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Initializing decadal climate predictions over the North Atlantic region

Daniela Mihaela Matei (1), Holger Pohlmann (2), Johann Jungclaus (1), Wolfgang Müller (1), Helmuth Haak (1), and Jochem Marotzke (1)

(1) Max Planck Institute for Meteorology, Ocean in the Earth System, Hamburg, Germany (daniela.matei@zmaw.de, 0049 40 41173-298), (2) Met Office, Hadley Center, Exeter, UK

Decadal climate prediction aims to predict the internally-generated decadal climate variability in addition to externally-forced climate change signal. In order to achieve this it is necessary to start the predictions from the current climate state. In this study we investigate the forecast skill of the North Atlantic decadal climate predictions using two different ocean initialization strategies. First we apply an assimilation of ocean synthesis data provided by the GECCO project (Köhl and Stammer, 2008) as initial conditions for the coupled model ECHAM5/MPI-OM. Hindcast experiments are then performed over the period 1952-2001. An alternative approach is one in which the subsurface ocean temperature and salinity are diagnosed from an ensemble of ocean model runs forced by the NCEP-NCAR atmospheric reanalyzes for the period 1948-2007, then nudge into the coupled model to produce initial conditions for the hindcast experiments. An anomaly coupling scheme is used in both approaches to avoid the hindcast drift and the associated initial shock. Differences between the two assimilation approaches are discussed by comparing them with the observational data in key regions and processes.
We asses the skill of the initialized decadal hindcast experiments against the prediction skill of the non-initialized hindcasts simulation. We obtain an overview of the regions with the highest predictability from the regional distribution of the anomaly correlation coefficients and RMSE for the SAT. For the first year the hindcast skill is increased over almost all ocean regions in the NCEP-forced approach. This increase in the hindcast skill for the 1 year lead time is somewhat reduced in the GECCO approach. At lead time 5yr and 10yr, the skill enhancement is still found over the North Atlantic and North Pacific regions.
We also consider the potential predictability of the Atlantic Meridional Overturning Circulation (AMOC) and Nordic Seas Overflow by comparing the predicted values to the respective assimilation experiments. Hindcasts of Atlantic MOC and Denmark Strait Overflow show higher predictability than the comparison experiments without initialization and damped persistence predictions up to about 5-6 years.