

Interactive comment on “Antarctic Ice Sheet fertilises the Southern Ocean” by R. Death et al.

Anonymous Referee #1

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This paper deals with the important question of iron sources to the Southern Ocean. Since primary productivity in the region is believed to be iron limited, it's important to understand the sources of iron and in particular how changes in iron source strength might affect productivity. The authors have done a good job of translating what we know of the iron content of subglacial meltwater and icebergs, and the circulation of water in the region, into quantitative estimates of iron flux. The main weakness of the paper is in how it deals with observations. For both the iron and the productivity estimates, there is very little comparison with observations. The paper would be considerably strengthened if more quantitative treatment of model-observation comparison were included. This is important, because I think the most interesting application of this model will be in using it to predict potential impacts of increased glacial-derived iron fluxes as warming increases. But the predictions are less believable if the status quo isn't well modelled.

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Main points:

1. The measured iron in Fig 1 is very hard to see. More informative would be cross plots showing model-observations with both dust alone, and dust + SGM + icebergs. Does scenario E really do a better job of capturing the observations?
2. There is some evidence to suggest seasonality in iron concentrations around Antarctica (see papers by Sedwick in particular), with high concentrations after ice melt and then depletion through the summer. If the model results are an annual average, and the observations are from single time-points, this needs to be taken into consideration when making a model-observation comparison.
3. While Fe data are relatively sparse, making model-observation comparison difficult, the satellite record of chl is much more detailed by comparison (though far from perfect in this region). I was therefore very surprised that a comparison between modelled and satellite-derived surface chl was not included. This could be done both annually (Fig 2) and seasonally (Fig 3). This is important because it's certainly possible that annual PP in the near coastal zone is in fact not limited by iron but is limited by light (ice cover, day length).

Minor points: 1. The sentence beginning on p. 12554 line 12 is way too long

2. Curious why WOA01 is used and not 09
3. p. 12556 line 20. Presumably some of the iron that upwells will also be lost during mixing with surrounding water during the upwelling- another loss that is not accounted for. It's not clear why the iron isn't released into a subsurface layer- what is the technical difficulty?
4. p. 12557 line 24. It's unclear, do you mean the sediment density of the debris layer?
5. p. 12557 line 28. What photographic evidence? How would debris get into englacial layers?

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