

The author utilized a multi model machine learning framework and innovatively constructed a multi-scale analysis system for global, far sea, and near sea environments, reconstructing surface ocean $p\text{CO}_2$ from 2000 to 2019. This work is a comprehensive and rigorous study. It has a significant contribution to the field of ocean carbon sinks. There are some aspects that can be further improved and perfected before the manuscript is considered for publication.

Major Points:

1. Introduction, Line55: It is necessary to clarify the scientific issues existing in previous studies on $p\text{CO}_2$
2. Line 94: $p\text{CO}_2 < 200 \mu\text{atm}$ or $> 600 \mu\text{atm}$ is considered an outlier in the article, but sufficient literature support or physical mechanism explanation is not provided.
3. Results and discussion: During the discussion, it is suggested to supplement some references and compare and discuss the results of this paper with those of previous studies.
4. Line 150: The transition between Section 3.1 (Correlation Detection) and Section 3.2 (Model construction and evaluation) feels somewhat abrupt. To enhance the logical flow, it would be helpful to briefly state at the beginning of Section 3.2 how the findings from the correlation analysis informed the subsequent modeling step.
5. Line 275: Describe missing and blank values in multi-source data
6. Line 290: To better showcase the novelty of your work, please add a direct comparison with the cited studies (Zhong et al., 2022; Chau et al., 2021).
7. Line 320: Regarding the description of Figure 12, do the influencing factors of $p\text{CO}_2$ in nearshore areas take into account river inputs or anthropogenic CO_2 emissions?
8. Line 376: The text beginning at line 376 should be moved to a new "Conclusion" section. As this content serves as the concluding discussion for the entire study.

Some minor suggestions:

1. Line 14: It is recommended to correct the indefinite article for grammatical accuracy. "a ocean surface..." should be changed to "an ocean surface..."
2. Figure1: It is suggested to supplement the longitude and latitude
3. Figure3: The variable represented by the horizontal coordinate needs to be marked
4. Line 120: "d represents the level difference of the variable", d should be corrected to D

5. Figure 3: o2 in the coordinate axis needs to be corrected