

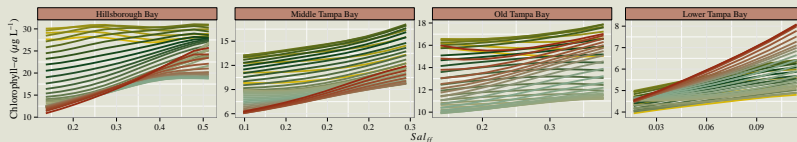
A Novel Approach for Evaluation of Water Quality Trends in Gulf Coast Estuaries

Marcus W. Beck¹ James D. Hagy III² Michael C. Murrell²

¹ORISE post-doc, USEPA National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, beck.marcus@epa.gov

²USEPA National Health and Environmental Effects Research Laboratory, Gulf Ecology Division

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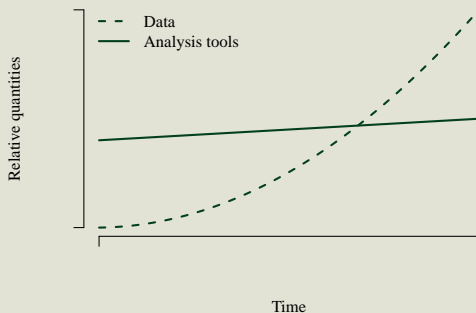


Managing coastal waters

How do we use data?

The good news: We are getting better at monitoring - standardized, automated, increased coverage, real-time/continuous

The bad news: Our ability to use these data for decision-making has not kept pace with availability!



Managing coastal waters

How do we use data?

Challenge 1: We have the data but often lack appropriate tools to unambiguously and quantitatively characterize trends

Challenge 2: We must use tools that can leverage the descriptive capabilities of large datasets

Our research explores novel techniques to address these challenges:

Case 1: Chlorophyll drivers in Tampa Bay

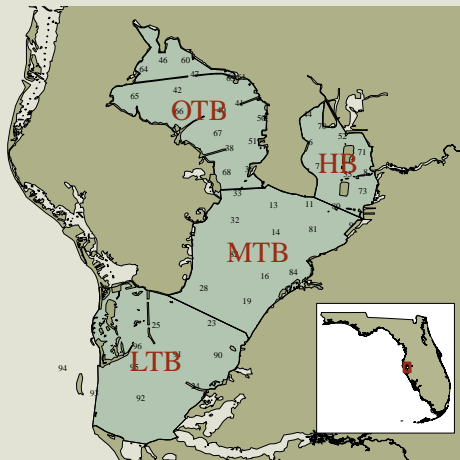
Case 2: Improving estimates of ecosystem metabolism

Case 1: Tampa Bay

Describing drivers of chlorophyll

- Four bay segments
- Monthly wq data at 50 stations from 1974 to present

Data from [TBEP (Tampa Bay Estuary Program), 2011]



Case 1: Tampa Bay

Describing drivers of chlorophyll

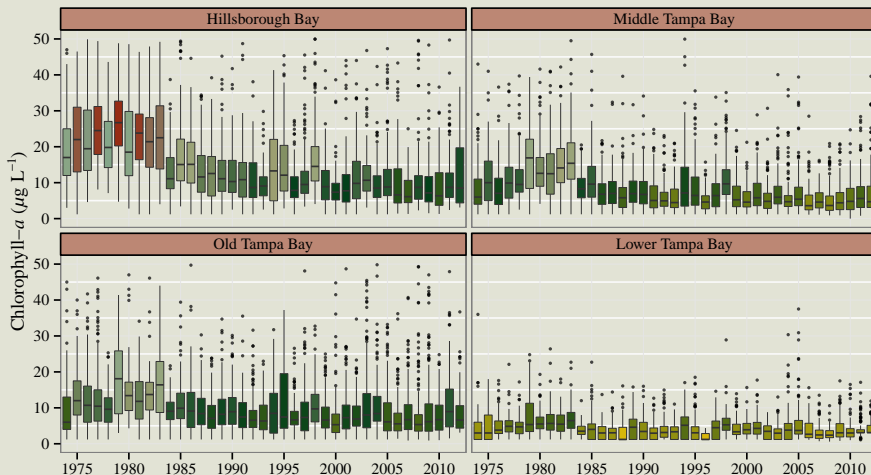


Figure: Annual trends in chlorophyll for each bay segment.

Case 1: Tampa Bay

Describing drivers of chlorophyll

What affects our interpretation of chlorophyll response to nutrients?

