

Thermal properties of SOA from Ozone and OH induced oxidation of terpenes

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Introduction

Secondary Organic Aerosols (SOA) constitutes a major fraction of atmospheric particles and they have an important impact on the climate by scattering and absorption of solar radiation. SOA have both direct and indirect climate effects where the latter is the least understood. Key steps yet to understand and quantify are formation, properties and transformation of SOA where knowledge today is poor (Hallquist et al., 2009).

Oxidation of four terpenes was studied with respect to both ozone and OH chemistry with a focus on thermal properties on the SOA formed.

Method

Four terpenes were oxidised in two separate flow through systems where ozone and OH chemistry was separated (figure 1). OH was studied in a Potential Aerosol Mass (PAM) chamber. PAM is defined as the maximum aerosol mass that can be produced from precursor gases (Kang et al., 2007). Ozone chemistry was studied in the laminar flow reactor GFROST (Gothenburg – Flow-tube Reactor for Oxidation Studies at low Temperatures) which is described elsewhere (Jonsson et al., 2008).

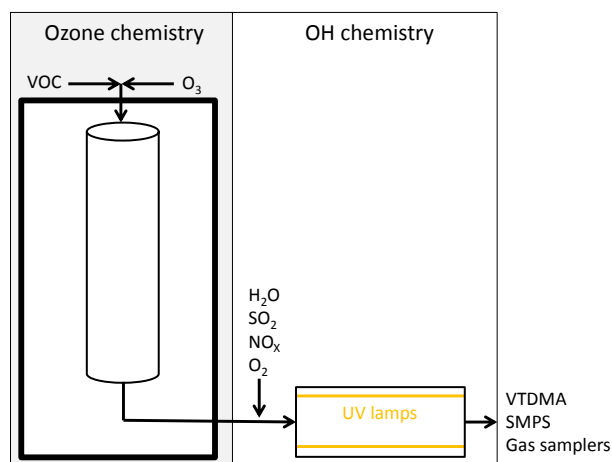


Figure 1. Set-up used to separate OH-chemistry (PAM-chamber) and Ozone chemistry (Laminar flow tube GFROST)

Low VOC levels were selected and high oxidation levels to simulate a few hours of ozone chemistry and 2 – 7 days of OH chemistry. The experiments were performed in room temperature and at atmospheric pressure.

Thermal properties of the SOA formed were studied with a Volatility Tandem Mobility Analyser (VTDMA). Oxidation of SO₂ was used to determine OH concentration using a T100U SO₂ analyzer (Teledyne). NO_x was selectively used to further simulate atmospheric conditions measured with a CLD 700 AL (Eco physics). Ozone was continuously measured with a 49C ozone analyser (Thermo environmental instruments inc.).

Results

Limonene, α -pinene, Δ -carene and β -pinene were oxidized in a number of experiments. The oxidant first attacking the VOC determine to a great extent the characteristics of the aerosol produced, both regarding number, mass and thermal properties. However, a terpene initially oxidised only with ozone will with additional OH oxidation become more volatile. This is presumably because of gas phase oxidation allowing more semi-volatile material to condense into the aerosol phase.

The PAM chamber has been coupled to a previously well studied laminar flow tube and VTDMA system. The PAM-chamber was thoroughly evaluated regarding e.g. temperature and OH concentration.

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Hallquist, M., et al. (2009), *Atmos. Chem. Phys.* **9**, 5155-5236

Jonsson, Å. M., Hallquist, M. and Ljungström, E. (2008), *Environ. Sci. Technol.* **42**, 16, 5938-5944

Kang, E., Root, M. J., Toohey, D. W. and Brune, W. H. (2007), *Atmos. Chem. Phys.* **7**, 5727-5744