

Abstract

A research vessel sailing across a warm eddy in the Kuroshio Extension on 13 April 2016 captured an abrupt development of stratocumulus under synoptic high pressure. Shipboard observations and results from regional atmospheric model simulations indicate that increased surface heat flux over the ocean eddy lowered surface pressure and thereby accelerated southeasterly winds. The southeasterly winds transported moisture toward the low pressure and enhanced the air-sea interface heat flux, which in turn deepened the low pressure and promoted low-level convergence and rising motion over the warm eddy. The lifting condensation level lowered and the top of the marine atmospheric boundary layer rose, thereby aiding the development of the stratocumulus. Further experiments showed that 6-°C sea surface temperature anomalies associated with the 400-km-diameter warm eddy accounted for 80% of the total ascending motion and 95% of total cloud water mixing ratio in the marine atmospheric boundary layer during the development of stratocumulus. The synthesis of in-situ soundings and modeling contributes to understanding of the mechanism by which the MABL and marine stratocumulus respond to ocean eddies.

Keywords Mesoscale warm eddy; Marine atmospheric boundary layer (MABL); Stratocumulus; Mechanism; Numerical simulation