

Long-term soil moisture responses to irrigation

Katrin Meusburger
Group: Biogeochemistry, Frank Hagedorn

Swiss Federal Institute for Forest, Snow
and Landscape Research - WSL
katrin.meusburger@wsl.ch

Soil moisture monitoring setup

Started 2003
calcaric Regosol with
available water capacity of
~110mm (until 1m)

Since 2014

- New setup
- **Soil temperature and soil water potential** in addition to volumetric soil water content
- A second treatment: irrigation stop



Photos by E. Graf-Pannatier

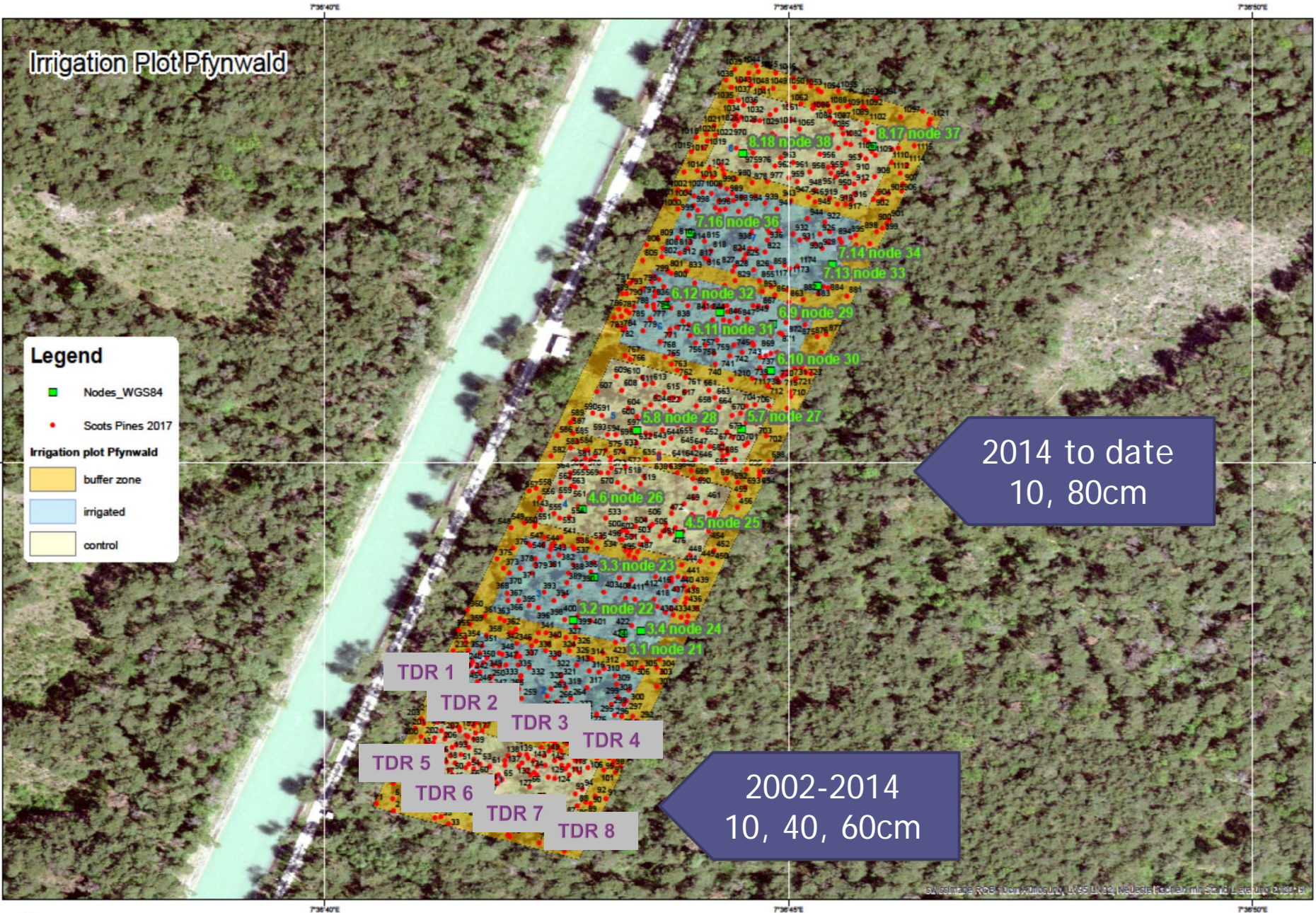
Irrigation Plot Pfywald

Legend

- Nodes_WGS84
- Scots Pines 2017

Irrigation plot Pfywald

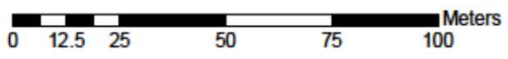
- buffer zone
- irrigated
- control



2014 to date
10, 80cm

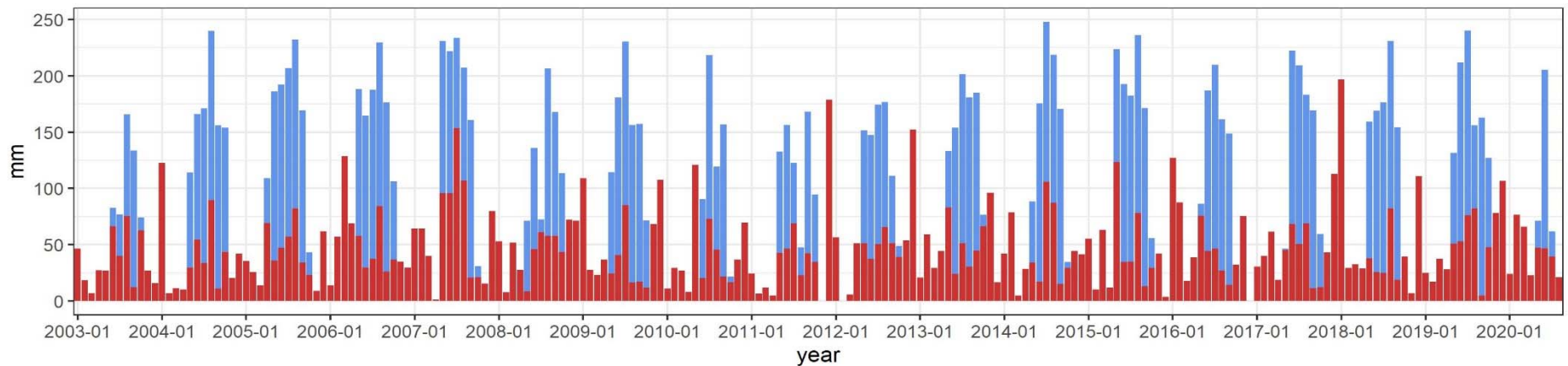
2002-2014
10, 40, 60cm

swissmade RoS - your warranty, 1195 UV30, Neudeck, Rastbach, mit Stand. Late. 01/10/14



