet in 100 years."

Source: tidesandcurrents.noaa.gov/sltrends/

October 2024

NORTH CAROLINA 2024 Sea Level Rise

SCIENCE UPDATE

Science panel applies 2022 sea level report projections to NC

10/28/2024 by Jennifer Allen

Debris associated with house collapse at 23001 G A Kohler Court in Buxton Sept. 20. Coastal

LOCAL

NC science panel says coast will see at least 1 foot of sea-level rise by 2050

The sea-level rise projection reflects the findings of a 2022 federal report, which also said ocean levels will increase, and accelerate, after 2050

Gareth McGrath
USA TODAY NETWORK

Nov. 12, 2024, 5:04 a.m. ET

Rows of sandbags protect threatened condominiums at the north end of North Topsail Beach on Oct. 21, 2024. the state's coastal science panel has said North Carolina should prepare for 1 foot of sea-level rise by 2050, which could create more challenges for coastal communities. *KEN BLEVINS/STARNEWS*

Members of the N.C. Coastal Resources Commission Science Panel

The Science Panel consists of the following individuals, who serve voluntarily and at the pleasure of the N C. Coastal Resources Commission

Dr. Laura Moore, Chair
Professor, UNC-Chapel Hill, Department of Earth, Marine and Environmental Sciences

Mr. Kevin Conner, P.E.
US Army Corps of Engineers, Wilmington

Dr. Reide Corbett
Executive Director of Coastal Studies Institute, Dean of Integrated Coastal Programs, East Carolina University

Dr. Andrea Hawkes
Associate Professor of Geology, University of North Carolina Wilmington

Dr. Joseph W. Long
Director Coastal Engineering Program, Department of Physics & Physical Oceanography, University of North Carolina Wilmington

Dr. Jesse McNinch
Research Oceanographer, US Army Corps of Engineers

Dr. A. Brad Murray
Professor, Nicholas School of the Environment, Division of Earth and Ocean Science, Duke University

Dr. Martin Posey
Professor, Department of Biology and Marine Biology, University of North Carolina Wilmington

