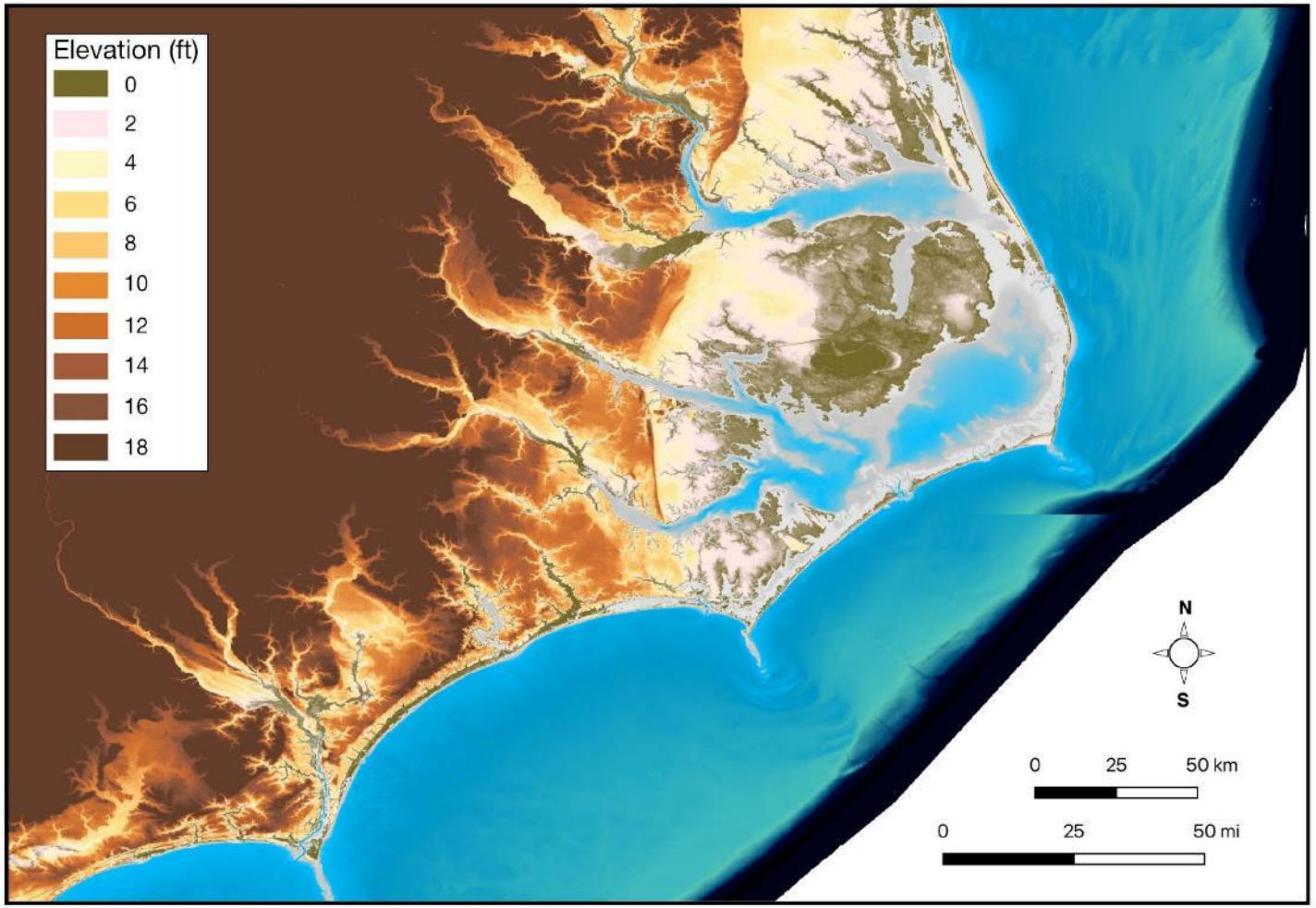
North Carolina's Changing Coast

Reide Corbett

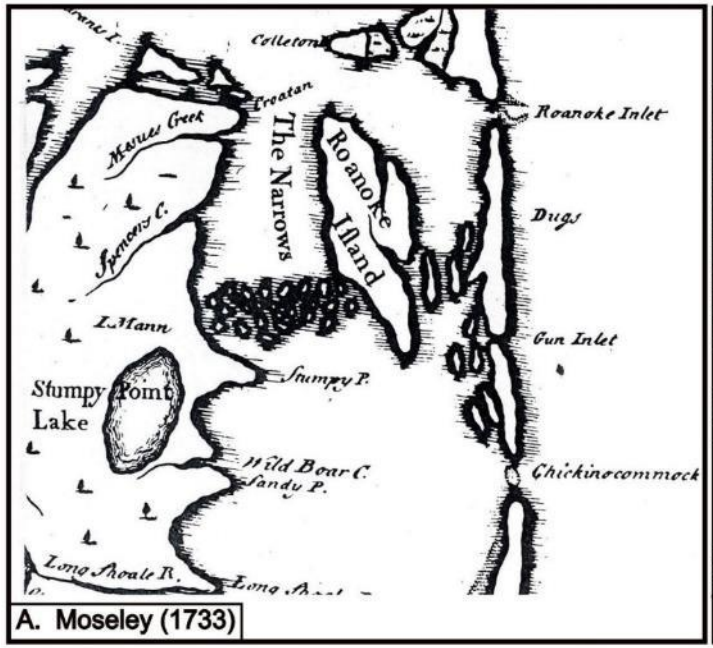
Dean of Integrated Coastal Programs
East Carolina University
Executive Director, Coastal Studies Institute



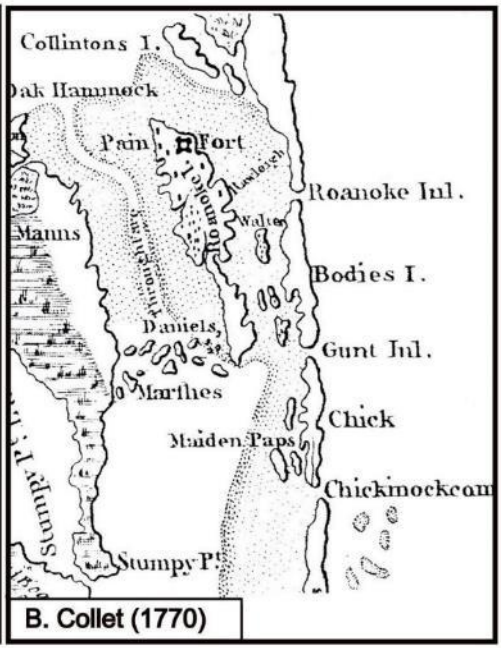
ECU

Coastal Studies Institute
University of North Carolina

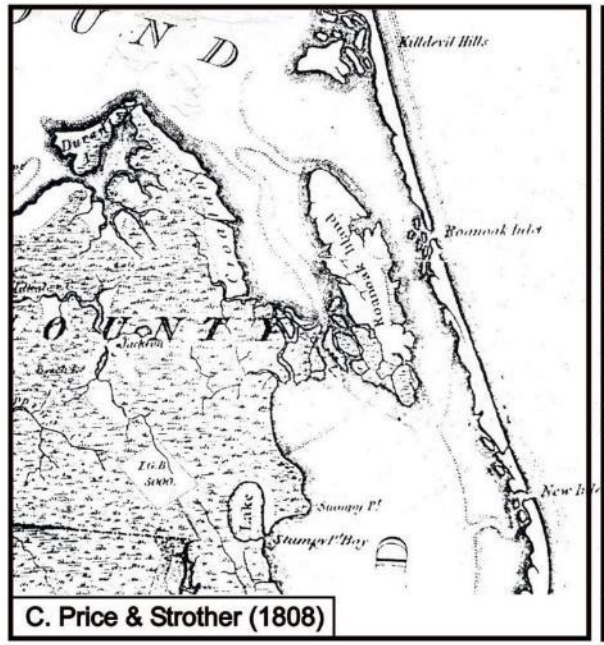
Change along the NC coast is NOT a new concept…



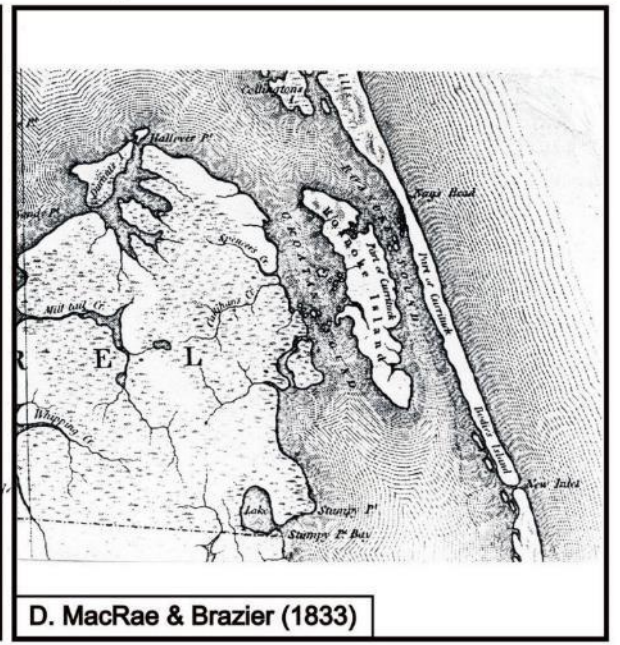
A. Moseley (1733)



B. Collet (1770)

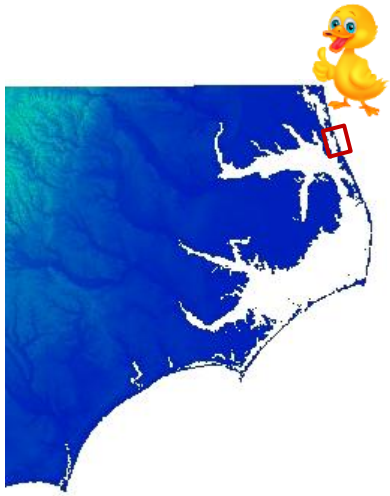


C. Price & Strother (1808)



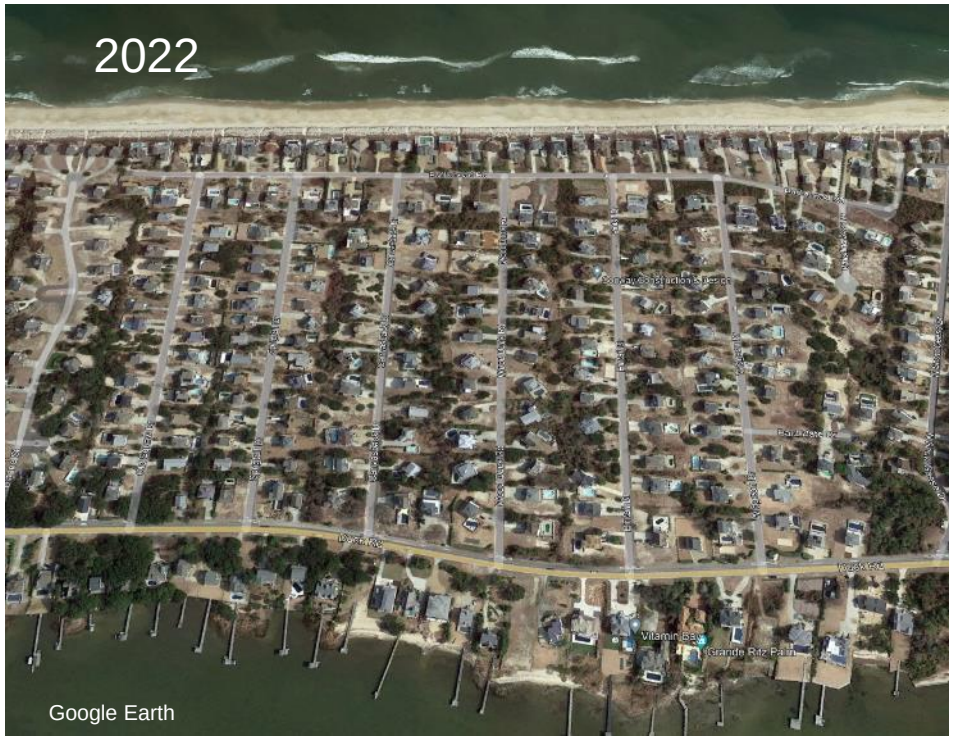
D. MacRae & Brazier (1833)

