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Interactive comment on "An assessment of the vertical diffusive flux of iron and other nutrients to the surface waters of the subpolar North Atlantic Ocean" *by* S. C. Painter et al.

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This an excellent paper which reports the vertical diffusive fluxes of iron and other nutrients to North Atlantic subpolar gyre. The main finding of the paper is that these fluxes represent only minor contributions to the surface waters and to the biological requirements. The oceanographic techniques are rather outside my expertise and others will have to comment on these details. My review will therefore be confined to more general aspects of the iron cycle. In this respect I find the paper to be a valuable contribution which is essentially publishable in its present form with amendments as suggested below. However the oceanographic work in this field often takes for granted some as-

sumptions which not soundly based. Firstly, the use of the term 'dissolved Fe' or dFe needs to be accompanied by an explanation that much of what is measured after filtration is not aqueous species but nanoparticles and/or colloids (depending on the filter size, see comments below). There is an abundant literature on this (a recent example is Fitzsimmons and Boyle, Geochim Cosmochim Acta 2014).The problem is that the dFe data is usually, as here, interpreted as though chemical effects alone are responsible for the observed changes, whereas in fact nanoparticles and colloids behave quite differently for example in aggregating (which may transfer material from being filterable to being trapped) and in transforming mineralogy (which may affect leaching characteristics). Nanoparticles and colloids also diffuse more slowly (a 10 nm nanoparticles diffuses an order of magnitude more slowly than an ion). I am not suggesting that the authors attempt to deal with this problem but a few lines of caution are necessary to make the reader aware of the inherent assumptions. Secondly, a general comment is that the oceanographic papers dealing with the iron cycle rarely adopt a comprehensive view of the processes that contribute to iron supply; references below make this point. This is not a major issue for this paper but it helps to perpetuate a very selective view of the iron cycle. Comments below are keyed to page and line numbers. 18519 lines 18-20. The term local continental landmasses suggests a riverine source but I think the authors mean to refer to shelf sediment recycling (which is the Elrod reference). There are also more recent important references relevant to shelf recycling by Lam (Geochim Cosmochim Acta, 2012 and previous Lam papers referenced therein). There are also likely to be other sources to the Irminger Basin from Greenland meltwaters and icebergs which should be noted here. Bhatia et al (Nature Geoscience, 2013 and references therein deal with Greenland meltwater fluxes). This paper is cited later but should be introduced here, as should iceberg input which is dealt with briefly by Wadham et al Transactions Roy Soc Edinburgh) for Greenland and Raiswell and Canfield in Perspectives vol. 1 (on the EAG website). Hydrothermal inputs are also likely (see Saito et al in Nature Geoscience 2013 and Tagliabue et al in Nature Geoscience 2010). Line 22. True that aeolian supply is often considered to be the dominant supply

but this view ignores the potential inputs mentioned above. A more cautious statement is required. 18521 line 18. What was the filter size? See comments above. Make it absolutely clear what has been measured; which will likely be a mixture of aqueous species, nanoparticulates and/or colloids. It may be best to do this on page 18526 line 9. 18524. There is a Caero in equation 3 and a CA in equation 4. Are these different? Clarify. 18526 line 25 on. The subsurface minima and maxima are interesting and may result from the behaviour of non-aqueous Fe species (nanoparticles and/or colloids). Take a careful look at the Fitzsimmons and Boyle paper to suggest other explanations apart from remineralisation. This behaviour reinforces my point about the difficulties in only interpreting dFe in terms of aqueous species. 18527 line 9. There are also problems because the diffusion of nanoparticles and colloids is much slower than aqueous species. Given the influence of turbulence I guess this is unimportant but see comments above. 18528 line 11. Presumably P-rich arctic outlow refers to riverine/meltwater flow. See comments above about these sources. 18532 line 23. Scavenging or aggregation. Aggregation would material from the filtrate to the filter, see above. 18533 line 5. Other inputs may also influence the observed seasonal changes. Inputs from shelf recycling will result from episodic re-suspension events, also there may be seasonal effects from meltwater and icebergs. Iceberg melting supplies nanoparticulate Fe (oxyhydr)oxides that would contribute to dFe measurements (see Raiswell et al , Geochem Trans, 2008). 18537 line 5. It might be more bioavailable if the diffusive flux represented a different mixture of aqueous, nanoparticulate or colloidal species, with more of the smaller size fractions. 18538 line 1. Agreed, most likely bioavailability. See earlier comments. 18539 line 13. Yes, glacial and meltwater sources are possible, as is shelf recycling. 18540 line 5 to 15. A valuable point to make.

Interactive comment on Biogeosciences Discuss., 10, 18515, 2013.