ARM Program Mobile Facility

Instrument Book

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SKYRAD Instruments

SKYRAD Shaded Precision Infrared Radiometer (PIR)

The PIR measures the amount of infrared (heat) energy that falls on a sensor under the shiny dome. This energy is the same kind of heat energy you feel when standing next to a campfire or cooking stove. The shiny dome reflects solar radiation but allows infrared radiation to pass through. This PIR is mounted on the solar tracker, and its sensor is shaded from the direct beam of the sun. The shading prevents heating of the dome and instrument by the direct sunlight; this heating could produce errors in the measurement.

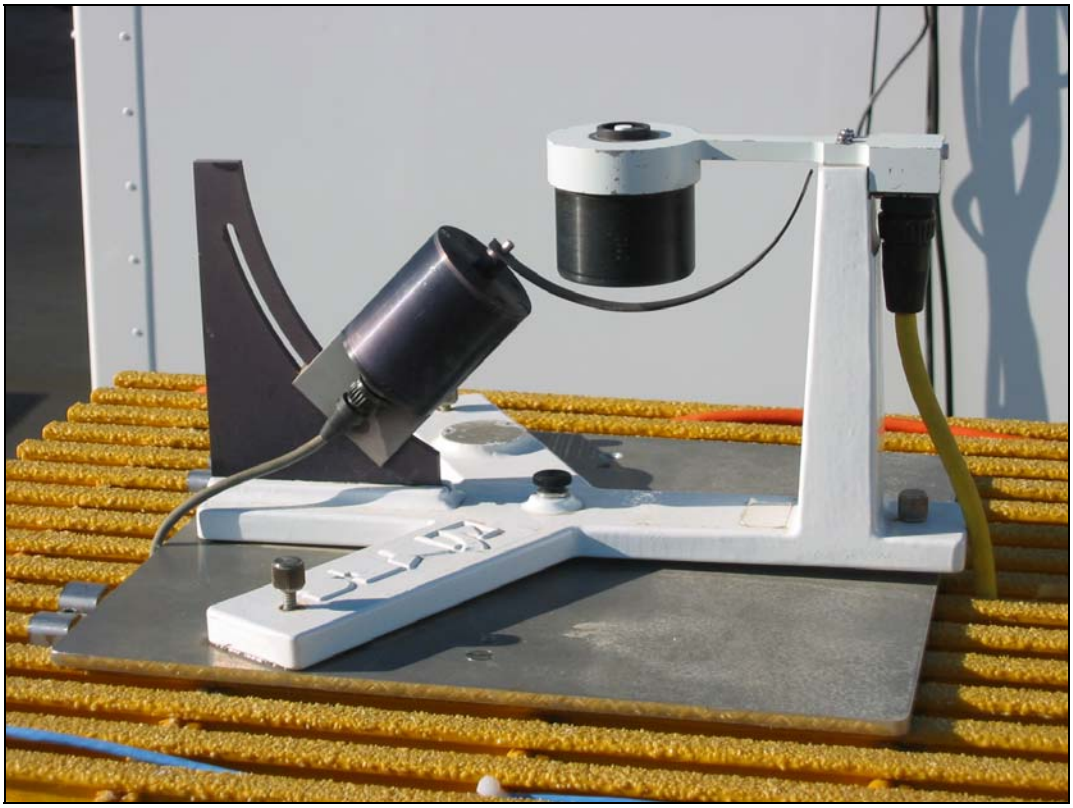
SKYRAD Instruments:

SKYRAD Unshaded Precision Spectral Pyranometer (PSP)

The PSP measures the amount of solar radiation (sunshine) that falls on the sensor under the clear dome. When pointed upward unshaded, the PSP measures the total amount of solar radiation coming directly from the sun plus the radiation that is scattered downwards by clouds, other material in the air, and the air itself. This value is called the “total” or “global” solar irradiance. The value is reduced when clouds are present.

SKYRAD Instruments:

Multi-Filter Rotating Shadowband Radiometer (MFRSR)



The MFRSR uses measurements of the total and diffuse solar radiation to determine properties of the atmosphere. The MFRSR has a black shading arm that rotates over the sensor every 15 seconds. When the sensor is unshaded, it measures total solar irradiance. When the shading arm blocks the sun from the sensor, the MFRSR measures the diffuse solar irradiance. The direct solar irradiance can be calculated by subtracting the diffuse value from the total value.

The MFRSR actually makes seven simultaneous measurements with seven detectors. One of these detectors measures all the sunlight coming in; this value is very similar to that obtained by the unshaded upward looking PSP. The other six measurements use the same kind of detector with different filters in front of them. These filters only allow certain portions of the sunlight to pass through them and on to the detector. As with the NIP, the amount of direct solar radiation depends on the height of the sun above the horizon and the cleanliness of the atmosphere. By measuring the direct solar irradiance at different sun angles, it is possible to calculate the amount of solar radiation at the top of the atmosphere and the amount that is removed by the atmosphere before it reaches the ground.

