

Interactive comment on “Nitrogen uptake and regeneration pathways in the equatorial Pacific: a basin scale modeling study” by X. Wang et al.

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We appreciate the reviewer’s constructive comments. We have revised the manuscript accordingly. The revised manuscript is attached as supplement. The following is our reply.

Specific Comments:

1. Model runs The model was initialized by climatology. What varies during the inter-annual runs so that they are different.

Reply: For the climatology run, the model is forced by climatological monthly means of solar radiation, cloudiness and precipitation, and 6-day averaged surface wind stress; For the interannual run, the model is forced by interannual monthly precipitation and 6-

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day wind stress. We have modified section 2.1 Ocean physical-biogeochemical model section to clarify this issue.

2. Do the equations for grazing (eqn 6 and 7) apply to both micro-zooplankton and meso-zooplankton?

Reply: Equation (6) deals with zooplankton excretion for both micro-zooplankton (ZS) and meso-zooplankton (ZL) whereas equation (7) computes remineralization from detritus and DON.

3. N₂-Fixation All the main rates for nitrogen cycling are considered except N₂-fixation. Bonnet et al (2009) have recently published (GBC, 23, GB3012) N₂-fixation rates from five stations along the equatorial Pacific and in the Bismark Sea. Measured rates (integrated) varied from 0.018 to 0.358 mmol N m⁻² d⁻¹. Bonnet et al state that N₂-fixation can account for as much as 50% of N demand. So some discussion about the role of N₂-fixation in the nitrogen balance would be appropriate.

Reply: We have added the following text: “This model does not simulate nitrogen fixation, which may result in underestimation of nitrogen uptake. However, a recent study shows that nitrogen fixation rate is very low in the upwelling region where nitrate concentration is often high (Bonnet et al., 2009)”.

4. Data – Model comparison When possible I think the data should be plotted in the same way as the model results so the reader can evaluate the statements made by the authors. For example in Fig. 1 the meridional sections observed during EqPac could be shown as Figures 1a and 1b.

Reply: This is a good suggestion. But, we are not able to do so because the data are not available.

5. Role of zooplankton Which zooplankton? I had the impression from Landry et al (1997) that in the HNLC part of the equatorial Pacific the growth rate of phytoplankton (P) was mostly balanced by grazing by microzooplankton (m). But in this paper I

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don't see a clear distinction made between microzooplankton and mesozooplankton. In fact I have the impression that when they refer generically to zooplankton they mean mesozooplankton (e.g., p. 8259 line 25 and page 8260 line 4 and everywhere where they refer to zooplankton excretion).

Reply: There are two sizes of zooplankton in the ecosystem model, i.e., microzooplankton and mesozooplankton. In this paper, zooplankton refers the sum of microzooplankton and mesozooplankton. As shown by equation (6), zooplankton excretion includes both sizes.

6. f-ratios I'm not sure I understand their distinction between f-ratios using new production versus nitrate uptake (Table 2). Nitrification is just oxidation of NH_4 to NO_3 and if that occurs in the euphotic zone the NO_3 still comes from remineralized NH_4 so would not be new production. Could the authors explain this a little better and maybe include some comparison with measured rates of new production?

Reply: This is a good point. We have reworded as "Modeled rate of new production ranges from 0.64 mmol N m^{-2} d^{-1} in the WWP to 1.82 mmol N m^{-2} d^{-1} in the EEP, which are similar to the observed values (Aufdenkampe et al., 2001; McCarthy et al., 1996). New production is approximately 50% of nitrate uptake in the WWP and CEP, and 67% in the EEP. The f ratio (0.1-0.19), the ratio of new production to total nitrogen uptake, is much smaller than the ratio (0.22-0.31) of nitrate uptake to total nitrogen uptake".

Technical Comments 1. There are many awkward word orders and missing words that can be fixed examples: p. 8254 line 28. Nitrification "rates" are "larger" p. 8253 line 1 these are excretion rate "constants" not rates; p. 8255 line 1 We carried out a sensitivity study: : : p. 8256 line 28 from the observations range from 0.5 -2.7: : : p. 8258 line 13 Previous observations along: : : p. 8260 line 11 regeneration is greater than ammonium uptake: : : p. 8260 line 17 a significant relationship with: : : p. 8260 line 22 text refers to eastern upwelling region (Fig. 9b and d) but neither 9b or 9d are

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in the EEP. In addition the figures are mislabeled in Fig 9. There are two Fig. 9c.

Reply: We have corrected all these and some other words as well.

Fig.2 Modeled concentrations of: : : Fig. 9 Caption says rates but a, b and c are concentrations

Reply: We have made correction.

2. In general it is best not to start sentences with "Fig 4 shows: : :"

Reply: We have reworded.

3. Standard procedure is to list cited references in chronological order.

Reply: We will apply the Biogeoscience format.

Please also note the Supplement to this comment.

Interactive comment on Biogeosciences Discuss., 6, 8247, 2009.

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