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Verification of decadal forecasts: CCCma decadal forecasts for CMIP5

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Decadal forecasts contributing to CMIP5 have been produced using CCCma's CanCM4 global climate model, the earth-system version of which, CanESM2, is used for long-term projections. The climate sensitivity and intrinsic variability of freely running CanCM4 are described, with emphasis on the Atlantic meridional overturning circulation (AMOC) and associated surface climate influences. Decadal forecasts are initialized by assimilating ERA reanalysis temperatures, winds and specific humidity into the atmospheric model component, while relaxing SST and sea ice concentration to observed time series. Performing this assimilation procedure in coupled runs beginning from different states generates an ensemble of forecast initial conditions. Several strategies for initializing the subsurface ocean have been considered including initialization through surface forcing alone as well as by assimilation of full-field or anomalous temperatures from three-dimensional ocean analyses. Results from these different approaches exhibit tradeoffs: forecasts initialized through surface forcing alone are best able to predict future AMOC as represented by the coupled analysis, whereas forecasts employing assimilation of subsurface ocean temperatures are better able to predict future surface temperatures, Various skill measures are compared with those of simple null forecasts including anomaly persistence, persisted trends, and model runs subject to historical forcings but without observation-based initialization. Skills are also compared between a the core CMIP5 set of forecasts, which are initialized every 5 years from the end of 1960 until the end of 2005, and a more complete set initialized at the beginning of every year from 1979 onward. A procedure is described for removing effects of volcanic forcing and higher-frequency unforced variability including ENSO in order to better isolate the unforced low frequency variability hypothesized to provide a potentially predictable signal.