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NWP model forecast skill optimization via closure parameter variations

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We present results of a novel approach to tune predictive skill of numerical weather prediction (NWP) models. These models contain tunable parameters which appear in parameterizations schemes of sub-grid scale physical processes. The current practice is to specify manually the numerical parameter values, based on expert knowledge. We developed recently a concept and method (QJRMS 2011) for on-line estimation of the NWP model parameters via closure parameter variations. The method called EPPES ("Ensemble prediction and parameter estimation system") utilizes ensemble prediction infra-structure for parameter estimation in a very cost-effective way: practically no new computations are introduced. The approach provides an algorithmic decision making tool for model parameter optimization in operational NWP.

In EPPES, statistical inference about the NWP model tunable parameters is made by (i) generating an ensemble of predictions so that each member uses different model parameter values, drawn from a proposal distribution, and (ii) feeding-back the relative merits of the parameter values to the proposal distribution, based on evaluation of a suitable likelihood function against verifying observations. In this presentation, the method is first illustrated in low-order numerical tests using a stochastic version of the Lorenz-95 model which effectively emulates the principal features of ensemble prediction systems. The EPPES method correctly detects the unknown and wrongly specified parameters values, and leads to an improved forecast skill. Second, results with an ensemble prediction system emulator, based on the ECHAM5 atmospheric GCM show that the model tuning capability of EPPES scales up to realistic models and ensemble prediction systems. Finally, preliminary results of EPPES in the context of ECMWF forecasting system are presented.