Guide for the installation of soil water monitoring devices

Vertisol agricultural area of Gedaref watershed

Content

Soil water monitoring campaign

Soil water monitoring, over certain soil profile depths (up to max. 1.0-1.5m), enables insight into the vertical soil water movement, thus concluding on different aspects of the soil water balance such as deep infiltration, plant available water and capillary rise characteristics of the soil considering different management. For the overall understanding of the water balance it is most important to obtain daily rainfall records from the area simultaneously. The soil water dynamics monitoring can be carried out in different soil profiles comparing the different treatments – as for example traditional seedbed preparation vs. deep ploughing to conclude on different soil moisture availabilities for field crops over the rainy season. The equipment should be installed in undisturbed soil in different depths over the soil profile. Concretely, the soil water monitoring equipment (eventually shipped to Sudan) consist of:

- Soil moisture (+ Temperature and Salinity) sensor: 5TE
- Soil matric potential (+ Temperatire) sensor: MPS6
- Soil mini-lysimeter (pressure transducer) [*1]
- Logger system (Em50)

[*1]   Mini-lysimeter are a large equipment to be shipped to Sudan – likely the transport will not be finished within rainy season 2017 (due to custom and shipping difficulties). Therefore, the following soil water dynamics assessment is described without Mini-lysimeter equipment (soil moisture and soil matric potential sensors only).

The above mentioned equipment, soil moisture and soil matric potential sensors, shall be buried in the soil in a good soil contact without disturbing the direct placement area (Figure 1) – the sensors measure representative soil volume characteristics in approximately 5-10cm radius around the installed sensor. For each studied treatment (e.g. traditional, ploughing, conservation agriculture) approximately 1.0m deep soil pit have to be buried and one clean, vertical front has to be created with a shovel. At certain depths (Figure 1), small holes shall be made into the vertical soil front, thus to place the sensors a little bit deeper (approximately 10-20cm), not directly at the disturbed soil front, which will be filled after installing - not to affect the sensors by probable preferential flow (vertically) along the disturbance front. To place the sensors, a small soil opening can be created with a knife to push the sensor in a good contact into the soil (Figure 1 (left)). Avoid the placement too close to big stones or soil cracks (leave about 10cm min distance to obstacles in the soil). After placing the equipment, pull the sensor cables through a security pipe (PVC or steel) vertically to above ground connected with the logger (Em50), which shall be fixed on a wooden or steel pipe, approximately 50cm above the soil surface for comfortable readout. The Logger can be secured by additional steel case if needed. Fill the pit and compact the soil to approximately native conditions. According to the actually available sensors (not all sensors have been shipped for 2017 rainy season), each soil profile monitoring could consist of:

- 2 Soil moisture sensors (5TE)
- 1 Soil matric potential sensor (MPS6)
- 1 Logger (Em50)

In case of above mentioned sensor availability (for three investigation pits?- please check delivered sensors available), the vertical distribution of the sensors can be:

