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Moisture sources of warm conveyor belts

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Warm conveyor belts (WCBs) play an important role in the dynamics of extratropical cyclones. They transport heat and moisture poleward and upward in the atmosphere, they are responsible for the major part of precipitation over the extratropical oceans and they induce/amplify upper-level ridges characterized by low values of potential vorticity (PV). Typically, due to the condensation of water vapour within WCBs, they ascend from the subtropical boundary layer to about 300 hPa, lose at least 10 g/kg specific humidity and increase their potential temperature value by more than 20 K. Key for this phenomenon are the synoptic-scale processes leading to ascent and poleward transport, and the high humidity values in the WCB air parcels prior to their ascent.

Here a statistical study is performed in order to identify the potential origin of the WCBs' water vapour. Possible scenarios are (A) that the subtropical boundary layer is moist over extended time periods (order of 10 days) "waiting" for a disturbance to come and export the humidity polewards, (B) moist air is advected from the tropics, and (C) that WCB air parcels take up moisture on relatively short time scales (a few days) prior to their ascent phase. Preliminary analyses for the 1999/2000 northern hemisphere winter season - based upon trajectory analyses using ERA40 data - suggest that scenario (C) is most frequent. The largest part of the WCB trajectories experience a significant increase in specific humidity values 0-3 days prior to their ascent out of the subtropical boundary layer (20-35N). Most of the uptake occurs in regions with sea surface temperatures above 290 K. The analysis will be extended to other winter seasons to test the generality of these results.