CAMPBELL® SCIENTIFIC

WHEN MEASUREMENTS MATTER

Agriculture & Soils

Systems and instruments for research and industry

Agriculture & Soil Monitoring Solutions

www.campbellsci.com/agriculture-systems

Research-Grade Instruments

Since 1974, Campbell Scientific has provided automatic weather stations, soil-measurement equipment and systems, and other measurement systems for thousands of applications around the world—in every climate.

Through this experience, our measurement systems have established a solid reputation for their reliability and longevity in the field, excellent measurement quality, and the flexibility to dial in on exact needs. At the same time, our customer support is unmatched in the industry.

We have the products and experience to help make your project successful. Please let us know if we can answer any questions.

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Agriculture and Soil Monitoring
Measurement Instruments for Agriculture and Soil Applications

RELIABLE
SINCE 1974
MONITORING

Campbell Scientific provides professional- and research-grade measurement systems for many applications within agriculture and soil moisture markets. Our systems measure both soil water and environmental parameters related to evapotranspiration, plant growth and development, and disease modeling. Multiple sensors can be networked in hard-wired or wireless systems, while portable, hand-held systems can make point measurements to verify irrigation scheduling or to perform site surveys.

Campbell products are key to agricultural research, irrigation and planting scheduling, harvesting, watershed studies, frost prediction, and timing for pesticide and fertilizer applications.

MAJOR SYSTEMS

	Measurements	Datalogger	Power	Communications
MetPRO | Research-Grade Meteorological Station Reliable Weather Monitoring	wind speed, wind direction, air temperature, precipitation, relative humidity, barometric pressure, solar radiation, soil water content	CR6	BP12 12 Vdc, 12 Ah battery recharged with 20 W solar panel	Compatible Communication Devices see pages 16, 17
WxPRO | Entry-Level, Research-Grade Weather Station For budget-conscious researchers	wind speed, wind direction, air temperature, precipitation, relative humidity, barometric pressure, solar radiation, soil water content	CR300, CR310	BP7 12 Vdc, 7 Ah battery recharged with 10 W solar panel	Compatible Communication Devices see pages 16, 17
SoilPRO | Research-Grade Soil Station	soil volumetric water content, soil temperature, soil electrical conductivity	CR300, CR310	BP7 12 Vdc, 7 Ah battery recharged with 10 W solar panel	Compatible Communication Devices see pages 16, 17
HS2 and HS2P HydroSense II | Soil Moisture Measurement System Fast and Portable	soil water content	NA (stand alone system)	6 Vdc, 4 AA batteries	display, bluetooth

More info: **435.227.9120**
campbellsci.com/agriculture-plant-physiology

Custom Systems

Most of the systems we sell are customized. Tell us what you need and we'll help you configure a system that meets your exact needs.

Dataloggers

All of our measurement systems are based around a programmable datalogger that measures the sensors, then processes, stores, and transmits the data. Our low-power dataloggers have wide operating temperature ranges, programmable execution intervals, onboard instructions, and ample input channels for commonly used sensors. Our dataloggers interface directly to most sensors, eliminating external signal conditioning.

Data are typically output in the units of your choice (e.g., wind speed in mph, knots, m/s). Measurement rates and data recording intervals are independently programmable, allowing calculation of 15-minute, hourly, and daily data values from 1-minute or 1-second measurements. Atypical events can trigger alarms and cause additional data to be recorded. Channel capacity can be expanded using multiplexers.

Sensors

Almost any sensor can be measured by our dataloggers, allowing stations to be customized for each site. Typical sensors used on our stations include, but are not limited to wind speed, wind direction, solar radiation, air and soil temperature, relative humidity, precipitation, soil moisture, barometric pressure, and leaf wetness.

Data Retrieval

We offer multiple communications options for data retrieval, which can be mixed within the same network. Telecommunications options include short-haul, telephone (land line, voice-synthesized, cellular), radio frequency, multidrop, and satellite. On-site options include storage module and laptop computer.

Software

Our PC-based support software simplifies the entire monitoring process, from programming to data retrieval to data display and analysis. Our software automatically manages data retrieval from networks or single stations. Robust error-checking ensures data integrity. We can even help you post your data to the Internet.

Agriculture and Soil Monitoring Case Studies

Our agriculture and soil monitoring systems have helped a variety of organizations reach their goals. The following are just a few of these:

In California, an automated system for alfalfa flood irrigation research included three water sensors buried and spaced in a row toward the lower end of a long bay, known as a check. As the water sheet proceeded down the field, a Campbell Scientific CR3000 Micrologger® recorded the arrival of water at each sensor, and used a cellular modem to transmit that information to the irrigators.

www.campbellsci.com/ca-irrigation

Forty-nine Campbell Scientific weather stations make up North Dakota's Agricultural Weather Network (NDAWN). Data from the network is used for irrigation scheduling, pesticide application scheduling, and various research projects. The standard stations monitor air temperature, relative humidity, wind speed and direction, solar radiation, rainfall, and soil temperature.

www.campbellsci.com/north-dakota-network

The West Texas Mesonet (WTM) project was initiated by Texas Tech University in 1999 to provide free real-time weather and agricultural information for residents of the South Plains region of western Texas. The WTM uses Campbell Scientific dataloggers, towers, enclosures, communication devices, and meteorological sensors.

www.campbellsci.com/wtmeso

In Colombia, Campbell gear is used to study greenhouse conditions for the purpose of battling fungus growth on roses. Two weather stations, powered by solar panels, included several LWS Leaf Wetness Sensors and SI-111 Infrared Radiometers positioned at among the plants. These sensors were connected to Campbell dataloggers using our AM16/32-series multiplexers.

www.campbellsci.com/fungus-roses-colombia

Data gathered from the Colombian study on fungus growth allow rose farmers to curtail fungus growth while being less dependent on pesticides. The study's LWS leaf wetness sensors are shown above.

