

Interactive comment on “What prevents nitrogen depletion in the OMZ of the Eastern Tropical South Pacific?” by B. Su et al.

Anonymous Referee #1

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This paper addresses the problem of biogeochemical models simulating complete depletion of nitrate in oxygen minimum zones, while observations show that complete depletion does not take place. The problem is addressed using a box-model of the Eastern Tropical South Pacific and investigated which processes that could be responsible for the discrepancy. The authors are able to produce the wanted effect by reducing the remineralization rate and thus indicate to how global biogeochemical models can be altered to account for this process. The model is tested with a varying degree of ventilation with the surrounding ocean regions, quadratic mortality, allowing nitrogen fixers to take up NO_3 and reduced denitrification.

This is an interesting paper that also demonstrate how box-models is a powerful tool for investigation ocean processes.

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My main concern with this paper the lack of systematic testing of the other parameters in the model, if the model sensitivity that been tested in previous publications it should be stated clearer. As previous optimization studies has shown biogeochemical models can give similar results with different combinations of parameters and I therefore think a systematic sensitivity analysis should be performed, unless previous publications can be cited. I also find that the composition of the paper is confusing, the authors jump back and forth among different runs, the paper could be made clearer with better structure (see suggestion below). The figures show a lot of information and I think the authors could get the message of the paper better across if they are more selective with the figures, for example reduce the number of panels to show fewer model variables, but focus on the ones most discussed in the text.

Therefore my conclusion is that revision is need before this paper can be accepted for publication

Concrete suggestions for improvement:

In general, when results form other literature is mention it is useful to add information about how the results where obtained, was it model or observation (what kind?), was it the same OMZ-region? (For example top of p11097)

I miss some discussion about the parameter choices and confidence and uncertainties, for example

- confidence about the nitrogen fixation being 1/3 of the maximum growth rate for phytoplankton.
- confidence about the remineralization rate in the different boxes?
- what about deviations from the redfield ratio in terms of nutrient uptake, the ability of some organisms to utilize organic phosphorous?
- In table 5: two parameters (UNF and M) have been set outside the range given in the column to the right. Could an explanation for this be added to the text?

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Explain how g_u and g_s were determined.

Is there any evidence that the denitrification rate is in fact slower under suboxic conditions that conventional parametrization of biogeochemical models suggest (other than it giving improved model results)? What was the justification used in Schmittner et al. (2008)?

The paper presents the 7 main model configurations summarized in table 4, but in between other experiments with sensitivity to different parameters are also described in the result section and a couple more appear in the discussion. The paper would be easier to read if these runs were described separately from the runs in table 4, for example under a sub-heading "3.3 Sensitivity runs".

Comparing model results to existing literature should be done in the discussion section (second paragraph p 11109).

It wasn't immediately clear to me that 'ventilation' meant that only oxygen would be exchanged with the SO, so it took me a while to figure out the difference between VID and OB, please state this clearer.

Show how the model phosphate compare to WOA2009.

P11108, L4 Mention which runs that are studied rather than refer the reader to figure 3.

Tables

Table 4: add a short description of each parameter.

Table 6: Are the models that are being compared also box models and are they configured for the same OMZ region?

Figures and figure labels.

Figure 2: I suggest indicating the WOA2009 level by a horizontal line rather than an

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extra bar.

Figure 4: This figure has too many panels, the text is so small it is almost unreadable. I do not understand the significance of the separate columns from the figure labels.

Figure 5 - label: suggest to change 'for different' to 'to'

Figure 6: It is hard to see the '**' on top of the x-axis.

Figure 7- label. Add "as a function of the oxygen concentration in the D box" to the end of the first sentence.

Figure 8 - what is meant by "all combinations of physical transport parameters in the literature range" (this is also mentioned in the text, but it is still unclear), perhaps I missed it, is this range indicated anywhere in the paper?

Figure 9: with only small differences between this and the original run, perhaps this figure can be omitted?

Technical issues: References to figures should be consecutive (fig 8 is referenced after fig 2 on page 11106)

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