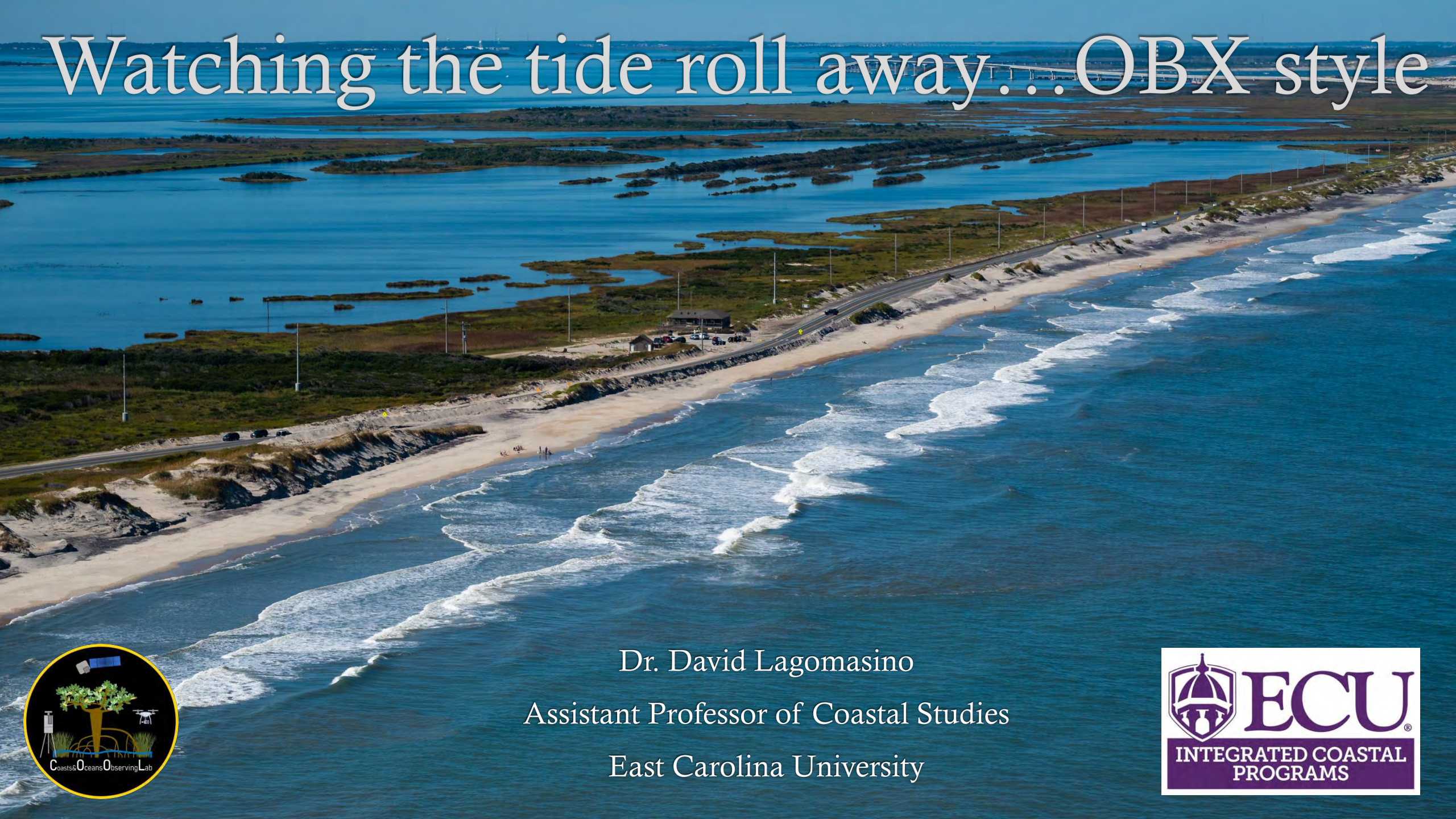
Watching the tide roll away…OBX style



Dr. David Lagomasino

Assistant Professor of Coastal Studies

East Carolina University

ECU OUTER BANKS CAMPUS

ECU INTEGRATED COASTAL PROGRAMS

Coastal Studies Institute
A Multi-Institutional Research Partnership

Coastal & Marine Science
Research, Education & Outreach

- Coasts and People
- Engineering
- Oceanographic & Coastal Processes
- Human Dimensions
- Hazards & Resilience
- Renewable Ocean Energy

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INTEGRATED COASTAL PROGRAMS

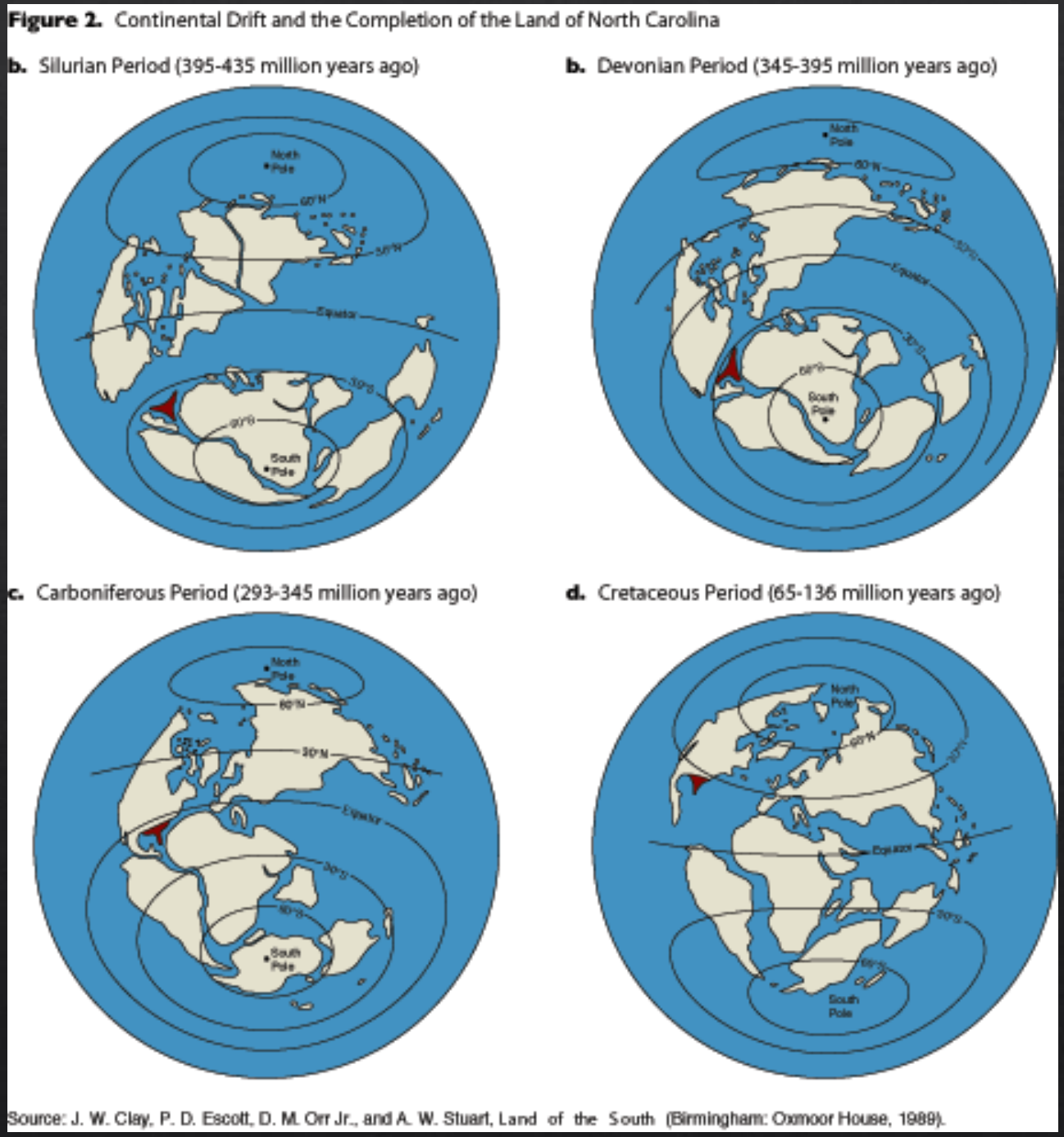
Coastal Studies Institute
A Multi-Institutional Research Partnership

What are we going to cover today?

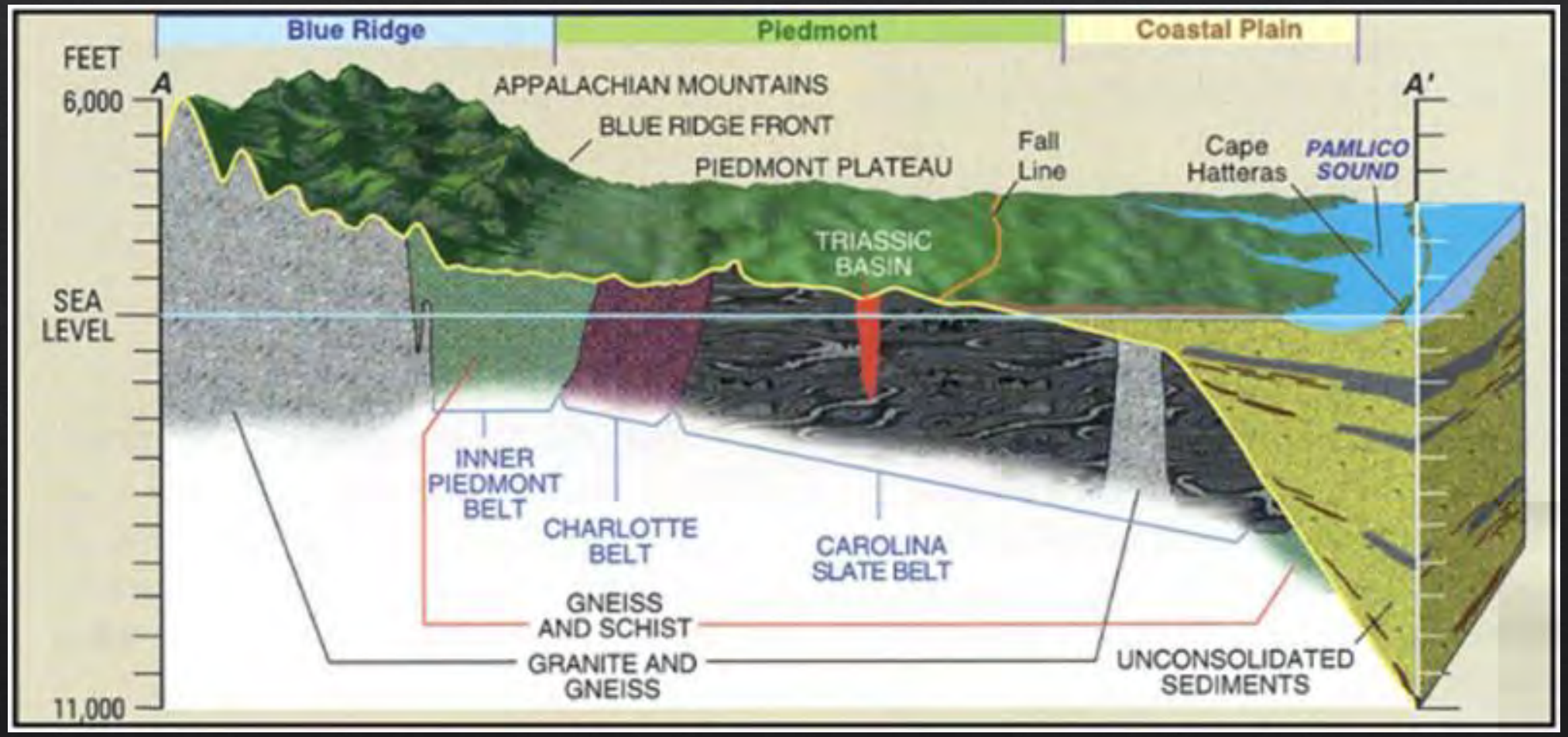
- **Coastal Evolution (thousands to millions of years)**
  - *The OBX beginnings.*
  - *The past is a window into the future.*
- **Modern processes (days to years)**
  - *How to barrier islands evolve?*
- **Implications of Sea Level Rise and other climate-related hazards**
  - *How will the system change? How will we respond?*

Pangea began breaking apart ~225 million years ago… laying the foundation for the OBX

- The opening and closing of ocean basins creates new mountain chains
- That uplift leads to erosion and the transport of sediments to the "new" ocean

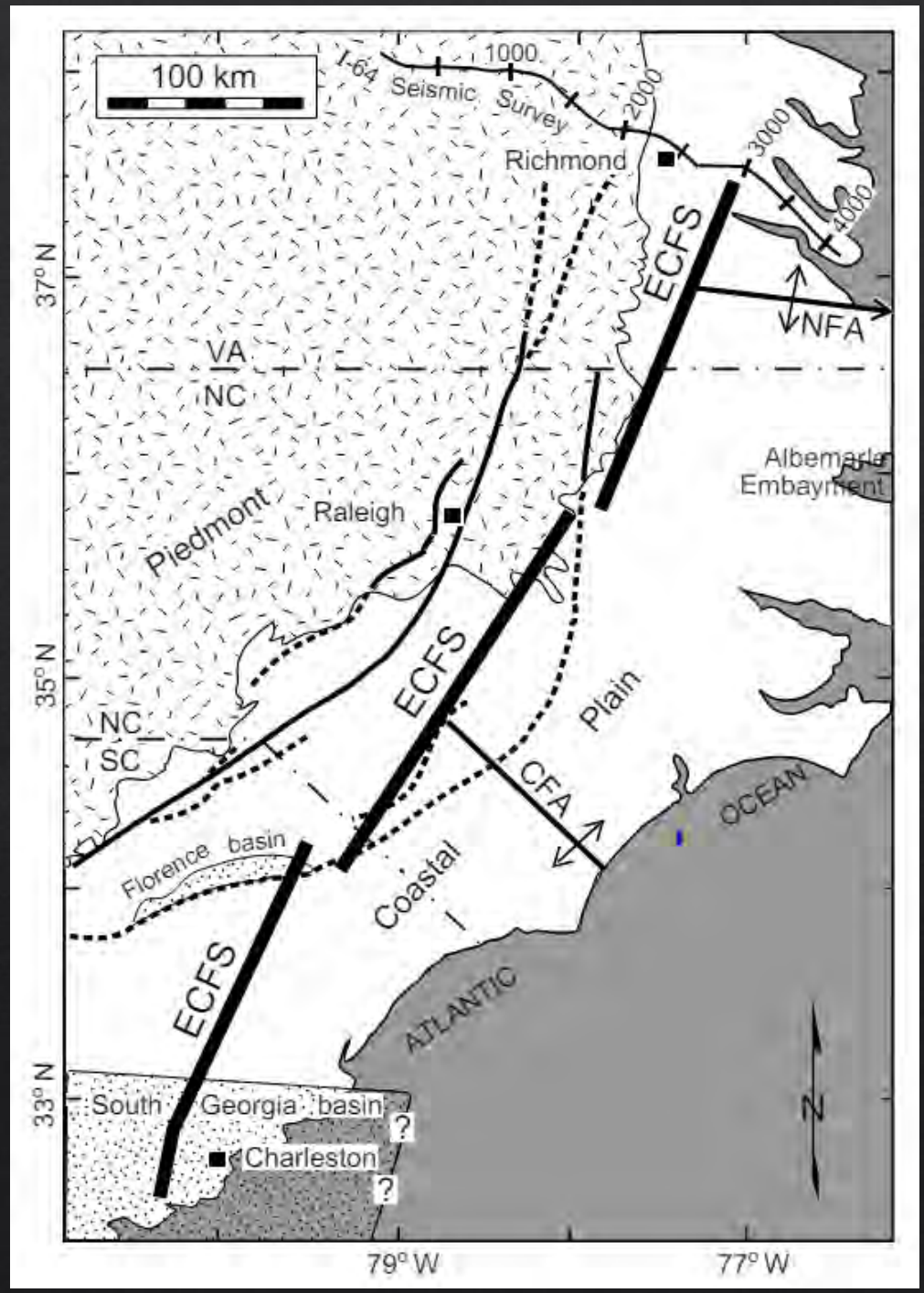


Mountain building processes formed the Appalachians and Piedmont.
Weathering and erosion lead to river systems transporting sediments.
Coastal embayments allowed for sediments to accumulate.

