REPORTING QUALITY OBSERVATIONS TO NOAA Application Note 30

and other weather observation groups

INTRODUCTION

This document provides guidelines for the setup and installation of your weather station so as to provide the highest quality observations for use by NOAA (National Oceanic and Atmospheric Administration) and other weather groups. Through the Citizen Weather Observer Program (CWOP), NOAA ingests weather data into its weather forecast models at the Forecast Systems Laboratory in Boulder, Colorado. As a Cooperative Observer (COOP), it is possible to supplement the sensor data from the NOAA equipment with data from your weather station. However, it should be noted that no consumer system has been officially approved for COOP use other than the equipment provided by the NWS. Other private media groups also have interest in "backyard" weather station data.

Since the number of "official" real-time observations is limited to the Automated Surface Observing System (ASOS) which has sites primarily at airports and military installations, using private weather stations provides a means to capture more observations without expending substantial resources to acquire, install, and maintain these high-end systems. More observations means better forecast prediction and forecast verification (checking to see if the forecast was correct). However, the quality of observations is also just as important. Since Davis Instruments weather station specifications closely mirror those used by the meteorological community, you can report professional quality observations for just a fraction of the price. Proper siting and installation of the weather station is the primary key here.

As the owner of a Davis Instruments weather station, you can help NOAA improve their forecasts by providing more ground-truth observations. The guidelines here follow recommendations provided by CWOP, NOAA and the National Weather Service (NWS). Data provided to other private weather groups also helps them in a similar manner since they also do their own in-house weather forecasting and forecast verification.

EQUIPMENT NEEDED

You can use any Davis Instruments weather station, but you will also need a PC with Windows 95 or Mac OSX or later, WeatherLink™ software and an Internet Connection to report your data to CWOP. If you have a Weather Wizard III® or Weather Monitor II®, it is highly recommended that you obtain a Radiation Shield (P/N 7714), the reasons for which will be discussed later. Refer to the weather station instruction manual for a list of tools and weather station mounting options. The WeatherLink Help files cover how to set up the software to report your data to CWOP. Additionally, Application Note 26 provides guidelines on choosing an Internet Service Provider (ISP) and setting up your Internet data transfer. This document will cover more information on becoming a member of CWOP or COOP later.

Optionally, you may choose to have a NIST traceable unit. In the U.S., the National Institute of Standards and Technology (NIST) develops and maintains the standards of measurement to which all others are ultimately compared. NIST traceability is typically required by public agencies that monitor weather conditions, but it is not a requirement for CWOP at this time. If you are a member or want to be a member of COOP, contact your local NWS office to see if NIST traceability is a requirement for your Davis Instruments weather station. For more

information about NIST, check out their website at http://www.NIST.gov . If resources allow, you may choose to have your weather station NIST certified. If so, then you have documentation that proves that your system has been compared to a higher-order standard. This may alleviate some concerns about data quality that may arise in the future. To be continually certified, you will need to be certified once every year. Contact Davis Instruments Customer Service for more details about having your station NIST certified.

ASSESSING YOUR ENVIRONMENT

Whether the weather station is installed at a business or at home, the type of building and surrounding environment has a dramatic effect on the values of the weather parameters throughout this location. It is generally best to have plenty of naturally (best) or artificially landscaped ground space that is flat or on a gentle slope away from the building. Also, the location should not be heavily shaded by trees. If you lack sufficient or acceptable ground space on the property, the next best, but not ideal location, is a rooftop location. Cases where rooftop installations are the only option are generally urban areas including multi-story office buildings, apartments, condominiums, or office space where the ground space is almost entirely paved. Never install a weather station over or near any sort of paved surface regardless of whether it is asphalt or concrete. Try to be at least 100 feet away from any driveway or roadway. If you lack a suitable location, see if you neighbors have an acceptable location and would be willing to allow you to put a weather station on their property. Be sure and tell them it is possible to locate it in an inconspicuous location. If you fail to find an “ideal” location, don’t be discouraged. Data can still be of value. In most cases, any data is better than no data.

FINDING AN INSTALLATION LOCATION

If you manage to find an available location on your property or nearby, next determine your exact station location and configuration. Generally and ideally, you should locate the temperature/humidity and rain sensors in the open ground space area and the wind sensor (anemometer) on the building rooftop. If possible, also try to choose a location not visible from the street. Some homeowner’s association covenants and city ordinances require that systems such as these not be visible to the general public. Generally, this means siting the weather station in a backyard or lot and a rooftop location toward the back of the building away from the street. Finally, make sure the location is easily and safely accessible. One important part of quality data is maintenance, so you should be able to return to the installation location to check, clean, and, if necessary, replace sensors. If you have the resources, professional contractors will, for a fee, install items for you.

