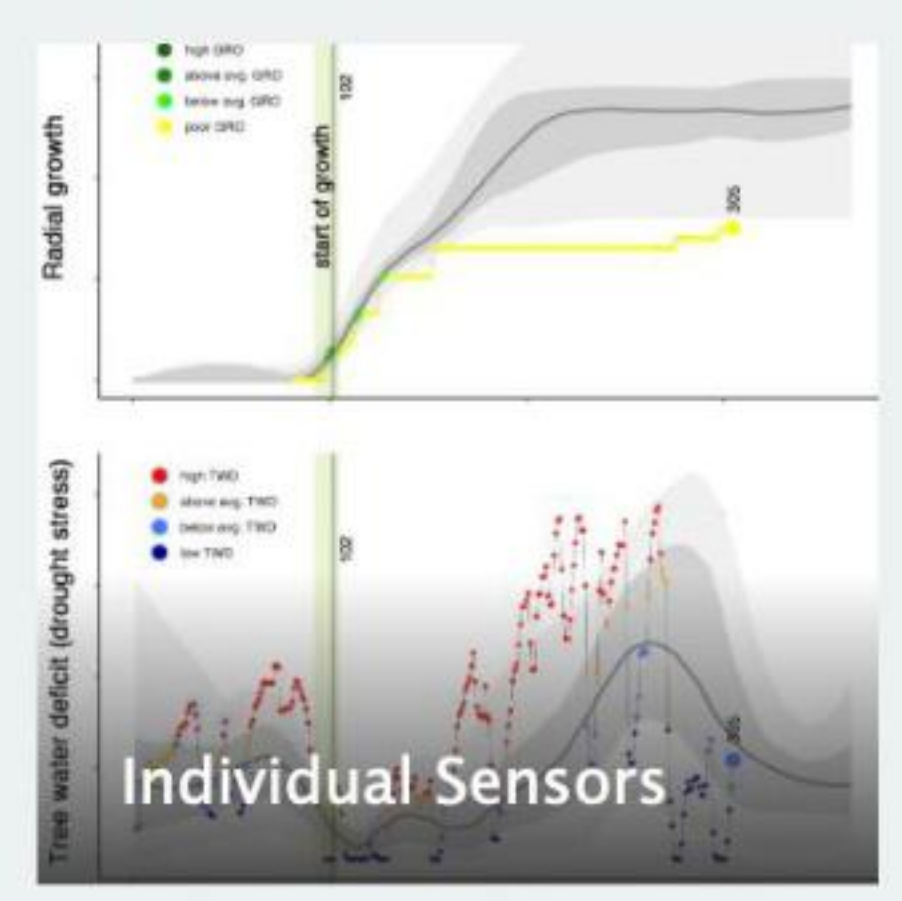
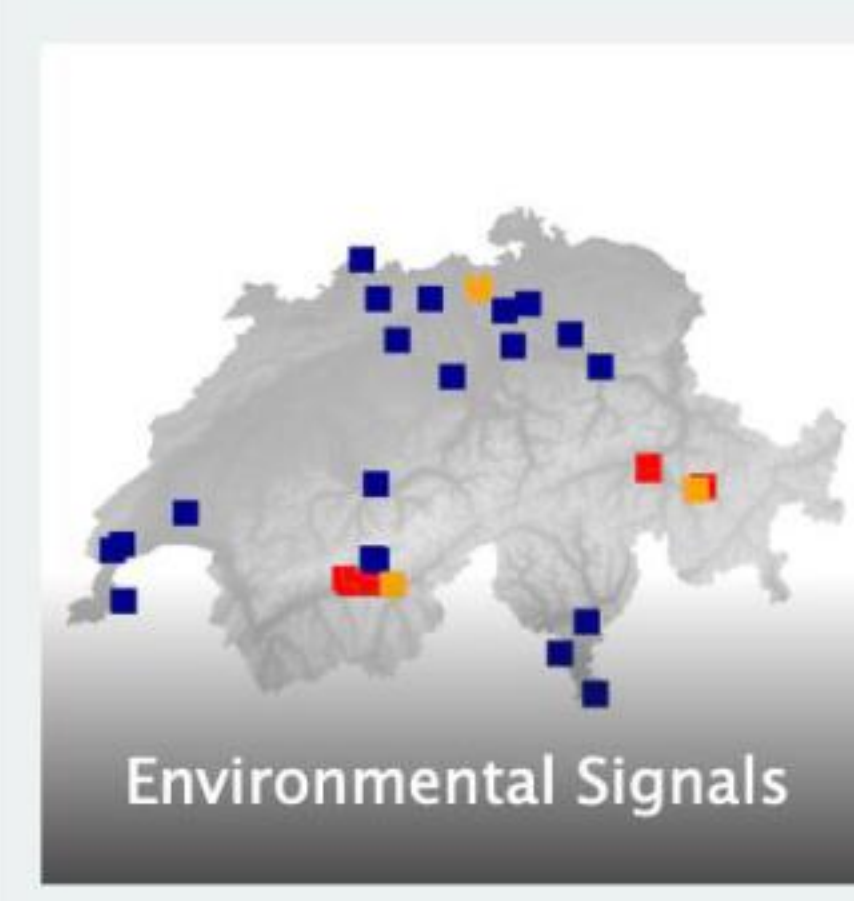
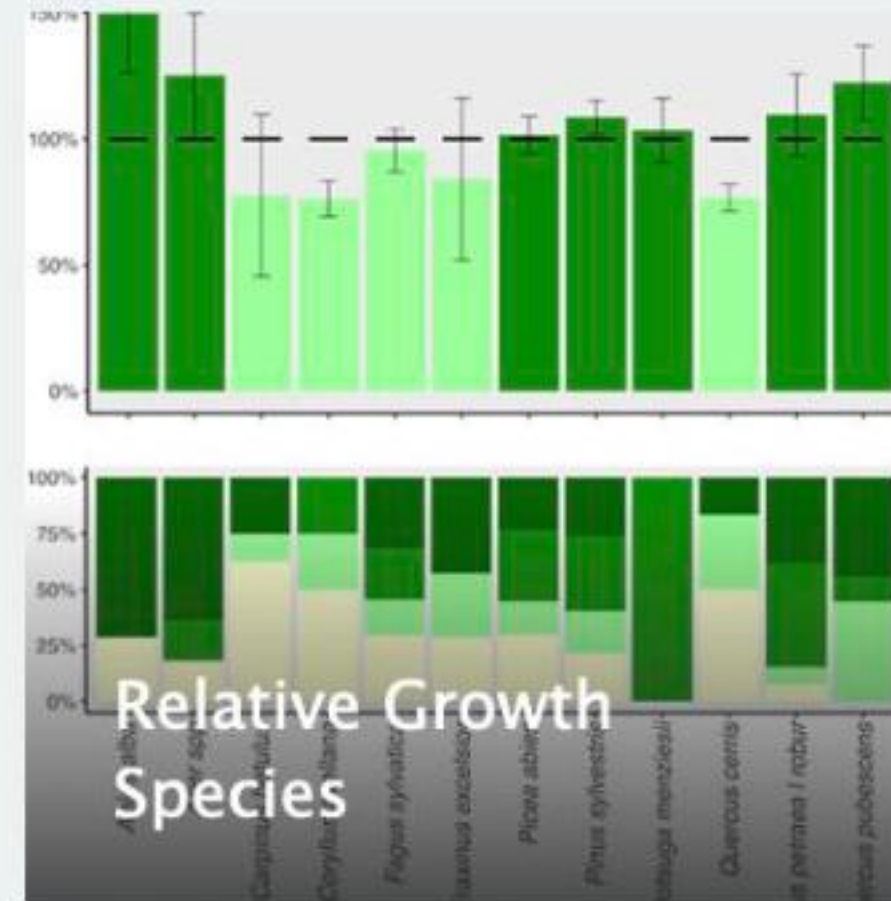
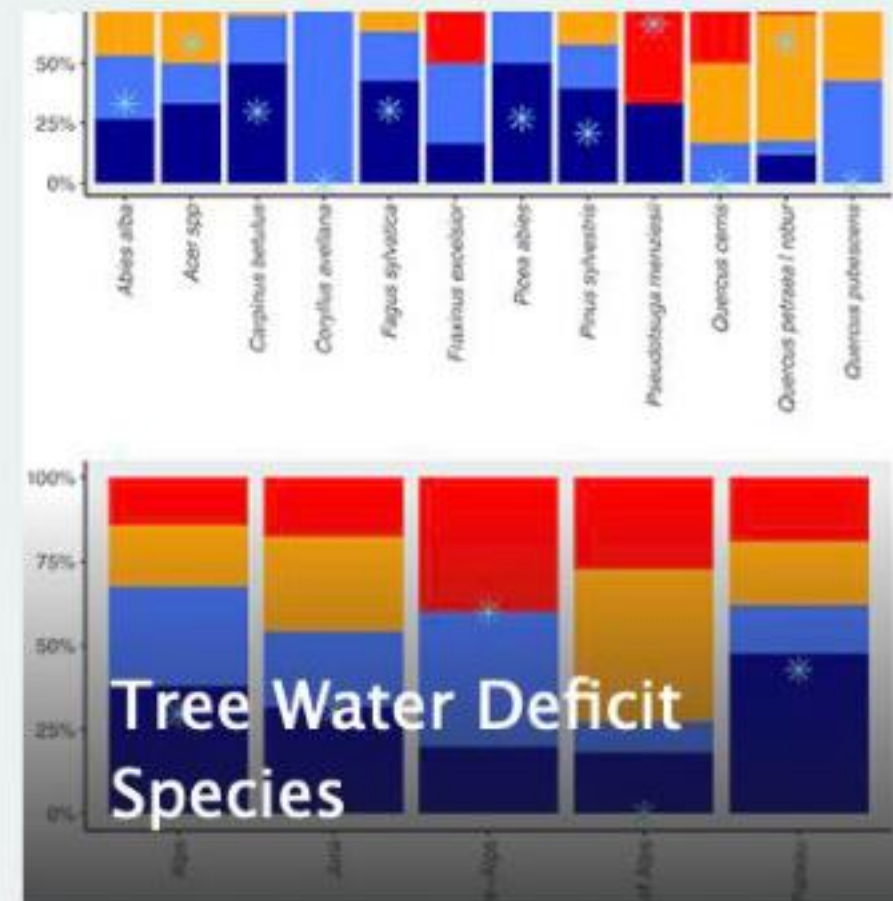
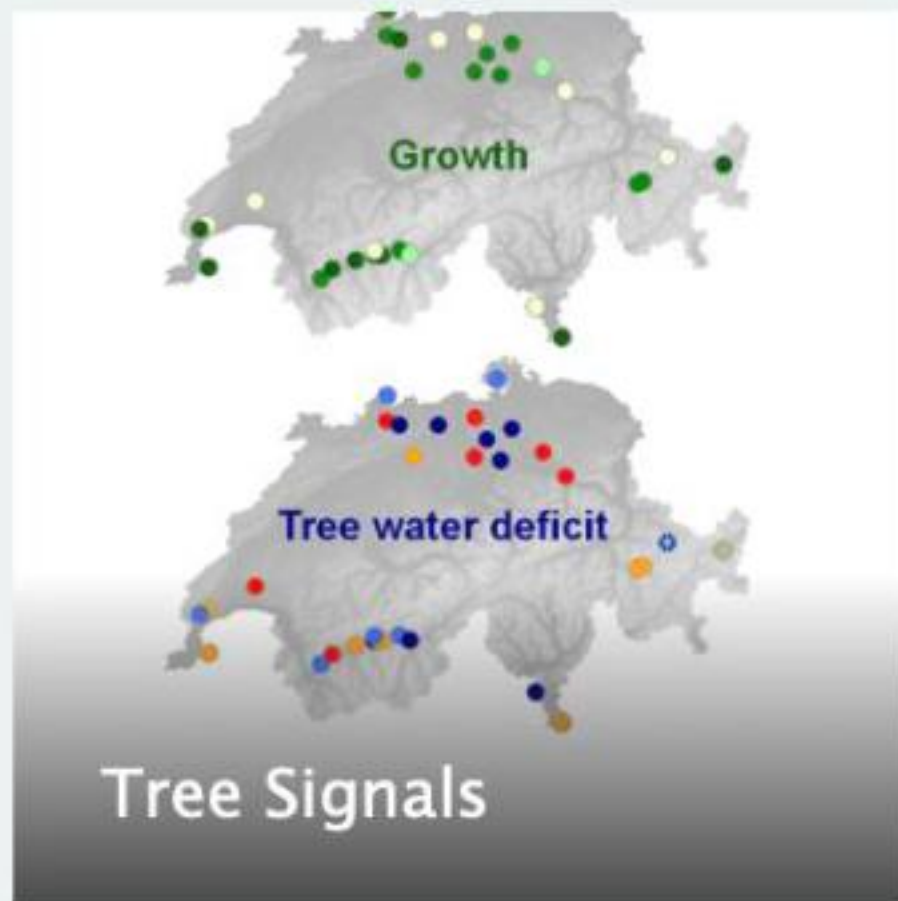


