

Interactive comment on “Coastal hypoxia/anoxia as a source of CH₄ and N₂O” by S. W. A. Naqvi et al.

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Received and published: 23 May 2010

We thank the reviewer for his/her very constructive comments and suggestions; all of them have been accepted as described below. In addition, we have also updated the manuscript citing several new papers that were published while the manuscript was in review (Brüchert et al., 2009; Solomon et al., 2009; Bange et al., 2010; Codispoti, 2010; Damm et al., 2010; Walker et al., 2010). There are few other additional references to the earlier work that have been included to support new text added in response to various comments by the referees.

RC = Referee’s Comment; AR = Authors’ Response

RC - I see some overlap between Section 4.5 and Section 5 which both discuss the

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Black and Baltic seas. Perhaps these sections could be combined. If the purpose of Section 5 is to highlight the conditions in enclosed basins, then that could be more specifically indicated in the section title.

AR - We had considered this overlap. However, it was precisely for the reason mentioned by the referee (i.e. to focus on processes in enclosed anoxic basins in a separate section) that we decided to split the information from the Baltic into two parts. However, following the referee's advice we have changed the title of Section 5 to "Methane and nitrous oxide in enclosed anoxic basins".

RC - Page 9458 line 10: I'm not sure about the term "back radiation". Here the authors use it to refer to radiation from the earth's surface which is subsequently absorbed by the atmosphere, but I see it used more often to describe thermal radiation from the atmosphere toward the earth. If the term is ambiguous, perhaps a more precise phrase could be used.

AR - We agree. We have rephrased the sentence removing the term "back radiation",

RC - Page 9461 line 11: What is meant by "in the shadow of the subtropical gyres"
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AR - The "shadow zones" are areas where subsurface waters are slowly ventilated as they fall within the "shadow" of subtropical gyres. In view of this comment, we have modified the text and added the relevant reference (Luyten et al., 1983).

RC - line 19: The abbreviation "EBUSs" is apparently used several times later in the paper as "EBUEs" - it should be consistent throughout

AR - We agree. We now use only "EBUE".

RC - Page 9465 line 17: The authors state that there are no published data from the NW African (Mauritanian) region, but Walter et al. (2004) Geophys. Res. Lett. 31:L23S07 provide data from only slightly farther south in what they describe as an upwelling regime.

AR - That region is to the south of Mauritanian upwelling. Nevertheless, we have now included a brief description of Walter et al's results.

RC - Page 9466 lines 7-8: Fisheries in the Benguela Current system were formerly rich but have been greatly over-fished, so to say that the conditions are "apparently not suitable" is not really true.

AR - This statement is based on previous publications (e.g. Lavik et al., 2009), but we have now changed it in view of the referee's comment.

RC - Page 9471 line 13: "While in THE case: : :"

AR - Accepted.

RC - Page 9674 : The description of Figures 5 and 6 is not clear. In the main paragraph on this page, the authors seem to discuss both sets of figures at the same time and it is not always stated which panel is being referred to. They mention Figures 6a and 6b, but the Figure 6 has no labels to identify the individual panels. I infer from the caption that the left column is "a" and the right column is "b", but it should be clearly stated. Also, is it appropriate to compare summer and winter monsoon periods from widely spaced years (1987 and 1998!)? How much interannual variability is there and can the summer conditions influence the following winter (or vice versa)?

AC - In response to the other review, we have now dropped the figure (Fig. 6 in the BGD manuscript). The text has been accordingly modified taking care of the above comments.

RC - Lines 12 – 21: In the discussion of Fig. 5, it is stated that N₂O begins accumulating with the onset of upwelling in May, but when I look at the figure, N₂O appears not to increase until July.

AC - There is considerable year-to-year variability. In some years upwelling does begin in May. Appropriate change has been made in the text in response to the above comment.

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RC - Section 4.3 (pages 9476-9479): this is the only major section of the paper which is not illustrated. Several references are discussed and it would be useful to include a figure or two as examples.

AC - We have added two new figures, one (Fig. 5) from the open-ocean and the other (Fig. 6) from the Gulf of California showing CH₄ and N₂O profiles as well as N isotopic composition of N₂O.

RC - Page 9486 line 27: (spelling) : RELATIVELY low O₂ : :

AR - Corrected.

RC - Page 9490 line 7: There is a brief mention of N₂O in the Mississippi estuary in Fox et al. (1987) Estuaries 10:1-12

AR - We have now included information from the Gulf of Mexico recently provided by Walker et al. (2010) as well as a reference to the paper mentioned by the referee.

RC - Page 9495 line 1: Check spelling for Farrington (Farrington?) here and in reference list

AR - Corrected.

Figures:

RC - Fig. 5: The contour scale in panel h (hydrogen sulphide) is extremely difficult to read.

AR - Changed.

RC - Fig. 6: As mentioned above, the parts “a and b” mentioned in the text are not identified on the figure. Also, the caption mentions that H₂S was not measured on cruise SK137, but it does not appear to be shown for the other cruise either.

AR - This comment is not applicable any more since the figure has now been removed.

RC - Fig. 8: The contour labels are too small, unless I magnify the view to 200x. In a

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laser print they are almost impossible to read.

AR - This figure has been redrafted and the size of contour labels increased.

RC - Fig. 10: It would be helpful to include a distance scale on the x-axis if possible, rather than just station numbers.

AR - The distance scale has been included.

Additional References

Bange, H. W., Bergmann, K., Hansen, H. P., Kock, A., Koppe, R., Malien, F., and Ostrau, C.: Dissolved methane during hypoxic events at the Boknis Eck time series station (Eckernförde Bay, SW Baltic Sea), *Biogeosciences*, 7, 1279–1284, 2010.

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Codispoti, L. A.: Interesting times for marine N₂O, *Science*, 327, 1339-1340, 2010.

Damm, E., Helmke, E., Thoms, S., Schauer, U., Nöthig, E., Bakker, K., and Kiene, R. P.: Methane production in aerobic oligotrophic surface water in the central Arctic Ocean, *Biogeosciences*, 7, 1099-1108, 2010.

Solomon, E. A., Kastner, M., MacDonald, I. R., and Leifer, I.: Considerable methane fluxes to the atmosphere from hydrocarbon seeps in the Gulf of Mexico, *Nature Geosci.*, 2, 561-565, 2009.

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BGD

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