Campbell Scientific, Inc.

Weather Stations

CAMPBELL SCIENTIFIC
CANADA CORP.
11564 - 149 street - edmonton - alberta - T5M 1W7
tel 780.454.2505 fax 780.454.2655
www.campbellsci.ca

Weather Stations

Campbell Scientific weather stations have become the world-wide standard for meteorological and climatological monitoring. In use on every continent and virtually every country, our weather stations are known for their precision measurement capability, rugged construction, wide operating temperature range, and low power consumption. Campbell Scientific weather stations offer the flexibility to easily change sensor configurations, data processing, and data storage and retrieval options.

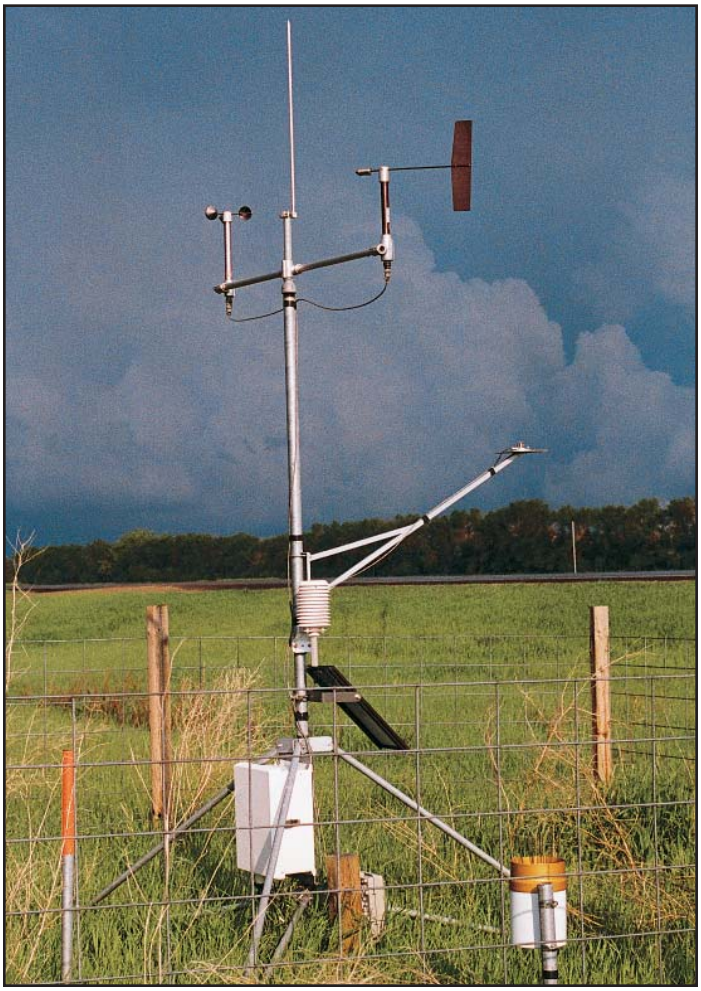
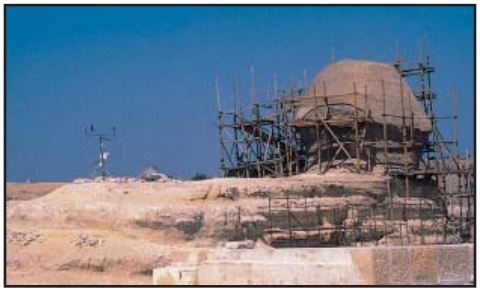


Photo Radu Carcoana, NDSU

The flexibility and long-term reliability of our weather stations have resulted in their widespread use in scientific, commercial, and industrial applications. This weather station in the North Dakota Agriculture Weather network provides data critical to the application of pesticides.

Tough Enough for the Extreme, Inexpensive Enough for the Routine

From frigid polar and alpine regions to the fiery Sahara, our stations have endured the elements for more than 25 years to provide accurate meteorological measurements. Most of our equipment has standard operating ranges of -25° to +50°C; extended ranges are from -55° to +85°C. The heart of every Campbell Scientific weather station is the datalogger, and every datalogger we manufacture is calibrated and tested to ensure accurate, reliable performance.



