Anonymous Referee #2

Received and published: 2 March 2015

General Comments: This manuscript describes the relations among SST, SSH and MLD in the northwestern Pacific subtropical region and SST frontal zone, and I think this direction is important to understand the SST changes in the Pacific region. But it is very difficult to understand what the authors emphasize, and frankly it seems to me that they just calculate relations among SST, SSH, and MLD. I found a lot of typos and mistakes, and lack of description to their results. I also see the less originality in the manuscript, as the correlations between SST, SSH and MLD can be expected in a phase of seasonal change. Therefore the manuscript needs to be revised in a major way. Supporting the authors, I guess the authors would want to show the oceanic processes to SST via MLD and SSH changes, that will contributes to the disappearance of SST front, which is well shown in Qiu et al (2014) from the point of view of surface heat budgets. Therefore my comment towards revision is to extend this work to understand the role of Mixed Layer Processes to the SST front disappearance. Qiu et al (2014) showed the importance of local air-sea flux exchanges (mainly latent heat flux due to anomalous wind), but does not show clearly roles of ocean mixed layer processes, and I guess that barrier layer effect may exist. Ocean remote forcing will not work in this region, the authors may not need to analyze SLA further.

RE: Following your valuable suggestions, we made major revisions:

(1) Calculate the steric heaight anomaly using in situ GTSPP data, and results are shown in Figure 3.

(2) We removed seasonal cycle of SLA using high-pass filter, and results are shown in Figure 6.

(3) We analyzed the monthly evolution of MLD, and the relationship between MLD and SST among three different zones. Results are shown in Figure 7-8.

(4) We rewrote the Summary and Concluding parts.

(5) We got text check help from text-check Company.

Specific Comments 1) I don't see notable description about "formation of shallow mixed layer depth (MLD) is important" for SST front disappearance in the paper by Qiu et al (2014).

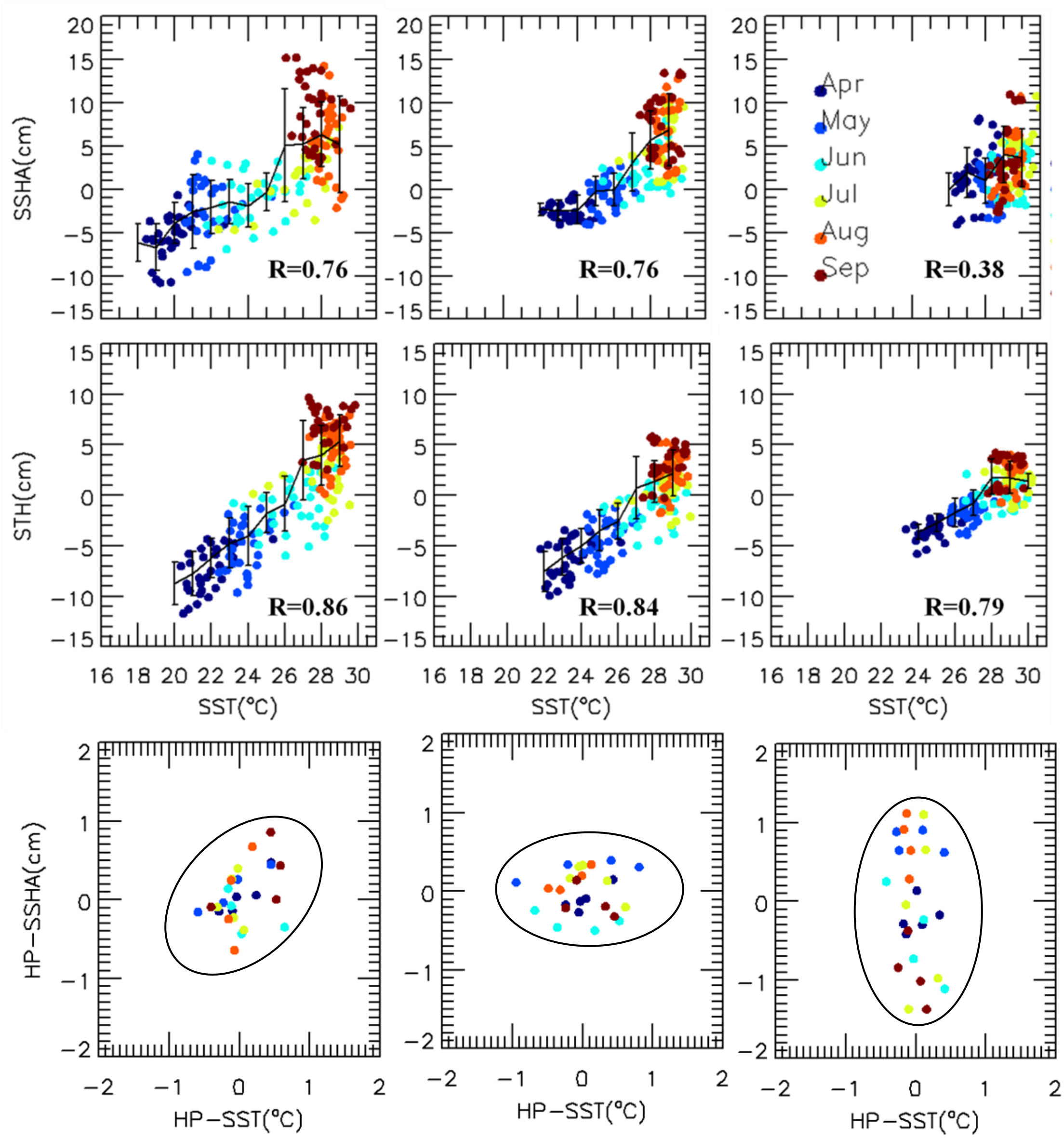
RE: Following your suggestions, we deleted this sentence in the abstract.

