Trouble-Free Wireless Weather Station Setup and Maintenance

The Definitive Guide

Second Edition

By Monax Test & Weather

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Personal Message from Monax Test & Weather

We hope you find Trouble-Free Wireless Weather Station Setup and Maintenance – The Definitive Guide useful and that it helps you to have many years of enjoyment with your weather station.

To contact us click on the link below or copy and paste it into your browser:

http://www.monaxtestandweather.com.au/

Preface

Weather can be majestic in its beauty and ruthless in its destructive power. It is always around us and its impact on us is unquestioned. At Monax Test & Weather we specialise in measuring and predicting weather with our range of weather stations and environmental monitoring equipment.

We have been selling and supporting our products in Australia, New Zealand and the UK since 2004 and we are glad you have decided to join our weather watching ranks. This guide is intended to step you painlessly through the setup of your wireless weather station and ensure your station runs seamlessly for many years.

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Chapter 1: So You've Bought a Weather Station, Now What?

STOP! Back away from your weather station until you read this!

When set up correctly weather stations can be lots of fun and provide years of trouble free operation. When set up poorly they can be one of the most frustrating experiences in the world.

You only need to look in any weather forum to read stories of troublesome weather stations and to see the problems you can have if care isn't taken during setup. These stories generally follow a typical pattern of multiple replacement parts or completely new units from a well-meaning but non-expert vendor and a customer who gets progressively grumpier until they eventually return the unit or cut their losses and throw it away.

But there is hope! It is possible to have a smooth and painless setup and years of excellent service from your station by following a few simple steps. So resist the urge to dive straight into setting up your station and **read this guide and your manual thoroughly**, it will save you an enormous amount of time in the long run and keep you out of the technical support areas of the weather forums.

Chapter 2: A Note on Batteries

The better the quality and charge of your batteries the greater the range your station will have and the fewer signal dropouts you will experience. It is for this reason that you should **avoid rechargeable batteries** as most are 1.2V not the 1.5V required by most weather stations.

Some stations like the Aercus Instruments WS3083 ship with rechargeable batteries but check whether they are alkaline rechargeable batteries as these are not very common and cannot be charged in standard battery chargers. When it comes time to replace alkaline rechargeables you can generally just use good quality non-rechargeable alkaline or lithium batteries as the trickle charge provided by most solar chargers is low enough that these batteries can cope with it.

Keep in mind that different types of batteries may perform better at different times of the year. During winter for instance, when the temperature may remain below freezing for extended periods of time, using lithium batteries is ideal because they function much better at low temperatures than alkaline batteries that are known to lose power in the cold and even freeze. When they thaw they will start working again, but obviously you do not want to have to wait for that.

Also be wary of batteries that ship with a station as their quality and charge levels vary greatly. You are almost always better to discard these and use your own new batteries.

Chapter 3: My Weather or Everyone's Weather?

Weather is a contradiction in terms in many ways. It can be incredibly powerful and paint with a broad brush over a wide area. We only need to see the widespread destruction storms and hurricanes cause each year to understand that. At other times weather can be subtle and isolated. If you have ever seen rain drifting out across open expanses like parks, fields, or water while you stand in bright sunlight, or a ray of light peaking through clouds off in the distance you will understand what we mean.

So the first thing to understand is that setting up a weather station can be a balancing of competing needs and you can encounter a number of trade-offs depending on your aims. Some users take great pride in the accuracy of their readings compared to their local weather service's data. Others simply enjoy tracking conditions at their place and are happy to use the weather service for a broader outlook. If you fall into the latter camp your setup job just got a lot easier. If you want to track accurate weather conditions for your wider town/suburb/city then you will face more trade-offs and typically spend more time fine tuning your setup.

Why is this? Mostly because if you are trying to be a mini weather service for your area you need to minimise the influence of the layout and obstacles at your place, e.g. trees, hills, buildings. If you are more interested in tracking conditions at your place then the impact of these things is all part of what creates the true weather conditions experienced at your place.

For example, if you are most interested in tracking conditions on your deck or in your back garden then a stand of trees down the end of your

garden that blocks the wind doesn't create any problems. However, it will cause your station to under-report wind conditions compared to those for your wider area, if this is what you are trying to measure. The Fence Mount setup below is a good example of a setup that will capture conditions at your place. The Roof Mount setup is going to be less influenced by obstructions and will give measurements closer to those for the general area.

