Impact of Data Assimilation on the Simulation of Typhoon Approaching Taiwan

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Abstract

FORMOSAT-3 GPSRO and GTS data assimilation with WRF 3DVAR and EAKF are utilized to investigate the impact of GPSRO data on forecasting of track, structure, precipitation and environment of typhoon Morakot in different DA system. Four experiments, named GTS, GPS, GTSe and GPSe had been conducted in this study. The first two experiments assimilate GTS data only and assimilate both GPSRO and GTS data with 3DVAR respectively, the latter two experiments are same as the former two experiments but with EAKF. The results in 11 DA forecast periods indicate that the GPS experiment has smaller track error in the first 24-hr forecast and the EAKF has the smallest track error at 36 hr forecast. The predicted mean typhoon track in 48 hours of the experiments with EAKF DA system is better than 3DVAR no matter what data was assimilated. The rainfall forecast skill with 3DVAR, The GTS experiment has higher skill over 1~50 mm. in the first 24 forecast hours. After assimilating GPSRO data, the forecast skill of the GPS experiment has larger ETS than the GTS experiment in the threshold of heavy rain. The GTSe experiment has larger skill when the accumulated rainfall is over 200 mm. The GPSe experiment has better performance than the others in 24-48 hours forecast. Compared predicted and observed 24-hr accumulated rainfall, the GPS and GTS experiments can predict heavy rain occurred in the southwestern Taiwan 12 hours in advance, and the experiments with EAKF can be 30 hours in advance. The increments of GPSRO in EAKF DA system seem contributed most to typhoon circulation. The forecast typhoon tracks with 3DVAR always deviate to the right side of best track; however the predicted tracks with EAKF deviate to the left. The deep layer steering flow in 3DVAR DA system reveals much weaker easterly and strong southerly, which resulted in typhoon moving northward rapidly, so the predicted tracks are on the right side. With strong easterly steering flow in EAKF system makes typhoon move westward, so the predicted typhoon tracks deflect to the left of best track. Time series of 3-h accumulated rainfall indicate the 3DVAR predicted rainfall always fell down in the mountain area. On the other hand, the GPSe experiment has captured convergence well and it mainly occurred in mountains and coastal area, so the accompany rainfall distributed in the offshore zone besides mountain. The heavy rainfall distribution is well captured with EAKF and much better consistent with the observations.