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Impact of stone content on soil moisture measurement with capacitive sensors 10HS (Decagon)

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Introduction

Lot of soil survey focused on agricultural soils with low stone content. Most of the soil water content sensors are placed on those soils and the calibration equations are developed for them. Yet some research take an interest in forest soils that are often much different from the previous ones and need soil specific calibration of the soil water content sensor. Often those soils have high stone content, low bulk density and higher organic carbon and are too rarely subject of publication.

Objects

The 10HS (Fig 1) are widely used cheap capacitive sensors (Mittelbach H., 2012; Ruehr N.K., 2012). In Wallonia, forested soils are mainly stony (Fig 2). Therefore, we decided to evaluate the influence of the stone content in the soil moisture measurement with the 10HS sensors.

Fig 1. 10HS soil moisture sensor (Decagon)

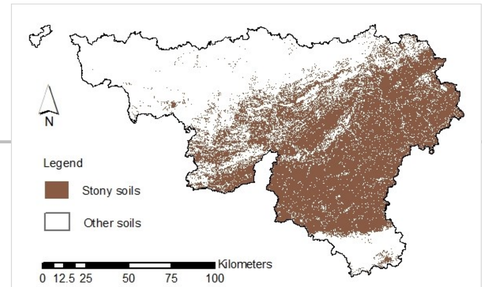

Fig 2. Stony soils localisation in Wallonia (Belgium) according to the walloon digital soil map

Pre-tests

Some anterior tests confirm the importance to build soil specific calibration curves. A previous study shows that the size of stones in repacked soil sample have no conclusive impact on the 10HS measurements. Unlike the stone content witch seems to influence those sensors. Those results needed to be deepen.

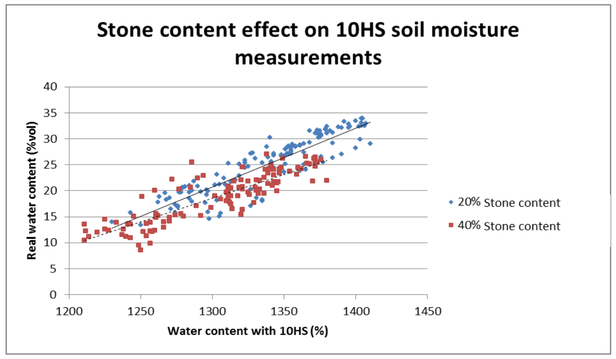

Fig 3. Stone content effect on 10HS soil moisture measurements. Pre-tests

Decagon Devices, 2010. Operator's manual Version 3.0. 10HS Soil Moisture Sensor, Decagon Devices, Pullman, WA.

Ruehr N.K, 2012. Effects of water availability on carbon and water exchange in a young ponderosa pine forest: Above- and belowground responses. Agricultural and Forest Meteorology, 164, 136– 148.

Mittelbach H., 2012. Comparison of four soil moisture sensor types under field conditions in Switzerland. Journal of Hydrology, 430–431, 39–49.

Material and Methods

The soil is a silt loam previously sieved and oven dried. The rocks are schist with quartz and sandstone elements. The 10HS is a capacitive sensor (Decagon Devices. 2010). It determines the soil moisture through the soil capacitance which is influenced by the soil permittivity (mainly dependant on the soil water). The measurement range is 0 up to 57% (depends on the calibration curve) and the accuracy is about 3% VWC (2% VWC with specific calibration curve).

The sample are constructed with 0, 20 and 40% of rocks (Fig 4) and saturated and equipped with the 10HS. The soil is dried with a natural air drying. Once a day the sample are weighted and a measurement with sensors is done to build the calibration curve.

Fig 4. Soil samples before wetting and mixing (0, 20 and 40% rock content)

Fig 5. Drying soil samples

First results and prospects

The first results seems to highlight an influence of the stone content on the 10HS measurement on our sample. The soil moisture overestimation increases with the stone content. More sample will be tested to confirm these first results.

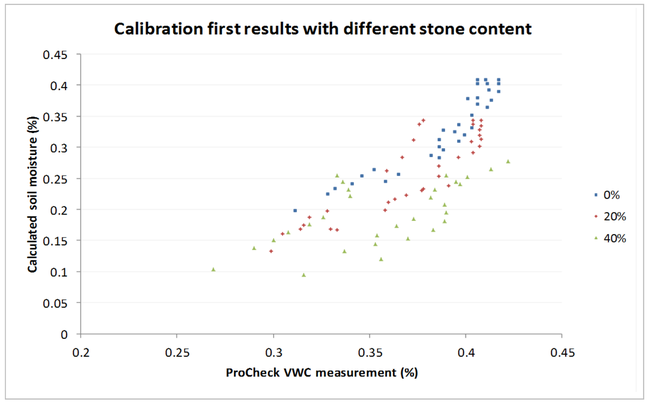

Fig 6. Stone content effect on 10HS soil moisture measurements. First results