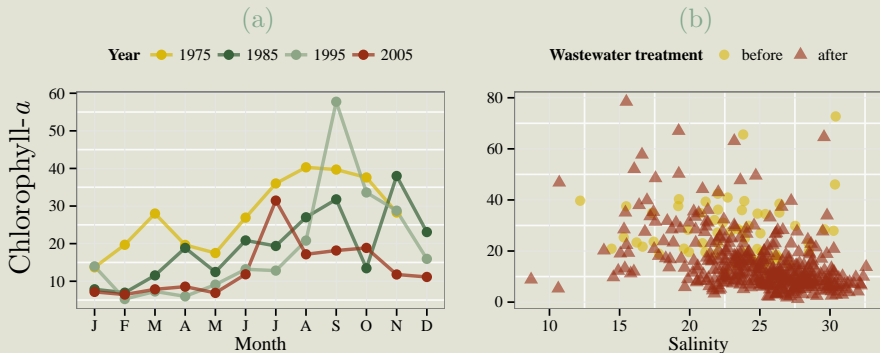


Figure: Variation in chlorophyll by (a) time and (b) salinity and management in Hillsborough Bay. Panel (a) is colored before and after wastewater treatment in 1979.

Case 1: Tampa Bay

Describing drivers of chlorophyll

The *weighted regression (WRTDS)* model is being developed by USGS for pollutant modelling in rivers [Hirsch et al., 2010]

Based on the idea that pollution concentration is a function of *time*, *discharge*, and *season*

Problem: We want to see if management has an effect on reducing pollutant load over time, but pollutant load varies with discharge.

Solution: Develop a model that accounts for changes in relationships between drivers of pollution over time.

Adaptation: Can this approach be used to evaluate chlorophyll trends in Tampa Bay?

Case 1: Tampa Bay

Describing drivers of chlorophyll

How does weighted regression work?

Case 1: Tampa Bay

Describing drivers of chlorophyll

Results show temporally consistent trends over time

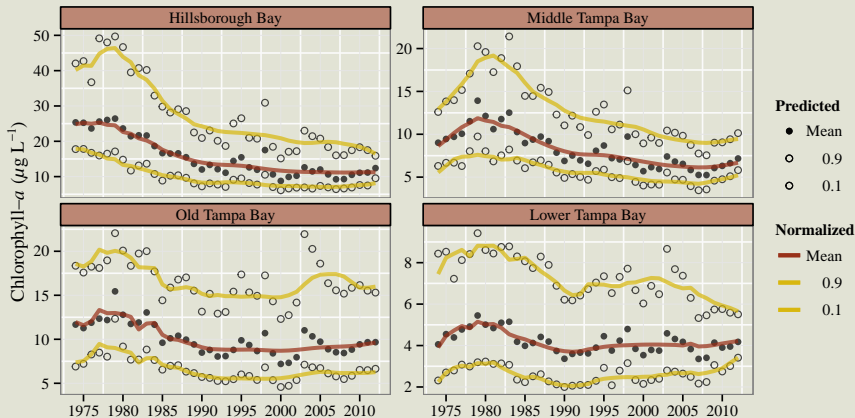


Figure: Predicted and salinity-normalized annual chlorophyll by segment.

Case 2: Improving estimates of metabolism

Application to Gulf Coast estuaries

The 'Odum' open-water method has been used for decades to estimate rates of ecosystem metabolism [Odum, 1956]

$$\frac{\delta DO}{\delta t} = P - R + D$$

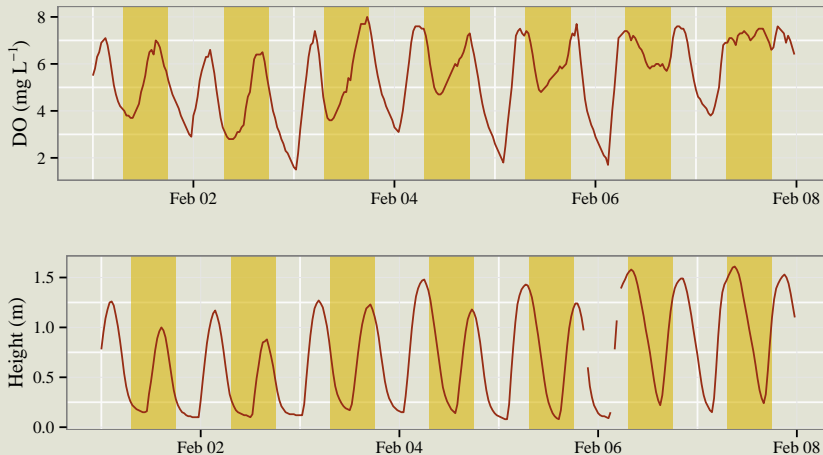
Metabolic rates provide a measure of productivity in a system - are estuaries sources or sinks of organic matter? [Caffrey et al., 2013]

Applications to estuarine monitoring data have been somewhat successful - why??

