Development of an optimum tracer set for apportioning emissions of individual power plants using highly time-resolved measurements and advanced receptor modeling.

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Abstract

Background. In previous studies, 11 elements (Al, As, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Se, and Zn) were determined in 30-minute aerosol samples collected with the University of Maryland Semi-continuous Elements in Aerosol Sampler (SEAS-II) for periods of from 2 to 18 months at more than 5 locations, including three EPA funded "Supersites" (Baltimore, Pittsburgh, and St. Louis) and two sites in the Tampa area during the Bay Regional Atmospheric Chemistry Experiment. At this time resolution, plumes from stationary high temperature combustion sources are readily detected as large excursions in ambient concentrations of elements emitted by these sources. Generic source type can be identified by chemical composition, but at 30-minute sampling resolution, the identity of the individual sources can often be determined by correlation of the concentration-vs.-time series data with wind direction. Moreover, the time-series data contain intrinsic information on the lateral diffusion of the plume (e.g., σ_y), which varies depending on distance and meteorological conditions. This information has been exploited by Park et al. (2006) who have developed an advanced Pseudo-Deterministic Receptor Model (PDRM). The PDRM uses the position of known sources relative to prevailing wind angles in what may be considered a Gaussian filter, to eliminate contributions from sources for which wind direction and dispersion conditions obviates their influence on air quality at the receptor site. As posed, the PDRM determines average emission rates of particle constituents and emitted gases from individual stationary sources, their time-dependent meteorological dispersion factors, and the source-resolved concentrations of these pollutants induced at the receptor site. The highly-time resolved data and PDRM have been used to estimate emission rates and hence emission profiles from individual power plants and coal-fired boilers in Tampa and Pittsburgh. However, we believe that additional maker species, i.e., including major elements Ca, Na, K, Mg, S, and P, as well as various other trace elements will improve resolving power of the method. It is likely that these will provide useful information for resolving plants with scrubbers and/or different coal sources.

Objectives. In this project we are using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) to analyze previously collected (including many of those analyzed previously) for up to 20 additional elements in an attempt to improve resolving power for individual

coal- and oil-fired power plants, and determine a optimum set of analytes. We have an archive of nearly 35000 slurry samples from which to choose subsets which have been influenced by coal and oil fired power plants, as well as many other sources.

Accomplishments to date. We have purchased a new generation Thermo-Electron X-series ICPMS, which is now being used for this project. Installation of the instrument was completed in March, and we have spent most of our effort on mastering its software and protocol development. The poster will show the progress made on the development of the slurry sample analysis protocol. This includes results of work to evaluate spectral interferences resulting from plasma gas ions, plasma ion reactions with matrix and analyte species, and isobaric interference; results of analyses of NIST standard reference materials (SRM). Detection limits and preferred isotopes for analytes in SEAS-II samples will be reported for normal, collision-cell, and cool-plasma instrumental protocols. Lastly, preliminary data on some of the SEAS samples will be reported.

Future work. Future work will encompass: 1) Analyses of selected archived 30-min samples, 2) modeling of the results using the PDRM, including determination of model stability on choices of marker species and constraints, 3) modification of the PDRM and runs to determine feasibility of determining secondary sulfate contributions from individual plants.

Students Supported: Gregory M. Beachley, PH.D. Candidate

References.

Park, S. S., Pancras P. J., Ondov, J. M., Poor, N. **(2005)** A New Pseudo-deterministic Multivariate Receptor Model for Accurate Individual Source Apportionment Using Highly Time-resolved Ambient Concentrations, ***J. Geophys. Res., 110***, No. D7,1 6 April. Citation no. D07S15