Fore[st]cast – Nowcast and predict forest condition

Data Science Projects for the Large-Scale Infrastructures (2024-2026)



Roman Zweifel, Mirko Lukovic, Micah Wilhelm, Jan Svoboda, Volodymyr Trotsiuk, Katrin Meusburger, Arthur Gessler (WSL)
William Aeberhard, Mathieu Salzmann & Michele Volpi (SDSC)



SDSC Oerlikon
10 July 2025



SDSC Call 2023

Swiss Data Science Center

*Call for Data Science projects for the Large Scale Infrastructures
(2023)*

Fore[st]cast – Nowcast and predict forest condition

Authors: Roman Zweifel, Mirko Lukovic, Katrin Meusburger, Arthur Gessler

*Collaborators: William Aeberhard (SDSC),
Mirko Lukovic (SDSC/FORWARDS, EU-Project)
Jan Svoboda (UPSCALE, Sinergia, SNF)
Micah Wilhelm (TreeNet)*

Kickoff, July 2024

Annual Meeting, July 2025

Project end, June 2026

SDSC Call 2023

Swiss Data Science Center

*Call for Data Science projects for the Large Scale Infrastructures
(2023)*

Fore[st]cast – Nowcast and predict forest condition

... We propose here a further step toward near real-time assessment of the condition of our forests. Our goal is to further develop a platform that reports on the current and predicted condition of trees in relation to environmental variables. ...

... With the TreeNet network we have developed a monitoring system that measures the responses of trees to their environment in near real-time and fully automatically. ...

... What we still lack is the prediction of growth and tree water deficits from days to seasons on continuous spatial scales to take full advantage of the infrastructure. ...

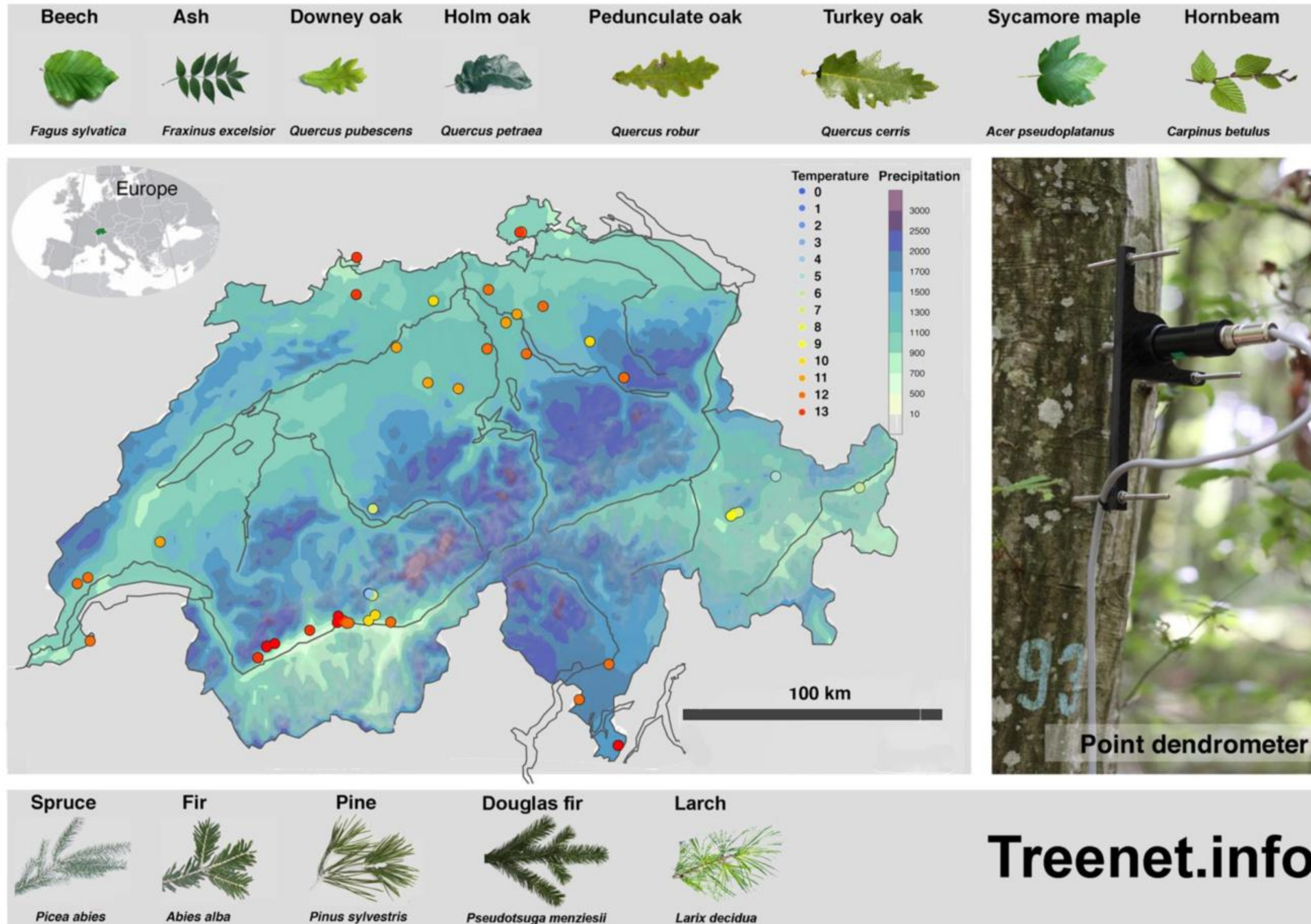
Kickoff, July 2024

Annual Meeting, July 2025

Project end, June 2026

The measurement infrastructure

TreeNet – The biological drought and growth indicator network



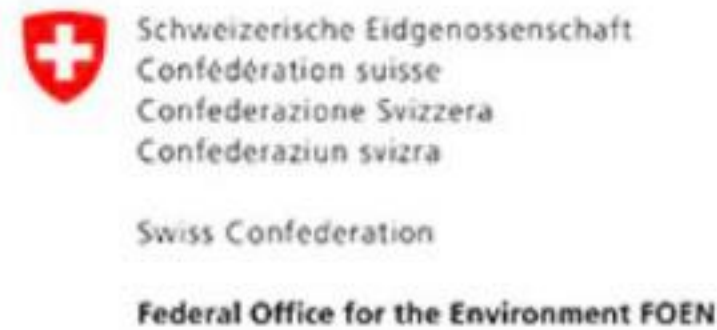
- > 600 trees with dendrometers
- 24 tree species
- 650 sensors in air and soil
- > 60 sites across CH
- Fully automated system
- LoRaWAN
- Central data processing
- > 150 Mio data points
- 320 GB data
- nowcasting

In near real-time!

