



Water quality monitoring and assessment of status and trends for optical water quality properties in NC estuarine waters



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Clean Waters and SAV: Making the Connection
Raleigh, NC
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NC DEQ Ambient Monitoring System

Monthly sampling
Largely focused on tributaries
1970's - present

Parameters

Secchi depth (at some locations)

Chlorophyll *a*

Turbidity

Total suspended solids

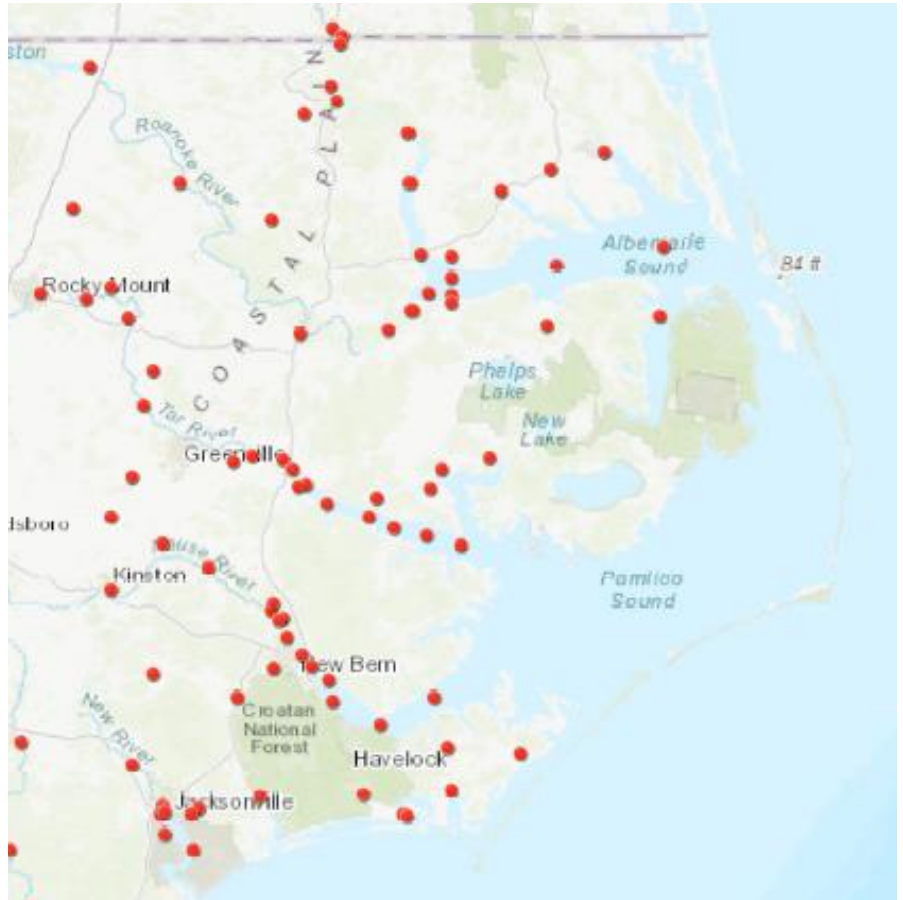
Temperature

Conductivity/ Salinity

pH

Dissolved oxygen

Total N and P, nitrate, ammonium, TKN





DMF's Estuarine Trawl and Gillnet Surveys



382 stations-south of Albemarle
S. to NC border, including OBX!

2008-present

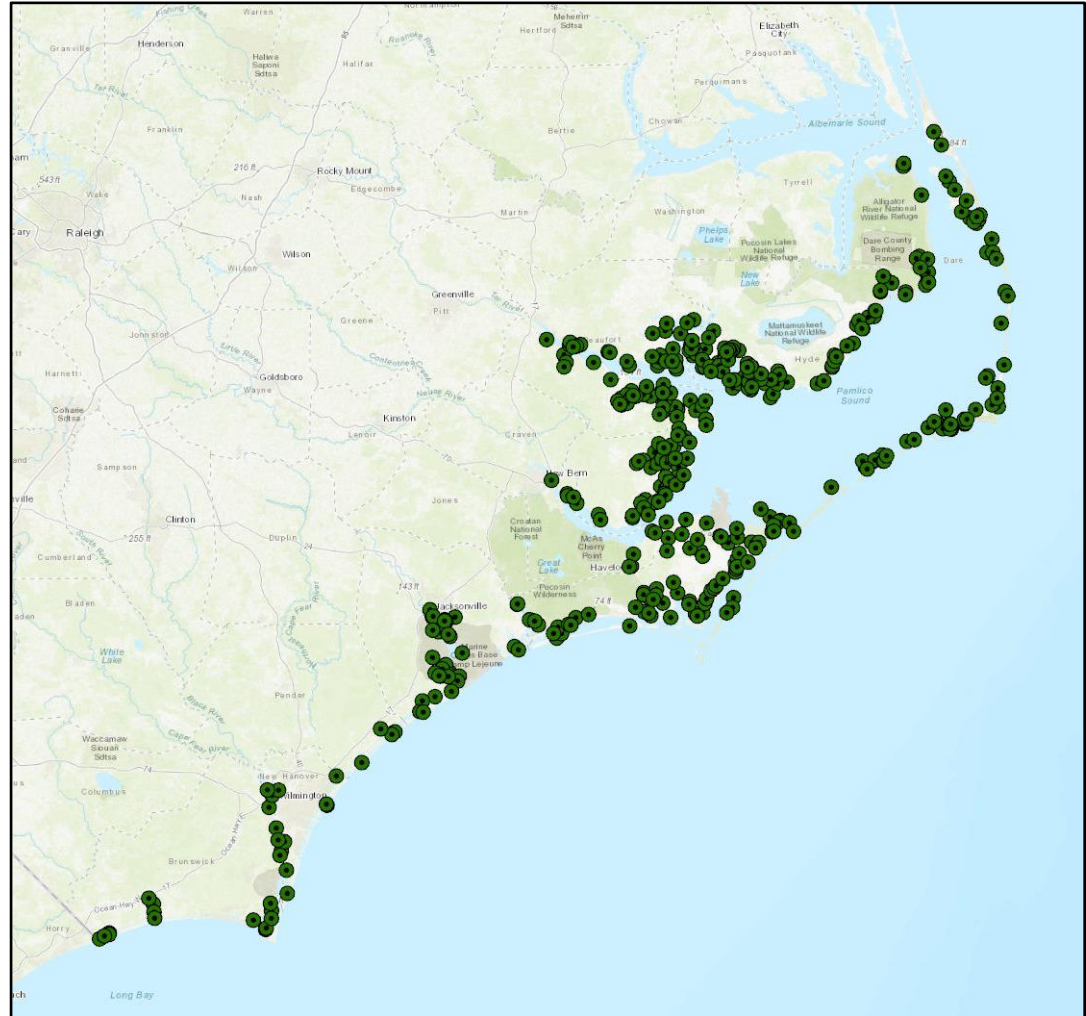
Sites sampled ≥ 2 times/y

Secchi depth

Salinity

Temperature

Dissolved oxygen



UNC-IMS ModMon/ FerryMon

Hans Paerl laboratory
 ModMon-Monthly/ twice monthly sampling
 FerryMon- Continuous
 Neuse River and SW Pamlico Sound
 mid 1990s – present

