



Variational and Ensemble-based Kalman smoothing for geophysical data assimilation

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Various forms of Kalman filtering, especially different types of Ensemble Kalman filters and hybrid variational-ensemble Kalman filters, have become popular in geophysical data assimilation. Kalman filters work well but they have the undesirable property that they leave behind discontinuous model trajectories that do not correspond to physically consistent and continuous model states. This is a problem in areas such as re-analysis of climate history. For that reason, a smoothing operation that is consistent with the corresponding Kalman filter algorithm is highly desirable.

We have implemented and compare the resulting model trajectories and corresponding model errors of two advanced Kalman smoothers, the Variational Kalman Smoother (VKS) and the Variational Ensemble Kalman Smoother (VEnKS) that are based on the Variational Kalman Filter (VKF) and the Variational Ensemble Kalman Filter (VEnKF), respectively. The comparison is done using the Lorenz95 model, so that the resulting similarities and differences in forecast skill and the quality of the ensuing model trajectories can be clearly understood and discerned in subsequent analysis.