Effects of Soil Texture on Plant Water Use: A Field Study of two Oak Forests in an Inner Alpine Valley of Switzerland

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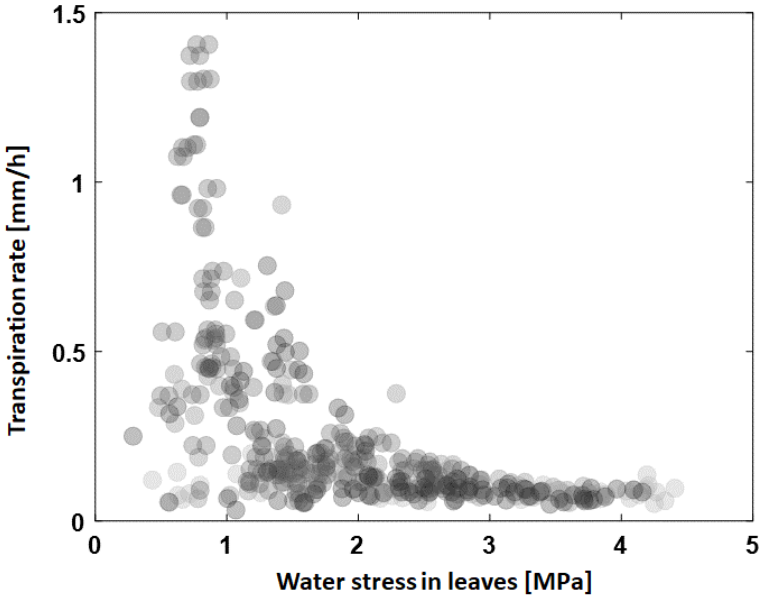
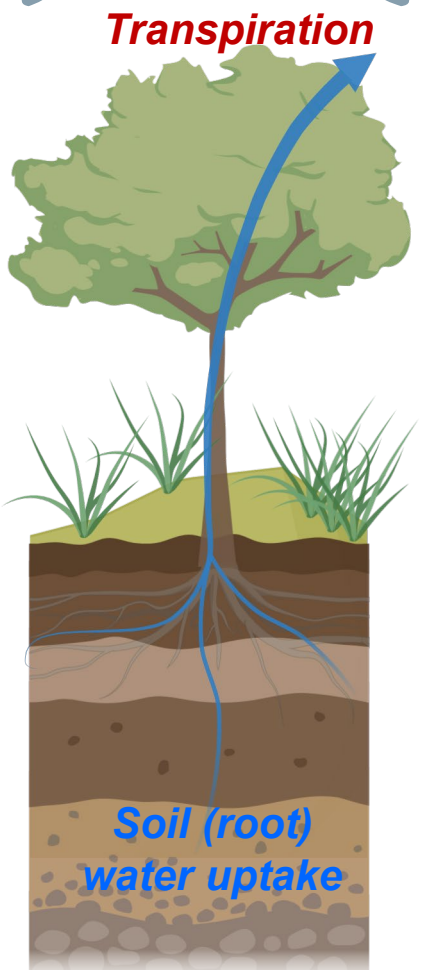
Water uptake from soils and trees ≠ during droughts

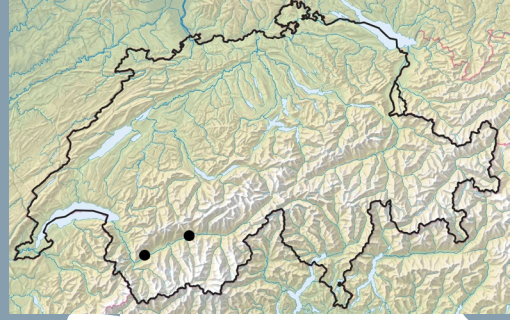
- Trees have to cope with increasing water stress
- Stomatal closure and soil hydraulic properties of dry soils limit transpiration
- Can we quantify controlling mechanisms?

