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Adaptive parameterisation of error statistics in ensemble or reduced order square root filters

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A good representation of state error statistics in square root or ensemble Kalman filters is often difficult to obtain, first because the nature of errors is complex and poorly known, second because these statistics must be represented with a limited number of error modes (or ensemble members), what can easily lead to the filter divergence.
A recipe consists in adjusting the statistics online during the assimilation process, a procedure commonly referred to as adaptive filtering. The classical strategy (Dee, 1995) is to introduce a dependence of error statistics on some random parameters. These parameters are then estimated to get the best possible coherence between the state error statistics and the innovation statistics.
In this work, we show how the solution of Dee (1995) can be (i) extended to the adaptive adjustments of observation error statistics, (ii) advantageously formulated for an ensemble or reduced order square root filter. In particular, the square root approach allows the estimation of optimal adaptive parameters at a reasonable computational cost. We will illustrate the benefits of the adaptive parameterisation with results from twin experiments with a high resolution Ocean model.
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Dee D., Mon. Wea. Rev., 123, 1128-1145 (1995)