# Response to Reviewer 1

General Comments: Kalmaegi was a fast-moving TC. At 8 m/s, the TC traverses ~600 km in 1 day and spent ~6 hours traversing AE1 (or AE2) with a diameter of about 150 km. In such a super-critically moving storm, most of the wind effect on the ocean is therefore through mixing (including perhaps that caused by near-inertial internal wave breaking in the upper ocean in the wake of the storm) rather than the wind stress curl. The latter would require that wind acts on the ocean in a time scale longer than the inertial period (~1.5 days at 19N). I understand the authors' hypothesis of the negative WSC (thus convergence) on the left side, etc., but I don't think it is a demonstrable one in this case and is most likely incorrect. The increased AE1 after Kalmaegi (Fig.3, etc.) is likely a complex eddy adjustment process. One may suspect such adjustment also from Fig.3 in which the "warm" area between AE1 and AE2, including that on the left side, shrinks or weakens. That area would have expanded following the authors' hypothesis.

**Response: We would like to thank you for your careful reading, helpful comments, and constructive suggestions, which have significantly improved the presentation of our manuscript. We have carefully considered all comments from the reviewer and revised our manuscript accordingly. The manuscript has also been double-checked, the typos and grammar errors we found have been corrected. The changes are highlighted in the manuscript. All page numbers refer to the revised manuscript file with tracked changes.**

Thank you for your comments.

We agree with the reviewer that during the forcing stage of a fast typhoon, there are exsits near inertial waves and they are very important. Here we show the snapshots of AE1 through its lifetime from 26 June to 14 October, 2014. We can see that the entire buoy array located within the AE1 from 31 July to 14 August (Figure S1). It can explain the near-inertial waves propagated downward into ocean interior from this period (Figure S2). It can be seen that near-inertial currents during 18 July to 19 August and 16-30 September, with a maximum near-inertial velocity of 0.61 cm $s^{-1}$, which are affected by typhoon Rammasun (16-18, July) and Kalmaegi (14-16, September). The near-inertial energy of Kalmaegi lasts from surface to 200 m, but near-inertial currents caused by typhoon Rammasun lasts longer, it stays at upper 50 m on 18-24 July, then the near-inertial energy enters and traps in AE1, it transmits downward since 25 July and stay at 50-200 m until 17 August. The transfer of energy from anticyclonic eddy to near-inertial waves is the main reason for the downward progpation and longtime perisistence of near-inertial energy (Chen et al, 2023). The near-inertial velocity distribution pattern of Station 4 during the period from 30 July to 19 August is different from station 1 and 4, because AE1 gradually moves away from station 4 (located in the northeast of the bouy array, Fig. S1), it captures weakest near-inertial energy. Due to the westward movement of AE1, the eddy center is near station 2, only station 2 catches the subsurface near-inertial signals during the period of 12 August to 8 September (the red box area in Fig. S2), and it is relatively small, with a maximum velocity of 0.18 cm $s^{-1}$.

