Water vapor transport in the pre-convective environment during COPS IOP 13a on 1 August 2007

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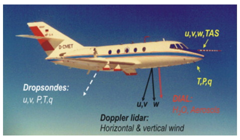
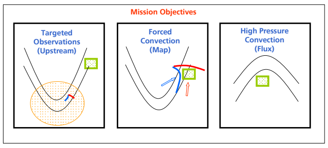
INTRODUCTION

During COPS 2007 the DLR research aircraft Falcon was for the first time equipped with the novel four-wavelength differential absorption lidar (DIAL) and the Doppler wind lidar. Both co-located systems operated simultaneously and allowed to measure vertical profiles of water vapor as well as wind speed and wind direction throughout the troposphere below the aircraft.

The unique combination of both lidars enables the calculation of a horizontal humidity transport which plays a significant role in the buildup of a convective environment.



MISSION OBJECTIVES

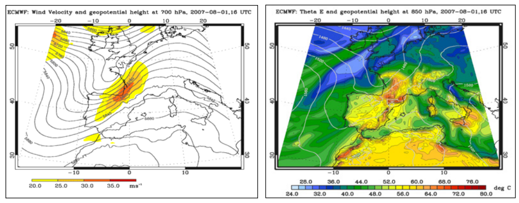


UPSTREAM: perform targeted measurements in upstream sensitive regions to gain additional data for assimilation into the ECMWF global model.

MAP: measure the pre-convective mesoscale wind and water vapor fields **(topic of this poster)**

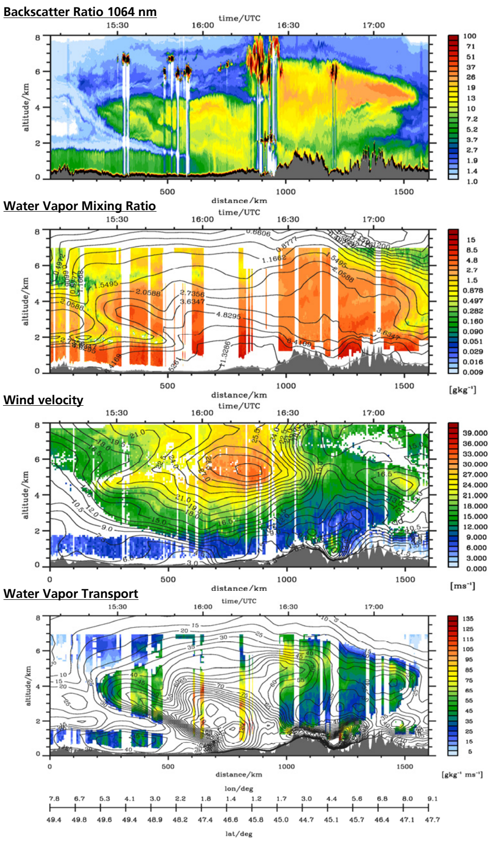
FLUX: measure latent heat fluxes when convection initiation was predicted to be mainly influenced by the orography and the surface humidity.

MISSION ON 1 AUGUST

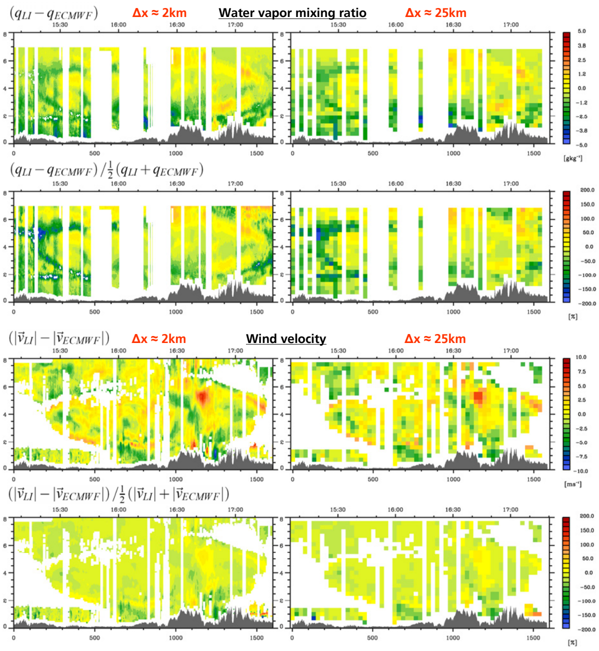


Synoptic Situation: Strong cyclogenesis on the leading edge of a trough located over eastern France and Spain. Intensive northeastward advection of warm and moist air, strong initiation of convection over southeastern France associated with the arrival of the cold front in the evening hours

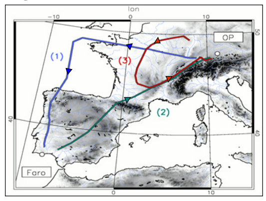
MEASUREMENTS & ECMWF DATA



DIFFERENCES LIDAR - ECMWF

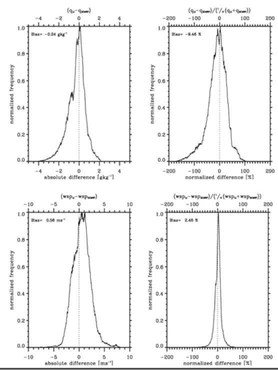


FLIGHT PATH

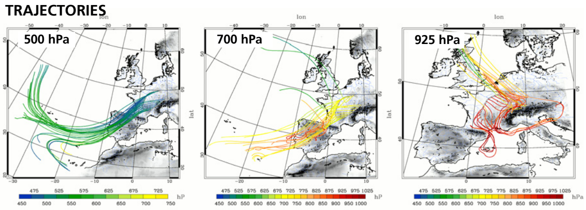


Flight 1 & 2: Upstream flights
(OP - Faro & Faro - OP)
Flight 3: Modified MAP flight over France

FREQUENCY DISTRIBUTIONS



TRAJECTORIES



Lagrangian trajectory calculations were performed with LAGRANTO to determine the origin of the measured air masses. 72h backward trajectories start every 5 minutes along the flight track in different heights.

Wernli, H. and Davies, H. C.: A Lagrangian-based analysis of extratropical cyclones. I: The method and some applications, Q. J. R. Meteorol. Soc., 123, 467–489, 1997.

CONCLUSIONS

- First co-located measurements of wind and water vapor with lidar were realized during COPS.
- The complex dynamic structure in the pre-convective environment is well reproduced by the ECMWF short-term forecasts.
- Trajectories give information about the air mass origins and underline the observed complex dynamic structure.

OUTLOOK

- data assimilation studies
- estimation of vertical humidity fluxes

ECMWF DATA

All comparisons are made with short-term forecasts from the European Centre for Medium-Range Weather Forecasts. Six hour T799 forecast runs were started from the analysis times (00,06,12,18 UTC) with an hourly data output to guarantee comparability with the lidar measurements, when interpolating in space and time.