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METER

QUANTIFYING THE CANOPY INTERCEPTION + WATER STORAGE USING THE PHYTOS 31

The PHYTOS 31 Dielectric Leaf Wetness Sensor by METER 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 PHYTOS 31 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 plant canopy surfaces or canopy water storage. 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 or dew accumulation under condensing conditions. Agricultural researchers and commercial growers have also used the leaf wetness sensor to monitor the amount and distribution of foliar agrochemical spray application.

The PHYTOS 31 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. Repeated testing of multiple sensors also 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 PHYTOS 31 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 PHYTOS 31 output.

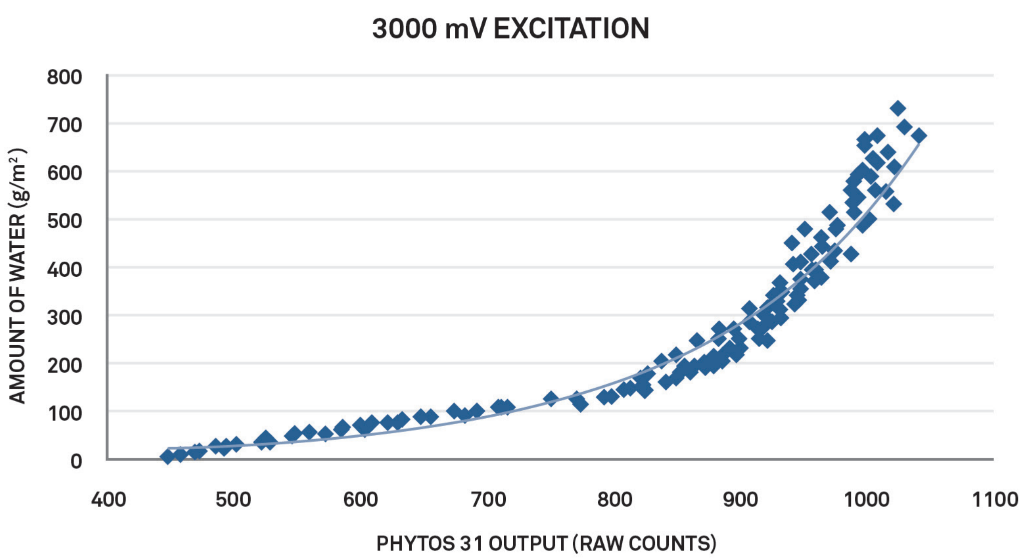

Figure 1 Amount of water(g/m^2) on the PHYTOS 31 surface as a function of PHYTOS 31 raw counts measured with METER Em50 series data logger

METER Group, Inc. USA
2365 NE Hopkins Court, Pullman, WA 99163
T +1.509.332.2756 F +1.509.332.5158
E info@metergroup.com W metergroup.com

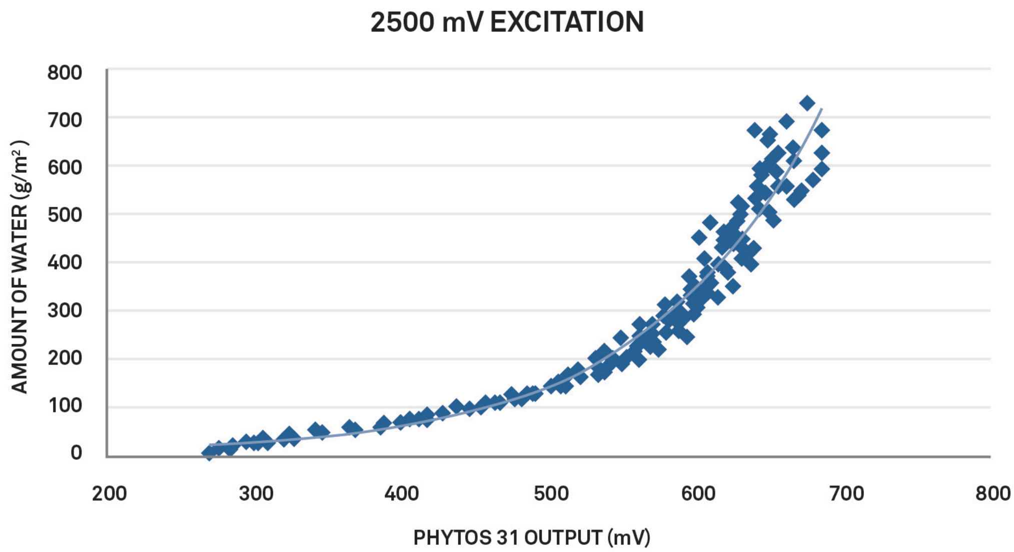

Figure 2 Amount of water(g/m^2) on the PHYTOS 31 surface as a function of the PHYTOS 31 mV output when excited at 2500 mV

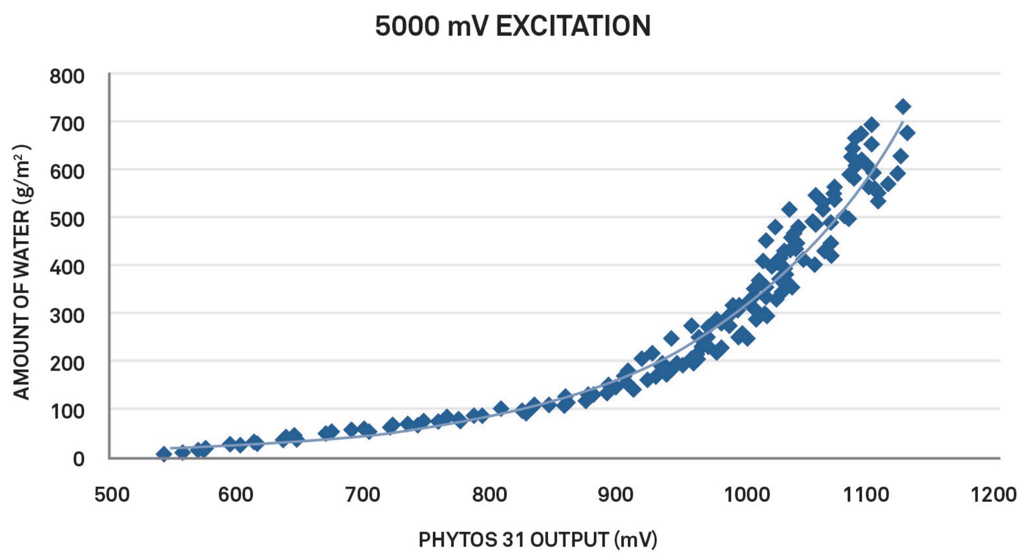

Figure 3 Amount of water on the PHYTOS 31 surface as a function of the PHYTOS #1 mV output when excited at 5000 mV

Note that the relationships presented for amount of water on canopy elements are on a g/m^2 of leaf area basis. This is fundamentally different from g/m^2 of ground surface area. To convert from a leaf area basis to ground surface area basis, the leaf area index (LAI) of the canopy needs to be known. METER's LP-80 ceptometer is a convenient option for determining LAI of many canopies. Also note that in most cases, the distribution of liquid water on leaf surfaces will not be homogenous throughout the canopy. Rainfall, dew, and spray application will all accumulate most quickly on the exterior leaves and more gradually on the interior canopy elements. The PHYTOS 31 must be deliberately placed at the position in the canopy that will provide canopy water storage information appropriate to provide the desired information.