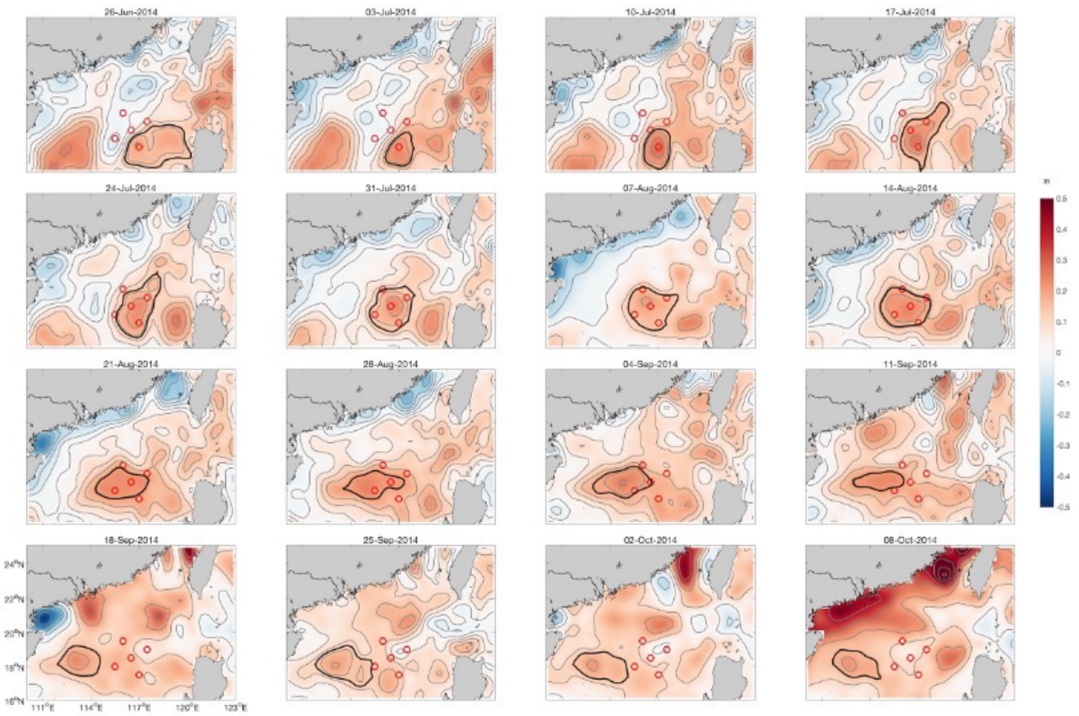


**Figure S1.** Eddy boundarys of AE1 and its distance from the buoy array during its lifecycle (26 June to 8 October). The color and gray contour lines represent sea level anomaly, while the black solid contours are AE1's boundaries. The five red dots represent the positions of 5 buoys.

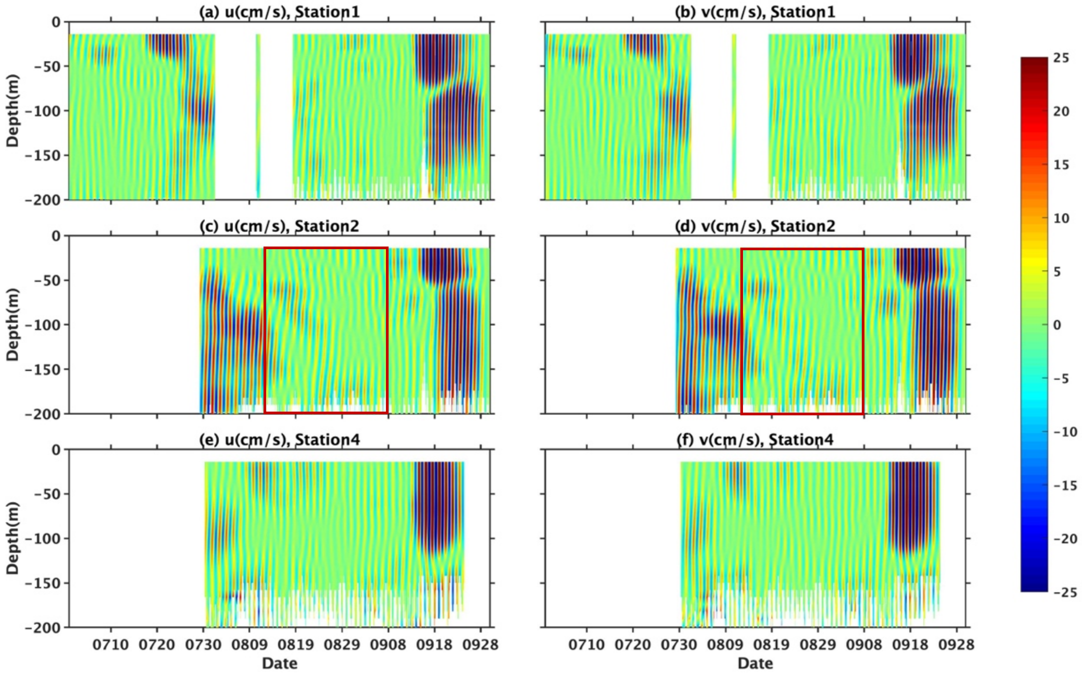


**Figure S2.** Eastward(a,c,e) and northward(b,d,f) near-inertial currents in the upper 200 m observed at station 1, 2 and 4.

