Expected Benefit of Cloud Radar and Microwave Radiometer Observations for Future Data Assimilation During Fog Conditions

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Abstract

Fog is still poorly represented in even the highest resolution operational NWP models. Continuous transmission, 95 GHz cloud radars (CR), sensitive to cloud droplets, open up the possibility of retrieving vertical profiles of fog microphysical properties with unprecedented capabilities. Additionally, ground-based microwave radiometers (MWR) can provide information on the thermodynamics and total liquid water path. This work aims at combining ground-based MWR and CR measurements with a one-dimensional variational approach (1D-Var) as a first step to 1D-Var + 3D-Var data assimilation.

Developments were made on an existing 1D-Var algorithm designed to retrieve temperature and humidity from MWR brightness temperatures. This algorithm, which uses the operational model AROME information as the background, was extended to make use of radar reflectivities to directly retrieve liquid water content profiles in addition to temperature and humidity profiles. The expected benefit to improvements in the AROME analysis is shown firstly by using synthetic observations. The benefit of the synergistic method will be discussed by comparing 1D-Var retrievals made with only one instrument to the dual-instrumental approach.

The 1D-Var algorithm will then be applied to real measurements from the SOFOG-3D field campaign. The CR and MWR were collocated at two sites where in-situ observations of cloud microphysics and temperature/humidity profiles during intensive observation periods

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were made. Retrievals will thus be validated using these in-situ measurements. The improvement brought to the AROME model analysis during fog events will be discussed through case studies and a statistical evaluation throughout the campaign.

Keywords: Cloud Radar, Microwave Radiometer, Fog, Cloud Microphysics, 1DVar