CAMPBELL SCIENTIFIC ®
WHEN MEASUREMENTS MATTER

MetPRO
Research-grade meteorological station

Reliable Weather Monitoring

Research-Grade Weather Station

Standard Measurements

- Wind speed
- Wind direction
- Air temperature
- Relative humidity

- Barometric pressure
- Precipitation
- Solar radiation
- Soil water content

Overview

The MetPRO™ is a highly accurate, durable, research-grade meteorological monitoring station, designed for a wide-variety of demanding environmental applications. This portable tripod station is suitable for both long-term and temporary deployments on flat or uneven terrain.

This system includes high quality sensors, which are needed for defensible data in environmental research as well as critical operations dependent on continual weather monitoring. The MetPRO's meteorological measurements can be used to calculate evapotranspiration, growing-degree days, wind chill, dew point, and other weather-related parameters.

Benefits and Features

❯ Obtain defensible data with high-accuracy instruments
❯ Deploy system remotely for unattended long-term monitoring
❯ Low-power design—operates on a battery recharged by a solar panel

❯ Reduce maintenance overhead with durable system components
❯ Connect remotely with IP-based modem communication
❯ Customize system for specific application needs

More info: **435.227.9120**
www.campbellsci.com/metpro

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Components

1 CR6-WIFI Measurement and Control Datalogger with integrated Wi-Fi modem

2 BP12 12 Ah Battery and Mount

3 SP20 20 W Solar Panel

4 05103 RM Young Wind Monitor with 17953 Nu-Rail Fitting

5 CM204 4 ft Crossarm

6 TE525WS Tipping Bucket with CM270 mounting kit and CM300-PJ Pedestal Mount

7 260-953 Alter-type Rain-Gage Wind Screen

8 EE181 Temperature and Relative Humidity Probe and RAD10E 10-Plate Radiation Shield

9 CS655 Soil Water Content Reflectometer

10 CS300 Solar Radiation Sensor with 18356 Leveling Base and CM225 Solar Radiation Mount

11 ENC12/14 Enclosure, 12 inch by 14 inch

12 CM106B 6 ft Tripod

13 CS100 Barometric Pressure Sensor

Some system sensors and components may not be available in all parts of the world. Contact your regional Campbell Scientific representative for details.

Customizations

You can order the MetPRO™ with the parts shown above or as a complete pre-wired, pre-programmed, pre-configured system.

This system is also fully-customizable. You can add sensors, measurement peripherals or communications devices to meet the needs of your specific application. Contact a Campbell Scientific sales engineer to design your custom solution.

CAMPBELL SCIENTIFIC®

WHEN MEASUREMENTS MATTER

WxPRO
Entry-level research-grade weather station

Full-Featured Weather Station
For Budget-Conscious Researchers

Measurements

- Wind speed
- Wind direction
- Air temperature
- Relative humidity
- Barometric pressure
- Precipitation
- Solar radiation

Overview

The WxPRO™ is an entry-level, research-grade weather station, designed for a wide-variety of environmental applications. This portable tripod station is suitable for both long-term and temporary deployments.

Designed for the budget-conscious researcher, this system is a lower-cost offering than the MetPRO™ while maintaining the quality instrumentation you'd expect from a Campbell Scientific solution. This system implements research-grade sensors, which are needed for defensible data in environmental research. The WxPRO's meteorological measurements can be used to calculate evapotranspiration, growing-degree days, wind chill, dew point, and other weather-related parameters.

Benefits and Features

- ❯ Full-featured weather station for the budget-conscious researcher
- ❯ Obtain defensible data with high-accuracy instruments
- ❯ Deploy system remotely for unattended long-term monitoring
- ❯ Low-power design
- ❯ Connect remotely with many communication options
- ❯ Customize system for specific application needs

More info: **435.227.9120**
www.campbellsci.com/wxpro

Components

1 CR300-WIFI Measurement and Control Datalogger with integrated Wi-Fi modem

2 BP7 7 Ah Battery and Mount

3 SP10 10 W Solar Panel

4 03002 RM Young Wind Sentry with 17953 Nu-Rail Fitting

5 CM204 4 ft Crossarm

6 TE525 Tipping Bucket with user-supplied mounting post or pipe

7 CS215 Temperature and Relative Humidity Probe and RAD06 6-Plate Radiation Shield

8 CS300 Solar Radiation Sensor with 18356 Leveling Base and CM225 Solar Radiation Mount

9 ENC10/12 Enclosure, 10-inch-by-12-inch

10 CS100 Barometric Pressure Sensor

11 CM106B 6 ft Tripod

Some system sensors and components may not be available in all parts of the world. Contact your regional Campbell Scientific representative for details.

Customizations

You can order the WxPRO™ with the parts shown above or as a complete pre-wired, pre-programmed, pre-configured system.

This system is also fully-customizable. You can add sensors, measurement peripherals or communications devices to meet the needs of your specific application. Contact a Campbell Scientific sales engineer to design your custom solution.

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

SoilPRO
Research-grade soil station

Reliable Soil Monitoring
Research-Grade Soil Station

Standard Measurements

- *Soil volumetric water content (VWC)*
- *Soil temperature*
- *Soil electrical conductivity (EC)*

Overview

The SoilPRO™ is a compact and durable stand-alone station designed to monitor soil properties including volumetric water content (VWC), temperature, and electrical conductivity (EC). Soil moisture measurements are critical for understanding land-plant interactions for agriculture, crop physiology and other environmental research.

The SoilPRO is a great option for researchers who need a single station to monitor soil moisture or as part of a network of stations to cover large agriculture plots or watersheds. This station combines a CR300-series datalogger with CS655 water content reflectometers to deliver the highly accurate measurements needed for defensible data in environmental research or critical operations. Multiple soil sensors allow monitoring of a soil moisture profile at different depths.

