Response to SC1 (26th September 2017)

Title: Importance of vertical mixing and barrier layer variation on seasonal mixed layer heat balance in the Bay of Bengal

We would like to thank you for the time and effort used to review our manuscript. Your helpful and constructive comments are highly appreciated. This reply addresses all the points highlighted by you.

<u>Specific comments</u>

The Abstract is not concise and clear enough. The new findings of this study should be clearly described in the Abstract.

Time series measurements from the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) moorings at 15° N, 90° E; 12° N, 90° E; 8° N, 90° E; 4° N, 90° E; 1.5° N, 90° E; 0° N, 90° E are used to investigate the seasonal mixed-layer heat balance and the importance of barrier layer thickness (BLT) and vertical mixing (Q_{-h}) in the Bay of Bengal (BoB). It is found that the BLT, Q_{-h} and mixed-layer heat balance all have a strong seasonality in the central BoB. Sea surface temperature (SST), salinity and wind are important for the observed strongest seasonal cycle of BLT in the central BoB, and wind is more important than the SST in the southern BoB. The heat storage rate (HSR) is primarily driven by latent heat flux and shortwave radiation (Q_{SW} and Q_L). Seasonal variations and the magnitudes of longwave radiation (Q_{LW}), sensible heat flux (Q_S), and horizontal mixed-layer heat advection are much weaker compared to those of Q_{SW} and Q_L. Q_{-h} follows a pronounced seasonal cycle in the central BoB and is significantly positively correlated with the seasonal cycle of BLT at each mooring location. The seasonal variability of the stability favors the Q_{-h} during winter and summer monsoon and suppress Q_{-h} during monsoon transition periods. We found that Q_{-h} plays the secondary role in the seasonal mixed-layer heat balance in the BoB. It is evident from the analysis that Q_{-h} associated with temperature inversion (ΔT) warms the mixed layer during winter and cools the mixed layer during summer. The warming tendency during winter is strong in the central BoB and weakens towards the equator, indicating a cooling tendency around the year. Our analysis further indicates the weakening of Q_{-h} during monsoon transition periods favors the existence of warmer SST in the BoB, associated with thermal and salinity stratification in the central BoB.

The following changes were made to the manuscript;

Time series measurements from the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) moorings at 15° N, 90° E; 12° N, 90° E; 8° N, 90° E; 4° N, 90° E; 1.5° N, 90° E; 0° N, 90°

E are used to investigate the seasonal mixed-layer heat balance and the importance of barrier layer thickness (BLT) and vertical mixing (Q_{-h}) in the Bay of Bengal (BoB). It is found that the BLT, Q_{-h} and mixed-layer heat balance all have a strong seasonality in the central BoB. Sea surface temperature, salinity and wind are important for the observed strongest seasonal cycle of BLT in the central BoB. Consistent with earlier studies, the seasonal mixed-layer heat balance is primarily controls by latent heat flux and shortwave radiation (Q_{SW} *and* Q_L) and we found that Q_{-h} plays the secondary role compared to the weaker horizontal mixed-layer heat advection in the BoB. It is noted that Q_{-h} is significantly positively correlated with the seasonal cycle of BLT at each mooring location. The seasonal variability of the stability favors the Q_{-h} during winter (high BLT) and summer (relatively low BLT) monsoon and suppress Q_{-h} during monsoon transition periods (Moderate BLT). It is evident from the analysis that Q_{-h} associated with temperature inversion (ΔT) warms the mixed layer during winter. Thermal and salinity stratification is obvious during monsoon transition periods and favors the existence of warmer SST in the BoB due to weakening of Q_{-h}. Our analysis further indicates entrainment (*E*) is more important in Q_{-h} and pointed out the weakening of *E* associated with BLT tends to weaken the SST-cooling during post-summer monsoon.

Line 203, Page 7: ". . .. . .illustrate the seasonal variability of sub surface conditions. . .. . ." Replace "sub surface" with "subsurface".

The computed vertical temperature gradient (*dT/dz*) (Figure 5a) and salinity gradient (*dS/dz*) (Figure 5b) illustrate the seasonal variability of sub surface conditions.

The following changes were made to the manuscript;

The computed vertical temperature gradient (*dT/dz*) (Figure 5a) and salinity gradient (*dS/dz*) (Figure 5b) illustrate the seasonal variability of subsurface conditions.