Contributions of biogenic volatile organic compounds to the formation of secondary organic aerosols, Lithuania

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Recent field and laboratory evidence indicates that the largest global source of secondary organic aerosol (SOA) in the atmosphere is derived from the oxidation of biogenic emissions. On a global budget, emissions of biogenic volatile organic compounds (BVOCs) (1150 Tg yr^{-1}) are suggested to be one order of magnitude higher than those of anthropogenic VOCs (Guenther *et al.*, 2006), whereas isoprene emission is 44% of total BVOCs emissions (Ding *et al.*, 2014). Previous studies (Faiola *et al.*, 2015) has shown that abiotic stress have significant impact on biogenic VOCs emission profiles. Abiotic stressors can increase the amount of BVOCs emitted, and induce emissions not emitted under baseline environmental conditions. Also it was observed early that biogenic emissions play a critical role in aerosol particle nucleation (Riccobono et al., 2014), and can enhance particle nucleation in forested areas.

The aerosol chemical composition was measured by an Aerodyne aerosol chemical speciation monitor (ACSM). 1-h time resolution ACSM data were analysed to elucidate the PM1 chemical composition using a graphical user interface SoFi (Canonaco *et al.*, 2013), developed at PSI to perform a positive matrix factorization (PMF) source apportionment of the non-refractory organic aerosol mass spectra. Secondary organic aerosol (SOA) particle number size distributions were measured with a scanning mobility particle sizer model 19.3.09 IFT/TT (TROPOS, Leipzig, Germany), with automatic sheath flow, temperature and relative humidity (RH) control.

Organic aerosol (OA) spectra analysis was performed during an entire year in Lithuania in forested environment of the South-East Baltic region (Fig. 1). The area in research site is dominated by conifers. Enhancement of BVOCs (dominating by monoterpenes and isoprene) emissions from the forest due to abiotic stress (high temperature and solar radiation) was observed. However, the presence of abiotic stress changed the composition of the secondary organic aerosol and as a result aerosol mass spectra. Positive matrix factorization was performed to understand the chemical characteristics of biogenic SOA (B-SOA) (Fig. 1). The background OA represented aged organic aerosol (with an intense signal of CO^{+}_{2} fragments) and a high degree of oxygenation O:C (>0.8). Our findings highlight the potential importance of gas-phase formation chemistry of stress induced new particle formation. We demonstrated that low-volatility vapours dominate the formation and growth of aerosol particles over forested regions.

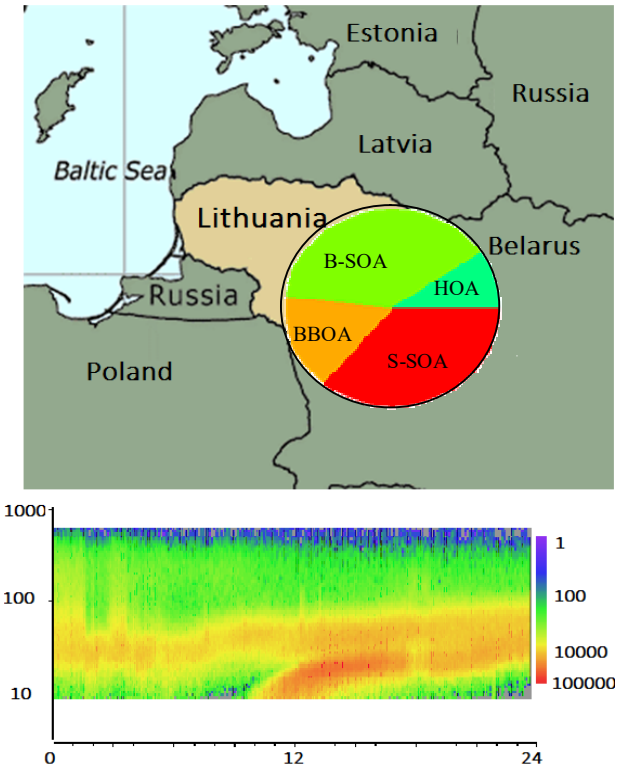

Figure 1. Source apportionment of NR-PM1 OA for the entire study in Rūgšteliškis during summer (B-SOA-biogenic SOA; HOA- hydrocarbon-like OA; BBOA-biomass burning OA; S-SOA-sulphur SOA) (upper) and new particle formation event (below).

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