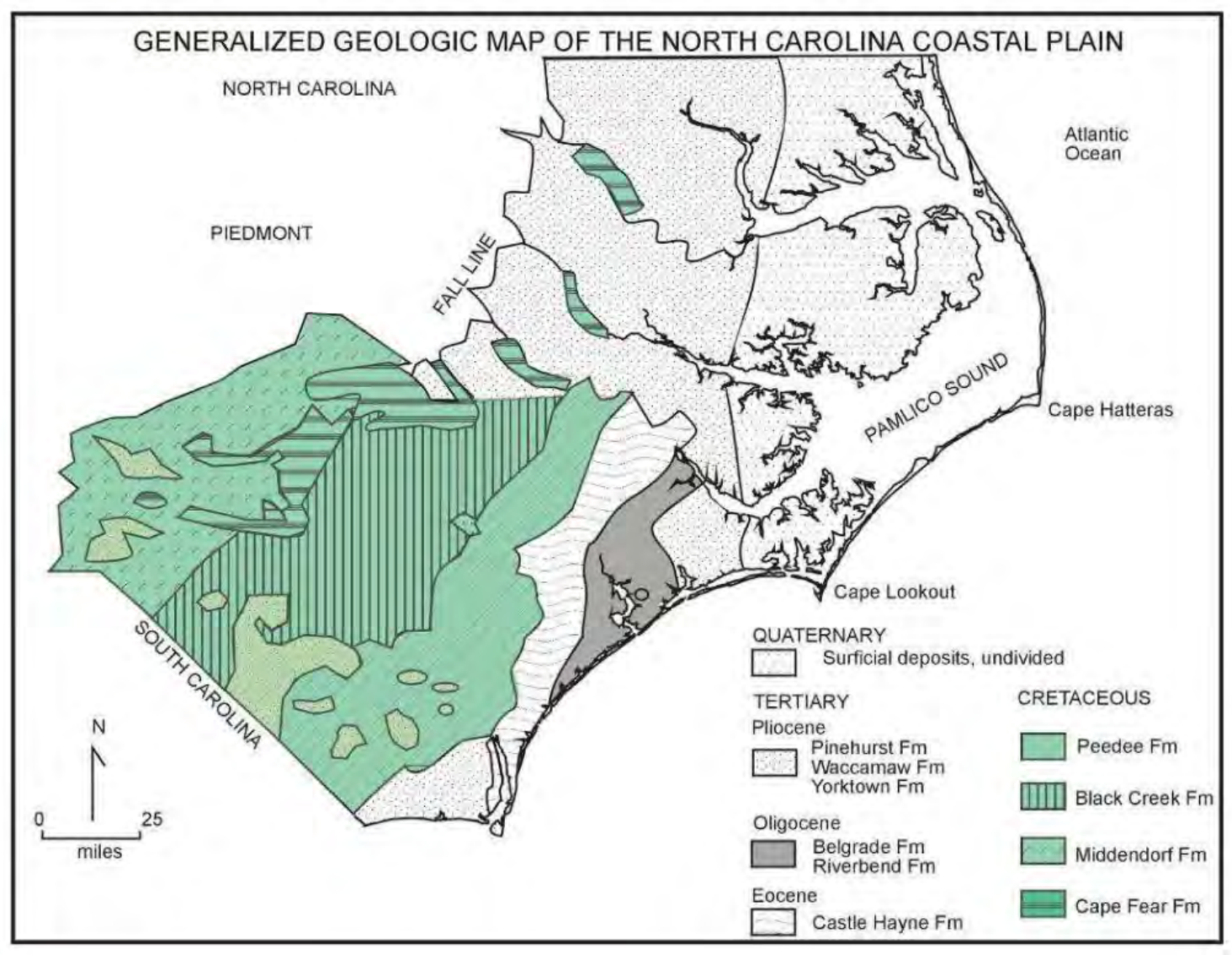


The collision and separation of continents have influenced the east coast

- The Albemarle Embayment is a geologic area of subsidence between two uplifted layers (Cape Fear and Norfolk Arch) that have influenced sedimentation over the past several million years.

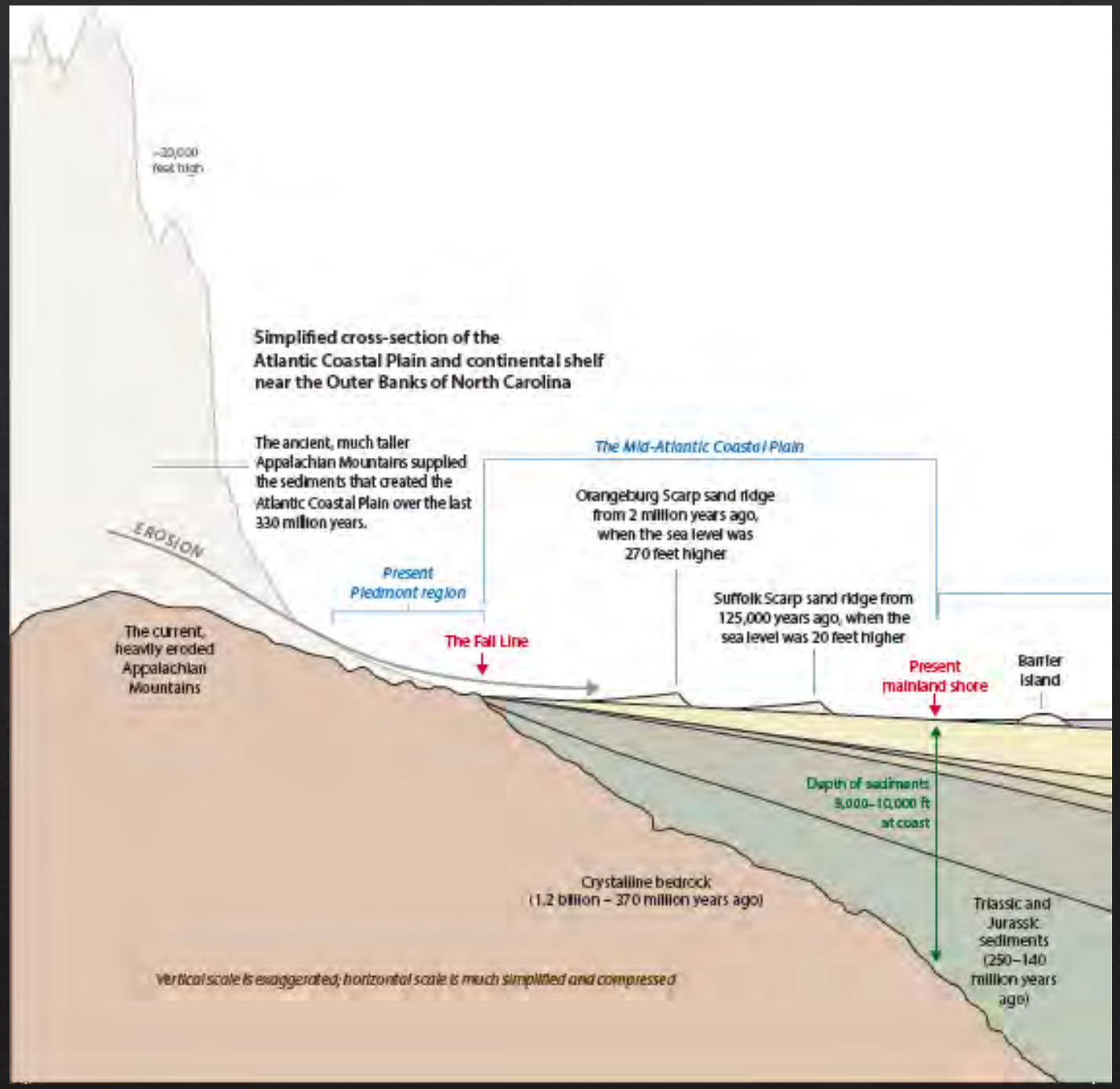


The Outer Banks is the modern sequence of sediments deposited on top of highly dissected units



- Older sediments occur at the surface south of the Cape Lookout High
- During glacial periods, river channels would have dissected through the embayment

The breakup of Pangea sped up the erosion of the Appalachian mountains and transporting sediments to the coast

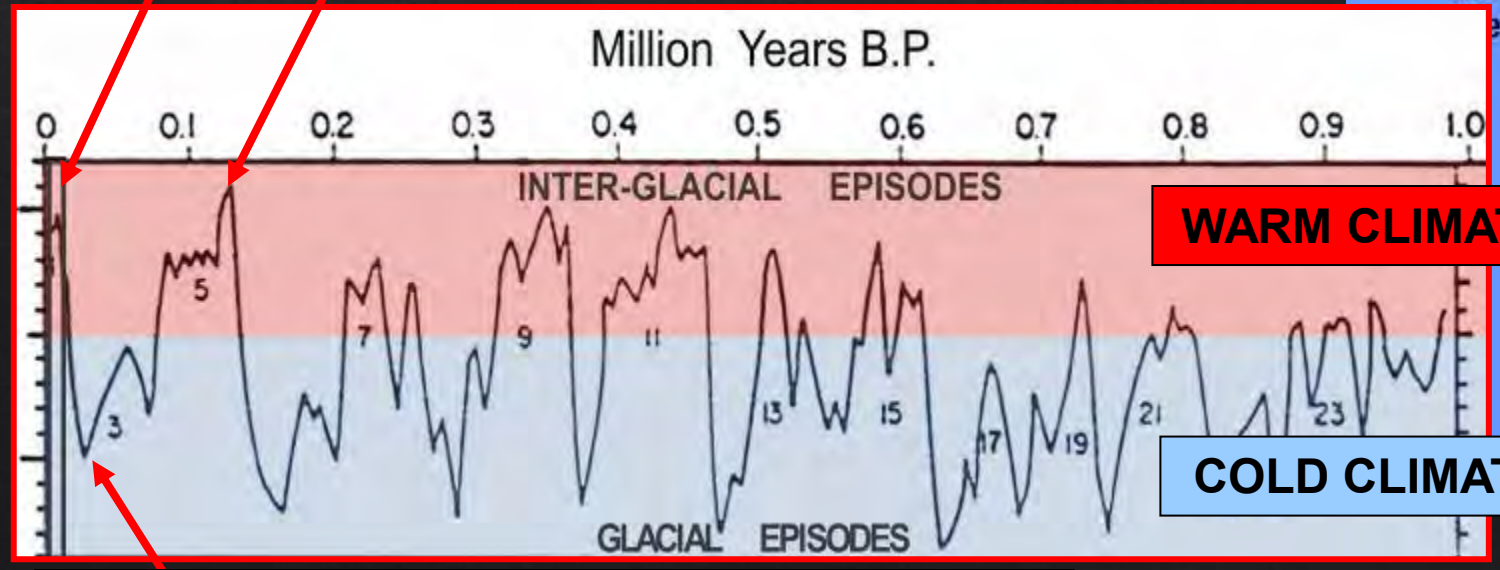


Changes to the System

Geologic Timescales

TODAY

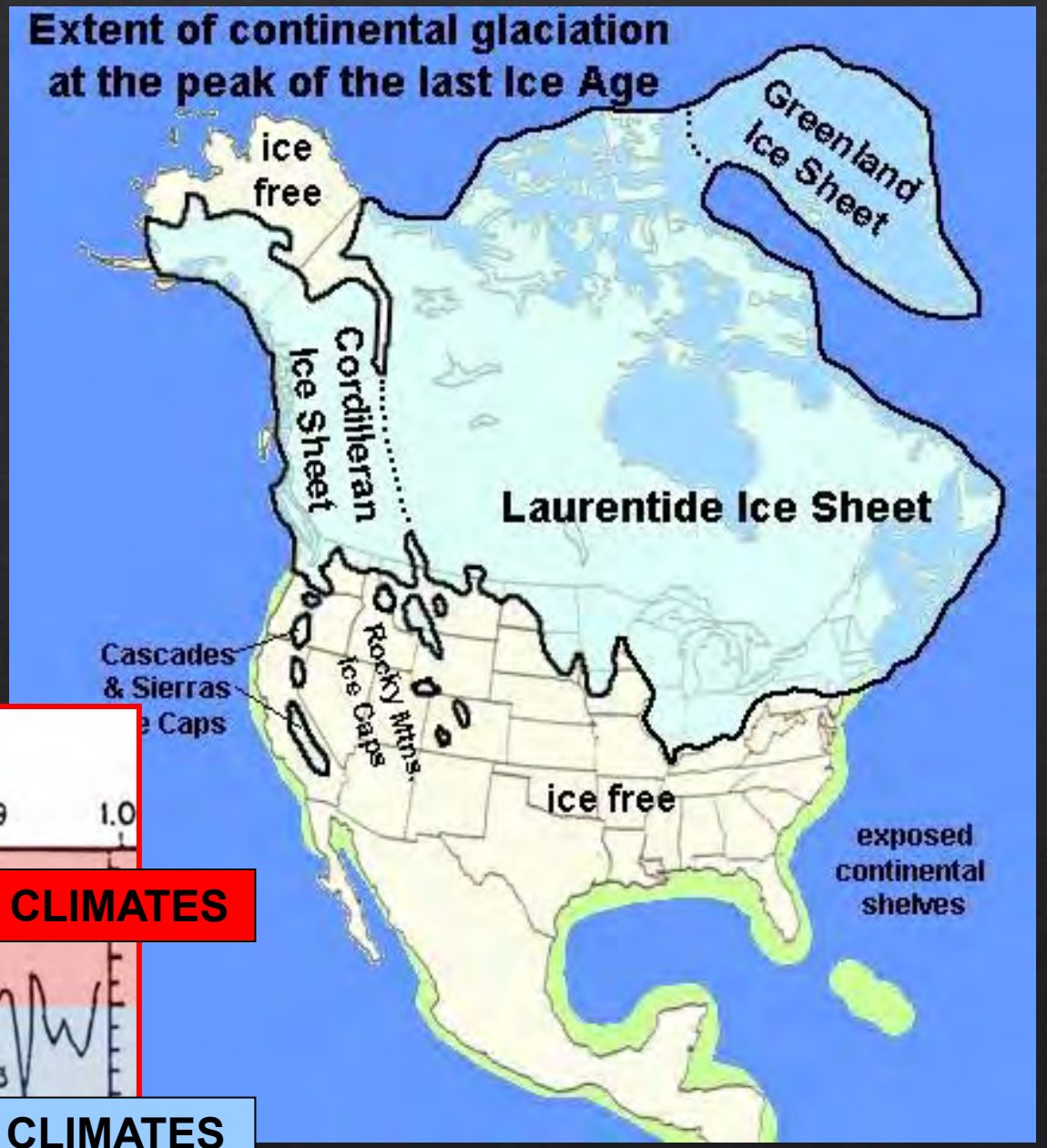
LAST INTERGLACIAL (~125,000 yrs BP)



