Development of the Next Generation of Flux Measurement Tools

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The United States Environmental Protection Agency (EPA) has proposed a pilot program that will add the ability to measure atmospheric fluxes of NO_2 and NO to its existing atmospheric deposition program. Since these fluxes have the potential to impact changes to the secondary National Ambient Air Quality Standards (NAAQS), there is concern about the lack of actual dry flux measurements in current flux assessment schemes. Our research effort will address this concern by creating and deploying a robust, inexpensive, and continuous multiple-species gas-flux monitoring system, which can provide data for a variety of relevant atmospheric pollutants. An inexpensive tool will allow for an exploration of the spatial variability of fluxes as multiple flux measurements would be possible for the same resources as was previously required for a single flux measurement site.

We have designed and built a prototype dynamic flux chamber, which currently measures CO_2 and CO fluxes as well as soil moisture and rainfall. The next step will be to integrate SO_2, NO, NO_2 and NH_3 gas sensors, as well as meteorological sensors (wind speed, solar radiation, etc.). We are also developing a model that will enable us to compare observed data to existing theory. The complete first-generation chambers cost less than $2500, and the ultimate goal is to reduce the cost to $1000 per chamber. This low-cost design is possible because of the use of inexpensive sensors. The sensors range from $5 to $150 in cost, and are currently used for alarm indicators in chemical and manufacturing processes. Through previous research efforts, we have demonstrated that these inexpensive sensors are often well suited for environmental assessment applications. The CO_2 sensor that is installed in the chamber is a non-dispersive infrared sensor, with noise of ~1 ppm. Electrochemical sensors will be installed to detect NH_3, NO_x and SO_2. Once these sensors are installed, we will conduct a feasibility study to characterize their performance as well as develop in-field automated calibration tools.

We will present the flux chamber development efforts and show pilot field study results for CO_2, ozone and possible other pollutants species depending on progress to date. We will also discuss how chamber parameters (volume, flow rate, sensor resolution etc.) affect results. In addition, we will bring the flux chamber to demonstrate the operation of the system.

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