

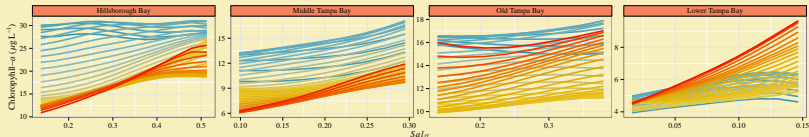
Adaptation of a Weighted Regression Approach to Evaluate Water Quality Trends in an Estuary

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Nov. 9, 2015



Beck, M.W., Hagy III, J.D. 2015. Adaptation of a weighted regression approach to evaluate water quality trends in an estuary. *Environmental Modelling and Assessment*. 20(6):637-655. doi: 10.1007/s10666-015-9452-8

Environ Model Assess
DOI 10.1007/s10666-015-9452-8

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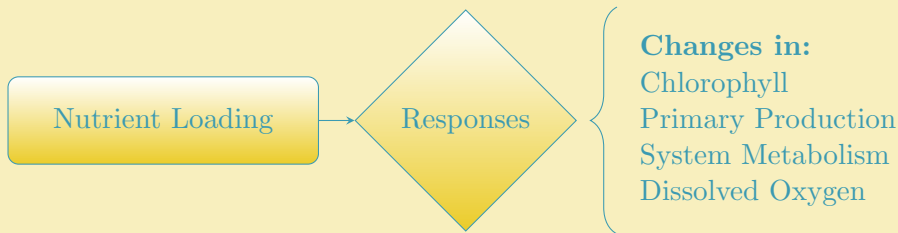
Received: 12 August 2014 / Accepted: 26 February 2015
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The eutrophication paradigm

Research and management in coastal waters

*Eutrophication (noun) - an **increase** in the rate of supply of **organic matter** to an ecosystem*

– [Nixon, 1995]



Adapted from [Cloern, 2001]

The eutrophication paradigm

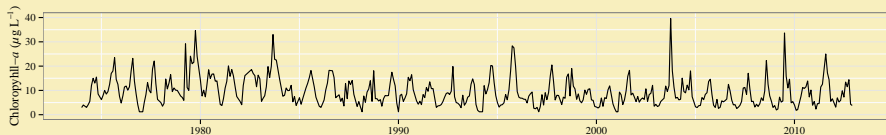
Research and management in coastal waters

Increasing availability of records describing **long-term changes**

Observed data can provide a means to an end, potentially **high power** with large sample size

Can we **develop** and **apply** tools that leverage the descriptive capabilities of these large datasets?

Can we **link descriptions** to **causal events** to inform management or understanding?

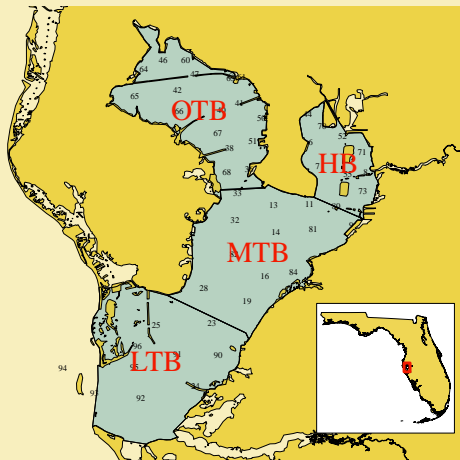


Tampa Bay

Understanding chlorophyll response to eutrophication

- Four bay segments
- Monthly wq data at 50 stations from 1974 to present
- Longitudinal profile of nutrient load and salinity

