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Biogeosciences Discussions

Interactive comment on "Historical records of coastal eutrophication-induced hypoxia" *by* A. J. Gooday et al.

Anonymous Referee #3

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The manuscript entitled "Historical records of coastal eutrophication-induced hypoxia" presents a comprehensive review of the literature dealing with various approaches to reconstruct productivity, carbon fluxes to the sea-floor and hypoxia based on the sedimentary archives. Both eutrophication and hypoxia are important issues and deserve special attention, but the use of proxies and tracers to estimate variations of productivity and hypoxia is a real challenge especially when other parameters such as early diagenesis and hydrographical changes have to be considered. From this point of view, the authors have made a good and useful contribution in presenting the principles and applications of most approaches including micropaleontological, geochemical and sedimentological techniques. However, because the subject is broad and complex, it is very difficult to cover thoroughly all aspects as it is difficult to make easy to read synthesis. Specialists might find caveats or incomplete referencing in their re-

spective disciplines and the non-specialist readers might have difficulties to follow the discussions dealing with case study of productivity-hypoxia history based on different tracers at different scales of time and space. Nonetheless, the manuscript presents a rich documentation suitable for publication. Some general comments made below and a few specific points might be considered to prepare the final version of the manuscript.

General considerations:

- In the manuscript, the focus is made on recent hypoxia related to anthropogenic forcing. However, the hydrographical context (stratification, vertical mixing, and bottom water temperatures for example) plays a determinant role independently from anthropogenic effect. Therefore, it would be helpful to add a short section (in or after the introduction) to describe what are natural conditions favourable to hypoxia, to summarize which are the physical, chemical and biological parameters fostering hypoxia and what are the areas of the world that are the most sensitive or vulnerable, with regard to hypoxia due to productivity, ocean or climate changes.

- The examples of application are very interesting, but difficult to follow. A map accompanying table 1 and showing the location of the case study discussed in the text would help.

- The interpretation of proxies in terms of hypoxia often depends on the local or regional context. A given tracer can be interpreted differently from one area to another and none is unequivocal. It would be useful to make sort of hierarchy of tracers and to distinguish those which are more universal from those which are equivocal (in an additional column of table 2, for example).

- Tracers and proxies of "productivity" do not necessarily provide insight into "eutrophication" since high productivity does not necessarily lead to eutrophication (in upwelling areas for example). This should be clarified in chapter 4 and Table 2.

Specific comments:

- page 2571. There is a statement about the correlation between hypoxia and eutrophication, which is relevant. It is my understanding that severe eutrophication results generally in hypoxia, but the contrary is not necessarily true since hypoxia may develop without eutrophication. Is this correct ? A few sentences could help to clarify the question.

- Both terms "proxies" and "tracers" are used throughout the text. What is the distinction between these 2 terms ?

- A table with a list of taxa tolerant to hypoxia and taxa intolerant to low dissolved oxygen concentration would be useful in section 3.1.

- page 2580, lines 10-18. A recent decrease in the isotopic composition of biogenic carbon probably results from the decrease of 13C in atmospheric CO2 due to the combustion of fossil fuel with low 13C values (Suess effect). Therefore, the interpretations reported here might be wrong.

- page 2595. What about the preservation of opal depending upon sedimentation rates, temperature and saturation of water in SiO2 ?

- pages 2597-2598. There are interesting studies dealing with dinocysts and productivity which were recently published (cf. for ex. Radi et al., Marine Micropal. 2007, 2008) notably in a recent issue of the Marine Micropaleontology (vol. 68, n° 1-2).

- Figure 4. Is the A-P index higher when agglutinated foraminifers dominate ? I am not sure to understand.

- Figure 6. Almost impossible to read.

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