

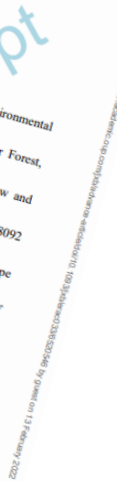
Photosynthetic acclimation and sensitivity to VPD and soil moisture changes

Leonie Schönbeck, Charlotte Grossiord, Arthur Gessler, Jonas Gisler, Katrin Meusburger, Petra D'Odorico, Andreas Rigling, Yann Salmon, Benjamin D Stocker, Roman Zweifel, Marcus Schaub



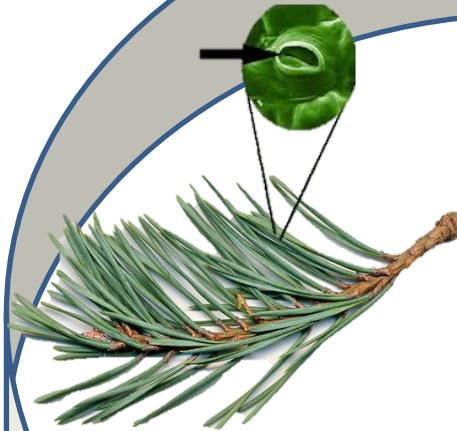
- Long-term yearly measurements as monitoring tool for plant physiology

