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Analysis of bioaerosol emission patterns of tropical fungi in the Amazon region

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Primary biological aerosol particles (PBAP), better known as bioaerosols, are considered to play a role in atmospheric and climate influencing processes. Fungal spores, as a part of PBAP, account for a large fraction of coarse particulate matter in some ecosystems, as for example the Amazon rainforest. In such highly diverse ecosystems, fungi play key roles as mycorrhizal fungi for nutrient uptake of plants and as decomposers in nutrient and water cycling, and thus their community structure strongly influences local ecosystem conditions. Despite this relevance, fungal spore emission patterns under natural conditions and the corresponding triggering factors are not well characterized, yet. In this study, we present a laboratory and field measurement techniques to quantify and analyze bioaerosol emission patterns and the effect of precipitation on fungal spore emission.

For investigations under field conditions, the particle emissions of fungi (Agaricomycetes) were characterized at their site of growth in the field using an optical particle sizer and a data logger. Particle concentrations and their size distribution (0.3 to 10 µm), as well as the microclimatic temperature and humidity were measured in close vicinity to the fungal fruiting body. Generally, field measurements were performed over a time span of 24 h with some exceptions ranging up to 6 days. For laboratory measurements, a newly developed glass chamber system was used to measure particle emissions of fungi under controlled conditions. During the chamber measurements, the humidity and temperature conditions were varied and recorded with a datalogger. To simulate precipitation events, the fruiting bodies were sprayed with water between measurement sections and particle emissions were monitored before and after moistening.

First measurements of fungi under field and lab conditions showed that high humidity values were necessary to trigger fungal spore emissions. In many cases, precipitation events and the moisture status of the fungus and substrate had an influence on spore release. Based on the results of 47 field measurements, it was possible to establish a function simulating the spore emission patterns of fungi during their diurnal emission cycle. During field measurements, an emission of up to 55,000 spores per second was recorded directly at the fungus, which, according to the function, may correspond to emissions of up to 2.8×10^9 spores per day. Chamber measurements showed that spore emissions generally started 2-3 hours after artificial moistening.

Increasing deforestation is expected to cause drier conditions and to increase the possibility of droughts, which will have an impact on the species composition and quantity of fungi in the Amazon. A combination of our field and lab emission data is expected to allow a new interpretation of bioaerosol emissions and composition in the Amazon, which can be used as a baseline to analyze the potential relevance of bioaerosols in regional atmosphere and climate processes.