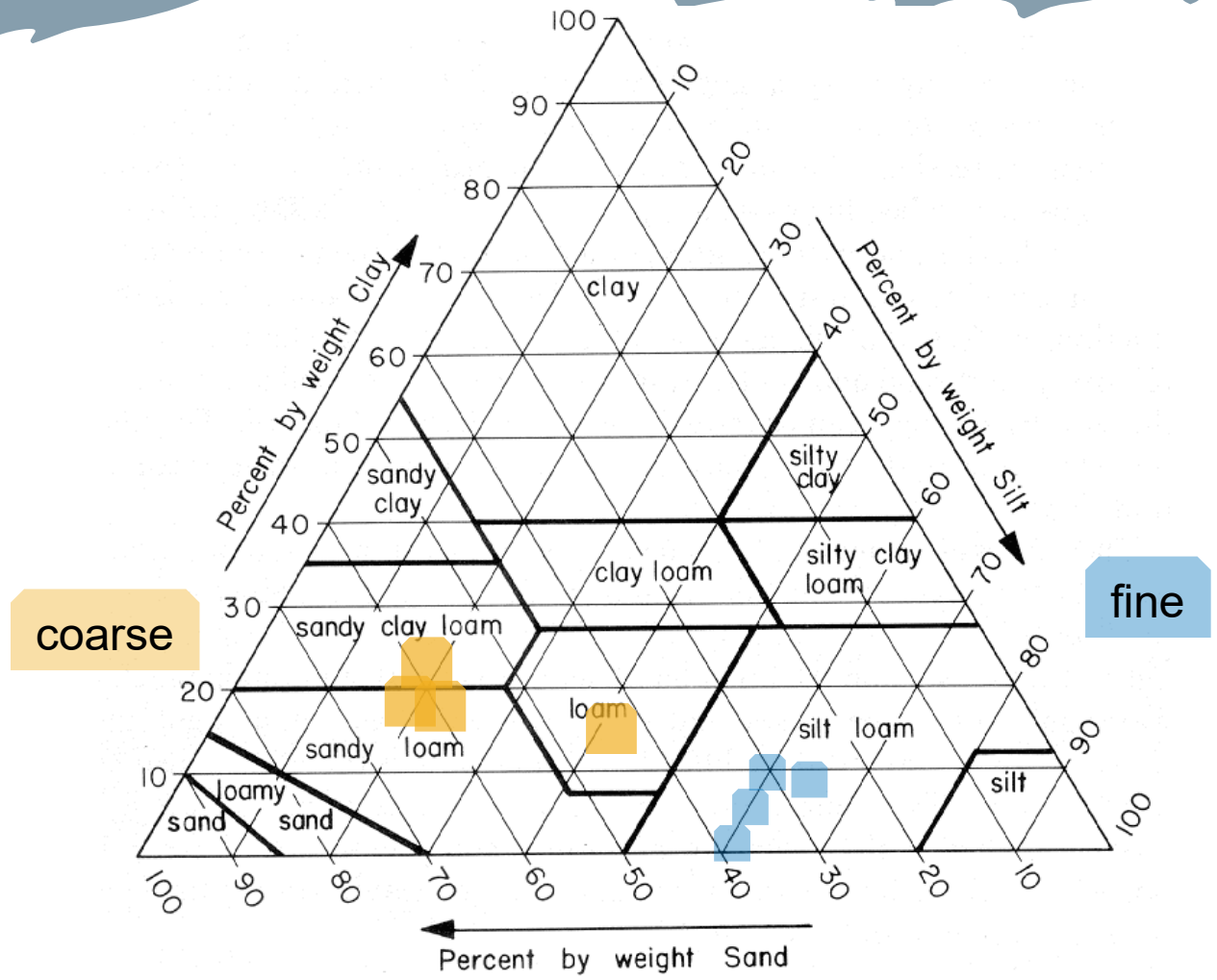


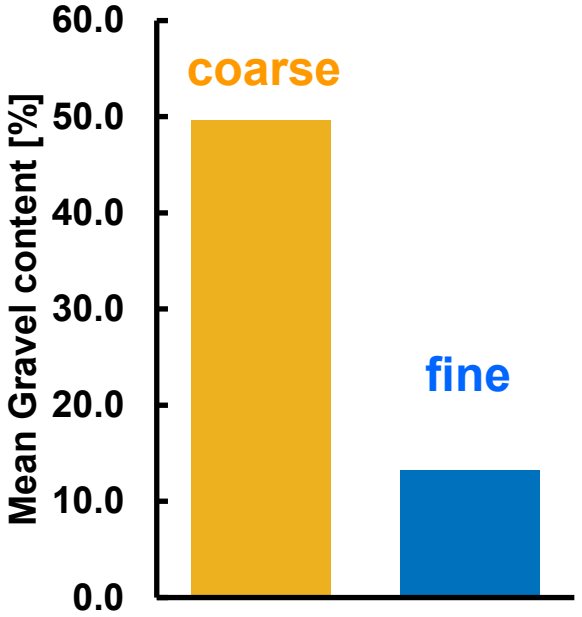


Soil water uptake ≠ Transpiration

Soil texture: coarse vs fine





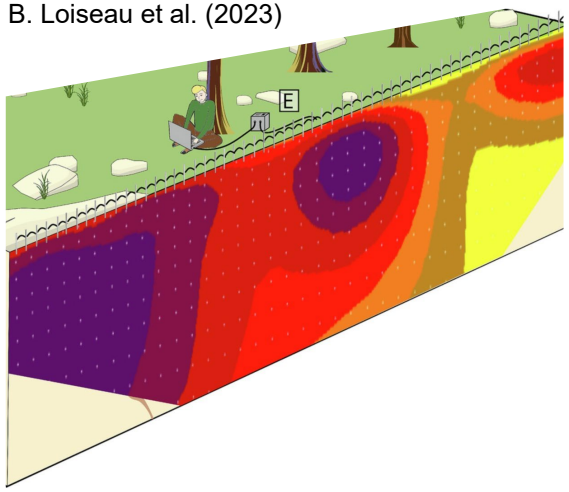


Tree perspective

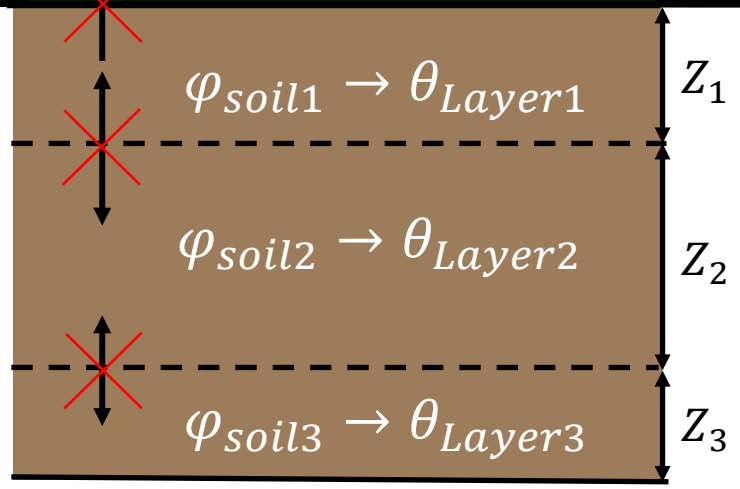
Sapflow

Tree water deficit (TWD)

