The Relationship of Climate Change to Coastal Hazard Risk

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Dr. Alex Manda is an associate professor of Water Resources in the Department of Geological Sciences. He is also affiliated with the Natural Resources and Environment Research Pan-University Cluster and the East Carolina University Water Resources Center. Dr. Manda's research focuses on investigating groundwater-surface water interactions, studying coastal hydrogeology and assessing the influence of environmental change on water resources in coastal regions. Dr. Manda earned his Bachelor's Degree in Geology from Cardiff University in the United Kingdom and his Master's Degree in Geology from Florida International University. He also has a PhD in Geosciences from the University of Massachusetts Amherst where he specialized in the hydrogeology of fractured rocks.

Impacts of climate change and sea level rise on coastal water quantity and quality

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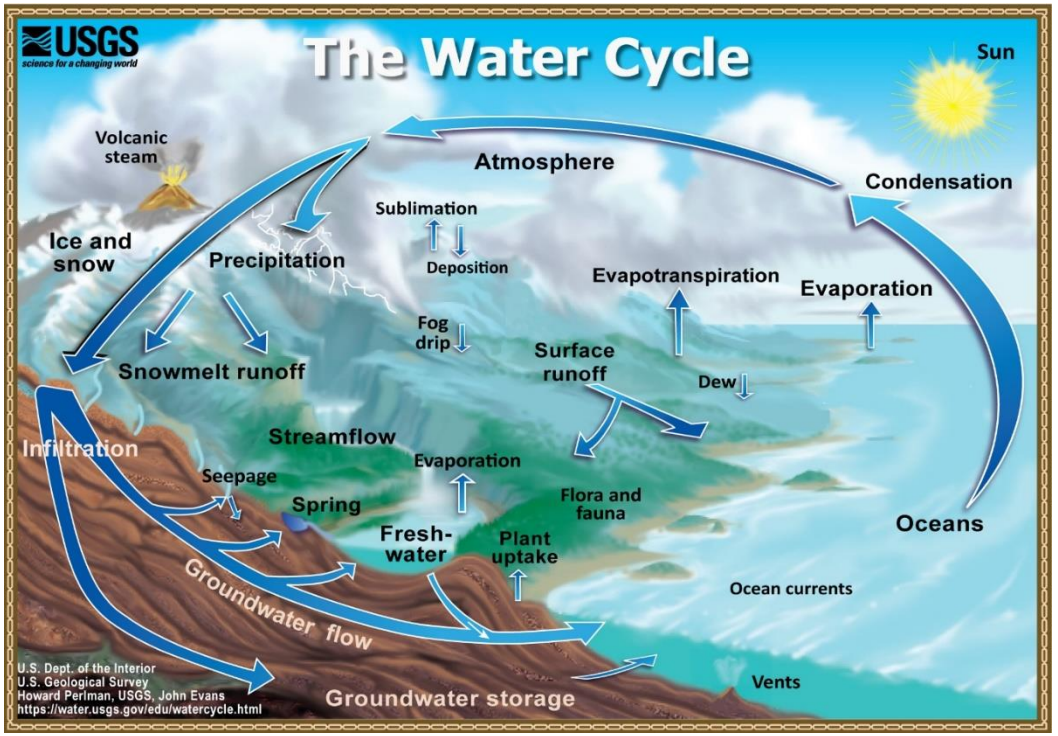
Groundwater and the Water Cycle

