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Biogeosciences Discussions

Interactive comment on "Nitrogen uptake by phytoplankton in the Atlantic sector of the Southern Ocean during late austral summer" *by* W. R. Joubert et al.

Anonymous Referee #2

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The goal of this paper is to quantify the nitrogen uptake rates and new production in terms of carbon during summer in the austral southern ocean. The authors present a large set of data (nutrient concentrations, nitrogen uptake and chlorophyll in various size fractions. . .) which have been collected along a latitudinal transect of 12 stations including 3 oceanic regions: Subtropical zone (STZ), Subantarctic zone (SAZ), Polar frontal zone (PFZ) and Antarctic zone.

The main results of the papers are that 1) large part of primary production was supported by regenerated nitrogen (especially urea) and 2) carbon export estimates derived from new production (15N-NO3 uptake) appeared largely higher than those de-

rived from 234Th flux. This topic is timely and important i) to understand the biogeochemical cycles in the southern ocean, ii) to establish correctly a carbon budget and iii) to quantify atmospheric CO2 sink. I am sympathetic to the point being addressed, and I think this work would be done to better understand how it is really possible to quantify carbon export. That said I do not feel comfortable with this paper. In fact, there are some major issues with the experimental procedures that greatly affect the conclusions and interpretation, and necessarily prevent suitability for publication. The main problems come from the estimation of nitrogen uptake rates and carbon export; thus, the paper presents many weak points:

1) Ammonium and urea concentrations were generally high (up to 3 μmoles.l-1) indicating very active processes of regeneration. These processes certainly lead to significant isotopic dilution during incubation. Then, urea and ammonium uptake rates have been certainly largely underestimated. 2) Estimates of carbon export were derived from nitrate uptake rates. But the part of nitrate issued from nitrification in unknown. Considering the significant regeneration activity revealed by high concentrations of ammonium, nitrification can not be ignored, especially at depth. Consequently, carbon export estimates from nitrate uptake have been overestimated, probably. Some additional information on nitrification could be given by nitrite concentrations, if available.

3) Nitrogen uptake rates and especially nitrate uptake rates show very high values at 10 and 1% incident light, often higher than those measured at surface (see stations L1, L2, S2, L3, L4, L5,L6, L76, S5). How the authors can explain these vertical profiles of nitrate uptake? I suppose that depths indicated in table 1 correspond to the 5 irradiance levels. Please improve. 4) More, considering the high values of nitrogen uptake observed under 1% light, integrated rates have been probably underestimated at several stations. 5) Urea is an organic substrate assimilated easily by heterotrophic bacteria. Then, how to be sure that urea uptake was only regenerated production, i.e. nitrogen uptake associated with photosynthetic carbon fixation? Heterotrophic urea uptake can lead to underestimation of f-ratio. I have some reservations on the use of uptake rates

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for the f-ratio estimates. Please discuss.

6) Comparison between the two estimates of vertical carbon fluxes need to be more deeply discussed according to the above comments.

Some specific comments a) STZ area does not seem to be really oligotrophic. Nitrate concentration ranged between 0.25 to 2.01 μmoles.l-1. Very low concentrations (<0.05 μmoles.l-1), as indicated in section 3.2, are not presented in table 1. More POC values are very high in this region, ranging from 5-8 to 12 μmoles.l-1. What is the origin of this biomass?

b) Figures 5 and 6 are not really useful or need additional discussion.

Finally, I found the discussion of low level on the whole. All the points listed above need to be more deeply discussed. In conclusion, I consider this paper not enough accurate to be published as it stands

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Interactive comment on Biogeosciences Discuss., 8, 4917, 2011.