WARM CLIMATES

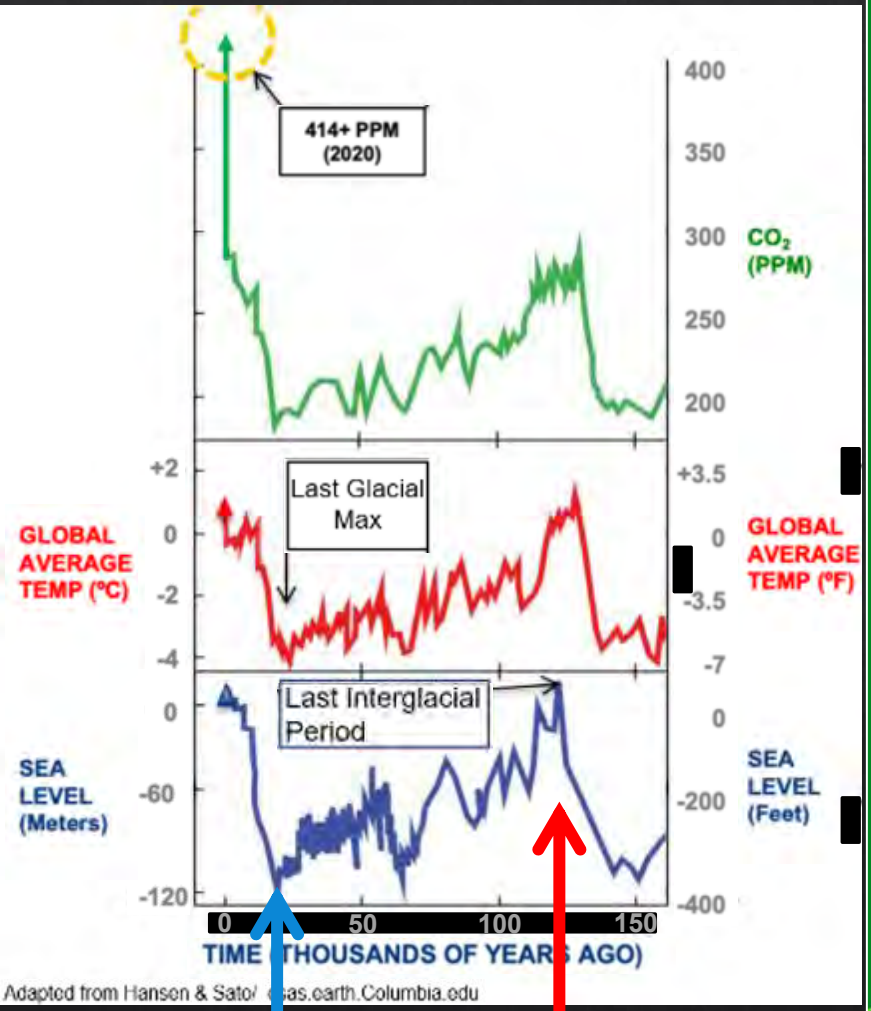
COLD CLIMATES

LAST GLACIAL MAXIMUM (~20,000 yrs BP)

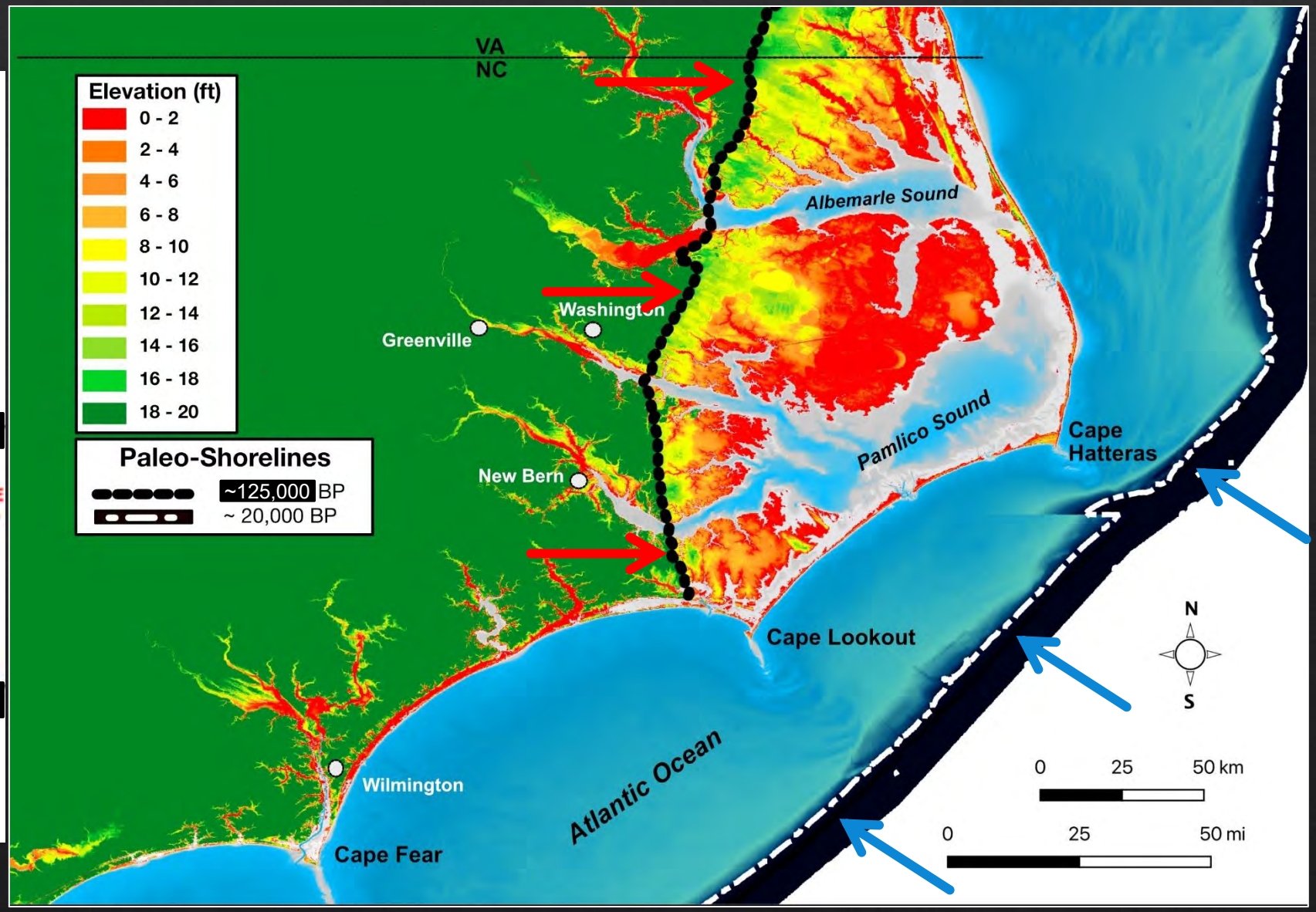


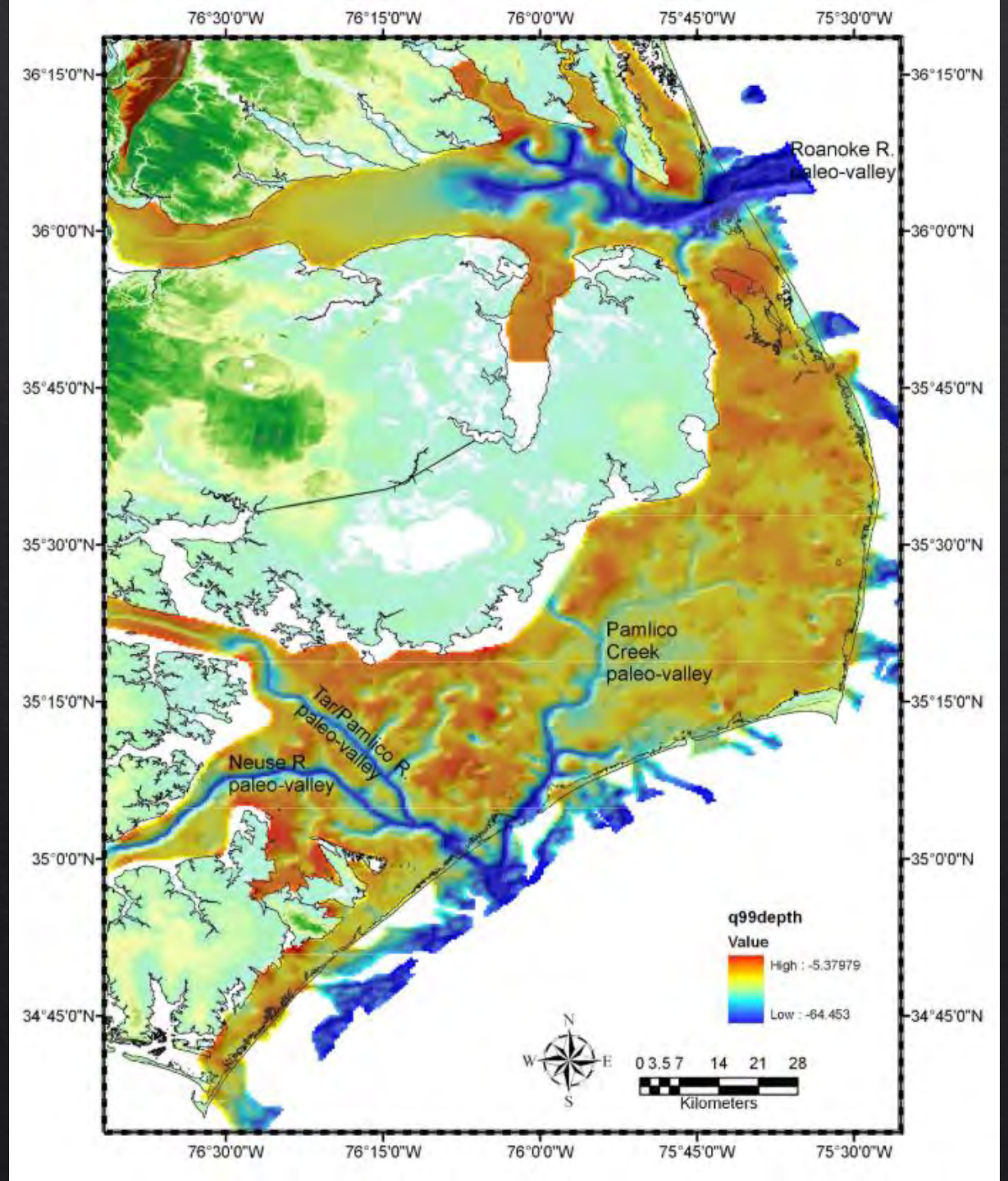
SHACKLETON & OPDYKE (1973)

