Development of strongly coupled atmosphere-ocean data assimilation scheme at the U.S. Naval Research Laboratory

Sergey Frolov[a], Craig Bishop[b], Teddy Holt[b], James Cummings[b]

[a] UCAR visiting scientists with the Naval Research Laboratory, USA
Sergey.Frolov.ctr@nrlmry.navy.mil, [b] Naval Research Laboratory, USA.

To better utilize sparse observational data and to improve prediction of strongly coupled ocean-atmosphere phenomena (such as hurricanes, deep-water formation, and wind-wave generation), we are developing a coupled data assimilation system for short-range oceanic, atmospheric, and wave forecasts. We are developing our system based on a combination of existing operational models: the COAMPS® atmospheric model [1], NCOM [2] ocean models, and the WAVEWATCH wave model [3]. To characterize the error distribution terms in the coupled model, we use a meta-ensemble drawn that utilizes: an ET flow-dependent ensemble [4,5,6] a method for generating smooth random fields with smoothing scales consistent with those used by existing 3DVAR assimilation schemes, and, possibly, static ensemble drawn from historic model runs. To mitigate for possible spurious correlations in the error covariance, we use both adaptive and static localization. Given this localized ensemble error covariance, we solve for the minimum variance estimator of the coupled state using a 3DVAR solver [7]. We test the developed system using a case of a deep-water formation in the Western Mediterranean associated with Mistral—periods of strong, cold winds over the Gulf of Lions. In this poster, we will present our initial experiments with a coupled system, including studies of the cross-fluid ensemble error covariance functions and convergence properties of a 3DVAR solver.

In a long-run our scientific goals include quantifying the impact of strongly coupled data assimilation, as compared to the COAMPS weakly coupled data assimilation system. We expect that localization of error covariances and the conditioning of the 3DVAR problem to present the main implementation difficulty for this project.

References

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