Minimal power requirements allow use of alkaline or rechargeable batteries charged by solar panels or ac power. However, all this performance won't cost a fortune. Low overhead and lean manufacturing allow us to offer quality equipment at reasonable prices.

(Above left) High atop Nevado Sajama in the Bolivian Andes, a Campbell Scientific weather station monitors conditions relevant to global warming. (Above right) Weather measurements on the Sphinx provide input for its preservation.

Applications

Meteorology

- **Individual Weather Stations** record site-specific conditions for meteorological research and routine weather measurement applications.
- **Weather Station Networks** provide regional and local real-time data for weather monitoring, forecasting, local warnings, and climatic modeling.
- **Air Quality and Diffusion Modeling** applications use the datalogger to monitor and control gas analyzers, particle samplers, and visibility sensors.

Other Meteorological Applications

- **Ground Truth for Satellite Imagery**
- **Fire Weather Stations**

Phil Geary, Campbell Scientific Ltd.

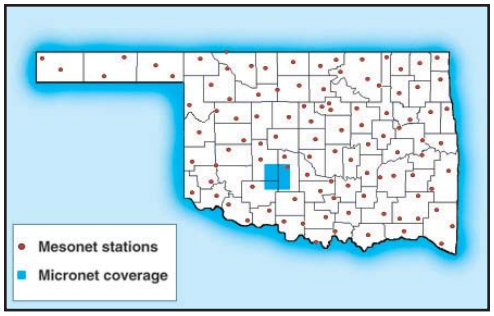
Campbell Scientific stations have become the standard used by the British Met Office.

Dr. Ken Crawford, OCS

The Mesonet: Oklahoma's Statewide Network

The Mesonet is composed of more than 115 Campbell Scientific weather stations that collect data for applications such as crop management, severe weather warnings, site-specific forecasts, and water resource management. Each station transmits data to the Oklahoma Climatological Survey (OCS) for processing and distribution to users via computer networks and bulletin boards, print and electronic media, and interactive public displays. The associated Micronet is an area of intensive study monitored by an additional 42 stations in the Little Washita Watershed.

Every 15 minutes, the Oklahoma Law Enforcement Telemetry System (OLETS) collects data from each station via radio telemetry.



Agriculture

- **Crop Management Decisions** such as irrigation scheduling, integrated pest management, plant pathology, and frost prediction are based on data provided by our stations.
- **Evapotranspiration** can be calculated on-board using the FAO-56 Penman-Monteith equation, which is accepted by the Food and Agricultural Organization of the United Nations.

Other Agricultural Applications

- **Erosion Studies**
- **Food Processing and Storage**

Other Applications

- **Utilities/Energy/Wind Power**
- **Ecological/Biological/Microclimate Studies**
- **Historical Preservation**
- **Automotive Testing**
- **Hydrometeorological Stations**
- **Mining/Mineral Extraction/Earth Science**
- **Highway and Pavement Studies**
- **Alpine/Snow Science/Avalanche Control**
- **Geotechnical/Structural Engineering**
- **Sports Events (e.g., Olympic Games)**
- **Assessing Local Lightning Hazards and Thunderstorm Research**

Pre-Configured Weather Stations

Our pre-configured weather stations offer research-grade performance with ease-of-use for weather and climate monitoring. They feature a standard sensor assemblage and simplified installation.

ET107 Weather/ETo Station

- Consists of measurement electronics, power supply, environmental enclosure, 2- or 3-meter aluminum pole, and a standard suite of sensors mounted to a crossarm
- Measures air temperature, solar radiation, relative humidity, rainfall, wind speed, and wind direction with the standard suite of sensors; optional soil temperature, soil water content, and snow depth sensors available
- Transmits data via short-haul, telephone, or voice-synthesized modems

The ET107 is an automated system designed for commercial agriculture, irrigation scheduling, and meteorological applications.