Chen Z, Yu F, Chen Z, et al. Downward Propagation and Trapping of Near-Inertial Waves by a Westward-moving Anticyclonic Eddy in the Subtropical Northwestern Pacific Ocean[J]. Journal of Physical Oceanography, 2023.

Since our corresponding author Han Zhang has previously published 6 papers (listed at below) and discussed the ocean response of typhoon Kalmaegi from multiple perspectives, including variations of near-inertial energy, vertical temperature, heat changes and their mechanisms during typhoon, so in this paper, near-inertial effect and mixing is not the focus. Moreover, AE1 is already far from the buoy array during typhoon Kalmaegi passed over NSCS, so the near-inertial waves at this period has little impact on AE1 and is excited by the first baloclinic mode (Zhang et al, 2017). Furthermore, daily reanalysis data is insufficient to study near-inertial waves in AE1 at this time.

Zhang H. Modulation of upper ocean vertical temperature structure and heat content by a fast-moving tropical cyclone[J]. Journal of Physical Oceanography, 2023, 53(2): 493-508.

Hong W, Zhou L, Xie X, Zhang H, Liang C. Modified parameterization for near-inertial waves. Acta Oceanologica Sinica, 2022, 41(10): 41-53. https://doi.org/10.1007/s13131-022-2012-6

Zhang H, Wu R, Chen D, Liu X, He H, Tang Y, Ke D, Shen Z, Li J, Xie J, Tian D, Ming J, Liu F, Zhang D, Zhang W. Net Modulation of Upper Ocean Thermal Structure by Typhoon Kalmaegi (2014). Journal of Geophysical Research: Oceans, 2018, 123(10): 7154-7171.

Zhang H, Chen D, Zhou L, Liu X, Ding T, Zhou B. Upper ocean response to typhoon Kalmaegi (2014). Journal of Geophysical Research: Oceans, 2016, 121(8): 6520-6535.

Wu R, Zhang H, Chen D, et al. Impact of Typhoon Kalmaegi (2014) on the South China Sea: Simulations using a fully coupled atmosphere-ocean-wave model[J]. Ocean Modelling, 2018, 131: 132-151.

Wu R, Zhang H, Chen D. Effect of Typhoon Kalmaegi (2014) on northern South China Sea explored using Muti-platform satellite and buoy observations data[J]. Progress in Oceanography, 2020, 180: 102218.

In addition, we believe that the ocean responds quickly to wind stress curl caused by typhoon Kalmaegi with no time lag. Ekman layer depth ($D_E$) varied with typhoon passage is shown in Fig. S3, when Kalmaegi approaches at 0000 UTC on 14 September, the mean $D_E$ within AE1 is only 21 m, while AE2 is 114 m, indicates that AE2 has already influenced by typhoon Kalmaegi. Then $D_E$ of AE2 sharply deepens, reaching a maximum depth of 241 m (Fig. S4) at 0000 UTC on 15 September when the center of Kalmegi is near AE2. As Kalmaegi moved northwest, the $D_E$ within AE1 reached its maximum depth of 262 m at 0000UTC on 16 September. The trends of $D_E$ within AE1 and AE2 are almost consistent, but AE1 lags AE2 by one day. From 15 September, $D_E$ within AE1 and AE2 gradually shallower, with the minimum $D_E$ of 60 m, which is 28 m higher than before typhoon, indicating that typhoon's effect through wind is still exist. For AE2, $D_E$ reached its minimum of 45 m at 0000 UTC on September, later increased gradually under the influence of tropical storm Fung-wong.

Due to the fact that near-inertial oscillation mainly manifests as the transfer of vertical energy, and Ekman Pumping can truly bring about vertical velocity changes, we believe that the theory of Ekman Pumping can be used to explain the vertical variation of AE1 and AE2. We have added these sentences at lines 447-456.

