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Measurement of primary biogenic aerosol particles with an ultraviolet aerodynamic particle sizer (UVAPS)

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Biogenic aerosols are ubiquitous in the Earth's atmosphere and they influence atmospheric chemistry and physics, the biosphere, climate, and public health. They play an important role in the spread of biological organisms and reproductive materials, and they can cause or enhance human, animal, and plant diseases. Moreover, they influence the Earth's energy budget by scattering and absorbing radiation, and they can initiate the formation of clouds and precipitation as cloud condensation and ice nuclei. The composition, abundance, and origin of biogenic aerosol particles and components are, however, still not well understood and poorly quantified. Prominent examples of primary biogenic aerosol particles, which are directly emitted from the biosphere to the atmosphere, are pollen, bacteria, fungal spores, viruses, and fragments of animals and plants.

In this study, particle number concentrations and size distributions over the range of 0.5-20 μm were measured in a period of four months from August to November 2006 in Mainz, Germany, by means of an ultraviolet aerodynamic particle sizer (UVAPS). In this instrument, particle counting and sizing by light scattering and time-of-flight measurements are complemented by the measurement of UV fluorescence at 355 nm (excitation) and 420-575 nm (emission), respectively. Fluorescence at these wavelengths is characteristic for reduced pyridine nucleotides (e.g., NAD(P)H) and for riboflavin, which are specific for living cells. Thus particles exhibiting fluorescence signals can be regarded as "viable aerosols" or "fluorescent bioparticles", and their concentration can be considered as lower limit for the actual abundance of primary biogenic aerosol particles.

Over the four-month measurement period the number concentration of fluorescent

bioparticles varied in the range of 0.001-2 cm^{-3} with an arithmetic mean value of 0.03cm^{-3}. They accounted for 0.05-21% (mean value 1%) of the total aerosol particle number concentration in the investigated size range. The mass concentration of fluorescent bioparticles varied in the range of 0.02-120 μg m^{-3} with an arithmetic mean value of 1.3 μg m^{-3}, corresponding to 0.08-94% (mean value 17%).

The total aerosol particle number size distribution was typically monomodal with a maximum at 0.7-0.75 μm in particle diameter. In contrast, the size distribution of fluorescent bioparticles exhibited great temporal variability with alternating mono-, bi-, and trimodal patterns. Maxima occurred at several diameters, mostly at 0.75 μm (coincident with the maximum of the total particle size distribution) and at 2.5-5 μm, but sometimes also at 1.5 μm or 15 μm. Variations of monthly mean values and time series of the number and mass concentrations and size distributions of fluorescent bioparticles and total aerosol particles will be presented and discussed.

References:

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