Fence Mount

Roof Mount

The most common frustrations we see come from users who don't have a clear understanding of this distinction. They typically have bought a mid-market weather station, spent little time on setup and can't understand why the readings of their $189 purchase don't match up with the readings of their local weather service.

This raises another important point which is that even with higher spec weather stations and a finely tuned setup you can get close to your local weather service's readings (who have spent vast sums and

employ huge teams to provide accurate conditions and forecasts for broader geographical areas) but there will always be times when your readings diverge.

Chapter 4: Setting Up Your Weather Station

Test First, Then Install

THE FIRST THING YOU ABSOLUTELY MUST DO before installing your weather station is test that all the components are working correctly. It is very time consuming to go back and forth, inside and outside, up ladders and down again so step one is a desktop test.

Remove the sensors and transmitter from the box and connect them up as per the user manual. You do not need to mount them to any mounting arms or poles at this stage they just need to be wired up to each other correctly.

NOW THIS NEXT BIT IS IMPORTANT! Almost all weather stations need to have the batteries put in the outdoor sensors BEFORE you put the batteries in the console. So do this first, then get the console and put the batteries in that. Doing this in reverse can result in long delays before the sensors and console sync up.

Each weather station will have a slightly different start up sequence but this is often all that is needed to get them running, however DO NOT TOUCH THE CONSOLE UNTIL IT IS SHOWING THE READINGS FROM THE OUTDOOR SENSORS or this can cancel the sync. Typically dashes are displayed until the outdoor readings appear. Once these readings appear you know your sensors are talking to your console.

By way of example here are the startup procedures for two popular models:

Aercus Instruments WS2083

1. Insert the batteries in the transmitter first.
2. Insert the batteries into the base console.
3. DO NOT TOUCH THE UNIT UNTIL THE OUTDOOR READINGS APPEAR (this can take up to 10 minutes in some cases).

La Crosse WS2355

1. Insert the batteries in the transmitter first and then into the rain gauge.
2. Insert the batteries into the base console.
3. DO NOT TOUCH THE UNIT UNTIL THE OUTDOOR READINGS APPEAR (this can take up to 10 minutes in some cases).

Now test each of the sensors in turn. Note: weather stations transmit at intervals so there will be a delay between testing each sensor and it appearing on the console's readings. Intervals commonly range from 5 - 90 seconds so check your manual for your stations transmission interval.

First, spin the wind speed sensor (this is known as the 'anemometer') and check that your console shows some wind speed.

Once you see the wind speed readings check that the wind direction sensor is working correctly. Typically wind sensors have an "N" for north somewhere on their base so align the nose of the wind direction sensor with that and check that your console is showing north. Do this

test a few times using different directions and check that what you see on the console matches where the wind speed sensor is pointing.

Next test the rain gauge. The rain gauge in a modern weather station is the self emptying variety. This is simply a small see-saw with a "spoon" on each end. As the rain flows down into the gauge it fills up one of the spoons until the seesaw tips, the water then spills out of the spoon and out the bottom of the gauge. Now the other spoon starts filling up until it too tips and empties. Your weather station knows how much water each tip represents and converts this to a rainfall reading.

To test the rain gauge, first check your manual for your station's rain resolution (typically found in the specifications section). The Aercus Instruments WS2083 for example has a resolution of 0.3mm meaning for each tip of the seesaw your console should record an additional 0.3mm of rain. Now either tip the gauge back and forth in your hand so you can hear the tipper moving inside or remove its cover and tip the tipper directly. Check that you are getting the correct rain readings for the number of tips you do.

Now test the outdoor temperature and humidity readings. The easiest way to do this is to put the outdoor temperature/humidity sensor (often this is part of the one transmitter unit) next to the console and leave for a period of time. You should expect over half an hour or so that the indoor readings (measured inside the console) converge with the outdoor readings.

Note though that it is not uncommon for there to be a slight difference even after leaving for a long time. Mid-market stations for example generally have a temperature accuracy of +/-1C and a humidity accuracy of +/-5%RH (Relative Humidity). Also the temperature and humidity sensors in the console and those in the outdoor sensor are

often calibrated differently as the outdoor sensors are designed to measure a wider range. So it is possible for the station to be working correctly but show up to a 2C difference in indoor and outdoor temperature and 10%RH difference in humidity.

