# Soil Moisture Measurements in TERENO preAlpine: Installation of SoilNet and Preliminary Results

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## Introduction

Detailed knowledge about the spatial distribution of soil moisture and subsurface temperature is an important prerequisite for the investigation of moisture and energy exchange between the land surface and the atmospheric boundary layer.

In early summer 2015 the TERENO grassland site at Peißenberg-Fendt was equipped with a wireless sensor network for measuring soil moisture, temperature, and matrix potential (SoilNet Version 3) and since June the system is operational.

## Installation of the Sensor Network

- 55 measurement profiles: 20 profiles follow a regular grid, 35 profiles are randomly distributed.
- Measurements of **soil moisture** (permittivity), **soil temperature**, and **matrix potential** at **5 cm**, **20 cm**, and **50 cm** depth at each profile.
- Two *TRUEBNER* SMT100 sensors (permittivity and temperature) and one *DECAGON* MPS-6 sensor (matrix potential and temperature) at each depth.
- Soil samples were taken along the regular grid for the determination of bulk density, soil chemistry and texture, pF-curves and for soil-specific sensor calibration.
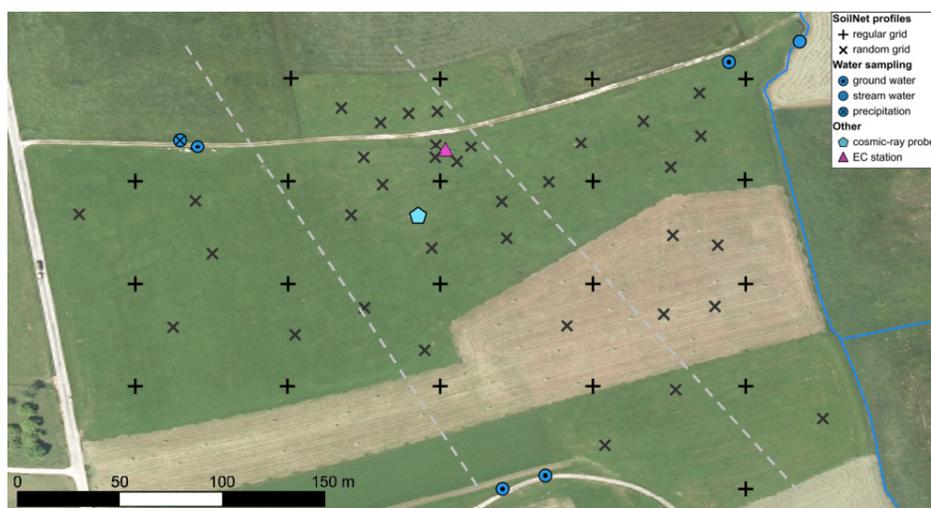


Aerial photograph of the field site showing the locations of the SoilNet measurement profiles as well as other relevant measurement installations. Grey lines indicate a first rough classification of the profiles into different types based on soil bulk density and texture.
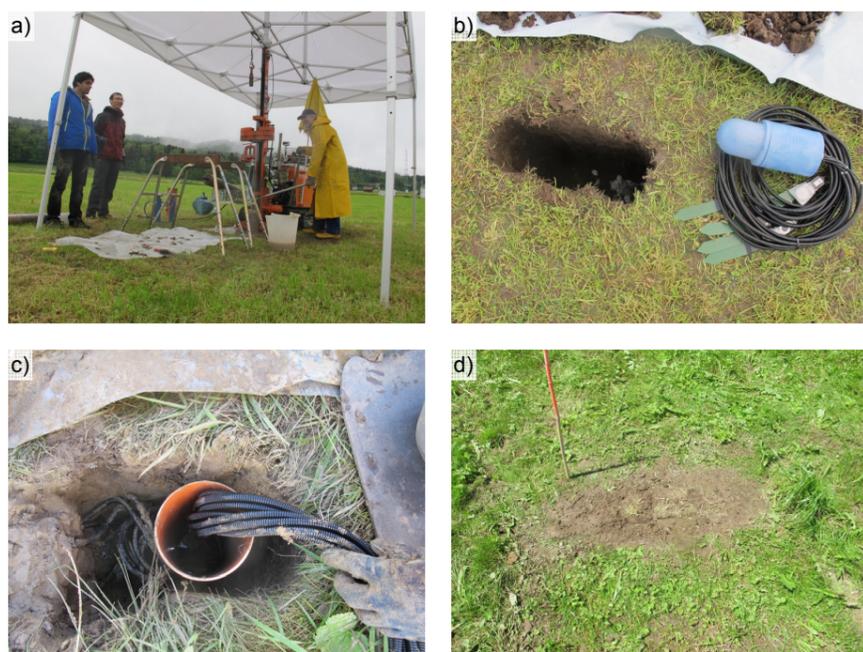


Installation of a measurement profile: a) drilling the hole for the installation, b) hole, ready for installation, together with end device and sensors, c) installed sensors and the KG pipe providing the housing for the sensor cables and the end device just before backfilling the hole, d) measurement profile from above just after installation was finished.

