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Assimilation Experiments for the Application of Dual-Radar Retrieval Wind Mosaics in Detailed Heavy Precipitation Forecast Produced by Landfall Typhoon "Meranti" (1614)

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Based on Longyan, Zhangzhou, Quanzhou Doppler weather radar data and Xiamen-Haicang dual polarization Doppler radar data, , , numerical experiments with dual-radar retrieved three-dimensional wind and mosaic technique in the Dynamic Earth Coordinate, WRF model and WRFDA assimilation system are performed to investigate the impacts of the dual-radar retrieved wind three-dimensional variational assimilation upon the detailed Fujian heavy precipitation forecast caused by landfall typhoon "Meranti" (1614) during the period of 14 to 15 September 2016. The results indicate that: (1) Dual-radar retrieval wind in the dynamic Earth coordinate can describe real wind fields reasonably, and its error is relatively small. The verification results between 14 times retrieval winds and wind profiler radar detections during "Meranti" landfall show that the mean absolute errors of retrieval wind direction and speed are 7.8° and 2.7 m s-1, respectively. (2) Retrieval wind sparsification in the horizontal direction have obvious impacts upon the assimilation and forecast results. Over-dense retrieval wind data have negative effects on the assimilation and forecast results. When horizontal resolution of retrieval wind arrives at 0.1°, the analyzed and forecasted typhoon stream structures begin to be destructed. The higher the horizontal resolution of retrieval wind, the more obvious the negative effect. Sensitivity experiment results indicate that numerical forecasts comes to the best when using 0.2° horizontal resolution data. (3) Using GFS 0.5°×0.5° analysis data as model initial fields, three experiments are carried out at different initiation time, i.e. 14:00 BLT 14, 20:00 BLT 14 and 02:00 BLT 15, September. It is found in analyzing the hourly evolution modelling of typhoon inner core and spiral rain band in Fujian province that the experimental results with different initiation time are obviously different. The simulation at initial time 20:00 BLT 14 comes to the worst and it is due to the typhoon maximum wind core being stronger than the observation in the initial time. (4) Based on the above three experiments with different initiation time, radar retrieval winds are assimilated by three-dimensional variational assimilation system. The hourly simulation of surface wind field, typhoon inner core and spiral rain band in Fujian province is obviously improved, and the simulation improvement valid time is up-to 16 hours. (5) The cycling assimilation experimental results of multi-time retrieval wind data indicate that their experimental results are obviously better than that of single-time assimilation for the detailed forecast of heavy precipitation. (6) The comparison results of hot and cold start experiments demonstrate that the hot start has obviously positive contribution to the heavy rainfall short-term numerical forecast and it is very important in the improvement of 0-6 hour short-time numerical forecasts.
Key words: dual-radar; wind field retrieval; assimilation; typhoon; heavy precipitation