

Heavy Rainfall Events Preceding the Arrival of Tropical Cyclones

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During recent active Atlantic hurricane seasons, observational evidence has suggested that heavy rainstorms sometimes can form unexpectedly well in advance of landfalling and near-coastal tracking tropical cyclones (TCs). The more extreme of these predecessor rain events (PREs) can cause significant flooding with little advance warning and can have even more serious implications if the TC itself later traverses the same region and additional heavy rainfall occurs. The relative frequency of PRE occurrence adds considerably to the forecast challenge prior and subsequent to TC landfall. It is therefore imperative to increase awareness in the meteorological community of the potential for PRE formation and to study the underlying physical processes responsible for when, where, and why PREs develop. The purpose of this presentation is to provide a synthesis of the important synoptic-scale features responsible for PREs with the major physical characteristics of PREs themselves.

Recent TCs associated with at least one PRE were identified and analyzed using radar imagery from NCDC, NHC best-track data, and NCEP/NARR gridded datasets. Precipitation data obtained from the NPVU online QPE archive and NWS products gleaned from online data sources were used to approximate how much rain fell during each TC/PRE event. Each TC examined showed some evidence of a peripheral moisture surge into the PRE, and each associated PRE produced 24-h normalized rainfall amounts of greater than 100 mm. A detailed data catalog was created to establish some general characteristics of each PRE.

A comparison of the PREs with a null case (Cindy 2005) showed that the Bosart and Carr (1978) schematic model of antecedent heavy rain occurring in a mid- and upper-level jet-entrance region confluence zone well downstream of Hurricane Agnes (1972) was somewhat applicable to the PRE cases. "Typical" PREs are located ~1000 km ahead of the parent tropical system, occur 1-2 days prior to the arrival of the TC at the latitude of the PRE, and last for ~12 h. Similarly, PREs are directly related to overall TC activity and have a strong tendency to form left of the eventual TC track. A climatological and case study approach will be used to demonstrate these points.