

# Choosing a Data Logging Weather Station

## *5 Important Considerations*

**T**he ability to monitor environmental conditions is crucial to research in fields ranging from climate variability to agriculture to zoology. Being able to document baseline and changing environmental parameters over time is increasingly important, and from the tropics to the poles, researchers are relying more and more on unattended weather stations for this purpose. Weather stations monitor conditions 24/7 at a specific site, rather than compelling users to rely on regional weather data.

Research-grade weather stations are typically stand-alone units supporting sensors that monitor environmental parameters such as temperature, wind speed, wind direction, rainfall, soil moisture, photosynthetically active radiation and others. The sensors can be attached to a metal tripod with mounting hardware, and are connected with cables to a data logger that stores measurements. Units typically run on battery and/or solar power and all components are designed to withstand long-term outdoor weather conditions.

Data logging weather stations can be deployed and left unattended for months at a time, collecting data at user-defined intervals and storing it into logger memory. Researchers download data manually or wirelessly, and use computer software to configure, deploy, retrieve and analyze information from the station.

Whether you have experience with weather stations and data loggers or are just getting started, this guide can help you choose a system appropriate for your needs. This report includes discussions of 5 important considerations you should keep in mind, and 10 questions you should ask manufacturers.

### **TIP:**

- Sensor specifications can include measurement range, operating range, accuracy, resolution, drift, and response time.
- You should consider whether the sensors require user calibration or not.

### **1. Parameters you need to measure**

### **2. Setting up the weather station**

### **3. Data retrieval options**

### **4. Reliable and accurate measurements**

### **5. Cost and manufacturer support**

#### **1. Environmental parameters you need to measure**

Your data logging weather station must be able to accommodate sensors for all the environmental measurements you want to record.

Depending on the manufacturer and model, weather stations can support sensors that monitor a wide range of environmental parameters, for example: temperature, relative humidity, wind speed and direction, barometric pressure, solar radiation, leaf wetness, and others. Most manufacturers sell sensors for use with their stations. If there are other sensors you need that they don't offer, make sure they can provide analog and/or digital inputs that are compatible with third-party sensors you'd like to use. See the next section for more information about third-party compatibility considerations.

The number of sensors you need will determine how many data channels your logger must accommodate. Be sure to take into account how many of each type of sensor you require as well. For example, will you be measuring soil moisture at two or three depths? If you're measuring temperature, rainfall, wind direction and wind speed, you can purchase a logger with only 4 input channels to save cost. If, however, you are monitoring a suite of conditions that require multiples of the same kind of sensor, you might want to choose a logger with a dozen channels or more. You don't need to buy more logging capability than necessary, though you should consider future monitoring requirements.

## 2. Ease of configurability: Setting up the weather station

Any weather station requires setup time and effort, but some stations require a steeper learning curve than others.

Setup of the more complicated weather stations can require significant wiring and programming knowledge. Sensors may connect to the logger at screw wire terminals, and users often need to wire in solar panels and/or batteries to each of the sensors. In order to ensure secure hardware setup, some manufacturers recommend that the user have demonstrated electrical wiring experience.

These more complex systems may also need the programming skills of a systems integrator to write programs to manage measurement timing, power and communications. This can involve taking the time to learn complicated software and possibly having to write a program for each sensor.

Simpler weather stations, on the other hand, can be set up and launched in much less time by someone with no training in electrical wiring or programming. These systems have “smart sensors” that simply plug into any port on the logger. The logger and accompanying software automatically recognize the sensor and display data in the correct units. The user simply chooses a sampling interval and selects an immediate or designated future launch time. Third-party sensors are easily accommodated with analog or digital pulse input adapters.

Some simpler systems have cable extensions that easily snap into existing lines, and sensors that can be added, removed, or rearranged in minutes - an important consideration while out in the field.

Consider also the software accompanying the weather station. Applications are generally Windows-based, but some manufacturers also make Macintosh versions. The software should enable you to quickly and easily perform tasks such as setting configuration parameters, designating launch times, and offloading data with point-and-click simplicity. Check the software’s graphing and analysis capabilities, including whether you can combine graphs to compare data between sites, or if you can view all of a site’s data clearly in a single graph. The manufacturer may also have special application-specific software available.

Since environmental parameter data often needs to be passed into other software programs such as spreadsheets or modeling programs, make sure that the logger software allows you to quickly and easily export data with the click of a mouse. Also be sure that you can print graphs.

### TIP:

- How much time and energy are you prepared to invest in setting up your weather station’s software and hardware?
- Consider who will actually be interacting with the weather station. Will it be you, or members of a team?

Finally, consider whether the manufacturer can provide all the necessary mounting hardware for the weather station. Having to engineer the brackets, shields and tripod yourself adds more time and expense to the setup of your weather station.

