

Manipulating precipitation & atmospheric water demand: Effects on adult *Pinus sylvestris* in the VPDrought project

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VPDrought

***A novel approach to disentangle atmospheric
and soil drought in a natural Scots pine forest***

Site

Scots pine forest in the dry inner-alpine Swiss Rhône Valley



Manipulations

Soil water availability

- Irrigation: double amount of mean annual precipitation (+600 mm)
- Roof: halve the amount of annual precipitation



Manipulations

Soil water availability

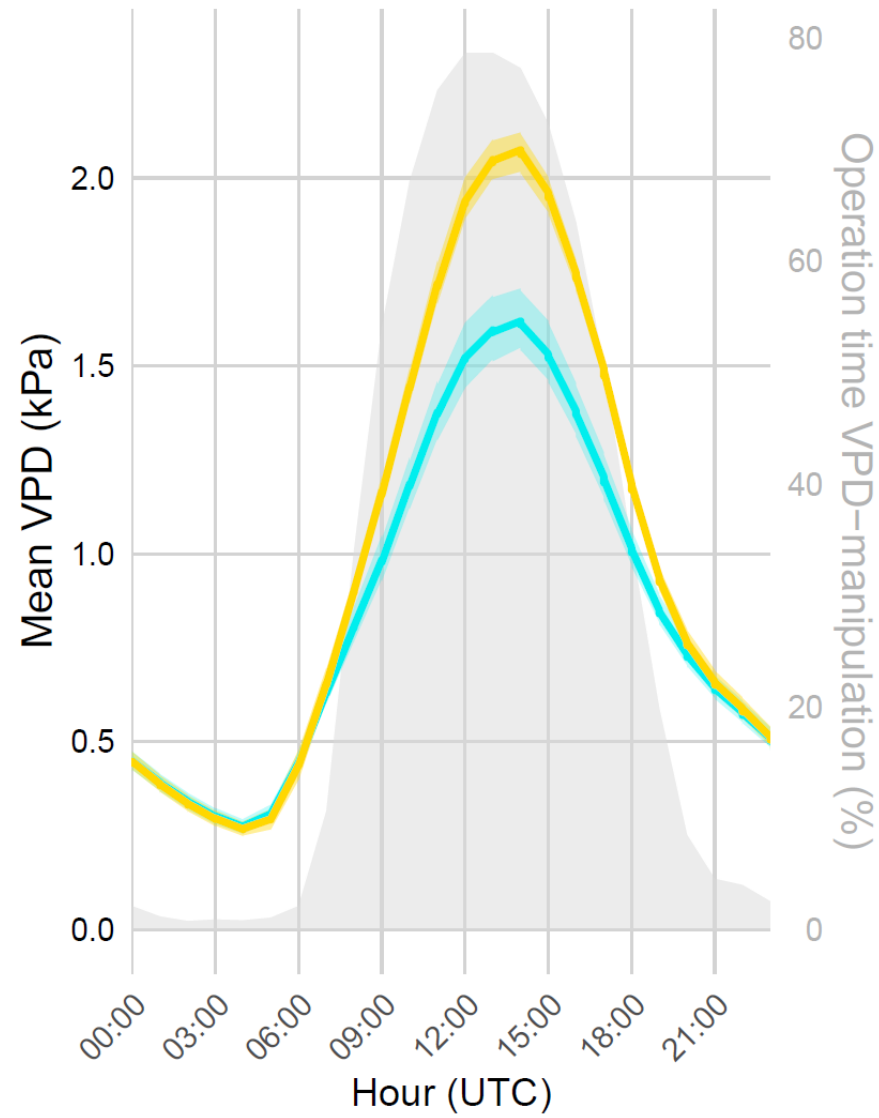
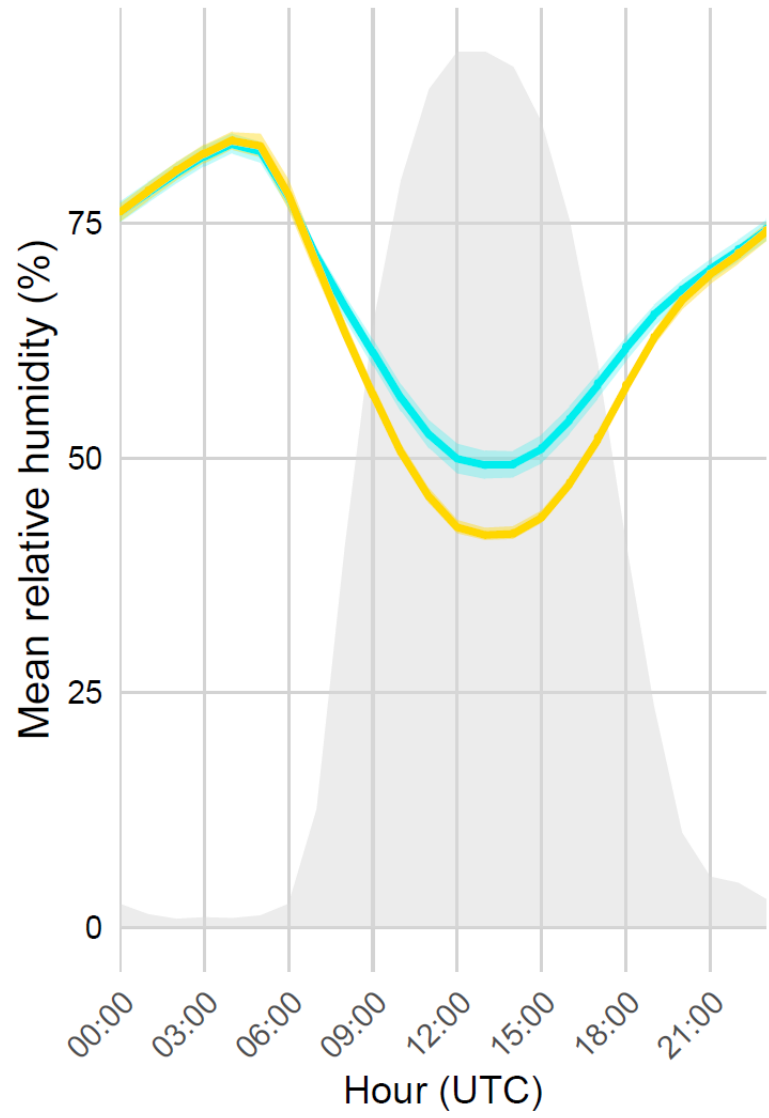
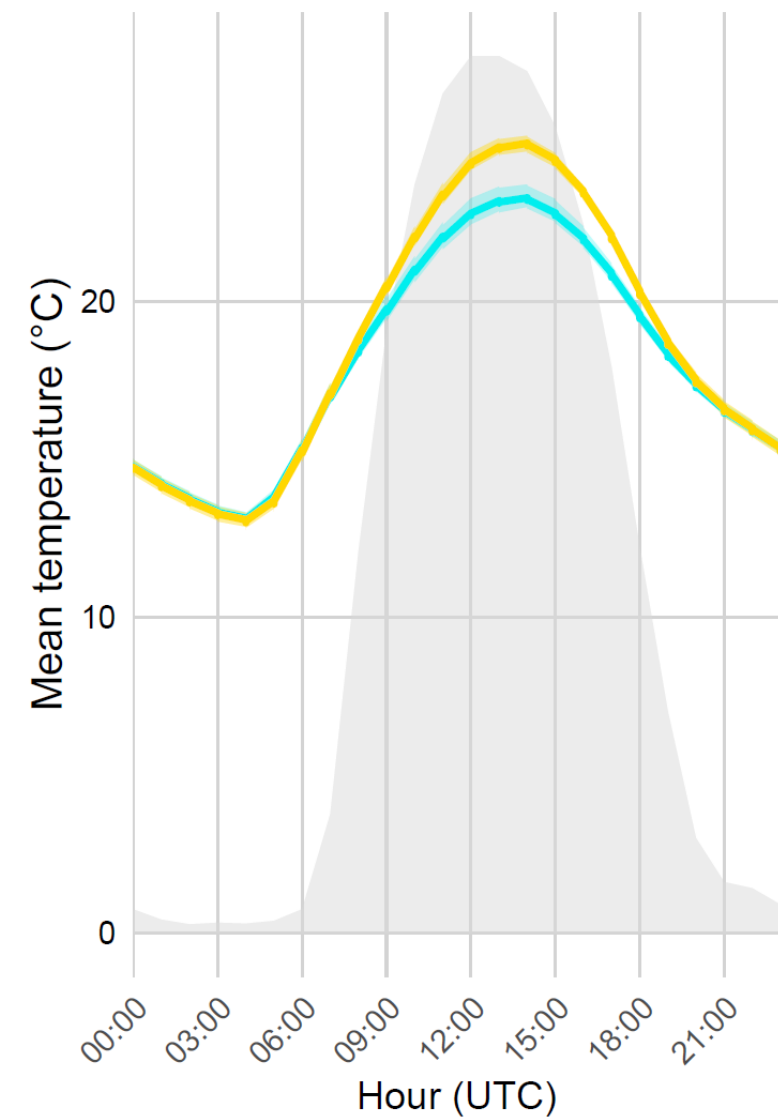
- Irrigation: double amount of mean annual precipitation (+600 mm)
- Roof: halve the amount of annual precipitation

Atmospheric water demand

- Spray very little water drops into the air:
reduce the vapor pressure deficit (VPD) by ca. 25%



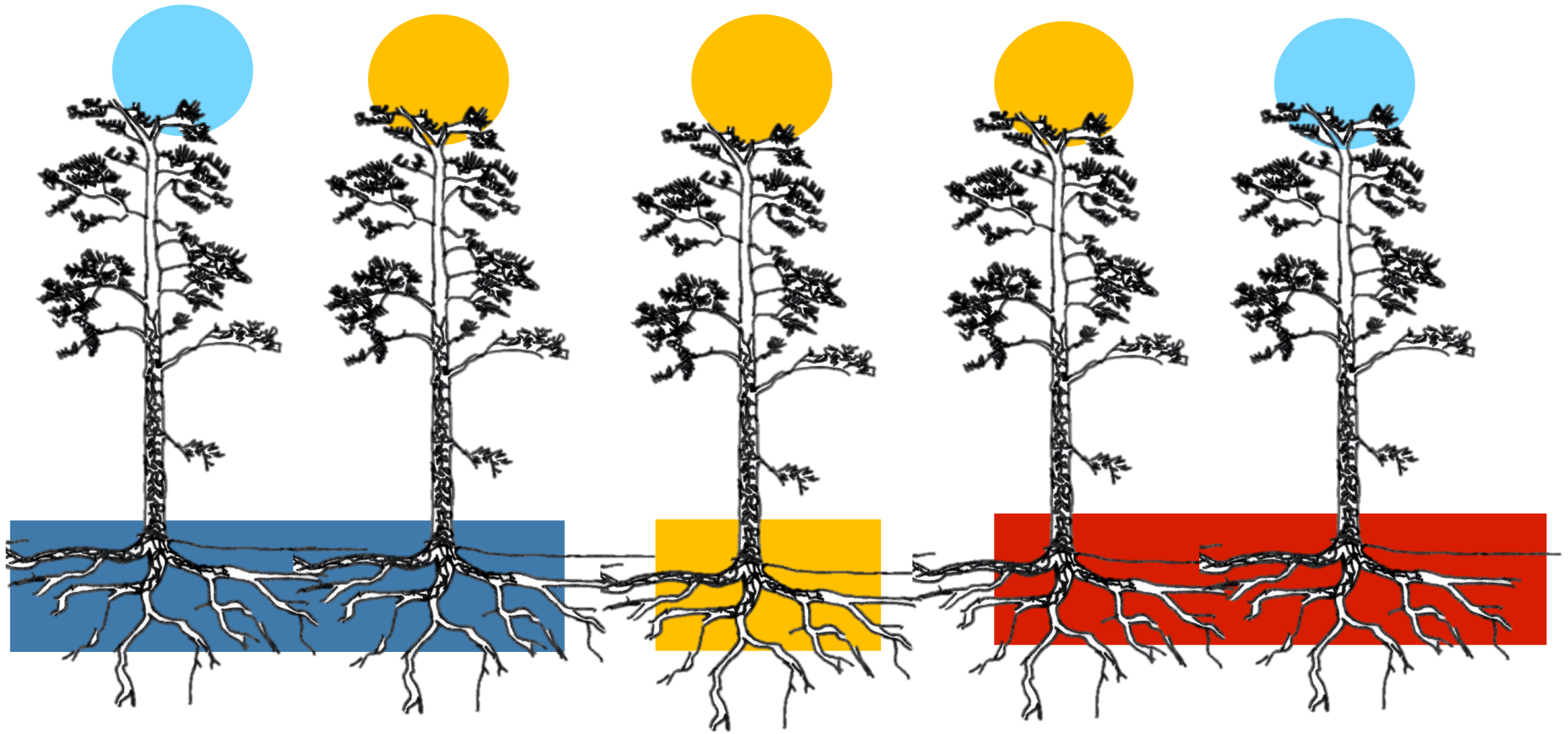
- Ambient condntions
- VPD reduced conditions