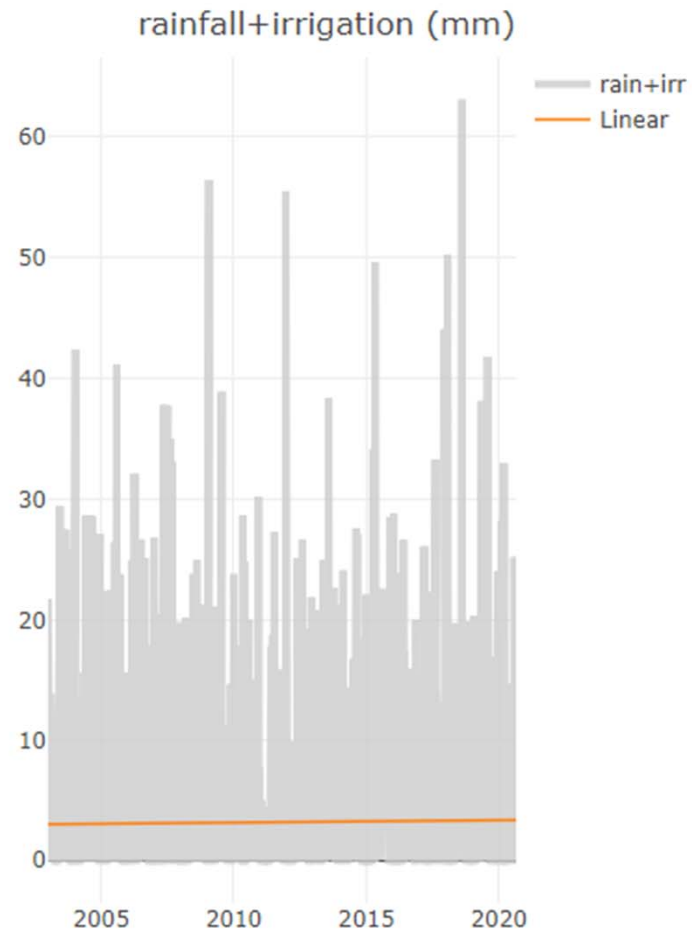
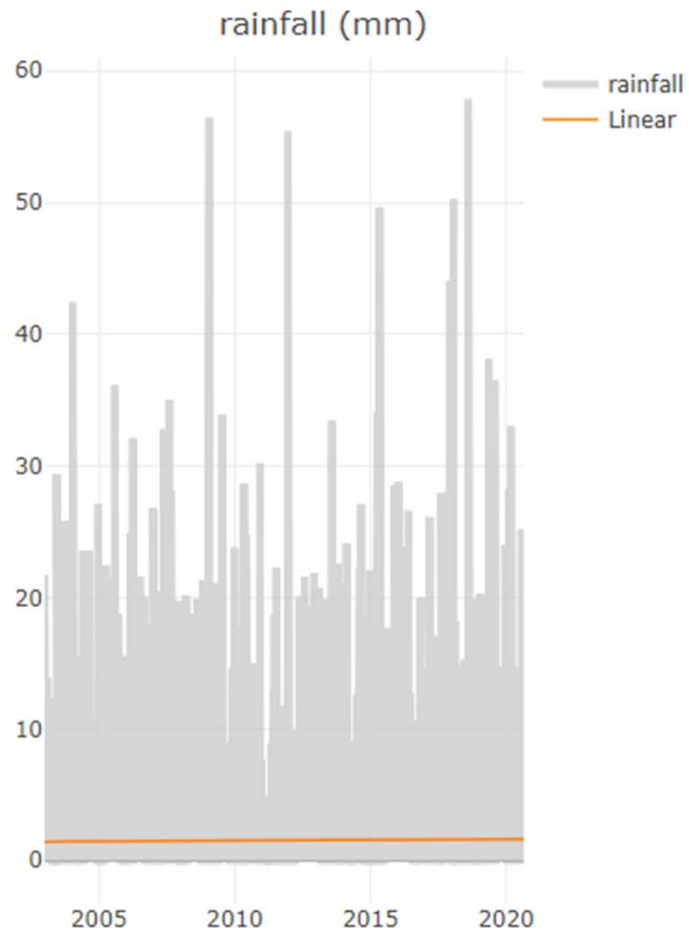
Rainfall

- **Prec** = 556 mm (1.1.2003-23.8.2020, MeteoSwiss Sion)
- **Prec+Irr** = 1159 mm (1.1.2003-23.8.2020, pers. comm. J. Gisler)