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



Tampa Bay

Understanding chlorophyll response to eutrophication

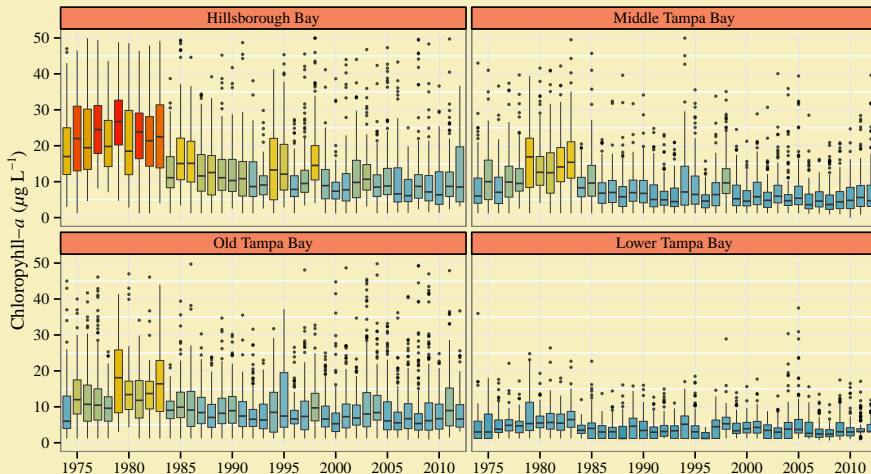


Figure : Annual trends in chlorophyll for each bay segment.

Tampa Bay

Understanding chlorophyll response to eutrophication

What affects our interpretation of chlorophyll response to nutrients?

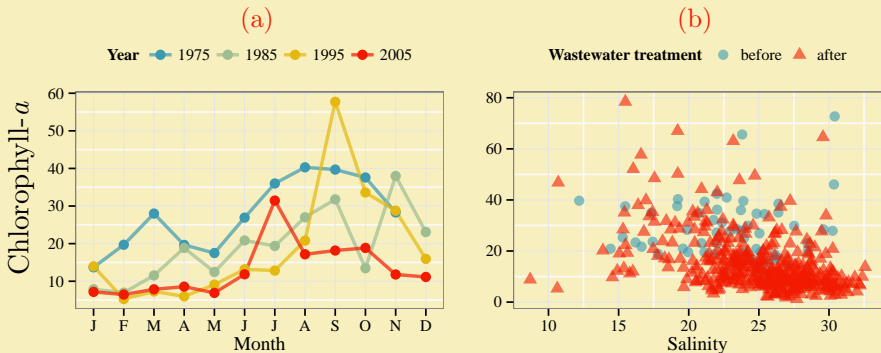


Figure : Variation in chlorophyll by (a) time and (b) salinity and management in Hillsborough Bay. Panel (b) is colored before and after wastewater treatment in 1979.

Tampa Bay

Understanding chlorophyll response to eutrophication

Problem: Response endpoints of eutrophication vary naturally over time and with discharge or tidal patterns

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

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

Models pollution concentration as a function of **time**, **discharge**, and **season**

Adaptation: Can this approach be used to evaluate chlorophyll trends in Tampa Bay [Beck and Hagy III, 2015]?

Tampa Bay

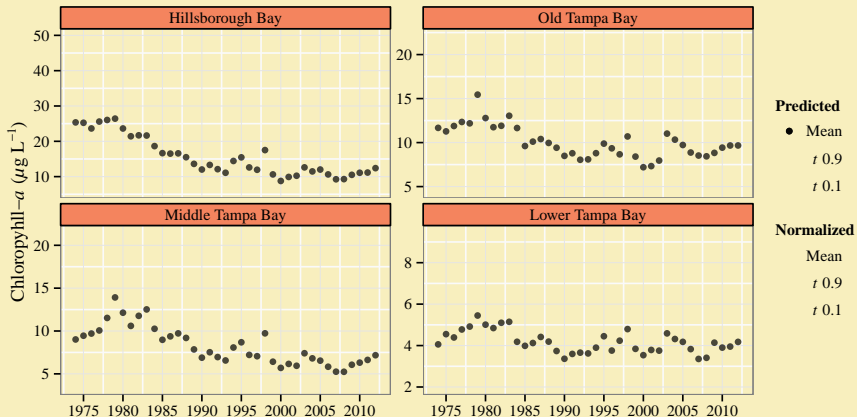
Understanding chlorophyll response to eutrophication

How does weighted regression work?

