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Ocean Science Discussions

Interactive comment on "N/P ratio of nutrient uptake in the Baltic Sea" *by* Z. Wan et al.

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Answer to general comments:

We cannot agree on these general comments. It is true we came across the issue regarding N/P ratio of nutrient uptake in the Baltic Sea while we were calibrating the ecosystem model ERGOM for operational purpose. This issue was investigated in several ways: 1. to analyze the rate of DIN changed before and after spring bloom to DIP changed at the same time; 2. to analyze impacts of atmospheric deposition and river loadings; 3. model case study; 4. to review literatures. The model results are presented only as a more accurate estimate to N/P ratio of nutrient uptake than one based on a steady state. In addition, a linear correlation of DIN to DIP based on observations was presented for different water layers in OSD-8-C411-2011. Even if the model results were held up, other analyzed results would reflect that a Redfield ratio

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of nutrient uptake does not stay in the Baltic Sea. In fact, the impact of different N/P ratio is impossible to be counteracted by changing other parameters listed in Table 1. They have different impacts in principle. For example, parameter 'Minimum irradiance' impacts on intensity of photosynthesis, but not on the rate of DIN changed before and after spring bloom to DIP changed at the same time.

Answer to specific comments:

C1: The statement "... because the Baltic Sea is relatively closed and the imported nutrients are less than the nutrient uptake." should be proved by giving estimates for nutrient uptake and nutrient transport.

A1: It states a common knowledge in the Baltic Sea. The imported nutrients are referred to a sum of nutrients from atmospheric deposition, river loadings and water exchange through Danish Straits. There are good estimates on each of them. Total nutrient taken up by phytoplankton from winter high level to summer lower level is also easy to be estimated. Probably, it will be less confusing to make it clear by referring to during spring bloom.

C2:In P.4, L 9-10, Table 2, how much reliable are the small values of nutrient concentrations (especially DIP) determined? Their imprecise definition can greatly change the final result.

A2: We cannot see a good reason to doubt on the accuracy of such a simple computation whose results were listed in Table 2. It is easy to reproduce the results of Table 2 on base of the scheme stated in Section 2.4 (P.7, L 6-13). The results are stable. Nevertheless the estimate is made on base of seven years of observations actually, the results of N/P ratio of nutrient uptake will not differ much if only two or three years of observations are applied.

C3: Why were the parameters changed so much in comparison to Neumann et al. (2002)?

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A3: We changed 6 parameters (total parameter number is 47). The concern to change parameter is that parameters are never certain but more or less subject to the initial fields and forcing condition, which we used are different from that in Neumann et al. (2002). The first three change parameters can modulate phytoplankton bloom timings. These changes made bloom timings of model closer to observations. Please compare Fig. 2a,d,g of this paper with Fig. 9 of Neumann et al. (2002). These parameter changes are impossible to change rate of DIN to DIP. Last two parameters can impact the fate of remineralized benthic detritus. These two parameters can impact total nutrient budgets and they are changed in purpose of total nutrient budgets balance. Change to the parameter 'nitrification rate of remineralized benthic detritus' is in principle not beneficial in 'tuning down' N/P ratio of nutrient uptake to calibrate model. A decrease of the parameter 'phosphorus lose of remineralized benthic detritus' may have a little help in 'tuning down' N/P ratio. In fact, the conclusion of this paper is supported in different ways, as stated in replying to general comments.

C4: The model run from 2001 to 2007 is too short to get equilibrium solution in the system water column - benthic layer. What is the impact to final results.

A4: Yes, the model simulation duration is not long enough to rebuild an equilibrium of whole water column, especially for benthic layer. The model is used in this paper as a tool to provide an estimate of N/P ratio of nutrient uptake more accurately than an estimate based on a steady state. The purpose of using model is to explain that the rate of observed DIN changed before and after spring bloom to DIP changed at the same time is caused by phytoplankton uptake with a non-Redfield ratio. It is unnecessary to wait for the model reaching an equilibrium of whole water column.

C5: A description of the benthic layer model should be given.

A5: The biogeochemical process of benthic layer is exactly same as in Neumann et al. (2002). A simplification is applied only for cutting re-suspension of benthic detritus. In other words, only the moment of benthic detritus is cutted, but not its biogeochemical

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activities.

C6: P.9, L. 4-5., “The model results of Case NP10 are the best approaching to observations in all tested cases.” This should be confirmed through statistical comparison between modeled results and observed data.

A6: You can see a revision accepting this suggestion soon after.

C7: Technical corrections.

A7: You can see a revision with these correction soon after.

Interactive comment on Ocean Sci. Discuss., 8, 1233, 2011.