Atmospheric Radiation Measurement
Climate Research Facility
U.S. Department of Energy

Southern Great Plains Newsletter

OCTOBER 2006
ANL/EVS/NL-06-10

Repair Capability Saves Resources and Keeps Data Flowing

The ACRF SGP site recently established a repair capability for its wind sensor equipment that is saving the program money and improving the availability of data.

Wind sensor equipment in the SGP domain includes 15 Surface Meteorological Observing Systems that make standard surface measurements of wind speed and wind direction (along with temperature, relative humidity, and precipitation), as well as temperature, humidity, wind and pressure systems installed at 5 locations.

Wind measurements are important variables, but collecting the data can be complicated. *Wind speed* can be expressed as a two-dimensional horizontal velocity vector: a **u** vector that measures north and south winds and a **v** vector that measures east and west winds. In some cases, a third **w** vector is measured to describe the vertical part of the wind that moves up and down. The combination of all three vectors most accurately describes a wind speed and direction measurement.

More commonly, the wind measurement is made by only measuring the speed and direction. *Wind direction* is measured in units of degrees, with north being assigned as 0° and 360°, east as 90°, south as 180°, and west as 270°. Wind direction is reported as the direction from which the wind is blowing. *Wind speed* is reported in units of meters per second or knots (nautical miles per hour). One meter per second is equal to 0.447 miles per hour, and one knot is equal to 1.12 miles per hour.

Three common types of sensors are used to measure winds:

- An *ultrasonic* wind sensor (Figure 1) measures speed and direction by measuring the time required for a sound signal to travel between transducers. The ultrasonic sensor is virtually maintenance free, because it has no moving parts, but its excessive cost limits its use at ARM facilities.

- A second type of sensor is *cup and vane* (Figure 2). As the cups are pushed by the wind, they turn the spindle to which they are mounted. The rotation rate is converted into wind speed. The adjacent vane is turned by the wind, detecting the wind direction.

- The third type of wind sensor is *propeller and vane* (Figure 3). The propeller is mounted to the front of the vane body. As the vane rotates with the wind, the propeller faces into the wind. The rotation rate of the spinning propeller is measured and converted into wind speed. The vane is mounted on a shaft connected to a potentiometer. As the vane turns, the voltage output from the potentiometer is converted to wind direction.

ACRF Southern Great Plains Newsletter is published by Argonne National Laboratory, managed by UChicago Argonne, LLC, for the U.S. Department of Energy under contract number DE-AC02-06CH11357.

Technical Contact: Brad W. Orr
Phone: 630-252-8665
Email: brad.orr@anl.gov
Editor: Donna J. Holdridge
Website: http://www.arm.gov

A propeller and vane sensor manufactured by RM Young is used in all of the SGP site's 15 Surface Meteorological Observing Systems and 5 temperature, humidity, wind and pressure systems. The RM Young sensor is rugged enough to function in both Oklahoma winters and summer thunderstorm winds, yet sensitive enough for ARM measurement requirements.

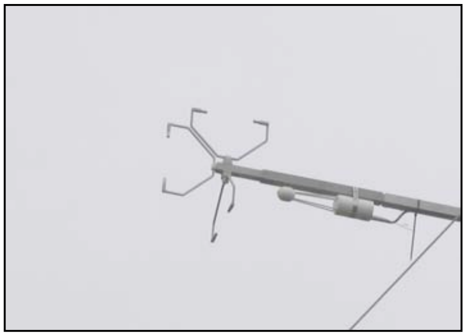

Figure 1. An ultrasonic wind sensor mounted to the end of a tower boom (ARM photo).

Figure 2. A cup (right) and vane (left) mounted as part of the energy balance bowen ratio (EBBR) system (ARM photo).

To maintain their accuracy, the RM Young wind sensors need to be checked and serviced once every two years. The recent addition of the wind sensor repair capability to the SGP maintenance facility now enables wind sensor checks and servicing to be completed on-site. The new capability saves money and utilizes skills the site technicians already have. ARM Surface Meteorological Observing System mentor Michael Ritsche was instrumental in acquiring test instruments and developing procedures to check and repair the wind sensors.

