Dear Anonymous Referee #1,

We very much appreciate your quick and constructive comments, which allowed us to improve the overall quality of our manuscript.

**Anonymous Referee #1 Comment (AC):** *I hope that the authors upload this data to either (or preferably both) of these databases, as it is a useful dataset for the community.*

**Author Reply (AR)**: Be assured that we will upload this dataset to both SOCAT and LDEO databases.

**AC:** *I would expect more profiles to be available in the CS regions, have the authors looked for research cruises or glider based observations of MLD in the CS region? More in-situ comparisons (outside of E1 station) against the modelled MLD would be welcome, as this is a complex region for MLD approximation.*

**AR:** We considered your remark and made 2 additional figures (in supplement material, Fig. S1) to compare the observed MLD in the Celtic Sea and at E1 fixed station with Armor-3D L4 Analysis observation products provided by the Copernicus Marine Environment Monitoring Service (ex-MyOcean, http://marine.copernicus.eu/). The later are combined products from satellite observations (Sea Level Anomalies, Mean Dynamic Topography and Sea Surface Temperature) and in-situ (Temperature and Salinity profiles) on a ¼ degree regular grid in our study area, and modelled MLD computed from the MARS3D model. These figures clearly show the robust approximation of MLD by the model, particularly concerning the start and the end of stratification, despite a small overestimation of the modelled MLD compared to the observed MLD from the Armor-3D L4 Analysis products. In the revised manuscript, we give these details at the end of Section 3.2. and refer to the supplement material for the new figures supporting our modelled MLD.

**AC:** *I would recommend using a finer scaled wind product, such as those available from the ASCAT sensor (KNMI have a 25 km coastal product that may be of interest.) Or alternatively, a modelled wind speed from ECMWF or equivalent.*

AR: We followed your recommendation and now use 0.125° by 0.125° monthly average wind speed data from ERA-interim reanalysis as described in Section 3.2. of the revised manuscript.

**AC:** *Additionally, I am confused as to whether a correction has been made to account for the variability of monthly wind speed data. The air-sea gas exchange parametrisation used requires either high resolution data, or the intrinsic variability of monthly data to be accounted for.*

**AR:** We agree and now considered the intrinsic variability of monthly wind speed data in the revised manuscript using the four-time daily wind speed data from ERA-interim reanalysis. We applied the formulation given by Jiang et al. (2008) based on Wanninkhof et al. (2002) as explained in Section 3.5. of the revised manuscript.

**AC:** *There is very little data in the CL, NCS and IS, and an abundance of data in SCS and WEC. As the Ferry box measurements are also based in this region rich in SOCAT data, I am not convinced by the extrapolation of the MLR outside of the SCS and WEC, nor am I convinced that the low stated RMSE of the synthetic $pCO_2$ data derived from the MLR fully describes the errors that occur from extrapolating so far north (into CL, NCS and IS).*

**AR:** We acknowledge the referee #1 for suggesting the use of $pCO_2$ data from the LDEO database. Thanks to this suggestion we now have access to new $pCO_2$ data, particularly in IS and nCS, which consolidate our assumptions for the $pCO_2$ by MLR. These new in-situ $pCO_2$ data are represented by yellow dots on the updated Figure 8 of the revised manuscript. These new results support our extrapolation in these poorly studied areas and therefore support the main purpose of this study, which is to have access for the first time to $pCO_2$ estimates in this area where only few $pCO_2$ data are currently available. Figures 8, Figure 4 and Table 1 have been revised in the manuscript to include these new sources of in-situ $pCO_2$ data.

In addition, as suggested by reviewers #2 and #3, we used the methods from Lauvset et al. (2013) and Omar et al. (2007) to calculate our uncertainties on air-sea $CO_2$ fluxes, which greatly strengthen our findings. We can now argue strongly on the role of different provinces as significant sink or source of $CO_2$ over a full seasonal cycle. We are very grateful for this tremendous improvement of our manuscript. We now give an explanation of the method in Section 3.5. based on the work of Lauvset et al. (2013) and Omar et al. (2007). All fluxes in the revised manuscript and figures are now given with their respective calculated uncertainties.

**AC:** *The issues of the sharp boundaries between systems regions in figures 9, 11 and 12 are also problematic, perhaps another reviewer has come up with a solution for this? For* *example, I am surprised in the strength of the gradient between the nWEC and sWEC, in figure 11 between August and October.*

**AR:** We based our separation of the different provinces on a 10 year dataset of SST covering the entire shelf (Fig. 2), which provides robust estimates of the mean location of thermal fronts. We feel that the use of fixed boundaries allow a clear discussion of our datasets and direct comparison between the representative provinces. The sharp boundaries between permanently well-mixed and seasonally stratified systems can appear as surprising, especially between August and October. However, these sharp boundaries are a fact that we observed every years between sWEC and nWEC waters. To support this we made 2 new figures (Figure S3 in supplement material) showing a comparison between in-situ $pCO_2$ data acquired during 2 crossing performed in August and September 2014 between Roscoff and Cork (Ireland) (from a newly exploited Voluntary Observing Ship, the ferry *Pont-Aven*) and mean $pCO_2$ data along the ferry tracks calculated from our MLR from 2003 to 2013. We did not have access yet to the requested satellite and modeled products in 2014, which explained the choice of using monthly mean $pCO_2$ estimates instead of newly computed $pCO_2$ estimates from remotely sensed and modelled data. These two figures and the new in-situ $pCO_2$ data between Roscoff and Cork clearly show the presence of these sharp boundaries and we hope that these new data sufficiently support and illustrate this phenomenon. In the revised manuscript, we added an explanation and reference to these figures to support our choice of fixed boundaries at the end of Section 4.3.2.

***References:***

Jiang, L.-Q., Cai, W.-J., Wanninkhof, R., Wang, Y., Hüger, H.: Air–sea $CO_2$ fluxes on the US South Atlantic Bight: spatial and seasonal variability. J. Geophys. Res., 113, C07019, doi:10.1029/2007JC004366, 2008.

Lauvset, S. K., Chierici, M., Counillon, F., Omar, A., Nondal, G., Johannessen, T., and Olsen, A.: Annual and seasonal $fCO_2$ and air–sea $CO_2$ fluxes in the Barents Sea, Journal of Marine Systems, 113–114, 62-74, 2013.

Omar, A. M., Johannessen, T., Olsen, A., Kaltin, S., and Rey, F.: Seasonal and interannual variability of the air-sea $CO_2$ flux in the Atlantic sector of the Barents Sea, Marine Chemistry, 104, 203-213, 2007.

Wanninkhof, R., Doney, S. C., Takahashi, T. and McGillis, W. R.: The Effect of Using Time-Averaged Winds on Regional Air-Sea $CO_2$ Fluxes, in Gas Transfer At Water Surfaces, AGU Monogr. Ser., vol. 127, edited by M. A. Donelan et al., pp. 351–356, AGU, Washington, D. C., 2002.