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Towards a Seasonal Prediction System using MPI-ESM

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We present preliminary results for the predictive skill of the MPI-ESM coupled climate model system on seasonal time scales. The final goal of the current research is a joint German contribution to the operational multi-model ensemble EUROSIP, issuing seasonal forecasts at ECMWF. The employed model is the MPI-ESM as used for the CMIP5/IPCC-AR5 simulations, consisting of the atmospheric component ECHAM6, and the oceanic component MPI-OM. The atmospheric horizontal resolution is T63 with 47 vertical levels (including the stratosphere and mesosphere), and the oceanic horizontal resolution is about 1.5 degrees with 40 vertical levels.
An assimilation run is performed between 1979 and 2011 (at present) by nudging both the atmosphere and the ocean to the ECMWF re-analyses. In the atmosphere, vorticity, divergence, temperature, and surface pressure are nudged, while in the ocean, temperature and salinity are nudged. In the atmosphere, temperatures are only nudged above the boundary layer. Sea ice concentrations in the Arctic and the Antarctic are nudged to NSIDC data.

Ensemble hindcast simulations are initialized from the assimilation runs between 1981 and 2011, starting each May and November, and run for 12 months each. For each start date, 10 ensemble members are generated with slightly modified initial conditions (through breeding in the ocean). The nudged experiment reproduces the global warming trend, though a warm bias remains. Hindcast experiments show a drift, highly variable on horizontal scales and crucially dependent on the timing of the initialization. Bias corrected individual forecasts for each start date largely reproduce the observed surface temperature anomalies at 2-4 months lead time. Nino 3.4 SSTs show a small RMS error, with most El Niño (e.g. 1997/98) and La Niña (e.g. 1988/89) events being predicted. We also investigate predictive skill in the North Atlantic. Stratospheric variability is reproduced well in the hindcast runs, with the ensemble spread representing the variability of reanalysis data. Further analysis will include investigating additional quantities and regions in order to establish the predictive skill of the seasonal prediction system.