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Diabatic processes and branch splitting of a warm conveyor belt in MetUM and COSMO model simulations

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Warm conveyor belts (WCBs) are broad regions of ascending, cloudy air in extratropical cyclones where large quantities of heat and moisture are transported polewards. Diabatic heating within the cloudy air modifies the potential vorticity (PV) in the WCB and thus can alter the circulation locally and downstream. In numerical weather prediction systems, the processes that give rise to diabatic heating are parameterized. The uncertainty associated with parameterized processes necessitates careful examination of phenomena such as WCBs where diabatic processes are likely to have a significant effect on grid-scale dynamics. In this investigation, two operational-class numerical weather prediction systems are used to simulate a WCB that formed as part of a cyclone in the North Atlantic during the period 23-25 November 2009. The COSMO and MetUM models were run at high resolution (0.125 and 0.11 degrees, respectively) over identical domains and starting from identical initial conditions provided by an ECMWF operational analysis. Trajectory analysis was performed in both models in order to identify the WCB, track the movement of air particles through the WCB, and construct a history of diabatic heating. In both models, the trajectory analysis reveals an interesting splitting of the WCB into two branches. The first branch, labelled WCB1, consists of particles that ascend rapidly along the cold front to near-tropopause altitudes and are discharged into the downstream ridge by anticyclonic flow at the northern extremity of the WCB. The second branch, labelled WCB2, consists of particles that ascend more gradually, turn cyclonically at the northern extremity of the WCB, and are deposited around the centre of the primary low. The split branching of the WCB implies that one portion of the WCB is more likely to influence the structure of the downstream ridge and trough, whereas the other portion is more likely to influence the structure of the primary low. In this presentation, the similarities and differences between the two WCB branches and their representation in the two models will be discussed.