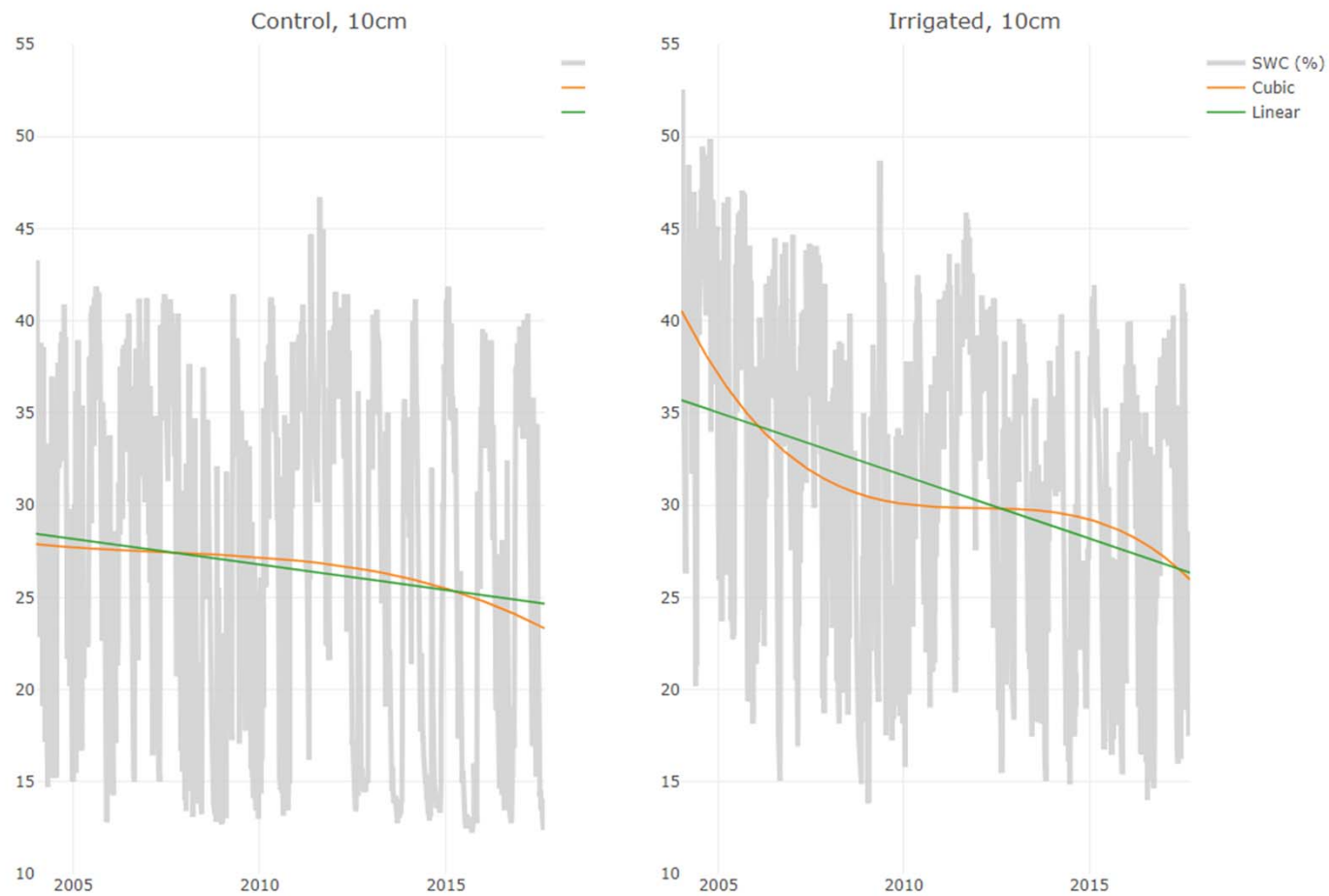


- Seasonal Mann-Kendall and Sen's slope trend test are significant for **Prec+Irr**
- However, the slope is marginal
- No trend for **Prec**

