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Discussions

Interactive comment on “Modelling carbon overconsumption and the formation of extracellular particulate organic carbon” *by* M. Schartau et al.

Anonymous Referee #1

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General Comments

This paper deals with the issue of apparent over-consumption of carbon, that is greater uptake of dissolved inorganic carbon than expected from simple considerations of nitrogen and phosphorus uptake. The authors parameterize a model using a combination of literature parameter values and comparison between the model and results from a mesocosm. In particular, the authors investigate the effect of including phytoplankton exudation of dissolved organic carbon and the coagulation of these exudates into transparent expolymer particles (TEP). This work ties in several previous threads into a nice story.

The paper is nicely presented and, though not conclusive, does provide many tantalizing suggestions for how to improve carbon budget models of planktonic ecosystems. There are some issues I have with the assumptions behind the model, and the presentation of the model equations.

Specific Comments

The authors optimize their model with a micro-genetic algorithm that uses a cost function derived from Bayesian arguments. There are some aspects of this methodology that I found confusing. In deriving their cost function, the authors assume a flat prior probability distribution. The allowed ranges of their parameters are between one and more than two orders of magnitude. For the larger ranges there is the danger than the flat prior distribution will skew the probabilities. Why did the authors choose this distribution over, say, Jeffreys prior distribution which would result in equal probabilities within equal-sized domains?

There are several uncertainties in modeling TEP production and dynamics. The authors assume that the production rate of extra-cellular polysaccharides is proportional to the amount of phytoplankton biomass (the term $\gamma_C f_{PCHO} PhyC$ in equation A13). I see a couple of problems with this. Firstly, I was under the, perhaps mistaken, impression that TEP production rates depended on the cell growth rates, not the amount of cell biomass. Secondly, the mesocosm experiment described in the paper shows varied phytoplankton dynamics which would suggest that perhaps a variable TEP production rate might have made more sense.

The "collision kernels" (β_{PCHO} and β_{TEPC}) were obtained from pervious work, and the kernels for aggregation between phytoplankton and detritus came from work by Ruiz and colleagues. It is not surprising to me that the use of these models caused some problems since the conditions were not identical. In addition, I am unconvinced that one can assert from these results that a division into two particle size classes is sufficient.

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The model certainly describes the observations quite well. But that is not too surprising, especially given the number of degrees of freedom available. I would have thought that a stricter test of the model and parameterization would be use the micro-genetic algorithm to estimate parameters based on the data up to (say) day 16, and then use this parameterization to predict the declines that occur after day 16. Alternatively, one could parameterize the model using data up to day 10 and then try and predict the observations between days 10 and 16; this is not as strict a test of the model, but if the parameterization is suited to the growth stage of the bloom, then it may be more appropriate and a comparison of the model under these conditions with those in the declining phase of the bloom may give some insight into how parameters change.

Technical Issues

There are a couple of typogrpahical mistakes in the presentation of the equations and I suggest that the reviewers scrutinize these equations carefully. For example, equation (A4) includes a term r_{phy} for the phytoplankton carbon respiration. This parameter is defined in equation (B5) as being $r_{phy} = r_C + \zeta V_C^N$. The parameter r_C is not listed in Tables 1 or 2, but r_{phy} is.

Interactive comment on Biogeosciences Discuss., 4, 13, 2007.