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The Physics of Very-Near Surface Salinity and its Effects on Remote Sensing

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An instrument capable of measuring surface salinity and temperature at satellite radiometric depths of 1-2 cm (the 'Salinity Snake') was deployed during two cruises of the Salinity Processes in the Upper Ocean Regional Study 2 (SPURS-2) during August—September 2016 and SPURS-2 and October—November 2017. Additional measurements at 1m, 2m, and 5m from through-hull systems allow the near-surface stratification to be estimated. Approximately 100 freshwater lenses with significant (>0.5 g/kg) salinity differences between the surface and 5m were found, ranging in size from 3 to 50 km. A significant portion (>40%) of these lenses were encountered during calm conditions without any measured precipitation on the ship. This suggests the potential persistence of such freshwater lenses for many hours or even days, and a strong dependence on wind-driven mixing, which acts to destroy very-near surface stratification.

Here, we present a first examination of upper ocean processes controlling the generation and destruction of near-surface salinity stratification. In this analysis, in-situ data are combined with ship-based rain radar and large-scale satellite-derived precipitation and wind-speed products. We classify precipitation events and resulting freshwater lenses and characterize their evolution and frequency of occurrence, including a quantification of the effects of background stratification and wind-driven mixing. Finally, the effect of near-surface salinity stratification on satellite salinity is quantified. While the mean difference is relatively small (0.02-0.1 g/kg depending on temporal and spatial smoothing), differences can be significant for satellite error budgets, buoy match-ups, and the treatment of along-track satellite data in general.