WPMP Monitoring

- **Trend Monitoring**
- **Probabilistic Monitoring**
- **TMDL/Assessment Monitoring**
- **Intensive Survey Monitoring**
- **Lake/Estuary Monitoring**
- **Biological Monitoring**
- **Fish Tissue Monitoring**
- **Facility Compliance Monitoring**
- **Groundwater Monitoring**

Bacteria Water Quality Standards

	May - October	November - April
Freshwater (E. coli) (Geometric mean)	126 counts/100mL	630 counts/100mL
Freshwater (E. coli) (Statistical Threshold Value)	410 counts/100mL	2050 counts/100mL
Marine waters (Enterococci) (Geometric mean)	35 counts/100mL	175 counts/100mL
Marine waters (Enterococci) (Statistical Threshold Value)	130 counts/100mL	650 counts/100mL

GEORGIA
DEPARTMENT OF NATURAL RESOURCES

Modeling the Altamaha Estuary for Numeric Nutrient Criteria Development

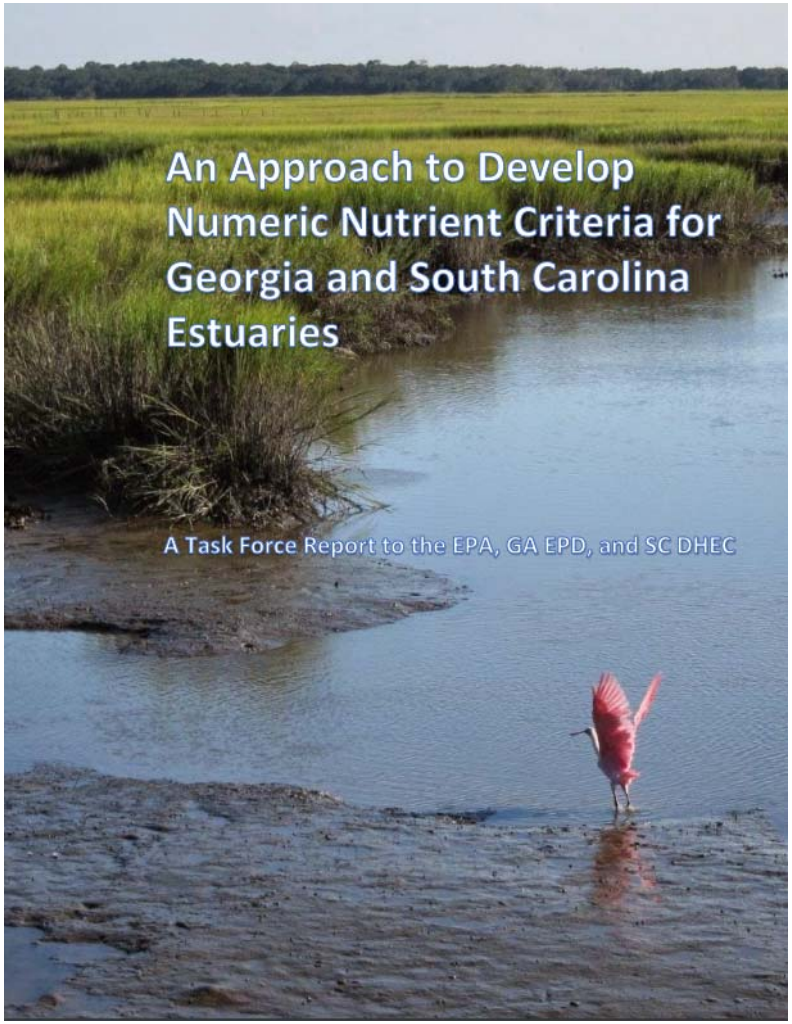
September, 2018

Reid Jackson

Outline

- **Numeric Nutrient Criteria Development Approaches**
- **Altamaha Estuary Field Study**
- **Modeling the Altamaha River Basin and Estuary**
  - **LSPC**
  - **EFDC**
  - **FVCOM**

The Approach Document



The Approach Document

- Compiled relevant literature and scientific data on South Carolina and Georgia estuaries
- Described scientifically viable approaches that may be used to develop Numeric Nutrient Criteria (NNC) for Georgia and South Carolina estuaries

Summary of Approaches

- The “Approach Document” describes three main approaches to developing Numeric Nutrient Criteria:
  - Reference Condition Approach
  - Stressor-Response Relationship (Regression Modeling) Approach
  - Water Quality Simulation Modeling Approach

Reference Condition

- Works well when ample data are available
- Involves using a percentile (ex. Geometric Mean) of water quality measurements
- Data must be from:
  - Similar least impacted waterbody
  - Time period of minimal impact from excess nutrients

Reference Condition

- Does not work well if there is little or no data
- Does not work for estuaries that are impacted or impaired by nutrients and there is no data from when it was unimpacted
- Does not work for unique estuaries

Stressor-Response Relationship

- Works best when ample data is available for many years and conditions, and where the response is fairly consistent
- Provides linkage between nutrients and aquatic life uses
- Provides response of variable(s) to a single stressor in a covariance model and/or a non-linear regression
- Uses graphs to make predictions

Stressor-Response Relationship

- Does not work well if there is little or no data
- Does not work well if there are complex relationships between nutrients and water quality responses
- Does not work well if the estuary shows unique ecological interactions and processes
- Does not address additive or interactive effects of more than one causal factor

Water Quality Simulation Modeling

- A hydrodynamic model is coupled with a water quality model
- Models both temporally and spatially
- Works best when important ecosystem processes are well understood
- Uses field data from process studies
- Complex interactions of physical, chemical, and biological processes can be simulated
- Various scenarios can be run – What if???

