Southern Great Plains Newsletter

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Aerosol Lidar Validation Experiment Scheduled for September

In a new field campaign using the ARM Climate Research Facility (ACRF), researchers will gather at the Southern Great Plains (SGP) site's central facility in September 2005 for the Aerosol Lidar Validation Experiment (ALIVE). Measurements from the SGP Raman lidar and micropulse lidar will be validated through comparison with data from the NASA Ames Airborne Tracking 14-Channel Sunphotometer, flown aboard a Jetstream 31 research aircraft. This sunphotometer measures the transmission of the solar beam over 14 specific spectral channels. The instrument has azimuth and elevation motors controlled by differential sun sensors that rotate a tracking head to lock onto the solar beam and keep the detectors perpendicular to the beam while the aircraft maneuvers during flight.

A Raman lidar (light detection and ranging) is a ground-based laser remote sensing instrument used to measure water vapor and aerosol extinction profiles in the atmosphere. (See "Climate Capsule" in this issue.) A lidar is based on the same physical principle as a radar. Pulses of energy are transmitted into the atmosphere, and the energy scattered back to the transceiver is collected and measured as a time-resolved signal. The distance to the scatterer is calculated from the time delay between an outgoing transmitted pulse and the corresponding incoming backscattered signal.

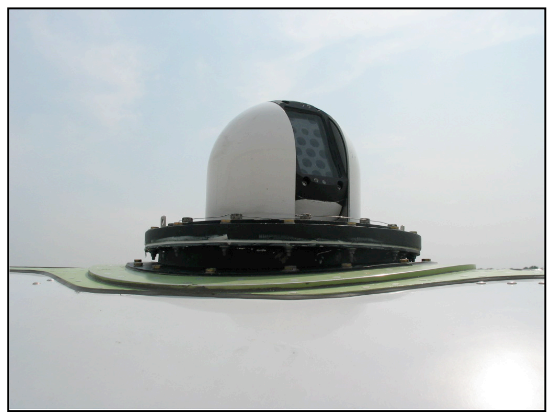

Figure 1. The NASA Ames Airborne Tracking 14-Channel Sunphotometer mounted on a Jetstream 31 aircraft (NASA Ames photo).

Raman lidar measurements provide aerosol extinction data having sufficient accuracy and spatial and temporal resolution for use in computing aerosol optical thickness from the surface up to an altitude of 7 kilometers.

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The micropulse lidar is a ground-based laser remote sensing system designed primarily to determine the altitude of clouds overhead in

Figure 2. The Raman lidar at the SGP central facility (ARM photo).

real time. In addition, post-processing of the lidar return can characterize the extent and properties of atmospheric aerosols.

Both micropulse lidar and Raman lidar measure backscattered laser energy at the transmission wavelength for aerosol measurements (355 nanometers). In addition, the Raman lidar measures Raman-shifted backscattered energy at wavelengths corresponding to water vapor (408 nanometers) and nitrogen (387 nanometers).

The Aerosol Intensive Observational Period (IOP) field campaign in May 2003 focused on atmospheric aerosols — tiny particles not usually visible to the unaided human eye. These aerosols interact with incoming solar radiation and can affect both daily weather conditions and long-term climate on Earth. During the Aerosol IOP, a host of guest instruments were deployed at the SGP site's central facility to complement the ACRF-installed aerosol-measuring instruments. Research aircraft equipped with aerosol- and cloud-sampling instrumentation flew above the site to collect data at different altitudes. Vertical sampling by aircraft yields specific measurements in the vertical column simulated by climate models. Comparisons were made between guest instruments and SGP instruments to verify and confirm the accuracy of measurements.

A main goal of the ARM Program is to improve understanding of interactions between clouds and solar radiation, so that their functions can be portrayed more accurately in global climate models. Aerosols can scatter, reflect, and absorb solar radiation, directly changing the amount of energy that travels through the atmosphere and reaches Earth's surface. Aerosols can also indirectly affect the transfer of solar radiation through the

Figure 3. The SGP micropulse lidar (ARM photo).

atmosphere by influencing the formation of clouds and altering cloud properties. Aerosols further act as particles on which cloud droplets form, thus increasing cloud

Climate Capsule

"Climate Capsule" is a monthly feature introducing climate and weather definitions.

Aerosol extinction profile

:also called extinction coefficient, is a measure of attenuation of light passing through the atmosphere due to scattering and absorption by aerosol particles. The integrated extinction coefficient over a vertical column of unit cross section is called the aerosol optical depth or optical thickness.

reflectivity and extending cloud life. To produce useful results, climate models must contain accurate representations of the influences of aerosols on solar radiation and radiative fluxes.

During the summer of 2004, the Raman lidar at the SGP central facility underwent a major tune-up to restore and improve its data-gathering capabilities and sensitivity. New signal acquisition and processing electronics were installed, the mirrors of the telescope used to receive backscattered light were stripped and recoated, the telescope was realigned, higher-transmissivity interference filters were installed to strengthen the signal reaching the detector, and the automated alignment subsystem was repaired.

The focus of this year's ALIVE field campaign is to test the upgraded Raman lidar against the NASA Ames Sunphotometer and compare its measurements with validated data from the May 2003 Aerosol IOP. The ARM Program calibrates all of its measurements to consistent standards, so that the data can be used as a massive body of comparable results.

Our Apologies: Due to an internal mailroom error, some empty, pre-addressed envelopes were mailed out last month. We apologize for the mix-up.