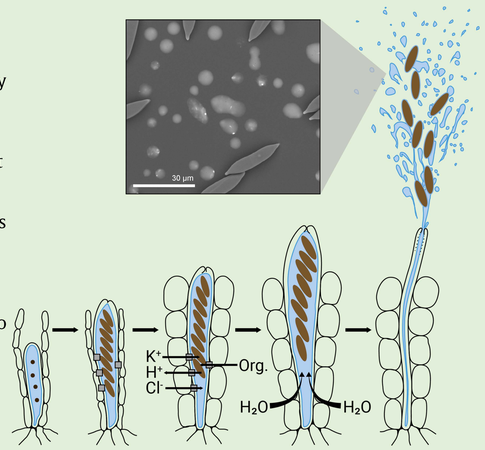
Fungal liquid jets as a source of sub- and supermicron particles

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Introduction

Submicron biogenic organic particles are abundant in the Amazonian atmosphere. They play an important role in cloud microphysics and are largely attributed to secondary organic aerosol formation.[1] However, the frequent occurrence of potassium-containing submicron particles under pristine conditions provides indirect evidence for additional, previously overlooked biological emission sources.[2] Fungi have been hypothesized to contribute to these biogenic emissions due to their diverse spore dispersal mechanisms.[3]
Here we introduce fungal liquid jets as a source of submicron particles.

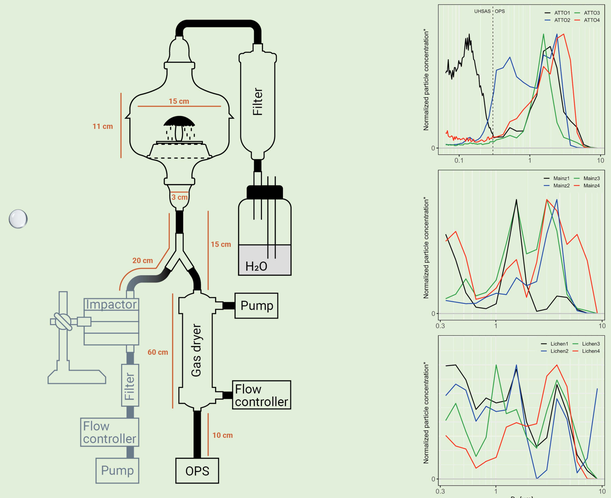


Adapted from Trail (2007)[4]

Active spore discharge

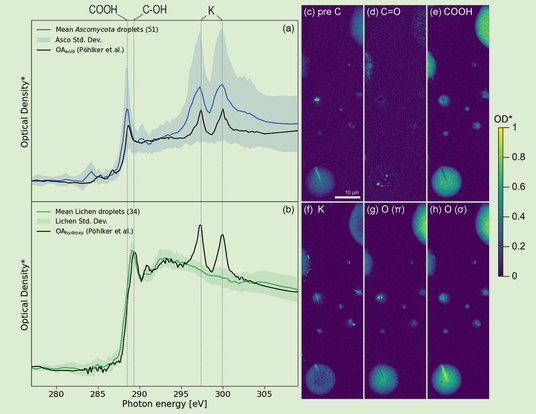
- The ascus, the sexual reproduction unit of *Ascomycota*, actively discharges spores via turgor pressure.[4]
- Osmolyte accumulation draws in water, raising internal pressure.
- When a threshold is reached, the ascus tip ruptures, ejecting spores and fluid at up to 870000 g.[4]
- Sudden deceleration nebulizes the co-emitted fluid into a fine spray.

Size distribution analysis in a pollution-free chamber



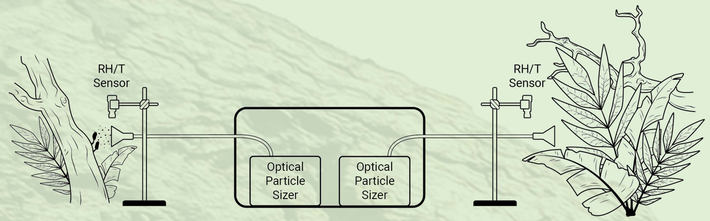
- Active spore discharge from *Ascomycota* (Brazil, Germany) and lichen (Germany) produces particles ('asco spray' and spores) with broad, multimodal size distributions.
- Several species emit strongly in the submicron range, sometimes below 300 nm.
- The multimodal spectrum reflects a mix of droplets and spores released via liquid jets.

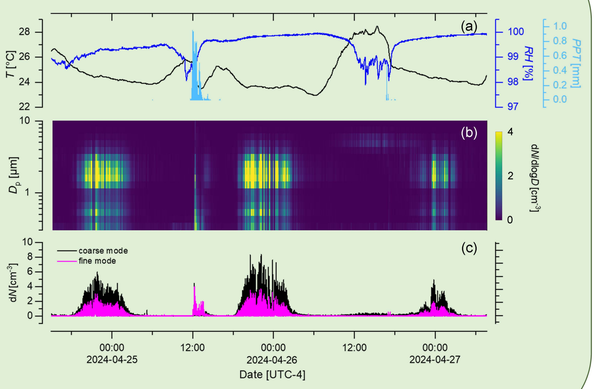
Chemical analysis via STXM-NEXAFS



- *Ascomycota* droplets contain potassium and carboxylic acids.
- Lichen droplets are rich in sugars and typically lack potassium.
- These chemical signatures align with ambient particles in the Amazon previously reported by Pöhlker *et al.* (2012).[2]

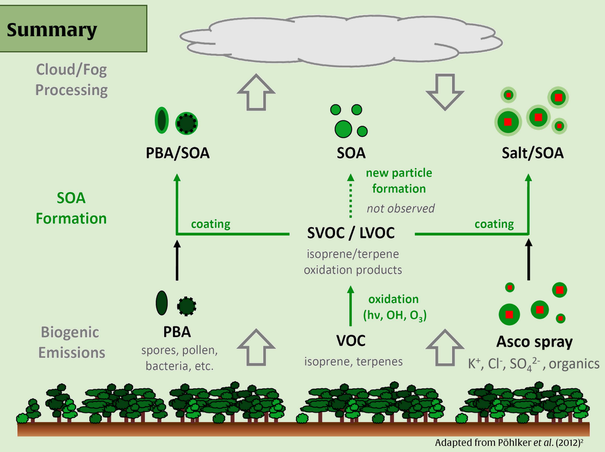
Particle measurements under natural conditions





- Field experiments on Amazonian *Ascomycota* in their natural habitat show nocturnal emission of both spores and fine droplets under ambient conditions.
- Particle size distributions resemble those from chamber measurements.
- Emissions peak at night and can be triggered by rain.

Summary



Adapted from Pöhlker *et al.* (2012)[2]

Biological aerosol particles are typically linked to the coarse mode, while submicron organic particles have mostly been attributed to secondary formation, as few primary sources were known. Here, we investigate an underexplored global source: fine droplets emitted during spore discharge by lichenized and non-lichenized *Ascomycota*. These droplets range from 60 nm to 10 µm and carry distinct organic and inorganic signatures. Our results suggest that some organic particles previously classified as secondary may in fact be primary fungal emissions, whose abundance, small size, and hygroscopicity potentially make them relevant for cloud formation and precipitation.

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Abstract:

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