

**ONSET®**



## **Bluetooth or USB Field Temp/RH Data Loggers: Which is Right for You?**

*A decision-making guide to choosing the  
most suitable temp/RH data logger for  
monitoring outdoor environments*

## Introduction

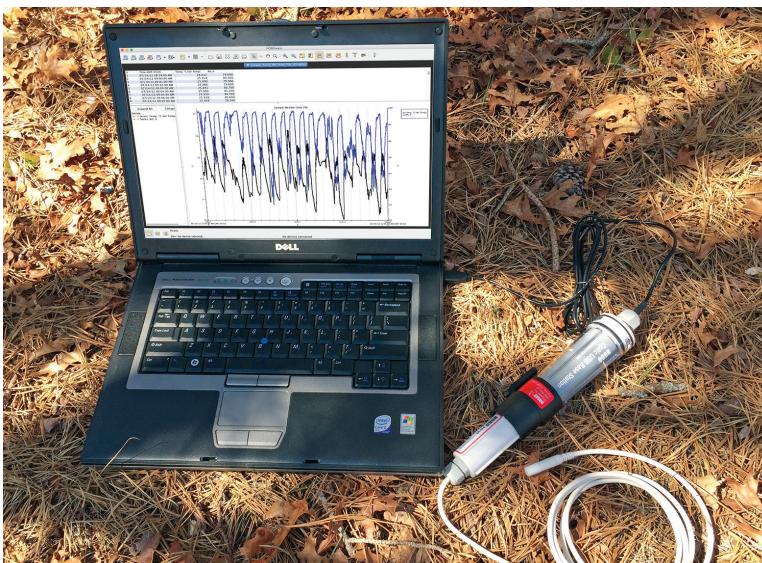
**Common to most outdoor field research is the need to systematically collect vital temperature and relative humidity (RH) data that can be used to formulate results and shape conclusions.**

Field research conducted in outdoor environments comprises a diversity of methods and incorporates several disciplines and scientific areas. Typical areas of study are agricultural research, forestry surveys, and ecological investigations. Common to most outdoor field research is the need to systematically collect vital temperature and relative humidity (RH) data that can be used to formulate results and shape conclusions.

In the field of ecology, for example, data obtained from outdoor field research allows investigators to better understand how natural systems respond to changing environmental conditions, providing insights for better protecting valuable ecosystems. Likewise, data obtained from outdoor research can provide environmental scientists with the means to analyze natural processes and evaluate the impacts of human actions on the environment. Additionally, data gathered from outdoor field research can be used to help improve agricultural practices, leading to more sustainable growing methods, higher crop qualities, and greater productivity.

To ensure thorough and accurate results—and rigorous investigative conclusions—emphasis in outdoor field research needs to be placed on the collection of quality data. For this reason, the use of robust and effective monitoring instruments is a very important consideration.

Data loggers that measure field temperature and RH are vital tools for supporting efforts in this field. Offering the capacity to automatically collect data on a 24-hour basis, field temp/RH data loggers are deployed in outdoor locations to measure and record information over time, providing a comprehensive and accurate picture of changing environmental conditions.



Generally, two categories of field temp/RH data loggers are available on the market: traditional USB options and newer models that utilize Bluetooth technology.

With USB field temp/RH data loggers, users must physically connect the data logger to the USB port of a computer or handheld device (a shuttle) to retrieve and download data—a task that is often routine, but one that can also become burdensome or challenging, depending on the environment or the specific location where the data logger is deployed. USB loggers can have either a USB connector built into them, or some other form of communication such as optical, in which case they use a base

station that plugs into a USB port in the computer. Because loggers with optical communication don't have electrical connections, which can be unreliable in the field, they can provide better reliability in field applications than loggers with USB connectors. If you are looking at loggers with optical communication, look for ones that can work with an optical data shuttle to offload data, without having to take a laptop into the field.

