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COSMO-DE-EPS – construction, diagnoses and verification of a limited-area ensemble prediction system on the convective scale

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Aiming to improve the very short-range forecast of severe weather triggered by deep moist convection and interaction with small-scale topography, DWD has developed the convection-permitting limited-area model COSMO-DE. This model has a horizontal grid-spacing of 2.8 km, covers the area of Germany and is in operational mode since April 2007.

To properly take into account the limited predictability of processes on this small spatial scale, the DWD project COSMO-DE-EPS is developing an ensemble prediction system based on COSMO-DE. The project aims to quantify forecast uncertainty and to support the beneficial use of COSMO-DE forecasts in warning and decision-making processes.

Project activities comprise the generation, diagnoses, verification, statistical postprocessing and visualization of ensemble forecasts. A pre-operational mode is foreseen to start in the beginning of 2010 with an approximate number of 20 members differing in physics parameters, lateral boundary conditions, and initial conditions. Operational implementation with about 40 members is envisaged to start in 2011.

The ensemble perturbation strategy focuses on model physics, lateral boundary conditions, and initial conditions. Model physics is perturbed by altering distinct parameters of the physical parameterization schemes either individually or in combination. Lateral boundary conditions are perturbed by nesting the COSMO-DE-EPS members into members of the COSMO-SREPS (ARPA-SIM, Bologna) which itself is a nested EPS with a grid-spacing of 10 km. Thus, the COSMO-DE-EPS represents the small-scale end of an ensemble chain which transfers uncertainty from large scales down to the convective scale. The development of initial condition perturbations is in its early stages. As a first approach modification of data assimilation parameters and insertion of analysis increments calculated from differences between COSMO-SREPS and control are being tested.

The quality of the current and further developed versions of COSMO-DE-EPS is assessed by PACprove, a probabilistic verification package developed as part of the project. PACprove is able to calculate numerous probabilistic and deterministic scores (for single members).

The structure of COSMO-DE-EPS will be presented. We will show that perturbations of the physics and the boundary conditions are both very important for the ensemble spread of forecasted precipitation and 2m-temperature. Furthermore, the combination of both perturbations leads to a greater impact on the spread. But verification clearly shows that the EPS is still underdispersive.

We expect a larger spread by involving the perturbation of initial conditions.

Also, it is well known that the implementation of a statistical postprocessing will lead to significantly better results. At first, we decided to focus on the improvement of ensemble precipitation forecasts using the logistic regression approach. The future plan will be the implementation of Bayesian Model Averaging.