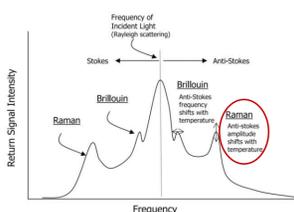


XT DTS (Silixa Ltd.) with sampling resolution of 0.25 m



Heat Pulse System (Silixa Ltd.)

ADTS can be used to measure soil moisture at a sub-metre spatial resolution along a fibre-optic (FO) cable. In active mode the FO cable is artificially heated and the cumulative temperature increase is converted to soil moisture.

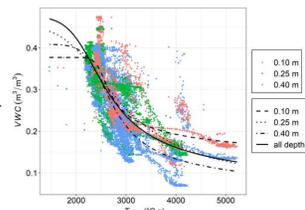


From Selker et al. 2006

$$T_{cum} = \int_0^{t_0} \Delta T dt \rightarrow \text{Soil moisture (VWC)}$$

From Sayde et al. 2010

Reference VWC from 5-TE (METER Group) soil moisture sensors



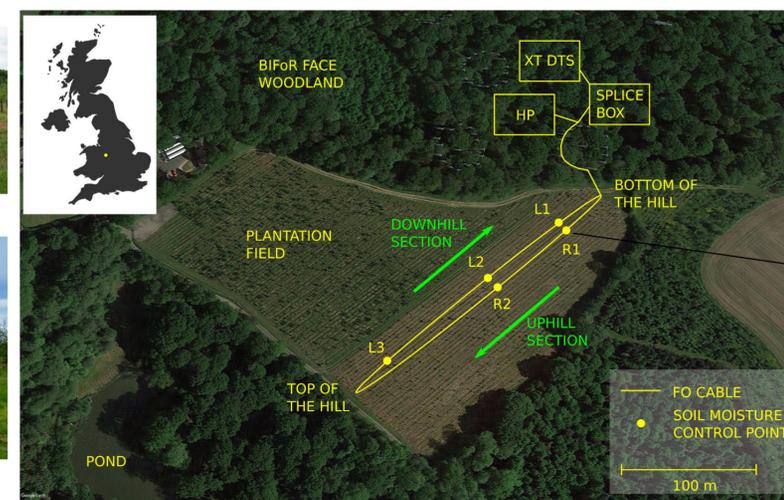
ADTS soil-specific calibration



Plantation field (photo May 2017)



Plantation field (photo May 2019)



Details of the field test site (Norbury Junction, UK)



Soil moisture control point (photo September 2018)

Methodology

Preliminary results

Introduction

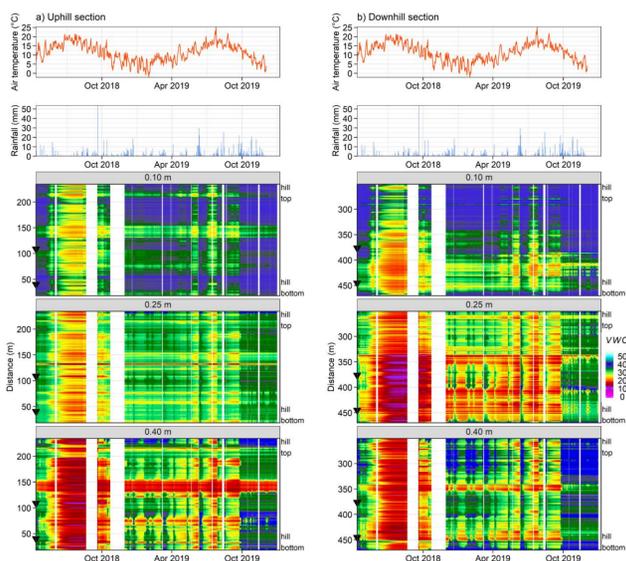
Soil is highly heterogeneous varying both spatially and temporally. Hence, understanding the soil behavior is challenging. Recent advances of the Active Distributed Temperature Sensing (ADTS) technique allow the soil to be monitored continuously at an unprecedented spatial resolution, potentially providing new insights on the soil processes occurring at the field scale.

Research questions

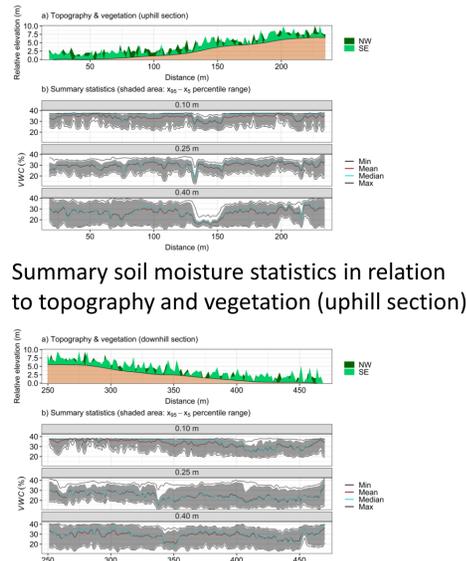
- Can ADTS be used to monitor the soil hydrological processes at the field scale?
- What are the main drivers of the spatio-temporal variability of soil moisture at the field scale?
- What is the impact of extreme events (i.e. storms, droughts) on the soil dynamics at the field scale and their implication on tree growth, stress and mortality?

Field test site

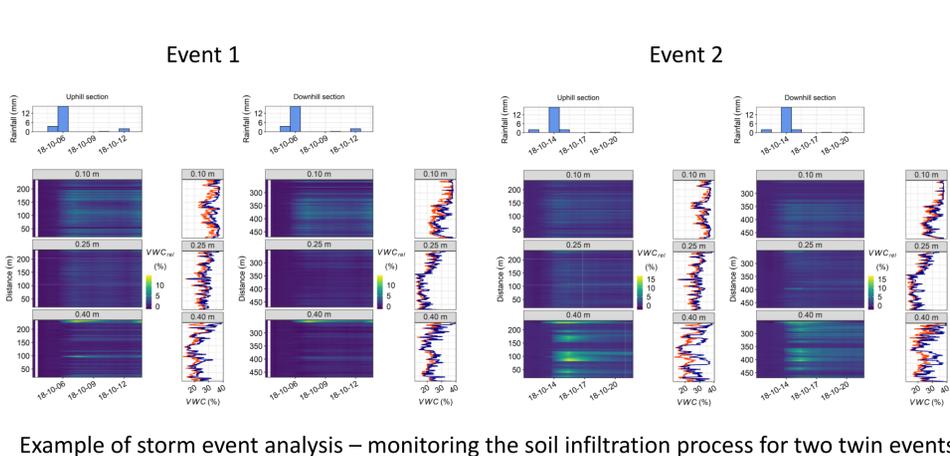
Summary



Spatio-temporal variation of soil moisture in relation to the weather



Summary soil moisture statistics in relation to topography and vegetation (downhill section)



Example of storm event analysis – monitoring the soil infiltration process for two twin events

References

- J. S. Selker, et al., Distributed fiber-optic temperature sensing for hydrologic systems. Water Resources Research 42 (2006).
 C. Sayde, et al., Feasibility of soil moisture monitoring with heated fiber optics. Water Resour. Res. 46, W06201 (2010).

- High field-scale soil moisture variation was observed by ADTS, both temporally and spatially (laterally and vertically)
- Soil moisture varies spatially by over 10% across the field and temporally by up to ±25% VWC within a matter of days (wetting events) or a few weeks (drying events)
- Rainfall (and lack of rainfall) is the main driver for change
- Infiltration is dependent on previous soil conditions
- Currently, no clear relationship between soil moisture and vegetation or topography has been found