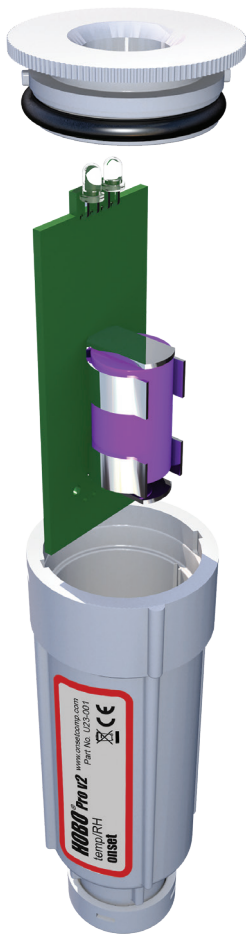
Data loggers with Bluetooth communication allow data to be transferred wirelessly to a mobile device. When looking at Bluetooth data loggers, keep in mind that there are different versions of Bluetooth. Loggers that use older versions of Bluetooth require “pairing” with the mobile devices, which means having to push a button on the logger to enable communications between it and the mobile device. This may not be practical for loggers in hard-to-access locations.

Data loggers with Bluetooth Low Energy (BLE) technology, also known as Bluetooth Smart or Bluetooth 4.0, allow data to be transferred wirelessly without having to connect cables or push a button on the logger. This means that you do not have to physically access the logger to offload data. Instead, you simply use an app on your mobile device to connect to any logger within range. The time savings when deploying loggers or retrieving data can be dramatic.

BLE is particularly well-suited to data loggers, as it uses less battery power. In addition, with a well-written app, Bluetooth loggers allow you to take advantage of the power and connectivity of today’s smartphones and other mobile devices.

The purpose of this white paper is to provide an unbiased comparison of USB and BLE field temp/RH data loggers for outdoor field research. In doing so, this analysis will seek to offer practical advice and objective guidance for determining which option is best for your unique application.





The HOBO U23 Temperature/RH Data Logger offers convenient user-replaceable battery.

## Important features to consider in temp/RH data loggers

Before examining the primary considerations that will help drive a decision between USB and BLE options, it's important to think about the key features and capabilities of field temp/RH loggers in general, regardless of whether they are USB or BLE.

### User-replaceable battery

With field temp/RH data loggers that have this option, the existing battery can be swapped out with a new one. The ability to replace the battery eliminates the need to purchase a new logger when the original battery dies.

### Measurement accuracy

It's critical to ensure that the logger will meet your accuracy requirements.

- Keep in mind that accuracy is typically specified as +/-X. This means that for two loggers measuring the same temperature or RH, one could be reading low by that amount, while the other reads high, so that they could provide readings that are twice the accuracy spec apart. For example, if the spec is +/- 0.5C, the readings from two loggers measuring the same temp could be 1.0C apart. This is especially important to keep in mind if you're comparing data between loggers deployed at different locations.
- You should also consider sensor drift over time, and the response time of the logger to changing conditions, as these factors can also affect the accuracy of measurements.
- In addition, radiation heating from sunlight can cause artificially high readings. Please refer to the section on solar radiation shields later in this document.

### Alarm notifications

A visual alarm is a valuable feature in that it alerts users that out-of-range conditions occurred. The user sets the temperature or humidity thresholds when the logger is configured.

- Do you need to be notified of the alarm immediately? If so, you need a logger that notifies you, and this is usually accomplished through the internet and a web-connected logger, which has cellular, Wi-Fi, or Ethernet.
- Alternatively, if there will be people on site who can check for alarms, a visual alarm on the logger or in the mobile app may work.
- In some cases you may just want to know that an alarm condition happened during the deployment, so you know to take a closer look at the data.
- Alarms can be especially useful in shipping applications where you want to be sure that conditions did not get too hot/cold during transport.



Above photo shows the MX2304 external temperature data logger with an alarm status, indicating a set temperature threshold has been exceeded.

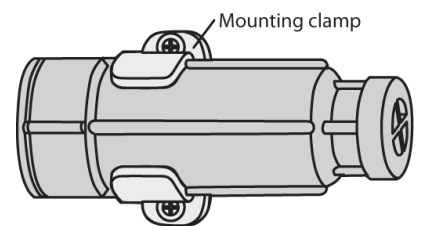
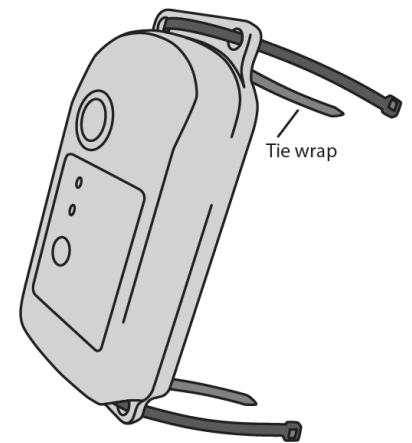
## Logging Modes

Besides the standard fixed-rate logging, determine whether you need any special logging modes such as: Wrap-when-full, Push-button start or stop, Time-date stop, Burst logging, or Statistics logging.