Weighted regression approach

Results for Tampa Bay

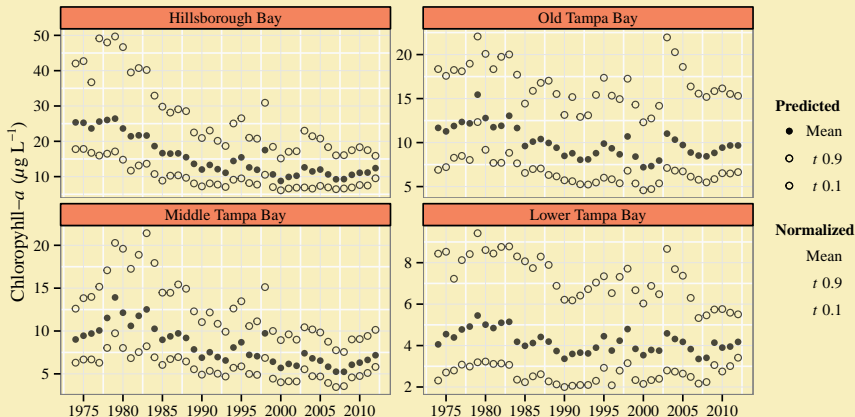
This gives us improved trend descriptions... observed predictions



Weighted regression approach

Results for Tampa Bay

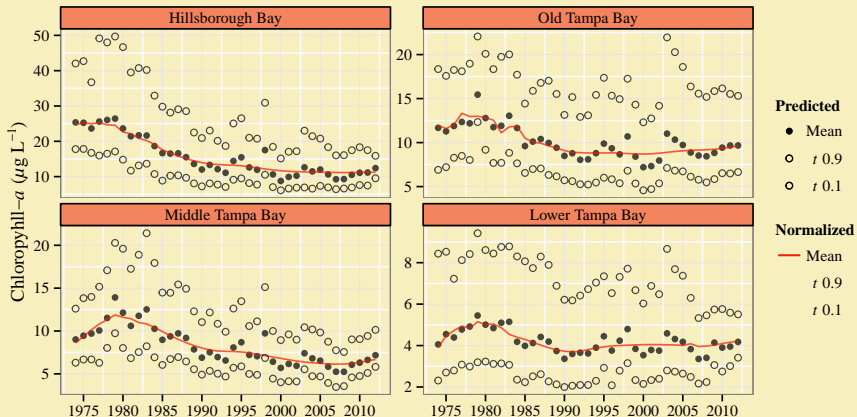
This gives us improved trend descriptions... quantile predictions



Weighted regression approach

Results for Tampa Bay

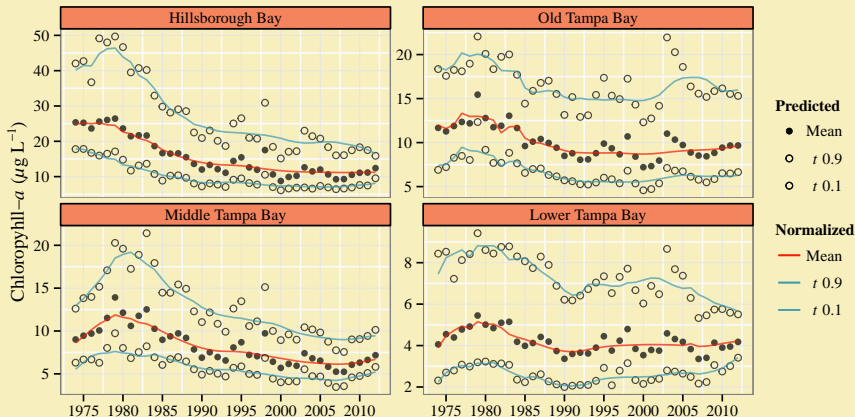
This gives us improved trend descriptions... observed, flow-norm



