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Inter-comparison of ensemble data assimilation schemes with a shallow water equations model

J. Ruiz (1), M. Jardak (2), and O. Talagrand (2)

(1) CIMA (CONICET-University of Buenos Aires), UMI-IFAECE (3351), (2) Laboratoire de Météorologie Dynamique, ENS, Paris

In this work three state-of-the-art ensemble data assimilation schemes (ensemble 4D-Var, local ensemble transform Kalman filter and particle filter) are implemented in a global shallow water equation model. A serie of experiments are performed to find the optimal settings of the different schemes for this particular model. The diffferent schemes are evaluated, among other criteria, by standard scores for ensemble evaluation (rank histograms, Brier score and reduced centered random variable) The sensitivity of these schemes to the assimilation window length and the number of available observations is explored using twin experiments under a perfect model assumption.
For the case of the particle filter and the ensemble transform Kalman filter, the properties of the background and the initial condition ensembles are assessed.
All the implemented techniques produce good results in terms of the state estimation. With respect to the inter-comparison, it is observed that 4D-Var and particle filter outperform the local ensemble transform Kalman filter for long data assimilation windows and in the case of sparse observation networks when forecast error might became non-gaussian. However a similar performance among the tested schemes is observed for short assimilation windows (6 hours) where the growth of the error in the forecast is linear.