## Preliminary Results

### Soil Sampling

Bulk densities at 5 cm, 20 cm, and 50 cm depth determined from the samples taken along the regular grid. Porosities were roughly estimated from bulk densities assuming a particle density of 2.65 g cm$^{-3}$.

| soil depth (cm) | bulk density (g cm$^{-3}$) (mean ± std.) | porosity (m$^3$ m$^{-3}$) (mean ± std.) |
|---|---|---|
| **5** | **1.12 ± 0.22** | **0.58 ± 0.08** |
| **20** | **1.27 ± 0.22** | **0.52 ± 0.08** |
| **50** | **1.03 ± 0.52** | **0.61 ± 0.20** |
| 50 (peat-type) | 0.33 ± 0.10 | 0.87 ± 0.04 |
| 50 (clay-type) | 0.98 ± 0.13 | 0.63 ± 0.05 |
| 50 (sand-type) | 1.52 ± 0.10 | 0.43 ± 0.04 |

Three different soil types with respect to bulk density and texture were distinguished at 50 cm depth. For a better differentiation (also at the other depths) further soil analyses are required.

### Soil Moisture Trend and Spatial Distribution
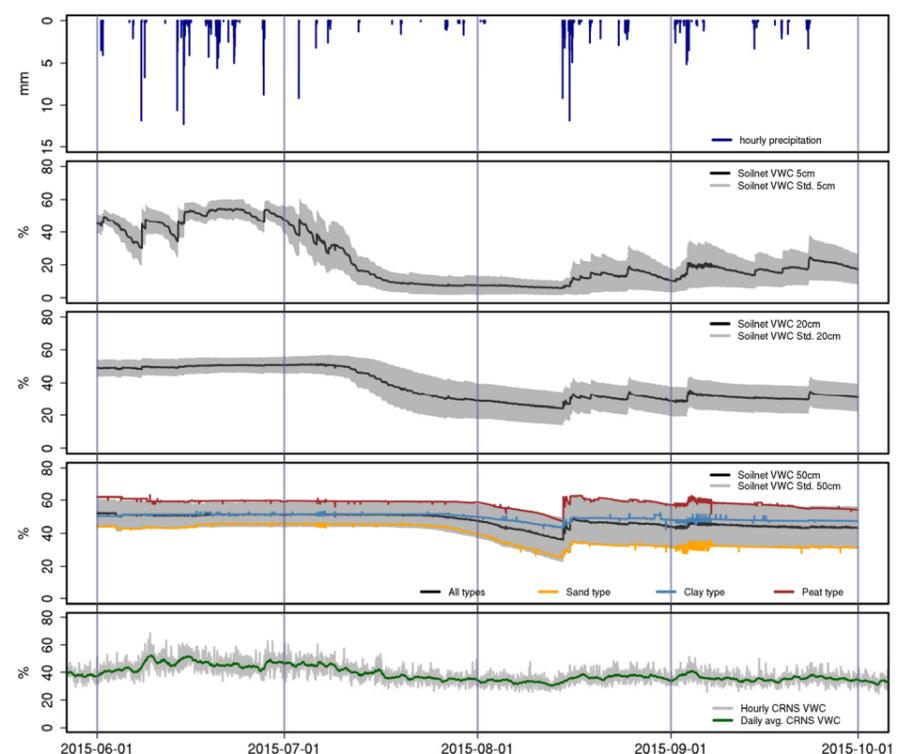


Comparison of precipitation, SoilNet soil moisture at 5 cm, 20 cm, and 50 cm depth, and soil moisture derived from measurements with a Cosmic-Ray Neutron Sensor (CRNS).
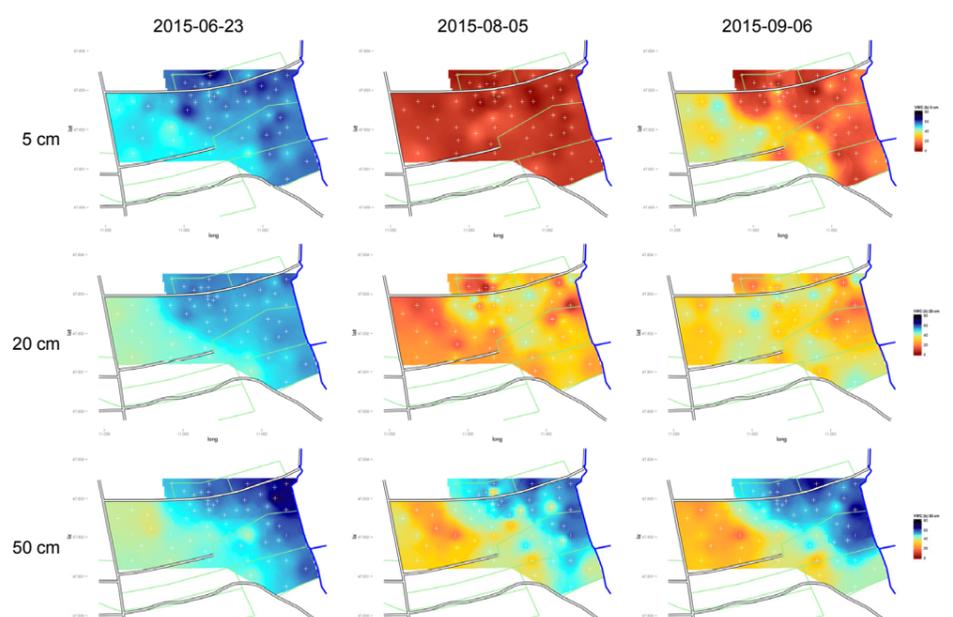


Spatial representation of SoilNet soil moisture measured at 5 cm, 20 cm, and 50 cm depth on 2015-06-23 (wet conditions), 2015-08-05 (dry conditions), and 2015-09-06 (intermediate conditions).