

Dual-Doppler Radar Observation of the Beijing Extreme Rainfall on 21 July 2012

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The extreme rainfall event hit Beijing on 21 July 2012 with a record-breaking amount of 460 mm in 18h. According to the radar and rain gauge observations, this rainfall event includes two stages: the precipitation in the warm sector ahead of the cold front, and the front-induced precipitation. The precipitation in the warm sector contributed to about 80% of the 24-h accumulated precipitation. This study examines the structure and evolution of the precipitation systems in the warm sector, using the measurements from two ground-based Doppler radars located in Beijing. An advanced multiple-Doppler radar synthesis technique particularly designed for dealing with non-flat surfaces is applied to analyze the three-dimensional wind fields over the terrain and plain.

The retrieved wind field and the surface observation show southeasterly winds prevail at low-level, and impinge on the northwestern mountains of Beijing at a nearly perpendicular angle at the beginning of extreme rainfall. The convection triggered by the terrain is local and quasi-stationary. The corresponding maximum updrafts are frequently observed in the upslope of the mountains, and thus the major precipitation occurs primarily in the windward side of the mountains. An analysis of the Froude number (0.11) reveals that the upstream atmosphere is statically unstable which indicates that the lifting of the incoming flow by the topography will easily trigger precipitation. The heavy rainfall then leads to the strong downdraft and cold pool near the surface. With the interaction of the cold pool and the environment wind shear, the new convective cells are triggered and organized into a southwest-northeast-oriented mesoscale convective system that further increases the rainfall intensity. Overall, the topography lifting by the terrain plays a dominant role in the Beijing extreme rainfall event.