Accounting for the observation error correlation in data assimilation

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It is known that some observations such as satellite radiances have the spatial and inter-channel error correlations. The current data assimilation systems in the operational centers mostly neglect the observation error correlations. It is important to account for the observation error correlations to effectively draw the information from the observation "BigData."

In this study, we developed a method to account for the observation error correlations in the local ensemble transform Kalman filter (LETKF: Hunt et al. 2007), and performed idealized experiments with the Lorenz-96 model (Lorenz et al. 1998) and the non-hydrostatic icosahedral atmospheric model (NICAM: Satoh et al. 2013). The condition number of the observation error covariance matrix (**R** matrix), or the ratio of the maximum and minimum eigenvalues, is essential for the stable performance of the LETKF. Reconditioning can make the **R** matrix well-conditioned by adding a small constant to all the diagonal terms of the **R** matrix. We examined that the reconditioning not only stabilizes the LETKF but also greatly improves the analysis accuracy by including the observation error correlations.

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