Contribution of surface precipitation evaporation to landfalling typhoon rainfall: A modeling study of Typhoon Utor (2013)

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Abstract

Surface evaporation is an important factor in hydrological cycle of precipitation process. It is unknown however how much the evaporation of surface precipitation contributes to rainfall in a landfalling tropical cyclone (TC). In this study, ensemble simulations were performed using the Weather Research and Forecasting (WRF) model to quantify the contribution of surface precipitation evaporation to rainfall in Typhoon Utor (2013) during and after its landfall over South China. Two ensemble simulations were conducted, one with all default model settings (CTRL) and one with the surface precipitation rate in the land surface module set zero within a radius of 500 km from the storm center so that the evaporation of surface precipitation was cutoff (No_evap). Results show that the evaporation of surface precipitation contributed about 15% - 20% to the total rainfall in the inner core within a radius of 100 km from the TC center after landfall while contributed only about 5% within a

radius of 350 km of the TC center. It is found that the cutoff of surface precipitation evaporation reduced soil moisture and thus surface evaporation during and after the landfall of the storm, which also reduced the latent heat flux to the storm and thus led to a slightly weaker storm in No_evap than in CTRL. Results from the water vapor budget analysis indicated that change in surface evaporation was the primary reason for the reduced water vapor mixing ratio in the storm over land, consequently leading to a decrease in total rainfall.

Key words: Evaporation of surface precipitation, rainfall in landfalling TCs, latent heat flux, water vapor budget.