- Precipitation
- Melting Ice and Snow
- Temperature
- Sea-level rise



USGS, http://water.usgs.gov/edu/watercycle.html

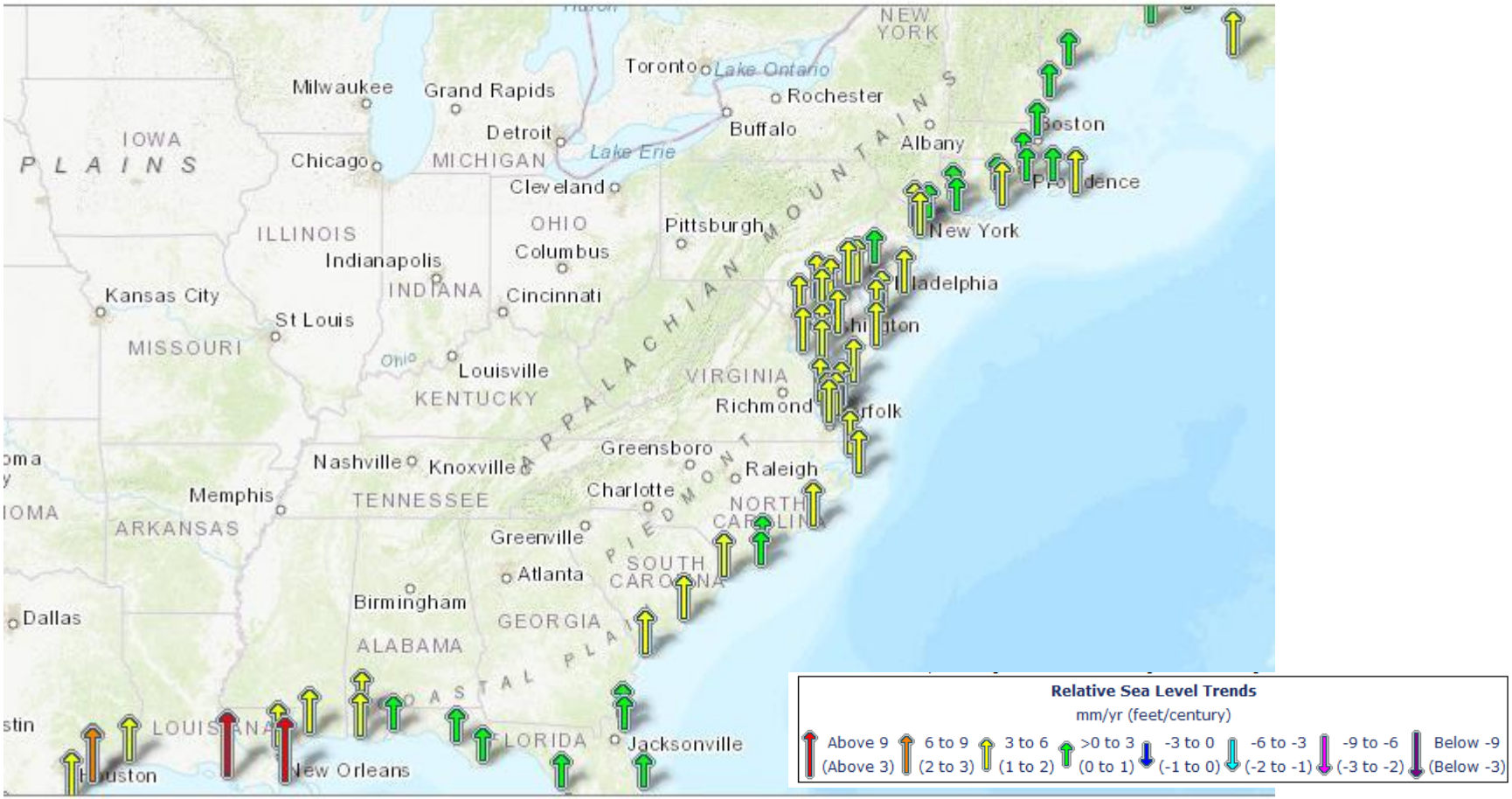
Sea-level rise

Spatial and temporal scales of geophysical processes affecting water levels

Physical Process	Spatial Scale			Temporal Scale	Potential Magnitude (yearly)
	Global	Regional	Local		
Wind Waves (e.g., dynamical effects, runup)			X	seconds to minutes	<10 m
Tsunami		X	X	minutes to hours	<10s of m
Storm Surge (e.g., tropical storms or nor'easters)		X	X	minutes to days	<15 m
Tides			X	hours	<15 m
Seasonal Cycles		X	X	months	<0.5 m
Ocean/Atmospheric Variability (e.g., ENSO response)		X	X	months to years	<0.5 m
Ocean Eddies, Planetary Waves		X	X	months to years	<0.5 m
Ocean Gyre and Over-turning Variability (e.g., PDO response)		X	X	years to decades	<0.5 m
Land Ice Melt/Discharge	X	X	X	years to centuries	millimeters to centimeters
Thermal Expansion	X	X	X	years to centuries	millimeters to centimeters
Vertical Land Motion		X	X	minutes to centuries	millimeters to centimeters

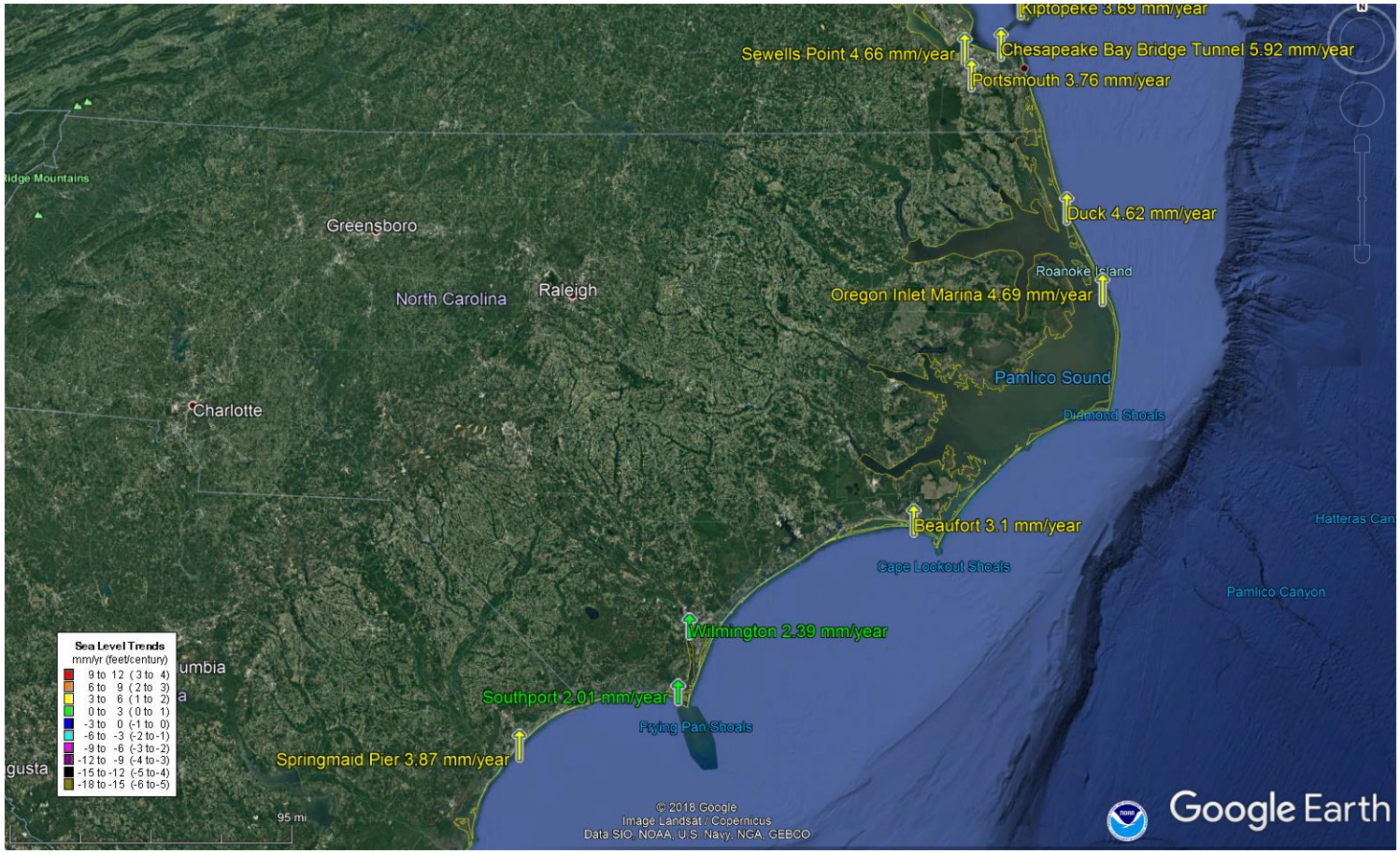
NOAA, 2017 NOAA Technical Report NOS CO-OPS 083