VPD reduction

Control

VPD reduction

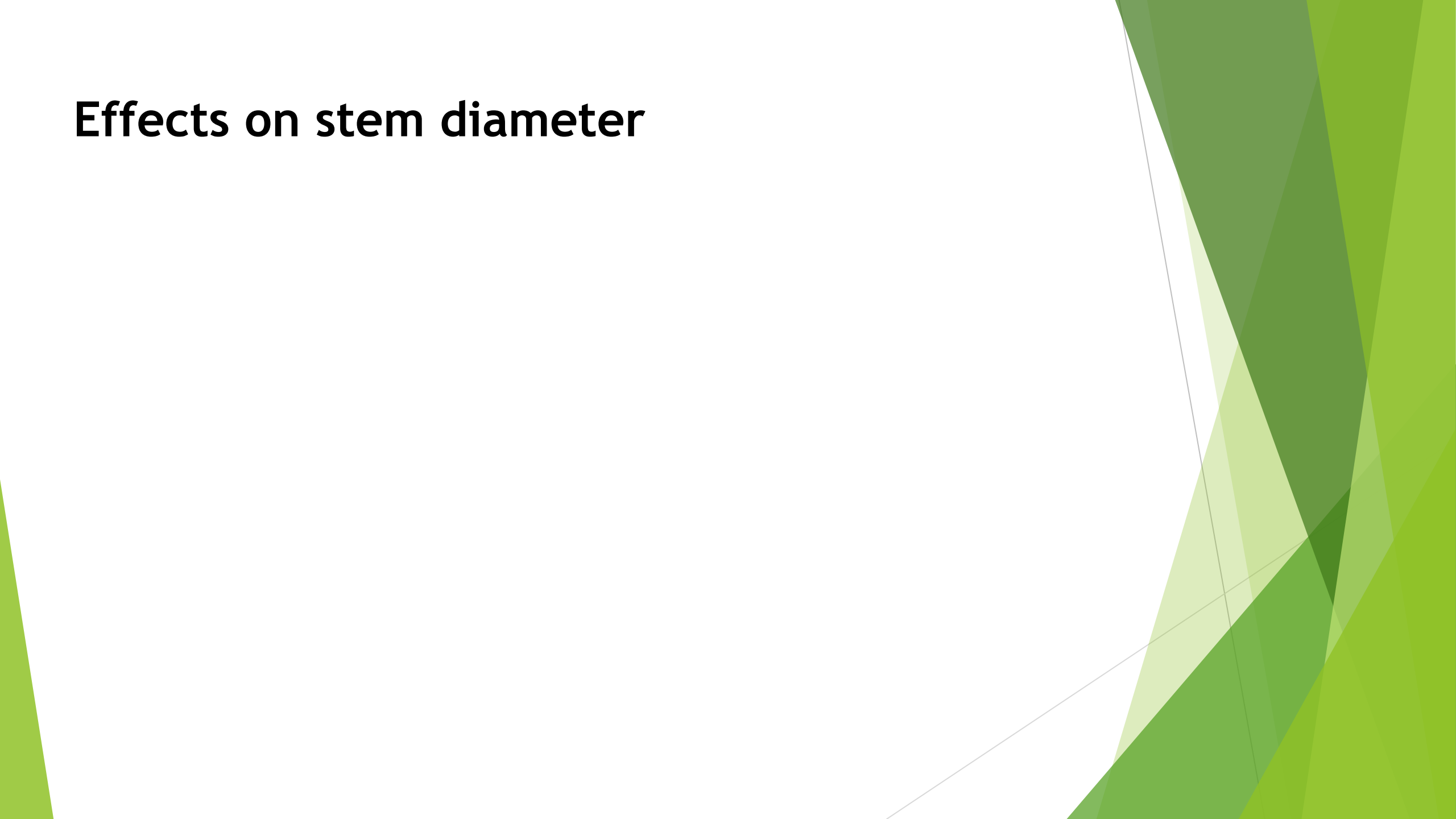


Irrigation

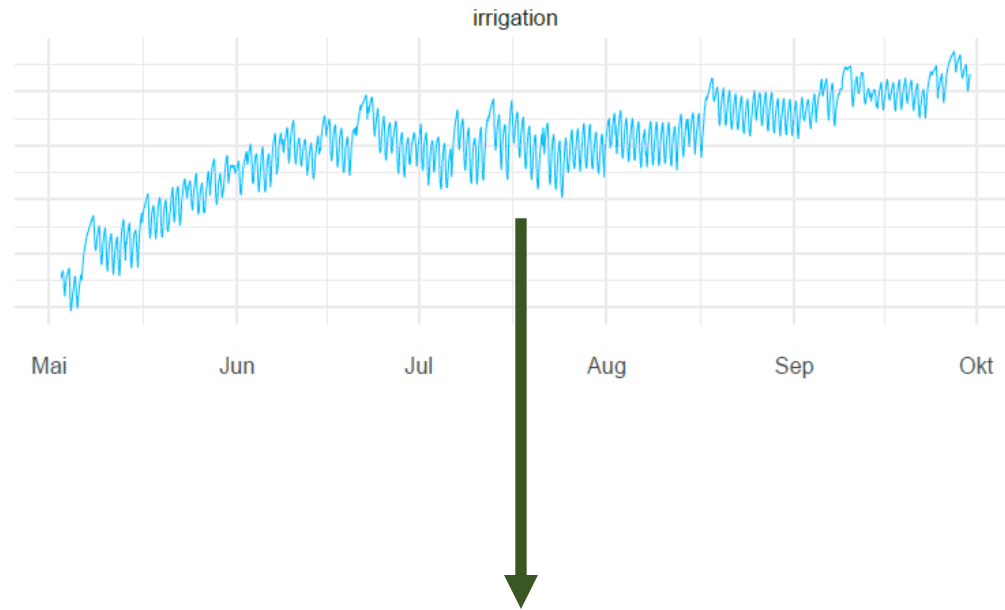
Control

Roots

Effects on stem diameter

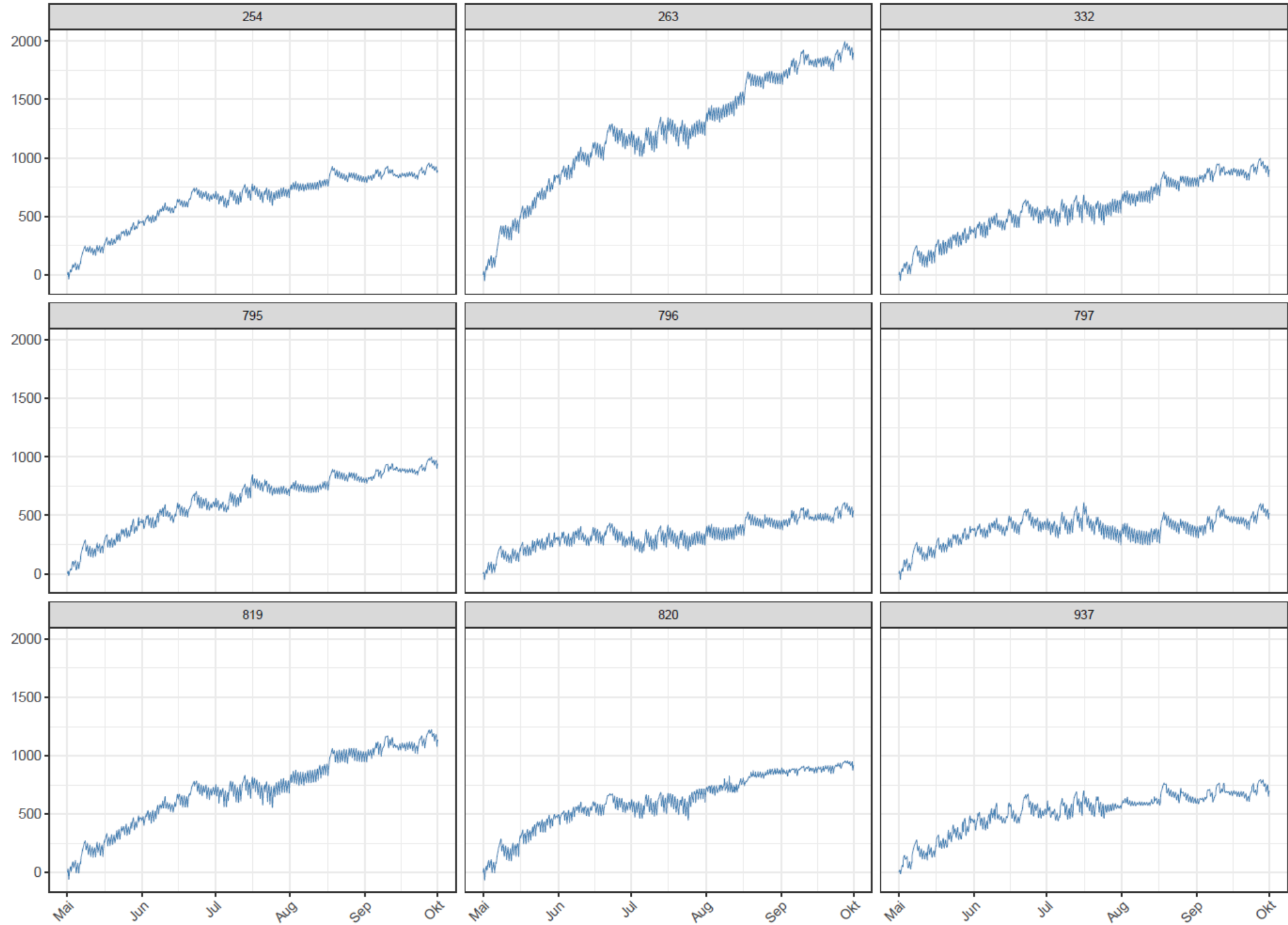


Stem diameter

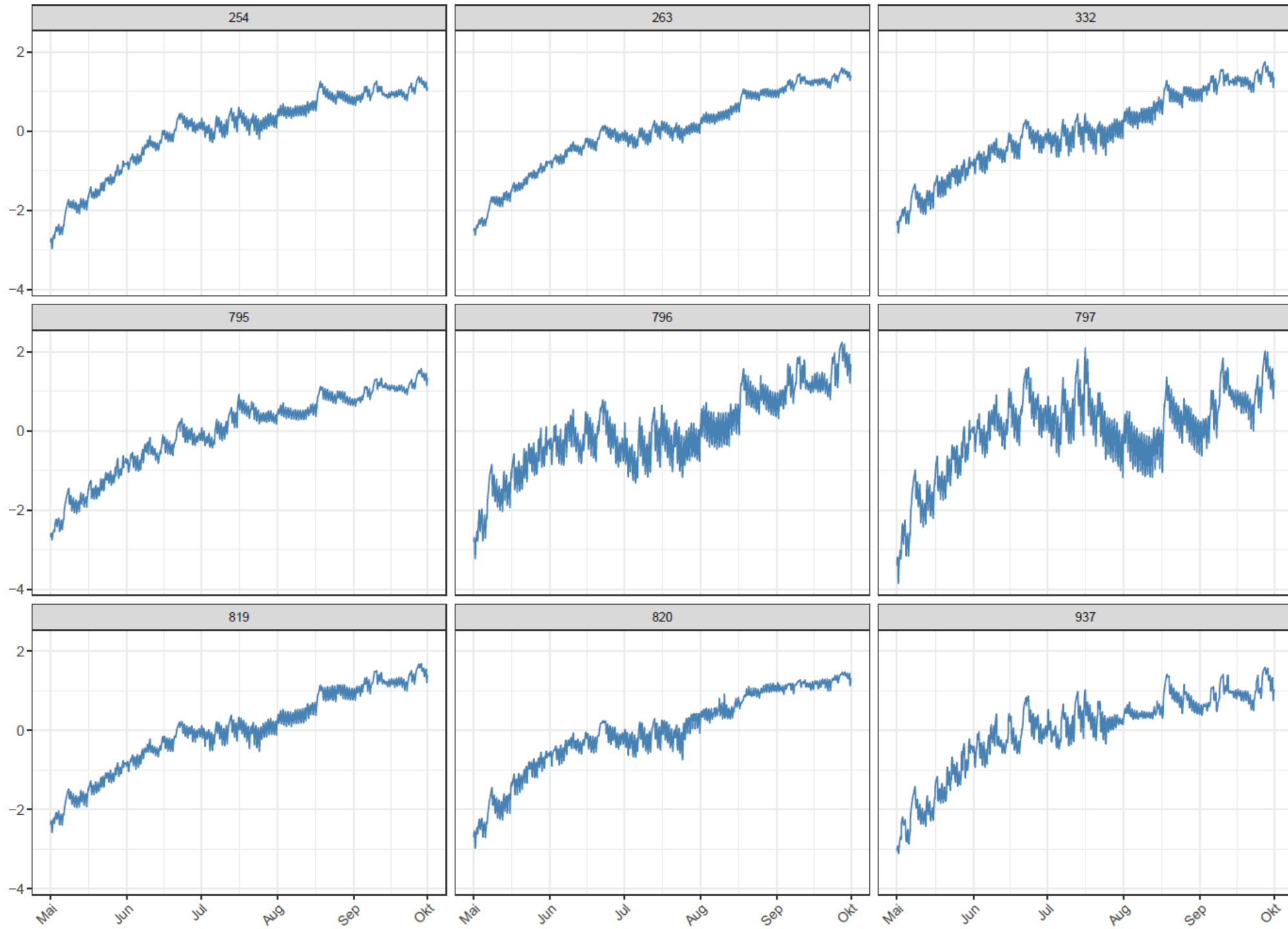


- 9 trees
- Individual tree time-series standardized and avaraged

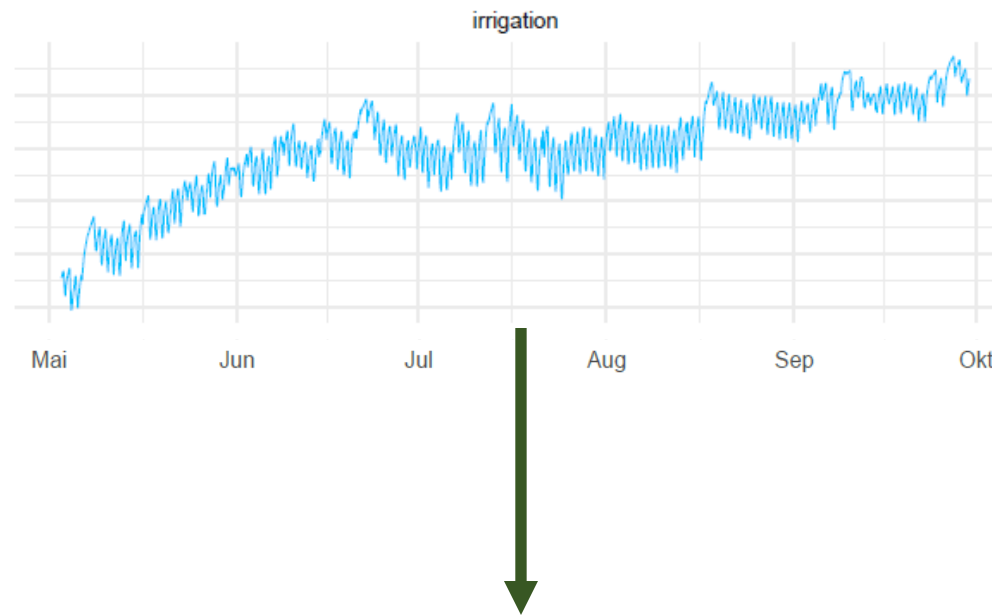