B. Loiseau et al. (2023)



Electrical resistivity tomography



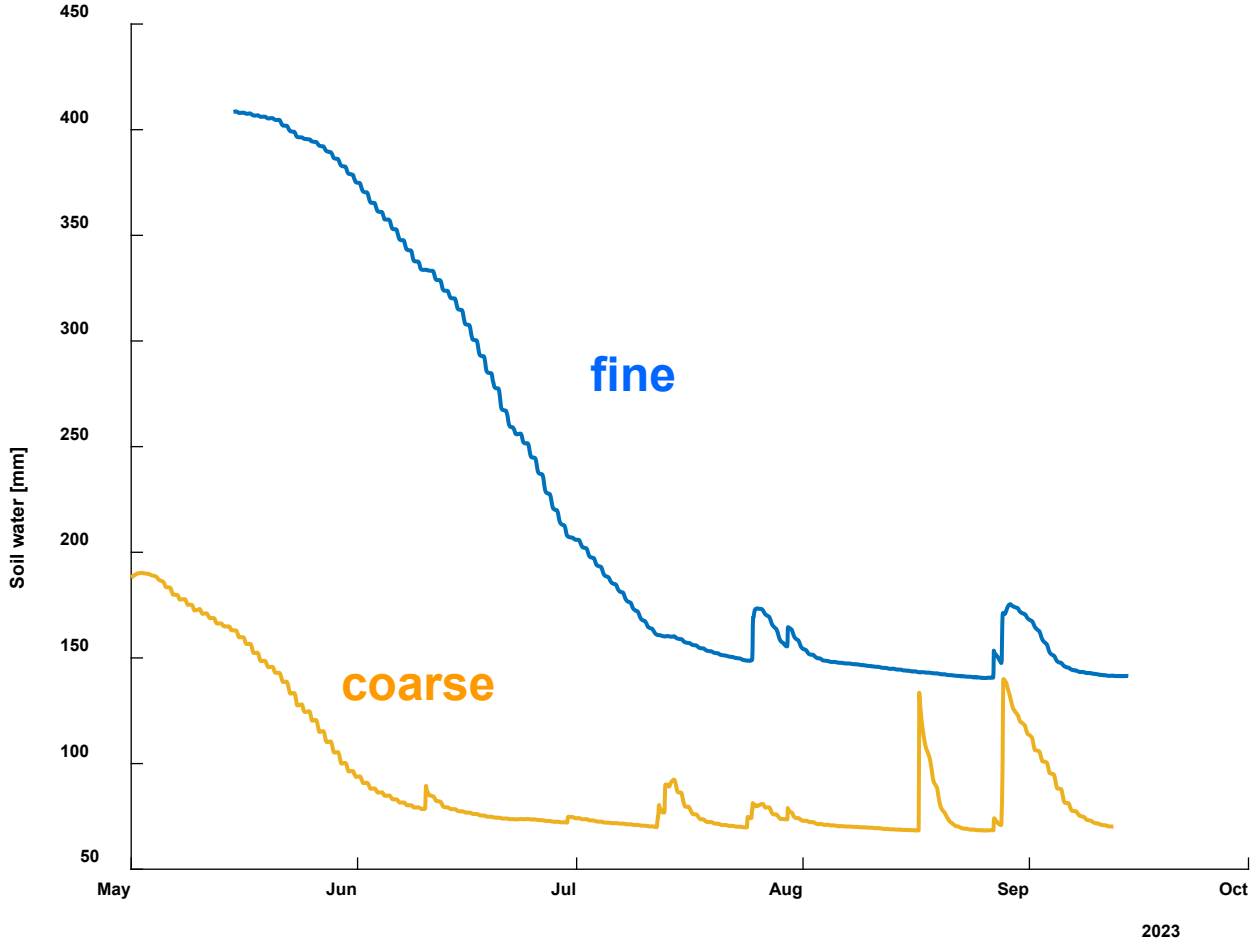
Soil perspective

Soil water uptake (SWU)

