16th Cyclone Workshop

The role of large-scale environmental factors in increasing tropical cyclone size

Benjamin A. Schenkel, Lance F. Bosart, and Daniel Keyser
University at Albany, State University of New York

Several of the most destructive tropical cyclones (TCs) within the historical record have been particularly devastating due to their substantial increases in size prior to landfall [e.g., TC Katrina (2005), TC Sandy (2010)]. In spite of the heightened damage potential associated with the expansion in TC size, our current comprehension of the factors responsible for growth in storm size remains incomplete. While previous studies have suggested that TC size may grow as a result of increases in environmental moisture content or larger angular momentum imports with increasing latitude, a comprehensive study of the factors governing increases in TC size is warranted given the potential benefits in a forecasting setting. Building upon the foundation of prior work, the present study will examine the large-scale environmental factors that contribute to the expansion in the size of North Atlantic TCs.

We hypothesize that the expansion of the TC circulation is due to favorable upper-level diabatically driven TC outflow resulting from the interaction of the TC with an upper-tropospheric jet in the presence of a sufficiently moist large-scale environment. The upper-tropospheric jet acts to decrease the inertial stability of the environment, enabling the TC-induced warming in the upper troposphere to expand in area and eventually yielding an expansion in the size of the TC. To investigate this hypothesis, storm-relative composites of North Atlantic TCs that have undergone statistically significant increases in TC size are constructed from the ECMWF ERA-Interim to determine the processes responsible for modulating the size of the TC. TC size will be determined from Extended Best-Track data for North Atlantic TCs from 1989 through 2012. Potential vorticity budgets will be computed from the storm-relative composites to determine the processes responsible for increases in potential vorticity at outer radii as the storm size expands. Lastly, TC Sandy will be used as a case study for comparison with the composites to determine the factors responsible for the expansion of Sandy's circulation.