## 3. Data retrieval options

Will you need to download your data weekly or once a year? Is the weather station on the roof of your building or near the Arctic Circle? Your choices for data retrieval depend on how often you wish to download measurements and how remote the station is.

Generally, there are two ways to download weather station data: on-site and remotely (usually via wireless networks).

On-site data download involves visiting the weather station and physically plugging into the logger to retrieve data. This can be done by connecting a laptop computer equipped with the appropriate software to the logger with a cable. Alternatively, data might also be downloaded with a shuttle-type device. These small hand-held units can hold data from multiple loggers and relaunch them without users having to bring a laptop into remote or environmentally harsh field conditions.

More and more researchers are taking advantage of wireless communications, and there are several options available for downloading weather station data and modifying logger settings. Long-range options include satellite, cellular and pager-based wireless systems that retrieve and send sensor data to a secure Internet server. These retrieval systems are best for remote field locations or for situations where data must be downloaded frequently. Short-range options include unlicensed radio modems in the 900 MHz or 2.4 GHz bands or licensed UHF/VHF modems.

## TIP:

- Web-based software that is intuitive and easy to use will make data downloading simple.
- If you need real-time weather monitoring with 5- to 15-minute updates, your weather station may require additional solar or AC power.

## 4. Reliable and accurate measurements

Data means nothing if it's inaccurate, incomplete, or doesn't make it back to the office. Choose a weather station with reliable sensors, durable hardware, and enough power to keep going even if you have to postpone a data download.

There are several things to consider to ensure reliable measurements. First, look at the operating range and accuracy. Carefully examine these specifications to make sure the sensors can measure desired parameters with the accuracy necessary for your research, and within the environmental conditions likely for your field site. When looking at accuracy specifications make sure they include all sources of measurement error (such as the A/D and reference voltage errors), and are not just for the sensor.

Your weather station's sensors and hardware will have to withstand the particular environmental conditions of your field site. Can the system hold up under driving rain, wide temperature fluctuations, and curious animals? What is its wind speed rating? Can the sensors be mounted with good spacing and minimal shading so that each has enough surrounding free space for accurate measurements?

Most remote weather stations are powered with either batteries or batteries recharged with solar panels. Batteries can last for a year or more out in the field and can be changed by the user. Check for battery power level indicators, and be sure to check if the logger will retain your data even in the event of a power failure. Data loggers with non-volatile EEPROM memory will retain data even if power is lost. Solar-power-based systems often require full sun, so for shady locations look for a battery-powered weather station. A third option, AC power, is limited to sites near buildings.

The best way to ensure that your data will be reliable and accurate is to work with an experienced and reputable manufacturer. Ask around to learn about other research-

ers' experiences with weather station hardware, software, and data, and don't be afraid to ask for references from the companies you're considering. A good question to ask is how many of their loggers have been deployed in the field, and for how long?

## 5. Cost and manufacturer support

The cost of research-grade weather stations ranges widely between manufacturers. For the lowest cost buy only the sensors and logging capacity you really need. If necessary, ensure that you can add other or duplicate sensors later. Consider future uses as well – a system that can be easily reconfigured for reuse can save money in the long run.

Be sure to add up all the system's components when estimating cost. This includes sensors, cables, logger, software, data retrieval systems, tripod, mounting hardware, and sensor mounting accessories. Almost all vendors sell a wide range of sensors for their stations; where some fall short is in the mounting options.

And again, your best choice is to work with an experienced and reliable company. Talk to colleagues, and ask the manufacturer lots of questions, especially if you have special requirements. How fast can they ship additional sensors or cables? Will the company be there in the future when you need support or want to expand your data logging capabilities?

## Conclusion

Choosing a research-grade data logging weather station can be a daunting task, but armed with the information presented in this guide, you're in a good position to find the right system for your research needs.

## 10 Questions you should ask manufacturers:

1. Do you offer the sensors I need, and can I buy only the ones I need right now?
2. How many data input channels can the data logger accept? Is there a maximum cumulative cable length?
3. What is the setup process like for your weather station?
4. Can the logger accommodate third party sensors, and how easy is it to set them up?
5. Can the sensors, logger and accessory hardware withstand the environmental conditions at my field site?
6. Is the logger memory large enough to hold all the sensor readings that will be taken between data downloads?
7. How user-friendly is your software, and can I easily

download data from the logger, generate graphs and export it to other applications?

8. What are your weather station's data download options?
9. How is the station powered? Will I lose data if the batteries fail?
10. What is your company's track record? How long have you been in business and how many of your loggers have been deployed?

### **About Onset**

Onset Computer Corporation has been producing small, inexpensive, battery-powered data loggers and embedded controllers since 1981, and has sold over one million loggers that are used around the world by over 50,000 customers. The company manufactures a broad range of data logger and weather station products that are used to measure temperature, humidity, light intensity, voltage, and a broad range of other parameters. Onset products are used widely in research, commercial, industrial, and educational applications.

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