**TreeNet links existing
infrastructure of forest
monitoring in Switzerland**

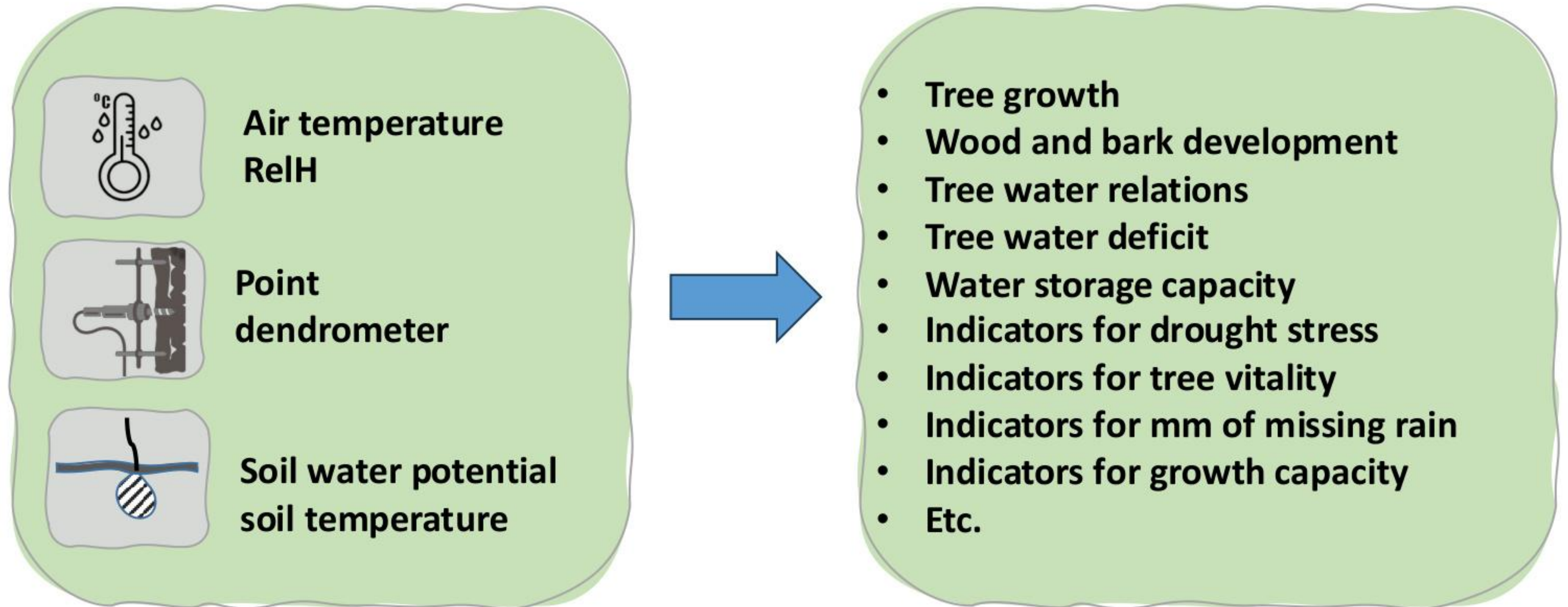
Treenet.info

TreeNet-CH is a collaboration of





TreeNet-CH measures and processes





Point dendrometers (Natkon) ...

... a method to monitor radial stem growth
and tree water relations

LORA WAN Decentlab GmbH, Dübendorf

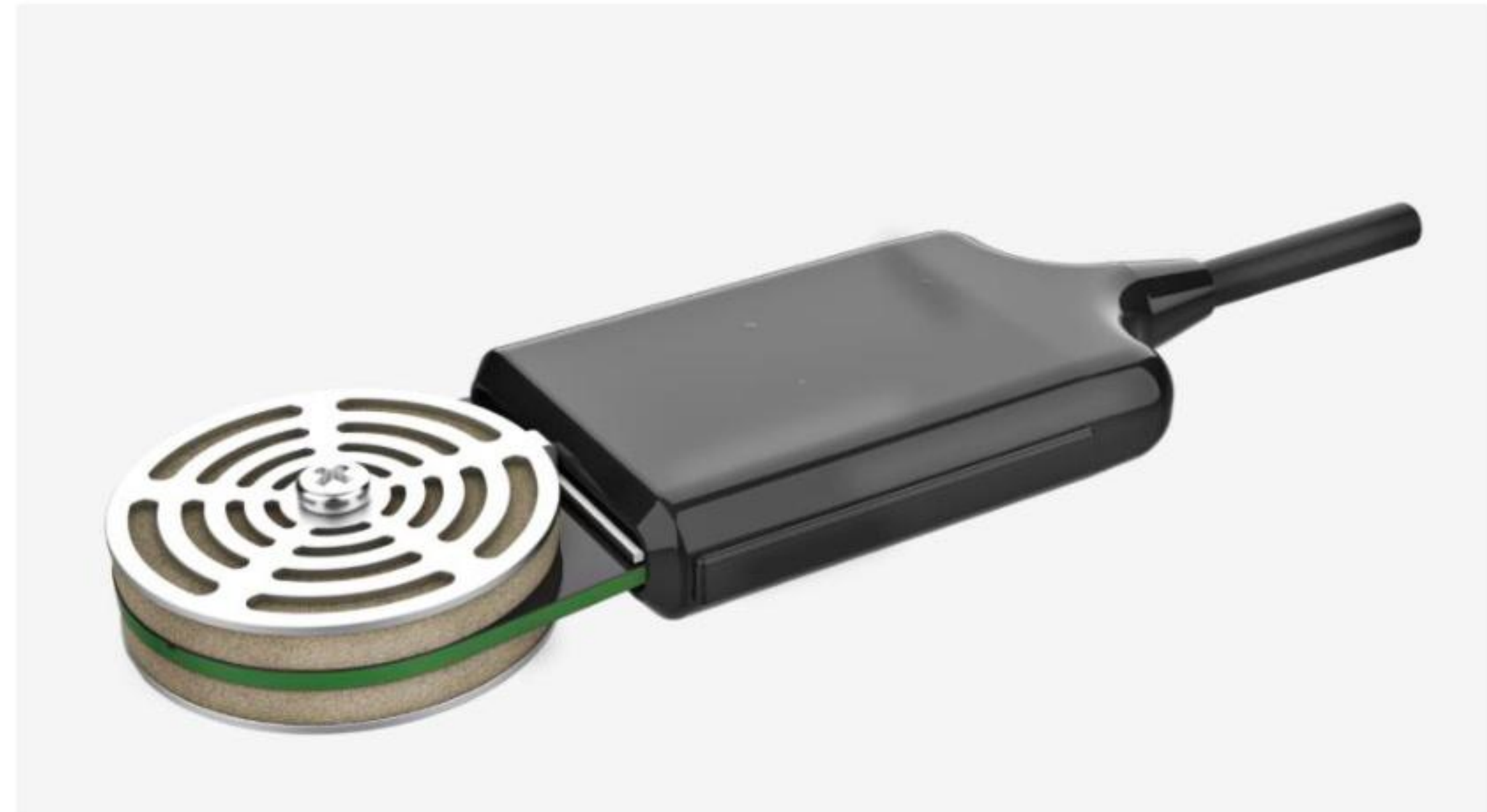


Automated, standardized LINKING METHODS for TreeNet

Air Temp/RelH (Sensirion/Decentlab)

