

8-1-2005

Mass Loading Measurements in Amargosa Valley

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Sagebiel, J. C., Gertler, A. W., Smiecinski, A. J., Shafer, D. (2005). Mass Loading Measurements in Amargosa Valley.

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University and Community College System of Nevada (UCCSN)



SCIENTIFIC INVESTIGATION PLAN (SIP)

Task Title: Mass Loading Measurements in Amargosa Valley

Task Number: DRI-FI-001

Document Number: SIP-DRI-047

Revision: 0

Effective Date: August 1, 2005

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REVISION HISTORY

Revision Number	Effective Date	Description and Reason for Change
0	8/1/05	Initial Issue

1.0 SCOPE, OBJECTIVES AND SUBTASKS

Scope and Objectives – This work will be conducted under Task DRI-FI-001, “Mass Loading Measurements in Amargosa Valley.” The objective of this task is to measure, with known accuracy, the levels of atmospheric mass loading (mass concentration of suspended particulates) accompanying soil surface disturbing activities in Amargosa Valley. Mass loading is used in the biosphere model to calculate inhalation exposure for the human receptor, the maximally reasonably exposed individual (RMEI). The mass loading currently used in the biosphere model is based on literature data from the analog sites rather than on site-specific conditions. This work is subject to the Nevada System of Higher Education (NSHE, previously UCCSN) QA program requirements.

The biosphere model divides the environment of the receptor into several mutually exclusive microenvironments (called environments for brevity). One of these environments, the **active outdoors** environment encompasses those locations where people actively disturb the soil surface, thus increasing particulate and contaminant concentration in air. Time spent active outdoors includes conducting dust-generating activities while working (e.g., plowing, excavating, and livestock operations), driving on unpaved roads, and recreating (e.g., gardening, landscaping, riding horses or motorbikes, walking on uncompacted soil) outdoors. Because dust concentrations in air are expected to decrease relatively quickly after dust-disturbing activities cease, this category is limited to the time when the activities are occurring.

The biosphere model calculates human exposure on an annual basis, so all quantities/parameters used in the model, including particulate concentration in air in an active outdoor environment, are representative of annual average conditions. Although this environment concerns the situations when people actively disturb the soil surface, it is expected that such activities will cause a wide range of particulate concentration in air. It is important that the measurements are designed such that they reflect a range of conditions to best represent an annual average and are not biased towards extreme values (high or low).

Task List – Primary activities involved in task DRI-FI-001, “Mass Loading Measurements in Amargosa Valley,” include:

- Conducting calibrations and operational checks of instruments, as required for qualified data;
- Collecting data in the field;
- Maintain appropriate records to document work being performed;
- The data will be provided to the BSC counterpart for submission to the TDMS in accordance with AP-SIII.3Q;
- All QA records are to be submitted to DCC, as required.

2.0 APPROACH

The measured values of atmospheric mass loading should be representative of the air in the breathing zone of a person involved in activities that disturb the soil surface and cause

suspension of soil particles. Specifically, the quantity to be measured is total mass concentration of suspended particulates (TSP), reported in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

Measurements to be Performed, Number of Samples, and Equipment

The measurements of atmospheric mass loading will be carried out for about ten soil-disturbing activities, but no less than seven. About ten samples should be collected for each activity and each particle size range to obtain statistically valid results (this is discussed further in the following section). The required quantities will be measured in an appropriate manner, i.e., following the equipment manufacturer's instructions and in accordance with applicable technical procedures. The instrument that will be used in the measurements is the Rupprecht & Patashnick Co., Inc Model 3020 Aerosol Monitor (DustScan Scout). This instrument can be configured to sample different particle size ranges, including TSP. Following each measurement activity, the data will be transferred from the instrument internal memory to a laptop, and checked to ensure integrity. All data transfers (including manual entries) are to be verified complete, accurate, and the verifications documented, in addition to discrepancies and their resolutions, if applicable, in accordance with QAP-3.1.