Parameters

Temperature

Salinity

pH

Turbidity

Chl a fluorescence

Dissolved oxygen

Continuous
 For FerryMon

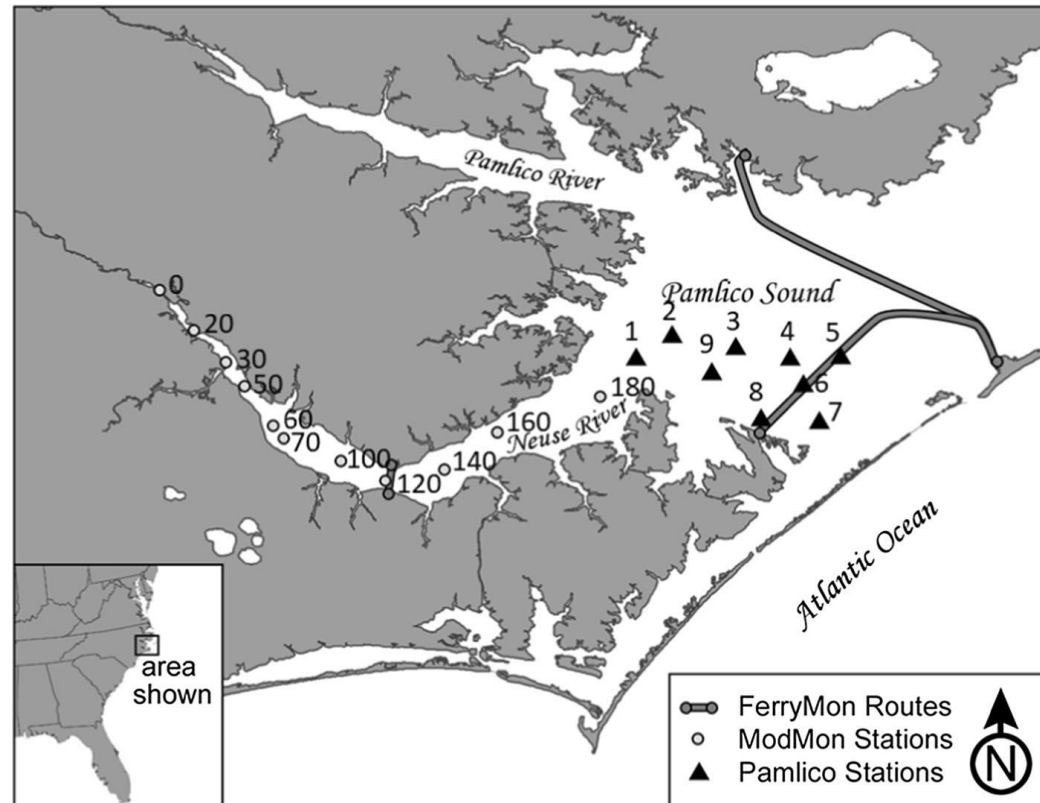
Secchi depth

PAR attenuation

Chlorophyll a & accessory pigments

CDOM

Nitrate, ammonium, DON, PN, phosphate



Monitoring Near Beaufort Inlet

NC NERRS/CALO- Monthly and continuous sampling
Middle marsh & Shackelford Banks
2008-present

Bogue Watch- IMS Piehler lab
Weekly/ biweekly at IMS dock

PICO-Duke Marine Lab- Johnson lab

Common parameters

Chlorophyll *a*, macronutrients,
salinity, temperature, turbidity,
dissolved oxygen, pH

Bogue Watch measures PAR
attenuation – NERRS and PICO
measure Secchi depth

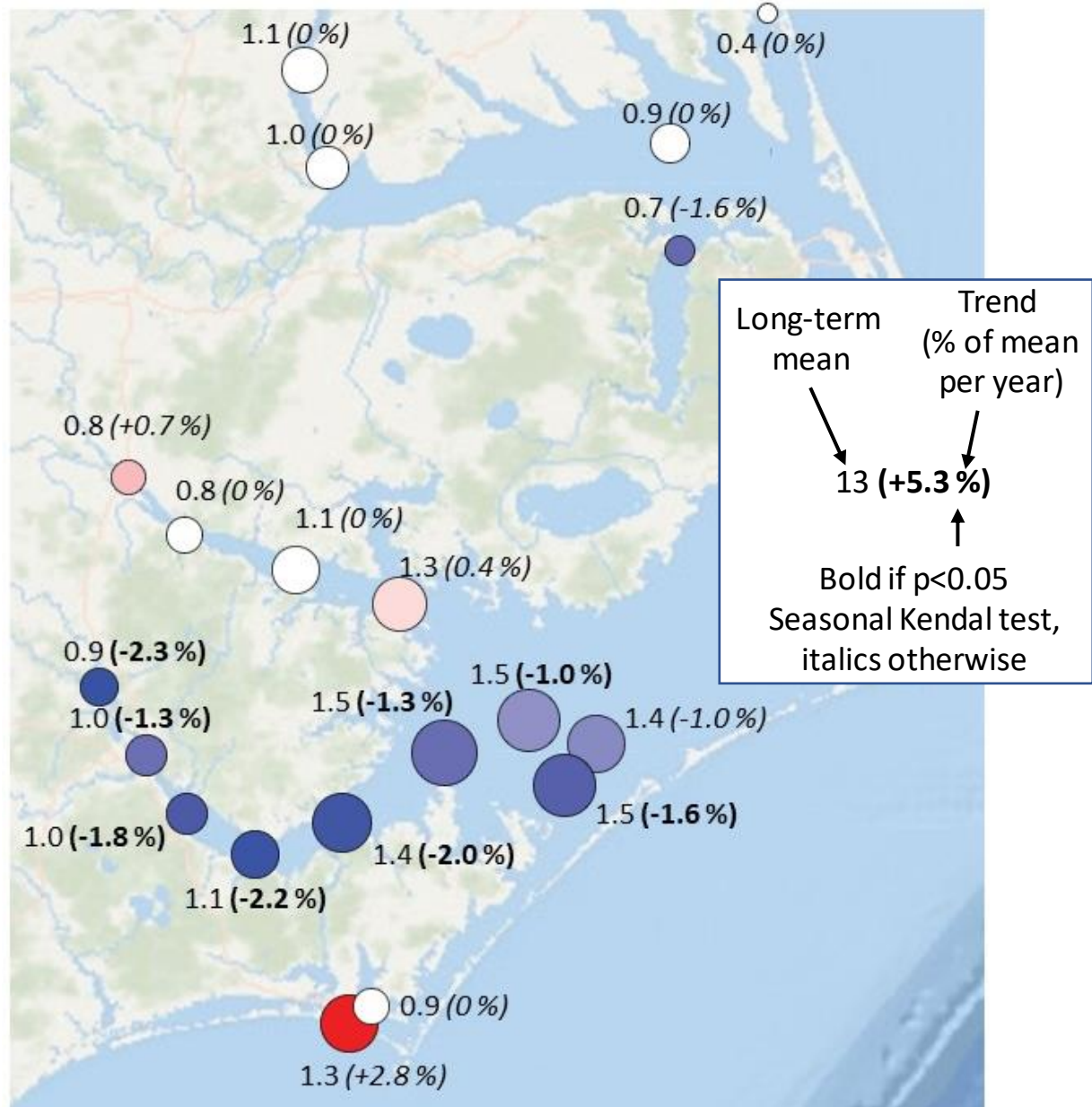


Status and Recent Trends For Secchi Disk Depth

Water Clarity as
Secchi disk depth (m)



- Decreases in water clarity in Neuse R./ SW Pamlico Sound/
- Slight improvements/no change in Pamlico River/ Albemarle S.
- Increasing clarity near Beaufort Inlet?