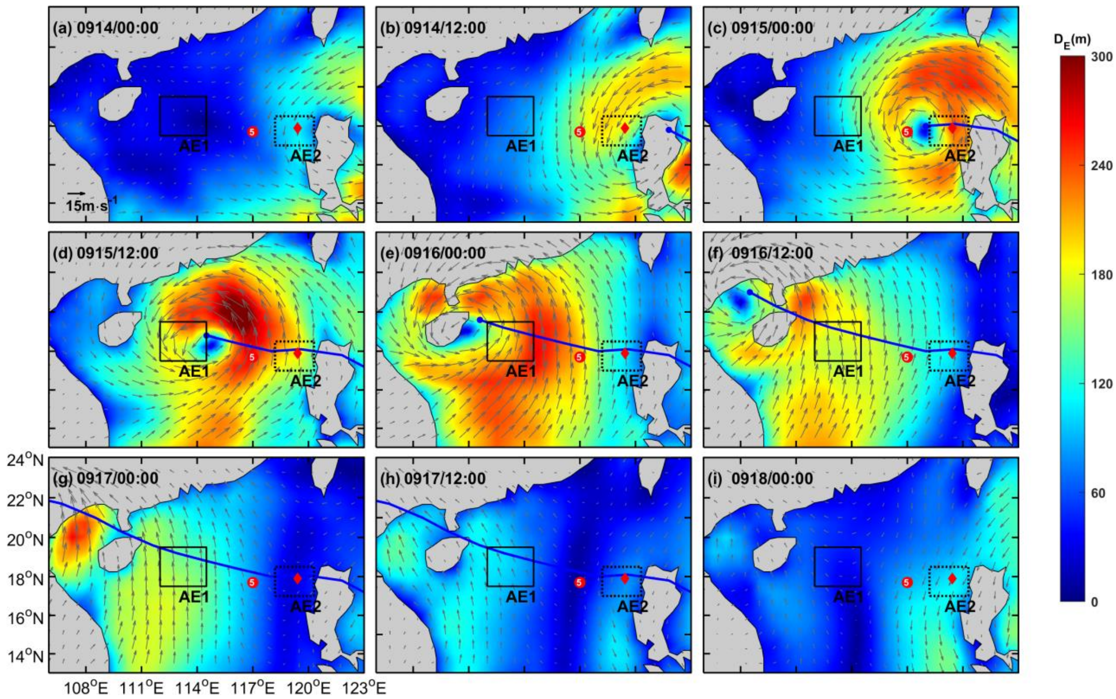


**Figure S3.** Ekman layer depth (DE) from 14 September to 18 September (a-i). The color represents the DE, the blue solid line is the path of Kalmaegi, the red dot and diamond are the positions of Station 5 and Argo 2901469 on 15 September, respectively. (Fig. 10 in manuscript)