Selection of Activities that Disturb Soil Surface

The measurements concern those activities that disturb soil surface causing enhanced levels of atmospheric mass loading. The soil surface disturbing activities should be selected such that they represent typical agricultural and recreational activities expected to be conducted outdoors in the Amargosa Valley region. The measurements may involve scripted activities as long as they are determined to be representative of the typical conditions.

The examples of such activities include plowing, disking, harvesting, driving an open and closed cab tractor or other agricultural equipment on unpaved road, driving other vehicles such as trucks, motorcycles, and ATVs on unpaved roads, walking on unpaved surfaces, horse riding, working in the yard, excavating and conducting activities that resuspend soil, such as using blowers, sweeping, digging, and raking.

A number of activities is proposed for consideration, but it is expected that the actual selection of the activities will likely be opportunistic and/or based on the input from the local points of contact. This is to avoid biasing the results by deciding a priori on a specific set of activities that may turn out not to be representative or not inclusive. The actual selection of activities should factor in an input from the local points of contact.

The duration of individual measurements will likely be activity-specific and will depend on how long it takes to obtain, for any individual activity, statistically valid and representative results and how long an activity would be normally conducted. For the measurement involving the local residents, the duration of measurements may need to be synchronized with their schedule, such as to cause as little disruption as possible. For the scripted activities such as walking or riding a vehicle on unpaved surface, the time required to obtain statistically valid data may be a deciding factor. This same factor may also influence the number of samples collected for any individual activity. For example, for an activity that results in a relatively steady level of mass loading, one would not need to collect 10 samples.

The following activities would likely involve the local residents:

- **Farming/agriculture** – measure mass loading in an open and/or close cab of different farming equipment while the equipment is used in the field. The measurements may include the phases when the equipment is being prepared for work and then put away, such that the measurements are representative of the entire process and represent the averages for the activity. The specific kind of equipment will depend on the equipment availability and actual activities conducted in Amargosa Valley at the time of the measurement campaign (e.g., tractor, backhoe, baler, bale mover/fork, plow, combine, cultivator, disk, hay inverter, manure spreader, sprayers, etc.)
- **Gardening/landscaping** – measure mass loading while gardening, weeding, digging, using hand gardening tools, like rakes, spades, lawn mowers, etc. This activity could be scripted but, again, the objective is to simulate normal behavior that people would display while engaged in such activities.
- **Recreation** - measure mass loading while riding a horse or an ATV on unpaved road. The activity could include preparations, such as getting a horse or an ATV ready.
- **Tending farm animals** – measure mass loading while tending farm animals, including feeding, watering, moving, exercising.
- **Construction/excavation** – measure mass loading while excavating using equipment or at a construction site while soil disturbing activities are conducted.

Scripted activities:

- **Walking on unpaved surfaces** – a perfect candidate for scripted activities that don't have to involve local residents – measure mass loading while walking on different unpaved surfaces. Different means the surfaces with different levels of soil compaction. One could expect a lower mass loading levels on desert pavement, which is poor in fines, and higher levels on previously disturbed surfaces where the dirt was loosened.
- **Driving a vehicle on an unpaved road**, possibly, with a window rolled down – analogous to walking, this activity may involve different surfaces (different soil compaction levels), and may be even a paved surface for comparison. Mass loading will be higher for someone following a vehicle riding on unpaved surface than that for a person in the first vehicle. Such a situation could also be included.

This above list of activities is by no means comprehensive and neither is it implied that every activity from the list should be investigated nor that an activity cannot be added. The scripted activities (walking and driving) could be investigated first to get a feel of the equipment performance and the necessary sampling times in a quasi-controlled environment. The activities involving the local residents will, inevitably, be more opportunistic in nature.

Documentation of the Results

The sampling results will be documented using the approved method, following the implementing procedure (IP), that ensures the quality and integrity of the collected data. Data reduction is not necessary as the instrument output (in this case mass of particles in the air in $\mu\text{g}/\text{m}^3$) is the same as the final data needed.

