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Fluorescent biological aerosol particle concentrations and size distributions measured in pristine tropical rainforest air during AMAZE-08

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Biogenic aerosols are ubiquitous in the Earth's atmosphere, influencing atmospheric chemistry and physics, the biosphere, climate and public health. They play an important role in the spread of biological organisms, and they can cause or enhance human, animal, and plant diseases. Moreover, they can initiate the formation of clouds and precipitation as cloud condensation and ice nuclei (CCN, IN).

Primary biological aerosol particles (PBAP) such as pollen, fungal spores, bacteria, and plant matter are emitted directly from the biosphere to the atmosphere, and may account for up to ∼30% of fine particulate matter (PM) and up to ∼70% of coarse PM in rural and rain forest air [1]. The actual abundance, variability and diversity of PBAP are still poorly understood and quantified, however. Within the last fifteen years, improvements in online detection of auto-fluorescence from individual particles has enabled fast, real-time measurement of fluorescent biological aerosol particles (FBAP) as a proxy for PBAP.

The ultraviolet aerodynamic particle sizer (UV-APS; TSI Inc. Model #3314) measures the concentration and aerodynamic diameter of particles in the size range of 1 – 20 um by light scattering and time-of-flight measurement, complemented by the measurement of fluorescence emission (420 – 575 nm) after excitation by a pulsed 355 nm laser. The instrument was developed for the rapid detection of viable agents of bio-warfare and utilizes fluorescence wavelengths characteristic of molecules involved in the metabolism of biological organisms, such as reduced pyridine nucleotides (e.g. NAD(P)H) and riboflavin. As a result, detection of fluorescence in observed particles may be an indicator for cell viability. Nevertheless, measured FBAPs by this technique can be considered a lower limit for the actual abundance of coarse (> 1 um) PBAP [2].

The UV-APS was operated continuously for approximately 40 days as a part of the AMAZE-08 campaign in a remote tropical rainforest region of Amazonia, Brazil [3,4]. The study exhibited FBAP size distribution peaks and concentrations that varied significantly with time, but showed significantly higher fractions of fluorescent biological material than during previous measurement locations. A dominant average peak at ∼3 um was surprisingly present, showing a clear diel cycle peaking in the early morning. These data suggests that the number concentration of FBAP may be dominated by fungal spores or agglomerated bacteria with aerodynamic diameters around 3 um rather than single bacterial cells with diameters around 1 um. FBAP number concentrations during a clean period significantly less affected by anthropogenic influence or atmospheric mineral dust were observed to be ∼3x104 m-3, with mass concentration ∼1 ug•m-3. The relative number fraction of FBAPs within all super-micron particles sampled was ∼40%. Comparison with filter samples analyzed by SEM-EDX show similar size-integrated and size-resolved trends, verifying the ability of the UV-APS to report FBAP properties as close approximations of PBAPs.

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[1] Elbert et al. (2007) Atmos. Chem. Phys., 7, 4569-4588.
[2] Huffman et al. (2010) Atmos. Chem. Phys., 10, 3215-3233.
[3] Martin et al. (2010) Atmos. Chem. Phys., 10, 11415-11438.
[4] Pöschl et al. (2010) Science, 329, 1513-1516.