RAWS-H Data Collection Platform

The RAWS-H contains a CR1000 datalogger with a Handar sensor connector panel. This allows you to replace a Handar Data Collection Platform with a RAWS-H and use the existing Handar sensors, enclosure, power supply, and tower.

RAWS-F Quick Deploy Station

Our RAWS-F (Remote Automated Weather Station for Fire Weather) is ideal for prescribed burns or other temporary installations. This quick deployment station can be setup in as little as 10 minutes—without tools. It consists of a 6 ft tripod, meteorological sensors, and an aluminum environmental enclosure that houses and protects a CR1000M module and a 12 V battery. The battery is recharged via a solar panel or an AC transformer. Each RAWS-F station is pre-programmed to comply with the National Fire Danger Rating System (NFDRS) weather station standards.

The outside of the enclosure has color-coded, keyed connectors for attaching wind speed and direction, air temperature and relative humidity, precipitation, solar radiation, and the optional fuel moisture/temperature sensors. Besides the connectors, a wiring panel is provided that allows the attachment of additional sensors.

The RAWS-F includes a CR1000KD for on-site communications. Telecommunications options are our GOES satellite transmitter or the VSP3 Vosponder Voice Radio Interface. The Vosponder allows customers to call a RAWS-F station via a hand-held radio and receive verbal reports of real-time conditions. Our RAWS-F station is also compatible with other communication equipment such as telephones, digital cellular transceivers, and RF.

Other Pre-Configured Stations

The RAW-P provides an enclosure with connectors for attaching the sensors. Campbell Scientific also supplies stations to Toro®, RainBird®, and Hunter for automating turf grass irrigation; contact them for more information.

Electric Field Meter

The CS110 can be used as an automated weather station. It measures the vertical component of the atmospheric electric field at the earth's surface. An embedded CR1000 datalogger, sealed connectors for attaching meteorological sensors, and three digital control ports for controlling external devices and/or triggering alarms are included. The datalogger measures the sensors, processes the measurements, stores the data in tables, and can initiate communications. Communication options compatible with the CR1000 include direct connect, Ethernet, phone modems (land-line and cellular), radios, short haul modems, satellite transmitters, and multidrop modems.

The CS110's measurements are useful for assessing the local lightning hazard and for thunderstorm research.

Build-Your-Own Weather Stations

The flexibility of our products allows you to select only the components you need, in the quantity you need to customize your own weather station.

