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Wind measurement in the atmospheric boundary layer based on coherent Doppler lidar during the transit of typhoon 'Dusuri'

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ABSTRACT

Typhoons represent one of the most extreme meteorological disasters causing coastal infrastructure damage and usually resulting in severe casualties and significant economic losses. The severe weather conditions during typhoon transit pose challenges in observing the vertical structure of the wind field, which leads to a scarcity of observational data. This seriously restricts the improvement of typhoon forecasting and early warning technologies. In this study, the vertical structure of the boundary layer wind field during the passage of Typhoon 'Dusuri' in 2023 is investigated, utilizing three coherent Doppler lidars deployed in three regions of Fujian Province, China. Firstly, the accuracy of the horizontal wind speed, wind direction, and the conventional meteorological parameters (such as temperature, relative humidity, and air pressure) observed by the coherent Doppler lidar is verified by combining the observations from automatic weather stations and wind profile radar. Then, the observed vertical structure of the wind field in the boundary layer is further compared with the classical logarithmic model for the near-surface layer, as well as the B-T model, D-H model, and Gryning model for the mixed layer. Finally, we statistically analyzed the variation of horizontal wind speed before and after the typhoon transit. The valuable observations of the wind field in the typhoon boundary layer obtained by the coherent Doppler lidar are expected to improve the boundary layer parameterization scheme in numerical typhoon prediction, which is of great significance for improving the accuracy of typhoon forecasting and early warning technology.

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