Mr. Spencer Rogers
North Carolina Sea Grant, Wilmington

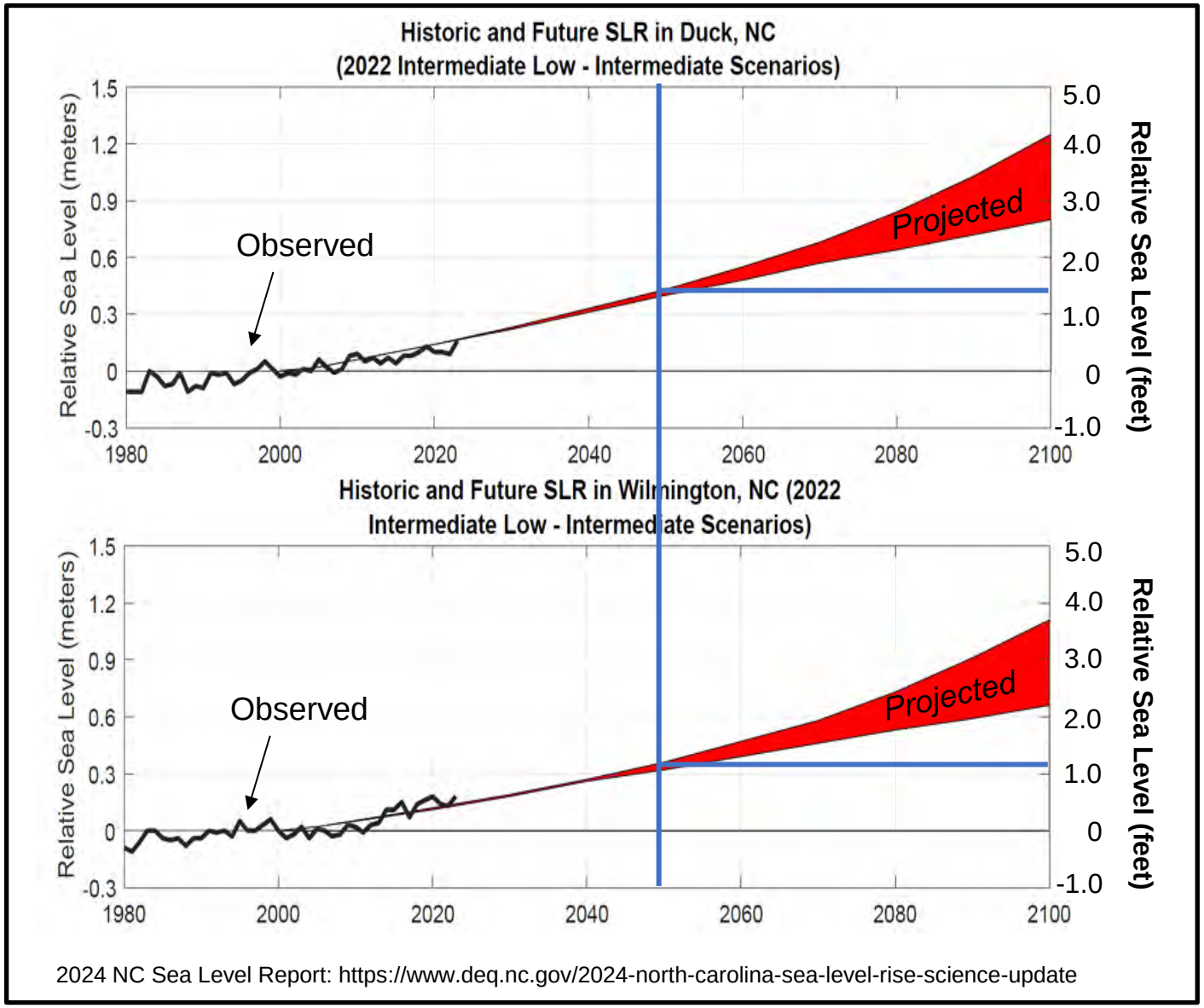
Mr. Greg "Rudi" Rudolph
Coastal Geologist, Sulmara Subsea

What does the latest science say about future SLR in NC?

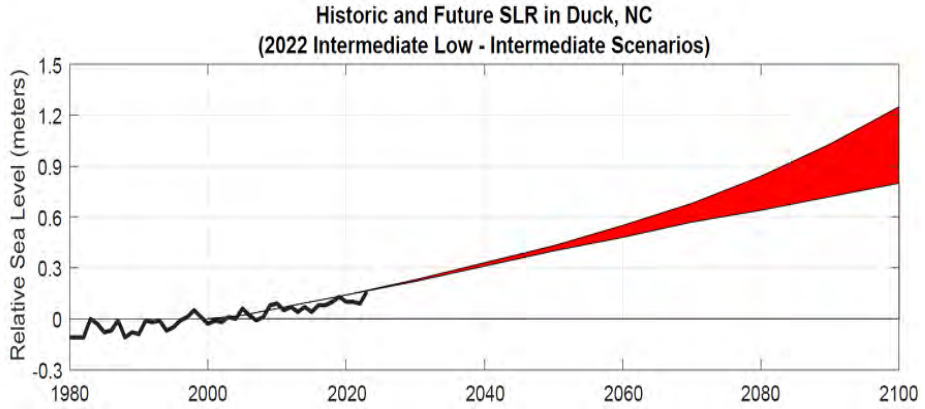
- The report projects **1.0 – 1.4 ft of sea level rise by 2050** (Intermediate-Low & Intermediate Scenarios) **in the Southeast,** relative to 2000.

- Emissions are **on track for a sea level rise of 2 – 4 feet by 2100** (Intermediate-Low – Intermediate Scenarios).

