Dear Associate Editor and reviewers August 11, 2021

I would like to thank the Associate Editor and reviewers again for their second comments on the revised manuscript. We have taken care of reviewers' comments and examined carefully ensuring to correct all bugs in the manuscript. The followings are second responses to reviewers' comments.

Replies to reviewers

Reviewer 1

General comments:

Overall, the authors have addressed my original comments and I find the manuscript has improved. However, I have one general comment. As the paper now stands, there is little comparison of this study with the flux results from other marginal sea studies in the Discussion, even though there are different marginal seas described in the Introduction. Ultimately, the authors compare the data in this study to the Costa Rica dome, BATS and the open Pacific Ocean. Are there no other studies regarding passive and active fluxes in marginal seas that can be discussed? Particularly other Pacific marginal seas, such as the Bering Sea, Japan Sea, East China Sea and California gulf, as well as any other published data from the South China Sea. The Discussion would benefit from a more in-depth comparison of the fluxes from different marginal seas. I also noticed a few lines within the manuscript that would still require English proofreading.

Reply: 1. We have added two reports stating active flux and total C flux from Northeast Pacific (Davison et al., 2013) and a global estimate (Hernández-León et al., 2020) for comparison. Actually, there were limited data containing both active and passive fluxes in a complete state covering various seasons and ocean regimes, particularly in the South China Sea. That may be why our data set are valuable for global C flux. 2. We have carefully examined the manuscript to ensure the quality improvement.

Specific comments:

Fig 9: perhaps the datum from a different source should be labeled somehow.

Also, is the black line a fit for all the points in the figure, or just data with a certain color? Please clarify in the caption.

Reply: We have revised the Fig. 9 caption by adding a statement (The solid black line denotes the linear regression (r = 0.8435, p < 0.01, n = 8) between INP and POC fluxes for all presented data) to complete the caption. Different icons were used to indicate different sources of data. To avoid confusion, additional labels may not be necessary for specific data.

Reviewer 3

Basically I think the authors did a good job in replying my concerns. But I still have some comments and/or suggestions before the manuscript can be considered as accepted for publication.

1 uncertainties in flux estimate.

Authors seem not able to present uncertainties due to limited data. I strongly suggest the authors clearly stated the uncertainties shortage problem in their flux estimates, to remind the readers for this point.

Reply: We have dealt uncertainty assessment. I am not sure why the reviewer claimed the shortage problem. The uncertainty (standard deviation) was derived from the spatial and seasonal (including extreme events) variability of the NSCS. The estimation (computation) of standard deviation follows exclusively the principle of statistical methods. Please see the added statements in Section 4.3 (The uncertainty of flux was mainly associated with the spatial and seasonal (including extreme events) variability in the NSCS. As active fluxes and passive fluxes may increase toward mesotrophic and eutrophic domains (Steinberg and Landry, 2017; Yebra et al., 2018; Hernández-León et al., 2019), these estimates (mean±std) may be regarded as the lower-bound fluxes under the state that the

oligotrophic regime dominates the entire region of SCS).

2 lateral migration of zooplankton or other swimmers.

In the SCS slope regions, there is already some work (Wang et al., 2019) doing the lateral migration. While their work is basically focusing on fish for their vertical migration, it also shed light in the lateral advection (as can be see from abstract). This phenomenon brings uncertainties to the active vertical flux estimates. I suggest authors cite and discuss this point with their current work.

Reply: Thanks for providing information. We have cited the reference (Wang et al., 2019) and added key points of ref. to Section 3.2.1 (The major located layers of migrators during day-time and night-time were comparable to those found for diel migrated fish in the northern slope of SCS (Wang et al., 2019) and Section 4.3 (There was an interesting report that the lateral migration of fish played an important role on determining DVM transport across the slope of NSCS (Wang et al., 2019), the impact of this issue on active fluxes is unknown in the oligotrophic ocean but this scenario warrants further study.

3 DOC and DON vertical flux

It is true that DOM vertical flux is largely constrained by water column hydrographical feature. Vertical mixing condition usually introduces surface DOM moving to deep waters. I agree that summer time is believed to be more stratified relative to winter times for the SCS, but this reply has two problems: 1) it avoids another two seasons: spring and autumn, which is hard to give a simple conclusion; 2) the meso-scale process which strongly interferes the water column vertical feature from its seasonal settings. Again, this refer to my previous suggested literatures that discuss about the eddies process and its dynamic impact on SCS biogeochemistry. I am glad to see that the authors have cited those eddy works in their revised version.

In addition, I suggest authors consider the seasonal DOM composition difference of the SCS, as well as the spring/autumn water column vertical feature difference in response to eddies (Zhu et al., 2021).

Reply:

DOC flux contributes a very small proportion (<5%) to total vertical C flux even pronounced seasonal (eddy) variations in DOM composition. Vertical DOC flux was determined exclusively by surface accumulation and downward transport in various seasons (summer-winter) in the oligotrophic ocean. Spring and autumn are transient seasons in the SCS. Cyclonic and/or anticyclonic eddies have profound impacts on vertical POC and active fluxes by pumping nutrients into the eutrophic zone. However, eddies also lift DOC-poor water and dilute DOC concentration in upper layers and decrease likely the vertical DOC flux. We don’t want to extend this arguments because of lacking data of DOM composition in our study. It is an interesting subject and the reviewer can explore for such studies.