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Biogeosciences Discussions

Interactive comment on "Coastal versus open-ocean denitrification in the Arabian Sea" *by* S. W. A. Naqvi et al.

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Review of ms BGD, 3, 665-695, 2006, "Coastal versus open-ocean denitrification in the Arabian Sea" by SWA Naqvi et al. .

General comments

The Arabian Sea is one of three major oceanic sites where denitrification in the water column takes place. Therefore the Arabian Sea is of considerable global significance for our understanding of the past, present and future nitrogen cycle in the ocean. The article under review gives a comprehensive overview of our current knowledge about open-ocean and coastal denitrification processes in the Arabian Sea. Literature data are presented together with previously unpublished data to illustrate the conclusions.

The ms is written in a clear and concise way. The conclusions are justified by the presented data. I have only a few minor comments and additonal suggestions/ideas (see below) and, therefore, I can recommend publication of the article in “Biogeosciences” with minor revisons.

Detailed comments

1) p. 666, l. 20-21, Introduction: This sentence is misleading. Nitrogen fluxes are not necessarily controlled by O2 alone (e.g. N2 fixation fluxes are controlled mainly by Fe, P,).

2) p. 669, l. 1-11: Based on results from moored sediment traps, Rixen et al. 2000 (Sedimentation in the western Arabian Sea: The role of coastal and open-ocean upwelling. Deep-Sea Res. II, 47: 2155-2178) were able to show that fluxes of organic material to the deep western Arabian Sea are higher than the fluxes of organic material to deep central and eastern Arabian Sea. Thus, the intermediate waters in the western Arabian Sea receive more organic material than the central and eastern Arabian Sea. Moreover, the shapes of N2O profiles from the western Arabian Sea are very similar to the profiles observed in the central and eastern Arabian Sea (Bange et al. 2001) . If we assume that the N2O consumption in intermediate layers is caused by denitrification, we can conclude that there are at least two different types of denitrification pathways operating in the Arabian Sea (see e.g. Bange et al. 2001, who suggested denitrification via IO3-/I- to explain the observed N2O profiles; see also Farrenkopf et al. 1997 (Sub-surface iodide maxima: Evidence for biologically catalyzed redox cycling in Arabian Sea OMZ during the SW intermonsoon. Deep-Sea Res. II, 44(6-7): 1391-1409.) This implies that the use of the secondary nitrite maximum as the sole indicator of denitrification might be misleading and might be the reason for the ‘apparent’ paradox that the denitrifying zone in the Arabian Sea is not directly connected to the centers of upwelling.

3) p.669, l. 12-15: The aerosol measurements by Siefert et al. 1999 (Chemical char-

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acterization of ambient aerosol collected during the southwest monsoon and intermonsoon seasons over the Arabian Sea: Labile-Fe(II) and other trace metals. J. Geophys. Res., 104(D3): 3511-3526.) support the view that the primary production during the SW monsoon is indeed Fe limited. Air masses during the SW monsoon are coming from the pristine southern hemisphere and do not carry much Fe to the Arabian Sea waters (Siefert et al. 1999).

4) p. 673, l. 2: Please provide a reference for the given range of denitrification estimates.

5) p. 673, anammox vs denitrification: The presence of anammox does not necessarily means that N2 production (from 15NO3- incubation experiments) is underestimated because both processes depend on the same substrate: nitrate. During anammox NH4+ reacts with NO2- to form N2. However, NO2- is delivered by denitrifiers via reduction of NO3- to NO2- (see Kuypers et al. 2005).

BUT: One might speculate that NO2- is delivered by nitrifier-denitriers under suboxic conditions. Then, indeed, we have two substrate-independend processes leading to N2: 1. classic denitrification and 2. nitrifier-denitrification coupled to anammox (for the 2. case incubation with 15NO3- would underestimate N2 formation rates).

6) p. 674, anthropogenic influences. The CATS data shown in Figure 4 are means for the period 1997-2004, which do not allow deciphering any interannual trends. Is it possible to separate the CATS data into annual data sets in order to see interannual variabilities/trends? (which might indeed be caused by anthropogenic activities)

7) p. 674, l. 25: Bange et al. 2001 calculated atmos. N depositions for the central and western Arabian Sea but not for the eastern (coastal) Arabian Sea. Thus the argument may not be valid.

8) section 5: N2O cycling. In Figure 4 an interesting novel N2O data set from CATS is shown, but is not discussed in the context of section 5. I would like to suggest to omit

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the N2O data in Figure 4 or to discuss the data in more detail.

9) Please provide subtitles “open ocean” and “shelf” in each section. This will help to clarify the structure of the ms.

10) Fig. 1a. Please indicate the location of CATS station.

Interactive comment on Biogeosciences Discuss., 3, 665, 2006.