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Comments on the preprint "Large-scale effects of benthic fauna on carbon, nitrogen, and phosphorus dynamics in the Baltic Sea

by Ehrnsten, Savchuk and Gustafsson.

This is a good paper trying to merge a benthic model with the older pelagic model by Savchuk and Wulff. The result is interesting, furthering modeling work is encouraged.

Remarks

Line 3, 22 and other places: Bioturbation in strictu means the mixing and turning over of the sediment. In the Baltic Proper that is dominantly carried out by the two amphipod species, who lies borrowed in the sediment during daytime, but swims about searching for food on the sediment surface during nighttime (they normally bioturbate the uppermost cm, down to ca 5 cm). To some part also Saduria takes place in the bioturbation but only on the surface layer. Species like Macoma, Halicyptus and Marenzelleria who are more or less permanently burrowed in the sediment (often deeper than 5 cm). They are more of bioirrigators. It should be mentioned early in the paper that the authors in their term bioturbation includes bioirrigation.

Line 65: Here is stated that the penetration depth of oxygen in Baltic Sea sediment is usually measured in mm rather than cm. This is only true for deeper bottoms from ca 60m or deeper. It could of course be found at shallower depth in archipelago areas, but those areas has been excluded in this work. I have measured redoxpotential at zoobenthos stations for more than 30 years and only on deep stations found oxygenation only in the top mm. The model here includes a depth interval of 0-120 m, so in the uppermost 60 m oxygenation is definitely better than what is said here.

Line 108: Limecola balthica has changed back to Macoma balthica (Caroline Raymond, pers. comm.)

Line 110: Pontoporeia is misspelled

Line 124: Misspellings: basalmaintenance and biomas s

Line 183: Why hindcast simulations for benthic variables.? There was a lot of data collected in the 1970s. For example in the Joint sampling programme (Elmgren 1978) and by revisiting the Hessel-stations (Cederwall & Elmgren 1980). There should also be a lot of Finnish data collected in the 1970s by Lassig and Andersin from the Finnish Institute of Marine Research. As far as I know these data were transferred to SYKE when the FIMR was closed down. Data from the Joint Sampling Programme and the Hessel project is stored in the benthic database BEDA. Contact Caroline Raymond or Mats Blomqvist.

Line 213: I strongly suggest you leave at least the Arkona Basin out, because the fauna here contains several other species than the ones you have mentioned in this preprint. Stick to the Gotland Basins, Gulf of Finland and Gulf of Riga who has a similar set of species.

Line 221, and Table 1: The benthic database BEDA contains primary data for 7 stations sampled in 1976 for the Joint Sampling Programme. In the mid 1990s a mapping of the macrofauna of the Gulf was done within the NMR financed Gulf of Riga Project. The results are published (Cederwall et al. 1999). Possibly the primary data are still held by Vadims Jermakovs, Latvian Institute of Aquatic Ecology (An institute where your colleague Bärbel Muller-Karulis earlier worked).

Line 277-279: Is the big difference in sedimentation between the BSAP scenario and the HIGH load scenario reflecting a difference in phytoplankton species composition? Historically the main input to benthic ecosystem has been the sedimentation of diatoms during the spring bloom, not the sedimentation during blue-green blooms. There has however been a shift in species composition in the spring bloom, where diatoms have decreased and other groups (who have lower sinking rate) have increased (Hjerne et al. 2019).

Line 397: cf Mäkelin & Villnäs 2022. Could the seasonal variations in benthic stoichiometry have any influence on your modelling work?

Fig 3: You show bars for the depth interval 0-30 m. I strongly suspect you have very few if any stations in the depth interval 0-10 m. This because you have outruled data from archipelagos and open sea research vessels don't like to go into shallow waters. Also these areas are dominated by transport bottoms hard to sample quantitatively. Finally in these shallow bottoms you have another set of species than the set you have worked with. You should change to the depth interval 10-30 m. In the text you mention that you had no shallower (<30 m) data from the Arkona Basin. The benthos database BEDA contains some data from the 1980s (Mats Blomqvist, pers. comm.) There is also a lot of data held by German institutes. But on the other hand I advise you to leave the Arkona Basin out of your paper since the fauna there differs so much from the Baltic Proper.

Table 1: Could be completed with Cederwall et al. 1999.

Table A4, footnote: Mäkelin & Villnäs is published in *Limnol. Oceanogr.* 2022. The reference is missing in the reference list.

Line 901: You should know that sharkweb/SMHI does not have a benthological quality control of the data delivered to them. They assume that laboratories deliver correct data. This is not always the case (Mats Blomqvist pers. comm.). I suggest you import data from BEDA.

Final comment: The macrofauna is not the only part of the benthic ecosystem. The meiofauna for instance can have biomasses of 5-10 g wetweight/m² (Elmgren 1976). To what extent does the meiofauna influence the sediment chemistry?

Summing up: This is basically a good paper well worth publishing after revision.

References

Cederwall & Elmgren 1980. Biomass increase of benthic macrofauna demonstrates eutrophication of the Baltic Sea. *Ophelia*, Suppl. I, 287-304.

Cederwall, Jermakovs & Lagzdins 1999. Long-term changes in the soft-bottom macrofauna of the Gulf of Riga. ICES J. Mar. Sci. 55, Suppl. A, 41-48.

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Mäkelin & Villnäs 2022. Food sources drive temporal variation in elemental stoichiometry of benthic consumers. Limnol. Oceanogr. 9999, 1-16.

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