Contrasting the evolution of Hurricane Sandy (2012) during ET with a canonical warm seclusion

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During the 12 hours before the landfall of Hurricane Sandy, cold continental air surrounded the low-level warm core of the cyclone, and the storm reached its lowest central pressure. Though described in previous literature as a warm seclusion, this feature differed substantially from other warm seclusion events associated with tropical cyclone extratropical transition (ET). During canonical warm seclusion events, the seclusion forms after the storm has completed ET and thus has acquired a lower tropospheric (900-600 hPa) cold core; this evolution can be diagnosed in the Cyclone Phase Space. During the seclusion event, the lower tropospheric warm core of the system redevelops, often rapidly, and the upper troposphere (600-300 hPa) may transition to a weak warm core.

The evolution of Sandy prior to landfall differed substantially from the warm seclusion evolution just described. The warm seclusion of Sandy occurred without the storm first completing ET; rather it occurred while the storm was undergoing transitioning, and before Sandy lost its lower tropospheric warm core. Furthermore, throughout the seclusion process, Sandy maintained a robust upper tropospheric warm core. Finally, whereas canonical warm seclusion events retain their lower tropospheric warm core for multiple days, the warm seclusion structure of Sandy lasted only 12-18 hours, as cold continental air penetrated the low-level vortex near the time of landfall.

The warm seclusion evolution of Sandy is simulated using the Weather Research and Forecast Model (Version 3.8) and compared to simulations of canonical warm seclusion events including Hurricane Keith (1988) and Hurricane Kate (2003). Dynamic and thermodynamic factors that contribute to each type of warm seclusion are analyzed for all three cases using high-resolution simulations of these storms. These simulations are used to demonstrate how the storm-environment interaction that led to Sandy’s pre-landfall warm seclusion differed from the Keith (1988) and Kate (2003) warm seclusion events. Finally, the similarities in storm evolution and hazards between Sandy and canonical warm seclusion events are discussed.