

## ***Interactive comment on “Modeling oceanic nitrite concentrations and isotopes using a 3D inverse N cycle model” by Taylor S. Martin et al.***

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Nitrogen plays a critical role in regulating oceanic primary productivity and there is an urgent need to improve our modeling technics to better predict future changes in the nitrogen cycle, in particular with expanding oxygen minimum zones. This study examines the importance of including nitrite in biogeochemical models in order to improve our understanding of the marine N cycle as well as to better capture nitrogen trends in the ocean. The explicit simulation of nitrite and its isotopic composition is a novel concept in this study, which was successfully applied.

Overall, the study is excellent. The model parametrization, the results and interpretations are all reasonable, and the manuscript is well-written and well-illustrated. I

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recommend publication following minor revision, which mainly consist of rephrasing, clarifications and few suggestions.

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### **General comments**

While the manuscript is well-written, it is rather complex and heavy to read. I highly recommend reducing the number of acronyms used in the manuscript. This will greatly ease the reading and help its understanding.

I would recommend adding a short sentence on why it is important to improve the N cycle in models in the abstract (and not only in the introduction).

### **Specific comments**

page 2:

line 16: Rephrase: e.g., N losses occur only where NO<sub>2</sub> oxidation is limited by oxygen.

line 17: change to “critical to asses” ...

page 3:

line 24: change to: “inversion without the need for a spin-up period as required by forward models”.

line 31: At this point, it is not entirely clear how the differences are optimized. The fact that it was done through sensitivity analysis comes too late in the paragraph. Maybe it should be mentioned earlier (beginning of the paragraph) that the optimization is done through sensitivity analysis.

Page 4:

line 4: To improve the reading is best to put it into words: Eg.g., Parameters that varied more than 5%, were...

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line 30: It should be mentioned that ammonium can be important in some OMZ (see for example Bristow et al., 2016)

Page 6:

line 15: value of 0.003676 (equation 6). The reference for this value is missing.

page 7:

line 16: Is there a better symbol for  $p_e$ ? Another symbol would make it clear that  $p_e$  is a value and not a word or typo.

line 22: avoid start a sentence with a symbol. Add a comma after equation 8 and "where": "0.419, where  $\phi$  has a constant value of ..."

section 2.3.2:

What about riverine input of  $\text{NO}_3$ ,  $\text{NO}_2$  and PON? If not accounted in the model, please add a sentence of why is this not relevant for this study.

page 8:

line 4: Why must the assimilation rates for DON and PON be calculated using observed surface  $[\text{NO}_3^-]$ ?

page 9:

line 1: How is this a refinement? Do you mean an improvement relative to what other model assume? In such case, how does a constant 14ksol improves PON solubilization?

page 11:

line 1-3: This should come before all oxygen dependent processes and maybe even be mentioned in section 2.1.

Page 12:

line 3: Please rephrase or explain what is meant by "cutoff points"

Page 13:

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line 21: Which 200, 160 boxes? This is not clear, as these specific numbers have not been addressed before.

Page 17:

line 27: Replace lessened by "low".

lines 21-31: Could this also be due to the fact that ammonium, and therefore, ammonification and nitrification are not explicitly included in your model? Nitrification and ammonium uptake, have large fractionation effect. To which extent could this be important, in particular for low oxygen zones? (See e.g., Hoch et al., 1992, Higgins et al., 2011, Bristow et al., 2016 and Ruvalcaba Baroni et al., 2015)

page 19:

line 25: It is not clear in this sentence why slow rates will lead to more  $\text{NO}_2$

Page 20:

line 14: Use full names instead of acronyms, especially in the conclusions

Figure 4: It would be easier for the reader to have the colour legend as well directly in the figure.

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