The effect of rain-formed fresh water lenses on mixing in the tropical and subtropical oceans

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With the advent of ESA SMOS and NASA Aquarius missions, it has become possible to measure the sea surface salinity (SSS) using satellites. Observations of SSS are of great utility in oceanic studies and models. However, the accuracy of inferring the value of salinity in the upper mixed layer from measurements of SSS is affected by a variety of factors including the formation of fresh water layers during heavy and frequent rainfall events in the tropical and subtropical oceans. It is therefore essential to understand the dynamical processes involved and quantify the change in SSS during and after rain events. During the second NASA Salinity Processes in the Upper-ocean Regional Study (SPURS-2) campaign in the eastern Tropical Pacific, deployment of instruments such as the Surface Salinity Profiler enabled accurate measurements of the decrease in salinity during rain events, providing a rich dataset to explore ideas on rain-formed fresh water lenses in tropical oceans. We report here on an effort to model such fresh water lenses using a second moment turbulence closure-based upper mixed layer model. The model runs are designed to encompass both low intensity and high intensity rain events. The MISO-BoB (Monsoon Intra-Seasonal Oscillations/Bay of Bengal) campaign in the Bay of Bengal in the summer of 2019 managed to sample several high intensity rain events during the summer monsoon and one of these events is also modeled. The results compare reasonably well with measurements made during these campaigns. We conclude that the maximum salinity decrease, surface salinity and temperature decrease due to the rain event are all functions of the parameter amount of rainfall divided by U_{10}^2, where U_{10} is the wind speed, and not functions of maximum rainfall rate or total amount of rainfall. The model results confirm the proportionality between the maximum salinity decrease and maximum temperature decrease during rain events, found by earlier studies.

Keywords: Oceanic mixing, Fresh water lenses, Sea surface salinity, Tropical and subtropical oceans