A Climatology of Central American Gyres

By

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Monsoon gyres, commonly found over the western Pacific Ocean, are characterized by broad low-level cyclonic circulations that occur at a variety of spatial scales ranging from 1500-3000 km. Low-level cyclonic gyre circulations, while less frequent and occupying a smaller scale, are also observed over Central America during the tropical cyclone (TC) season. A noteworthy gyre observed during the 2010 PREDICT field project served as a "collector" of TC Matthew and a source for TC Nicole. During October 2011, devastating flooding occurred in Guatemala and El Salvador when TD 12-E, embedded in a gyre circulation, made landfall on the Pacific coast of Central America. These gyre occurrences, their apparent links to TC activity, and their association with high-impact weather motivates this presentation.

A preliminary analysis of Central American gyres suggests that their spatial scales vary between 1000-2000 km. These gyres also tend to be co-located with reservoirs of deep moisture that are characterized by high precipitable water values (>50 mm) and embedded deep convection on their southern and eastern sides. Catastrophic flooding can occur when gyre cyclonic circulations interact with the topography of Central America.

A Central American gyre climatology including gyre frequency over the TC season will be presented. This climatology is then used to craft a gyre composite using previous gyre cases from 1980-2010. Particular attention will be given to the common synoptic and sub-synoptic scale features that precede and take place during gyre formation. This includes the role that intraseasonal and interannual circulations such as the Madden-Julian Oscillation (MJO) and El Nino-Southern Oscillation (ENSO) might play in gyre development. TC genesis events within gyre circulations will also be highlighted and examined further. Finally, the results of a September 2010 case study will be used to illustrate the impact Central American topography has on the development of gyre circulations. The Weather Research and Forecasting (WRF) model will be employed to understand the role of topography in the gyre's formation and evolution by running several simulations comparing a control run to simulations with adjusted terrain.