$$SWU = \sum \Delta\theta_{Layer_i} * Z_i$$

Water Balance

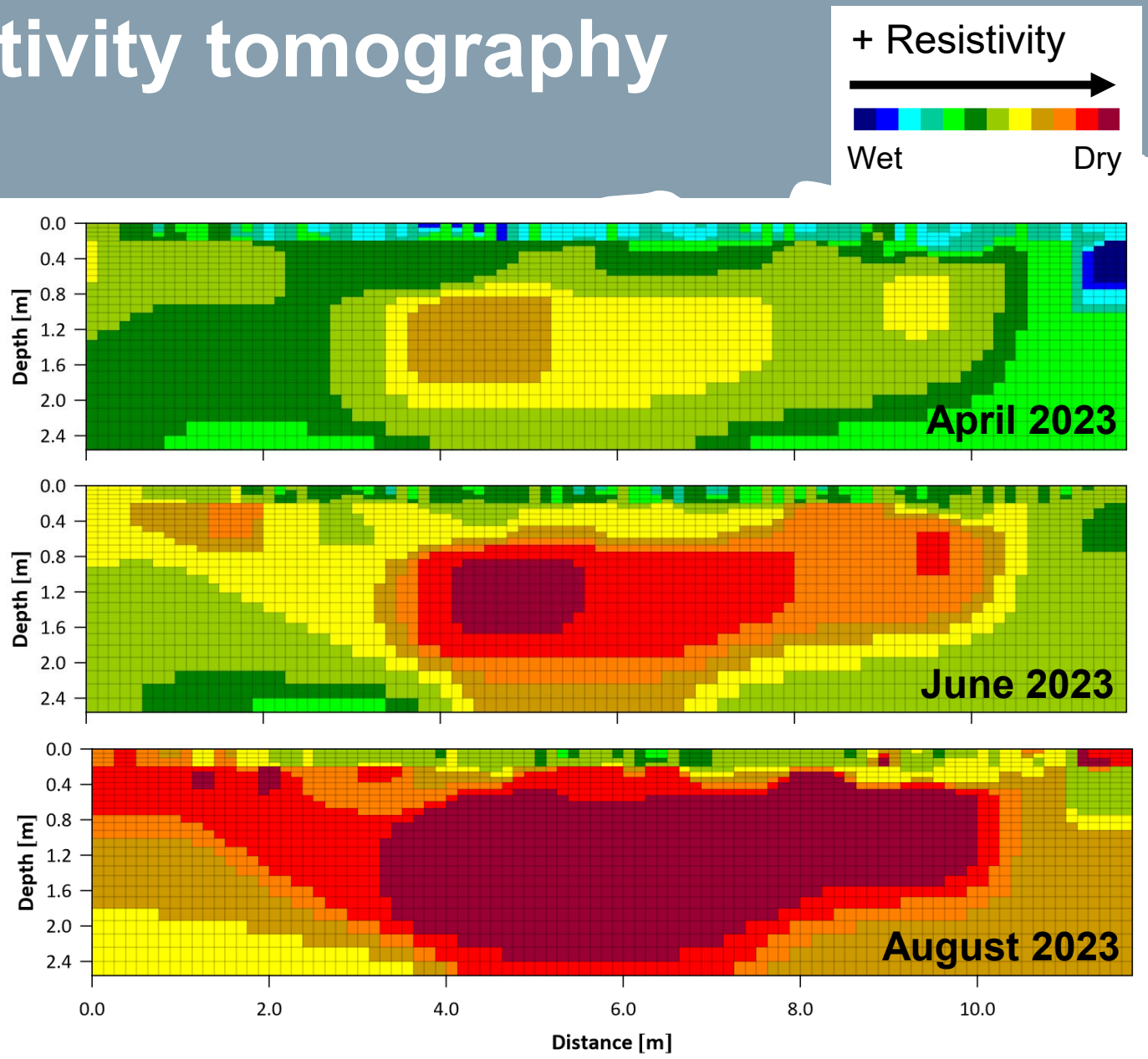
Soil water over growing season



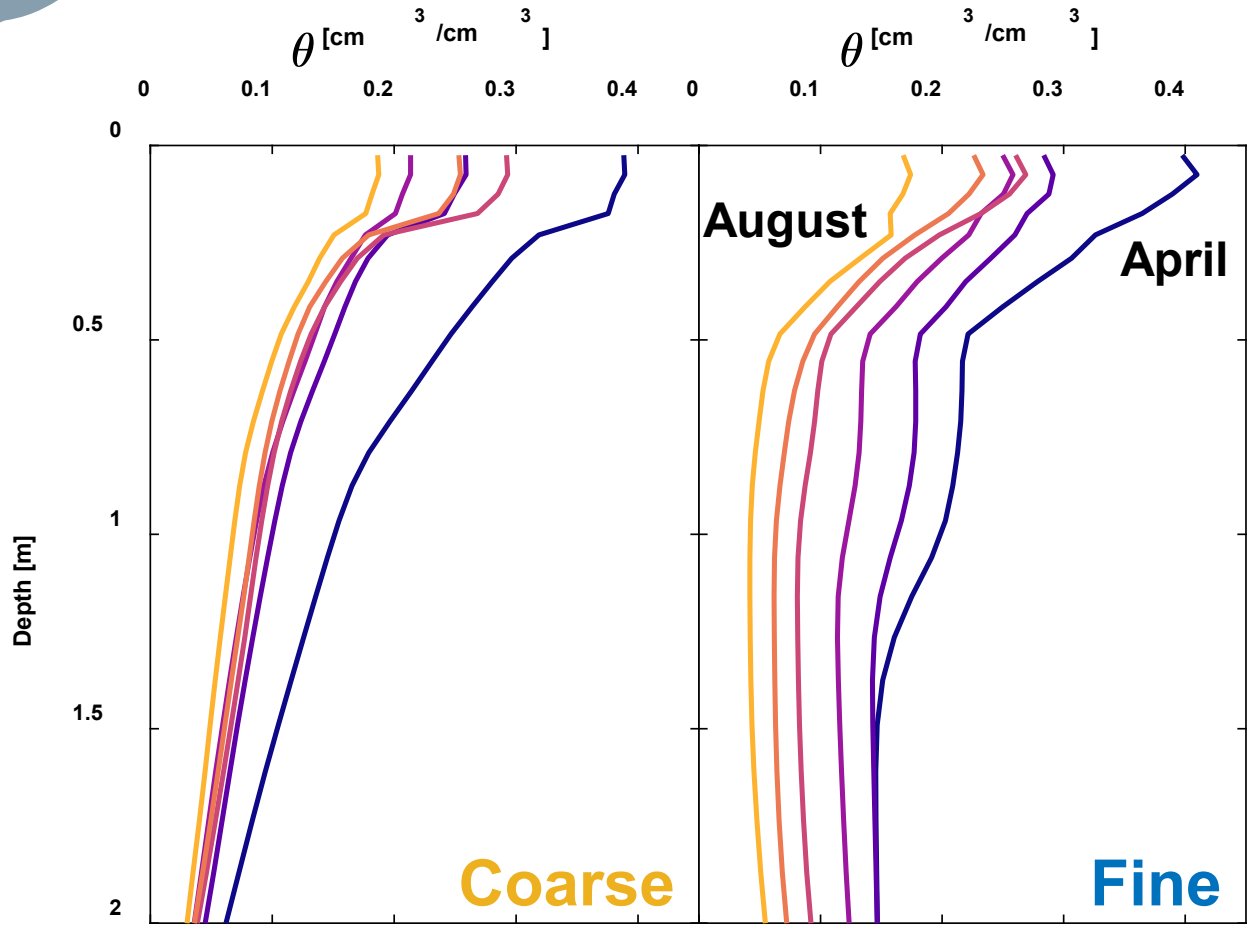
- Sites dry before peak Summer
- Different water availability
- Sites dry at different speeds

