

Interactive comment on “Potentially Bioavailable Iron Delivery by Iceberg-hosted Sediments and Atmospheric Dust to the Polar Oceans” by Rob Raiswell et al.

Anonymous Referee #2

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This is a very well and logically written paper which deals with an aspect of the iron cycle which is poorly constrained, namely the flux of iron coming from particulate sources to the polar oceans. I find the paper a comprehensive and informative synthesis of the current knowledge in this area, with useful new data informing the different iron fluxes. A key strength of this paper is that it also establishes the uncertainties on these fluxes and the areas where future research is needed. The end result is pleasingly robust, clearly laying out uncertainties and making good use of statistical tests for determining reproducibility. As such I recommend publication of the manuscript, subject to the authors addressing the following major point and considering the minor changes.

Major point:

C1

I just have one major comment - The paper assumes all dust to be low in solubility based on their samples. However, there are two issues with this –

Firstly, although dust solubility is open to interpretation, a number of studies have shown that anthropogenic dust sources may be important, and even more important in some areas of the globe - e.g. iron from combustion, biomass burning etc. . . e.g. Sedwick et al., 2007 (10.1029/2007GC001586), Luo et al., 2008 (10.1029/2007GB002964) Ito et al., 2013 (10.1029/2012GB00437), Ito 2015 (10.1021/acs.estlett.5b00007) to name just a few. . . This delivery of anthropogenic aerosols is likely to be highly variable and as such may not be captured by a small number of samples or from natural sources – that seems especially likely if there is no high Fe solubility in your aerosol samples as would be expected for anthropogenic Fe (e.g. Sedwick et al., 2007; up to 19%; 10.1029/2007GC001586). If this is the case, then dust sources in your paper may be seriously underestimated– indeed a recent study attributed sporadic high deposition of soluble Fe to Antarctica from biomass burning and it could be the dominant particulate dust Fe source to the Southern Ocean (Winton et al., 2016; 10.1002/2015GB005265.; Ito et al 2015). By only assuming low Fe solubilities, the paper seems to miss this possible Fe source.

Secondly, but by using dust samples from other areas of the globe, it may be that you are poorly representing Antarctic dust, especially combustion Fe sources. I would say that the integrated composition of dust delivered to the Southern Ocean is probably not very similar to the dusts sampled in this manuscript. So while I realize that it is difficult to draw any strong conclusions about the effect of anthropogenic sources of dust to the polar oceans based on your dataset, I think it needs discussion in the paper in the context of uncertainties on the dust flux being calculated.

There are also a small number of minor comments that require the authors attention:

L17 I think ‘dusts’ could be ‘dust’ here and in other places. Dust is usually used as a plural. But at authors discretion.

C2

L23 What about other forms of iron in dust? Think it would be good to make this clearer here. Nanoparticulate Fe is unlikely to be the only bioavailable form.

L39 There are recent Fe-isotope informed calculations for multiple sources also –eg. Conway and John 2014 (doi:10.1038/nature13482). I think this would be a valuable citation here, especially as an emerging approach to constraining different sources of dissolved Fe, including dust and particulate bound Fe.

L42 I think you can remove 'the' prior to 'iceberg-hosted'

L74 The Tagliabue reference should be 2016?

L79 'of' Antarctica would read better.

Lines 147-150. Some more detail of collection would be good here. How was the window cleaned etc? There is not detail of how the med samples were collected. It's important to demonstrate that these samples were obtained cleanly.

L158 Needs a space before 10

L162 What is 2-line and 6-line ferrihydrate? Might be worth clarification for the reader.

L184 This section misses references and coverage of other techniques which post date the Jickells and Spokes work (it is quite an old study now. . .) for leaching dust – such as ultrapure water leaches or seawater or acidic leaches, as carried out by American groups such as Sedwick et al. or Buck/Landing et al. or the Conway et al study you cite - and as such rather underrepresents the dust solubility literature.

L325 This is a long sentence, please add a comma after sources

L344 Conway et al also appear to show some seawater-leached data for the Dome C samples. The sentence is also a little clunky. . .perhaps change to 'have' to 'measured' and remove 'data'. These samples are a useful citation, but of course miss any modern anthropogenic sources – might be worth making this point.

C3

L353 Double ..

L364 See my major point about anthropogenic sources.

L376. Can you also present this as an Fe solubility percentage in terms of total Fe, that would make comparison to other work easier. Same for Table 5?

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C4