

Development and Testing of Particle Number Flux Measurement System

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Objective

Particulate material is a major atmospheric pollutant, causing significant impacts on air quality, visibility, and climate. Accurately modeling particulate levels critically depends on our understanding of particle sources and sinks. Quantifying the contributions of major point sources is relatively easy, but estimating emissions from distributed sources is quite difficult with great potential for biases and uncertainties. Similarly difficulties arise when try to model the loss of particulates via surface deposition processes.

One way to improve estimates of distributed sources and sinks is by measuring their cumulative effects on the 'canopy' scale. Several techniques exist for measuring the flux of pollutants into or out of an urban or natural canopy. The most rigorous of these is the eddy covariance technique, wherein highly time resolved concentration measurements are correlated with the rapid wind fluctuations associated with atmospheric turbulence. In this project the student will develop and test an eddy covariance system to measure particle number flux. This system is to be deployed this fall for a field experiment investigating urban emissions in Tianjin, China.

Preliminary Training

This project will involve the collection and analysis of very large data sets- typically flux calculations involve averaging 30 minutes of 10 Hz. Most of the analysis will use the Igor Pro software package. Igor is a powerful program, but has a somewhat steep learning curve. Significant time at the start of the project will be devoted to learning Igor Pro.

The instrument operation and data collection will be managed using the LabView software package. This also has a steep learning curve, but many LAR researchers are experienced with it and many sample codes already exist for eddy covariance measurements. Still, some time will be required to build a comfort level with the software.

The instruments actually used for the measurements are easy to operate. They include a condensation particle counter, a sonic anemometer, and complementary temperature and water vapor measurements. Training on operating these instruments will occur early in the project.

Project Tasks

1. The first task will be to assemble a test apparatus in the laboratory. All of the major system components (i.e., the particle counter, the sonic anemometer, the data acquisition hardware) are operational, but they have not yet been operated as a single system.
2. The student will need to develop data acquisition software using LabView. Similar programs for other eddy covariance measurement systems are available to aid in this task.
3. Data analysis procedures will be developed using IgorPro. Codes for analyzing the sonic anemometer data are in place, but not for the particle data, and the existing flux calculation routines will likely need to be modified some for the new system.
4. The student will test the full system at a local site.
5. The student will prepare a poster for the end-of-summer symposium.

References

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