Water Quality Simulation Modeling

- Does not work well if there is inadequate data for model inputs or calibration
- Does not work well if the mechanism describing the nutrient sources, biological responses, and/or water quality are not understood
- Does not work well if the linkages between model outputs and use attainment are not well defined

Modeling the Altamaha Estuary

- Georgia EPD is developing water quality models that can be used to set low DO and numeric nutrient criteria for the Altamaha Estuary
  - LSPC (Load Simulation Model C++)
  - EFDC (Environmental Fluid Dynamics Code)
  - FVCOM (Finite-Volume Community Ocean Model)
- Georgia EPD is doing field studies to collect data to be used in the estuary models

Altamaha Estuary Field Study

- EPD collaborated with EPA SESD, and UGA
  - Continuous monitoring and chemical sampling duties were split between EPD and UGA
  - SESD providing chlorophyll a analytical support
  - UGA provided chemical analytical support and SOD and DOC measurements
  - UGA developed and calibrated the FVCOM water quality model
- Funded by EPA Multipurpose Grant (~$142K)
- Sampling occurred from Mar 2017 - Mar 2018

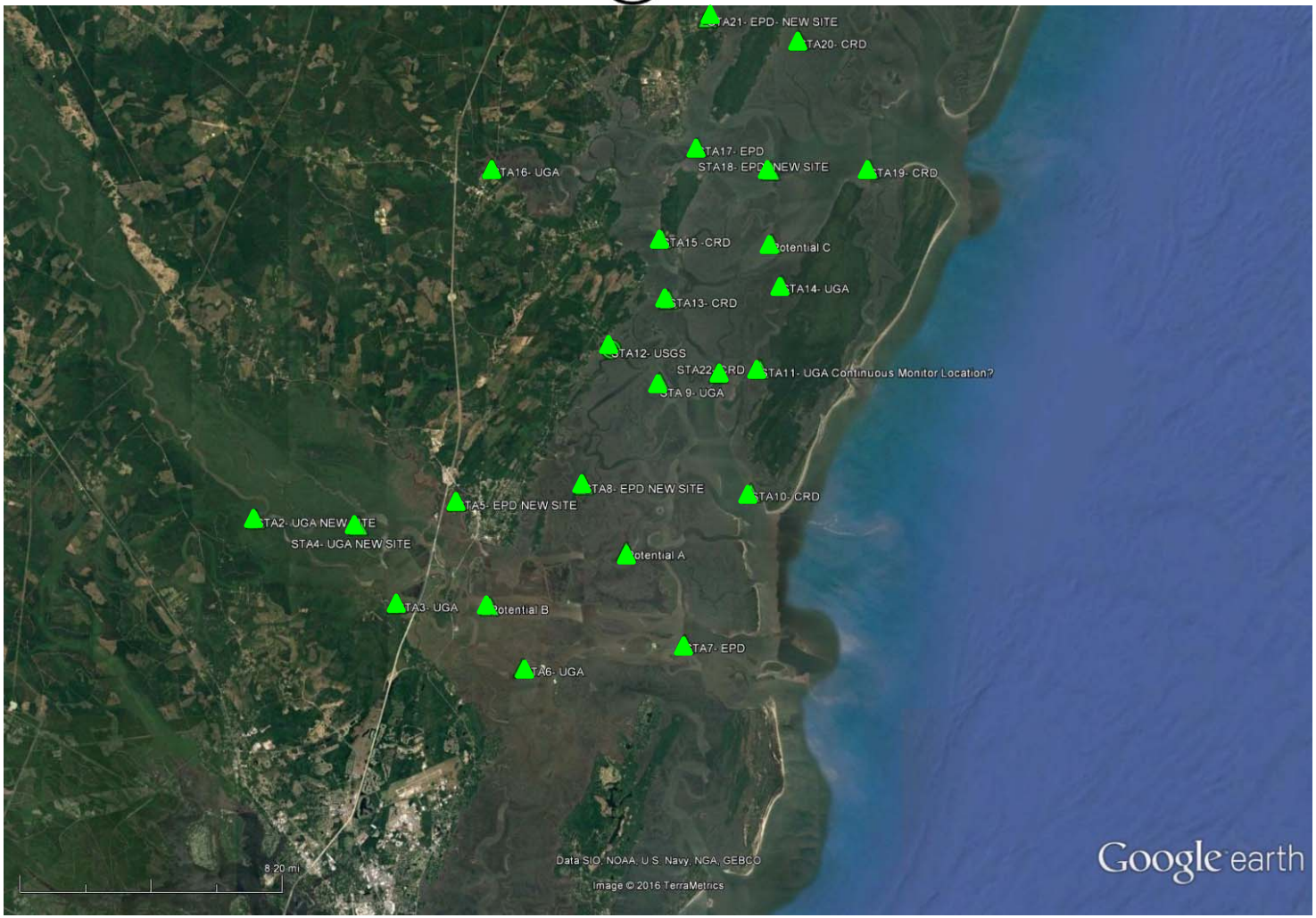
Chemical Sampling

- Parameters sampled monthly
  - BOD (5-day)
  - TOC
  - Total Suspended Solids
  - Alkalinity
  - Hardness
  - Turbidity
  - NH3
  - NOx
  - TKN
  - Total P
  - Ortho P
  - Chlorophyll *a*

