Impact of stochastic atmospheric physics in ECMWF's monthly forecasting system

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ECMWF's ensemble prediction system contains an explicit representation of model uncertainties with the aim to describe errors, or uncertainties, due to the sub-grid scale physical processes. Currently two schemes are active: the stochastically perturbed physical tendency (SPPT) scheme and the stochastic kinetic energy backscatter (SKEB) scheme. SPPT introduces multiplicative noise to the total physics tendency of wind, temperature and humidity. SPPT has the largest effect on the ensemble in the extended forecast range.

Here we show, using experiments with the monthly forecasting system of ECMWF ensemble prediction system, what the impact of these two model uncertainty schemes is on the systematic errors and predictive skill. In particular, we will discuss how slowly evolving errors like SST biases evolve during the course of the month and what the systematic errors in the atmosphere are. The stochastic schemes result in a reduction of excessive tropical rainfall near the ITCZ and an increase in rainfall over the Western tropical Pacific, leading to a reduction of these overall biases. The systematic errors in the frequency of tropical storms are also improved by increasing the number of simulated tropical storms.

In terms of probabilistic forecast quality it has been found that SPPT increases the under-dispersive spread of MJO predictions by a significant amount which results in improved skill scores. Tropical temperature and precipitation forecasts are also improved during the month due to the stochastic physics schemes.