

Interactive comment on “Carbon, oxygen and biological productivity in the Southern Ocean in and out the Kerguelen plume: CARIOCA drifter results” by L. Merlivat et al.

Anonymous Referee #1

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General comments:

The manuscript by Merlivat et al. describes the dynamic of the CO₂ system and dissolved O₂ during the KEOPS 2 experiment on the Kerguelen plateau, based on high-frequency measurements from a lagrangrian buoy. Based on in-situ data, the authors compute the daily DIC consumption and NCP during short periods in the most stable water masses. They then discuss the link between this biological production and the dFe concentrations distribution and hydrodynamic properties in the study region. Their main conclusions are that the approach used to estimate NCP provides conclusive results and that one should be cautious when extrapolating air-sea CO₂ fluxes in such dynamics ecosystems as the Kerguelen plateau.

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My general opinion is that this study provides interesting insights on the link between biological production/respiration, dFe concentrations and air-sea CO₂ and O₂ fluxes in fertilised waters. The approach used in the manuscript to compute NCP is not new and has been used by the authors before. In my view, the clarity of the manuscript could be improved (see my specific comments below) and some results highlighted before publication. Each page and line numbers correspond to the printer-friendly version of the manuscript under discussion.

Specific comments:

Page16878, line17-19: Please rephrase sentence, where was the sink and where was the source of CO₂?

Page16879, line25-26: Here and elsewhere in the manuscript, decide if you define a new acronym, for example NCP in brackets (NCP) or between commas, NCP, and do not define twice the same parameter, (for example DIC is redefine in the conclusion!) please homogenise all the manuscript.

P16881, l25-26: Please provide an estimated accuracy for the computed DIC as this is particularly relevant in the NCP computations.

P16881, l28-29: Indicate accuracies of the O₂ measurements (Winkler and Optode).

P16884, l3-15: I think there is a confusion here in the definition of DIC_{max} and O₂_{min}, it should read “At night, as a result of respiration and of the mixing between the warm layer and the mixed layer, DIC increases and O₂ decreases; they reach maximum (DIC_{max}) and minimum (O₂_{min}). . .”

P16885, l3: For clarity the paragraph of section 3.4 starting with “Between two consecutive mornings (l13, p16887) and finishing by “we will discuss later the uncertainties related to this choice (l24, p16887) should be moved here in section 2.4.

P16885, l12: Replace last sentence by: “In the polar frontal zone, data showed O₂ undersaturation”.

P16886, I23-I25: I do not see this increase of 2 $\mu\text{mol}/\text{kg}$.

P16887, I10: units should be in $\mu\text{mol}/\text{kg}$, not 5 and 12 mmol/kg .

Section 3.4: As mentioned in the comment above, the description of h/h^* should be moved to section 2.4. Here in section 3.4, I would recommend to comment in slightly more details Table 1 and keep the results of NCP from table 2 as described in the current version.

P16890, I24-28: The comparison of NPP versus NCP and how it leads to the underestimation of NCP is confusing, especially the conclusion: “We take into account an underestimation of 33% to compute NCP”. Please clarify how this underestimation is taken into account in your final results in tables 1 and 2.

P16890, I3: Should read 130 $\text{mmol m}^{-2} \text{d}^{-1}$, not 13 $\text{mmol m}^{-2} \text{d}^{-1}$, please correct.

P16890, I15: Replace “Finally” by “further” and do not start on a new line as this is still part of your argument supporting your choice of h , h^* and MLD.

P16890, I27: Last sentence starting with “Notwithstanding...”, is unclear and I think should be rephrased as “NCP based on O_2 measurements have to be considered with caution when the biological contribution is small...”

End of section 4.3: After the review of papers on O_2/DIC ratios, it would be interesting to discuss the highlight of this study compared to those previous papers.

First line of section 4.4: This is the first time you discuss Fig. 4, either relocate it or use it earlier in the manuscript to describe the buoy trajectory.

Last sentence of section 4.4: I think the last conclusion of the last sentence needs to be discussed in more details.

P16892, I23-24: “. . .as clearly the control by light and nutrients to sustain the biological production of organic matter must be very similar on both sides of the polar front”, Could you provide a reference for this argument?

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P16893, I25-27: Rephrase sentence, not clear.

P16894, I8-9: Rephrase sentence, not clear.

Figures:

Figure 1: The grey dots are not visible, please modify, also use an arrow instead of a blue dot to show when the buoy is crossing the front as this is particularly relevant in the discussion.

Figure 2: Why do you use a reverse scale for DIC? In my view, it is better to have the O₂ vs DIC signal in opposite directions for scientific purpose.

Figure 3: Increase size of the black line, not clear.

Figure 4: The trajectory of the CARIOCA should be in white, not visible in black.

Figure 5 to 7: The quality of these figures is rather poor. Some axes are difficult to read, colours not visible, etc. . . My advice would be to use thinner lines with no data points and shades of Grey/Black for the plots, and only colour for specific dots or events you want to illustrate such as on figure 7.

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