Quantification of the impact of extratropical transition on the midlatitude flow: From case studies to a composite view

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As a tropical cyclone (TC) recurves and undergoes extratropical transition (ET), its diabatically enhanced outflow may interact with the extratropical flow such that a jet streak forms and an upper-level ridge amplifies. In some instances, the TC–extratropical flow interaction can amplify a Rossby wave train that disperses far downstream of the TC. Therefore, ET may cause high-impact weather in the vicinity of the transitioning TC as well as in downstream regions such as North America or Europe.

Previous studies have quantified the impact of ET either for individual storms or in an idealized framework. Furthermore, composite analyses of recurving western North Pacific (WNP) TCs during 1979–2009 indicate that Rossby wave amplification is a general characteristic of ET. In this study we unite the case study approach with composite analysis to quantify the integrated impact of ET in a variety of ET scenarios and to elucidate the general characteristics of ET.

Recurving WNP TCs are composited based upon the strength of the TC–extratropical flow interaction. Time-lagged composites relative to the TC recurvature point are constructed from 0.5° NCEP Climate Forecast System Reanalysis data. Then a potential vorticity (PV) surgery technique based on PV inversion is employed to remove the TC from the composite fields. These modified composite fields serve as initial conditions for the mesoscale COSMO model to simulate the midlatitude flow evolution in the absence of ET. Comparing this "NOTC" simulation against "CNTRL" simulations initialized from the unmodified composite field allows for a quantification of the impact of ET on the midlatitude circulation. Preliminary results suggest that ridge amplification and jet streak formation are inherent characteristics of ET, while Rossby wave amplification and dispersion depend upon the strength of the TC–extratropical flow interaction.