

## Simulation of Quasi-Linear Mesoscale Convective Systems in Northern China: Lightning Activities and Storm Structure

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Two intense quasi-linear mesoscale convective systems (QLMCSs) in northern China were simulated using the WRF (Weather Research and Forecasting) model and the 3D-Var (three-dimensional variational) analysis system of the ARPS (Advanced Regional Prediction System) model. A new method in which the lightning density is calculated using both the precipitation and non-precipitation ice mass was developed to reveal the relationship between the lightning activities and QLMCS structures. Results indicate that, compared with calculating the results using two previous methods, the lightning density calculated using the new method presented in this study is in better accordance with observations. Based on the calculated lightning densities using the new method, it was found that most lightning activity was initiated on the right side and at the front of the QLMCSs, where the surface wind field converged intensely. The CAPE was much stronger ahead of the southeastward progressing QLMCS than to the back it, and their lightning events mainly occurred in regions with a large gradient of CAPE. Comparisons between lightning and non-lightning regions indicated that lightning regions featured more intense ascending motion than non-lightning regions; the vertical ranges of maximum reflectivity between lightning and non-lightning regions were very different; and the ice mixing ratio featured no significant differences between the lightning and non-lightning regions.