Effect of Vertical Error Correlation on the Assimilation of GPM/DPR Spectral Latent Heating

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The Japan Meteorological Agency has been assimilating the space-borne radar, GPM/DPR, in its operational system. The background errors and observation errors in a precipitation system targeted by the radar observation are strongly correlated toward the vertical direction depending on the phase of hydrometeors. This correlation becomes more significant when the vertical layer of the space-borne radar observation data becomes higher resolution and the vertical distribution of the observation becomes denser than horizontal distribution. Thus, the treatment of vertical error correlation is an important issue in the data assimilation for space-borne radar. However, in the operational assimilation system, the observation error correlation is neglected in order to reduce the computational cost. It leads to an underestimate of the observation error and causes an over-correction in the assimilation.

In this study, the data assimilation method that creates the initial value of the Local Forecast Model which is the highest resolution model in the JMA NWP system has been enhanced to treat the error correlation in the vertical direction. This new method sequentially assimilates analysis values obtained from the steady-state Kalman filter by a nudging method. The observation error covariance matrix in this nudging method is statistically calculated for each precipitation type, and the non-diagonal elements of observation covariance are not neglected in the vertical direction. The inverse matrix included in the Kalman gain is given by the Moor-Penrose inverse matrix. The correction amount using this Kalman gain is smaller than the increment calculated under the approximation of diagonal matrix of observation error covariance and is reduced the overestimation of the approximation. In the observation sensitivity experiment targeted severe weather events, the assimilation of GPM / DPR spectral latent heat data using this method resulted in an improvement of precipitation forecasts.

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