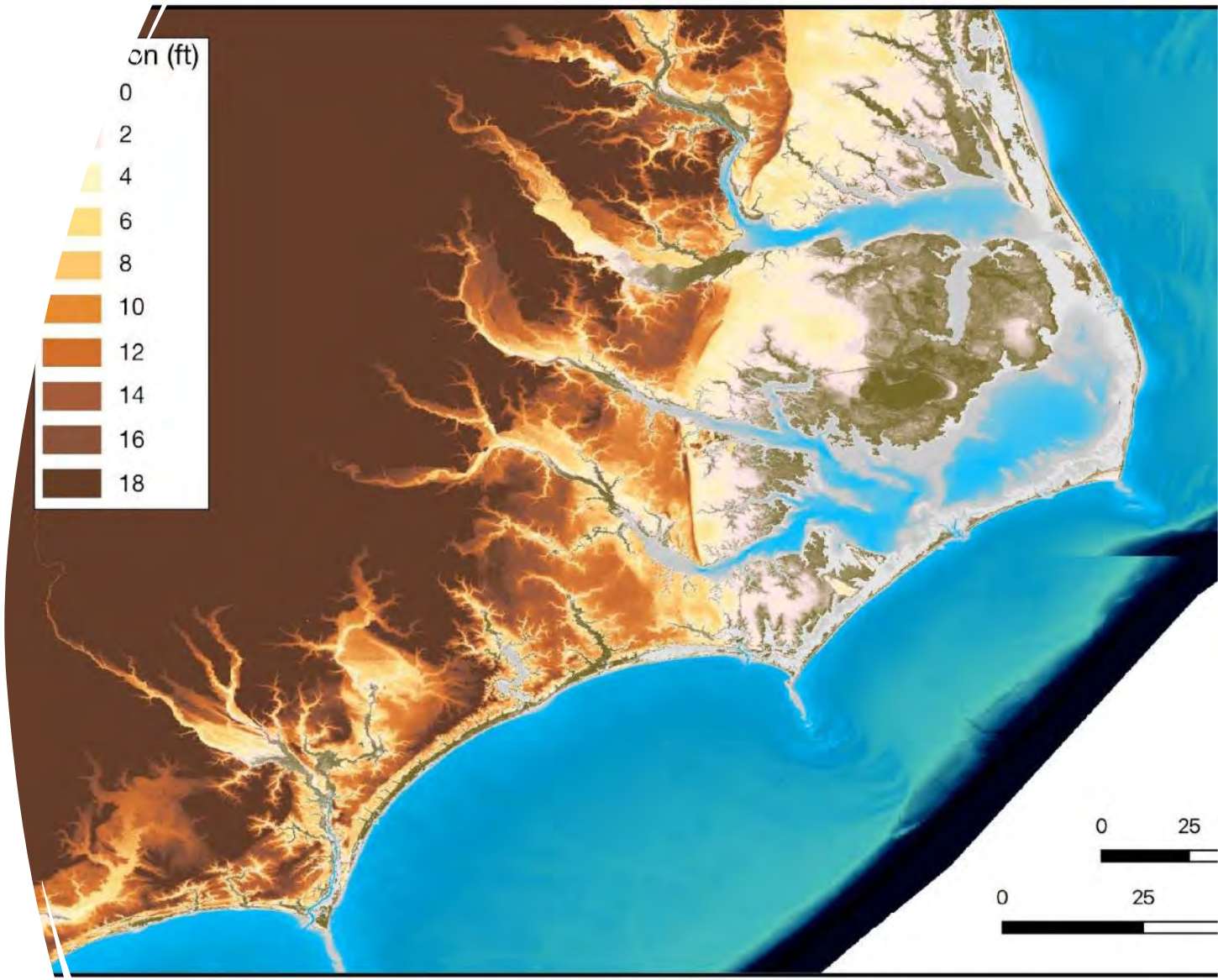
- RSLR in NC varies, with higher rates in the north relative to the south, largely due to differences in vertical land motion.



2024 NC Sea Level Report: https://www.deq.nc.gov/2024-north-carolina-sea-level-rise-science-update



Are there examples of environmental changes in coastal NC?