1 Soil moisture sensor   at approximately 30cm soil depth
1 Soil moisture sensor + 1 matric potential sensor   at approximately 100cm soil depth
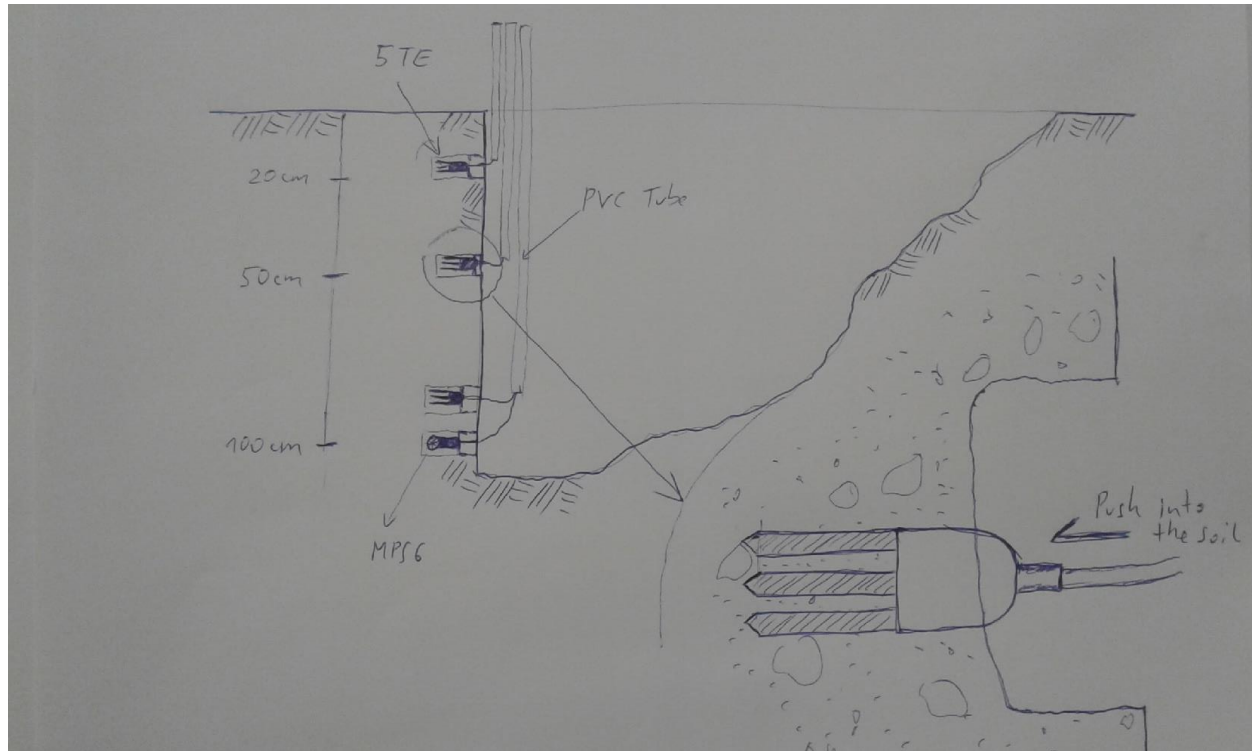

Fig 1.: Sketch of the soil water monitoring pit (cut through), with enlarged detail how to burry/place the sensors on the left side of the sketch. The sketch shows three different depths, in case 4 sensors per pit are available. If only 3 sensors per pit are available – please skip the reading/sensors at 50cm depth.

