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Algorithmic tuning of physical parameterization schemes in NWP models

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Integration of physical parameterization schemes with dynamics in NWP model is a major challenge. On one hand, need to improve the realism of physical processes can be demonstrated by process studies, large eddy simulations, and such like. On the other hand, it is hard to prove that the improvement in physical realism leads to a generally improved model skill. One reason is that the parameterization schemes of sub-grid scale physical processes contain tunable parameters, and it is very hard to manually specify their optimal values. 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 research and operational NWP. 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 (T42L31) show that the model tuning capability of EPPES scales up to realistic models and ensemble prediction systems. Finally, encouraging results of the EPPES algorithm in the context of the ECMWF forecasting system are presented.