Authors response: We thank reviewer #1 for his valuable comments and for highlighting the importance of the work presented in this study in the context of the global carbon budget.

We addressed all comments raised by the reviewer and provide a point-by-point answer below (in blue). Changes and additions to the original manuscript have been introduced using the Word's "track changes" option and the line numbers noted in our answers refer to the revised manuscript with the track changes option. We also took this opportunity to correct several typos in the manuscript.

On behalf of the co-authors,
Alizée Roobaert

Reviewer #1 Evaluations:

This paper thoroughly evaluated the model performance in the coastal region. Then, it examined the drivers of pCO2 seasonal variations in several coastal regions using the decomposition method recently proposed.

Recent studies have shown that the CO2 uptake in the coastal ocean cannot be ignored in the global CO2 budget. The detailed analysis the variability of the coastal CO2 flux has been needed.

The manuscript is well organized and easy to follow.

- **R1C1: My concern is just that the decomposition results are shown in the only three coastal regions.**

As the authors mentioned, uncertainty of the reconstructed pCO2 dataset is not small especially in the data limited region. Therefore the model performance is not necessarily doubtful even if the model output is not consistent with the observation-based estimates.

As long as the discrepancy is clearly stated, the decomposition result in other regions and the detailed discussion of the geographical distribution of the driving force is useful for our understanding.

R1R1: We understand the reviewer's comment regarding the opportunity offered by our new method to analyze the seasonal variability of pCO_2 in others coastal regions than the ones presented in our study. The primary objective of this study is to introduce the coastal-tailored approach to quantify biological and physical contribution to pCO_2 changes and demonstrate that it works by showcasing a few case studies where the model performance is good compared to available observations and existing literature.

Naturally, we agree with the reviewer that the performance of the model is not necessarily doubtful in region with poor coverage in the pCO_2-based dataset and that investigating the rest of the global coastal ocean is a worthy endeavor. This first manuscript presents and evaluate the new methodology in detail, in line with the scope of the Ocean Sciences journal, and will allow to investigate coastal seasonal pCO_2 variability at the global scale in a second step by referring to this paper. We have, however, significantly extended the model to data comparison by adding direct comparison to raw SOCATv6 data in MARCATS that are well sampled, but also at 4 coastal sites (Antarctic Peninsula, Queensland Plateau NE Australia, Papua New Guinea and Terra Nova) where SOCATv6 data have a good spatio-temporal coverage even if they are located in MARCATS that are poorly sampled (See our new Fig. 6). Finally, we have changed the wording "model skill" to "model to coastal-SOM-FFN agreement" everywhere in the main text, figures

and tables, to emphasize that a poor agreement does not equate a poor skill and added the following sentence in line 387-390:

"Note that the model-SOCATv6 seasonal evaluation in Terra Nova presents a good agreement although the MARCATS scale (Sea of Labrador, M11) evaluation to which this region belongs to reveals a low agreement, showing that a poor agreement between coastal-SOM-FFN and the model does not equate to poor model skill when these regions are under sampled by SOCATv6."

Other minor comments are follows;

- **R1C2: Line 139 and many others, "Socatv6": "SOCATv6" would be better.**

R1R2: We agree with R1C2, and this has been changed accordingly everywhere in the main text, figures and in the supplementary material.

- **R1C3: Figure 1a: Dots and dashes in the inserted table are not similar with those in the main body of Figure 1**

R1R3: Indeed, there is an inconsistency in Fig. 1a between the dots patterns used on the map at the top of the figure to represent the level of 'model to coastal-SOM-FFN agreement' and the table presenting the legend. We thank the reviewer for pointing this out and we have updated the figure accordingly (see below).

Updated figure:

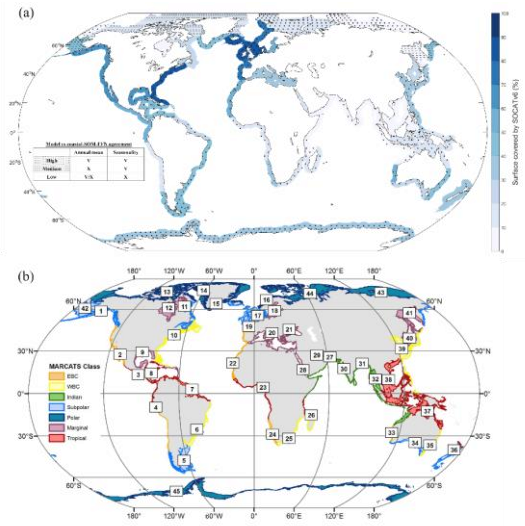

Figure 1: (a) SOCATv6 spatial ~~Data~~ coverage (color) and agreement between model and coastal-SOM-FFN ~~model to coastal-SOM-FFN agreement~~ product~~skill~~ (symbols) in coastal MARCATS (Margins and CATchment Segmentation) regions. The blue intensity indicates the fraction of the MARCATS' surface area covered by SOCAT~~ocat~~v6 observations (from light to dark blue). Dots indicate where the model fulfils three evaluation criteria ('high' ~~skill~~ agreement regions) on the spatio-temporal pCO_2 distribution (i.e., annual mean mismatch < 20 µatm between MOM6-COBALT and coastal-SOM-FFN, Pearson correlation coefficient > 0.5 and seasonal amplitude mismatch < 20 µatm). Dashes indicate where the model only fulfils two criteria (seasonal amplitude and phase, 'medium' ~~skill~~agreement). Other's regions ('low' ~~skill~~ agreement with no symbol) do not fulfil the two criteria associated with seasonality. Details on ~~model skill~~model to coastal-SOM-FFN agreement are in Table 1. (b) Discretization of the coastal seas into 45 MARCATS (Laruelle et al., 2013) grouped into seven classes: Eastern (MARCATS 2, 4, 19, 22, 24, and 33) and Western (MARCATS 6, 10, 25, 35, and 39) boundary currents (EBC and WBC, respectively), polar (MARCATS 13, 14, 15, 16, 43, 44, and 45) and subpolar margins (MARCATS 1, 5, 11, 17, 34, 36, and 42), tropical margins (MARCATS 3, 7, 8, 23, 26, 37, and 38), Indian margins (MARCATS 27, 30, 31, and 32), and marginal seas (MARCATS 9, 12, 18, 20, 21, 28, 29, 40, and 41).