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Biogeosciences Discussions

Interactive comment on "From heterotrophy to autotrophy: a freshwater estuarine ecosystem recovering from hypereutrophication" *by* T. J. S. Cox et al.

Anonymous Referee #2

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Text in general: Really awkward sentence structure, verb tense usage, and wording throughout. The Intro doesn't effectively summarize the literature and current state-of-the-art of eutrophication reversal in estuaries or any aquatic systems for that matter. The real question I think is what processes are contributing to increased chlorophyll concentrations in the water column while inorganic nutrient loads are decreasing. The authors speculate about the role toxicity (to NH4+, DO, reducing conditions) may play but rather than conduct any field / lab experiments rely on a modeling exercise to support their speculation. The intro should focus more on secondary controls on phytoplankton biomass during eutrophication and it's reversal. Non-linearities and thresholds and regime shifts are not a strength of this manuscript. Shifting balance between

autotrophy and heterotrophy during reduction in inorganic n loading is to be expected and has been discussed in previous papers. an example of a regime shift might a shift from benthic algae to phytoplankton, etc. but these authors don't even comment about plants other than those measured by suspended chlorophyll concentrations.

The site description is confusing. Are the 20,000 km2 of catchment the size of the terrestrial watershed draining into the estuary? Does the freshwater tidal portion of the estuary include the entire 240 km of tidal rivers? Are those tidal rivers and their adjacent wetlands included in the 20,000 km2 watershed? Is the 35 km long tidal reach just a portion of the larger 240 km long system? These simple questions about 3 sentences in the study area section of the proposal are representative of the awkward, imprecise wording of the entire manuscript.

Low oxygen is a human-induced impact or a consequence of nutrient enrichment due to human activities in the watershed? Isn't degradation of allochthonous material typical of almost all freshwater systems? Is water over-saturated with CO2 a problem? Isn't it typical of many freshwater systems, whether they've been impacted or not? I think harmful algal blooms often are the result of nutrient enrichment, but not always.

Many paragraphs to not begin with a topic sentence! For example – Data sources and Numerical modeling paragraphs.

Figure 1 caption is confusing. It's impossible to tell where the estuary begins and ends. Where are the 240 km of tidal creeks and rivers? Where does the freshwater tidal portion start – separate from more saline parts of the estuary?

Fig 2 – what's the difference between annual and FW averaged concentrations? What is a FW averaged concentration? What's the breakdown between TDN, NH4+, DON and NO3-? Why report TDIN and not NO3-? How does loading of NH4+ and NO3- compare? How much spatial gradient is there along the 240 km of tidal reaches and where were the 2 pre-1995 DO samples collected from? Is it possible that the 2 early on low values were not representative of the regions where samples are now collected?

I am not familiar with the older papers claiming nitrification to be the major process consuming O2. You should show NO3- concentrations and rejustify this conclusion. I think you need to prove that water column chlorophyll concentration is an adequate proxy for all autotrophic biomass. What about macroalgae and the relative importance of various autotrophic functional groups during the period you're studying?

Your mathematical model pertains only to the water column – GPP of suspended chl, but oxygen is controlled also by benthic processes. I don't think you can speculate too much about controls on phytoplankton production as being influenced by DO and reducing substances being that your model excludes benthic processes which are always major players in shallow water systems.

The fact that your system may be shifting from being heterotrophic to autotrophic isn't unexpected, occurs in other systems – even along systems and between nite and day intervals in most systems. Seems like your major interest here is in understanding why chl has increased while DIN loading has decreased. I don't think your model is the way to address this. you need to conduct field/lab experiments to examine the effects of low do, high NH4+, reducing substances under controlled conditions.

It is incredulous to me that nitrification is the process most responsible for oxygen update in an estuary. Nitrification is generally a very slow process – with autotrophs typically outcompeting chemosynthetic bacteria. I'd have to see data on benthic oxygen consumption and sulfide reoxidation etc to be convinced.

Interactive comment on Biogeosciences Discuss., 6, 5431, 2009.