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An ensemble ocean data assimilation system for seasonal prediction in Australia and its comparison with other state-of-the-art ocean reanalyses

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The ocean analysis system for the first generation seasonal prediction system in Australia, called the Predictive Ocean Atmosphere Model for Australia versions 1 (POAMA; http://poama.bom.gov.au/), was based on a univariate OI system (Smith et al. 1991) that assimilates only in situ temperature observations. Such univariate analysis schemes have been shown to provide benefits in reducing uncertainty and improving initial conditions for dynamical seasonal forecasts (Alves et al., 2004). However, due to the lack of appropriate multivariate formulations, this approach has a detrimental effect on the salinity and velocity fields of the model. Therefore, recent development has focused on dynamically balanced multivariate analysis schemes for ocean data assimilation. A new ensemble-based ocean analysis system called the POAMA Ensemble Ocean Data Assimilation System (PEODAS; Yin et al., 2011) has been developed and transitioned into operation. PEODAS is an approximate form of ensemble Kalman filter system, its approximations being necessary to reduce its computational cost. It is based on the multivariate ensemble optimum interpolation of Oke et al (2005), but uses covariances from a time evolving model ensemble. The construction of the ensemble explicitly represents errors in surface forcing (Alves and Robert, 2005), and the ocean model error is accounted for by introducing ocean perturbations through a simple method - additive inflation. Since PEODAS integrates small ensemble members at each analysis cycle, techniques for background covariance conditioning methods such as localization and the inclusion of the lagged ensemble perturbations are introduced in the system to increase the rank and reduce the noise. The ensemble-based background error covariances are state-dependent, inhomogeneous, anisotropic, and multivariate; they facilitate the simultaneous assimilation of different observation types in a single analysis step, and yield potentially dynamically consistent analyses. A re-analysis from 1980 to present has been completed with this system. Both in situ temperature and salinity observations are assimilated, and current corrections are generated based on the ensemble covariances. The comparisons of PEODAS reanalysis to other state-of-the-art reanalyses including ECMWF ORA-3 and NCEP GODAS are also presented, with a particular focus of representations of the main modes of climate variability.