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# Full state ocean initialization using an ensemble Kalman Filter in a coupled climate model

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We initialize the oceanic component of the coupled climate model MPI-ESM by assimilating subsurface full state observations of temperature and salinity using an Ensemble Kalman Filter (EnKF). Here, we present preliminary results from the assimilation of synthetic observations, allowing us to thoroughly test the assimilation scheme. For the realization of the EnKF, we implement the Parallel Data Assimilation Framework (PDAF) in its offline version. We use synthetic observations for subsurface temperature and salinity, representing an ideal observation dataset without inconsistencies. The synthetic observations have been generated from a high resolution NCEP forced simulation with the same ocean model (horizontal resolution of 0.1 degrees, and 80 vertical levels; the STORM setup). We compare our assimilation against a reference simulation which uses anomaly nudging of the ECMWF reanalysis datasets in both the atmosphere and the ocean. For both methods, an analysis step is performed every month. Even weak constraints, i.e. a conservative observation error, noticeably influence the hydrographic characteristics on a regional scale, e.g. Labrador Sea and tropical oceans. With the synthetic observations, we analyze the role of surface versus subsurface observations, and continuous versus sparse data. Based on the analysis with the synthetic observations, we also enhance the assimilation system with respect to ensemble size, analysis interval, and observation error treatment. Ultimately, we aim to use the MPI-ESM/PDAF system for the assimilation of subsurface ocean temperature and salinity observations for the initialization of the decadal prediction with MPI-ESM.