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Oceanic sub-surface temperature and salinity assimilation in MPI-ESM with the singular evolutive ensemble Kalman filter

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We present results from the assimilation of observed oceanic 3-D temperature and salinity fields into the global coupled Max Planck Institute Earth system model using an ensemble Kalman filter from January 1996 to December 2010. Our study is part of an effort to perform and evaluate assimilation and prediction within the same model without the use of re-analysis data. We use two assimilation setups, one where oceanic observations over the entire water column are assimilated, and one where only oceanic observations below 50∼m depth are assimilated. We find that the variability in terms of correlation of simulated temperature, 0-700∼m heat content, sea surface height (SSH), and the Atlantic Meridional Overturning Circulation (AMOC) with observations improves due to assimilation, most prominently in the tropical oceans. Improvements are strongest in quantities that are not directly assimilated (SSH, AMOC) and in the sub-50∼m assimilation experiment. The magnitude of the variability in terms of the root-mean-square error remains largely similar before and after assimilation, except for the AMOC where it improves through assimilation. While the improvement through assimilation is not spatially uniform or universal, we present with the initialisation of the oceanic component in a global coupled climate model directly from observations a first step towards the initialisation of (decadal) predictions within such a system.