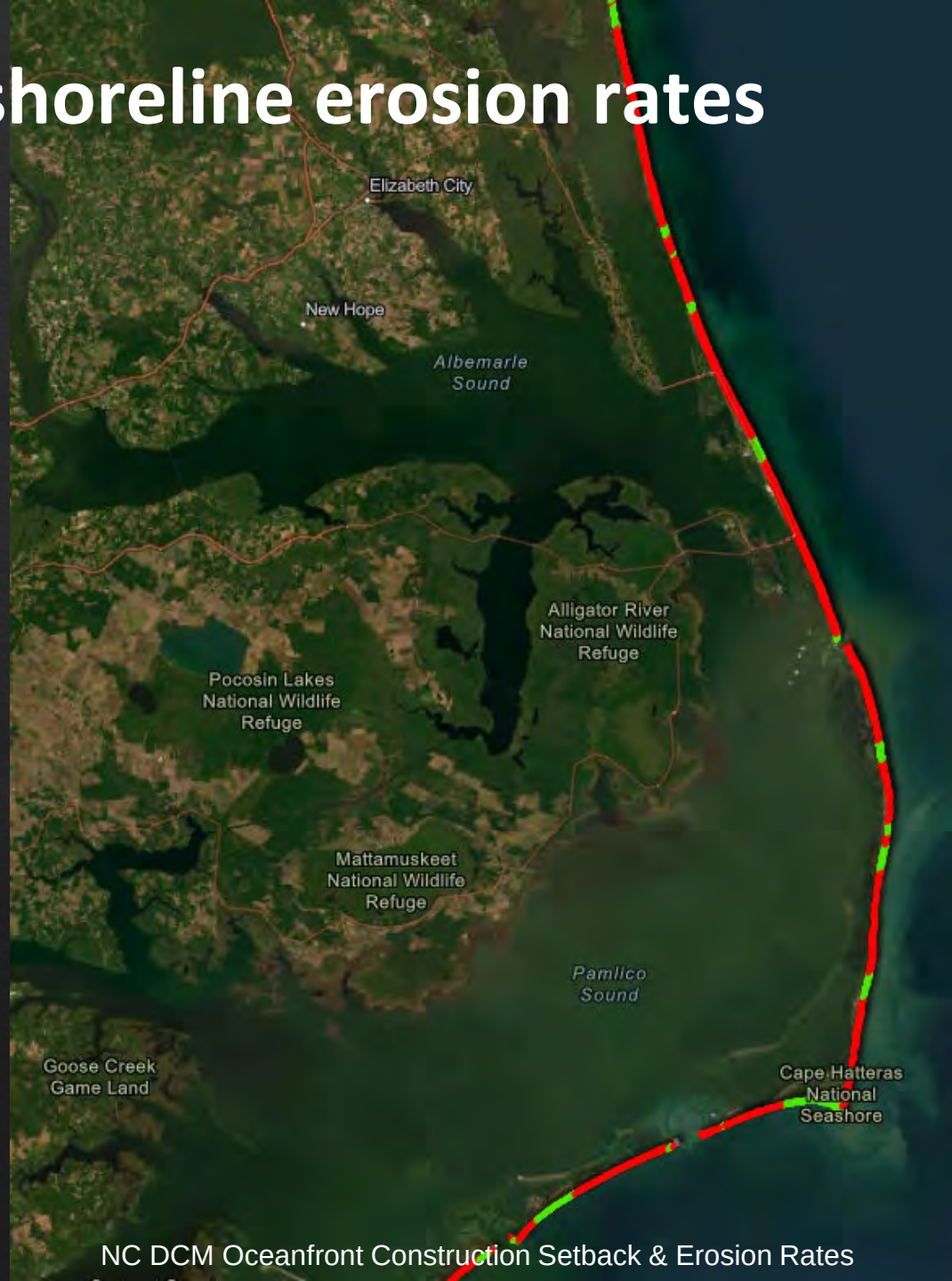
Continued and increasing long-term shoreline erosion rates

- The ocean shoreline erodes over time where more sand is lost from the shoreline than supplied.
- Losses related to sea level rise will increase and so background, long-term erosion rates will increase.

