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The representation of model error in the global ensemble prediction system ICON-EPS

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The application of ensemble weather forecasts in power forecasting is one objective within the research project gridcast, a cooperation between the German Weather Service (DWD), the Fraunhofer Institute for Energy Economics and Energy System Technology (IEE) and the four German transmission system operators as associated partners. In order to achieve this goal, the estimation of forecast uncertainty and model error in the global ensemble forecasting system ICON-EPS is investigated.

Operational since January 2018 at DWD, ICON-EPS runs as a 40 member ensemble with a forecast lead time of up to 180 hours and a horizontal grid resolution of 40 km. Besides the forecast on the global scale, the ICON model also provides an ensemble forecast on a nested domain over Europe up to 120 hours and with a horizontal resolution of 20 km. These forecast horizons up to five days and beyond are particularly interesting for transmission system operators who need to have as early as possible a quantification of uncertainty of the underlying weather forecasts in order to estimate e.g. the uncertainty of power forecasts or to assess in advance risks and impacts on the grid's stability.

Ensemble forecasts of surface variables as e.g. wind gust, wind speed near the surface, or global radiation, suffer from an insufficient spread-skill reliability. This lack of forecast skill could be caused by inadequate parameterizations of sub-grid-scale physical processes or radiation. Here, this inherent model error is directly simulated with a stochastic differential equation (SDE). The flow-dependent parameters of the SDE are estimated off-line based on temporal and spatial correlations. The SDE modifies the forecast tendencies at each model time step. In order to estimate the parameters of the SDE, a first guess of the model error has to be appropriately quantified. As a first approach, assuming perfect initial conditions, the model error could be estimated in terms of forecast error over short lead times. However, since the global ICON forecast is based on an "incremental analysis update" which incorporates small drips of the analysis increment into the model around the state of the analysis, the "truth" as reference is quite difficult to figure out in an appropriate way. We present results of investigations on estimating the inherent model error in ICON-EPS and show first results of the parameter estimation for the stochastic "model for the model error" in the global ensemble forecasts.