

Tsuyuki, T., 2024: Hybrid ensemble Kalman filter to mitigate non-Gaussianity in nonlinear data assimilation. *J. Meteor. Soc. Japan*, **102**, <http://doi.org/10.2151/jmsj.2024-027>.

Plain Language Summary: It is known that the deterministic ensemble Kalman filter (EnKF) is less robust than the stochastic EnKF in strongly nonlinear regimes. The theoretical consideration of this study indicates that strong non-Gaussianity tends to persist in high-frequency assimilation cycles of the local ensemble transform Kalman filter (LETKF), leading to the degradation of analysis accuracy in nonlinear data assimilation. A hybrid ensemble Kalman filter that is more robust to nonlinearity than the LETKF with less sampling noise than the stochastic EnKF is proposed.

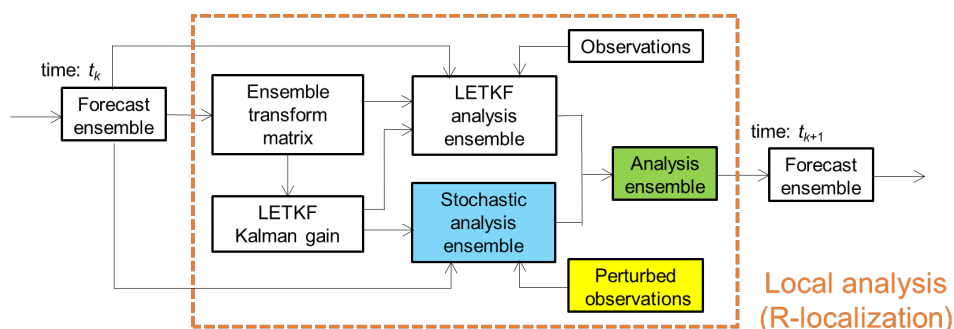


Figure 1. Workflow of the hybrid EnKF.

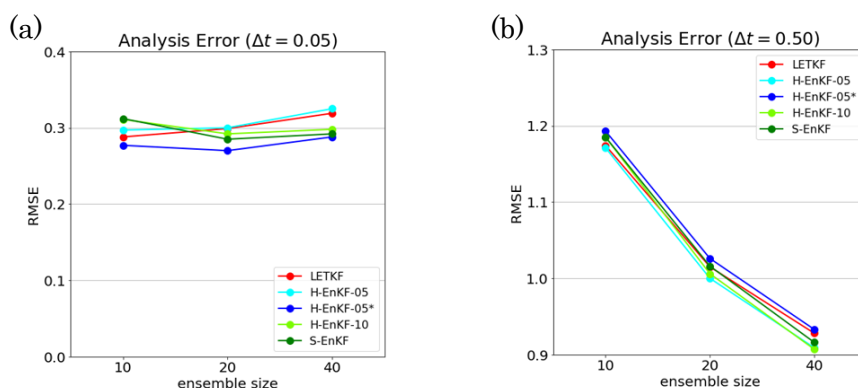


Figure 2. Analysis RMSEs of LETKF (red), hybrid EnKFs (cyan, blue, light green), and stochastic EnKF (green) in data assimilation experiments with a nonlinear observation operator for (a) high-frequency and (b) low-frequency assimilation cycles.

- The reason for less robustness of the LETKF to nonlinearity than the stochastic EnKF is clarified through a theoretical consideration.
- A hybrid EnKF that combines the LETKF and the stochastic EnKF with small additional computational cost is proposed for data assimilation in strongly nonlinear regimes.
- Data assimilation experiments using the Lorenz-96 model show that a hybrid EnKF with appropriate parameters significantly improves analysis accuracy in high-frequency assimilation cycles with a nonlinear observation operator.