EMS Annual Meeting Abstracts
Vol. 14, EMS2017-207, 2017

A new stochastic scheme perturbing partial model tendencies

Clemens Wastl, Yong Wang, and Christoph Wittmann
ZAMG, Vienna, Austria, (clemens.wastl@zamg.ac.at)

The horizontal resolution of numerical weather prediction (NWP) models has significantly increased in the past years and has entered the convection permitting scale. However, despite the small mesh size there are still many processes in a convection permitting NWP model that are unresolved and must be parametrised. Such parametrisations pose a source of model uncertainties that can in some situations significantly decrease the skill of the forecast. A very popular method to account for model uncertainties in an Ensemble Prediction System is the use of stochastic parametrisation schemes. Such schemes are producing an ensemble of perturbed members where each member sees a different, but equally likely stochastic forcing. They are usually quite simple, computationally very effective and have shown to significantly improve the reliability of weather forecasts. The most popular method of stochastic physics is called SPPT (Stochastically Perturbed Parametrisation Tendencies) and has been developed at the ECMWF. In SPPT a spectral pattern generator produces random noise which is used to perturb net model tendencies of temperature, water vapor content and winds. SPPT improves the reliability of forecasts by reducing biases in the ensemble forecasts and yielding a greater ensemble spread. However, an often mentioned shortcoming of the rather simple SPPT approach is the lack of physical consistency. In SPPT only one single stochastic pattern is calculated and equally applied to the parametrised net tendencies of model variables. However, this implies that the different schemes are perfectly correlated with each other and have the same error characteristics. This assumption is not always justifiable as several studies have shown. The perturbation of net tendencies in SPPT also implies that the error characteristics of one parametrisation scheme is not considered in the subsequent one. Following these shortcomings we have developed a scheme where the partial tendencies of the physical parametrisation schemes radiation, shallow convection, turbulence and microphysics are perturbed separately including a consideration of the error representation in the subsequent schemes. This method increased the stability of the model in the way that the tapering function, which is used in SPPT to reduce the perturbations to zero in parts of the atmosphere, could be switched off. The newly developed scheme has been tested over a 1-month summer and winter period, respectively, and verified against upper air analyses and surface observations. It led to a statistically significant increased ensemble spread and to generally improvements in the probabilistic performance compared to standard SPPT.