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Introducing a "stochastic dynamics" technique to account for atmospheric model uncertainty at a seasonal time scale: a comparative study between two coupled climate models

Lauriane Batté (1), Michel Déqué (1), Francisco J. Doblas-Reyes (2,3)
(1) Météo-France, CNRM-GAME, France (lauriane.batte@meteo.fr), (2) IC3, Barcelona, Spain, (3) ICREA, Spain

The "stochastic dynamics" technique (Batté and Déqué, 2012) is based on a combination of two approaches to improve atmospheric models: one is the estimation and correction of model initial tendency errors, the other is the introduction of in-run random perturbations to account for model uncertainties. The method is implemented in a two-step approach:

1. the initial tendency errors are estimated by running the model with atmospheric nudging (relaxation) of prognostic variables towards reference data,
2. the corrections of these errors are drawn randomly and added to the model dynamics in-run as perturbations during a seasonal hindcast experiment ; different corrections are used for each ensemble member and updated every six hours.

This technique was implemented in the ARPEGE-Climate component of the CNRM-CM coupled climate model and in IFS for the EC-Earth Earth system model. A statistical analysis of the initial tendency errors of both models gives some insight on the nature of the perturbations added in the seasonal hindcast runs. The impact of these perturbations on seasonal forecast quality is analyzed in terms of systematic error, spread-to-skill ratio, correlation of the ensemble mean and probabilistic skill. A comparison of the results from each coupled model gives additional information as to how model-dependent hindcast improvements are.