Exploring the potential of assimilating lightning flash observations with an ensemble Kalman filter

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To predict severe storm development, it is essential to obtain good initial conditions with data assimilation. Many previous studies have assimilated radar observations into severe convective storms and shown the profound impact on Numerical Weather Prediction (NWP). Besides, a few studies have demonstrated the potential of high-spatiotemporal resolution infrared radiance observations by next-generation geostationary satellites for improving sudden severe rainfall prediction. Satellite observations may play a major role over the ocean and mountains, where ground-based radar observations are not available.

To further improve the accuracy of NWP for severe storms, it would be beneficial to assimilate lightning flash observations from geostationary satellite-borne lightning sensors. Hydrometeors may obtain electric charge via collision processes, and their charge separation depends on the surrounding environment. Therefore, lightning flash observations would reflect microphysical processes and storm development more directly compared to infrared radiance observations by geostationary satellites. This study aims to explore the potential of assimilating the lightning flash observation for improving severe-storm prediction. To do so, we use an ensemble Kalman filter with an NWP model including explicit lightning discharge processes. As the first step, ensemble-based correlations between lightning flash observations and the atmospheric variables are investigated. The results show that the infrared radiance observations do not always detect the location of the convective core due to broad-range anvil clouds, whereas the lightning flash observations are more directly associated with the convective core.

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