Biogeosciences Discuss., 7, C1740–C1744, 2010
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Biogeosciences Discussions

Interactive comment on "Formation of anoxia and denitrification in the bottom waters of a tropical estuary, southwest coast of India" *by* G. D. Martin et al.

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Received and published: 9 July 2010

Interactive comment on "Formation of anoxia and denitrification in the bottom waters of a tropical estuary, southwest coast of India" by G. D. Martin et al.

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We are thankful to you sir, for the critical comments and suggestions. The reply to specific comments are provided below.

General Comments

Comment 1) Water column anoxia is a well-described phenomenon in many estuaries receiving anthropogenic nutrient loads. The contribution of suboxic coastal upwelling waters to estuarine anoxia in the Cochin backwaters may offer an interesting twist on the usual story. The authors could perhaps have made a more compelling case for their story with some simpler presentation of data. I would have liked to have seen, for example, a table showing mean nutrient contents for freshwater vs. marine water fluxes into the backwaters. As it is, from Fig. 4, it is hard to see any correlation between the salinity of the water and is nutrient content, as one might expect.

Ans: We agree with this. Accordingly, we have incorporated this important point. The Scatter plots for salinity vs. nutrients during the spring and neap phases are shown in Fig. 4d.

Point 2) There is also frequent reference to the production of greenhouse gasses. However, no measurements were made. The authors might perhaps be more specific about what gasses they are referring to, and how their putative production is related to the conditions found in the estuary.

Ans: We have observed an increase in the nitrite concentration towards the oxygen depleted zone, where a corresponding decrease was noted in the nitrate concentration indicating the prevalence of denitrification. The heterotrophy and high emission of CO2 measured in this estuary (Guptha, et al., 2009) could be as a consequence of water column anoxia and denitrification. This is further evidenced by the correlation between salinity, nitrate, nitrite and AOU (Fig. 4d).

Point 3) There are many figures or panels included which do not contribute to the authors' story and are not referenced in the text. Perhaps these could be omitted to make the authors'story clearer. Since the authors frequently refer to the influence of organic matter on estuarine biogeochemical cycling, it would have been nice if some measurements of organic or particulate matter were included.

Ans: The discussion has been suitably modified to explain figures (3, 4a-d, 5c) in the

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text. Information on the organic matter has also been included.

Specific Comments

1. Please cite source or methods for data in Fig. 2 and Fig 4a. I would much prefer to see standard time units rather decimal units.

Ans: Data in Fig. 2 is cited in the P.1755.L.25. The source of data is central water commission (CWC), India (http://www.cwc.gov.in). Data used to plot the Fig. 4a was collected by mooring a SBE26plus tide gauge (accuracy 0.01% of full scale, ∼3mm) at barmouth for a period of 30 days.

2. Why does the data in Fig 2b stop in 2001?

Ans: Data in Fig. 2 was obtained from Central Water Commission. Due to technical reasons, processing of data for the period 2001 to 2009 is delayed.

3. The manuscript would be much improved by a careful revision and editing of grammar and sentence construction.

Ans: We have carefully edited grammar and sentence in the new version.

4. It may be difficult to draw any conclusions about denitrification from the authors' data, other than that it is probably occurring. In this heavily organically-loaded environment, I do not think it would be unusual for denitrification to proceed directly to N2 without a significant accumulation of nitrite, so perhaps nitrite cannot be used to gauge the Intensity of denitrification.

Ans: The significant correlations between salinity and nitrite (r2=0.69) and AOU vs. nitrite (r2=0.71) indicates denitrification to be present in high saline region. Furthermore, the AOU-PO4 relationship also indicates that denitrification favors an increase in the phosphorous levels.

Technical Corrections

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Correction 1. The definition of suboxic and hypoxic given differs from one part of the manuscript to another.

Ans: It is defined in the new version.

Correction 2. The data in Fig. 5 could perhaps be presented in a simpler manner. The horizontal resolution of sampling stations appears insufficient to permit this kind of interpolation. The shapes of the lines appear to be artifacts of the smoothing algorithm.

Ans: The graph has been redrawn in the new version.

Correction 3. I would appreciate it if the figure legends were more descriptive.

Fig. 1: Please explain the transects and sampling points.

Ans: A detailed description on the hydrographic observations carried out is included.

Fig 3, 4b, and 4c: Please use correct notation for chemical constituents and units and define abbreviations.

Ans: All the units and abbreviations are corrected in the new version.

Fig 5: Figure legend should explain negative and positive distances from bar mouth relative to Fig. 1. What is the meaning of the two crosses on the inset figure? Please describe other features of figure such as bathymetry.

Ans: They actually represent the beginning and end of observations during each tidal phase. These features are described in Figure 1 and 5.

Fig 6. Please use correct notation for units, and define abbreviations. Please indicate the meaning of S and C in the bar labels in the legend.

Ans: The corrections are incorporated. The S and C are defined in the new legends.

References

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Interactive comment on Biogeosciences Discuss., 7, 1751, 2010.