The effect of soil type and crust presence on non-rainfall water inputs: laboratory and field experiments

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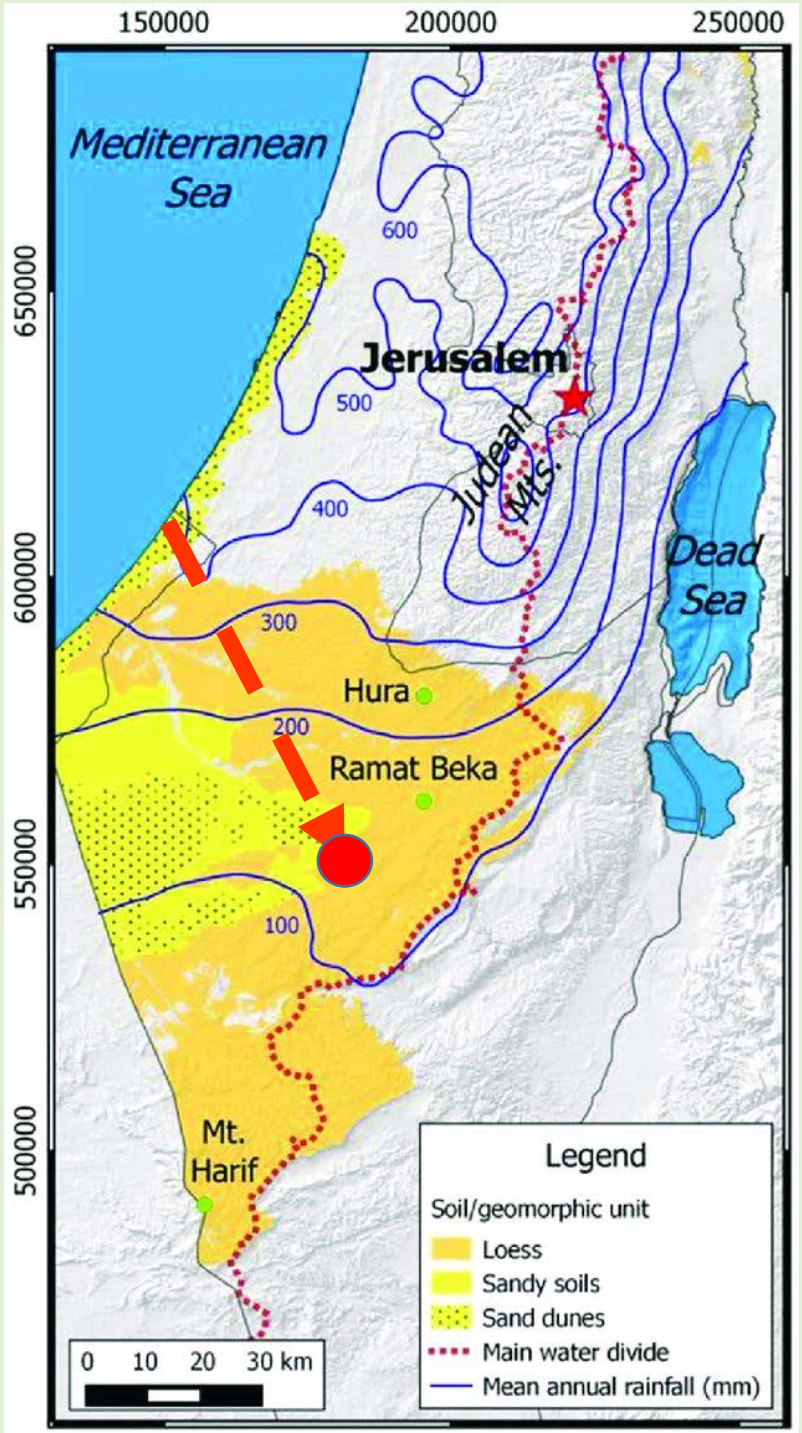


During the dry summer months the sea breeze is the most important meteorological feature in the South- West region.

Both soil types are covered by thin crusts

- Loess by a physical crust
- Sand dunes by biological crust

Schematic distribution of main soil types in the Western Negev and Gaza strip. (O. Crouvi et al., 2015)

OBJECTIVES:

Evaluate

- the magnitude of atmospheric water vapor absorption of the two main soil types in the area;
- the effect the absence of a crust has on the water vapor absorption patterns.

MATERIALS & METHODS

Selected properties of various soil layers

Soil	Depth	Sand (%)	Silt (%)	Clay (%)	Organic matter (%)	Electrical conductivity (dS/m)	Water content at saturation (%)	Sodium content (mEq/L)
Sand	crust layer	81	16	3	0.91	5.14	35	3.8
	1-5cm	86	12	2	0.36	0.47	23	0.9
	5-10cm	87	11	2	0.32	0.37	22	0.8
Loess	crust layer	41	47	12	0.78	2.27	27	12.5
	1-5cm	47	43	10	0.87	8.65	30	58.3
	5-10cm	46	44	10	0.55	8.03	29	56.7