Lastly, if you have a station like the Aercus Instruments WS3083 that has UV and/or light readings make sure you are getting some numbers on your console that broadly make sense. An easy test is to take the UV/light sensor outside and check the readings and then bring it indoors and check the readings. Note: if you have an Aercus Instruments WS3083 the UV/light data transmits every 60 seconds separately to the other outdoor sensors so these will be out of sync with each other and you can have good communication with one lot of sensors and not the other.

Now that you know your outdoor sensors are working properly you can move on to installing.

Installing - A Tale of Compromise

There are three interconnecting factors that are crucial to the performance of your weather station:

1. The first is the placement of the console/receiver, which should be in a spot where it is convenient for you to use. If you plan to link it with a computer or other device you should consider this when you are choosing a place for the unit.

2. The second is the placement of the weather sensors, which is extremely important. This determines the accuracy and reliability of the data they record and report.

3. The third is the communication between the sensors and the

receivers. Interference needs to be minimised to allow information to be transmitted.

Location of the Console/Receiver

The first thing you should consider when choosing a place for your console is how far it will be from the outdoor sensors. The transmitting range can vary greatly between devices and this range will be reduced every time the signal has to pass through a wall. Most weather stations quote a range which is the maximum range in an open field, e.g. 100m is common. In practice when going through normal walls or roofs a safe rule of thumb is to expect a usable range of 20-40% of that theoretical maximum.

To minimise the amount of obstruction between the receiver and sensors, position the receiver near an outside wall where possible.

If you are going to connect to a computer the obvious location to site the receiver in is the room that you keep your computer in. If this location also happens to be nice and close to the best place to mount your outdoor sensors you are one of the lucky ones.

If you are not going to connect to your computer then you can consider the location of the weather sensors before the location of the receiver.

Location of the Outdoor Sensors

Once you have found a location for your sensors we strongly advise you to check that you are still receiving the signal on your console before permanently mounting!

There is rarely a perfect place to site your weather station sensors although often there is an obvious "best" place. This is because different types of weather sensors have different ideal sites. The main

trade-offs are:

- The sensors need to be located somewhere easy to reach for maintenance and battery changes, but out of the way of everyday activity.
- Rain gauges like unobstructed rain and minimal wind (to minimise splash out). Wind sensors on the other hand like unobstructed wind.
- Temperature sensors need to be shaded (often times under the eaves of a house is a good place) whereas rain and wind sensors need to be unobstructed. Note, if you have bought a desktop unit such as the Aercus Instruments WS1173, La Crosse WS9040, or Oregon Scientific RMR802 the outdoor sensor is not weatherproof and MUST BE SHELTERED FROM THE RAIN by mounting under an eave or similar.

Also as discussed earlier you need to decide whether you want to measure the conditions at your place or try to get accurate conditions for your area as this impacts where and how you locate your sensors. If you want to measure conditions at you place then a lot of what follows is not critical other than allowing for access for maintenance and shielding the temperature sensor from excessive sun, so you can to a large extent simply locate the sensors where you want to measure those conditions. If you want to try and get accurate measurements for your area then the advice that follows is important.

One of the most important things to remember about siting particular kinds of weather sensors involves temperature sensors. To report accurate data they must not receive direct sunlight or sunlight that has been strongly reflected off nearby surfaces. The light will not only heat

up the sensor, causing it to yield higher readings than it should, it can even damage them. Wind and rain sensors are the opposite of temperature sensors in that they report the most accurate data when they are placed away from sheltering buildings or trees that may block the wind or rain.

Here are the main things to consider:

- If you are located in the Northern Hemisphere, you can site your temperature sensors on north-facing walls slightly below the eaves. This will provide shelter from the rain while still having the sensor low enough that its readings are not affected by heat emanating from the roof. If you are in the Southern Hemisphere, site your temperature sensors on a south-facing wall. If you do decide to install your temperature sensor in this position it might be a good idea to install the wind and rainfall sensors on the nearby roof, if it is not pitched too steeply.

- If you are unable to mount your temperature sensor in the shade then you are likely to record temperatures higher than what you see from your local weather service who measure temperature in the shade. This is because the solar shields that most common stations ship with are ok but don't do a complete job of protecting the temperature sensor from direct sun. You can easily make your own shield to ensure accurate data collection by simply making slots in a sheet of plastic and placing it over the sensor. This is the preferred approach if you have solar powered batteries as the solar panel needs to be fully exposed to sunlight for best results.