First, assess your ground location. If possible, select a location that has a natural ground cover surface. This way, your readings will be “representative” of the natural, local environment. Natural surfaces will have vegetation that grows naturally in the climate in which you live. In semi-arid or arid areas, such surfaces are referred to as “xeriscapes” or dry landscaping that may consist of cactus, scrub brush and be interspersed with sandy areas. You can check with a local landscaping company or supplier for what types of vegetation grows naturally in your area. Otherwise, regularly mowed turf-grass will suffice. Note that all agricultural applications where the calculation of evapotranspiration (ET) is involved, the temperature and humidity sensors need to be installed over well-irrigated, regularly mowed grass. If possible, install all the sensors between two orchards, two vineyards or two row crops. If this is not possible, install the sensors near the edge of the primary crop of interest. Be sure and locate the weather station where a sprinkler system will not directly spray the weather station. This can adversely affect the readings. Choose an area with the gentlest slope possible. Never install on a steep hillside

if at all possible unless the entire neighborhood is located on a hillside. The rain collector will need to be installed level regardless of the slope of the landscape. Never install near a body of water such as a pond, lake or swimming pool. Avoid low lying areas that don't drain well, that is, areas that experience a lot of standing water.

It is highly recommended that Weather Wizard III or Monitor II users obtain the Davis Radiation Shield, P/N 7714. If this is prohibitive, the temperature sensor will need to be installed in a shady location. Unfortunately, this is often times on the north side of a building. If you must install your temperature sensor up against a building, avoid locations near heating or air conditioning units, exhaust vents, or other sources of heat. Choose a location that remains in the shade all day long, and if possible, is over a landscaped or dirt surface. Stay away from areas with asphalt, concrete, or brick pavement.

Siting your rain collector in a manner that limits the effect of "rain shadow" or blockage from nearby objects needs to be assessed. Rain shadow occurs when rain, that otherwise might fall into the gauge, is captured or deflected by obstructions upstream. As a rule of thumb, the top edge of the rain collector should be no less than twice the height away from any obstruction such as a fence, tree, or building. Never install a rain collector near a building. For heavily forested areas, site your rain collector in a clearing or meadow. Because temperature/humidity sensors should be installed about 5 feet (1.5 m) above the ground, on a Vantage Pro or Vantage Pro2 Integrated Sensor Suite (ISS, where the rain collector is above the temperature/humidity radiation shield), the rain collector will be about 6 feet (2 m) off the ground. In this case, the distance between a 10 foot (3 m) wall and the ISS can be 8 feet (0.5 m) because the difference in height between the 10 foot wall and the Vantage Pro rain collector is only 4 feet (1 m). If necessary, you can site your rain collector away from your ISS. See Application Note 32 for details.

Next, assess the location for your anemometer. As stated before, the easiest way to get your anemometer up into the wind is to install it on the roof of the building or on a tall antenna tower. If at all possible, install it on a rooftop location. If you cannot, then you should install it as high as possible in the surrounding landscape.

Finally, your barometric pressure readings will also be sent to NOAA if you join the CWOP. The barometric sensor is located inside your display console or Weather Envoy. If at all possible, the console should be located indoors in a dry, indoor location away from outside doors, heating and cooling registers, and direct sunlight. Barometric sensors can be affected by rapid changes in temperature from these sources. Avoid pressurized rooms.

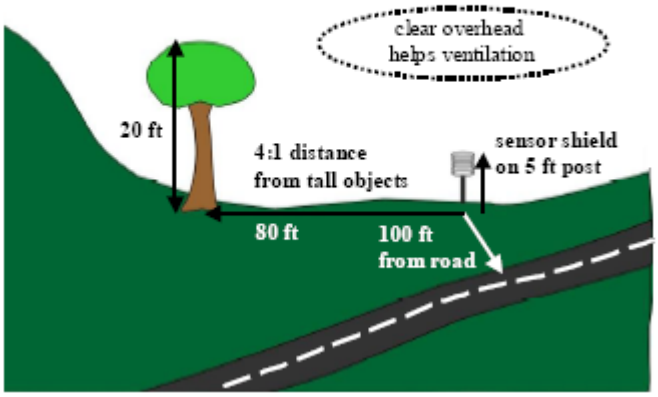
If your weather station location is remote, obtain the Complete System Shelter P/N 7724 to house the console or Envoy. Do not completely seal off the shelter because your system will need exposure to outside air to obtain the true air pressure and to ventilate excessive hot air on hot days. You will also need to connect to the weather station from a phone line and transfer the data to your computer and then to CWOP. Application Note 27 provides guidelines on setting up a remote modem.

