What makes you think your controller is so smart?

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Where does the “smart” in a smart controller come from? Smart comes from sensors, in all varieties. With the goal of automatically watering plants according to their need in a world where weather conditions change constantly, sensors must play a central role in making decisions about when and how much to irrigate. If you believe in the old “garbage in, garbage out” philosophy, a close look at how sensors are used in any smart control system becomes paramount. There are four things that must be taken into consideration: what is being measured, sensor quality, sensor maintenance, and sensor installation. Getting all four of these right presents obstacles that are easily overcome by utilizing an ET Weather Station that is shared with the community. Before we discuss the details of success with sensors, and the value of sharing weather data with the community, a brief discussion of Evapotranspiration (ET) is necessary.

The most common and most successful approach to sensor-based irrigation is the use of weather information to calculate Evapotranspiration (ET). ET is a measurement of the amount of water that has evaporated from the soil and transpired through the plant itself. The research around ET began in the 50’s with a lysimeter and a weather station. A lysimeter measures the weight of the soil and water where plants are growing. By calculating the changes in the weight, a very accurate measurement of evapotranspiration can be obtained. A lysimeter is not cheap or easy to set up and use, so a weather station measuring everything that could effect soil moisture (solar radiation, temperature, wind, humidity, and rain) was installed next to the lysimeter. Researchers used the weather station measurements and complex mathematics to tell them the same thing the lysimeter was telling them. By the 80’s, this science had become exact enough to become a major part of commercial landscape and agricultural irrigation water management. Since then, thousands of sites have obtained incredible results with the use of an ET weather station to automate water management.

In 1999, the Irrigation Association requested a “benchmark reference evapotranspiration (ET) equation.” There was a need for an ET equation that was reliable and universal across the country. The Result was “The ASCE Standardized Reference Evapotranspiration Equation” which uses a measurement of air temperature, humidity, solar radiation, and wind speed. The Irrigation Association, in their Best Management Practices, has endorsed this approach to calculate ET. In addition to a sensor for solar radiation, temperature, wind and humidity, a sensor measuring rain is also necessary to determine the amount of water rainfall adds to the soil. These five sensors are necessary for a weather station to have a “full sensor set” and to be considered an “ET Weather Station.” The ASCE Standardized ET equation is highly accurate and proven based on years of nationwide testing.

An ET weather station measures all the weather conditions that have an effect on how quickly the landscape dries out. Each of these fives sensors serves an important purpose. Eliminating any of these sensors compromises the accuracy of the end result. For example, if solar radiation is not measured, then landscapes will be over-watered when it is overcast.

An ET Weather station, and some smart controllers use a tipping bucket rain gauge which measures rain as opposed to the more common rain shut off device, which only knows if it is wet or dry. In Florida, the average Rainfall a year is higher than the average ET in a year. With this in mind, we need to realize that an accurate rain measurement is as important as an accurate ET measurement. A simple rain shut off device ignores small rain storms, and does not adequately delay watering after large rain storms. Clearly, knowing how much rain has entered into the root zone is essential to getting optimum results.

Sensor quality is essential to success. Who wants a temperature sensor that reports 200 degree days? We need sensors to be accurate, giving us the right information. We need sensors to be reliable, so that the information we need is always available. We also need sensors that will last. Most irrigation professionals would never install products with a short life expectancy, yet many sensors will not provide long-term results, which can impact the entire landscape. Poor results will occur if sensors are not accurate, reliable, and long-lasting.

Sensor quality alone is not enough to guarantee long-term results. Even the best sensors require regular calibration, cleaning, and maintenance. As irrigation professionals, we must realize that when we use sensors for irrigation control, long-term results will not occur without a plan for maintenance. Our goal should be sustainable results. Without sensor maintenance, sustainability is lost.

If you take the best sensors and implement a plan for sensor maintenance, you are still one step short of success. Sensors must be sited properly for reliable results. The goal is to find a place where the measurements will adequately represent the conditions that affect the landscape. Weather stations are meant to be installed in the landscape (preferably in grass), and must be installed away from obstacles that will effect the measurement of the sensors. For example trees could cast a shadow on a solar radiation sensor and buildings may block wind. Finding the right site for sensor installation is critical to success.

When you consider all the factors, it becomes clear that if a reliable, accurate, and sustainable solution is desired, we need a full sensor set (all five sensors) of high quality sensors that are well sited, plus we need a plan for maintenance. Sharing weather information with as many sites as possible may be the only way to do this in a cost effective way.

For years Maxicom and other central control systems have been sharing weather data from a single station for school districts and large parks departments that have sites that are spread out across a community with great success. Some smart controllers use this same concept to make weather data available to an unlimited number of sprinkler controllers. For a moment, lets visualize a community with 1,000 sprinkler controllers. To accurately automate water management, remember that we will need all five sensors. If we were to install five sensors on each sprinkler controller we would be installing 5,000 sensors. To keep costs down, the sensors will have to be of lower quality. Finding the right location for 1,000 sensors will also be very challenging. Next we must determine a solution for maintaining these 5,000 sensors in hope of providing sustainability. Using on-site sensors in this example will be very challenging, and wrought with difficulties. On the other hand, if we choose to share weather information, we can now use one high

quality ET weather station, and all 1,000 controllers will share the data. Only one good site needs to be found and maintenance only needs to occur on one ET weather station.

A question that some have about using weather data from a regional weather station is how closely conditions at the weather station site match the site of the landscape. To answer this question, we must discuss ET and rain separately. Let us discuss ET first. In practice, parks departments, universities, and other large property owners have been sharing weather data from a regional weather station with great success for many years. When you start to think about the weather parameters that effect ET, and how much they change over an area, this starts to make sense. You can ask yourself "how far do I have to go before I notice any significant change in temperature, cloud cover, wind, and humidity." In general terms, these parameters tend to be stable over larger areas. Researchers are also finding this to be true. For example, the California Irrigation Management Information System used 200 weather station sites to determine that the entire state of California has 18 "CIMIS Reference Evapotranpsiration Zones." The average difference between the weather stations within a zone is about 0.01 inches per day. Sharing ET data from a regional weather station works.

Because rainfall can be highly localized, an on-site measurement of rain is necessary if a site is any distance from the regional weather station. Once again we can look to parks departments, universities, and other large property owners using central control systems as an example. These types of properties use ET from a regional weather station, but often measure rain on sites that are not close to the regional weather station. In the same sense, some smart controllers support an on-site rain measurement so that ET measurements comes from a regional ET weather station, and rainfall measurements come from an on-site rain gauge.

Smart controllers have become a major hot topic in the industry and represent a bright future for irrigation. They are having a major impact on the way we irrigate. When sensors are used properly, the impact of smart controllers is huge. Healthy and beautiful plant material is possible in many instances with half the water we are currently using. These kinds of results can become the norm when smart controllers use a high quality ET weather station that measures all five parameters and is well sited and well-maintained. This is most effectively accomplished by sharing weather data. With smart controllers that use shared weather data, you obtain the highest quality data without the burden of purchasing, installing, and maintaining sensors. Using shared data brings simplicity and sustainability to smart control.