EGU2020-18794
https://doi.org/10.5194/egusphere-egu2020-18794
EGU General Assembly 2020

A portrayal of an orographic Warm Conveyor Belt using observations from aircraft, lidar and radar

Maxi Boettcher[1], Andreas Schäfler[2], Harald Sodemann[6], Michael Sprenger[1], Stefan Kaufmann[2], Christiane Voigt[2], Hans Schlager[2], Donato Summa[4], Paolo Di Girolamo[3], Daniele Nerini[5], Urs Germann[5], and Heini Wernli[1]

[1]Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland
[2]DLR, Germany
[3]Universita degli Studi della Basilicata, Potenza, Italy
[4]Istituto di Metodologie per l'Analisi Ambientale, Consiglio Nazionale delle Ricerche, Italy
[5]MeteoSwiss, Switzerland
[6]University of Bergen, Norway

Warm conveyor belts (WCBs) are important airstreams in extratropical cyclones, leading to the formation of intense precipitation and the transport of substantial amounts of water vapour upward and poleward. This study presents a scenario of a WCB that ascended from western Europe towards the Baltic Sea using aircraft, lidar and radar observations from the field experiments HyMeX and T-NAWDEX-Falcon in October 2012.
Trajectories based on the ensemble data assimilation system of the ECMWF are used to quantify probabilistically the occurrence of the WCB and Lagrangian matches between different observations. Despite severe limitations for research flights over Europe, the DLR Falcon successfully sampled WCB air masses during different phases of the ascent. The overall picture of the WCB trajectories revealed measurements in several WCB branches: trajectories that ascended from the East Atlantic over northern France while others had their inflow in the western Mediterranean region and passed across the Alps. For the latter ones, Lagrangian matches coincidentally occurred between lidar water vapour measurements in the inflow of the WCB south, radar measurements during the ascent at and its outflow north of the Alps during a mid-tropospheric flight leg over Germany.
The comparison of observations and ensemble analyses reveals a moist bias of the analyses in parts of the WCB inflow

and an underestimation of cloud water species in the WCB during ascent. In between, the radar instrument measured strongly precipitating WCB air mass with embedded linking trajectories directly above the melting layer while orographically ascending at the southern slops of the Alps. An inert tracer air mass could confirm the long pathway of WCB air from the inflow in the marine boundary layer until the outflow in the upper troposhpere near the Baltic sea several hours later. This case study illustrates the complexity of the interaction of WCBs with the Alpine topography, which leads to (i) various pathways over and around the Alpine crest and (ii) locally steep WCB ascent with increased cloud content that might result in enhancement of precipitation where the WCB flows over the Alps. The combination of observational data and detailed ensemble-based trajectory calculations reveals important aspects of orographically-modified WCBs.