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Comparison of the SIRF and EnKF on the Lorenz two scale system

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Abandoning the concept of Gaussianity and linearity in the data assimilation aspect leaves one only with a few options. The variational and most of the sequential techniques i.e. the 4D-vars and the Kalman Filters are in some way based on the Best Linear Unbiased Estimator (BLUE) and only gives optimal results in a Least Squares sense, but not in a maximum likelihood sense if they were to be used to estimate states in non-Gaussian state space distributions. The Ensemble Kalman Filter (EnKF) thus handles the nonlinear evolution of the states, but the use of the BLUE for estimation still requires Gaussian distributions in order to be optimal in a maximum likelihood sense. In this presentation we will address the Sequential Importance Re-sampling filter (SIRF), which is a member of the particle filter family. The SIRF has no assumptions on Gaussianty and is fully capable of handling nonlinearities. The SIRF has been setup on a toy model i.e. the Lorenze two-scale system. The Lorenz system was first suggested by (E. N. Lorenz and K. A. Emanuel, 1998) to mimic the interaction between the atmosphere and the oceans. In this setup the suggestion from (L.A. Smith, 2000) is used, in which an new interaction is introduced between the two coupled Lorenz equations, called the Lorenz two-scale system. It has an inner ring that mimics small scale interactions and the outer ring that mimics large scale interactions. The Lorenz two-scale system is then being solved by a Runge-Kutta 45 (rk45) to obtain the true state. Now the inner ring is being replaced by a parameterization, such that only the equations of one ring needs to be integrated. This represents our numerical prediction model without the capabilities of fully resolving the small scales. The SIRF is then being used to assimilated the true state into the large scale model, to see if the SIRF is capable of retaining the effect of the small scales via the data assimilation routine. The SIRF will be compared to the EnKF solution of the same system and various

measurement update intervals.

References

E. N. Lorenz and K. A. Emanuel, 1998: Optimal Sites for Supplementary Weather Observations: Simulation with a Small Model. J. Atmos. Sci. 52, 399-414

L.A. Smith, 2000: Disentangling Uncertainty and Error: On the Predictability of Nonlinear Systems. Nolinear Dynamics and Statistics, chapter 2, Birkhauser 2000.