

## ***Interactive comment on “Effect of mesoscale eddy on thermocline depth over the global ocean: deepen and uplift” by Xiaoyan Chen and Ge Chen***

**Anonymous Referee #3**

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In this manuscript, the authors show the spatial and seasonal changes in mixed layer thermocline depths both in anticyclonic and cyclonic eddies with Argo profiles and satellite SSH. Though the analysis was interesting, I feel additional analysis and discussions were needed to clarify the advantage of this study.

In this study, the authors focused on the changes in the thermocline depths. As the authors did not distinguish the seasonal thermoclines from permanent ones, almost of all the changes probably represent the seasonal thermocline changes, which are generally located just below mixed layers. So, the thermocline depth changes in this study can be very similar to the mixed layer depths. Actually, seasonal changes (Figs. 2c and d), spatial distributions (Figs. 4 and 5), and the relationships with the amplitudes (Fig. 6) were similar to the ones in Gaube et al. 2018, which was cited by the authors in this

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manuscript. The detailed comparison with Gaube et al. 2018 would be needed to clarify the difference and similarity of the changes in MLD and thermocline depths because the authors seemed to emphasize changes in the thermocline not in the mixed layers (around L. 45-54). It may be useful to show gradients of thermocline to clarify differences from Gaube et al. 2018. I think the temperature and salinity changes around eddy thermocline depths were focused on clarifying the eddy roles in heat/freshwater transports by previous studies. If the authors focus on this theme, comparison with the results Sun et al. (2019; doi:10.1038/s41598-018-38069-2) may be useful. They estimate the trapping and stirring effects in heat transport. The former may be related to the thermocline (gradient/depth) changes in the eddy core, and the latter may be related to the changes with the edge (Figs. 7-9 in this study).

At least, the analysis to clarify the differences of changes in thermocline from the ones in MLDs is needed before publication. The main results may be fully rewritten based on the new analysis. So I would like to recommend the authors to withdraw at this time and to resubmit.

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