Figure 3. An RM Young propeller and vane wind sensor mounted as part of a Surface Meteorological Observing System at the SGP site (ARM photo).

In checking the wind sensors, output from both the propeller (speed) and potentiometer (direction) are compared to expected values. The propeller is removed from the wind sensor body, and an RPM (revolutions per minute) generator is attached to the propeller shaft, driving the shaft at various RPM values that mimic expected wind speeds experienced in the field. The output data are checked for conformance to the manufacturer's specifications for accuracy. If the sensor is out of conformance, the propeller assembly is replaced, and the performance of the new unit is verified. Internal bearings that allow the propeller shaft to spin smoothly are also checked and replaced if they are worn or binding.

The wind direction sensor is checked by mounting the sensor on a fixed assembly and rotating the sensor through 360°. The output is checked for accuracy at 15° increments. If the potentiometer fails the testing, it is replaced, and the sensor is checked again.

Figure 4 shows electronics technician Mark Klassen performing checks and maintenance on one of the RM Young wind sensors. Mark was profiled in the May 2006 issue of this newsletter (http://education.arm.gov/outreach/publications/sgp/may06.pdf).

Before the SGP wind sensor repair capability was established, the sensors had to be returned to the manufacturer for checks and repairs. Doing this work in-house achieves considerable savings in shipping and repair costs. Lessening downtime while sensors are being repaired is also a critical factor in achieving the important ARM goal of excellence in data availability and quality.

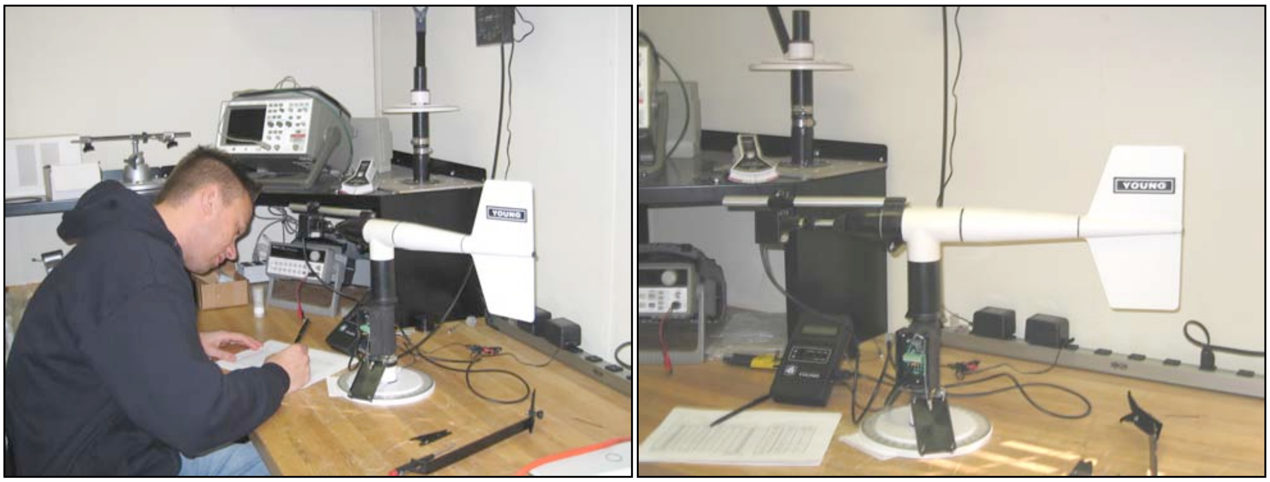

Figure 4. Mark Klassen (left) tests a propeller and vane wind sensor in the new wind sensor repair station at the SGP Central Facility. At right is a close-up view of the wind sensor readied for testing (ARM photos).