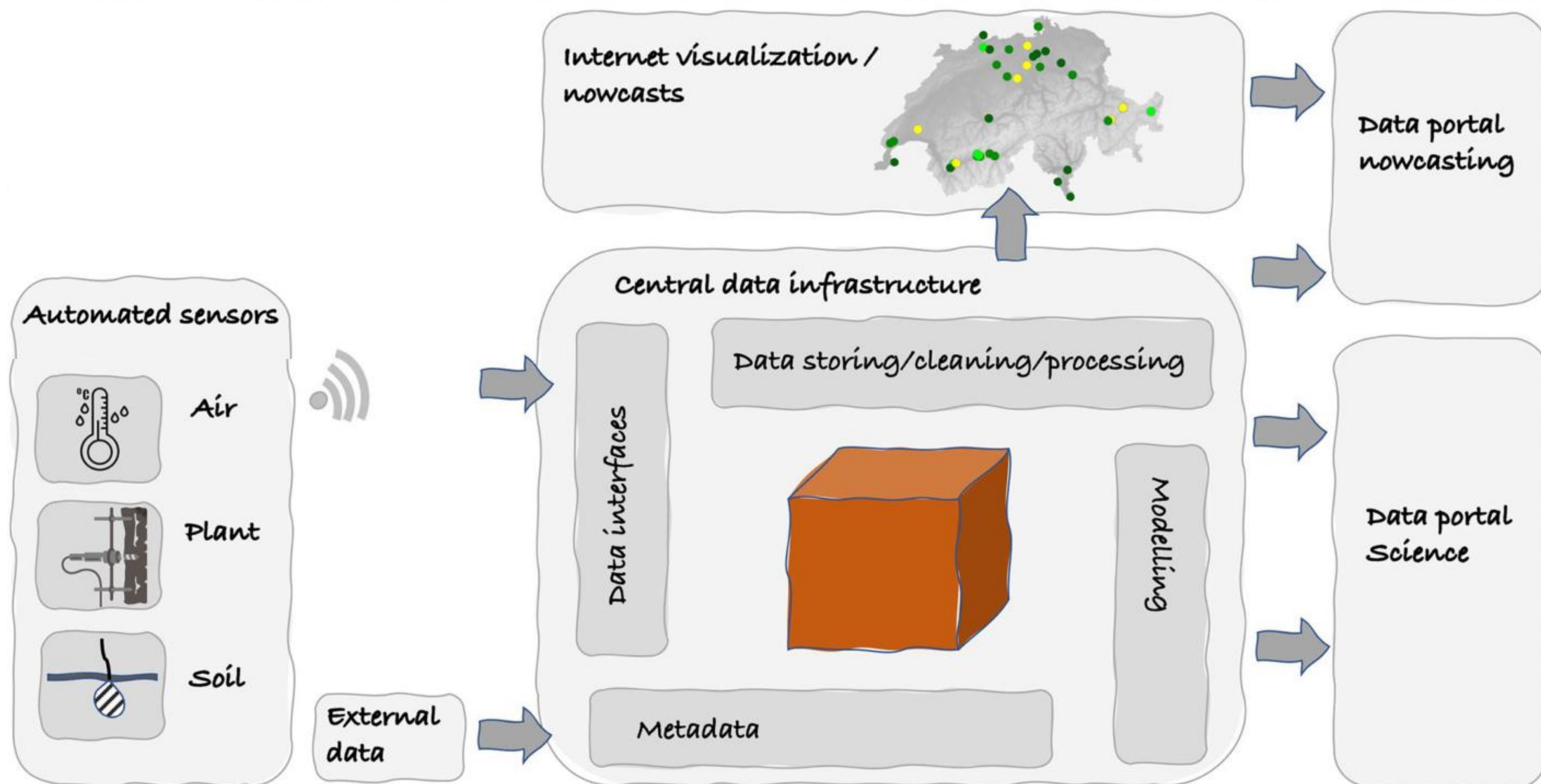


Soil water potential/temp sensor (TEROS-21, Meter Group)

