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Accounting for model uncertainty in EC-Earth3: impact of SPPT on seasonal forecast quality

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In recent years, stochastic parameterization has emerged as a new method to take into account atmospheric model uncertainty in monthly to decadal climate predictions. One straightforward method consists in applying in-run multiplicative noise to the physical tendencies computed by the atmospheric model. The stochastically perturbed parameterization tendency scheme (SPPT; Palmer et al. 2009) designed at ECMWF introduces univariate Gaussian perturbations to the wind, humidity and temperature tendencies. This method along with a stochastic backscatter algorithm showed promising results at a monthly-to-seasonal scale with the ECMWF coupled model when compared to multi-model ensemble techniques (Weisheimer et al., 2011).

SPPT was implemented in the IFS atmospheric component of the EC-Earth3 Earth system model. Two sets of space and time scales for the perturbation patterns were tested in EC-Earth3 to represent uncertainties at the seasonal time scale. The impact of these perturbations is analyzed in terms of systematic error, spread-to-skill ratio, anomaly correlation of the ensemble mean as well as probabilistic skill. Results depend on the variable and region studied. Over the Tropical Pacific, both of the SPPT settings tested result in a reduction of the systematic error and an increase in ensemble spread for sea-surface temperature, and these improvements translate into enhanced probabilistic skill.