Sporadic low salinity signals in the oceanic mixed layer observed by the Kuroshio Extension Observatory buoy

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The hourly measurements of air-sea interaction parameters made at the Kuroshio Extension Observatory (KEO) buoy since 2004 have produced an extensive dataset that can be used to understand the dynamics of the oceanic mixed-layer under extreme weather conditions. Our analysis of the KEO-buoy measurements reveals the presence of sporadic low-salinity signals (SLSSs) in the mixed-layer when, for example, tropical cyclones (TCs) approach. These intermittent features cannot be reproduced by one-dimensional turbulence closure models. Here SLSS and sporadic low-temperature signals (SLTS) are identified within the buoy data by using flags which are set to unity when the values of normalized salinity and temperature, respectively, fall below -1 (minus one). Application of this definition to the hourly time series of salinity and temperature measured at 10m depth by the KEO buoy has allowed us to identify 244 SLSS events and 191 SLTS events over the 11-year analysis period. A composite time series of the flagged events, constructed with reference to the start time of each SLSS event, shows that these episodes decay monotonically over 1-2 days in all four seasons, a time-scale that is closer to the near-inertial period rather than to the decay-times of instability processes associated with oceanic eddies and currents. Both winter (January-March) and spring (April-June) seasons show a peak in the composite time series of wind velocity diurnal variation (WVDV) near the start time of SLSS events, which indicates that atmospheric cyclones and anticyclones play a role in their genesis. Moreover, SLSS events can be terminated by the entrainment of saltier subsurface water parcels to the mixed-layer in response to storms. The discovery of the WVDV peaks following SLSS commencement is the reason the present study has adopted a time scale of 1 day for WVDV analysis. This temporal resolution has enabled us to identify a TC-related delay in the development of the WVDV peaks, which may represent a fundamental characteristic of the influence of TCs on these events.

Keywords: precipitation, salinity, hourly measurment

