A large ensemble decadal prediction system with MPI-ESM

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Current state-of-the-art decadal ensemble prediction systems are run with an ensemble size of 10 to 40 members, their retrospective forecasts of the past are used to assess the system's prediction skill. Here, we present an attempt for a large ensemble decadal prediction system for the time period 1960-today, with an ensemble size of 80 members, based on the low resolution version of the Max Planck Institute Earth system model (MPI-ESM-LR). The ensemble is forced with CMIP6 conditions and initialized every year in November through a weakly coupled assimilation using atmospheric reanalyses via nudging and observed oceanic temperature and salinity profiles via a 16-member ensemble Kalman filter. To generate ensemble members beyond 16, we use additional physical perturbations at stratospheric height. The analysis of our large ensemble prediction system presented here aims for answering two questions: (1) How does the ensemble mean deterministic prediction skill for global and North Atlantic key climate indices change with ensemble size? (2) How well may the 80-member ensemble serve as a basis for a robust statistical analysis of probabilities of extremes in the North Atlantic sector? Preliminary results for global and regional air surface temperature show that in terms of ensemble mean ACC and full ensemble CPRSS with reference data, the 80-member ensemble leads to similar prediction skill as the 16-member ensemble. This indicates that the additional ensemble members may lead to a better sampling of the distribution of model trajectories, paving the way for a more robust statistical probabilistic analysis.