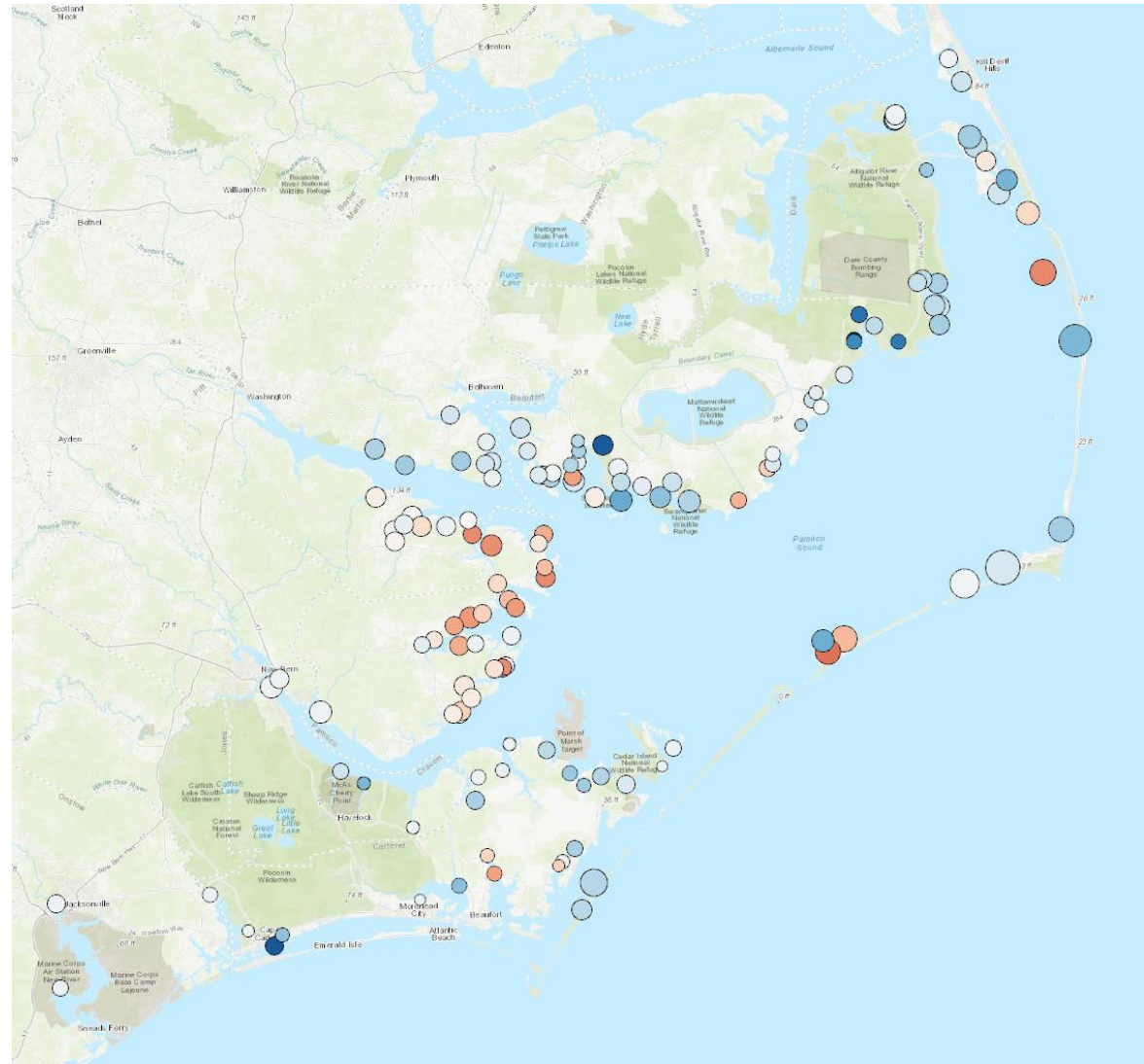




DMF Estuarine Trawl Survey (2008-2019)

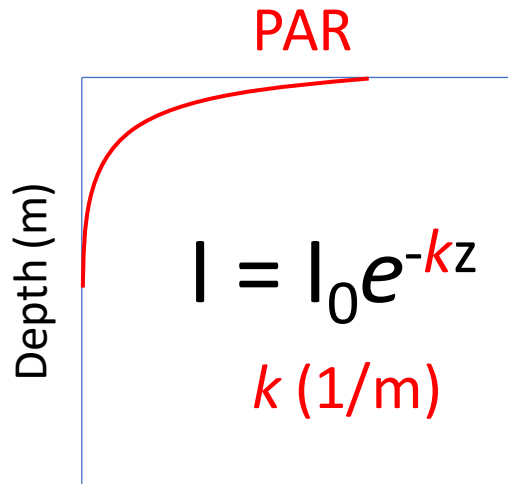


- Increasing water clarity around Bay River/ Goose Cr.
- Mostly weak decreases or no change in water clarity
- OBX have deeper Secchi depths with a mix of increasing and decreasing trends

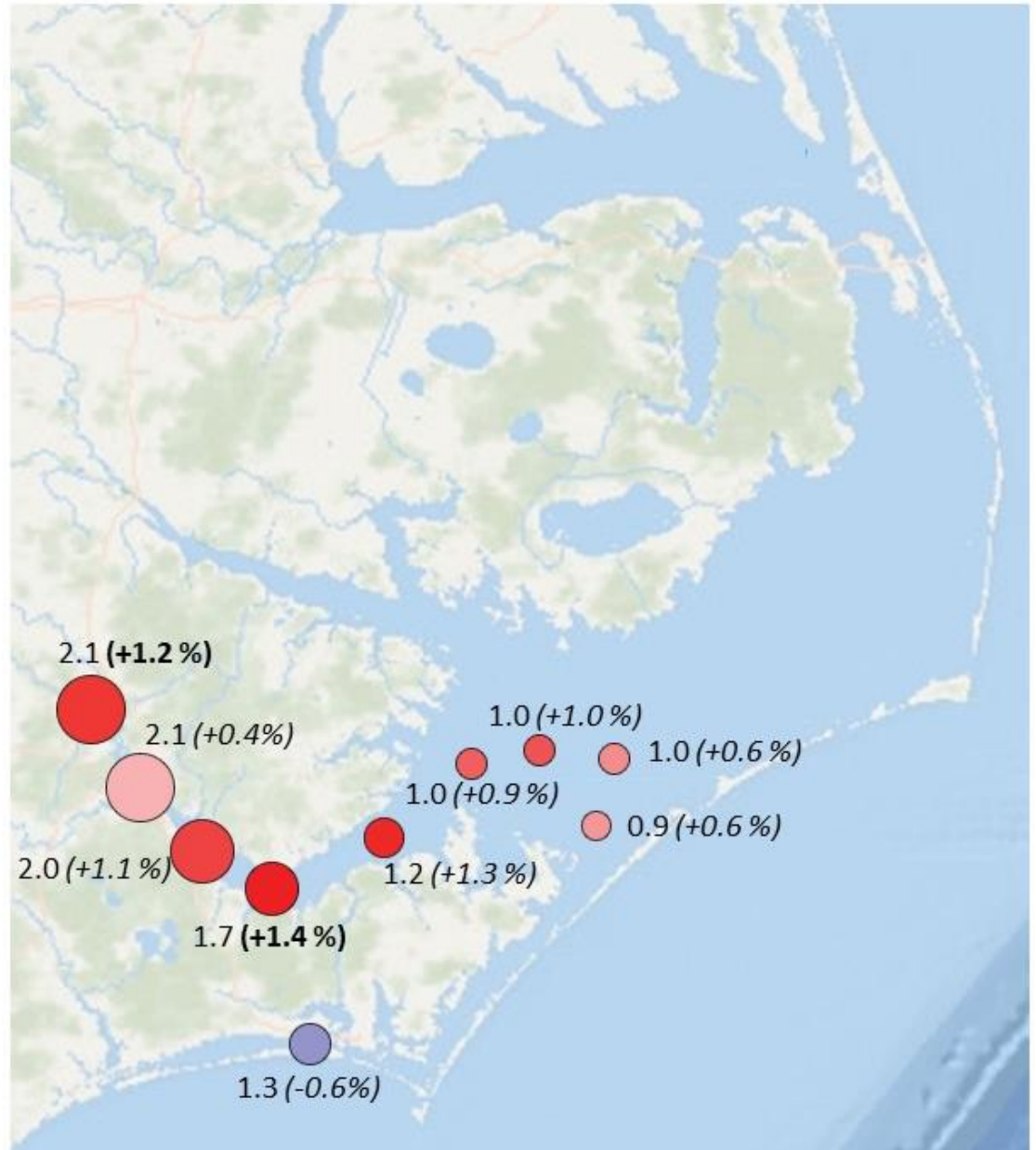


Status and Recent Trends For PAR Attenuation (2000-2020)

