Accounting for the horizontal observation error correlation of satellite radiances in ensemble Kalman filter

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A recent development in sensing technology increased the number of observations both in space and time. It is essential to effectively utilize the information from observations to improve numerical weather prediction (NWP). It is known to have correlated errors in observations measured with a single instrument, such as satellite radiances. The error-correlated observations are usually thinned to compensate for neglecting the horizontal observation error correlation in data assimilation. This study explores to explicitly account for the horizontal observation error correlation of Advanced Microwave Sounding Unit-A (AMSU-A) radiances using global atmospheric data assimilation system NICAM-LETKF, which comprises the Nonhydrostatic ICosahedral Atmospheric Model (NICAM) and Local Ensemble Transform Kalman Filter (LETKF).
In this study, we estimate the horizontal observation error correlation of AMSU-A radiances using innovation statistics (Desroziers, 2005). The computation cost of inverting the observation error covariance matrix will increase when non-zero off-diagonal terms are included. In this study, we assume uncorrelated errors between different instruments and observation variables, so that the observation error covariance matrix becomes block diagonal. We can suppress the computational cost by up to 10 % by inverting the small block diagonal matrices. We perform data assimilation experiments at 112-km horizontal resolution with diagonal and non-diagonal observation error covariance matrices. The results show that the analyses and forecasts of temperature and zonal wind are improved by accounting for the horizontal error correlations in the mid- and upper-troposphere. We will present the most recent results at the workshop.

Keywords: Data assimilation, Observation error correlation, Satellite radiances, Ensemble Kalman filter