## Mounting mechanisms

Look for a logger that can be easily mounted in your field sites. Consider how you want to mount your loggers in place:

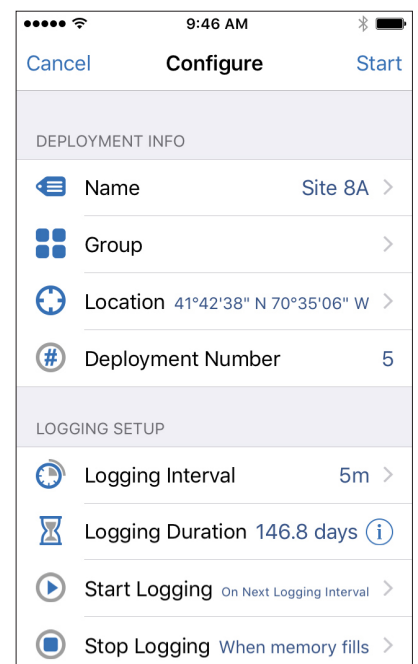
- Zip-ties are easy, fast, and secure, for speedy field deployments.
- Screws take a little more time, but are a little more secure.
- Look for a logger that includes integrated mounting holes for your preferred mounting method.
- Some loggers come with brackets that allow the logger to be removed for data download.



## Processing data from multiple loggers

If you are deploying several loggers at a time, look for loggers with these time-saving features:

- Launch time-saving options: This is the ability to define a deployment configuration once (logging mode, logging rate, start time, etc.) and use it to configure all the loggers for a deployment without having to re-enter this information for each logger.
- Bulk-export or bulk-share option: This is the ability to select multiple files and export or share them all at once.
- Automatic upload option: This is the ability for the software to automatically merge data into a web database when the device or computer is connected to the internet.



Phone screen capture above shows the Configure settings in HOBOMobile for the MX2301 temperature/relative humidity data logger

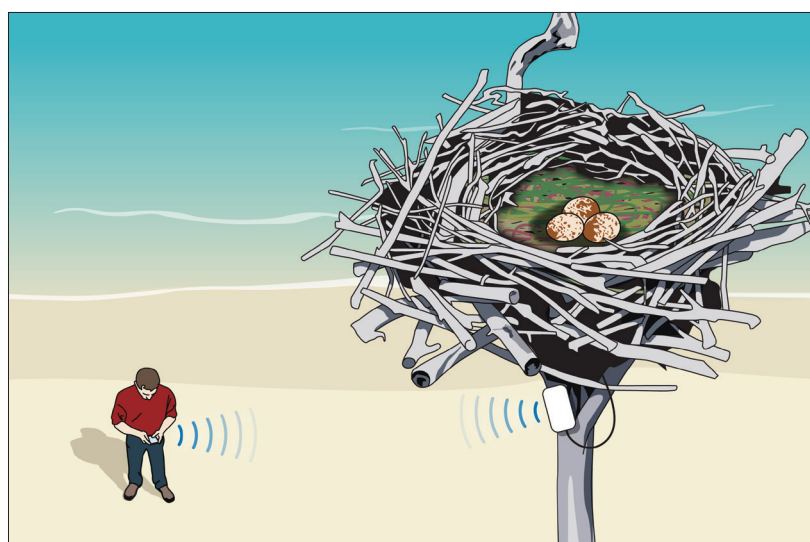
## Key aspects to consider between BLE and USB field temp/RH data loggers

**With BLE temp/RH loggers, users can quickly and seamlessly transmit data wirelessly to mobile devices from up to 100 feet away, without coming into physical contact with the logger**

For users weighing both BLE and USB field temp/RH data logger options, a range of important factors should be considered. The following topics represent key drivers to evaluate when deciding which option is more appropriate.

For existing users currently employing USB field temp/RH data loggers, changing up equipment schemes to switch over to BLE can be a difficult proposition. Many users may not necessarily feel a need to upgrade to newer BLE technology. And continuing with the same technology means using the base stations and software you already have, and not having to use two sets of software and communication devices in the field.

Nevertheless, given the potential to significantly streamline both data logger deployment and data retrieval in the field, the convenience and advantages offered by BLE can be significant.