- Wind and rainfall sensors can also be mounted at the top of out-of-the-way fence posts in a yard. In this case, the temperature

sensor can be sited on the shady side of the post, slightly lower than the others.

- Mounting these sensors on a roof will most likely be the best choice if your yard is unsuitable. When the proper measures are taken, like shielding temperature sensors from sunlight, the roof is an excellent location for the sensors to be exposed to the weather and collect accurate data.

- The rain gauge needs to be cleaned regularly (every few months depending on how exposed to leaves, birds and bugs it is) and so should not be sited somewhere that is too difficult for you to access. Also, make sure the compartment(s) that house the batteries in each sensor can be opened easily.

- Rain gauges should be sited so that their lips are the highest point in the area. Placing one slightly above a fence post or wall is a good idea.

- Wind sensors, or anemometers, will produce the most accurate data when they are sited in an area where the wind blows without being obstructed by any nearby objects. Many home weather station users would be hard-pressed to meet the World Meteorological Organisation's standard placement, which is 10m above the ground with no interferences at or above that height. A compromise is usually the most practical outcome for home weather station installations. The simple fact is that finding an ideal site is difficult so it is up to you how far you want to go with finding a suitable place for your wind sensor.

- Once a site has been located the mast of the wind sensor should be mounted exactly perpendicular to the ground (use a

bubble/spirit level to ensure that it is vertical) and the wind direction indicator should be faced north. YOU MUST ENSURE THAT THE NORTH ON THE BASE OF THE WIND DIRECTION SENSOR IS POINTING NORTH OTHERWISE YOU WILL GET INCORRECT WIND DIRECTION READINGS!

- Depending on which station you have and how you have mounted your sensors you may have excess cable that you need to tidy. We have found that wrapping the cables around the support arms on a sensor tree can provide a very clean/tidy look and prevent water flowing down cables and into sensors.

- For sensors powered by solar energy, refer to the manufacturer's instructions on battery backup, orientation, and precharging.

- If you're serious you could consider using a Stevenson screen to shield your weather sensors. Most research and official weather stations use them. They can be expensive, but are fairly easy to assemble and very useful. Your wind and rainfall sensors could be mounted on top of it. A Stevenson screen is basically a slatted box with legs. The sides are made of slotted boards with covers over the slots and there is a gap between the sides and the roof, which is doubled. You will find many plans for home made expensive and inexpensive versions by searching Google.

However, this piece of equipment is not always necessary. A simple shield for your temperature sensor is usually enough.

- The wireless connection between the sensors and receivers is crucial to the efficacy of the weather station. If the signal transmitted by one of your sensors is poor or out of range of the receiver try relocating the sensors or console (be aware of possible sources of interference such as PCs, portable phones etc) and/or replace the batteries. To test whether range or interference is an issue bring the transmitter and console next to each other and follow the appropriate reconnect procedure so the console picks up the sensor signal again. If that is ok then you may have a range or interference issue.

Keep in mind that while these recommendations should be closely followed, some compromise is ok and is even expected.

Once the outdoor sensors are installed the last thing you will need to do is return to your console and calibrate the barometer. Barometric pressure sensors are usually placed inside the indoor display console of a weather station, making the position of the console itself important as the physical environment it is in will affect the pressure measurements. Ideally, you should install the display console indoors where the temperature is fairly constant.

The elevation of your weather station will also affect the barometer's measurements and is one of the reasons why the barometer must be calibrated. A barometer measures air pressure relative to sea level so needs to be calibrated to adjust for its elevation.

Calibrating the barometer is usually a very simple matter, simply go to your local weather service website and find the pressure reading for

your area. Then follow the instructions in your manual and adjust the pressure on your console to match.

Chapter 5: Maintenance

An Ounce of Prevention is Worth a Pound of Cure

A weather station is a delicate piece of electronic equipment that spends its entire life outside in the elements. This is one of the toughest things to accomplish in the world of electronics, particularly so for weather equipment as it requires protection from excessive moisture but also needs air to circulate freely in order to give accurate temperature and humidity readings.

As a rule of thumb, mid-market stations such as Aercus Instruments, Oregon Scientific, La Crosse and Technoline can be expected to last 3-5 years before spare parts may be needed. Higher spec stations like Davis can be expected to last in the order of 7-10 years. Maintenance plays a big part in this though, and this is particularly true for mid-market stations that benefit greatly from a little TLC.