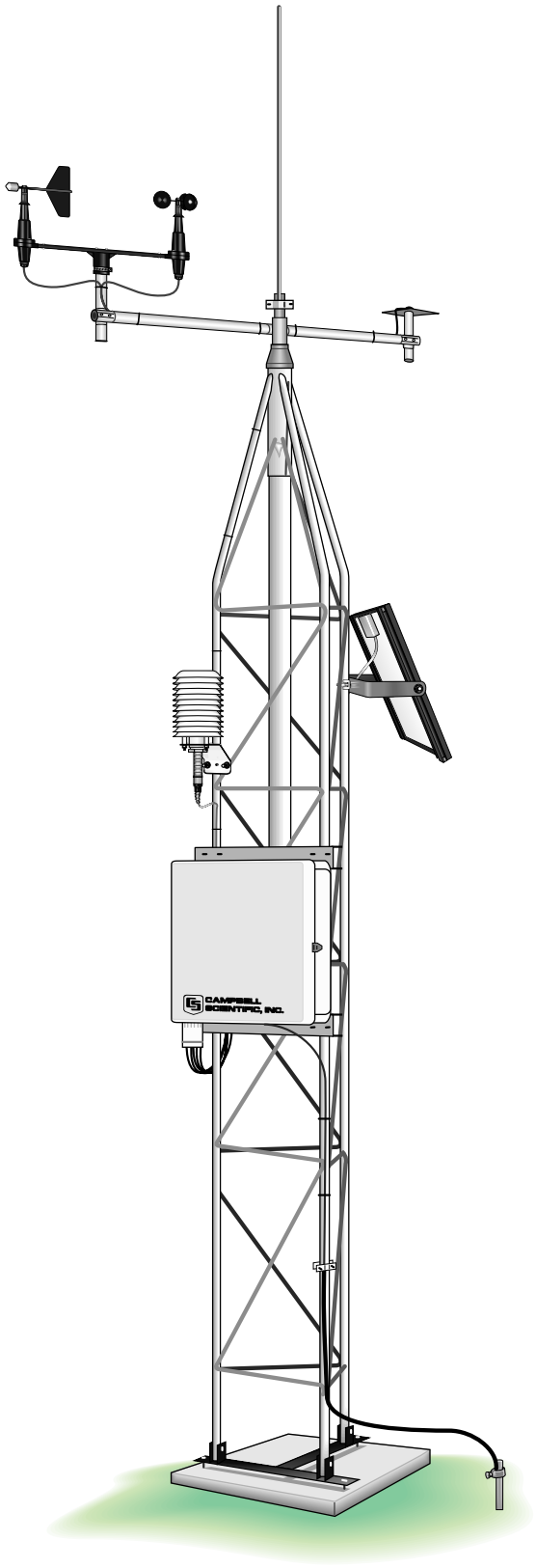
Tripods and Towers

Our corrosion-resistant tripods and towers provide sturdy support for sensors, solar panels, and enclosures. We have galvanized-steel tripods with 6- or 10-foot heights, stainless-steel tripods with 10-, 15-, or 20-foot heights, and towers with 10-, 20-, or 30-foot heights. Mounts for attaching wind sets, pyranometers, temperature and relative humidity sensors are available.