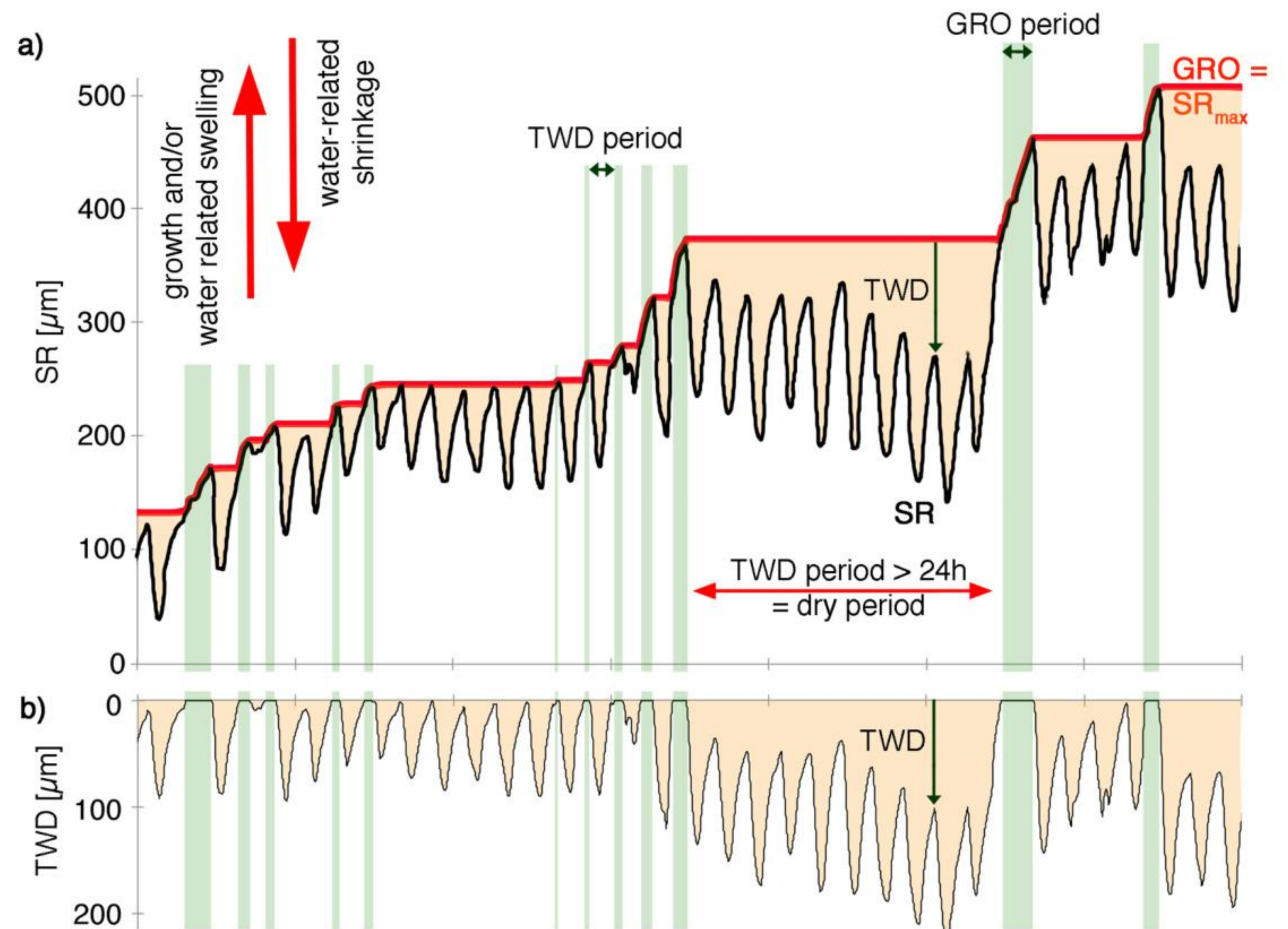


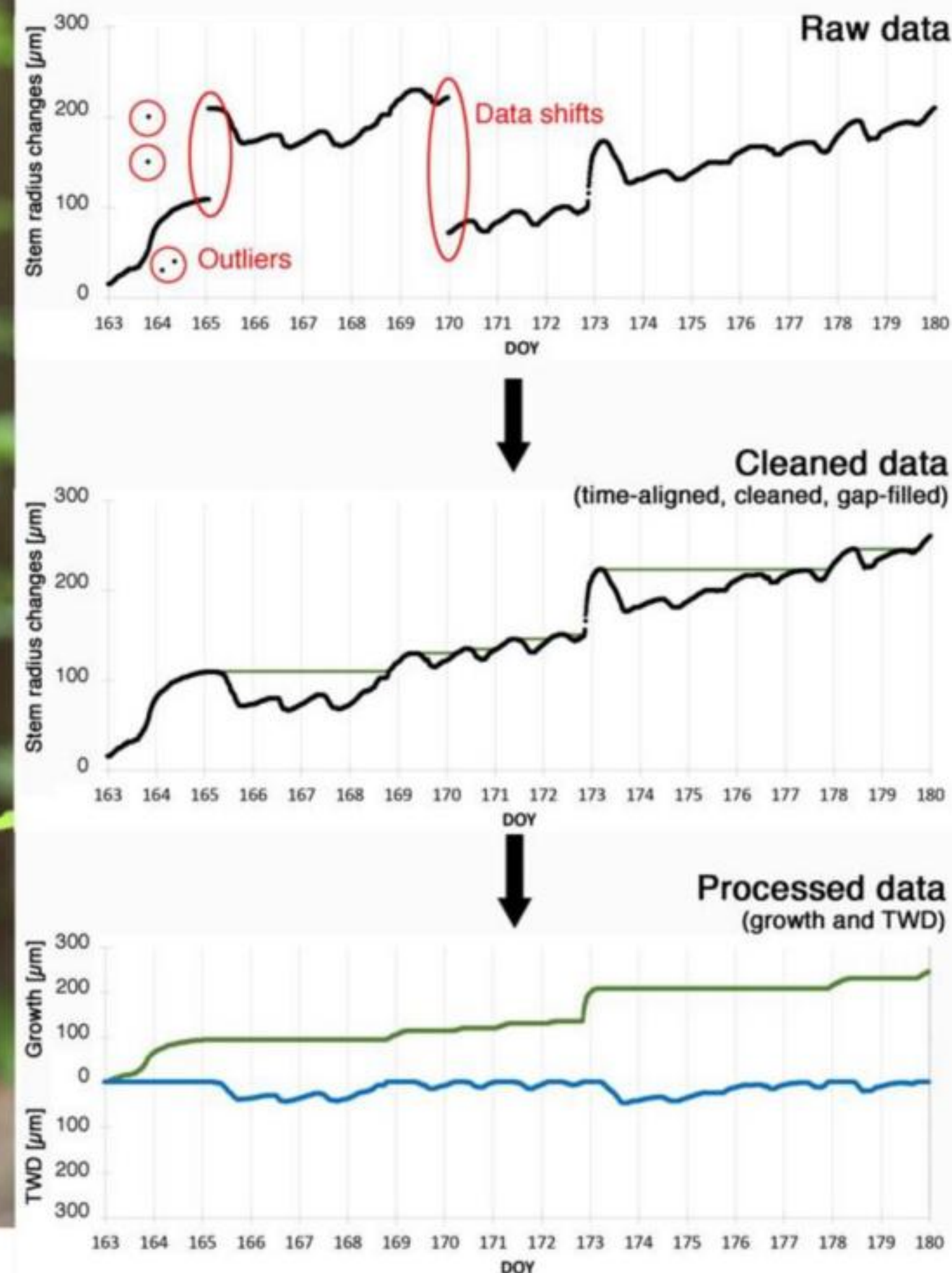
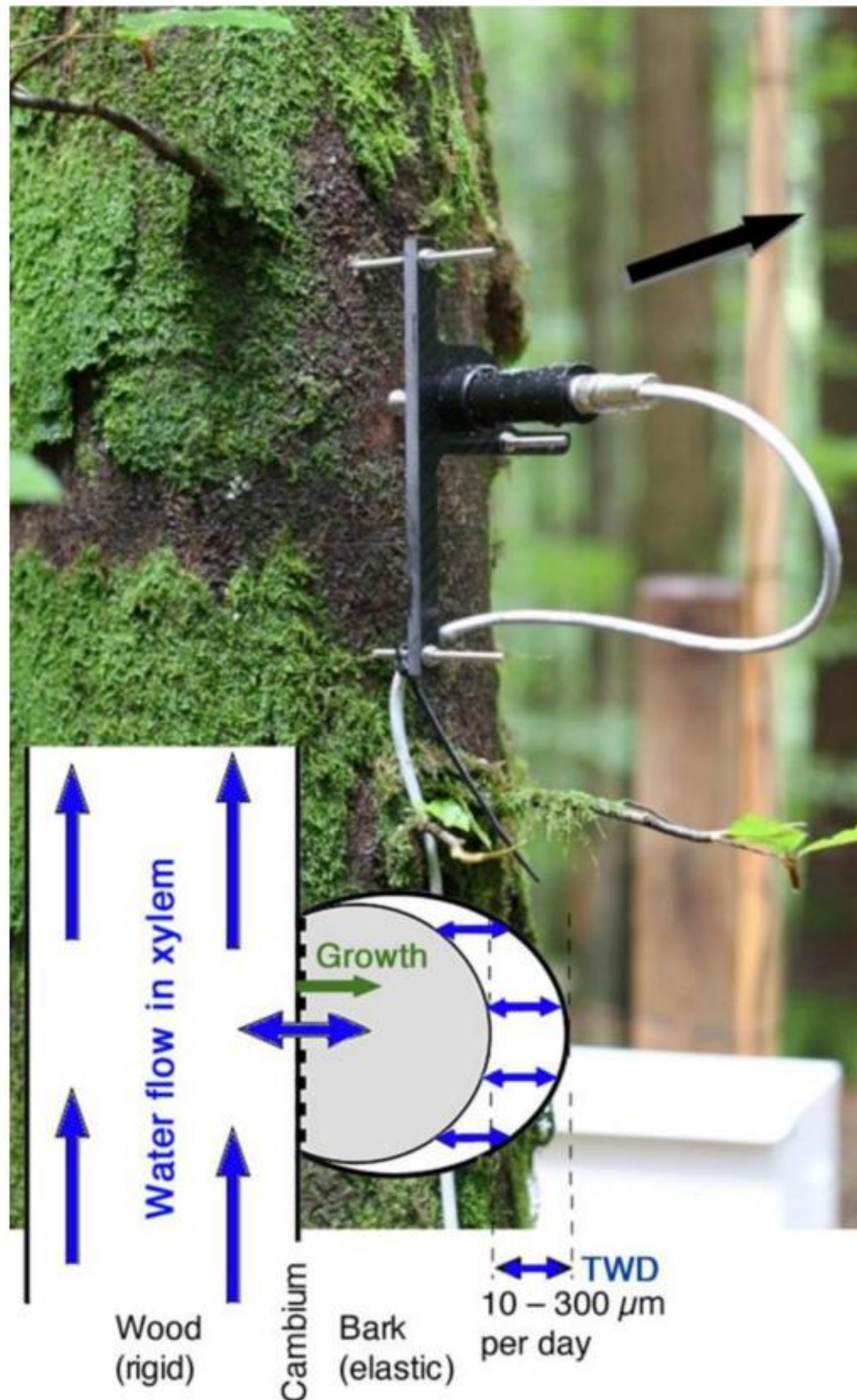