- Insights into acclimation processes

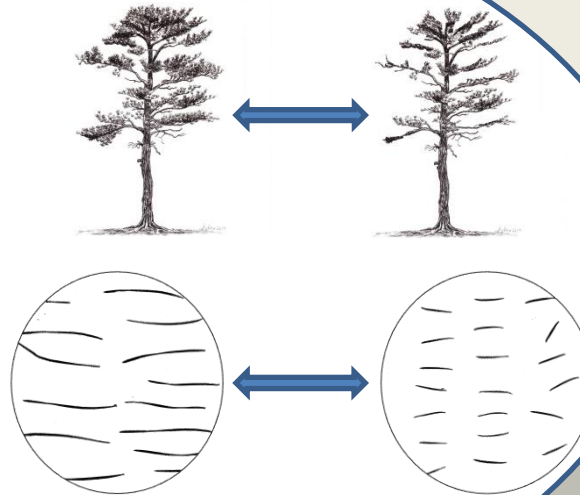


Acclimation

Short-term
Leaf-level,
stomatal &
non-stomatal
(biochemical)
adjustments

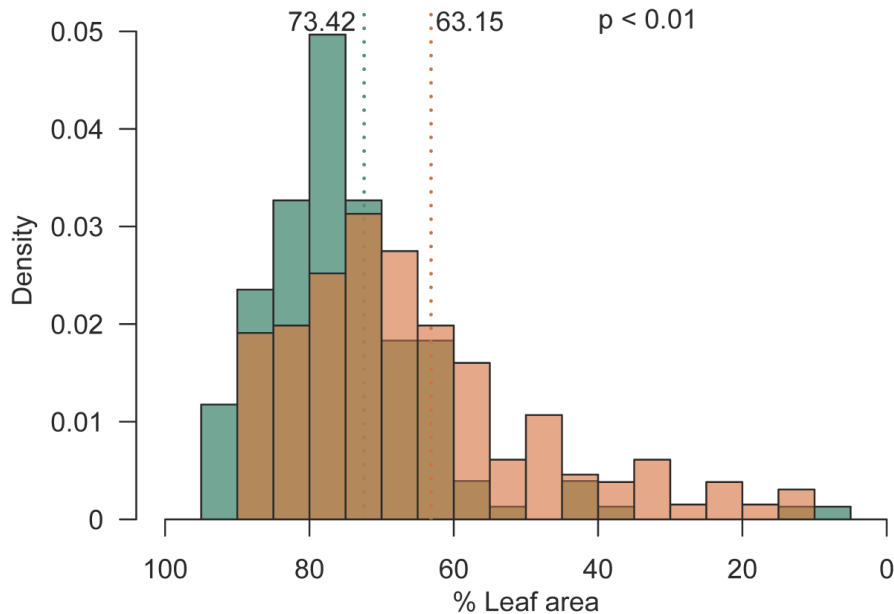


