Calibration of ECH$_2$O Probes with a 5 V Excitation

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Introduction

Excitation voltages for reading ECH$_2$O probes can vary from 2 to 5 V. However, the ratio of output to input voltages changes from about 10 to 40% Full Scale (FS) with a 2.5V excitation to 10 to 35% FS with 5V excitation. Therefore, the output is not quite ratiometric. Early in our experimenting, we determined that we would provide extensive support for the 2.5V calibration, as it seemed widely useful and only limited support to other voltages. However, as we have calibrated the probes in different soil types, we have collected some data at 5V and provide it here as a reference.

Observations

All calibrations were conducted according to the method set out in our ECH$_2$O calibration application note (http://www.decagon.com/appnotes/echocal.pdf). A range of soil types were tested to show how the probe was affected by differences in soil texture. An in-depth discussion of ECHO response to texture, salinity and water content, as well as calibration data for 2.5V is available in another application note (http://www.decagon.com/appnotes/echo_analysis.pdf).

ECH$_2$O 2O cm Probes: Comparing data from the 2.5V (in echo_analysis.pdf) and 5V calibrations (Fig. 1) indicates there may be slightly higher variability in the 5V calibration with respect to soil type compared to 2.5 V, but it may not be enough to matter.

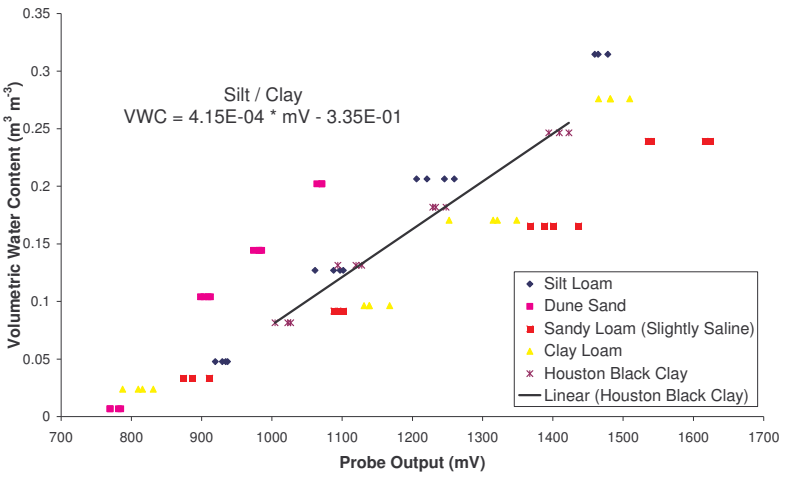

Fig. 1. ECH$_2$O 20 cm probe calibration with 5V Excitation

Fig. 1. also shows the calibration equation that can be used to convert millivolts (mV) into VWC (VWC = 4.15E-4 * mV – 0.335). This equation will work well for fine textured soils. For soils with significant amounts of sand (sandy loam to sand) as well as soils that have saturation extract electrical conductivities of (ECs) greater than ~1 dS/m, we strongly recommend a soil specific calibration.

ECH$_2$O 10 cm Probes: ECH$_2$O 10 cm calibration curves are shown in Fig. 2. Two calibration lines are provided, one for fine textured soils and the other for very low EC sand. We observed that as EC increased in the sand up to ~0.3 to 0.5 dS/m, the calibration slope decreased and the regression line became more similar to the fine-textured soil. As EC increased beyond that, calibration slopes continued to decrease. Because of this, we strongly recommend a soil-specific calibration for all coarse textured soils. The standard calibration for probes in fine textured soils is

VWC = 4.37E-4 * mV – 0.325, which appears to be applicable for saturation extract ECs up to ~1 dS/m.

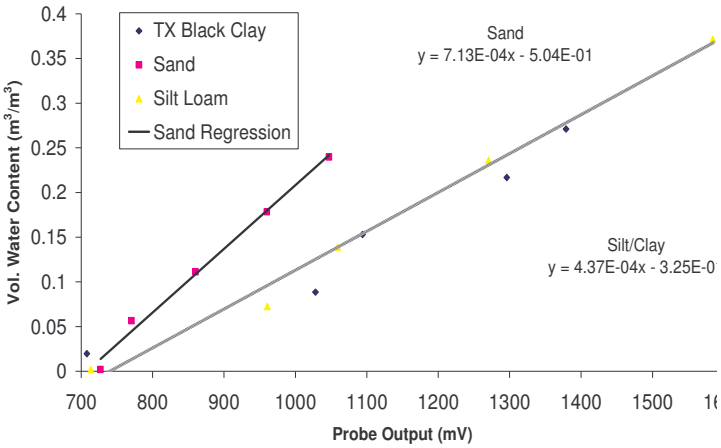

Fig. 2. ECH2O 10 cm Calibration with 5V exitation

ECH_2O 5 cm Probes: ECH_2O 5 cm calibration data are shown in Figure 3. These data were collected in four soils ranging from silt loam to sand with electrical conductivities ranging up to 5 dS/m. Unlike the 10 cm and 20 cm probes, there is no apparent difference in calibration due to differences in soil texture and electrical conductivity. However, the calibration equation becomes nonlinear when the probes are excited with 5V.

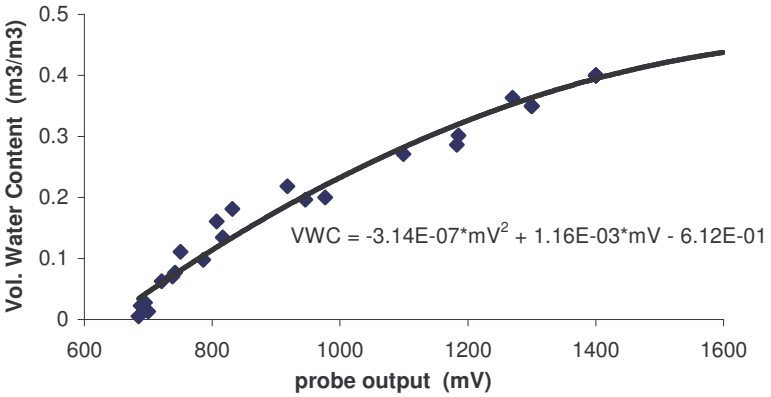

Figure 3. ECH2O 5 cm calibration with 5V exitation

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