Water clarity as
PAR attenuation (1/m)

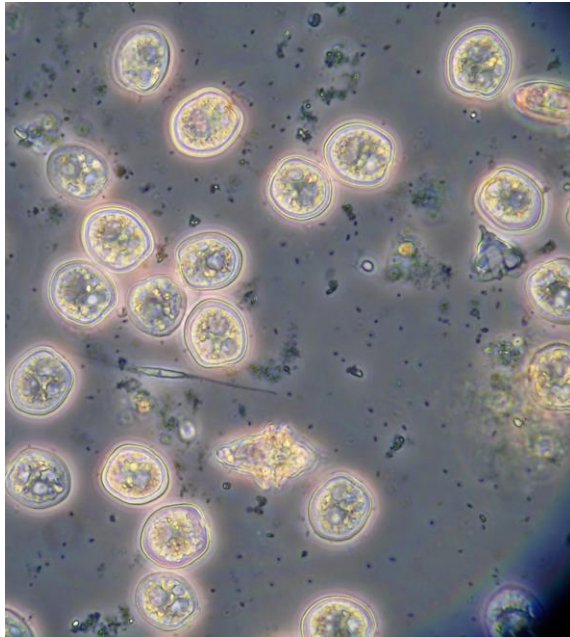


- Decreases in water clarity in Neuse R./ SW Pamlico Sound
- Increasing clarity in Bogue Sound?
- Trends consistent with Secchi

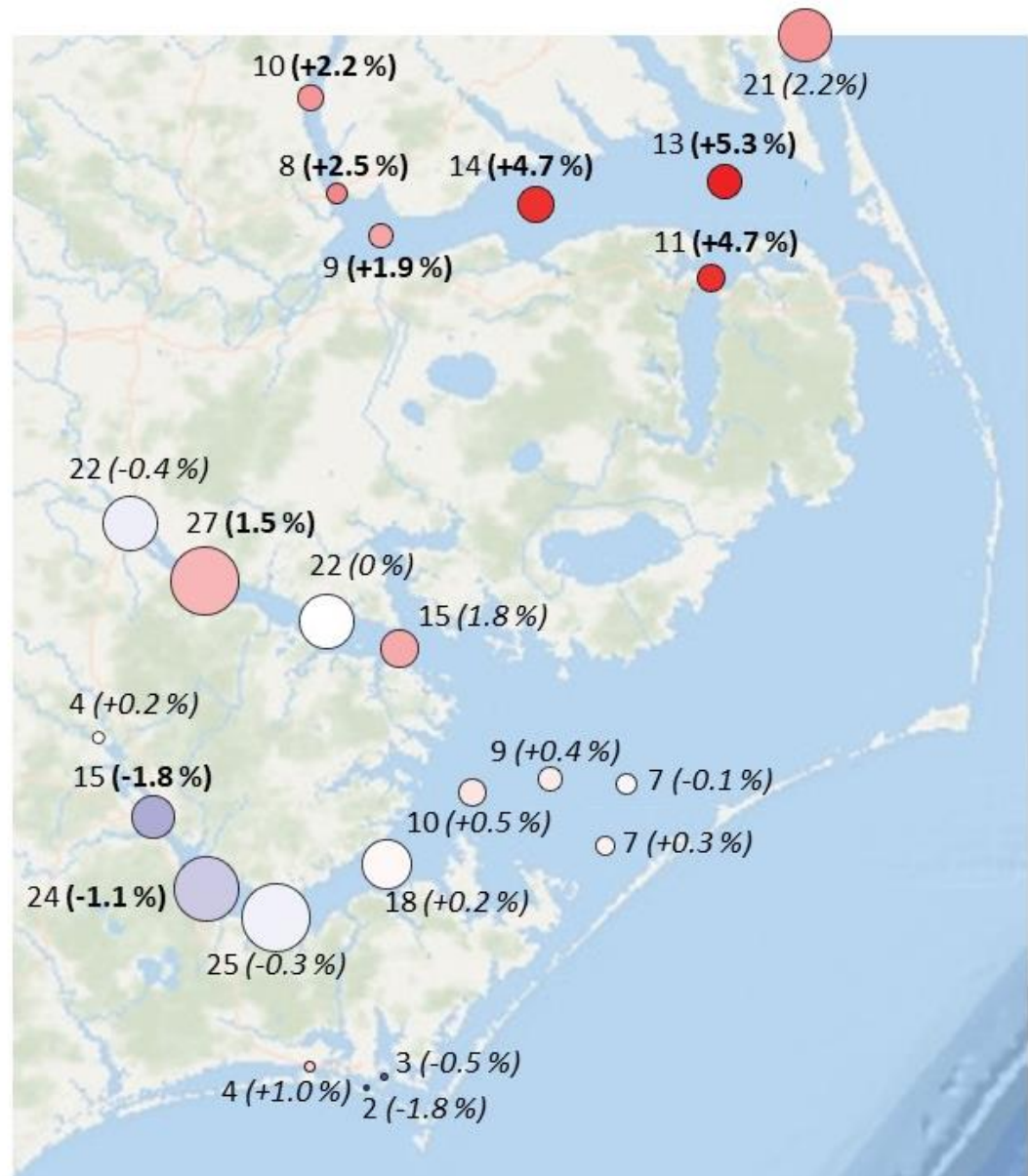


Status and Recent Trends For Chlorophyll a (2000-2020)

