Microphysical evolution of convective clouds during Hurricane Harvey (2017) observed by coastal polarimetric radars

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Abstract: Forecasts of extreme precipitation events such as hurricanes are highly sensitive to the parameterization of microphysical schemes in numerical weather prediction (NWP) models. However, due to limited *in-situ* and remote sensing observations, it is always a challenge to verify and enhance the underlying microphysical assumptions in the NWP models, and these assumptions are often inadequate in representing the changing atmospheric state. The microphysical processes of precipitation associated hurricanes during their landfall are more complicated because of the land-ocean interaction in the coastal zone. Hurricane Harvey (2017) was the first major hurricane of category 4 intensity since the dual-polarization upgrade of the National Weather Service (NWS) Weather Surveillance Radar – 1988 Doppler (WSR-88D) network. The polarimetric radar measurements can better characterize the hydrometeor shape, size, and number of particles compared to traditional single-polarization radars. The evolution of Hurricane Harvey was well captured by the coastal polarimetric radars (i.e., KHGX and KCRP) before and after its landfall. Through the polarimetric radar observables and their distributions, this paper investigates the microphysical structure of precipitation associated with Harvey. In particular, the radar reflectivity ZH, differential reflectivity ZDR and specific differential phase KDP are jointly utilized to resolve the evolution of convective updraft strength. Both the warm cloud and ice phase microphysical processes, such as collision, coalescence and breakup of raindrops, are characterized using these radar measurements. The rainfall rates and raindrop size distribution (DSD) parameters are also derived based on the polarimetric radar measurements. The changing microphysical processes at different evolvement stages of Harvey, as well as the DSD characteristics at different parts of the convective storm system are examined to gain insights into this extreme event.