Long-term
Structural
adjustments

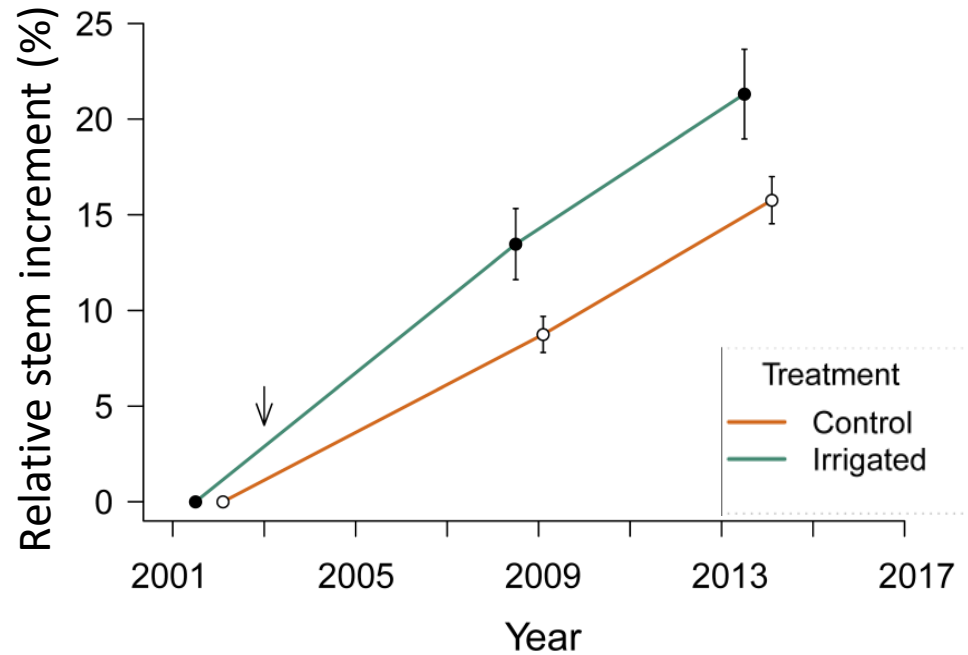


Pfynwald – structural acclimation

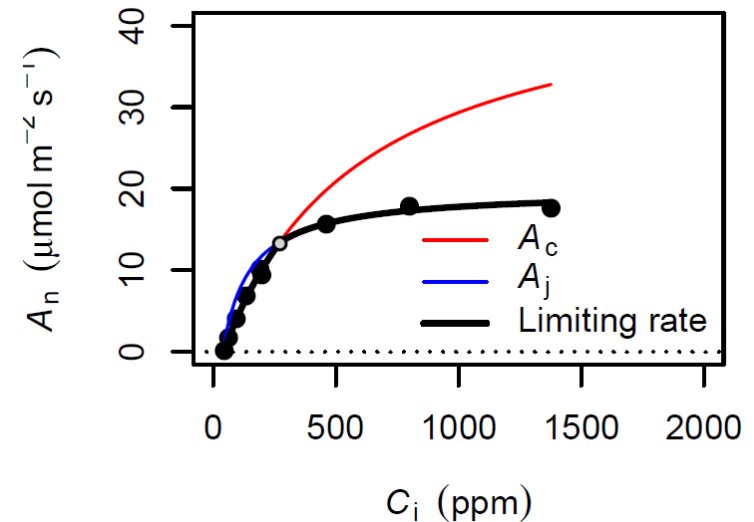
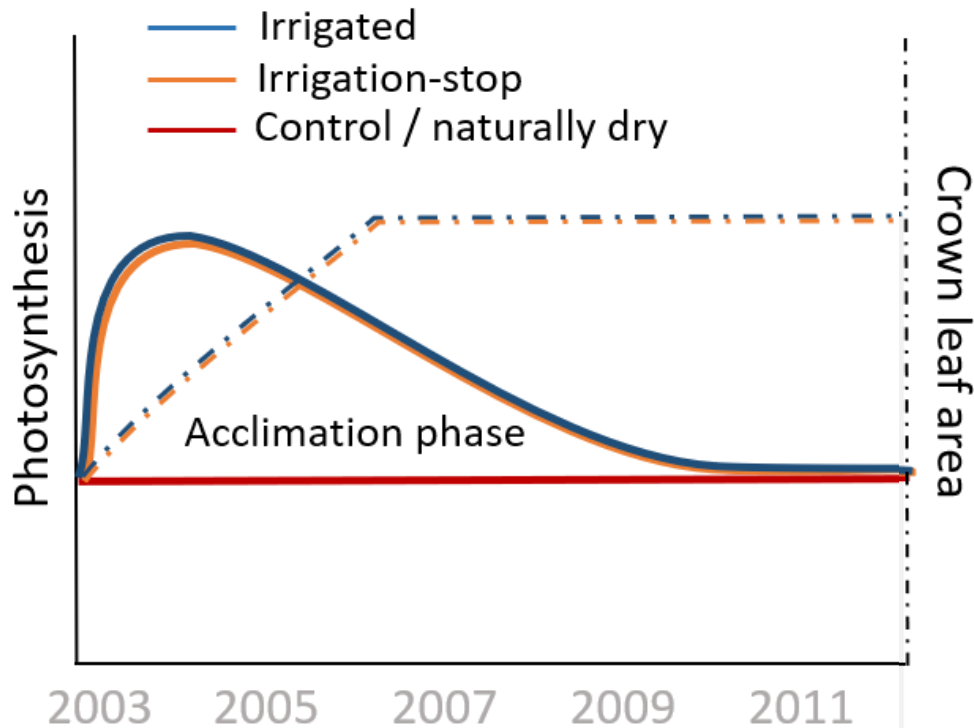
Relative leaf area crown