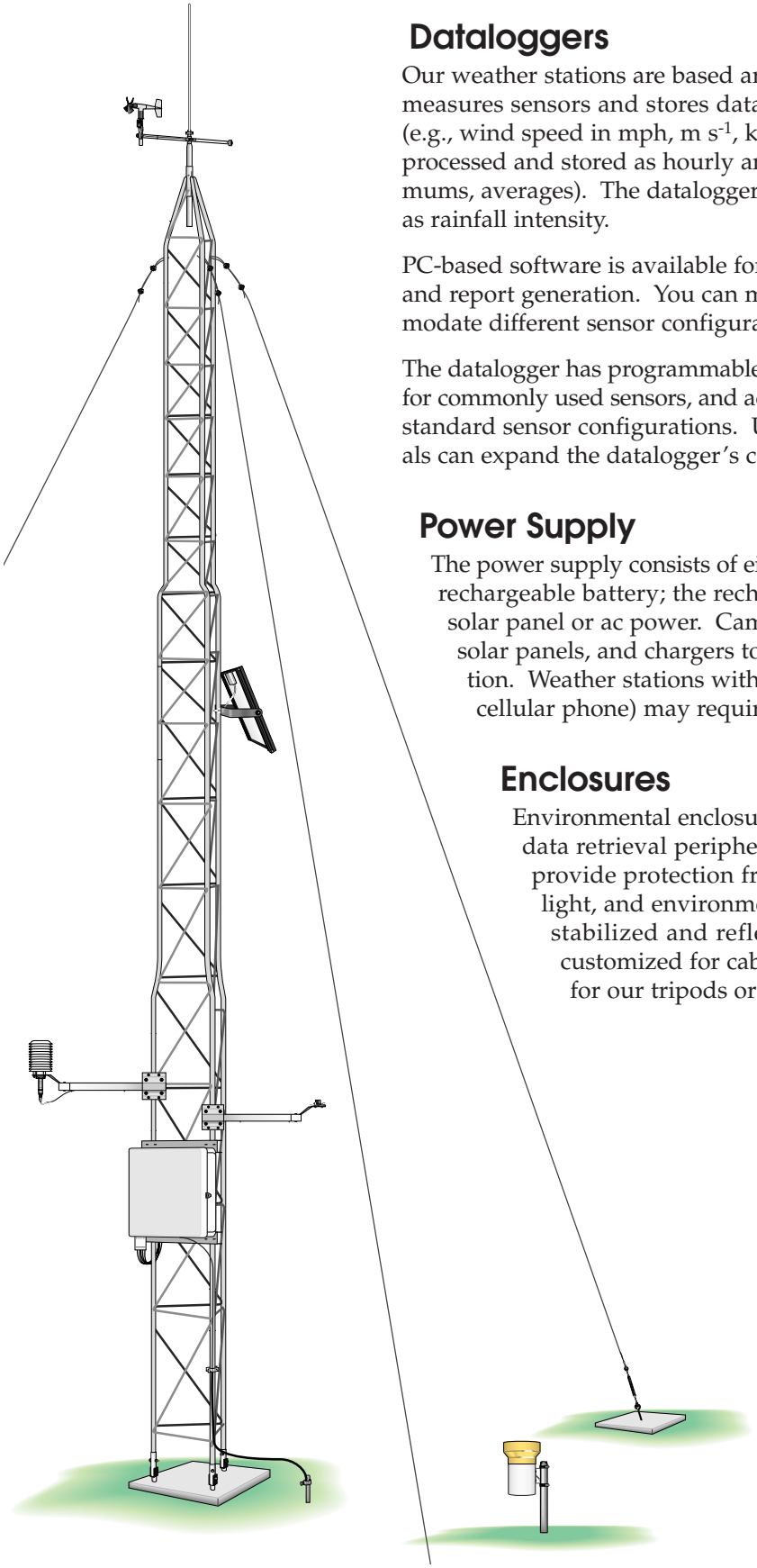
Sensors

Campbell Scientific offers high quality sensors for measuring the parameters listed below. These sensors interface directly to our dataloggers. If measurement needs are specialized, our dataloggers' analog, pulse counter, and digital inputs are compatible with sensors offered by most manufacturers.

- **Wind Speed:** cup, propeller, or sonic anemometers.
- **Wind Direction:** vanes containing precision potentiometers or sonic anemometers. A single sensor assembly may measure wind speed and direction.
- **Solar Radiation:** silicon cell or thermopile pyranometers, quantum sensors, or net radiometers.
- **Temperature (air, water, soil):** thermistors, thermocouples, or RTDs.
- **Relative Humidity:** capacitive sensors that use integral signal conditioning. RH and air temperature sensors are typically housed in a single body.
- **Precipitation:** tipping bucket rain gages or weighing gages. A snowfall conversion adapter that uses antifreeze or a heated tipping bucket can measure the water content of snow.
- **Snow Depth:** ultrasonic distance sensors.
- **Barometric Pressure:** capacitance or strain gage pressure transducers.
- **Soil Moisture:** moisture blocks, analog output tensiometers, or reflectometers.
- **Fuel Moisture:** thermistor and reflectometer in a Forest Service-approved ponderosa pine dowel.



Campbell Scientific weather stations can be customized using our standard product line to suit individual needs, employing a variety of towers, sensors, power supplies, and data retrieval products.



Dataloggers

Our weather stations are based around a programmable datalogger that measures sensors and stores data, in your choice of engineering units (e.g., wind speed in mph, m s^{-1}, knots). Sensor measurements are often processed and stored as hourly and daily arrays (e.g., maximums, minimums, averages). The datalogger also supports conditional outputs, such as rainfall intensity.

PC-based software is available for datalogger programming, data retrieval, and report generation. You can modify the program at any time to accommodate different sensor configurations or data processing requirements.

The datalogger has programmable execution intervals, on-board instructions for commonly used sensors, and adequate input channels to accommodate all standard sensor configurations. Use of measurement and control peripherals can expand the datalogger's capabilities.

Power Supply

The power supply consists of either a set of alkaline batteries or a sealed-rechargeable battery; the rechargeable battery can be recharged via solar panel or ac power. Campbell Scientific offers a range of batteries, solar panels, and chargers to meet the needs of your specific application. Weather stations with high current drain peripherals (satellite, cellular phone) may require one of our larger capacity batteries.

