CERERIS®
in agris cum auxilia artis
smart agriculture
monitors and DSS
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Use of DSS (Decision Support Systems) in modern agriculture

In the 21st century agriculture ought to look, and infact, looks much different from the past, though institutions and scientists have always tried to put logic and new discoveries at work in the fields, yet it is the first time in which the use of simple, low-cost, devices, and the availability of a wide area communication network, enables the management of data in real-time, to allow quick decision-making about treatment with pesticides and irrigation.
If we add the novelty of an unpredictable weather, due to global warming, it really becomes important to use some devices, that we manufacture in Italy, at DPS-Promatic srl, to manage daily operations.

What can you measure with our stations and monitors?
We manufacture professional, low-cost, wireless weather stations and irrigation monitors that are the key to any DSS. They can contribute to increased quality and savings in a number of way. Through our CERERIS DSS dashboard and database, it is possible to use the information provided by the on-site units in the most convenient and efficent way.

Improving irrigation efficiency

Nowadays farmers compete on prices with imported crops and they must optimize irrigation and pest management to save money and run a profitable business.
Optimizing irrigation is one of the best strategies, not only to save water, that anyway is becoming more and more expensive, but also to save fertilizers. In many crops, like, for example, tomatoes, fertilizers are supplied with the so called ferti-irrigation (or fertigation) technique, that means solving fertilizers into the irrigation water. If water is applied, for example, twice a week, in larger than needed quantity, it will end up in lower soil depth along with fertilizers, where the plant will not be able to use it. Moreover, if it rains and you have no meaning of measuring the actual humidity of soil, you may think irrigation is not needed, but this is difficult to assess without a measurement, even for experienced farmers. Normally farmers that don't have a way of monitoring irrigation end up with a standard routine regardless of real needs and this is certainly not an optimal solution. This is where our DSS systems, stations and monitors may help.

Let's see in details how irrigation can be optimized

Evapotranspiration

Evapotranspiration is the sum of evaporation from the land, plus transpiration from the plants. Everyday the sun heats the land and causes water to evaporate, plus the plants cede water vapour to the air through the leaves. There are well know formulas, like FAO Penman-Monteith or Hargreaves that allow to calculate how much water has gone into the atmosphere every day and how much one need to provide to compensate. To calculate this with the best accuracy our station measures sun radiation, wind speed, rainfall, air pressure, air temperature and relative humidity.

The calculation of evapotranspiration is a simple and low cost way of monitoring large areas leaving to the farmer the responsibility of irrigating according to prescriptions. There is no feedback from the field. You may prescribe to do something, but you don't know if this has been done. To solve this issue, one needs to monitor the humidity of the soil.

Soil moisture monitors

Since many years monitoring soil humidity is achieved with tensiometers. These devices are like a fake root, measuring how much force is needed by the plant to extract water from the surrounding soil. A traditional tensiometer is a pipe of transparent plastic with a porous ceramic tip, that emulates the root, and a pressure gauge that measures the pressure inside the tube. This device must be filled with water from time to time. Water flows out of the porous tip and according to how dry is the surrounding soil, the dial-meter will show osmotic pressure in centibar.

A tensiometer measures the force with which water is held in the soil; this force, called soil tension or potential, indicates how difficult is for plant roots to remove and use the available water.
Because standard water-filled tensiometer need periodic refilling and replacement of the tip, since 1978 the company Irrometer Inc. developed a, so-called, Granular Matrix Sensor, that has 2 electrodes inside a block of gypsum, to insulate the electrodes from surrounding soil salinity.
Many tests have permitted to correlate the readings from these sensors to standard tensiometers reading, and, even if they seem slower in reacting to quick soil changes, they have the advantage of no maintenance, they are robust and easy to read and integrate in a DSS system.
They need to be replaced every 2 or 3 years, because, with time, the reading of the lower values tend to change and the minimum reading, instead of being 0, will increase to values up to 10.

How many sensors should be used?
Normally we suggest 2 redundant sensor groups, at 2 different depth. The duplication is needed by the fact that external events may render the sensor unusable, as it happens when animals cut the wires, or cracks in the ground expose sensors to the air.
Each group should be placed at least every 10 hectares (25 acres), or less, if soil type is not uniform.
Areas with different crops should have separated monitoring. According to the type of crop, different values should be used for irrigations. These values should be chosen with the assistance of an agronomist because they depend on type and variety of crops, and type of soil.
Just as an indication, to be verified with a specialist with knowledge of crop and soil types, in some areas we have witnessed starting irrigation of industrial tomato at 40 cb, and keep the system on until the probe goes below 10.

