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Biogeosciences Discussions

Interactive comment on “Influence of consumer-driven nutrient recycling on primary production and the distribution of N and P in the ocean” *by* A. Nugraha et al.

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General Comments

This paper extends Tyrrell's model of N and P cycling in the global ocean to explore the potential importance of nutrient recycling be herbivores, using Sterner's model of consumer nutrient recycling (CNR). The resulting model illustrates that CNR can control total primary productivity (by supplying P) and affect competitive interactions between N-fixers and non-fixers. The model was parameterized using available data, and model results are largely consistent with empirical values. This paper makes a convincing case for the potential importance of CNR affecting TPP, phytoplankton dynamics,

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Interactive Discussion

Discussion Paper

and concentrations of dissolved nutrients in the ocean, and should spur further empirical research investigating these nutrient pathways and further constraining important parameters. This study represents and important contribution linking food webs, physiology, and the biogeochemistry of the global ocean.

The importance of these homeostatic herbivores stems from their potential to recycle nutrients through excretion at N:P ratios that are different than ambient ratios. One point that may deserve further emphasis is that the importance of N:P excretion ratios depends on the fate of the nutrients that are bound in consumer biomass, a point that is not always considered in empirical studies of CNR. In a steady state model, if all of the herbivore biomass was eventually remineralized and became available for uptake by phytoplankton, the differential ratios by which herbivores excrete nutrients would be canceled out by the N:P ratios of herbivore biomass remineralization. In this model, a fraction of detritus is removed from the system through settling, allowing for herbivore excretion ratios to affect dissolved N:P ratios at steady state.

Specific Comments

6:4 Could use additional explanation. Why does this assumption imply that non-fixers are N-limited?

13.16 This is an interesting result, that N-supply does not affect total phytoplankton biomass but does control herbivore biomass. I am not sure whether this is an artifact of the model or a real result; further explanation here might be helpful.

14.21 I understand the rationale for the model, although I wonder about the implications of modeling herbivory as a constant fraction of a constant phytoplankton mortality rate. Would the dynamics be different if, say, herbivory was depended on biomass of both herbivores and phytoplankton?

I like Figures 5-9, contrasting the results of Tyrrell's model with recycling by consumers at different N:P ratios feeding on algae with different N:P ratios.

BGD

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Interactive Comment

Technical Comments

There are several instances where word choice may be improved:

2:19 Change “contributes” to “accounts”

8:15 Change “is” to “in”

10:17 Change “higher” to “lower” (?)

22:22 Change “converged towards” to “was set at” (?)

Fig. 1 “Phosphorus” is misspelled

Fig. 2 Egestion arrow is backwards (?)

Fig. 4 Legend: “using the following set of assimilation efficiencies” (?)

Interactive comment on Biogeosciences Discuss., 7, 111, 2010.