

Interactive comment on “Isotopic fractionation of carbon during uptake by phytoplankton across the South Atlantic subtropical convergence” by Robyn E. Tuerena et al.

Anonymous Referee #1

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This paper presents data about spatial variation the carbon isotopic composition of POC and DIC in the subtropical convergence zone of the south Atlantic and authors interpret their findings in terms of CO₂ solubility (temperature) and phytoplankton physiology (cell size; growth rate). Authors conclude to an important weight of cell size and growth rate in setting the measured isotopic composition of the phytoplankton. They also discuss the impact of the ongoing atmospheric CO₂ increase and resulting ocean warming on future isotopic fractionation and phytoplankton isotopic composition.

The authors are rather conservative in providing information about some methods used. In particular about the following: Phytoplankton size classes as deduced from

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pigment assemblage. Just referring to Bricaud and Uitz seems hardly enough .. the few lines (27 to 33) at page 6 don't really enlighten this issue. The same holds for the use of Rau's diffusion model. There is no discussion whatsoever about 'why this model (which is quite complex) is selected, neither about the model parameters (including growth rate) which are mainly taken from the original Rau paper.

Page 6, Line 15 (and also page 7, line7): It is not clearly stated how model estimates based on 'temperature alone' are obtained, except for a reference to Rau et al. 1989. Is this the same as the original Farquhar model as described by François et al. ? If so, that model does not consider cell size .. but you mention a constant cell size of 10 μm was used. Please clarify.

Page 7, Line 1 and Figure 5: authors state that cell radii were smaller in the subtropical waters compared to the SASW. From Figure 5 this is hardly visible.

Page 8 Line 6: these trends 'contrast' the global observed variability... They contrast in what sense?

Page 8, line 21: the sentence 'A higher growth rate increases the expression of a high ε_p on smaller phytoplankton' is unclear. Please reformulate.

Page 8 lines 20 to 27: the whole of the discussion here is highly hypothetical, and only yields a statement that waters north of the SSTC have 'the potential to elevate growth rates'. Later in the discussion it seems the 'potential for' has become a solid fact (e.g. line 14 and lines 19-20 at page 9).. Also it is likely that this frontal area is influenced by N-nutrient rich AAIW and SAMW waters. Have the authors considered this ?

Page 9, line20: Why would decreased light limitation lead to higher growth rates ? Higher biomass and higher primary production, yes, but why higher growth rates ?

Page 9, Lines 16-20: increase cell size reduces the expression of a high ε_p as shown by the higher $\delta^{13}\text{C}_{\text{POC}}$ and lower ε_p ..). It seems to me the data points rather fit the general trend of $\delta^{13}\text{C}$ and ε_p , and highlighted offset mentioned, appears weak.

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Though this is not the subject of this paper, it is interesting to see this decrease of $\delta^{13}\text{C}$ DIC also in cold North Atlantic waters. What is the explanation for this phenomenon? Page 10, line 5: “.. predicting increases in ε_p and decreases in $\delta^{13}\text{CPOC}$ “. Figure 9 rather shows increasing temperature would result in decreased ε_p and increased $\delta^{13}\text{CPOC}$..

Page 12: the authors conclude to the significance of their findings for future studies of $\delta^{13}\text{C}$ in food web studies. They could add that this also extends to future studies about the fate of plankton organic matter in the deep ocean. In that aspect an useful paper that can be cited is the one by Cavagna et al., BG 10, 2013 “Water column distribution and carbon isotopic signal of cholesterol, brassicasterol and POC in the Atlantic sector of the S.O.”

Minor things: Page 4 line 6: 50 ml of 100% HgCl_2 were added; I guess you mean 50 μl ..? Page 10, line 11: the wording ‘physiological status’ is rather vague.. can you specify more ? Figures 4 and 5: mark the waters located north and south of the SSTC Figure 7: the full red line is not specified

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