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



Carolina Dunes

Duck, NC



Today's Goals

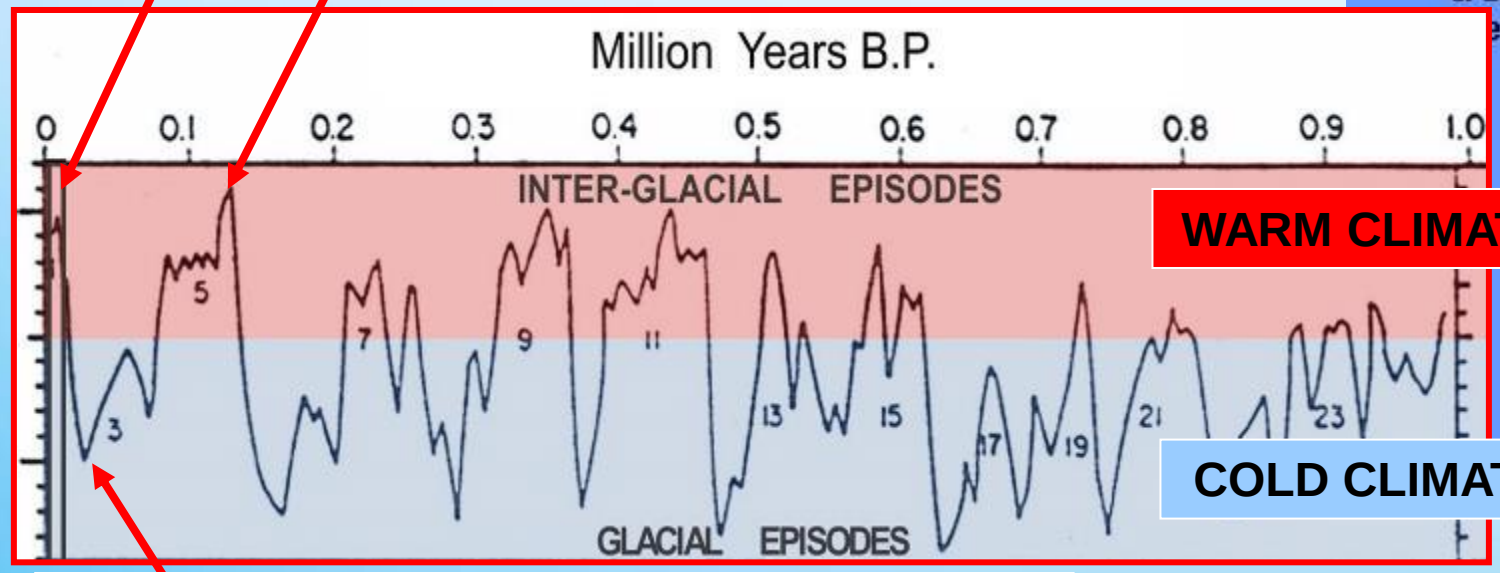
- **Coastal Evolution**
  - *The past is a window into the future.*
- **Modern processes**
  - *Drivers of change…for better or worse change is happening!*
- **Implications of Sea Level Rise and other climate-related hazards**
  - *How will the system change? How will we respond?*

Changes to the System

Geologic Timescales

TODAY

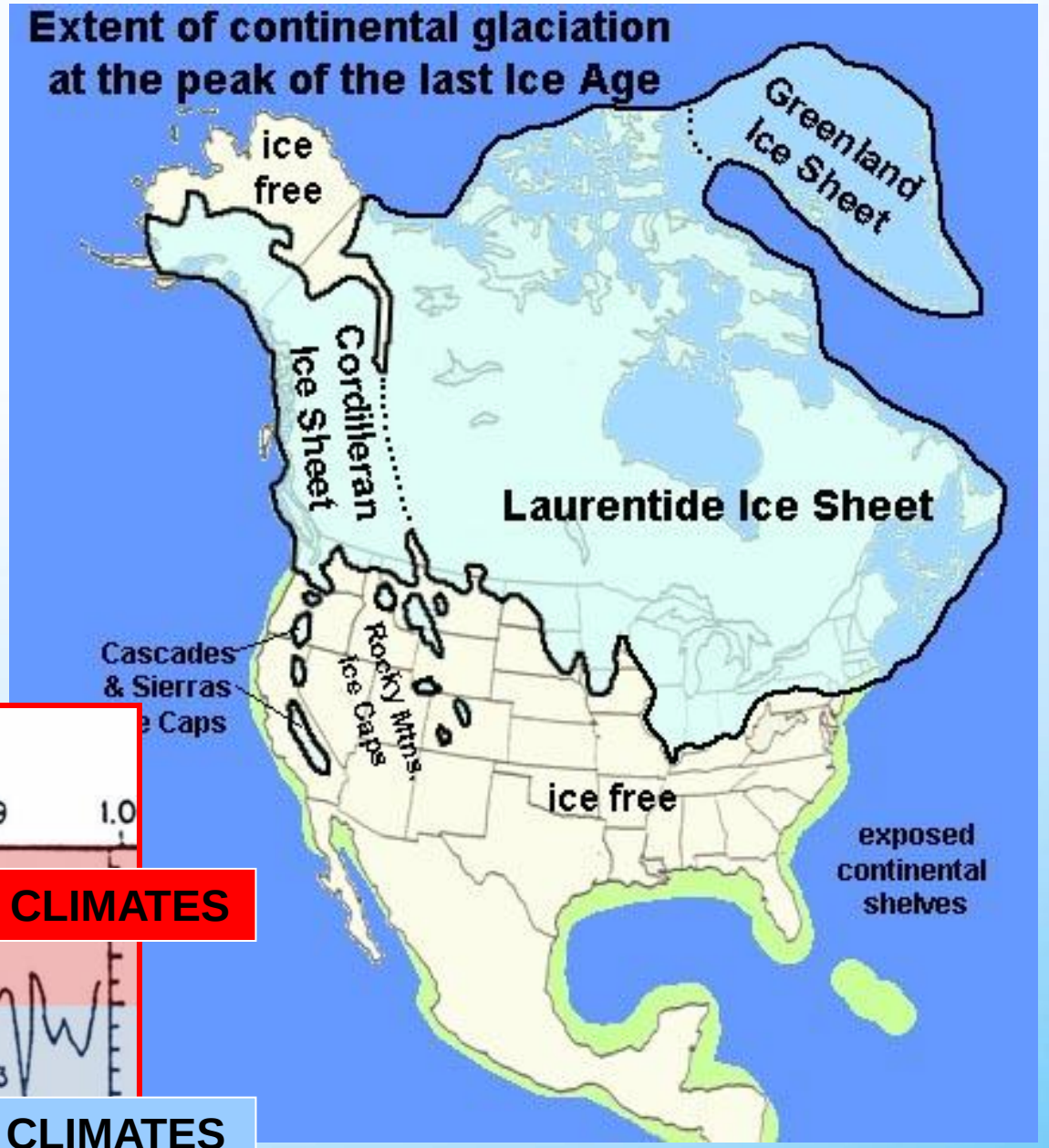
LAST INTERGLACIAL (~125,000 yrs BP)



WARM CLIMATES

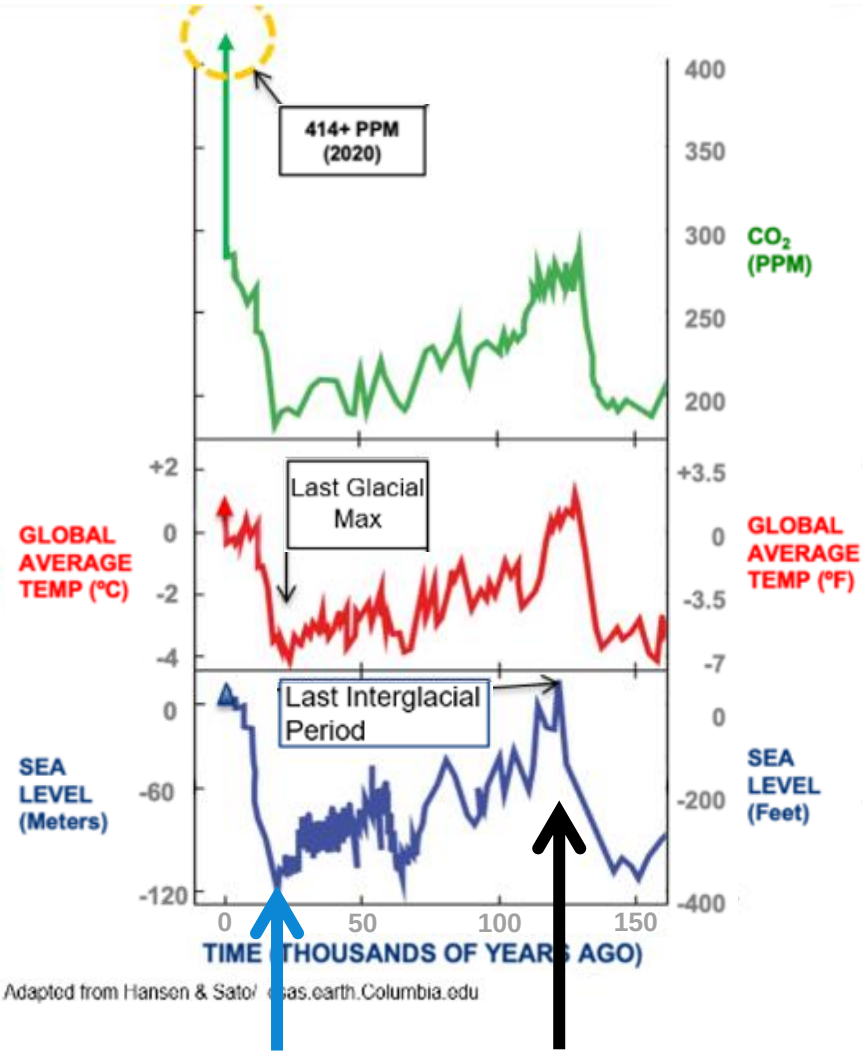
COLD CLIMATES

LAST GLACIAL MAXIMUM (~20,000 yrs BP)



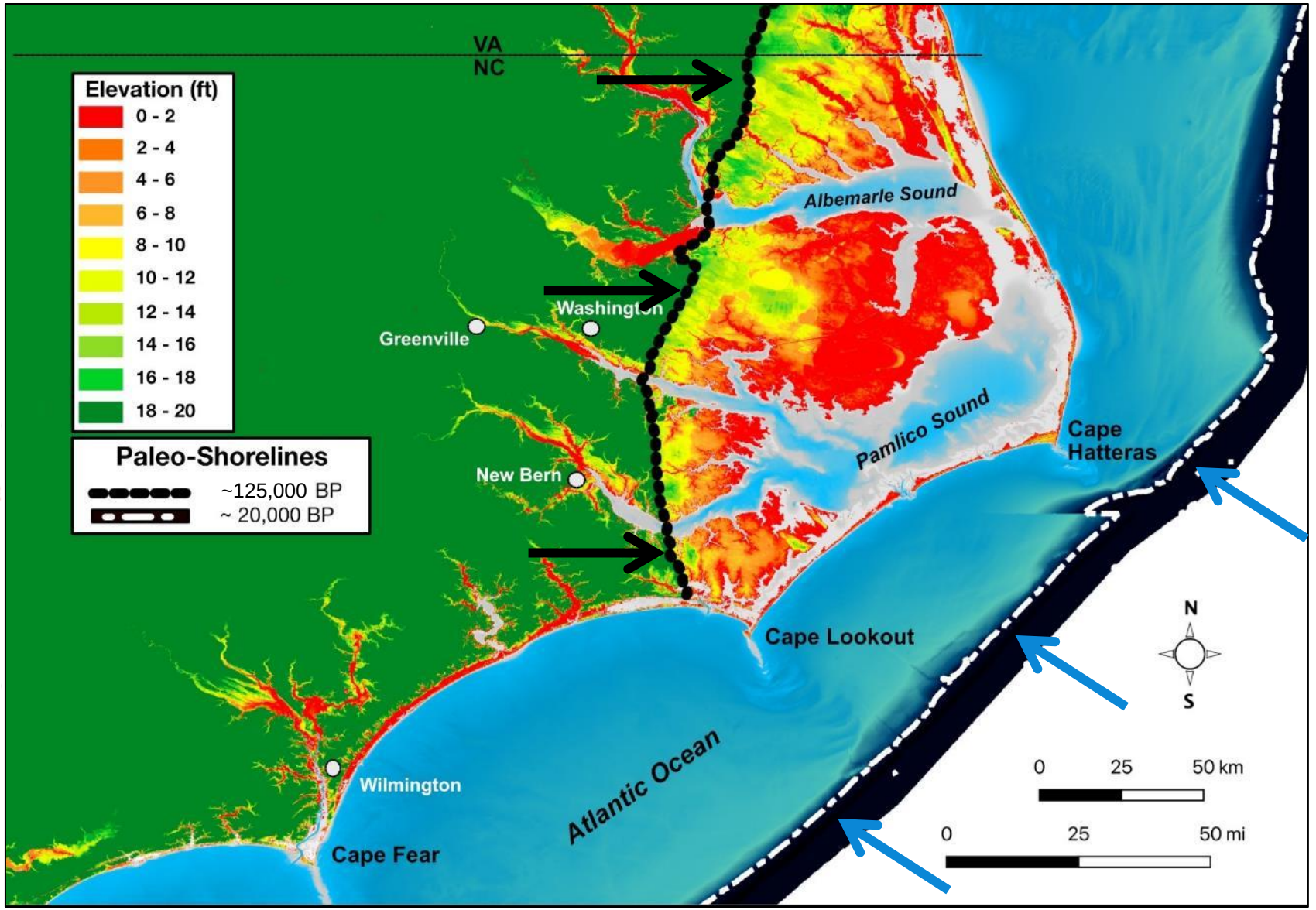
SHACKLETON & OPDYKE (1973)

