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A comparison of EAKF and particle filter: towards a ensemble adjustment Kalman particle filter

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Bayesian estimation theory provides a general approach for the state estimate. In this study, we first explore two Bayesian-based methods: ensemble adjustment Kalman filter (EAKF) and sequential importance resampling particle filter (SIR-PF), using a well-known nonlinear and non-Gaussian model (Lorenz '63 model). The EAKF can be regarded as a deterministic scheme of the ensemble Kalman filter (EnKF), which performs better than the classical (stochastic) EnKF in a general framework. Comparison between the SIR-PF and the EAKF reveals that the former outperforms the latter if ensemble size is very large that can avoid the filter degeneracy, and vice versa.

On the basis of comparisons between the SIR-PF and the EAKF, a mixture filter, called ensemble adjustment Kalman particle filter (EAKPF), is proposed to combine their both merits. Similar to the ensemble Kalman particle filter, which combines the stochastic EnKF and SIR-PF analysis schemes with a tuning parameter, the new mixture filter essentially provides a continuous interpolation between the EAKF and SIR-PF. The same Lorenz '63 model is used as a testbed, showing that the EAKPF is able to overcome filter degeneracy while maintaining the non-Gaussian nature, and performs better than the EAKF given limited ensemble size.