Soil Moisture Measurement Accuracy at the CEOP Mongol Reference Site

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Purpose

To discuss the accuracy of the TDR soil moisture measurement at the CEOP Mongol reference site

Method

Laboratory tests using glass beads and site soils

Procedure of probe error test

Basic calibration by a TDR probe maker (IMKO) based on the Topp equation

Probe error test using glass beads (mean particle diameter:0.1mm) in laboratory → Fig.2

Probe error test using site soils in laboratory → Fig.3

Photo 1 Our TDR probe (TRIME IT of IMKO)

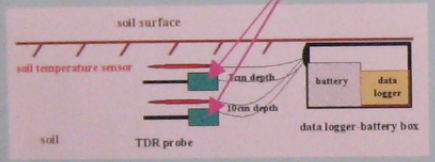

Fig. 1 Soil moisture measurement system of ASSH (Automatic Station for Soil Hydrology) and AWS (Automatic Weather Station)

Monitoring data analysis

Water budget analysis of the 3cm depth TDR probe (Photo 1) data during rainfall : Comparison of soil moisture change ΔS from 0cm to 6.5 cm depth which is the mean depth of the 3cm and 10 cm depths of TDR probes) with rainfall amount ΔR during rainfall infiltration during Δt in the early stage with no surface runoff and evapotranspiration → Fig.4

$$\Delta R = \int_0^t \overline{Ri}\, dt \qquad S = \int_{0\,cm}^{6.5\,cm} \Delta\theta_3\, dz$$

t : time, z : depth

$\Delta\theta_{3cm}$: change of volumetric water content of the 3 cm depth TDR probe during Δt from the start of rainfall to t

R_i :rainfall intensity (mm/h)

Results and Discussion

Probe errors

- maximum absolute error = 3.8 % and mean maximum absolute error = 2% at the saturated water content (40%) in glass beads(Fig.2)
- slight difference between glass beads and site soils (Fig.3)
- small bias (Fig.3)→ another calibration necessary for the range less than about 1.8 %
- overestimation of about +2 to +1 % in site soils (Fig.3)

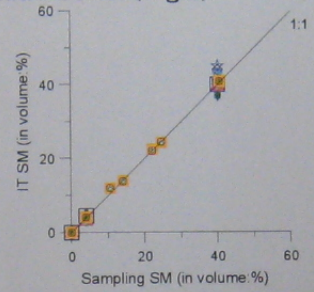

Fig.2 Results of probe error test of all the TDR probes before installation in the CEOP Mongol reference site using glass beads (IT:TDR, SM: soil moisture)

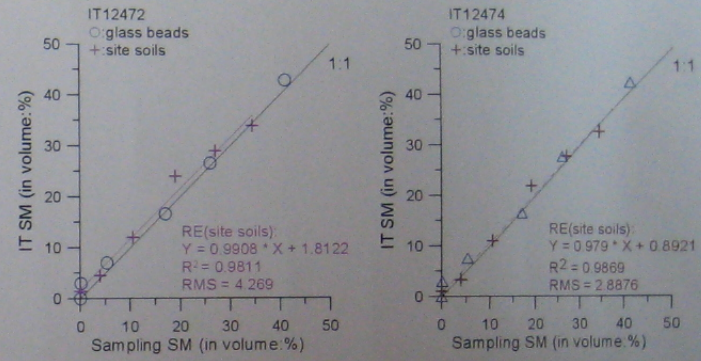

Fig.3 A sample of probe error test results of two probes (IT12472, IT12474) using glass beads and site soils

Comparison of ΔS to ΔR at two stations (Fig.4)

- High linearity of the regression lines with a small bias due to interception in lower rainfall intensity events
- Overestimation: about 6% (DRS) and 9 % (MGS) of ΔR → due to small surface runoff and the measurement area and/or the error of TDR probe
- In-situ high accurate measurement of soil moisture at the CEOP Mongol reference site

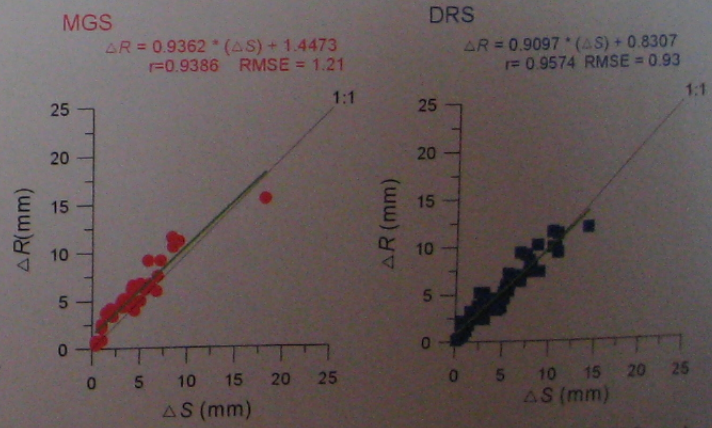

Fig. 4 Relationships between ΔS and ΔR of MGS and DRS (MGS: Mandalgobi station, DRS: Deren station)

Conclusions

- The mean maximum absolute error of all the employed TDR probes was about 2% at the saturated water content (40%) in glass beads.
- The measurement accuracy of TDR probe was less than 2 % in site soils