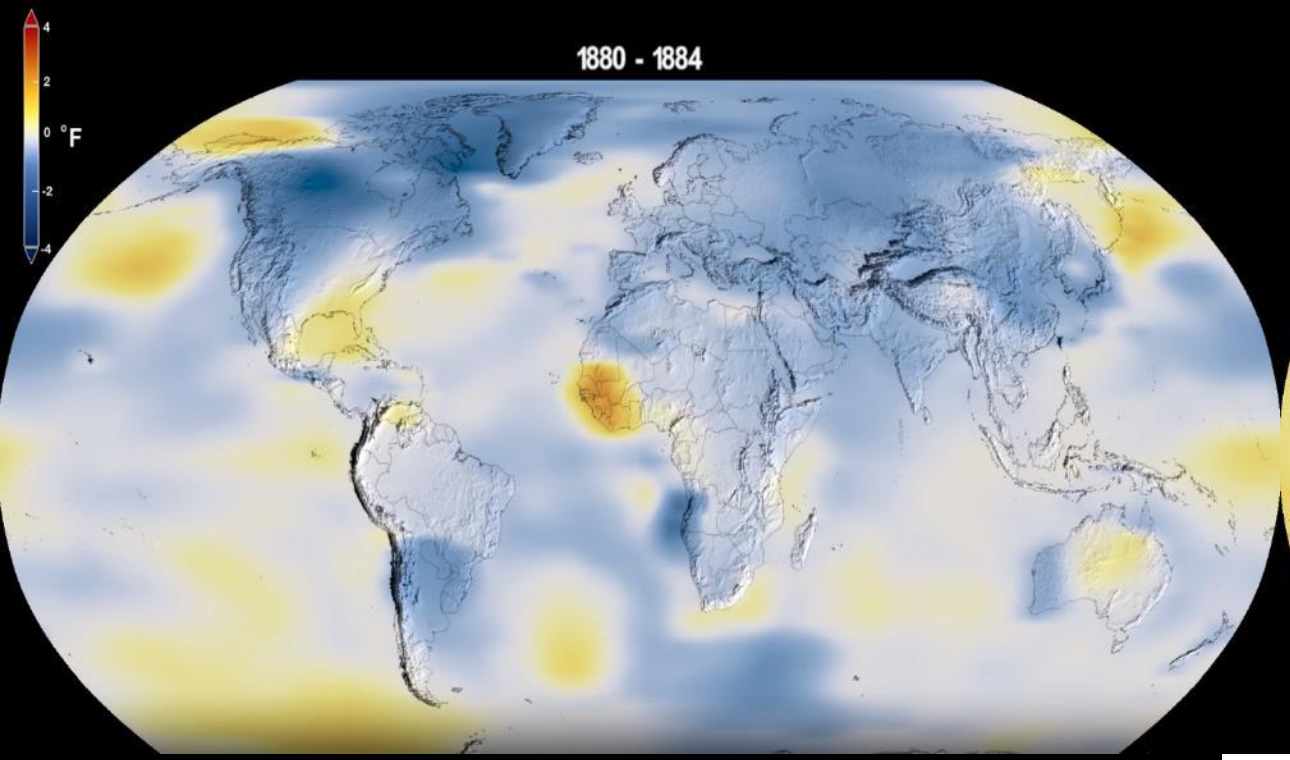
North Carolina's Shorelines of the PAST

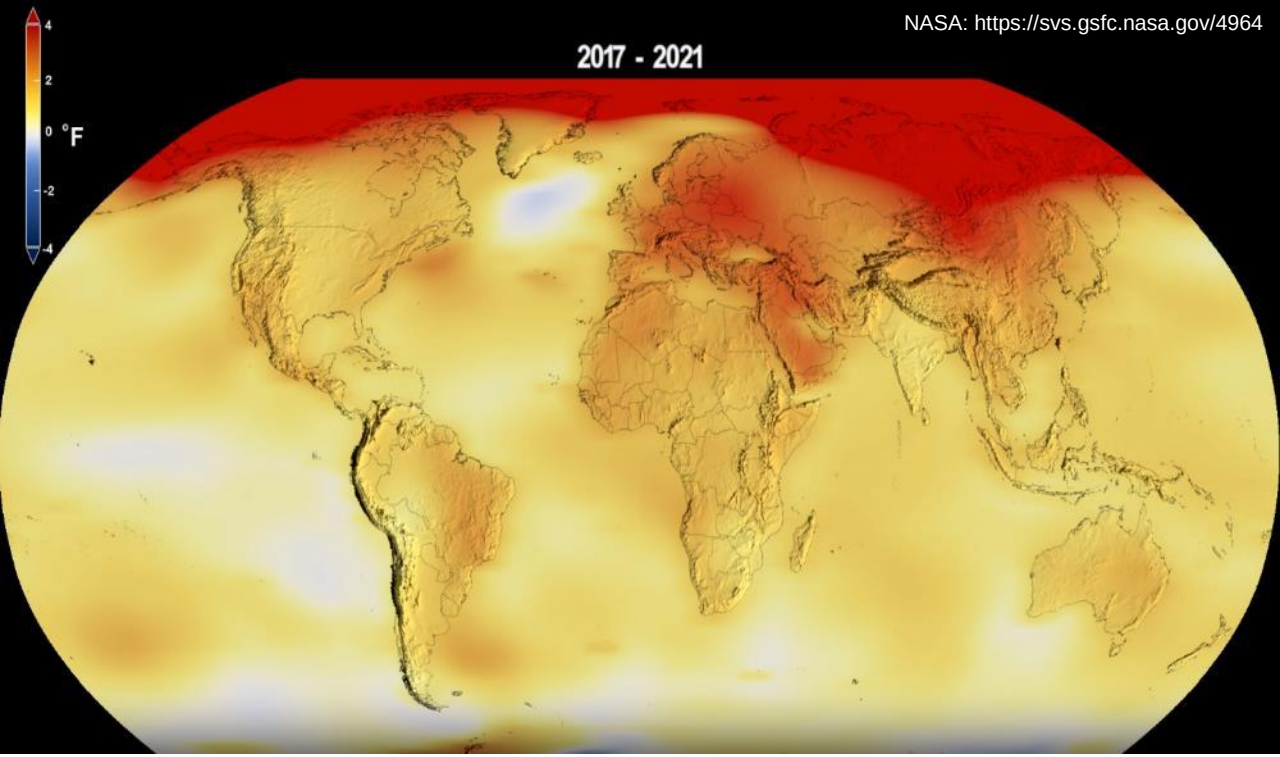


Glacial

Interglacial

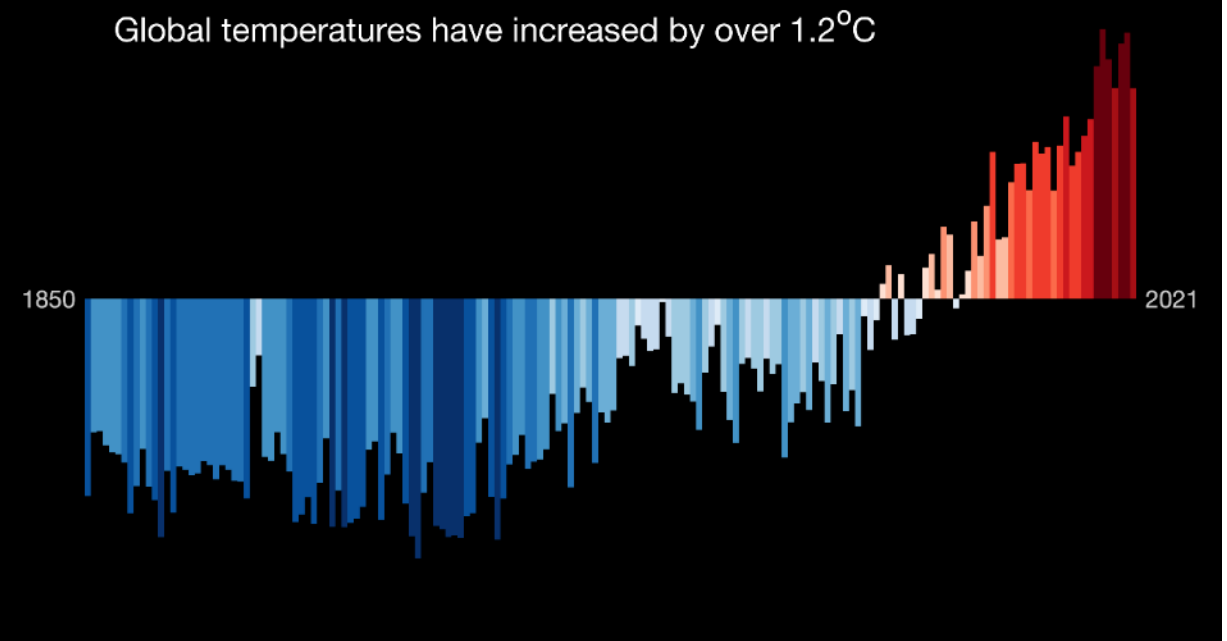






NASA: https://svs.gsfc.nasa.gov/4964

"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 *changing*!