Benefits and Features

❯ Soil WVC, temperature, and EC measurements at multiple depths
❯ Defensible data obtainable with accurate instruments
❯ Remote system deployment with low-power design

❯ System can be networked with other stations to cover large plots
❯ Remote connection with many communications options supported
❯ Customize system for specific application needs

Components

1 CR300-WIFI Measurement and Control Datalogger with integrated Wi-Fi modem

2 ENC8/10-SC-MM 8-inch-by-10-inch enclosure

3 BP7 7 Ah Battery and Mount

4 SP10 10 W Solar Panel

5 CS655 Soil Water Content Reflectometers (user-specified quantity; default is three)

6 User-supplied post

Some system sensors and components may not be available in all parts of the world. Contact your regional Campbell Scientific representative for details.

Customizations

You can order the SoilPRO with the parts shown above or as a complete pre-wired, pre-programmed, pre-configured system.

This system is also fully-customizable. You can add sensors, measurement peripherals or communications devices to meet the needs of your specific application. Contact a Campbell Scientific sales engineer to design your custom solution.

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WHEN MEASUREMENTS MATTER
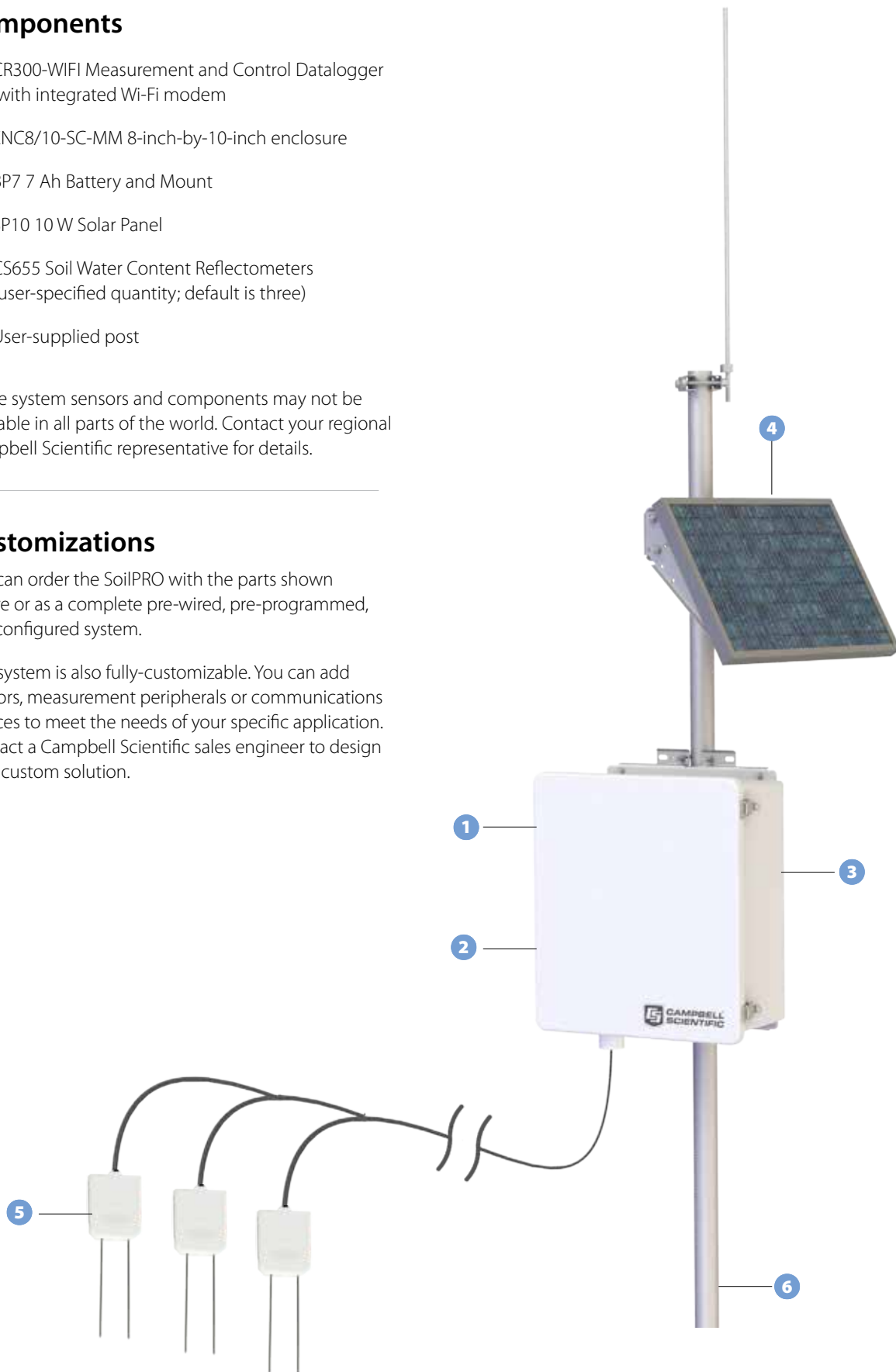
HS2 HydroSense II
Soil Moisture Measurement System

Fast and Portable
Soil Water Content Measurements

Related Product

HS2P
HydroSense II Pole System

Overview

The HS2P is a combination of the Hydrosense II soil-water sensor with a strong handle and pole that make it easier to insert the probes into the soil. The lightweight pole allows soil testing without bending over. The HS2P is portable, with the layout of the buttons on the display allowing for operation with one hand. The HS2P also includes the same database, analysis and management software as the HS2.

Specifications

❯ Weight With Display and Rods: 1.4 kg (3 lb)
❯ Handle Width: 29.2 cm (11.5 in)
❯ Handle to bottom of sensor: 29.2 cm (32.4)
❯ Top of display to bottom of sensor: 96.5 cm (38 in)

Overview

The Hydrosense II is a portable, handheld device for easily obtaining soil measurements. It is the next generation of the Hydrosense soil-water measurement system. Improvements over its predecessor include a more rugged probe design, additional navigation buttons for the display, expanded memory, an internal GPS receiver, Bluetooth communications, and more powerful PC software.

