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Free Tropospheric Precipitation does not serve as Proxy for Air Microbial Composition

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Knowledge about and interest in composition and abundance of primary biological aerosols (PBAs), such as aerosolized bacteria and fungi, is rapidly increasing. However, most bioaerosol studies are restricted to ground-based sampling within the planetary boundary layer (PBL) or focus on extreme events or civilisation and health related topics.

Data on free tropospheric PBA concentration and diversity is rare, due to sampling challenges. To address infrastructure challenges above PBL, snow and cloud water have been used as a proxy for free tropospheric PBA composition.However, aerosolized microorganisms can act as cloud condensation nuclei and be incorporated in clouds, which likely offer more hospitable conditions due to water and nutrient availability, where microbes might even multiply. PBAs can further trigger precipitation by acting as ice nuclei in clouds, thus species selection, multiplication and separation at precipitation might occur. Further, it is obsolete if below PBL seasonal variations in PBAs are reflected in the free troposphere.
We investigated seasonal variability of PBA abundance and diversity and distinction of PBAs, cloud and precipitation in free tropospheric conditions and the abundance and diversity of IN-active bacteria with molecular methods (Illumina MiSeq, 16S and ITS).

Results reveal a species separation of PBA composition between summer and winter and high seasonal variability in fungi. Variability revealed to be much higher in PBAs than in precipitation. Firmicutes were much higher in air than in snow.The ratio of bacteria to fungi differed significantly between air and precipitation forms, indicating a selection for suspended bacteria. We found an accumulation of IN-active bacteria in snow, with a higher share of total bacteria than recently estimated and many unique IN-bacteria in snow and air respectively.Our results reveal, that free tropospheric precipitation or cloud water does not serve as a proxy for air mass PBA composition.