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Interactive comment on "A uniform pCO_2 climatology combining open and coastal oceans" *by* Peter Landschützer et al.

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Reviewer Rik Wanninkhof, NOAA/AONL A uniform pCO2 climatology combining open and coastal oceans Peter Landschützer, Goulven G. Laruelle„ Alizee Roobaert, and Pierre Regnier

The is a nice descriptive paper providing the procedures of merging the coastal pCO2 NN data from Laruelle et al. 2017 with the global fields of Landschützer et al. 2016. It gives an overview of the means of merging, and then provides an extensive analysis of the differences in the region of overlap using several coastal locations as examples. Writing style, syntax and grammar are very good and procedures are clearly described. Figures are of good quality but I wished there would be a way the more clearly show

the coastal area that shows up as a thin multi-colored rind in the figures.

The paper is an important contribution in documenting the procedures and outcomes of the combining exercise, and shows, on the whole, a consistent final product. Laruelle et al. 2017 mentioned that the products could be "readily merged". As this paper aptly describes the merging is not "readily done" but requires specific procedures, assumption and approaches which are well detailed in this manuscript. My comments below should not be considered a requirement for changing the manuscript, that seems good as is, but rather issues that came to mind while reading the paper. It therefor does not require a point by point rebuttal.

General comments - There should be some indication of how many observations there really are in the coastal region (and Open ocean overlap). % of pixels with observations (where the pixel is the 0.25 degree monthly "grid box" for the time period) is a good metric for each of the 30ËŽ regions investigated. - Different predictors are used for the coastal product and the open ocean dataset. E.g. Coastal uses wind and bathymetry (and sea ice); while the open ocean uses mixed layer depth (MLD). Is there any estimate how different the nn outputs are? That is, perhaps some mention if the different predictors influence the comparison between open ocean and coastal. In particular, what is the effect of not using MLD in the coastal product when we know large parts of the broad Western shelves are strongly stratified for part of the year? - What is not empathized is that in the overlap region the pCO2 observations used in coastal and open ocean products are exactly the same (I believe). - Is the data quality for the coastal data lower than for the open ocean? And, if so, does this have an effect (That is, I believe that that are more SOCAT "C" cruises in the coastal than in the open ocean).

Specific comments Page 1. Line 9 "This also illustrates the potential of such analysis to inform the measurement community about the locations where additional measurements are essential to better represent the aquatic continuum": This is also mentioned in the conclusions but I do not see clear evidence of how this is the case. Page 3. Line

5 “whereas Roobaert et al. (2019) suggests that this difference stems from the uneven latitudinal distribution of surface areas between coastal and open ocean but that adjacent open and coastal regions behave similarly.”: I don’t understand this. Page 3, line 15. “As a signiĳňĄcant fraction of this CO2 outgassing derived from terrestrial carbon inputs likely takes place near the coast or across the coastal-open ocean transition,”: I believe that the working assumption is that this outgassing occurs in the southern hemisphere far away from the rivers (due to slow oxidation of riverine supplied terrestrial organic matter).

Page 4: It would be illustrative to show a map of the different provinces for coastal and open ocean (I know the boundary are not fixed but they do not vary that much) Page 4 line 20 “Firstly, we replaced the mixed layer depth proxy of the NNopen from de Boyer Montegut et al. (2004) to the Argo based MIMOC product”: a. How much difference does this make?; and b. If it is purely ARGO based it will be for water depths > 1200 m so much of the open ocean coastal overlap would not have good MLD.

Page 7. Line 14 “N is the number of available gridded data from SOCATv5 available in a given 30x30 raster box and the subscript l refers to either NNopen or NNcoast”: This information would be of interest as a table for each 30 by 30 region Page 8. Line 17 “Figure 5 reports the absolute pCO2 difference in % between NNcoast and NNopen along the common overlap area relative to the mean partial pressure of the merged climatology.”: Including this in a table for each province or 30 by 30 region along with the st deviation would be illustrative. Table 1- providing the % of coastal-no obs. And % coastal-open collocated would be of interest.

Fig 6. Providing the standard deviation of the mismatch shown d,e,f as extra panels would be of interest. Fig 7- 12 repeating the legend rather than stating “like Fig 6” will make reading the paper a bit easier Page 13. Line 5 “The area is spatially well covered both in the open and coastal ocean SOCAT datasets”: It would be worthwhile to quantify what “well covered means” . Page 15. “Some of the best monitored regions spanning both coastal and near-shore open ocean can be found along the US coast

(Fennel et al., 2008; Laruelle et al., 2015; Fennel et al., 2019)”: Perhaps include reference to “Signorini, S. R., Mannino, A., Najjar, R. G., M., F. M. A., Cai, W.-J., Salisbury, J., Wang, Z. A., Thomas, H., and Shadwick, E. H.: Surface ocean pCO2 seasonality and sea-air CO2 flux estimates for the North American east coast, J. Geophys. Res., 118, doi:10.1002/jgrc.20369, 2013.”

Page 15: “climatological nature of the merged product, which does not reïňĆect the variable upwelling as a result of interannual variability linked to ENSO events.”: Could this be verified by looking at the standard deviation? Page 17. Figure 10 The N-S spatial trend in panels d-f is pretty apparent. While it is alluded to in the text the description seems a bit vague.

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