First Lorenz workshop workshop abstract

The role of mid-tropospheric humidity in tropical cyclone genesis and intensification

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Abstract:

The mechanisms that control tropical cyclone genesis and intensification remain a key area of research in hurricane prediction. Both observational case studies and numerical modeling studies suggest that mid-tropospheric relative humidity (MTH) can influence the likelihood of genesis and the potential for future intensification. While these studies are suggestive, the importance of mid-tropospheric humidity remains unclear. This uncertainty reflects, in part, the absence of observations with sufficient space/time coverage and accuracy to adequately quantify the concentrations of water vapor in the mid-troposphere.

In this study, we use microwave satellite observations at 183 GHz to monitor the mid-tropospheric relative humidity associated with Atlantic easterly waves (AEWs) and tropical cyclones (TCs) under all-sky conditions. A 12-year data set (2001-2012) of AEWs and TCs is analyzed to characterize the humidity environment associated with developing and non-developing AEWs, and intensifying and weakening TCs. The analysis reveals a strong zonal asymmetry in the near-storm MTH environment. This feature is unique to the mid-tropospheric relative humidity and does not appear in a similar analysis of the total column water vapor. Storms which develop/intensify are characterized by higher levels of MTH and the enhanced moisture concentrations are apparent up to 48 hours before intensification. The largest signal is found in AEWs, which are up to 20% more likely to develop into TCs if the near-storm MTH is within the top tercile. Tropical storms and hurricanes are ~10% more likely to develop under the same conditions, while the intensity changes for major hurricanes (category 4-5) show no clear relationship to near-storm MTH.