2) What kind of results the authors will have if the seasonal change will be removed from the analysis or if just focus on seasonal change only? As seasonal signal seems to be strong and the present results just show the seasonal characteristics.

RE: Following your valuable suggestions, we used a high-pass filter to smooth out the seasonal variations, which is shown in the bottom row of Figure 6.

The descriptions are in Line198-214:

'We further examined the relationships between SLA and SST after removing the seasonal cycle, using a high-pass filter, and called the resulting values HP-SLA and HP-SST. They are shown in Figure 6 g-i. In the cold zone, HP-SLA and HP-SST displayed a weak linear relationship with a correlation of 0.4. In the front zone, the variation in HP-SSH was smaller than that in the cold and warm zones, but the variation in HP-SST was larger. In the warm zone, the relationship between HP-SLA and HP-SST was opposite to that in the front zone, indicating that the disturbances in SLA did not result from those in SST. The warm zone located in the area of subtropical countercurrent field reported by Kobashi and Kawamura (2001) contained three branches of geostrophic current. These suggest the possible significant influence of oceanic currents on SLA in the warm zone. In the cold and front zones, SLA cycles were dominated by steric height, which was induced by air-sea heat balances. But in the warm zone, SLA cycles were not related to the steric height anomaly, and were possibly induced by oceanic currents. A strong subtropical countercurrent occupied the warm zone (Kobashi and Kawamura, 2001; Qiu and Kawamura, 2012), which further suggests that variation in SLA is induce by the oceanic current in the warm zones.'



3) Nowadays, GTSPP include a large amount of Argo floats data, and Argo float data provide vertical high-resolution data than others, so good to use Argo data by extracting from GTSPP datasets for estimating MLD and Barrier layer.

RE: The GTSPP data include profiles float data, and we actually used them in the formal manuscript. We added the 'Argo profiling float data' in Line 100-101.

4) It will be necessary to show the three components of steric, dynamics, and barotropic components of SSH before showing analysis of steric component, although from Figure 5 it seems that steric component will be largest. Also, it is necessary to

show the errors from freshwater component to steric component.

RE: Thanks for your valuable suggestions. We made a comparison between satellite SLA and steric height in Figure 3. Descriptions are in Line155-164:

‘The variation in SLA, and steric height components calculated from the above two methods are shown in Figure 3. Both SLA and steric height anomaly displayed significant seasonal variation, with negative values in winter and peak values (>15 cm) in mid-summer. The seasonal cycle in SLA was consistent with that of steric height. The amplitude of the steric height anomaly was much larger to the north than that to the south of the SST front. The steric height anomaly calculated from GTSPP data (Equation 2) was considered to represent the true oceanic conditions. That derived from air-sea heat flux roughly displayed the temporal variation in the true steric height. However, some mesostructures to the south of the SST front (within the black boxes of Figure 3a,c) were excluded, possibly due to the coarse resolution of the NCEP/NCAR net heat fluxes or the loss of freshwater flux. ‘