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Ocean Science Discussions

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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"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. 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

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the bottom and ventilate intermediate layers, thus strongly modifying the redoxcline." We are completely aware of the fact that 1D modelling studies have some severe limitations whenever the horizontal processes are important. This becomes obvious from the simulations for the year 2003 when a stronger inflow took place and consequently the results became worse. Neglecting the year 2003 would have improved the simulation results. Nevertheless as already shown in many other of the cited 1D modelling studies many important aspects of the system and especially of the oxygen dynamics can be studied in detail.

"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." Yes, we found air-sea exchange and vertical mixing to be the major trigger for oxygen dynamics. Indeed, we have checked the influence of different approaches for determining the tuning parameter vertical mixing, but it turns out, that the effect from tuning to the bottom oxygen is very small. This is due to the fact that the dynamical range of bottom oxygen is much smaller than that at the surface. Furthermore the optimization was practically done during a quasi stagnation period from 1998 until 2002. The fear of the "completely wrong tuning" is therefore unjustified.

"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

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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 the point of adding a broader discussion about vertical mixing processes we must disagree, because this is clearly behind the scope of the paper and an extensive review is just published (Reissmann et al., 2009). Considering the scarcity of turbulence measurements in the Baltic Sea we find the statement about the need of a one order of magnitude higher mixing in the models than in the measurements surprising.

"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." Yes, primary production is contributing to the O2 balance in the surface mixed layer. To clarify that point we add in the manuscript a table showing the separate contributions from the physical air-sea oxygen flux and from primary production. For practical purposes, by far the largest part of the annual surface oxygen dynamics can be well described by even neglecting the contribution from primary production.

We are incorporating as much as possible the further minor remarks, like referring the paper by Kuznetsov et al. (2008) and improving figures and text.

Many thanks for the useful comments, which will improve the manuscript.

Please also note the Supplement to this comment.

Interactive comment on Ocean Sci. Discuss., 6, 2115, 2009.