Interactive comment on "On modeling the Southern Ocean Phytoplankton Functional Types" by Svetlana N. Losa et al.

Anonymous Referee #1

In this paper the authors use the Darwin-MITgcm to simulate the phytoplankton composition in the Southern Ocean. The paper is focused on the parametrization of the model to improve coccolithophore abundance, include two sizes of diatoms and two life stages of Phaeocystis in the Southern Ocean. The paper is an interesting model development, but I am not sure whether this really fits in the goals of Biogeosciences. The introduction doesn't provide any context or current challenges of why the work is being done. The results and discussion section lacks quantitative assessment of the model. Overall I was left wondering what science advancements or challenges this paper was providing or highlighting. In the introduction the authors seem to switch back and forth between defining PFT as plankton or phytoplankton functional type (see L23 and L 45 for example). The reader is left wondering whether starting at L46, they are

talking about phytoplankton or plankton. This is very confusing and I don't think brings any context to the paper. Along those lines, I thought the whole introduction wasn't very helpful in describing the context and problems tackled by this paper. The intro is mostly about how people have defined phytoplankton functional types when this paper appears to be mostly about the challenges that goes into representing phytoplankton diversity in a model. The introduction also presents only a very marginal portion of the work that has been done in the modeling of phytoplankton communities. Suggesting that this work started off with the paper from Le Quere et al. (2005) and Follows et al. (2007) when this work had started a lot earlier than this. The authors present all the other models in one sentence (L58) summarizing them as only including 2-3 phytoplankton groups and mention one other model that has four. This really comes across as a very narrow view of the work that has been done in this area. The intro would have benefited from expanding on the work and the challenges that have already been learned from the various models out there instead of the classification of PFTs. Furthermore, the view that the Darwin model 'has the highest potential to simulate globally relevant PFTs' is again narrow minded at best especially considering that the authors support this argument by saying that the Darwin allows to represent more than three and up to several thousands of phytoplankton groups (L64). The reader then finds out a few lines later (L85) that the version used here distinguishes only 6 phytoplankton groups (there are several models out there that do this) and not thousands like initially said. This brings the question of why (a) the authors need to state that this model has in fact 'the highest potential' among all models and (b) since they limit their phytoplankton groups to 6 does it really still stand as having the highest potential? The introduction should be focused more on the challenges that the modeling community has faced, the recent advances etc rather than try to convince the reader of why one model is superior to the others (without properly describing their model or the others). Results and discussion: this section lack some quantitative assessment of how well the model does compared to the in situ data. Why not report RMSE, bias etc? everything seems to be based on a few snapshots without a clear description of why the

authors chose those snapshots and a quantitative assessment. It is very hard to know what are the scientific advancements or lessons learned from this paper from the results and discussion section. Supplementary material: as detailed in some of my minor comments it appears that some information in the supplementary material would have benefited to be discussed in detail (and potentially included) in the main text. Similarly, the author sometimes refer to a Figure in the paper and compare it to a figure in the supplementary material which is very hard to follow (L334).

Minor comments: L16: this sentence needs a reference L20: needs a reference L57: three no thee L84: 'The version of the Darwin model used in our study simulates, among total 42 biogeochemical compartments.' change to '...among a total of 42...'. Btw what do you mean by compartments? As in variables? L85: earlier on this paper it said that the Darwin model had several thousands of phytoplankton groups? How did we end up with 6 only? Methods: what is the spatial resolution of the biogeochemical model? Same as the circulation model? L111: are the CDOM spectral slope used constant values? L128: why do the authors compared to this other model? Seems like a random comparison L150: so the model was spinned up for 6 years only? Was that enough to get stable conditions for the biogeochemistry? did the authors check for that and if so how? L168: define Chla L175: why were these groups not included if they have the observations for it and the model allows to discriminate for them? Section 2.2.1: there should be a 1-sentence description of how they went from pigments to phytoplankton classification Were the in situ data matched for the same day/year as the model run? From my understanding the model was run for the period 1999-2012? Section 2.2.2: The results present some snapshot from various month and year. Why did the authors not compare just a whole climatology for 1999-2012? Or annuals? How did they decide which year to compare? L20: Did the authors look at the full seasonal cycle to conclude this or just the two months that they presented? L236:'to the end of the considered period of time' . What period of time is that? L247-249: how long does it take for the large Phaeocystis to outcompete coccolithophores? L278: 'in the model world'. What does that mean? As in in your model? L287: 'Similar to Figure 2,

Figure 7...' how is Figure 2 similar to Figure 7? One shows all 3 methods while the other compares July and January output from the model. L294: instead of referring throughout the paper to the study by smith et al (2017) refer to it as the in situ dataset. Otherwise the reader is left wondering here for example what that paper is and why we are taking the same area. The first time I read the paper I didn't make the connection that this was the in situ dataset used for comparison. L324-329: this paragraph seems random, doesn't report any of the results yet seems like it should be discussed in the main paper (not appendix) since it contains some quantitative assessment of how well the model does. L331: 'the worst statistics.' use a different word than 'the worst..' L348: "...which indeed might support a biochemical/physiological hypothesis on the coccolithophore distribution...". Which hypothesis is this? Why does this come up for the first time in the conclusion section? This hypothesis wasn't mention anywhere else and it's unclear what it is referring to. L351: how do you define palatability? How did you conclude this from the results presented here? L369: phytoplankton not phytolankton L387: "..the information from these different sources becomes closer..." how can you say it becomes closer? In what way? L396: not only are cruises carried out close to the shelf but they are also mostly during spring and summer introducing another bias. Figure 2: the first column uses the method as the title but the third column's title describes the variable instead