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Analysis of ensemble quality of initialzed hindcasts in the global coupled climate model MPI-ESM

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Global coupled climate models have been used to generate long-term projections of potential climate changes for the next century. On much shorter timescales, numerical weather prediction systems forecast the atmospheric state for the next days. The first approach depends largely on the boundary conditions, i.e. the applied external forcings, while the second depends largely on the initial conditions, i.e. the observed atmospheric state. For medium range climate predictions, on interannual to decadal time scales, both initial and boundary conditions are thought to influence the climate state, because the ocean is expected to have a much larger deterministic timescale than the atmosphere. The respective climate model needs to resemble the observed climate state and its tendency at the start of the prediction. This is realized by incorporating observations into both the oceanic and atmospheric components of the climate model leading to an initialized simulation.

Here, we analyze the quality of an initialized ensemble generated with the global coupled Max Planck Institute for Meteorology Earth System Model (MPI-ESM). We initialize for every year for the time period 1960 to 2014 an ensemble run out to 10 yaers length. This hindcast ensemble is conducted within the MiKlip framework for interannual to decadal climate prediction. In this context, the initialization of the oceanic component of the model ensemble is thought to impact the model state within the first years of prediction, however, it remains poorly known, for how much longer this impact can be detected. In our analysis we focus on the North Atlantic ocean variability and assess the evolution in time of both the probability density function (PDF) and the spread-error-ratio of the ensemble. Firstly, by comparing these characteristics of the initialized ensemble with an uninitialized ensemble we aim to (1) measure the difference in the initialized and uninitialized ensemble, (2) assess the evolution of this difference in time, and (3) measure the time scales on which we can detect the influence of the initialization. Secondly, by comparing the initialized ensemble with re-analysis products, we aim to quantify the (4) quality of the simulated ensemble spread and (5) the predictive skill of the ensemble.