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

Marcus W. Beck[1] James D. Hagy III[2]

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

[2]USEPA National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, hagy.jim@epa.gov

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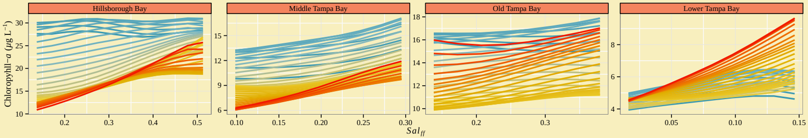
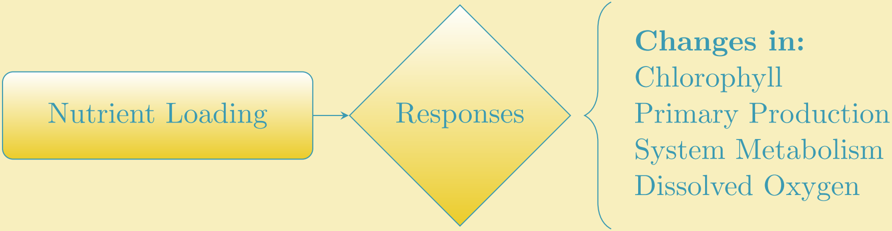


The eutrophication paradigm

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

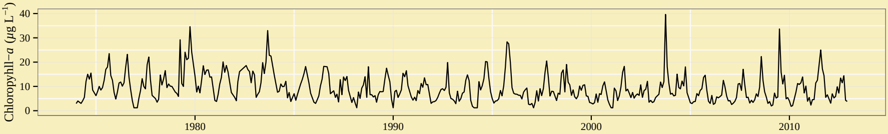
Research and management in coastal waters

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?

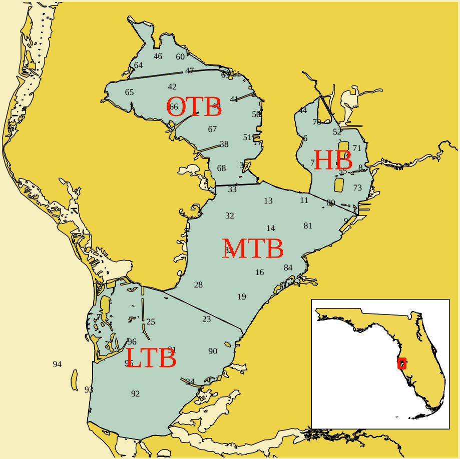


Tampa Bay

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

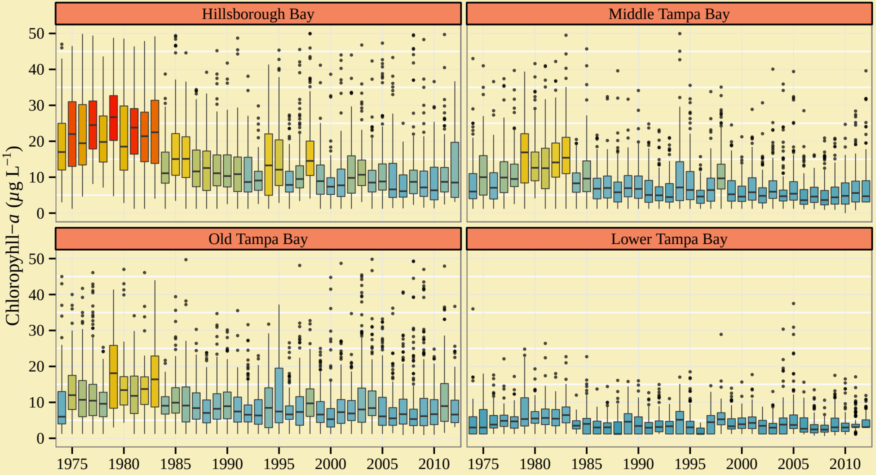
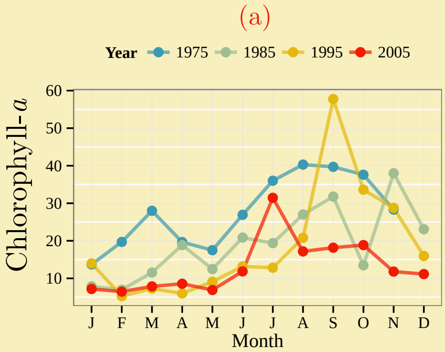


Figure : Annual trends in chlorophyll for each bay segment.

What affects our interpretation of chlorophyll response to nutrients?



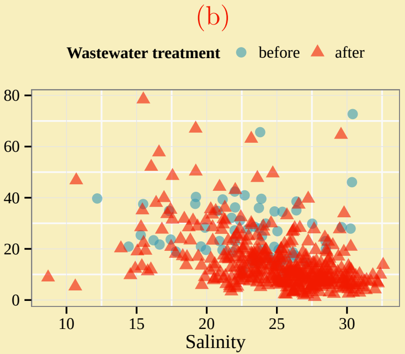


Figure : Variation in chlorophyll by (a) time and (b) salinity and management in Hillsborough Bay. Panel (a) is colored before and after wastewater treatment in 1979.