Sea-level trends

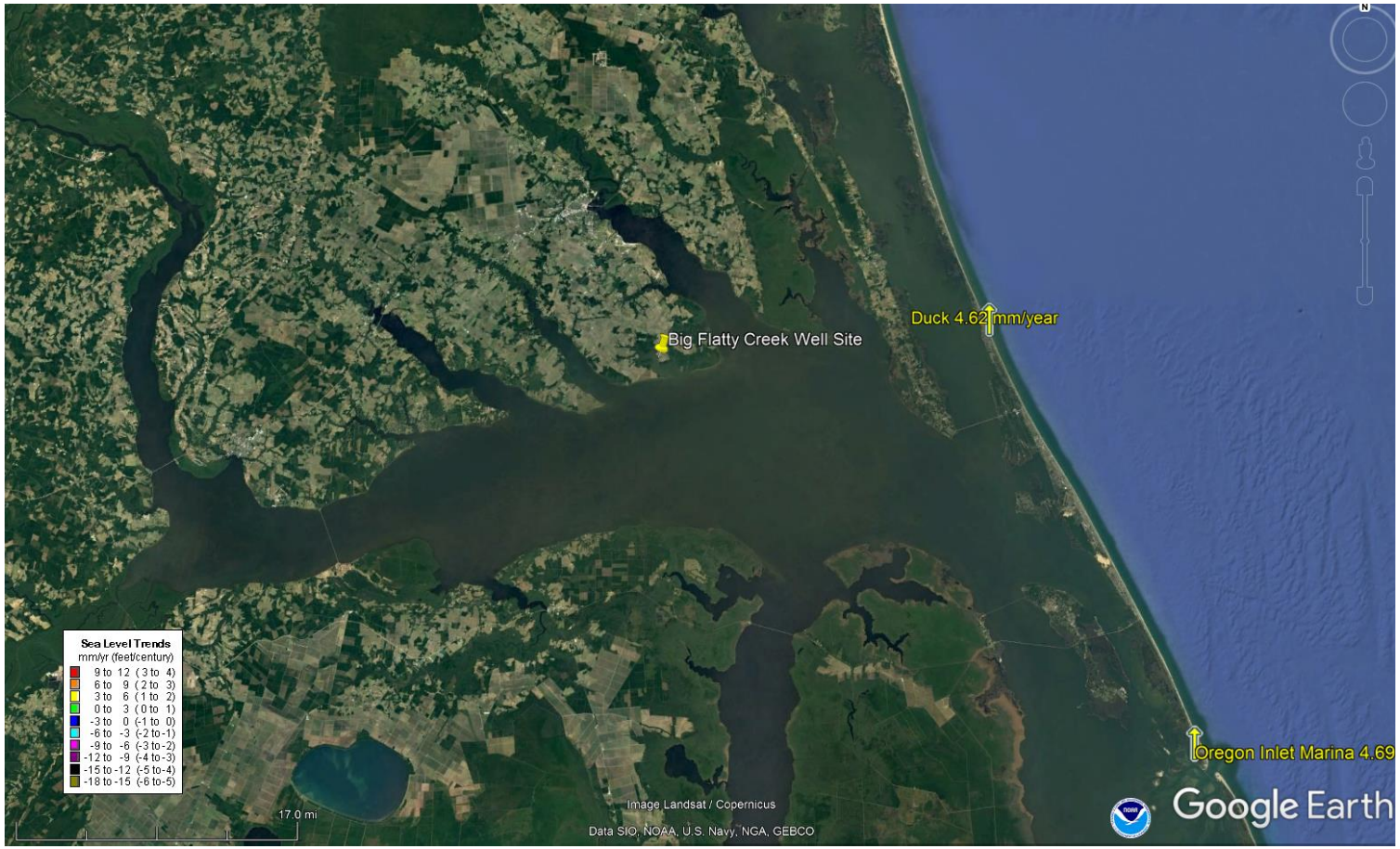


Source: NOAA
https://tidesandcurrents.noaa.gov/sltrends/sltrends.html

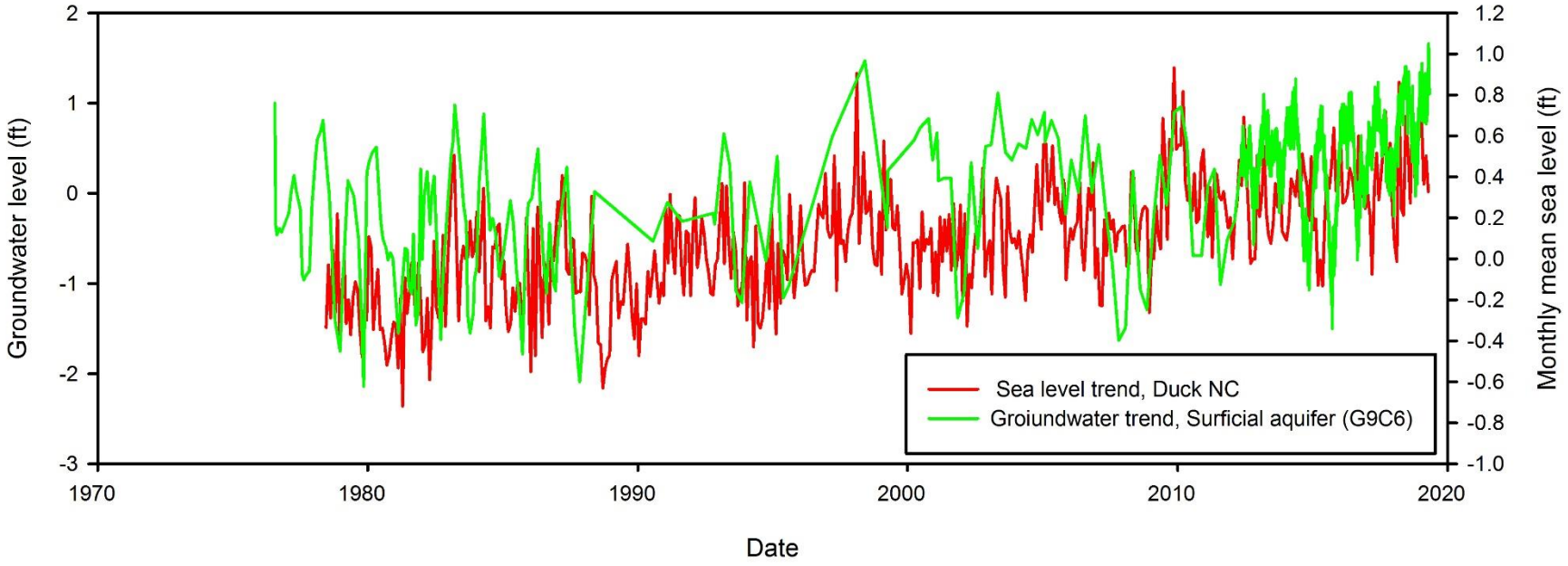
Sea-level trends in North Carolina



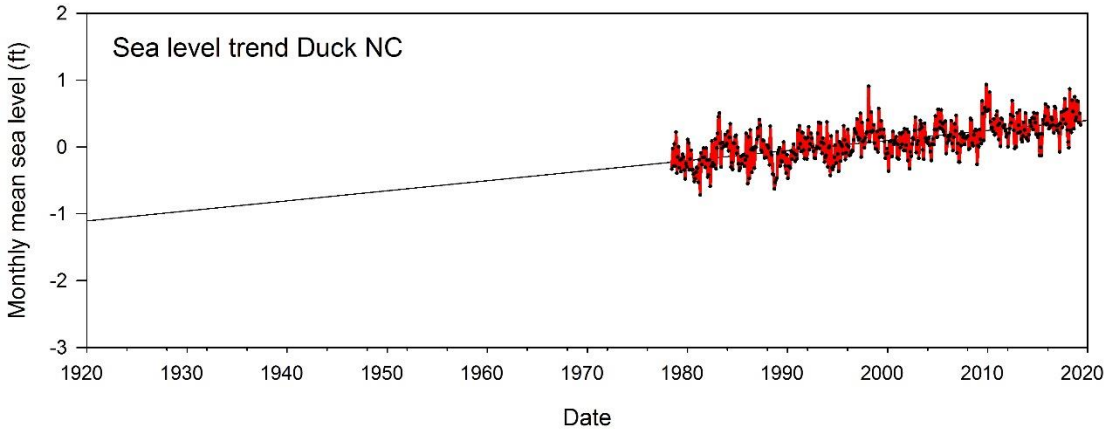
Conditions in Northeastern North Carolina



