Impacts of dense and frequent surface observations on a sudden severe rainstorm forecast: A case of an isolated convective system

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To investigate the predictability at 1-km resolution for a sudden severe rainstorm event occurred on September 11, 2014 around Kobe city, we perform a series of data assimilation (DA) experiments using the Local Ensemble Transform Kalman Filter (LETKF) with the JMA-NHM (NHM-LETKF). In this event, a cumulonimbus generated suddenly near the Kobe city center around 0800 JST. It developed rapidly within 10-minutes, and brought heavy rainfalls over 50 mm h^{-1} from 0830 JST to 0930 JST, affecting people's morning activities.
The control run (CTRL) was performed with only reflectivity and radial velocity data from the Phased Array Weather Radar (PAWR) in Osaka University. We installed the automated weather stations Meisei "POTEKA II" at 8 locations in Kobe city, and have been observing surface data every 30 seconds. We performed DA experiments with the additional temperature and relative humidity data from the surface stations. Since we found that the surface station data had significant biases, a bias correction method has been developed with the Kobe observatory data as the unbiased ground truth. Two DA experiments with the raw data (NOBC) and the bias corrected data (BC) have been performed.
CTRL showed strong echoes and surface rainfalls, although the rainfall intensity is smaller than the JMA analyzed precipitation based on the radar and gauge networks. NOBC showed a significant decrease in surface relative humidity because of the dry biases of the surface station data, and consequently, showed decreased surface rainfalls. By contrast, BC showed stronger rainfall intensity, better matching with the JMA analyzed precipitation. The results suggest that the dense and frequent surface DA have a potential to improve the forecast accuracy for sudden severe rainstorms.

Keywords: Data assimilation, Sudden severe rainstorm forecast, An isolated convective system