Benefits and Features

❯ Large LCD and four navigation button that simplifies operation
❯ Splash-proof housing
❯ Onboard data storage of more than 1000 points
❯ Integrated GPS receiver for tagging measurements
❯ Bluetooth for wireless connection to PC
❯ Data exportable to Google Earth, GPX and CSV
❯ Rugged probe design that allows insertion into harder soils

Soil Moisture Sensors

Two sensor options are offered. The CS658 has 20 cm rods and the CS659 (shown above) has 12 cm rods. These probes use the same accurate measurement technique as the old probes, but their housing has been redesigned to aid insertion into and removal from hard soils. Their rods are secured to the probe housing with ferrule nuts to provide extra stability during insertion. A molded plastic grip connects their cable to the housing, which provides better grip.

Handheld Display

The display consists of a three-inch LCD and four navigation buttons that make changing settings and taking measurements as easy as possible. The integrated GPS allows a latitude and longitude to be associated with each measurement. Zones can be created on the unit which group measurements together so that average soil moisture can be calculated for an area.

More info: **435.227.9120**
www.campbellsci.com/hs2

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

Automated Monitoring Sensors
Sensors for Agriculture Applications

Rugged, Reliable, and Ready for any Application

RELIABLE
SINCE 1974
MONITORING

Almost any sensor can be measured by our dataloggers, allowing stations to be customized for each site. Typical sensors used on our stations include, but are not limited to: wind speed, wind direction, solar radiation, air and soil temperature, relative humidity, precipitation, soil moisture, barometric pressure, and leaf wetness.

WIND SPEED & DIRECTION

Sensor		Wind Speed		Wind Direction	
		Range	Accuracy	Range	Accuracy
03002 | Wind Sentry Set Reliable, competitively-priced; good all purpose wind set	3-cup anemometer and vane	0 to 50 m/s (112 mph)	±0.5 m/s (1.1 mph)	0 to 360° (mechanical) 0 to 352°, 8° open (electrical)	±5°
034B | Wind Set Reliable, accurate wind measurements	3-cup anemometer and vane	0 to 50 m/s (110 mph)	< 10.1 m/s (22.7 mph): ±0.11 m/s (0.25 mph) >10.1 m/s (22.7 mph): ±1.1% of true	0 to 360° (mechanical) 0 to 356°, 4° open (electrical)	±4°
05103 | Wind Monitor Light-weight, sturdy instrument	helicoid-shaped, 4-blade propeller and fuselage-shaped sensor body	0 to 100 m/s (0 to 224 mph)	±0.3 m/s (0.6 mph) or 1% of reading	0 to 360° (mechanical) 0 to 355°, 5° open (electrical)	±3°

TEMPERATURE & RELATIVE HUMIDITY

	Relative Humidity			Temperature		
	Sensor	Measurement Range	Accuracy (at 25°C)	Sensor	Measurement Range	Accuracy
HMP155A | Accurate, Wide Temperature Range Higher end sensor	HUMICAP®180R (recalibratable)	0.8 to 100% RH	±1% to ±1.7% depending on RH	PT100 RTD	-80° to +60°C	±(0.055 - 0.0057 x temperature)°C
EE181 | Accurate and Rugged Coating on RH element protects it from contaminants	E+E Electronik HC101	0 to 100% RH	±(1.5 + 1.5%*mV) % RH (-40° to +60°C)	PT100 RTD	-40° to +60°C	±0.2°C to ±0.5°C depending on temperature
CS215 | SDI-12 Output Competitively priced, general purpose	Sensirion (SHT75)	0 to 100% RH	±2% to ±4%, depending on RH	Sensirion (SHT75)	-40° to +70°C	±0.3°C at 25°C; ±0.4°C (+5° to +40°C); ±0.9°C (-40° to +70°C)

More info: **435.227.9120**
campbellsci.com/agriculture-systems

BAROMETRIC PRESSURE

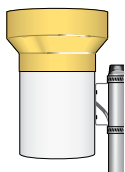|	Measurement Range	Elevation*	Temperature Range	Accuracy	Current Consumption
CS100 | Standard Barometer Housed inside weather-proof enclosure	600 to 1100 mb[b]	~ 2000 ft below sea level (as in a mine) to 12,000 feet above sea level	-40° to 60°C	±0.5 mb @ +20°C; ±1.0 mb @ 0° to 40°C; ±1.5 mb @ -20° to +50°C; ±2.0 mb @ -40° to +60°C	< 3 mA (active); < 1 µA (sleep mode)
CS106 | Wider Pressure Range Resides inside weather-proof enclosure	500 to 1100 mb	~ 2000 ft below sea level (as in a mine) to 15,000 feet above sea level	-40° to 60°C	±0.3 mb @ +20°C; ±0.6 mb @ 0° to 40°C; ±1.0 mb @ -20° to +45°C; ±1.5 mb @ -40° to +60°C	< 4 mA (active); < 1 µA (sleep mode)

*The CS100 is available in special ranges of 500 to 1100 and 800 to 1110; contact Campbell Scientific for more information.

PRECIPITATION

	Sensor Type	Orifice Diameter	Resolution (Rainfall per Tip)	Accuracy	Operating Temperature
TE525WS | Rain Gage 8-inch orifice meets the National Weather Service recommendations. Compatible with the CS705 snowfall adapter.	Tipping bucket with magnetic reed switch	20.3 cm (8 in)	0.01 in (0.254 mm)	Up to 1 in./hr: ±1% 1 to 2 in./hr: +0, -2.5% 2 to 3 in./hr: +0, -3.5%	0° to +50°C
TB4 | High-End Rain Gage Accurate and Ideal for high-intensity precipitation	Tipping bucket with siphon and dual reed switch	20 cm (7.9 in)	0.01 in (0.254 mm)	better than ±2% at 500 mm/hr (19.7 in/hr)	0° to 70°C
CS700H | High-End Electrically Heated Rain and Snow Gage Rugged, accurate, and ideal for high-intensity precipitation, even in freezing conditions	Tipping bucket with siphon and dual reed switch	20 cm (7.9 in)	0.01 in (0.254 mm)	better than ±2% at 500 mm/hr (19.7 in./hr)	-40° to 70°C

