QUALITY ASSURANCE PROJECT PLAN (QAPjP) and QA Report for Pacific 2001

Prepared by: Dr. Douglas Worsnop
Date:

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Principal Investigator

Dr. Douglas Worsnop, Aerodyne Research, Inc., 45 Manning Rd., Billerica, MA 01821-3976

Team Members

Manjula Canagaratna, Hacene Boudries, Philip Silva, Aerodyne Research, Inc.

Measurement Program
Continuous measurement of particle size and composition using an aerosol mass spectrometer (AMS)

Measurement Species and Units

Nitrate mass	$\mu g\ m^{-3}$ at ambient temperature and pressure
Sulfate mass	$\mu g\ m^{-3}$ at ambient temperature and pressure
Ammonium mass	$\mu g\ m^{-3}$ at ambient temperature and pressure
Organic carbon (OC) mass	$\mu g\ m^{-3}$ at ambient temperature and pressure

Representative Size Range (if PM)
60 nm – 1.5 μm

Measurement Platform (surface, airborne)

Surface—1 m above ground level in trailer

Measurement Sites (surface only)
???

Measurement Objective(s)
Measurement Details

0.0. Field Measurements

Measurement Principle
All PM components are measured using thermal-vaporization-electron impact mass spectrometry. Volatile and semi-volatile chemical species present in particles are vaporized and ionized and then detected with a quadrupole mass spectrometer.

Instrumentation (Manufacturer/Model)
The AMS is developed and assembled at Aerodyne. The mass spectrometer is a Balzers quadrupole system, QMG 400. Turbomolecular pumps are manufactured by Varian. Electronics and instrument frame are produced in-house at Aerodyne.

Flow System

Inlet of AMS has PM2.0 cyclone on front end to remove large particles. AMS inlet uses a pinhole and particle lens focusing design of McMurray to deliver submicron and micron size particles into vacuum for mass spectrometric analysis.

Inlet Height Above Ground (if surface)

2 m above ground level through top of trailer.

Nominal Flow Rate
The flow rate on the AMS averages ~1.5 cc s^{-1}

Flow Measurement/Control
A mass flow meter is used to constantly monitor the flow.

Flow Temperature and Pressure
Ambient temperature and pressure.

Sampling Times/Period/Frequency

The sampling time and frequency of the AMS can be varied depending on the atmospheric concentration of PM to allow for better time resolution. Typical sampling time for field studies are 5 second values averaged to a 10 minute integration time.

Sampling Methods

No sample preparation or storage. Sample is analyzed on-line, continuously.

Filter Type/Coating Type/Reagent Type

No filters or reagents.

Planned Changes to Instruments or Methods During Study

None.

0.0. Laboratory Measurements (If Applicable)
N/A

Laboratory Name and Address

Analytical Method(s)

Sample Extraction or Work-up

Analytical Detection Limits

Quality Assurance/Quality Control

0.0. Field Quality Assurance/Quality Control

Traceability
N/A

Calibration
The quadrupole transmission efficiency is calibrated using a rare gas mixture containing N2, Ne, Ar, Kr, Xe. This occurs at the beginning and end of the study and at any point if the resolution settings of the mass spectrometer are changed. The primary mass calibrant of the AMS is monodisperse ammonium nitrate particles. These are size selected using a differential mobility analyzer. The AMS count rate is then compared to the count rate on a condensation particle counter. Secondary calibrants are ammonium sulfate and various organic compounds such as oxalic acid and oleic acid. Daily checks of the mass calibration are planned. In addition, the weak signals due to gas-phase nitrogen and oxygen are used as a continuous check of the multiplier gain sensitivity.

Zeros and spans
Zero checks are made by attaching a HEPA filter to the inlet line to the AMS. Zero checks are performed occasionally, perhaps once a week.

Blanks
N/A

Field Quality Control procedures
N/A

Precision determination
N/A

Comparison with other measurements
N/A

Inspections and Audits

N/A

0.0. Laboratory Quality Assurance/Quality Control

N/A

Traceability

Calibration procedures

Blanks

Other lab QC

Precision determination

Comparison with other methods

Audits

Data Management and Quality Control

0.0. Raw Data Recording

All data is recorded automatically by the AMS data acquisition software. This includes ambient temperature and pressure, and all instrumental parameters such as flow, in addition to the mass spectral data.