Continued and increasing long-term shoreline erosion rates

Buxton

NC Division of Coastal Management



NC DCM Oceanfront Construction Setback & Erosion Rates

SUNDAY MORNING ›

Coastal residents on climate change: "The ocean's coming for you"

CBS NEWS

SUNDAY MORNING

BY BEN TRACY

JANUARY 8, 2023 / 10:19 AM / CBS NEWS

*"**The ocean has become an increasingly greedy neighbor.** Storms are more frequent, and more fierce. Parts of these Barrier Islands have retreated more than 200 feet in the last two decades. **Some beaches are now losing about 13 feet a year**, according to the National Park Service."*

https://www.cbsnews.com/news/coastal-residents-on-climate-change-sea-level-rise-beach-erosion/

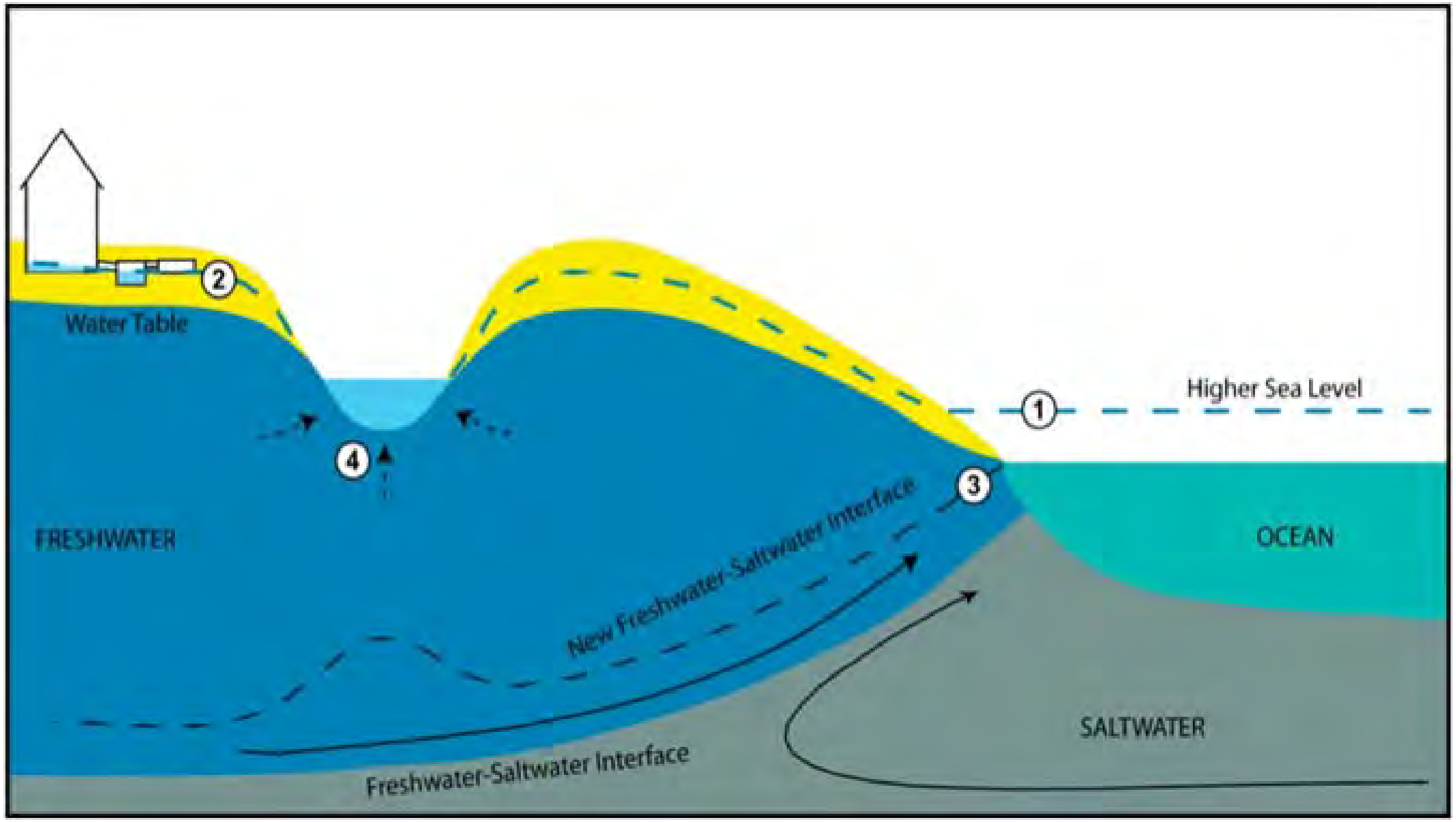
Imelda, Humberto Wreak Havoc On North Carolina Beach Homes

