2.9 Using automatic weather stations

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Key points

- Automatic weather stations (AWS) provide site-specific atmospheric information that irrigators can use to assist irrigation scheduling decisions.
- There are a range of factors to consider when purchasing an AWS: sensor availability, accuracy, robustness, method of calculating ET_o, maintenance issues and availability of technical support.
- The siting of the AWS is critical to the accuracy of climatic data recorded.
- Regular and proper maintenance of the AWS is necessary to obtain accurate data.

Purchasing an automatic weather station

There are a number of weather station suppliers and manufacturers in Australia. A fact sheet version of this WATERpak chapter produced by DAFF Qld contains a short list of suppliers, but this list is not updated frequently. Industry irrigation and plant science researchers and extension professionals regularly purchase and maintain weather stations and would be a good source of up to date information on current suppliers.

There are a range of factors to consider apart from cost when purchasing an AWS: for further details, see the Bureau of Meteorology's *Automatic weather stations for agricultural and other applications* document.

Some key factors are:

- The sensors available, their accuracy, precision, and robustness – for ET_o calculations, sensors for solar radiation, maximum and minimum temperature, relative humidity and wind speed are needed.
- If ET_o is automatically calculated by the AWS, determine what method is used; the Penman-Monteith method is preferred.
- Maintenance should be able to be performed on an AWS without affecting the climate record.
- The format of the data output should be simple, flexible, preferably human-readable without reformatting, and independent of the AWS manufacturer. It should also be possible to remotely download data.
- The availability and quality of technical support if the AWS malfunctions.

Siting an automatic weather station

The quality of the weather data from an AWS is a function of the quality of the sensors used and the appropriateness of its siting. Ideally the AWS should be placed in the centre of an open space of at least 50 m by 50 m, which is covered by a short, green grass and surrounded by crops. The site should be on level ground and not shielded by trees or buildings, which would affect the data recorded. It should not be close to steeply sloping land or in a depression where temperatures are frequently higher during the day and cooler at night. Avoid rock outcrops, stone or gravel surfaces near the AWS.

Table 2.9.1 summarises suggested measurement heights and exposure for different sensors in an AWS relative to an existing (or likely future) obstruction such as a growing tree.

Table 2.9.1. Suggested heights and exposure for AWS sensors

Sensor type	Measurement height above ground level	Exposure considerations
Wind	2 m	No closer than 10 times the obstruction's height
Air temperature & relative humidity	1.25 to 2 m	The sensors must be housed in a ventilated radiation shield to protect the sensor from thermal radiation. No closer than 4 times the obstruction's height and at least 30 m from large paved areas.
Solar radiation	To facilitate levelling/ cleaning install at a height of 3 m or less	The sky should not be blocked by any surrounding object. Objects less than 100 above the horizontal plane of the sensor are allowed.
Rain	300 mm (at greater height wind affects the accuracy of measurement)	The sensor should be no closer than 4 times the obstruction's height. The orifice of the gauge must be in a horizontal plane, open to the sky, above the level of in-splashing (that is, above the level of any structures likely to cause splashing into the gauge).

Source: Campbell Scientific Australia 2001; Doorenbos 1976

Varying environmental conditions such as moisture or a growing crop can affect the measurements taken by an AWS in relation to its siting. Three possible effects are:

- the 'clothesline effect', where air passing from dry unvegetated surfaces to moist vegetated surfaces impacts on vapour pressure gradients and heat transfer.
- the 'leading edge effect', where air moves from one type of surface to another surface that differs in temperature, moisture content or roughness. As air passes over the 'leading edge' of this surface change, it gradually adjusts to the new surface. There is a zone where the air is modified but not adjusted to the new surface – placement of an AWS here can give misleading data.
- The 'oasis effect' where an isolated moisture source (a dam or crop for example) is surrounded by a dry area. If the wind draws moist air from the dam or crop, then the relative humidity measurements near this moisture source do not represent the general condition in the area.

Locating an AWS used to calculate ET_o on the roof of a building to make it easier to access data is not acceptable. High air temperatures result from heat convected or conducted from the building surface. The physical and radiative properties of the building material can be important in determining heat loading. A surface with high reflectivity may cause high irradiance values as incoming solar radiation is reflected onto the sensor from the surrounding walls and roof.

Thoroughly discuss the siting of your weather station with your supplier (and don't forget likely future changes in the exposure of the site, through the construction of new buildings or the growth of trees).

Maintenance

Regular and proper maintenance of the weather station is essential to obtain accurate data. The owner of the AWS can carry out routine and simple maintenance. This should include:

- Regular checking and clearing the rain gauge collector of dust and debris. Bird droppings are a particular problem.
- The wet bulb sensor wick should be changed at least weekly throughout the year and more often during hot, windy weather. The water reservoir should be clean and free of algae. To test if the wick is working, feel for moisture at the top of the wick. Replace it if dry and clean the water reservoir. Algae make the wick hydrophobic, causing it to dry out rapidly in hot weather.
- Weekly maintenance is generally unnecessary on AWS sensors used to directly to measure relative humidity. They are prone to calibration drift and are adversely affected by moist or dusty environments. Therefore metallic screens or cellulose acetate film is often used to protect these sensors. Monthly sensor element replacement is necessary if it becomes contaminated. Monthly calibration is also recommended.
- Check the bearing in the wind-run anemometer by listening for any noises as the cups rotate. The cup rotation can also be halted by hand to check for any friction evident at low wind speed. The only way to check the calibration in the field is with a newly calibrated anemometer.
- Check the solar radiation sensor for dust and debris, and clean as required.

More difficult maintenance such as sensor calibration, sensor performance testing and sensor component replacement generally requires a skilled technician and specialised equipment.

Obtaining weather data

Depending on your needs, it may not be necessary to have an onsite weather station as weather data is available from a number of sources. If you are located close to a Bureau of Meteorology weather station, it is possible to download historical rainfall and temperature data for specific years or a more complete data set for the past year. Historical data is also available from the SILO service on a subscription basis.

In some areas, local weather station networks are in place, for example the Darling Downs and Namoi. CSIRO's IrriGATEWAY also has weather stations in Southern NSW and the Gwydir.

References

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