Tampa Bay

Understanding chlorophyll response to eutrophication

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

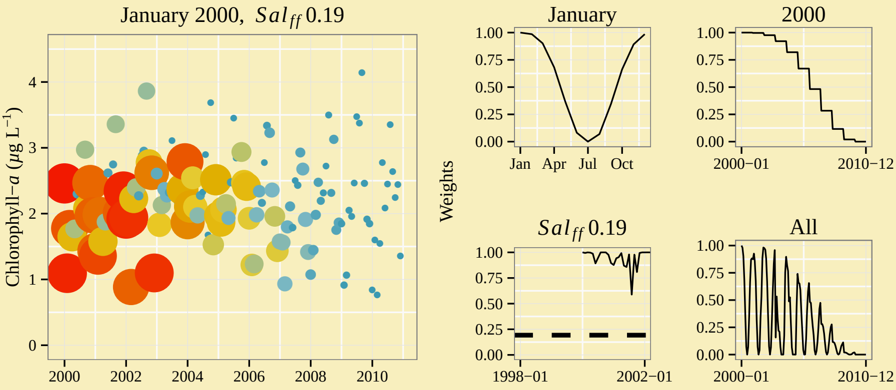
Solution: Develop a model that accounts for changes in relationships between drivers of pollution over time.

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

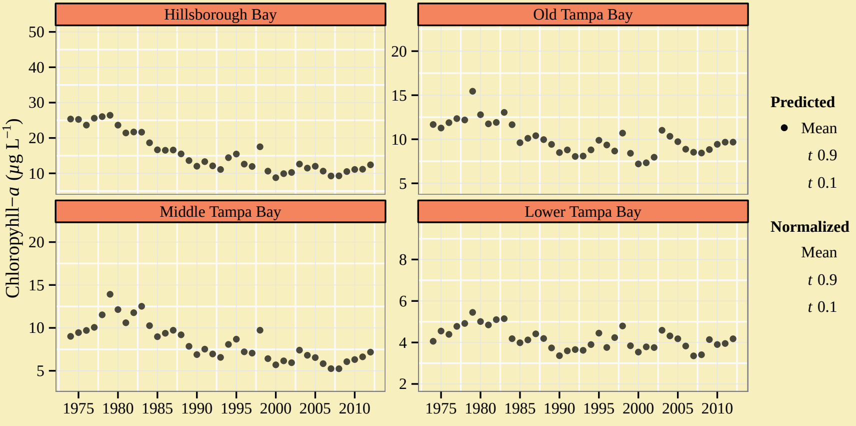
Adaptation: Can this approach be used to evaluate chlorophyll trends in Tampa Bay?

How does weighted regression work?



Weighted regression approach
Results for Tampa Bay

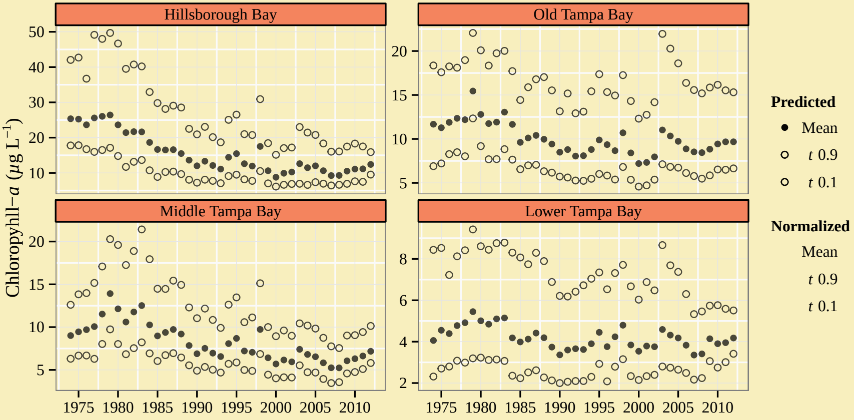
This gives us improved trend descriptions... observed predictions