10/5/25

The Weather Channel

https://weather.com/storms/hurricane/video/north-carolina-beach-homes-collapse-in-imelda-waves

Rising water table



Rising water table

Stormwater Runoff Backup → Increased Flooding During Storms

Credit: Island Free Press

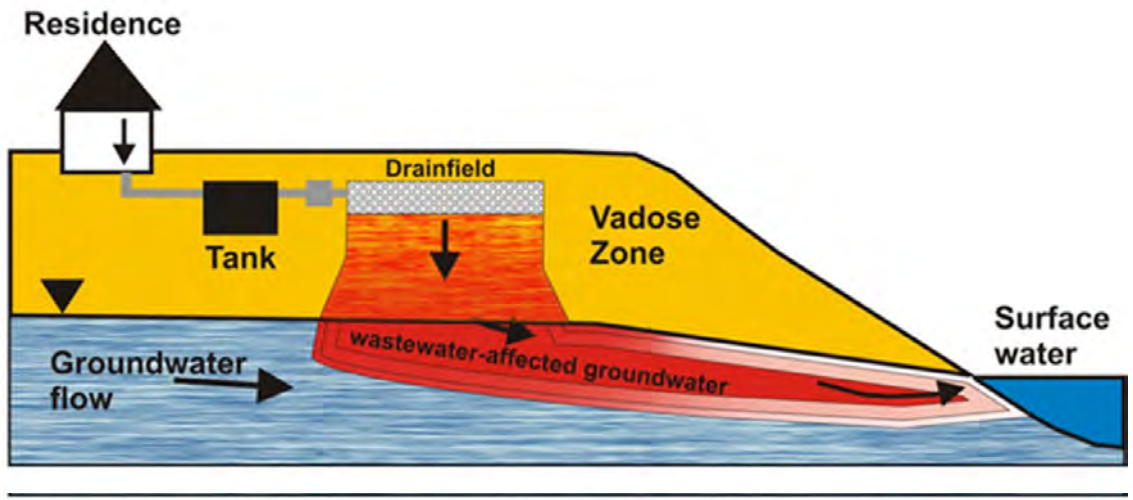
Credit: Outer Banks Voice

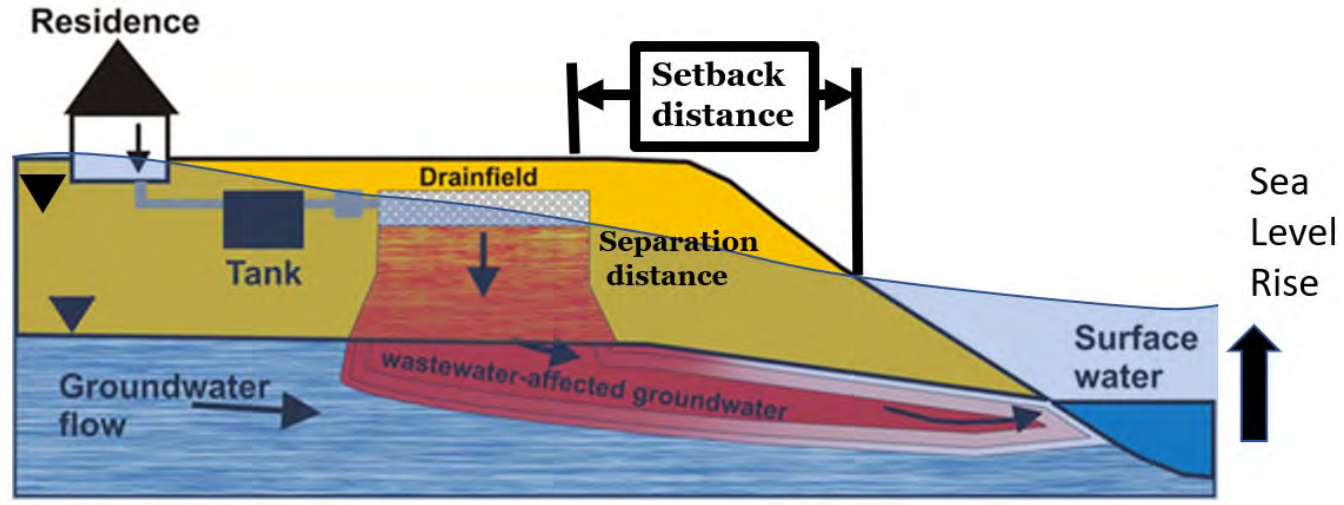
Exacerbated by…

Credit: http://jockeysridge.blogspot.com/v

Credit: Reide Corbett

