Interactive comment on* "Eddy characteristics in the Northern South China Sea as inferred from Lagrangian drifter data"** ***by J. X. Li et al.

Responses to the comments of referee #1

First of all the authors are extremely grateful to anonymous referee involved for providing his/her excellent comments and valuable advice on this paper. In the following, referee comments are in black text with actions taken following in blue.

1. In section 1 introduction: second paragraph. The authors mentioned that "The eddy characteristics in the NSCS have not been well documented", but to my knowledge, it is not really the fact. I recommend the authors notice these two literature (Nan et al., 2011; Wang et al.; 2008) concerning the eddy characteristics in the NSCS. The authors may wish to improve the section 1 after the thorough reading. In this way, this will make the interested readers understand the correlative information before studying the authors' distinct view on the eddy characteristics in the NSCS.
   Good suggestions. We added some sentences to summarize the former works on the eddy characteristics in the NSCS as suggested and added several references.

2. In section 3.4. I have a major concern with respect to the eddy generation mechanisms in the SCS. There are many causes for the generation of eddies in the SCS, such as wind stress curl, topography, instability of the Rossby waves, Ekman pumping, the interaction of monsoon circulation with land, the interaction between the – effect and topography, orographic wind jets, and instability of the background currents, and among others (Nan et al., 2011). I recommend the authors should explain it in detail, and it would be helpful to state this point to the readers.
   Good suggestions. Eddy statistical characteristics in the NSCS based on our developed eddy detection method from drifters is a useful first step in gaining an overview of their generation, but not their dynamics. Likely mechanisms include the Kuroshio intrusion, wind stress curl and etc. as the reviewer mentioned above. Modeling studies will be needed to further investigate the dynamic mechanisms in the study region. In this paper, we chose not to explicitly show this and refer interested readers to the previous work on this subject. Hopefully this is acceptable.

3. In section 3.5. I do not agree with the authors' analysis of the geostrophic or ageostrophic balance of these eddies in the NSCS. Why are the submesoscale eddies ageostrophic from eddy edges to eddy cores? The authors are suggested to give more compellent explanation.
   Good suggestions. Mesoscale eddies are largely quasi-geostrophic, which are characterized by small Rossby number ($Ro << 1$). At the radius of 80 km, the relative vorticity ξ is about 1% of f , suggesting that mesoscale eddies are in the geostrophic balance. Thus the consideration of the geostrophic relationship to determine the swirl velocity at the eddy edges from altimetry measurements appears to be appropriate for large eddy diameters (Chaigneau and Pizarro, 2005). While around the center, the

vorticity rate ($|\xi / f|$) is about 0.4. A relative vorticity of about 0.4 times the planetary vorticity suggests that eddy cores are ageostrophic. Although the mesoscale eddies may be considered in geostrophic balance, ageostrophic dynamics and centrifugal effects may play an important role for the growth and decay of the mesoscale cores. However, processes at submesoscale are distinguished by order one Rossby and Richardson numbers; their dynamics are distinct from those of the quasi-geostrophic mesoscale. They are not described appropriately by the traditional quasi-geostrophic theory that applies to mesoscales. It is not fully three-dimentional and nonhydrostatic, either (Thomas et al., 2008). The conclusion that the submesoscale eddies are ageostrophic from eddy edges to eddy cores seems a little cursory. Many questions remain open in regards with submesoscale eddies because they are notoriously difficult to observe and model. We revised this conclusion, added several sentences in the text to clarify it and added a reference.

4. Two typos errors: in the first sentence of Abstract (Page 1576, Line 1), "on the Northern South China Sea" should be "in the Northern South China Sea". Figure 5, the label of x-axis should be "Longitude" not "Longtitude".
   The two typos errors were corrected in the new version of the paper.

5. Just a minor comment, Figure 3, Figure 4 and Figure 5 all depict the drifter trajectories. However, the labels of their axes seem not uniform, in Figure 3 and 4 it is "134 135 136…", while in Figure 5 it is "50W 49W 48W…". It would benefit the manuscript if the three figures maintained the same formatting.
   Good suggestions. We have revised the labels of the three figures to make them uniform as suggested.

References:

Chaigneau, A., and O. Pizarro (2005), Eddy characteristics in the eastern South Pacific, *J. Geophys. Res.*, 110, C06005.

Thomas, L. N., A. Tandon, and A. Mahadevan (2008), Submesoscale processes and dynamics. *Eddy Resolving Ocean Modeling*, M. W. Hecht and H. Hasumi, Eds., Amer. Geophys. Union, 17-38.