SOIL MOISTURE

	Measurements	Water Content Accuracy	Water Content Precision	Current Drain
CS616 | Reflectometer with 30-cm Rods High accuracy and precision; designed for long-term monitoring	volumetric water content of porous media (such as soil)	±2.5% VWC using standard calibration with bulk EC of ≤0.5 dS m⁻¹, bulk density of ≤1.55 g cm⁻³, and measurement range of 0% to 50% VWC	0.05%	65 mA @ 12 Vdc (when enabled) 45 µA (quiescent typical)
CS625 | Reflectometer for CR200(X)-series Loggers High accuracy and precision; designed for long-term monitoring	volumetric water content of porous media (such as soil)	±2.5% VWC using standard calibration with bulk EC of ≤0.5 dS m⁻¹, bulk density of ≤1.55 g cm⁻³,and measurement range of 0% to 50% VWC	0.05%	65 mA @ 12 Vdc (when enabled) 45 µA (quiescent typical)
CS650 | Reflectometer with 30-cm Rods Innovative and more accurate in soils with high bulk EC without site-specific calibration	soil electrical conductivity (EC), relative dielectric permittivity,volumetric water content, soil temperature	±3% VWC typical in mineral soils, where solution EC ≤3 dS/m	< 0.05%	Active (3 ms): 45 mA typical @ 12 Vdc (80 mA @ 6 Vdc, 35 mA @ 18 Vdc) Quiescent: 135 µA typical @ 12 Vdc
CS655 | Reflectometer with 12-cm Rods Innovative and more accurate in soils with high bulk EC without site-specific calibration	soil electrical conductivity (EC), relative dielectric permittivity, volumetric water content, soil temperature	±3% VWC typical in mineral soils, where solution EC ±10 dS/m	< 0.05%	Active (3 ms): 45 mA typical @ 12 Vdc (80 mA @ 6 Vdc, 35 mA @ 18 Vdc) Quiescent: 135 µA typical @ 12 Vdc

SOLAR RADIATION—QUANTUM

LI190R | Quantum Sensor
Accurate and versatile

Sensor	Measurement Description	Spectral Range	Sensitivity	Operating Temperature
silicon photovoltaic detector mounted in a cosine- corrected head	Measures Photosynthetic Photon Flux Density (PPFD), in both natural and artificial light	400 to 700 nm	Typically 5 µA per 1000 µmol s^{-1} m^{-2}	-40° to +65°C

SOLAR RADIATION—TOTAL INCOMING

CS300 | Silicon Pyranometer
Accurate, dependable, and ideal for long-term deployment in harsh conditions

CS320 | Digital Thermopile Pyranometer
Thermopile accuracy, digital simplicity, affordable price

LP02 | ISO-Second-Class Pyranometer
High quality device with protective dome

CMP3 | ISO-Second-Class Pyranometer
Protective glass dome and solar shield

Sensor	Measurement Description	Spectral Range	Sensitivity	Operating Temperature
silicon photovoltaic detector mounted in a cosine-corrected head	Measures sun plus sky radiation	300 to 1100 nm	0.2 mV/Wm^{-2}	-40° to +55°C
Bblackbody thermopile detector with an acrylic diffuser	Monitors solar radia-tion for the full solar spectrum range	385 to 2105 nm	NA	-50° to +50°C
Blackened thermopile protected by a dome	Monitors solar radia-tion for the full solar spectrum range	305 to 2800 nm	15 µV/W/m^2	-40° to +80°C
Blackened thermopile protected by a dome	Monitors solar radia-tion for the full solar spectrum range	310 to 2800 nm	5 to 20 µV/W/m^2	-40° to +80°C

LEAF WETNESS

237 | Wetness Sensing Grid
Determines electrical resistance on sensor surface

LWS | Wetness Sensing Grid
Detects the presence of water or ice anywhere on the sensor's surface

Operating Temperature Range	Dimensions	Weight	Requires Painting?	Requires Field Calibration?
-40° to 150°C; sensor may crack if the temperature drops below -40°C	7.1 x 7.6 x 0.64 cm (2.75 x 3.0 x 0.25 in)	91 g (3 oz) with 10 ft cable	Yes	Yes
-20° to 60°C	11.2 x 5.8 x 0.075 cm (4.4 x 2.3 x 0.0295 in.)	0.14 kg (5 oz) with 15 ft cable	No	No

SURFACE TEMPERATURE (PLANT CANOPY)

SI-111 | Precision Infrared Radiometer
Determines surface temperature of an object without physical contact

Field of View (FOV)	Target Temperature Output Signal	Wavelength Range	Absolute Accuracy	Repeatability
22° half angle	60 µV per °C difference from sensor body	8 to 14 µm (corresponds to atmospheric window)	±0.2°C (-10° to +65°C) ±0.5°C (-40° to +70°C)	±0.05°C (-10° to +65°C) ±1°C (-40° to +70°C)

WATER, SOIL, AND AIR TEMPERATURE

109 | Temperature Probe
Rugged, Accurate, Versatile

108 | Temperature Probe
Rugged, Accurate, Versatile

Sensor	Measurement Range	Steinhart-Hart Equation Error	Time Constant in Air	Tolerance
BetaTherm 10K3A11B Thermistor	-50° to +70°C	0.03°C at -50°C(maximum)	30 to 60 s in a wind speed of 5 m s^{-1}	±0.2°C over 0° to 70°C range
BetaTherm 100K6A1IA Thermistor	-5° to +95°C	≤±0.01°C over measure-ment range	30 to 60 s in a wind speed of 5 m s^{-1}	±0.2°C over 0° to 70°C range

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Dataloggers
Also known as Data Loggers, Data Recorders, and RTUs

Rugged, reliable, and ready for any application

RELIABLE
SINCE 1974
MONITORING

Dataloggers are the heart of a data acquisition system. They measure sensors at a specific scan rate, process data, store the data, and initiate telecommunications. Our dataloggers also have control capabilities allowing them to respond to specific site conditions by opening flood gates, turning fans off/on, etc. All our dataloggers share similar measurement and programming capabilities. Selection of the appropriate datalogger depends mainly on the type, number, precision, and speed of measurements required.

