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Analysis of the chemical composition of organic aerosol at the Mt. Sonnblick observatory (12.95E, 47.05N) using novel thermal-desorption proton transfer reaction mass spectrometer (TD-PTRMS) technique

Rupert Holzinger (1), Anne Kasper-Giebl (2), Gerhard Schauer (3), Michael Staudinger (3), and Thomas Röckmann (1)

(1) Institute for Marine and Atmospheric research Utrecht (IMAU), Utrecht, Netherlands (r.holzinger@uu.nl, +31 30 254 3163), (2) Institute of Chemical Technologies and Analytics, Vienna University of Technology, (3) Zentralanstalt für Meteorologie und Geodynamik (ZAMG), Salzburg, Austria

A new combination of aerosol collection (humidification aided impaction and controlled thermo-evaporation) and high mass resolution Proton-Transfer-Reaction Mass-Spectrometry (PTR-MS) was used to measure the composition of organic aerosol at the Mt. Sonnblick observatory (∼3100 m.a.s.l.) in Austria during a 6 weeks period in summer 2008. Fractional mass differences as low as 0.01 Da were resolved and more than 400 compounds have been tentatively identified by their molecular formula. Besides pure hydrocarbons and oxygenated compounds, we also observed organic compounds containing nitrogen, sulfur, or halogen atoms. The concentration of the detected compounds covered the range of 10s of picogram to 100s of nanogram per cubic meter. During the campaign six distinct periods have been identified which were separated by short periods of low temperature and very low organic aerosol concentrations (most compounds were below the detection limit). The maximum sum concentration of all detected compounds was up to a few microgram per cubic meter which is in agreement with EC/OC analysis of aerosol filter samples and demonstrates that a fraction of >50% of the total organic carbon is detected with our new approach. Different regimes of aerosol processing and ageing are revealed by the measured thermograms. During some periods more low volatility compounds have been detected than during other periods. Entrainment of contaminated air from the boundary layer was regularly observed. Because most of the detected compounds could be identified by their molecular formula the degree of oxygenation can be directly calculated. A higher degree of oxygenation corresponds with lower volatility of the respective aerosol sample, which is in agreement with current understanding of aerosol ageing. It remains to be established how well the calculated oxygenation corresponds with the real degree of oxygenation mostly because a significant fraction of oxygen may be lost when evaporated aerosol compounds are ionized via proton transfer reactions. Several of the observed compounds have the potential to serve as tracers for sources and/or processes of organic aerosol.