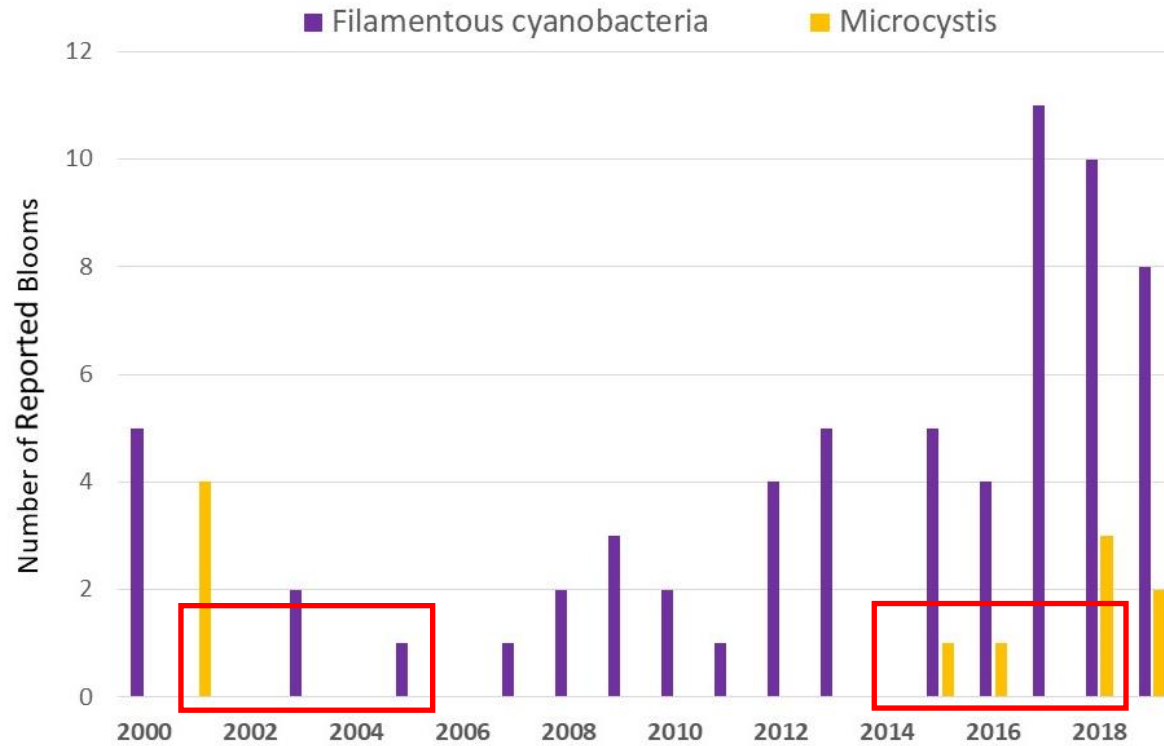
Phytoplankton Biomass as Chlorophyll a ($\mu\text{g/L}$)



- Rapid increases in Albemarle S.
- Weak increases/ no change in Pamlico River and Pamlico Sound
- Decreases in upper/ mid Neuse
- Weak change at high salinity sites



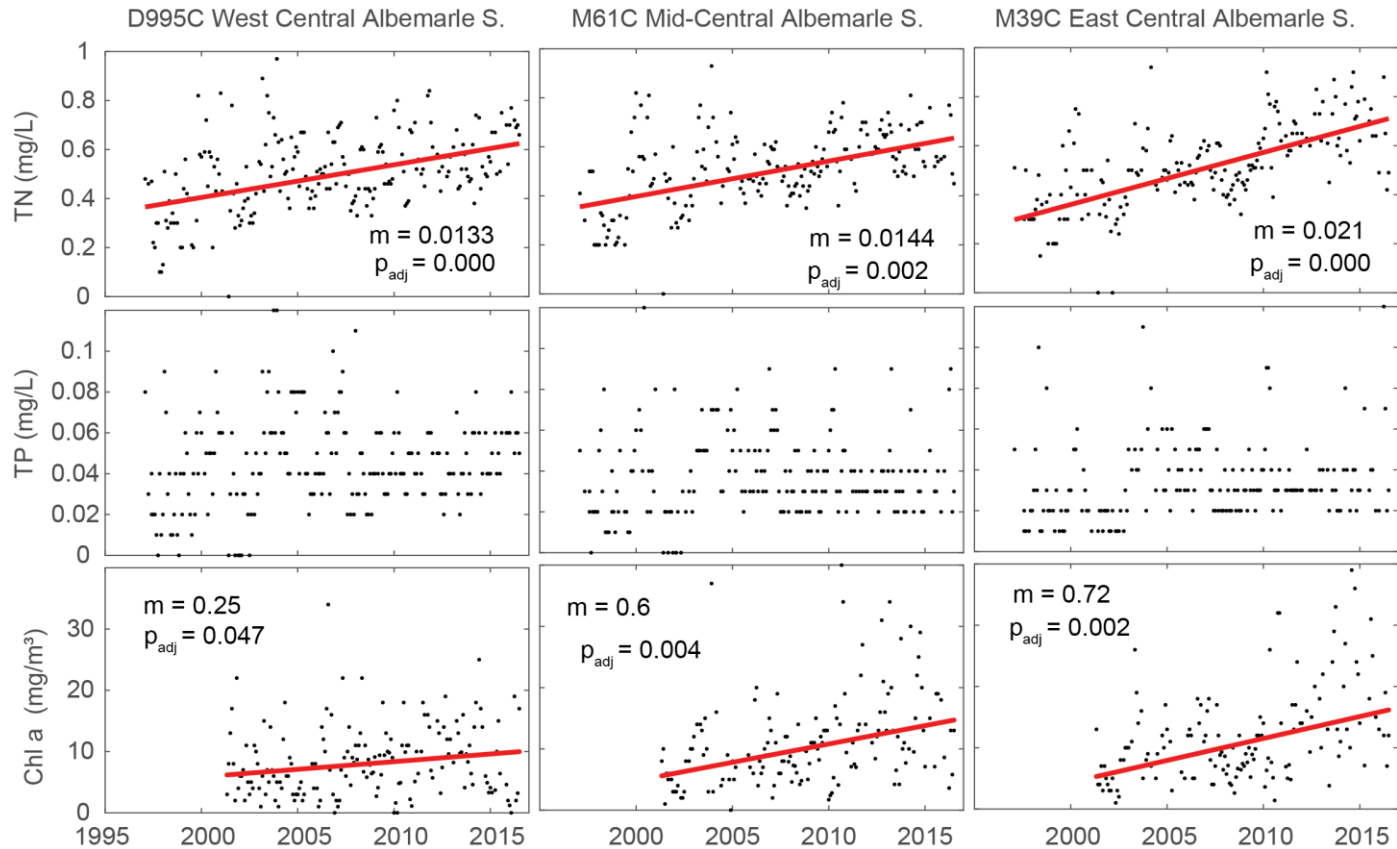
Increasing trend in bloom reports within the Albemarle Sound region



Data and figure provided by Elizabeth Fensin, NCDEQ-DWR.

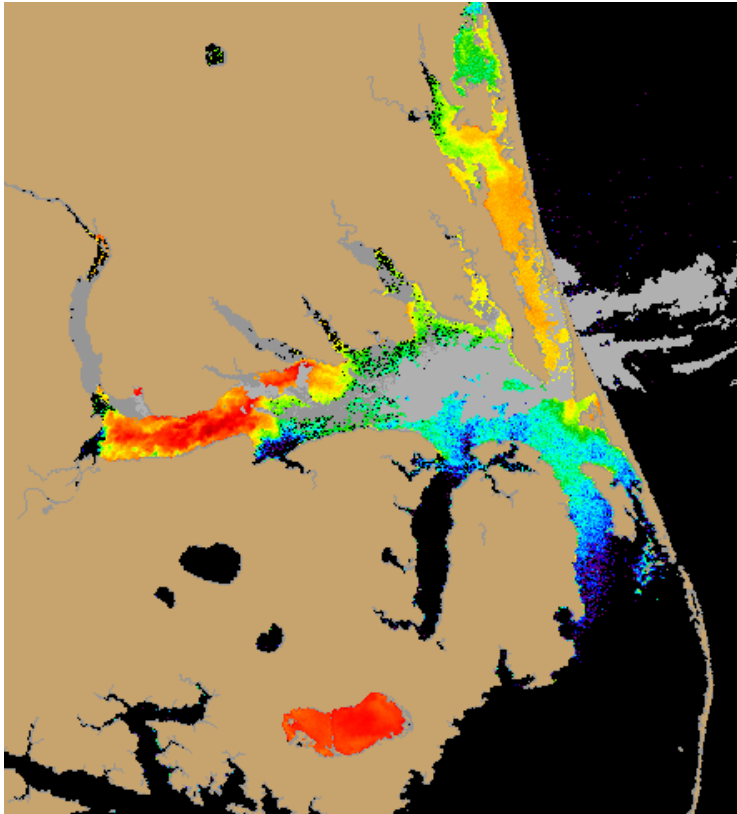


Blooms are symptomatic of an increase in trophic status throughout Albemarle Sound