Septic system failure

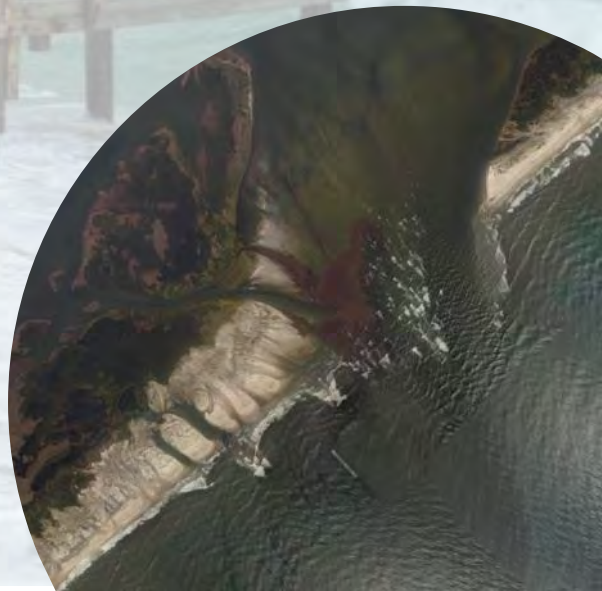




- High-tide flooding, extreme precipitation and sea level rise result in “immediate and long-term losses of on-site wastewater system functionality”
- These factors reduce unsaturated soils underneath the drainfield; lead to poor treatment, backing up, and **pollution**.

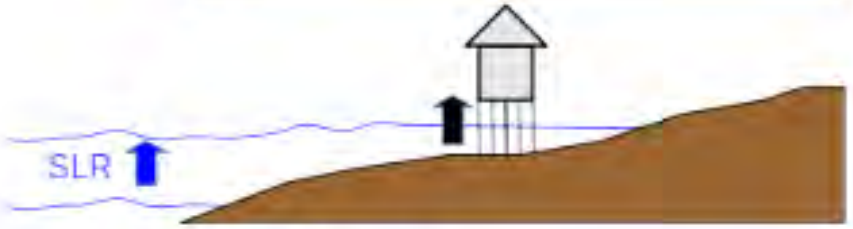
From Harrison, Edwards, Humphrey, O’Driscoll, Hill & community partners

What can we do?