ERT: Electrical resistivity tomography

- **Time-Lapse**
- **Spatially resolved**
- $\theta_{soil} = f(resistivity)$



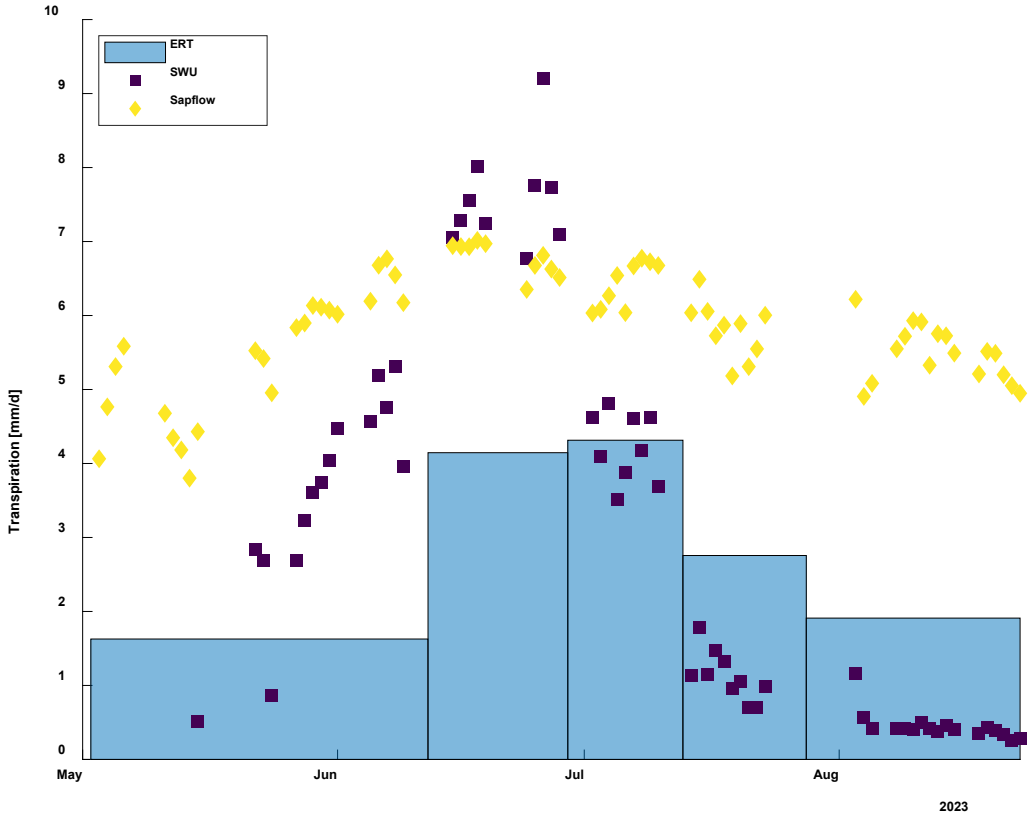
ERT: Soil water in growing season



- Soils dry down to > 2 meter depth
- Soils dry at different rates
- More water storage in deeper layers
- Reliant on water in top soil

