ARM PROGRAM SGP CART SITE

Atmospheric Radiation Measurement Program

Facilities Newsletter – September 1999

Upcoming Intensive Observation Periods at SGP CART Site

The ARM SGP CART site will host several Intensive Observation Periods (IOPs) in the near future. Two projects of note are the International Pyrgeometer Intercomparison and the Fall Single Column Model (SCM)/Nocturnal Boundary Layer (NBL) IOP. Both projects will bring many U.S. and international scientists to the SGP CART site to participate in atmospheric research.

The International Pyrgeometer Intercomparison IOP will take place on September 20-October 1, 1999. A pyrgeometer is an instrument that measures invisible radiant energy that reaches Earth's surface from the sun. (More technically, a pyrgeometer measures the surface irradiance of long-wave infrared energy.) Twelve pyrgeometers will be located at the calibration facility (see Figure 1) of the SGP CART site's central facility near Lamont, Oklahoma. In addition, two special sky-scanning instruments will be brought to the CART site. One instrument, used as the standard for solar radiance measurements, is from the World Radiation Center in Switzerland. The second instrument is from the Australian Bureau of Meteorology. The sky-scanning instruments will measure solar radiance reaching Earth's surface from all points in the sky. This measurement will be converted to surface irradiance, the value used to calibrate and verify the pyrgeometers. Accurate measurement of surface irradiance is difficult because the instrumentation used relies on new

Figure 1. The radiometer calibration facility at the SGP CART site's central facility near Lamont, Oklahoma.

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technology that has not been fully developed. These measurements are important for understanding the effects of clouds and humidity on surface irradiance. Changes in surface irradiance can contribute to climate change.

The Fall SCM/NBL IOP will support the Cooperative Atmospheric-Surface Exchange Study-99 (CASES-99) and will take place during the entire month of October. Participants from many universities, the Department of Energy research laboratories, the National Oceanic and Atmospheric Administration (NOAA), and the National Center for Atmospheric Research (NCAR) will come to the SGP CART site to conduct coordinated research.

One of the focuses of CASES-99 is the structure and evolution processes in the NBL, a stable layer that develops in the atmosphere at night after the sun has set. Scientists wish to study the interaction between the surface type, surface conditions, the complexity of the terrain, and the overlying atmosphere during stable nighttime conditions. Specific goals of the field project and subsequent research include investigating internal gravity waves; shear instabilities; turbulence; heat and momentum fluxes; surface heterogeneity; diffusion, dispersion, and travel of ground-based plumes; and the transition from the unstable daytime boundary layer to the stable NBL. All of these factors determine the extent to which the surface is "connected" to the upper atmosphere. During the daytime, the sun's energy mixes the near-surface atmosphere and the upper atmosphere. At night, the connection between the two usually occurs as frequent, short bursts of wind that last only a few minutes. The month of October was chosen for this IOP because it typically has a relatively large number of clear, calm nights. Such conditions improve the chances for development of a stable NBL.