0.0. Final Data Reporting

Data will be reported as 10 minute averages.

0.0. Data Quality Control and Validation

All data values will be flagged as Valid (V) or Invalid (I). Raw data will inspected and all instrument and power failures, zero and calibration periods will be flagged as invalid.

0.0. Validity Flags

The NARSTO flags will be used as followed:

V0 Valid value
V1 Valid value but comprised wholly or partially of below-MDL data
V2 Valid estimated value
V3 Valid interpolated value
V4 Valid value despite failing to meet some QC or statistical criteria
V5 Valid value but qualified because of possible contamination (e.g., pollution source, laboratory contamination source)
V6 Valid value but qualified due to non-standard sampling conditions (e.g., instrument malfunction, sample handling)

M1 Missing value because no value is available
M2 Missing value because invalidated by data originator
H1 Historical data that have not been assessed or validated]

0.0. Below Method Detection Limit Values

Below-MDL values for the various chemical species will be estimated from the primary and secondary calibrations. Typical determined MDL for chemical constituents in PM is 0.1 $\mu g\ m^{-3}$.

0.0. Derived Parameters

None.

0.0. Explanation of Zero or Negative Data

Data Quality Objectives (Pre-Study)

0.0. Accuracy

Mass loading accuracy for PM constituents has been determined to within 30% during previous field studies through intercompariosn with other techniques.

0.0. Precision

Precision for chemical constituents of PM is determined from multiple runs of primary and secondary calibrants. Precision for inorganic constituents (nitrate, sulfate, ammonium) is typically within a few percent. For OC, precision is less predictable and is dependent on the types and variety of organic compounds present.

0.0. Comparability

Integrated data can be compared to any filter measurements as well as with other continuous measurement techniques, such as TEOMs.

0.0. Representativeness

As the Langley site is downwind site, the data will be representative of secondary particulate matter, with nitrate, sulfate, ammonium, and oxygenated organic compounds that will form.

0.0. Completeness

PM completeness objective = 90%. Number of 10 minute periods with valid data divided by total number of 10 minute periods in the campaign.

0.0. Other Quality Information

End of Pre-Study QAPjP

Start of Post-Study QA Report

Significant Changes to Site, Instruments or Methods During Study

The AMS instrument initially deployed at Slocan has been moved to Soumas site during the last week of experiment. Data collected by the AMS include all three sites initially selected but not during the entire period of the PACFIC 2001 field experiment. At Langley site we collected data from August 11 to September 01, 2001. At Slocan we collected data from August 12 to August 24, 2001 and finally at Sumas we collected data from August 25 to August 31, 2001.

Post-study Data Quality Indicators (DQIs)

Accuracy

The accuracy has been estimated to 30%.

Precision

Precision for chemical constituents of PM is determined from multiple runs of primary and secondary calibrants. Precision for inorganic and organic constituents (nitrate, sulfate, ammonium) and organic constituents is estimated to less than 5%.

Comparability

Data collected by the AMS during PACIFIC 2001 will be compared to multitude of data collected by different techniques like filter measurement, gas chromatography, GC-MS, LC-MS, etc. This intercomparaison exercise will confirm the abability of the AMS instrument in term of qualitative and quantitative measurement of aerosols.

Representativeness

By sampling at three different sites (Slocan, Langley, Sumas) and coupled with meteorological data, our data will be representative of primary and secondary aerosols, and probably give an understanding of physical and chemical processes of formation of aerosols in the Fraser Valley in Vancouver.

Completeness

PM completeness objective = 80%. Almost 90% of missing data are due to power failures and the rest is due to AMS instrument calibration. The number of data collected is about 8184 samples including information on chemical composition and size distribution of aerosols. The number of data collected at Langley, Slocan and Sumas are 3493,2239 and 2452, respectively. The frequency of sampling at Langley, Slocan and Sumas, is about 15, 15 and 2 minutes, respectively.

0.0. Blank correction (describe whether done and method used):

The blank is corrected automatically on each run during the entire field experiment.

0.0. Other Quality Information

References: