Mass Spectrometry of Atmospheric Aerosol: 1 nanometer to 1 micron

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Despite much effort in the past decades, uncertainties in both climate impacts and health effects of atmospheric aerosols remain large. Aerosol mass spectrometry (AMS) has enabled size resolved measurement of sub-micron aerosol in the ambient atmosphere. Elemental analysis (C, H, O, N, S; via time-of-flight mass spectrometry, ToFMS) has separated primary and secondary aerosol and shown that organics become highly oxidized on a time scale of days, with low volatility oxidized species dominating remote aerosol loading. Parallel application of ToFMS to directly sample atmospheric ions has provided the first observation of molecular cluster ions involved in atmospheric nucleation of new particles. Chemical ionization mass spectrometry (CIMS) has extended detection to neutral molecules and clusters, detecting highly oxidized multifunctional organics in the gas phase. The CLOUD photochemical chamber experiment at CERN has resolved the interaction of H_2SO_4 and low volatility organic vapors in nanoparticle nucleation and growth. Formation and growth kinetics of molecular clusters has been resolved for the first time at atmospheric concentrations and pressure, on a time scale of minutes.