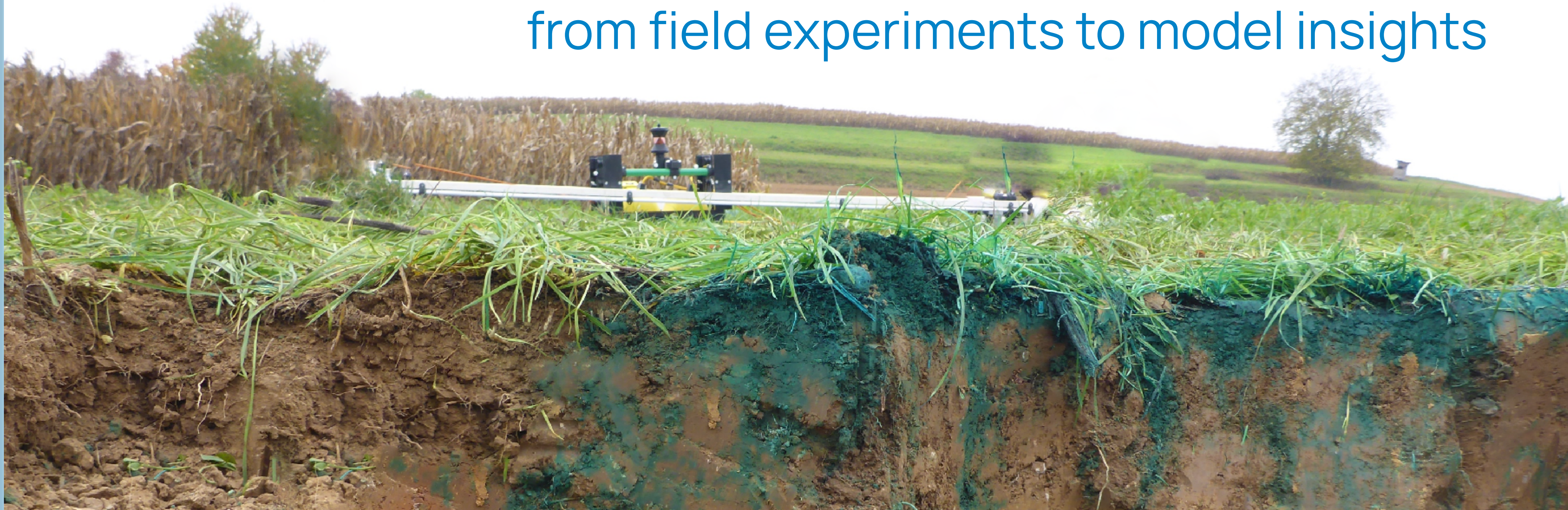


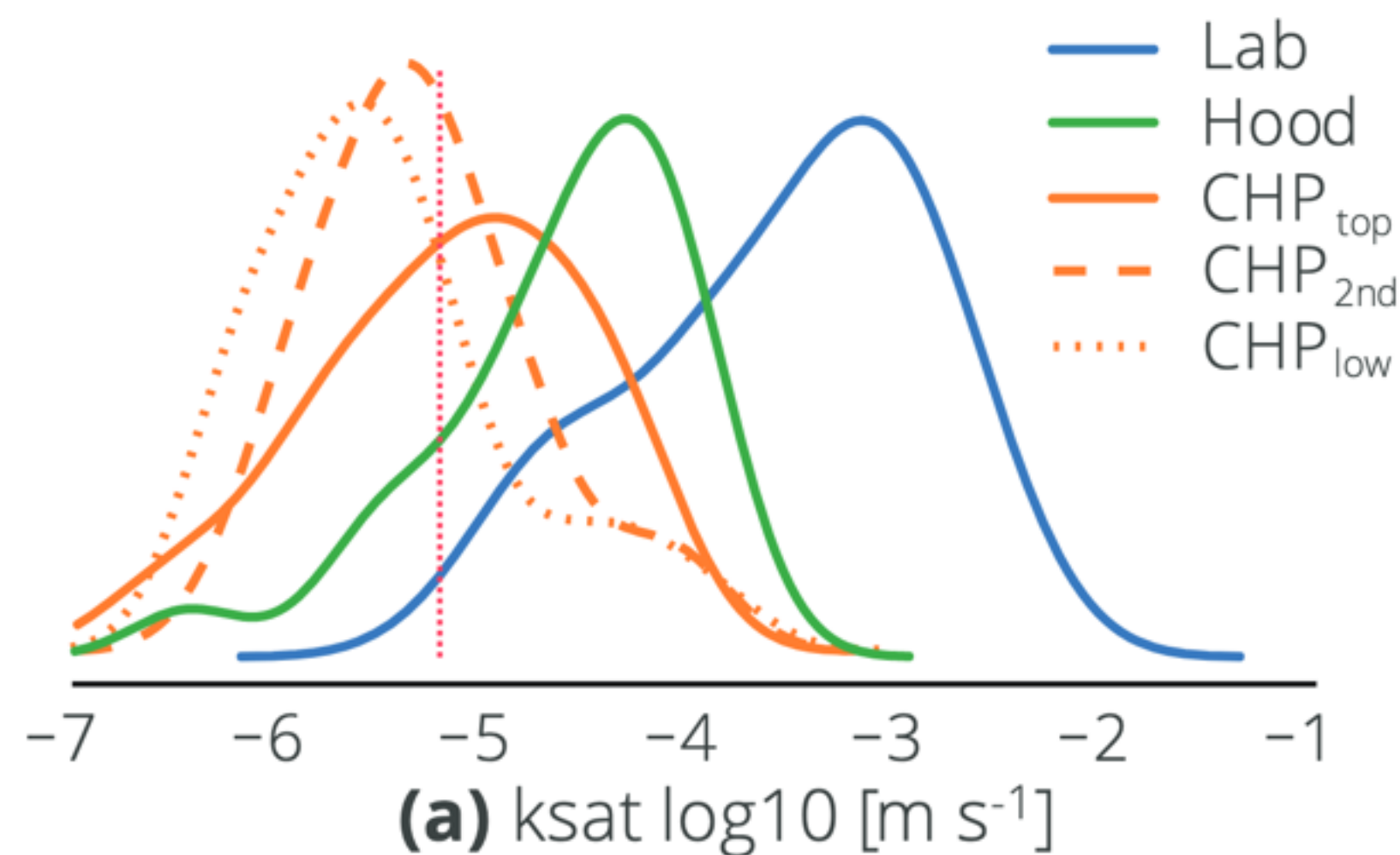
Initial non-uniform soil water redistribution as inherent hydrological process

from field experiments to model insights



Let's measure infiltration and k_{sat}

In situ and lab measurements



- Which method should be trusted?
- Which values are correct?

Problem: We cannot really see what is happening in the soil...

Let's put a little more effort into that...

Irrigation experiments with dye and other tracers

Silty soil slate slopes



silty soil on marl plains



Silty soil with clay band on sand

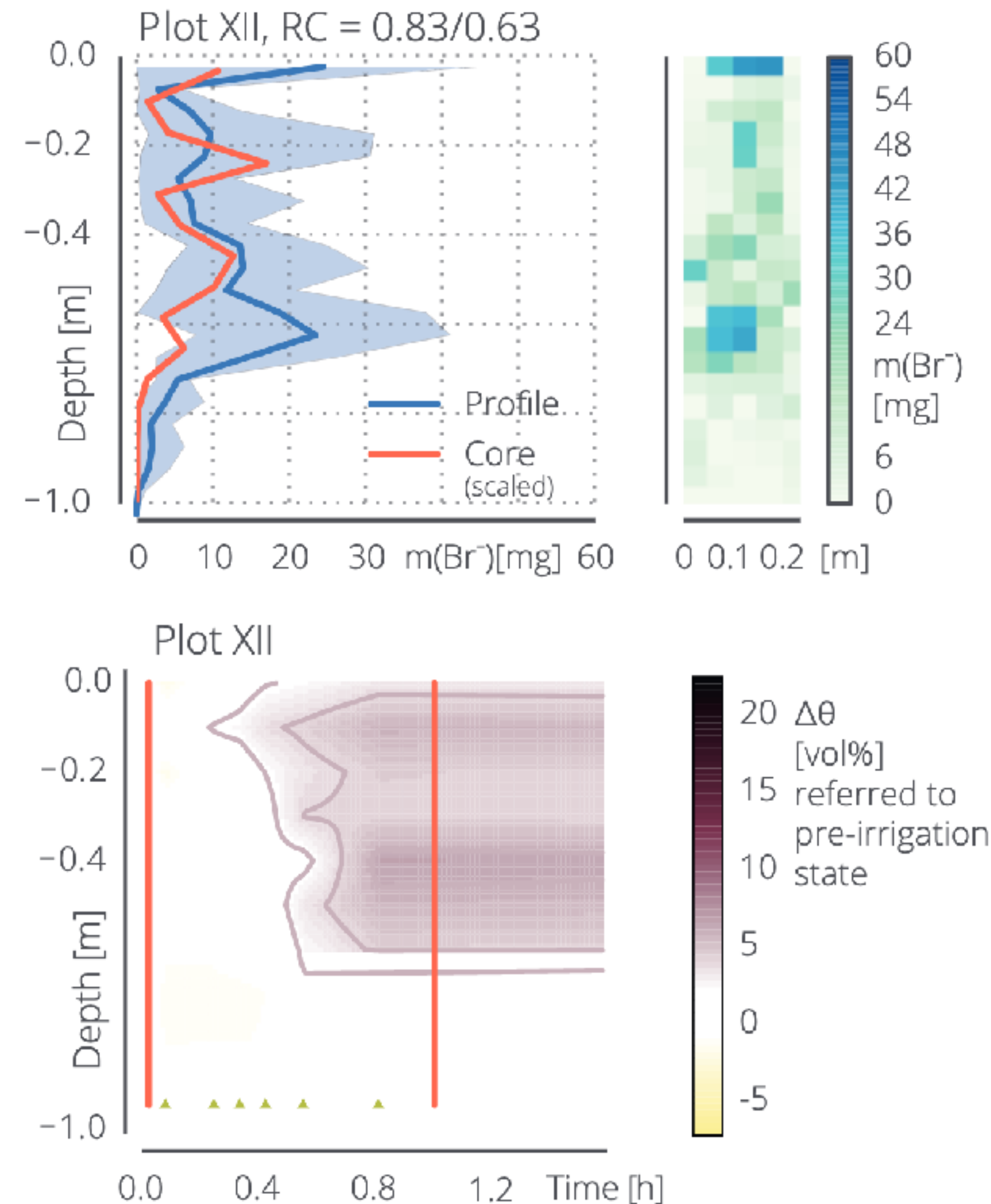
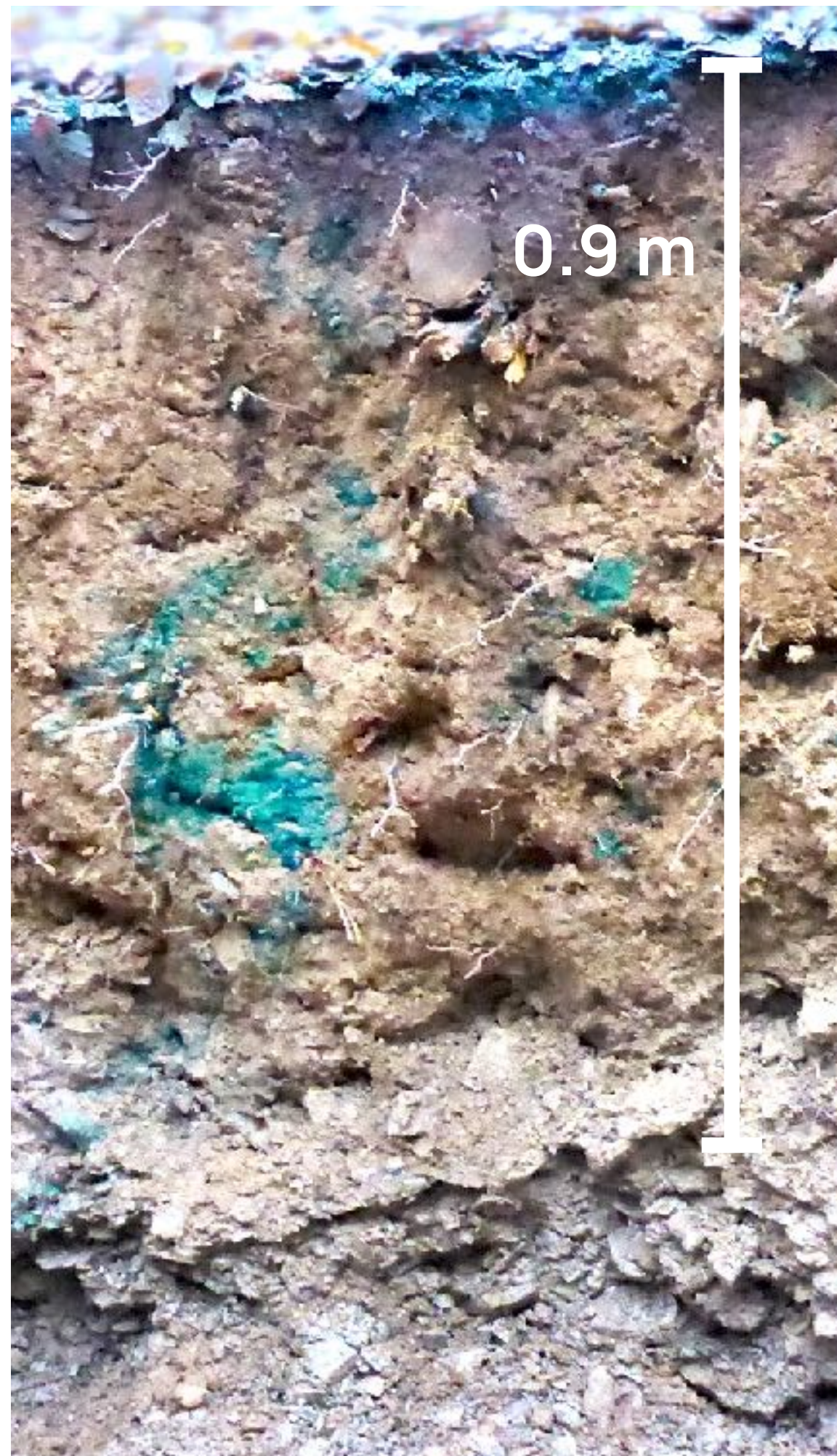