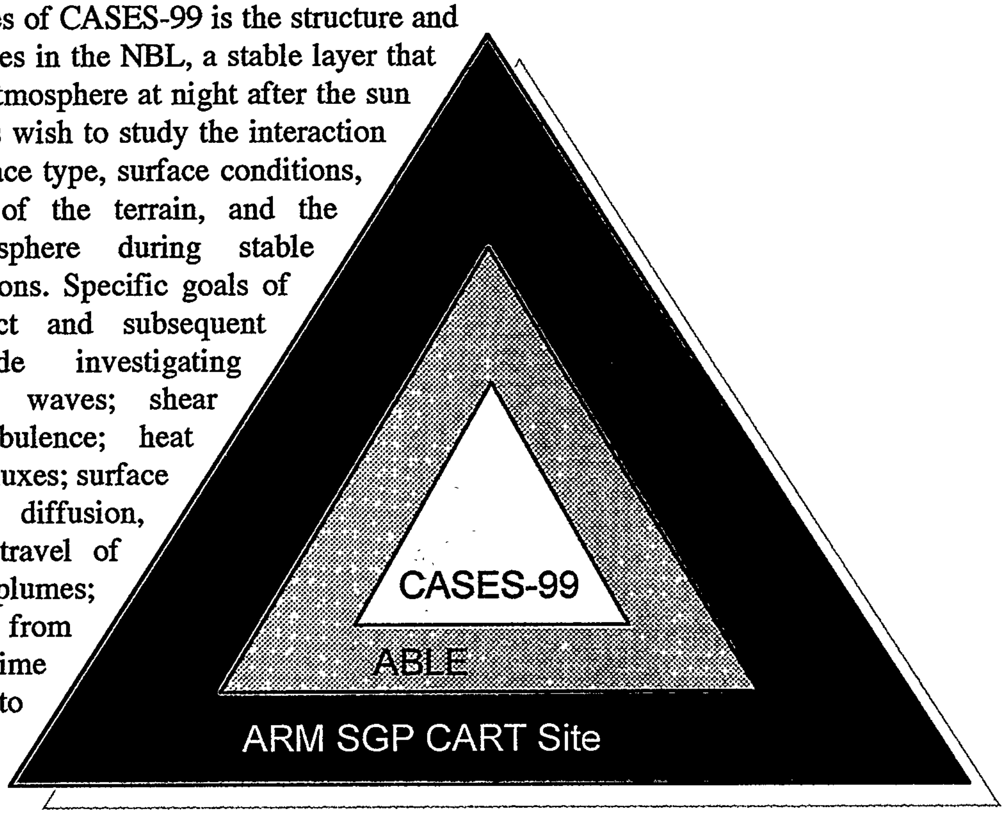

Figure 2. Schematic representation of the relative scales and location of CASES-99, ABLE, and ARM.

The center of the CASES-99 study area will be within the Atmospheric Boundary Layer Experiments (ABLE) area in the Walnut River Watershed in eastern Kansas. This area of Kansas is bounded by Whitewater on the north, Beaumont on the east, and Oxford on the south. ABLE, operated by Argonne National Laboratory, maintains an array of instrumentation consistent with the ARM instrumentation but on a much smaller scale. Figure 2 is a schematic representation of the relative sizes of the CASES-99, ABLE, and ARM research areas. ABLE instruments include a 915-MHz radar wind profiler, an eddy correlation system, an energy balance Bowen ratio station, automated weather stations (similar to ARM's surface meteorological observation stations), and acoustic sodars. In addition to the ABLE instrumentation, participating organizations will be bringing additional equipment to measure meteorological values, soil temperature and moisture, and surface heat and moisture fluxes.

Figure 3. The NOAA Long EZ aircraft used to measure wind, temperature, humidity, and turbulent fluxes at heights as low as 65 feet above the ground.

Several aircraft will be used to gather data during CASES-99. NOAA will provide the Twin Otter and the Long EZ aircraft (Figure 3), while NCAR will be flying the Wyoming King Air research plane. The NOAA Long EZ aircraft can fly as low as 65 feet above the ground, providing measurements of wind, temperature, humidity, and turbulent fluxes. The measurements made by this aircraft complement those made by the Wyoming King Air, which can fly only to 500 feet above the ground. A helicopter-borne, turbulence-measuring instrument from Germany is also scheduled to fly during the IOP.

The data collected will be analyzed by using computer modeling techniques. Efforts will be made to find correct, appropriate model parameterizations for the stable layer. The CASES-99 experiment is unique because it addresses all scales of motion — smallest to largest — used in climate models. In the past, NBL observations and studies were weak because of the lack of collaborative measurements. CASES-99 has taken this issue into serious consideration and has planned to use a large variety of instruments over a relatively small area (three miles by three miles). The number of instruments to be used in this NBL study is unprecedented, and the quantity and quality of data to be provided to the research community will ensure successful results. Atmospheric scientists will be able combine the observations from state-of-the-art instrumentation made during this IOP with improved computer models to advance their understanding of atmospheric dynamics and turbulent bursts in the NBL.