QUARTERLY PROGRESS REPORT

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Title: The Pittsburgh PM Supersite Program: A Multidisciplinary Consortium for Atmospheric Aerosol Research

Principal Investigators: Spyros Pandis, Cliff Davidson, and Allen Robinson

Institution: Carnegie Mellon University

Project Period: May 15, 2000 – August 15, 2001

Investigators: Spyros Pandis, Cliff Davidson, Allen Robinson, Neil Donahue, Andrey Khlystov (*Carnegie Mellon Univ*.), Anthony Wexler (UC Davis), Murray Johnston (*Univ. of Delaware*), Wolfgang Rogge (*Florida Intern. Univ*.), Mark Hernandez (*Univ. of Colorado*), Jeff Collett (*Colorado State Univ*.), Susanne Hering (*Aerosol Dynamics*), Jonathan Kahl (*Univ. Wisconsin*), Barbara Turpin (*Rutgers Univ*.), Bruce Doddridge, John Ondov, Steven Buckley (*Univ. of Maryland*), *RJ Lee, Inc.*, Kevin Crist (*Ohio University*), Delbert Eatough (*Brigham Young University*), Urs Baltensperger (*Paul Scherrer Inst.*), Phil Hopke (Clarkson U.), Jonathan Samet (*Johns Hopkins*), Richard Sextro (*LBNL*), William Aljoe (*DOE-NETL*).

Objectives: Characterization of the atmospheric aerosol in the Pittsburgh region; development and evaluation of current and next generation atmospheric aerosol monitoring techniques; quantification of the impact of the various sources to the PM concentrations in the area; elucidation of the links between PM characteristics and their health impacts; study of the responses of the PM characteristics to changes in emissions.

Work Status: The installation of the remaining instrumentation was completed during June. All the baseline measurements started operating on June 1st and the intensive measurements started on July 1st. Out of the 47 measurements planned for the July 2001 intensive (Table 1), 46 operated during that period with minimum data loss. The single particle mass spectrometer (RSMS-II) started operating in August because of delivery delays with its power supply manufacturer. Most of the measurements (38 of them) are continued during the baseline-sampling period, some of them with reduced measurement frequency (Table 1).

The Pittsburgh Supersite team operated four satellite sites during the July intensive (Lawrenceville, Hazelwood, Florence, and Greensburg) on a daily basis. All samples were collected and sent to RTI for analysis. Additional satellite sites were operated by the DOE/NETL (South Side, Holbrook, Steubenville).

Table 1. Pittsburgh Supersite Measurements

Instrument	Quantities Measured	Measurement Period	Frequency
Ultrafine SMPS (low RH) (ambient RH)	Size distribution (3-50 nm) Water distribution (3-50 nm)	Baseline Baseline	10 min 10 min
Regular SMPS (low RH) (ambient RH)	Size distribution (15-500 nm) Water distribution (15-500 nm)	Baseline Baseline	10 min 10 min
APS (low RH) (ambient RH)	Size distribution (0.5-10 μm) Water distribution (0.5-10 μm)	Baseline Baseline	10 min 10 min
Epiphaniometer	PM surface area	Baseline	10 min
TEOM (30°C)	$PM_{2.5}$ mass concentration	Baseline	10 min
FRM	$PM_{2.5}$ mass concentration	Baseline	1 day
Dichotomous Sampler	$PM_{2.5}$ mass concentration $PM_{2.5-10}$ mass concentration	Baseline Baseline	1 day 1 day
MOUDI-1	PMx mass concentration PMx mass concentration PMx major ions	Baseline Intensive Intensive	1 day 8 hr 8-24hr
MOUDI-2	PMx OC-EC distribution	Intensive	8-24 hr
CMU Inorganic Sampler	$PM_{2.5}$ major ions NH_3 HNO_3 PM_{10} major ions $PM_{2.5}$ major ions NH_3 HNO_3 PM_{10} major ions	Baseline Baseline Baseline Baseline Intensive Intensive Intensive Intensive	1 day 1 day 1 day 1 day 4-6 hr 4-6 hr 4-6 hr 4-6 hr
LPI impactor	Size distribution of functional groups	Intensive	1 day
$PM_{2.5}$ Hi-Vol –1	$PM_{2.5}$ Metals	Baseline	1 day
$PM_{2.5}$ Hi-Vol – 2	$PM_{2.5}$ Bioaerosols $PM_{2.5}$ Polar organics	Baseline Baseline	1 day 1 day
Speciation Sampler	Organic speciation	Intensive	1 day
PM_{10} Hi-Vol	PM_{10} metals	Baseline	1 day
CMU organic sampler	$PM_{2.5}$ OC and EC	Baseline Intensive	1 day 4-6 hr