absolute measurement values



standardized measurement values

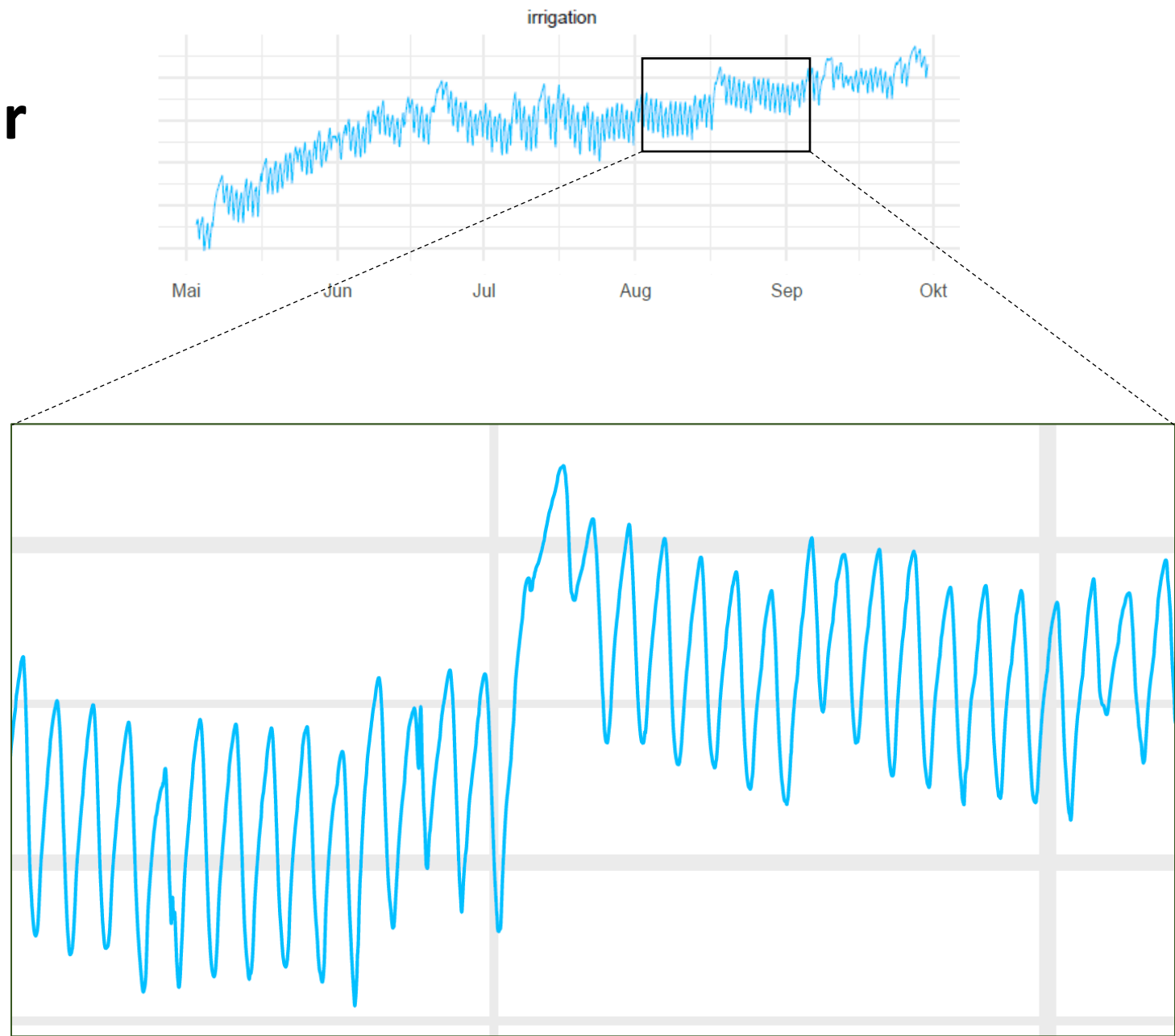


Stem diameter

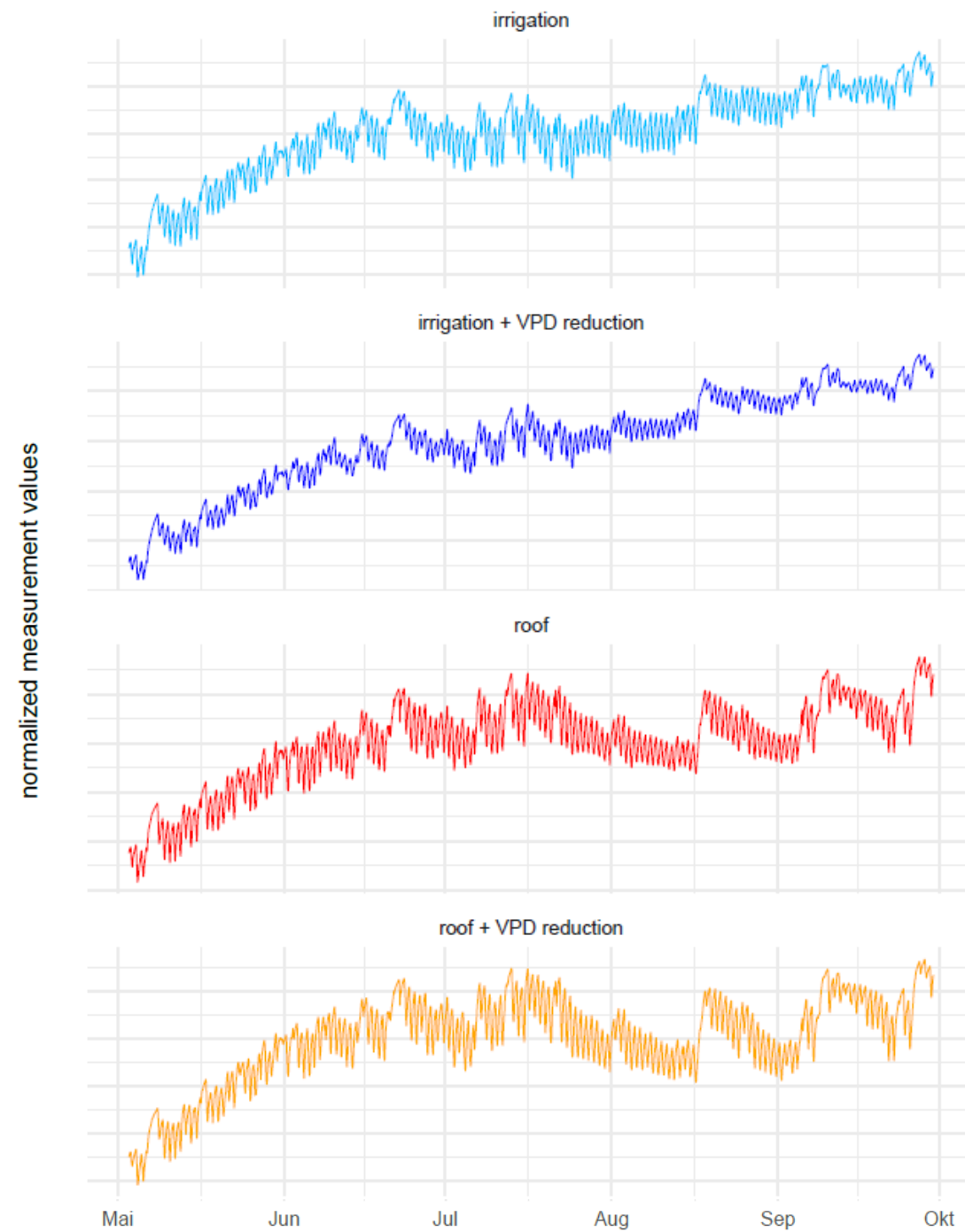


➤ Only compare temporal differences!

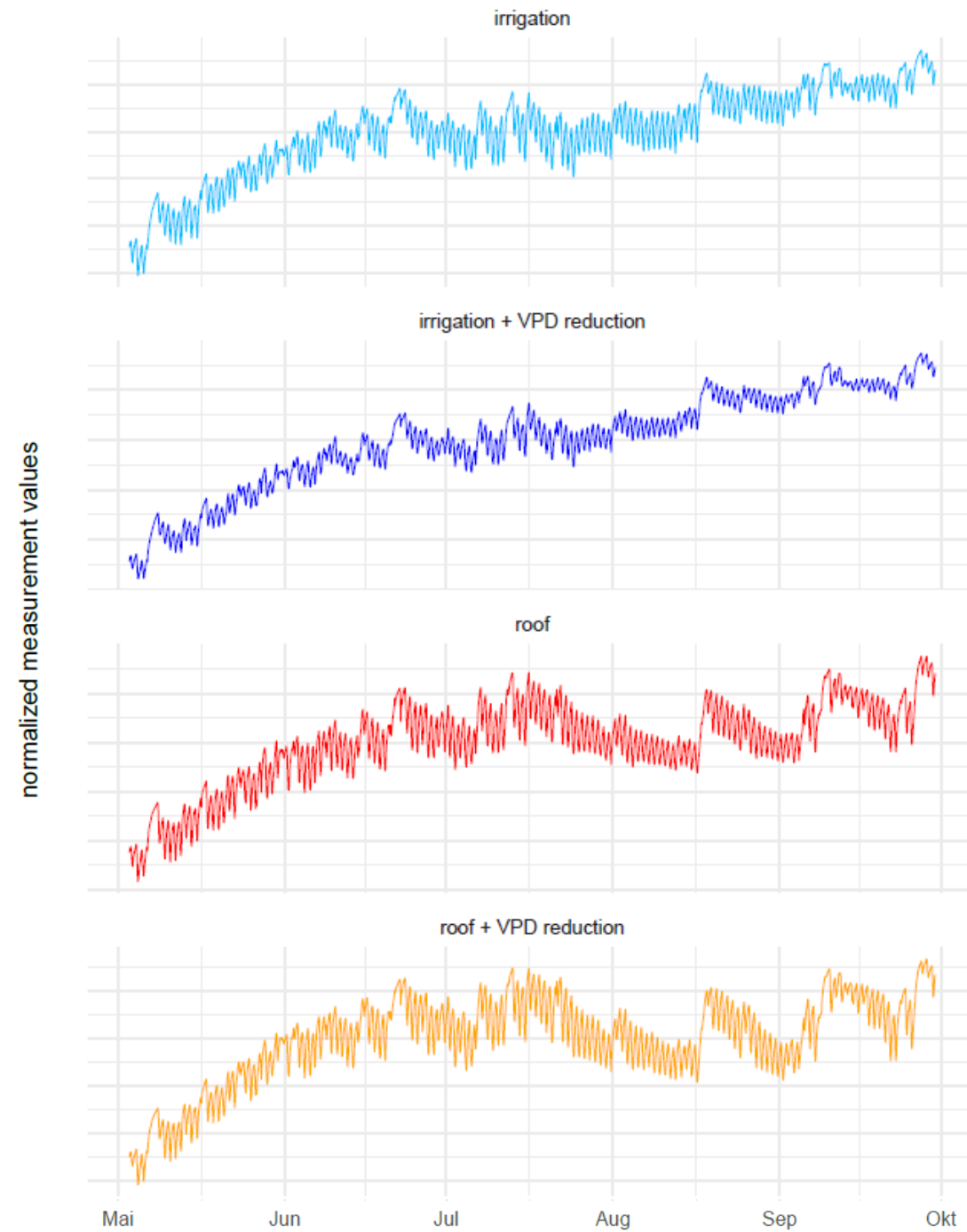
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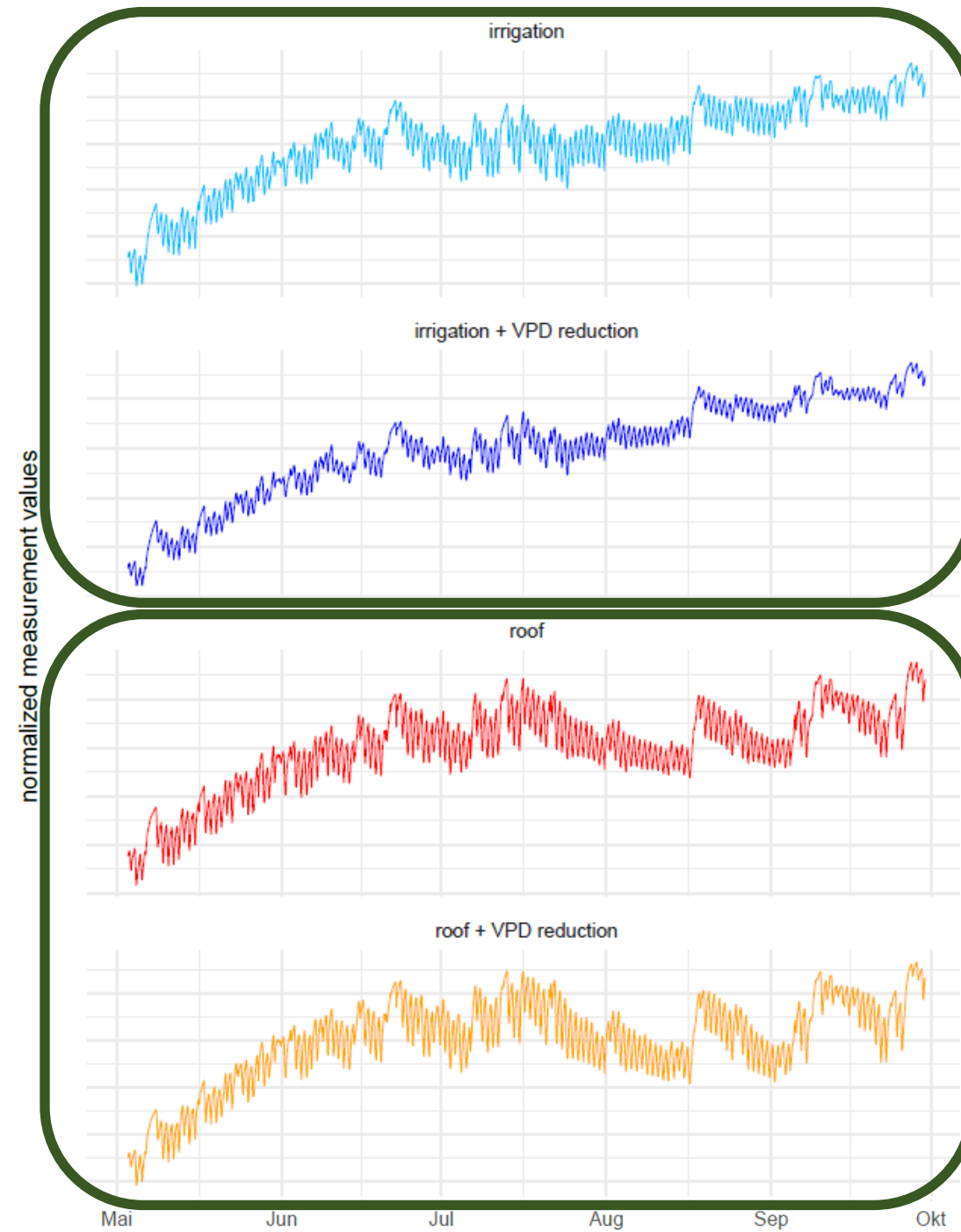
Stem diameter