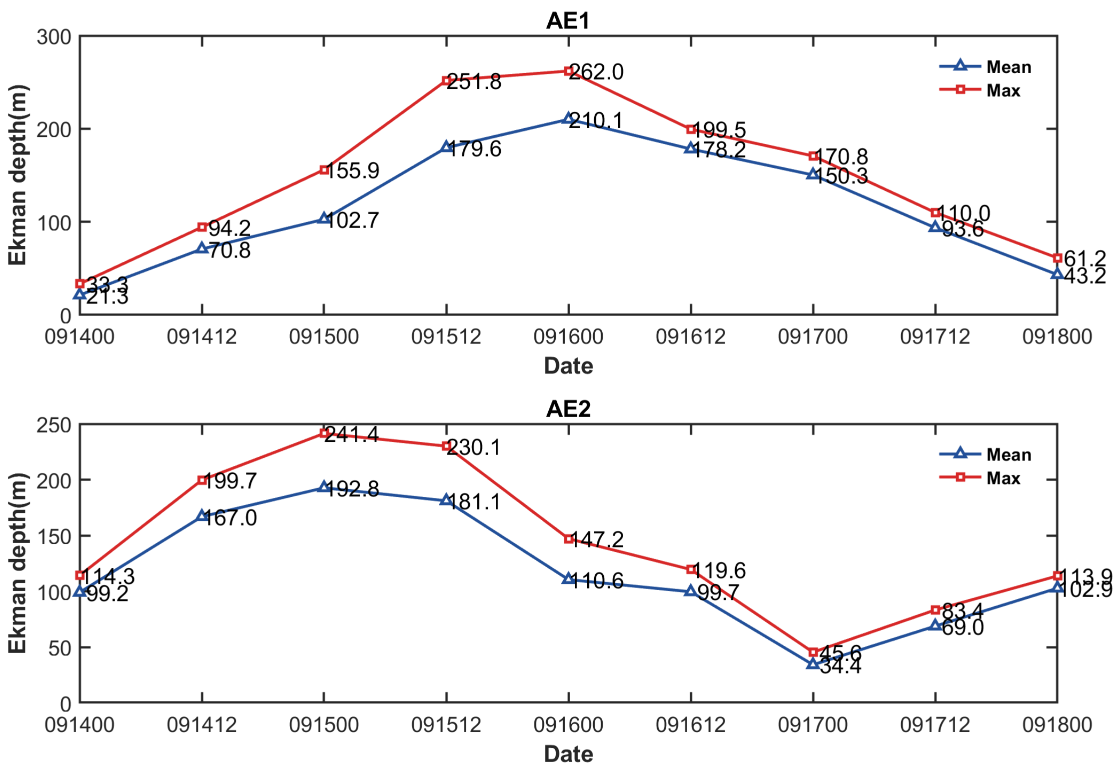


**Figure S4.** Timeseries of $D_E$ from 14 September to 18 September within AE1 (a) and AE2 (b), respectively. The red line is the maximum $D_E$ and the blue line represents the mean maximum.

Regarding the second question, it can be seen from Figure 9 (line 458) that during typhoon Kalmaegi, the Ekman Pumping Velocity (EPV) on the left side of the typhoon path has both positive and negative values, so there exists both upwelling and downwelling on the left side of the path. In AE1, vertical velocity is downwelling, and most other places on the left side are upwelling. With the effect of advection, the overall cooling effect is greater than the warming effect, so the warm area is decreasing.

Two other general comments. 1) AE1's increased amplitude, Ro and EKE = 1.3 cm, 1.4e-2 and 107 (cm/s)^2 are small. Are they statistically significant, and were errors and confidence levels estimated? Similarly for AE2. 2) Inertial oscillatory response persists long (~5 days and longer) after a storm passes (see e.g. Wu et al. Effect of Typhoon Kalmaegi (2014) on northern South China Sea explored using Muti-platform satellite and buoy observations data; Prog Oceanogr. 180 (2020) 102218). The effects of inertial motions on the Authors' results and analyses were not discussed and I am unsure, for example, how the effects were filtered out or accounted for and how they may affect their estimates.

**Response:** Thank you. Because there are only two eddies studied here, too few samples to conduct significant testing. Although the increase (decrease) of amplitude, $R_o$, EKE of AE1 (AE2) are small, their proportion is not small compared to their average value. So we add these sentences on abstract at lines 14-17:

The amplitude, Rossby number (Ro) and eddy kinetic energy (EKE) of AE1 increased by 1.3 cm (5.7%), $1.4\times10^{-2}$ (20.6%) and 107.2 cm2 $s^{-2}$ (49.2%) after the typhoon, respectively, while AE2 weakened and the amplitude, vorticity and EKE decreased by 3.1 cm (14.6%), $1.6\times10^{-2}$ (26.2%) and 38.5 cm2 $s^{-2}$ (20.2%), respectively.

2) Thank you for recommending a very good paper and results. We have cited some of the conclusions from Wu et al (2020) at introduction of line xx. From Fig. S2, the near-inertial oscillation can persistence longer than 1 month.

Wu R, Zhang H, Chen D, et al. Impact of Typhoon Kalmaegi (2014) on the South China Sea: Simulations using a fully coupled atmosphere-ocean-wave model[J]. Ocean Modelling, 2018, 131: 132-151.

Other Comments:

L14: Rossby number (Ro = relative vorticity/Coriolis parameter);

**Response:** Thanks, we have added this defination.

L16: Rossby number;

**Response:** Thanks you, it have been corrected。

L166: vertical feedback of the ocean by ... Kalmaegi: Not sure what this means, what "feedback", maybe "response..."?

