EMS Annual Meeting Abstracts
Vol. 16, EMS2019-914, 2019

Impact of Hydrometeor Initialization on Short-Term Convective-Scale Numerical Weather Prediction

Mayeul Destouches, Thibaut Montmerle, and Yann Michel
CNRM, Université de Toulouse, Météo-France, CNRS, Toulouse, France (mayeul.destouches@umr-cnrm.fr)

Cloud and precipitation forecasting is both an essential and challenging task in Numerical Weather Prediction (NWP). In this process, a significant part of the errors can be traced back to imperfect initialization of the models. As regards the 3D fields of rain, cloud water, ice crystals, rain and graupel (hydrometeor content fields), several barriers make their initialization a sensitive issue: strong non-linearity of observation operators, strong non-Gaussianity of model errors, spatial discontinuity and positivity of the variables. Hence, these variables are generally neglected in the initialization process, and assumed to adapt to large-scale fields such as temperature and humidity. This talk aims to challenge this practice.

Could hydrometeor initialization substantially improve short-term forecasting? Two NWP experiments have been conducted to answer this question. In the reference experiment, hydrometeor fields are evolved by the convective-scale model AROME-France, but kept unchanged through the three hourly analysis steps, which are based on a 3D ensemble variational assimilation scheme (3DEnVar). In the test experiment, hydrometeors are modified by the analysis, by the means of their explicit inclusion in the control variables and by the use of ad hoc background error covariances. Like the other "classical" control variables, such covariances are sampled from an Ensemble of Assimilation based on AROME, and localized in order to reduce the sampling noise. Since no hydrometeor observations are considered yet, increments of hydrometeors are obtained through their cross-covariances with other variables.

The improvement in forecast skill for precipitation and cloud cover is then respectively assessed by comparisons with observations performed by ground based scanning radars and by the SEVIRI imager onboard the MSG geostationary satellite. Spatial verification methods, based on FSS and neighborhood-based contingency tables, are used for this purpose. Effect of the assimilation procedure on the initial balance of the analyzed fields will be further discussed.