5TM/TE Volume of Sensivitity

Douglas R. Cobos, Ph.D.

Introduction

One of the most important factors to evaluate when selecting a soil moisture sensor is the volume of soil that is integrated into the volumetric water content measurement. For many field applications, a large volume of sensitivity is advantageous from the standpoint of minimizing errors caused by small scale soil heterogeneity. However, for some field applications (e.g. near surface measurements) and most greenhouse and laboratory applications, a sensor with a small volume of sensitivity is desirable. To this end, Decagon offers the 5TM and 5TE soil moisture sensors. This application note describes a set of tests that were conducted to quantify the volume of sensitivity of the 5TM and 5TE, and the results of those tests.

Methods

The tests used to evaluate the volume of sensitivity of the 5TM/TE sensors have been described in Sakaki et al. 2008, and are described here briefly. With this method, the sensor tested is the EC-5, which resembles the 5TM and 5TE in its two-prong dimensions (the third prong on the 5TM/TE is used for measuring temperature). The results for this testing can therefore be applied to them. The sensor is suspended in air above a large water surface. The sensor output is recorded as the sensor is lowered from a distance far from the water toward the water surface. When the output changes appreciably due to the proximity of the water, the outer edge of the volume of sensitivity has been reached. This process is repeated at different sensor orientations to obtain a three-dimensional representation of the sensor's volume of sensitivity.

Results and Discussion

The 5TM/TE volume of sensitivity is encompassed by an envelope shown in Figure 1. If an ellipsoidal cylinder is drawn around the sensor with the dimensions measured experimentally, the total volume of influence of the 5TM/TE is approximately 181 cm3. It is well known that the electric field distribution inside the volume of sensitivity is strongly weighted toward the sensor surfaces, so this volume should be taken as a maximum possible measurement volume. Care should still be taken to ensure good soil-sensor contact to avoid air gaps at the sensor surface where it is most sensitive. Decagon recommends that the 5TM/TE not be installed within 3 cm of the soil surface or any foreign object in the soil.

Figures 1a-c. Idealized volume of sensitivity of the 5TM/TE sensors. It should be noted that this sketch is a highly simplified representation of the actual geometry of the volume of sensitivity, but the overall result should adequately approximate the real physical situation.

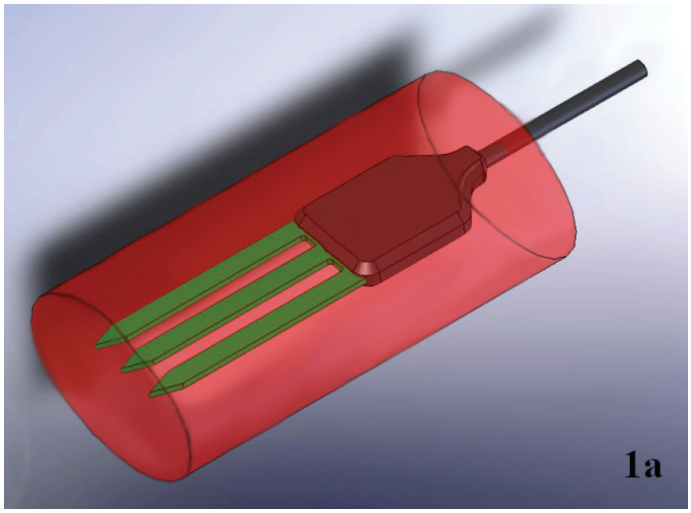


Figure 1a: Gives a conceptual view of the volume of sensitivy

Figure 1b: Shows the volume of sensitivity looking across the prongs parallel to the flat plane of the prongs.

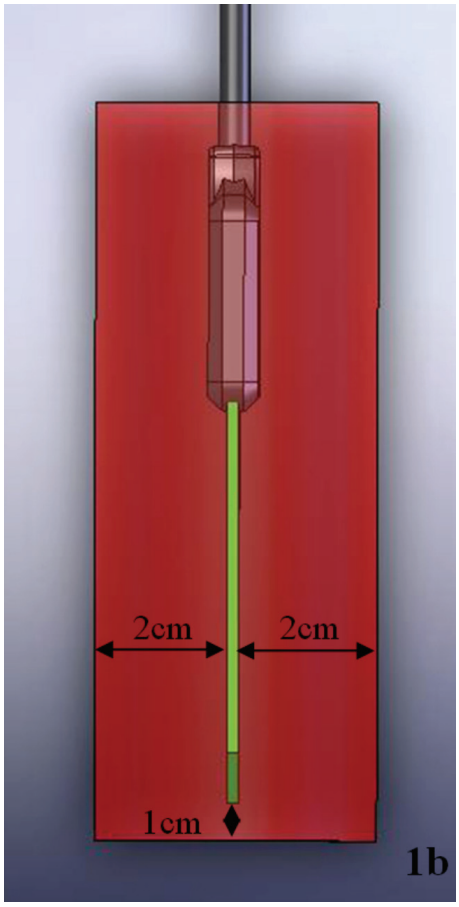
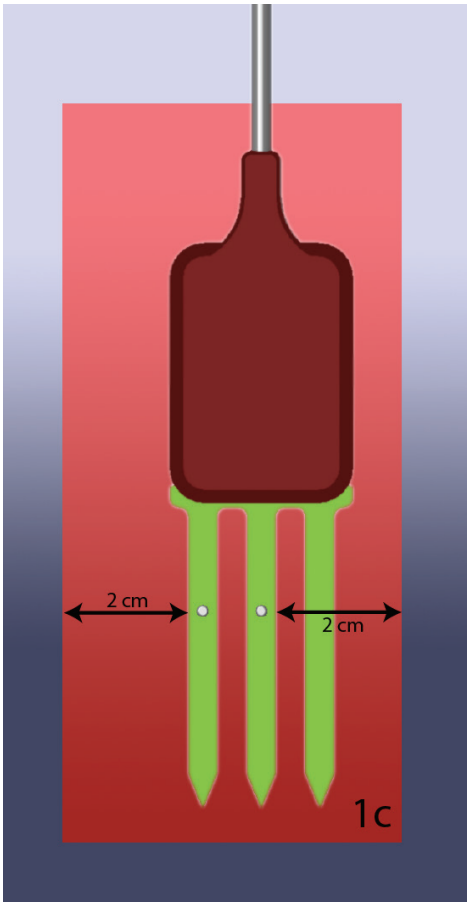


Figure 1c: Shows the volume of sensitivy normal to the flat plane of the prongs.



References

Sakaki, T., A. Limsuwat, K. M. Smits, and T. H. Illangasekare (2008, Water Resour. Res., Special Issue on Measurement Methods, *in revision*), Empirical two-point α-mixing model for calibrating ECH2O EC-5 soil moisture sensor.

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