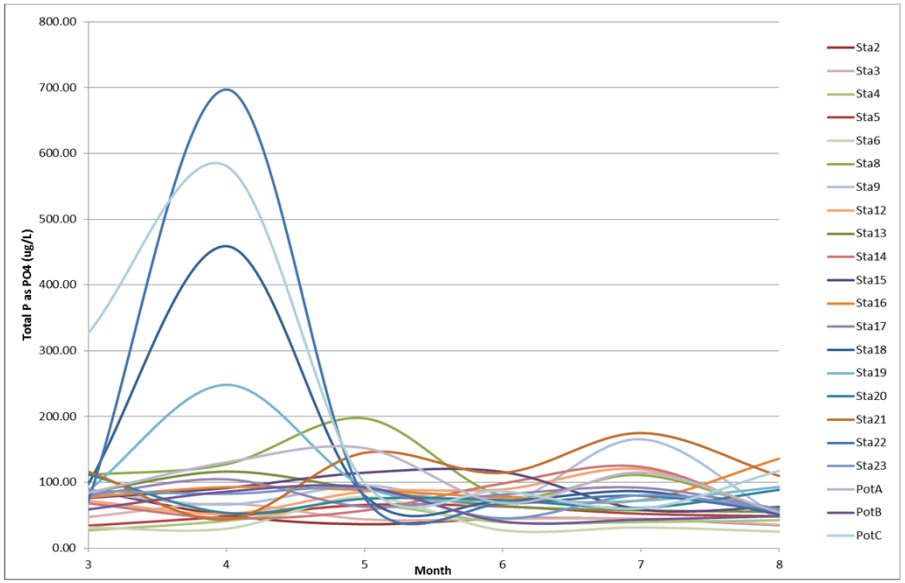
In-Situ Sampling

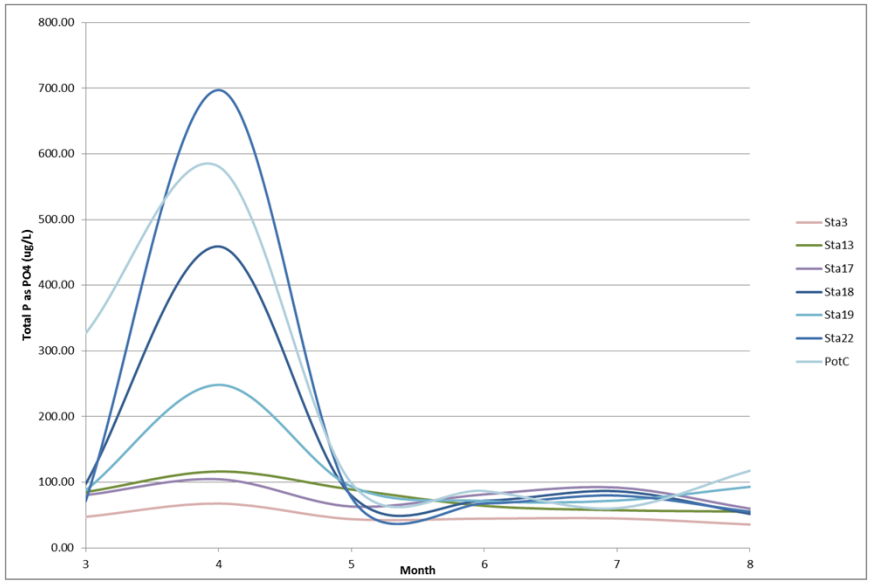
- Continuous Monitoring
  - Dissolved Oxygen
  - Temperature
  - Conductivity
- Quarterly Field Measurements
  - Dissolved Organic Carbon
  - Sediment Oxygen Demand