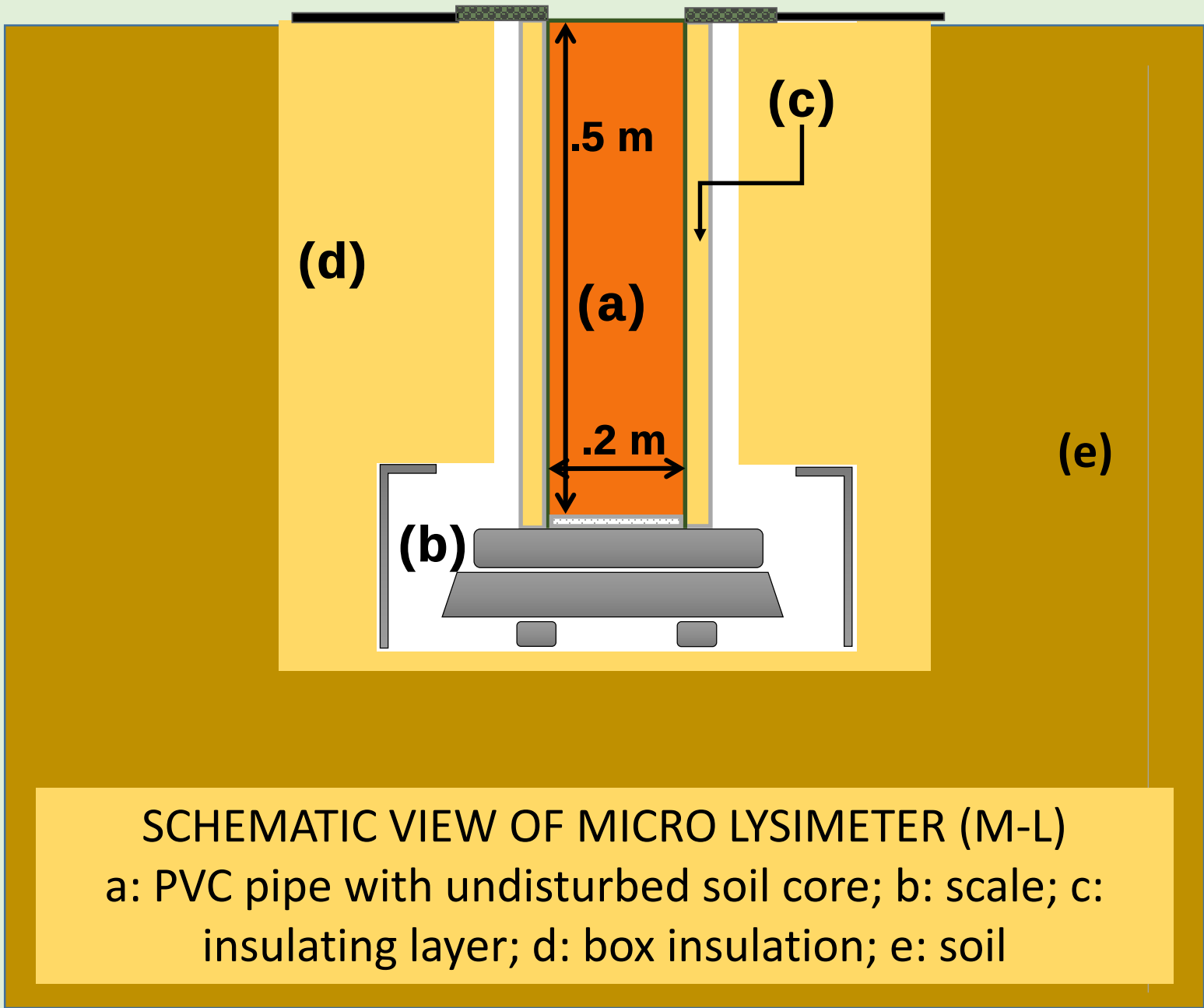
MATERIALS & METHODS

Field Trial

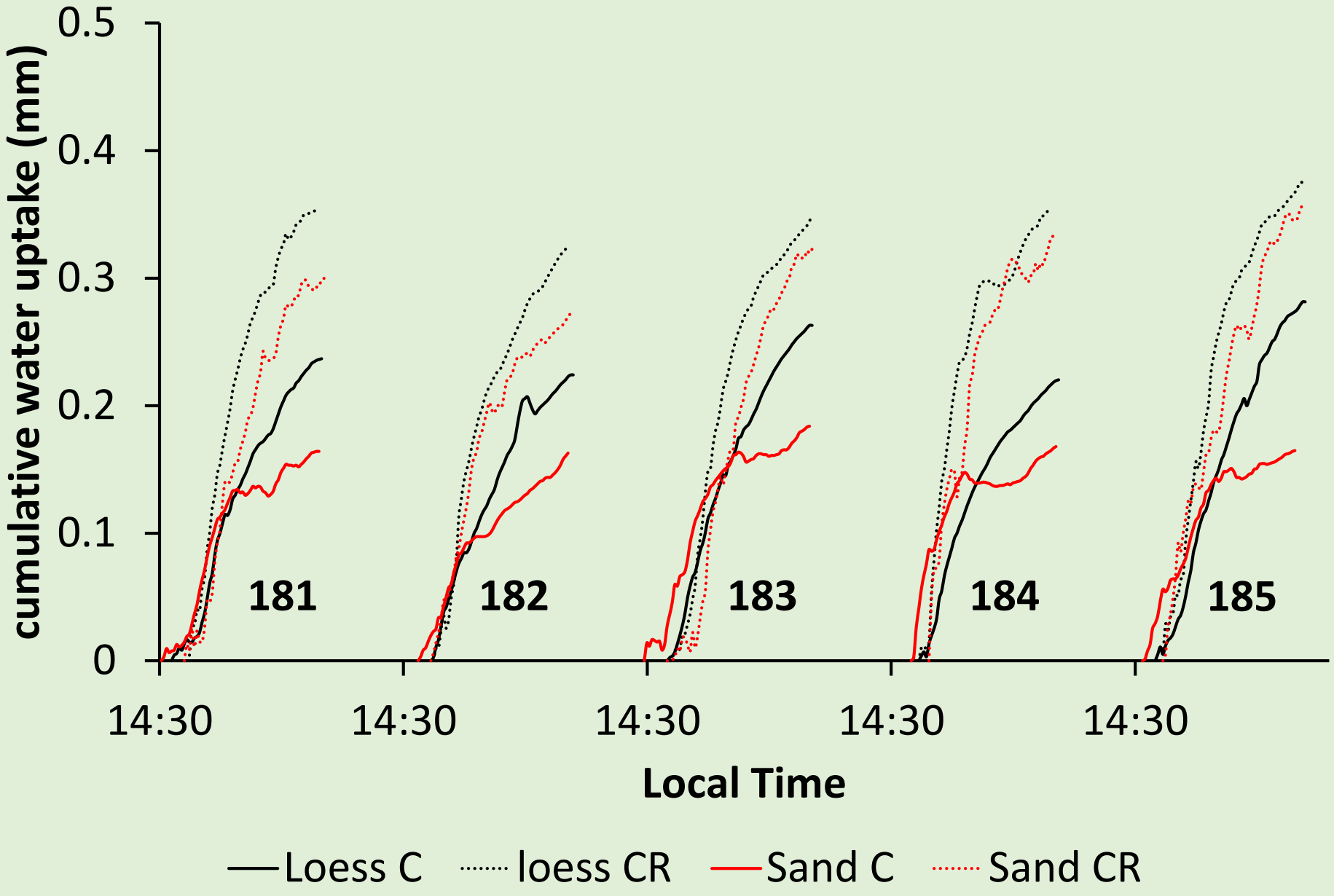