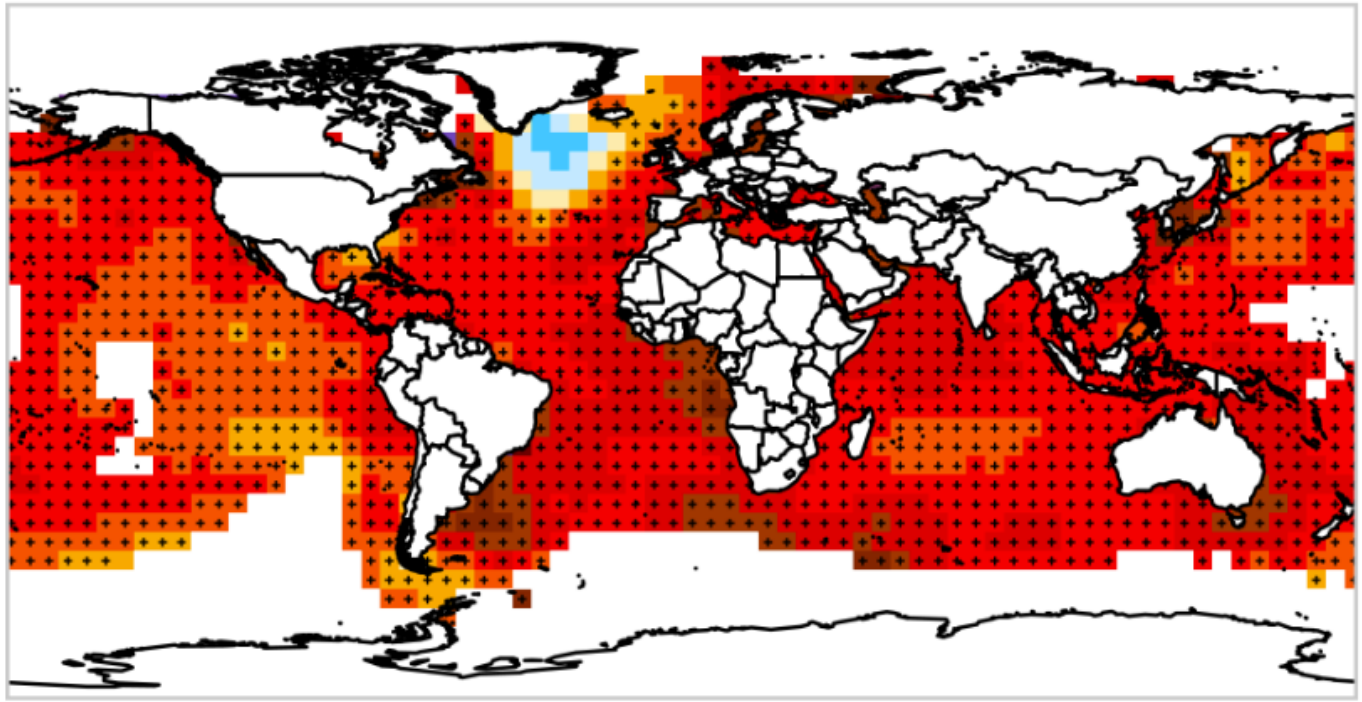
Melting Glaciers

Muir Glacier, Alaska, 1941 and 2004

Fig. 7.1a Muir Glacier, 1941

Fig. 7.1b Muir Glacier, 2004

Rising Ocean Temperatures

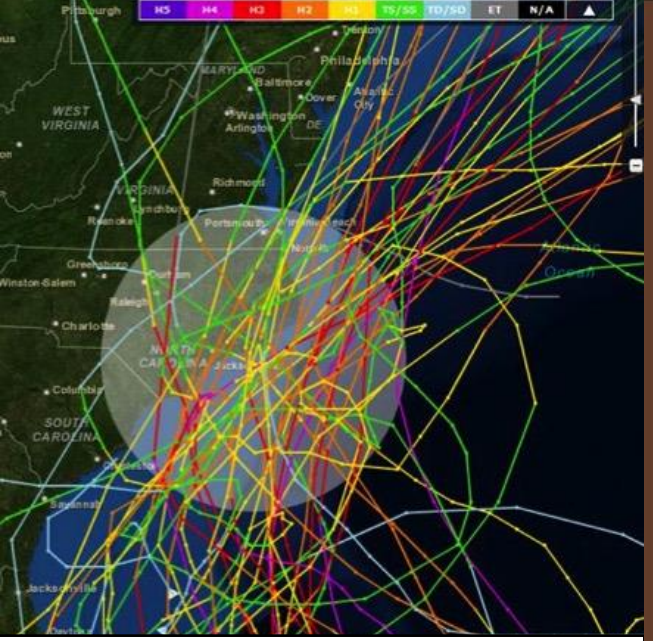


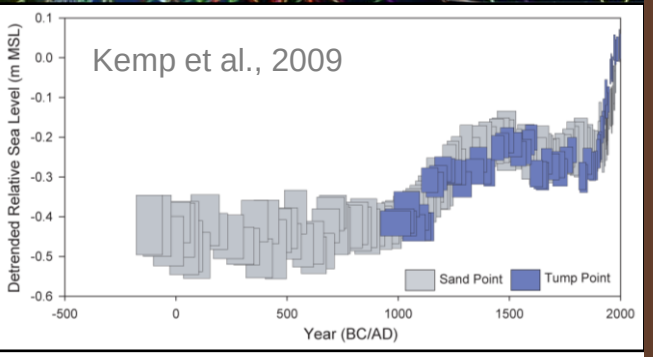
Change in sea surface temperature (°F):

-1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 Insufficient data

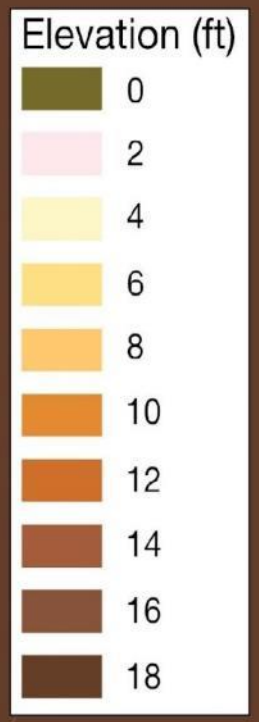
+ = statistically significant trend

Data source: IPCC, 2013; NOAA, 2021

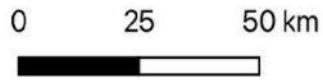




- Low, extensive
- Geology
- Dynamic setting
- Storms
- Sea Level
- Humans



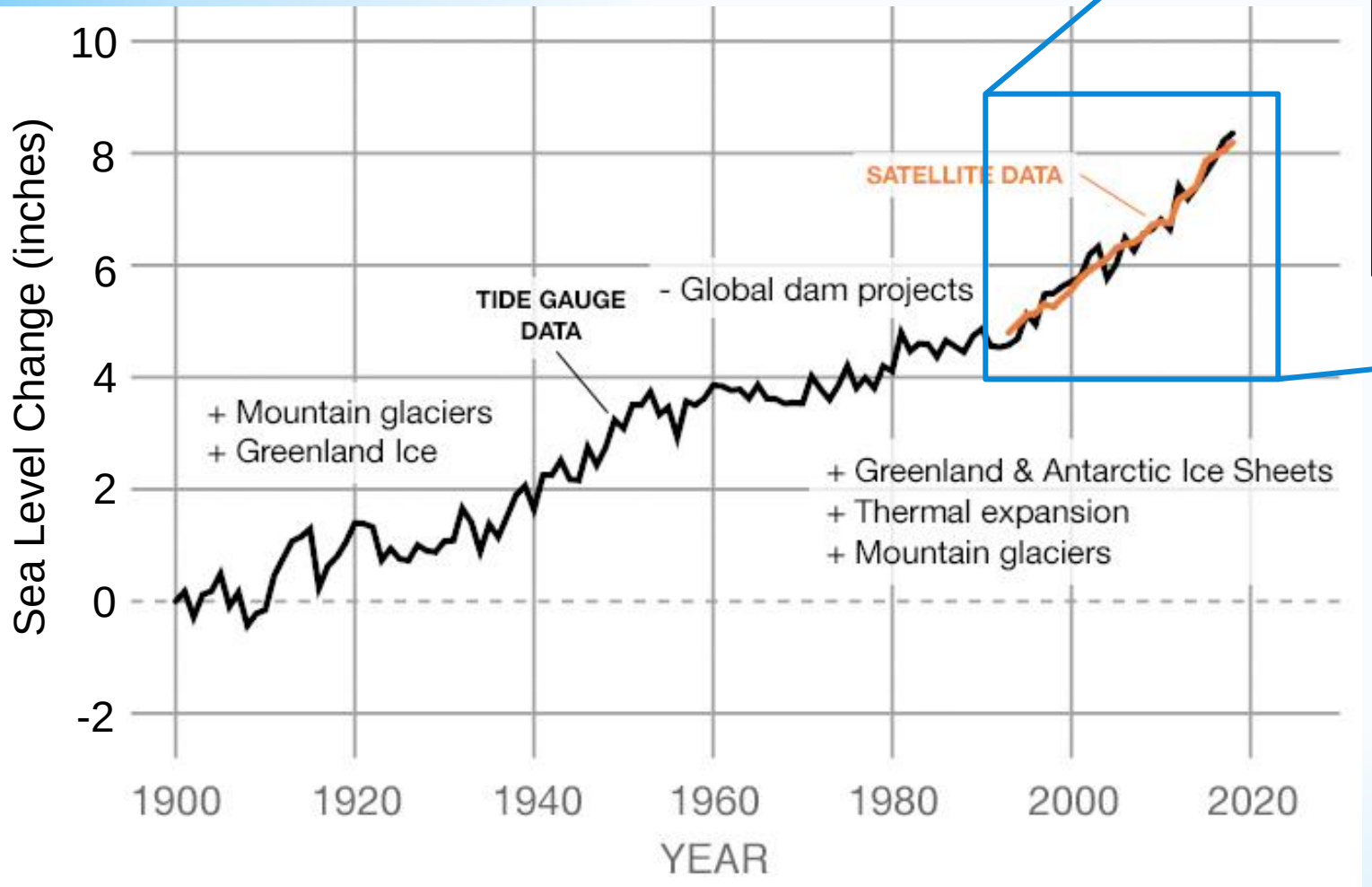
The first step in the process is identifying the vulnerability!

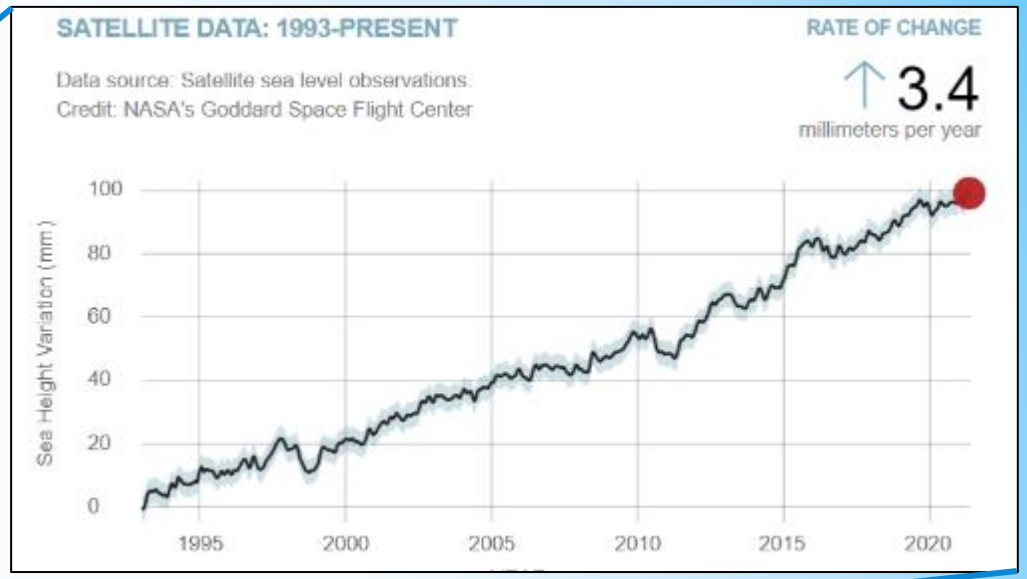


Modern Eustatic Sea Level Change

1.3” per decade

Global sea levels are rising, with recent rates being unprecedented over the past 2,000-plus years.





Coastal tide gauge and satellite data shows how much sea level changed from about 1900 to 2018.