Waterproofing

Some parts of weather sensors like the battery and transmitter are not always waterproofed. Instead the solar radiation shield that sits over the top is designed to keep rain out but still let air circulate. In certain conditions these can fail, e.g. strong wind that blows rain sideways. Providing some extra waterproofing can go a long way towards ensuring optimal functioning. To waterproof a compartment simply apply silicone sealant or waterproof grease regularly.

Problems created by water penetration can also be minimised by establishing a drip loop on any cables. This is an easy process; just give the cables enough slack so that instead of travelling in a straight line from one destination point to another they droop down creating a

low point that water can drip off of. Alternatively wrap the excess cable around the sensor mounting arms as discussed earlier.

Wind Sensors

Wind sensors must be inspected and cleaned, and the bearings lubricated at least once annually. To ensure the accuracy of the directional wind data check that the wind vane is oriented properly and adjust it if needed. In winter be careful with trying to remove ice as the plastic of the sensor can easily break at very low temperatures. It is usually best to simply let the ice melt by itself or bring the sensor inside where it is warmer. Most of the year you don't have to perform any maintenance unless you notice that it stops rotating freely during light winds. In that case you must closely examine and probably clean it. If the problem persists you may have faulty bearings in which case it is easily fixed with a replacement anemometer from the relevant retailer or manufacturer.

Cold Temperatures

If you live in a place where it tends to get extremely cold you might find that the low temperature or freezing rain impairs the movement of the rain gauge or the wind sensor. In that case just spray penetrating fluid on the movable parts.

Also note that it is normal behaviour for any LCD screens on outdoor sensors to fade when the temperature reaches -18C. Like alkaline batteries, they will resume working when the weather warms up again.

Rain Gauges

The primary issue with rain gauges is that the funnel can be clogged by dirt, debris, or even birds' nests, and must be checked frequently (every

few months depending on how exposed to leaves, birds and bugs it is). Thoroughly clean both the funnel and the tipping bucket (by removing the cover) with water and a mild detergent. Check underneath the sensor as well but be wary of any creepy crawlies that may be living under it.

Fastening a couple of loose lengths of wire to the rain gauge can be a good preventive measure against birds and will not affect the data collection process.

Light and UV Sensors

Solar radiation and UV light sensors should be inspected every few months. Their lenses and/or covers need to be cleansed of any dirt, dust, or debris that accumulates.

Chapter 6: Weather Station Troubleshooting

Here are the most common issues that we see along with explanations and solutions:

6.1 I Am Not Receiving Any Outside Data

This is the most common issue experienced with wireless weather stations. Check that batteries in all transmitters and the console are fresh and fully charged. Alkaline batteries slow down and freeze in colder temperatures which leads to signal dropouts so we recommend Lithium batteries in colder climates. Also avoid rechargeable batteries as many are 1.2V (standard 1.5V required) and they leak their peak charge quickly even if they are 1.5V.

Put the batteries in the receiver last to force a proper resync. Note make sure you follow precisely the startup instructions in your manual as stations vary. Removing the batteries from some consoles will erase the historic data so where possible download the data to your PC first. For this reason some stations have a “seek” procedure which forces the console to search for the transmitter without having to restart the console, for example, most Aercus Instruments stations will seek out the transmitter if you hold the Down button for 4 seconds.

Check that the transmitter is not out of range. Test this by taking the receiver closer to the transmitter, remove and reinsert the batteries (or follow your station's resync procedure) and wait for a few minutes to see whether the signal is picked up.

Check for sources of interference (cordless phones, baby monitors, PC monitors etc). If this is an issue the console and/or transmitter will need to be relocated.

If none of these is causing the problem you may have a faulty transmitter so contact your retailer or the manufacturer for a replacement.

6.2 Lower Than Expected Wind Speed

Some stations allow you to display either Average or Gust wind speed. When set to Average, wind speed is measured as the average speed recorded over the period between transmissions. In gusty weather this can appear as though it is under reading. Set this to Gust to view the maximum wind speed during each transmission interval.

The other cause for low wind readings can be faulty bearings. You can typically tell that you have a bearing issue when the anemometer jams when you try to spin it manually. In this case it is easily fixed with a replacement anemometer from the relevant retailer or manufacturer.

6.3 Incorrect Wind Direction Readings

Check that you have aligned the north on the wind sensor base (often marked as 'N') with north at your location.

6.4 Wind and Rain Spikes

Weather stations may sometimes display spikes in values that have

nothing at all to do with the weather conditions they are meant to be recording. These instances are caused by radio frequency (RF) interference, which can be extremely difficult for the average user to determine the source of.

