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A composite view of the intensity and motion of warm-seclusion cyclones

Julian Quinting (1), Jennifer Catto (1,2), and Michael Reeder (1)

(1) School of Earth, Atmosphere and Environment, and ARC Centre of Excellence for Climate System Science, Monash University, Australia (julian.quinting@monash.edu), (2) College of Engineering, Mathematics and Physical Sciences, University of Exeter, Exeter, United Kingdom

Warm-seclusion cyclones in the Australian region have been linked to heavy rain and extreme winds causing damage to the coastal areas of south and southeastern Australia. To better understand the dynamics of these systems, this study investigates the effect of distinct upper-level potential vorticity (PV) anomalies on the intensity and motion of the cyclones through the piecewise PV inversion of a set of 573 warm-seclusion cyclones. In their mature stage, the cyclones are typically associated with either an upper-level PV streamer, a PV cut-off or a cyclonically breaking trough. The maximum intensity of the cyclones associated with a PV streamer is dominated by a corresponding upper-tropospheric cyclonic PV anomaly, whereas diabatically generated lower-tropospheric cyclonic PV anomalies make the strongest contribution to the intensity of the cyclones associated with a cyclonically breaking trough. The cyclonically breaking trough and a downstream ridge induce an anomalous northeasterly low-level flow across the low-level cyclone centre, steering the cyclones further poleward than those cyclones associated with a PV streamer or a PV cut-off. In the latter case, the upper-level PV anomaly primarily slows the eastward motion of the cyclones. In agreement with recent idealised studies, the analysis suggests that the effect of upper-tropospheric PV anomalies on the motion of midlatitude cyclones is analogous to the beta-gyres controlling the motion of tropical cyclones.