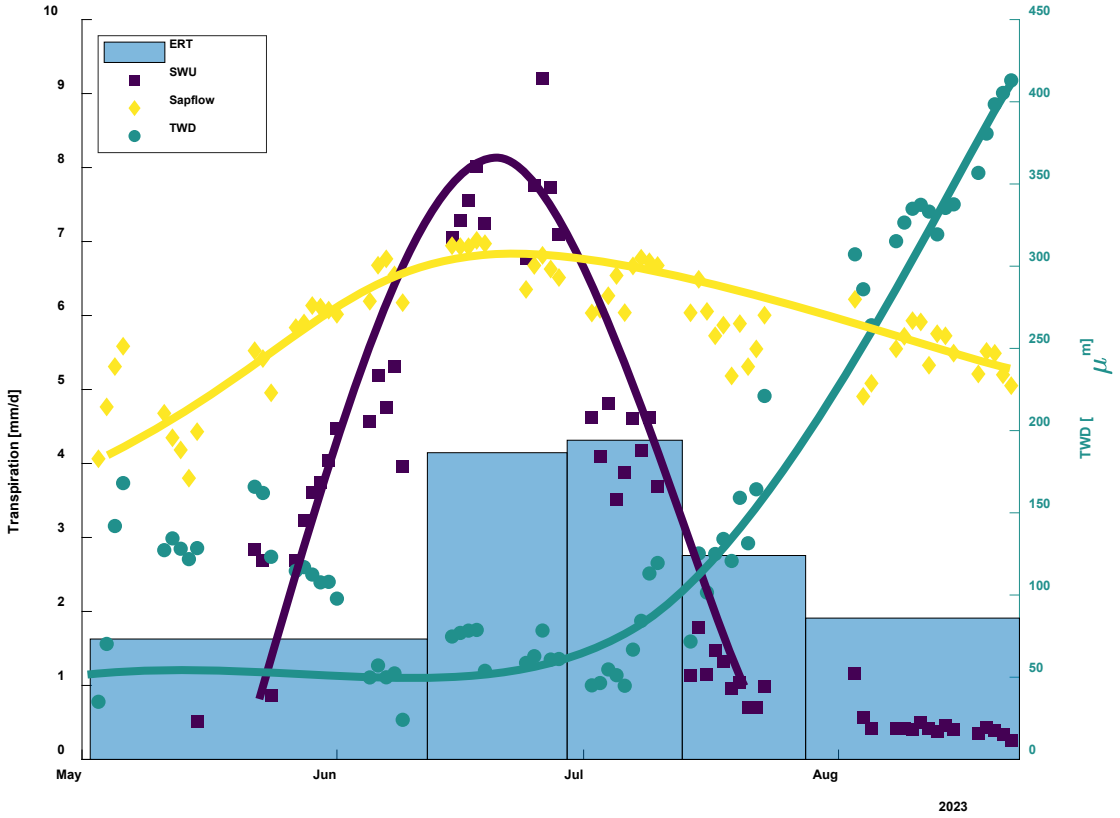
Result: Increasing TWD with soil drying

Fine

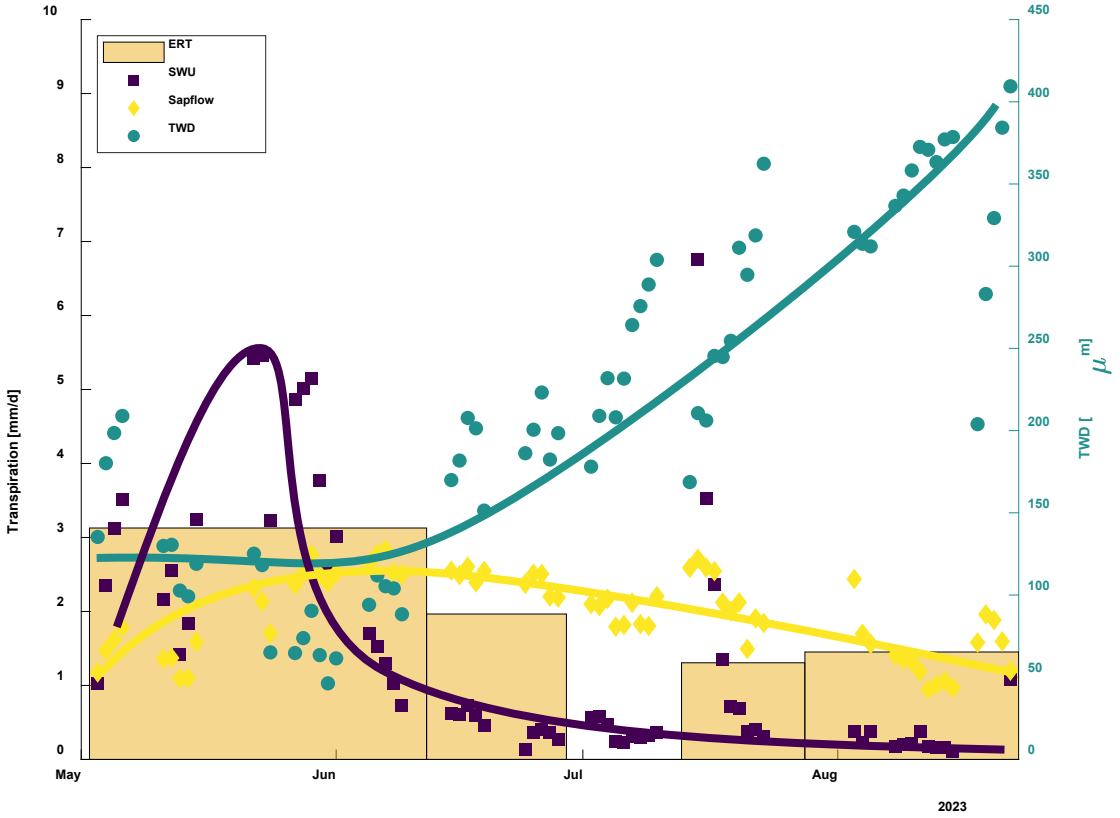


Result: Increasing TWD with soil drying

