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Recent development of a supermodel - an interactive multi-model ensemble

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An interactive multi-model ensemble (named as supermodel) based on three state-of-the-art earth system models (i.e., NorESM, MPIESM and CESM) is developed. The models are synchronized every month by data assimilation. The data assimilation method used is the Ensemble Optimal Interpolation (EnOI) scheme, for which the covariance matrix is constructed from a historical ensemble. The assimilated data is a weighted combination of the monthly output sea surface temperature (SST) of these individual models, but the full ocean state is constrained by the covariance matrix. The synchronization of the models during the model simulation makes this approach different from the traditional multi-model ensemble approach in which model outputs are combined a-posteriori.

We compare the different approaches to estimate the supermodel weights: equal weights, spatially varying weights based on the minimisation of the bias. The performance of these supermodels is compared to that of the individual models, and multi-model ensemble for the period 1980 to 2006. SST synchronisation is achieved in most oceans and in dynamical regimes such as ENSO. The supermodel with spatially varying weights overperforms the supermodel with equal weights. It reduces the SST bias by over 30% compare to the multi-model ensemble. The temporal variability of the supermodel is slightly on the low side but improved compared to the multi-model ensemble. The simulations are being extended to 2100 to assess the simulation of climate variability and climate change. Performing prediction experiments with the supermodel is the main perspective in the next step.