Impact of aerosols in cloud electrification: Results from cloud modeling and measurements at the Amazon region

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OVERVIEW

Amazonian convective systems have unique microphysical characteristics, varying from a maritime convective behavior (rainy season) to a continental behavior (wet-dry transition season). These characteristics modulate the electrification of these systems, however it is not well understood which are the dominant processes that intensify the number of lightning from one season to another. The fact is that coincidentally or not the same modulation of the Amazonian precipitation regulates the period of farmer fires to prepare the pasture for cattle, releasing high concentrations of aerosols into the atmosphere. The weather radar and lightning measurements at Southwest Amazon showed that convective storms of different sizes happened to have more positive CG lightning during the very polluted period of biomass burning, while this tendency was decreased with the establishment of the wet season and consequently less pollution.

The objective of this work is to investigate the role of aerosol into the electrification of thunderstorms, as well as the thermodynamic, topography and large-scale effects. Therefore, we will present results from detailed cloud microphysics seen from weather radar and cloud simulations using a 1D cloud model that have particle electrical charge transfer and lightning parameterizations.

(a) RaCCI measurements

(b) The 1D model

CONCLUSIONS

1) Convective storms of different sizes (radar data) happened to have more positive CG lightning during the very polluted period of biomass burning, while this tendency was decreased with the establishment of the wet season and consequently less pollution.

2) Further studies are needed to understand how the thermodynamics of could explain an inverted dipole/tripole, however a combination of high CINE and high/moderate CAPE is important to strong updrafts, and the topography was the key for cloud development during the dry polluted period of high CINE.

3) The new charge transfer parametrization of Avila and Pereyra (2000), which is dependent on supercooled cloud size spectra, suggests that clouds with small sized droplets (polluted environments) could be more positively charged at lower levels (inverted dipole) and contribute to elevate the number of +CGs.