Fine



Coarse



Result: Increasing TWD with soil drying

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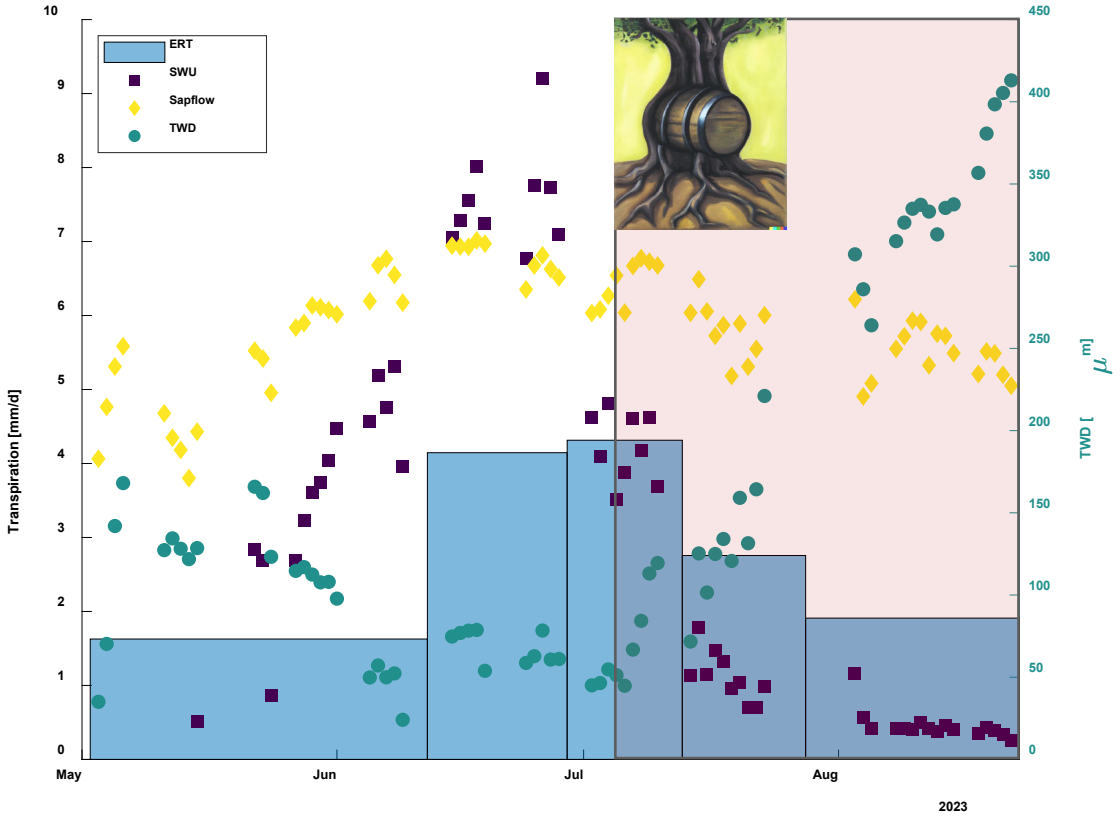