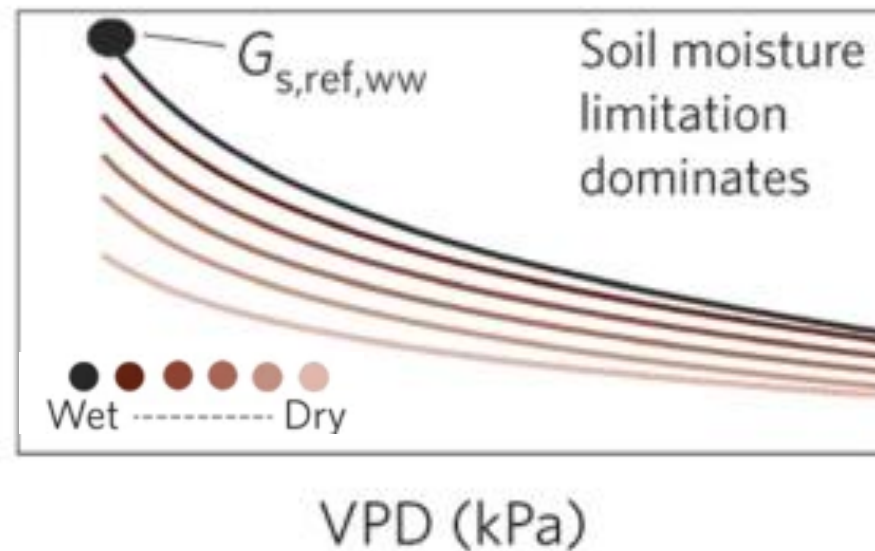
Relative stem increment



Photosynthetic acclimation



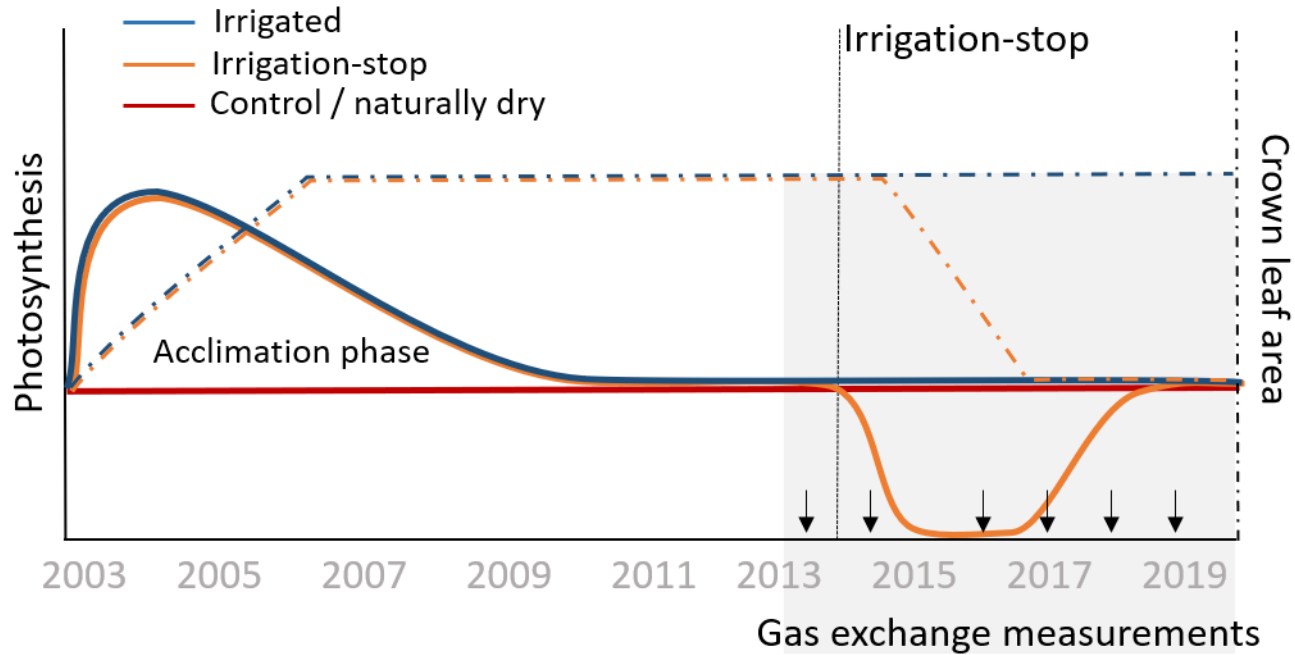
Stomatal sensitivity



Aims

1. **Acclimation** of stomatal and photosynthetic properties in response to long-term change in soil moisture
2. **Sensitivity** of stomatal conductance to short-term VPD and soil moisture variation
3. **Recovery** of photosynthetic properties when drought follows a long-term acclimation to high soil moisture

Design



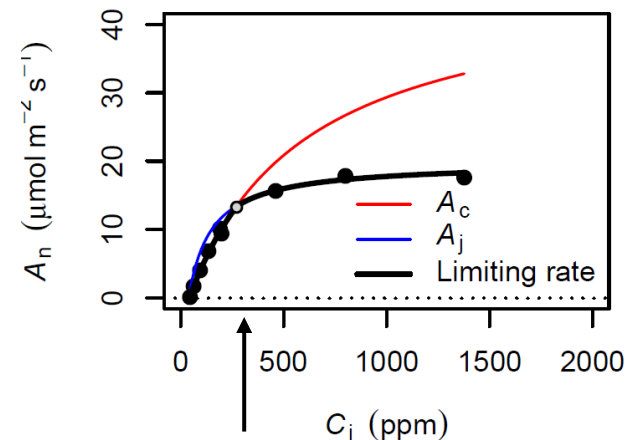
Design

In general:

