Comment on nutrient criteria

Chuanmin Hu to: Stephanie Sanzone 12/07/2010 09:20 AM

Cc: Judith Lang, hu

comments_Nutrient_Criteria_Hu.pdf

Dear Stephanie:
Attached please find some comments about the nutrient criteria document.
Sorry I couldn't respond earlier - hope it is not too late. Please let me know if you have questions.
Best regards,

Chuanmin

Comment on "Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters" (November 17, 2010)

Overall this is a great document that puts many materials from various disciplines together in a context for nutrient criteria. I think the whole community will thank EPA for leading this effort. Please see some comments below from Chuanmin Hu, University of South Florida (hu@marine.usf.edu), with inputs from Judith Lang and Frank Muller-Karger.

On the use of indicators:

"B.1.1 Scientific Justification for Not Proposing Water Clarity as a Indicator Variable"

Pages B-1 and B-2: The difference between "clarity" and "turbidity" may need to be clarified. The former refers to the amount of light loss due to everything (particles + dissolved) while the latter is for particles only. The most recent work to relate downwelling diffuse attenuation coefficient, K_d, to water clarity (Secchi depth as proxy) has been shown in Chen et al. (2007a), and time-series of satellite-based turbidity for Tampa Bay has been reported in Chen et al. (2007b).

These are technical points. However, my main concern is on the justification for NOT using water clarity as an index. In B-1-1, this whole justification is listed in one sentence: "The use of transparency or water clarity as an indicator variable is confounded by the fact that clarity can be affected by constituents in the water not related to nitrogen/phosphorus pollution, specifically by both natural and introduced materials including suspended algae, dissolved organic matter, suspended detritus (seston), and suspended inorganic material (tripton)." If this argument holds true, the same can be said for satellite-based chlorophyll-a (see below). Further, it is water clarity (a measure of everything in water) and not just chlorophyll-a that affects seagrass and fish. So, I am not sure if omitting water clarity can really be justified.

On the various forcings on water-column chlorophyll-a:

P19, "Coastal physical forcings such as wind, currents, and tides are known to influence coastal chlorophyll dynamics together with nutrient loadings from the land. Thus, all of these processes will be represented when using remote sensing as a reference condition approach."

This is an excellent observation. Numerous studies showed the influence of these forcings on algal blooms and other properties. An example is given in Weisberg et al. (2004) to show how coastal upwelling near Tampa Bay influenced satellite-derived chlorophyll-a concentrations. An overview of the physical forcing on the West Florida Shelf is given in Weisberg et al. (2005). Then the question is, without a thorough understanding of all these forcings at various spatial/temporal scales (seasonal to inter-annual for example), how do we tie the observed indicator (in this case, chlorophyll-a) to land-based N and P?

On the accuracy of satellite-based chlorophyll-a:

P19: "Due to interference from colored dissolved organic matter and bottom reflectance on satellite measurements, EPA is not considering the derivation of numeric criteria using remote sensing data in coastal waters from Apalachicola Bay to Suwannee River (Big Bend) and South Florida."

The approach to include remote sensing is applauded, as it is perhaps the only means at present to reduce potential bias due to undersampling in most of the coastal waters along Florida's coast. What is said about the Big Bend is a valid observation. However, many of the Florida coastal waters suffer from the similar problems (CDOM influence, shallow bottom, sediment resuspension). Hu (2008) showed that during spring the shallow bottom off the entire west Florida coast is often visible, and sometimes this visibility can extend to waters of 35-m deep. Hu et al. (2003a) showed that SeaWiFS-based chlorophyll-a for nearshore-waters in the NEGOM region was significantly off (a factor of >2). Recent algorithm upgrades (in SeaDAS6.1) may improve the estimates, but the environmental reasons for the erroneous satellite-base chlorophyll-a still exist. Also, in the vicinity of Charlotte Harbor, during the rainy season coastal waters can be significantly influenced by land-based CDOM and other materials (Hu et al., 2004). This type of influence can lead to coastal blooms and adverse impact on the benthos (Hu et al., 2003b). On the other hand, the WFS may be occasionally under influence of the Mississippi River and Suwannee River (Del Castillo et al., 2001; Jolliff et al., 2003).

All of these factors together would lead to some cautious note on the accuracy of the satellite-based chlorophyll-a, especially over the extremely shallow-waters within the 3 nautical miles off shoreline. The validation results in Figs. 4-5 appear plausible, but when examining the data more closely, one may find that for a large in situ range (0.5-5 mg m-3), there is virtually little relationship. Our own results at USF show similar things. The high correlation is simply a result of large dynamic range, and does not necessarily mean tight relationship for each individual range. So even if the time-series shows repeated seasonal cycle we are not certain how much of that is due to CDOM or bottom. In our experience we found that satellite chlorophyll-a in the range of 0.5 – 2 tends to be more influenced by the shallow bottom, while higher values more influenced by CDOM. Adding to this complexity is the straylight contamination from land. Although 1 pixel closest to land is excluded in the analysis (great approach indeed!), SeaWiFS straylight contamination can extend to 4-km within the bright target (either clouds, ice, or land). How straylight affect the satellite chlorophyll within 3 nautical miles off land is largely unknown.

In short, I strongly support the use of remote sensing data products in the EPA effort to establish nutrient criteria and highly praise the colleagues who prepared this very thorough analysis using the most updated algorithms. However, I believe that the accuracy in the satellite-derived chlorophyll-a in near-shore waters is still a research area (in contrast, satellite-derived turbidity and water clarity are more mature, see Chen et al., 2007a & 2007b), and would suggest adding some discussions on these potential artifacts and cautious interpretations, and adding some text for future improvement to polish this approach.

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Jolliff, J. K., et al., 2003. Dispersal of the Suwannee River plume over the West Florida shelf. Simulation and observation of the optical and biochemical consequences of a flushing event. *Geophys. Res. Lett.* 30(13). doi:10.1029/2003GL016964.

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