

Enhancement of the secondary organic aerosol yields and the formation of low- and extremely low-volatility organic compounds during the oxidations of α -pinene in the presence of acidic seeds

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Secondary organic aerosols (SOAs) affect human health and climate change; however, the factors (e.g., temperature, acidity of pre-existing particles, and oxidants) influencing their formation are not sufficiently understood. The temperature and acidity dependence of SOA yields and chemical components of SOA from α -pinene ozonolysis and α -pinene photooxidation under low NO_x conditions were systematically investigated under 278–298 K temperatures in the presence of neutral ($(\text{NH}_4)_2\text{SO}_4$) and acidic ($\text{H}_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4$) seeds by using a compact chamber. The slight negative temperature dependence of the SOA yields was observed and the enthalpies of vaporization were estimated to be 25–48 kJ mol^{-1} , which is in agreement with the value of 40 kJ mol^{-1} applied in the CMAQ model. The SOA yields increased ~10–30 % with the increase in the acidity of seed particles ($[\text{H}^+] = 220 \text{ nmol m}^{-3}$) at low SOA mass loadings. Those increases were thought to be caused by the formation of low- and extremely low-volatility organic compounds such as dimer esters and organosulfates, which were measured by means of negative electrospray ionization liquid-chromatography time-of-flight mass spectrometry coupled to ion mobility spectrometry. To achieve better simulation of monoterpene SOA formation in the SOA module of the model, we propose that the conversion rate (τ^{-1}) of semi-volatile organic compounds (SVOCs) to non-volatile compounds (NVOCs) should be faster under acidic conditions compared with that under neutral conditions.

Keywords: α -Pinene, Photooxidation, Ozonolysis, Secondary organic aerosol, SOA yield, Organosulfate