Use of Microphysical Variables for the Assimilation of IASI Cloudy Radiances in Convective Scale Models

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This poster focuses on new developments for the assimilation of cloud-affected radiances from the Infrared Sounding Interferometer (IASI) into the convective scale model AROME with a focus on heavy rainfall events over the Mediterranean region. The radiative transfer model currently used (RTTOV) to simulate cloudy radiances assumes single layers of opaque cloud and requires the estimation of cloud parameters (cloud top pressure and effective cloud fraction). Due to the restriction of this cloud modelling to opaque scenes, very few cloudy data are assimilated in an operational context. In this study, we propose to use the advanced radiative transfer model RTTOV-CLD that directly includes profiles of microphysical variables (liquid water content, ice water content and cloud fraction). This radiative transfer model enables a more realistic cloud representation taking into account multi-layer clouds and cloud scattering.

Firstly, the bias and the standard deviation of the innovations observation minus simulation are presented. A screening procedure to select homogeneous field of view in both observation and model spaces and to reject worthless cloud-affected radiances is also presented. This screening procedure based on the AVHRR imager is essential to have acceptable innovations but also Gaussian distributions of background and observation errors ([1]).

Secondly, this work presents one dimensional variational assimilation (1D-Var) retrievals. To that end, the cloud variables (liquid water content, ice water content) are added to the state vector and analyzed simultaneously with temperature and humidity. A new selection of 134 IASI channels were selected to improve the retrievals of cloud variables. With this new subset of channels, retrievals of temperature, humidity, liquid and ice water contents have been evaluated in the context of observing system simulation experiments and have shown encouraging results ([2]).

Finally, to prepare for the assimilation of cloudy radiances in the 3D-Var assimilation system of AROME, we evaluate the degree to which short-term forecasts can be improved if clouds are fully included in the assimilation system. To that end, a one-dimensional version of the AROME model is used to evaluate if the 1D-Var cloud increment can last during a 3 hour forecast. The evolution of the total cloud water content is compared when the AROME forecast is initialized with the analysis resulting from the 1D-Var or with the initial background. The gain of information brought by the analysis of the cloud variables in addition to temperature and humidity is also studied.

References

[1] P. Martinet, N. Fourrié, V. Guidard, F. Rabier, T. Montmerle, and P. Brunel. "Towards the use of microphysical variables for the assimilation of cloud-affected infrared radiances", *QJRMS*, doi: 10.1002/qj.2046, 2013.

[2] P. Martinet, L. Lavanant, N. Fourrié, F. Rabier, and A. Gambacorta. "Evaluation of a revised IASI channel selection for cloudy retrievals with a focus on the mediterranean basin", *QJRMS*, submitted, 2013.