Soil water sensors and equipment set-up

Soil water sensors and equipment are from same company as the already shipped pressure transducers (DECAGON company), which provides consistency with the other sensors and also same reed-out devices as well as software (ECHO2O Utility software). To properly install, control and read out the device, ECHO2O Utility software must be installed on the read out laptop (which should be already the case because of the culvert – pressure transducer). Once the software is installed, the logger can be connected with the laptop, by USB cable, and the settings as well as read out can be controlled over the software interface. For the software, please go to https://www.decagon.com/en/data-loggers-main/software/ech2o-utility/ (Decagon is the device manufacturer) and download the free software called 'ECHO2O Utility' (Fig. 2).
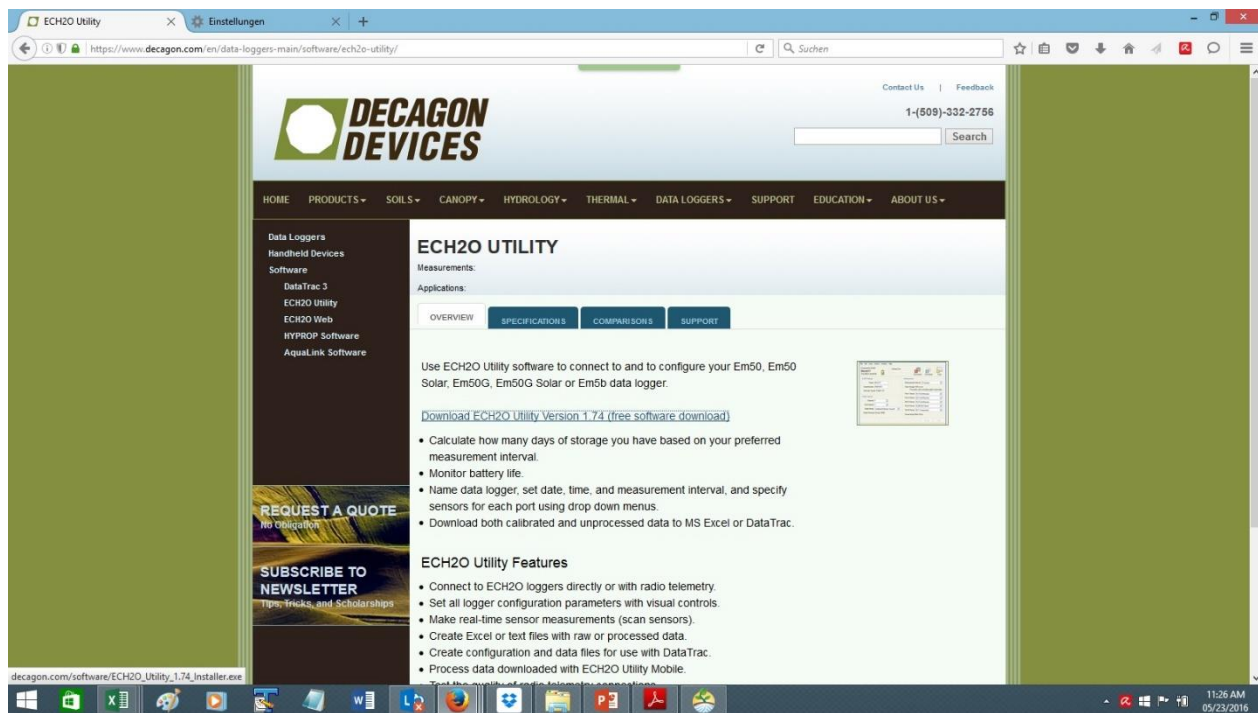
Fig. 2: Screenshot - downloading the ECHO2O Utility software.

Please check the equipment in the laboratory or office if it is working prior to burying the sensors in the soil of the watershed. This step is also important for pre set-up through the ECHO2O software. Among the sent equipment there is a readout cable (USB) which can be connected to the logger via the 'COMM PORT' (Fig. 3).

Fig. 3: Connecting the logger to the COMM PORT with the USB readout device. The USB port shall be connected to the computer

After connecting the readout USB cable, the other sensors (soil moisture (5TE) 2x, and soil matric potential (MPS6) 1x) can be connected to three of the input PORT's of the logger (Em50) – probably use port P1, P2 and P3. You should check the devices in the lab - you can put the soil water sensors in a wet towel for practice and pre-installation.

Fig. 4: Testing the sensors in the office (prior field installation) and setting up the logging procedure (e.g. timing of recording).

Having the software installed and the COMM PORT connected to the laptop via the USB readout cable, the software can be opened and used to control the device and readout (Fig. 5).

Fig. 5: Opening and using ECHO2O software

First, the device shall be connected (button in upper-central user-interface) and each Port-Sensor shall be defined by the user in the 'Sensor Measurement' part through the interface. The soil moisture sensor '5TE' device measures Water Content, which you can find in the drop-down window next to the e.g. 'Port 1 Sensor' indication. The soil matric potential sensor (MPS6) measures Water Potential – please select accordingly in the drop-down bar. Thereafter, the user

