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Ensemble Kalman filtering with residual nudging: some recent progress

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The ensemble Kalman filter (EnKF) is an efficient algorithm for many data assimilation problems. In certain circumstances, however, divergence of the EnKF might be spotted. In previous studies (Luo and Hoteit, 2012, 2013b,a), the authors proposed an observation-space based strategy, called residual nudging, in order to improve the stability of the EnKF when dealing with linear observation operators. The main idea behind residual nudging is to monitor, and if necessary, adjust the distances (misfits) between the real observations and the simulated ones of the state estimates, in the hope that by doing so one may be able to obtain better estimation accuracy.

In a more present study (Luo and Hoteit, 2014), residual nudging is extended and modified in order to handle nonlinear observation operators. Such extension and modification result in an iterative filtering framework that is able to achieve the objective of residual nudging in the presence of nonlinear observation operators, under suitable conditions. The 40 dimensional Lorenz 96 model is used to illustrate the performance of the iterative filter. Numerical results show that, while a normal EnKF may diverge in the presence of nonlinear observation operators, the proposed iterative filter performs very stably and leads to reasonable estimation accuracies under various experiment settings.

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