Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 4, 2119-2143, 2004
www.atmos-chem-phys.net/4/2119/2004/

Physical properties of the sub-micrometer aerosol over the Amazon rain forest during the wet-to-dry season transition - comparison of modeled and measured CCN concentrations

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Abstract. Sub-micrometer atmospheric aerosol particles were studied in the Amazon region, 125 km northeast of Manaus, Brazil (-1°55.2'S, 59° 28.1'W). The measurements were performed during the wet-to-dry transition period, 4-28 July 2001 as part of the LBA (Large-Scale Biosphere Atmosphere Experiment in Amazonia) CLAIRE-2001 (Cooperative LBA Airborne Regional Experiment) experiment. The number size distribution was measured with two parallel differential mobility analyzers, the hygroscopic growth at 90% RH with a Hygroscopic Tandem Mobility Analyzer (H-TDMA) and the concentrations of cloud condensation nuclei (CCN) with a cloud condensation nuclei counter. A model was developed that uses the H-TDMA data to predict the number of soluble molecules or ions in the individual particles and the corresponding minimum particle diameter for activation into a cloud droplet at a certain supersaturation. Integrating the number size distribution above this diameter, CCN concentrations were predicted with a time resolution of 10 min and compared to the measured concentrations. During the study period, three different air masses were identified and compared: clean background, air influenced by aged biomass burning, and moderately polluted air from recent local biomass burning. For the clean period 2001, similar number size distributions and hygroscopic behavior were observed as during the wet season at the same site in 1998, with mostly internally mixed particles of low diameter growth factor (~1.3 taken from dry to 90% RH). During the periods influenced by biomass burning the hygroscopic growth changed slightly, but the largest difference was seen in the number size distribution. The CCN model was found to be successful in predicting the measured CCN concentrations, typically within 25%. A sensitivity study showed relatively small dependence on the assumption of which model salt that was used to predict CCN concentrations from H-TDMA data. One strength of using H-TDMA data to predict CCN concentrations is that the model can also take into account soluble organic compounds, insofar as they go into solution at 90% RH. Another advantage is the higher time resolution compared to using size-resolved chemical composition data.

Final Revised Paper (PDF, 1594 KB) Discussion Paper (ACPD)

Citation: Rissler, J., Swietlicki, E., Zhou, J., Roberts, G., Andreae, M. O., Gatti, L. V., and Artaxo, P.: Physical properties of the sub-micrometer aerosol over the Amazon rain forest during the wet-to-dry season transition - comparison of modeled and measured CCN concentrations, Atmos. Chem. Phys., 4, 2119-2143, 2004. Bibtex EndNote Reference Manager