5.2 ASSIMILATION OF AIRBORNE DOPPLER W-BAND RADAR DATA IN THE KILOMETRE-SCALE NWP MODEL AROME

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Because of their high sensitivity to cloud microphysical and dynamical properties, Doppler W-band radars are very complementary to the traditional sensors whose measurements are commonly used in data assimilation. Currently, these data are not used to initialise kilometre-scale NWP models such as the AROME model from Mto-France (Seity et al. 2011).

This study investigates the potential of Doppler W-band radar to improve the quality of analyses and short-term forecasts of heavy precipitation events in the Mediterranean area. Here, we take advantage of the data collected in various conditions by the airborne Doppler W-band radar RASTA (Radar Airborne System Tool for Atmosphere, Delano et al. 2013) over the Western Mediterranean during the HyMeX SOP1 field campaign dedicated to intense rainfall. This unique instrument allows the documentation of the microphysical properties and the three components of the wind field in the vertical at a high resolution of 60 m and quasi-continuously in time during the flights.

First, several data assimilation experiments were conducted over the two-month field campaign period to assess the impact of RASTA horizontal wind data. They are directly assimilated in the AROME 3D-Var assimilation system every 3 hours when they are available. The positive impact of the assimilation of RASTA wind data is first evidenced in a case of strong convection. More generally, the scores show that the assimilation of RASTA wind data improves the 6, 9 and 12-hour precipitation forecasts greater than 30 mm.

Next, the assimilation of the W-band radar reflectivity is also investigated by employing the 1D+3D-Var assimilation method that is operationally used to assimilate the radar reflectivity in AROME (Caumont et al. 2010, Wattrelot et al. 2014). This method requires the simulation of vertical profiles of reflectivity, which is done here through the use of the observation operator of Borderies et al. (2018). Vertical profiles of relative humidity are first retrieved from observed and simulated vertical profiles of reflectivity via a 1D Bayesian retrieval, and then used as pseudo-observations in the 3D-Var assimilation system of AROME. A validation of the 1D Bayesian retrieval with in-situ measurement of humidity will be presented. Finally, the respective impacts of the W-band reflectivity and Doppler velocity data assimilation will be discussed.

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