

Interactive comment on “The relative importance of selected factors controlling the oxygen dynamics in the water column of the Baltic Sea” by S. Miladinova and A. Stips

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Comments by Hans Burchard on “The relative importance of selected factors controlling the oxygen dynamics in the water column of the Baltic Sea” by Miladinova and Stips.

This is an interesting model study, which tries to quantify impacts of various factors on oxygen dynamics in the Baltic Sea.

Without doubt, the oxygen levels below the halocline are mainly determined by an imbalance of more or less steady loss due to mineralisation of organic matter and strongly episodic lateral advection of salty and oxygen-rich waters of North Sea origin.

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These events occur on all depth levels, the stronger the inflow, the deeper the impact. The weakness of the present study is that the dominant impact of the inflow events cannot at all be considered due to the 1D character of the modelling approach. The statement given on lines 16-18 on page 2123 that only major inflow can reach deep enough in the Baltic Sea is not fully correct, because weaker inflows may somewhere detach from the bottom and ventilate intermediate layers, thus strongly modifying the redoxcline.

Instead of lateral advection, vertical mixing is here found to be the major trigger for oxygen dynamics. This may be a problematic statement, since deviations between observations and model results have been assessed over the entire water column, whereas the dynamics near the surface and near the bottom are substantially different. Near the surface the mismatch between oxygen observations and model results are minimised for a vertical exchange intensity which was in effect for temperature and salinity (which have been nudged). This is because there T, S and O₂ are all strongly linked to vertical exchange. Near the bed, T and S and O₂ are mainly determined by lateral advection, and there an optimisation of vertical mixing as means for fixing O₂ concentrations may lead to completely wrong tuning.

What should be really added is a discussion about vertical mixing mechanisms in the Baltic Sea, which are by far not dominated by vertical mixing processes in water columns situated in the center of subbasins. The role of diapycnal boundary mixing connected to isopycnal internal mixing needs to be discussed. In 1D models, vertical mixing needs to be about one order of magnitude higher than locally measured (Reissmann et al., 2009).

On top of page 2137 it is concluded that near surface O₂ concentrations do only depend on vertical fluxes in the surface mixed layer, which cannot be true since primary production clearly increases O₂ concentrations.

Concerning the oxygen dynamics in the Baltic Proper, it may be useful to mention a

recent paper by Kuznetsov et al. (2008).

In general, the good agreement between observed and simulated temperature, salinity and density data should be tuned down, because it is a direct consequence of the nudging.

On page 2133, I would suggest to discuss how k_{min} is impacting on the oxygen concentrations.

The Taylor diagrams and the sections 6.2 – 6.4 are a bit hard to read. Maybe, the graphics could be optimised, e.g. the data points fig. 11 would profit from being distributed to two subplots.

I hope that these comments are useful to the authors.

Regards, Hans Burchard.

References:

Kuznetsov, I., T. Neumann, and H. Burchard, Model study on the ecosystem impact of a variable C:N:P ratio for cyanobacteria in the Baltic Proper, *Ecological Modelling*, 219, 107-114, 2008.

Reissmann, J., H. Burchard, R. Feistel, E. Hagen, H.U. Lass, V. Mohrholz, G. Nausch, L. Umlauf, and G. Wieczorek, State-of-the-art review on vertical mixing in the Baltic Sea and consequences for eutrophication, *Progr. Oceanogr.*, 82, 47-80, 2009.

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