

Interactive comment on “Data-based estimates of the ocean carbon sink variability – first results of the Surface Ocean $p\text{CO}_2$ Mapping intercomparison (SOCOM)” by C. Rödenbeck et al.

Anonymous Referee #1

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Summary of paper This paper explores the various new methods used to create full coverage open-ocean $p\text{CO}_2$ maps for recent decades. Along with a general overview of the methods, including their similarities and differences, the authors delve into statistical comparisons involving mean annual values, interannual variability and seasonal amplitudes.

General Comments This is an excellent paper presenting worthy mapping methods with detailed analysis of seasonality and interannual variability within and between methods. The objective of fostering inter-method investigations and conversations is a valuable contribution as a whole. I think this work provides a valued resource to the ocean carbon community and has excellent scientific significance. However, I feel it

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could improve on its aim to provide an uncertainty estimate or assessment of ocean carbon. One critique- it would be beneficial if the authors could provide a suggestion for an “optimal” method of those presented here. It is perhaps the case that the “optimal” method would vary for regional studies versus global studies, but guidance from the authors on this selection would prove valuable for the users of these maps who are less in-tune with their intricacies. I acknowledge that this work is not meant to rank methods but instead exploit the benefits of their complementarity, however some comments on optimal methods would be appreciated.

Specific Comments

-The emphasis throughout is on the consistencies and differences between regressing and non-regressing methods (including the amplitude of the interannual variability). I think further information and discussion on the methods tying interannual variability to model simulations would be helpful.

-SOCAT provides values of $f\text{CO}_2$ while LDEO provides values of $p\text{CO}_2$. This paper discusses differences in $p\text{CO}_2$, which leads me to believe that all values have been converted to $p\text{CO}_2$. Was this transition done consistently between methods or is this an additional source of (albeit, I recognize small) variability?

-I appreciated the attention to detail with regard to spatial gap filling and other considerations made before intercomparisons between methods were discussed. I did wonder if a monthly climatological value was used for this pixel filling or if it was just an annual climatological value regardless of month.

- What is the amount of data is shared between the LDEO and SOCAT datasets? Is this a large percentage, leading to possibly smaller differences than expected in the methods utilizing these separate databases? Additionally, for those methods using the SOCAT dataset, was there consistency between methods in using the gridded product (either weighted or unweighted) versus using the individual observations to create the maps?

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- Figure 3 is exceptional and a great way to display the discussion.

- Figure 1A: "Monthly pCO₂ variations over 3 arbitrary years as estimated" could maybe be changed to Monthly pCO₂ variation over years 2003-2005 (chosen arbitrarily) as estimated. . ." Very valuable figure. - Explain figure A3 more in the caption. Is this the difference between the observations and what is shown in Fig A2? Have you accounted for "sampling" the maps at month and pixel that data exists for this comparison? - Figure A5- could you possibly improve by showing an area-weighted mean coverage or maybe the number of pixels (1x1 gridcells) with at least one observation per year vs the total number of gridcells in the biome? - Footnote 5 gives a contradictory message than that stated earlier on the page (14063) in Lines 1-4 concerning the data density in the NA SPSS. This biome in fact has the highest data density (especially in the 2000s). Sparse data cannot simply be blamed for methods that strongly differ in their seasonal cycle amplitude. - The sentence on pg 14064, line 18-19 stating "sampling biases pose the most prominent challenge to all the mapping methods" is a strong conclusion from this research and should be highlighted further throughout the paper and in the conclusions. - Appendix A gives a great concise description of the various methods, allowing a reader to not have to reference each paper individually- very nice inclusion.

Technical Correction Page 14069, Line 25. Remove ", however," for clarity.

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