Monitoring Sites

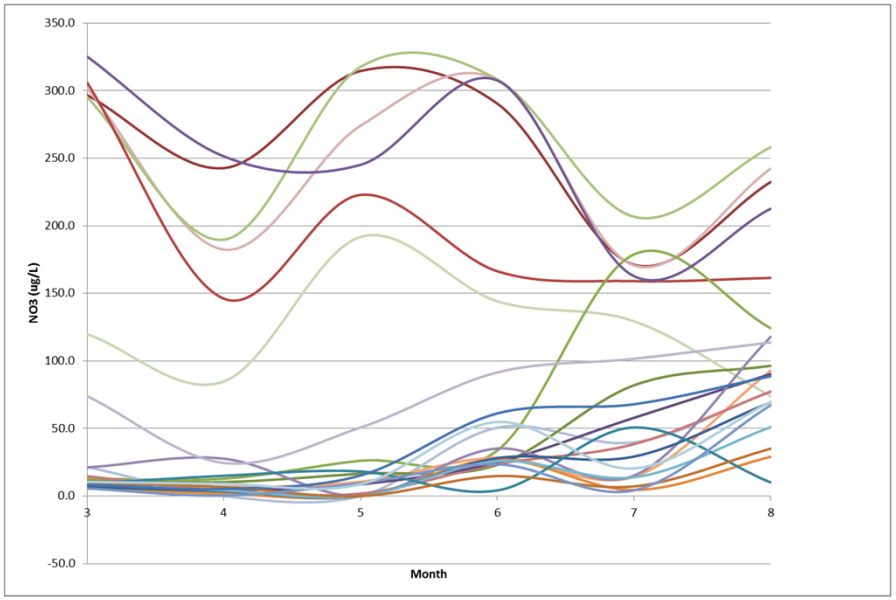


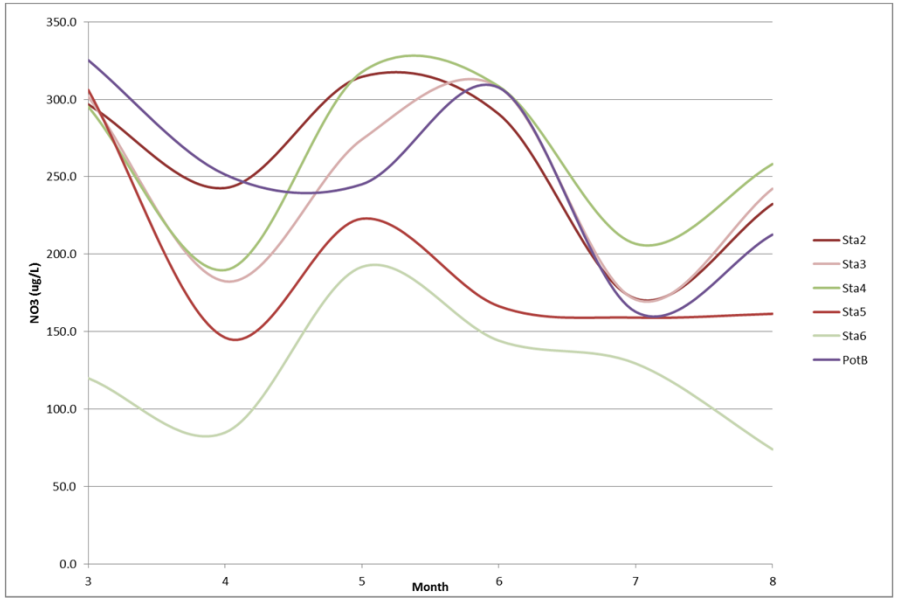
Chemical Data: TP as PO4



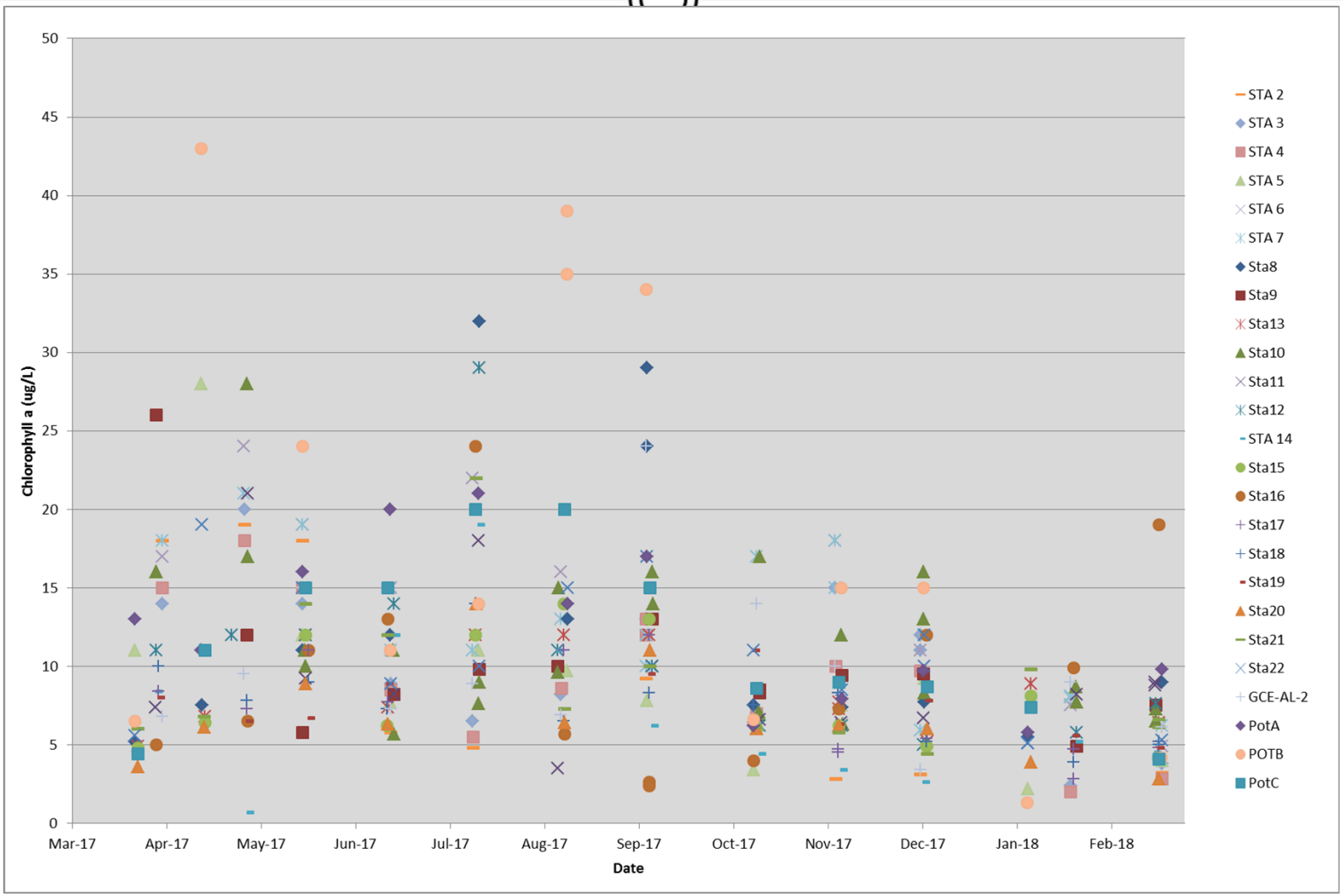


Chemical Data: NO3

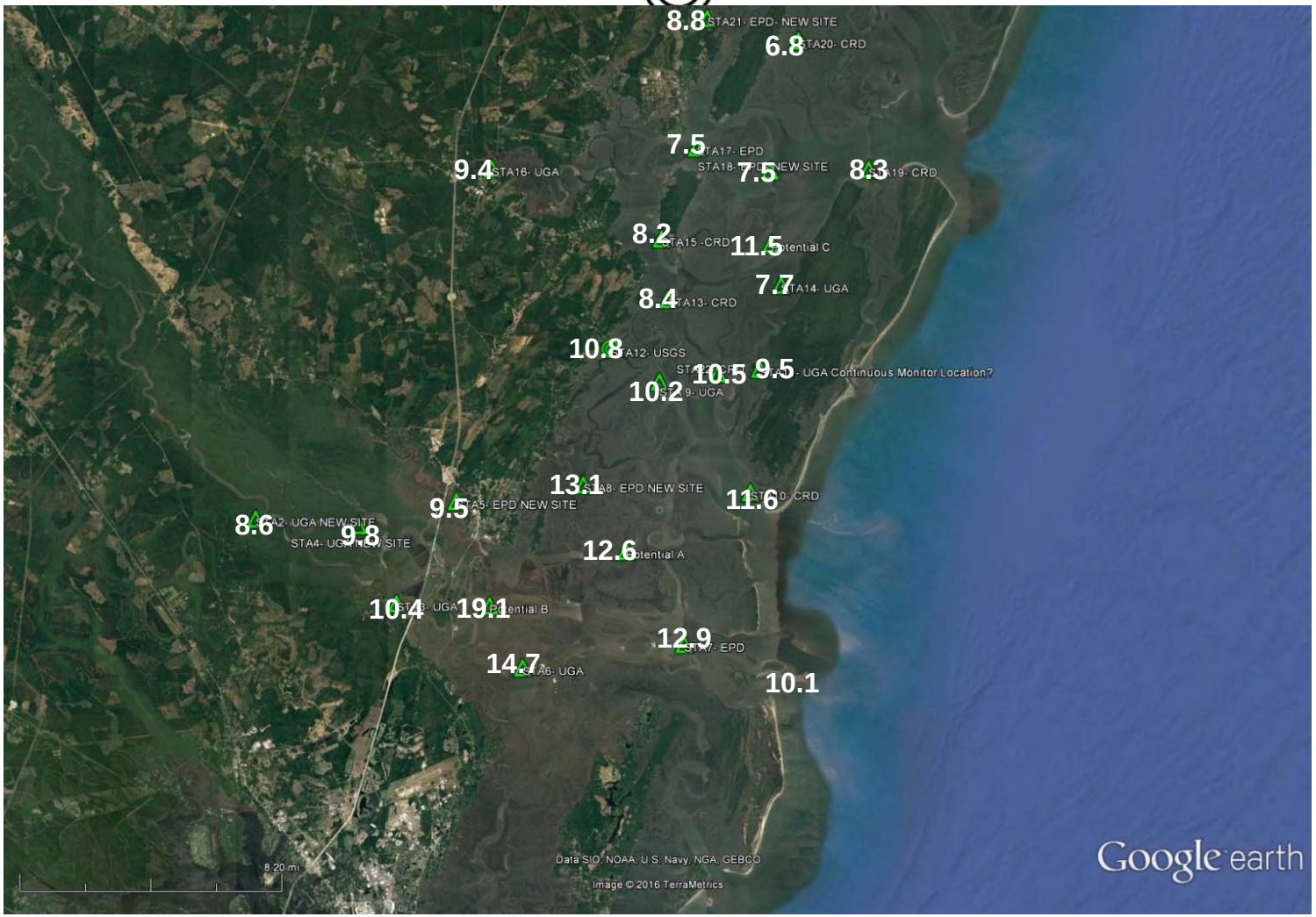




