

Dear Dr Roobaert and co-authors,

Thanks for the revised manuscript, which is now accepted to publication in Ocean Science. Upon submitting the final files, please consider the below technical corrections.

Response: We thank both reviewers and the editor for their constructive comments on our manuscript and are delighted that it has been accepted for publication in the Ocean Science journal. We have addressed all final comments from the editor. Please find below our detailed response.

On behalf of co-authors,

Alizée Roobaert

L225 I would not call this marginal, as the reduction is about 25%. Please change wording.

Response: We agree that this was misleading. The argument for choosing the space-varying only is based on the improvement compared to the initial bias using the traditional approach of Sarmiento and Gruber and the relatively tedious calculation of the time and space varying coefficient which is more difficult to implement. We rephrased as follows:

Line 222: “At this location, the use of the regression-based coefficients greatly improves the recovery of the simulated pCO<sub>2</sub> compared to using the traditional coefficients of Sarmiento and Gruber (2006), reducing the rmse from 83 μatm to 24 μatm corresponding to a bias reduction of 71%. The use of both space and time dependent regression-based coefficients further reduces this bias, bringing down the rmse from 24 uatm to 18 uatm corresponding to an additional 7% reduction of the initial bias (83 μatm). Based on these results, we chose to use This improvement is only differs by 25 % compared to the space varying only, motivating our choice to use the simpler approach of the space dependent only coefficients, which is a simpler approach to implement here and in future studies. ~~This additional improvement is however marginal, motivating our choice to use the simpler approach of the space dependent only coefficients.~~”

L259 Not sure what you mean with: the surface pCO<sub>2</sub> concertation (especially the last word)

Thank you for catching this typo. We corrected to “the surface pCO<sub>2</sub> concertation” in “surface pCO<sub>2</sub> concentration”.

L275 and other places: Not sure why you call the SOCAT data raw. SOCAT data haven been QCed, and thus are not raw.

Response: We agree with the editor and removed “raw” everywhere in the text (specifically L131, L139, L279 and L313).

L352 the east coast of the U.S.A.

Response: The English guidelines of the Ocean Sciences journal states that “*Cardinal directions should only be capitalized when part of a proper noun*”. The most appropriate way might actually be to use “East Coast” rather than “east coast”. We looked at the literature in this region and decided to use the more commonly used regional name of “U.S. East Coast” (see for instance Najjar et al., 2018). We changed everywhere in the text and figures.

L499 and other places: I think biology should be biological processes. “Biology” is the discipline, but generally it is about the processes in this discipline which interests us.

Response: We agree with the editor and modified accordingly. We also change “physics” by physical processes. These changes are in Lines 28, 493, 503, 508, 566, and 616.

All the listed bibliography items have been updated and corrected:

L640 Bakker et al: Please check the author list, some are doubled.

Response: We updated the list of the author

L723 Change to: Global Biogeochem. Cycles, 23(1), GB1005, doi:10.1029/2008GB003349, 2009.

Response: The reference has been modified.

L726 Change to: Science, 363, 1193–1199,

Response: The reference has been modified.

L732 Please add editor, publisher and city

Response: The reference has been modified.

L746 Add volume, pages

Response: The reference has been modified.

L774 Delete n/a-n/a,

Response: The reference has been modified.

L776 Add journal name

Response: The reference has been modified. We also changed the type of citation which is a book section instead of a journal article.

L780 Change to: Science, 315, 637–639,

Response: The reference has been modified.

L806 Add volume and article number

Response: The reference has been modified.

Note that we also added some text in the Acknowledgements section and modified some typos in the text.