We would like thank Luke Gregor for his useful comments. Please find below our detailed responses to each comment.

Luke Gregor: I'd like to thank the authors for incorporating my suggestions into the manuscript. They have sufficiently addressed the points that I raised. The figures are also much improved! Clear and big. Same applies to the captions, much clearer. Thank you.

One point that I think the authors should add to their conclusion, is that the only addresses short term interannual variability (3 years). Gloege et al. (2021; https://doi.org/10.1029/2020GB006788) used different ML methods and model simulation output to show that long term variability may not be captured, even if short-term interannual variability is well captured. Just a sentence to point out this limitation is enough.

Authors: Thank you for this interesting comment. We added in the conclusion: In this study we focused on the reconstruction of short-term interannual variability (3 years: 2008-2010) of pCO_2. The results can be different for long-term variability which will strongly depend on the data availability and its distribution over a longer period (Gloege et al., 2021). (lines 447-450).

LG: Further, I picked up on some minor issues that need to be corrected:

L41: *on board ~~of~~ volunteering observing ships*

A: modified as suggested (line 41).

LG: L42: *sampled in space and ~~also in~~ time*

A: modified as suggested (line 42).

LG: L49: *prevent ~~a year around~~ sampling → prevent year-round sampling*
A: modified as suggested (line 49).

LG: L51-L54: thank you for adding these studies. However, I feel that the outcome of these studies also needs to be included, *e.g.*, how many floats can capture variability.

A: We added in the text: "Both studies showed that 150-200 floats can be sufficient to reconstruct a seasonal climatological CO_2 flux (Kamenkovich et al., 2017) with an error less than 0.1 PgC/yr for the Southern Ocean uptake (Majkut et al., 2014)." (lines 55-57)

LG: L60: *This study*. I find the reference to *this* a bit ambiguous. I suggest the following: *Here, we extended the scope...* and later: *We explored design options...*
This makes it very explicit that you are referring to your study and not one previously mentioned.

A: modified as suggested (line 62).

LG: L83: *observing systems* may be a little ambiguous. Perhaps *observing platforms* is better, but the authors can choose to stick with the original if they feel that it is clear enough. This would have to be changed in section 2.1 also.

A: We replaced “observing systems” by “observing platforms” in lines 84, 93, 94 and 444.

LG: L178: *As previously (Denvil-Sommer et al. 2019)* → *As in Denvil-Sommer et al. (2019),*

A: modified as suggested (line 180).

LG: Fig4: would it be possible to maintain the aspect ratio of the figure, so that the contours maintain their circular shape?

A: We modified proportions of sub-plots in Figure 4. We applied the same changes to Figure S1.