Protocol of FUTMON Action D3-Soil moisture workshop

25 -26 May 2009 in Freising/Germany

Organiser:
Stephan Raspe
Bavarian State Institute of Forestry

Participants:
See list of participants

TOP 1:
Bulten: Field set of taking undisturbed soil samples,

Discussion:
Still difficult to take forest soils with high gravel content and roots present with this equipment, problem to take samples from dry soil, which should be taken in a wet situation, recommendation to dig a pit in forest soils and gradually sample each horizon starting from the top and removing it afterwards. In the upper horizons roots can be cut at the circumference of the soil core with a sharp knife before driving the soil core into the horizon, afterwards visual inspection of the degree of disturbance

Bulten: pF values and measurement

Discussion:
Hydraulic contact with the soil core on the sand as well as the kaolin boxes is important (surface of the sand or kaolin is flexible and adapts to the soil core), measurement of pF=0 should be done with a pcynometer to get total porosity, according to Bulten it has to be done on a separate soil core since the soil core has to be dry to avoid interaction of humidity from the soil core with the mercury of the pycnometer, other experience from the university of Freiburg where field fresh samples were used in the pycnometer, weighing a completely saturated soil cores seems to be impossible

TOP 2:
Nicolas: pF measurements

Discussion:

Hydraulic contact of the soil cores on the ceramic pressure plates maintained by kaolin cover
Small soil cores are a trade-off between easier soil sampling and representaiveness of the soil, larger soil cores (100 cm^3 or 250 cm^3 seem to be more representative),
Comparison between suction tables and pressure tables not yet performed, is going to be made in FUTMON
Open questions: How many profiles and repetitions per horizon are needed? How to handle organic layers in the sampling for soil physical measurements?

TOP 3:

Keller: Hyprop system

Discussion:
Special tensiometers T5 with special ceramics with a boiling point above 8 bar, practial limit for measurements 3 bar, depending on the soil it takes 3-5 days to get all values, in addition time for saturating the soil core

Problem to get micro tensiometers into a sample with gravel content, disturbance of the undisturbed soil core by the model: soil core is won with adapted mask taking into account the positions of the micro tensiometers
Improvement of the method to consider an independent value of pF 4.2, but software yet cannot include independent values from the dry range
for the fitting of the pF curve according to the different models
Number of replicates depends on soil (recommendation 5-20)
Comparison to suction plates see publications of Schindler or Durner

TOP 4:

Campbell: WP4 system

Discussion:
Packing of the disturbed soil sample impacted by the individual operator,
Reproducible?, up to .1 or .2 g/cm³ to the original density possible
Very fast procedure (2 days) compared to suction plates (weeks)

TOP 5:

Cools: FUTMON protocol

Discussion:
The ring test should also include alternative methods from labs where available since planning of the FUTMON often includes these methods instead of ISO-methods
Additional set of soil cores needed
Pycnometer method for determining total porosity not included in ISO and yet not in field protocol
Soil sampling on the plots can be performed starting after the ring test in fall 2009
Time of storage of ring samples limited since biocides often contain tensides which change hydraulic properties, plants can even germinate at low storage temperatures (diverting experience here!)
Quality of the water concerning surface tension of water should be also be measured as well as temperature

TOP 6:

v.Unold: Tensiometers

Discussion:
Effect of salinity on the self-refilling tensiometer: Pores of tensiometer ceramics are much too big to cause any osmotic effect by salts. Salt ions will NOT be excluded, but get in equilibrium with the tensiometer water meanwhile seconds from deionisized water to concentrated salt solution.
Soil water degases itself during selfrefilling due to the vacuum, the integrated pump generates. The pump transports the gas/steam mixture to the exhauster back into the soil, so it is a closed hydraulic circuit. If the sensor detects bubbles water filling starts automatically. This gives you always perfectly filled tensiometer is in a range 0 ... 850 hPa (pF 2.9) with reliable data.

"Noise" of the signal of the pF-meter?