North Carolina's Shorelines of the PAST



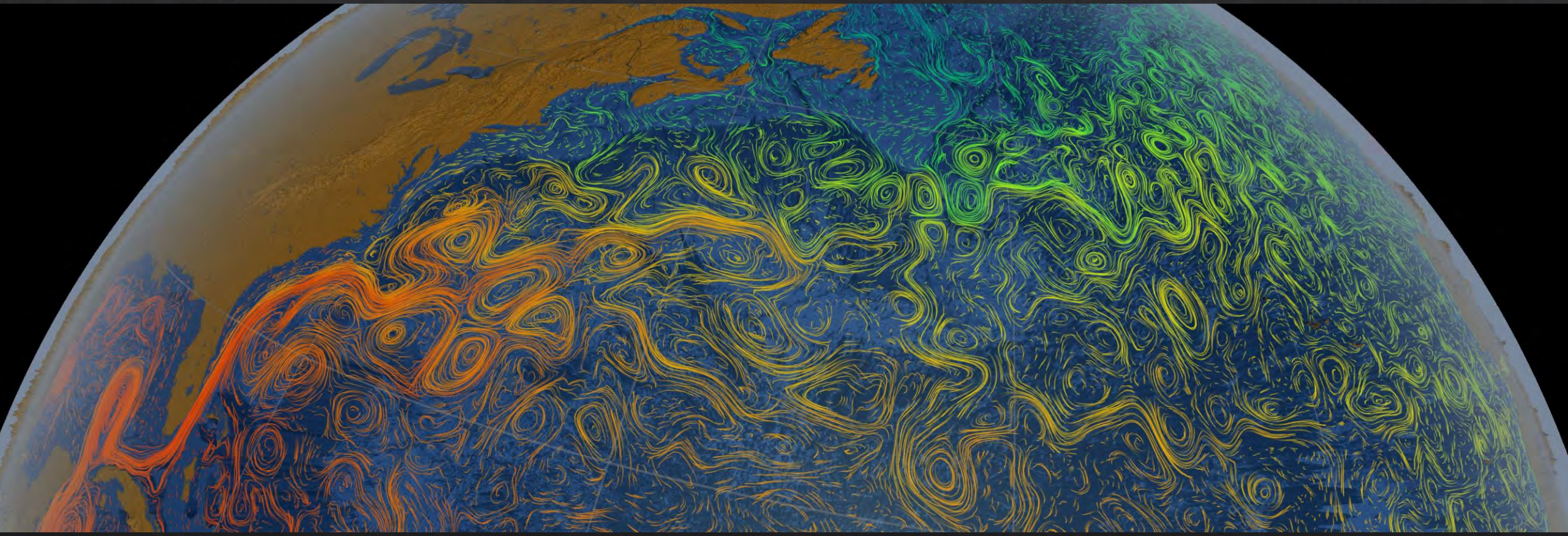
Glacial Interglacial



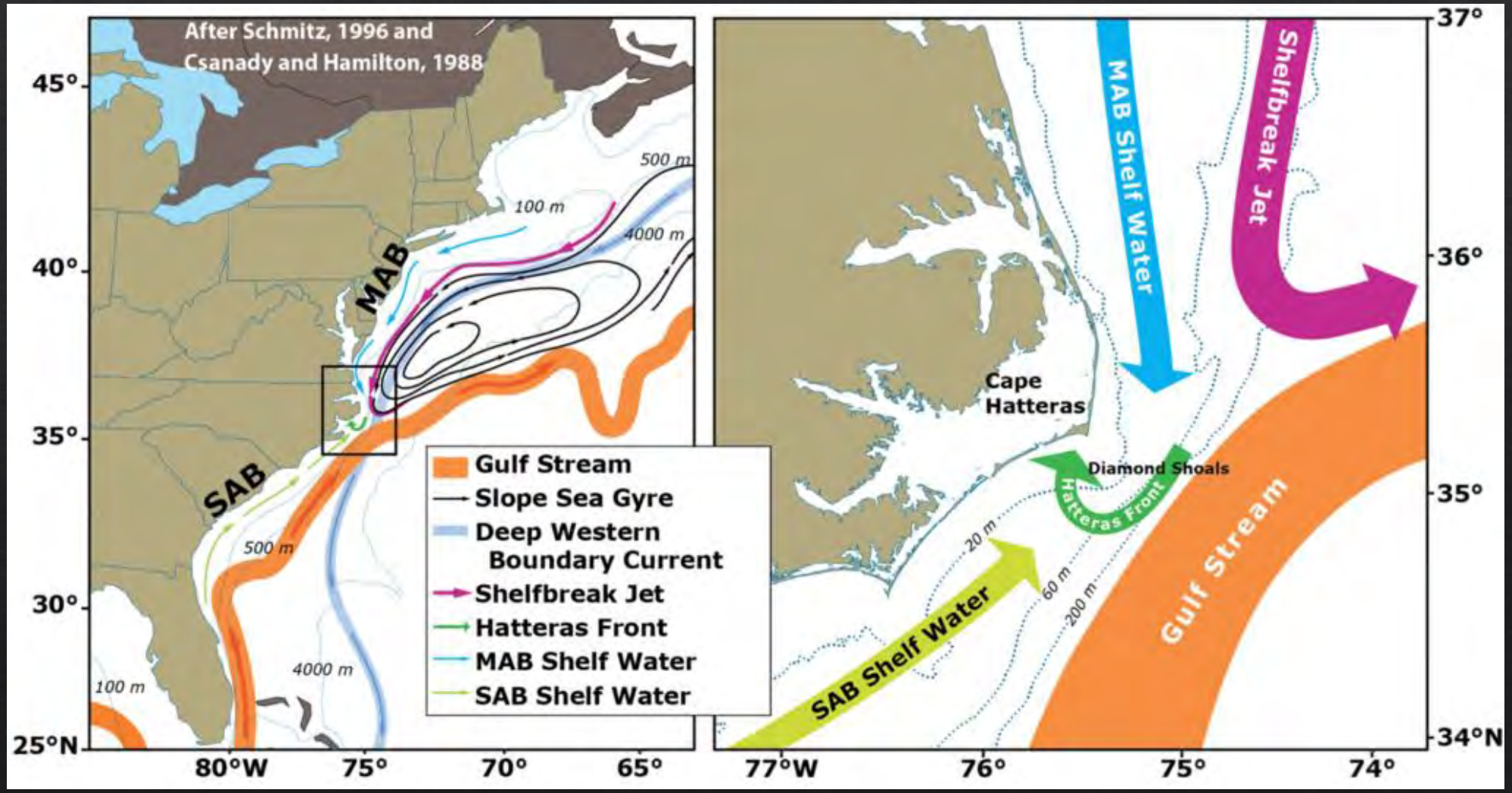


- At the end of the Pleistocene, during the Last Glacial Maximum, sea level was much lower and river valleys had been incised through eastern North Carolina

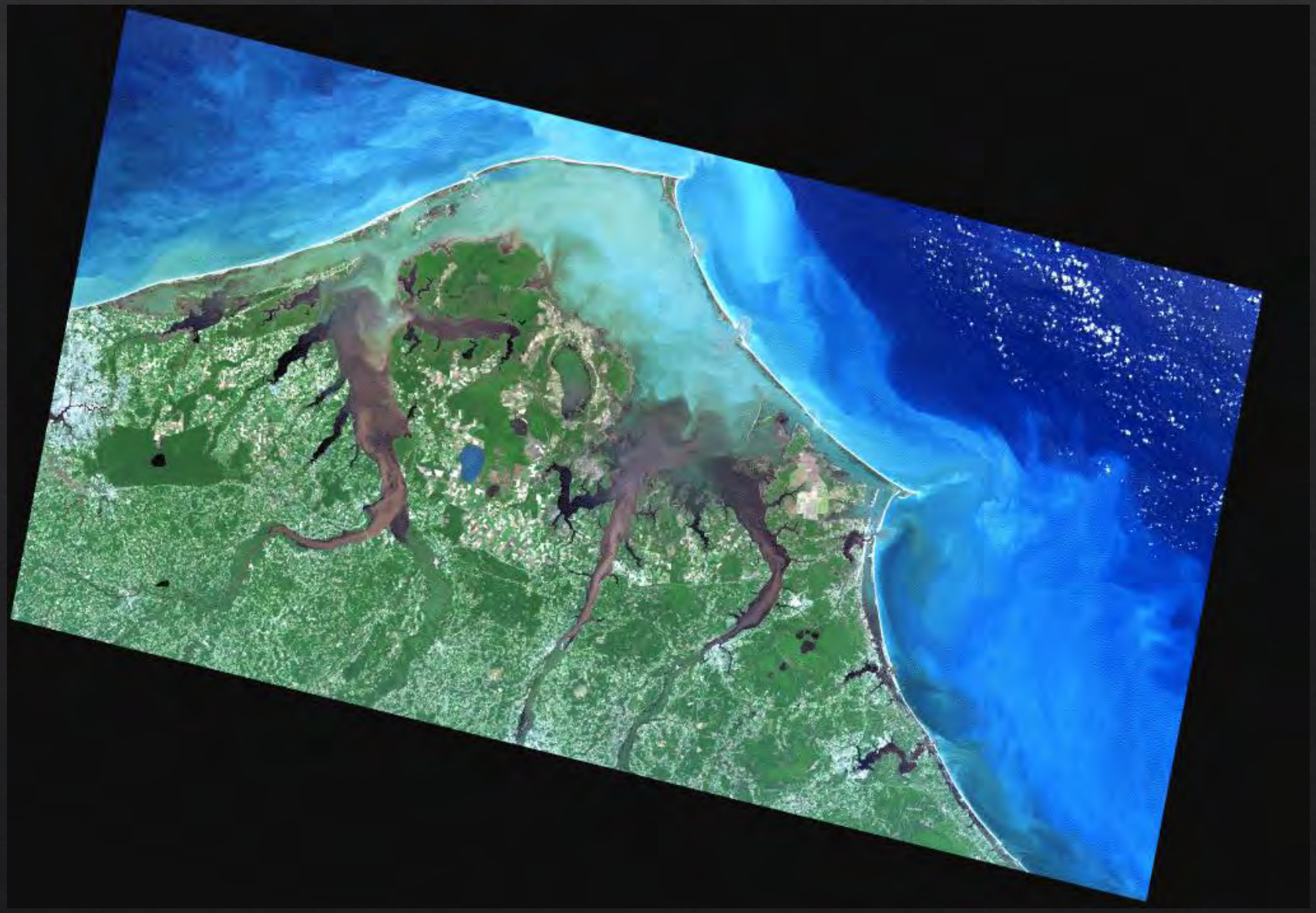
Convergence of ocean currents at Cape Hatteras



Temperate and subtropical water create a unique mixture of temperature, salinity, and nutrients



Barrier islands typically form in regions that are tectonically stable, relatively flat, and near a sediment source (river deltas)



The making of a barrier island…

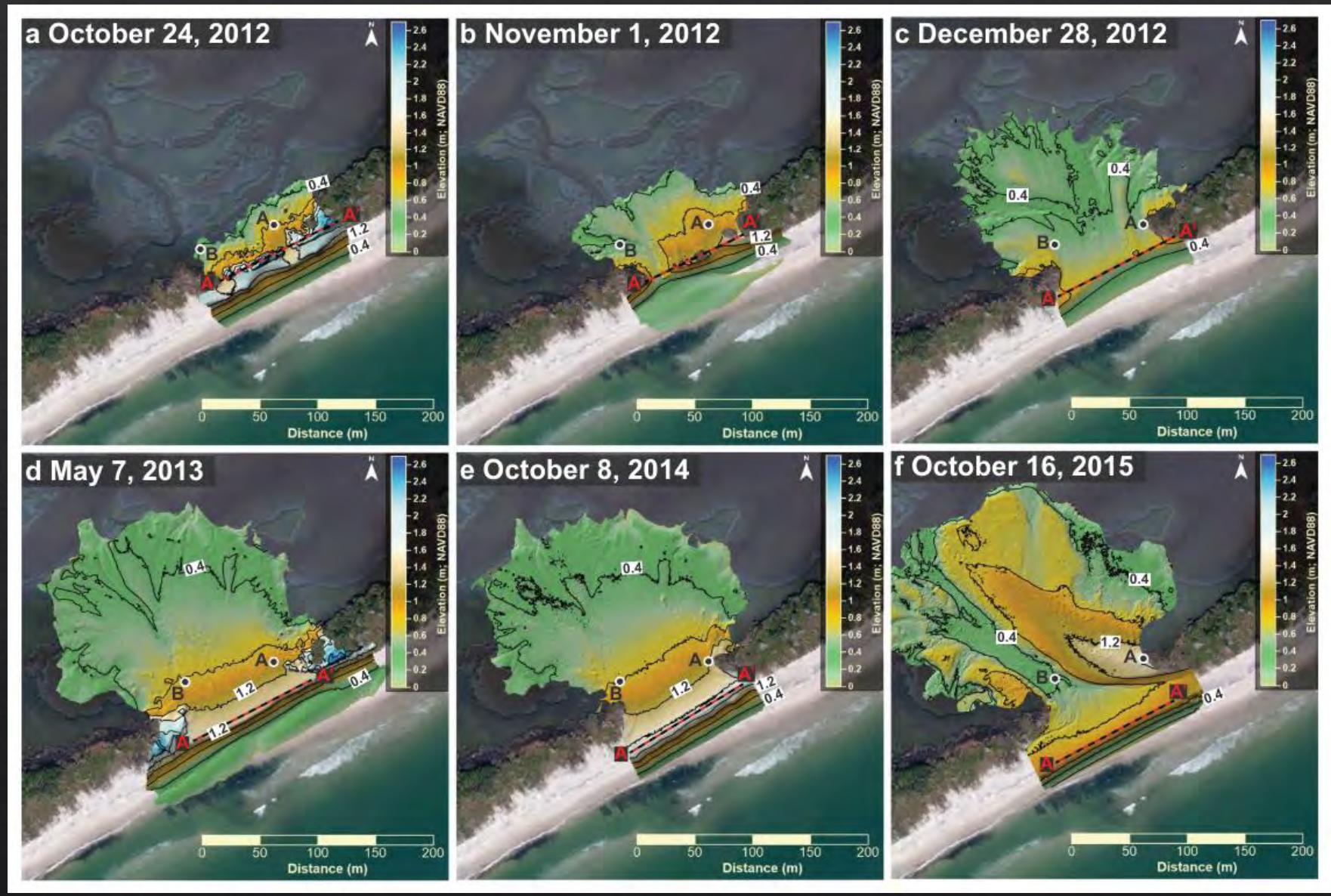
Overwash

Longshore Transport

Flood Tide Delta Accretion

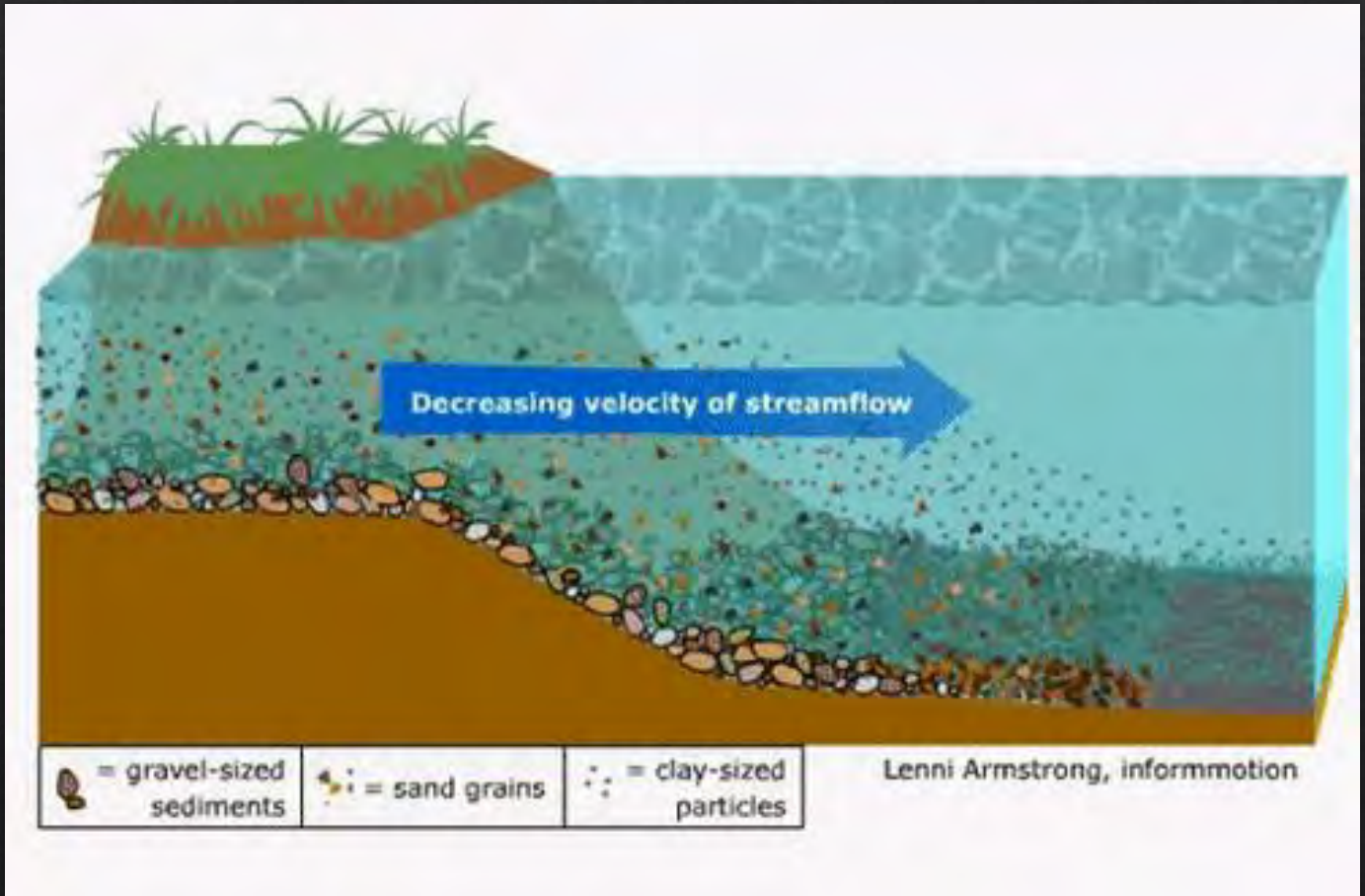
The breach opens the door for more sand

- The initial overwash from high-energy storms break down the dune barrier.
- Once the barrier is down, lesser storms can overwash and the movement of sand over the island