Data flow from sensors in the field to users



The Data





- Measuring stem radius fluctuations
- μm resolution
- Temp and humidity in air and soil

- **Tree stem shrinks during the day**
(more transpiration than water uptake from the soil)

- **Expansion of the tree stems at night**
(replenishment and new cells)

- Irreversible increment -> **Growth (GRO)**
- Reversible changes – **Tree water deficit (TWD)**

- **Indicator for growth performance**
- **Indicator for drought stress**

The Fore(st)cast tasks



Summary State of the Art TreeNet (project start)

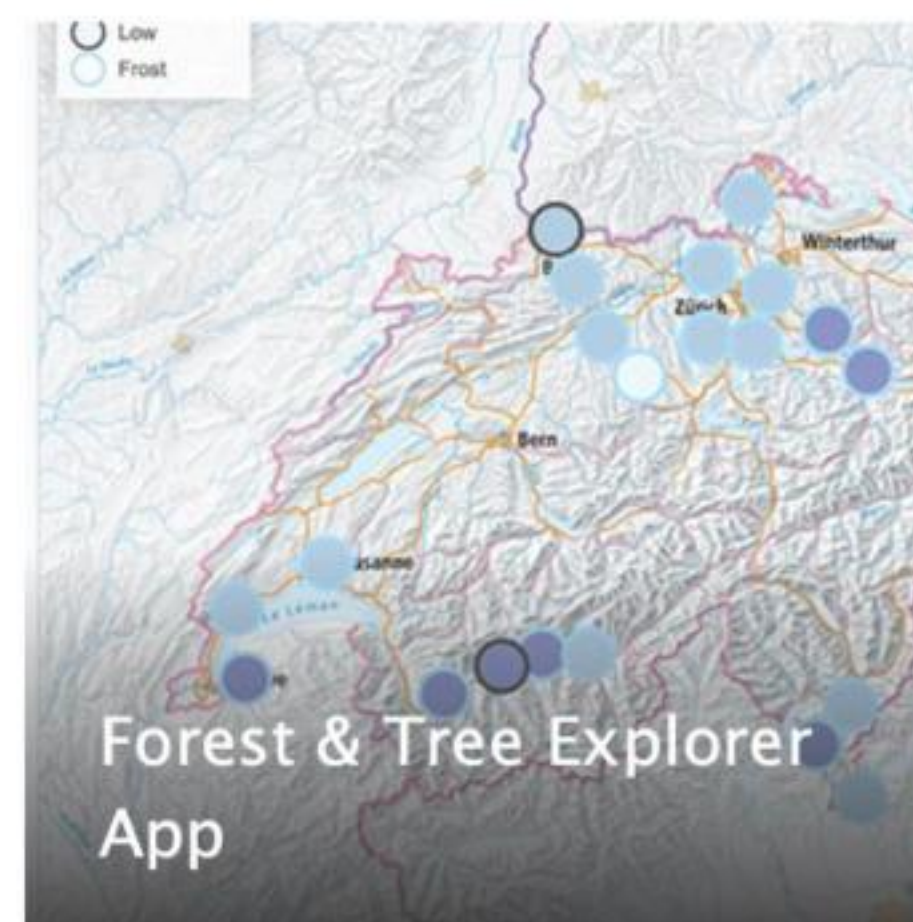
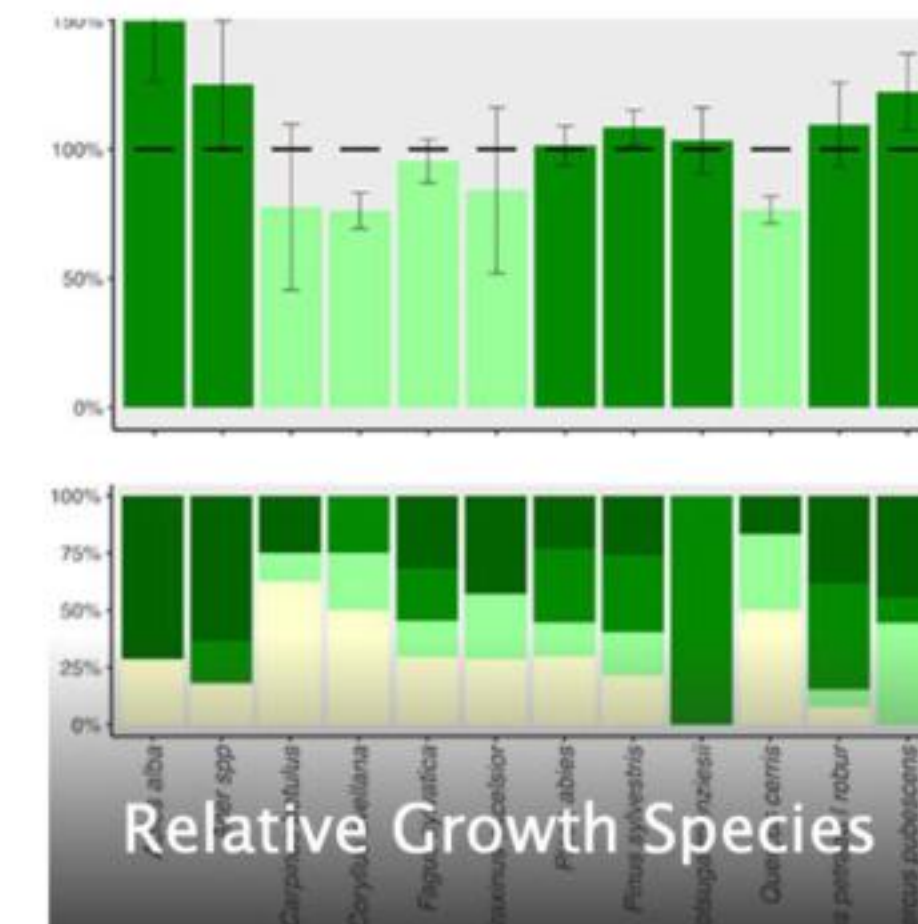
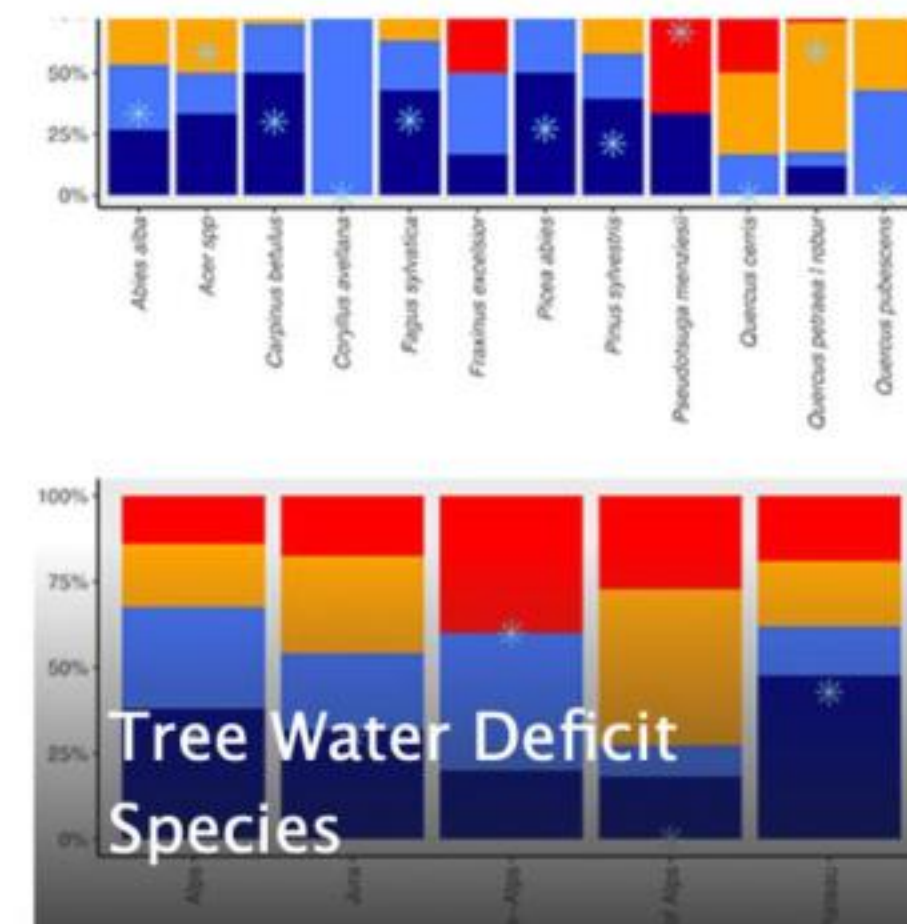
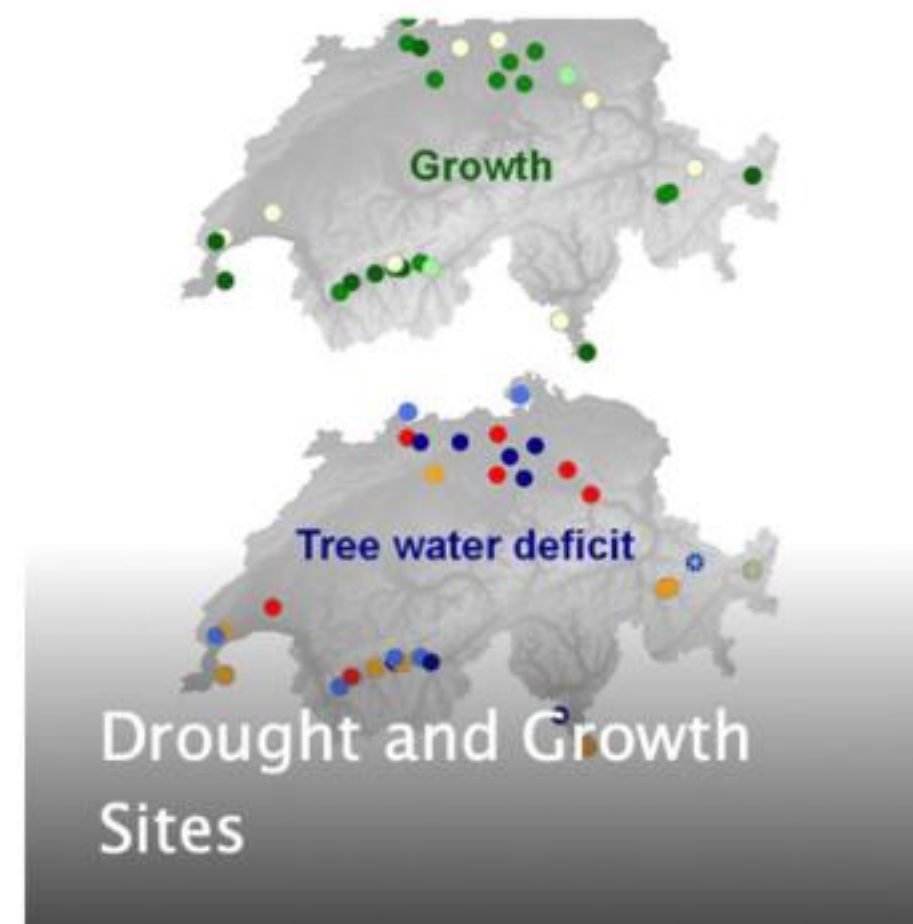
- Established measurements system
- Established data transmission into central data server (10 Min)
- Automated processing (anomaly detection, cleaning)
- Linear gap-filling of short gaps
- Nowcasts for points
- No predictions

