EC-5 Volume of Sensitivity Application Note

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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, the EC-5 soil moisture sensor is a good solution. This application note describes a set of tests that were conducted to quantify the volume of sensitivity of the EC-5, and the results of those tests.

Onset adds smart sensor adapters to the ECH_2O proves so that they are plug-and-play compatible with HOBO® U30 stations and HOBO Micro Stations. The S-SMC-M005 soil moisture smart sensor incorporates the EC-5. Onset also offers the W-SMC HOBOnode wireless soil moisture sensor, which uses the ECH_2O EC-5.

Methods

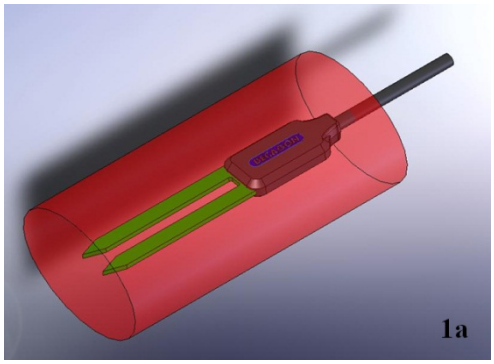
The tests used to evaluate the volume of sensitivity of the EC-5 sensor have been described in Sakaki et al. 2008, and are described here briefly. With this method, the sensor is suspended in air above a large water surface. The sensor output is recorded as the sensor is lowered from a distance far from 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:

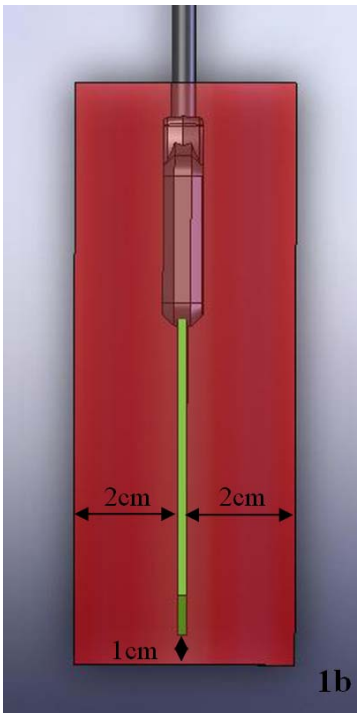
The EC-5 volume of sensitivity is encompassed by an envelope shown in Figure 1. If an ellipsoidal cylinder is drawn around the sensor with the dimensions measured experimentally, the total volume of influence of the EC-5 is approximately 181 cm^3. It is well known that the electric field distribution 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. It is recommended that the EC-5 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 EC-5 sensor. 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.

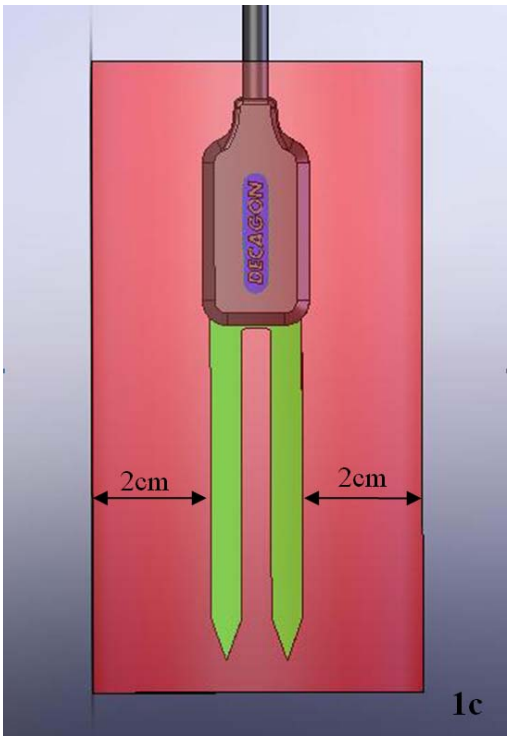
1a: Gives a conceptual view of the volume of sensitivity.



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



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



Reference

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 ECH_2O EC-5 soil moisture sensor.