Groundwater vs Sea-level rise

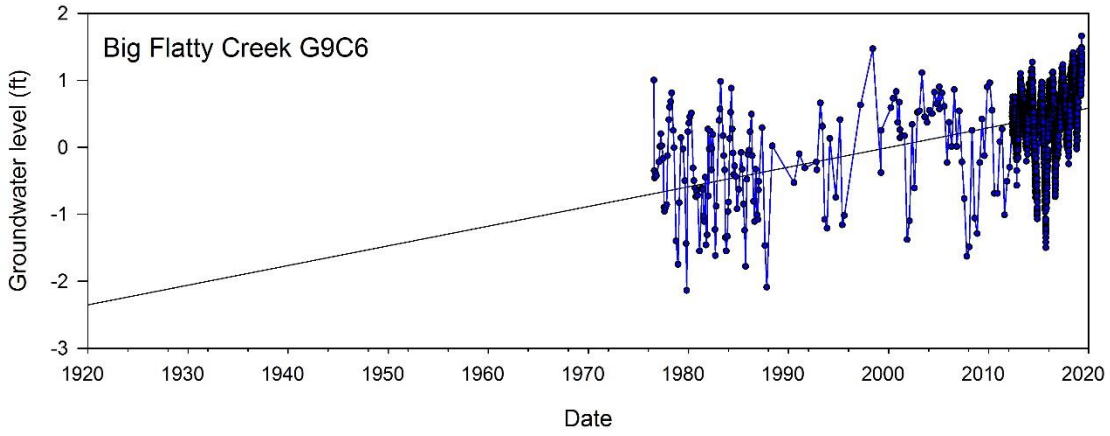


Data Sources: NOAA and NC DEQ

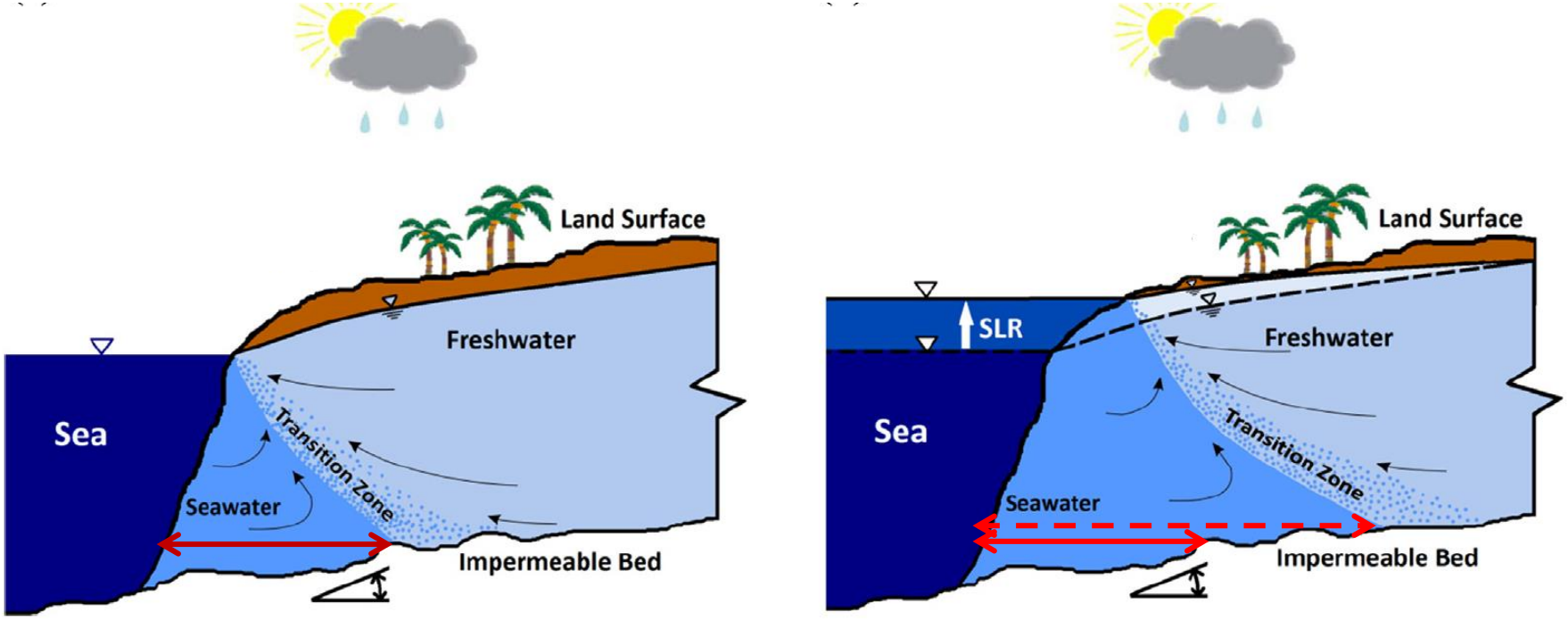


Available data: 1978 to 2018
Change: 1.52 feet in 100 years

Available data: 1976 to 2018
Change: 2.96 feet in 100 years