Global Mean Sea Level Rise (GMSL) vs. Relative Sea Level (RSL)

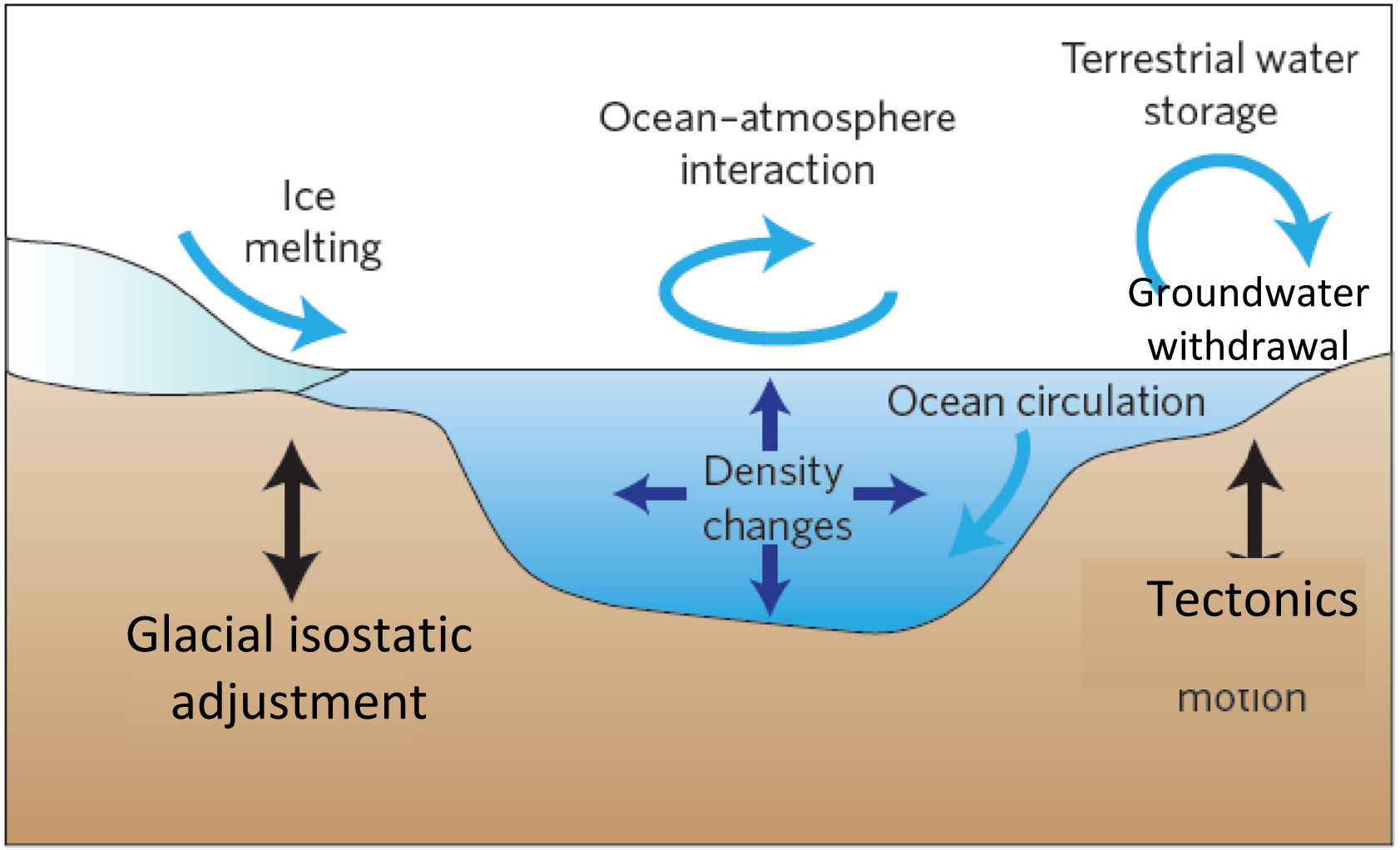
GMSL depends on:

- Melting of land ice
- Water density (temp, salinity)

RSL depends on:

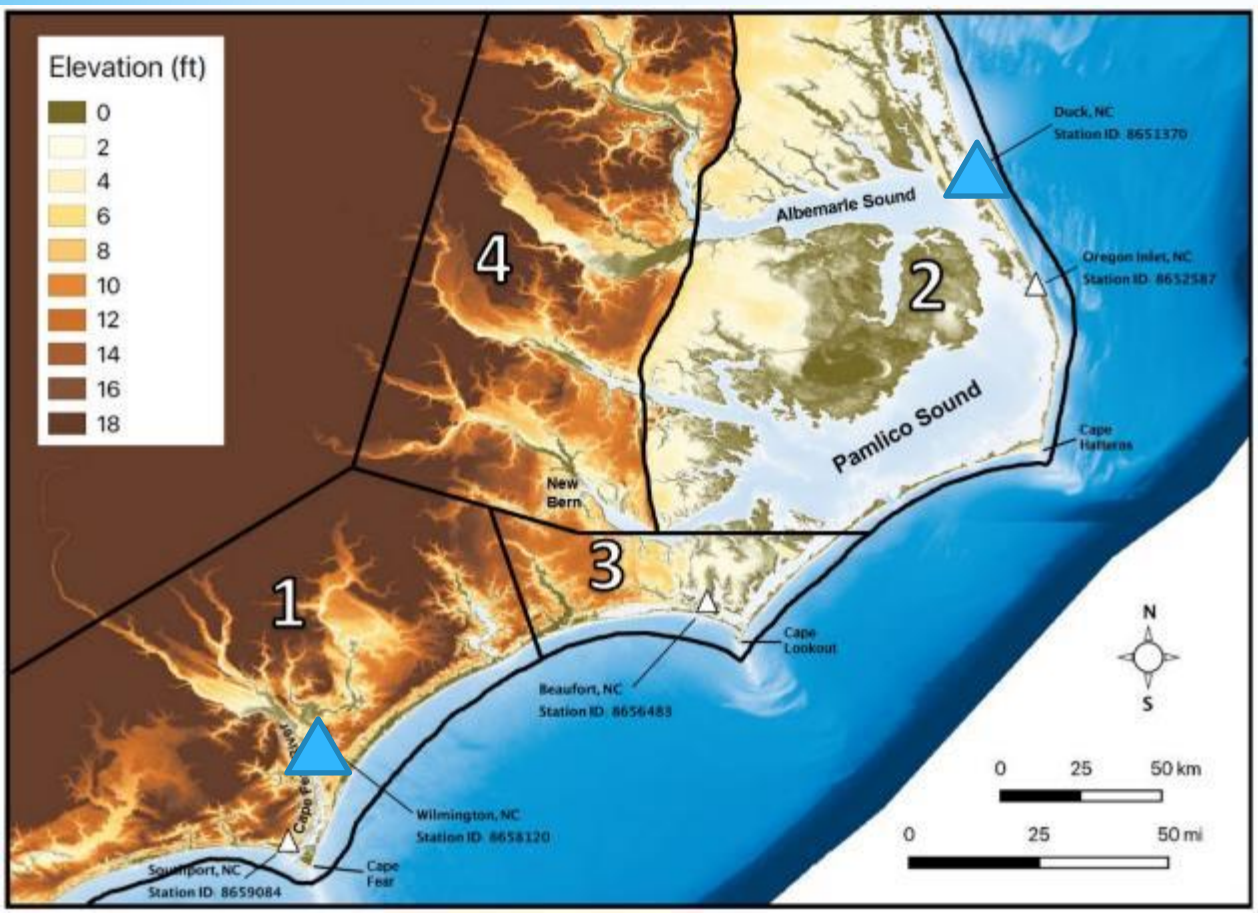
- Local water level (winds, tides, ocean currents)
- Local land motion (glacial adjustment, tectonics, groundwater & oil withdrawal)

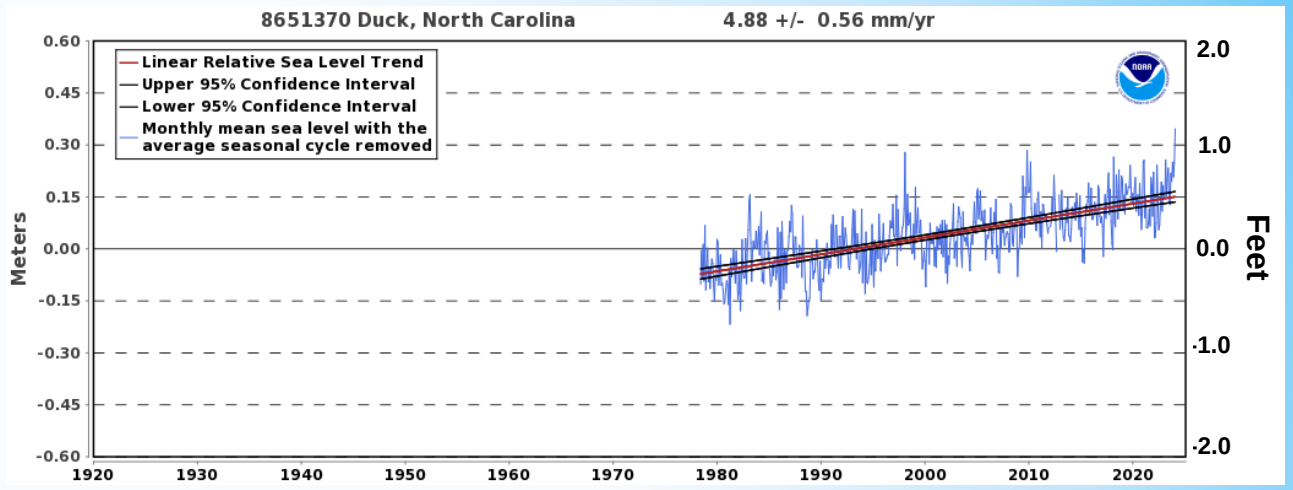
RSL = Ocean + Land



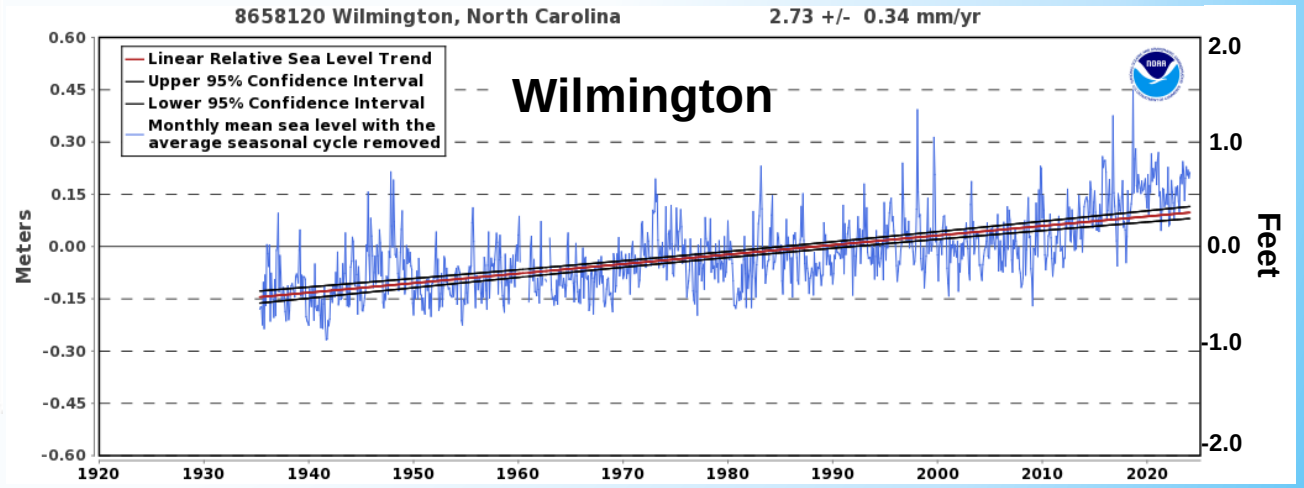
Modified from NRC 2012

Current rate of sea level rise in NC





"The relative sea level trend is **4.88 mm/yr** with a 95% confidence interval of **+/- 0.56 mm/yr** based on monthly mean sea level data from **1978 to 2023** which is equivalent to a change of **1.60 feet** in 100 years."