3.0 STANDARDS

The data shall meet the input requirements specified for the biosphere model. This requires mass loading concentrations for a variety of activities. Functional compliance may be demonstrated by the programmatic review of instrument calibration documentation. No other standards are specified for this activity.

4.0 IMPLEMENTING PROCEDURES/ DOCUMENTS

All work will be performed in accordance with the implementing procedure, IPR-032, "Particulate Matter Measurements Using the Rupprecht & Patashnick Company, Inc. DustScan Scout."

5.0 EQUIPMENT

Equipment Used - Rupprecht & Patashnick Company, Inc. DustScan Scout.

Calibration Requirements – It is anticipated that calibration services will be performed by Met-One Instruments, Incorporated.

Protective Measures – Instruments will only be operated as per manufacturer's requirements for protection.

6.0 HOLD POINTS/ DECISION POINTS

Hold Points - There are no prerequisites or hold points associated with this task. Decision points associated with operational checks and any actions taken will be documented as appropriate.

Environmental Conditions – Instruments will only be operated as per manufacturer's requirements for environmental conditions. Due to expected reduction in atmospheric mass loading, measurements will not be conducted during periods of rain.

7.0 RECORDS AND DELIVERABLES

All QA records will be controlled and submitted in accordance with QAP-17.0. Records designated as QA records in the NSHE QAPs and IPs listed include but are not limited to:

- Hard copies and/or electronic media containing reduced concentration data;
- Data review check sheets;
- Quality-affecting reports, including a final technical report.

Submittals are provided to DOE in accordance with the cooperative agreement.

- Data packages including all supporting information to be submitted in accordance with QAP-3.6, "Submittal of Data.";
- Quality-affecting reports;
- Non-Q progress reports.

No scientific notebook will be used in this task.

8.0 VERIFICATIONS AND REVIEWS

Internal verification of all data will be performed to check compliance to the procedures and to verify the accuracy of data reproduction. Internal technical reviews will be performed and documented on the data generated in this task. Any data generated or submitted without full internal verification will be labeled as “preliminary data”. Pertinent QA records will be reviewed in accordance with QAP-3.0 prior to submission of data. Technical reports will be developed in accordance with QAP-3.4.

9.0 SOFTWARE

No software will be developed in this study. Software packages used in this study include:

- Microsoft Excel spreadsheet software used for data presentation and graphical representation;
- Instrumentation and interface software associated with the Rupprecht & Patashnick Company, Inc. instrument.

10.0 INTERFACE CONTROLS

External Interfaces:

BSC

Internal Interfaces:

PI: Alan Gertler

Quality Control Specialist: Jeffery Tappen

Investigator: John Sagebiel

Technicians: As needed

11.0 OTHER REQUIREMENTS

All applicable QA controls will be applied.

Accuracy, Precision, and Representativeness – Calibration will be conducted prior to starting work and will be documented.

Potential Sources of Error and Uncertainty – The main source of uncertainty is the variability of the source strength. The user can select from among four measurement ranges of the instrument: 0-0.5 mg/m³ (500 µg/m³), 0-1 mg/m³, 0-10 mg/m³, and 0-100 mg/m³. The corresponding mass resolutions are 0.001, 0.001, 0.01 and 0.1 mg/m³.

Schedules – Data collection and instrument operational checks will be conducted daily. It is anticipated that field measurements will be performed in August 2005 and reporting performed in September 2005.

Procurement and Subcontracts – No subcontracts will be used for this task. Procurements will be required for purchase of additional gauges and datalogger calibration services, and will be generated in accordance with QAP-7.0 “*Control of Quality Affecting Procurement and Receipt.*”

References

IPR-032. “*Particulate Matter Measurements Using the Rupprecht & Patashnick Company, Inc. DustScan Scout.*”