A Climatological Comparison of Predecessor Rain Events and Diabatic Rossby Vortices Associated with Recurving Tropical Cyclones

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Recurving tropical cyclones (TCs) tend to favor the onset of heavy precipitation that is distinct from the precipitation associated with the TC circulation. Such heavy precipitation may occur in conjunction with two types of meteorological phenomena: the predecessor rain event (PRE) and the diabatic Rossby vortex (DRV). A PRE is defined as a mesoscale to subsynoptic scale precipitation system featuring an average rainfall rate greater than 100 mm / 24 h that is displaced 500–2000 km poleward of a TC. In contrast, a DRV is defined as a short-scale, diabatically dominated moist baroclinic cyclone that grows without significant upper-level forcing. Thus, PREs are defined based on their sensible weather impact, whereas DRVs are defined based on their governing dynamics.

A common aspect of DRVs and PREs that accompany recurving TCs is that they form when moisture transported poleward from the TC impinges on a low-level baroclinic zone and results in ascent and attendant strong diabatic heating. Once generated, however, they may exhibit significantly different behavior: DRVs propagate rapidly downshear and can play a role in subsequent explosive cyclogenesis, whereas PREs tend to be nearly stationary and can result in significant flooding.

Given these similarities and differences between DRVs and PREs, it is of interest to compare the climatological characteristics of the two phenomena, with the intent to identify synoptic characteristics that predispose the environment to DRV versus PRE genesis with TC recurvature. To accomplish this, a 2001–2010 climatology of PREs associated with recurving western North Pacific TCs is constructed using 3-hourly 0.25° × 0.25° gridded precipitation rates obtained from the NASA Tropical Rainfall Measuring Missing (TRMM) 3B42 product. This climatology is then compared with a climatology of DRVs associated with recurving western North Pacific TCs constructed for the same 10-yr period. The climatology of DRVs associated with recurving western North Pacific TCs is assembled by joining separate climatologies of western North Pacific DRVs (Boettcher and Wernli 2013) and western North Pacific recurving TCs (Archambault et al. 2013).