Incorporating flow dependent ocean information into weakly coupled atmosphere-ocean 4D-Var data assimilation: experiments with an idealised system

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Abstract

Strongly coupled data assimilation (DA) is scientifically and technically challenging; as a first step operational centres are implementing weakly coupled DA systems in which the model-observation misfits for the separate atmosphere and ocean domains are measured against the coupled model forecast state, but the analysis is computed independently for each model component. One of the challenges with this approach is representation of the flow dependent interaction between the atmosphere and ocean at the air-sea interface within the DA scheme. This is especially important in the prediction of phenomena where strong air-sea interaction is important.

We explore this problem in an idealised single-column coupled atmosphere-ocean system. In particular, we consider methods for incorporating flow dependent forecast error covariance information derived from ocean ensembles into variational weakly coupled DA. A key aspect of this is to investigate different methods for generating the ocean ensemble, with the goal of producing a limited sized ensemble that best represents the uncertainty in the ocean fields. We examine how the structure of the ocean ensemble forecast error correlation matrices change when different ensemble generation methods are used, and how the inclusion of this information alters the coupled analysis compared to using static forecast error covariances.

Keywords: coupled data assimilation, atmosphere, ocean, hybrid covariances, 4DVar

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