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Amazonas Rainfall Modifying Gas Concentration and Forming Nucleation Particles Near the Surface

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This study combines ground-based gas phase, particle, and rainfall measurements at the ATTO site to study the impact of rainfall events on greenhouse and reactive gas concentrations and discuss how this process is relevant for producing new particles. Measurements of CO2, CH4, CO, O3, NO, and NO2 concentrations were collected from the surface to 79m using a tower at the ATTO site in the central Amazon forest northeast of Manaus, Brazil. Particle size distribution was measured by an SMPS and rainfall by a rain gauge at the top of the tower. Data collection started in 2012, and this analysis covered the period up to 2020. The 30-minute interval dataset was used to study how convective events modify the concentration of these gases. During the rainfall events, CO2, CO, and CH4 concentrations decrease, though CH4 varies less with height than CO and CO2. The daily cycle of NO2 presents an interesting characteristic showing distinct daily evolution for the concentration in the upper and lower levels. The decrease in NO2 concentration in the upper level and the increase near the surface in the afternoon, which is the typical time of rainfall events, indicate that a specific process occurs near the surface. With the joint analysis of gas-phase observations with ultrafine particles and rainfall data, it was possible to evaluate the interesting physical-chemical processes occurring during the rainfall events that might be important for particles nucleation. The time of rainfall events was defined as the first-time rain rate reaching 3 mm/hours, a typical value of the beginning of convective rainfall events. Interestingly, during rainfall events, there is a significant injection of O3 above and inside the canopy, and at this moment, its concentrations can increase by 300%. At the same time, NO decreases, and NO2 increases its concentration, suggesting a reaction between NO and O3 forming NO2. The concentration of NO2 follows the increase in particle concentration smaller than 20nm. This result opens new perspectives on the role of new particle formation related to rain and vertical mixing in the Amazon.