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Rain-Induced Freshwater Lenses in the ITCZ – From Observations to Modeling

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The recent Salinity Processes in the Upper Ocean Regional Study – 2 (SPURS-2) field program has provided a unique dataset of concurrent salinity and meteorological observations. These measurements are leveraged to inform small-scale modeling of freshwater lenses, which are prevalent features in both the intertropical convergence zone (ITCZ), monsoon areas, and high latitudes, with 100 freshwater lenses identified in the data. Results from idealized high-resolution Regional Ocean Modeling System (ROMS) forced at different wind speeds has revealed a strong dependence of the lens persistence time to wind forcing, with higher persistence at lower wind speeds.

We use shipboard measurements of freshwater lenses gathered during two SPURS-2 to study the physical processes leading to the creation and dissipation of surface salinity stratification by precipitation. In addition to regular shipboard thermosalinograph measurements at 5 m depth, the Underway Salinity Profiling System provides measurements at 3 m and 2 m, and the 'salinity snake' instrument continuously samples the top 1-2 cm. These observations are leveraged to run a suite of high-resolution 3-D ROMS model simulations. The models are forced using ancillary information from ship-borne precipitation radar as well as other observations. We are thus able to generate statistical information about both the prevalence and the persistence of haline surface stratification in the ITCZ.

Our results indicate that rain-induced stratification can persist for tens of hours in low wind, where mixing is reduced. Since near-surface stratification can influence air-sea fluxes, we investigate these impacts in the model. Based on these findings and the general statistics of the prevalence and persistence of freshwater lenses, we suggest how the effects of rain-induced stratification may be parameterized in global models.