GNDRAD Instruments

GNDRAD Precision Spectral Pyranometer (PSP)

The PSP measures the amount of solar radiation (sunshine) that falls on the sensor under the clear dome. When the PSP is pointed downward, it measures the amount of solar radiation reflected from the surface below. The value depends on the amount of sunshine hitting the surface and how well the underlying surface reflects the sunshine.

GNDRAD Instruments:

GNDRAD Precision Infrared Radiometer (PIR)

The PIR measures the amount of infrared (heat) energy that falls on a sensor under the shiny dome. This energy is the same heat energy you feel when standing next to a campfire or cook stove. The shiny dome reflects solar radiation but allows infrared radiation to pass through. When the PIR is pointed downward, it measures the upwelling infrared irradiance or heat energy given off by the surface below.

Surface Meteorology (SMET) Instruments

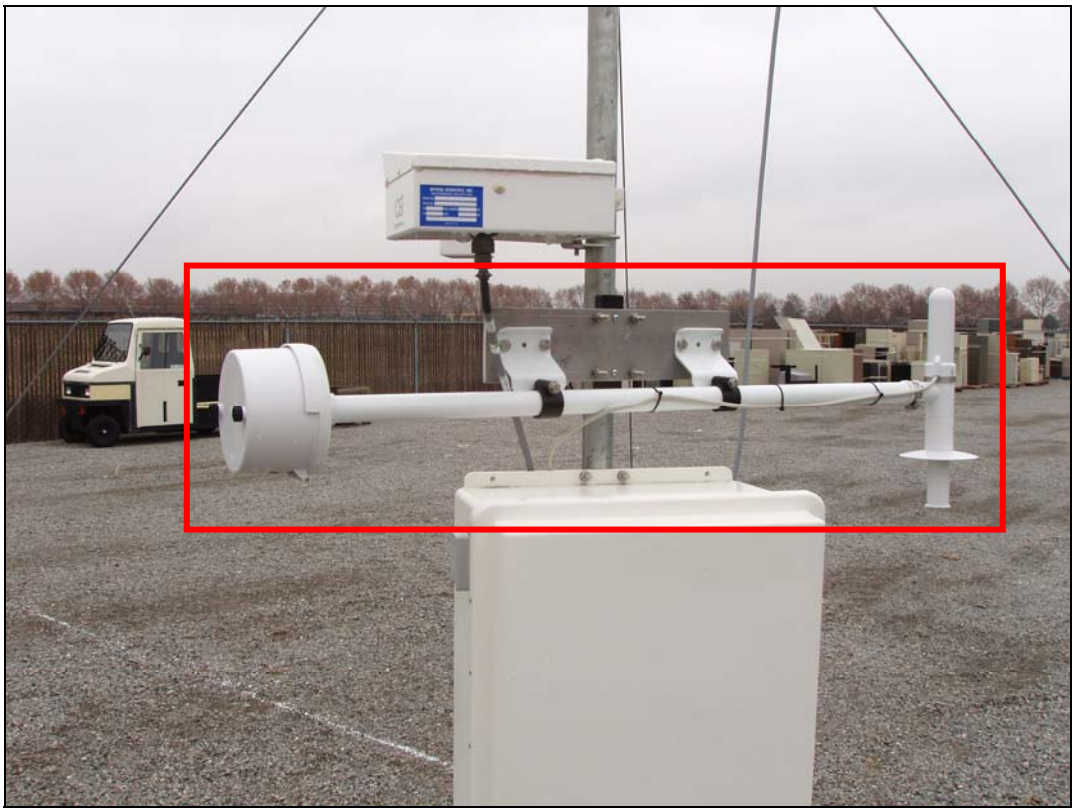
There are several instruments associated with the Meteorological Tower, which stands 3 meters tall. These measure wind speed and direction, temperature, humidity, atmospheric pressure, and rainfall.

SMET Instruments:

Propeller Vane Wind Sensors (WND)

