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Biogeosciences Discussions

Interactive comment on "An iron budget during the natural iron fertilisation experiment KEOPS (Kerguelen Islands, Southern Ocean)" *by* F. Chever et al.

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This paper presents a detailed evaluation of iron data from the KEOPS experiment. The concentration data for dissolved and total dissolvable Fe are presented, and placed into a box model framework to calculate various rates of input and output and transformation (dissolved to particulate Fe).

The data looks reasonable considering the proximity to sedimentary (primarily resuspension) sources of dissolved and particulate Fe. The modeling reveals that lateral advective input is the dominant term in the budgets, however the lateral velocities are presented without variance estimates. Including velocity variance in the calculations

is likely to yield large variance in the Fe fluxes. And, since lateral advection is the largest term, this would generate larger variance estimates for the various fluxes that are calculated by difference. I recommend a thorough evaluation of the model flux estimates that incorporates the lateral velocity variances, followed by an evaluation of the statistical significance of all calculated fluxes.

Indeed, the velocity variance ($\pm$ 0.5 cm s-1, Park et al.: Internal tides and vertical mixing over the Kerguelen Plateau, Deep Sea Res. II, 55, 5-7, 582-593, 2008b.) was not taken into account in the calculation of lateral velocities. Taking into account this variance leads to larger variance estimates for the fluxes. An example of the flux calculation taking into account this variance is developed below (for the lateral advection of DFe in the surface box): the mean current velocity estimated by Park et al. (2008b) (= 4 $\pm$ 0.5 cm s-1) is multiplied by the section of the box (350 km width and 150 m depth), leading to a hydrological flux (Fw) of 1.81 $\pm$ 0.23 * 1014 L d-1. Multiplying the water flux Fw by the DFe concentrations from the transect C in the upper box, (Fw1*[DFe]C)1 (= 0.44 $\pm$ 0.03 nmol L-1) gives value of 23.9 $\pm$ 4.6 * 103 mol d-1 (instead of the previously flux of 23.9 $\pm$ 1.6 * 103 mol d-1 calculated without velocity variance). Variances of all the fluxes have been re-estimated in the same way. The importance of each term of this model was then tested by a one way ANOVA test (SigmaPlot®). Given that the "n" value is not known for all the fluxes (i.e. for atmospheric flux and for physical parameters like the Kz or the water flux), different "n" values (n= 3, 20 and 50) were tested and a Tukey comparison test was performed. Results showed that the lateral advection is statistically different from the atmospheric flux and from the diapycnal flux for all the "n" values tested ($p<0.001$). The results of the statistical tests were added to the manuscript (p 17, line 324-326):

"A Tukey test with different "n" values (from 3 to 50) shows that the lateral advection is always statistically different from the atmospheric and diapycnal fluxes ($p< 0.001$) for DFe and Feapp."

One of the problems with modeling such a dynamic region is whether to assume the system is at steady state. I see no serious discussion of this issue. Only by assuming steady-state can one calculate the E and F fluxes.

We agree with the reviewer. Our budget was constructed with the assumption that the system is at steady-state, even though the bloom was ended (which is indicative of a system in non steady-state, as also pointed out by P. Boyd). However, results of this budget revealed the weak impact of the biogenic pool on the apparent particulate iron stock. Indeed, the biogenic pool represents only 3.3 % of the total pool and the E1 flux (close to the biological uptake) is largely smaller than the lateral supply of iron. For these reasons, we can argue in favour of a system at steady-state. A sentence has been added, p 12, lines 201-203 to explain our assumption of a system at steady state and another p 17, lines 333- 334 to confirm that this assumption is verified:

p 12: "A steady state was assumed to allow the construction of this budget. Results of the calculated fluxes will give information on the relevance of this assumption."

p 17: "Whatever the state of the bloom, this result confirms a posteriori our assumption of a steady state."

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