INSTALLATION GUIDELINES

TEMPERATURE AND HUMIDITY

As stated before, the best location for the temperature/humidity sensors is inside a radiation shield located over the ground. Second best is a rooftop location. Either way, the shield

should be mounted so that the sensors are about 5 feet (1.5 m) +/-1 foot (0.3 m) above the ground or rooftop (or, for ground installations or flat roof installations, 2 feet (0.6 meters) above the average maximum snow depth, whichever is higher).



RAIN COLLECTOR

If you have a Vantage Pro or Vantage Pro2 system, your rain collector will be mounted above your temperature/humidity radiation shield since both are included as part of the ISS. If you have a Weather Wizard III or Weather Monitor II, you will need to find a separate location for your rain collector. Generally, the best location will be similar to that of the temperature-humidity sensors. A 2 foot (0.6 m) mounting height for stand-alone gauges is usually best. The area above the gauge should be free of obstructions. Avoid areas where a sprinkler system will produce false rain readings. Make sure the rain collector is a level as possible. Since Davis rain collectors use tipping bucket technology, accuracy degrades significantly if the unit is not level. A T-shaped trough in the base of the rain collector provides a simple way to determine how level the rain collector is. Consult the appropriate instruction manual for more details. The Rain Collector Shelf (Part #: 7704) and Sensor Mounting Arm (Part #: 7702) back plate can be used together to mount a rain collector to a pole.

The following figure provides an example of a wind shield that professionals use. Some shields use aluminum and others use wood. Either way, it may be possible to build an inexpensive version of your own.

ANEMOMETER (WIND SENSOR)

As stated before, it is easiest to mount your anemometer on your roof to achieve height. The standard mounting height is 33 feet (10 m) for most applications. For agricultural applications when calculating ET, 6 feet (2 m) is the standard mounting height. For two or more story buildings, this can be achieved by installing the anemometer at least 10 feet (3 m) above the highest point on the roof (regardless of height above the ground) to minimize the affects of the roof on the wind. For most single story buildings, you will need to use an already existing, secured TV or radio antenna tower to achieve this height. Seek profession help to install a TV or radio tower. Generally, if you are uncertain about the safety of your proposed task, seek professional help.

If there are obstructions such as trees within 66 feet (20 m) of the anemometer, you should mount your anemometer at least 7 feet (2 m) above these tree tops. Due to stability issues, CWOP does not encourage members to install masts longer than 16 feet (5 m), if tripod mounted, or 33 feet (10 m), if ground based mast connected to a building or supported using guy wires. For masts higher than 33 feet (10 m), seek professional installation.

If you decide you cannot mount your anemometer from your rooftop, you should make every attempt to satisfy the siting guidelines. Never install an anemometer near the side of a building. Get as far away from the building as possible. Install the anemometer as high off the ground as possible. If there are no other obstructions such as trees on your property, and you have at least 0.25 acre of property and a one story building, you may be able to use a Mounting Tripod if you place it at least 50 feet (15 m) away from the building. For two or more story buildings, you will probably need to use a tower mount for any ground based installation unless you have approximately 2.5 acres or more. Any property with a lot of large trees will probably require a tower mount. As with a rooftop mounting, if you have trees on your property, you may want to consider installing the anemometer at least 7 feet (2 m) above the height of the tree tops.

Note that the Vantage Pro anemometers are designed to be mounted with the mounting arm facing “true” north. If you live in an area where all the streets run north-south or east-west in a

THE COOPERATIVE OBSERVER NETWORK (COOP) (United States Residents Only)

The following website provides guidelines on how to join: http://www.weather.gov/om/coop/become.htm. In summary, contact your local NWS office and they will determine whether there is a need for a COOP site in your location. If you are selected for COOP, your local NWS office will provide the "official" equipment for monitoring. Unofficially, many COOP observers supplement their "official" readings with readings from their Davis Instruments weather stations.

