Autofluorescence of atmospheric bioaerosols – studies on biofluorophores and biological standard particles

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Primary biological aerosol particles (PBAP) such as pollen, fungal spores, bacteria, biogenic polymers and debris from larger organisms are known to influence atmospheric chemistry and physics, the biosphere and public health. PBAP account for up to ~30% of fine and up to ~70% of coarse particulate matter in urban, rural and pristine environment and are released with estimated emission rates of up to ~1000 Tg/a (Elbert et al. 2007).

Continuous measurements of the abundance, variability and diversity of PBAP have been difficult until recently, however. The application of online instruments able to detect autofluorescence from biological particles in real-time has been a promising development for the measurement of PBAP concentrations and fluxes in different environments (Huffman et al. 2010; Pöschl et al. 2010). The detected fluorescent biological aerosol particles (FBAP) can be regarded as a subset of PBAP, although the exact relationship between PBAP and FBAP is still being investigated.

Autofluorescence of FBAP is usually a superposition of fluorescence from a mixture of individual fluorescent molecules (fluorophores). Numerous biogenic fluorophores such as amino acids (e.g., tryptophan, tyrosine), coenzymes (e.g., NAD(P)H, riboflavin) and biopolymers (e.g., cellulose) emit fluorescent light due to heterocyclic aromatic rings or conjugated double bonds within their molecular structures. The tryptophan emission peak is a common feature of most bioparticles because the amino acid is a constituent of many proteins and peptides. The influence of the coenzymes NAD(P)H and riboflavin on the autofluorescence of bacteria can be regarded as an indicator for bacterial metabolism and has been utilized to discriminate between viable and non-viable organisms (Lakowicz 1999). However, very little information is available about other essential biofluorophores in fungal spores and pollen.

In order to better understand the autofluorescence behavior of FBAP, we have used fluorescence spectroscopy and fluorescence microscopy to analyze standard bioparticles, atmospherically relevant chemical substances and ambient aerosol samples (Pöhlker et al. 2012). In particular, we focused on pollen as an adequate bioaerosol type for this kind of explorative studies (Pöhlker et al. in prep.). Our aim is (i) to give a clear and general picture on the autofluorescence properties of native pollen and (ii) to illustrates, by means of *one* standard particle type, how offline fluorescence techniques can support the application of LIF in ambient air. Moreover, pollen represents atmospheric particles of high relevance, particularly due to its high allergenic potential with severe social and economic impacts. We suggest that our results can support the development and application of autofluorescence-based detectors for a specific monitoring of allergenic pollen in the atmosphere.

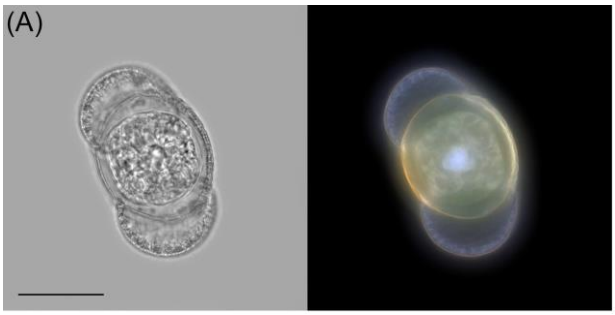

Figure 1. Microscopy images of *Pinus sylvestris* pollen in bright field (left) and fluorescence (right) mode. Micrographs illustrate the diverse autofluorescence properties with contributions from cell wall, cytosol, and organelles. Scale bar = 30 µm.

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