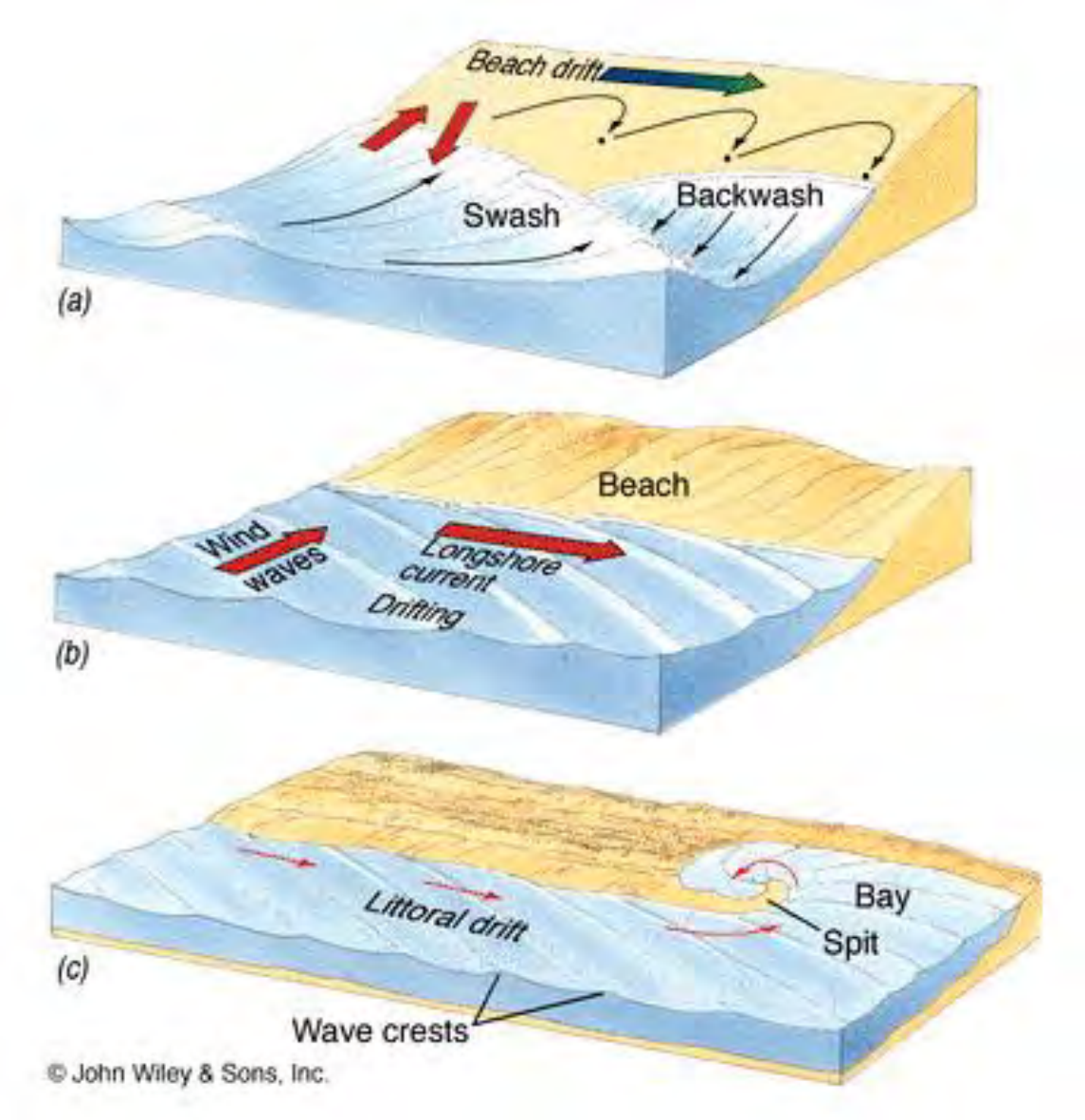
Rodriguez et al, 2020

Water and sand mix to move sediments from mountains to beaches



- Faster water can move larger and heavier sediments while smaller particles get carried away
- As water slows, large particles fall out of suspension and deposit on the seafloor.
- Muds accumulate in areas with slow moving water

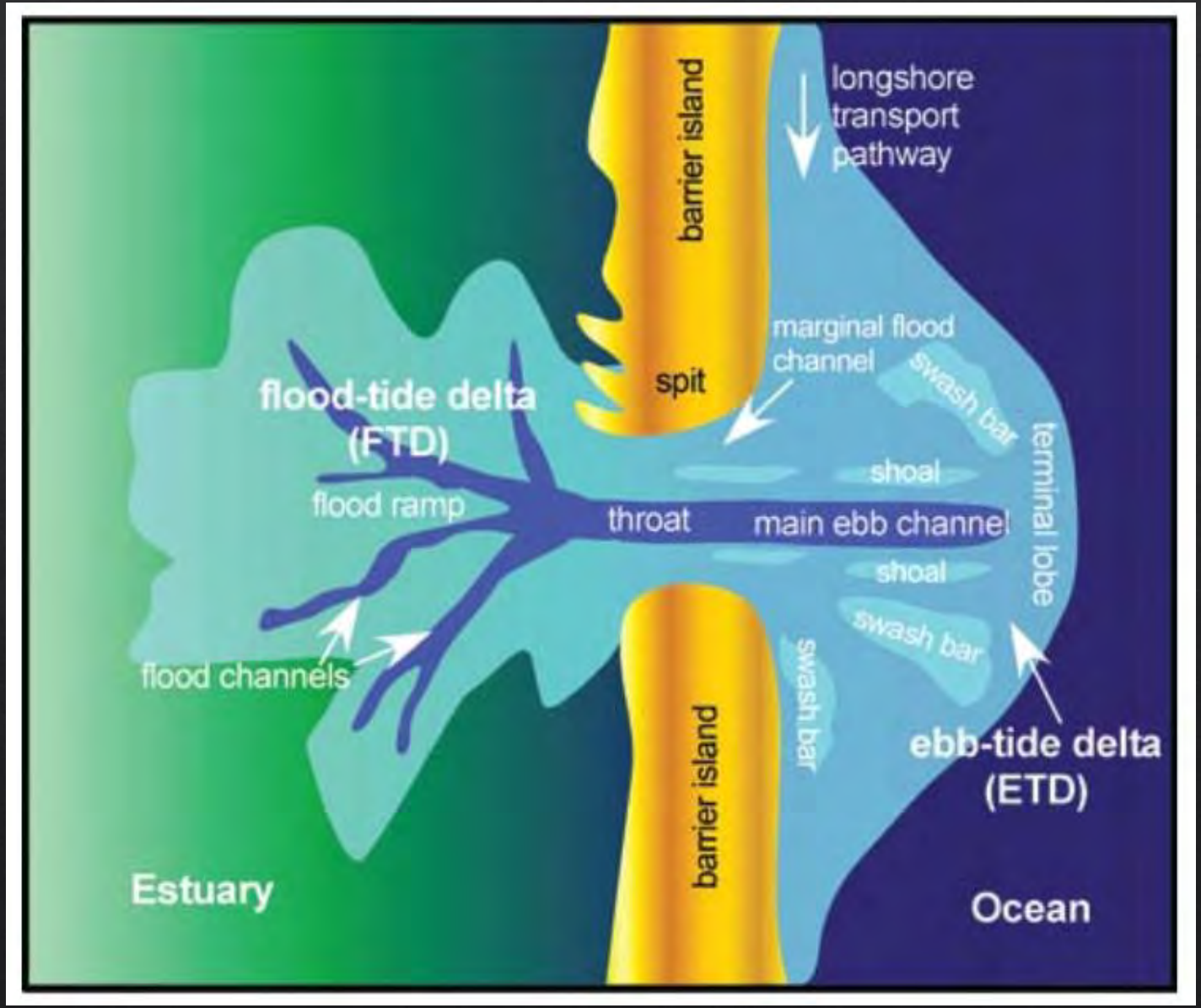
Winds and currents help to transport sediments along the coast



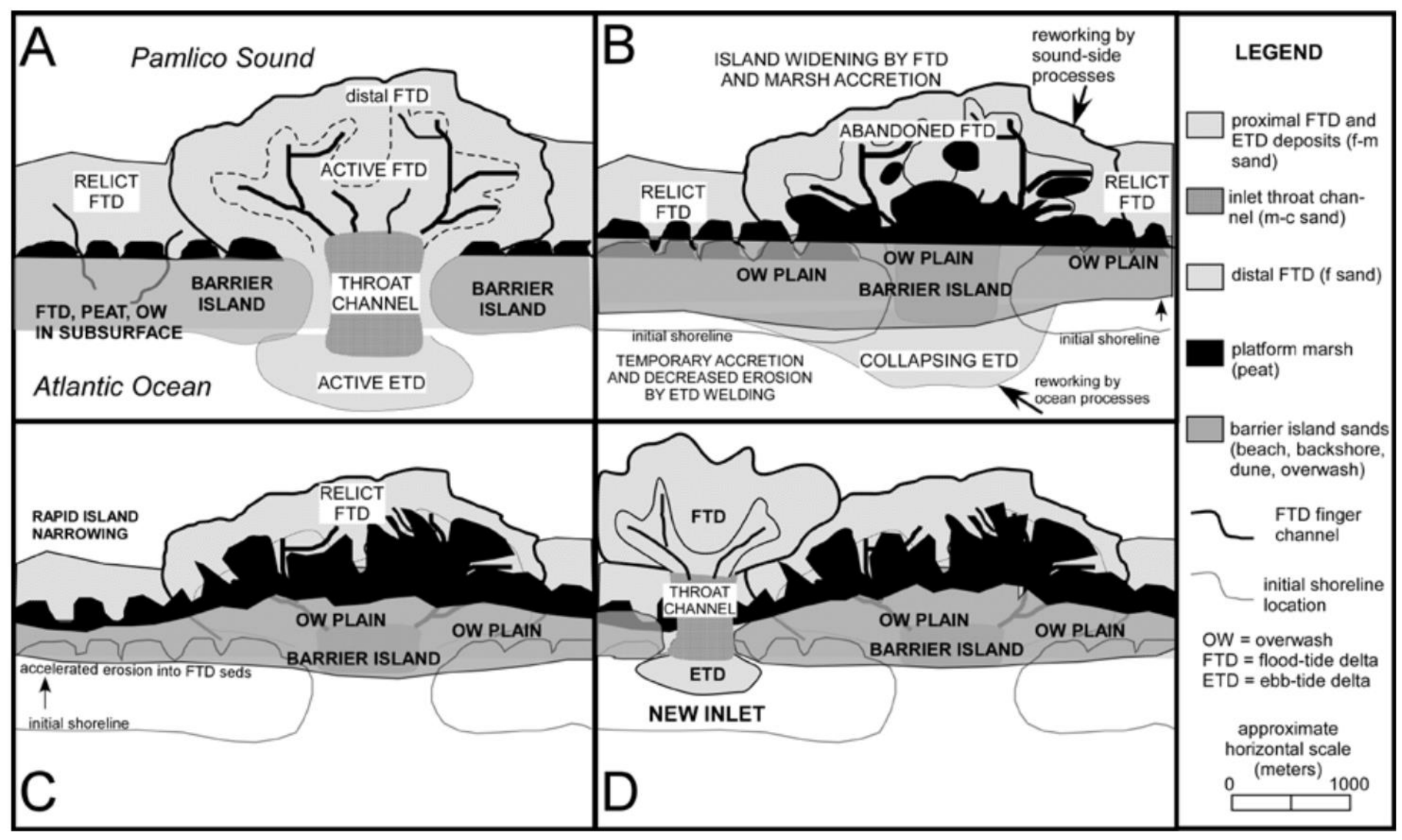
- Longshore current refers to water movement along a shore
- Longshore drift is the movement of sediment that occurs because of wave refraction

Lots of water moves lots of sediment

- Water and sand can enter inlets during the incoming (flood) tide and are deposited on the estuary side forming a Flood-Tide Delta (FTD)
- The outgoing (ebb) tide moves sand out the main channel and deposited on the Ebb-Tide Delta (ETD) which form swash bars and eventually merge with the down current beach
- FTD and ETD are important storages and source of sand to nearby beaches.