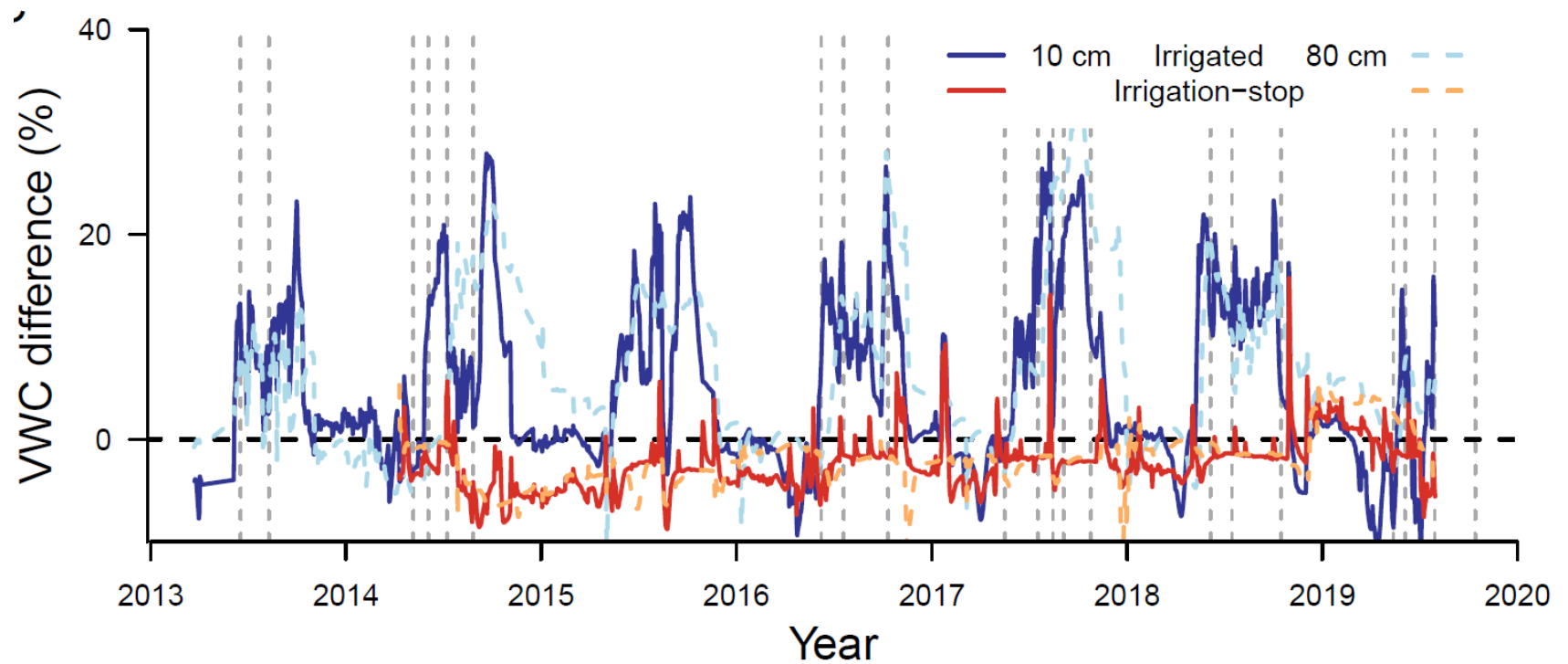
- Three times per year – June, August, October
- 9 Scaffolds, 3 trees per scaffold = 27 trees (9 per treatment)
- A / C_i curves – photosynthesis at increasing CO₂ concentration
- Other data – diurnal measurements, point measurements, gas exchange during 2017 labelling experiment, etc.



