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AEROSOL PARTICLE SIZE DISTRIBUTION AND HYGROSCOPIC GROWTH IN THE AMAZONIAN RAIN FOREST

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KEYWORDS

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INTRODUCTION AND EXPERIMENTAL

Despite widespread concern and increased international efforts at conservation, the world's tropical forests continue to disappear at an unprecedented rate. Altered cycles of water, energy, carbon and nutrients, resulting from changes in Amazonian vegetation cover induced by human activities, are expected to have climatic and environmental consequences at local, regional and global scales. To address these questions, an international research initiative, called The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) is planned to take place in the Amazon over 1997-2003. LBA is a multidisciplinary research effort, which has been jointly designed by Brazilian, European and North-American research communities in response to the world-wide concern about the fate of tropical rain forest and about the global implications of the changes, which the Amazon region has been undergoing.

As a part of LBA, the first CLAIRE (Cooperative LBA Airborne Regional Experiment) field campaign took place during the wet season in March-April 1998 (Andreae et al., 1998). A full suite of aerosol, gas and meteorological measurements were carried out near Manaus at Balbina, the CLAIRE Amazonian ground station. This presentation deals with the measurements of sub-micrometer aerosol particle size distributions (3-800 nm; Differential Mobility Particle Sizer, DMPS) and hygroscopic growth (35-264 nm; Hygroscopic Tandem Differential Mobility Analyser, H-TDMA). This was the first time ever that both these type of measurements were made in the pristine Amazonian rain forest.

RESULTS

Particle concentrations in the pristine Amazonian rain forest during the wet season were low, typically 350 cm^{-3}. Incidents of elevated particle concentrations were caused by local anthropogenic pollution sources. The sub-micrometer aerosol particle size distribution was bi-modal (Aitken and accumulation mode with geometric mean around 65 nm and 120 nm respectively) for most of the time. The accumulation mode particles are believed to have formed via in-cloud processing of Aitken mode particles. At several occasions, new particle formation was observed after sunrise. When the newly formed particles appeared, they had already grown to sizes (>20 nm) considerably larger than that which the primary particles have at the time of homogeneous nucleation (ca. 1 nm). This is a strong indication that the ultrafine particles were not formed directly at the place of observation close to the ground but most likely aloft. The rising of the sun in the morning caused both the triggering of gas phase photochemical reactions, converting precursor gaseous species into less volatile compounds, and at the same time breaking the night time inversion, thus facilitating vertical turbulent

mixing. Subsequent to their formation, the ultrafine particles grew into the Aitken mode by condensation of low-volatility vapours during a time period of typically 6 hours. An example of such a time sequence is shown in Figure 1.

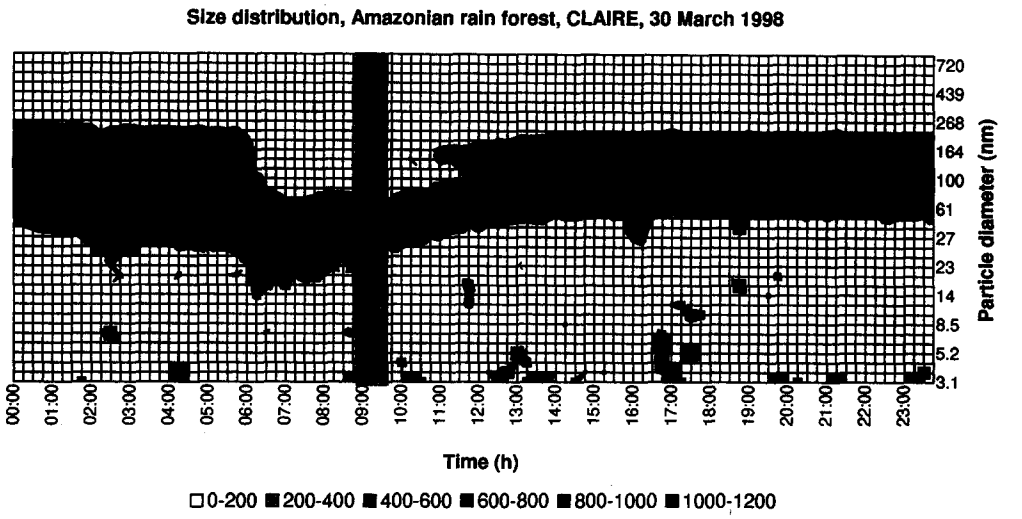

Figure 1. Example of 24 hours of particle size distributions measured in the Amazonian rain forest during the wet season. The concentration (grey) scale is $dN/dlogD_p$ (cm^{-3}). The 09:00-09:30 break is due to instrument maintenance.

In contrast to the multi-modal hygroscopic behaviour found in the polluted continental and remote marine environments, the hygroscopic behaviour of sub-micrometer aerosol particles in the pristine rain forest during the wet season is essentially uni-modal with quite low diameter growth factors (*ca.* 1.2-1.4 when taken from a dry state to a relative humidity of 90%). Even though these growth factors imply that a major mass fraction of the Aitken mode particles most likely was added by condensation of low-volatility organic compounds originating from oxygenated non-methane hydrocarbons, the formation mechanism of the particles is yet uncertain. It is quite conceivable that the compounds responsible for particle formation through homogeneous nucleation (e.g. water vapour – sulphuric acid) are different from those condensing onto the newly formed particles.

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