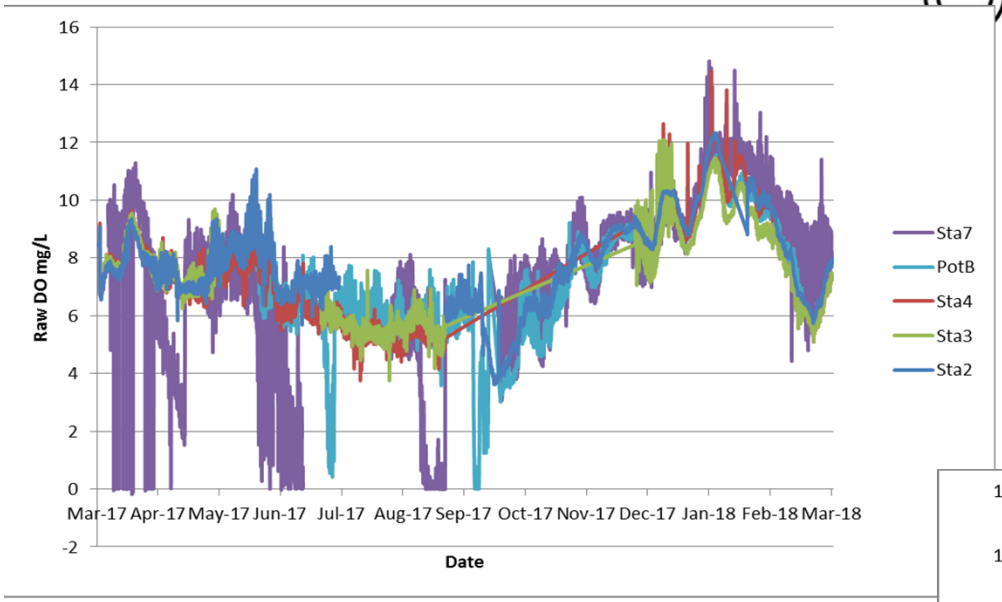
Chlorophyll *a*

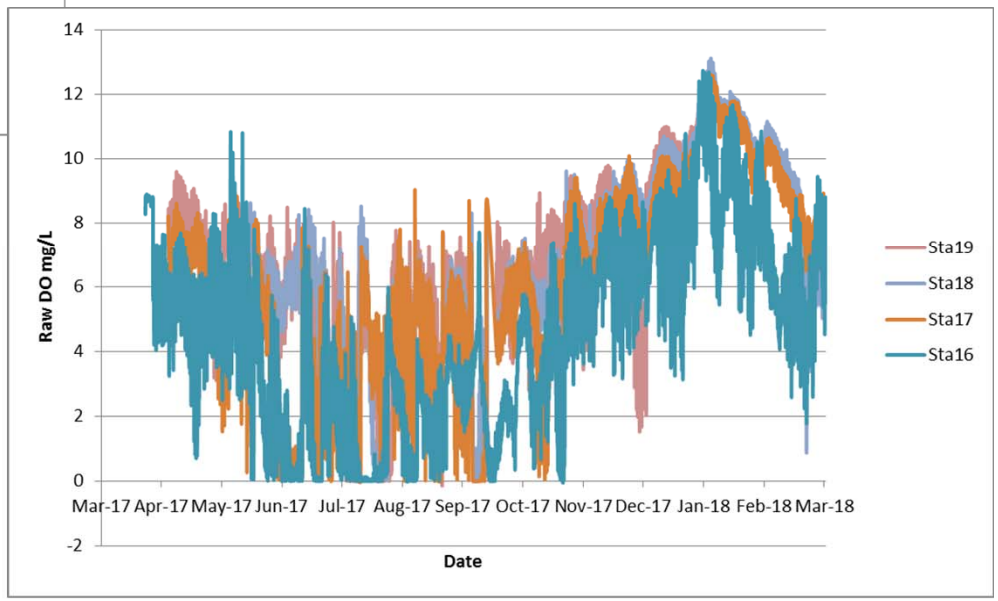


Average Chlorophyll *a*

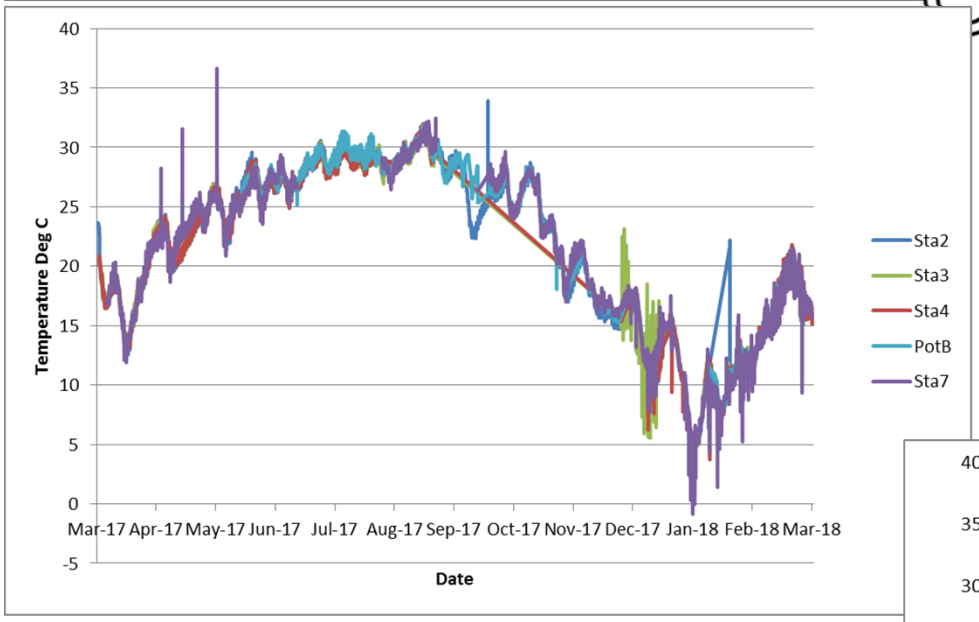


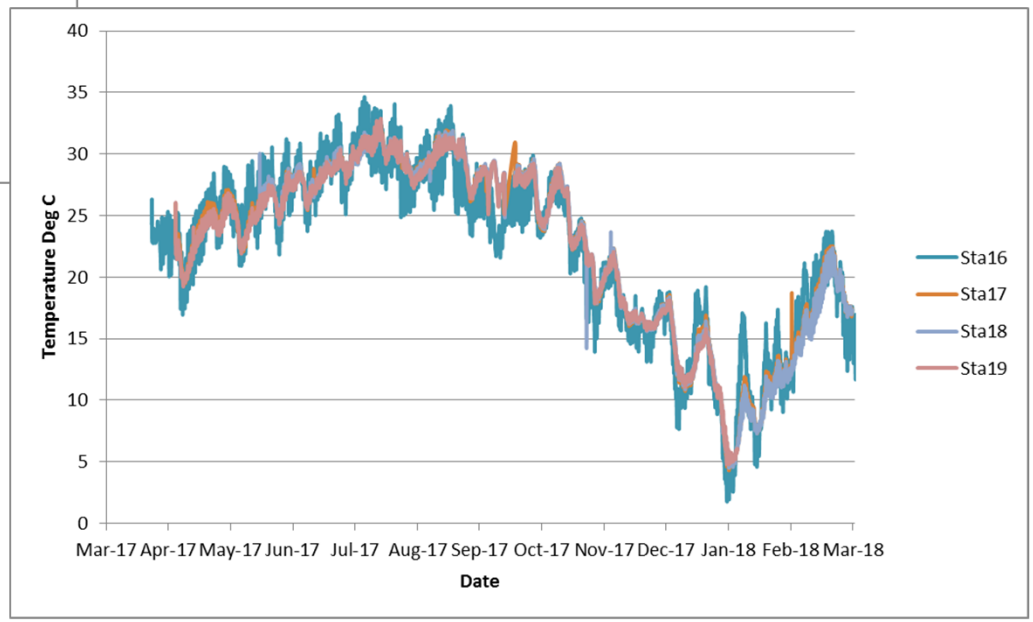
In Situ Data: DO





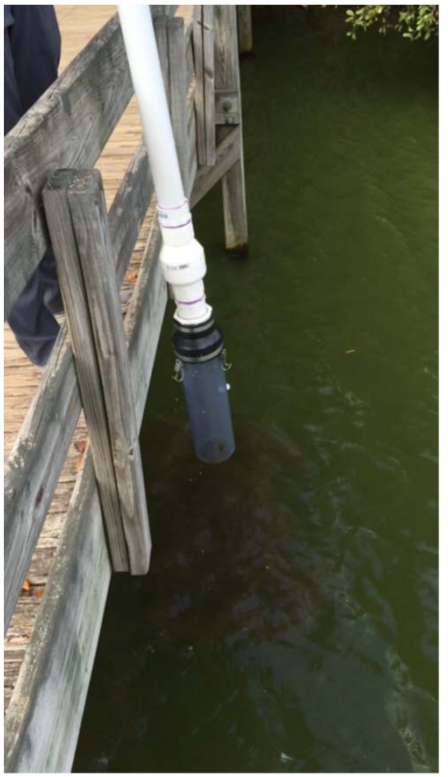