Sandy fluvial plain



Let's put a little more effort into that...

Irrigation experiments with dye and other tracers

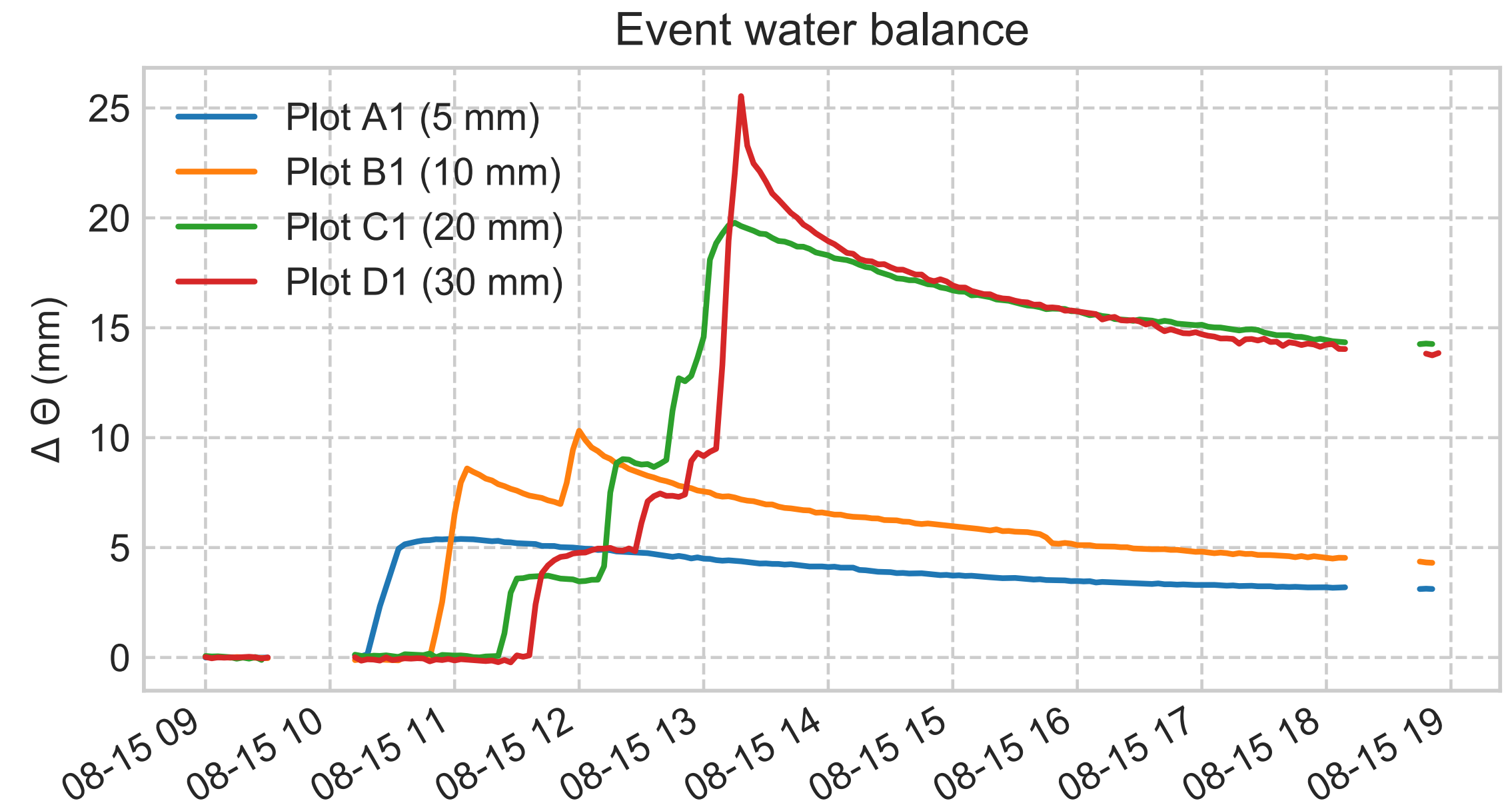
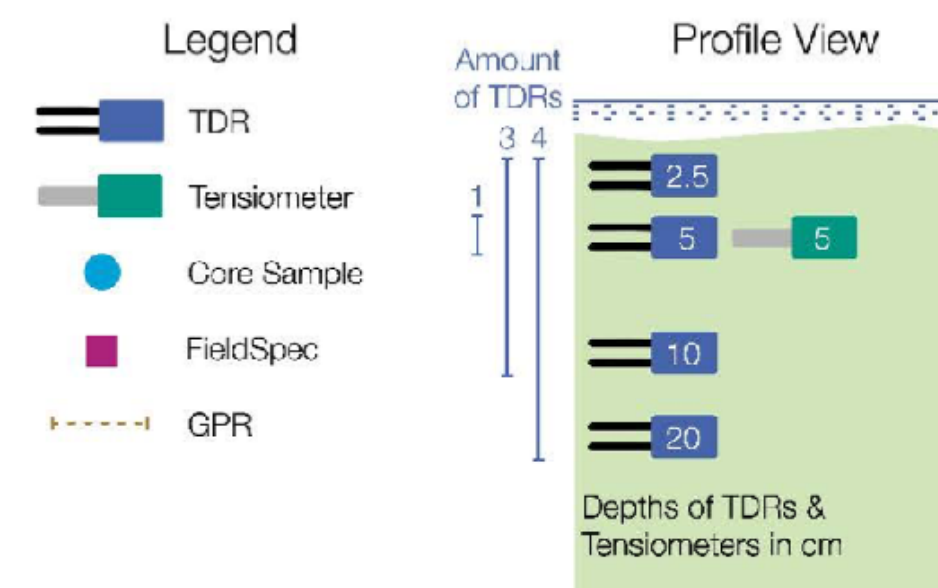
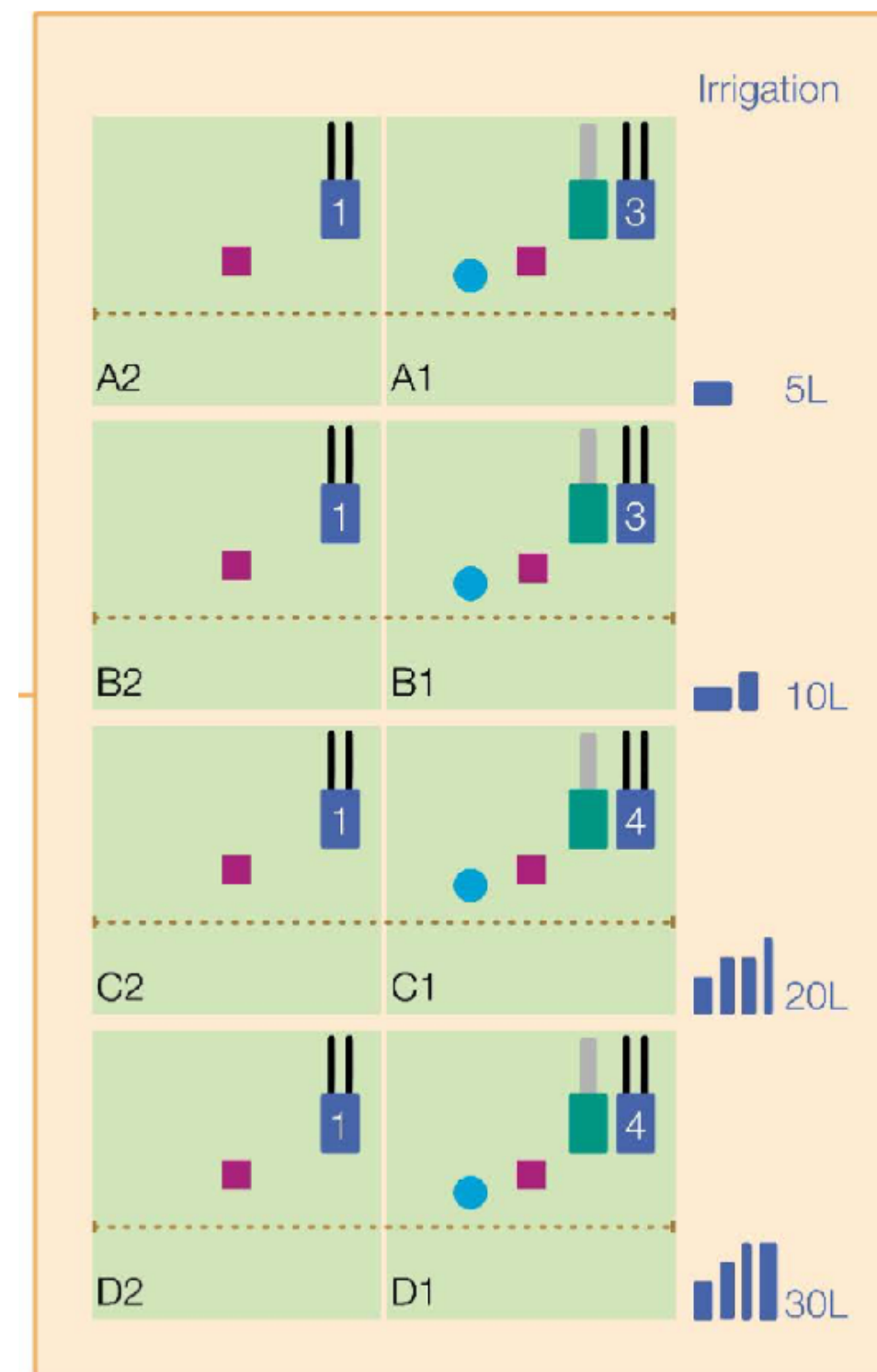
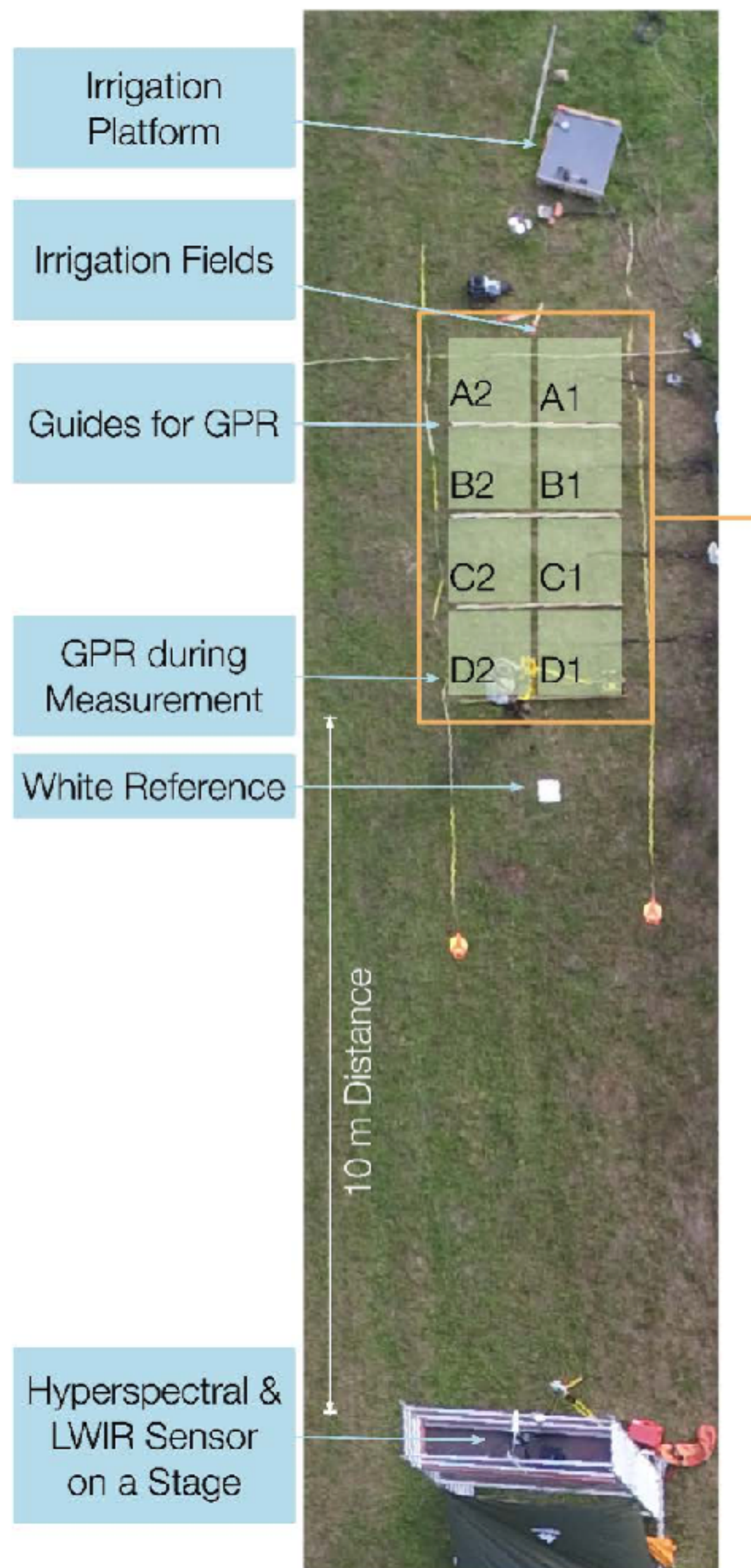


