SIMULTANEOUS MEASUREMENTS OF CARBON, NITROGEN, SULFUR, OXYGEN, AND HYDROGEN WITH THERMAL/OPTICAL ANALYSIS

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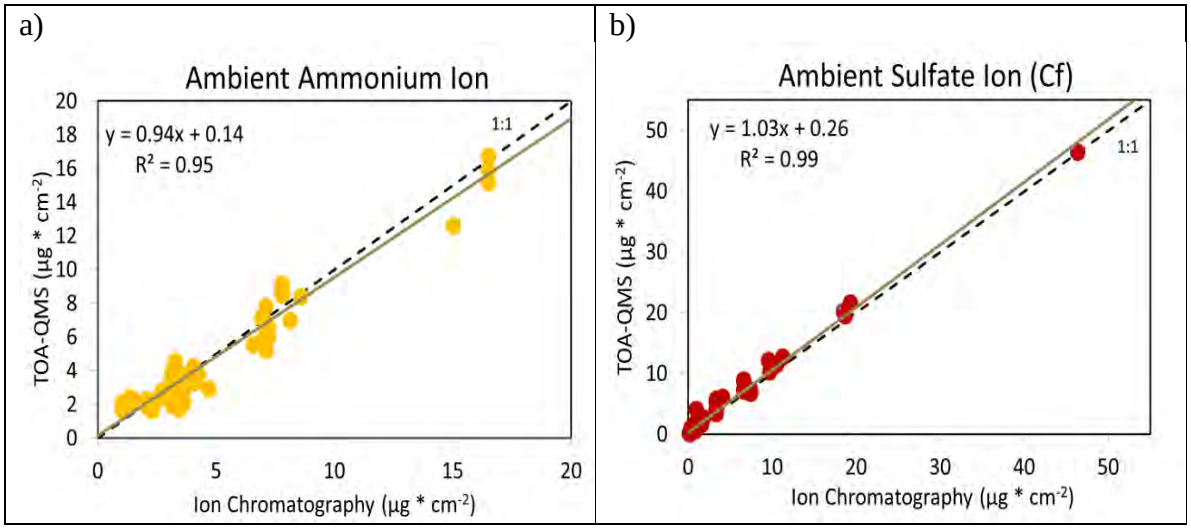
Thermal/optical carbon analysis obtains organic and elemental carbon (OC and EC) measurements on more than 100,000 samples each year worldwide. By replacing the flame ionization detector with a mass spectrometer it is possible to obtain additional measurements of thermally evolved hydrogen (H), nitrogen (N), sulfur (S), and oxygen (O) along with the carbon (C) concentration. C, H, N, and S are determined by the Pregl-Dumas method, where evolved gaseous species are oxidized in a high temperature (~900 °C) CHNS reactor containing oxidizing agents to convert organic components to CO_2, H_2O, NO_x/N_2, and SO_2. The oxidation products are measured by a quadrupole mass selective detector (MSD). Quantification of O is based on the Unterzaucher method in which O is converted to CO in the O reactor, consisting of a nickel-coated carbon reactant. CO is then oxidized to CO_2 using metal oxides and is quantified by a nondispersive infrared (NDIR) sensor. Calibration of this system with chemicals of known quantities of C, H, N, S, and O shows that the signal and element quantity have excellent linearity (R^2>0.99). After subtracting O associated with sulfates and nitrates, it is possible to estimate the degree to which C in the samples is oxygenated, typical of compounds in biomass burning and secondary organic aerosol.



These plots compare ammonium and sulfate ions deduced from an ion balance on N, S, and O from the Thermal/Optical Carbon Analyzer-Quadrupole Mass Spectrometer (TOA-QMS) with values obtained from the same samples by ion chromatography (IC). There are wintertime ambient samples obtained at the Fresno supersite.