EMS Annual Meeting Abstracts
Vol. 8, EMS2011-248, 2011
11th EMS / 10th ECAM

Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Diabatic processes in extratropical cyclones: a climatology of warm conveyor belts

E. Madonna (1), H. Joos (1), O. Martius (2), and H. Wernli (1)

(1) ETH Zurich, Institute for Atmospheric and Climate Science, Zurich, Switzerland (erica.madonna@env.ethz.ch), (2) University of Bern, Oeschger Centre, Bern, Switzerland

During their intensification and in the mature stage, extratropical cyclones are typically associated with three coherent major airstreams – the dry intrusion, the cold conveyor belt and the warm conveyor belt, respectively. These airstreams are important for the dynamics of the cyclone evolution, and potentially also for the rapid long-range transport of atmospheric constituents. Climatologically, they are key for the meridional and vertical transport of water vapor and heat, linking the atmospheric boundary layer and the tropopause region.

Warm Conveyor Belts (WCBs) are strongly ascending cloud producing flows. They can be regarded as the primary cross-isentropic (i.e. diabatic) airstream within extratropical cyclones. During their rapid ascent from the boundary layer to the upper troposphere in about 1-2 days, WCBs transport a large quantity of sensible and latent heat poleward and upwards, which leads to cloud formation, the release of latent heat, and a significant modification of tropospheric potential vorticity.

In this study a detailed climatology of WCBs is compiled for the 21-year time period of the ERAinterim reanalysis data set (1989-2009). WCBs are identified from comprehensive trajectory calculations that select air parcels in the vicinity of cyclones with a minimum ascent of 600 hPa in 48 hours. The global geographical distribution of WCB starting regions and their tracks will be presented for different seasons.

A central aspect of the study is the analysis of the typical evolution of key parameters along the WCB flows, including water vapor, cloud water content (liquid and ice), potential temperature, and potential vorticity. It will be investigated whether the typical PV evolution along WCBs is sensitive to the geographical region, the season and the initial moisture content. Moreover, the relationship between cyclones and WCBs will be investigated, linking individual WCB trajectories to extratropical cyclone tracks. This will allow investigating in detail which categories of cyclones (e.g., geographical region, cyclone strength) are associated with intense and weak WCBs, respectively.