Four micro-lysimeters :

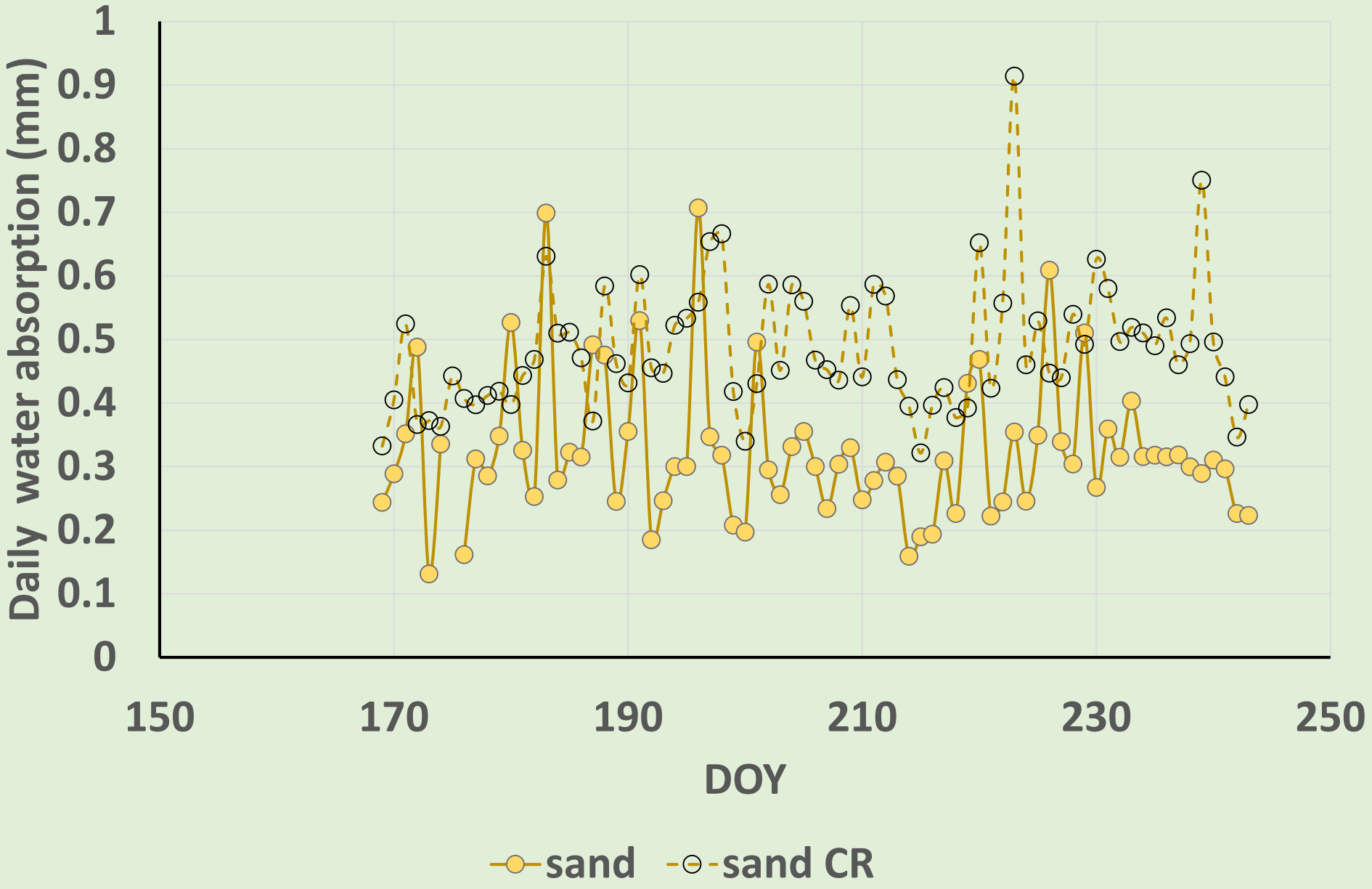
1. Sand
2. Loess
3. Sand crust removed
4. Loess crust removed

