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The impact of learning strategies for interactive ensembles in the presence of unresolved scales

Wim Wiegerinck (1,2) and Frank Selten (3)

(1) SNN Adaptive Intelligence, Nijmegen, Netherlands (w.wiegerinck@science.ru.nl), (2) Department of Biophysics, Donders Institute for Brain, Cognition and Behavior, Radboud University Nijmegen, The Netherlands, (3) Royal Netherlands Meteorological Institute, De Bilt, The Netherlands

Recently, supermodels consisting of an ensemble of dynamically interacting models have been proposed as an alternative to the common non-interactive multi-model ensembles in order to improve climate predictions. A challenge in supermodelling is that the interaction terms between ensemble members are to be learned from data. In this paper we show that the choice of the learning strategy can have a significant impact on the climatological skill of the resulting supermodel.

We perform model studies in an imperfect model class scenario, which means that the model class of the assumed ground truth is more complex than the model class of imperfect models in the ensemble. The assumed ground truth is modelled as a three-level, quasi-geostrophic spectral model on the sphere, truncated at T42. The models in the ensemble as similar, but with different parameters and, importantly, truncated at T21. In this setting, we apply a conventional learning strategy aimed to optimise short-term prediction skill of the supermodel as well as a novel attractor learning strategy, which aims to optimise the climatology of the supermodel directly.
The simulation results show that conventional short-term prediction learning can actually lead to a long-term climatological error that is significantly larger than that of each of the imperfect models. Attractor learning mitigates this problem, at least to some extent.