

Biogeosciences Discuss., referee comment RC2
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Comment on bg-2022-123

Anonymous Referee #2

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-RC2>, 2022

In the manuscript *Nitrogen isotopes reveal a particulate-matter driven biogeochemical reactor in a temperate estuary*, Dähnke and colleagues present a timely study to assess estuarine nitrogen processing, taking advantage of conditions that enabled the isotopic analysis of nitrate, nitrite, ammonium, and particulate nitrogen along the Elbe estuary. Overall, this is an interesting dataset, with a lot of potential, but additional details are needed in several places to allow the reader to validate your conclusions and place them in context, these areas are outlined below.

Throughout, language such as unusual, exceptional, and unique are used to describe the conditions encountered, so how applicable are your results, just to these conditions? How often do these conditions occur? Are your findings applicable to the conditions seen in Sanders et al, 2018? It would be nice to see more comparisons drawn to this dataset.

Nitrification rates: more details are needed both in the methods and data interpretation.

- Nitrite and nitrate concentrations were stable, meaning all ammonium had been utilized?
- room temperature, was this close to insitu conditions?
- 14 days seems a long time and that bottle effects would be likely, was there any sign of this in the data? Exponential behavior for example? It would be beneficial to show some of this data, maybe in a supplement. How representative are these rates of insitu, as

there seem to be a number of caveats, none of which are mentioned and there is also no comparison of the rates determined to those in the literature to put them in context, it is only mentioned that they are high.

- you mention in the methods that ammonia and nitrite oxidation rates were determined but this is not mentioned in the results/discussion.

Isotope mass balance box model: it is difficult to assess the outcomes of the model as no details are provided, equations, parameters etc, please provide this in the methods or supplement.

Specific comments

Line 34 to 36: it is not clear how the second half of the sentence links to the first

Line 106: How was chlorophyll analyzed

Line 126 / Nitrate Isotopes: There is no mention of a nitrite removal step, so are these actually N+N and not nitrate only? Please note the implications of this.

Line 137: You note here that high concentrations were needed for isotope analysis of

nitrite and ammonium, please include what concentrations needed to be greater than for isotopic analysis

Line 225: For ammonium you use ϵ_{amm} to represent the isotope effect for ammonium removal and then go on to discuss uptake and oxidation, which is great, but why not the same for nitrite? Here you assume it is just nitrite oxidation (ϵ_{nitox}), but highlight later in the manuscript a potential role for denitrification in this system (e.g. Line 372), which would also consume nitrite, what would be the implications of this for your calculated isotope effect?

Figure 4 and associated text: it would be nice to see some errors on the calculated isotope effects.

Line 294 to 298: Across these lines, you discuss how nitrification scales / correlates with N content (%) and indicators of OM quality, where do I see this, you refer to Figure 4, but this is your isotope effects figure. These relationships need to be clearly evident to support your conclusions.

Line 305 to 307 (and throughout this section): more explanation is needed for SPM reactivity, use the literature, for example, why does low C/N suggest its fresh and labile, references and details are needed for the reader to keep up with your line of thinking and confirm your conclusions.