# Reconditioning the observation error covariance matrix in the local ensemble transform Kalman filter: experiments with the Lorenz-96 model

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It is natural that the observation errors are correlated if measured with the same instrument, such as radiosondes, radars, and satellite sensors. Radiosonde observations would have the error correlations in the vertical. Satellite radiances would have the horizontal and inter-channel error correlations. However, in the operational data assimilation systems, the observation errors are usually assumed to be uncorrelated for simplicity and computational efficiency.
The condition number of the observation error covariance matrix affects to the convergence efficiency when minimizing the cost function when the observation error correlation is considered in the variational data assimilation methods. However, it is still unknown how the condition number affects in the local ensemble transform Kalman filter (LETKF). In this study, we explore the potential impact of the condition number of the observation error covariance matrix in the LETKF. We performed a series of observing system simulation experiments (OSSEs) to account for the observation error correlations in the LETKF with the simple toy Lorenz-96 model using different observation error covariance matrices of the low and high condition numbers. The results show that the LETKF becomes very unstable when the condition number is large. ‘Reconditioning’ is a method to reduce the condition number of a matrix by slightly modifying the original matrix. The experiments using the ‘reconditioned’ observation error covariance matrix show that the LETKF is significantly stabilized, while the impact on the analysis accuracy is minimal.

Keywords: Data assimilation, Observation error correlation, Condition number, Reconditioning

 