



Laboratory and modelling studies on the atmospheric stability of levoglucosan

Andreas Tilgner, Dirk Hoffmann, Yoshiteru Iinuma, and Hartmut Herrmann

Leibniz-Institut für Troposphärenforschung, Chemistry, Leipzig, Germany (tilgner@tropos.de)

Aerosol particles are known to influence important atmospheric processes such as cloud formation and the solar radiation budget. Therefore, much effort is spent to characterise and locate the sources of atmospheric particles. Source apportionment studies using molecular tracer compounds are a common approach to distinguish between different sources. The anhydromonosaccharide levoglucosan (1,6-anhydro- β -D-glucopyranose) is a widely used and very specific tracer compound for particle emissions from natural and anthropogenic biomass combustion processes. Levoglucosan is formed in large quantities during the pyrolysis of cellulose at temperatures above 300°C. Even if levoglucosan is widely used in source apportionment studies only few studies investigated the atmospheric stability of this tracer compound so far. Furthermore, oxidation processes by free radicals in aqueous particles are not yet considered as a potential sink reaction for this highly water soluble compound. Therefore, detailed kinetic studies on the reactivity of levoglucosan towards three important atmospheric free radicals (OH, NO₃ and SO₄⁻) in aqueous solutions were performed for the first time using the laser flash photolysis technique. Laboratory studies on the stability of levoglucosan were done both in the presence and absence of other water soluble reaction partners. The results obtained in the different experiments will be presented, compared and discussed. Furthermore, the experimental data were implemented into the parcel model SPACCIM (Spectral Aerosol Cloud Chemistry Interaction Model; Wolke et al., 2005) in order to study the degradation fluxes of levoglucosan in cloud droplets and aqueous particles considering a detailed microphysics and multiphase chemistry. The model calculations, performed under different conditions (summer, winter, with cloud passages, without cloud passages, different relative humidity and iron contents), show that levoglucosan can be oxidised readily by OH radicals in the tropospheric aqueous phase. Mean degradation fluxes of about 7.2 ng m⁻³ h⁻¹ in summer and 4.7 ng m⁻³ h⁻¹ in winter were calculated. The detailed results of the model calculations will be presented and the influence of the different model scenarios on the calculated degradation fluxes discussed. Model calculations demonstrate that under certain atmospheric conditions the oxidation of levoglucosan can be as fast as that of other atmospherically relevant organic compounds and it may not be as stable as previously thought in the atmosphere particularly under high relative humidity conditions.

References:

Wolke, R.; Sehili, A. M.; Simmel, M.; Knoth, O.; Tilgner, A.; Herrmann, H. SPACCIM: A parcel model with detailed microphysics and complex multiphase chemistry. *Atmos. Environ.* 2005, 39, 4375–4388.