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Characterization of the model error in COSMO-D2-EPS using a flow-dependent partial SDE

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The growing share of renewable energy in power generation increases the impact of the weather on the stability of the power grid. Especially prior to severe weather events, not only high-quality weather forecasts but also information about forecast uncertainties is needed by the transmission system operators (TSOs) to prepare stability provisions. To this end, in the research project *gridcast* the German Meteorological Service (DWD) aims at an improved representation of the inherent model error in its convection-permitting ensemble prediction system COSMO-D2-EPS.

We describe the model error using the following stochastic ansatz: The tendency equations for a set of relevant variables for power prediction like temperature, zonal and meridional winds, and relative humidity are extended by an additive tendency error approximated by a partial stochastic differential equation (SDE). This SDE consists – similar to an Ornstein-Uhlenbeck equation – of a damping term and a random field. However, the SDE is augmented with an additional diffusion term that ensures spatial correlations. Each of the three terms has a strength parameter that is assumed to be a function of (possibly different) flow-dependent predictor variables. Hence the relative importance of the three terms varies in space and time according to the respective weather conditions. The functional form of the parameters can be approximated from past estimates of the model error based on COSMO-D2 ensemble forecasts.

We present theoretical properties of the SDE and motivate its choice as representation of the model error. Furthermore, we investigate a method to determine the parameters of the SDE and apply this method to the operational COSMO-D2-EPS at DWD for the model error of relevant forecast variables. First numerical results along the development of the scheme are presented.