RF interference can be caused by many things, including cables crossing or laying parallel to other cables, or a nearby malfunctioning device that is emitting stray RF. It can also be caused by your weather station being too near a power line or a cable that is picking up RF from another transmitter.

Some software comes with filters that ignore data that looks like a spike. This generally needs to be switched on and set so check your software's manual for this. You can also try adding a ferrite core, changing the location of the weather station's components, and rerouting, reorienting, and twisting the cables. If none of these possible solutions fix the problem, you will have to use screened cable. CAT 5 network cable is best for this.

6.5 Higher Than Expected Rain Readings

Depending on how you have mounted your rain gauge, wind can sometimes get in underneath it and move the lightweight tipper inside which causes false rain readings. If you are getting rain readings when there is no rain and/or your high rain readings coincide with strong winds this is most likely your problem. To fix this mount the rain gauge on a flat surface or place a flat piece of plastic on the underside of the rain gauge to prevent the wind getting in.

False rain readings can also be caused if your mounting pole is able to wobble in the wind (as this can cause the tipper to tip) so make sure you have everything mounted as securely as possible.

6.6 Lower Than Expected Rain Readings

This is often due to obstructions in the rain gauge. Remove the cover from the rain gauge and check for spider webs etc that may be impeding the tipper's motion. Tip the tipper back and forth, and check that each tip is registering on the console correctly (remember to allow for your stations transmission interval).

6.7 My Rain Gauge Seems Inaccurate

There are some common errors to watch out for when comparing rain readings between devices:

- Comparing the readings to a manual rain gauge that reads in mls. All weather stations measure in mms which will produce a different reading to a gauge reading in mls. To convert between the two you divide the mls by the surface area of the weather station rain gauge (in cm^2) and multiply by 10.

- Tipping water from one rain gauge into the weather station rain gauge. Even if both gauges read in mms, unless both rain gauges have exactly the same size mouth opening the reading will be different. To explain, "mm" as used in rain measurement means "mm per square meter" so the wider the area capturing the rain the more volume of water each mm equates to (and vice versa), e.g. to cover a football field in 1mm of water takes considerably more water than to cover the bottom of an ice cream container in 1mm. Weather stations of course make a calculation to convert the volume of water they measure to a standard "mm per square meter" but the actual volume of water captured before this calculation is made depends on the surface area of the gauge in question.

- Comparing to your local weather service or a rain gauge not located exactly next to the weather station rain gauge. Rainfall varies significantly in different locations and even small differences in location can cause significant variations due to the impact of wind and/or obstructions from buildings etc. Even two rain gauges placed side by side at the same height may read slightly differently as each will react differently to wind and splash out (although you would expect them to be close).

- Comparing over different time periods. When comparing two rain readings they must be measured over exactly the same time period. Some users confuse the start and end times that their weather stations are measuring over.

To test whether your gauge is reading correctly, follow these steps:

- Place the console and transmitter near each other to rule out interference or distance issues.

- Remove the cover on the rain gauge and check for spider webs or anything that might be restricting its movement.

- Tip the tipper back and forth a few times and note what gets registered on the console. If it is working properly, after allowing for transmission intervals, each tip of the tipper should register the amount as per your stations specifications in its manual.

6.8 My Temperature Sensor Seems Inaccurate

If your outdoor temperature sensor is reading higher than you think is correct see the Setting Up Your Weather Station chapter above to make sure it is getting enough protection from the sun.

If you are getting differences between two temperature devices note

that each thermometer will have its own accuracy and you need to add these together to get the maximum possible difference. Two thermometers with accuracies of +/- 1C for example can differ from each other by up to 2C subject to these additional issues:

- Each thermometer may be calibrated to a different temperature, meaning they become less accurate as they move away from their calibrated temperature.
- Outdoor temperature sensors and indoor temperature sensors are typically designed to measure different temperature ranges and have different response times, which creates differing calibration curves.
- Temperature and humidity are inter-related and a thermometer will read a little differently at a constant temperature as humidity changes. Each thermometer will respond differently to various temperature/humidity combinations.
- Electronic thermometers use linear approximations which can also introduce differences.

Errors are usually greater at the extremes of each temperature sensors range. Because of the issues above it is difficult to obtain an accurate comparison under non-laboratory conditions.

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Good luck with your weather watching!