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A Method to Extract and Interpret Additional Aerosol OC Fractions from Thermal Optical Analysis

Abstract: Carbonaceous particulate matter is ubiquitous in the ambient environment and comprises a major fraction of aerosol mass in New York State. Its sources are many and varied, including fixed and mobile combustion sources, biological sources, and atmospheric transformations of anthropogenic and natural hydrocarbon species from gaseous to condensed forms (SOA or secondary organic aerosol production). The complexity of gaseous and condensed phase chemistry of carbonaceous particulate matter and its precursors presents a major challenge to measurement, modeling, and policy-related science. This project will, at a modest cost, greatly increase the characterization and understanding of the sources and evolution of carbonaceous aerosol species. The work will undertake targeted laboratory experiments using the commonly employed thermal optical method that will characterize the thermal evolution of known species and classes of species during measurement. This characterization of thermogram profiles will pave the way for re-analysis of existing data for additional information about carbon volatility classes, and for optimizing the thermal optical method used in real time carbon aerosol analyzers in order to most effectively generate the maximum amount of useful data from the measurement method.

Targeted Research Area to be Addressed: This proposal targets Research Area A. Combustion Products – Improve Monitoring, Characterization, and Understanding of Processes Involving Organic Species in Ambient Air. The proposed work will add an important level of detail to the existing continuous and filter based measurements of carbonaceous aerosols in New York. Present methodology reports only “EC” and “OC” for continuous measurement systems. Using laboratory measurements of known carbonaceous species, combined with closer inspection of the analysis thermograms, we will assign carbon-containing species to empirical volatility classes and use those classes to interpret ambient data. The national filter speciation networks (STN and IMPROVE) do report multiple “thermal fractions” for “OC”, but these carbon fractions are rarely used in analysis and source apportionment since scientists don’t know how to interpret them. The laboratory data obtained in this project will allow interpretation and use of these very large data sets. The proposed research will greatly improve the understanding of links between the (empirically defined) measured EC and OC quantities and the emissions of carbonaceous PM and its precursors. This in turn will address a number of the policy questions listed in the solicitation, including those involving emissions estimates, emissions controls, and ambient concentrations.

Usefulness and Value of Project Results: This project aims to extract the maximum utility from existing data sets of continuous and filter based measurements of carbonaceous aerosol in New York State. It will also point the way for optimizing the method and operation characteristics of thermal optical measurement of PM carbon so that data obtained in the future will be better suited for addressing scientific and policy-relevant goals related to electrical generation and other sources of carbonaceous aerosols. The first objective is to use the thermal optical measurement method to characterize a suit of primary and secondary carbonaceous aerosol compounds. These compounds will include some (or all) of the compounds generated by Hogrefe et al. (2007a, 2007b) for study by a high resolution aerosol mass spectrometer. Each compound will be collected on a quartz fiber filter and analyzed with a Sunset Real Rime ECOC