Stem diameter



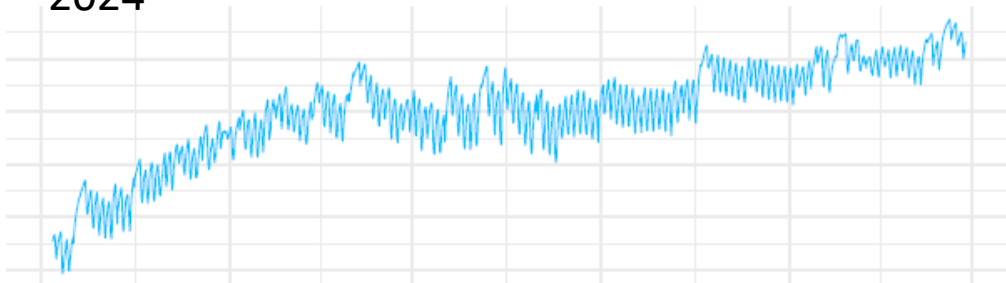
Stem diameter



standardized measurement values

2024

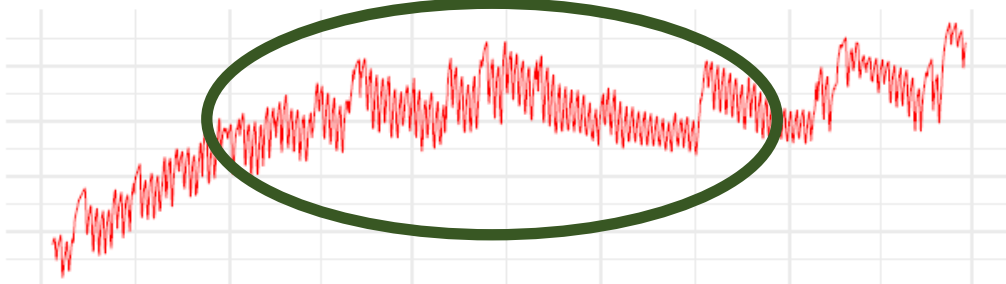
irrigation



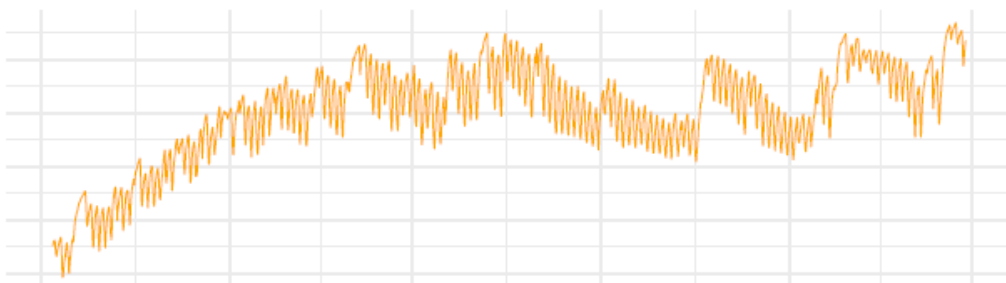
irrigation + VPD reduction



roof



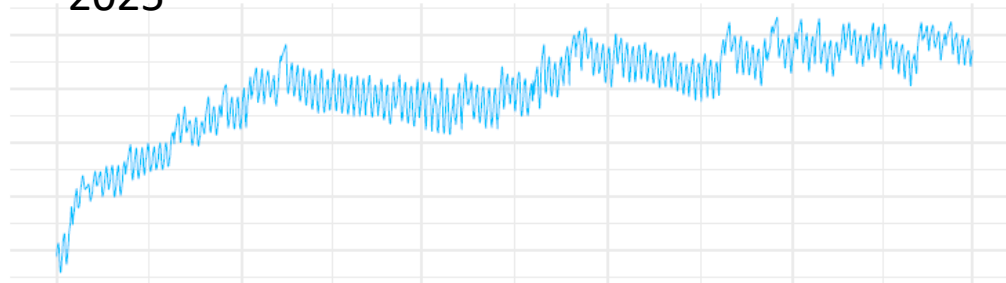
roof + VPD reduction



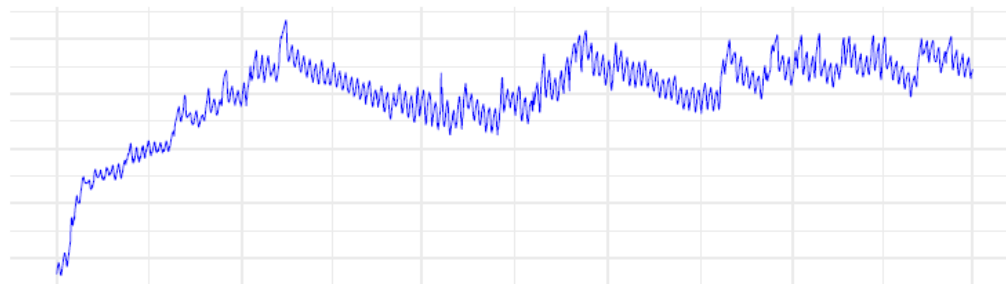
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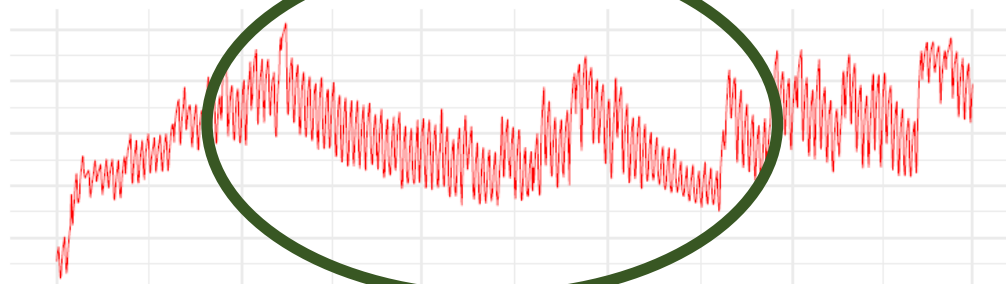
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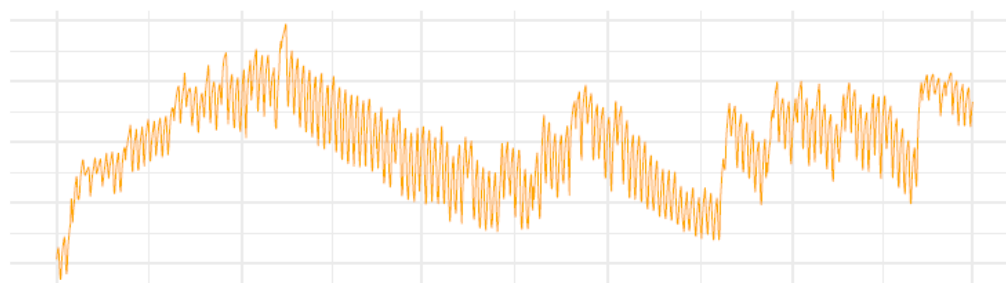
irrigation + VPD reduction



roof



roof + VPD reduction

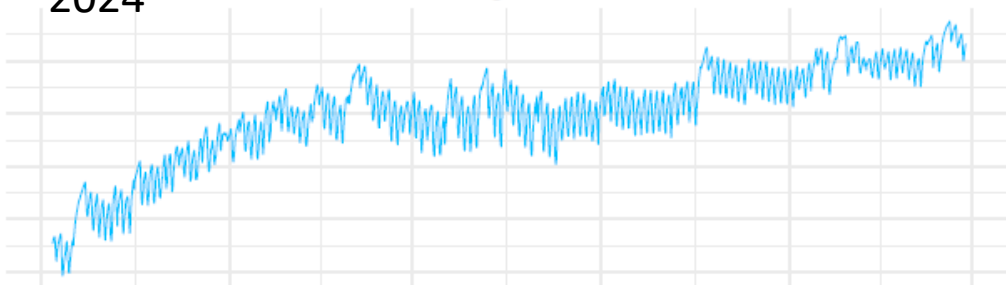


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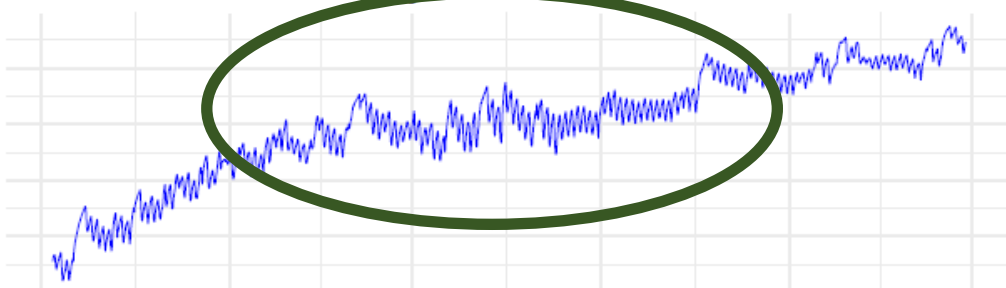
standardized measurement values

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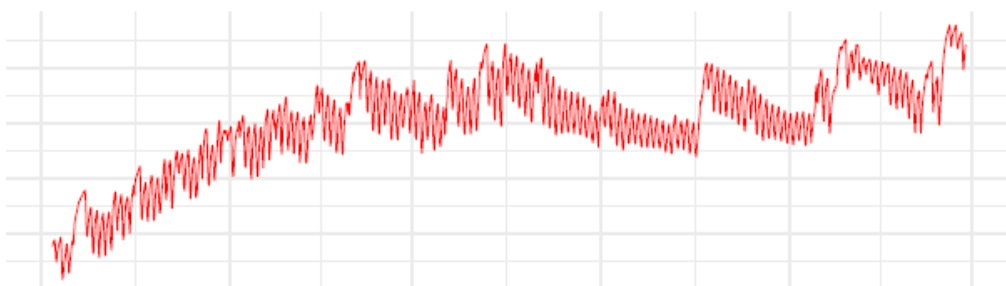
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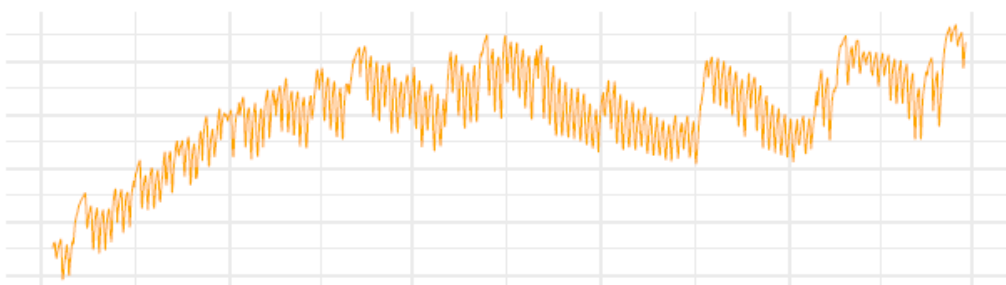
irrigation + VPD reduction



roof



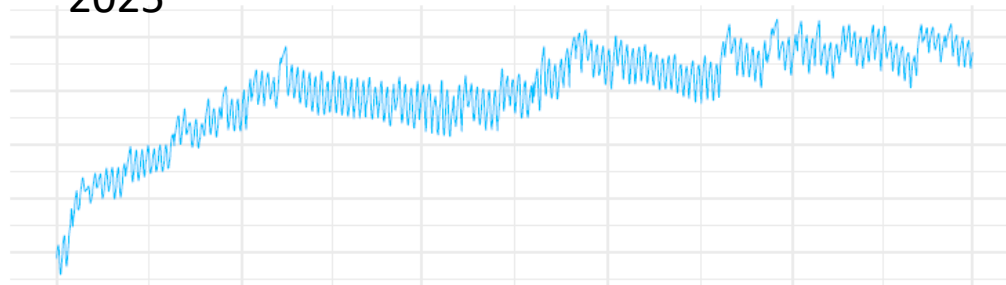
roof + VPD reduction



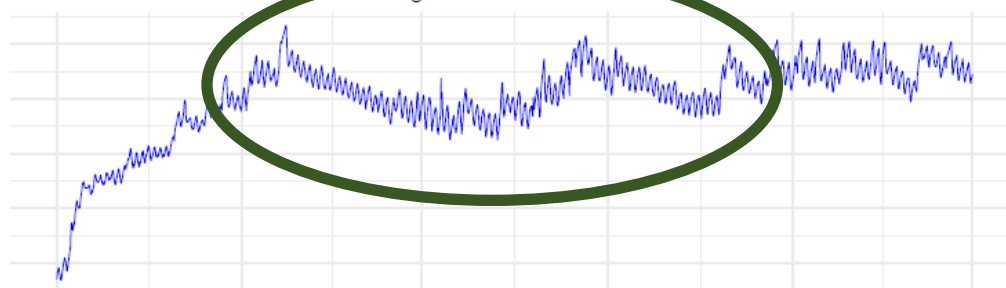
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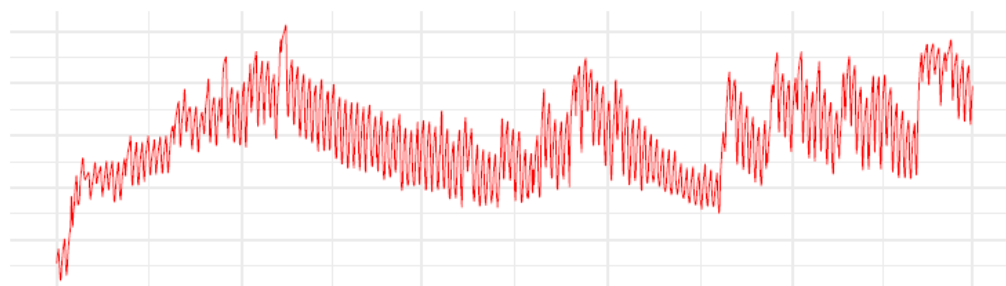
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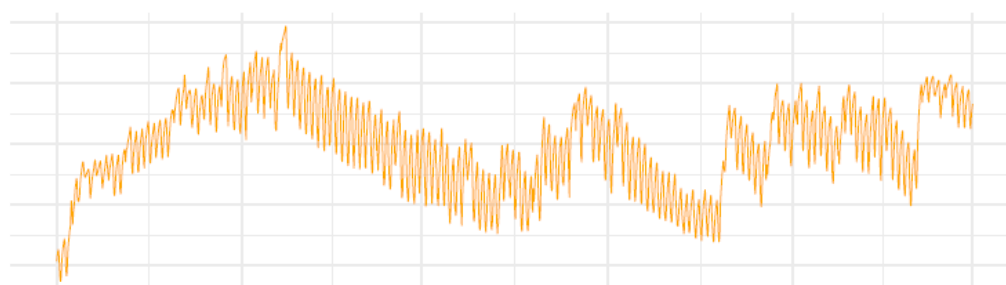
irrigation + VPD reduction



roof



roof + VPD reduction

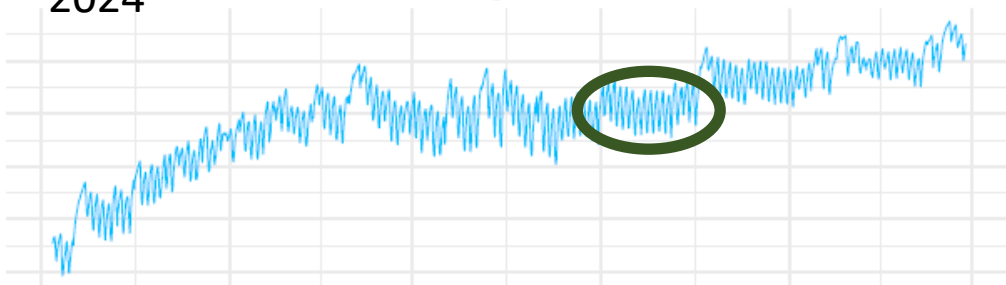


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standardized measurement values