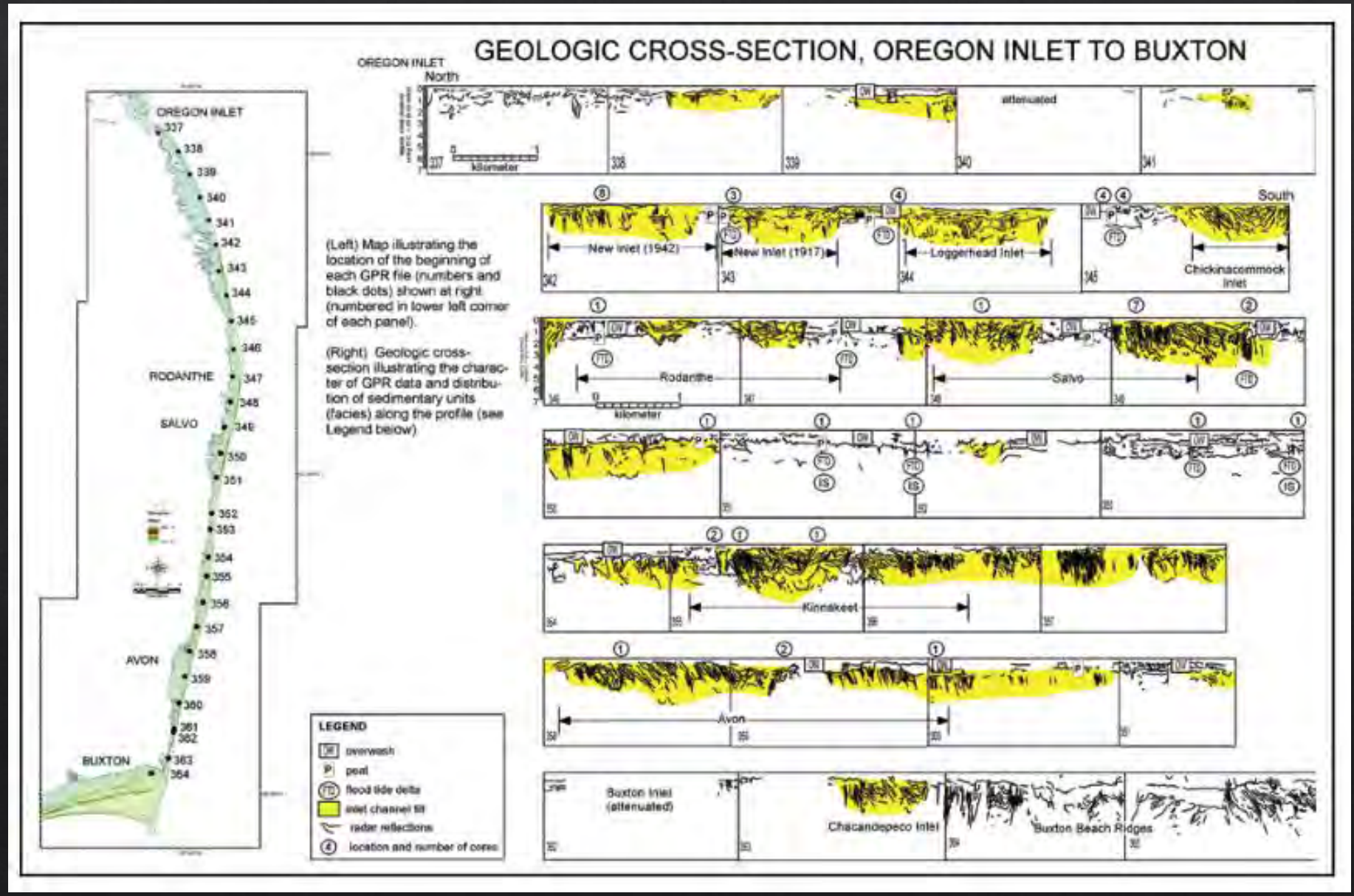


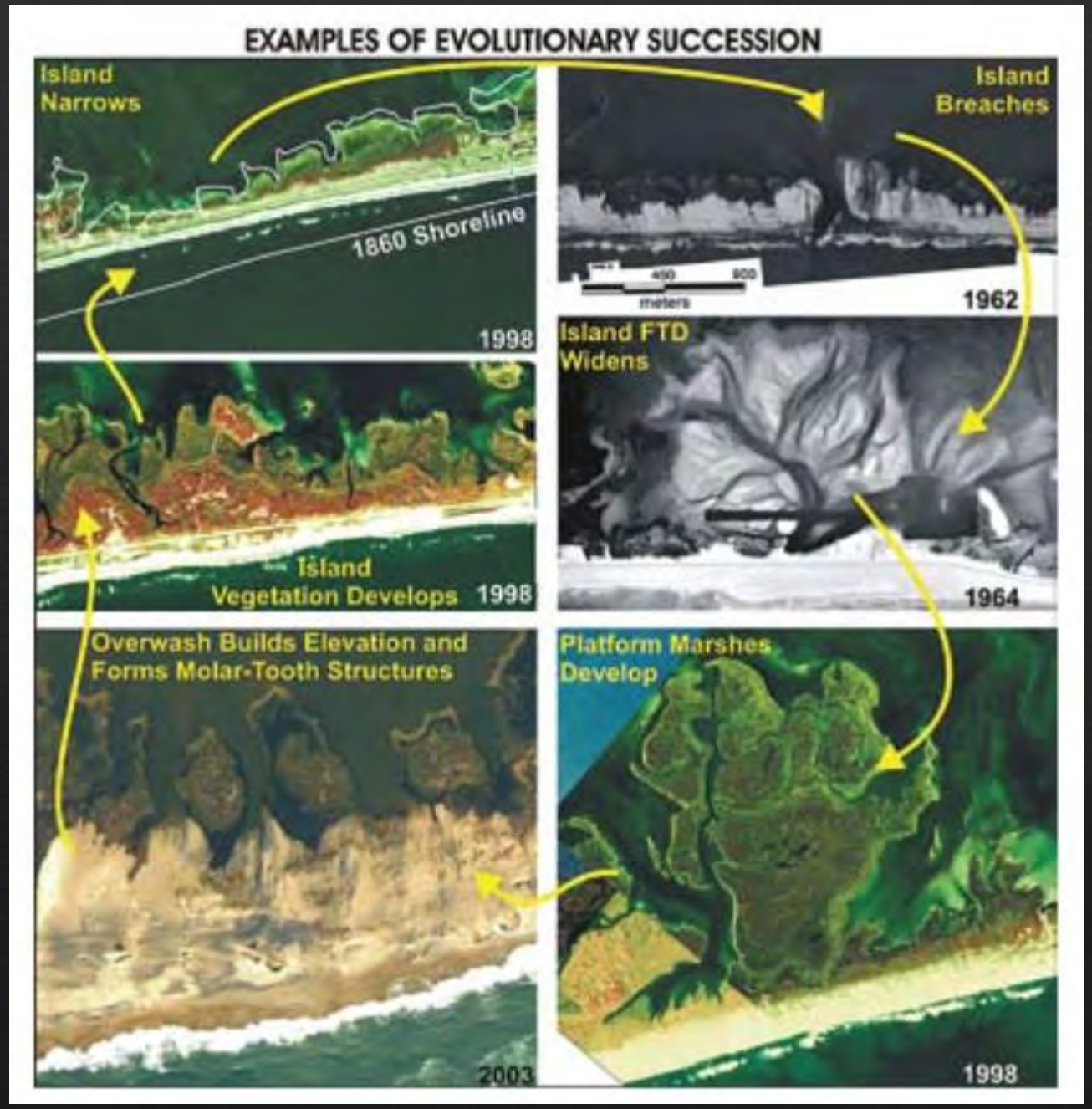
Barriers islands evolve in response to shoreline recession and inlet formation



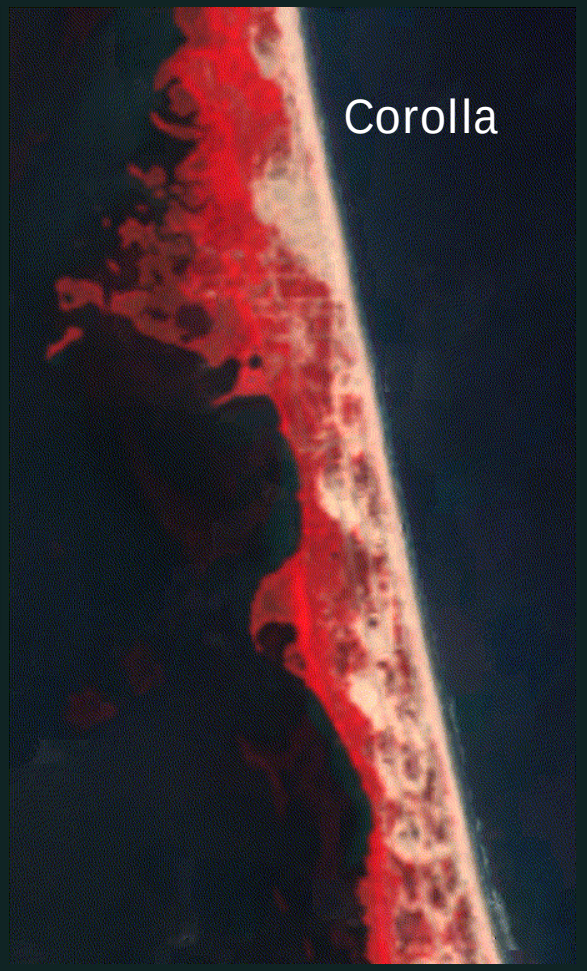
Sediment characteristics tell the story of shifting sands

- Changes in the sediment size, quantity and shape provide information about the environment in which they were deposited.





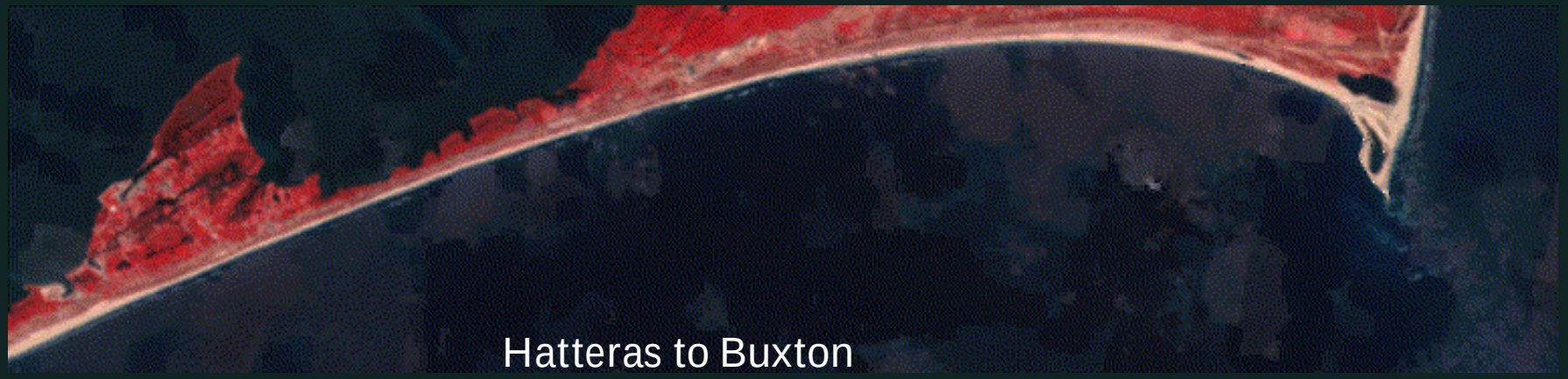
- The number and size of inlets is naturally adjusted to (i.e., is in equilibrium with) the volume of water discharged from the rivers and the amount of water that enters and exits the estuaries daily due to astronomical and wind tides

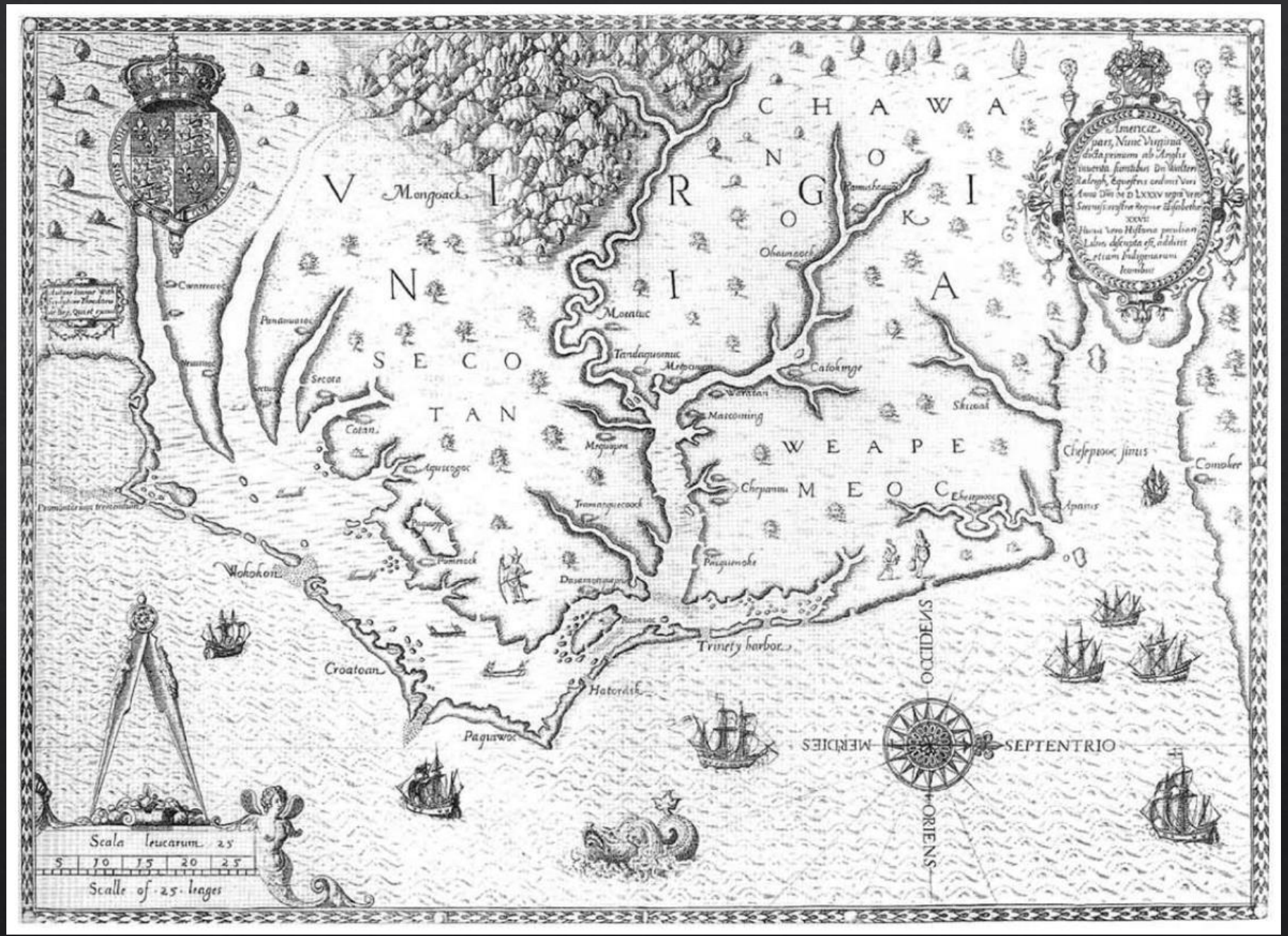


The Outer Banks has changed a lot in the last 20 years...

...the last 200 years

...the last 20,000 years



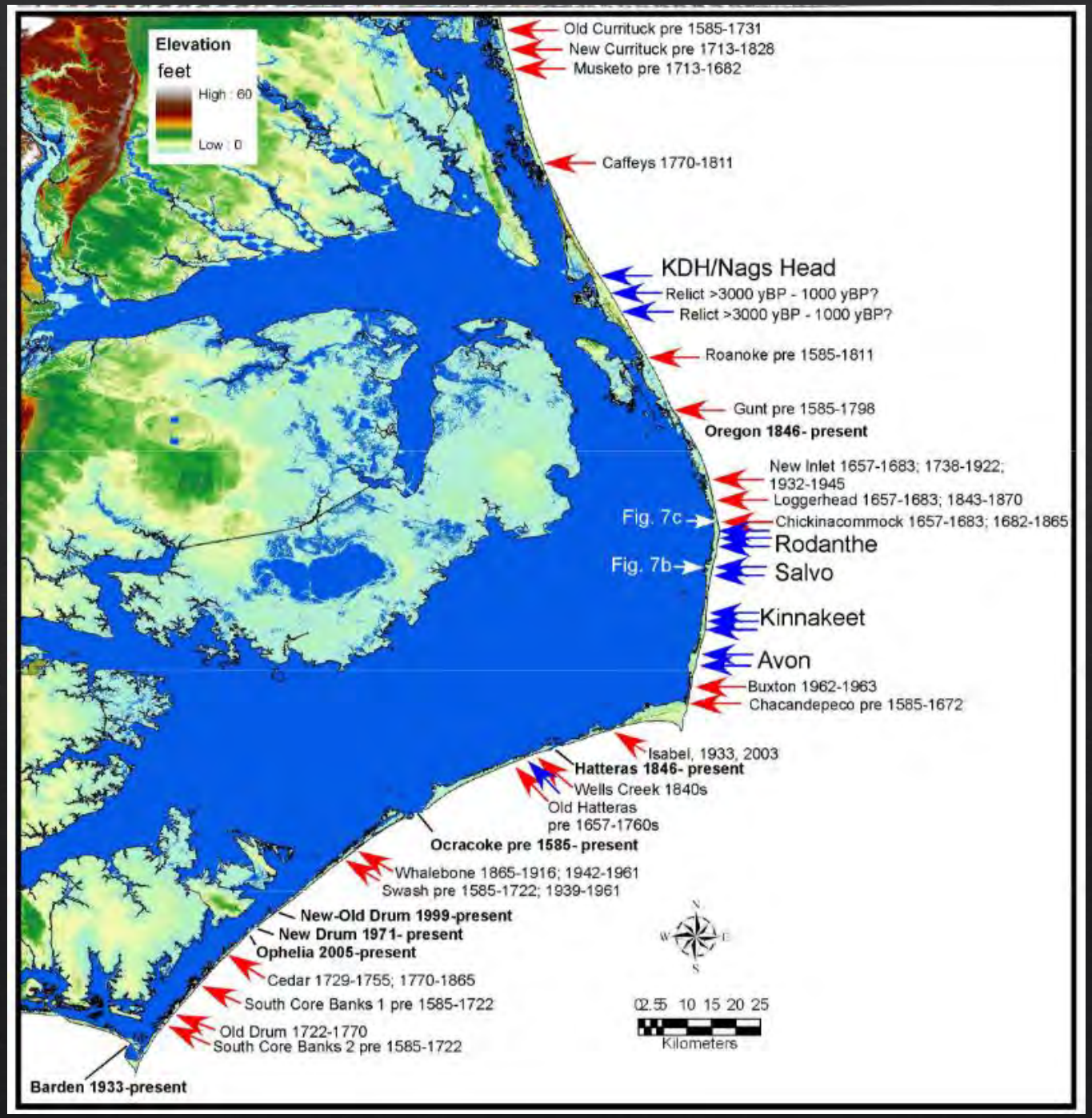


White-De Bry map of 1590

Shifting sands open and close inlets

- Numerous historical inlets have been identified along the Outer Banks, a combination of documented and undocumented (geologic sediments).

