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Near-surface Salinity and Temperature Structure Observed with Dual-Sensor Drifters in the Subtropical South Pacific

Shenfu Dong (1), Gustavo Goni (1), Denis Volkov (1,2), Rick Lumpkin (1), and Gregory Foltz (1)
(1) NOAA/AOML, United States, (2) CIMAS/Univ. of Miami, United States

Three surface drifters equipped with temperature and salinity sensors at 0.2 m and 5 m depths were deployed in April/May 2015 in the subtropical South Pacific Ocean with the objective of measuring near-surface salinity differences seen by satellite and in situ sensors and examining the causes of the differences. Measurements from these drifters indicate that, on average, water at a depth of 0.2 m is about 0.013 psu fresher than at 5 m and about 0.024°C warmer. Events with large temperature and salinity differences between the two depths often occur when surface winds are weak. In addition to the expected surface freshening and cooling during rainfall events, surface salinification occurs under weak wind conditions when there is strong surface warming that enhances evaporation and upper ocean stratification. Further examination of the drifter measurements demonstrate that (i) the amount of surface freshening and vertical salinity gradient heavily depend on wind speed during rain events, (ii) salinity differences between 0.2 m and 5 m are positively correlated with the corresponding temperature differences, and (iii) temperature exhibits a diurnal cycle at both depths, whereas the diurnal cycle of salinity is observed only at 0.2 m when the wind speed is less than 4 m/s. Its phase is consistent with diurnal changes in surface temperature-induced evaporation. Below a wind speed of 6 m/s, the amplitudes of the diurnal cycles of temperature at both depths decrease with increasing wind speed. Wind speed also affects the phasing of the diurnal cycle of T5m with the time of maximum T5m increasing gradually with decreasing wind speed. Wind speed does not affect the phasing of the diurnal cycle of T0.2m. At 0.2 m and 5 m, the diurnal cycle of temperature also depends on surface solar radiation, with the amplitude and time of diurnal maximum increasing as solar radiation increases.