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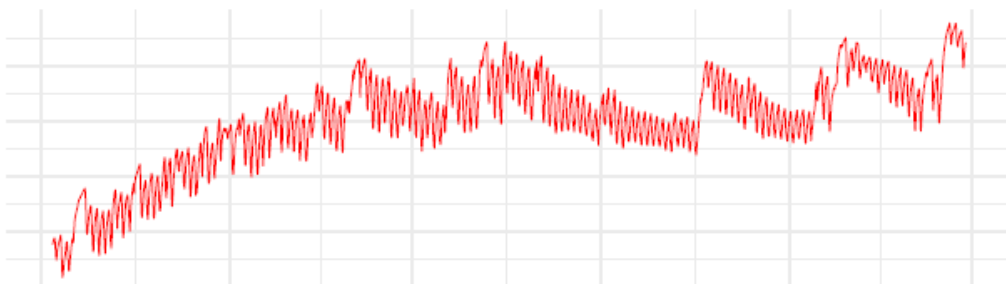
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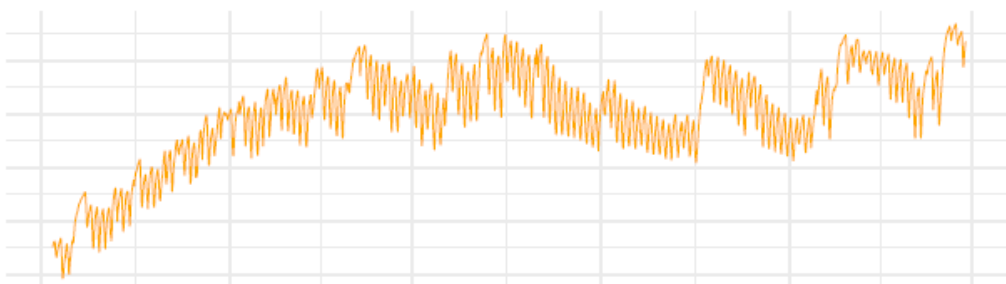
irrigation + VPD reduction



roof



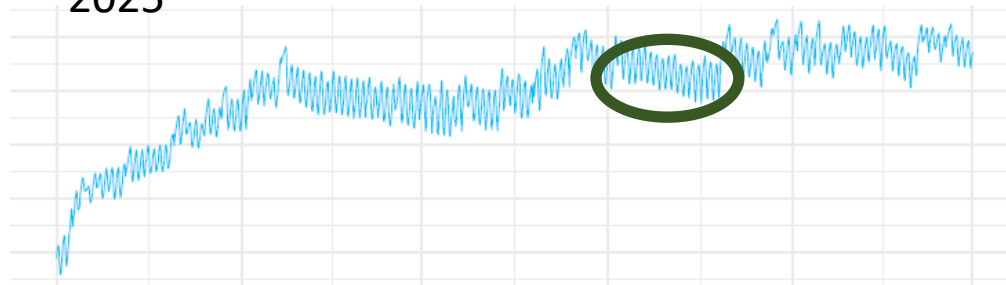
roof + VPD reduction



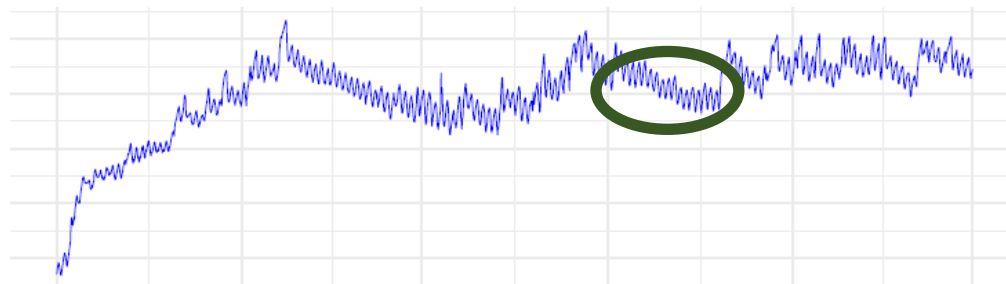
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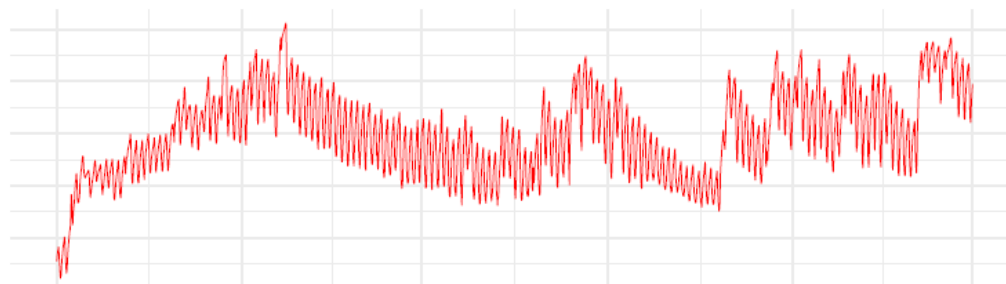
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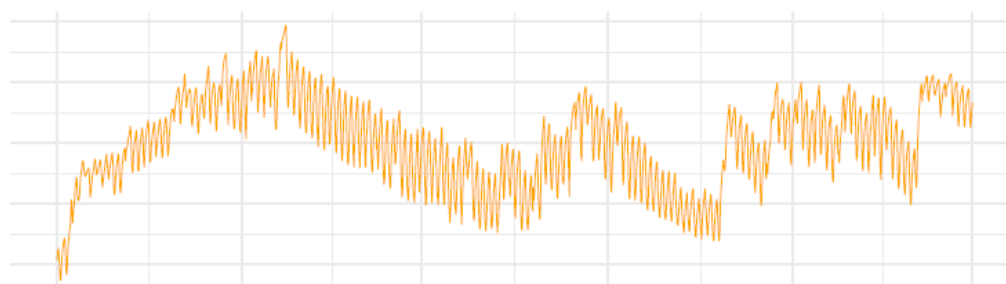
irrigation + VPD reduction



roof



roof + VPD reduction

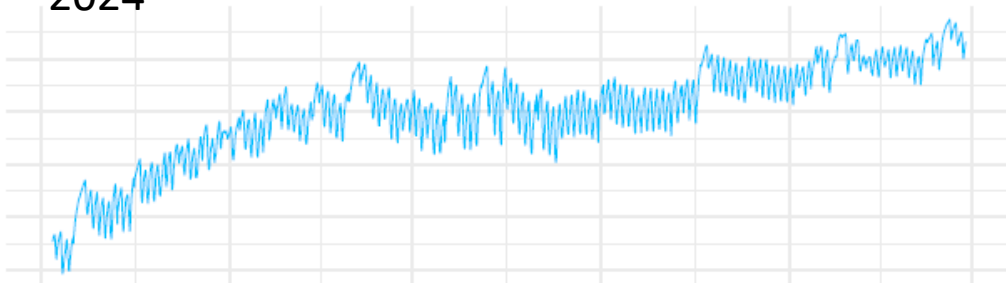


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standardized measurement values

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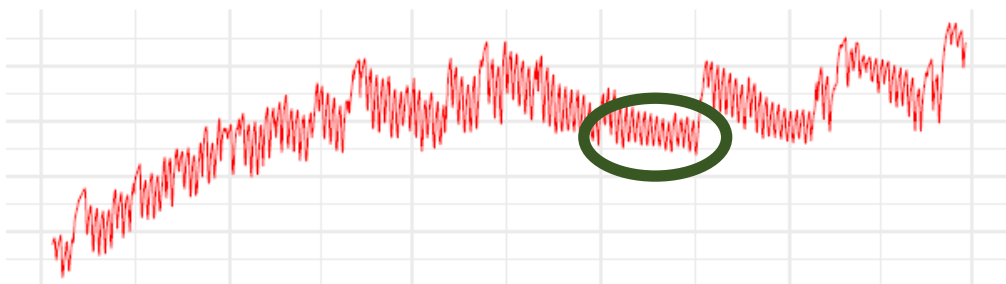
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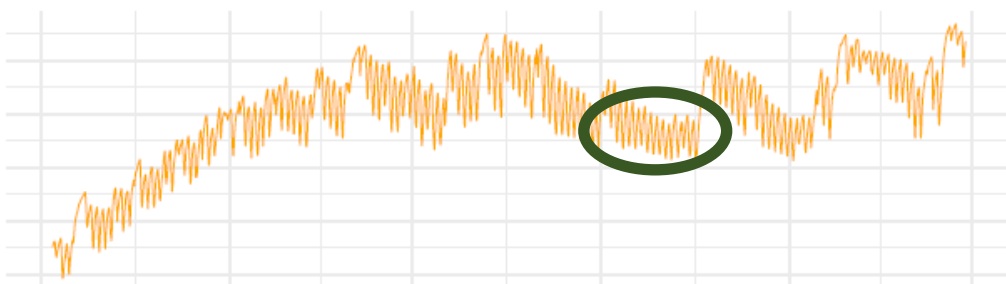
irrigation + VPD reduction



roof



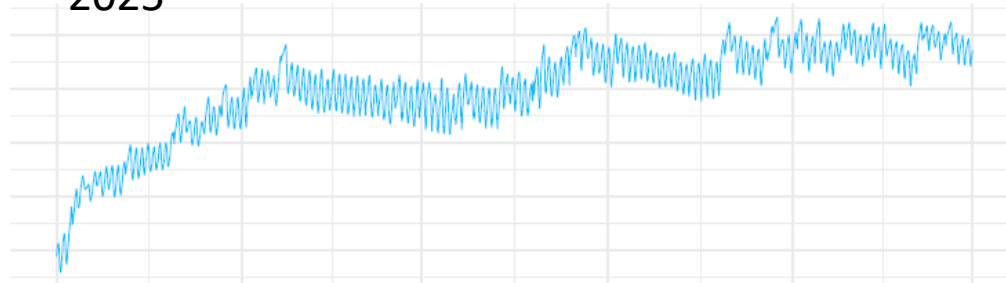
roof + VPD reduction



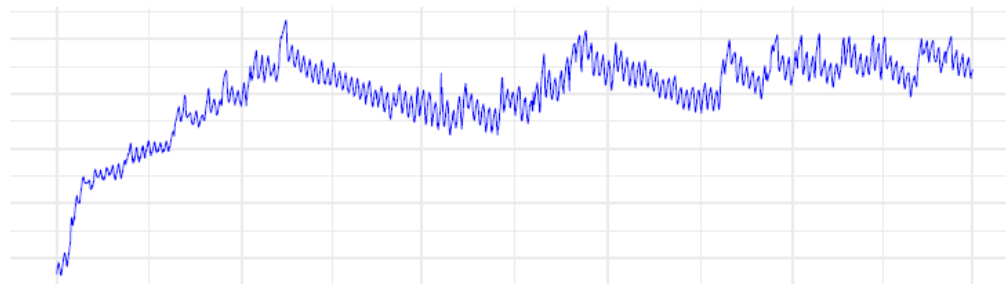
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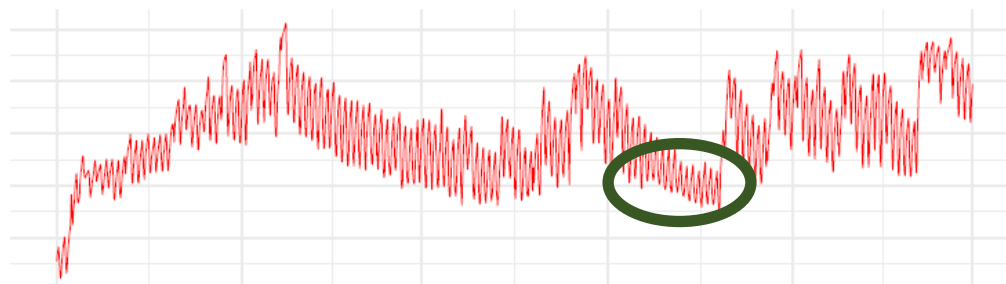
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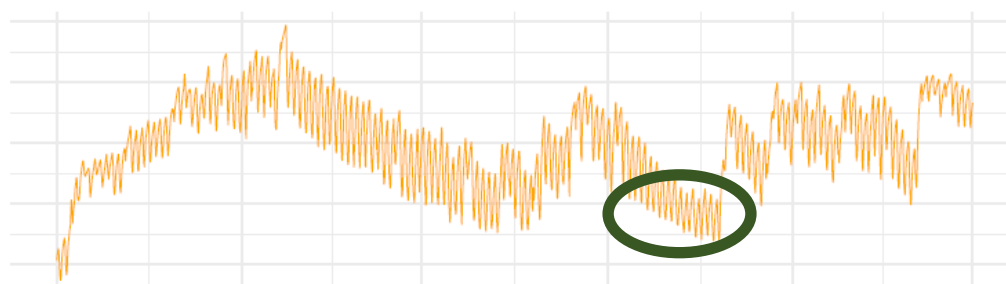
irrigation + VPD reduction



roof



roof + VPD reduction

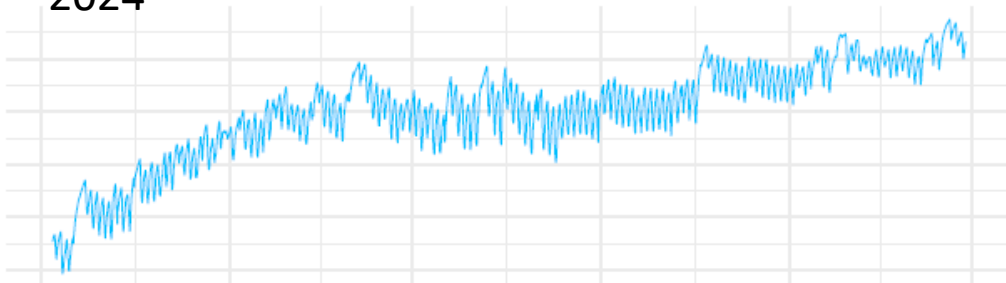


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standardized measurement values

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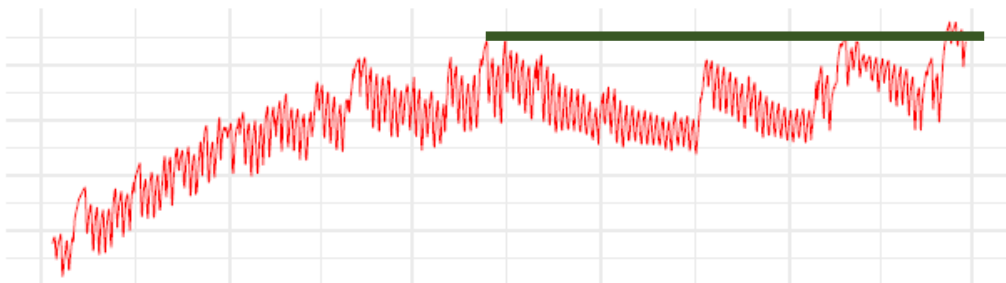
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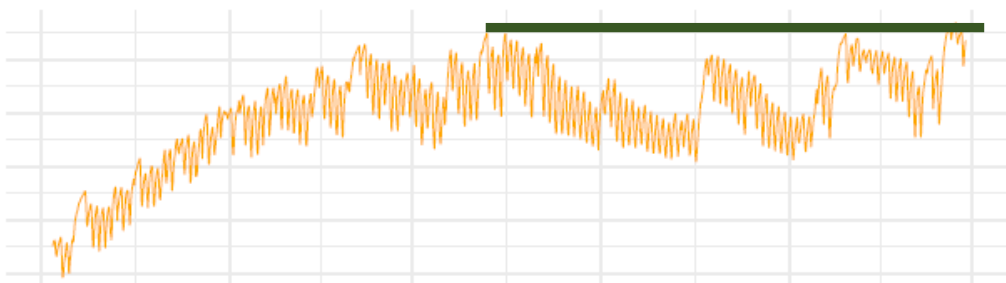
irrigation + VPD reduction