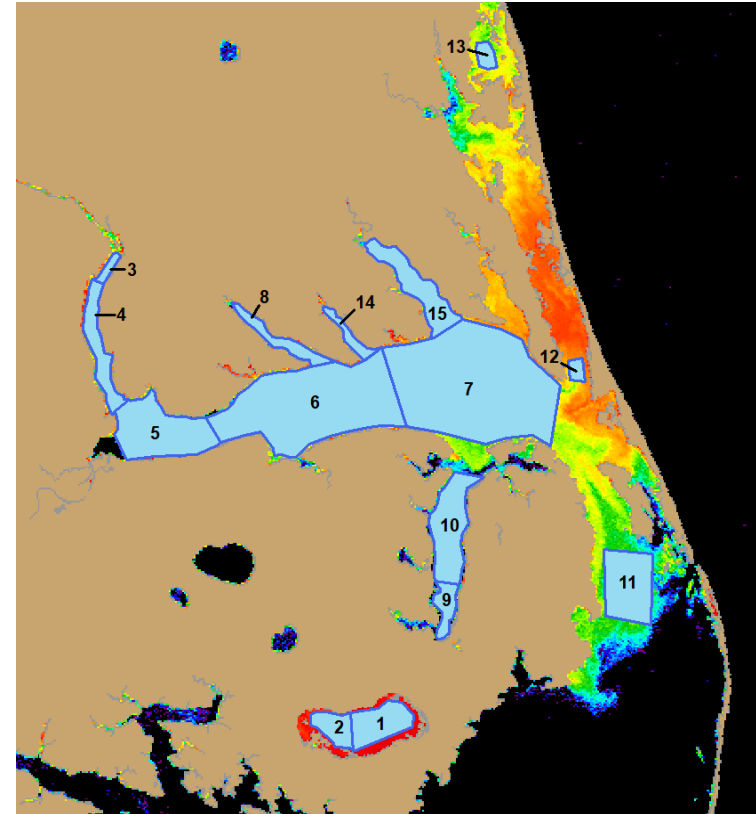


Remote Sensing for Remote Estuarine Waters

Cyanobacteria index (Wynn et al. 2008)



GIS delineated polygons



NOAA NCCOS Collaborators: Wayne Litaker, Richard Stumpf, Chris Holland, Travis Biggs

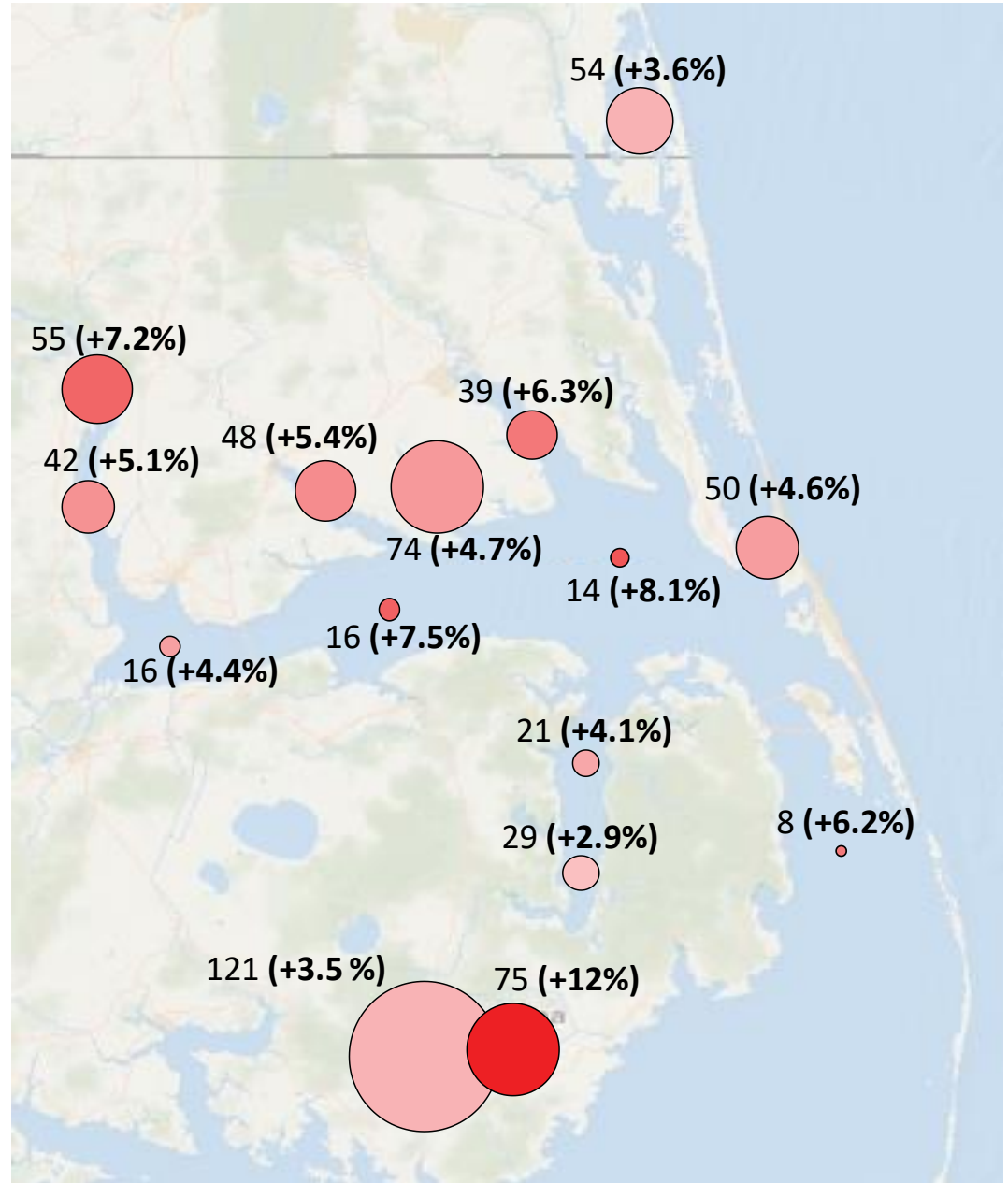
Status and Recent Trends For Cyanobacteria Index (2002-2018)

Cyanobacteria Index: remotely-sensed proxy for cyanobacterial Biomass (A.U.)

