Dear reviewer,

Thank you for your insightful suggestions. We have substantially revised and reorganized the manuscript to improve the clarity and coherence of the scientific questions. We sincerely hope that the revised version meets your expectations.

This study presents data obtained from UVP deployments on a continental slope in a marginal sea, focusing on particle distributions, abundance, POC flux, and potential influencing factors such as mesoscale eddies. The particle imaging data are valuable and have the potential to contribute to the broader biogeochemical and oceanographic community. However, the overall novelty of the study is not readily apparent. The manuscript largely reads as a descriptive study, and many of the conclusions reiterate findings that have already been documented in prior work, including those cited within the manuscript.

Response: Thank you very much for your valuable comment. We appreciate your candid assessment. We agree with your opinion that the original presentation may have appeared overly descriptive. In response, we have substantially revised the manuscript, from the Introduction to the Results and Discussion sections, to better highlight the core scientific questions and improve clarity and structure.

Marine particles or aggregates play a crucial role in oceanic carbon export and the functioning of the biological pump, serving as highly efficient carries of organic carbon to the deep ocean. However, due to inherent difficulties in sampling, their distribution pattern, size characteristics, and controlling mechanisms remain poorly understood. In recent decades, the development of UVP has enabled significant progress in studying particle dynamics in various oceanic regions. Nevertheless, there is still a lack of such observations in the western Pacific, particularly in the SCS. Therefore, characterizing the distribution and properties of marine particles in the SCS and identifying their key drivers represents the first objective of this study. Secondly, mesoscale eddies are a prominent and frequently occurring physical feature in the SCS, and their influence on particle distribution and carbon export is both significant and inevitable. While several previous studies have investigated the impact of eddies on POC export in the SCS using sediment traps, the sediment trap method is limited in the ability to capture high-resolution vertical flux data and provide no information on the size composition of particles. This limitation hampers our ability to fully understand the mechanisms by which mesoscale eddies regulate particle-mediated carbon export. In this context, our use of UVP data offers a new perspective by resolving the vertical structure and size-dependent characteristics of particle fluxes, thereby deepening our understanding of eddy-driven biogeochemical processes in the region.

Finally, we have revised and reorganized the manuscript according to your valuable comments, and we hope that the updated version meets your expectations.

One notable example is the attribution of the increasing relative contribution of small particles to total POC flux with depth to large particle disaggregation. This interpretation appears speculative and is not sufficiently supported by the presented data. In regions such as the South China Sea, sediment resuspension and lateral transport of particulate matter are also known to influence their contribution to the POC flux. Without additional constraints, it is difficult to disentangle the relative contributions of these processes. In this context, Figure S5 does not clearly demonstrate a vertical trend. I recommend the authors perform statistical analyses (e.g., regression or correlation tests) to better support their interpretations.

Response: Thank you for this insightful comment. We agree that the original Fig. S5 was insufficient to support the interpretation regarding the increasing contribution of small particles with depth. In the revised manuscript, we have removed Fig. S5 and restructured the analysis by categorizing the water column into two layers: the epipelagic layer (0-200 m) and the mesopelagic layer (>200 m), instead of using previous depth intervals. Our updated results show that in the upper 200 m, small particles contributed an average of 19% ± 9% to the total POC flux, while large particles accounted for 81% ± 9%. Below 200 m, the contribution of small particles increased to 28% ± 12%, with large particles contributing 72% ± 12%. This increase in the proportion of small particles at depth was statistically significant (t-test, $p < 0.05$). Based on this revised analysis, we have updated the discussion accordingly. Moreover, we appreciate your suggestion regarding other possible mechanisms, such as sediment resuspension and lateral transport, which are known to influence POC flux in the SCS. In response, we have incorporated a discussion of intermediate nepheloid layers and their potential contribution to small particles at depth, to present a more comprehensive interpretation of the observed patterns.

The manuscript would also benefit from improved organization. The rationale and scientific questions driving the study are not clearly articulated in the Introduction, making it difficult to follow the study's objectives and scope. Furthermore, the final portion of the Discussion section, which touches on data uncertainty, lacks clear linkage to the preceding content. A more structured and cohesive progression of ideas is needed to strengthen the overall narrative and scientific discussion.

Response: Thank you for your valuable comment. We have revised the Introduction to more clearly articulate the rationale and scientific questions guiding this study, with an emphasis on the ecological significance of marine particles and the role of mesoscale eddies in modulating particle-mediated biogeochemical processes in the SCS. To improve the coherence and logical flow of the Results and Discussion section, we have restructured it around three clearly defined focal points: (1) Marine particle distribution and controls: cross-system comparisons and regional characteristics; (2) Numerical dominance of small particles vs. biogeochemical significance of large particles, and (3) Eddy-driven variability in particle dynamics and carbon export. This restructuring aims to strengthen the manuscript's overall narrative and facilitate a clearer interpretation of the key findings. Additionally, we have removed the *Data Uncertainty* paragraph and incorporated the relevant content into Section 4.3 of the Discussion to ensure a more integrated and coherent link with the preceding analysis.

The manuscript currently includes an excessive number of figures in the main text. I recommend moving some of these to the Supplementary Information to improve the flow and readability of the paper. In general, the manuscript lacks conciseness and requires significant revision to enhance clarity and focus. Some issues related to formatting and presentation should be addressed. For example, in the Abstract, the abbreviation "ESD" should be spelled out upon first use. Additionally, there is inconsistency in the formatting of parentheses and statistical values (e.g., "mean: xx" vs. "mean = xx"). Additionally, the legends in some figures contain inconsistent font styles or sizes, which affects the overall readability and professionalism of the visuals. A thorough review and standardization of formatting across the manuscript are needed.

Response: Thank you for your constructive feedback regarding the clarity and formatting of the manuscript. We fully agree that the number of figures in the original submission was excessive. In the revised version, we have reorganized the figures in accordance with the updated structure and content of the manuscript. The main text now includes 9 figures, and 3 figures in the Supplementary Material. In

addition, we have carefully reviewed and standardized formatting throughout the manuscript. We have spelled out “ESD” (equivalent spherical diameter) upon its first mention in the Abstract. Harmonized the use of statistical expressions (e.g., using “mean: xx” consistently). Standardized font style and size in all figure legends to improve visual consistency and readability. We have also conducted a comprehensive formatting check across the entire manuscript to enhance its overall clarity and professionalism.

Once again, thank you very much for your valuable comments. We sincerely hope that our responses and revisions meet your expectations.

Best regards,

Shujin Guo