- Flow paths
- quantifiable tracer concentrations
- profile soil moisture dynamics

Problem: We can only do this once per spot. What happens at other θ_{ante} , intensities, ...

On the hunt for replicates

No more excavation, remote sensing on board

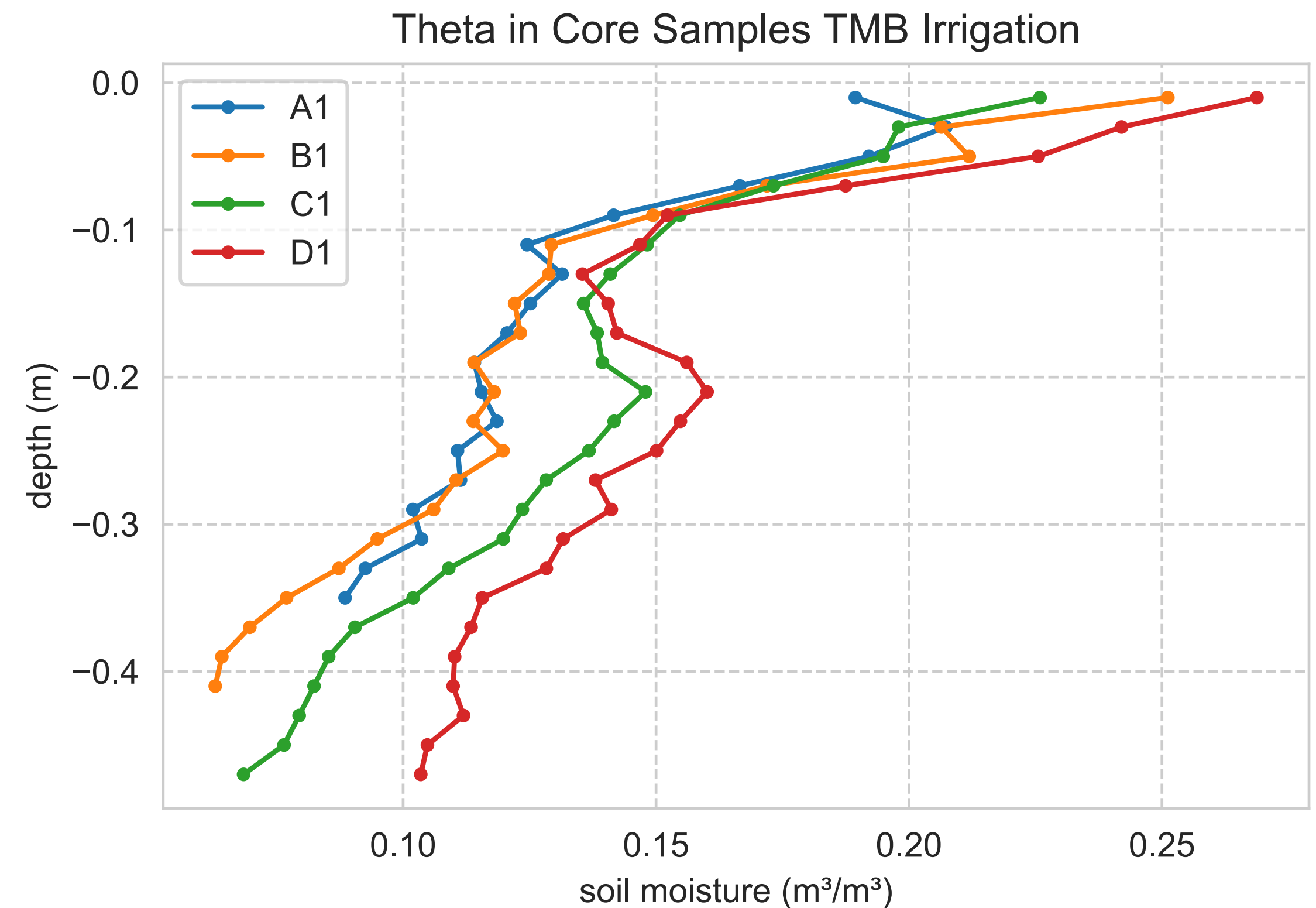
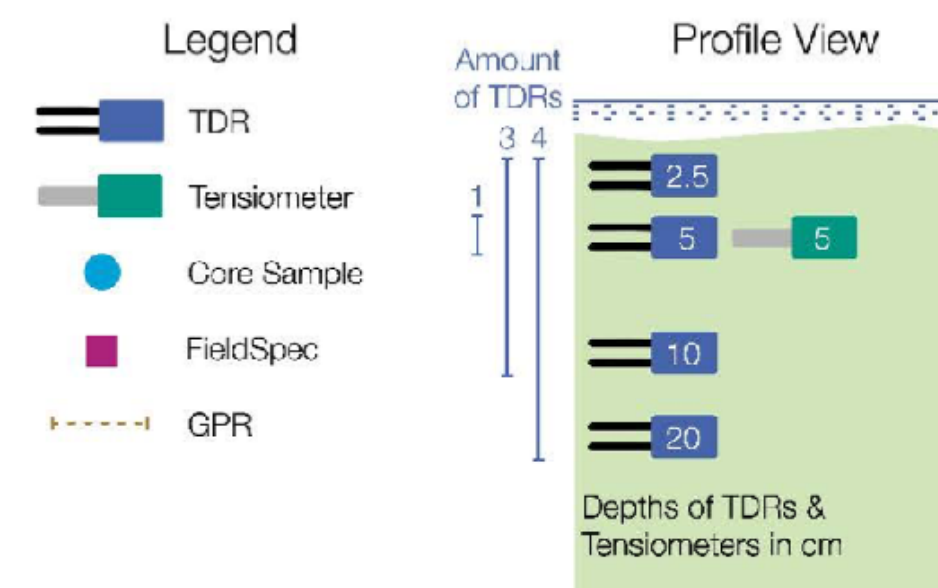
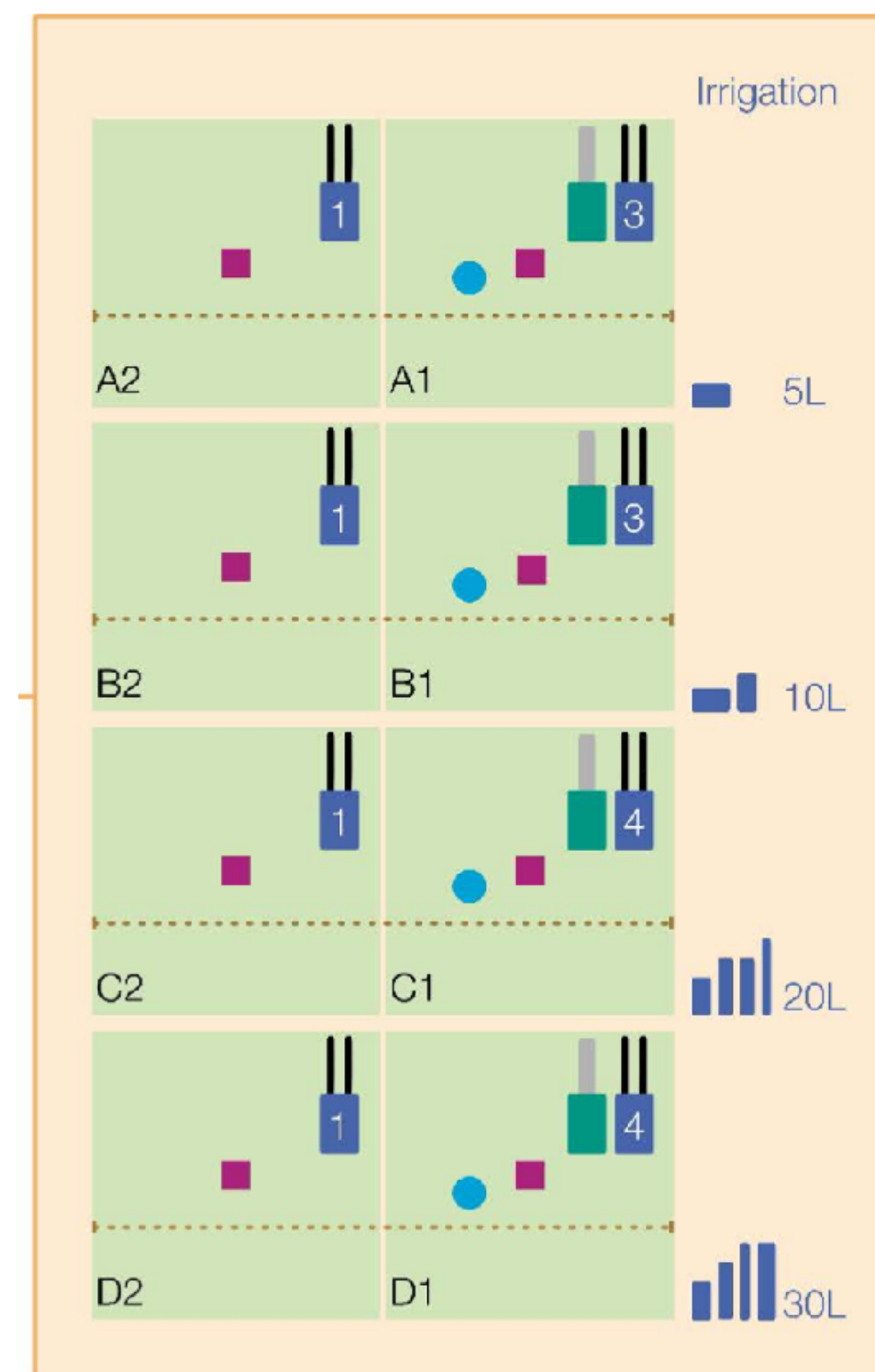
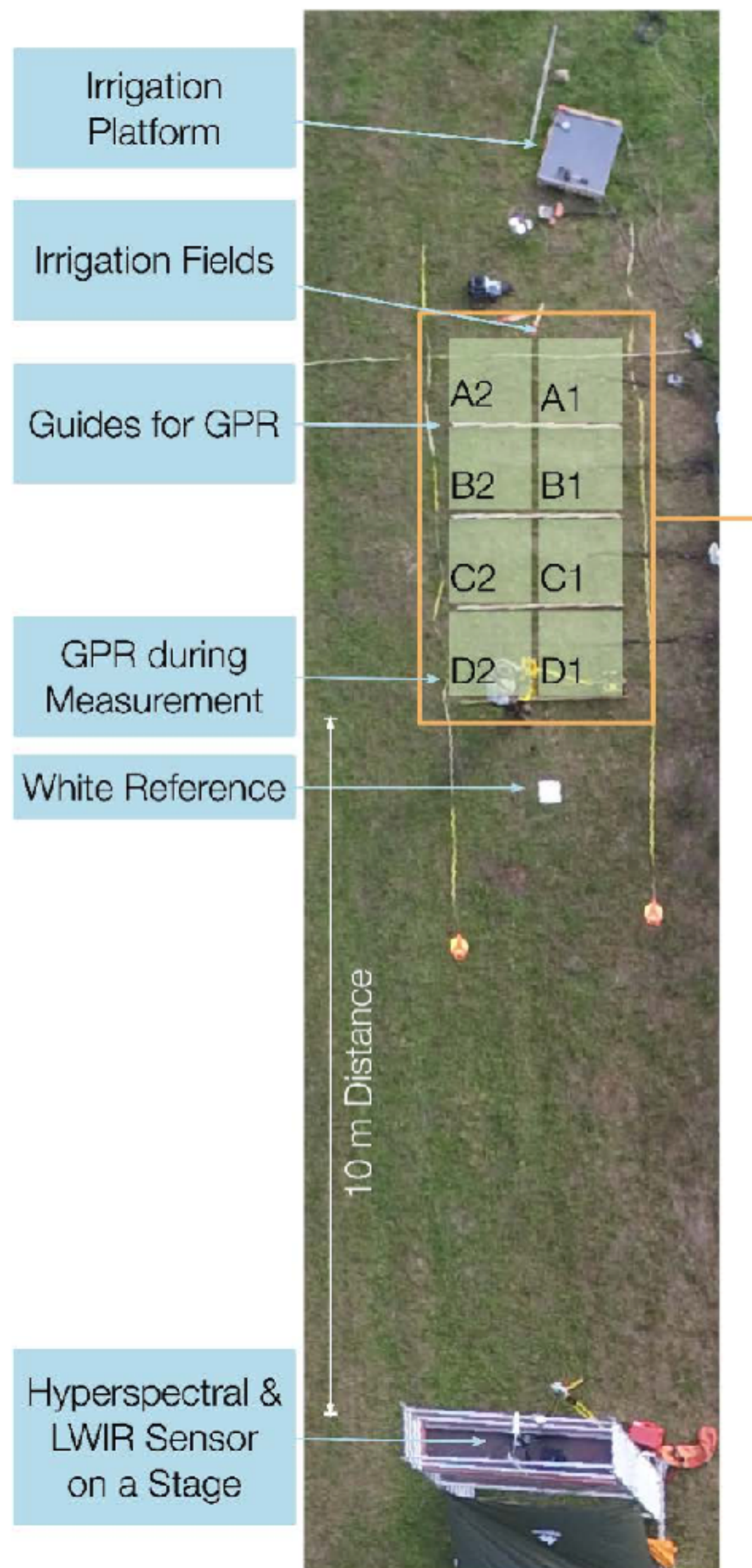


