Biogeosciences Discussions

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Comment on bg-2022-123

Anonymous Referee #1

Referee comment on "Nitrogen isotopes reveal a particulate-matter-driven biogeochemical reactor in a temperate estuary" by Kirstin Dähnke et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-123-RC1, 2022

General comments

- This paper reports nitrogen transformation along the Elbe estuary and river by tracking concentration and the stable isotope composition of nitrogen compounds and particulate matter. The authors constructed a total nitrogen isotope mass balance to explore potential processes and controls on the evolution of riverine nitrogen along the estuarine reach. They also determine the *in-situ* nitrogen isotope effect of ammonium and nitrite oxidation and of remineralization.
- The Elbe River is the most important source of reactive nitrogen to the Southern North Sea which regarded as a problem area of eutrophication. The topic of this study is important because they investigate contribution of complicated N recycling processes (e.g. remineralization, nitrification) for nitrate production based on obtained *in-situ* nitrogen isotope effects. In addition, they provided a novel insight into the potential control process of nitrification in the Elbe estuary.
- Sampling and experimental procedures are clearly explained in detail. To confirm the activity of nitrification, the authors perform not only nutrient and isotope analysis but also nitrification rate measurement. Those combined approach is suitable for determination of contribution of nitrification.
- For the most part, the results are clearly presented, and the biogeochemical data are well illustrated with figures. However, there are some specific comments on determination of *in-situ* isotope effect of nitrification and the total isotope mass balance modeling.
- In summary, I recommend the publication of this paper if the authors add some discussions and make minor revisions as shown below.

Specific comments

Line: 62

The significance of evaluation of nitrogen transformation along Elbe estuary under "intense summer oxygen depletion" is a little vague. Why do sample the water column under unusual condition? Please revise them for clearer description.

Line: 70

In the explanation of study site, there is a lack of information where an agricultural catchment area and areas of nutrient discharge (Line 71-73) exist. Where is the input of N ? Those information helps us to understand the interpretation of geochemical data along Elbe Estuary.

Line: 128

As for nitrate isotope analysis, how was nitrite removed from the nitrate samples? Some samples contained enough nitrite for isotope measurements. Thus, the presence of nitrite interfered with nitrate isotope measurements.

Line: 150

It seems that both of ammonium oxidation and nitrite oxidation occur between stream km 641 and 656. Isotope compositions of nitrite could be affected by both of ammonium oxidation and nitrite oxidation. Do you consider the influence of ammonium oxidation on nitrite isotopes?

Line:261

How did you calculate and conclude that the drop of oxygen isotope values in the harbor region was due to nitrification? What is the value of oxygen composition of river water ($\delta^{18}O_{H2O}$) ?

Line:320

The authors constructed a total isotope mass balance by modeling. I understood the assumption of the model. However, the equation, parameters and calculation method were not presented in this text. Therefore, it is difficult to understand the conclusion that Total N fluctuations are driven by PN fluctuations. I'm not so familiar with this box model, but it seems better that the authors briefly explain equations and parameters in the box model and a modeling software in the method section or supplemental information.