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Organized flow structures in the atmospheric boundary layer over the sea detected by a 3D scanning Doppler lidar

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Observations of Atmospheric boundary layer (ABL) over the sea started at Ikeshima Island, Nagasaki Prefecture from July 2009 using a 3D scanning coherent Doppler lidar. During this period, small-scale vertical vortices (dust devil-like vortices; DDVs), convective cell circulation and streaks were observed.

DDVs associated with convective cell circulation (fishnet patterns of wind field) were detected not only in the daytime under relatively weak condition (2.4 m s^{-1}) but also in the nighttime under relatively strong wind (9.1 m s^{-1}). The diameter of the vortex core ranged from 45- 104 m, maximum vertical vorticity was 0.18 s^{-1}. The environmental conditions during the DDV events are characterized by a relatively strong wind (2.4-9.1 m s^{-1}), a deep boundary layer height (1-1.2 km) and a large temperature difference between the sea and air (8K). These conditions suggest that DDVs over the sea occur under strong unstable conditions.

Streaks were also observed, over the sea (with fetch several 100 km), under near-neutral conditions with strong wind. This result indicates that streaks did not appear to be generated by any particular surface feature.

Simulation of these flow structures by a Large Eddy Simulation (LES) model and comparison of the simulated structures with those observed by the 3D-CDL will contribute to the understanding of dynamics of flow structure and will be useful LES validation.

Keywords: LES validation, Doppler lidar, Organized flow structure