Model Study on the Formation of the Charge Structure with a Large Lower Positive Charge Center in Tibetan Plateau Thunderstorms

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Abstract

A thunderstorm occurring in Datong, Qinghai province, China, was simulated using a 3D numerical model. The simulation results showed that a large lower positive charge center was formed in a triple charge structure of the Tibetan Plateau thunderstorm and most of the lightning flashes were initiated between the lower dipole. These results are consistent with the observed facts. The further analysis indicated that the weak updraft in the Tibetan Plateau thunderstorm restrained the non-inductive charging process above the reversal temperature isotherm, in which graupel obtained negative charge, but maintained the strength of the non-inductive electrification below the reversal temperature isotherm. As a result, the upper positive charge center in the triple charge structure was significantly weakened while the lower positive charge center was not evidently changed. This led to the lower positive charge center looked larger than the upper positive charge center. The weakened upper positive charge center also reduced the number of lightning flashes initiated in the upper dipole. This also caused relatively more lightning flashes to initiate in the lower dipole, and the total number of lightning flashes in the Tibetan Plateau thunderstorms was less than that of the thunderstorms in other regions. Moreover, the very low freezing height to the ground in the Tibetan Plateau ensured that enough ice particles could be generated in such a weak updraft and the subsequent electrification processes could be strong enough to initiate lightning.

Topic Areas

Cloud Processes, Thunderstorm Electrification and Lightning

Submission Format

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