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A Bayesian hierarchical model for error covariance in the Mediterranean Forecast System

C. Wikle (1), S. Dobricic (2), L. Berliner (3), N. Pinardi (2,4), R. Milliff (5)

(1) University of Missouri, Columbia, MO, USA, (2) INGV, Bologna, Italy, (3) Ohio State University, Columbus, OH, USA, (4) University of Bologna, Bologna, Italy, (5) NorthWest Research Associates, CoRA Division, Boulder, CO USA

Daily variability in amplitude and vertical structure of forecast-analysis misfits in the Mediterranean Forecast System (MFS) motivate a Bayesian Hierarchical Model (BHM) implementation. A BHM is developed for the error covariance matrix part of the background error covariance term in the reduced order optimal interpolation method of MFS. We consider data stage distributions (i.e. likelihoods) from forecast model misfits based largely on ARGO data, and in departures of daily forecasts from long-term average year-day values. Both vertical structure and temporal evolution are targetted in process model stage distribution (i.e. priors) construction. While the error covariance BHM is developed specifically for MFS, the concepts are generalizable. The BHM provides a practical means for evolving background error covariance matrices, and estimating uncertainty, in sequential data assimilation systems employing the optimal interpolation approximation.