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Biogeosciences
Discussions

Interactive comment on "Description of the biogeochemical features of the subtropical southeastern Atlantic and the Southern Ocean south off South Africa during the austral summer of the International Polar Year" *by* F. A. C. Le Moigne et al.

Anonymous Referee #2

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Anonymous reviewer 2

General Comments:

This manuscript describes the biogeochemical distribution of nutrients, chlorophyll-a, particulate organic matter (Nitrogen and Carbon), particulate inorganic carbon and biogenic silica along a transect in the South-Eastern Atlantic Southern Ocean in late austral summer (2008). The authors present an unprecedented amount of biogeochem-

ical data (water column profiles) for this undersampled HNLC region of the Southern Ocean. The data obtained is divided into four biogeochemical domains namely, Subtropical domain, the confluence of Subtropical and Sub-antarctic domains, the Polar Frontal zone (PFZ) and the northeastern branch of the Weddell Gyre. Each domain is discussed relative to its corresponding hydrography and biogeochemical characteristics, relating the observed chemical distributions to underlying physics. Overall the manuscript should be improved according to the "Specific and Technical comments", and there is some discussion points that should be better contextualised, in the discussion section, particularly relating the observed distribution to temporal timescales. Oligotrophic conditions in the surface waters in the northern (subtropical) region are supported by relatively low export production estimates from cited literature. The authors suggest no significant variation in nutrient concentrations throughout the growing season, however this highly turbulent region (Agulhas retroflection), observed Eddy activity and the elevated and variable chl concentrations in the surface throughout the year possibly could indicate highly variable conditions through the growing season. In the Subantarctic where the eddy activity was observed, tongue-shaped density contours are called on in support of the observed nutrient distributions. It is not clear how these silicate from Fig6 (taking the individual profiles adjacent to and within the eddies) support this trapping of 'distant waters' (in the cyclonic eddy) and winter convection (in the anticyclone). I think this section could benefit from seeing (a figure) the actual density contours from the cited literature. A diatom bloom in the Polar Front zone is inferred from the silicate gradient across the Polar Front, the depletion of silicate, low concentrations of chl-a, and relative accumulation of ammonium, based on previous published data in other regions. It is however difficult to infer temporal variability in nutrient concentrations from the current dataset, particularly referring to the bloom as a single event. Seasonal drawdown of silicate and nitrate well as daily production rates are estimated from seasonal drawdown of silicate and nitrate assuming a 90 day productive period, is useful, however the dataset gives stronger supports for spatial distribution patterns than for temporal variability. For instance Si* data support the spatial

distribution and potential decoupling of Si and NO3 cycles. The spatial distribution is well supported the data does not support temporal removal of silicate which makes the temporal explanation speculative. The final paragraph in the conclusions is also speculative, and does not warrant a conclusion, but should be integrated into the main text of the manuscript, instead of being tagged on at the end. The conclusions should better highlight the relevance of this work with regard to the Southern Ocean biogeochemical zonation.

Specific and Technical comments Introduction: This overview of the Southern Ocean biogeochemical and physical characteristics sets the scene for the historic current understanding of the importance of understanding the Southern Ocean characteristics. The use of some terms is grammatically incorrect or ambiguous. For instance, p5015 line5 “biogeochemical divides separate” could read ‘biogeochemical features separate or divide’. The use of “the conception. . .” (P5015 line10) is unclear. P5015 line 28,: it is “annual production that is potentially limited to annual supply” not production in general. P5016 line 13,: what is meant by “biogeochemical functioning”? Does it mean biogeochemical features?

Sampling: P5017 line 2,: Figures are mislabelled. The reference to Fig. 2 (Si(OH)4, NO3 and PO4,) should be moved earlier in to distinguish it from Figs 3-4 which is upper 300m plots. P5018 line 6,: abbreviation for chlorophyll-a already defined earlier in text, and should be used consistently. P5018 line 14,: replace “by acidic (HCl) smokes” with ‘with concentrated HCl’.

Results: P5019 line3,: “. . .domain ‘which’ extended. . .” . the word ‘which’ or ‘that’ is missing from the text. P5019 line13-14,: is the subtropical and subantarctic zones the same as subtropical and subantarctic domain? It is not clear where the boundaries of the specific zones/domains are. P5019 line 19,: reference required for eddy-slope interaction. P5020 line 30,: Winter water is not defined anywhere, and it is not shown from the data, so it needs a reference. P5021 line 14,: “Nitrate and Phosphate increased southward. . ..”. This increase with latitude is only apparent in the surface not

in the entire water column and should be stated as such. I think the reader would benefit by indicating/labelling the water masses on Figure 2, since although it is described in the text (and referenced) it is not always clear where these water masses are with respect to its nutrient characteristics, without having to go to a figure in the referenced manuscripts. P5022 line4,: Rephrase “Persistent concentrations. . .”. P5022 line23,: which concentrations is referred to in the top 100m? P5023 line 4,: replace “undetectable” with ‘below detection limit”. The latter speaks of the instrumentation limits whereas the former is absolute.

Discussion: P5024 line 5: Silicate concentrations remained low north of the PF despite increases in the other major nutrient concentrations while all nutrients were depleted in the surface north of the Subantarctic Front. Consider revising this opening first sentence. P5024 line 18,: ”. . .extremely very low. . .”. Use one or the other, not both. P5025 line 10,: ‘upward pointing tongues” of silicate profiles within and adjacent to the observed cyclonic eddy are given as support for trapping of distant waters (and later in the text winter convection fig6b). However it is not clear from the individual silicate profiles. Is a similar pattern observed for nitrate and phosphate? Perhaps a reference to a section (ie fig2) would suffice for the changes in nutrient isopycnals? However it is apparent from Fig 2 either, without looking at the density surfaces of Arhan et al 2011. P5027 line 25,: spelling of stoichiometry. P5024 line 14,: ‘extent’ instead of “extend”. P5028 line 22,: Several limiting factors (light, Fe, Si) not just Fe, could be responsible for augmented uptake ratios of Si:N away from 1. Although the Fe concentrations are low in the surface (<0.2 nM) since Fe limitation was not explicitly tested, the authors should highlight other possibilities. P5030 line 2,line12,: Figure 9 and 10 absent from manuscript? Plots referred are panels b and c in Figure 8. P5031 line 2,: Sea ice inferred for possible Fe deposition. Is sea-ice melt possible for diatom blooms stimulation this late in the austral summer season at such northerly latitudes (55oS)?

Interactive comment on Biogeosciences Discuss., 9, 5011, 2012.