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Mesoscale Factors Contributing to the Extreme Rainstorm on 20 July 2021 in Zhengzhou, China, as Revealed by Rapid Update 4DVar Analysis

Abstract

This paper aims to investigate the extreme rainfall event causing hourly precipitation of 201.9mm, occurring on July 20, 2021, in Zhengzhou, China. This study utilizes 2-km analyses with a 6-minute updated cycle generated by the Variational Doppler Radar Analysis System (VDRAS), which assimilated radar data and dense surface observations, to analyze this event, we demonstrate three key mesoscale systems contributing to the development of the rainstorm.,

One of the three mesoscale systems is a mesolow, which played a crucial role in the formation and intensification of the rainstorm, triggering three convective cells along the convergence bands and the three cells eventually merged together leading to extreme precipitation in Zhengzhou. Furthermore, we provide evidence suggesting that the mesolow, along with a barrier jet and a downslope flow near the Taihang Mountains north of Zhengzhou, contributed significantly to the local intensification of the rainstorm and the occurrence of intense 1-hour rainfall. These three mesoscale features coexisted in the vicinity of Zhengzhou several hours before the extreme 1-hour rainfall, synergistically enhancing local wind convergence and moisture transport. Our analysis also indicated that the robust midlevel south/southwesterly winds from the mesolow, in conjunction with the gravity-current-modified low-level northeasterly barrier jet, heightened the vertical wind shear, creating a favorable local environment that supported the development of the severe rainstorm.

Keywords

Variational Doppler Radar Analysis System (VDRAS)

Reference

Sun, J. Z., Li, R. M., Zhang, Q. H., Trier, S. B., Ying, Z. M., & Xu, J. (2023). Mesoscale Factors Contributing to the Extreme Rainstorm on 20 July 2021 in Zhengzhou, China, as Revealed by Rapid Update 4DVar Analysis. *Monthly Weather Review*, **151**(8), 2153-2176. <https://doi.org/10.1175/Mwr-D-22-0337.1>