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Nucleation, growth, and formation potentials of secondary organic aerosols from plant emissions

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Plant emitted VOC are major precursors of secondary organic aerosols (SOA). Plant emissions commonly depend on light, temperature and on stressors. So far most laboratory investigations on formation of SOA focused on single VOC such as a-pinene. In this study we investigated the formation of SOA by oxidation of a VOC mix emitted by spruce, pine, and birch trees as representatives of species of Boreal forest.

The experiments were performed in the Juelich plant chamber under well defined conditions for the plants. Air carrying the plant emissions was transferred from the plant chamber to a separate reaction chamber. SOA formation from the VOC introduced into the reaction chamber was initiated by OH radicals from UV-photolysis of ozone in presence of water. VOC measurements were conducted with a Proton-Transfer-Reaction Mass Spectrometer to determine the emission kinetics, and online-GC-MS systems for compound identification. The number density and the size distribution of the aerosols were measured with an Ultra CPC and SMPS, respectively. The SOA composition was analyzed by an Aerosol Mass Spectrometer.

Nucleation rates of 0.04 to 150 cm-3 s-1, growth rates up to 21 nm h-1, and the maximum SOA volumes up to several 109 nm3 cm-3 were observed during this experiments. Maximum SOA volumes, nucleation rate $<$ 150 cm-3 s-1 and growth rates depend approximately linear on the concentration of carbon fed into the reaction chamber. The slopes and intercepts of these linear relations served to derive SOA formation potentials. The SOA formation potentials are larger for the mixture of VOC emitted by spruce, pine, and birch, than for a-pinene as single compound. The threshold for new

particle formation from real plant mixtures is lower than expected from laboratory experiments using a pinene.