- largest differences in subsurface
- remote sensing cannot discern plots

Problem: No full flow field observed...

On the hunt for replicates

No more excavation, remote sensing on board

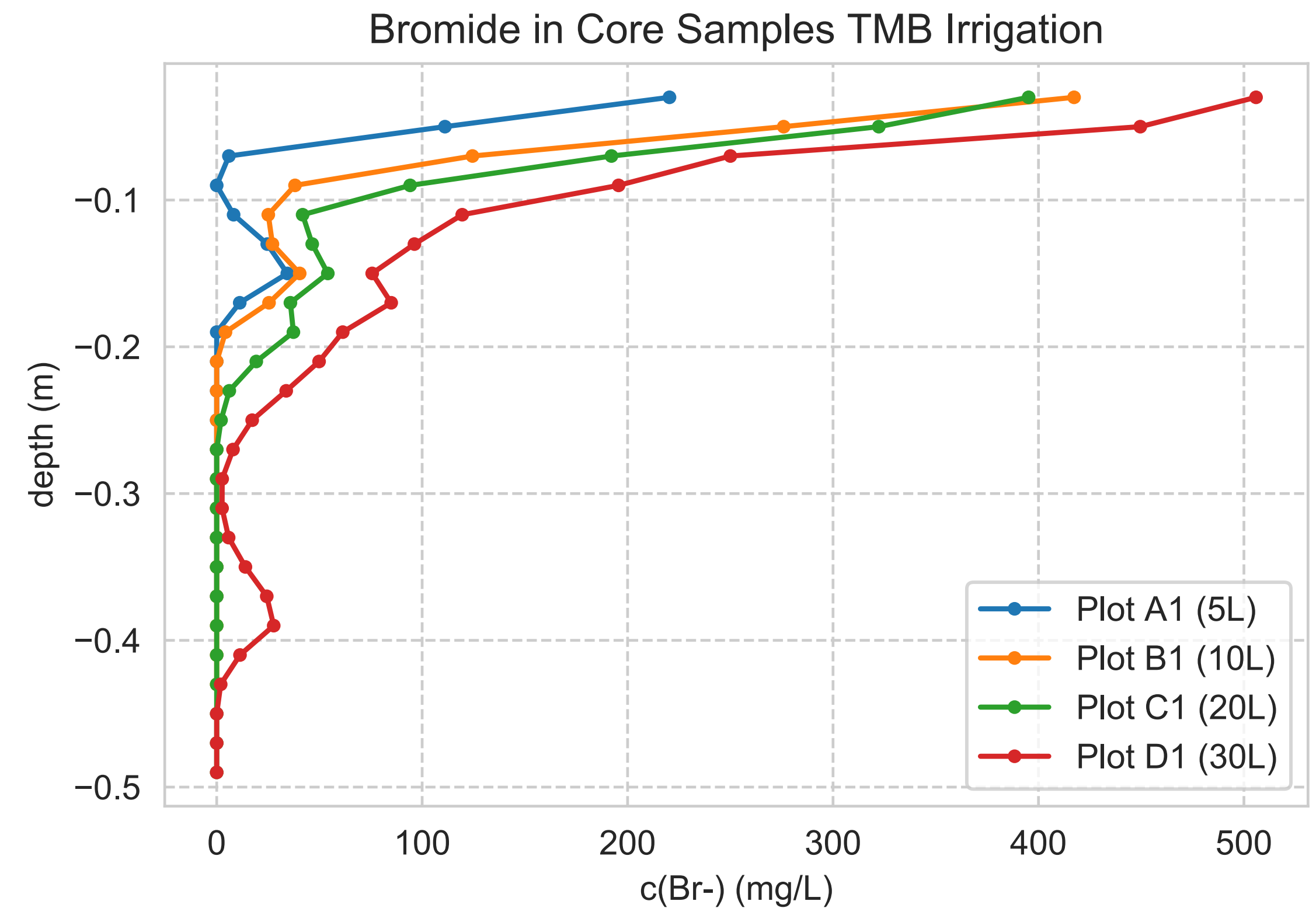
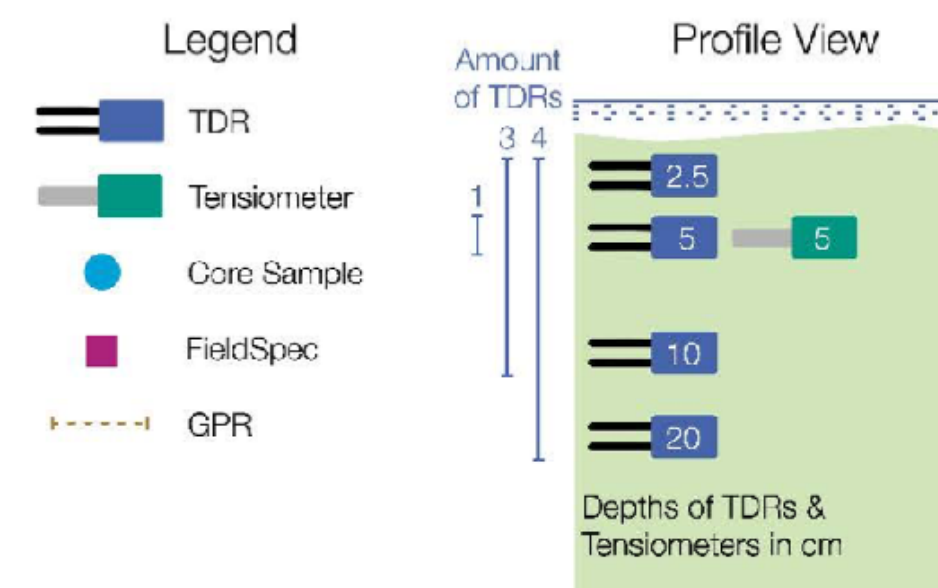
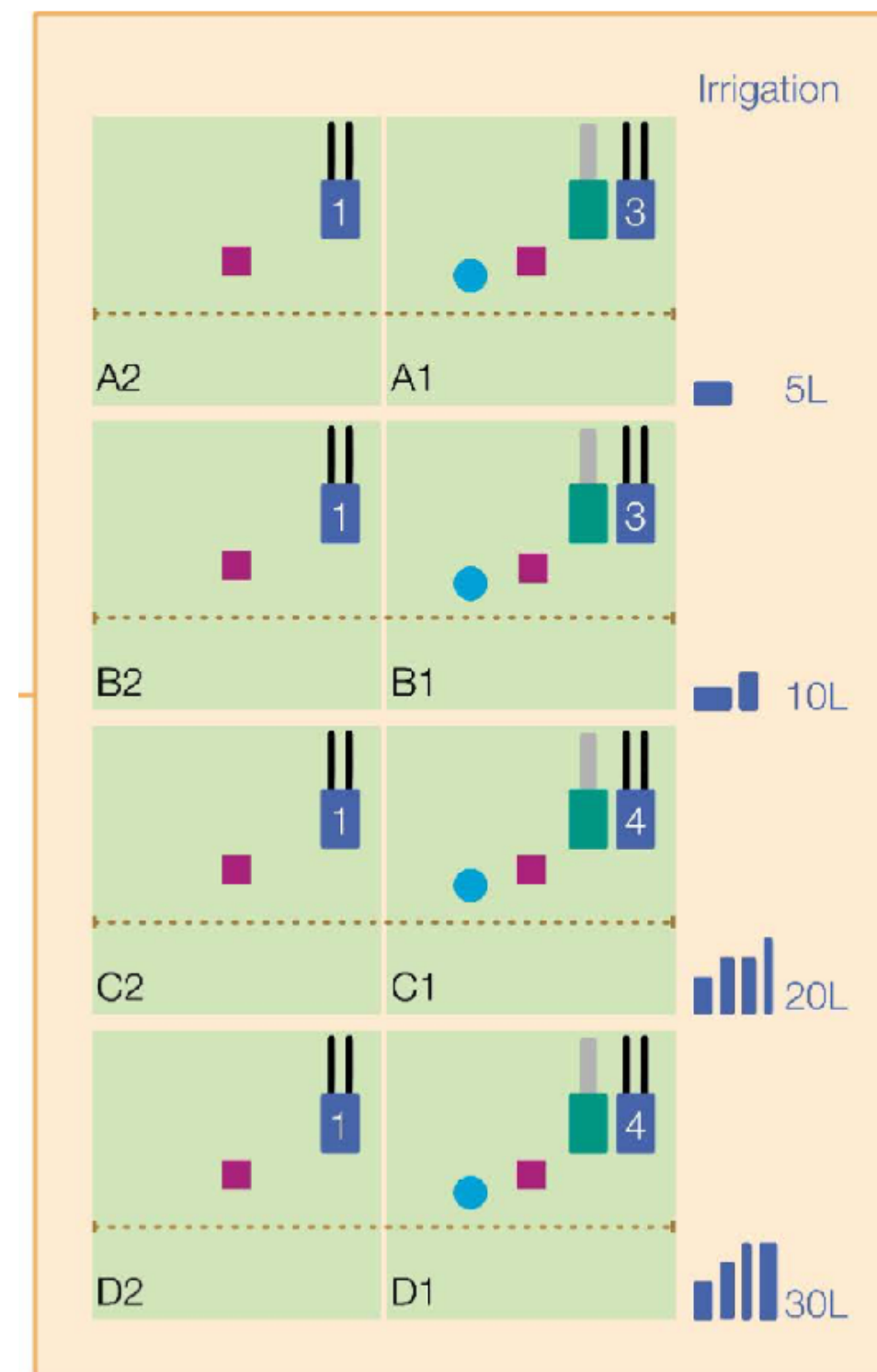
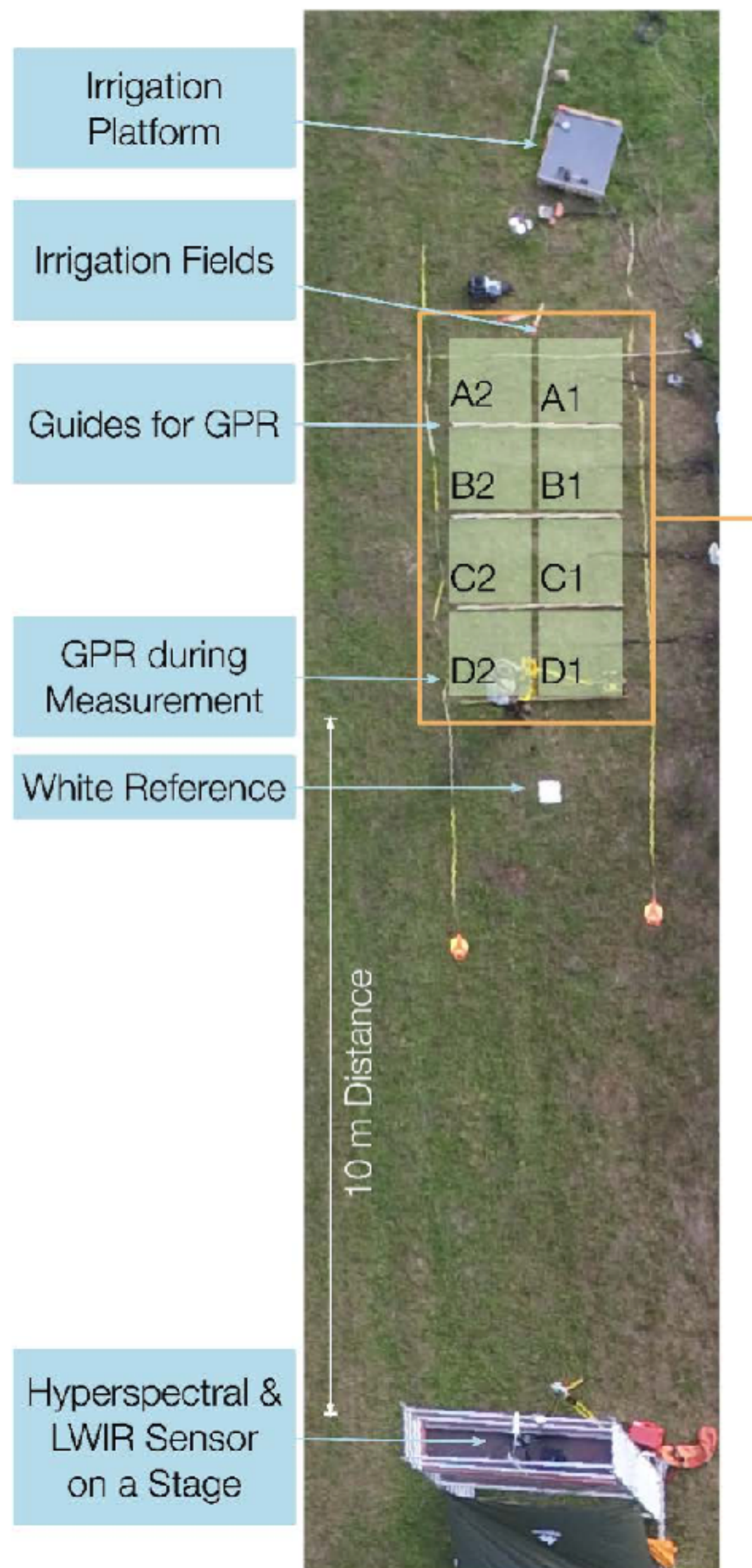


- largest differences in subsurface
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On the hunt for replicates

No more excavation, remote sensing on board



- largest differences in subsurface
- remote sensing cannot discern plots

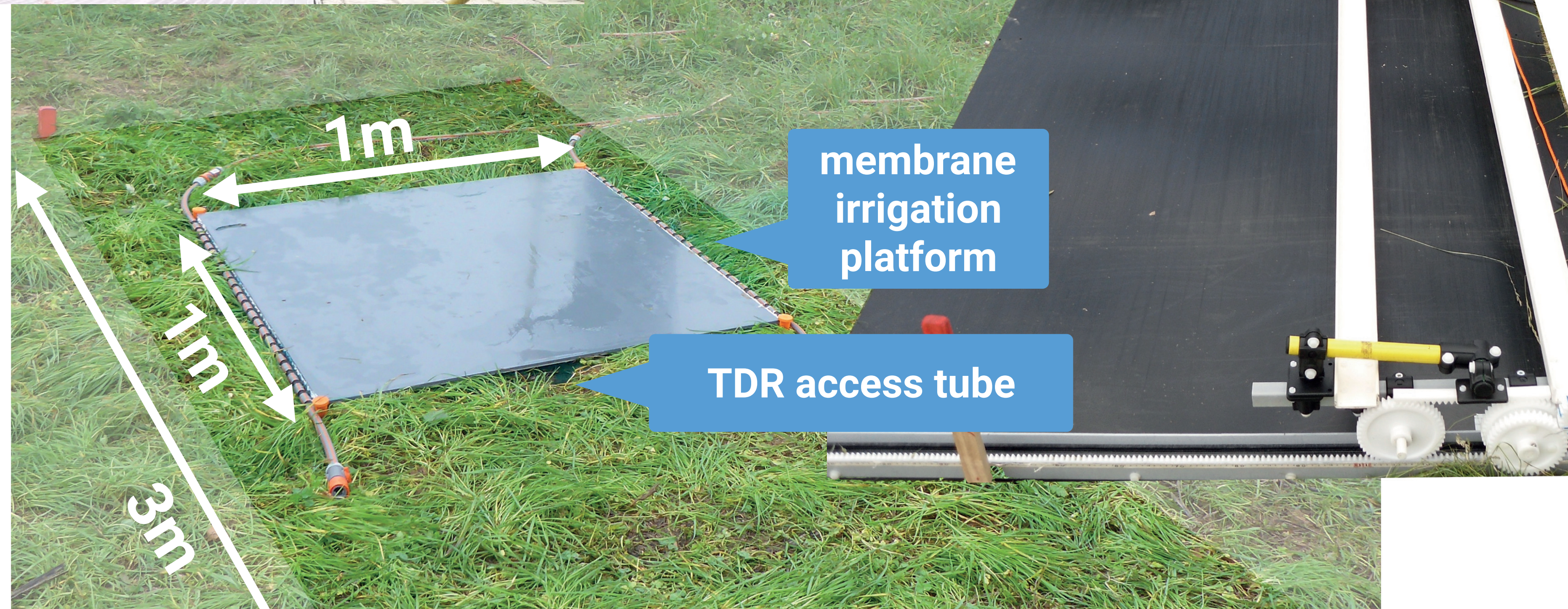
Problem: No full flow field observed...