In Situ Data: Temperature





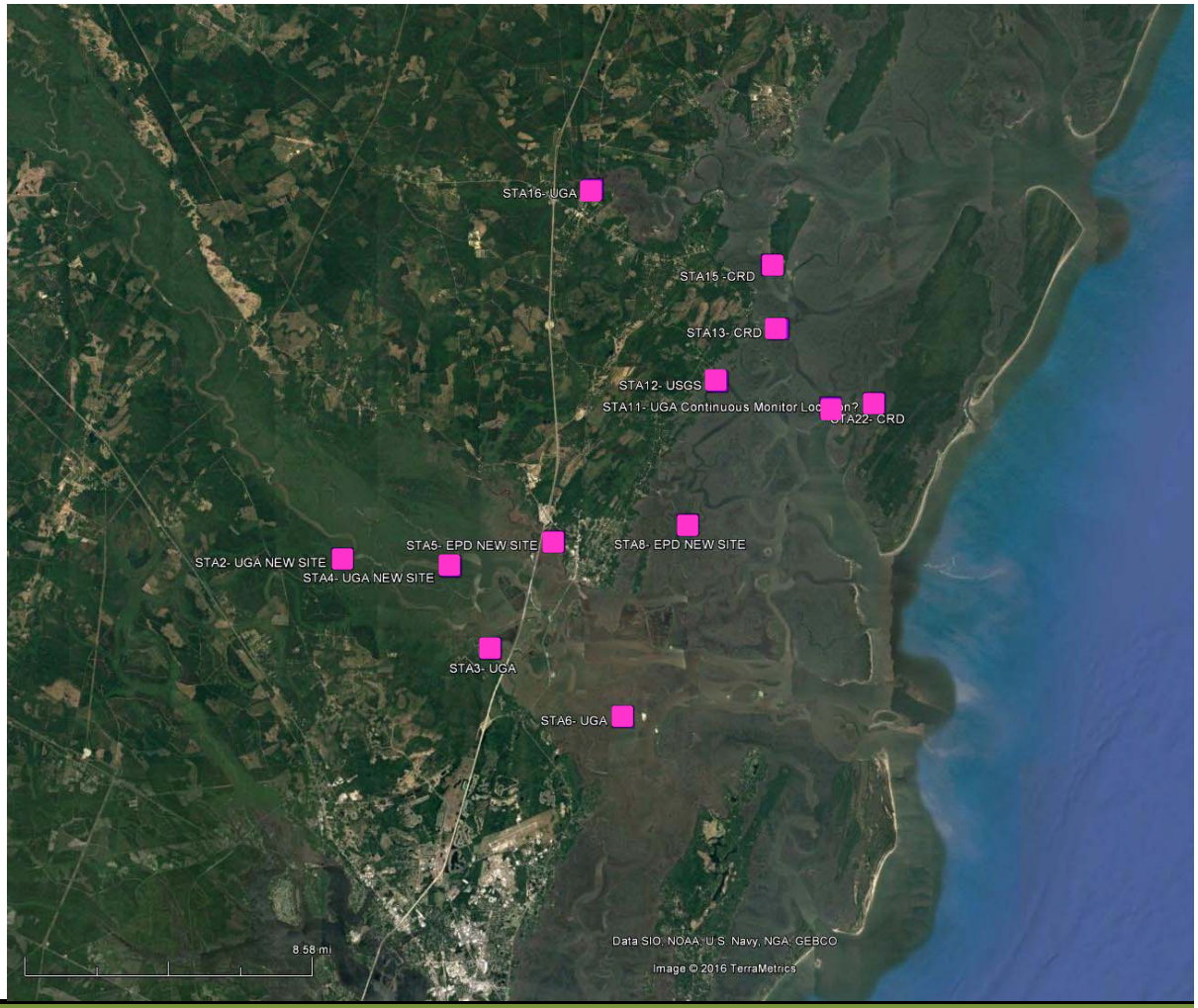
Sediment Oxygen Demand

- Sediment Oxygen Demand
- Nutrient Fluxes



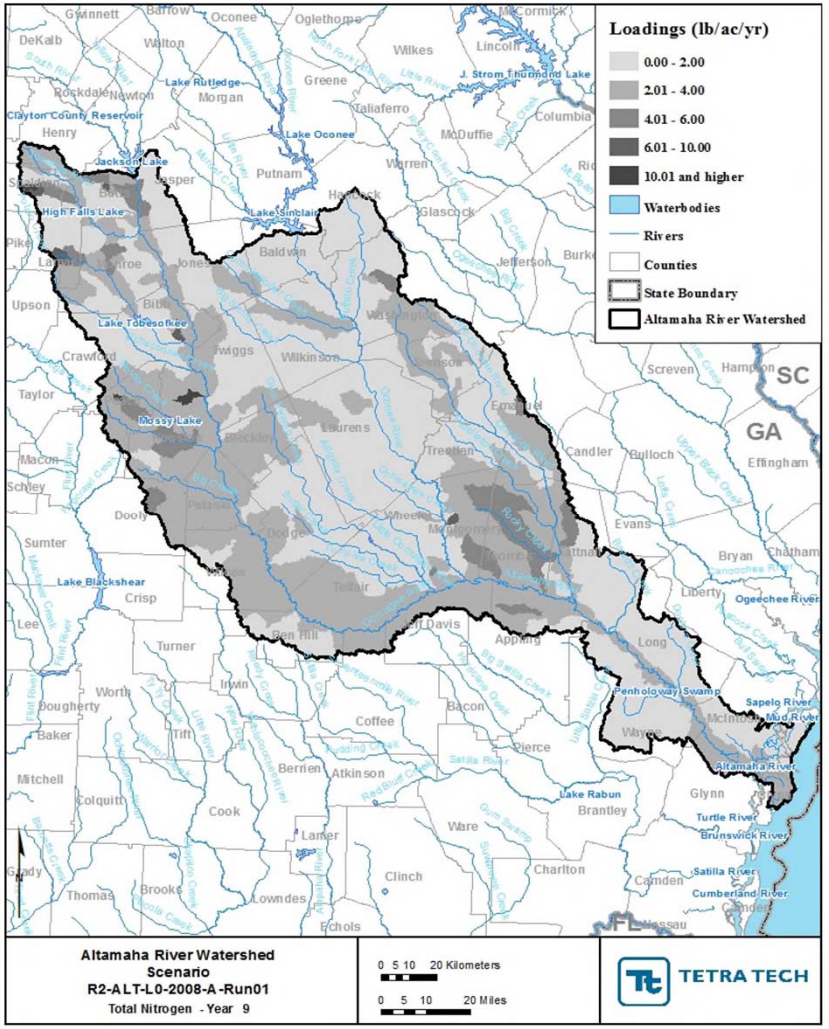
Sediment Oxygen Demand

Sediment Oxygen Demand Monitoring Sites



The Modeling Approach: LSPC

- Hydrodynamic Watershed Model
- Evaluates Point and Non Point Sources
- Examines effects on nutrients and DO levels
- Uses varying meteorological conditions
- Rainfall and land use driven



