Exploring Strategies in Coupled Atmosphere-Ocean Data Assimilation with a Low-Order Climate Model and CMIP5 Data

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Motivated by the need for initial conditions for decadal climate predictions, we explore the utility of assimilating time-averaged observations and choice of atmospheric variables in a coupled atmosphere-ocean framework. Of particular interest is the initialization of the Atlantic Meridional Overturning Circulation (AMOC), a major driver of the low-frequency variability of North Atlantic climate and its predictability. AMOC initialization under contrasting scenarios of observation availability is investigated, including the extreme case of assimilating atmospheric observations only. Experiments are carried out with an ensemble Kalman filter and the idealized low-order coupled climate model described in [1], representing interactions between large-scale atmospheric circulation and an ocean basin driven by the AMOC. Results from this simplified system are complemented by "no cycling" data assimilation experiments based on comprehensive coupled model output from CMIP5 simulations. Results from the low-order model indicate that AMOC analyses of comparable accuracy are obtained whether time-averaging of observations is applied or not when the ocean is well-observed. Time-averaged data assimilation is however more effective at initializing the low-frequency component of the AMOC when the ocean is only partially observed or not observed at all. Results from assimilation experiments using CMIP5 data further support these findings.

References

[1] Roebber, P. J. "Climate variability in a low-order coupled atmosphere-ocean model." ***Tellus*****, vol. 47A, pp. 473-494, 1995. (Journal Article)**