4D near-surface GPR

detect the change in soil water in 3D during irrigation



GPR guide platform

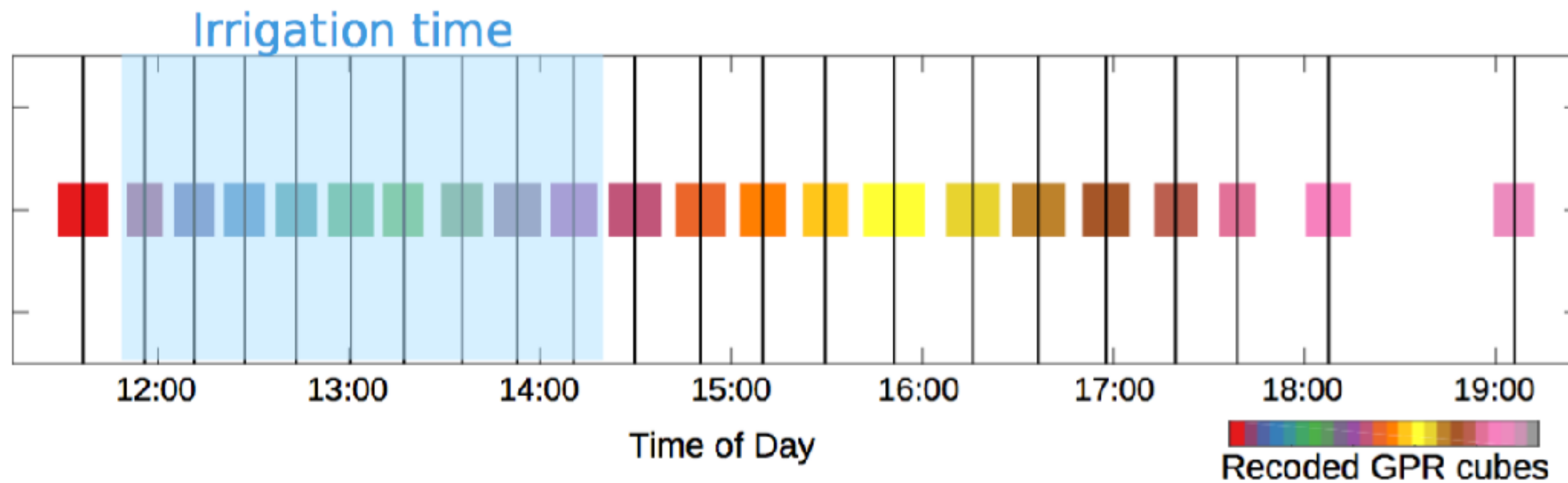


membrane
irrigation
platform

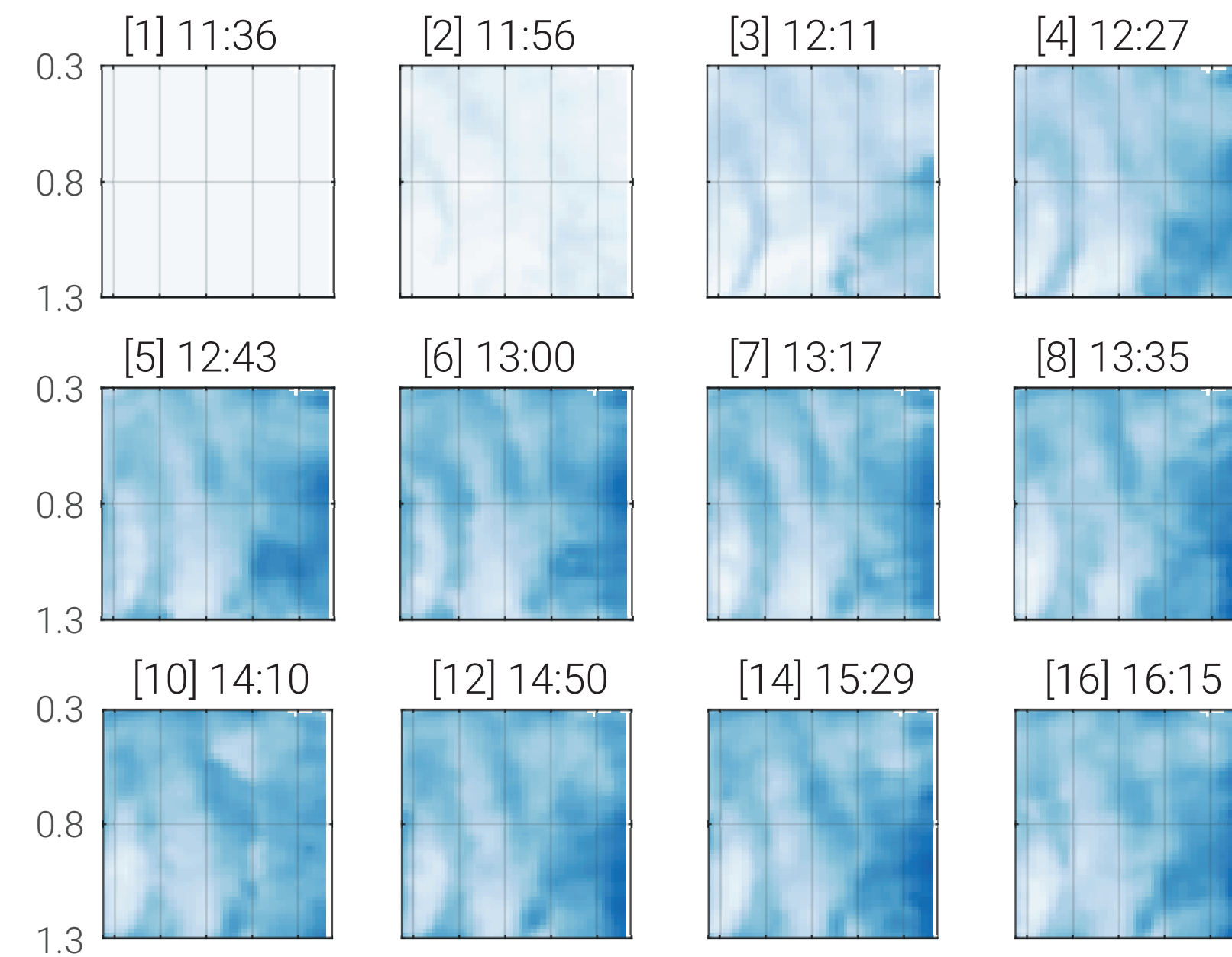
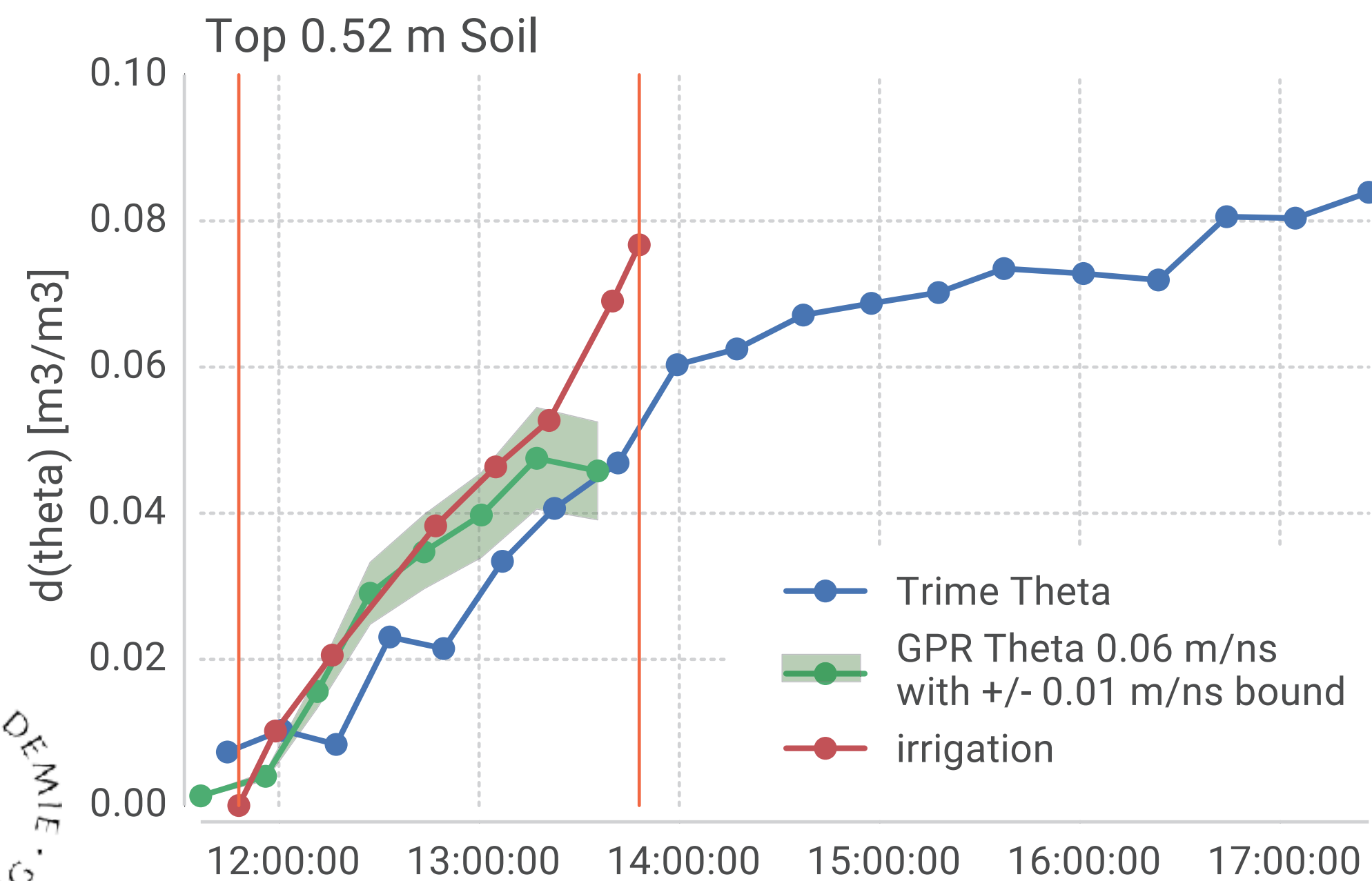
TDR access tube

