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Comparison of initialisation methods in global dynamic decadal climate forecasts

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The forecast quality of decadal predictions is strongly constrained by the successful representation of both the impact of the varying radiative forcing and the correct phase of the internal variability. The requirement to correctly address the internal variability uncertainty and obtain skilful forecasts is an accurate knowledge of the initial state of the system.

The initialization can be split in two stages. First, the best knowledge of the system state has to be built from the observations available using a physical extrapolation of the observations. The second stage consists in creating an ensemble of initial conditions. A straightforward way of initialising a climate prediction system consists of providing the model with the observed values of the initial state variables. However, predictions suffer from both drift and biases caused by the inadequacy of the dynamical models currently in use, where models reproduce only an approximation to the real world. Introducing the best knowledge of the real initial state into the model will consequently cause an unavoidable drift of the model towards its preferred state. The drift alters the simulated mean state and variability along the forecast and makes a posteriori corrections necessary. An alternative is offered by the anomaly initialization technique, which tries to eliminate at least the impact of the drift. The philosophy behind it consists in initializing the model close to its own mean climate, but with the correct phase of the observed low-frequency variability. For this purpose, the model is initialized with the sum of the long-term mean state of the model and the anomalies of the reanalysis. This work compares different formulations of these two initialization methods in the framework of the EC-Earth global forecast system.

The benefits of the anomaly versus full-field initialisation is assessed over a set of retrospective forecasts initialized every two years over the 1960-2006 period using the ORAS4 reanalysis as observed initial ocean state, the ERA40 reanalysis before 1979 and the ERA-Interim one afterwards for the atmosphere component and a LIM2 sea-ice run forced by atmospheric observational estimates for the sea-ice component. Forecast quality measures such as the ensemble-mean mean squared skill score and the correlation will be presented to assess the accuracy of the retrospective forecasts for the AMO, PDO, ocean heat content, surface temperature and precipitation.