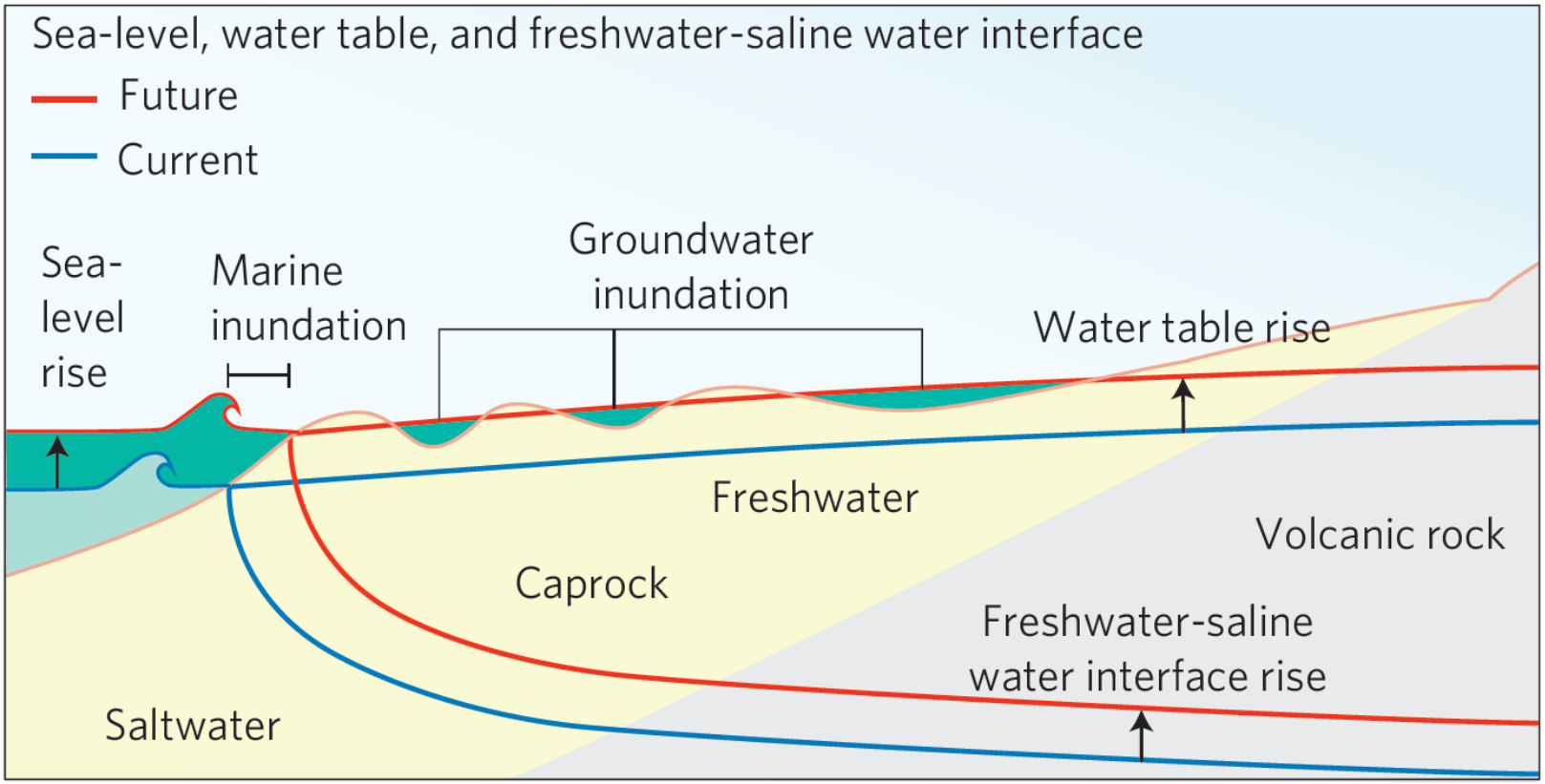


Sea-level rise



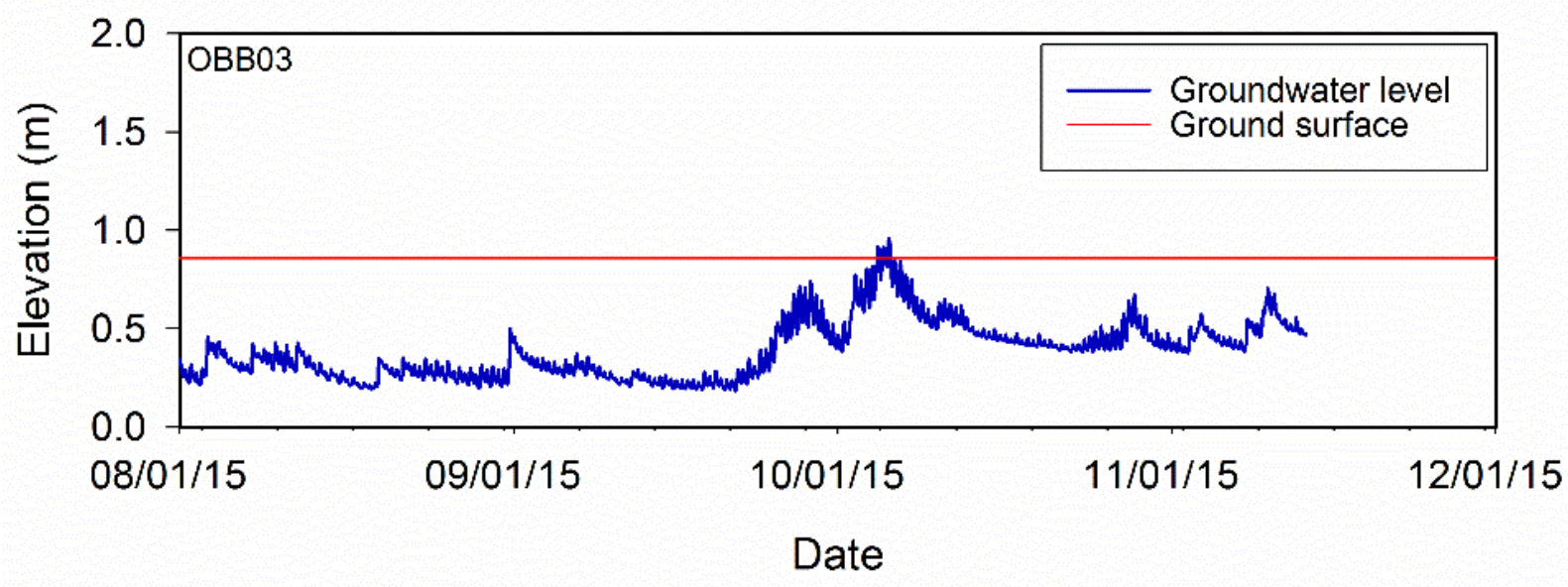
Ketabchi et al. 2016, Sea-level rise impacts on seawater intrusion in coastal aquifers: Review and integration, Journal of Hydrology, 535, 235-255