Rainfall trends

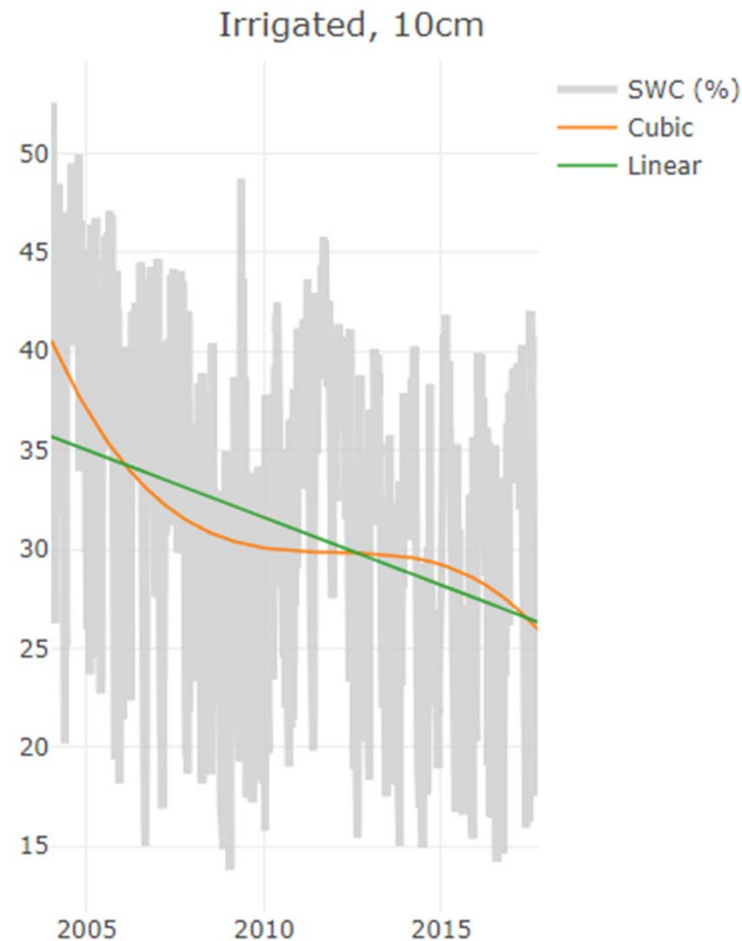


Soil water content: 10cm

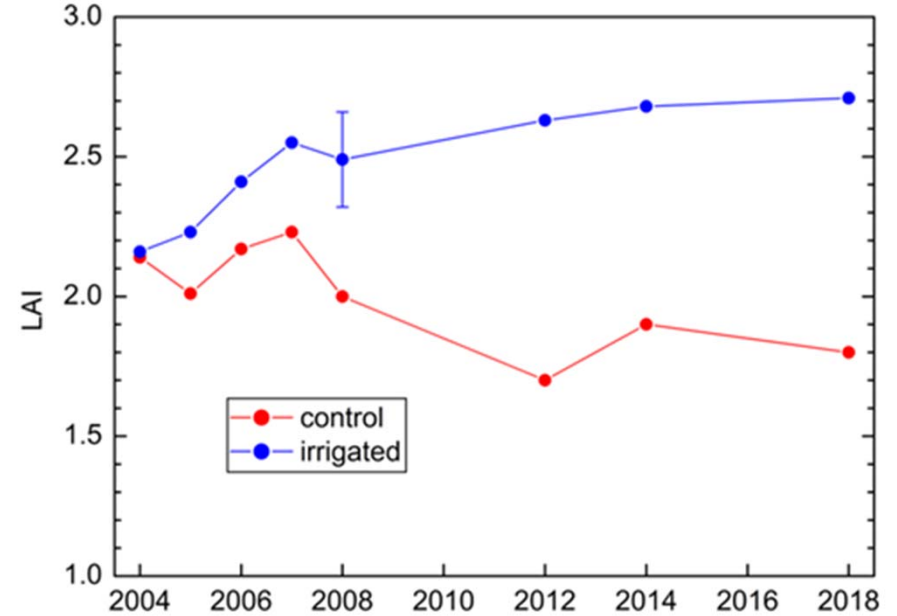


- Decreasing trends are both significant, but with varying slope

Decreasing SWC at irrigated plots



=>crown size adjustment
Leaf area index (LAI)