MAJOR SPECIFICATIONS

	Channels	Input Voltage Range	Analog Voltage Resolution	Max Scan Rate	Communications
CR6* | One datalogger, countless applications Powerfully versatile multi-tool for data acquisition; onboard vibrating-wire measurement **The number of measurements listed in the Channels column assumes all of the U and/or C channels are configured for that type of measurement.*	12 universal (U) and 4 control (C) terminals are programmable to measure up to: • 12 SE analog inputs • 6 DF analog inputs • 16 pulses • 12 voltage switched excitation • 12 current switched excitation • 2 RS-232 • 2 RS-485 • 16 I/Os, • 8 SDI-12	±5000 mV	to 80 nV	1 kHz	Integrated Ethernet Port (standard) Wi-Fi wireless modem (optional) RF407: 900 MHz Radio (optional) RF412: 920 MHz Radio (optional) RF451: 1 W, 900 MHz Radio (optional) Compatible Communication Devices see pages 16, 17
CR300 | Capable, compact, low-cost, high-functioning datalogger Small applications requiring long-term monitoring and control	Analog Voltage: 6 SE or 3 DF Analog Current 4 - 20 mA: 2 Pulse: 2 Switched Excitation: 2 voltage Digital: 2 I/O	-100 to 2500 mV	to 0.23 µV	10 Hz	Integrated Wi-Fi wireless modem (optional) RF407: 900 MHz Radio (optional) RF412: 920 MHz Radio (optional) Compatible Communication Devices see pages 16, 17
CR310 | Compact datalogger with Ethernet Small applications requiring Ethernet communication	Analog Voltage: 6 SE or 3 DF Analog Current 4 - 20 mA: 2 Pulse: 2 Switched Excitation: 2 voltage Digital: 2 I/O	-100 to 2500 mV	to 0.23 µV	10 Hz	Integrated Ethernet Port (standard) Wi-Fi wireless modem (optional) RF407: 900 MHz Radio (optional) RF412: 920 MHz Radio (optional) Compatible Communication Devices see pages 16, 17
CR800 | Smaller, simpler datalogger Research-grade power for smaller installations	Analog: 6 SE or 3 DF Pulse: 2 Switched Excitation: 2 voltage Digital: 4 I/O or 2 RS-232	±5000 mV	to 0.33 µV	100 Hz	Compatible Communication Devices see pages 16, 17
CR1000X | Rugged, versatile datalogger Multipurpose Monitoring and Control	Analog Voltage: 16 SE or 8 DF Analog Current 4 - 20 mA: 2 Pulse: 2 Switched Excitation: 4 voltage Digital: 8 I/O or 4 RS-232	±5000 mV	to 0.02 µV	100 Hz	Compatible Communication Devices see pages 16, 17

More info: **435.227.9120**
campbellsci.com/dataloggers

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Telemetry Peripherals
Wireless, remote, hard-wired, or two-way communication

Rugged, Reliable, and Ready for any Application

RELIABLE
SINCE 1974
MONITORING

Campbell Scientific offers a full line of telemetry peripherals that support remote communications between dataloggers and PCs. These peripherals have wide operating temperature ranges allowing their use in extreme, remote environments. They facilitate the accessibility, analysis, sharing, and reporting of data.

MAJOR SPECIFICATIONS

	Transmission Distance or Area	Current Drain @ 12 Vdc	Service Requirements
NL121 | Ethernet Interface Connects CR1000 or CR3000 to LAN or Internet	Worldwide	58 mA typical, 3 mA Ethernet off	Ethernet access
NL116 | Ethernet Interface and CompactFlash Module Connects CR1000 or CR3000 to LAN or Internet and stores data on a CompactFlash card	Worldwide	58 mA typical, 3 mA Ethernet off	Ethernet access
NL201 | Ethernet Interface Connects dataloggers to LAN or Internet via Ethernet	Worldwide	50 mA active 2 mA forced standby	Ethernet access
NL241 | Wi-Fi Network Link Wireless Network Link	Worldwide	< 1.5 mA (standby) 7.5 to 8 mA (client, idle) 65 to 75 mA (client, communicating) 67 mA (access point, idle) 70 mA (access point, communicating)	Wi-Fi hotspot (access to standard 802.11b/g/n networks)
RV50 | Sierra Wireless 4G LTE Cellular Gateway	Dependent on antenna used and LTE, CDMA/EV-DO, and GSM/GPRS/EDGE/WCDMA coverage	1 mA typical enable/ignition sense low 65 to 95 mA typical idle 250 to 300 mA typical active	Network coverage at the datalogger site and account at Verizon, AT&T, T-Mobile USA, Rogers, Bell, or Telus
COM220 | Phone Modem Ideal for sites with telephone access	Worldwide	12 µA quiescent 30 mA active	If not available at the site, phone lines must be installed.
COM320 | Voice Phone Modem Make your datalogger speech capable	Worldwide	100 µA quiescent 35 mA active	If not available at the site, phone lines must be installed.
MD485 | RS-485 Multidrop Interface Connect many dataloggers with a single cable	1219 m (4000 ft) Can increase distance by using more MD485s or combining with spread spectrum radios, Ethernet, or phone	1.2 mA standby 2 to 7 mA communicating	CABLE2TP two-twisted pair cable must be installed between networked dataloggers and base.

