Ensemble methods for diagnosing forecast errors and for probabilistic forecasting

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Main error sources in numerical weather prediction (NWP) are the uncertainty in the initial conditions and the model error itself (originating from the imperfect formulation of the model equations and their discretization) [1]. In regional models (i.e. when the NWP model is integrated over a certain geographical region of the Earth), another forecast error component appears, namely the uncertainty implied by the lateral boundary conditions. Knowledge obtained via the diagnosis of the above-mentioned forecast error components can serve as a basis for the improvement of NWP models as well as for their correct interpretation. In the frame of the presented work initial, model and lateral boundary uncertainties are diagnosed and compared for very short-range forecasts (up to the range of 6 hours) of the ALADIN regional model [2] (operationally applied at the Hungarian Meteorological Service). The methodology for the separation of different error sources is based on the Ensemble Data Assimilation (EDA) and on the multi-physics techniques. Spectral error diagnostics allow the examination of error contributions to different spatial scales. Results show, that very short-range forecast errors originate primarily from the uncertainty of the initial conditions (as expected) and from the model error (uncertainty in the physical parametrisations), especially on the small spatial scales. Errors implied by the lateral boundary conditions affect larger spatial scales and are of secondary importance for the very short-range.

Inspired by the results above (namely that an important part of the full forecast error originates from the uncertainty in the initial conditions) attempts has been taken to improve the operational regional ensemble prediction system (EPS) of OMSZ. These attempts consisted of replacing the downscaled initial perturbations provided by global EPS systems [3] [4] by those generated via regional EDA perturbations applied for the surface initial conditions and via regional singular vector computations. It has been shown [5] that the improved representation of the regional initial uncertainty implies an improved reliability of the ensuing EPS system.

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