Proposed tasks

- (I) Adjust and implement a recently developed approach to gap-fill data with machine learning.***
- (II) Develop and implement a method for anomaly detection.***
- (III) Scale point data to larger areas.***
- (IV) Develop tree growth and drought stress predictions.***



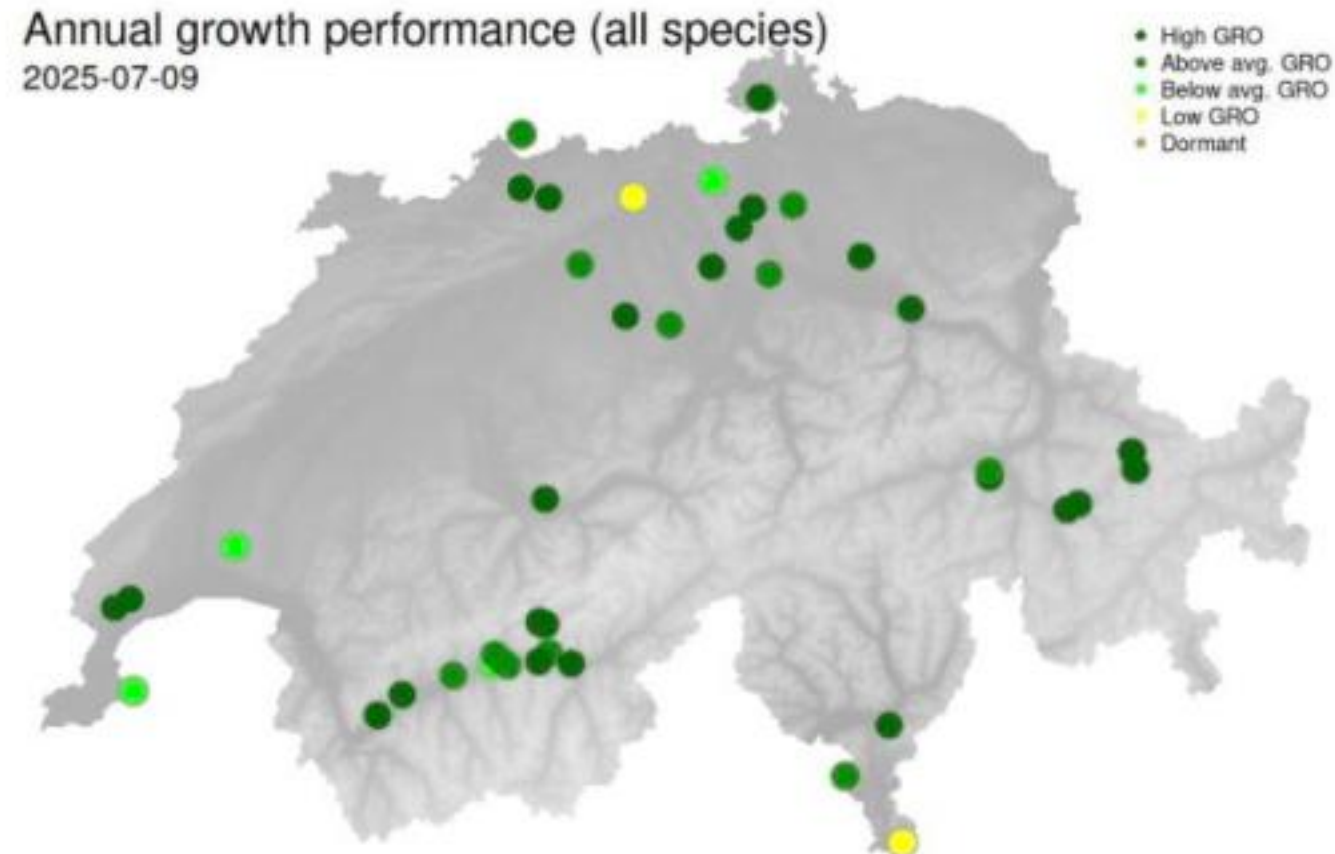
Nowcasts



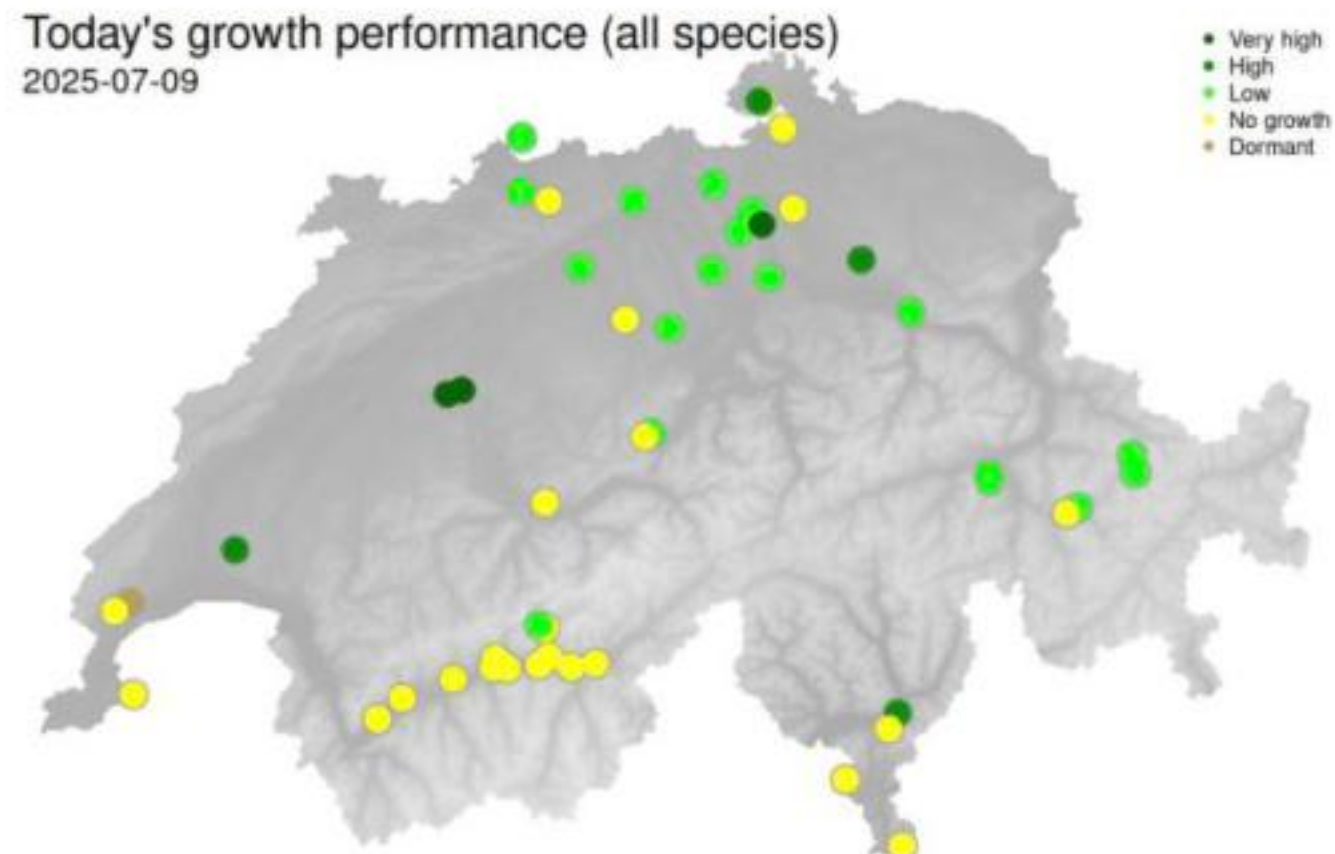


Actual growth and drought indices

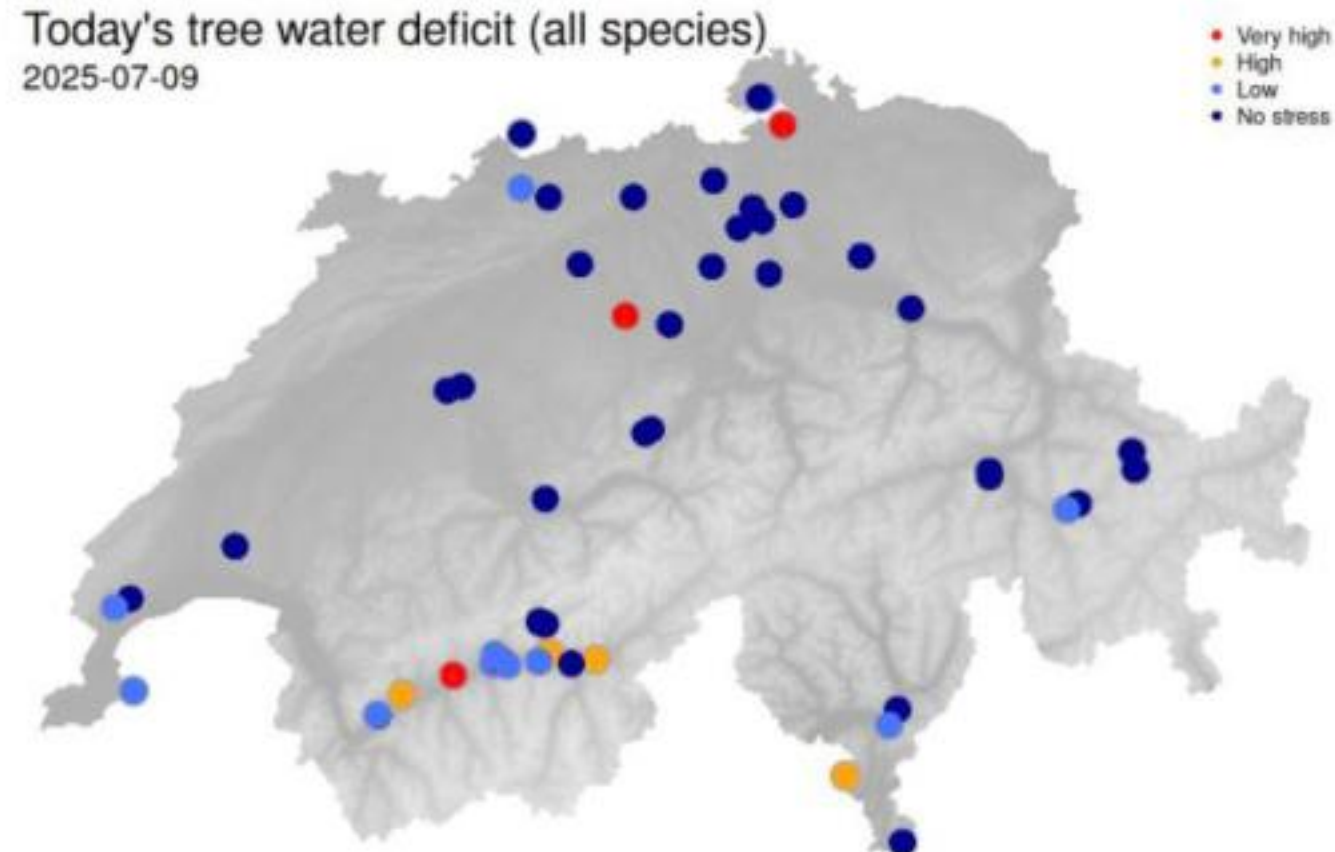
Annual growth performance (all species)
2025-07-09



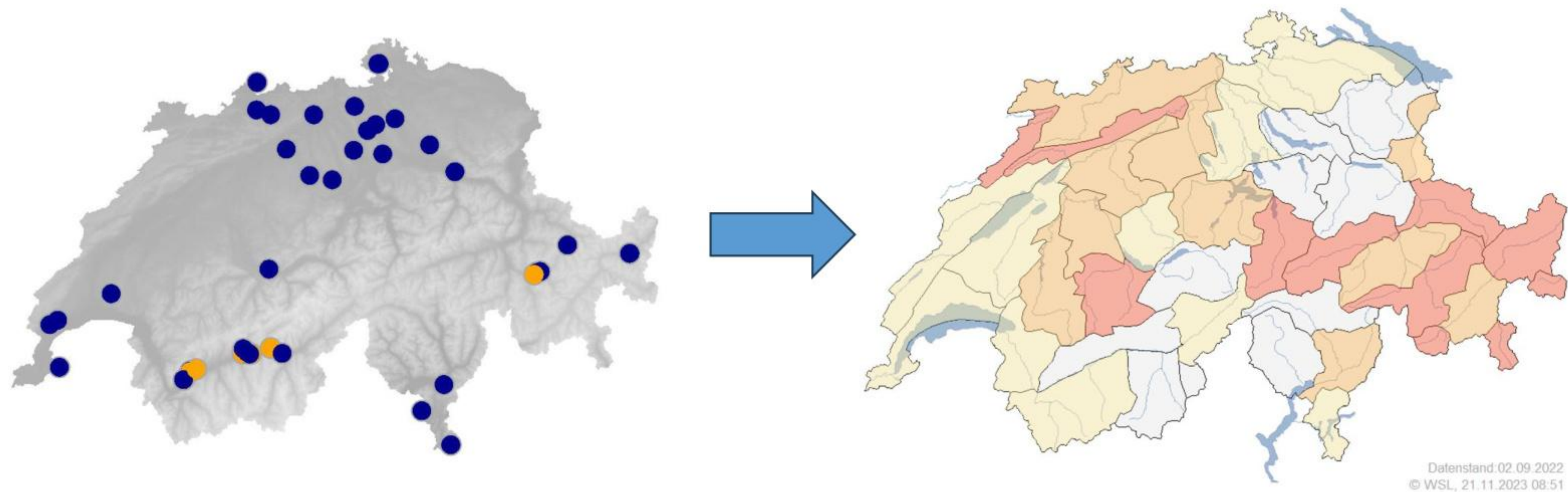
Today's growth performance (all species)
2025-07-09



