EGU21-11283
https://doi.org/10.5194/egusphere-egu21-11283
EGU General Assembly 2021

How Weather Events Modify Amazonian Surface Aerosol Particle Size Distributions

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In the last years, several studies were published evaluating aerosol-cloud-precipitation interactions. These studies improved the knowledge and reduced the uncertainties in the quantification of the aerosol aerosol-cloud interactions. However, there were only very few attempts to describe how clouds modify the aerosol properties. The main goal of this study is to evaluate the effect of weather events on the Particle Size Distribution (PSD) at the Amazon Tall Tower Observatory (ATTO). This research combines different types of datasets, all co-located at the ATTO towers. Basically, the data were obtained from the new generation of GOES satellites, GOES-16, the SIPAM S Band radar and two Scanning Mobility Particle Sizers (SMPS) installed at the heights of 60 and 325 m from 2017 to 2020. In addition, the LAP 3000 radar wind profile recently installed at the ATTO- Campina site was employed to evaluate the vertical distribution of the vertical velocity. The combination of these datasets allows to explore changes in PSD due to the different meteorological processes. The diurnal cycle shows an increase of nucleation particles and decrease in Aitken and accumulation modes during the night. The early morning is the time of minimum mass concentration. From the early morning to the middle of the afternoon, a contrary behaviour is observed, where the concentration of nucleation particles decreases and Aitken and accumulation mode increase, characterizing a typical particle growth process. In the late afternoon, when rain starts, PSD begin to have the night behaviour described above. Composite studies were computed to evaluate how the PSD evolve during rainfall events. The composite from lighting density shows a large increase in nucleation particles from around 100 minutes before the maximum lighting density, reaching maximum values nearly 200 minutes later. The nucleation particles growth rate increases exponentially with the thunderstorm intensity. Aitken and accumulation modes have a different behaviour, with decreasing number concentration from around 100 minutes before the maximum lighting activity and reaching the minimum concentration at the time of maximum lighting activity. This effect could be related to the more intense downdraft in thunderstorms that intensify the transport of ultrafine particles from the upper atmosphere as described in recent studies using GoAmazon and ACRIDICON-CHUVA data. Another possibility could be the transport of O_3 and NO_2 column densities during thunderstorms events, helping the oxidation of volatile organic component forming secondary organic aerosol at

the surface. This is an open question and needs further studies specifically designed to understand the chemical processes occurring near-surface during intense rainfall events. The first data from the radar wind profile installed at the ATTO-Campina site was employed to compute the vertical distribution of the vertical velocity. The downdrafts are mainly located below 10km, but the layer of maximum concentration of ultrafine particles is mainly above 10km. In addition, the number concentration of nucleation particles at 60m is around twice the value at 325 m, in contrast to former studies showing an increase in ultrafine particles with height. CAFE-Brazil, scheduled for 2022, will be an opportunity to study these open questions.