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Idealized warm conveyor belts in moist baroclinic waves: PV and energy diagnostics

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This simulation study investigates the occurrence of Warm Conveyor Belts (WCB) in
idealized extratropical cyclones. WCBs are key structures of extratropical cyclones associated with intense precipitation, strong cross-isentropic mass fluxes and latent heating, leading to diabatic Potential Vorticity (PV) modification along the WCB and hence influencing the upper level Rossby waveguide leading to ridge amplification and subsequent enhanced downstream cyclogenesis. We analyse this upper level PV modification associated with WCBs by comparing moist and dry runs of our simulation. Moreover we quantify the kinetic energy generated by baroclinic conversion as the WCB ascends and the downstream dispersion of the energy by ageostrophic geopotential fluxes acting as source for the downstream cyclone kinetic energy.To investigate these processes in detail, idealized moist baroclinic simulations on an f-plane are performed using a channel version of the weather prediction model COSMO. The model has periodic zonal and relaxing lateral boundary conditions. The basic states comprise a baroclinic jet structure and different moisture profiles corresponding to wetter and drier initial conditions. To investigate up and downstream development, a finite amplitude upper level perturbation in the form of a positive PV anomaly is implemented. To quantitatively investigate WCBs, forward trajectories are calculated and objective selection criteria are applied to identify WCBs. Along these flows, we track the evolution of PV, pressure, potential temperature,relative humidity and equivalent potential temperature.