**Review of**
**"Fate of legacy ammonium in the coastal Baltic Sea"**
**by Dana Hellemann et al.**
**Egusphere-2026-959**

This is an interesting manuscript on legacy organic matter and ammonium in Baltic Sea sediments, and on benthic ammonium fluxes. The authors high-light and quantify (via modelling) the very long time the Baltic Sea needs to recover from decades of enhanced eutrophication and oxygen deficiency – even if external nutrient loads are drastically reduced. This quantification is welcome and highly needed.

Considering the very long time the Baltic Sea needs to recover (as mentioned above), it would be an improvement of the manuscript if the authors could include a section giving their view on the suitability of sea-based methods (often also called ecological engineering) to improve the environmental status of the Baltic Sea or at least the coastal part of the Baltic Sea. Would, according to the authors, for example oxygenation (in one way or the other) faster lead to improvements than only reduction of external nutrient loads? Are there any other sea-based methods that the others favour or recommend? Considering that the authors' model results suggest so very strong persistence of the legacy OM and ammonium, one would expect that the authors add this section and respond to the questions I have raised. I am sure that most future readers of this manuscript have the same questions.

I am not much involved in modelling any longer, so it essential that at least one of the other reviewers is a modeller and thoroughly scrutinizes the modelling part of the manuscript. I have not done that.

General: The model includes different levels of organic loading, but I did not notice whether you discussed variable C/N ratios of the deposited organic matter. Would doing that improve the model predictions?

Comments by line number

Line (L) 20: ... *accumulated via OM burial and mineralization*...
Please instead write "...accumulated via OM **deposition** and mineralization..."
The term burial is often used to reflect the ultimate removal of a substance from further (re)cycling.

L 40 and elsewhere: ...*phosphate ($PO_4^{3-}$)*....
$PO_4^{3-}$ is not the main species of dissolved inorganic P in seawater. Please instead use Dissolved Inorganic Phosphorous (DIP) – here and everywhere in the manuscript.

L 45-46: ...*$PO_4^{3-}$ due to its crucial role in the repeated occurrences of massive cyanobacteria blooms and metal recycling*...
Do you mean the role of metal recycling in the dynamics (retention and release) of $PO_4^{3-}$ (or DIP)? If so, this is not what you wrote.

Figure 1: There are more published papers on NH4 effluxes under varying bottom water oxygen conditions in the Baltic Sea than those cited in Figure 1. Since this manuscript focuses on the Baltic Sea, I suggest that the authors are more comprehensive in this regard and cite more of these papers.

L 77-78: *This is not only a larger pool of bioavailable N than the pelagic pool of dissolved inorganic nitrogen (DIN) in the coastal Baltic Sea…*
Please explain how you define the **coastal** Baltic Sea, preferably the first time you mention the coastal Baltic Sea.

L 111: … *and thus available…*
Should be: …and **is** thus available…

L 124-125: *Only a small part of water column NO3- is assumed to diffuse back into the sediments, as coastal water turbulence is stronger than diffusion.*
I do not think that this is correct. The nitrate formed during nitrification in the oxygenated bottom water may very well be taken up by the reduced sediment surface and consumed by either denitrification or DNRA – regardless of turbulence. Please rewrite or at least explain yourself in greater detail.

L 125-127: *In the absence of hydrogen sulfide (H2S), this NO3- can be reduced to N2, while in the presence of H2S dissimilatory nitrate reduction to ammonium (DNRA) dominates, further enriching the NH4+ pool.*
Please be more specific and correct: Denitrification **can** proceed with H2S as electron donor. Also, please provide references stating that DNRA dominates (over denitrification) in the presence of H2S.

L 281-287: In sediments with high organic loading, can an abundance of sulphide explain low rates of nitrification, and hence high ammonium effluxes, even under normoxic bottom water conditions?

L 335-336: "*For instance, a higher salinity is often found in open coastal systems*;…"
Is it? If so, why? And higher than where? I do not understand what you mean. A clarification is absolutely necessary.