NONHYDROSTATIC NUMERICAL SIMULATION FOR THE "96.8" EXTRAORDINARY RAINSTORM AND THE DEVELOPING STRUCTURE OF MESOSCALE SYSTEM*

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ABSTRACT

During the period of 3-5 August 1996 (for short "96.8"), an extraordinary rainstorm event occurred in Henan, Hebei and Shanxi Provinces in China, resulting in a severe flood catastrophe. Synoptic analyses indicate that the stable gross col field and the interaction between a northward moving typhoon (down into low pressure) and its eastern lateral Pacific subtropical high are the large- and meso-scale circulation conditions in which the "96.8" extraordinary rainstorm occured. The mesoscale typhoon-low and its specific dynamical and thermodynamical structures are directly related to this rainstorm event. The nonhydrostatic version of the mesoscale numerical model MM5 is used to investigate numerical simulation of this case. The simulation with the full physical processes of nonhydrostatic version MM5 is capable of reproducing the genesis, development and evolution of the large-scale and meso-α scale synoptic systems. The simulation results using a two-way interactive nesting procedure reveal that the typhoon-low possesses an intense coupled mechanism between the dynamical and thermodynamical fields, namely, the developing typhoon-low possesses the structure of a cyclonic vorticity column with warm center and high humidity, the lower levels of the vorticity column are moist convectively unstable and have negative moist potential vorticity; the intense ascending motion and the intense divergence at the upper levels and convergence at the lower levels, as well as the development of the convective cloud cluster are intercoupled; the intense southerly jet which companied by the typhoon-low is important in the development and maintenance of the typhoon-low and convective cloud cluster, but also transports the moisture and heat energy of the "96.8" extraordinary rainstorm. The analysis of the simulated results for precipitation indicates that the distribution of the rainfall belt and density compared with that of the corresponding observations is basically in agreement, although some rainfall centers are smaller or larger than the corresponding observations for the coarse or fine mesh domain, respectively.

Key words: Extraordinary rainstorm, Nonhydrostatic MM5, Two-way interactive nesting, Numerical Simulation, Mesoscale Structure.

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*This study was funded by the National Key Foundational Research Develop Program Project (G1998040907) and the National Natural Science Foundation of China.