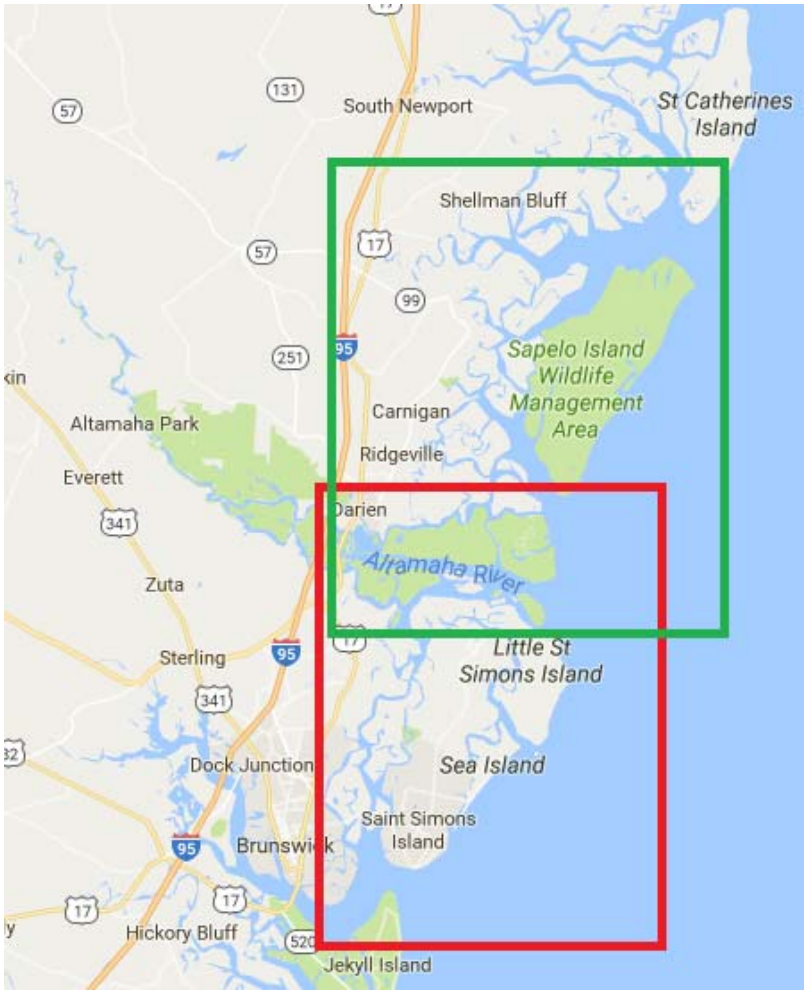
Modeling the Altamaha Estuary

EFDC

Covers the coastal area from Altamaha Sound south toward Saint Simons Sound

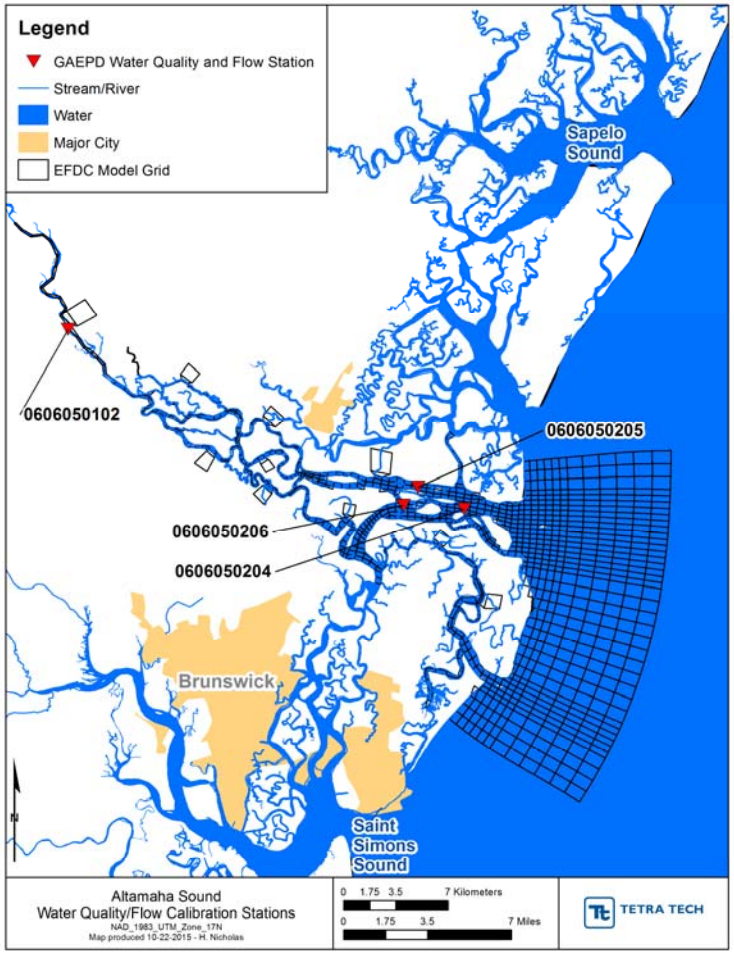
FVCOM

Covers the area from the Altamaha Sound north towards Sapelo Sound



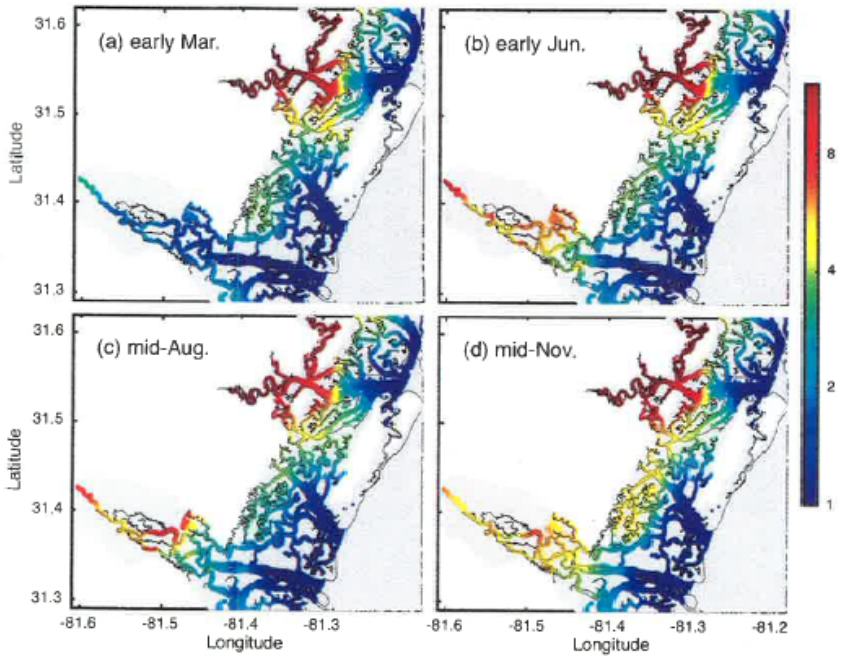
The Modeling Approach: EFDC

- 3 Dimensional Hydrodynamic Model
- Developed for the Georgia State-Wide Water Plan
- Calibrated to existing conditions 2000-2012
- Models DO and can model nutrients and chlorophyll *a*



The Modeling Approach: FVCOM

- 3 Dimensional Hydrodynamic Model
- Hydrodynamics calibrated to data from the last +10 yrs
- Models residence time of suspended particles and degradation of dissolved organic matter
- Models nutrient dynamics and the biological responses



Questions?

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