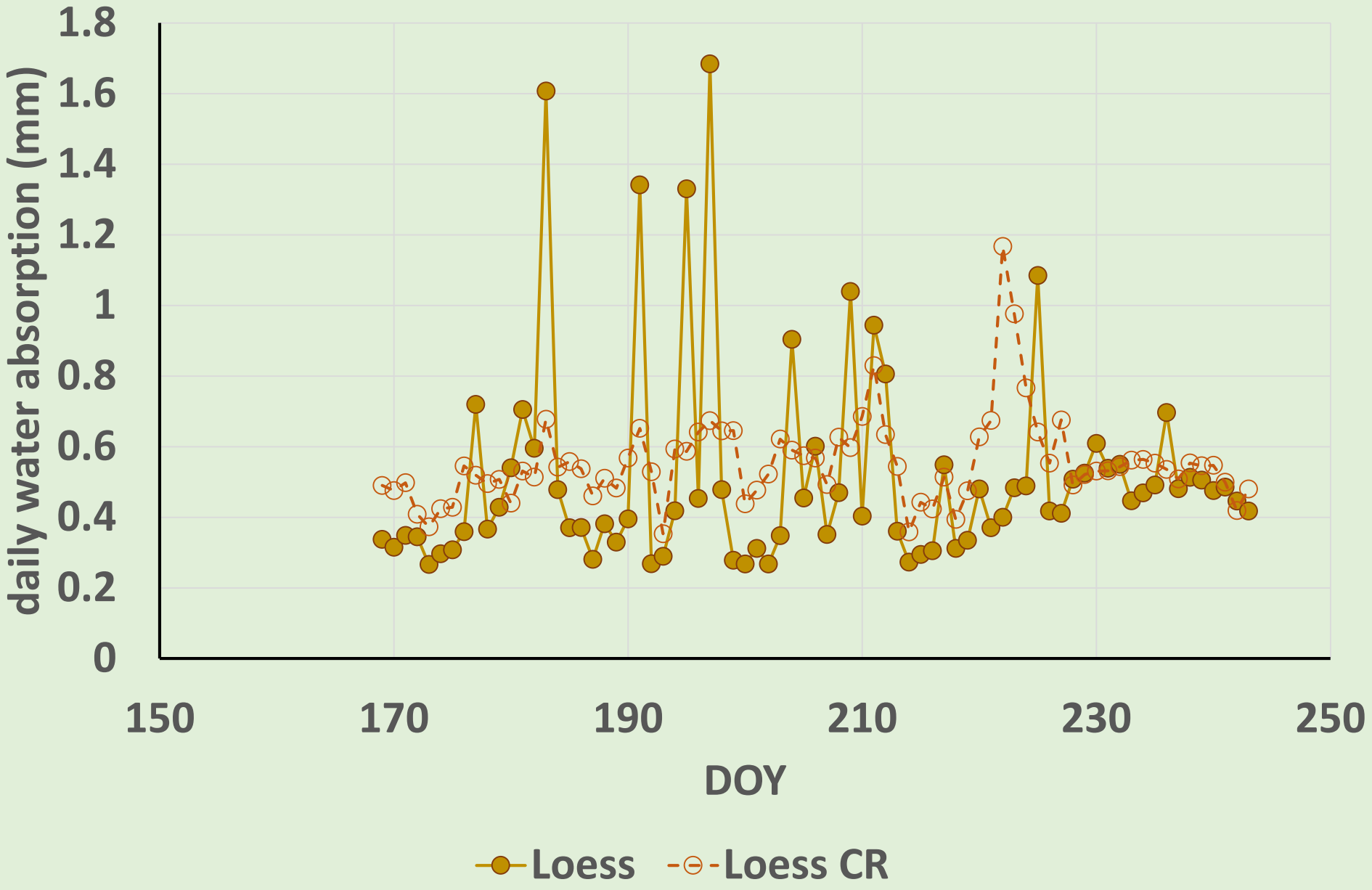
Scale: 30 kg with 0.1 gr resolution (equivalent to 0.004 mm). Electronic output connected to DAS. One min. burst averages were recorded every 15 min.