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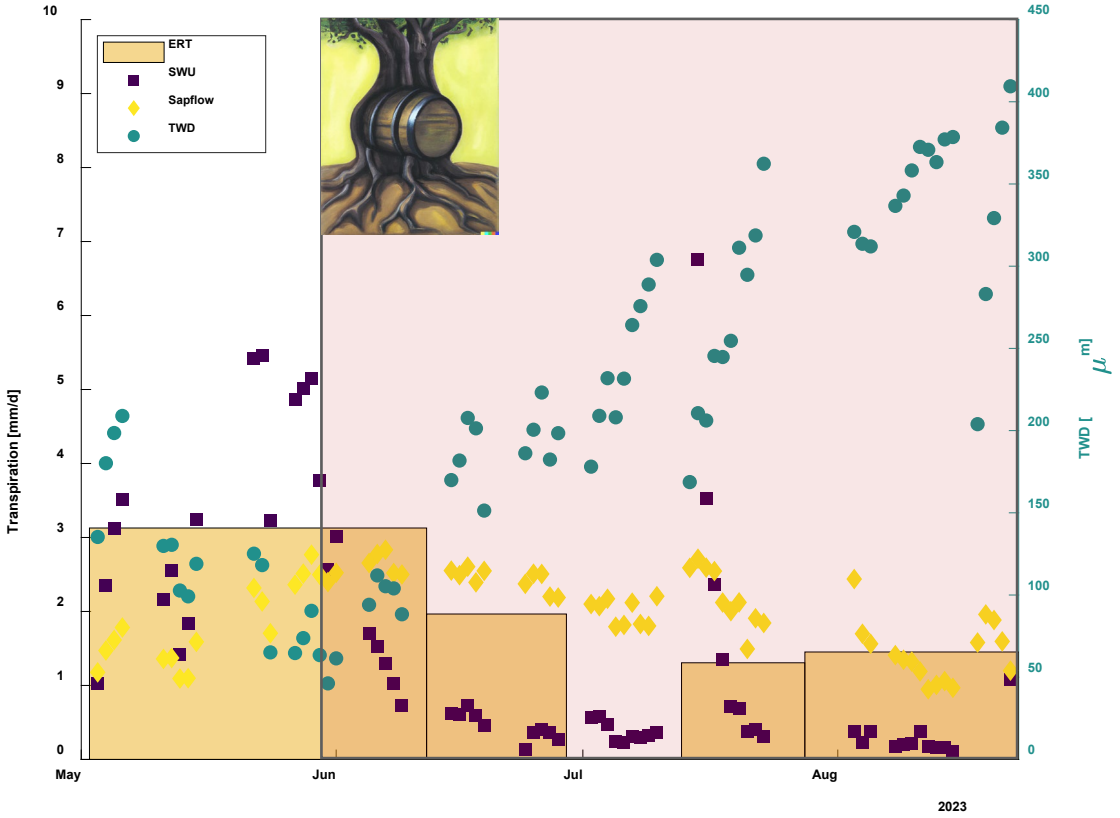
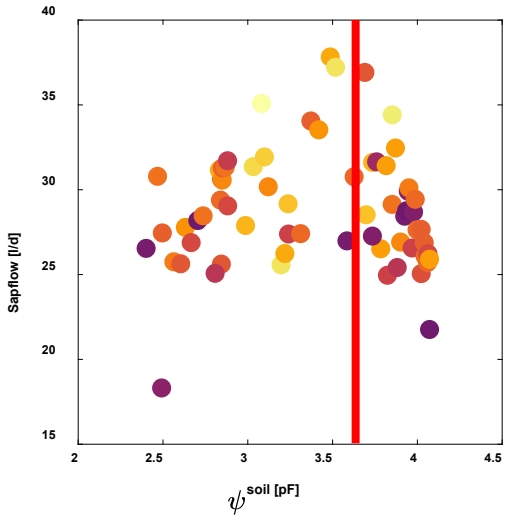
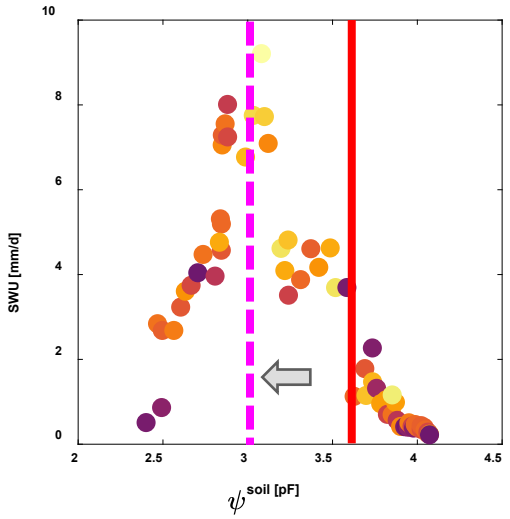


Result: Soil drying drives decline in water uptake

Fine





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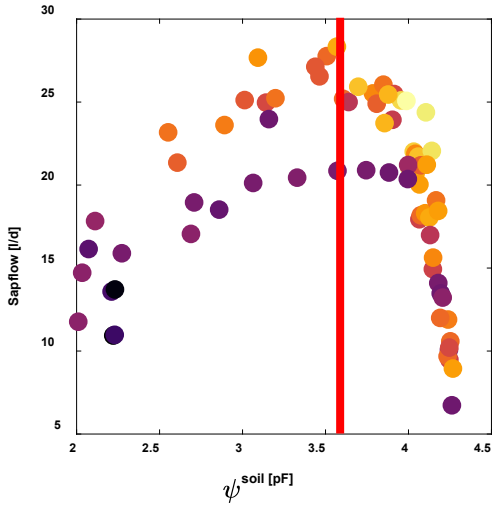

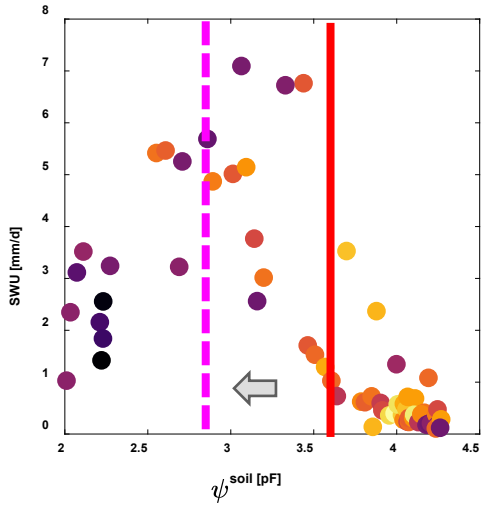

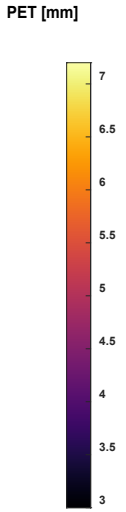

Summary

→ Downy oaks have an internal water storage

→ Soil water uptake ≠ Transpiration

→ Soil texture and gravel content determine onset of water supply decline

→ Soil drying reduces Sapflow and SWU