TOP 7:

Liu: Equitensiometer

Discussion:
Sodium concentration should be not too high since it affects electronics, eventually problem for salty soils in drier environment
Different off-sets after a drying cycle

TOP 8:

Wessel-Bothe: pF-Meter

Discussion:

Contrasting comparsion between pF-meter and tensiometer under different conditions lab/field(v.Unold, Brando), probably due to different consideration of hysteresis during the calibration process
Neutral institution for testing?

TOP 9:

Campbell: Echo Sensors for matric potential, water content and soil temperature

Discussion:
If proper hydraulic contact is made for the MPS-1 sensor e.g. with homogenized soil then it makes more sense to measure soil matric potential instead of soil volumetric water content, since the latter is more prone in gravel-rich soils to introduce errors due to little contact with the surrounding soil
Life span of ECHO-Probes is 3-5 years, more expensive sensors like soil moisture have the advantage that they have a longer time span due to the fact that no electonic parts are buried in the soil (up to 10 years)

TOP 10:

Pannatier: Calibration of EC-5 soil moisture probe

Discussion:

Deviation of the calibration curves from lab measured soils from the calibration relationship of Decagon, shift of 10 vol.% from the Decagon relation, might be dependent on dry bulk density (fit for alluvial soils), time consuming individual calibration process might be substituted by finding a relation towards dry bulk density since the gradients of the calibration curve were the same as for the Decagon relation

TOP 11:

Derome: Delta-T Profile Probe – PR2/6

Discussion:

How many depths? Constant depth steps versus genetic horizons
Three mandatory depths in the protocol: 0-20, 20-40, 40-60 cm

Precision of the profile probe, since there is no direct contact to the soil?
Information on Delta-T Website

TOP 12:

Ruth: water content sensor with a flat sensitive sensor

Discussion:

No commercial version of the sensor available, eventually interesting for measuring soil water content in the upper organic layer; problem of swelling and skrinking in the organic layer for all sensors!
Difficulty to get the soil in close contact to the sensor due to large number of rods

TOP 13:

Sramek: Gypsum block sensors and Campbell CS616 for soil volumetric content

Discussion:

Variation of the soil moisture content not only caused by the soil but also by the forest type…..

TOP 14:

Vermeiren: water balance experience in Flanders, usage of WatBal model

Discussion:
WatBal calculates total ET, no ET components
Manual readings of the Tektronix cable tester for TDR-measurements subjective, new methods?
Climatic data from national weather service will be used for FUTMON since dense network exists, no complex terrain in Belgium

TOP 15:

Sverrild: Soil water measuring and modelling with CoupModel in Denmark

Discussion:
Manual monthly event-related readings at various locations in Denmark, Cable tester profile for measuring soil moisture, type: Campbell, problem of contact to soil while measuring^

TOP 16:

Closing discussion

Sampling for pF curve (mandatory if organic layers > 5 cm organic sample, sampling windows 0-20 cm, 20-40 cm, 40-80 cm) and soil moisture measuring depths should be the same, ranges are given to ensure that genetic horizons or other soil physical properties can be considered (special importance of A-horizon for evapotranspiration), but also that texture information from BIOSOIL can be used, report the exact depth, zero plane is the upper border of the upper mineral horizon, minimum: 1 probe/depth range, importance for derivation of pedotransfer functions as well as gaining direct soil hydraulic parameters for water budget modelling

Repetition for small-scale variability (0-20 cm: 3 replicates, 20-40 cm: 3 replicates, 40-80 cm: 3 replicates)

Recommendation to take into account the canopy structure, plots in the middle between trees as well as the periphery (where possible)

Frequency of soil moisture measurements: minimum requirement that when a wider timescale than daily values are used a sufficient long, representative time series covering different moisture conditions could be used instead, strongly recommended to use daily values (Special case Denmark)

Calibration of sensors needed, but laborious, submission of not calibrated data + mark,

Technical recommendation of how to install the TDR-probes in an annex of the field protocol, contact to experienced installers of soil moisture equipment (Grimmeisen, Unold, UGT etc)

Further discussion by the Google group or mail

Lothar Zimmermann and Stephan Raspe