THE CITIZEN WEATHER OBSERVER PROGRAM (CWOP)

It is possible there may not be a need for a COOP station in your location. It is possible to provide data to NOAA through the CWOP program. The program is open to anyone who has the equipment listed at the beginning of this document. The following website provides details on how to join: http://www.wxqa.com/SIGN-UP.html . Most of the information in this document is based on the guidelines CWOP has provided.

GLOBE

If you are an educator or member of an educational institution, then you may participate in the GLOBE program. Global Learning and Observations to Benefit the Environment is a worldwide hands-on, primary and secondary school-based education and science program. Teachers and other educators who wish to lead students in GLOBE need to attend special workshops in order to fully participate in the program. Visit the following website for more details: http://www.globe.gov/fsl/html/aboutglobe.cgi?intro&lang=en&nav=1

WEATHER UNDERGROUND

As with CWOP, you only need Internet access to send data to Weather Underground. Contact Weather Underground for the software that will interface with WeatherLink. This software is not compatible with WeatherBug (below). The following website allows you to sign up:

http://www.wunderground.com/signup/signup.asp?mode=pws

WEATHERBUG

WeatherBug offers a co-branded version of Davis Instruments weather stations. These operate just like our weather stations except they have a different name on the box and display console. They also include WeatherBug software that automatically uploads data to their network. This software does not include the Weather Underground feature and may not include the CWOP upload feature. Visit the following website for details: http://www.weatherbug.com/backyard/

LOCAL MEDIA (Newspapers, Radio & TV Stations)

Contact your local media weather departments and ask them if they would be interested in your weather data. Note that one outlet in each TV market will probably have exclusive agreements with other weather station vendors that will not allow you to use a Davis Instruments weather station to send them data. Other than those, they should be happy to receive your data.

dirty. A buildup of material inside the shield reduces its effectiveness and may lead to inaccurate temperature and humidity readings. Keep areas between radiation shield plates free of debris that may obstruct air flow. This type of maintenance will probably need to be done on an annual basis, or more often during drier times of the year when regular rains do not wash dust off the radiation shield. Consult the appropriate instruction manual for details on how to disassemble and reassemble the radiation shield.

RAIN COLLECTOR

Determining if your rainfall measurements are correct is more difficult. Precipitation can be highly variable over very short time and distance. For this reason, NOAA does not yet have quality control algorithms to verify the accuracy of rainfall readings. So, maintaining rainfall accuracy is up to you. In addition to following the siting guidelines earlier in this document, use the maintenance guidelines below to ensure the most accurate readings.

For greatest accuracy, clean several times a year. Dust and debris can accumulate on the tipping bucket, affecting its operation. Spiders and insects can make their homes in the base, and birds have been known to nest in the funnel. To clean the rain collector, remove the funnel from the base. Gently clean the tipping bucket and the funnel with water and a mild liquid detergent. Rinse thoroughly.

If you use the Rain Collector Heater, only use the device during periods when freezing weather is expected. The heat generated by the heater is enough to cause evaporation of rain water when used during liquid precipitation events. As a general guideline, leave it turned off during the summer months.

To check the accuracy of the rain collector, compare the Davis Rain Collector with a tube type “manual” rain gauge. Use a rain gauge with an opening diameter of at least 4 inches. If you are a COOP member, you can safely use this type of gauge for comparison provided it is located near your weather station. Rain gauges with openings smaller than 4 inches (1.5 cm) will not be sufficiently accurate or precise. Make sure there are no cracks in the rain gauge. In areas that experience freezing weather, plastic gauges can crack and develop leaks. Place the tube type rain gauge directly next to the Davis rain collector. If using the device to measure frozen precipitation, remove the funnel and center tube and melt the catch. Use the center tube for measurement. Compare the totals on three storms. Based on this, develop an average for how far off the readings are. There are adjustment screws under the rain collector bucket that are designed to fine tune readings. Use at least three rain storms to determine the appropriate adjustment. DO NOT compare rainfall readings to reading obtained from television, radio, newspapers, or the neighbors. Due the wide variation in rainfall over small distances, such readings are not an accurate measurement of the weather readings taking place at your site. The rain collector is carefully tested and calibrated at the Davis Instruments factory to conform to its stated specifications.

Additionally, the NWS WSR-88D Doppler radar measures storm precipitation amounts (to the nearest 0.25 inch). Check the storm total precipitation amount over your location from the WSR-88D total precipitation product for a gross check (generally good in non-winter precipitation events). Doppler radar precipitation reports are available on your local NWS Weather Forecast Office web page, which can be found by going to the NWS national page and clicking on your location on the map: http://www.weather.gov/ .