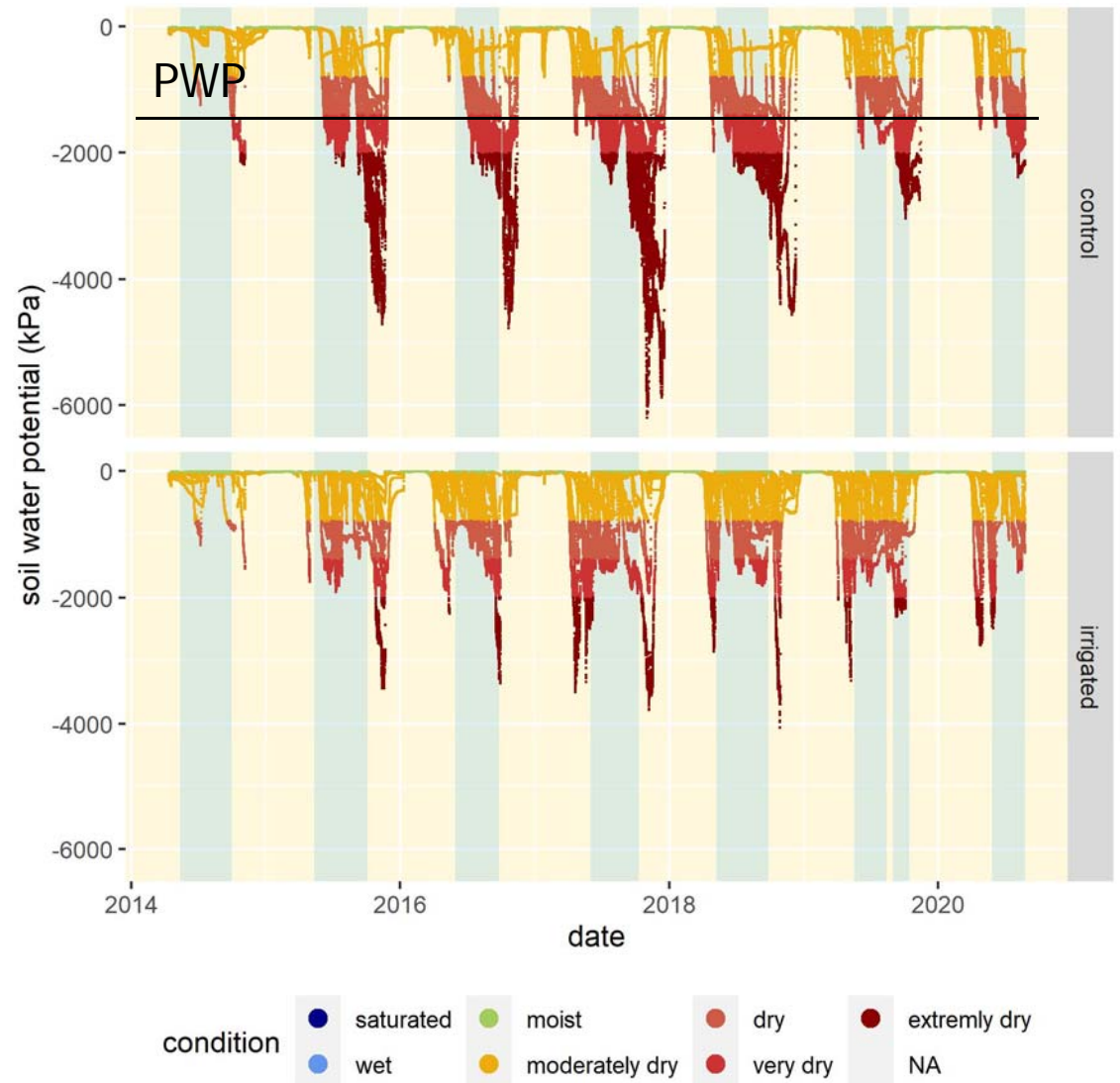
Source: P. Schleppei

Strongest decrease at Irr. until new equilibrium is reached
