

Overall, I find this to be a worthy contribution to the field and suggest publication with minor changes. It does a good job of examining where measurement limitations are important in a complicated, under-determined system. I am not a modeling expert so I will not address the validity of their approach, other than to say that they do an impressive job of examining the multitude of process in sediment N cycling.

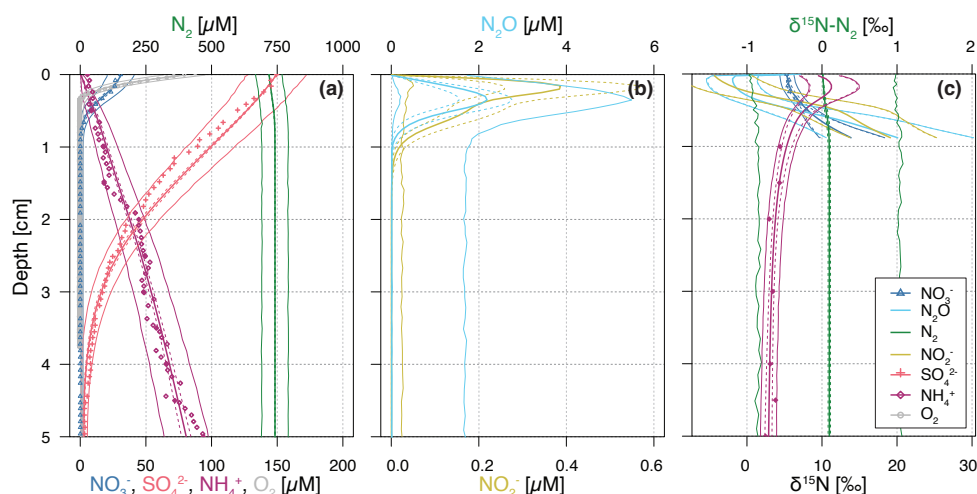
We thank Dr. Brandes for the kind and insightful feedback. We have assessed the implications of each comment and input, and will adapt the manuscript accordingly. Please refer to the points below for a detailed plan on how we intend to revise the text.

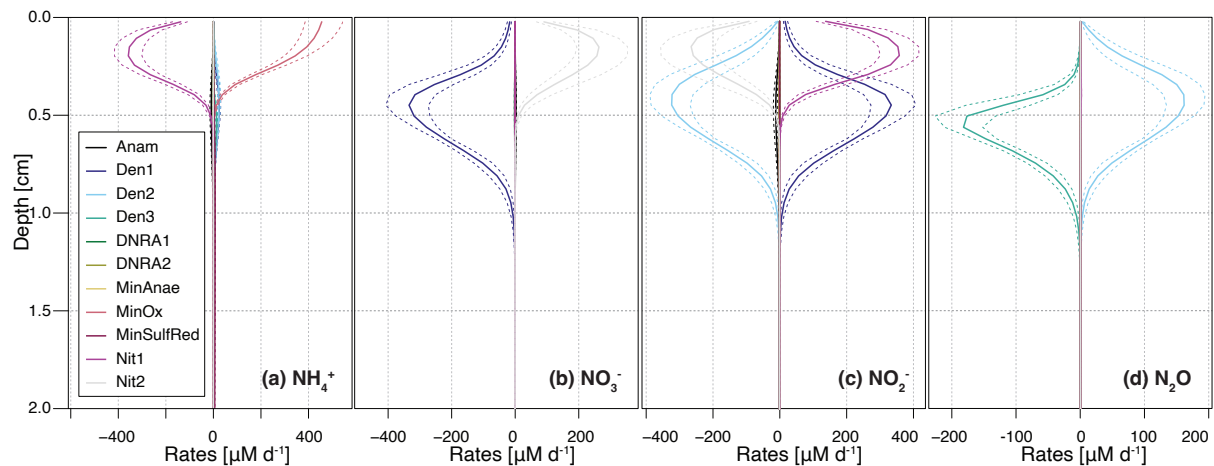
Specific comments- Line 61. Replace 'all' with 'present'. This century has seen tremendous advances in the ability to measure N cycle species, and it would be folly to state that these advances will not continue into the future.

We agree with Dr. Brandes' comment and will change "if not impossible at all" to "if not impossible at present" on Lines 60-61.

Fig 2 and other color plots. -These should be redone with an eye to increase legibility and distinction between parameters. It is quite difficult to distinguish between yellow, light orange and other similar colors, why not use a wider range?, and please consider those who are colorblind! The best practice is to assume that the reader might only have a greyscale printoff of the figure and make sure that your images are legible in grayscale.

We acknowledge the difficulty in identifying and distinguish the distinct profiles and will attempt to improve the graphics to the best of our possibilities. We have included here examples of Figure 2 (color palette: bright Paul Tol) and Figure 3 (color palette: muted Paul Tol) to show the potential improvements of graphs.





The concept of diffusion in sediments influencing the effective isotopic fractionation expressed in sediment (but not the intrinsic isotopic fractionation of denitrifiers) has been discussed widely in the literature, it is not at all a surprise that they find this as a requirement in their model. They may wish to better acknowledge this in their discussion/conclusions.

We appreciate Dr. Brandes' insightful comment emphasizing the well-established role of diffusion-limitation in influencing isotope dynamics within sediments. Indeed, we plan to submit a follow-up paper that provides an in-depth assessment of isotope dynamics across several benthic habitats using the model, addressing this aspect in detail. We envision the current paper as a presentation of the model, focusing on its validation and technical aspects. While its main objective of the present paper was to introduce the model framework, we will nonetheless acknowledge the reviewer's input and explicitly address this point in the discussion/conclusions of the revised manuscript. Given the similarities with the comments from Reviewer #1, we will detail how we plan to edit the text in the RC1_Reply file.