Frost protection

Another important use of our stations and monitors is to try to prevent frost damage in spring, when plants have already new gems and flowers and a sudden temperature decrease may destroy them all.
As an example, kiwi gems and flowers can resist to about -0.9 degrees centigrade. In april, in the center of Italy (Lazio) we have witnessed sudden decreases down to -5 degrees. If this happens, even for a few hours in a single night, all the harvest may be lost.
This can be prevented via water spraying above the crops, provided that there is enough water to keep the system running until temperature goes above zero.
The key-point here is: when to activate the system? This is where we may assist with our wireless temperature and humidity monitors. Our systems calculate the dew-point, the temperature to which air should be cooled in order to be saturated with water vapour.
Another way of measuring temperature with a correlation to humidity is using a web-bulb thermometer. Results in this case lie between dry air temperature and dew point.
In both cases the values are correlated with relative humidity in the air. We use dew-point that is accurate and needs no wet device.

How dew-point values affect risk of crop damage?
If there is humidity in the air, this water vapour will condensate, at lower temperatures, and turn to water droplets. For example, a temperature of 3.6° C, with a Rh (relative humidity) of 91.6% gives a dew point of 1.9° C, but a temperature with 8°C, with a Rh of 44.6%, gives a dew-point of -3.1C.

This means that if the temperature drops quickly below zero, with such little humidity, hence such low dew-point, there will be no water droplets on the leaves and flowers when the temperature goes below zero.

These water droplets, that freeze, and we see often in early morning, during spring, offer a certain protection to the plant, because the passage from liquid to solid state (water to ice) gives energy in form of heat. This heat will protect the plant, as long as the passage of state goes on.

On the contrary, if there is little humidity and dew-point is well below zero, crops will be severely damaged. This is called **black frost** (because no white ice crystals appear on the leaves when passing through zero temperature, or because vegetals turn black in a few days, after being hit).
In the old days (but even today) farmers would read forecasts, and if there were the risk of such a night, they would stay all night long in the fields, reading temperatures and waiting to see if starting the spraying system or not. With our systems they can stay home and watch data coming from our devices on their smartphones, or even wait for an alarm. Knowledge in this case is power and piece of mind at the same time.

Pests management

Another important use of DSS is pest management. It is well known that the global aim is to reduce use of pesticides, because of regulations, because most times they are dangerous for health, because of market pressure on producers.
The standard behaviour, for example, in a crop like grapes, is to use systemic treatments every 2 weeks, in spring and early summer, regardless of weather conditions.
This is an easy way for the farmer, because every 2 weeks he will tour his farm with a tractor load of pesticides and spray the crops. Yet this is expensive and in the long run it may affect crops health, because they become less resistant to diseases.
There are many diseases and companies have developed algorhythms to forecast when exactly one needs to spray to prevent the spreading of them, because knowing temperature, humidity, and other parameters provided by our stations, it is possible to forecast this.
A very simple use of a station, to prevent Peronospora, is to spray with copper only if some conditions happen, like 10 mm of rain and temperature above 10 degrees in the previous 24 hours, along with vegetation longer than 10 cm. If this is done at the right time, thanks to the alarm received by our stations, there could be no need to spray again too much, just occasionally, depending on the years. This saves money and reduces copper (toxic heavy metal) accumulation in the ground.

What we do and what we don't?

We supply state-of-the-art electronic devices, connected with state-of the-art mobile networks (like **nb-iot**, that is part of 5G technologies) that, if properly maintained, provide long term reliability and correct measurement.
We provide a place to store all these data and means to aggregate and read them in numeric form or graphics.
We don't provide solutions to act automatically for the individual farmer because every type of crop and soil and climate needs a knowledge that only an agronomist can offer.
We don't provide an automatic system to switch pumps and start irrigation, because we are not dealing with gardens but with huge fields, where human experience is most needed. We help the farmer, not replace him.
The agronomist can make a decision based on the data sent by our stations and monitors and stored in our databases.
This is why, together, they are called DSS or Decision Support System.
We have branded them as CERERIS DSS in honour of the roman goddess of agriculture.
You can rely on DPS-Promatic equipment, you can rely on CERERIS DSS.