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MAJOR SPECIFICATIONS

	Transmission Distance or Area	Current Drain @ 12 Vdc	Service Requirements
SRM-5A | Short Haul Modem	Up to 12.2 km (7.6 miles) depending on data rate and wire gage	2.2 mA quiescent; 10 to 15 mA active	Dedicated two-twisted pair cable connects one field station with base.
RF320 Series with RF500M | Narrowband VHF/UHF Radios with Radio Modem — Long-distance option for communication	Up to 40.2 km (25 miles) between stations (line-of-sight and interference affects transmission length). Repeaters can be used to increase line-of-sight.	RF320-series radio: 25 mA receive standby <900 mA (transmit 2 W RF power) <1200 mA (transmit 5 W RF power) — RF500M radio modem: < 15 mA (active)	FCC-assigned frequency and license. Requires line-of-sight
RF401A and RF411A | 900 MHz Spread Spectrum Radios	Up to 16 km (10 miles) with Yagi antennas at ideal conditions; up to one mile with inexpensive omnidirectional antennas (line-of-sight obstructions and interference affects transmission length)	<0.5 mA stand-by 15 mA receiving < 80 mA transmitting	Shares frequency with other devices. Must not cause harmful interference to licensed radios. Requires line-of-sight
RF407, RF412, and RF427 | 900 MHz Spread Spectrum Radios	Up to 16 km (10 miles) with Yagi antennas at ideal conditions; up to one mile with inexpensive omnidirectional antennas (line-of-sight obstructions and interference affects transmission length)	Transmit: < 80 mA (250 mW TX Power) Receive: 15 mA Stand-by: < 0.5 mA (depending on power saving mode)	Shares frequency with other devices. Must not cause harmful interference to licensed radios. Requires line-of-sight
RF422 | 868 MHz SRD860 Radio	Up to 5 km, depending on antenna (line-of-sight obstructions and interference affects transmission length)	Transmit: < 25 mA (25 mW TX Power) Receive: 15 mA Stand-by: < 0.5 mA (depending on power saving mode)	Shares frequency with other devices. Must not cause harmful interference to licensed radios. Requires line-of-sight
RF451 | 900 MHz Spread Spectrum Radio — 1 W power supports longer distances	20 to 25 miles with Yagi antenna at ideal conditions; up to one mile with inexpensive omnidirectional antenna (line-of-sight obstructions and interference affect transmission length)	6 mA sleep mode 15 mA idle 40 mA receiving 650 mA transmitting	Shares frequency with other devices. Must not cause harmful interference to licensed radios. Requires line-of-sight
ST-21 | Argos Satellite Transmitter	Worldwide	1.1 mA quiescent 375 mA transmitting	Must receive formal permission from Service Argos and pay a fee. Must use data for environmental purposes.
IRIDIUM9522B | Satellite Modem and Interface Kit	Worldwide (including poles, oceans and airways)	Operating: 333 mA Standby: 125 mA	Needs a SIM card. Must pick a service provider and pay a fee.
HUGHES9502 | Inmarsat BGAN Satellite IP Terminal	Worldwide between +70° and -70° latitude	Transmit: < 1.7 A peak Narrowbeam w/o transmit: 333 mA Idle (regional beam): < 84 mA Sleep (wake on Ethernet packet): < 0.8 mA Off, GPIO sleep pin control: < 0.3 mA	Needs a SIM card. Must pick a service provider and pay a fee.
TX321 | GOES or Meteosat Transceiver	GOES: North America Meteosat: Europe	<5 mA, idle <100 mA, during GPS fix <2.6, transmit	GOES — Must be U. S. government agency or sponsored by such an agency. Apply at: http://noaasis.noaa.gov/DCS. Meteosat — Apply at: www.eumetsat.int

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WHEN MEASUREMENTS MATTER

Starter and Datalogger Support Software
For datalogger programming, communications, and data display

Ready for any Application

RELIABLE
SINCE 1974
MONITORING

MAJOR SPECIFICATIONS

	Software Level	Contemporary Dataloggers Supported	Communications Supported	Other Products Supported	Scheduled Data Collection Supported	Data Display Supported
SCWin | Short Cut Program Generator for Windows — Download free of charge	Entry	CR300-series, CR200X-series, CR6, CR800, CR850, CR1000X, CR1000, CR3000, CR9000X	N/A (program generator only)	over 100 sensors (including generic measurements), multiplexers, AVW200-series Vibrating Wire Interfaces, ET107	N/A (program generator only)	N/A (program generator only)
PC200W | Datalogger Starter Software — Basic tools, download free of charge	Entry	CR300-series, CR200X-series, CR6, CR800, CR850, CR1000X, CR1000, CR3000, CR9000X	direct connect	PC cards, CompactFlash cards, microSD cards	no	numeric, simple, line graph
PC400 | Datalogger Support Software — Easy Setup with powerful tools and editors	entry to intermediate	CR300-series, CR200X-series, CR6, CR800, CR850, CR1000X, CR1000, CR3000, CR9000X	direct connect, Ethernet, short-haul, phone modems (land-line, cellular, voice synthesized), RF transceivers (UHF, VHF, and spread spectrum), multidrop modems	most commercially available sensors, SDM devices, multiplexers, relays, vibrating wire interfaces, ET107, CompactFlash cards, microSD cards, PC cards	no	numeric, graphical, Boolean data objects
LoggerNet | Datalogger Support Software — Easy Setup with powerful tools and editors	intermediate to advanced	CR300-series, CR200X-series, CR6, CR800, CR850, CR1000X, CR1000, CR3000, CR9000X	direct connect, Ethernet, short-haul, phone modems (land-line, cellular, voice synthesized), RF transceivers (UHF, VHF, and spread spectrum), multidrop modems. Combinations of communication devices supported	most commercially available sensors, SDM devices, multiplexers, relays, vibrating wire interfaces, ET107, CompactFlash cards, microSD cards, PC cards	yes	numeric, graphical, Boolean data objects
LoggerLink | Mobile Apps for iOS and Android	entry to intermediate	CR300-series, CR200X-series, CR6, CR800, CR850, CR1000X, CR1000, CR3000	iOS or Android device communicates with the datalogger via an IP device (NL116, NL121, NL201, NL241 RV50)	Bluetooth (LoggerLink for Android only)	no	numeric, simple, line graph

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CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Oklahoma's Statewide Mesonet

Campbell gear helps make timely, useful weather information available to citizens of Oklahoma