Groundwater and Marine Inundation

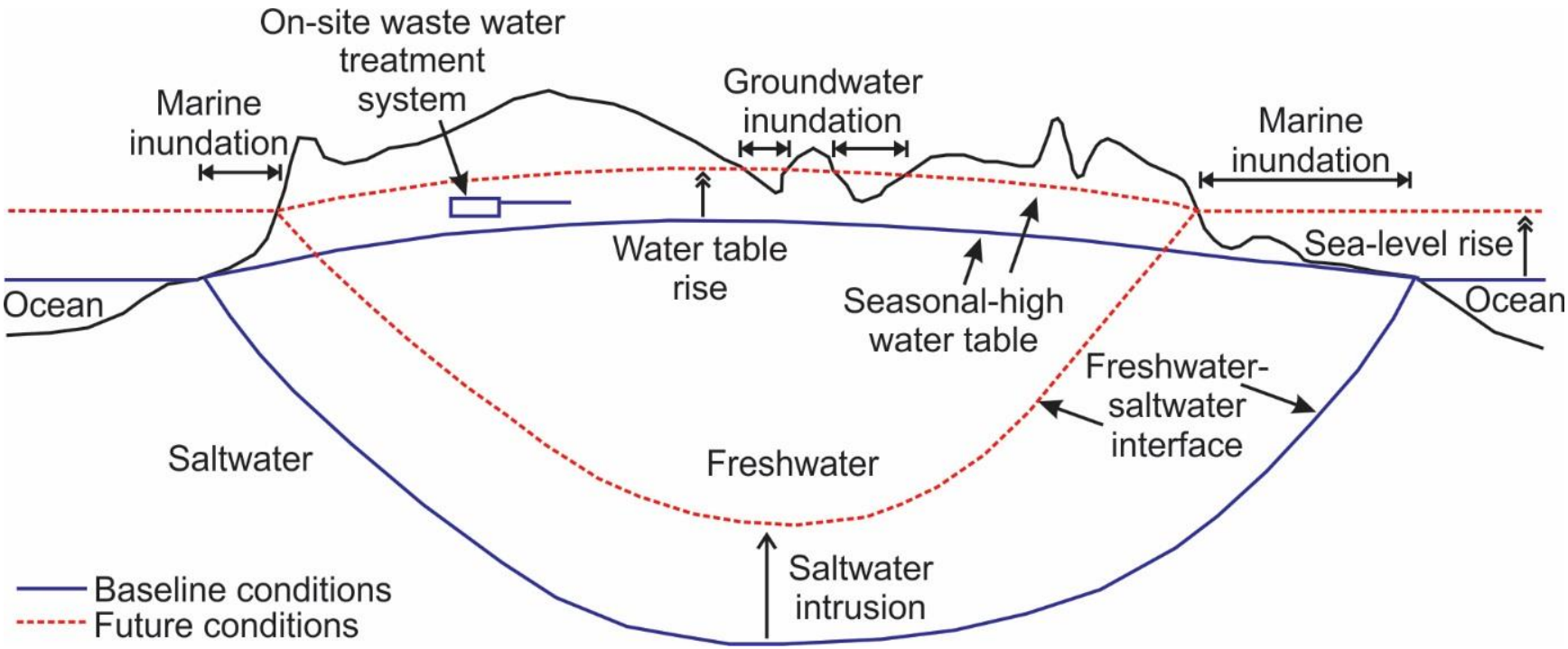


Rotzoll K, Fletcher CH. 2012. Assessment of groundwater inundation as a consequence of sea-level rise. Nature Climate Change DOI: 10.1038/NCLIMATE1725.

