Review of
Seasonal variations and controlling factors of nitrogen fluxes at the sediment-water interface in a semi-enclosed inland sea
by
Wu et al.
egusphere-2025-6187

A one-dimensional vertical sediment model to simulate nitrogen cycling was developed. Using this model, attempts to determine the direction and magnitude of nitrogen fluxes at the sediment-water interface were made.

My impression of this manuscript includes:

1) Important parameters (such as vertical particle flux, including PON flux) is not involved and explained clearly enough, including the relation between vertical PON flux and the concentration of PON in the bottom water;
2) The argumentation is often unclear or obscure. It is hard to follow the logics of the thinking of the authors;
3) Important factors influencing benthic DIN fluxes, and N cycling in sediments, appear not to be considered;
4) Statements without back-up, or without clarified assumptions, are made;
5) The findings claimed by the authors do not appear novel to me.

This is explained below.
Also, specific remarks by line number are given below.

Line (L) 51-52: *"Furthermore, nitrous oxide, a byproduct of denitrification…"*
N2O is also a product of nitrification.

L 56-59*: "Direct observation of particulate organic nitrogen (PON) flux at this interface poses challenges due to the influence of resuspension processes. Consequently, numerous studies focused on DIN flux and its seasonal variations primarily through in situ observations, incubation experiments, or estimations based on Fick's law…"*
What has problems of estimating PON deposition, due to resuspension, to do with the DIN flux and its seasonal variations? Logics, and/or explanations, are lacking here.

L 61-62: *"…that DIN flux exhibits seasonal variations, with higher levels in summer and lower levels in winter, likely influenced by water temperature…"*
What about influence of seasonally varying deposition of reactive organic matter?

L 68-69: *"Moreover, the direction of DIN flux varies across different regions, with the underlying mechanisms remaining unclear…"*
Are underlying mechanisms really remaining unclear? In what way are they unclear. Please clarify.

L 146. *"…ODU (the oxygen demand units)…"*
What does the oxygen demand units mean? Do you mean sediment oxygen uptake?

L 158: *"…vertical diffusion caused by bioturbation…"*
Also by molecular diffusion as stated below.

L 163: Please explain what ODU oxidation and ODU burial mean.

L 166-168: *"The exchange fluxes of NH4+ , NO2− , NO3− , DO and ODU at the interface are determined by the product of the diffusion coefficient and their concentration gradient between the fluff layer and the overlying water."*
No influence of bioturbation, which is mentioned above?

L 173: *"…while the exchange fluxes of NO3− and DO there are set to zero."*
Why are they set to zero? Clarification is needed.

L 231: *"…to be 50 times faster than that in the sediment below it…"*
How did you arrive at the factor of 50? Please explain.

L 348-349: *"N-loss is produced through denitrification and anammox inside the sediment, which releases N2 and N2O to the atmosphere."*
Do you have observations confirming that the N2 and N2O really are released to the atmosphere? No transformation of N2O in the water column? No fixing of N2 in the water column by e.g. cyanobacteria?

L 402-403: *"Sinking of PONbw serves as the source of PON in the sediment, controlled by the concentration of PONbw and bottom stress."*
The vertical particle flux of PON through the water column must be an important factor determining the PON concentration in the surface sediment. Furthermore, sinking of PONbw is not only controlled by the concentration of PONbw and bottom stress, but also of the sinking rate of the PON particles. The reasoning by the authors is obscure to me. Please clarify.

L 405-406: *"…the extent of seasonal variation in PON inventory is relatively minor…"*
What is the magnitude of the variation of the vertical particle flux of PON through the water column? Would that not have an influence on the seasonal variation in PON inventory? Again, I have problems following your argumentation.

L 416-417: *"…only the bottom water temperature …as it affects the mineralization rate that produces NH4+ in the sediment…"*
I would be very surprised if not also the quality and the quantity of organic matter in the sediment (and their seasonal variation) would have a strong influence on the seasonal variations of NH4+ inventory. Please explain why this is not so in this study.

L 455-456: *"The DO flux is primarily controlled by bottom water temperature (Figure 8e). Temperature regulates molecular diffusion and thus governs the exchange of DO across the sediment–water interface."*
Is the DO flux really not at all influenced by the oxygen demand in the sediment, i.e. by the reactivity of organic matter undergoing oxidation in the sediment?

L 469-470: Please explain what you mean with *reflective boundary conditions*.

L 490-492: *"NH4+ is released from the sediment to the bottom water in our study area. Such upward flux has been commonly observed in other coastal regions, including Northern Adriatic Sea (De Vittor et al., 2012), Vilaine Bay (Ratmaya et al., 2022) and Eastern Taiwan (Zhou et al., 2017)."*
A benthic efflux of NH4+ has been observed numerous times in a wide variety of coastal and continental margin environments world-wide. This is a very common observation.

L 520-522: *"…we found that the flux of PON settling from the bottom water to the sediment is the main source of nitrogen in the sediment…"*
Is this not a quite trivial finding? What else would it be? DIN uptake by the sediment? Benthic (dark) N2 fixation? By the way, was benthic N2 fixation measured or modelled?

L 534-536: *"Denitrification is the main process of the nitrogen removal and contributes to the seasonal variation of N-loss. However, the overall nitrogen removal amount is relatively low, possibly due to the low NO3− concentration in the bottom water caused by the oligotrophic environment of Harima Nada."*
What about the importance of coupled nitrification-denitrification in these sediments? Did you consider this process?