

## Initialization of the coupled model MPI-ESM for seasonal predictions

**Johanna BAEHR**

*University of Hamburg, Germany, [johanna.baehr@zmaw.de](mailto:johanna.baehr@zmaw.de)  
Robert Piontek, Kristina Fröhlich, Michael Botzet, Wolfgang Müller  
Presenter : Johanna Baehr*

We focus on two aspects of the initialization of the MPI-ESM coupled model to perform seasonal predictions: the generation of the initial conditions and the generation of the ensemble. To generate the initial conditions, we perform several nudging simulations with full-field nudging in both the atmospheric and the oceanic components to the respective ECMWF re-analysis. We find that nudging in the atmosphere can result in a spurious drift in the global surface temperature, which is independent of the wave numbers included in the spectral nudging, but can be reduced if the planetary boundary is excluded from the nudging (especially for temperature) or the resolution is increased. Combined atmosphere and ocean nudged experiments show improved variability in surface temperature over nudging in the atmosphere and ocean separately.

To generate the ensemble spread, we implement bred vectors in the ocean component. We first test the ensemble generation in an uninitialized framework to separate the growth of perturbations to generate the ensemble spread, and any drift resulting from a potential initialization shock. To account for the vertical dependence of the variability in the ocean, we introduce a depth dependent norm for the bred vectors. We compare ensembles initialized from lagged initialization and bred vector perturbations against the spread of an uninitialized control simulation. For seasonal timescales, the bred initialized ensemble shows for most analyzed regions improved spread compared to a lagged initialized ensemble for ocean temperatures averaged over 0-700m and 1000-3500m, and also salinity. For hindcast simulations which are initialized from a nudged experiment, we compare ensembles initialized from lagged initialization and ensembles initialized from bred vectors against sea surface temperature observations. Both, the rank histograms, and the spread skill score indicate at least comparable if not improved spread and forecast error for the breeding based ensemble compared to the lagged initialized ensemble. The initialization based on full field nudging in both the atmosphere and the ocean with the planetary boundary layer excluded, and the ensemble generation based on oceanic breeding is now implemented in the MPI-ESM seasonal forecast system.