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Interactive comment on "Factors controlling the competition between *Phaeocystis* and diatoms in the Southern Ocean" *by* Cara Nissen and Meike Vogt

Anonymous Referee #2

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This is a very nicely written paper about a comprehensive and thorough model study that addresses the contribution of Phaeocystis to NPP and POC production in the Southern Ocean. The authors undertake a great effort to parameterize, test and constrain their model. Also, the discussion and conclusions take into account the uncertainties associated with this Phaeocystis, which I really appreciate. I enjoyed reading the paper and have just a few moderate comments and suggestions.

One of the outcomes of this study is that the relative and absolute importance of Phaeocystis for biogeochemical fluxes in this region is determined by its loss processes, in particular zooplankton grazing, and the so-called aggregation. Here, a few additional

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sentences might help that discuss:

(a) The choice of food preferences and feeding parameterization of zooplankton. What I could find in preceding papers of the BEC model is that zooplankton is parameterized via fixed feeding preferences. However, other biogeochemical models have applied zooplankton grazing formulations that saturate with the total amount of food, or even employ a switching behaviour of zooplankton (see, e.g., Appendix A of the classic paper by Fasham et al., 1990, J. Mar. Res., 591-639). A few notes on that could complement the discussion; also, given that this process seems to be of importance, it might be helpful for the reader to have a brief explanation of the grazing formulation (and the preferences) in the methods description (so that the reader does not have to look up earlier papers).

(b) Aggregation: To my opinion, this term is somehow loosely defined in the present paper. Sometimes it is referred to as "mortality" (Table 1), sometimes as aggregation. Do phytoplankton become detritus after aggregation? But why? Theoretically, this process only describes that the cells or colonies collide and stick together - will they instantaneously stop being "green", i.e. cease photosynthesis and growth and become detritus? I assume that this is the case in the model, possibly with the argument that in this case they sink out of the euphotic quickly. However, given that in many cases aggregates ("marine snow") sink rather slowly, or not at all, this does not have to be the case. As for (a), given the large importance of this loss term for the simulated biogeochemistry, I would recommend some more in depth model description and discussion of this assumption,

Some few smaller comments:

Table 1 and line 175: The unit of quadratic mortality (aggregation) is given as 1/d. Shouldn't it be 1/((mmol N/m3)*d), given that it will be multiplied with the squared concentration?

Line 184: "we us monthly climatological fields for all tracers" - For all nutrients? Dis-

solved inorganic tracers? Please specify.

Lines 197-214, spinup procedure of the coupled model: here a simple diagram of the spinup procedure could help a lot! E.g. (if I understood correctly),

..30y physics.....10yBEC...10yBaseline..10ySensi

|————————————|————|————|————|

.....|5yAn|.....|5yAn|

Line 275: "phytoplankton biomass ... is the balance" - I suggest to rephrase this as "phytoplankton biomass ... is determined by the balance"

Line 320 and elsewhere: "In ROMS-BEC" - I assume what is referred to here is the baseline experiment? If so, I'd suggest to use "Baseline", to not confuse this simulation with the earlier non-Phaeocystis model and simulation.

Figure 4: The upper and lower panels would be easier to compare if in the lower panels the x- and y-axis were swapped (i.e., to have always temperature on the x-axis.

Figure 5: The caption could also note over what depth these terms were calculated.

Figure 6: If I add up the different contributions to POC formation in the right panel (60-90S) I end up with (6+17+4(bluearrow)+0.2+0.1+13+9=49.3% but the p-ratio is given as 45%. Does the blue arrow not contribute to the total flux? If so, then in the left panel the p-ratio should be 3+19+0.8+3+5+2=32.8% (and not 37%). Please clarify.

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