=>Parkinson's Law (get more, spend more) applies for trees

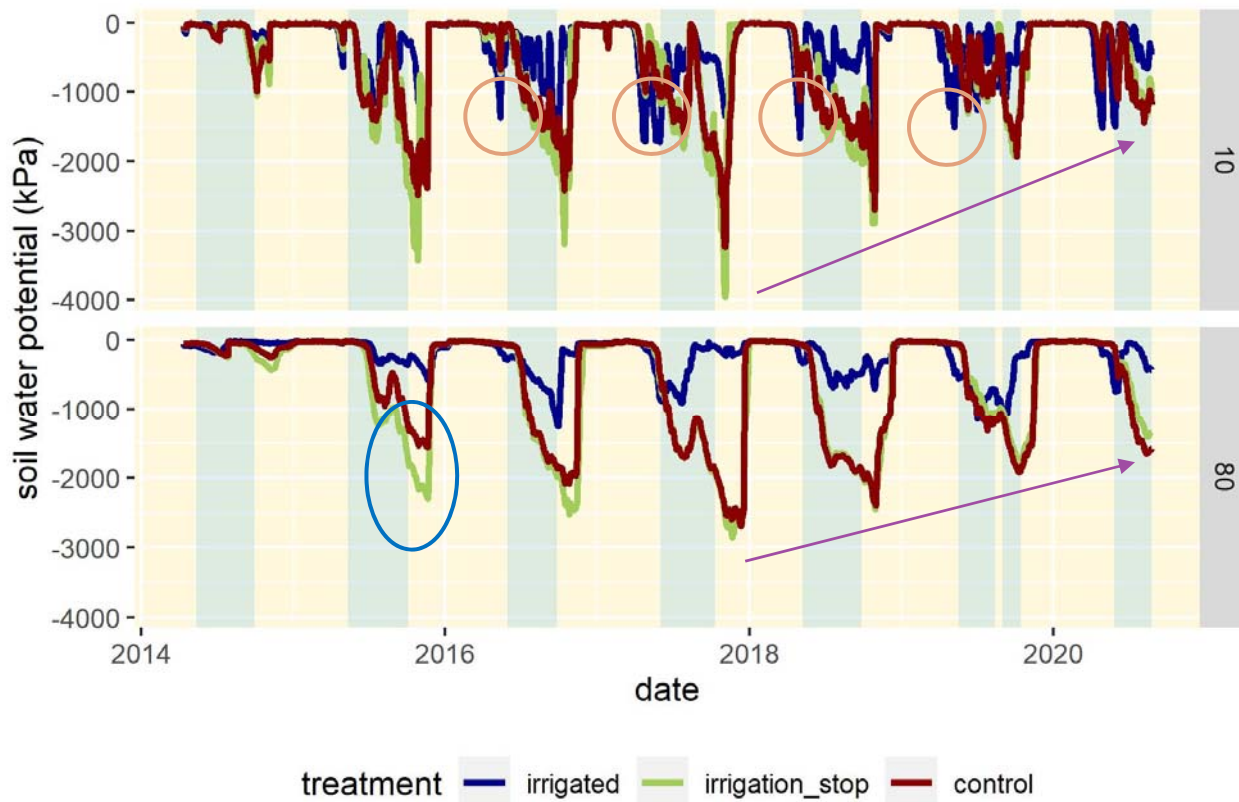
Release from drought stress?