Case 2: Improving estimates of metabolism

Application to Gulf Coast estuaries

The 'Odum' method assumes DO represents biological processes...



Case 2: Improving estimates of metabolism

Application to Gulf Coast estuaries

Challenge: DO time series may represent variation from physical and biological processes

Solution: The weighted regression approach could be used here...

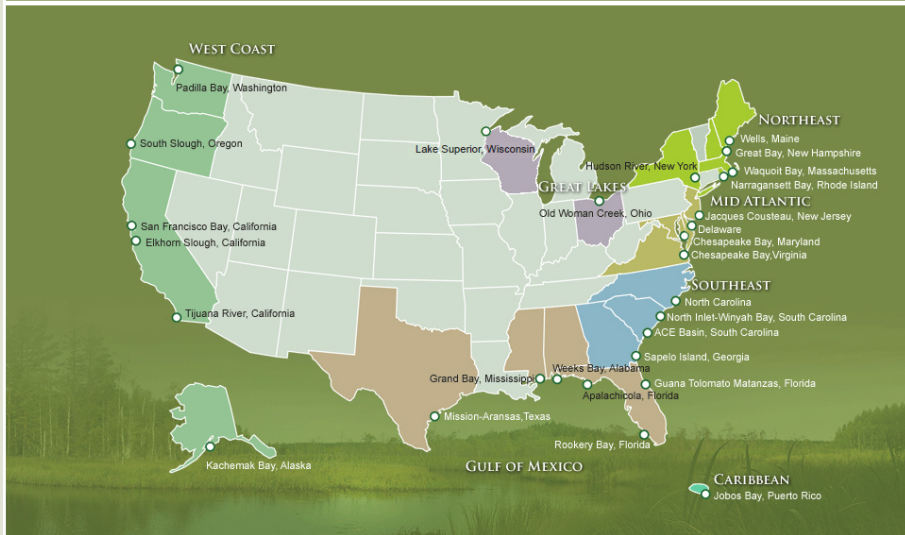
$$\ln(Chl) = \beta_0 + \beta_1 Sal_{ff} + \beta_2 t$$

$$DO = \beta_0 + \beta_1 H + \beta_2 t$$

Case 2: Improving estimates of metabolism

Application to Gulf Coast estuaries

NERRS Reserves

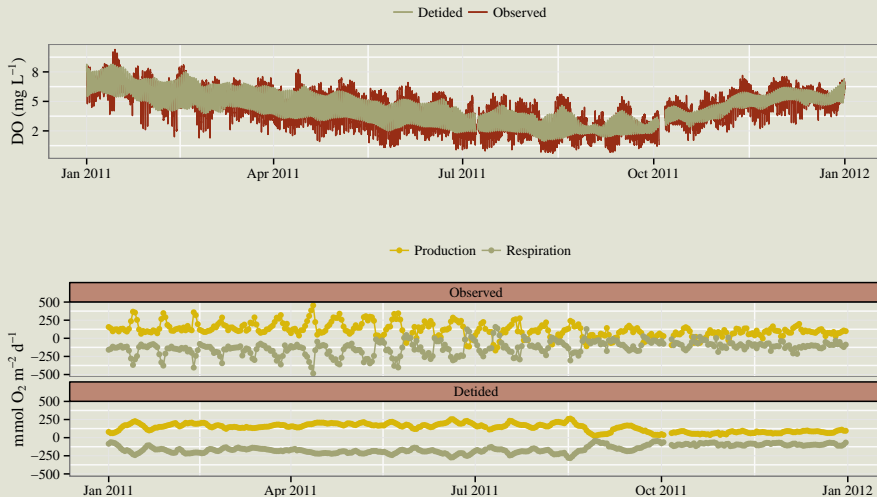


Case 2: Improving estimates of metabolism

Application to Gulf Coast estuaries

Case 2: Improving estimates of metabolism

Application to Gulf Coast estuaries



Conclusions

The analysis of water quality will continue to require the use of novel techniques, such as weighted regression

These needs are motivated by:

- The continued relevance of stressors that influence ecosystem conditions
- Our increasing ability to gather raw, uninterpreted data

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Wes Anderson Cavalcanti color
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Funding sources and contact:



beck.marcus@epa.gov

Phone: 8509342480

Github: github.com/fawda123/

Blog: beckmw.wordpress.com/

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