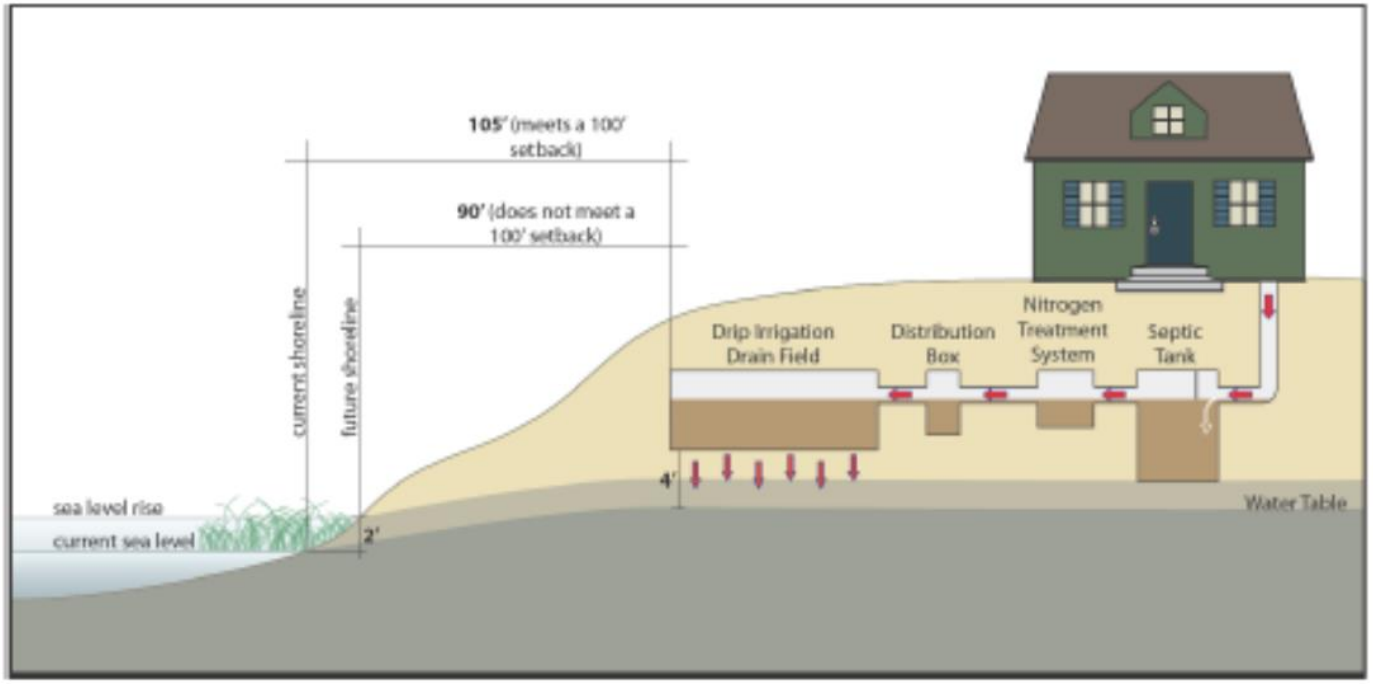
Groundwater flooding



Impact on infrastructure

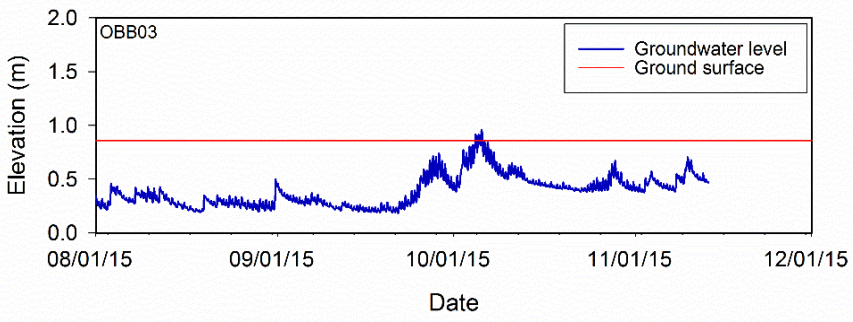


Impact on septic systems

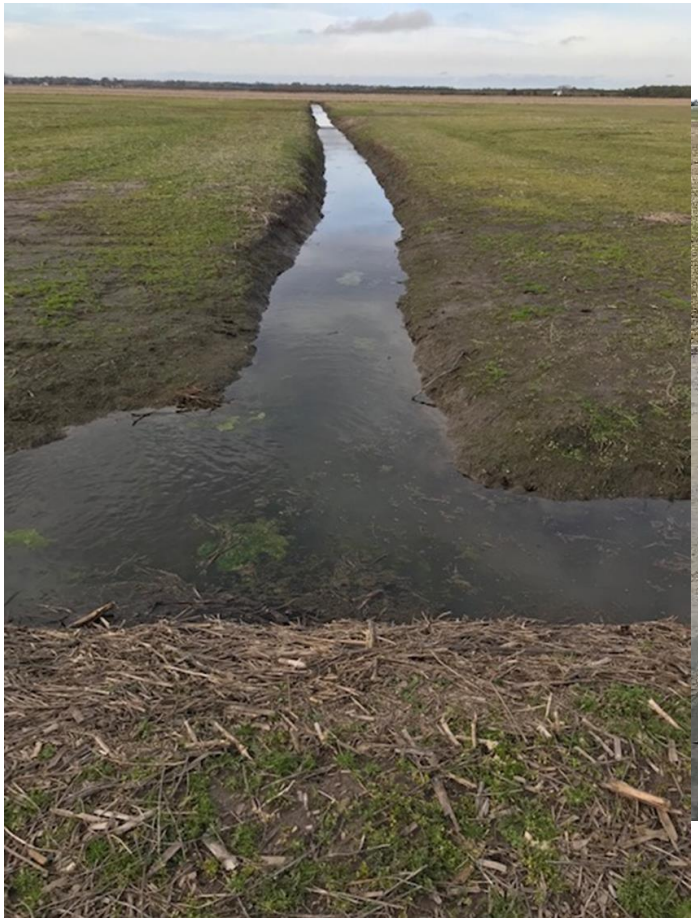


Stormwater flooding

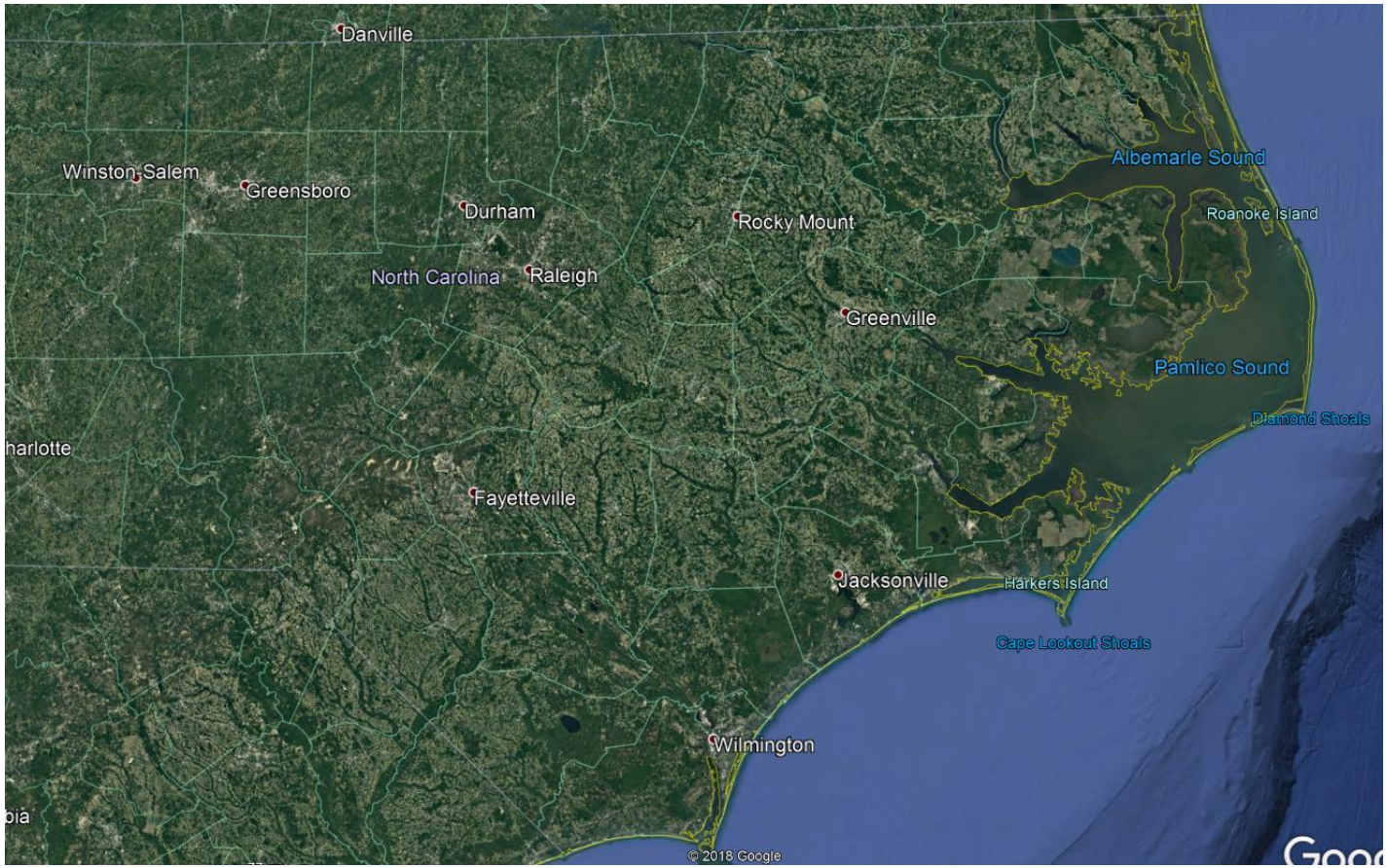
Photo Credit: Emerald Tidings February, 2014