Gas exchange measurements

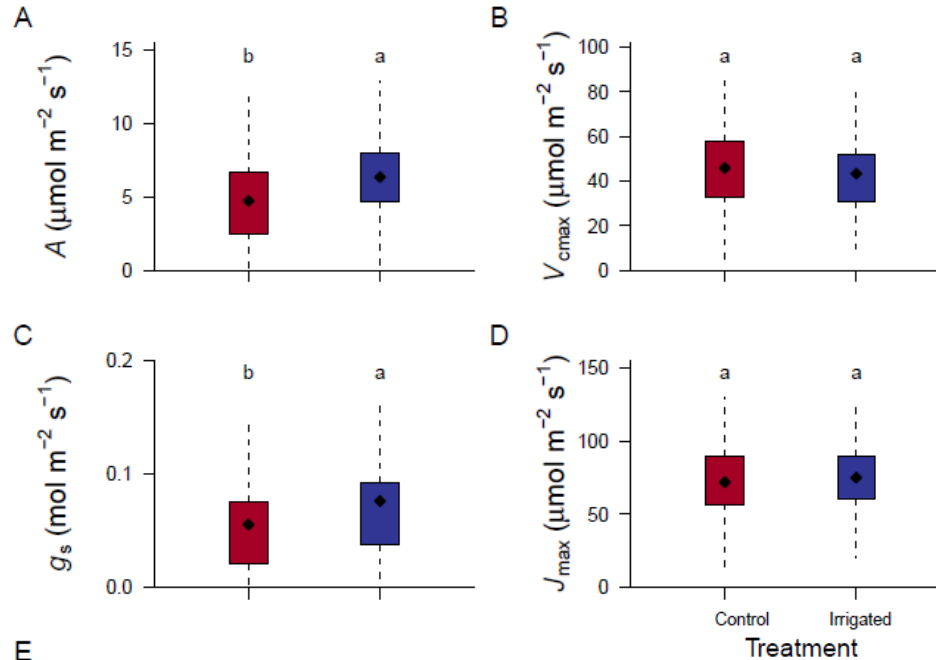


Soil water



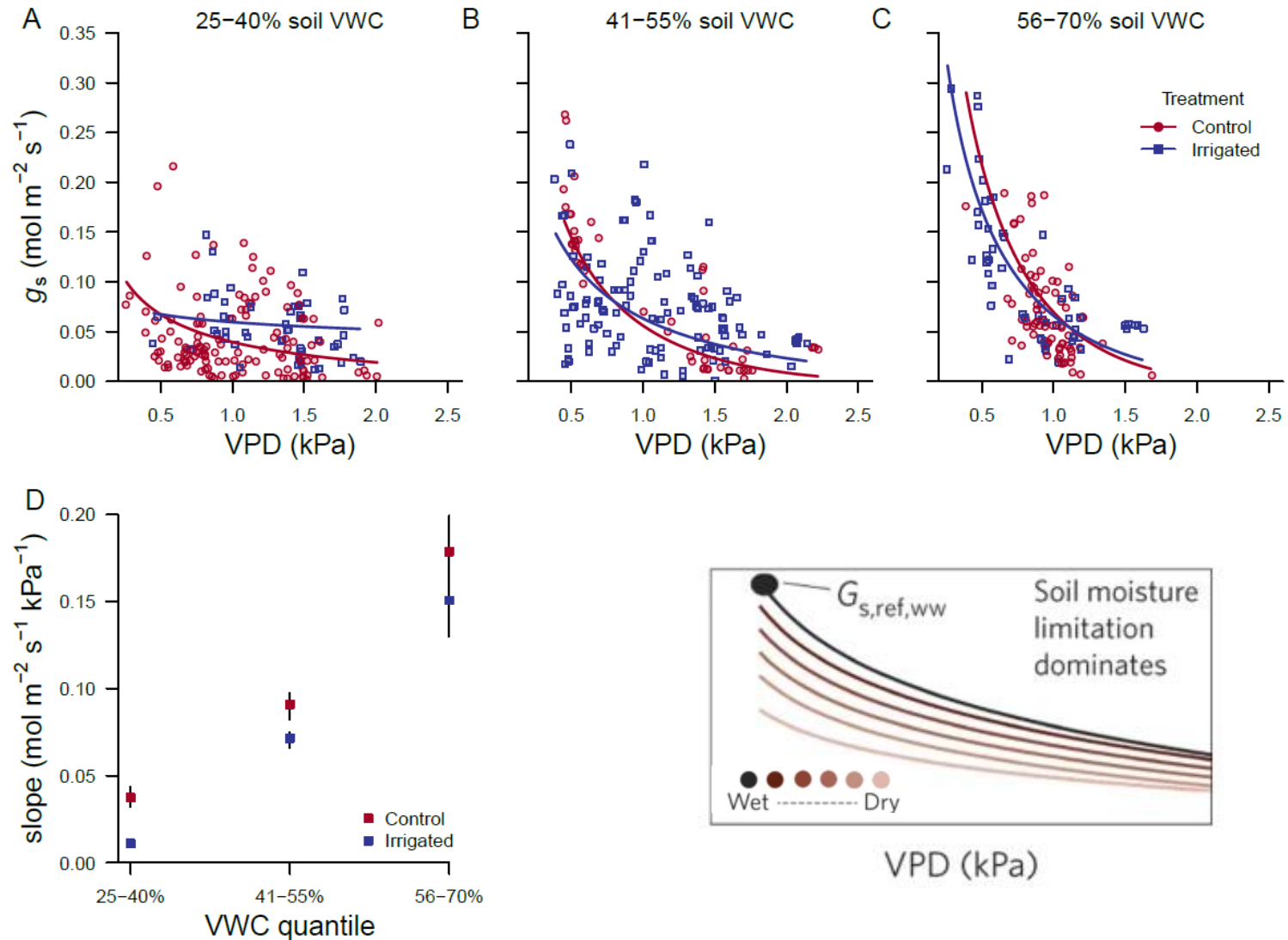
Long term acclimation

photosynthesis



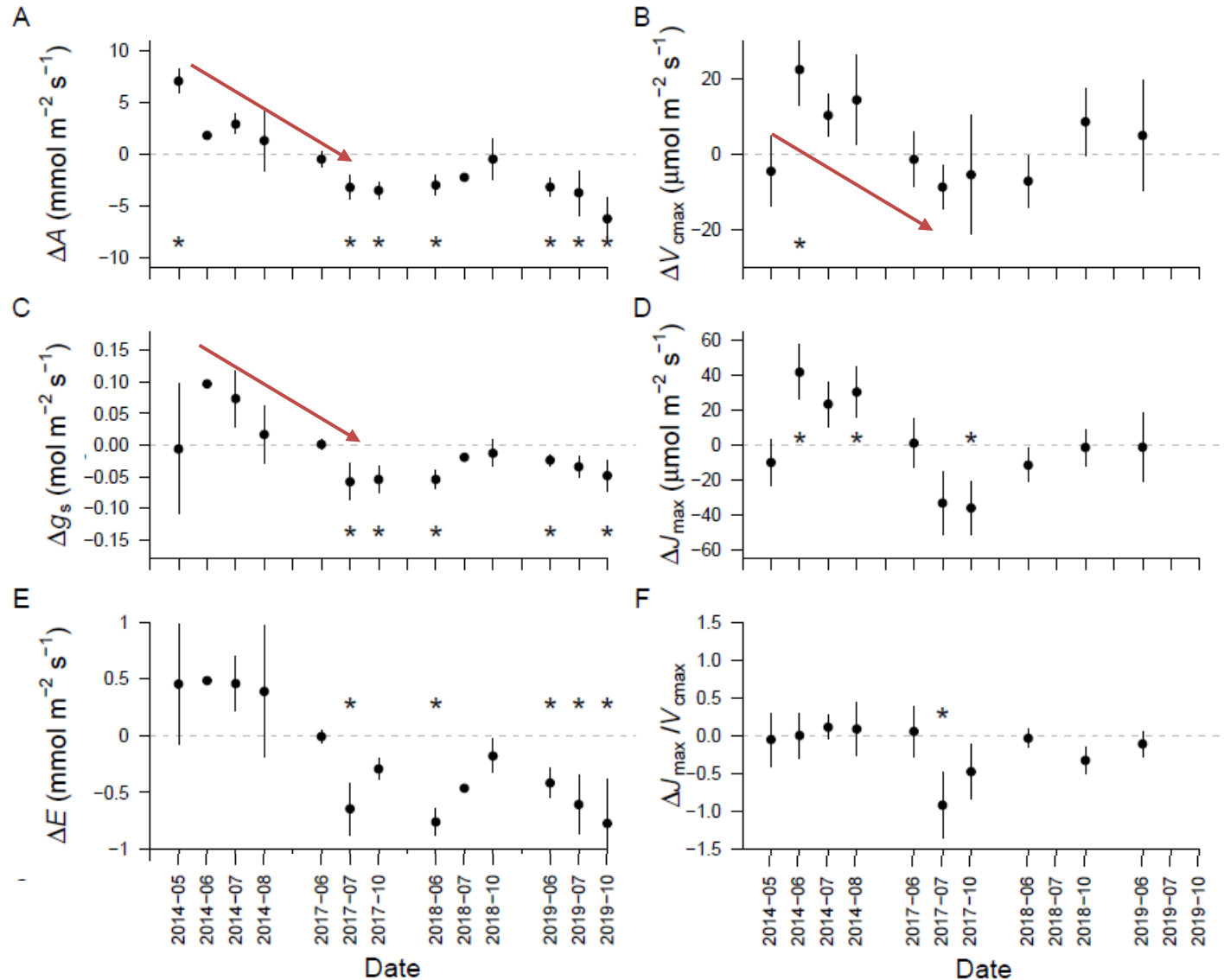
Transpiration

Stomatal sensitivity to VPD



How fast do trees react / acclimate?

Difference with irrigated trees



Slow response to extreme drought

- Gas exchange measurements done on previous years' needles