can define the 'measurement interval' – probably use 1 or max. 2 hours for final set-up in the field (for 12 to 24 measurements per day) – also because of probably wrong/changing starting times and to have enough data in case some readings are bad. The interface will give information about the according read out interval and storage (using 1 hour the device needs to be read out probably each year – but in general its recommended to read out the device each week or at least every month). In the lab/office, please check the readings by using 'Scan' button and check the values. The values should be in m^3/m^3, °C and mS/cm (5TE) and kPa and °C (MPS6) – please see Figure 6. Just for trial, set the logging time interval to 1 min and wait some 3 minutes to check the download file – if the correct values are given.
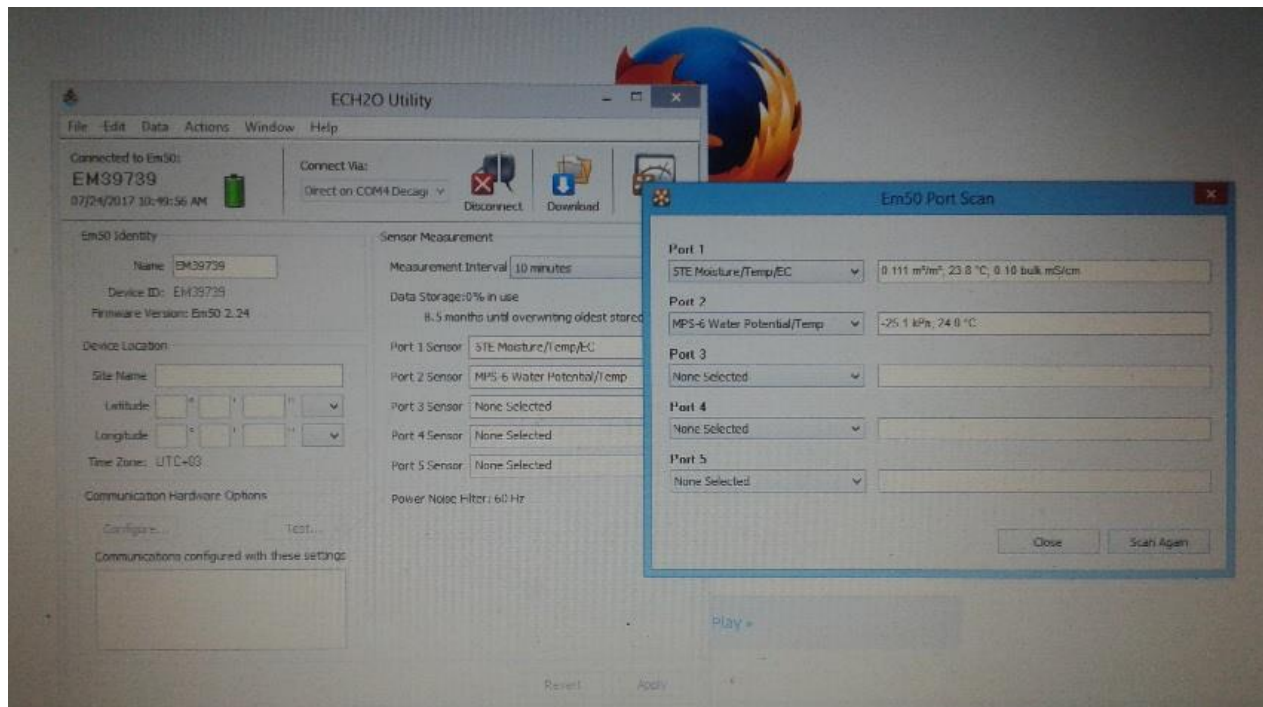

Fig. 6: Checking the devices using 'Scan' button.

For read out you can 'Download' the data (Item on the upper right side of the interface) as an excel file. This will be the final data given from the sensors and to be saved on the laptop.

For the field, change the logging time to approximately 1 hour. After you fixed all settings you can disconnect from the COMM PORT and remove the readout device. The device will start to log once the sonsors are connected and the interval is given and you push the 'Apply' button! Please check the readings (using 'Scan') a last time in field before filling the soil pit.

Please check the device and readout prior installation in the laboratory/office.

You can put the sensors in a wet towel for approximately 10 minutes and log the data – and control then the downloaded excel sheet if it is working.

Please check the time settings. Should be around 1 hour.

Once installed in the field – please read out the data frequently and ensure that the memory space is never full.

Please note all the manual measurements (like soil sampling) synchronic to the clock of the logger.

If you have any further question – don't hesitate to contact your ICARDA partners.