Geophysical Research Abstracts
Vol. 15, EGU2013-4517, 2013
EGU General Assembly 2013

Assimilation of Chinese Doppler radar and lightning data with WRF-GSI in the analysis of a MCS case

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The radar-enhanced GSI (Grid-point Statistics Interpolation, version 3.1) system is modified to assimilate radar/lightning-proxy reflectivity with WRF-ARW3.4.1. First, lightning ground stroke data are converted to reflectivity using a simple assumed relationship between flash density and reflectivity. Then the reflectivity information is used in a complex cloud analysis in GSI to improve the cloud/hydrometeors and moisture distributions. In addition, the radar/lightning-proxy reflectivity is also converted to 3-d temperature tendency at the same time. Finally, the model-calculated temperature tendencies from the explicit microphysics scheme and cumulus parameterization at 3-d grid points where radar temperature tendency is available are replaced in forward full-physics step of diabatic digital filter initialization (DDFI) in WRF-ARW3.4.1 core. The WRF-GSI system is tested using a MCS case occurred on 5 June 2010 with assimilating Hefei Doppler radar and lightning data in Anhui province. Three assimilation experiments with assimilating radar reflectivity, lightning and both radar and lightning, respectively are conducted through comparisons with a parallel experiment without assimilation. Results reveal a high correlation between the converted lightning-proxy reflectivity and Hefei Doppler radar observed reflectivity. Reflectivity from a forecast with radar/lightning-proxy reflectivity assimilation is a much better match with the observed reflectivity than that from the parallel experiment without assimilation, especially in the first 6 hours. Results also show that the assimilation of radar/lightning-proxy reflectivity is able to improve the short-range (3 and 6h) precipitation prediction. But the forecasted precipitation intensity is stronger than the observation.