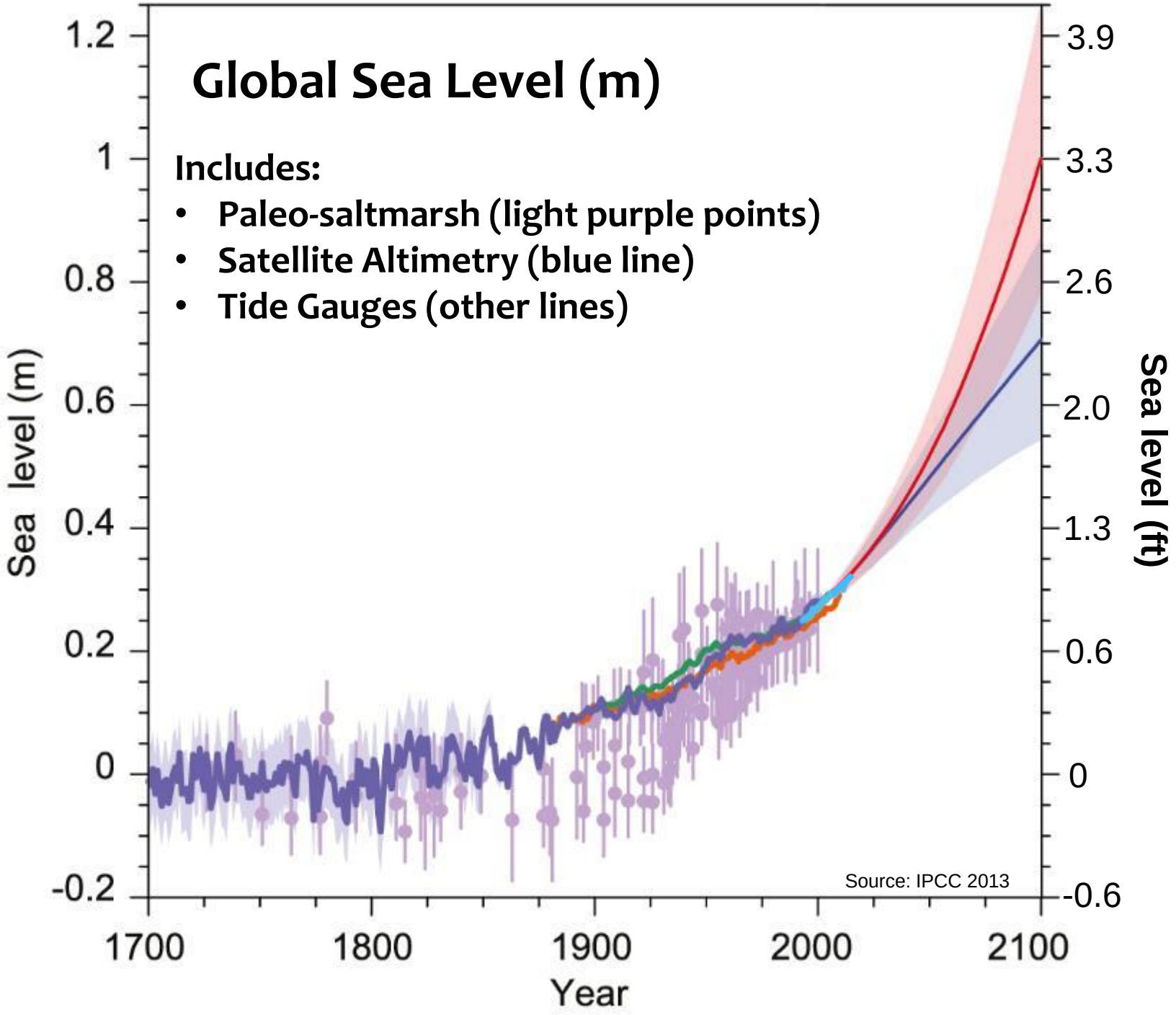
"The relative sea level trend is **2.73 mm/yr** with a 95% confidence interval of **+/- 0.34 mm/yr** based on monthly mean sea level data from **1935 to 2023** which is equivalent to a change of **0.90 feet** in 100 years."

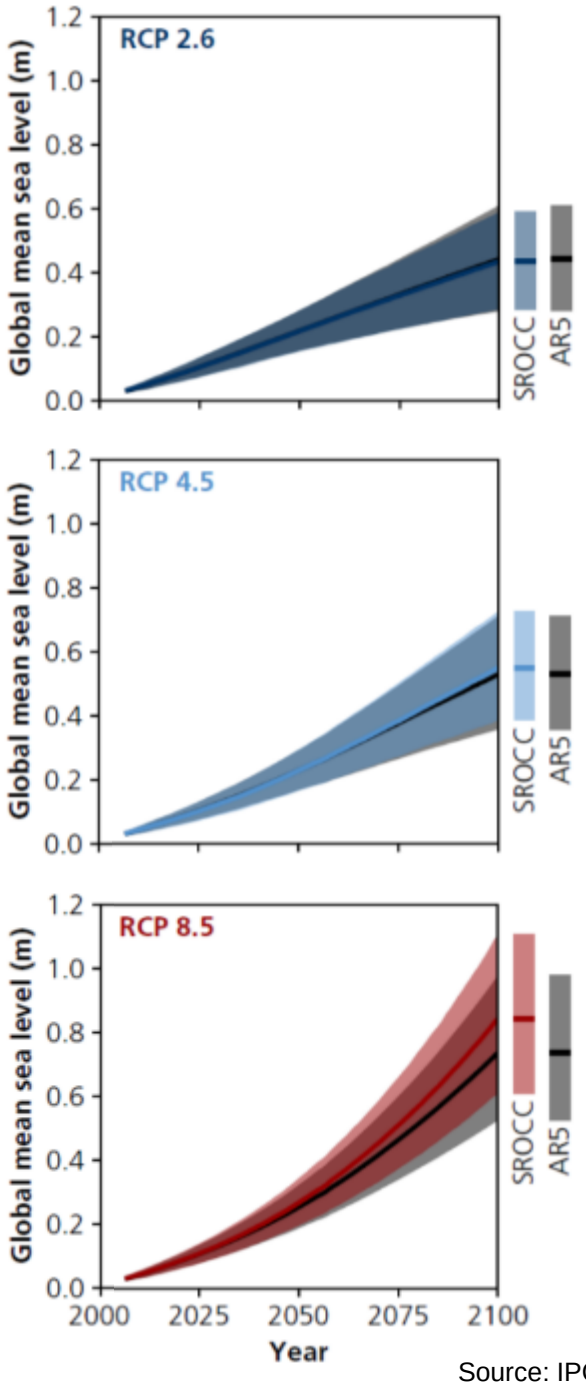
Graphic and text from NOAA found here: https://tidesandcurrents.noaa.gov/sltrends/

Global Sea Level (m)

Includes:

- **Paleo-saltmarsh (light purple points)**
- **Satellite Altimetry (blue line)**
- **Tide Gauges (other lines)**

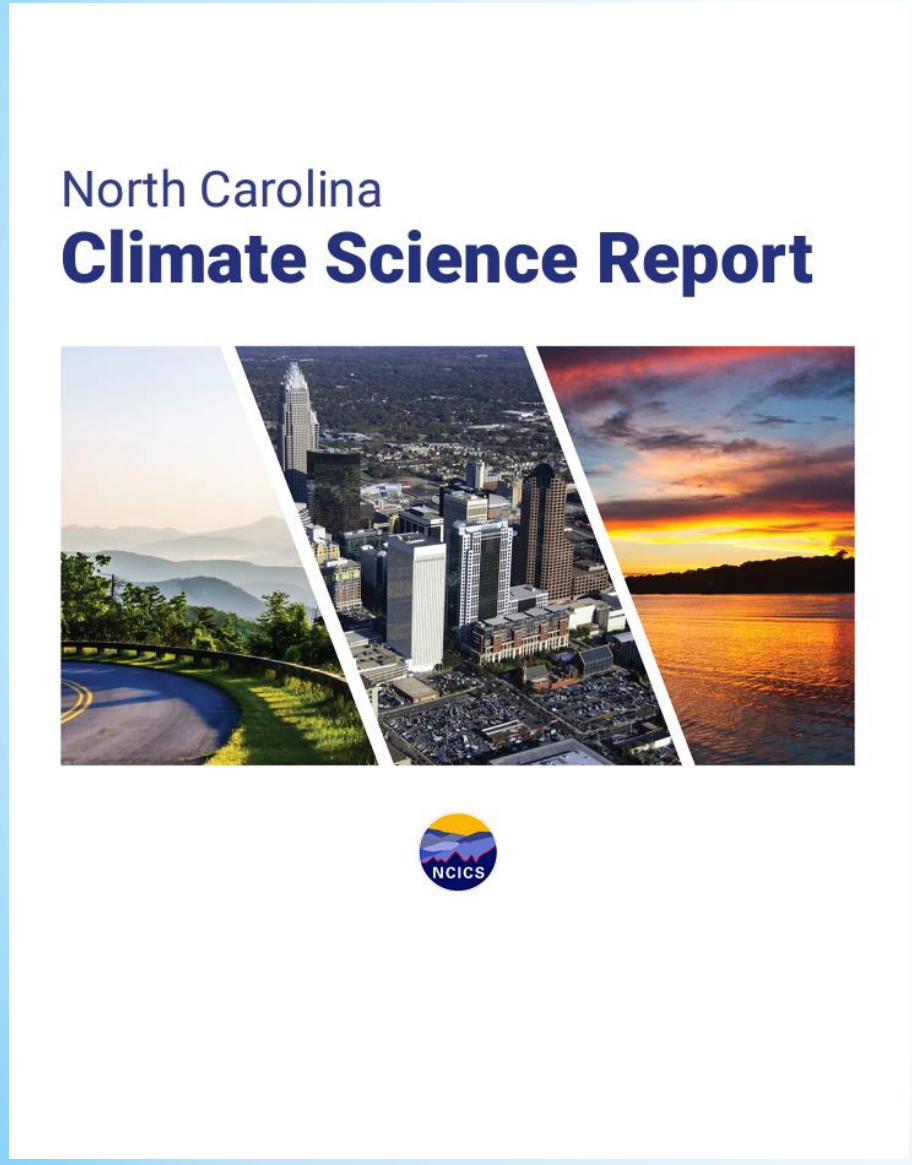




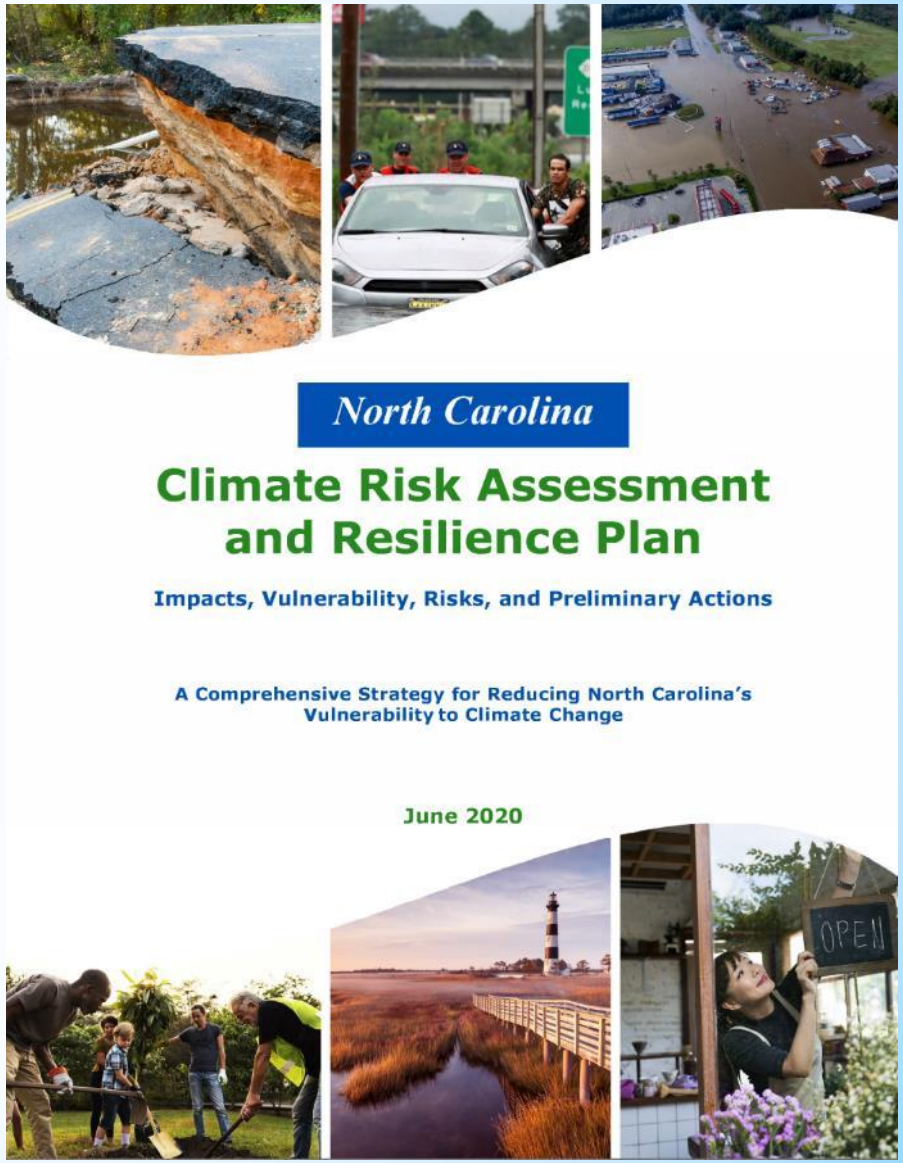
Source: IPCC 2019

NC taking a Proactive Approach

Executive Order 80: “North Carolina’s Commitment to Address Climate Change and Transition to a Clean Energy Economy”



https://ncics.org/wp-content/uploads/2020/10/NC_Climate_Science_Report_FullReport_Final_revised_September2020.pdf



https://files.nc.gov/ncdeq/climate-change/resilience-plan/Executive-Summary-and-Key-Findings.pdf

