TreeNet annual meeting 2026

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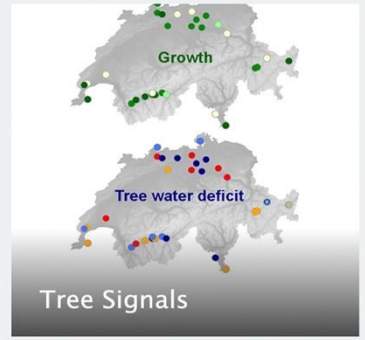
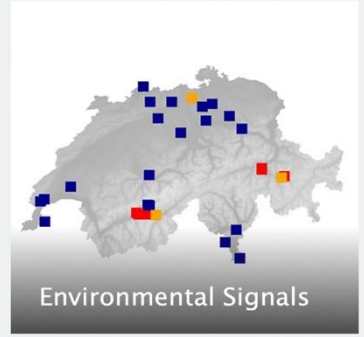
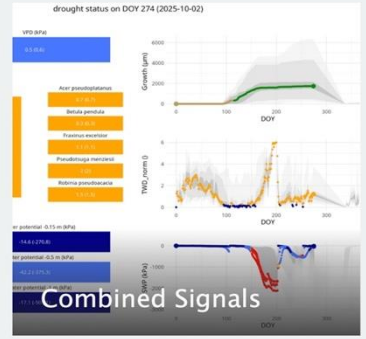
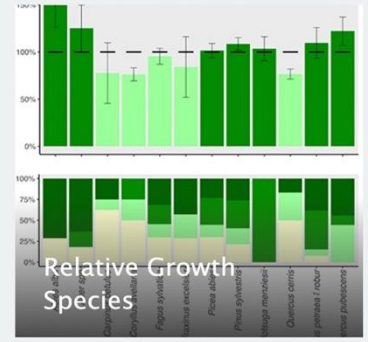
WSL, Birmensdorf, Switzerland

