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Interactive comment on "Mechanisms of dissolved and labile particulate iron supply to shelf waters and phytoplankton blooms off South Georgia, Southern Ocean" *by* Christian Schlosser et al.

Anonymous Referee #2

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This study proposes a discussion of the sources of iron and related elements (Mn, Al) to the South Georgia region. A major objective of the study is to quantify the sources of iron (dissolved and particulate) on the shelves surrounding the island and to discuss how this iron is transported offshore to sustain the strong bloom that is observed over hundreds of kilometers downstream of the island. This study is based on observations collected during three cruises (2 cruises dedicated to seawater sampling and one cruise during which sediment cores have been collected). This study is rather interesting and provides a nice collection of data very useful to understand and constrain the iron cycle in that important and particular region. In particular, they have estimated the potential impact of grazers (more specifically krill) which is sufficiently rare to be no-

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ticed. The author suggests that krill play an important role in the delivery of iron on the shelf that is even more important than diffusive and advective fluxes from the sediments and than meltwater supply (which remains unconstrain). They also state that a large fraction of the iron that is supplied to the region downstream of the island is transported as biogenic particulate iron. I had some major issues concerning this paper. However, most of them have been addressed in the responses to reviewer 1 which are available on the website. Since, for most of them, I think they are appropriate, i focus here my concerns to the unaddressed ones.

I think that the budget is rather speculative and very uncertain. Many numbers are based on a study (De Jong et al., 2012) performed in a different region, that is the Antarctic Peninsula. This area shares some similarities with the South Georgia Island: a shelf area located in the Southern OCean. However, this does not guarantee that the numbers (diffusive and advectives fluxes) are comparable. Many processes may be significantly different such as tidal mixing, tidal residual current, upwelling (or downwelling) over the shelf, inertial waves, ... As a consequence, I would say that the similarity in terms of geography does not necessarily support the idea that processes should be identical. I understand that better constraining the numbers is a very difficult (if not impossible) task. However, uncertainties should be more extensively discussed.

The authors suggest that a large part of the offshore supply from the island to the downstream region is sustained by lateral transport of biogenic materials rich in iron (luxury uptake by phytoplankton on the shelf). That's a valid explanation. However, there are some other potential explanations. For instance, labile iron hydroxydes formed on the shelf can also be transported offshore. Iron adsorbed onto biogenic (or non biogenic) particles can also be advected offshore. This should be also discussed by the authors. Over the shelf, the authors state that a large fraction of the iron is being supplied by krills which ingest lithogenic materials (while filtering seawater) and release it as either dissolved iron or as particulate iron within fecal pellets. However, they assume that all of the excreted and egested iron is available as new dissolved iron. This is

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true if this process solubilizes part of the refractory material which would be otherwise unavailable. This seems to be the case since the LPFe fraction is higher in fecal pellets (∼2.5%) than in suspended materials (<1%). This is also true if krills drive a net transport of iron, for instance from the sediment to the open ocean. Again this seems to be true as krills are feeding, at least partly, on sedimentary materials. However, the contribution of this source of food to the total diet of krills is unknown. And thus, the net source of iron due to krills should be uncertain. In other words, it's impossible to quantify the amount of iron that is newly supplied to the system (either by feeding on sediments or by solubilizing an otherwise unavailable iron pool) and the amount of iron that is recycled within the system (grazing on suspended particulate materials and living organisms). This should be better discussed in the manuscript.

Finally, I have a more specific comment already made by reviewer 1 and that has not been really discussed by the authors. They claim that LPFe exhibits an exponential decrease with the distance from the coast. That's a rather strong assumption knowing that the relationship is derived from three points in one case (stations 14, 13, and 11/12) and from 2 points in the other case (14 and 13). I may have misunderstood something (a plot would help) but 3 or 2 points are not enough to constrain the shape of a function (when this shape is unknown). This explains the very high R2. For instance, 2 points could be fitted by a linear function, a polynomial function, or any continuous function ...

In conclusion, I think this paper has the potential to be published in biogeosciences. However, it should be significantly revised before.

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