Field Study: Intercomparison of Two Continuous Ammonia Monitors

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Measurement of ambient ammonia is becoming increasingly important because of ammonia's connection to long-term health effects on human beings and because of its precursor role in aerosol and PM formation. And yet, the research community lacks a suitable intercomparison of various instruments for ppb and sub-ppb level ammonia detection. We present preliminary intercomparison data from two new instruments for monitoring ambient gas-phase ammonia at sub-ppb concentrations that have been collocated and operated at a site in rural Illinois since July 28, 2003. One monitor, the Nitrolux™-200 is commercially available from Pranalytica Inc. of Santa Monica, CA and employs laser-based photoacoustic spectroscopy for the detection of ammonia. For this instrument gaseous samples are continuously drawn through the measurement cell, where they are interrogated spectroscopically with the output radiation of a carbon dioxide laser. The laser is line-switched between wavelengths with and without ammonia absorption to subtract out contributions from other ambient gases, yielding an updated interference-free measurement of ammonia approximately every 30 seconds. The second monitor is an ion chromatograph coupled with both a wet denuder and mist particle collector, designed and built by researchers at Texas Tech University. This instrument collects and analyzes gases and particles sequentially, at 15-minute intervals. The anions are analyzed by the ion chromatograph. Ammonia and ammonium are separated from the effluent with a membrane device and quantified by a conductivity detector. As the figure below shows, the two instruments track each other qualitatively quite well. Preliminary comparisons show excellent agreement between the two instruments: mean and maximum concentrations over the month of data collected to date are 1.4 and 9.7 ppb, respectively, for the Nitrolux™-200, and 1.6 and 7.1 ppb, respectively, for the ion chromatograph. The correlation of the measured ammonia concentrations for the two instruments when ammonia was present at levels greater than 2 ppb between July 28 and August 3 was better than 85%. During the period of August 13 to 18, when ammonia was present at even higher concentrations, the Nitrolux™-200 shows a time lag of approximately five hours relative to the IC machine, presumably because of water condensation in the unheated sampling lines exterior to the instrument, which might have trapped gas-phase ammonia until volatilized later in the day. The side-by-side consistency of these two instruments implies that researchers in the field of ambient ammonia monitoring will now have more diagnostic tools available for their field studies.

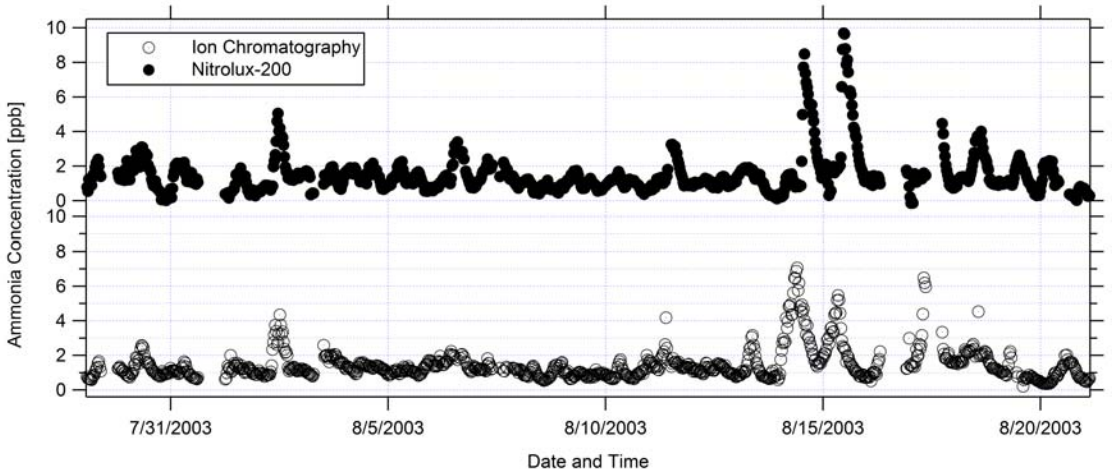

Figure 1. Measured data from collocated ammonia monitoring instruments. Top Panel: Photoacoustic instrument (Nitrolux™-200 by Pranalytica, Inc.). Bottom Panel: Ion chromatograph (Texas Tech University).