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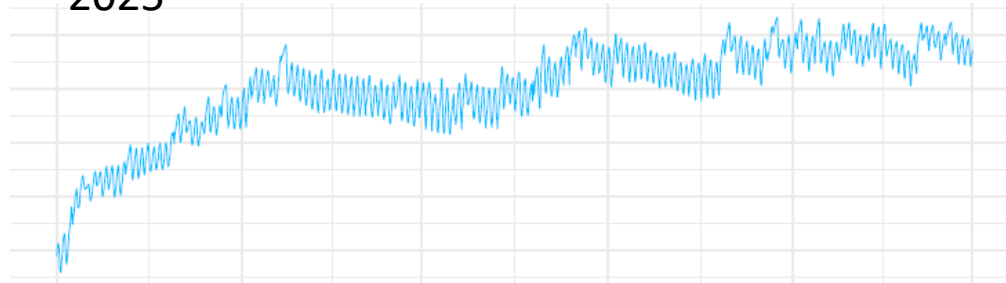
roof + VPD reduction



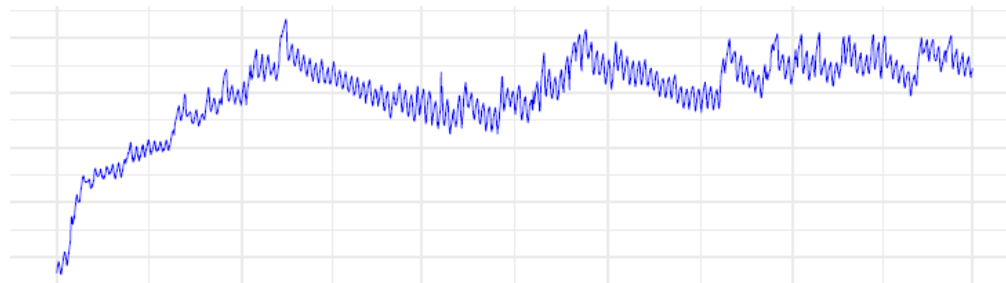
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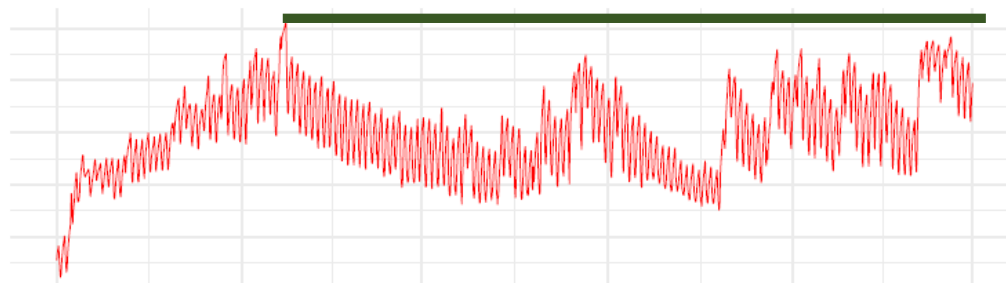
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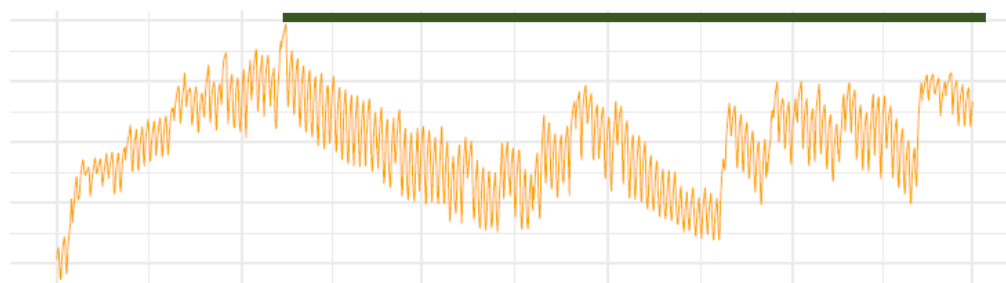
irrigation + VPD reduction



roof



roof + VPD reduction

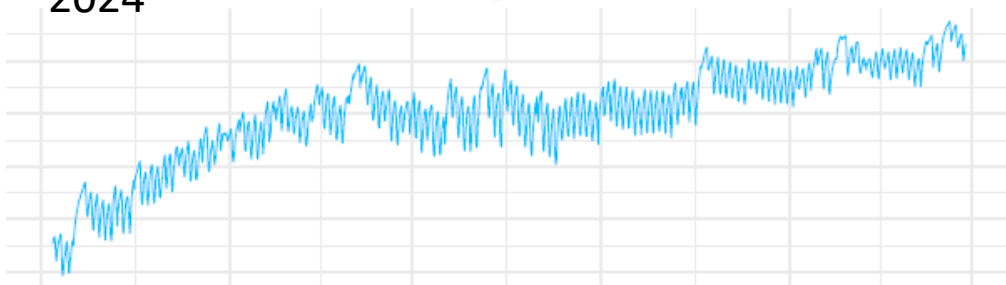


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standardized measurement values

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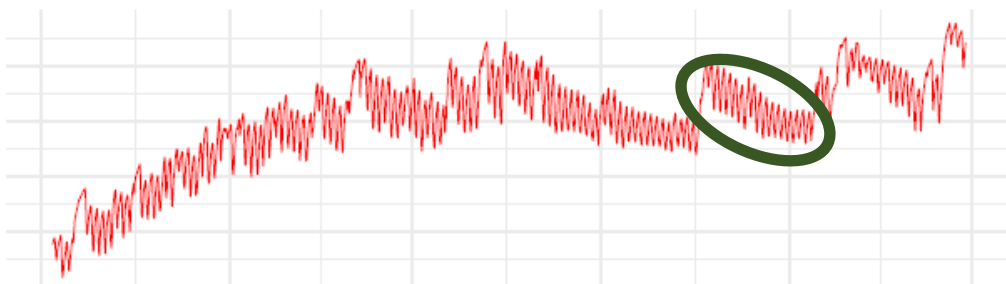
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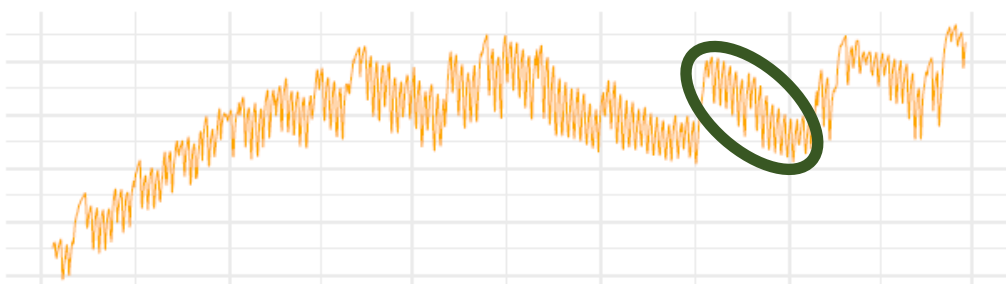
irrigation + VPD reduction



roof



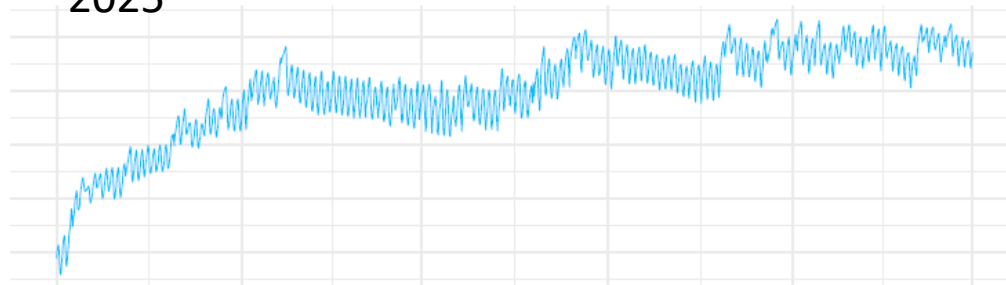
roof + VPD reduction



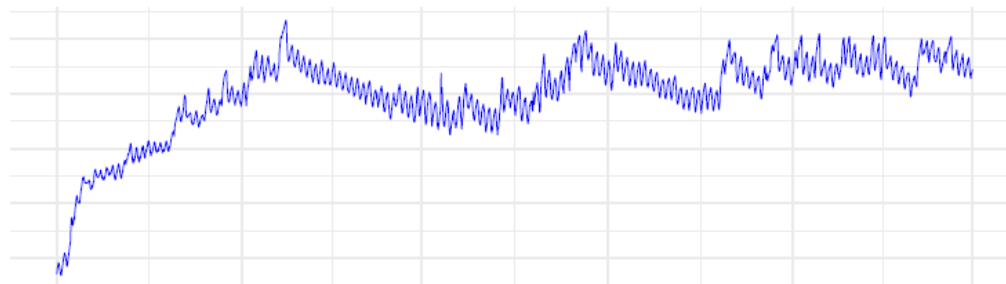
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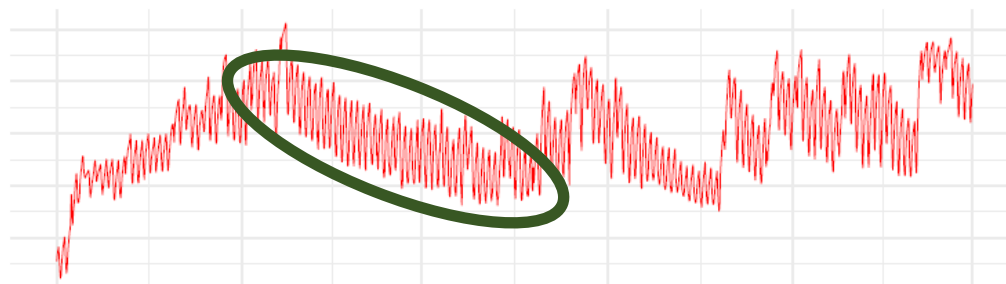
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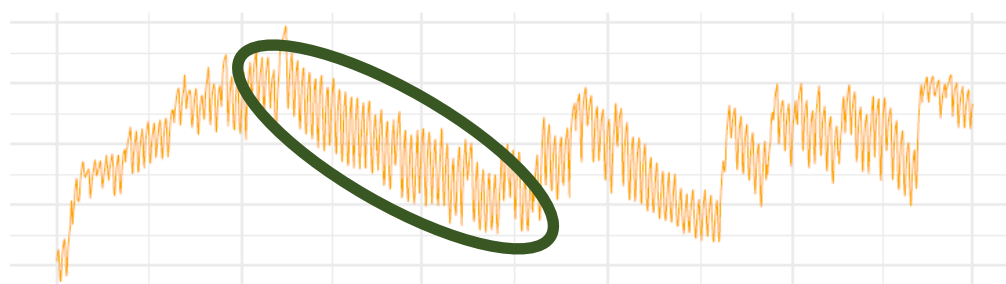
irrigation + VPD reduction



roof



roof + VPD reduction

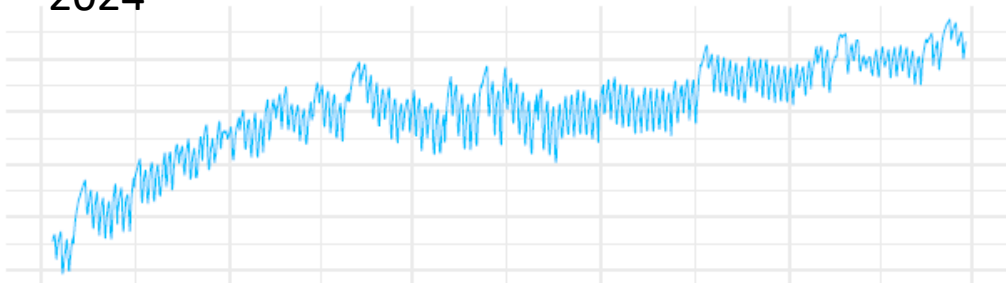


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standardized measurement values

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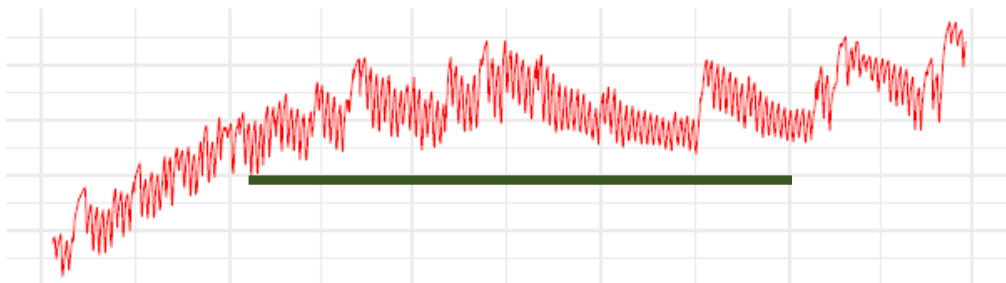
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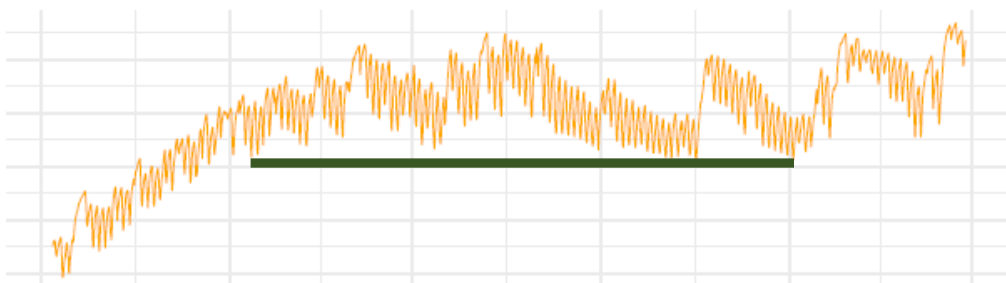
irrigation + VPD reduction