October 2024

NORTH CAROLINA

2024 Sea Level Rise

Science Update

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

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

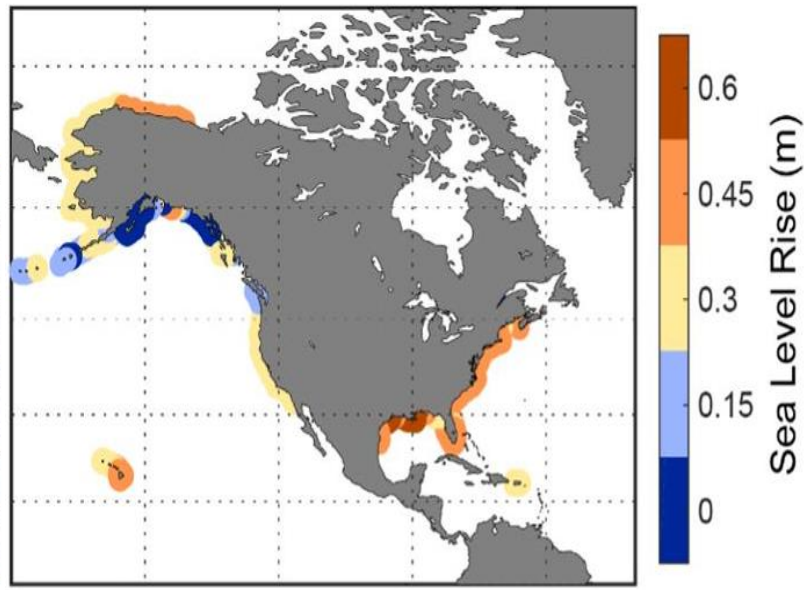
Gareth McGrath
USA TODAY NETWORK

Published 5:04 a.m. ET Nov. 12, 2024 | Updated 5:05 a.m. ET Nov. 12, 2024

Science panel applies 2022 sea level report projections to NC

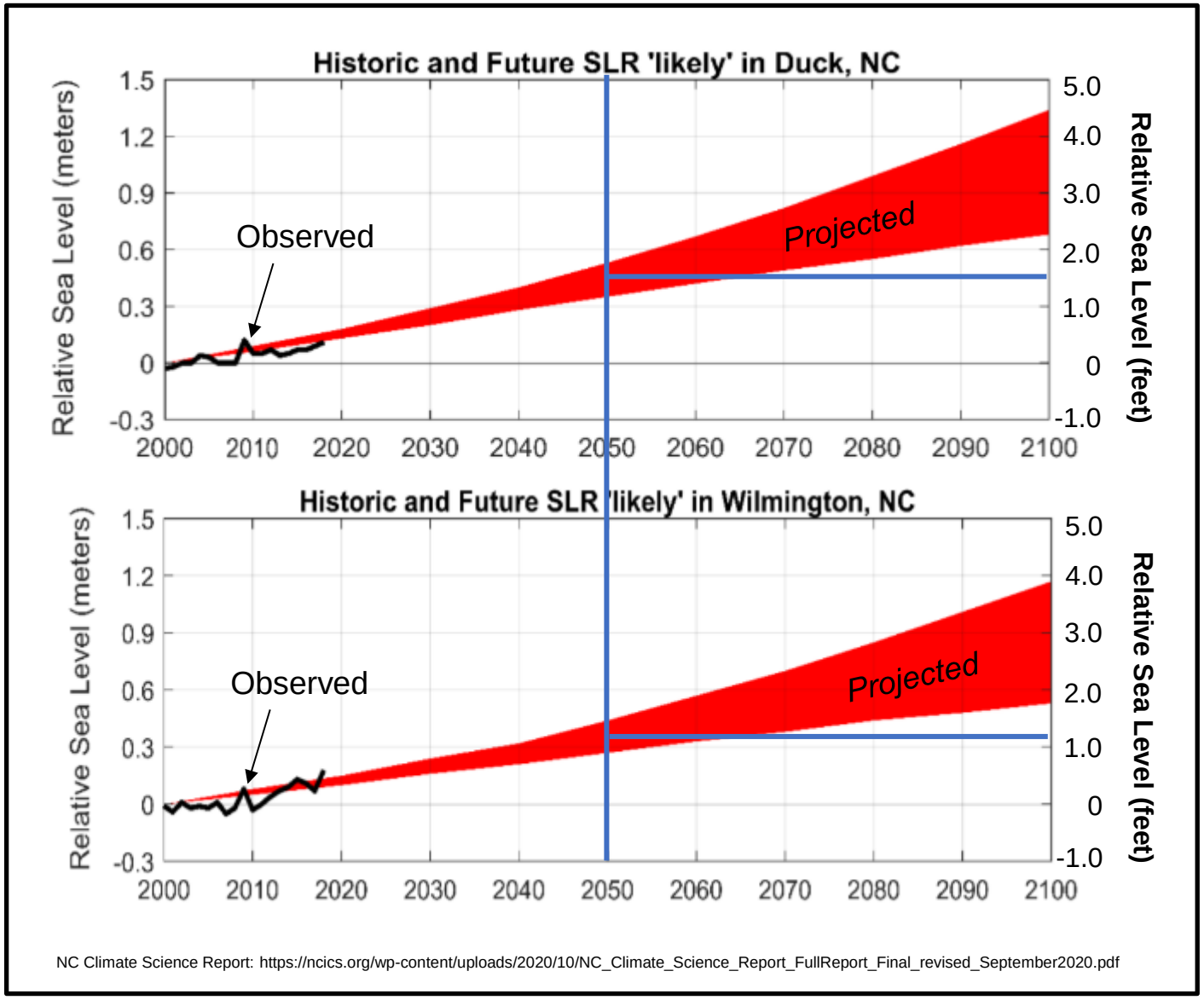
10/28/2024 by Jennifer Allen

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

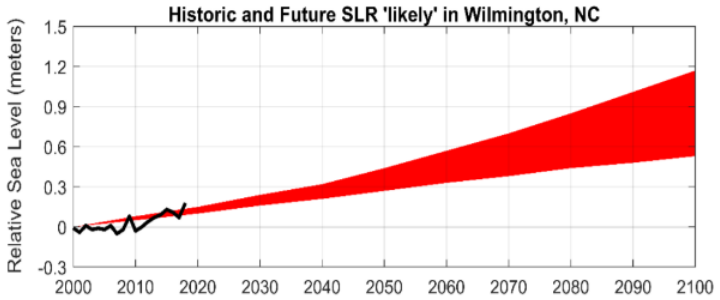


What does the latest science say about future SLR in NC?

- The report projects **1.0 – 1.4 ft of sea level rise by 2050** (Intermediate-Low & Intermediate Scenarios) **in the Southeast,** relative to 2000. The actual amount will depend on future emissions and ice loss from Greenland and Antarctica.
- Extrapolation of **observations and model scenarios are consistent**. This lends increased confidence in estimates.
- Emissions are **on track for a sea level rise of 2 - 7 feet by 2100** (Intermediate-Low – Intermediate Scenarios). These projections are less certain because they strongly depend on future greenhouse emissions scenarios.
- RSLR in NC varies, with higher rates in the north relative to the south, largely due to differences in vertical land motion.

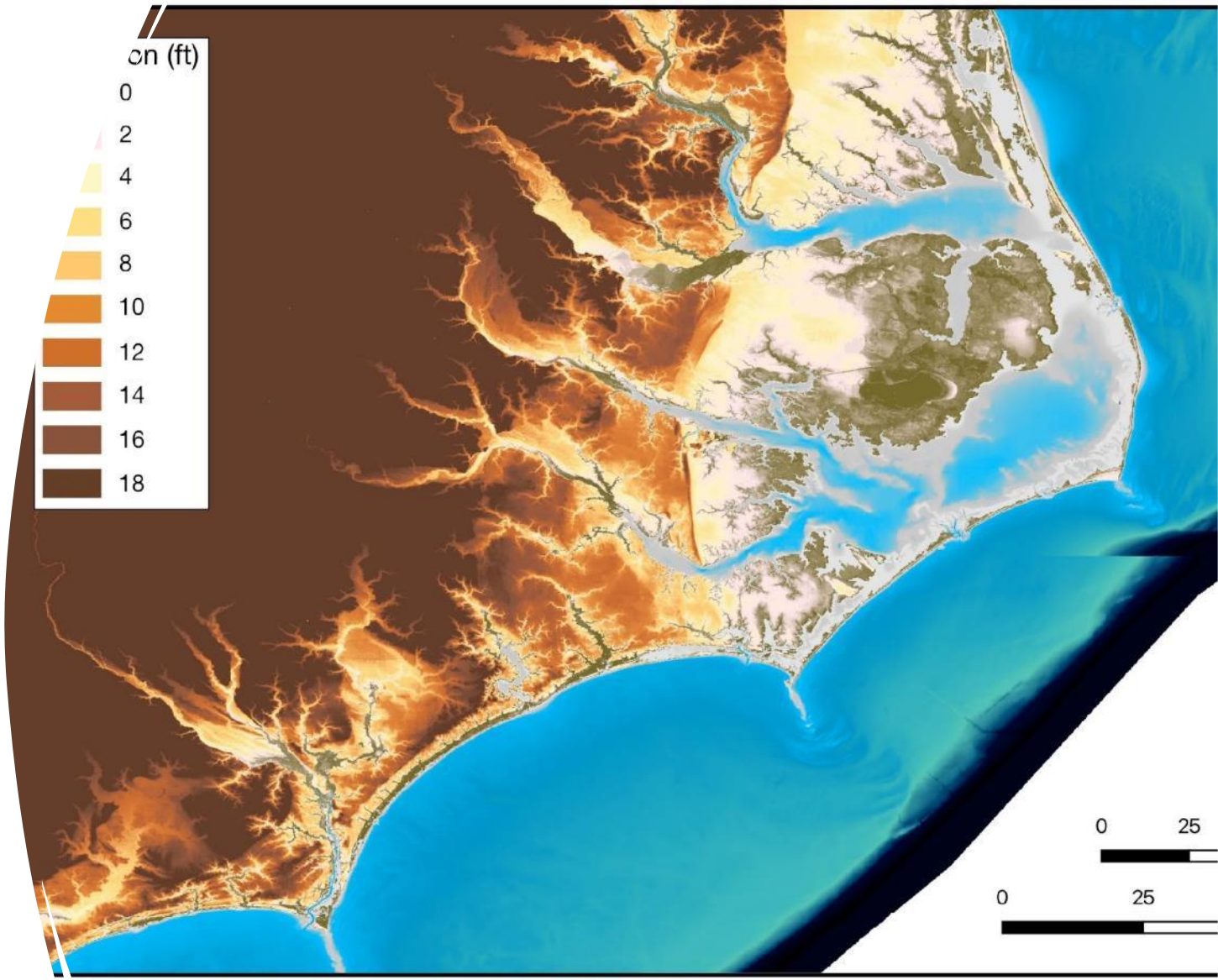


NC Climate Science Report: https://ncics.org/wp-content/uploads/2020/10/NC_Climate_Science_Report_FullReport_Final_revised_September2020.pdf



We understand how our system evolved, sea level drivers today, and future projections.

Are there examples of environmental changes in coastal NC?



Land use changes

The Washington Post
Democracy Dies in Darkness

Climate Environment Weather Climate Solutions Climate Lab Green Living

The swift march of climate change in North Carolina's 'ghost forests'

As sea levels rise and storms become more intense, scientists are racing to study the rapid loss of trees and marshland along the Outer Banks

Credit: RTI

- Transition from pine to shrub to dead trees to marsh.
- Conversion decreases aboveground carbon storage.

The Washington Post

National

Ruined crops, salty soil: How rising seas are poisoning North Carolina's farmland

- Soil salinization becoming more prevalent in the coastal SE US.
- Reduces productivity of working lands; prevents crops from growing.

