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Impact of initialization procedures on the predictive skill of a coupled ocean-atmosphere model

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We investigate the sensitivity of the forecast skill of decadal climate predictions to the three different initialization approaches: full state initialization (FSI), anomaly initialization (AI) and full state initialization employing flux correction (FC). For this purpose, a coupled ocean-atmosphere climate model (MITgcm/UCLA CGCM) is used. The ocean initial conditions are sampled from the GECCO state (the German contribution to Estimating the Circulation and Climate of the Ocean project). For each initialization approach the assimilation run and a series of hindcasts were carried out. The assimilation runs produce atmospheric initial conditions for the 10-years hindcasts. The ensembles of hindcasts are performed at constant intervals every 5 years over the period 1961-2010. The predictive skill of initialized decadal hindcasts is evaluated with respect to the GECCO fields in terms of the anomaly correlation coefficient and the root mean square error skill score. The initialized hindcasts are compared against uninitialized hindcasts (externally forced) and low-skill forecasting methods such as the persistence forecast. The skill estimation focuses on identifying regions and duration of high predictability of the sea surface temperature and the Atlantic meridional overturning circulation in the context of the three initialization approaches. The correlation of the sea surface temperature is significant in the first lead year for all three initialization schemes over wide areas of the ocean, particularly in the northern and the eastern North Atlantic, the tropical Pacific Ocean and the extratropical Southern Hemisphere. In FC the skill remains significant for some areas in the North Atlantic for the averages 2 to 5 years and 6 to 9 years; in the equatorial Pacific for the averages 6 to 9 years. For these time intervals FC shows an advantage over FSI and AI. The predictability of the Atlantic meridional overturning streamfunction at 26.5°N using FSI is for time scales of up to 5 years superior to AI and FC.