Drought stress proxy
= soil water potential

- Control:
permanent wilting point (PWP) is exceeded
- Irrigated:
critical values still occur, no comfort zone

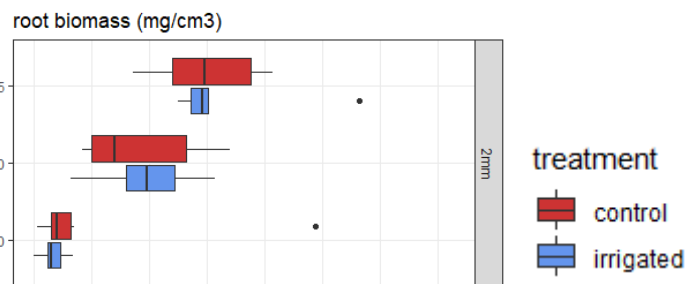


Irrigation stop



- Different behaviour of Control and Irr-Stop: Legacy effect remains for 3 years
- What enables the Irr-stop-trees to extract more water (larger crown, more roots?)
- Larger crown is more demanding
- Water demand is compensated by RWU in deeper layers and reduced sap flow*
- Speculative: Why is there a decreasing trend after 2017 (damage?)

*Zweifel et al., 2020



Conclusion and Activities

Take home

- Trees are also just human: if they get more, they spend more!
- The irrigated trees are not in their comfort zone (spring, autumn)
- PWP is exceeded for Scots pine
- Irr-stop: enhanced RWU from deeper layers compensated the demand

Next steps

- Corrections for temperature and porosity effects of the soil water potential sensors (Walthert & Schleppi, 2018 and in prep.)
- Fit the water balance model LWF-Brook90R to all three treatments

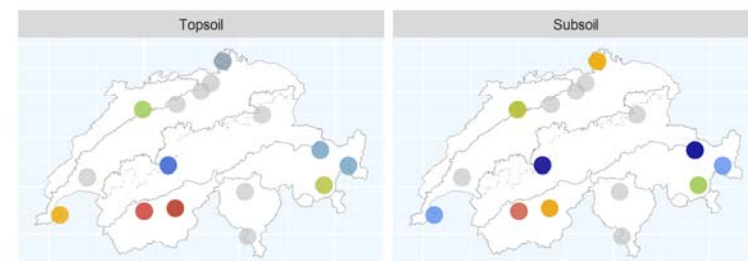
Some advertising

<https://www.wsl.ch/de/projekte/swisspot-swiss-forest-soil-water-potential-network.html>

SwissSPOT- Swiss forest Soil water POTential network at the LWF sites

THANKS FOR YOUR ATTENTION!

SPOT - soil water potential (kPa)
2020-08-17



soil moisture condition

● saturated	● moist	● dry	● extremely dry
● wet	● moderately dry	● very dry	● NA