Response to Reviewers' comments on ms no: egusphere-2024-3273 "Marine carbon dynamics in a coral reef ecosystem of Southern Taiwan" (Meng, Chang, Chou, Fan, Hsieh, Mayfield, and Chen)

Anonymous Referee #1

The authors have improved their manuscript; however, there are still some issues that I would like the authors to consider.

Thank you for your valuable feedback and for acknowledging the improvements made in our manuscript. We appreciate your time and effort in reviewing our work. In this revision, we have carefully addressed the remaining issues and make the necessary revisions to enhance the clarity, accuracy, and overall quality of the manuscript. Please find our detailed responses to each of your comments below

Line 56: Capitalize IPCC, 2021

Thank you for the reminder, and we apologize for the typo caused by the EndNote format. We have ensured that it is properly capitalized in the text.

Lines ~160: How long did each survey take? Authors stated samples were collected during daylight but was the time difference between 9am and 5pm? If so, that could be a significant difference.

Thank you for your inquiry. The sampling times for each survey are listed in Table S1 for reference. In this study, we aimed to minimize the overall sampling duration. However, due to the large number of sampling stations and the need to collect multiple samples for different variables at each station, the duration varied. We endeavored to complete each survey within approximately six hours.

Regarding the time difference between 9 AM and 5 PM, we acknowledge that this could introduce variability. While we strived to maintain a consistent sampling timeframe, logistical constraints occasionally led to deviations. We appreciate your thoughtful comment and hope this is understandable, particularly given the challenges of conducting fieldwork at sea.

Line 175: delete total for total TA

Thank you for the correction. We have deleted it as per your suggestion.

Line 269: Is there a figure or table to show this?

Thank you for the reminder. This relationship is presented in Table S2, and we

have now explicitly indicated it in the revised manuscript for clarity.

Lines 293-296 and 323-343: Again, there is no meteorological, satellite Chl a, or tidal+current data provided to support this statement. Other studies such as Hsu et al., 2020 (JGR) modeled that eddy upwelling occurs in the region year-round, not just seasonally in spring. Why did we not observe any trends in the other months then? Likewise, Tai et al., 2020 (Frontiers) also demonstrated that internal waves impact the SCS and can bring seawater pCO2 and pH to even lower observed levels than what was observed. The interpretation of this data information does not provide any evidence to support that upwelling is occurring.

Thank you for your valuable feedback. We acknowledge the absence of direct meteorological, satellite-derived Chl *a*, and tidal/current data in our study, which limits our ability to robustly confirm the occurrence of upwelling. While our interpretation is based on in-situ measurements, we now explicitly address this limitation in the revised discussion (L325–329, 335–339).

Regarding the seasonal signal, we agree that previous modeling studies, such as Hsu et al. (2020), suggest year-round eddy upwelling in the region. However, the absence of clear trends in our data during other seasons may be due to the transient nature of such upwelling events, which can last less than two hours and may not be adequately captured during the temporal window of a single cruise (335–339).

In contrast to the lower seawater pCO_2 and higher pH associated with internal wave-driven upwelling in the South China Sea (Tai et al., 2020), our observations showed elevated pCO_2 and reduced pH. This discrepancy could reflect differences in the source water characteristics or the spatiotemporal evolution of upwelling events in our study area (Chakraborty et al., 2023). We have clarified these points to emphasize the interpretive limitations and the need for supporting datasets in future work (L325–329).

Chakraborty, K., Joshi A. P., Ghoshal, P. K., Ghosh, J., Akhand A., Bhattacharya T., Sreeush, M. G., and Valsala, V.: Mechanisms and drivers controlling spatio-temporal evolution of pCO_2 and air-sea CO_2 fluxes in the southern Java coastal upwelling system, *Estuar. Coast. Shelf Sci.*, 293, 108509, 10.1016/j.ecss.2023.108509, 2023.

Hsu, P.-C., Lee, H.-J., Zheng, Q., Lai, J.-W., Su, F.-C., and Ho, C.-R.: Tide-induced periodic sea surface temperature drops in the coral reef area of Nanwan Bay, southern Taiwan, *J. Geophys. Res. Oceans*, 125, e2019JC015226, 10.1029/2019JC015226, 2020.

Tai, J.-H., Chou, W.-C., Hung, C.-C., Wu, K.-C., Chen, Y.-H., Chen, T.-Y., Gong, G.-C., Shiah, F.-K. and Chow, C. H.: Short-term variability of biological production and CO2 system around Dongsha Atoll of the northern South China Sea: Impact of topography-flow interaction, *Front. Mar. Sci.*, 7, 511, 10.3389/fmars.2020.00511, 2020.

Line 336: Where did these nutrient values come from, please discuss in methods.

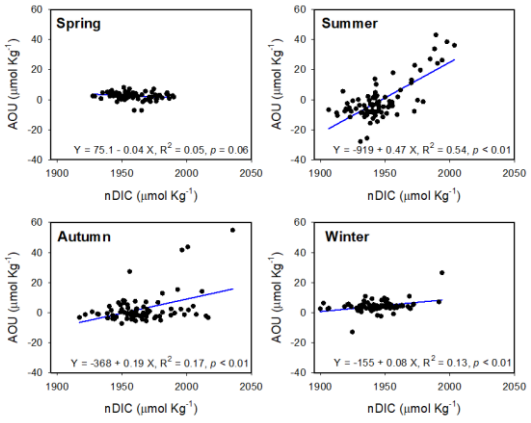
Thank you for your comment. The method for nutrient analysis has been incorporated into the Methods section in this revision to clarify the source of the nutrient values (lines 174–175).

Lines 408-421: Why not compare your nDIC to DO? You can convert mg/l to umol/kg and discuss the relative amount of photosynthesis/respiration.

Thank you for the helpful suggestion. In response, we have converted DO (mg/L) to µmol/kg and derived apparent oxygen utilization (AOU = O_2s – O_2m), where O_2s is the equilibrium saturation concentration calculated using in-situ temperature and salinity following Benson and Krause (1984). We then examined the relationship between AOU and nDIC to assess the relative influence of photosynthesis and respiration on carbon dynamics.

Our analysis shows that the photosynthesis/respiration signal, inferred from the nDIC–AOU relationship, is most pronounced in summer (photosynthesis/respiration ratio = 0.47), and nearly undetectable in spring (see figure below). This seasonal pattern supports our interpretation of stronger biological activity in summer, consistent with the observed correlation between pCO_2 and Chl *a*.

While we have incorporated these findings to strengthen our discussion (lines 427–429), our analysis remains primarily focused on temperature and Chl *a* as key drivers of carbonate system variability. We hope this clarification adequately addresses your comment.



Benson, B. B., and Krause, D.: The concentration and isotopic fractionation of oxygen dissolved in freshwater and seawater in equilibrium with the atmosphere, *Limnol. Oceanogr.*, 29, 620-632, 10.4319/lo.1984.29.3.0620, 1984.

Lines 538-540: I believe it is appropriate to de-emphasize that the system is a sink during winter and source during the autumn, summer, and spring as the data and spatial is too coarse for such a dynamic region.

Thank you for your valuable suggestion. We agree and have adjusted the sentence to further de-emphasize the sink or source characterization. In this revision, it has been modified to: "*During winter, CO_2 diffusion into the bay from the atmosphere, whereas in the spring, summer, and autumn, the bay tended to release CO_2*" (lines 554–555).