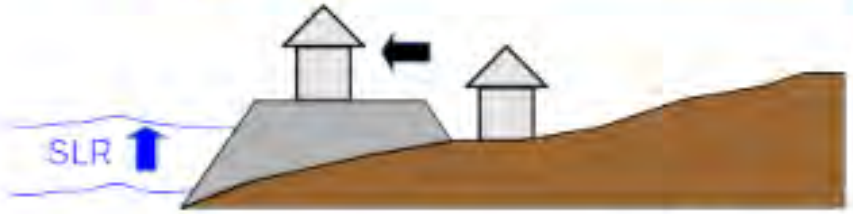


No response

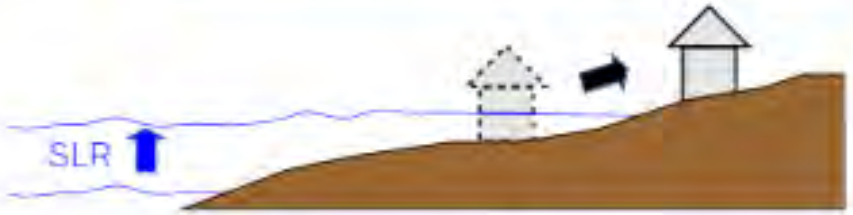
Protect



Accommodate

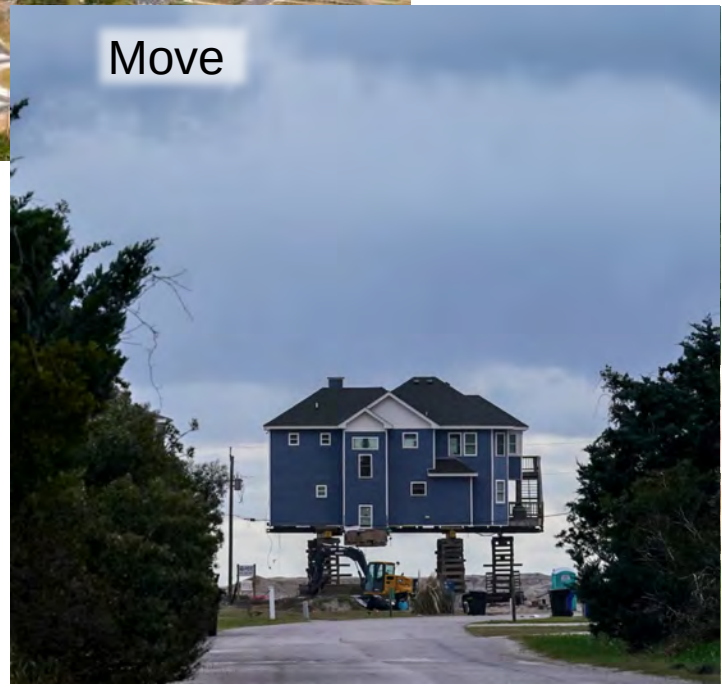


Advance



Deconstruct or Move

Ecosystem-based adaptation (EbA)



2019 - IPCC SR Ocean and Cryosphere; CH. 4. Sea Level Rise and Implications for Low Lying Islands, Coasts and Communities; https://report.ipcc.ch/srocc/pdf/SROCC_FinalDraft_Chapter4.pdf

What are My Options Right Now?

Homeowner Costs/Financial Assistance for Home Deconstruction

	Homeowner Can Pay Full Cost	Potential for Insurance Funding?	Potential for FEMA (HMGP) Funding?
Let the home collapse 	**Yes** Homeowner will be required to pay for debris cleanup (costs vary, estimate upwards of $50K)	**Maybe** But an insurance payout is not guaranteed (up to $250K for the home, up to $100K for belongings)	No
Deconstruct the home 	**Yes** (~$30K-50K)	**Maybe** One homeowner was successful in 2025	**Likely** FEMA will need to award Dare County the grant
Purchase a new lot and move the home – backward on the same lot or to a new lot 	**Yes** New lot: There are a limited number of available land parcels in the Outer Banks	No	

At-Risk Oceanfront Structures
Dare County Public Meeting

Takeaways

- Developed barrier islands, and properties on them, are increasingly vulnerable to storm and climate hazards.
- There are emerging sound-side (high tide flooding) and groundwater hazards (septic and water quality issues), which may not make it to flood disclosures, but influence property livability.
- These emerging hazards may also influence whether people stay or go.

ECU

corbettd@ecu.edu