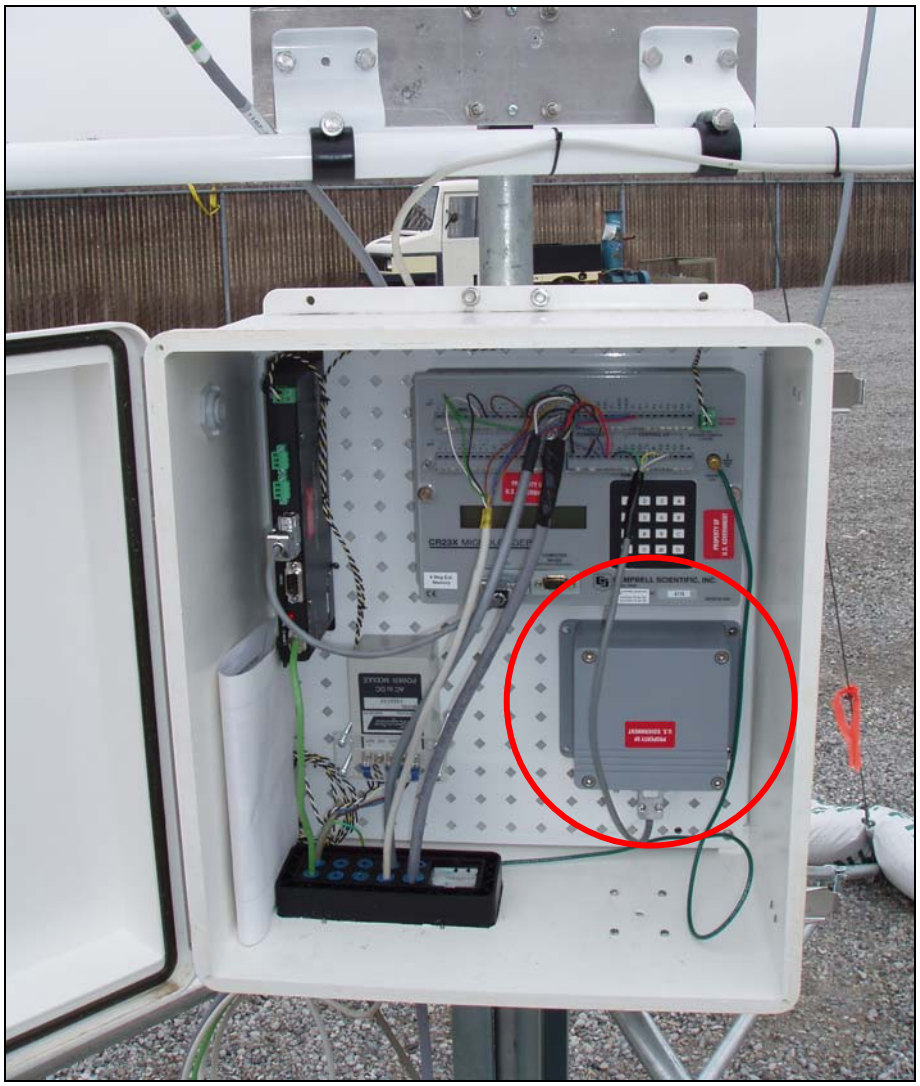
The wind sensor is mounted on the top of the Meteorological Tower. The propeller measures wind speed. The direction of the wind is measured by the position of the vane.

SMET Instruments:
Temperature and Humidity Sensors (T/RH)



The temperature and humidity sensors are mounted inside a tube to protect them from direct sunlight. The tube is attached to the Meteorological Tower near the bottom. A small fan at one end draws air into the tube and over the sensors.

SMET Instruments:
Barometer



A barometer measures atmospheric pressure and is housed inside the logger container on the Meteorological Tower. A tube connects the barometer to the outside.

SMET Instruments:
Optical Rain Gauge (ORG)

Mounted on the Meteorological Tower, the ORG measures the rate of rainfall in millimeters per hour (mm/hr). It sends an invisible beam of light from one of its ends to a detector at the other end. When raindrops fall, they break the beam. The rain rate is determined by measuring how often the beam is broken. It can be used to calculate the total amount of rain that has fallen in any given period.

Microwave Radiometer (MWR)

The MWR measures time series of column-integrated amounts of water vapors and liquid water. Water vapor is just the water molecules in the air; you can't see them. Liquid water is the water droplets in the clouds. The value the MWR reports for the water vapor is what you would get if you could get all the water vapor above a rain gage to condense as liquid water in the gage. Although clouds look like they contain a lot of water, the liquid water values the MWR measures are usually a few tenths of a millimeter. The MWR does not detect ice. Clouds higher than 5 kilometers (km) are usually composed of ice particles rather than water drops, and the MWR does not detect them.

Microwave Radiometer Profiler (MWRP)

The MWRP provides continuous profiles of water vapor, liquid water, and temperature up to 10 km height. Those profiles are obtained at 10-second intervals during clear, cloudy, and precipitating conditions. The temperature measurements are taken with the Infrared Thermometer (IRT) mounted on top.

Ceilometer

The Ceilometer measures the distance from the ground to the bottom of a cloud directly overhead. This distance is called “cloud base height.” The Ceilometer can measure cloud bases up to about 8 kilometers (km) above the surface. The Ceilometer sends out a pulse (flash) of light and measures how long it takes for the light to come back after being reflected off the bottom of a cloud.

Micro Pulsed Lidar (MPL)

The MPL works just like the Ceilometer but can see clouds that are much higher. The MPL can detect cirrus clouds, which can be as high as 16 to 17 km high.

Cimel Sunphotometer (CIMEL)

The Cimel Sunphotometer (CIMEL) is a multi-filter, automatic, sun-tracking radiometer that measures aerosol, water vapor, and ozon, as well as the direct solar radiance and reflected sky radiance at the Earth's surface. Measurements are taken at pre-determined discrete wavelengths in the visible and near-infrared parts of the spectrum to determine atmospheric transmission and scattering properties. The CIMEL operates only during daylight hours (i.e., sun above horizon).