SCHEMATIC VIEW OF MICRO LYSIMETER (M-L)
a: PVC pipe with undisturbed soil core; b: scale; c: insulating layer; d: box insulation; e: soil


cumulative water uptake (mm)
0.5
0.4
0.3
0.2
0.1
0
181
182
183
184
185
14:30
14:30
14:30
14:30
14:30
Local Time
Loess C
loess CR
Sand C
Sand CR


Daily water absorption (mm)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
150
170
190
210
230
250
DOY
sand
sand CR


daily water absorption (mm)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
150
170
190
210
230
250
DOY
Loess
Loess CR

Interim conclusions from field study

- The Loess crusted soil absorbed more water vapor than the crusted sandy soil

- Both crust types significantly restricted water vapor absorption by the respective underlying soils.

The latter aspect was studied in a laboratory study carried out under isothermal conditions.

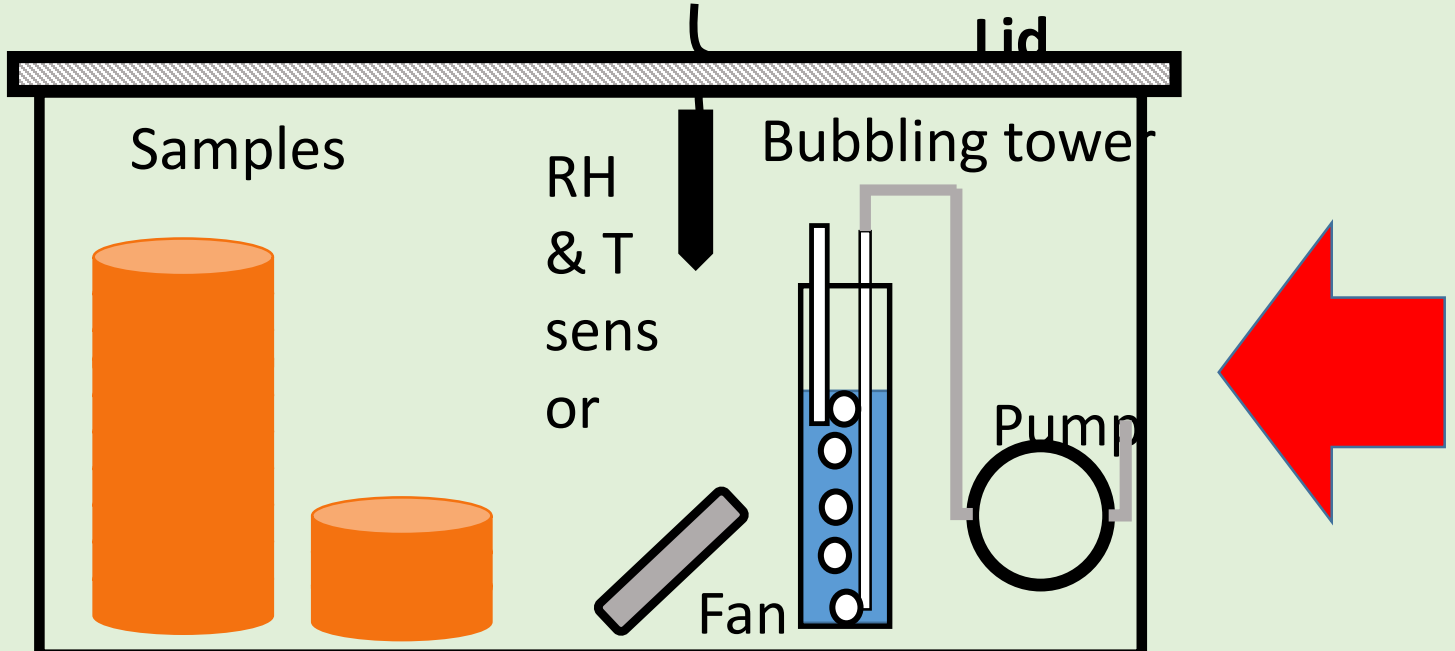
M&M. Isothermal lab trial

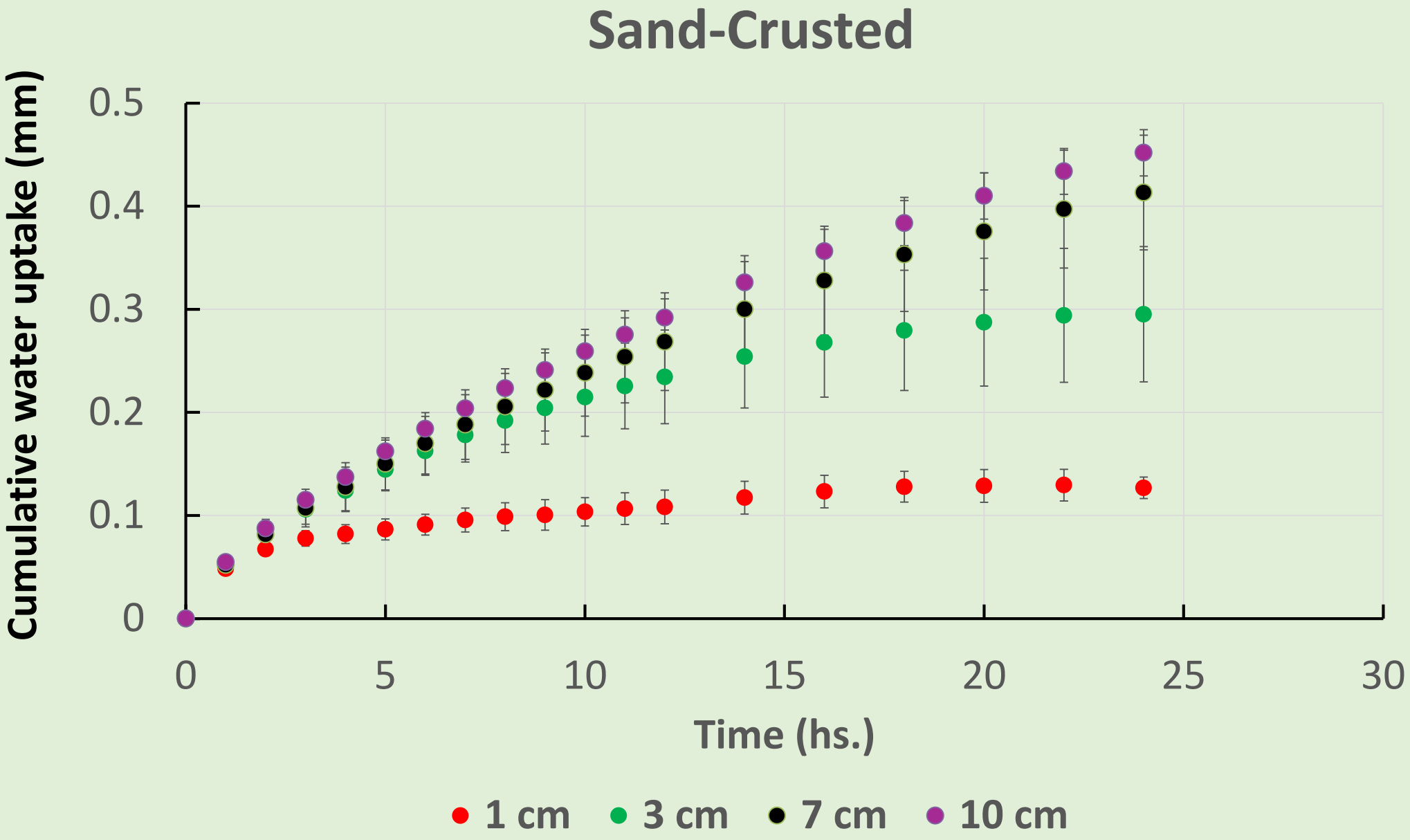
Undisturbed soil cores were obtained in the field. 4 replicates per depth (1,3,7 & 10 cm), per treatment (C, CR) for both soils.

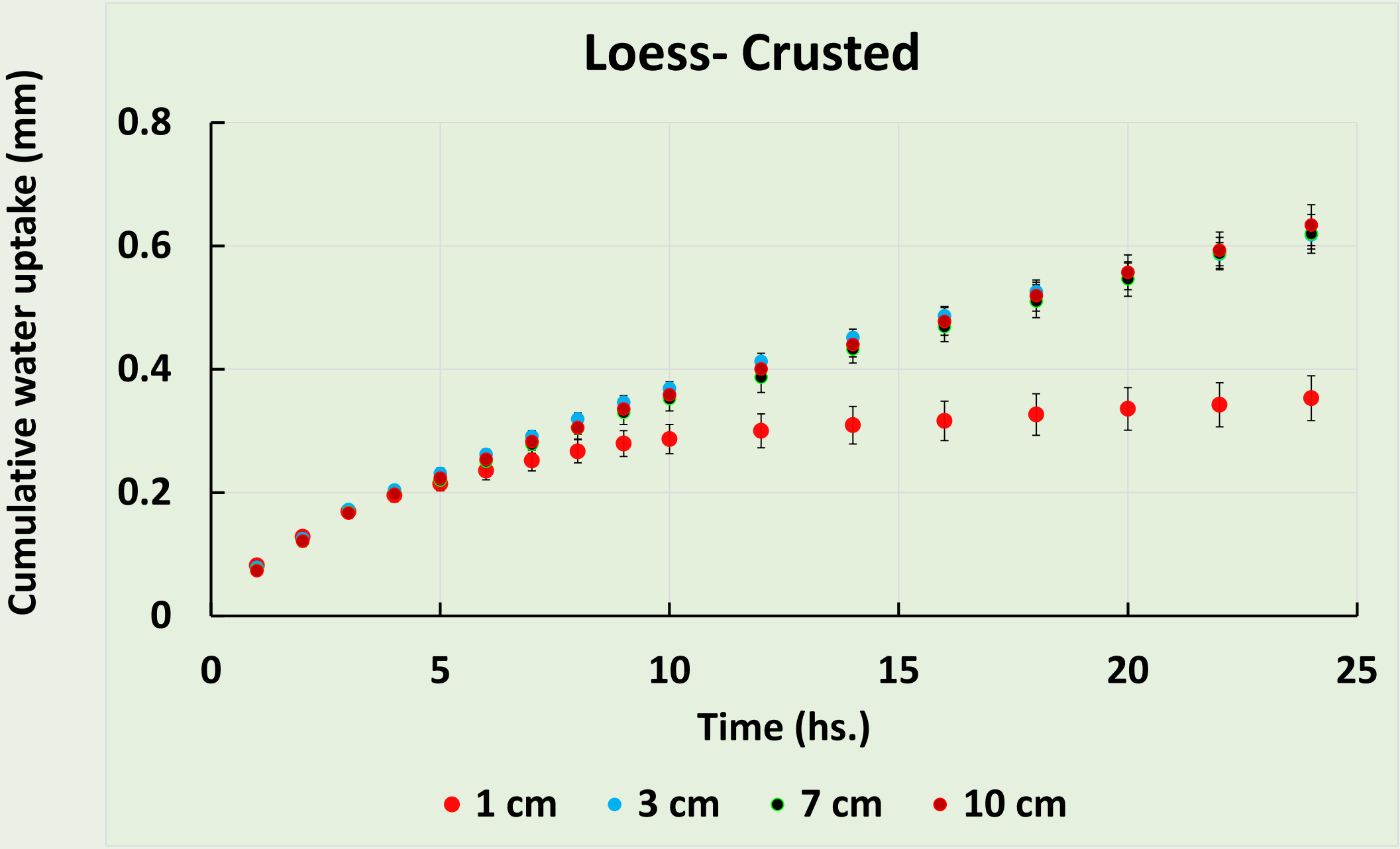
Ventilated oven (50 ºC)

