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Decadal Prediction skill in NASA/GMAO forecast system

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The GMAO's GEOS-5 Atmosphere-Ocean General Circulation Model (AOGCM) has been used for the decadal prediction runs in the CMIP5 experiment suite. The 10-year forecasts starting at every December from 1959 to 2010 are initialized from an ocean and sea-ice reanalysis conducted using a multi-variate Ensemble Optimal Interpolation scheme in the GEOS-5 AOGCM while the atmosphere is constrained by MERRA (1979-2010) and a related atmospheric analysis (prior to 1979). The forecast skill of a three-member-ensemble mean in the decadal forecasts is compared to that in a forced CO_2 experiment without initialization. The forecast skill in 3year-averaged SST is systematically increased in decadal forecasts over the Northern Atlantic with the aid of initialization. However, the initialization reduces the skill in predicting the warming trend over some regions outside the Atlantic, presumably from dynamical adjustments to the initialization. After the linear trend is removed, the decadal forecasts exhibit a predictable signal up to almost a decade over the subpolar and western-tropical Atlantic. The results for ocean heat content in upper 500m are similar to those for SST.
The annual-mean Atlantic Meridional Overturning Circulation (AMOC) index is predictable up to a 5-year lead forecast, consistent with the predictable signal in upper ocean heat content over the Northern Atlantic. However, prediction skill is relatively low along the North Atlantic Current (NAC). This low skill is related to the fact that the spatial pattern of the dominant decadal mode in upper ocean heat content over this region is quite different in the reanalysis and forecast. A large-scale temperature budget analysis shows that this difference in the decadal mode is due to a model bias, implying that realistic simulation of the climatological fields is crucial for skillful decadal forecasts.