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Interactive comment on "Nitrogen cycling in the Southern Ocean Kerguelen Plateau area: evidence for significant surface nitrification from nitrate isotopic compositions" *by* F. Dehairs et al.

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bg-2014-443: Reply to Reviewer 1

p. 13909, lines 20-25: It would be helpful if all of the features described here were included in Figure 1. We have added a panel showing the mean surface velocity field superimposed on the MODIS Chlorophyll distribution

p. 13910, lines 3-8: It would be clearer if these water masses were identiïňĄed on the T/S plot. Done

p. 13910, line 14: Figure 1b doesn't show chorophyll. However, it would be nice to see

this as a panel in Figure 1.

A panel with the MODIS chlorophyll distribution has been added to Figure 1

Figure 1a: I assume that the shading shows bathymetry. It would be helpful to have a color scale bar.

We have added a bathymetry scale bar to Figure 1.

p. 13914, section 3.2: This section was rather brief and does not describe the N-S section. If there is no utility in showing the N-S section, they should leave it out. As a side note, it would be helpful to see the sections outlined either on ïňĄgure 1 (although it might make that panel too cluttered), or in a sub plot in the section ïňĄgures, making them 6-panel composites instead of 5 panel composites.

Reply: The W to E and S to N sections have been added to Figure 1. We prefer to keep the description of the S-N section shown in Figs 3B and 6B and which includes two stations representative for Plateau and Meander (Table 1). Also, TNS6 is taken as the t0 condition for the model calculation of nitrification above the Plateau; so we feel it is important to keep these graphs.

p. 13923, line 24: 'isotopic ïňĆuxes' may be better here than 'isotope effects' which have a speciïňĄc deïňĄnition related to isotopic fractionation.

These equations yield the isotopic signature of the NO3 that is produced from nitrification. We would rather keep the term 'isotopic effect'.

Equation 1: Based on their description of the model, I tried to set it up and got a different result. Either they've made an error in calculation or in description of the model, and I think it would be helpful to see more of the derivation here in order to evaluate given that the cited paper is in prep. One possible misunderstanding is how f and y are deïňĄned. If f is actually the fraction of ammonium uptake relative to the remineralization ïňĆux, and y is actually the fraction of nitrite uptake relative to ammonia oxidation, then I think we get the same result.

Reply: The reviewer is right; f is indeed the fraction of ammonium uptake relative to ammonium remineralisation (with Rem. = AmU + AmO) and y is the fraction of nitrite uptake relative to ammonium oxidation (with AmO = NiU + NiO). We corrected the text accordingly. Note that we also replaced f by x as suggested.

p. 13924: It looks like they changed the f term from equation 1 to an 'x' in the later equation. I think they should stick to the same terms in both equations. Since they use f in the Rayleigh term, they should probably stick with 'x' in both equations to denote the ammonia uptake fraction.

Done, see reply above.

p. 13925: The estimated rates of nitriïňĄcation at the Plateau are 12-22 mmol/m2/d over the 100 m euphotic zone, which corresponds to 0.12-0.22 mmol/m3/d or 0.12-0.22 umol/L/day or 120-220 nmol/L/day. These rates seem high. Are they feasible? How do these rates compare to other reported euphotic zone nitriïňĄcation rates?

Reply: These rates indeed are unexpectedly high. The peculiar conditions of this Southern Ocean environment, with mixed layer depths generally exceeding the euphotic layer depth, is thought to induce this condition. Nitrification is generally considered to be light inhibited and any nitrification occurring below the euphotic layer but still within the mixed layer would feed the entire mixed layer with new nitrate. This aspect is discussed in detail in the paper by Fripiat et al., which has now been submitted to Global Biogeochemical Cycles. We have added a few lines (at page 13926, Line 3) in the text highlighting this: "The conditions leading to the high upper ocean nitrification above the Plateau are believed to be related with the depth range of the euphotic layer and the mixed layer. Above the Plateau the euphotic layer (0.1% PAR level) is consistently shallower than the mixed layer and any nitrate produced from nitrification, a process which is supposedly inhibited by light (references), at the bottom of the euphotic layer therefore becomes retained in the surface mixed layer. This aspect is discussed in more detail in a paper by Fripiat et al. (submitted)."

Interactive comment on Biogeosciences Discuss., 11, 13905, 2014.

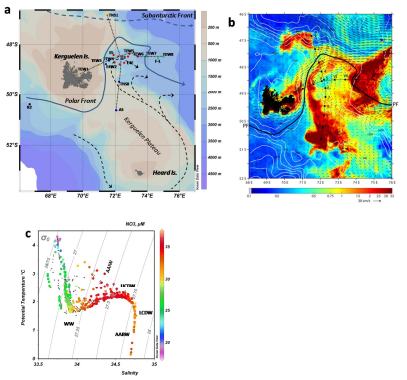

Figure 1: "(a) Kerguelen area with KEOPS 2 sampling grid. Blue dots = 'Plateau' stations; Red dots = 'Meander' stations; Green dots = stations at the Polar Front and north of the PF; black dot = 'Reference' station; Orange dots = stations outside the Plateau and Meander areas. The black line marks the position of the Polar Front; (b) MODIS Chlorophyll distribution (colour bar: mg m^{-3}); arrows represent the current speed, with scale marked by the small black arrow under the colour scale bar; (courtesy F. d'Ovidio); (c) T-S diagram (all stations) with [NO_3^-] superimposed. (ODV-AWI, R. Schlitzer).

Fig. 1.