CMU denuder-sampler	$PM_{2.5}$ OC and EC	Baseline Intensive	1 day 4-6 hr
PC-Boss sampler	$PM_{2.5}$ major ions $PM_{2.5}$ OC and EC	Intensive Intensive	4-6 hr 4-6 hr
In-situ OC/EC analyzer	$PM_{2.5}$ OC and EC	Baseline	2-4 hr
SEAS	$PM_{2.5}$ metals	Intensive	30 min
R&P Nitrate	$PM_{2.5}$ nitrate	Baseline	10 min
R&P Sulfate	$PM_{2.5}$ sulfate	Baseline	10 min
ADI Carbon	$PM_{2.5}$ carbon	Baseline	10 min
Nephelometer (Ambient RH)	Scattering coefficient	Baseline	10 min
CCN counter	CCN concentration	Special	1 hr
TDMA	Growth factor	Special	1 hr
SEM sampler	Aerosol morphology-SEM	Intensive	1day
Steam Sampler	$PM_{2.5}$ major ions NH_3 (gas and aerosol) HNO_3 (gas and aerosol)	Baseline Baseline Baseline	1-2 hr 1-2 hr 1-2 hr
RSMS-II	Single particle composition	Baseline	Continuous
LIBS	Single particle metals	Intensive	Continuous
O_3 NO_x SO_2 CO	Gas-phase concentrations	Baseline	10 min
VOCs	Gas-phase concentrations	Baseline Intensive	1 day 8 hr
Hydrogen peroxide Organic peroxides	Gas-phase concentration Gas-phase concentration	Baseline Baseline	10 min 10 min
Fog water collector	Fog liquid water content Fog water composition	Baseline Baseline	
Wind speed Wind direction Temperature RH Solar radiation UV radiation	Meteorology	Baseline	10 min

Upper air data (ozone, scattering coefficient, and meteorology) were collected during seven flights by the U. of Maryland and LADCO/Purdue airplanes for July 6, 22, 23, August 1 and 2.

The analysis of most of the samples proceeded in almost real time and the results are currently validated following the study's QA/QC protocol. A server has been set-up in CMU with all the available data. Some of the preliminary findings of the study are summarized below:

- The summer of 2001 was characterized by relatively low daily average PM concentrations in Western Pennsylvania. The highest daily average $PM_{2.5}$ concentration was a little above 50 μg m^{-3}. However, a number of periods of concentrations around 100 μg m^{-3} were identified, as well as periods of rapid concentration changes (e.g., change from 20 to 80 μg m^{-3} in a few hours). There were also a number of days with extremely low $PM_{2.5}$ concentrations (e.g., the daily average $PM_{2.5}$ concentration on July 2 was only 5 μg m^{-3}). The study appears to have captured most of the concentration space during the summer with the exception may be of the very high concentration regime.
- The size distribution measurements revealed several periods of fast ultrafine particle production. Most of these periods were in the early morning (around 8 am) and were characterized by low PM mass concentrations. The increase in peak aerosol number concentrations as mass concentrations decrease will be investigated in detail during the rest of the study.
- The concentrations of the organic fine PM components were similar to the sulfate concentrations for most periods. A number of interesting periods of high sulfate concentrations with relatively low organic PM were also identified.
- High OC/EC ratios during several periods suggest formation of secondary organic aerosol.
- The nitric acid remained in the gas phase during daytime, but was transferred to the particulate phase during the night. Significant nitrate formation due to nighttime chemistry was observed during most of the evenings.
- The new continuous sulfate (R&P, steam sampler), nitrate (R&P, steam sampler), ammonium (steam sampler) and OC/EC (Sunset labs) instruments performed quite well (both in reliability and precision).

These results together with further analysis will be discussed during the November meeting of the Supersite PIs in RTP.

Changes in Key Personnel Involved in the Project: None.

Expenditures to Date: During the first eighteen months of the project the Supersite team has used approximately all the budget for the corresponding period.

Quality Assurance Requirements: The revised Quality Assurance/Quality Control plan was approved during June.

Planned Activity for the Subsequent Reporting Period: Major activities planned for the seventh quarter of the project include:

- Continuation of the baseline measurements
- Analysis of the remaining samples by the CMU team and its collaborators.
- Data analysis and synthesis in preparation for the November meeting of the Supersite PIs
- Presentation of preliminary results in the annual AAAR meeting in October in Portland
- Design and coordination for the second intensive (January 2001).
- QA/QC of the July intensive data. Preparation of the data files for submission to EPA.

Supplemental Key Words: Airborne particulate matter, aerosol, size distribution, ultrafine, fine and coarse particles, atmospheric chemistry, source-receptor, measurement error, study design, epidemiology, regional modeling, source/receptor analysis, Pittsburgh, Ohio River Valley, Western Pennsylvania, photochemistry, meteorology, trajectory modeling, peroxides.

Relevant Web Sites: homer.cheme.cmu.edu