Botanisches Institut Basel
13 January 2026



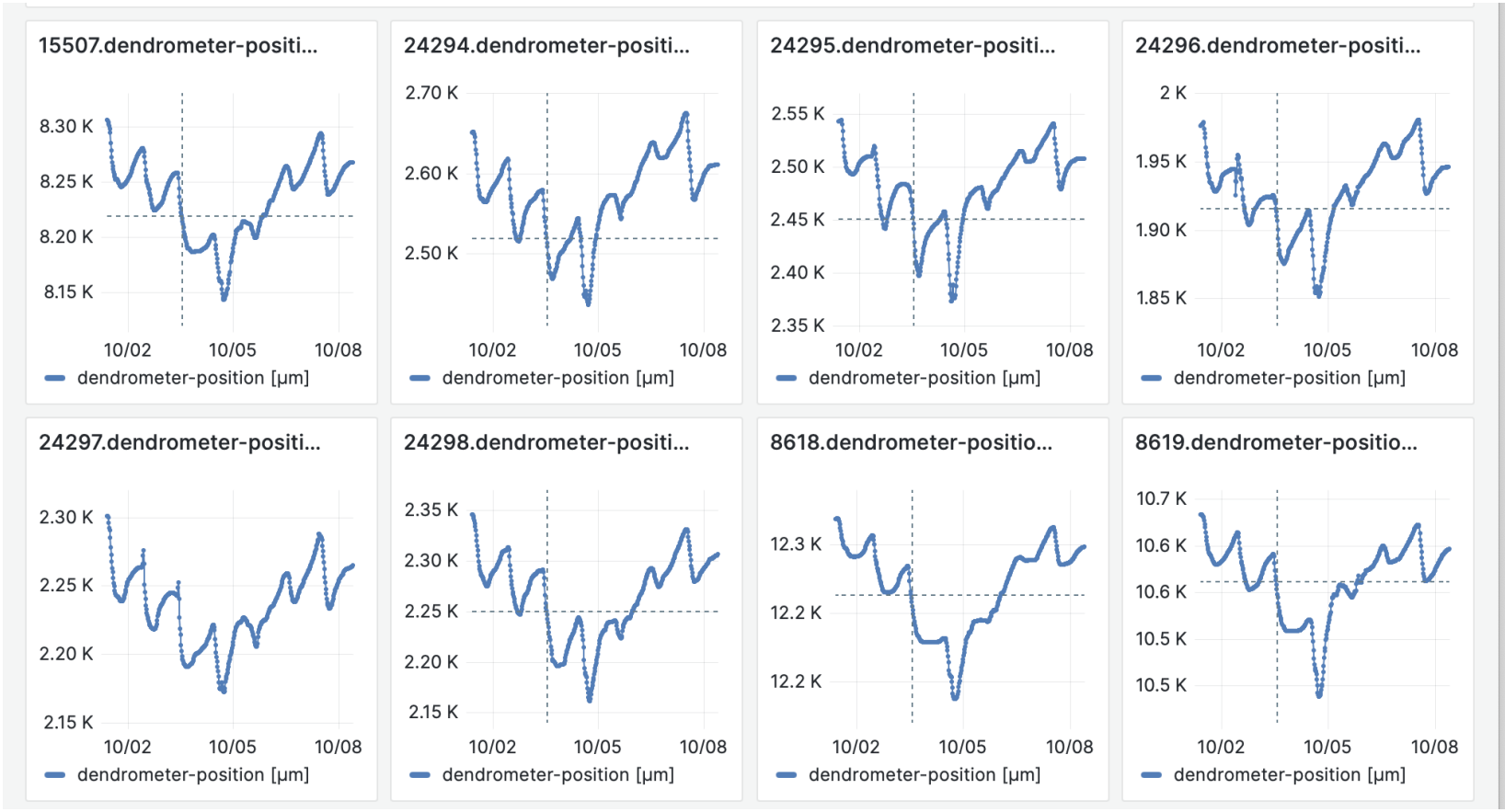


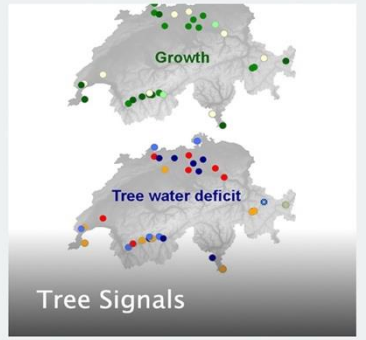


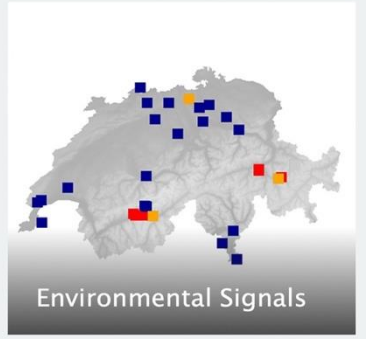


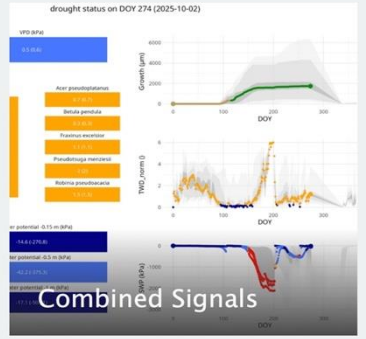
From raw …

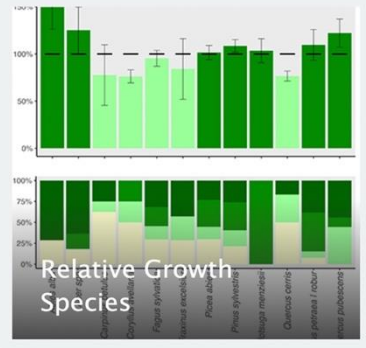
… to physiological











From raw …

Air
- Temperature
- Relative humidity
- VPD

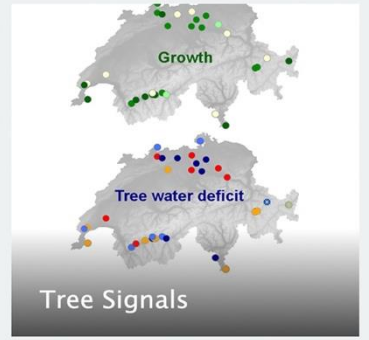
Tree
- Stem radius changes

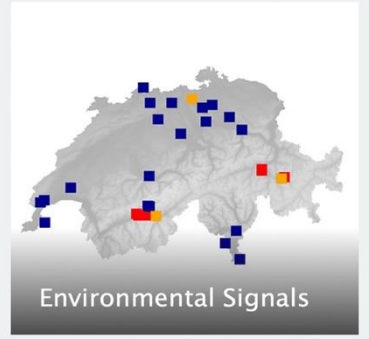
Soil
- Soil water potentials
- Soil temperature