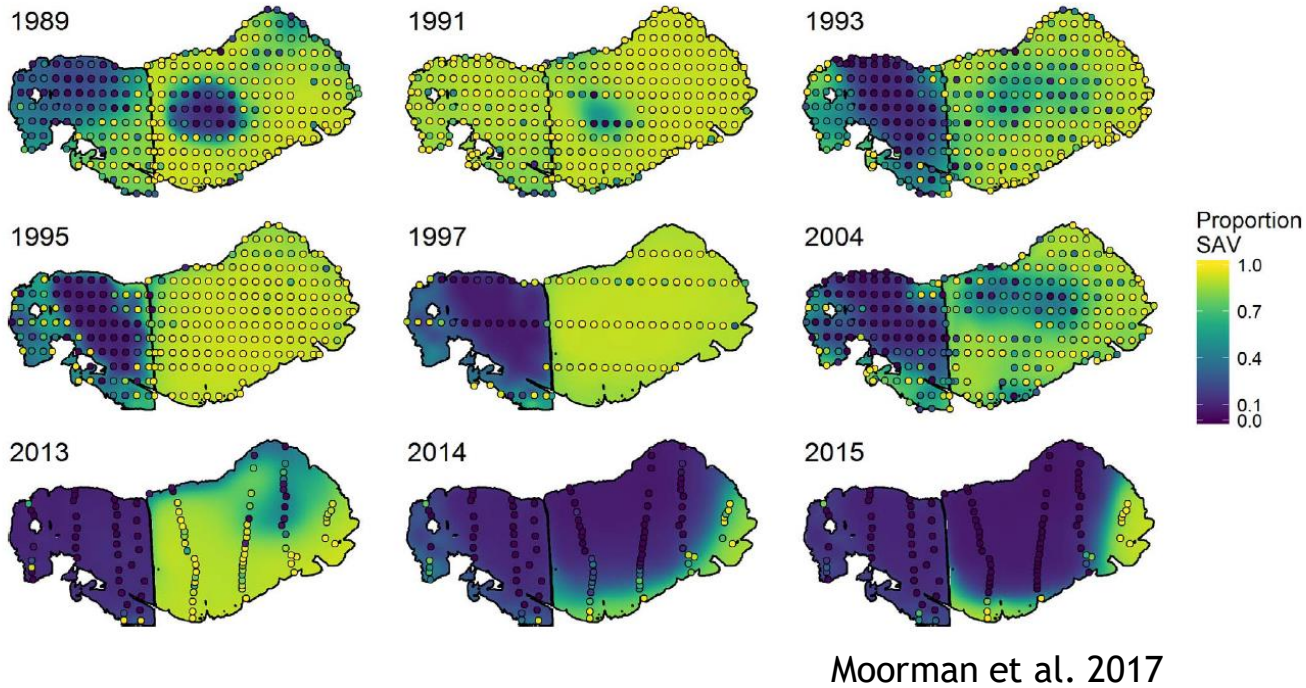


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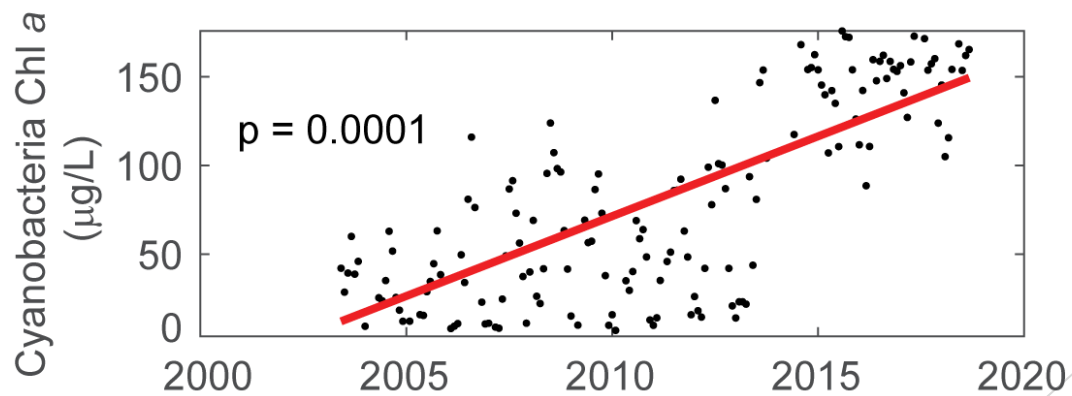
- Corroborates rapid increase of cyanobacteria biomass in Albemarle Sound region including Lake Mattamuskeet



A State Change for Eastern Lake Mattamuskeet



Sentinel Area 1- Eastern Lake Mattamuskeet

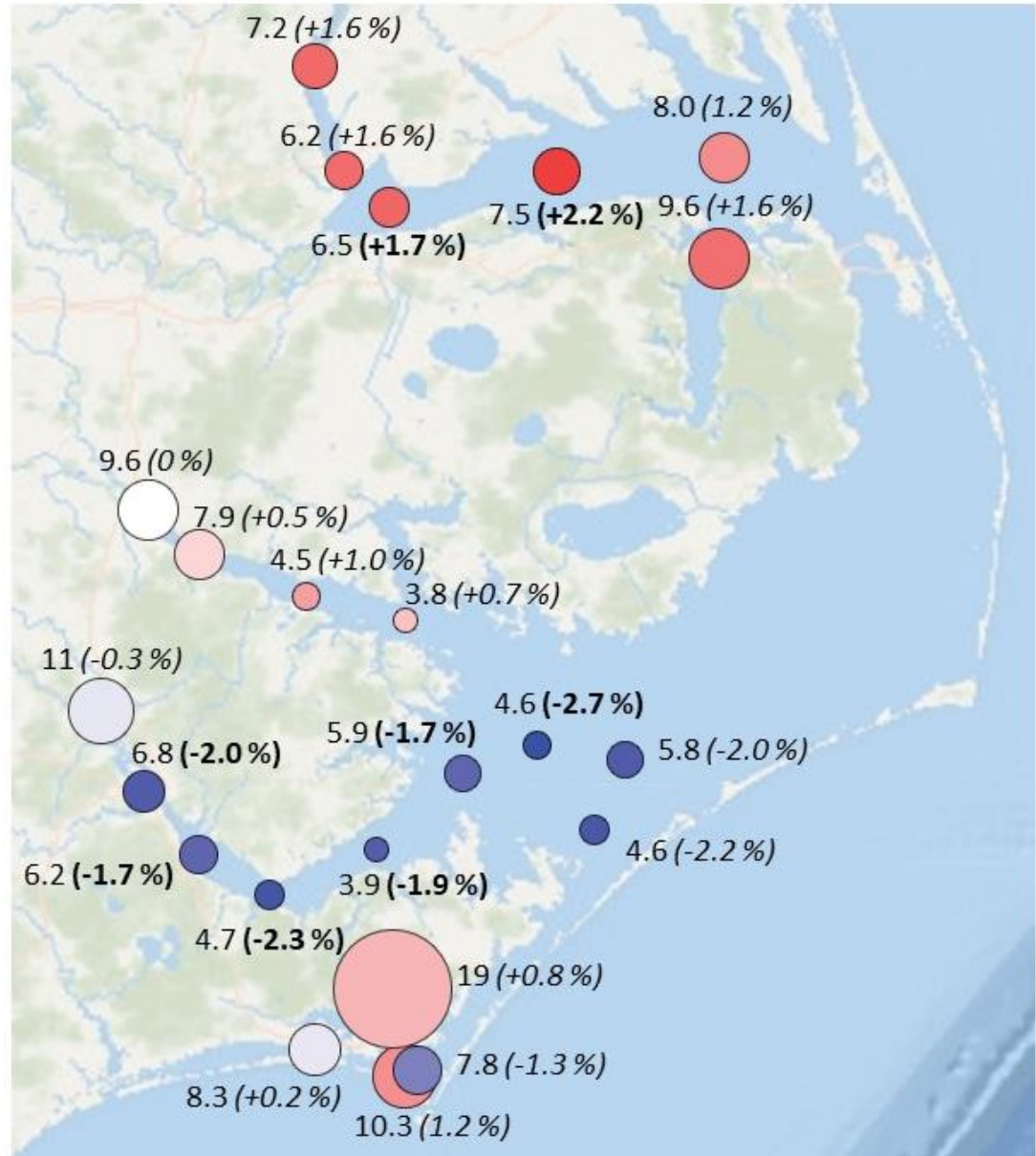


Status and Recent Trends For Turbidity (2000-2020)

Turbidity a factor in light attenuation (NTU)



