SOA formation from biogenic VOCs – Chemical composition and influence of the reaction conditions

Anke Mutzel, Maria Rodigast, Yoshiteru Iinuma, Olaf Böge and Hartmut Herrmann
Leibniz-Institute for Tropospheric Research (TROPOS), Permoserstr. 15, 04318 Leipzig

Monoterpenes are the second most important group of the biogenic volatile organic compounds (BVOCs). Their oxidation yields products with multiple functional groups which can partition into the particle-phase and hence contribute to the formation of secondary organic aerosol (SOA). It is known that SOA formation is influenced by parameters such as relative humidity (RH), nitrogen oxides (NO_x) and particle-phase acidity. Large uncertainties exist in the currently available literature data as their influences on the SOA formation contradict each other. The overall aim of the present study was to obtain insights into their influences on the formation processes and chemical composition of SOA. To fill the gap in the literature data, the SOA formation was investigated from the first generation oxidation products of the two most important monoterpenes, namely pinonaldehyde originating from α-pinene and nopinone from β-pinene. In these experiments, experimental conditions such as RH (0%, 50%, 75%), seed particle acidity (neutral and acidic) and NO_x mixing ratio (≈100ppt and 100 ppb) were varied and the formed SOA was characterised with regards to (i) SOA yield and (ii) particle growth. It was found that in addition to the reaction conditions the chemical structure of the precursor compound is very important for the SOA formation. It was observed that SOA formation from the oxidation of an aldehyde was considerably influenced by the presence of NO_x whereas SOA formation from the ketone oxidation was influenced by all of the investigated experimental conditions.
Furthermore, it was found that all the β-pinene oxidation products can be explained by the further oxidation of nopinone whereas two important SOA marker compounds of α-pinene, namely terpenylic and pinic acid, could not be explained by further reaction of pinonaldehyde bur rather by the oxidation of myrtenal. These missing SOA marker compounds were likely the reason for the considerably smaller pinonaldehyde SOA yields (Y_{SOA}: 5%) than those of nopinone (Y_{SOA}: 25%).