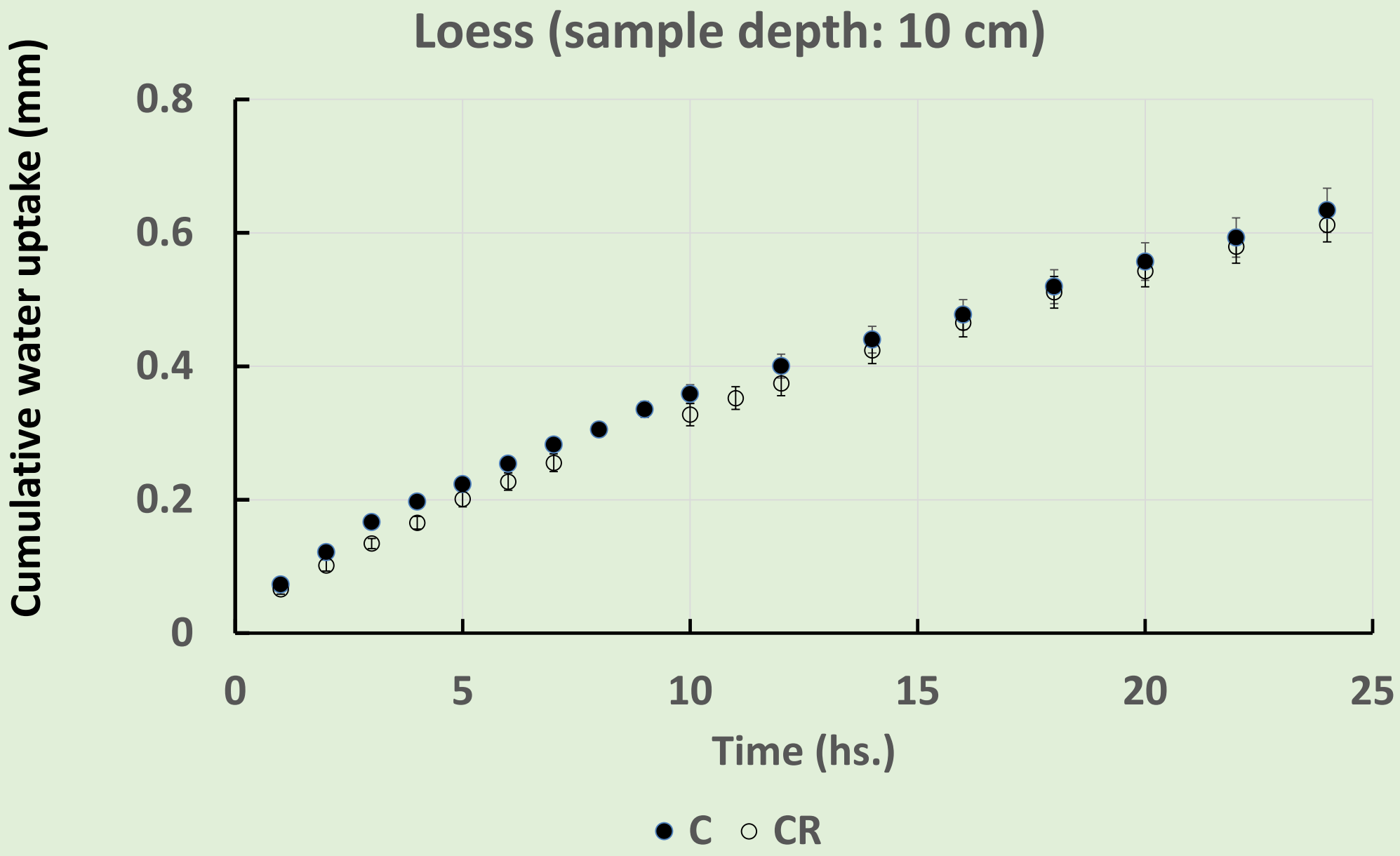
Samples were cooled in a dry air through-flow dessicator and placed in constant RH boxes.