- Decreases in Neuse R. and SW Pamlico Sound
- Increases in Chowan/ Albemarle Sound
- Weak increases in Pamlico River
- Mixed trends at high salinity sites

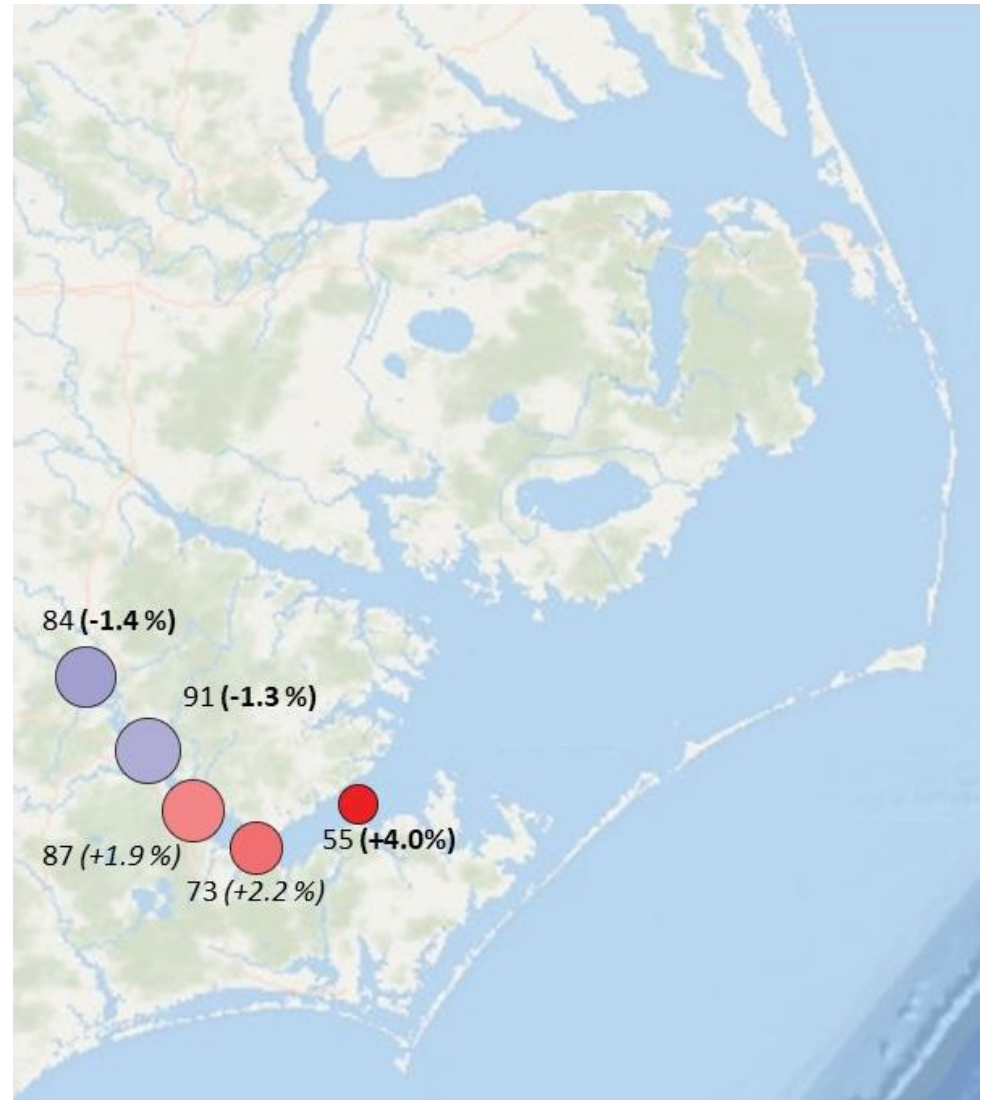


Status and Recent Trends For CDOM (2000-2020)

Colored Dissolved Organic Matter (CDOM), another Light attenuating factor (quinine sulfate equivalents ($\mu\text{g/L}$))

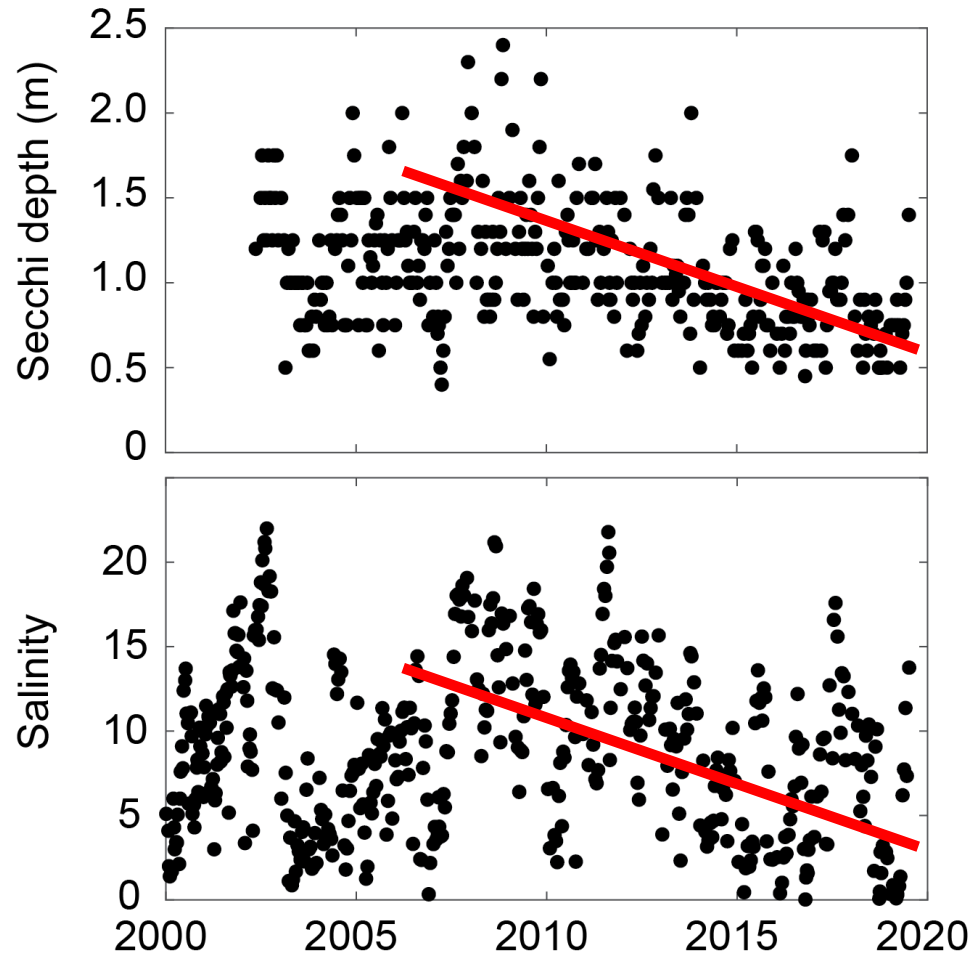


- Decreasing upstream of Trent R.
- Increasing downstream in Neuse



Recent trends are influenced by climatic cycles

Neuse River Estuary at Cherry Point (ModMon 120)





Conclusions

- Lots of good water quality data for NC estuarine waters- need more analyses including causal and confounding variables
- Water transparency has declined recently in the Neuse and southwestern Pamlico Sound- possibly CDOM related
- High salinity SAV zones show a mix of weak positive and negative water clarity trends
- Albemarle Sound region is in trouble with rapid increases in Chl a , turbidity, and cyanobacteria bloom frequency
- SAV will be a critical end point for establishing numeric nutrient criteria for the Albemarle region

