Biogeosciences Discussions, 1, S214–S217, 2004
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Biogeosciences Discussions

Interactive comment on "Link or sink: a modelling interpretation of the open Baltic biogeochemistry" *by* M. Vichi et al.

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Received and published: 20 September 2004

Answers to Referee #1

We are grateful to Referee #1 for pointing out the importance of the gas exchange transfer at the sea surface as a closure for the oxygen cycle in the waters. We acknowledge that the model specifications for this process were omitted from the manuscript; this will be amended in the final revision.

Particularly, the following part will be added in Sec. 2.1 after the description of the meteorological forcing functions:

Oxygen transfer rates at the sea surface have been computed by means of the parameterizations proposed by Liss and Merlivat (1986) and Wanninkhof (1992).

We also tested the sensitivity of the model results to the parameterisations proposed by Kuss et al. (2004). The results will be added to the final discussion as a remark for future experiments and considerations. As expected, nutrients and plankton distri-

bution in the surface layers are not affected by oxygen fluxes at the air-sea interface, but even the near-bottom dynamics are only slightly modified. The importance of the flux parameterisation on surface O_2 dynamics is shown in the following figure (http://www.bo.ingv.it/~vichi/BGD/osat_comparison2_c.png), where we compared the results from the standard run and the parameterisations tested by Kuss et al. (2004). The results highlight the importance of the wind dependency as also pointed out by Kuss et al. (2004). Both parameterisations give lower oversaturation during summer and lower undersaturation in winter. A quadratic dependency yields much faster transfer rates at the sea-water interface during summer, leading to a faster adjustment of oxygen towards the saturation concentration and thus too low oversaturation in the water. Nevertheless, Kuss et al. (2004) argument for a steeper dependence (cubic) on windspeed (c.f. p. 181) appears sensible, as the authors also admit that the use of their quadratic parameterisation yields exaggerated CO2 fluxes into the sea during the low-wind summer period that cannot be balanced by primary production. Both parameterisations, however, improve the results during the winter period in all the layers, and this is an interesting result that will be mentioned in the discussion. A cubic dependency appears superior, but enhances the discrepancy with the observations in summer, which are probably due to underestimated primary productivity by the model, as already pointed out in the manuscript. This might also suggest that the dependence on windspeed should be still more "cubic", i.e., fluxes should be still lower at low windspeeds.

The main reasons for not mentioning the works by Schneider et al. (2002; 2003) in the discussion are the different location and time-window of the dataset they used. As also indicated in the text, our intention is also to present the results from a simulation of the Eastern Gotland basin (cf. Vichi, 2002). Since the two basins have distinct features, particularly due to the different hydrodynamical conditions, we preferred to compare model results with data (and considerations) from the same area. Nevertheless, the

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general implications on carbon export and N-fixation, drawn out by Schneider et al. (2002; 2003) apply to the whole open Baltic, and will be mentioned in the final revision.

Concerning the balance of nitrogen cycles in the surface and intermediate Baltic waters, we do believe that N-fixers do play an important role, because many independent indications have been provided by a number of authors. However, the quantification of this contribution is still an open question and it is important that different methodologies be applied to quantify it properly. The use of C, N, P or O balances from measurements (Osterroht and Thomas, 2000;Rahm et al., 2000; Larsson et al., 2001 give us only a portion of the nutrient cycles and we are still far from having a mechanistic understanding of the underlying processes. The ERSEM model is an attempt to bring together and parameterise the cycling of the most relevant elements through the foodweb, with the final aim to compare with the observations of state and rate variables. This dynamic approach is complementary to the static approach of using concentration-based balances. In this sense, we are more interested in analysing model failures, because they emphasize the need for process refinements which could finally lead to better understanding of system functions. At present, our results only hint at the lack of some processes, as in the case of the summer plankton dynamics in the upper layers.

Minor comments

1. All the references “in press” will be checked prior to the submission of the final revision.

2. Due to the large number of figures, the major concern about colour printing is cost. A possible solution would be to add the colour plates as additional material, together with the other additional tables.

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Interactive comment on Biogeosciences Discussions, 1, 219, 2004.