 - Physiological characteristics
- Ecological memory effect into newly built structures
 - Pines need +/- 4 years to renew the full crown

Conclusions

1. Acclimation

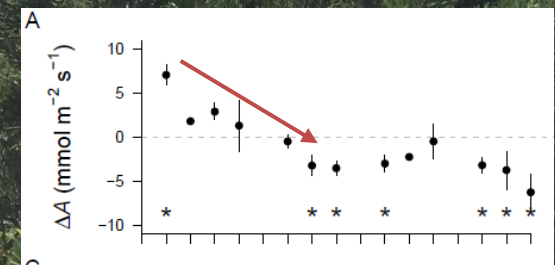
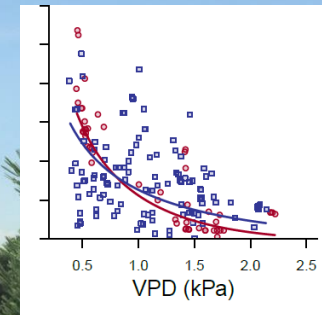
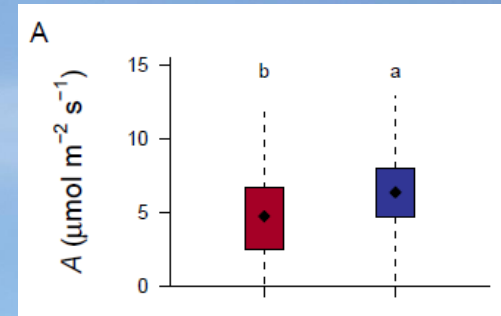
- Irrigated trees still have higher photosynthesis; control trees still have similar capacity