roof



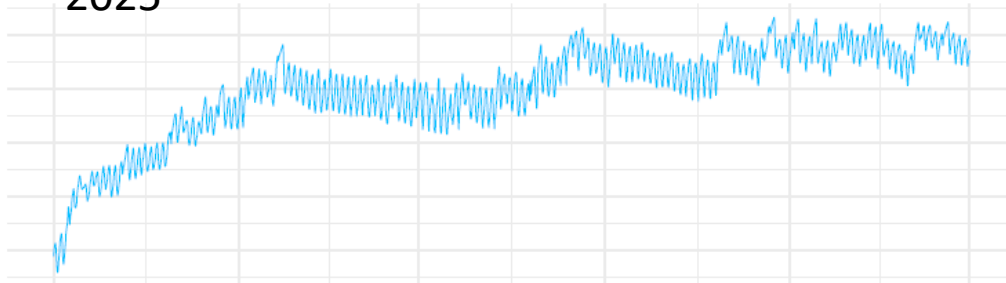
roof + VPD reduction



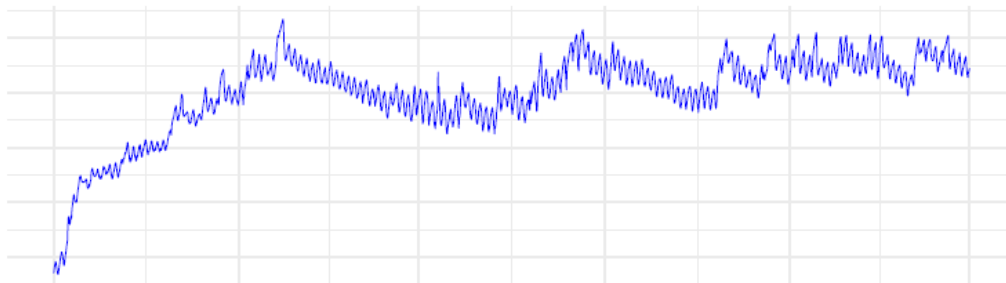
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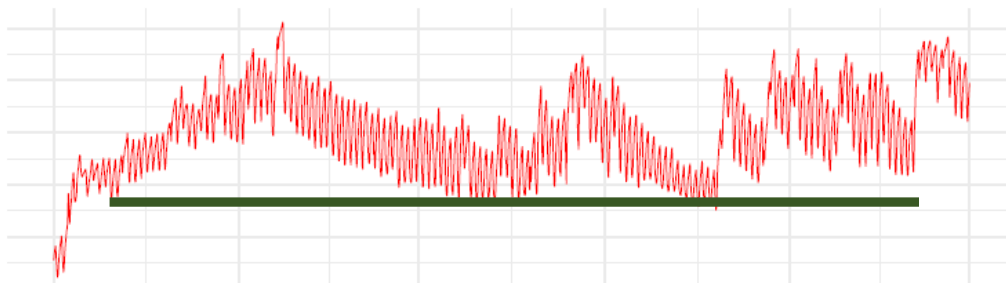
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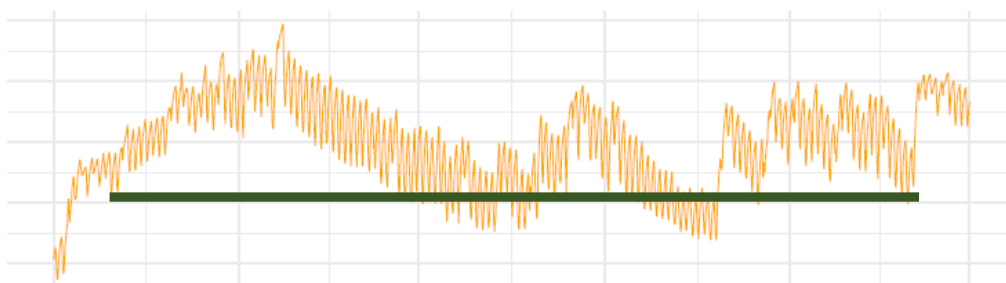
irrigation + VPD reduction



roof



roof + VPD reduction

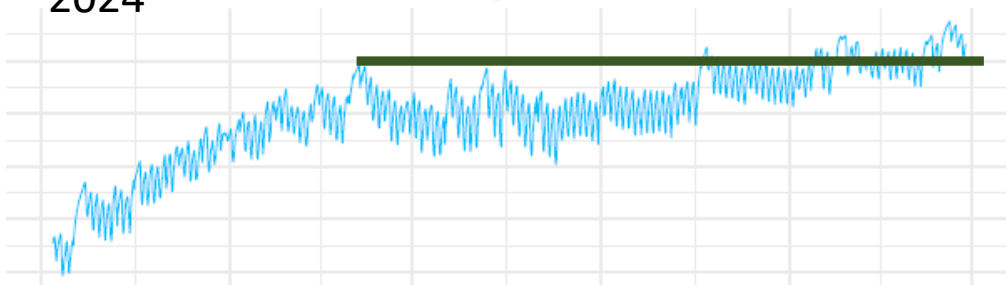


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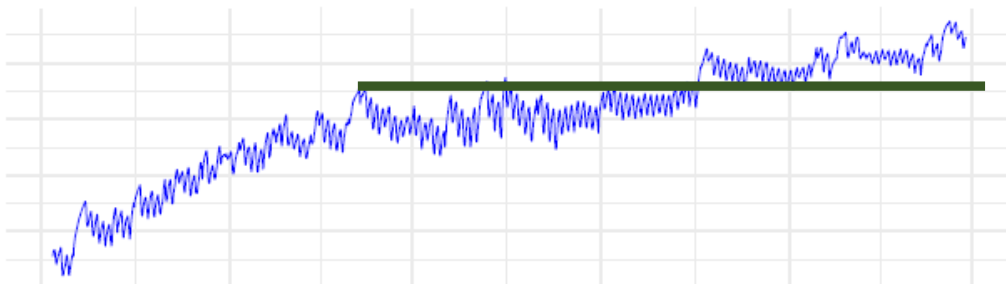
standardized measurement values

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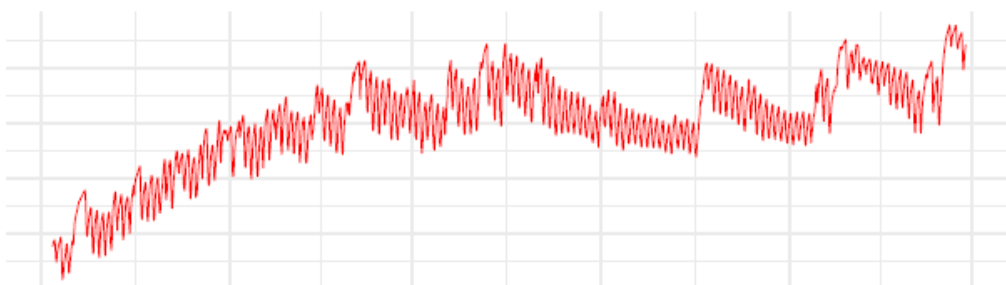
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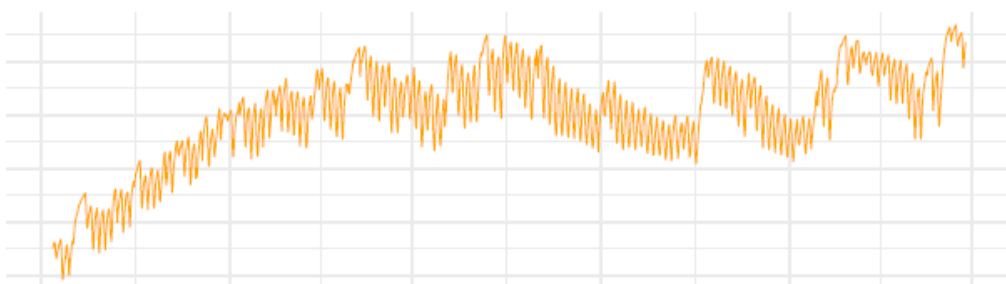
irrigation + VPD reduction



roof



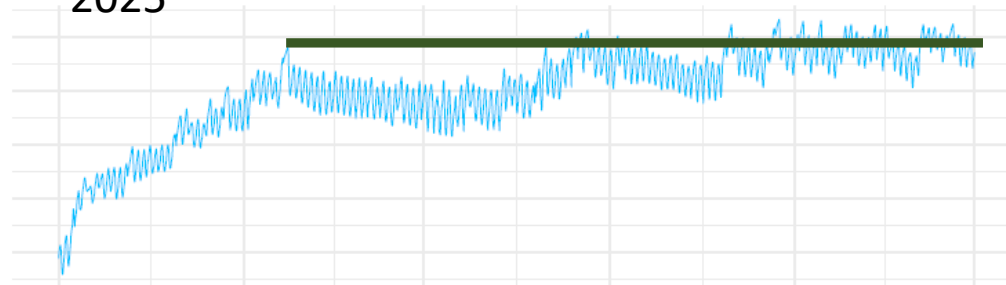
roof + VPD reduction



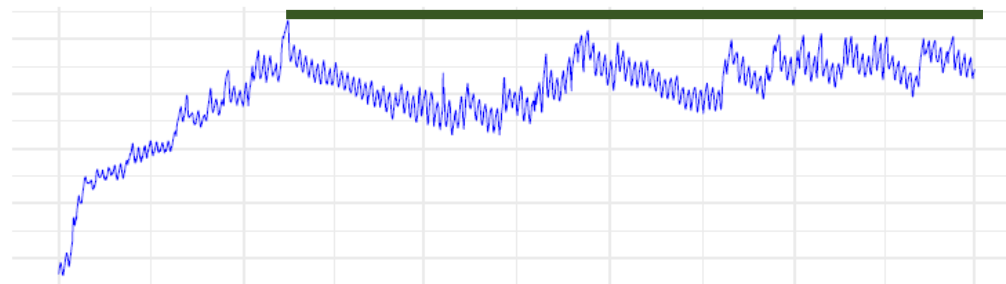
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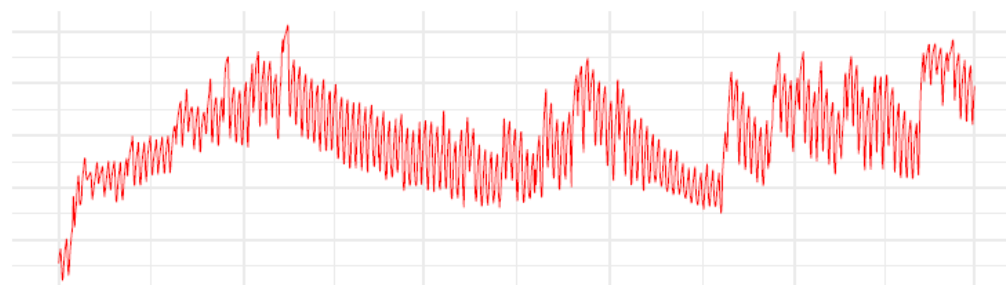
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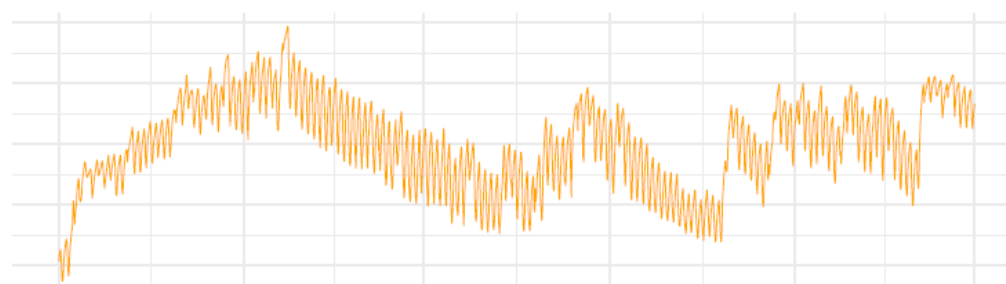
irrigation + VPD reduction



roof



roof + VPD reduction

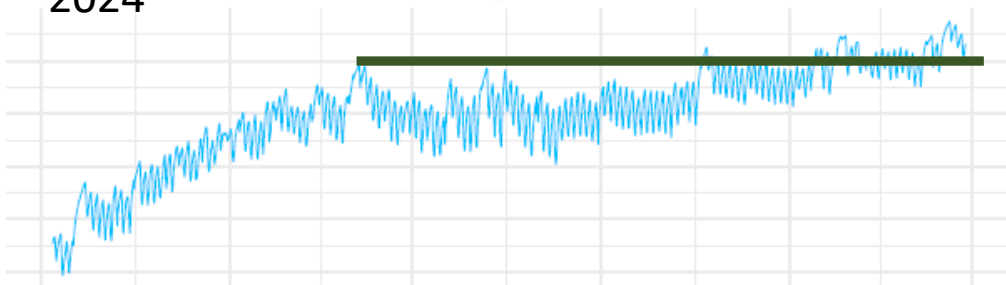


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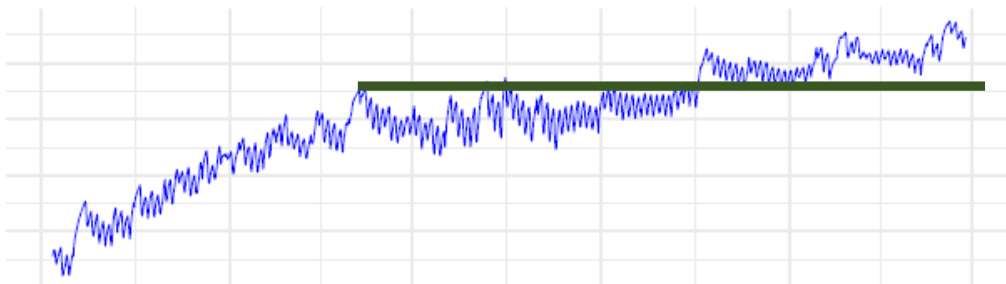
standardized measurement values

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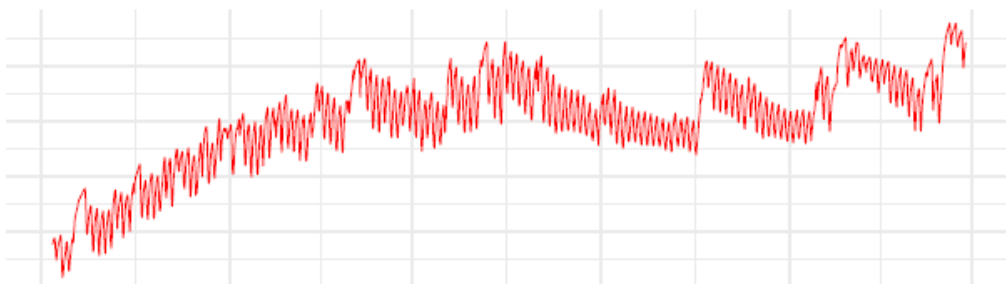
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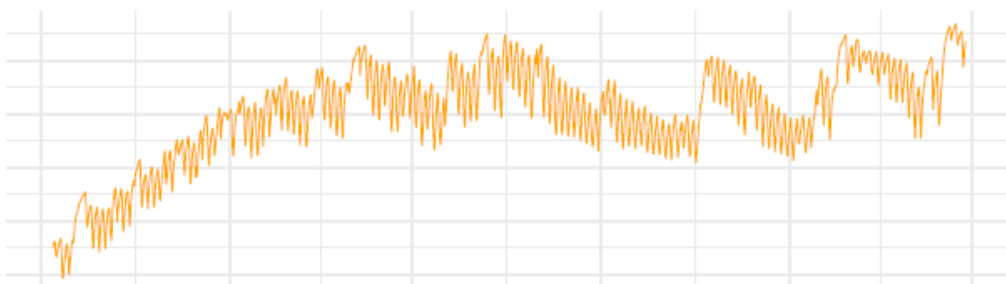
irrigation + VPD reduction



