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Interactive comment on "Export fluxes in a naturally fertilized area of the Southern Ocean, the Kerguelen Plateau: seasonal dynamic reveals long lags and strong attenuation of particulate organic carbon flux (Part 1)" *by* M. Rembauville et al.

Anonymous Referee #2

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The Southern Ocean is a large component of the oceanic carbon sink, and knowledge of particle export and remineralization in this area is important for understanding the global carbon cycle. This interesting manuscript presents a 1-year time series of mid-water particle export, collected using a moored sediment trap at 300 m depth in the Permanently Open Ocean Zone overlying the Kerguelen Plateau, together with a comprehensive set of physical parameters. Reported annual export rates were overall low (98 mmol m-2 y-1), with two periods of high export rates lagging peaks in surface

chlorophyll by approximately 1 month. The manuscript is well written, the results are well presented and the method limitations and uncertainties are clearly explained. I do, however, not fully agree with the interpretation of the flux synthesis. In particular, the conclusion that POC flux is rapidly attenuated is not clearly supported by the results.

The main discussion focus of this manuscript is based on the comparison of flux estimates from a long-term moored sediment trap to those from short deployments of various sampling devices (drifting sediment traps, UVP, 235Th; Table 3). The authors argue that there is an apparent rapid reduction in POC flux between 200 and 300 m depth. The first problem with this analysis is that the individual flux estimates had been collected using a wide range of equipment types integrating over different time periods; a direct comparison of the individual measurements to calculate flux attenuation is therefore tricky. A closer look at the data in Table 3 reveals moreover that there is no consistent trend in fluxes with depth. For example, according to the UVP, fluxes increased with depth in Feb 2005. When plotting all POC flux data against depth from Table 3 an overall decrease of POC flux with depth becomes apparent. Fitting a power-law gives an attenuation coefficient (b) of 1.16, which is considerably lower than the proposed 7-11.3. Rather, this attenuation coefficient lies well within the reported range of 0.4-1.7 (Martin et al. 1987; Marsay et al. 2015). Looking at Figure 8, one may argue that there is strong flux attenuation in Oct/Nov. A power-law fit to the approximate data gives b $\sim$ 5. Yet, the same problematic applies as discussed above: As fluxes had been collected using different methods, it is questionable how valid the regression is. Based on the presented data I therefore disagree with the notion that 'rapid attenuation of flux beneath the WML is a genuine ecological feature of the Kerguelen Plateau bloom.'

The authors next suggest mechanisms behind the apparently high flux attenuation. They explore the potential role of bacteria in remineralizing the POC flux by calculating bacterial carbon demand. The use of bacterial carbon demand in this context is incorrect; rather they should compare flux attenuation to bacterial respiration (see Giering

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et al. 2014). It is moreover not clear where the estimate for the flux attenuation (22.9 mmol m-2 d-1) comes from. According to Table 3, averages for POC flux at around 200 m and around 300 m depth are 22 and 12 mmol m-2 d-1, respectively. The POC loss between these two depths (∼10 mmol m-2 d-1) is similar to calculated integrated bacterial respiration (5-10 mmol m-2 d-1). As the data do not support the conclusion that bacteria cannot account for the loss of POC flux alone, the subsequent discussion is somewhat uncalled for.

Unfortunately, the current version of the manuscript needs major revision as the central conclusions do not appear to be supported by the analysis. Nonetheless, the core results of this manuscript are very interesting, in especially the offset between peaks in chlorophyll and export fluxes. I would suggest stepping away from analysing pieced vertical profiles and instead discuss the seasonal progression. There has also gone a lot of effort into the enumeration and identification of swimmers; I wonder whether it is worth looking into the ecology of these swimmers.

References:

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