Enclosures

Environmental enclosures house the datalogger, power supply, data retrieval peripherals, and a barometer. The enclosures provide protection from dust, humidity, precipitation, sunlight, and environmental pollution. Our enclosures are UV-stabilized and reflect solar radiation. Enclosures can be customized for cable-entry openings or mounting brackets for our tripods or towers.

Easy Set Up

Our weather station installation manuals provide step-by-step instructions with detailed illustrations. Station set-up time for most customers is a few hours.

The UT30 tower places the wind speed and direction sensor at a 30 ft (10 m) measurement height that meets EPA requirements.

Data Retrieval Peripherals

To determine the best option for your site, consider the accessibility of the site, availability of service (e.g., cellular phone or satellite coverage), quantity of data collected, and time between data downloads.

On-site options:

- CompactFlash® cards
- Laptop Computer
- Datalogger keyboard display
- PDA Handhelds
- DataView Displays

Telecommunication options:

- Short-Haul Modems
- Telephone (land line, digital cellular, and voice-synthesized)
- Ethernet
- Radio Frequency (RF) Transceivers (VHF narrowband, UHF narrowband, or spread spectrum)
- Multidrop Interface (coaxial cable)
- Satellite Transmitters (Argos and High Data Rate GOES)

Claude Labine, Campbell Scientific Canada

Meteorological conditions are measured at Lake Louise, Alberta, Canada. The data are telemetered via phone-to-RF link to a base station.

Software

Starter

Our starter software is available, at no charge, from www.campbellsci.com/downloads or from our Resource CD.

Short Cut Program Builder creates weather station programs that measure sensors and output data. It supports the meteorological sensors on our U.S. Price List.

PC200W Starter Software allows you to transfer the weather station program and collect data via a direct communications link (i.e., an optically isolated RS-232 interface or a similar device).

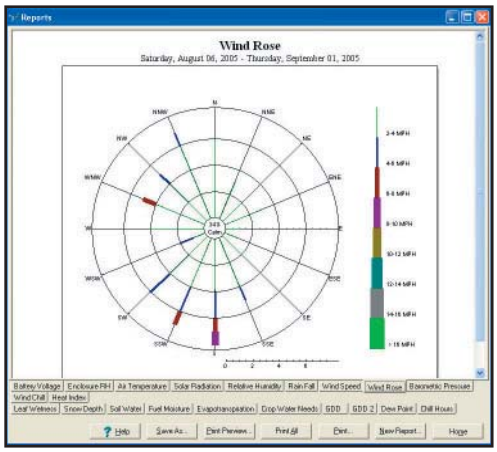
Datalogger Support

PC400, our mid-level software, provides advanced programming and telecommunications without introducing large network complexity. Scheduled data collection and combinations of communication options (e.g., phone-to-RF) are not supported.

LoggerNet is a full-featured software package based on a server application and several client applications. LoggerNet supports connection to a single datalogger and large datalogger networks. This software package supports scheduled data collection and combinations of communication options (e.g., phone-to-RF).

Application Specific

Visual Weather is for customers who want reliable, real-time weather data and printed reports without worrying about technical details, such as programming, using client-server technology, or maintaining databases. For preconfigured weather stations, it generates a program as sensors, scan interval, and communications path are selected. Short Cut is included for configuring custom weather stations.