4D near-surface GPR

observe infiltration in high spatial-temporal resolution

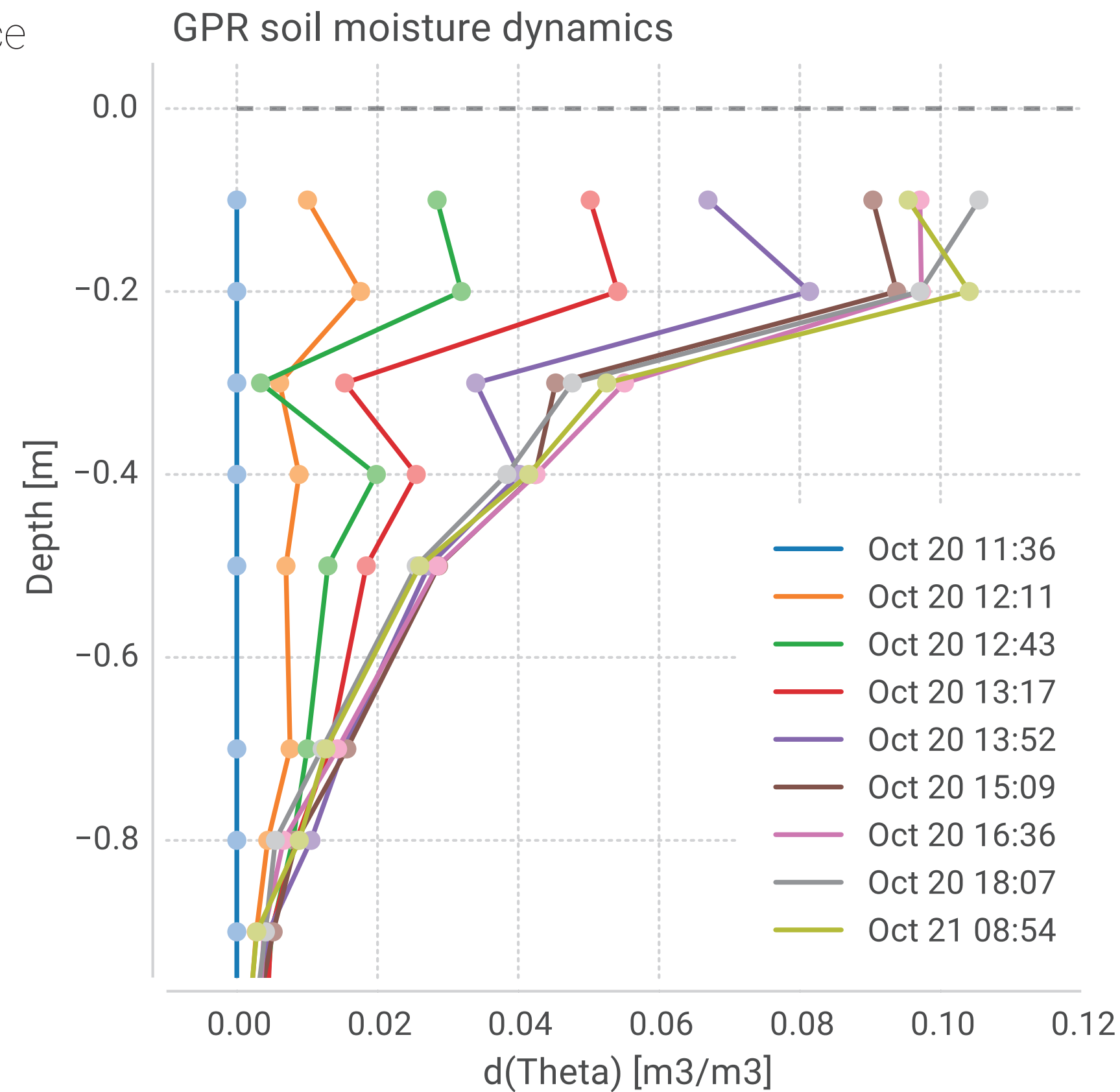
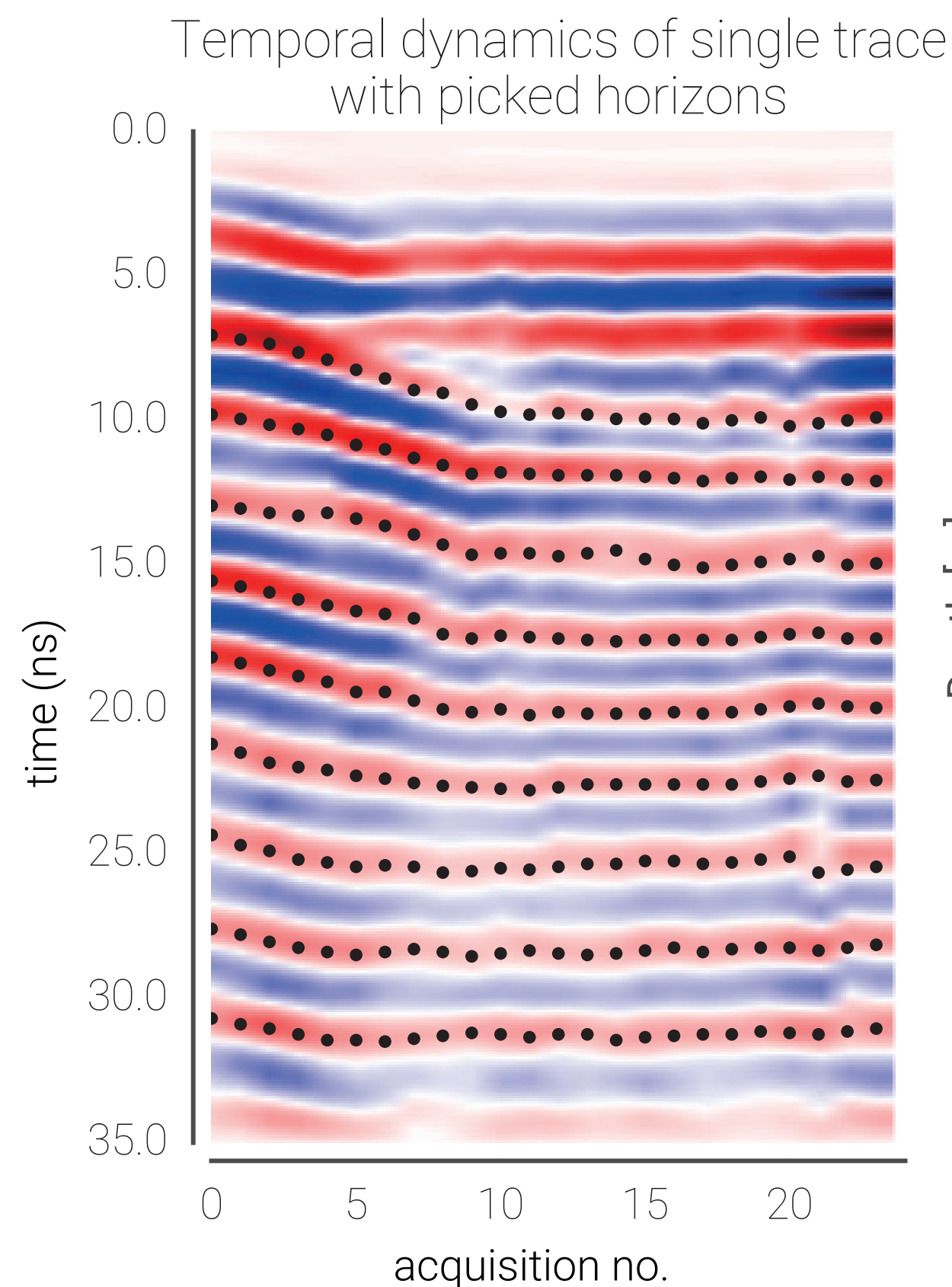


- we start to get closer to the process with such high temporal resolution



4D near-surface GPR

observe infiltration in high spatial-temporal resolution



