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Burst evolution of a deep dense fog by combining with low-level cloud

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Field experiments were conducted during a deep dense fog event that occurred in Nanjing 13-14 December 2007. This fog event persisted 14 hours, including 4 hours of super dense fog stage. The boundary layer structure and physical mechanisms of the fog were analyzed based on the field observations from tethersonde system, eddy covariance system, fog droplet spectrometer, and automatic weather station, etc. Formed through radiative cooling, the surface fog layer was followed by a cloud layer caused by low-level cold advection. The thickness of surface fog layer increased and cloud layer descended to lower altitudes in the development stage. With the influence of weak cold advection just above ground, the surface fog layer entered its burst evolution and some microphysical parameters of fog droplets increased significantly in 15 minutes, such as number concentration, liquid water content, mean and maximum diameter. The rising surface fog combined with descending low-level clouds to form the deep dense fog with visibility less than 15 meters, and the thickness of the combined fog layer reached 600 meters. Both the vertical momentum and downward long-wave radiation fluxes increased significantly in the beginning of the burst stage, and the net radiation fluxes approached zero at the same time. A strong surface inversion layer persisted throughout the successive stages of fog evolution because of the successive weak cold advection in the ground layer and the radiative cooling of the lower fog layer restrained by the upper fog layer.