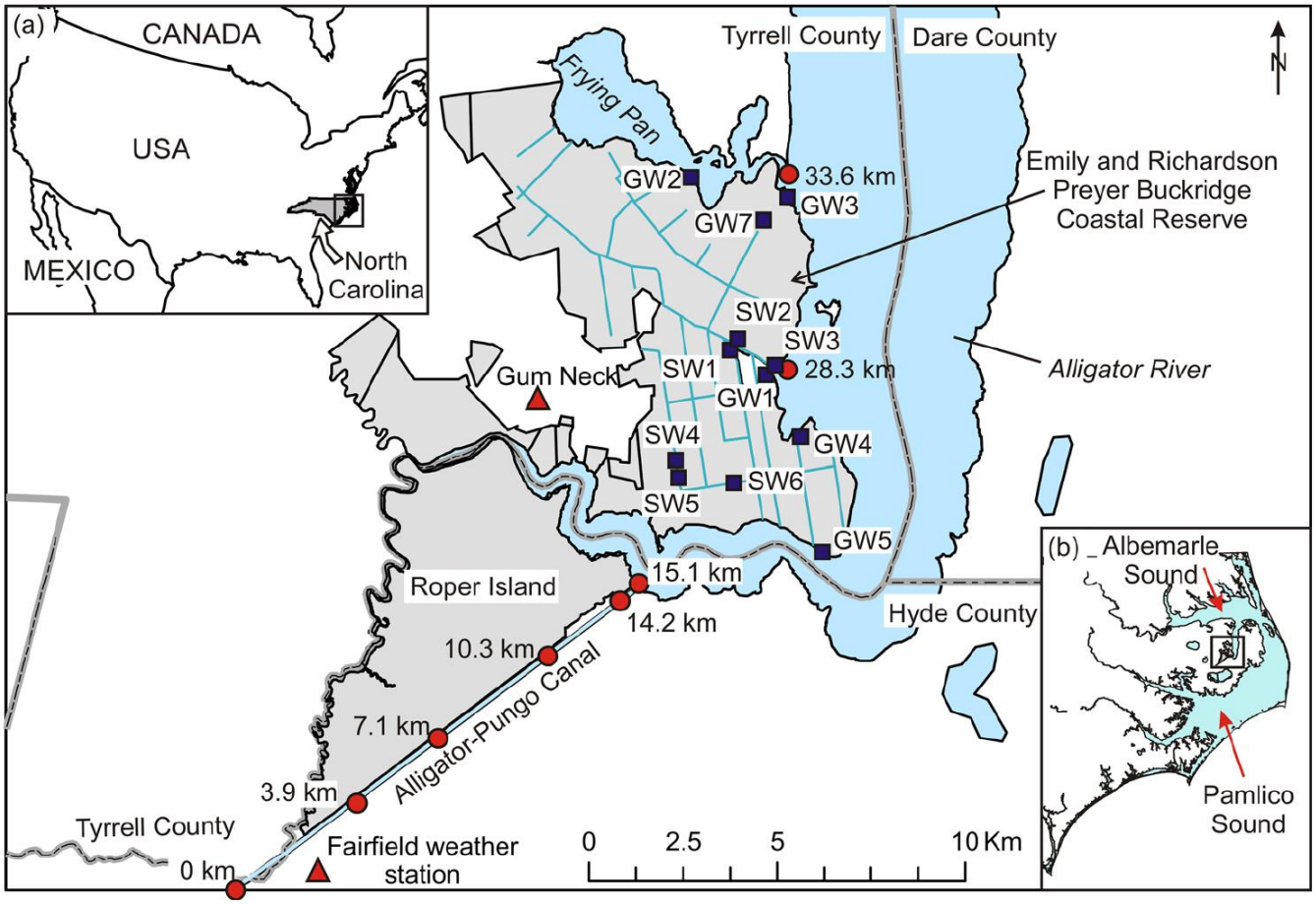
Saltwater Intrusion – Surface water



Change in shoreline position



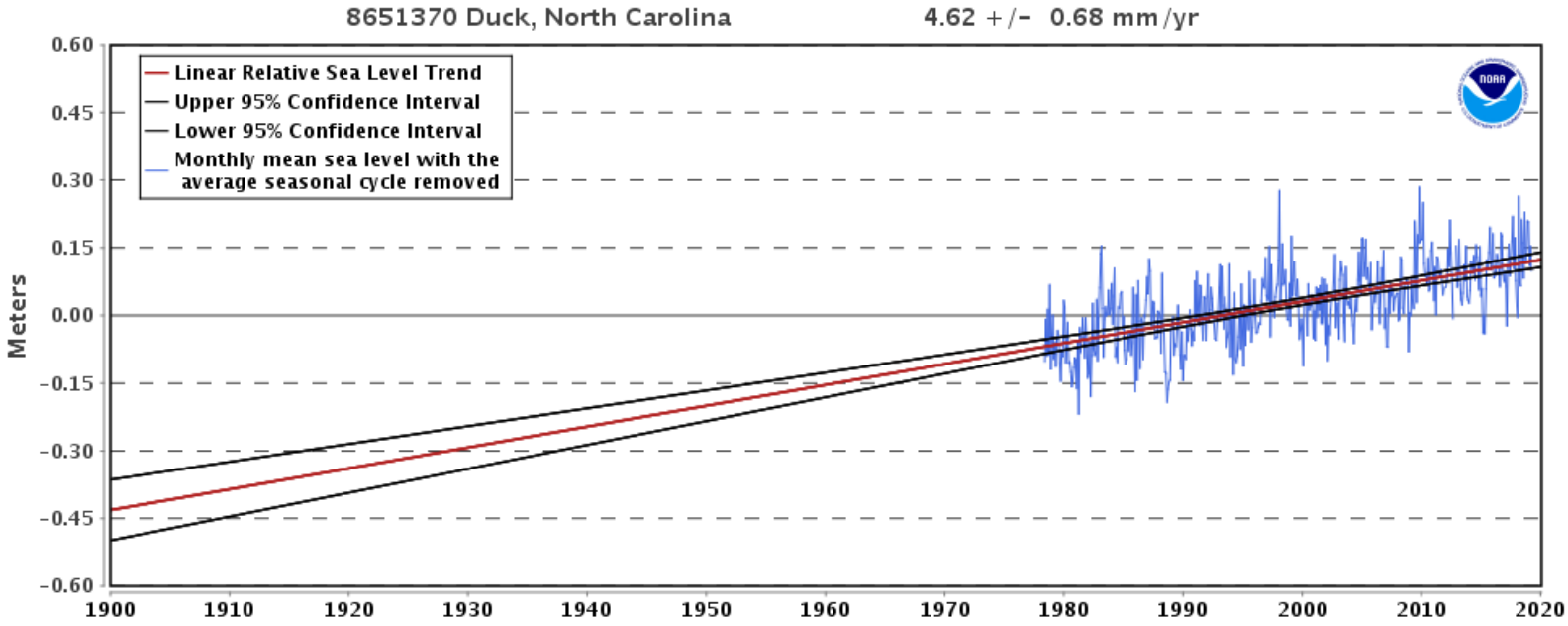
Recent work and findings in eastern North Carolina



Saltwater intrusion and flooding – Wind tides

QUESTIONS

Sea-level trend – Duck North Carolina



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