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Observations and model simulations of an elevated rotor during a heavy precipitation event in the Eastern Pyrenees (The Cerdanya-2017 field experiment)

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In the framework of the GWOP'17 (Gravity Waves and Orographic Precipitation) project, we use measurements from The Cerdanya-2017 field campaign to analyze episodes of mountain waves, orographic precipitation and their associated processes over the Oriental Pyrenees. In particular, we analyze the episode of 15-16 January 2017 when a strong northern flow perpendicular to the Pyrenees generated mountain waves and lead to important precipitation accumulations over the area.

We use observations from the main instrumented site located at the Das aerodrome: a Doppler wind lidar (LIDAR), a Wind Radio Acoustic Sounding System (RASS), a Micro Rain Radar (MRR), a Parsivel Disdrometer, an automatic weather station (AWS) and atmospheric soundings (RS). In addition, we also explore the measurements from an ultra-high frequency wind profiler (UHF) radar located a few km to the north-west of the aerodrome site.

According the satellite images and the RS profiles, mountain waves were formed, probably trapped in a thin layer and vertically propagated above. Several observations revealed the non-stationarity of a wave that was displaced towards the north in the afternoon, which was seen by comparing the vertical wind speed evolution of the MRR and the UHF. Indeed, as a consequence of a decrease in the horizontal wind speed, the wavelength shortened and then a rotor was formed under the first wave crest. The formed rotor was highly transient, observed only for two or three hours. According to the LIDAR, the RASS measurements and the surface stations, the rotor seemed to be elevated from the surface, with the base of the recirculating flow at around 150 m and a radius of 4 km. Within the rotor, a strong turbulent zone was seen near the upstream edge of the lee wave, as it is expected in a rotor circulation.

On the other hand, strong precipitation occurred during the whole episode with important accumulations, around 90 mm at a mountain top AWS and around 18 mm at a valley bottom AWS. For this case, the presence of the rotor did not seem to affect neither the precipitation intensity nor the disdrometric propierties of snow according to MRR and disdrometer measurements. The episode was dominated by snow that increased in intensity during the second day and ended with the entrance of a strong northern downslope windstorm.

In addition to observations, model simulations were run for the period of interest and compared with observations when possible. Model outputs are used to better understand the flow circulation, the rotor formation and the precipitation structure and evolution.

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