A Comparison Study of Cloud Parameterization Schemes Associated with Lightning Occurrence in Southeastern Brazil Using the High Resolution WRF Model

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ABSTRACT: The intent of this study is to identify the combination of convective and microphysical WRF parameterizations that better adjusts to lightning occurrence over southeastern Brazil. High resolution Weather Research and Forecasting (WRF) model simulations were run for twelve thunderstorm cases in the 2005/2006 summer. Three different convective parameterizations (Kain-Fritsch, Betts-Miller-Janjic and Grell-Devenyi ensemble) and two different microphysical schemes (WSM6 and Thompson) were tested. A comparison was made between the WRF grid point values of surface-based CAPE, LI, K-Index, equivalent potential temperature, vertical velocity and ice mixing ratio near lightning locations and all grid point values. Histograms were built up to show the occurrence of different values of these variables for WRF grid points associated with lightning to all WRF grid points. These distributions showed a very similar shape independent of the physical scheme considered, except for KI-Index and ice mixing ratio. A statistical evaluation of the various combinations of parameterizations was made using parameters such as POD (Probability of Detection), FAR (False Alarm Ratio), and CSI (Critical Success Index). The analysis indicates Thompson as the microphysical scheme with better potential to represent lightning occurrence. The Betts-Miller-Janjic parameterization has generally worst skill compared to the others convective parameterizations. The differences in the results when using the Kain-Fritsch and Grell-Devenyi ensemble schemes were not large.

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