Characteristics and Precipitation of Three Types of Convective Storms During the Beijing Extreme Rainfall of 15-17 July 2018

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An extremely severe precipitation event took place in Beijing in 15-17 July 2018. Influenced by relatively stable subtropical high and westerly trough, the precipitation was characterized by persistent rainfall, large cumulative rainfall and strong local rainfall intensity. Due to the difference of convective environmental conditions and storm structure characteristics in different stages, the hourly rainfall intensity showed a gradual feature of decreasing in turn. Based on the vertical structure characteristics of convective storms, the convective storms affecting this process were divided into three types: low-echo-centroid, high-echo-centroid and mixed convective storm. And the environmental conditions, structural characteristics and precipitation characteristics of the three types of convective storms were compared and analyzed. The results showed that: (1) The low-echo-centroid convective storm corresponded to the extreme precipitation in the warm zone at the edge of the subtropical high on the 16th morning, during which the warm and wet layers were deep and the vertical wind shear was weak. Convective storms mostly developed vertically with low echo centroid. They had the characteristics similar to tropical storms with heavy precipitation. The corresponding maximum minute precipitation was 3.3-3.6 mm. The efficient and persistent heavy precipitation caused by the low-echo-centroid convective storm with "train effect" was the direct reason of extreme precipitation in Minyun, Beijing. (2)The high-echo-centroid convective storm mainly occurred between 16th and the early morning of 17th, which was influenced by the trough and the subtropical high. During this period, the dry air intruded into the middle layer and the vertical wind shear of the whole layer was stronger. The strong echo of convective storm had high centroid and obvious drape structure. And the convective storm had strong locality and fast movement. The hourly rainfall intensity and maximum minute rainfall caused by high-echo-centriod convective storm were weaker than those caused by low-echo-centroid convective storm.(3) Mixed convective storms corresponded to heavy precipitation in the upper trough transit on the 17th. The energy and water vapor conditions in this period were significantly weaker than those in the earlier period. The echo and precipitation intensity of mixed convective storm was the weakest in the three types of storms. The intensity and magnitude of precipitation in different stages of this process were determined by the corresponding environmental conditions, structural characteristics and moving propagation characteristics of different types of convective storms.

Keywords: Extreme precipitation, Low-echo- centroid convective storm, High-echo- centroid convective storm, Mixed convective storm, Minute rainfall, “Train effect”