

Interactive comment on “Constraining the response of phytoplankton to zooplankton grazing and photo-acclimation in a temperate shelf sea with a 1-D model - towards S2P3 v8.0” by Angela A. Bahamondes Dominguez et al.

Anonymous Referee #1

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General comments

The manuscript describes improvements made to a 1D nutrients-phytoplankton model in order to better describe the dynamics of the pelagic ecosystem in terms of phytoplankton growth and zooplankton biomass. Model simulations that included flexible stoichiometry and photo acclimation mechanisms for phytoplankton and variable grazing by zooplankton were compared with an ample set of observations collected in a temperate shelf sea. The integration of modelled and observed estimates of phytoplankton biomass and physiology, and zooplankton biomass, constitutes the main strength of the

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work.

However, from my perspective, it is not clear under the current state of the manuscript what are the main findings of the work and why are they relevant. Model improvements are not innovative per se, and it is not clear how these improvements have contributed to provide insight into the dynamics of the ecosystem in such shelf sea.

Also, the model description is not very detailed and this makes difficult to understand which are exactly the model improvements that the authors are testing in this work. The description of sampling procedures is not complete, since relevant information about samples' collection and analysis techniques is missing.

Specific comments

Introduction

My main comment about the introduction is that is not clear from the text what is the point of the work, what does it add to the existing knowledge?

L50-54 This paragraph is difficult to understand. The authors say that they implemented flexible stoichiometry in the model and photoacclimation in the chlorophyll description, but they cite Droop which suggest that they have also included some functional relationship between growth rate and internal nutrient status or quotas. I think the authors should clarify which are exactly the modifications done in the model, only flexible stoichiometry or a full Droop's model.

L65 The authors mention here several models, but it is easy to get lost at this point. Perhaps a list of the models compared would be useful.

L69 “the effects of photo-acclimation and flexible stoichiometry” on what?

Methods

L107 Is that really internal nitrogen (m³ as phyto biovolume) or it is just phytoplankton nitrogen concentration in sea water? I believe is the latter, as in zooplankton (L108),

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so the sentence should state nitrogen and not internal nitrogen.

L101-118 This model description is not very clear. Does S2P3-NPZ includes flexible stoichiometry? I guess it does since phytoplankton is described with Chla and N. If the ratio is fixed there is no need to compute both. The authors mentioned in the introduction that the approach used was a Droop model, where the growth rate has to depend on the internal quotas of nutrients. The way the authors describe the model it seems that S2P3-Photoacclim allows flexible stoichiometry but it is not clear how growth depends on quotas. It is also the growth dependent on quotas in S2P3-NPZ? I would suggest the authors to include the equations of the phytoplankton growth model they are using, to ensure clarity and reproducibility.

Figure 1. I imagine the idea of Figure 1 is to illustrate those equations without having to display them. Figure 1 is useful but not all symbols are explained. For instance, u , Z (zooplankton?) and QP are not described. Also, uptake of N in a) is $u \times \text{PhytoChla}$ but in b) to d) is $u \times \text{PhytoC}$, I would say that a Q is necessary somewhere to convert units. And also in Figure 1, it is not clear how growth or uptake depend on quotas, if they do. Since one of the main goals of the manuscript is to account for flexible stoichiometry and hence simulate elemental quotas, maybe for improving clarity the authors could give clear names or symbols to each quota and refer to them throughout the manuscript.

L126. The description of the sampling performed during the SSB programme needs improvement: L129. Samples collected for what? Chlorophyll? L131. Please, indicate where this mooring is located. L132. I don't understand what info gives the term "stainless and titanium". L133. How these discrete samples were collected? with bottles? L134. The details about the CDT deployment in the other locations (not CCS) are missing.

L136. The description of the sampling of zooplankton biomass needs improvement: L138. How this zooplankton samples are collected? With nets? If so, please, specify

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the type of net and the type of trawl. L140. How zooplankton biomass was measured?

L146. The description of the sampling for phytoplankton is also very vague: L148. Phytoplankton samples were collected with bottles? At "a number of stations" seems very vague.

Results

L177 The behaviour of S2P3-Photoacclim (blue line) seems very different to S2P3-NPZ, similar maybe in magnitude but not in timing.

L185 Zooplankton biomass increased 1 month later than phytoplankton in 2014 but definitely not in 2015.

L190 The expression "have not reached the SPB" is ambiguous. Maybe they haven't reached the peak of the bloom, but, at least for S2P3-NPZ, the accumulation of biomass has already started accordingly to Figure 3. It would be necessary to clarify to which event of the SPB the authors refer.

Figure 4. I miss the same figure for 2014, are CTD data not available for this year?

L203. The description of results regarding phytoplankton physiology seems a bit short and does not give much information about the agreement of the model and observations: L205 If it is a 1D model, are not the vertical gradients the only ones available? Figure 5. The vertical gradients are difficult to see for observations, especially for P_{max} .

L218. To which location correspond Figures 6 and 7?

L236. In Figure 7 I don't feel it is possible to see which event follows which. Maybe a mean seasonal cycle with some metric for interannual variability would be more easy to interpret.

Figure 7 legend. Does this "forced with all meteorological components" refer to the whole model result? I imagine it does, but here it seems it refers to NPP only.

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L244. Parameters listed in Table 1. The reader does not know where these parameters fit into the model. They are not in Figure 1 and no equation that includes them is shown in the manuscript.

Not all A Figures are described, are all necessary?

L276. The meaning of this sentence is not clear to me.

Table 2. It is not clear what this “timing of the SPB” means. Is it day of the onset, day of the peak? DW is dry-weight? If I am not wrong, it is not explained anywhere in the manuscript.

To which location/area correspond the metrics in Table 2 and Table 3?

Conclusions

L300. I am afraid I wouldn't call this work innovative. NPZ models that include grazing are commonly used. Flexible stoichiometry I would say is almost the norm when describing phytoplankton pools. And the description of photoacclimation through the parameterization proposed by (Geider et al. 1998) is virtually standard in biogeochemical models.

L305. This last sentence is difficult to understand. And also, I miss one sentence or paragraph that clearly states why this work is an advance in our knowledge.

Technical corrections

L18 SSB acronym not defined.

I would say “data” is plural (datum is the singular) and has been used as singular in several places (L20, L75, L82).

Sections 2 and 3 use mainly present tense, but there are several pasts in between that maybe can be reviewed (L76, L82, L103).

L203 “Moreover” and “also” in the same sentence sound redundant.

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L250. I am not sure, but I feel it is more clear to refer to ingestion rate of zooplankton and not phytoplankton.

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