2. Sensitivity

- Control trees show slightly higher sensitivity to VPD changes – can capitalize beneficial circumstances

3. Recovery

- Time lag in response, due to structural and ecological memory?



Resources

- <https://www.envidat.ch/dataset/pfynwaldgasexchange>
 - DOI: 10.16904/envidat.238
- <https://academic.oup.com/jxb/advance-article-abstract/doi/10.1093/jxb/erac033/6520546>
 - DOI: 10.1093/jxb/erac033

The screenshot shows the Envidat dataset page for '2013-2020 gas exchange at Pfynwald'. The page includes a description of the dataset, funding information, related publications, and a list of data and resources. A large 'Preprint' watermark is visible across the page.

2013-2020 gas exchange at Pfynwald

Gas exchange was measured on control, irrigated and irrigation-stop trees at the irrigation experiment Pfynwald, during the years 2013, 2014, 2016-2020. The measurement campaigns served different purposes, resulting in a large dataset containing survey data, CO₂ response curves of photosynthesis, light response curves of photosynthesis, and fluorescence measurements. Measurements were done with LiCor 6400 and LiCor 6800 instruments. Until 2016, measurements were done on excised branches or branches lower in the canopy. From 2016 onwards, measurements were done in the top of the crown using fixed installed scaffolds. All metadata can be found in the attached documents.

Funding Information:

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- Swiss National Science Foundation (link) (Grant/Award: 310030_189109)
- Swiss National Science Foundation (link) (Grant/Award: P200P3_174958)
- Swiss National Science Foundation (link) (Grant/Award: 31003A_157126)
- Swiss National Science Foundation (link) (Grant/Award: CRSK-3_190802)

Related Publications

Photosynthetic acclimation and sensitivity to short- and long-term environmental changes Leonie Schönbeck, Charlotte Grossiord, Arthur Gessler, Jonas Gislér, Katrin Meusburger, Petra D'Odorico, Andreas Rigling, Yann Salmir Stocker, Roman Zweifel, Marcus Schaub bioRxiv 2021 01 04 425174, doi: <https://doi.org/10.1101/2021.01.04.425174>

Citation:

Schönbeck, Leonie; d'Odorico, Petra; Gislér, Jonas; Gessler, Arthur; Schaub, Roman Zweifel; Marcus Schaub bioRxiv 2021 01 04 425174, doi: <https://doi.org/10.1101/2021.01.04.425174>

Data and Resources

- **Pfynwald gas exchange**
Full dataset of Pfynwald gas exchange data taken in the period from June 2013...
- **Variable names and units**
Variable names, description and units for the Pfynwald Gas exchange data
- **Instrument details**
Instrument details for all LiCor instruments used during collection of...
- **Methods ACI curves**
Parameters and methods for CO₂ response curves of Photosynthesis. Metadata
- **Methods Fluorescence**
Parameters and methodology for Fluorescence measurements Metadata for
- **Methods survey**
Parameters and methods for point measurements / survey measurements
- **Methods light response**
Methods and parameters for light response curves

Photosynthetic acclimation and sensitivity to short- and long-term environmental changes in a drought prone forest

Leonie Schönbeck^{1,2}, Charlotte Grossiord^{1,2}, Arthur Gessler^{1,4}, Jonas Gislér^{1,5}, Katrin Meusburger^{1,4}, Petra D'Odorico^{1,4}, Andreas Rigling^{1,4}, Yann Salmir Stocker^{1,4}, Roman Zweifel^{1,4}, Benjamin D. Stocker^{1,4}, Marcus Schaub^{1,6}

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Highlight

Acclimation to irrigation increased gas exchange in *Pinus sylvestris* L., but reduced the sensitivity to short-term changes. In addition, structural adjustments led to an attenuation of initially strong leaf-level acclimation.

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Thank you!

