Application Note

Predicting the amount of water on the surface of the LWS dielectric leaf wetness sensor

Douglas R. Cobos

Decagon's LWS Dielectric Leaf Wetness Sensor was designed primarily to measure leaf wetness duration, or the total amount of time that the canopy experiences wetness. However, due to the unique utilization of the dielectric measurement technique to sense wetness on the surface of the sensor, the LWS can also be used to quantify the amount of water on its surface, which can be a good approximation of the amount of water on the leaves in the canopy. This measurement can be used to understand canopy interception of precipitation, which is a major component of the water balance and energy balance in full canopy ecosystems. Similarly, leaf wetness amount can be used to understand fog deposition processes in maritime ecosystems. Several agricultural researchers have also used the leaf wetness sensor to monitor the amount and distribution of foliar agrochemical spray application.

The LWS is calibrated during the production process to have a very repeatable sensor output when dry, allowing the dry-to-wet threshold to be precisely known for calculating leaf wetness duration. However, repeated testing of multiple sensors indicates that the amount of water on the surface of the sensor can be accurately predicted from the sensor raw output. The following data sets were obtained by carefully misting increasing amounts of water onto the surface of the LWS while simultaneously measuring the mass of the sensor and water and sensor output at three common excitation voltages (2500, 3000, 5000 mV). This test method was repeated three times on a total of six sensors.

At all three excitation levels, it is apparent that the amount of water on the sensor surface can be predicted quite accurately when small amounts of water are present on the surface. The scatter in the data increases as the amount of water increases past about 150 g/m^2, due primarily to differences in the droplet size and distribution that evolve as water is added to the sensor surface. Despite the increased scatter in this region, the data obtained should still be useful. It should be noted here that the data shown were collected using tap water with electrical conductivity of approximately 0.32 dS/m. Rainfall, fog, and condensation generally have quite low electrical conductivity and should be approximated well by the relationships shown. However, some agrochemicals can have very high electrical conductivity, which can skew the LWS output.

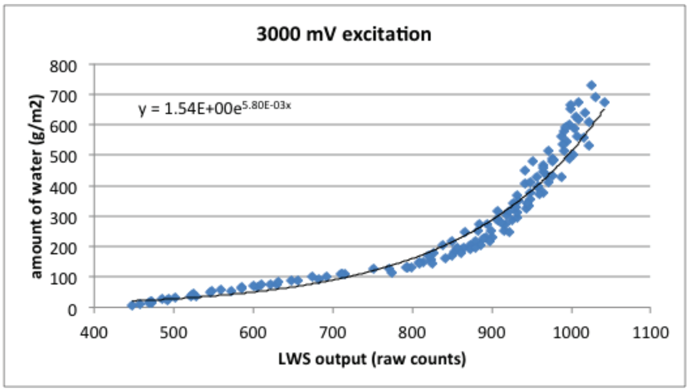

Figure 1. Amount of water on LWS surface as a function of LWS raw counts measured with Decagon Em50 series datalogger.

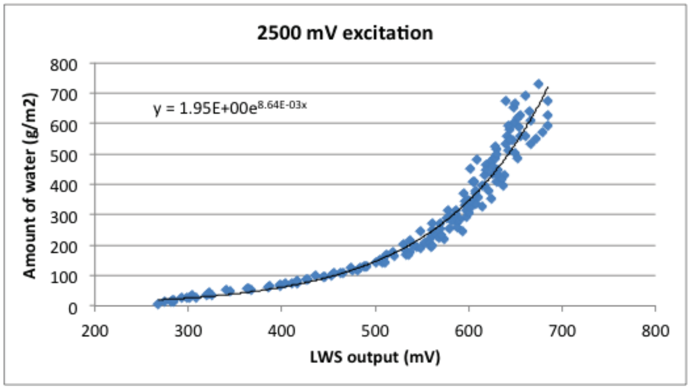

Figure 2. Amount of water on LWS surface as a function of LWS mV output when excited at 2500 mV. This relationship can be used with Campbell Scientific or other third-party data acquisition systems that excite the LWS at 2500 mV.

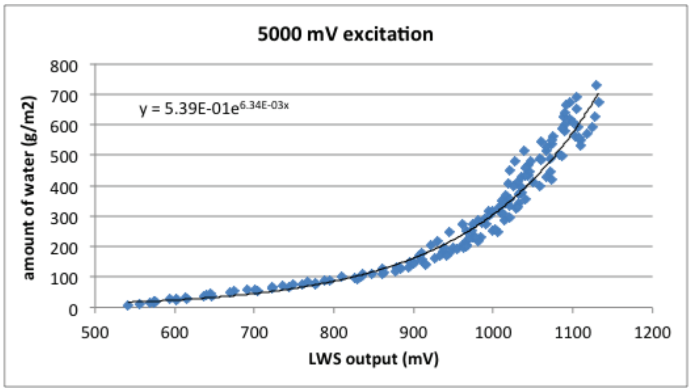

Figure 3. Amount of water on LWS surface as a function of LWS mV output when excited at 5000 mV.

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