Tropical Cyclone Intensification in Sheared Environments: Katia (2011) and Ophelia (2011)

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Even though vertical wind shear is generally detrimental for tropical cyclone (TC) development, TCs can form and intensify within moderate ambient shear values (≥ 5 m s\textsuperscript{-1}). To investigate how TCs intensity in spite of moderate shear, we employ a 96-member ensemble generated from a six-hourly cycling data assimilation system with the Advanced Hurricane Weather Research and Forecasting (AHW) model. Two weak tropical storms were investigated with the AHW ensemble: Katia (2011), which was affected by easterly shear, and Ophelia (2011), which was affected by westerly shear. Five-day forecasts for both TCs were characterized by large variability in the intensity, motivating us to compare the underlying mechanisms between two subsets of members that predicted either the TCs would intensify or remain weak tropical storms. In the case of Katia, the key difference between the subsets was the lower tropospheric moisture in the right-of-shear quadrant. With more water vapor in the lower troposphere, buoyancy-driven updrafts moistened the mid troposphere and enhanced the likelihood of deep moist convection in the subset that predicted intensification. By contrast, the main difference between the two subsets of Ophelia was the amount and location of convection. With more convection in the left-of-shear quadrant from the onset, stronger upper-level divergence and negative potential vorticity generation set the stage for a favorable interaction between Ophelia and a nearby upper-tropospheric trough. Both cases suggest that observations from lower and mid-tropospheric moisture could help reduce initial conditions uncertainty and improve numerical forecasts for TC intensity changes in sheared environments.