*The above illustration depicts using a mobile device to easily download data from a BLE data logger in a hard-to-reach location.*

### Data access

For outdoor field monitoring, data access can be a critical issue—especially in applications where data loggers need to be deployed in hard-to-reach or limited-access locations. In these situations, USB temp/RH data loggers—due to the need to physically connect to a computer or handheld device in order to download data—can be more difficult to work with.

With BLE temp/RH loggers, users can quickly and seamlessly transmit data wirelessly to mobile devices from up to 100 feet away, without coming into physical contact with the logger, thus

overcoming many of the logistical challenges associated with downloading data from limited-access areas. Some examples where BLE temp/RH loggers can be beneficial include:

- Critical or endangered habitats
- Bird nests
- Tree canopies
- Crop fields
- Human-confined spaces that might present a safety issue
- Bat caves (where bats could be disturbed)
- Environmental chambers that could be compromised if opened
- Rooftops and green roofs
- HVAC studies or energy-auditing applications that require site-specific outdoor temperatures (data from a BLE logger placed on the outside could be obtained from inside a building)

## Data sharing

Because of the power of today's mobile devices, BLE data loggers that work with them provide greater flexibility and convenience in terms of where data can be transmitted and how it can be shared. The logger app on a mobile device can easily convert data into Excel or text files, and it lets you download and send data in a few simple steps. The logger apps can work with other apps on the mobile device to share these files via email, messaging, or Google Drive, or automatically upload data to web databases, like Onset's HOBOLink. And all of this can be done while still in the field, without having to return to the office to share data. As such, for users who need to share data files or measurement data, BLE temp/RH data loggers can be the most effective option.

It is, however, also easy to export data from a desktop program to Excel or other programs, often with more powerful formatting options available, such that the files can be directly opened in the other programs. Desktop software like HOBOWare, for example, provides the ability to customize exported data in terms of international date and decimal formats. If you will be looking at data on your own laptop computer, using USB loggers that can be directly offloaded to your laptop can save you the step of having to transfer files later.

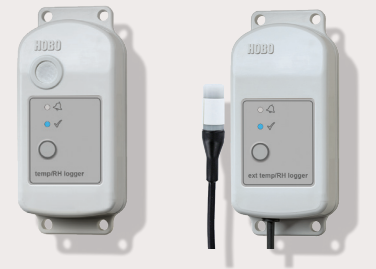
## Durability

When determining the durability of a logger, look for its IP or NEMA rating, and confirm that it's made from all UV-resistant materials. For outdoor deployments, you should use loggers that are rated IP64 or higher, or NEMA 4 or higher. For use in corrosive environments, look for RH sensors that are user-replaceable.

Also keep in mind that loggers requiring electrical connections can be less reliable in field deployments. Ideally you'd want a logger that can remain sealed during deployments and data offload. Having to open the logger in the field can expose electronic circuits to moisture, which can lead to failures.

Generally speaking, the ability for both BLE and USB temp/RH data loggers to withstand harsh environmental conditions will vary from manufacturer to manufacturer. (See sidebar for a comparison of Onset temp/RH loggers.)

### Comparing Durability



Onset's BLE options—the HOBO MX series temperature/RH loggers—are IP67-rated and have housing made of 100% UV-resistant materials.



Onset's Optic USB options, which include the HOBO U23 Pro v2 series temperature/RH loggers, use optical communications in the logger for reliable data download with a base station or data shuttle.

While both are durable, the BLE option is generally more robust and could represent a better choice for monitoring in extreme climates such as arctic regions, deserts, and coastal areas.

On the other hand, if you are monitoring in an environment that's corrosive to RH sensors—with high levels of ammonia in the air, for example—you may want to use HOBO U23s, as they are equipped with user-replaceable RH sensors.

## Cost of ownership

Product costs can vary among manufacturers. In general, however, for temp/RH data loggers the BLE option is less expensive for users who need only one or two data loggers. Cost savings are realized because BLE users don't need to buy computer software or a base station—all they need is the free app to run on their mobile devices.

For larger studies that involve the purchase of dozens of loggers, however, the extra cost associated with peripheral equipment required for USB temp/RH data loggers becomes less of a factor.

## Alarm notifications

Both USB and BLE loggers can provide alarm notifications. With BLE loggers, however, the app can highlight which (if any) loggers in the area have exceeded limits, letting the user offload and review data from those loggers first.



