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Combined use of Raman Lidar and DIAL measurements and MESO-NH model simulations for the characterization of complex water vapour field structures, their genesis and their role in the activation of Mesoscale Convective Systems

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As part of the Cevennes-Vivarais site, the University of Basilicata Raman lidar system BASIL (Di Girolamo et al., 2009, 2012, 2916) was deployed in Candillargues (Cévennes-Vivarais Southern France Lat: 43°37' N; Long: 04°04' E; Elev: 1 m) and operated throughout the duration of HyMeX-SOP 1 (September-November 2012), providing high-resolution and accurate measurements, both in daytime and night-time, of atmospheric temperature, water vapour mixing ratio and particle backscattering and extinction coefficient at three wavelengths.

Measurements carried out by BASIL on 28 September 2012 reveal a water vapour field characterized by a quite complex vertical structure. Reported measurements were run in the time interval between two consecutive heavy precipitation events, from 15:30 UTC on 28 September to 03:30 UTC on 29 September 2012. Throughout most of this observation period, lidar measurements reveal the presence of four distinct humidity layers.

The present research effort aims at assessing the origin and transport path of the different humidity filaments observed by BASIL on this day. The analysis approach relies on the comparison between Raman lidar measurements and MESO-NH and NOAA-HYSPLIT model simulations. Back-trajectory analyses from MESO-NH reveal that air masses ending in Candillargues at different altitudes levels are coming and are originated from different geographical regions.

The four distinct humidity layers observed by BASIL are also identified in the water vapour mixing ratio profiles collected by the air-borne DIAL LEANDRE 2 on-board of the French research aircraft ATR42. The exact correspondence, in terms of back-trajectories computation and water budget, between the humidity layers observed by BASIL and those identified in LEANDRE2 measurements has been verified based on a dedicated simulation effort.

In this research work we also try to identify the presence of dry layers and cold pools and assess

their role in the genesis of the mesoscale convective systems and the heavy precipitation events observed on 29 September 2012 based on the combined use of water vapour mixing ratio and temperature profile measurements from BASIL and water vapour mixing ratio profile measurements from LEANDRE 2, again supported by MESO-NH simulations.