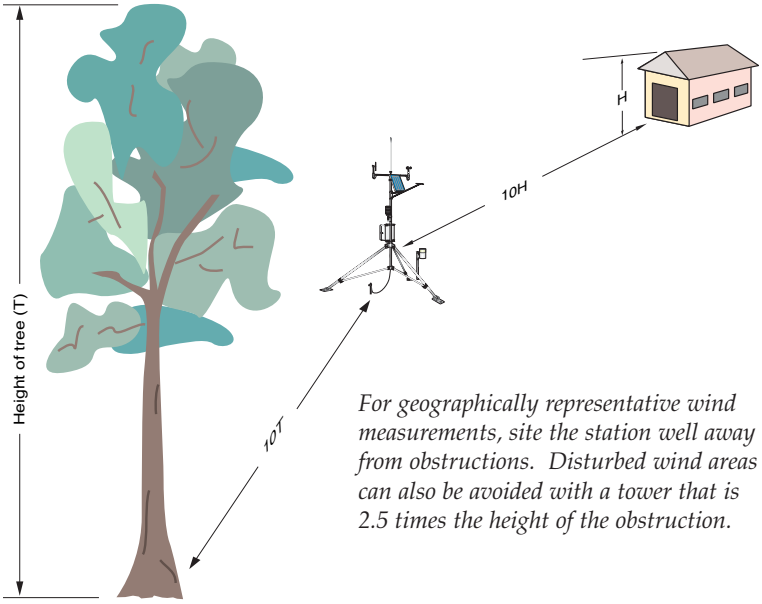
Using Visual Weather software, customers can create a wind rose report that displays the distribution of wind directions at multiple wind speeds.

Site Selection and Sensor Placement

Wind, air temperature, and water vapor pressure measurements are affected by surface type and roughness, soil moisture, regional topography, and obstructions.

Sites selected for their applicability to a broader area should be free from obstructions such as buildings, trees, and steep slopes. Ten meter towers are often used to raise measurement heights above low-lying obstructions.

The following table lists the suggested measurement heights and exposure (distance to an obstruction) for each type of sensor.



For geographically representative wind measurements, site the station well away from obstructions. Disturbed wind areas can also be avoided with a tower that is 2.5 times the height of the obstruction.

	Measurement Height or Depth	Exposure Considerations
Wind	3 m ±0.1 m recommended (AASC) 2 m ±0.1 m, 10 m ±0.5 m, optional (AASC) 10 m (WMO & EPA)	No closer than ten times the obstruction's height.
Air Temperature & Relative Humidity	1.5 m ±1 m (AASC) 1.25-2.00 m (WMO) 2.00 m for temperature only (EPA) 2 m & 10 m for temperature difference (EPA)	The sensor must be housed in a ventilated radiation shield to protect the sensor from thermal radiation. The EPA recommends the sensor be no closer than four times the obstruction's height and at least 30 m from large paved areas.
Solar Radiation	Height should be consistent with the exposure standard (AASC, WMO, EPA). To facilitate leveling/cleaning, CSI recommends installing at a height of 3 m or less.	The sky should not be blocked by any surrounding object. However, objects ≤5° above the horizontal plane of the sensor are allowed.
Precipitation	1.0 m ±0.2 m (AASC) 30 cm minimum (WMO)	AASC & EPA suggest the sensor be no closer than four times the obstruction's height. The orifice of the gage must be in a horizontal plane, open to the sky, and above the level of in-splashing and snow accumulation.
Soil Temperature	10 cm ±1.0 cm (AASC) 5 cm, 10 cm, 20 cm, 50 cm, 100 cm (WMO)	Measurement site should be 1 m^2 and typical of the surface of interest. The ground surface should be level with respect to the immediate (10 m radius) area.

References:

The State Climatologist. 1985. Publication of the American Association of State Climatologists: Heights and exposure standards for sensors on automated weather stations, (9), 4, October, 1985.

EPA. 1987. On-site meteorological program guidance for regulatory modeling applications, EPA-450/4-87-013. Office of Air Quality Planning and Standards, Research Triangle Parks, North Carolina 27711.

WMO. 1996. Guide to Meteorological Instruments and Methods of Observation. WMO No. 8, 6th ed. WMO, Geneva.

Tanner, B.D. 1990. Automated weather stations, Remote Sensing Reviews 5, (1): 73-98.

We would like to discuss your weather station needs. Please contact us at one of our offices, or visit our web site at: www.campbellsci.com

11564 149 Street | Edmonton, AB T5M 1W7 | CAN | phone (780) 454-2505 | www.campbellsci.ca
Australia | Brazil | Canada | England | France | Germany | South Africa | Spain | USA [headquarters]