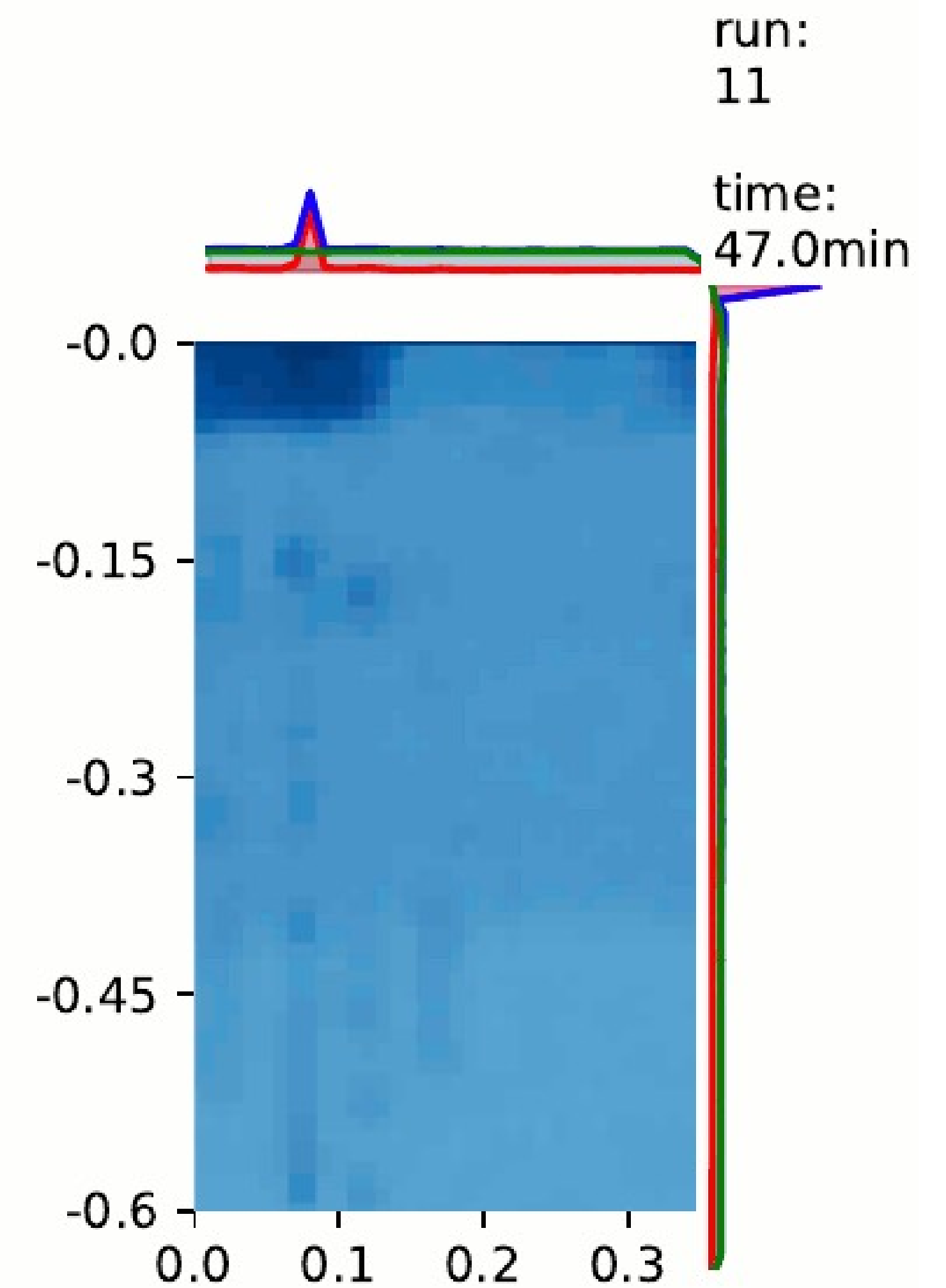
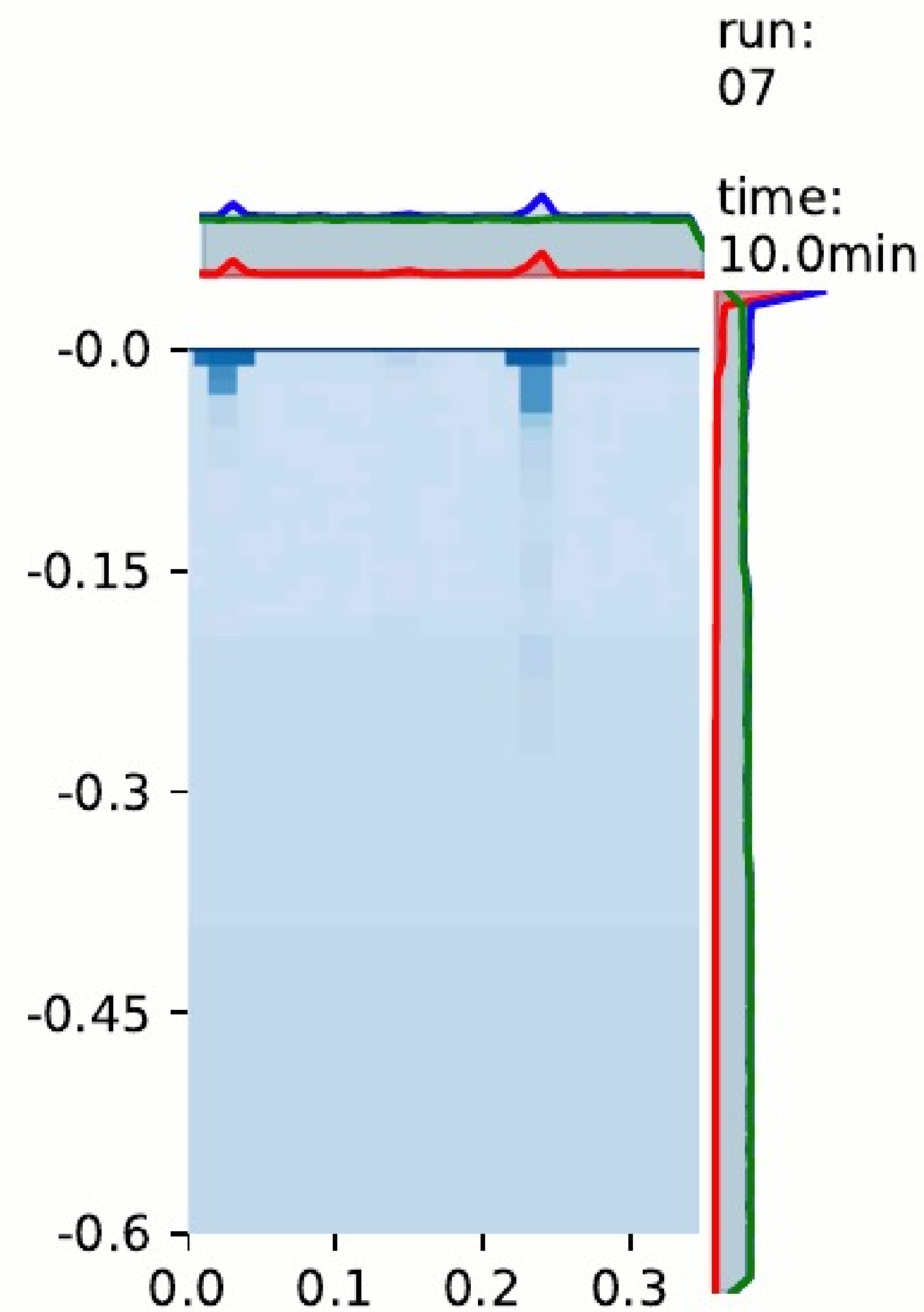
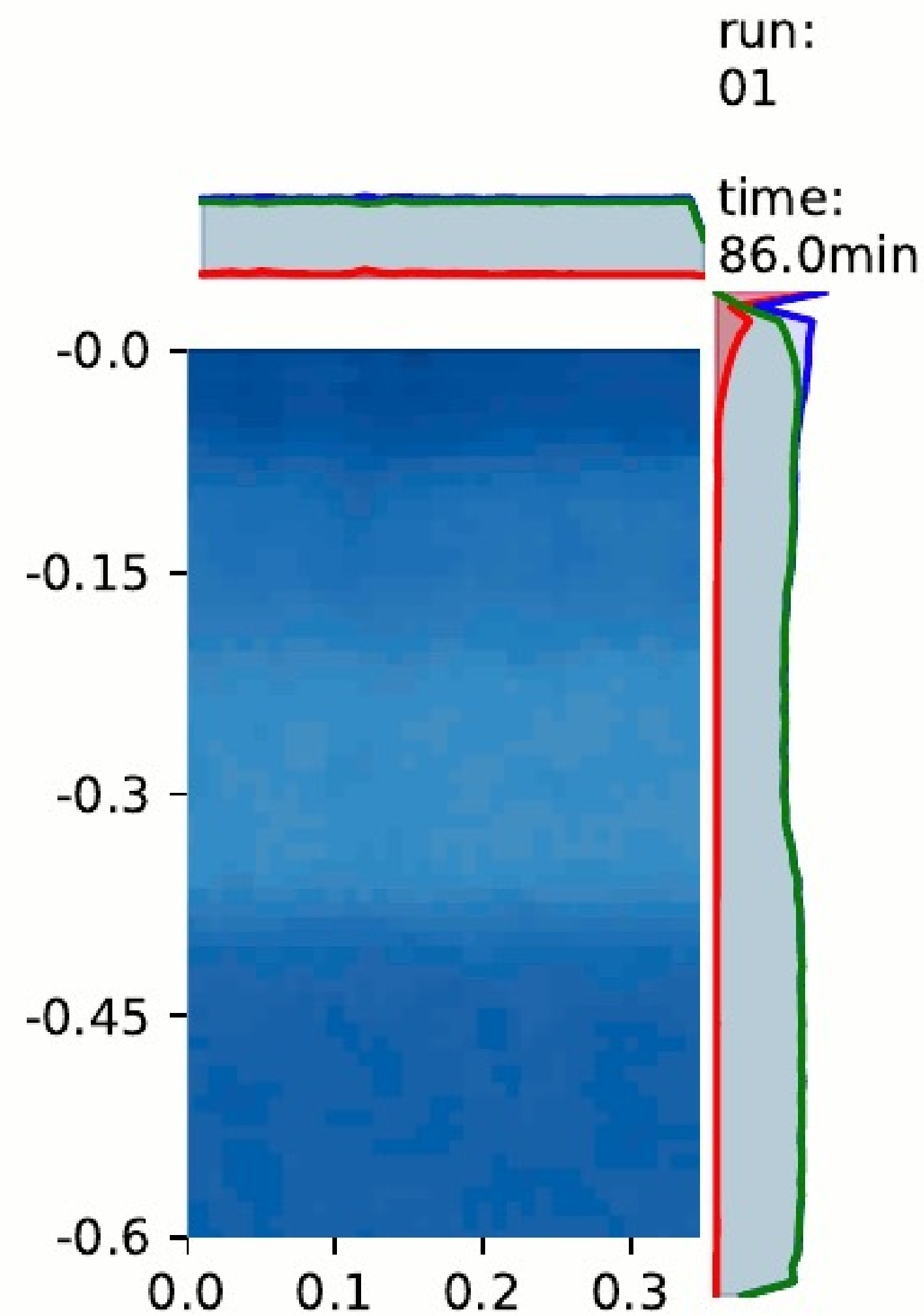
- we start to get closer to the process with such high temporal resolution
- the high temporal resolution allows for picking of “horizons” over time
- the largest changes in soil water happen until shortly after the irrigation

