Geophysical Research Abstracts
Vol. 17, EGU2015-9048, 2015
EGU General Assembly 2015

Assimilation of radar and in-situ data for the study and the parameterization of the raindrop size distribution dynamics

Francois Mercier, Laurent Barthes, Aymeric Chazottes, and Cecile Mallet
LATMOS, UVSQ / IPSL, Guyancourt, France (mercierf90@gmail.com)

The understanding of the rain microphysics and its spatiotemporal variations is of great importance for various applications (rain parameterization in weather models, reflectivity / rainfall relation in radar meteorology, hydrology, flash floods…). Moreover, the understanding of rain microphysics necessarily has to go through the study of the Drop Size Distribution (DSD) and its variability.

We propose here a novel approach for studying the vertical variations of the DSD consisting in coupling colocalized observations of different natures in numerical propagation models via a 4D-VAR data assimilation algorithm. The aim of this work is to study the temporal variability of the DSD parameters (drop number, distribution shape and scale) and to evaluate the relative importance of the microphysical phenomena both in the rain variability and in the models parameterization.

The observations come from the HyMeX database and have been recorded in the Cévennes, France, during the autumn 2013. They consist of optical disdrometer measurements (drop fluxes on the ground) and of Doppler reflectivities at different heights recorded by a K-band vertical pointing radar.

The propagation model is a model of partial differential equations discretized on a time-height grid. It propagates the DSDs through space and time and is able to take into account different physical phenomena such as gravity, vertical wind, evaporation or collisions between drops.

The principle of the 4D-VAR algorithm consists in looking for the DSDs at the cloud base which, once propagated by the numerical model, are as close as possible to the observations.

The 4D-VAR algorithm has been successfully tested firstly on simulated observations (disdrometer DSDs and Doppler spectra). It allowed assessing its sensibility to different parameters (parameterization of physical phenomena, errors on observations…). Then the algorithm has been applied to the HyMeX data. By working successively on disdrometer and radar data, we found characteristic times of variation for the cloud base DSD parameters (with a gamma parameterization). These characteristic times for the gamma parameters enable to retrieve DSDs ensuring both a good reproduction of each kind of observations and coherence between their different natures. We found that this 4D-VAR algorithm is a good way to study the vertical variability of rain microphysics: the spatiotemporal model brings coherence between successive observations when the different natures of observations used force the retrieved parameters to be coherent over different scales.

The presentation will firstly focus on the data available and the propagation model used. Then the 4D-VAR algorithm will be presented and validated with twin experiments. Then, results will be successively given on simulated and real data. Finally, we show the response of the model to several sensitivity tests.