roof



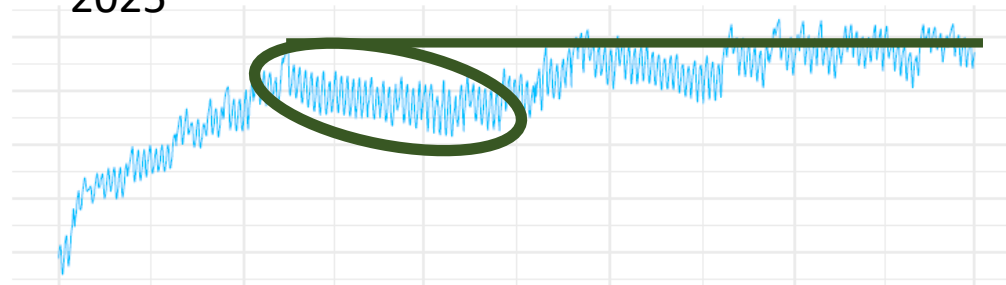
roof + VPD reduction



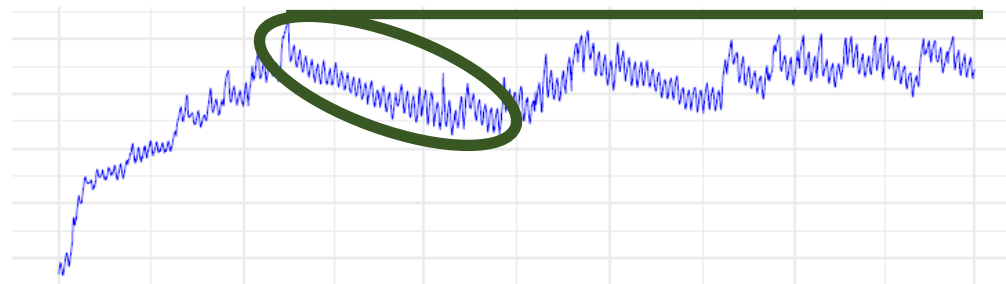
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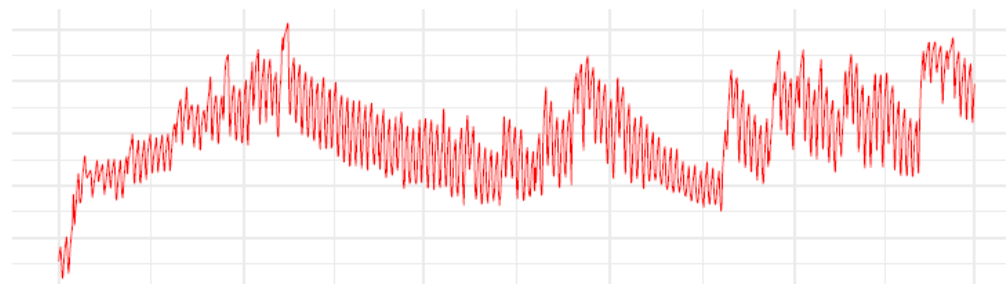
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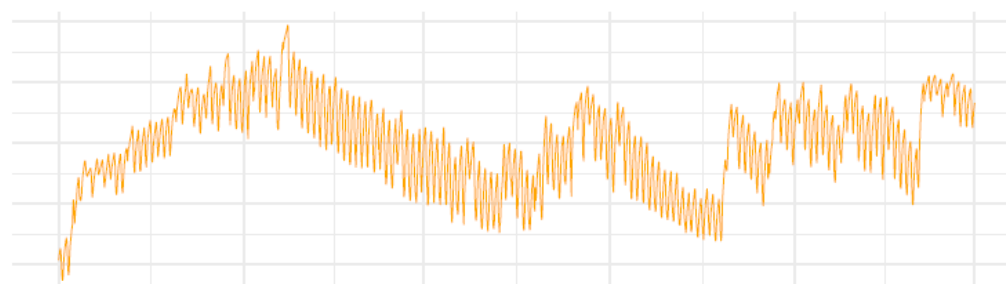
irrigation + VPD reduction



roof

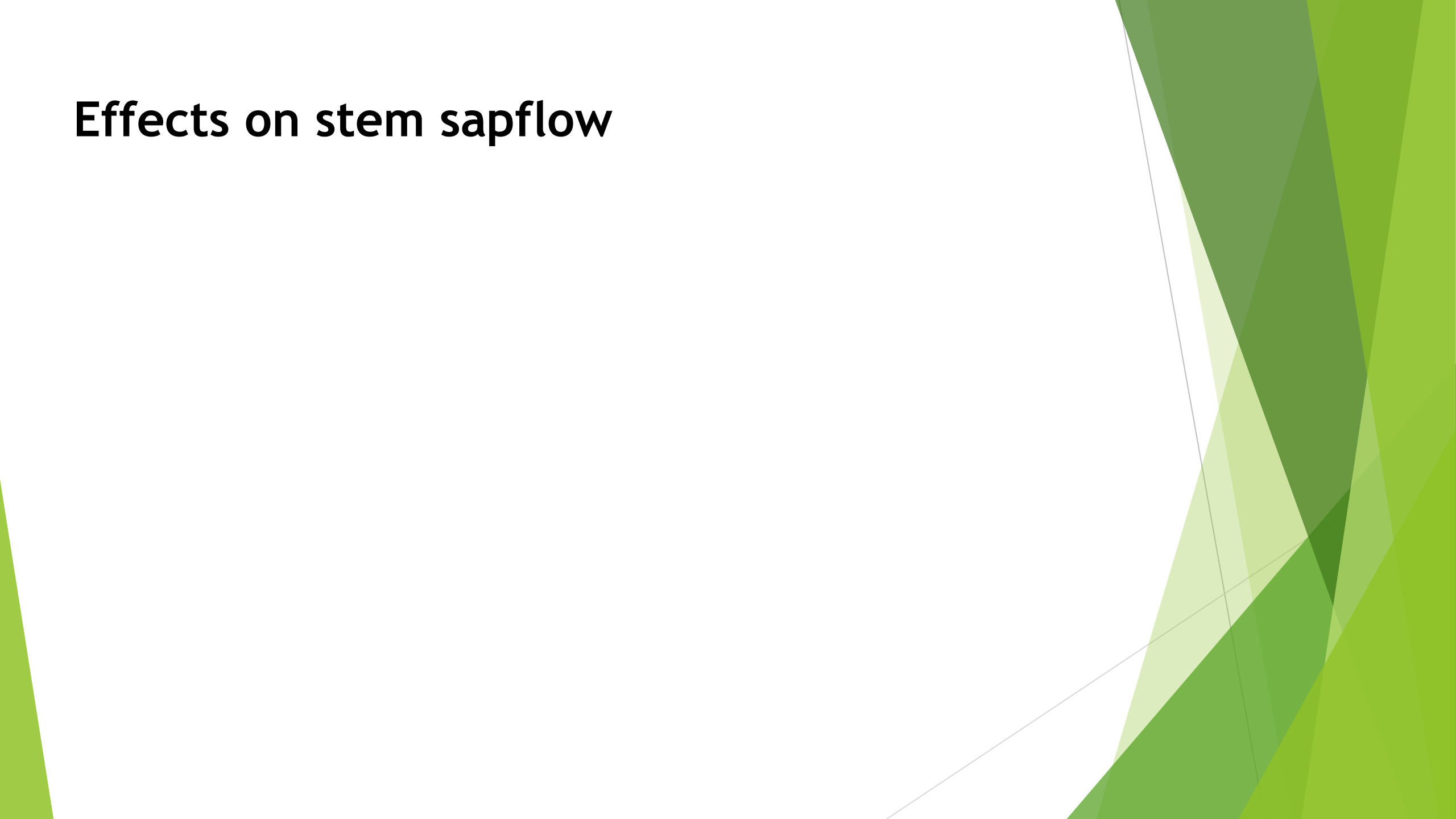


roof + VPD reduction



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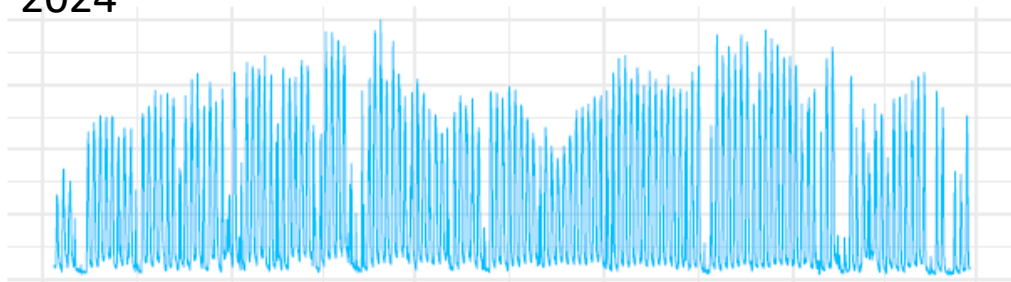
Effects on stem sapflow



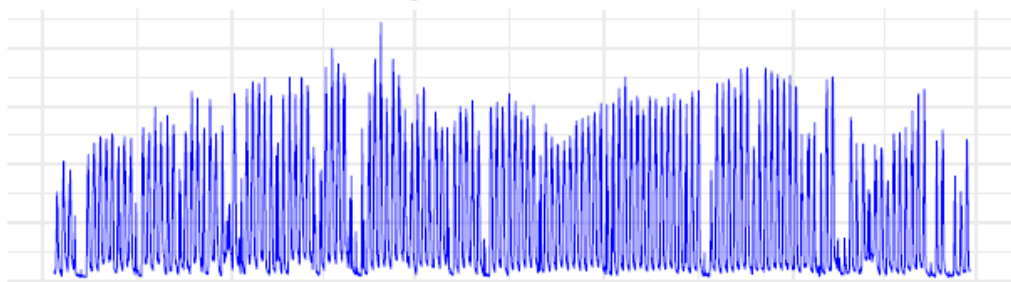
standardized measurement values

2024

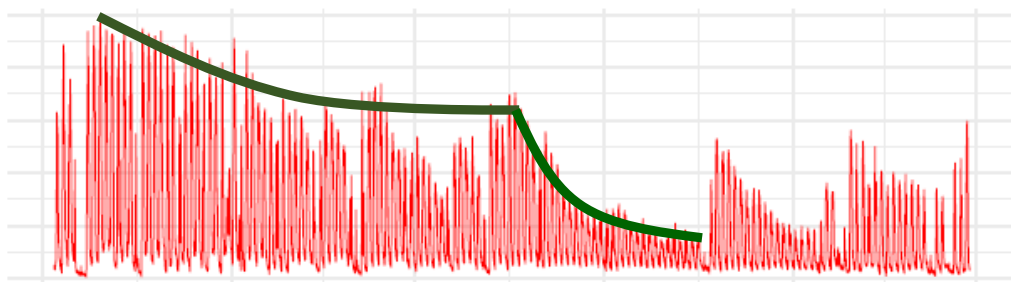
irrigation



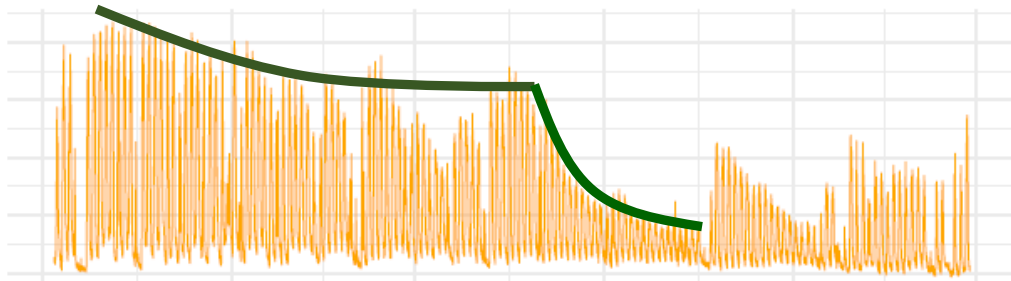
irrigation + VPD reduction



roof



roof + VPD reduction



Mai

Jun

Jul

Aug

Sep

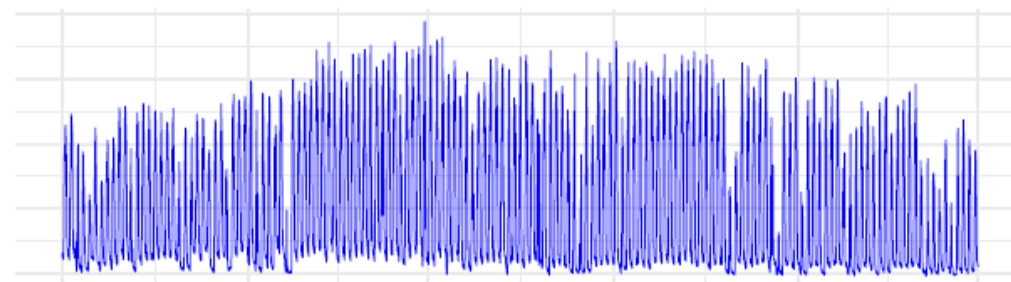
Okt

2025

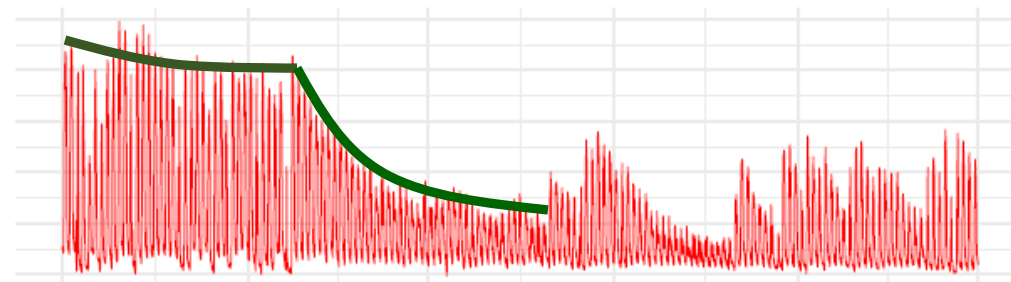
irrigation



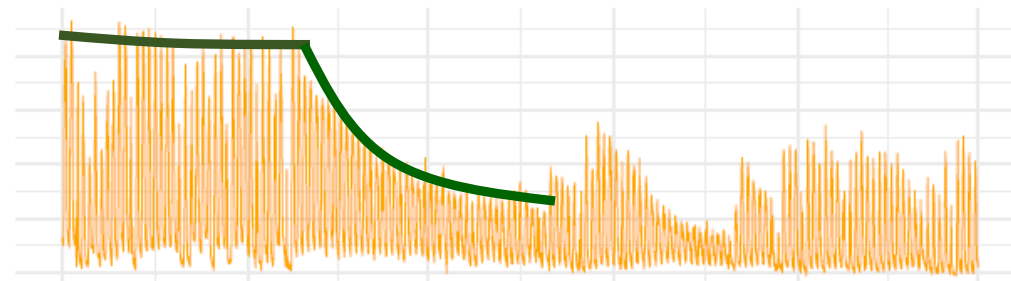
irrigation + VPD reduction



roof



roof + VPD reduction



Mai

Jun

Jul

Aug

Sep

Okt

Preliminary conclusions

Roof treatments (low soil water availability)

- Trees exposed to high VPD show a conservative water regulation strategy
- Trees exposed to reduced VPD seem to have higher transpiration rate
 - Faster depletion of water resources
 - Higher water stress in second half of the season

Preliminary conclusions

Irrigation treatments (high soil water availability)

- No obvious difference in water regulation strategies of trees by different VPDs
- Trees profit of reduced VPD in second half of the season
- Same effect of reduced VPD as for roof treatments

in 2024
in 2025

Preliminary conclusions

- Weather conditions and the occurrence and sequence of certain conditions/events have a major impact
- Important thresholds and non-linear processes involved

The interpretation is a challenge - it remains exciting!