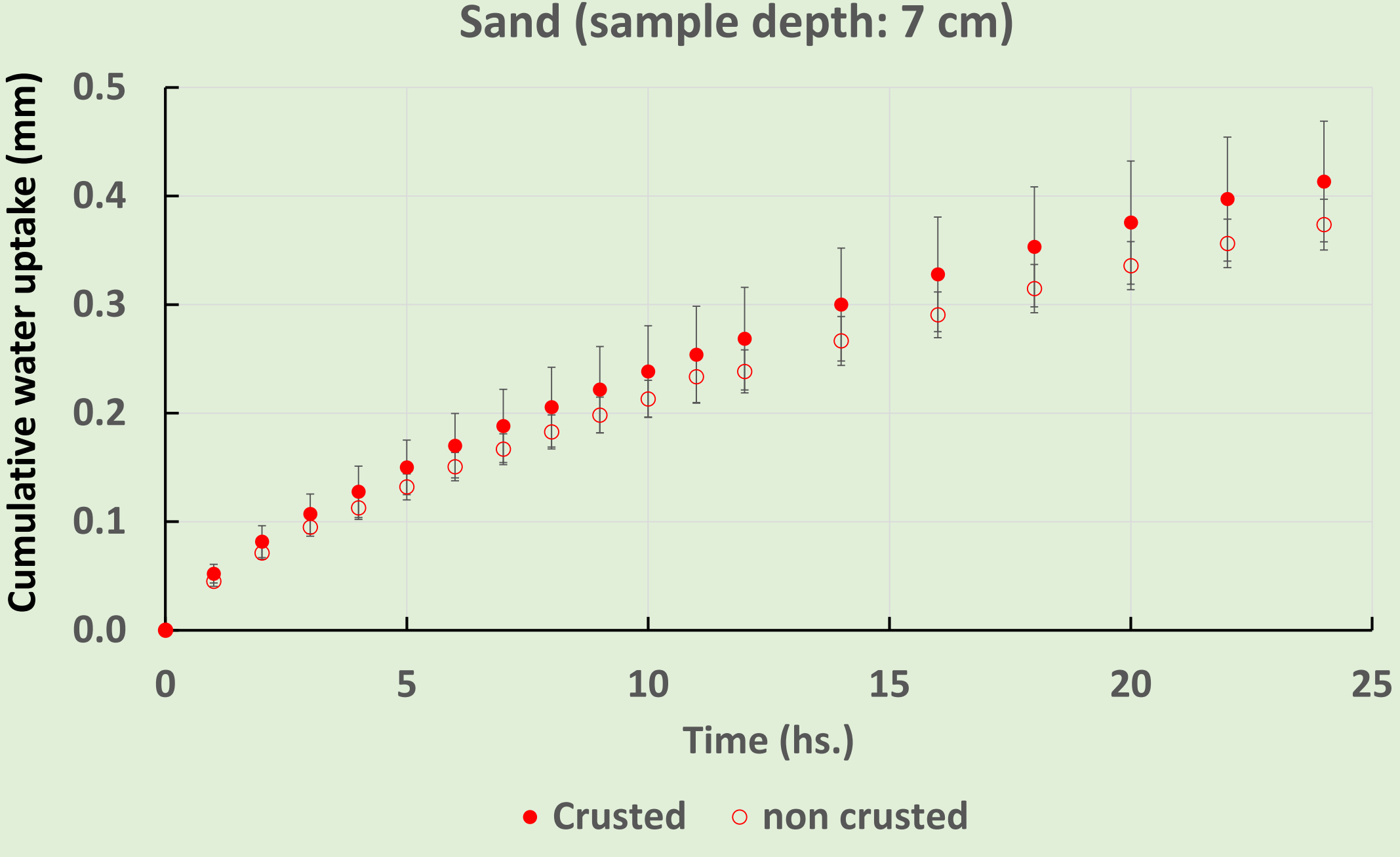
In each box one replicate of each . Samples were weighed at fixed intervals and returned to the box.




Sand-Crusted
Cumulative water uptake (mm)
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
Time (hs.)
1 cm
3 cm
7 cm
10 cm


Loess- Crusted
Cumulative water uptake (mm)
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hs.)
1 cm
3 cm
7 cm
10 cm


Loess (sample depth: 10 cm)
Cumulative water uptake (mm)
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
Time (hs.)
C
CR


Sand (sample depth: 7 cm)
Cumulative water uptake (mm)
0.5
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
25
Time (hs.)
Crusted
non crusted

Interim conclusion from isothermal lab study

- The depth of the sample strongly affects the total amount of water vapor absorption of the sandy soil and this aspecy is slightly less marked for the loess soil
- Presence of a crust does neither affect the water absorption patterns nor the total water vapor absorption.

CONCLUSIONS (from both studies)

- The presence of a crust strongly affects water vapor absorption patterns and the total water absorption under natural field conditions.
- The fact that the absorption patterns of the crusted samples in the field differed from those measured under isothermal conditions strongly suggests that the presence of a crust affects the flux of sensible heat in the soil and hence the surface energy balance.


Thank you for attention