Weighted regression approach

Results for Tampa Bay

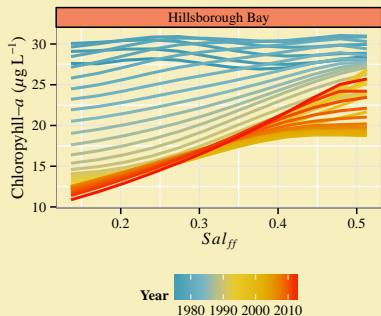
This gives us improved trend descriptions... quantile, flow-norm



Tampa Bay

Understanding chlorophyll response to eutrophication

Because the model is dynamic, we have parameters describing the relationship of chlorophyll with other factors specific to different time periods



- Early period (blue) - point-sources
- Late period (red) - non-point sources
- Chlorophyll shows increasing response to freshwater input in recent years

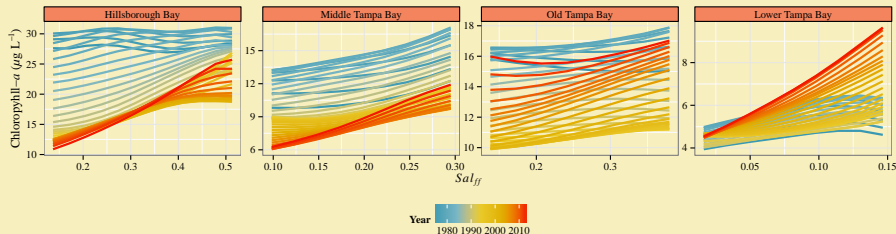
Tampa Bay

Understanding chlorophyll response to eutrophication

What does this mean for Tampa Bay and elsewhere?

- Predictions followed observed chlorophyll – but increased clarity in the description
- More detailed evaluation of trends allows greater insight into drivers of change

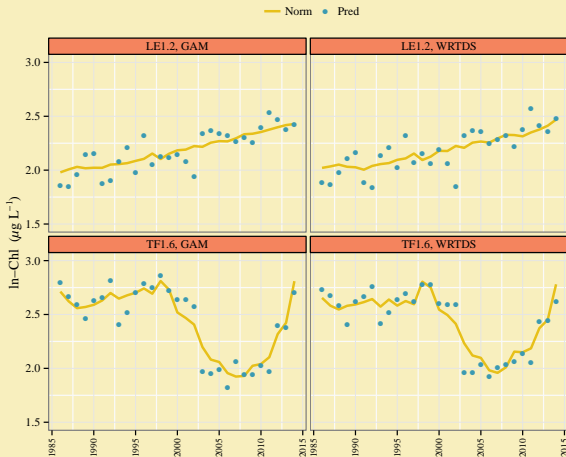
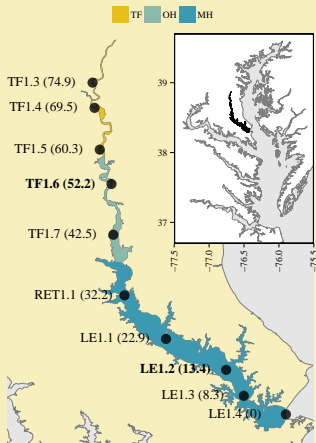
The model parameters show us a picture...



WRTDS adaptations and products

Additional study systems

Currently comparing WRTDS and GAMs for trend evaluation



WRTDS adaptations and products

Additional study systems

Adapting weighted regression to 'detide' dissolved oxygen time series
[Beck et al., 2015]

LIMNOLOGY and OCEANOGRAPHY: METHODS

ASLO

Limnol. Oceanogr.: Methods 00, 2015, 00–00
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doi: 10.1002/lom3.10062

Improving estimates of ecosystem metabolism by reducing effects of tidal advection on dissolved oxygen time series

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Wednesday 11:15, B110-112

Acknowledgments:

Research staff and employees at USEPA Gulf Ecology Division

Field staff and data managers at Hillsborough County Environmental Protection Commission

Research coordinators, technicians, and field staff of the National Estuarine Research Reserve System

Wes Anderson Zissou color theme borrowed and adapted from github.com/karthik



Image credit: Stephen Morrow

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WRTDS tidal package:
https://github.com/fawda123/wtreg_for_estuaries

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