UPPER-TROPOSPHERIC PRECURSORS ASSOCIATED WITH
SUBTROPICAL CYCLONE FORMATION IN THE NORTH ATLANTIC BASIN

by

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**ABSTRACT**

Oceanic cyclones exhibiting properties of both tropical and extratropical systems have been categorized as subtropical cyclones (STCs) since the early 1950s. The opportunity to investigate the roles of baroclinic and diabatic processes during the evolution of STCs from a potential vorticity (PV) perspective motivates this study. This study investigates the roles of baroclinic and diabatic processes during the evolution of STCs by calculating three PV metrics from the National Centers for Environmental Prediction Climate Forecast System Reanalysis 0.5° gridded dataset. The three PV metrics quantify the relative contributions of lower-tropospheric baroclinic processes, midtropospheric diabatic heating, and upper-tropospheric dynamical processes during the evolution of individual cyclones. Quantification of these three contributions reveals the changing PV structure of an individual cyclone, indicates fluctuations in the dominant energy source of the cyclone, and aids in categorizing the cyclone.

A cyclone-relative composite analysis performed on subjectively constructed clusters of North Atlantic STCs identified from a 1979–2010 climatology is presented to document the structure, motion, and evolution of upper-tropospheric features linked to STC formation. The STCs included in the climatology are separated into five clusters representing the most common upper-tropospheric features linked to STC formation:
PV Streamers, Cutoffs, Midlatitude Troughs, Subtropical Disturbances, and PV Debris. STCs forming in association with PV streamers and cutoffs have a well-defined midlatitude connection, developing near a region of upper-tropospheric PV injected into the subtropics during an upstream anticyclonic wave breaking (AWB) event. STCs forming in association with midlatitude troughs also have a well-defined midlatitude connection, but are not associated with an upstream AWB event. In contrast, STCs forming in association with subtropical disturbances do not have a well-defined midlatitude connection, developing in the vicinity of low-amplitude upper-tropospheric disturbances progressing around the northern periphery of upper-tropospheric subtropical anticyclones. STCs forming in association with a disorganized region of upper-tropospheric PV deposited in the subtropics several days prior to STC formation (i.e., PV debris) have the least-evident midlatitude connection of the STCs identified in this study. Case studies and conceptual models are presented to illustrate the upper-tropospheric features linked to STC formation within each cluster.