LEGEND

- OSU/OU Research **(18)**
- Academic/Foundation **(11)**
- Federal/City/State **(15)**
- Airport **(10)**
- Privately Owned **(66)**
- ARS Micronets **(35)**
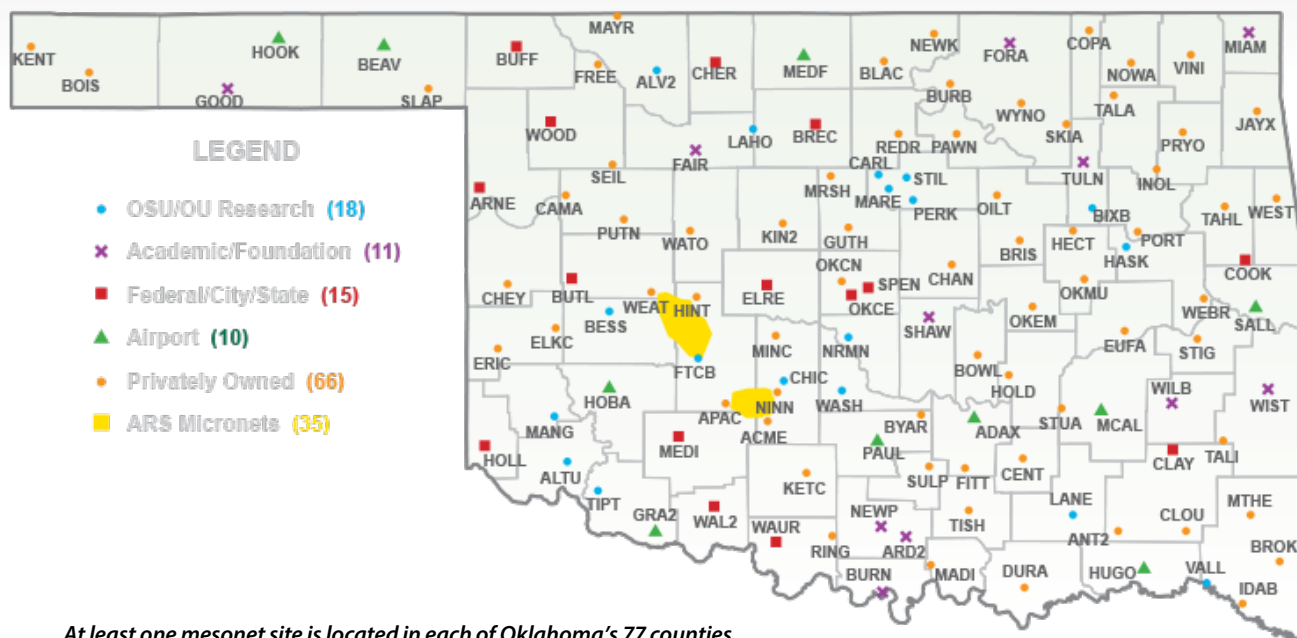
At least one mesonet site is located in each of Oklahoma's 77 counties.
The map above shows distribution of the automated weather stations.

The Oklahoma Mesonet is a statewide environmental monitoring network developed through the cooperative efforts of Oklahoma State University and the University of Oklahoma. The mesonet is a bold, ambitious project to make timely and useful weather information available to the citizens of Oklahoma.

The mesonet consists of 121 CR6-based automated weather stations that continuously measure an array of weather and soil instruments. An additional 35 mesonet-like stations in dense micronets over the Fort Cobb and Little Washita watersheds are funded by the Agricultural Research Service. Each CR6 stores five-minute data summaries and is polled every 5 minutes. Data are relayed from each remote station to a central processing site. This rapid and reliable data

transfer is accomplished using a combination of radiotelemetry (RF500M modems), the Oklahoma Law Enforcement Telecommunications System (OLETS—an agency of the Oklahoma Department of Public Safety), and Campbell Scientific's LoggerNet Datalogger Support Software package.

The central processing site, or base station, is located in the Oklahoma Climatological Survey (OCS) at the National Weather Center in Norman, Oklahoma. The central processing site consists of four instances of LoggerNet Linux for data collection and handling.

The LoggerNet network communication software package provides the operational features associated with two-way communication. This minimizes transmissions required from the

Case Study Summary

Application:
Agricultural and meteorological network

Location:
Oklahoma, USA

Sponsoring Organization:
Oklahoma State University
University of Oklahoma
Oklahoma Climatological Survey

Contributors:
Dr. Ken Crawford, Gary Grimsley, Oklahoma Climatological Survey

Products Used:
CR6-WIFI, CDM-A116, LoggerNet, LoggerNet Linux, RF500M

Communication Links:
RF telemetry, Ethernet

Measured Parameters:
Air and soil temperature, relative humidity, wind speed & direction, barometric pressure, solar radiation, rainfall, soil moisture

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central site and allows for real-time communication link status.

Remote operations executable from the central site include:

- Setting the weather station clock
- Downloading weather station programs
- Retrieving stored data following periods of communication failure
- Conditional selecting of alternate reporting intervals or output variables (This feature is especially useful for the mesonet, which collects one-minute observations during tornadic events.)
- Real-time monitoring of instantaneous measurements

The LoggerNet computers collect data from the OLETS high-speed data link, check for any missing reporting stations, and then send the data to an on-line database system over a TCP/IP link. The database checks the data quality, manages data storage, and assists in disseminating the observations and certain value-added products to a statewide community of users—all within minutes of each observation time.

Data is distributed by the OCS via the Oklahoma mesonet website. (www.mesonet.org)

A 2009 National Research Council report* named the Oklahoma Mesonet as the "gold standard" for statewide weather and climate networks. The mesonet is unique in its capability to measure a large variety of environmental conditions at so many sites across an area as large as Oklahoma. In addition, these conditions are relayed to a wide variety of customers very quickly after the observations are taken.

A mesonet station at Eufaula, Oklahoma, is one of 121 automated weather stations that continuously measure environmental conditions.

* National Research Council, "Observing Weather and Climate from the Ground up: A Nationwide Network of Networks," Washington, D.C., 2009