Stochastic sea ice parameterization in the context of polar predictability

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Abstract

Climate models have to deal with different kinds of uncertainties. On the one hand there are uncertainties related to the initial and boundary conditions. In numerical weather prediction the inaccuracy in initial conditions is commonly addressed by producing ensembles of forecasts with perturbed initial states to estimate the evolution of the probability distribution of the model variables. On the other hand there are also uncertainties inherent to the model itself. The numerical discretization, the parameterizations of subgrid-scale processes, and insufficient knowledge of the involved physical processes lead to uncertainties, especially when it comes to climate integrations. It might therefore be necessary to include estimates of model uncertainty in studies of predictability to be able to assess more reliably the potential of regional and global weather and climate predictions. One way to account for inherent model uncertainty, or more precisely the uncertainty connected to specific parameterizations, is the inclusion of stochastic parameterizations.

In this study we compare the evolution of spread in sea ice variables between two sets of ensembles, one set with initial atmospheric perturbations and one set with a stochastically perturbed key parameter of the sea ice rheology. For this purpose we use the new fully coupled atmosphere – ocean – sea ice model ECHAM6-FESOM. The aim is to quantify the extent to which the omission of model uncertainty leads to an overestimation of potential polar predictability, and to identify specific areas and seasons in which initial perturbation ensembles are under-dispersive compared to stochastic parameterization ensembles.