*The HOBO MX2301 Temperature/Relative Humidity data logger shown mounted inside the RS1 Solar Radiation Shield*

## Radiation shield integration

With many outdoor applications, the need to protect data loggers from direct sunlight is essential in order to prevent false high readings from heating caused by solar radiation. Both USB and BLE temp/RH data loggers have cables/probes that can easily be placed inside a radiation shield.

BLE options, however, allow users to mount loggers inside a shield, eliminating the inconvenience of having to remove the sensor from the radiation shield to download data and then reinstall it...and eliminating the risk of exposed cables that can be chewed by insects or rodents.

## Conclusion

When choosing temp/RH loggers it's critical to select loggers that meet your measurement needs and that hold up well in harsh field conditions. Once these basic requirements are met, you should consider the advantage of BLE loggers for deploying in hard-to-access locations, where wireless data offload can save a lot of time and prevent disruption to the environment. And because they work with an app on your phone or tablet, BLE loggers give you access to all the convenience and power that today's mobile devices provide.



## Other informational resources available from Onset:

### Data Logger Basics

In today's data-driven world of satellite uplinks, wireless networks, and the Internet, it is common to hear the terms "data logging" and "data loggers" and not really have a firm grasp of what they are.

Most people have a vague idea that data logging involves electronically collecting information about the status of something in the environment, such as temperature, relative humidity, or energy use. They're right, but that's just a small view of what data logging is.

### Choosing a Conductivity Logger

Whether you are selecting a conductivity logger for the first time or have experience measuring conductivity, this paper can help you determine the type of logger that best suits your needs. It highlights the five most important considerations in selecting and deploying a conductivity logger: measurement range and accuracy, other factors that affect accuracy, ease of deployment and offload, software capabilities, and cost of ownership.

### Choosing a Temperature Data Logger

This guide details features to consider when choosing a temperature data logger, including accuracy requirements, data access needs, software packages, and power requirements. Explore real-world application examples that illustrate how users have incorporated portable data loggers into their temperature monitoring projects.

Whether you are an experienced data logger user or just getting started, this guide can help you choose the ideal temperature logger for your application.

### Monitoring Green Roof Performance with Weather Stations

A data logging weather station is the ideal tool for documenting green roof performance, as it can measure weather parameters such as rainfall, stormwater runoff, temperature, relative humidity, wind speed, solar radiation, and a host of non-weather parameters, such as soil moisture. And it measures these parameters on a continuous basis (say every five minutes, hourly, or at some other interval appropriate to the situation).

The information a weather station collects can help you make wise choices about designing, tuning, and maintaining a green roof. This guide explains how a weather station can be a valuable component of a green roof project, and shares information particular to this type of application.

### Deploying Weather Stations: A Best Practices Guide

From the tropics to the poles, climate, agriculture and other researchers rely on unattended research-grade, data logging weather stations. For example, the US Department of Agriculture uses weather stations to study anything from molecular plant pathology to forest management. Non-government groups, such as universities, use weather stations to study a wide array of subjects including how glacial activity affects air temperature. Additionally, commercial companies depend on weather stations to conduct businesses.

Our best practices guide, *Deploying Weather Stations*, shares field-proven tips and techniques for installing research-grade weather stations in the field. A range of topics are discussed, including weather station site location, sensor placement, system configuration, and cable protection.

### Monitoring Wetlands with Data Loggers: A Best Practices Guide

Wetlands act as a natural filter for polluted water and thus play an essential role in water quality protection. They serve as floodwater storage to help minimize erosion, and create a habitat for many fish and wildlife.

While a variety of factors have decreased the number of wetlands in the U.S. by half since 1950, many organizations are restoring wetlands back to their original flourishing ecosystems. To ensure success, it is necessary to monitor wetland factors such as water level, temperature, and rainfall.

**Access our full resources library at:  
[www.onsetcomp.com/learning](http://www.onsetcomp.com/learning)**

## About Onset

Onset is a leading supplier of data logger and monitoring solutions used to measure, record and manage data for improving the environment and preserving the quality of temperature-sensitive products. Based on Cape Cod, Massachusetts, Onset has been designing and manufacturing its products on site since the company's founding in 1981.

Visit Onset on the web at [www.onsetcomp.com](http://www.onsetcomp.com).



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