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Numerical Simulation and Analysis of the Localized Heavy Precipitation Event in South Korea based on diagnostic variables

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Accurate prediction of precipitation is one of the most difficult and significant tasks in weather forecasting. Heavy precipitations in the Korean Peninsula are caused by various physical mechanisms, which are affected by short-wave trough, quasi-stationary moisture convergence zone among varying air masses, and a direct/indirect effect of tropical cyclone. Many previous studies have used observations, numerical modeling, and statistics to investigate the potential causes of warm-season heavy precipitation in South Korea. Especially, the frequency of warm-season torrential rainfall events more than 30 mm/h precipitation has increased threefold in Seoul, a metropolitan city in South Korea, in recent 30 years. Localized heavy rainfall events in South Korea generally arise from mesoscale convective systems embedded in these synoptic scale disturbances along the Changma front, or from convective instabilities resulting from unstable air masses. In order to investigate localized heavy precipitation system in Seoul metropolitan area, analysis and numerical experiment were performed for a typical event in 20 June 2014. This case is described to a structure of baroclinic instability associated with a short-wave trough from the northwest and high moist and warm air by a thermal low from the southwest of the Korean Peninsula. We investigated localized heavy precipitation in narrow zone of the Seoul urban area using numerical simulations based on the Weather Research and Forecast (WRF) model with convective scale. The topography and land use data of the revised U.S. Geological Survey (USGS) data and the appropriate set of physical scheme options for WRF model simulation were deliberated. Simulation experiments showed patches of primary physical structures related to the localized heavy precipitation using the diagnostic fields, which are storm relative helicity (SRH), updraft helicity (UH), and instantaneous contraction rates (ICON). SRH and UH are dominantly related to rotating term of motions; ICON describes divergent and deformation terms. The use of the ICON is better suited for explain this localized heavy precipitation event.