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Including the spatial observation error correlation in data assimilation of AMSU-A radiances

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Recent developments 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 observations with the horizontal error correlation are usually thinned to compensate for neglecting the error correlation in data assimilation. This study explores to explicitly include the horizontal observation error correlation of Advanced Microwave Sounding Unit-A (AMSU-A) radiances using a global atmospheric data assimilation system NICAM-LETKF, which comprises the Nonhydrostatic ICosahedral Atmospheric Model (NICAM) and the Local Ensemble Transform Kalman Filter (LETKF). This study performs the data assimilation experiments at 112-km horizontal resolution and 38 vertical layers up to 40 km and with 32 ensemble members.

In this study, we estimate the horizontal observation error correlation of AMSU-A radiances using innovation statistics. 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 observation errors between different instruments and observation variables, so that the observation error covariance matrix becomes block diagonal with only horizontal error correlations included. The computation time of the entire LETKF analysis procedure is increased only by up to 10 % compared with the case using the diagonal observation error covariance matrix. The analyses and forecasts of temperature and zonal wind in the mid- and upper-troposphere are improved by including the horizontal error correlations. We will present the most recent results at the workshop.