Comparison of 4D-EnVAR and 4D-LETKF when running with 1000 ensemble members

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Abstract

The typical number of ensemble members in ensemble data assimilation is of the order of 100 in almost all forecast centers. The increase of the number of ensemble members in one order from 100 to 1000 is expected to better produce ensemble analyses, since uncertainties are much better represented with 1000 members. In this study, three 1000-member ensemble data assimilation schemes are compared using the same observation dataset as the operational meso-scale data assimilation system of the Japan Meteorological Agency: (1) the hybrid four-dimensional variational-ensemble assimilation 4D-EnVAR, (2) the four-dimensional local ensemble transform Kalman filter 4D-LETKF, and the four-dimensional local diagonal ensemble transform Kalman filter 4D-LDETKF. Vertical localization is turned off in all schemes to retain significantly vertical correlations, which also helps to reduce computational costs considerably. It is found that 4D-EnVAR produces better analyses and therefore better forecasts than the two ETKF variants, which can be attributed to the use of climatological error covariances beside ensemble error covariances in 4D-EnVAR.

Keywords: data assimilation, EnVAR, LETKF, 1000 members

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