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A comparison between ensemble hindcasts obtained from oceanic and from atmospheric perturbations in the MPI-ESM climate model.

Camille MARINI

Institut für Meereskunde, Universität Hamburg, Germany, camille.marini@zmaw.de
Armin Koehl, Detlef Stammer
Presenter : Camille Marini

The ocean is the slow component of the climate system, whose memory is a key hypothesis for decadal predictions. It is thus crucial to generate ensembles that represent the uncertainties on the oceanic state, and in particular on the oceanic initial conditions, which is the focus of our study.
We compute oceanic perturbations as the singular vectors of the tangent propagator of a linear dynamical system that approximates the evolution of the 3-dimensional oceanic temperature (T) and salinity (S), based on Hawkins and Sutton (2009). We consider the first four singular vectors and apply a rotation and a scaling in a similar way as in Molteni et al (1996), so that the amplitudes of the perturbations represent the uncertainties on the oceanic reanalysis used as initial conditions to elaborate the hindcasts.
These four perturbations are added and subtracted to initial conditions to create ensembles with nine members (1 unperturbed and 8 perturbed). Ensemble hindcasts are run with the Max Planck Institute Earth System Model (MPI-ESM). They start every year from 1991 to 2010 and last 10 years. Initial conditions are taken from an "assimilation" run, where T and S are nudged towards the T and S anomalies of the newest version of the GECCO reanalysis (German partner of the consortium for Estimating the Circulation and Climate of the Ocean, Koehl and Stammer 2008).
The reliability of these ensemble hindcasts is evaluated using Talagrand diagrams, Q-Q plots, ensemble spread skill score, among others. Besides, these hindcasts are compared with hindcasts obtained with the same setup, but where the ensembles are generated with atmospheric lagged initialization, as was the case for the CMIP5 decadal experiments with the MPI-ESM model.
This work is part of the German project MiKlip on decadal predictions, and more precisely of the Module A dedicated to initialization of decadal predictions.

Ref :
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