Today's tree water deficit (all species)
2025-07-09



➤ <https://treenet.info>



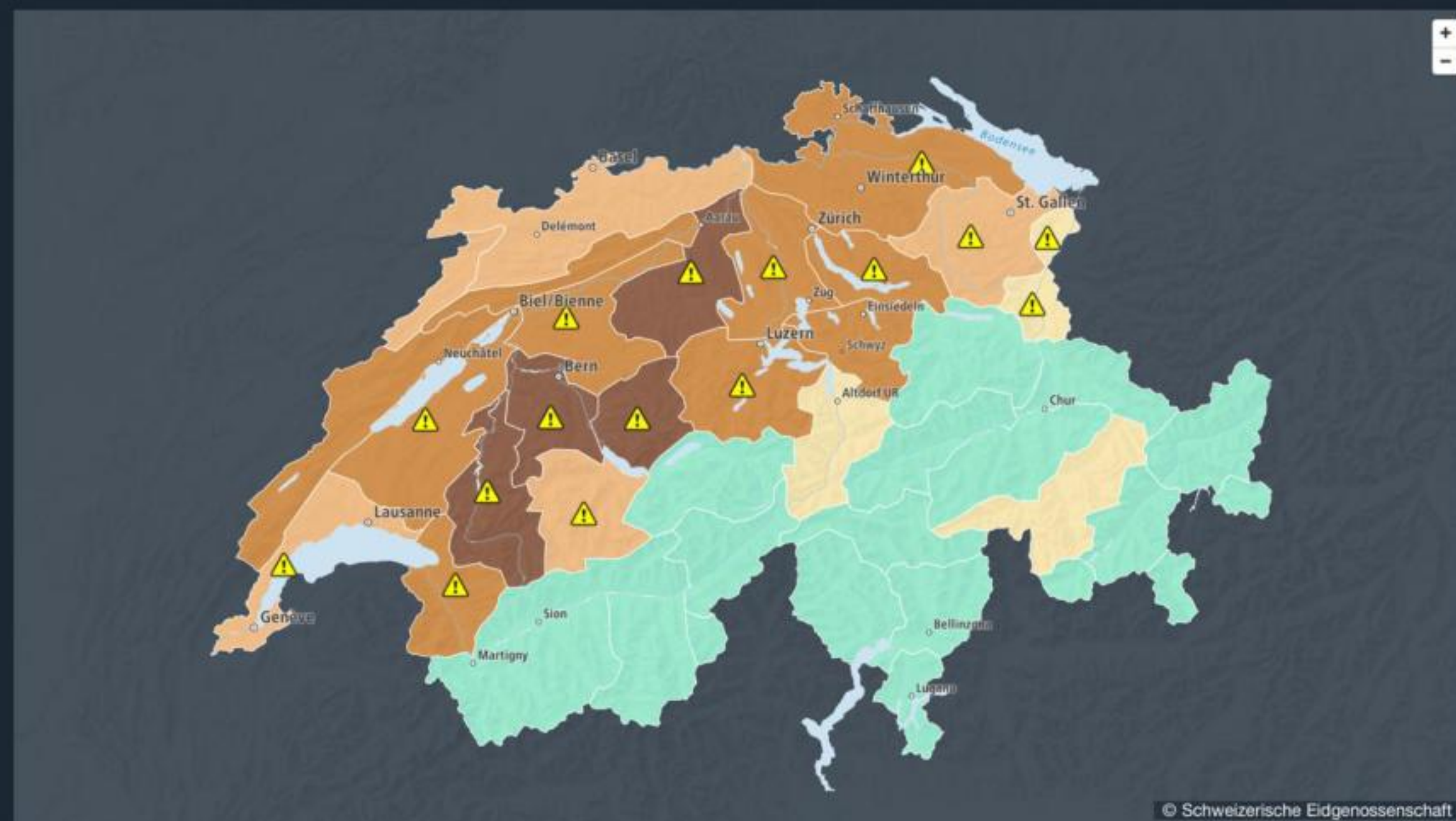
Trockenheit

Situation bis 06.07.2025

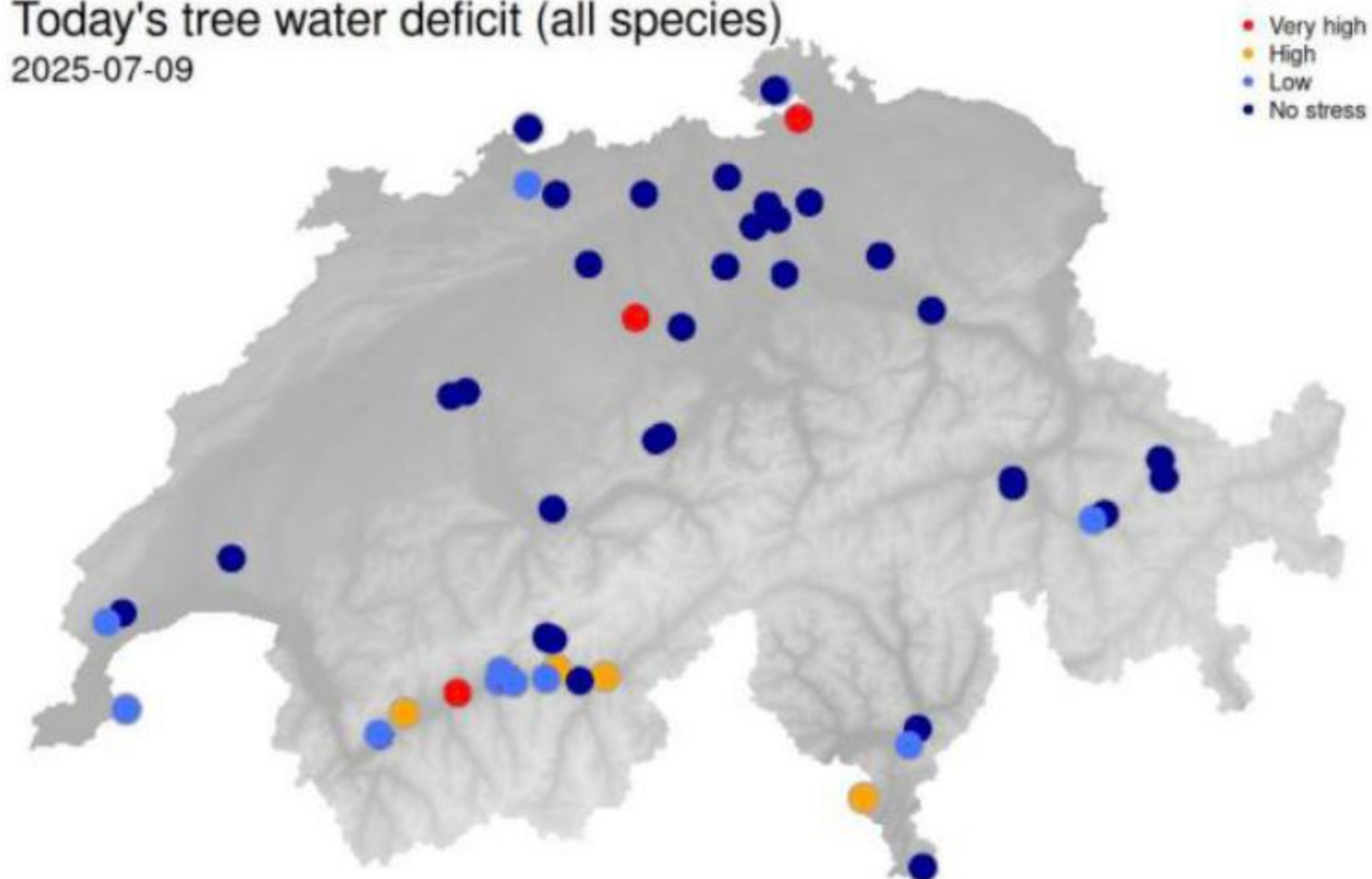
Klicken sie auf die Region für genauere Informationen.

■ Nicht trocken
 ■ Leicht trocken
 ■ Trocken
 ■ Sehr trocken
 ■ Extrem trocken
 [Legende](#)

Liste anzeigen



Today's tree water deficit (all species) 2025-07-09



The program

Program

9:30 to 9:55 **Welcome coffee** (18th floor)

10:00 to 10:30 **Introduction** by Roman Zweifel (14th floor, Room S17)

10:30 to 11:15 **From the past to the future: temporal interpolations and predictions** by Jan Svoboda

11:15 to 12:00 **From points to areas: spatial interpolations** by William Aeberhard

12:00 to 13:30 **Lunch at Tibits** (short walk)

13:30 to 14:15 **From gap filling to virtual trees** by Mirko Lukovic

14:15 to 14:30 **TreeNet IT infrastructure** by Micah Wilhelm

14:30 to 14:45 **Achievements to date and goals for the second year**

14:45 to 15:45 **Discussion rounds**

- The novel national drought platform; expectations
- Data exchange with Renku/Switch/WSL/MeteoSwiss/BAFU
- Options for future collaborations with SDSC
- Spontaneous topics

15:45 to 16:00 **Wrap up**

Achievements to date and **next goals**

(0) Data portal and data exchange infrastructure



- ShinyApp-based data portal -> manual data access
- Daily mirroring of data on Switch platform -> automated data access
- **Implement gridded data products (MeteoSwiss/SoilNet/others)**
- **Evaluate Renku data portal**
- **Transfer data to drought platform**

(I) Anomaly detection



- ML-based process with gridded data -> Meteodata and dendrometer cleaning
- **Implement into TreeNet processing environment**

(II) Gap-fill data with machine learning



- ML-base process -> Meteodata and dendrometer gap filling
- Combining the functionality of (I) and (II)
- **Implement into TreeNet processing environment**

Achievements to date and **next goals**

(III) Prediction in space

- Two ML-based approaches working (Jan and William)
- Fine tuning (spatial resolution)
- Turn into nowcast values (relative to historic data)
- Output for drought platform
- Implement into TreeNet processing environment



(IV) Prediction in time

- Working prediction approach
- Fine tuning (temporal resolution)
- TWD into mm of missing rain
- Implement into TreeNet processing environment

(V) Scientific papers

- 1-2 method papers
- 1 ecological paper