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# **Calibration and Field Support System for Aircraft-Based Atmospheric Measurements**

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## **LONG TERM GOALS**

Our long term goal is to ensure the quality of atmospheric measurements of aerosols, radiative fluxes, and gases made from airborne platforms. These measurements are critical to understanding anthropogenic climate perturbations.

## **OBJECTIVES**

The objective of this work is to develop a field deployable calibration system that will make it possible to calibrate aerosol measurement instruments, radiometers, and chemistry measurements during field campaigns.

## **APPROACH**

The aerosol instrument calibration system is designed to provide both size and number concentration standards that can be deployed to the field and used to characterize the performance of instruments as they are installed onboard atmospheric research aircraft. Two differential mobility analyzers (DMAs) with different column lengths are used to cover the size range from as small as 3 nm to as large 1 micrometer diameter. An automated flow control system will be used to ensure simple and stable operation of the DMAs. A vibrating orifice generator is incorporated to provide calibration aerosols for particles larger than 1 micrometer to facilitate calibration of optical particle counters, cloud condensation nucleus spectrometers, and other large particle measurement instruments. Two condensation nucleus counters will be used to provide concentration standards and to serve as detectors for the DMAs. A Droplet Measurement Technologies Micropositioner probe will provide an ability for optical alignment and view volume measurement of optical probes. The calibration system will be operated using a National Instruments LabView based data acquisition and control system.

The calibration system will also support radiometric measurements through the acquisition of an

integrating sphere, uniform intensity light source. Chemical measurements will be supported through a calibration gas delivery system, a zero air production system, sample handling and storage facilities, and through the use of the aerosol calibration system to preparation of aerosol standards of known concentration and composition for the calibration of aerosol chemical composition measuring instruments.

## **WORK COMPLETED**

The major components of the aerosol calibration system have been ordered, and a number of components have been received. The calibration system will employ a TSI model 3071 DMA column for particles up to 1 micron in diameter, and the recently announced TSI nano-DMA column for the ultrafine particles. TSI 3010 and 3025 condensation nuclei counters, and other auxiliary aerosol equipment have also been ordered. A 12 inch diameter integrating sphere uniform intensity light source has been designed and constructed by Labsphere.

## **RESULTS**

The first shipments of equipment have only recently been received.

## **IMPACT/APPLICATIONS**

The calibration system that is being developed under this grant will provide calibration data that is necessary to validate measurements of atmospheric aerosols and gases, and of the radiative properties of the atmosphere, and it will do so for the instruments in the state that is encountered in the field. It will make it possible to quantify degradation that occurs during flight and will help to ensure that instruments are functioning properly throughout measurement campaigns.

## **TRANSITIONS**

We are in the process of completing the ordering and assembling the system. By making the system portable and automating the operation to the maximum extent possible, it is anticipated that it will be possible to use the calibration system to validate the performance of instruments on multiple platforms during a campaign .

## **RELATED PROJECTS**

Measuring the atmospheric aerosol size distribution using a combination of the Caltech ACAD (Automated Classified Aerosol Detector), Caltech cloud Condensation Nucleus spectrometer, optical probes (PMS PCASP and FSSP, and Droplet Measurement Technologies CAPS [Cloud/ Aerosol/Precipitation Spectrometer]), cascade impactors, nephelometers, and related instruments on board the CIRPAS Pelican and Twin Otter are important in furthering our knowledge of the nature of the atmospheric aerosol and its effect on the atmospheric radiation balance, cloud evolution, and other atmospheric phenomena.

## **IN-HOUSE/OUT-OF-HOUSE RATIOS**

All work was done at Caltech.