- Previous inlets are backfilled with sand and have distinctive properties when measured with ground penetrating radar

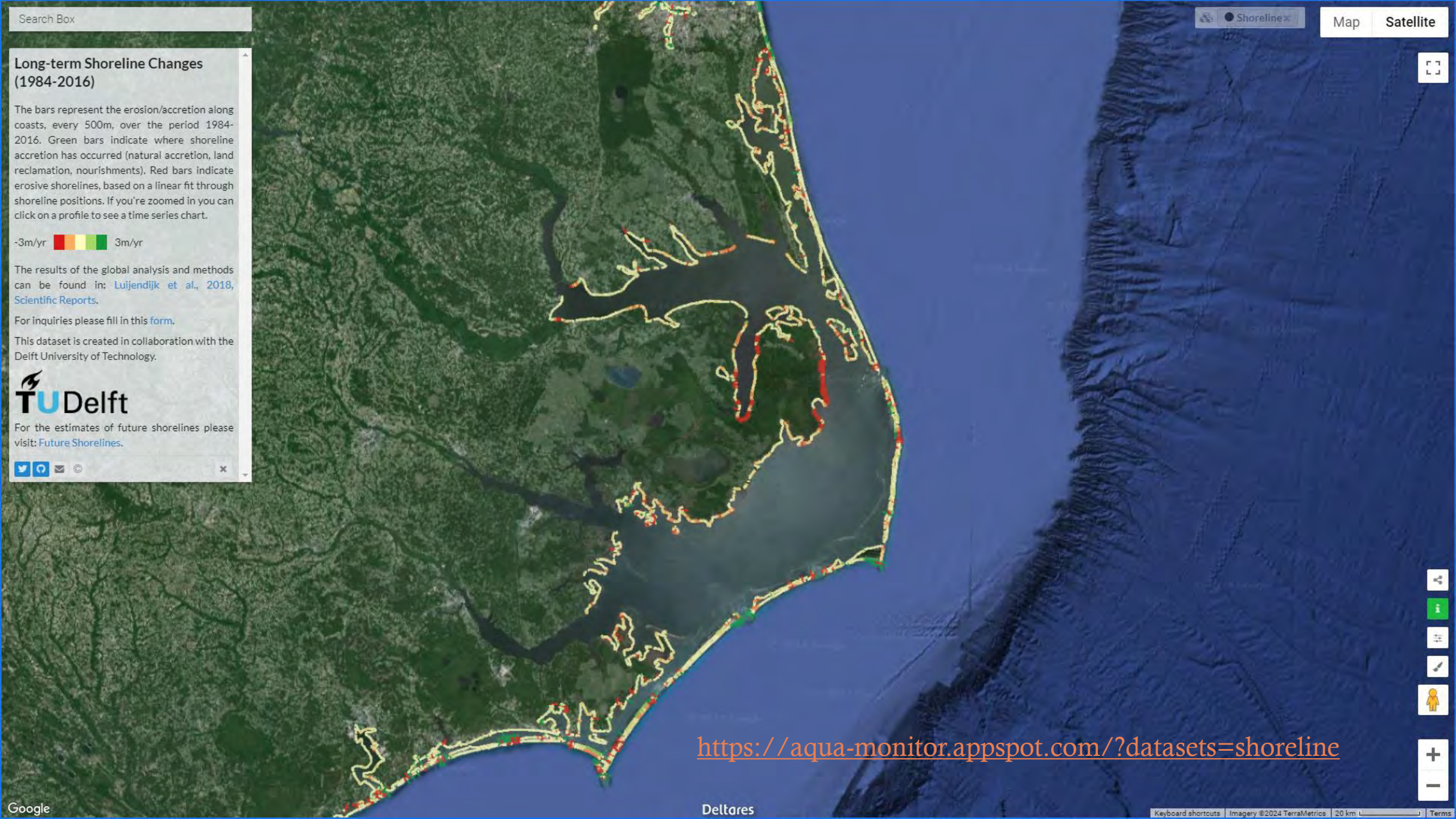


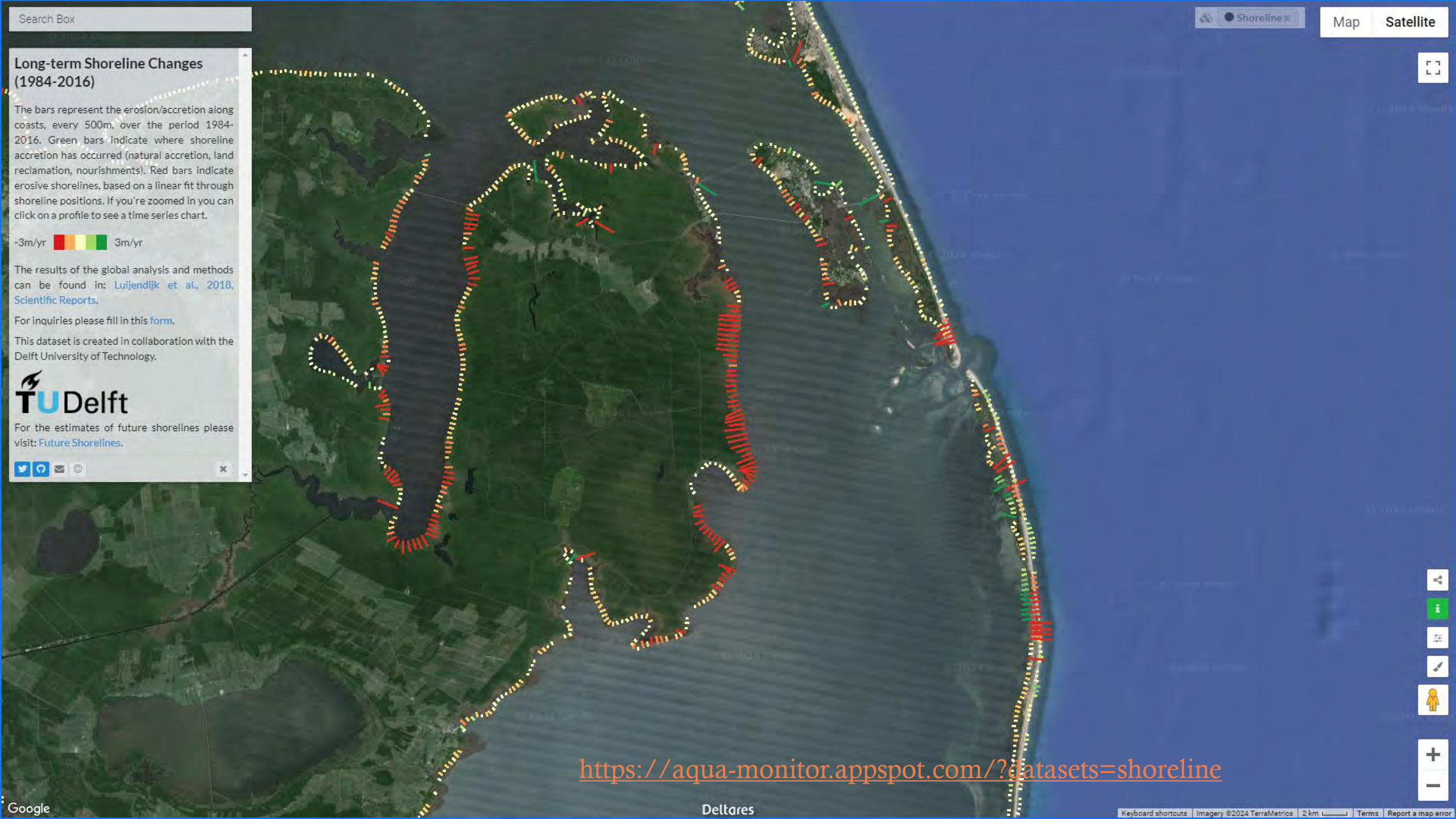
Continued and increasing long-term shoreline erosion rates

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.


Search Box
Long-term Shoreline Changes (1984-2016)
The bars represent the erosion/accretion along coasts, every 500m, over the period 1984-2016. Green bars indicate where shoreline accretion has occurred (natural accretion, land reclamation, nourishments). Red bars indicate erosive shorelines, based on a linear fit through shoreline positions. If you're zoomed in you can click on a profile to see a time series chart.
-3m/yr
3m/yr
The results of the global analysis and methods can be found in: Luijendijk et al., 2018, Scientific Reports.
For inquiries please fill in this form.
This dataset is created in collaboration with the Delft University of Technology.
TU Delft
For the estimates of future shorelines please visit: Future Shorelines.
Shoreline
Map
Satellite
https://aqua-monitor.appspot.com/?datasets=shoreline
Google
Deltares
Keyboard shortcuts
Imagery ©2024 TerraMetrics
20 km
Terms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For inquiries please fill in this form.
This dataset is created in collaboration with the Delft University of Technology.
TU Delft
For the estimates of future shorelines please visit: Future Shorelines.
Shoreline
Map
Satellite
https://aqua-monitor.appspot.com/?datasets=shoreline
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CBS NEWS

SUNDAY MORNING ›

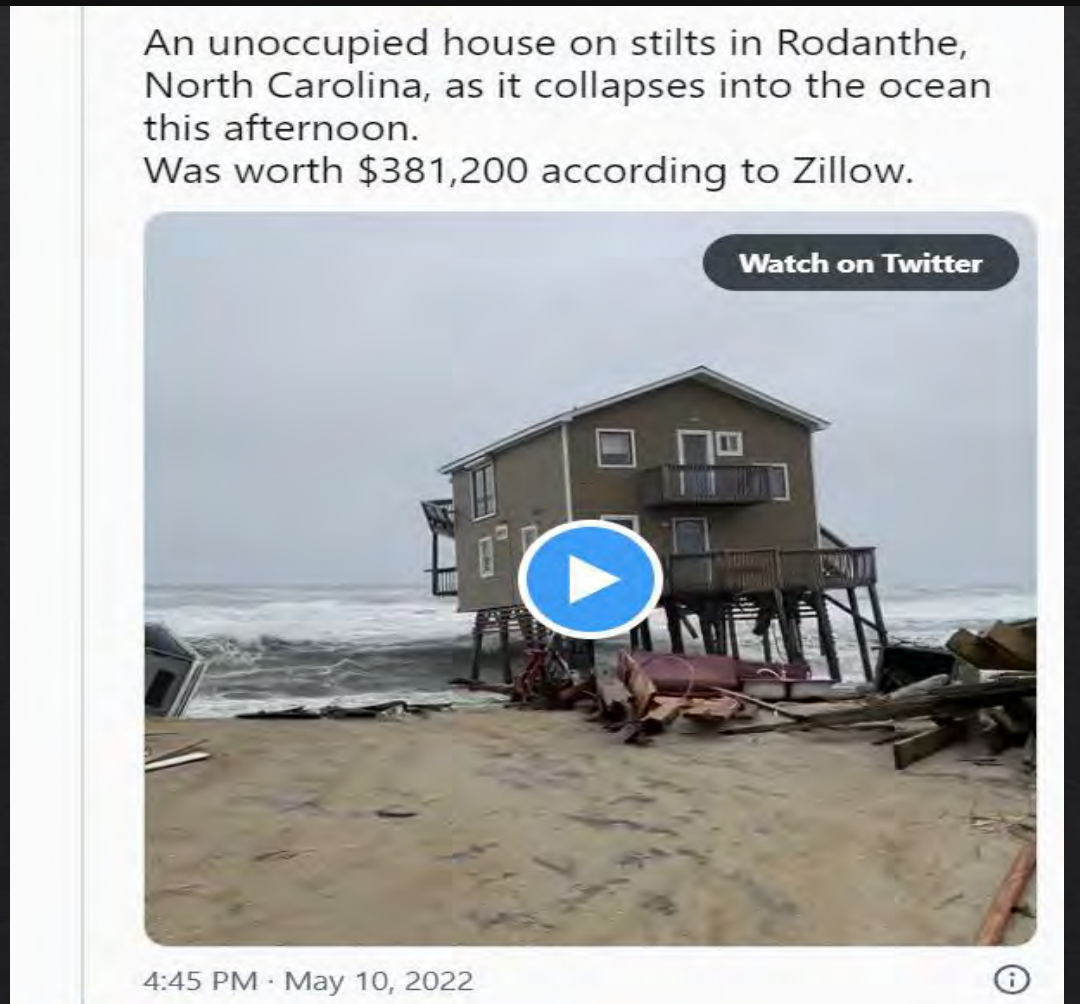
Coastal residents on climate change: "The ocean's coming for you"