**Response:** Sorry for misunderstanding. It is proper to use “response”, we have replaced it.

Also: I assume GLORY assimilates Argo data but not the Station data. If so, then it is unsurprising that GLORY agrees with ARGO but not Station 5 (Figure 1).

Only Station 5 on the left side of the storm was used to support the authors' hypothesis. To support (refute?) the Authors' hypothesis I suggest using data from other Stations (except #3), right and left of Kalmaegi.

**Response:** Due to the lack of temperature data at S1, we added the vertical profiles of S2 and S4 were compared with GLORYS12v1. The RMS between GLORYS12V1 and Station 2 (Station 4) is 0.14 (0.10), with significant deviations in the mixed layer and thermocline. Although compared to S5, the RMS of S2 and S4 is a little larger, but still acceptable.

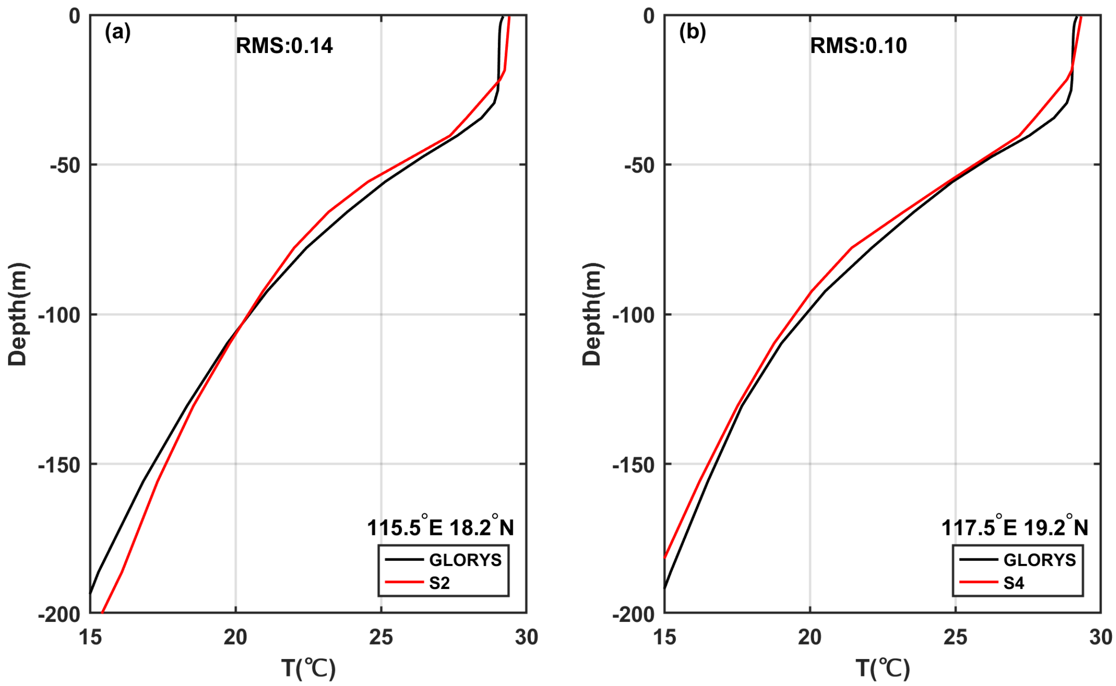

**Figure S5.** Evaluation of GLORYS12V1 data performance during September 2014. (a) Vertical monthly mean temperature within the anticyclonic eddy AE2 (119.5°E 17.9°N) as measured by Station 2 (115.5°E 18.2°N) . (b) Comparison of vertical monthly mean temperature recorded at Station 4 (117.5°E 19.2°N).

L223: ... weak wind stress curl, to be more precise. The term "wind shear" is also customarily taken as "vertical wind shear" in TC studies in meteorology so can be confusing.

**Response:** Thank you, the word "vertical" has been added to be more precise.

L245: ... with 6-hourly dots.

**Response:** Thank you, the word "6-hourly" has been added to be more precise.

**All of the co-authors are so grateful to the reviewer for the time spent on our manuscript. The comments and suggestions provided by the reviewer are invaluable for us to improve our manuscript. We are so appreciated.**