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Diffuse Irradiance Study Works to Set Measurement Standard

The ACRF sites have many instruments that measure and collect data on atmospheric conditions, clouds, and solar radiation. These instruments need to be verified and calibrated frequently to ensure that they are providing accurate measurements, because quality research requires quality measurements.

For two weeks in October 2006, the ACRF SGP site was host to several high-precision instruments that measure solar radiation. Results were compared among these visiting instruments and the resident solar radiation instruments installed across the SGP site.

The type of solar radiation instrument of interest in this comparison was the pyranometer, which measures the solar radiation reaching Earth's surface. Clouds, water vapor, dust, and other aerosol particles can interfere with the transmission of solar radiation. The amount of radiant energy reaching the ground depends on the type and quantity of absorbers and reflectors between the sun and Earth's surface. Pyranometers can also be used to measure solar radiation reflected from the surface.

Figure 1. Pyranometers mounted with solar trackers collect solar radiation data at the SGP central facility (ARM photo).

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A pyranometer has a thermoelectric device (a wire-wound, plated thermopile) that produces an electric current proportional to the broadband shortwave solar radiation reaching the detector. The detector, which is painted black, is mounted in a precision-ground glass sphere for protection from the elements. The glass must be kept very clean, because dirt and dust scatter and absorb solar radiation and make the measurement incorrect.

Each pyranometer (Figure 1) is mounted to a solar tracker — a device that shades the instrument continually and blocks out the sun's direct rays. The pyranometers make measurements of *diffuse irradiance*, which is an important value for use in validating the clear-sky and cloudy-sky radiative transfer codes in climate models. Measurement of diffuse irradiance currently has no absolute standard; the purpose of the October comparisons was to define a *working standard* for ARM.

The main goal of the diffuse irradiance study was to obtain simultaneous measurements with well-characterized, shaded pyranometers that were pre-selected on the basis of performance in two previous studies. All of the pyranometers used in the current study were characterized in the laboratory for angular and spectral response before the two-week study began. ARM managers hope to select a set of these pyranometers to establish the working standard for the ARM science team.

The measurement of diffuse irradiance has improved in recent years, and researchers expect that the results from this study will resolve remaining biases. Accurate measurements of solar radiation are needed so that scientists can accurately replicate the interactions of solar radiation and clouds in global climate models -— a major goal of the ARM Program.

Figure 2. Three pyranometers collect data during the diffuse irradiance field campaign at the SGP Central Facility (ARM photo).