SUNDAY MORNING

BY BEN TRACY

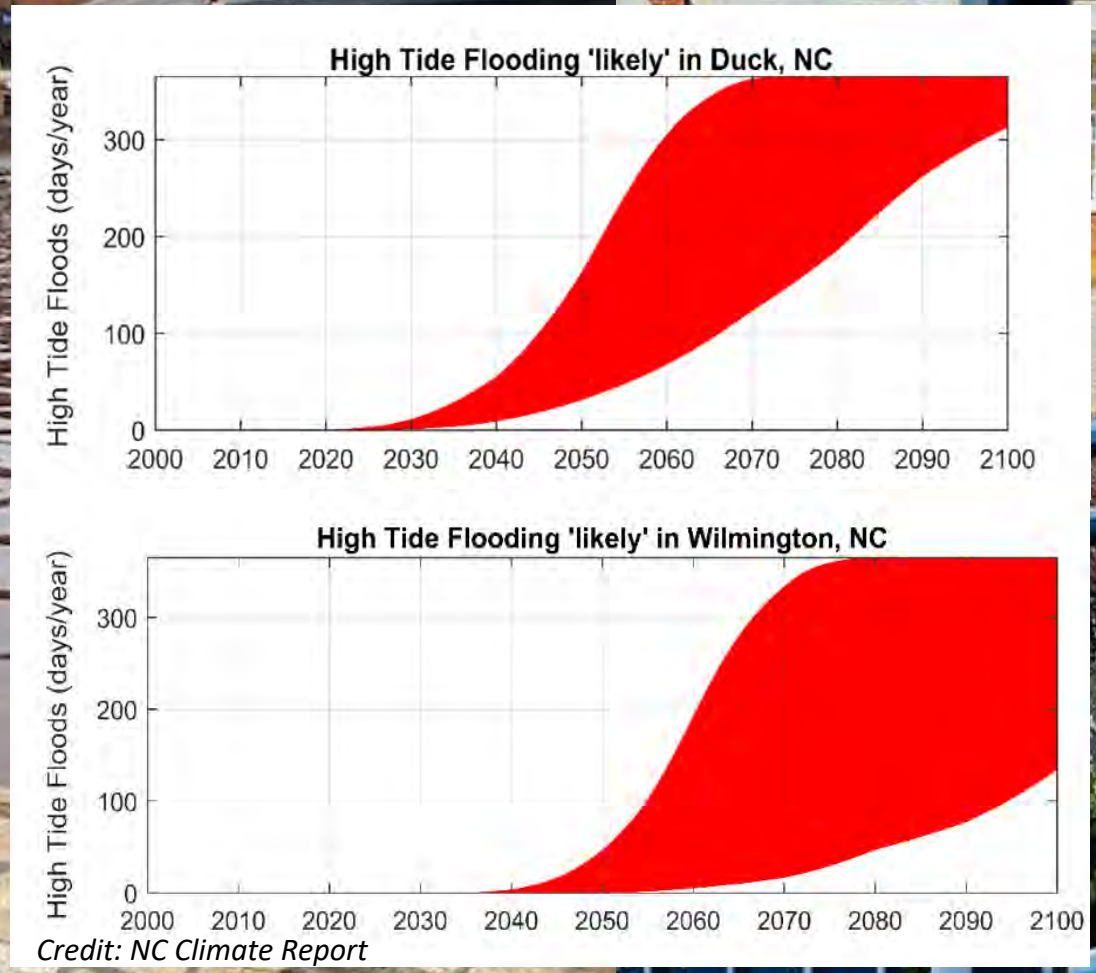
JANUARY 8, 2023 / 10:19 AM / CBS NEWS

"*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."*



Wilmington – Oct. 2018

Town of Manteo – April 2022

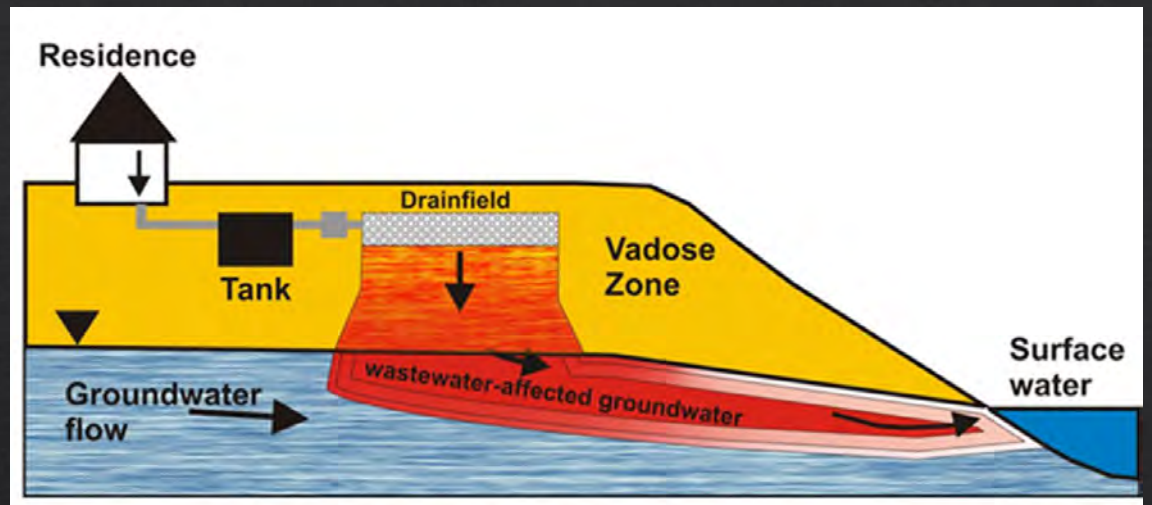


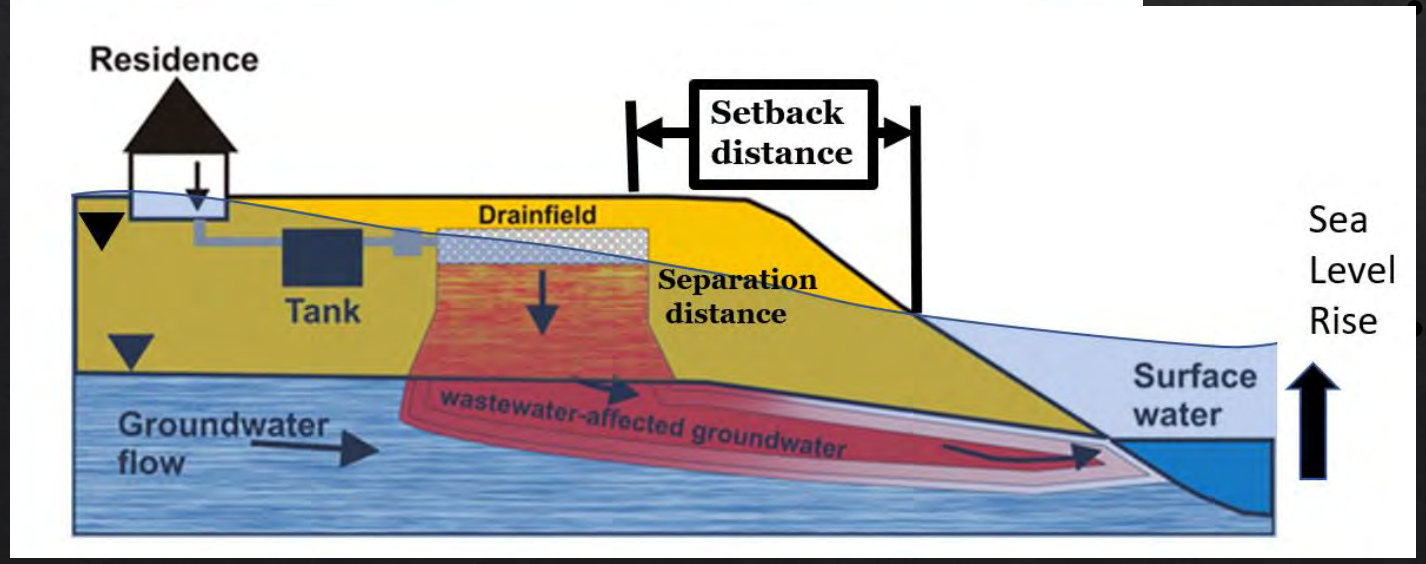
Credit: NC Climate Report

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

Credit: Reide Corbett

Septic system failure



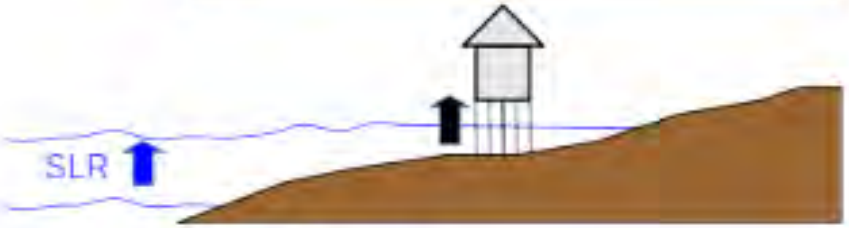


- High-tide flooding, extreme precipitation and sea level rise result in "immediate and long-term losses of on-site wastewater system functionality"
- These factors reduce unsaturated soils underneath; lead to poor treatment, backing up, and **pollution**.

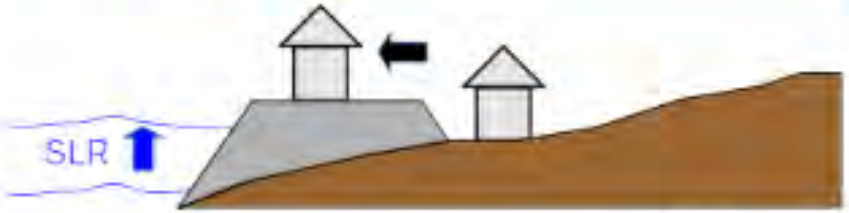
From Harrison, Edwards, Humphrey, O'Driscoll, Hill & community partners

No response

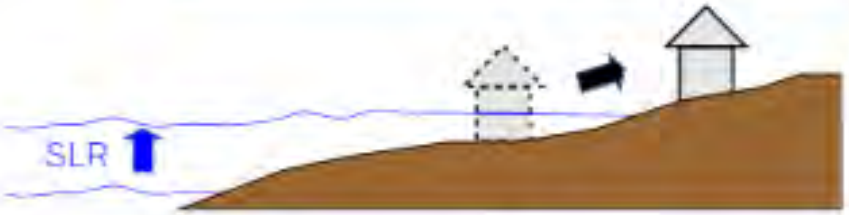
Protect



Accommodate

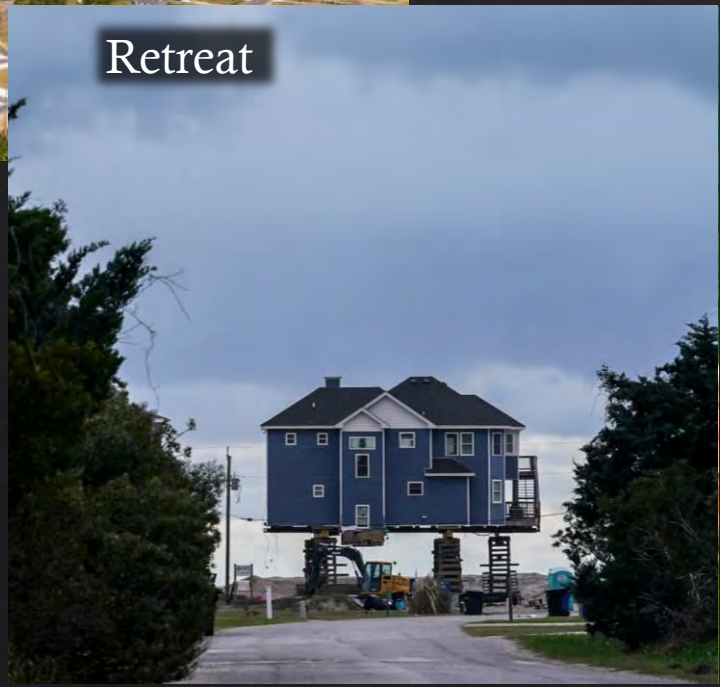


Advance



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

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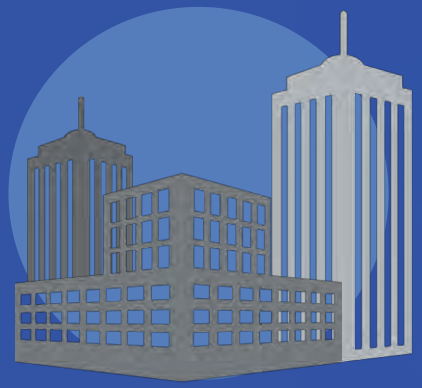
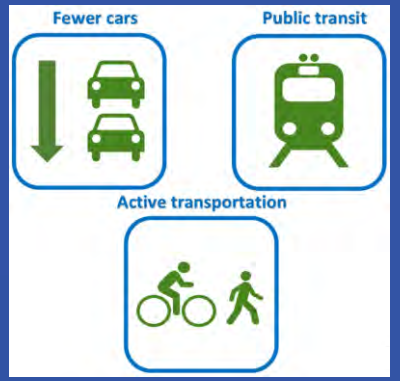
Better Buildings



Renewable Energy

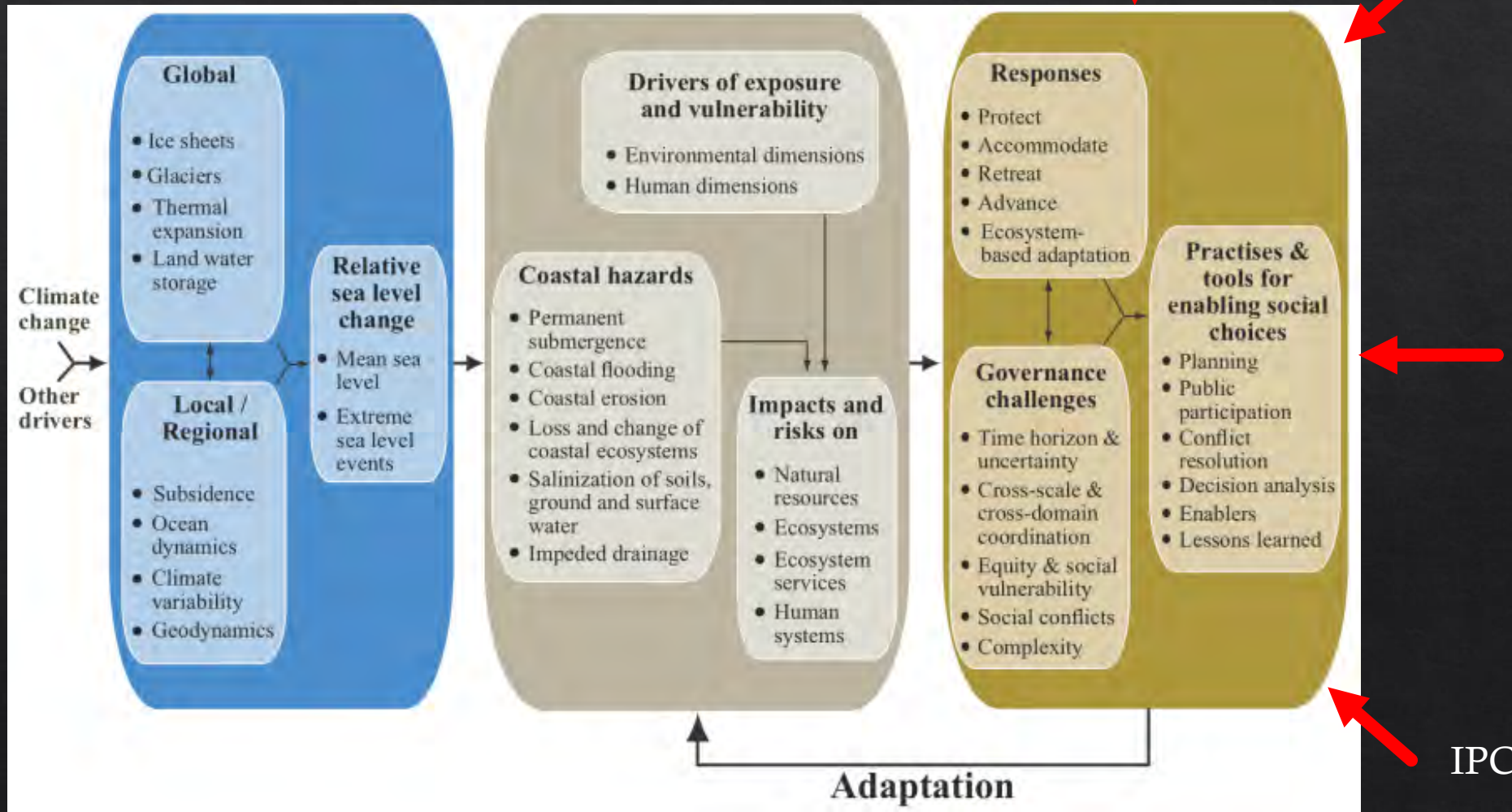
Carbon Sinks



Transportation

Summary

- Climate Change & other drivers are changing the coastal landscape
- NC has many coastal hazards to consider.
- Adaptive planning is needed.



IPCC, 2019


Visit and learn more!

References

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