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Offline identification and characterization of biogenic primary emissions

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Primary biological particles (e.g. pollen, spores) are known to have adverse influence on human health. Several studies illustrated also their ice-nuclei activity (Vali et al., 1976) showing their potential role in the climate changes. Nevertheless, the contribution and the chemical characterization of the biogenic emissions are poorly understood.
The Aerodyne aerosol mass spectrometer (AMS, Aerodyne) has significantly advanced real-time PM1 monitoring. The AMS provides both quantitative measurements of the non-refractory (NR) components (organic aerosol (OA), Cl-, NO_3-, NH4+, SO42-) and organic fraction mass spectra of the submicron fraction. Application of the positive matrix factorization (PMF) and other statistical tools such as ME-2 (Paatero, 1999; Canonaco et al., 2013) demonstrated that OA AMS mass spectra contain enough information to differentiate several factors subsequently associated with different aerosol sources (Jimenez et al., 2009). However, AMS measurements are restricted to the PM1 fraction and the AMS deployment remains complex and expensive, limiting long-term sampling and the spatial coverage.
We explored a novel offline AMS application (Dällenbach et al., 2014) including a water extraction of the particulate matter from quartz filters by sonication. The resulting liquid extracts are nebulized generating an aerosol analyzed by High-Resolution-Time-of-Flight-AMS. The approach allows registering mass spectra and monitoring different particle size fractions not available by normal online AMS measurement (e.g. PM10). Moreover it broadens the sampling coverage since the filters are relatively easy and inexpensive to be collected and stored, furthermore filter samples are already routinely collected at many air quality stations worldwide.
PM1, PM2.5, and PM10 filter samples from Payerne (a rural site on the Swiss Plateau)were collected both in summer and in winter. We clearly identified using PMF the contribution of biogenic primary emissions in summer in the coarse fraction, contributing up to 4 μg m-3. The spectral pattern of the associated factor, suggests that a great part of these particles consists of carbohydrates. AMS results are then combined with other data, including sugars and carbohydrates measured by Ion Chromatography coupled to Pulsed Amperometric Detector (IC-PAD) in order to assess the sources of primary biogenic particles.

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