- ▶ echoRD model w/ identical soil, macropores, event but different antecedent conditions

Reck et al. 2018 <https://doi.org/10.2136/vzj2017.08.0147>

Modelling of infiltration

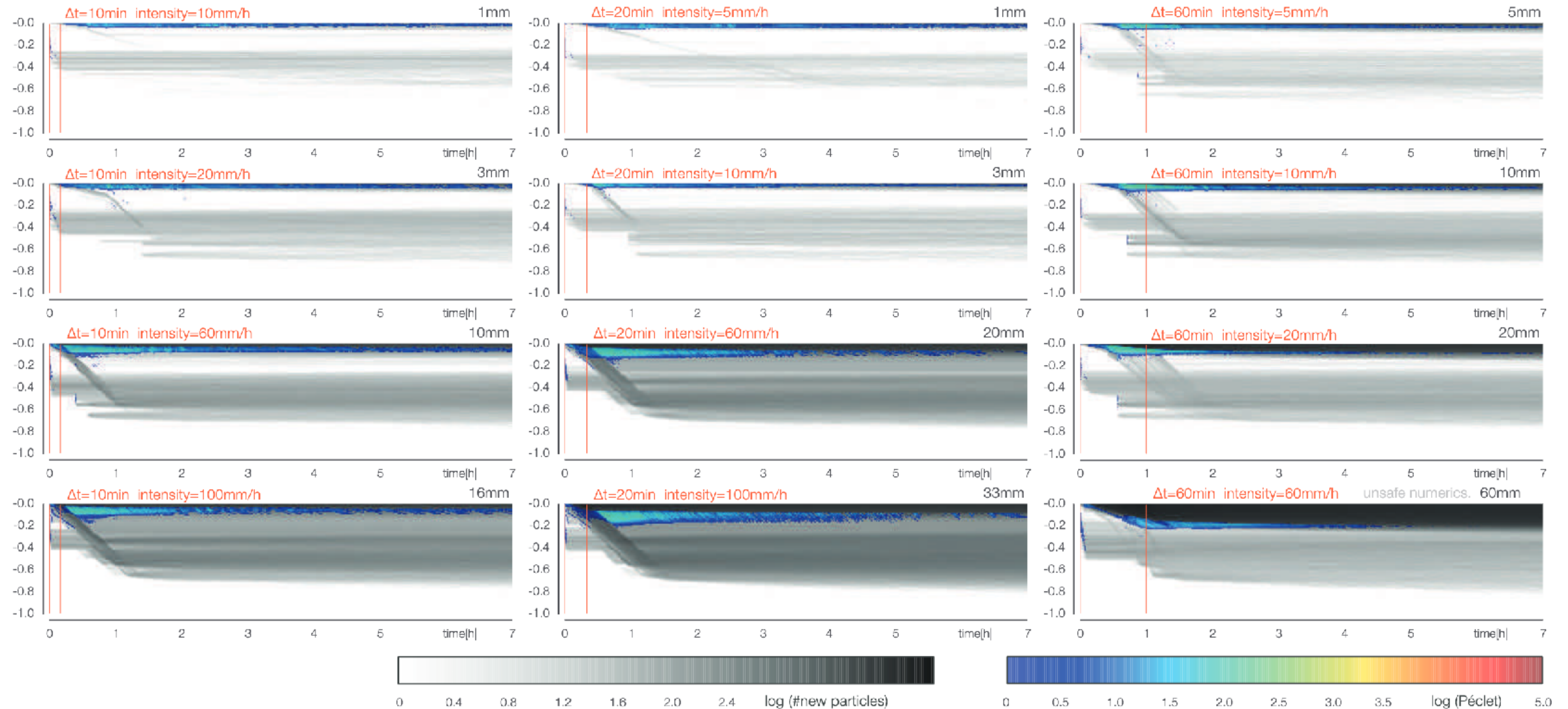
When and why do we see preferential flow?



- echoRD model w/ different intensities and duration on sandy soil

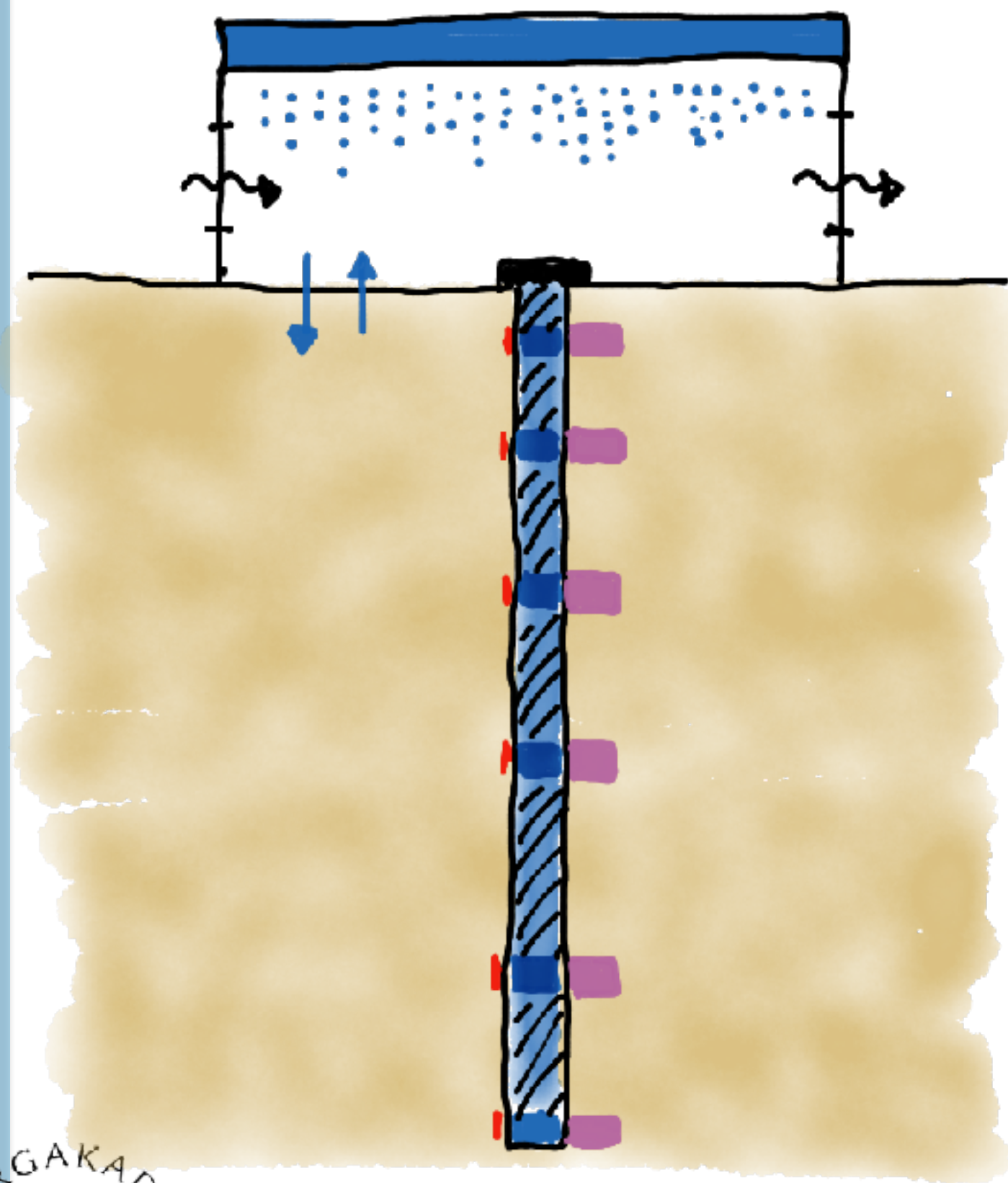
Modelling of infiltration

When and why do we see preferential flow?



A proof of the pudding?

Infiltration links boundary conditions with internal soil physics



IRRIGATION

VENTILATION
(controlled boundary)

■ TOR
(θ , p_{em} , etc)

■ Tensiometers
(ψ)

- Thermometers
(or heat flux)
(T)

What are the challenging parts in defining soil physical characteristics?

- Functional properties at non-equilibrium

What are central target variables/ applications of PTFs?

- Model parameters for barely applicable, scale and time variate concepts

Let's build a new generation of data basis for functional PTFs...

- extended instantaneous profile experiment?