Continued and increasing long-term shoreline erosion rates

Credit: USGS; Google Maps; Paul Horn/InsideClimate News

S. Nags Head

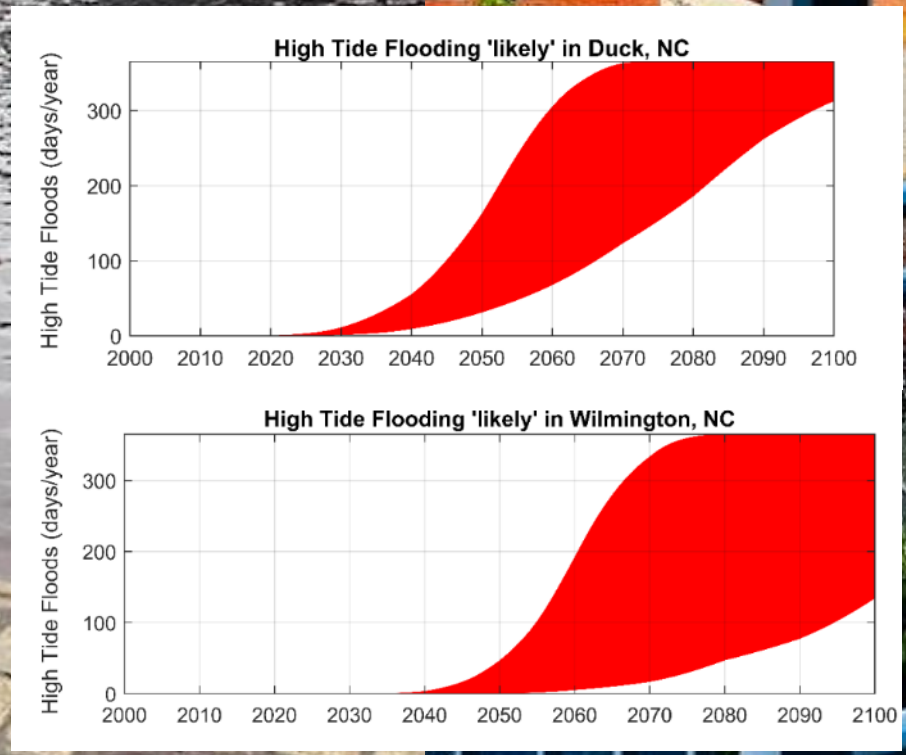
- The ocean shoreline erodes over time where more sand is lost from the shoreline than supplied.
- Losses related to sea level rise will increase and so background, long-term erosion rates will increase.

NC12 Ocracoke, March 2024; NCDOT

Wilmington – Oct. 2018

Town of Manteo – April 2024

By 2080, high tide flooding ‘likely’ up to >350 days/year in Duck and Wilmington.



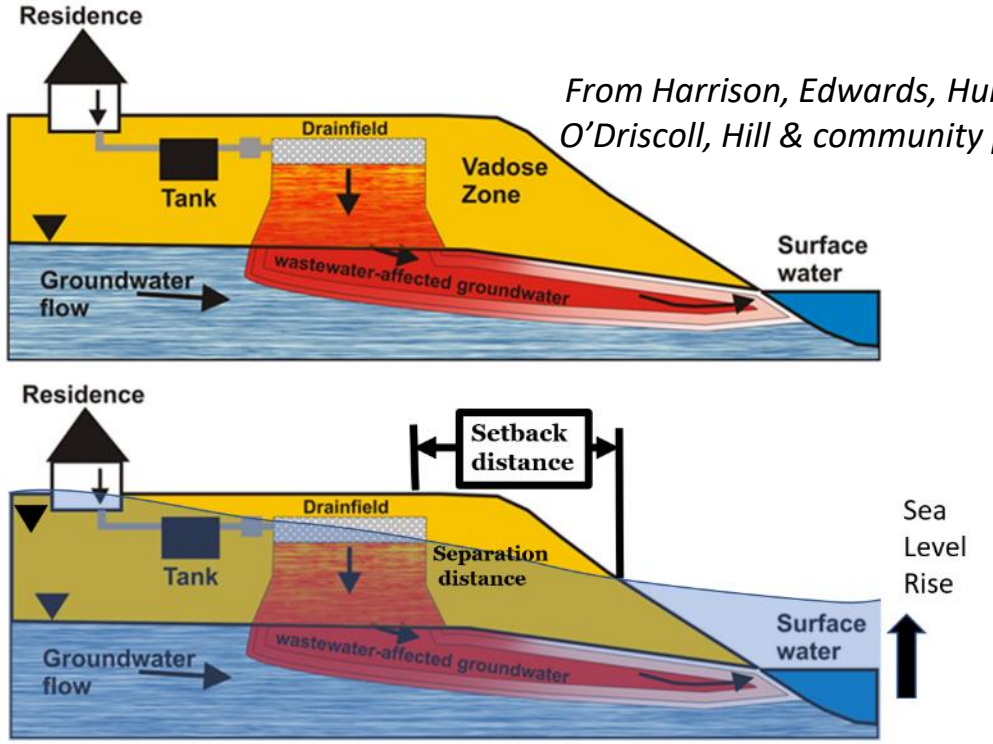
Credit: NC Climate Report

Credit: Reide Corbett

Rising water table

Credit: Outer Banks Voice

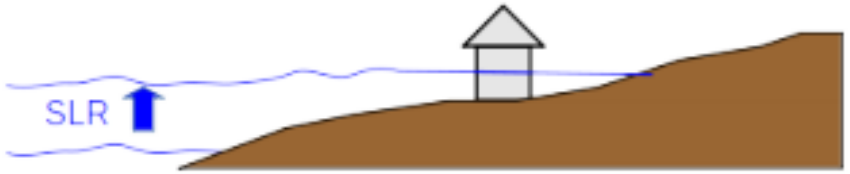
Credit: Island Free Press



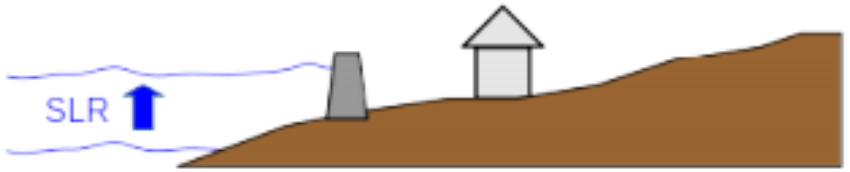
From Harrison, Edwards, Humphrey, O'Driscoll, Hill & community partners

AGAIN…

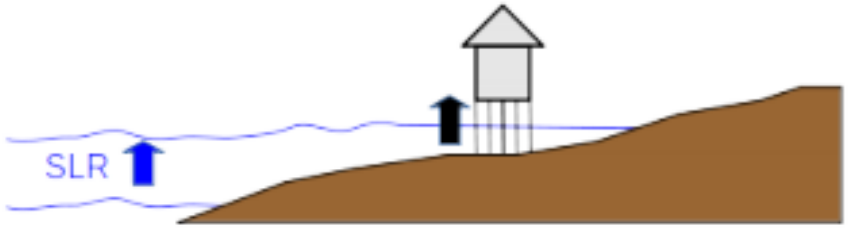
What can we do?



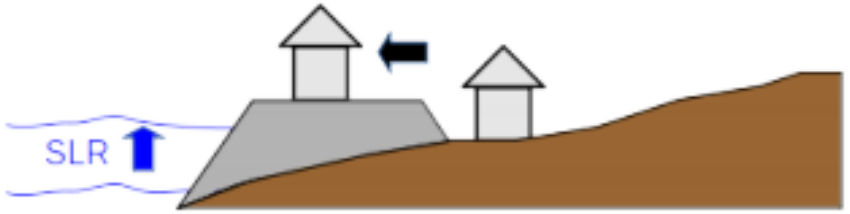
No response



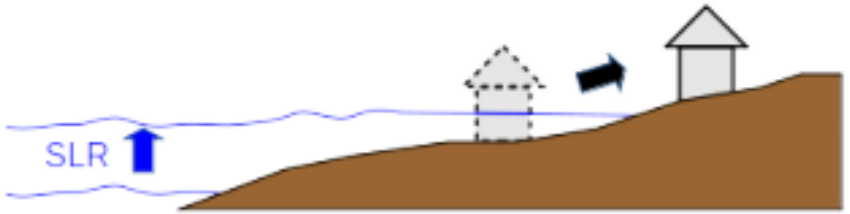
Protect



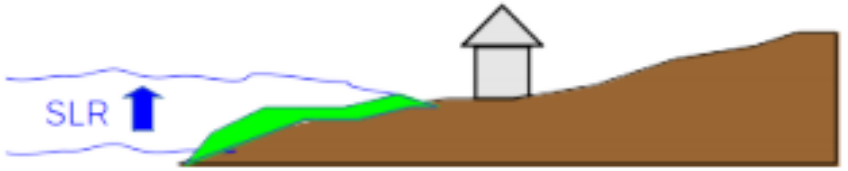
Accommodate



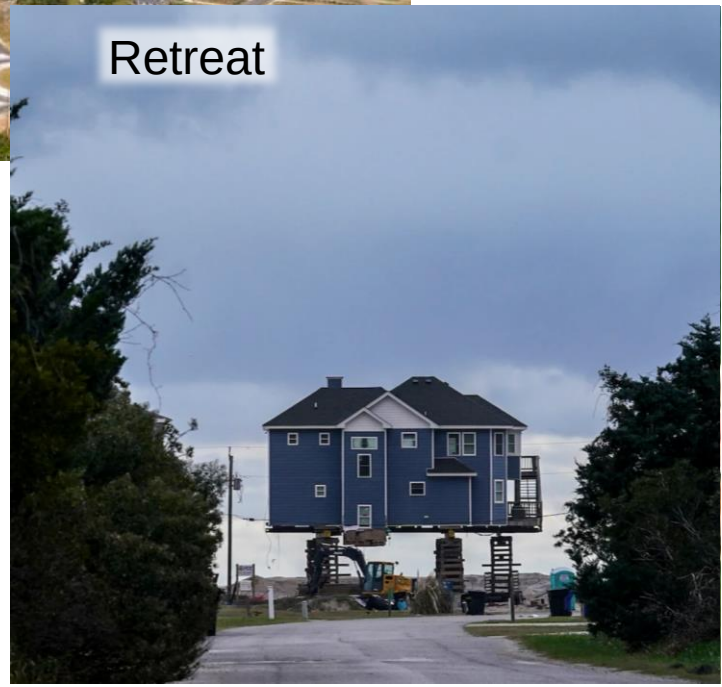
Advance



Retreat



Ecosystem-based adaptation



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

Managed Retreat

A coastal management strategy that is purposeful, coordinated movement of people and buildings away from risks and allows the shoreline to move inland, rather than attempting to hold the line.

ReBUILD NC

Strategic Buyout Program

Home > Homeowners > Strategic Buyout Program

ReBuild NC Centers Open

Strategic Buyout Program applicants who need assistance should call 833-275-7262 to schedule an appointment.

Learn More

THE OUTER BANKS VOICE
YOUR BEST SOURCE FOR LOCAL NEWS, UPDATED THROUGHOUT THE DAY

Feb. 27 meeting to address vulnerable beachfront homes, public can tune in

By Outer Banks Voice on February 21, 2023

The North Carolina Department of Environmental Quality (DEQ) and the Cape Hatteras National Seashore (CHNS) will hold a meeting on Monday, Feb. 27 at 1 p.m. concerning threatened oceanfront structures, and the public can tune in remotely.

Only last month, on Jan. 18, Dare County Manager Bobby Outten and CHNS Park Supervisor Dave Hallac attended a crowded community meeting in Rodanthe to discuss the issue of beach erosion in that community and whether a beach nourishment project could be implemented to address that issue.

Collapsed home in Rodanthe. (File photo: National Park Service)

CHNS buys two threatened oceanfront properties in Rodanthe

By Submitted Story on October 11, 2023

THE OUTER BANKS VOICE
YOUR BEST SOURCE FOR LOCAL NEWS, UPDATED THROUGHOUT THE DAY

Moving Forward

Must use our experiences of recent past to plan for the future…we should expect more of the same, more often, with greater impacts.

Need to consider the TRIPLE BOTTOM LINE as we move forward…moving our decision making framework toward greater sustainability.

Credit: Taylor, 2021; chainpoint.com

We can’t use yesterday’s numbers to plan for tomorrow’s events.

Photo illustration by Natalie Matthews-Ramo/Slate.