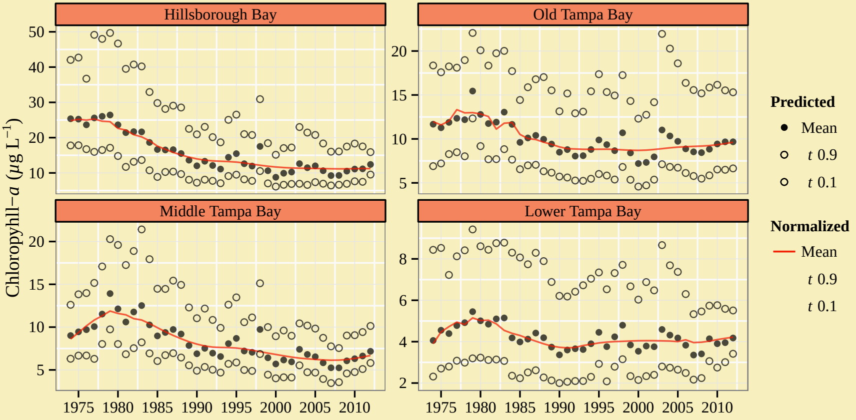
Weighted regression approach

Results for Tampa Bay

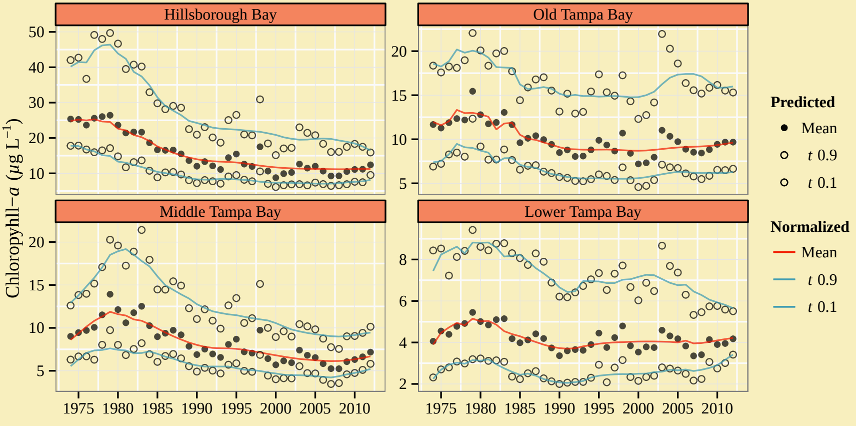
This gives us improved trend descriptions... quantile predictions



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



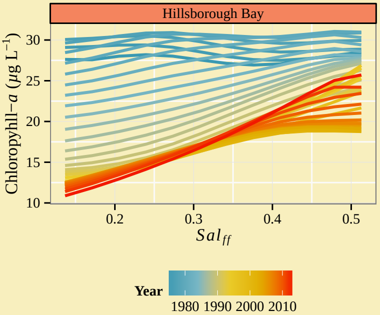
This gives us improved trend descriptions... quantile, flow-norm



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

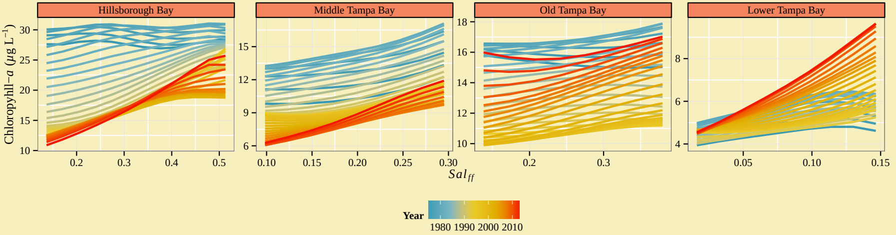
Tampa Bay

Understanding chlorophyll response to eutrophication

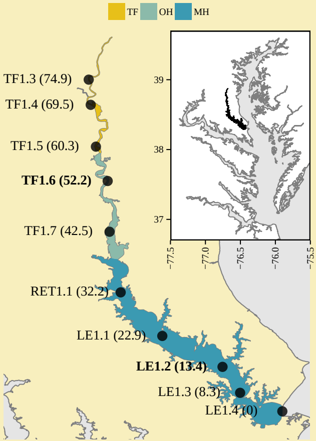
What does this mean for Tampa Bay and elsewhere?

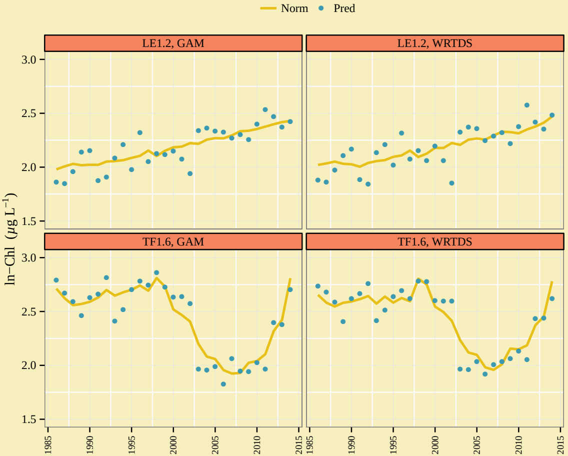
- Predictions followed observed chlorophyll – but increased clarity in the description
- More detailed evaluation of trends allows greater insight into drivers of change

The model parameters show us a picture...



Currently comparing WRTDS and GAMs for trend evaluation





WRTDS adaptations and products

Additional study systems

Adapting weighted regression to 'detide' dissolved oxygen time series

LIMNOLOGY and OCEANOGRAPHY: METHODS

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

Marcus W. Beck,*[1] James D. Hagy III,[2] Michael C. Murrell[2]
[1]ORISE Research Participation Program, USEPA National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, Florida
[2]USEPA National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, Florida

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Image credit: Stephen Morrow

Funding sources and contact:

beck.marcus@epa.gov

Phone: 8509342480

Blog: http://beckmw.wordpress.com/

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

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