Comments and Text for Tampa Bay manuscript.

here is some suggested text for opening the discussion. Feel free to blend in aspects of your own text that you see as important

**Discussion**

Application of the Weighted Regressions on Time, Discharge and Season (WRTDS) model to a analyze a long-term record of chlorophyll-a in 4 segments of Tampa Bay provided an improved quantitative description of long-term changes relative to commonly applied methods. Because the quantitative description could be conceptually related to expected causes, the results enabled generation of informed hypotheses regarding ecosystem behavior and change and could suggest a potential approach for developing quantitative thresholds for water quality management. These conclusions are supported by several key aspects of the results obtained from the model. First, the WRTDS model provided statistically better predictions of chlorophyll-a, measured as both higher R2 and lower root mean square error (RMSE; Table 2). Secondly, WRTDS results for segments of the Bay that were historically most impacted by nutrient loading pointed to shifts in the response of chlorophyll-a to changes in freshwater inflows. These changes are temporally coherent with known changes in nutrient sources, suggesting that the WRTDS results quantify a response to changes nutrient forcing. Third. because WRTDS provided improved description of chlorophyll-a in relation to known drivers (e.g., time, discharge, season), the model better described long-term patters in unexplained variability. Finally, adaptation of WRTDS to predict quantiles in addition to the mean response provided information about long-term shifts in phytoplankton dynamics that could be ecologically informative. In total the results obtained by applying WRTDS to the Tampa Bay chlorophyll-a time series suggest that this model could be broadly useful for analyzing and interpreting the growing number of long-term data sets for water quality in estuaries.

**4.1 Improved Description of Chlorophyll-a using WRTDS**

- WRTDS explained more of the variability in chlorophyll-a over time than an un-weighted additive linear model. Improved model fit results in part from more flexible parameterization. This increases the ability of the model to describe historical patterns, but reduces application to predicting future chlorophyll-a.

- If drivers of chlorophyll-a are changing over time, predicting future chlorophyll-a while assuming that drivers are not changing could be of limited value.

- For example, WRTDS showed that the relationship between chlorophyll-a and freshwater forcing changed over time. Therefore, predictions of chlorophyll-a in the near future would by necessity be based on the most recent estimates of the ecosystem response to freshwater forcing, not the long-term average response.

- Hirsch et al. (2010) also used WRTDS to quantify changes ecological drivers, pointing to long-term changes in the strength and direction of discharge effects on nutrient concentrations in rivers.

- Watershed drivers of changes described by Hirsch et al. (2010) may drivers of observed changes in chlorophyll-a in Tampa Bay.

Ecological/Conceptual Points Regarding Chlorophyll-a vs. Nutrients:

- When nutrient loading and phytoplankton biomass is very high, responses to changes in nutrient loading or freshwater inflow may be muted because high equilibrium phytoplankton biomass is maintained by growth limitation due to self-shading, rather than nutrients availability (Wofsy 1982). May explain HB response in 1970-80 in Fig 9.

- When phytoplankton growth is sometimes nutrient limited, production and biomass may be positively correlated with river forcing, which provides relief from nutrient limitation. e.g., HB 1990-2000 in Fig 9.

- If nutrient concentrations associated with river flow do not stimulate phytoplankton growth sufficiently to overcome flushing, biomass could decrease in associated with high flow (e.g., Murrell et al. 1997). e.g., HB 2000-2012 in Fig 9.

- Open question: what is the difference between HB and OTB that would result in different relationships?

- If we want to explain these observations in terms of changes in relative magnitude of total load, point source loading, and non-point source loading ... we need a reference that describes these patterns in Tampa Bay.

**4.2 Changes in Chlorophyll-a Variability**

- Most analyses of changes in water quality focus on changes in mean water quality. Additive linear models generally fit a constant seasonal cycle, a constant response to variations in freshwater inflow, and a linear trend to describe the long-term change.

- A quantile regression model describes changes in quantiles, such as the median (50th percentile) and any upper or lower quantile. These estimates still emphasize on trends in the level, not the degree of variability of that level.

- The flexible parameterization of the WRTDS provides a more detailed quantitative description, including a description of variabiliy

enables us to describe the data But, the most important aspects of long-term changes in water quality