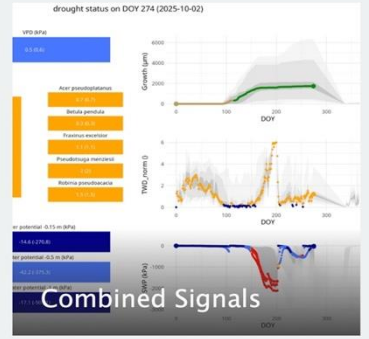
… to physiological

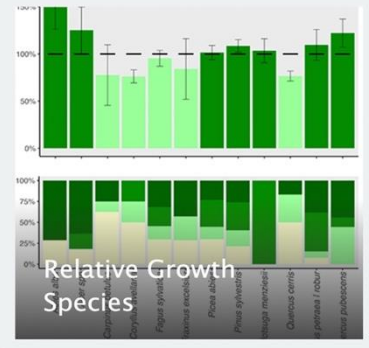
Tree
- GRO.yr
- GRO.rate
- GRO.period
- GRO.historic
- TWD.actual
- TWD.historic
- GRO.signal
- TWD.signal
- Combi.signals

Site
Species
Region









Data flow

Raw data

Raw data monitoring

Browser based service tools
Visualisation
Alarm messages
Measurement device surveillance

Field site records

Raw data server

IoT Cloud

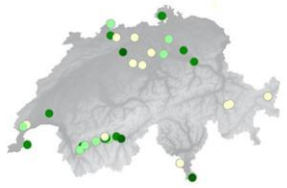
DecentLab

WSL/LWF
ETH Zurich

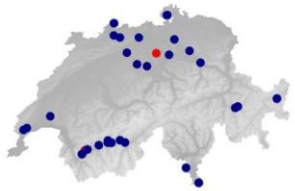
Processed data visualization (near real-time)

treenet.info

Growth indicators



Tree water deficit indicators



TreeNet data server

Raw data:
Level L0

Processed data:
Level L1, L2, LM

Data processing

treenetproc
L1: time alignement (10 Min)
L2: automated cleaning

treenetvis
Visualisations statistics
Maps

Metadata sheet

Device/time based list
Coordinates
Tree characteristics
Processing parameters

Manual check

treenetproc
LM: manual cleaning

Data export

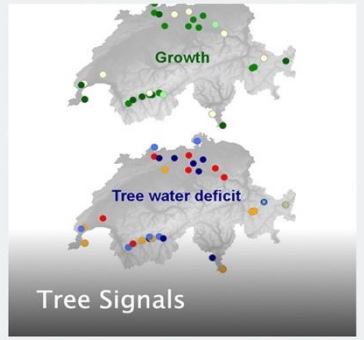
Data server partners
Data download (L1, L2, LM, L2M)
Data aggregations:
-> 10 min to annual
-> Species
-> Sites to regions
Graphical data

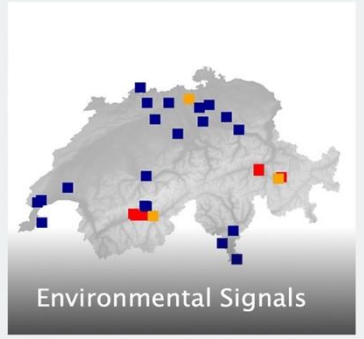
Stem growth (GRO)
GRO periods
GRO rates
GRO indicators

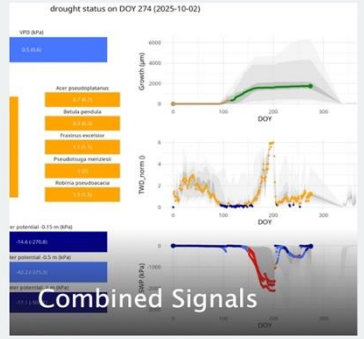
Tree water deficit (TWD)
TWD periods
TWD indicators

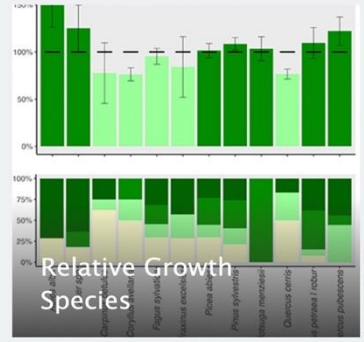
Air temperature
Relative humidity
Vapour pressure deficit
Soil temperature
Soil water potential
(solar radiation, precipitation)

Processed data



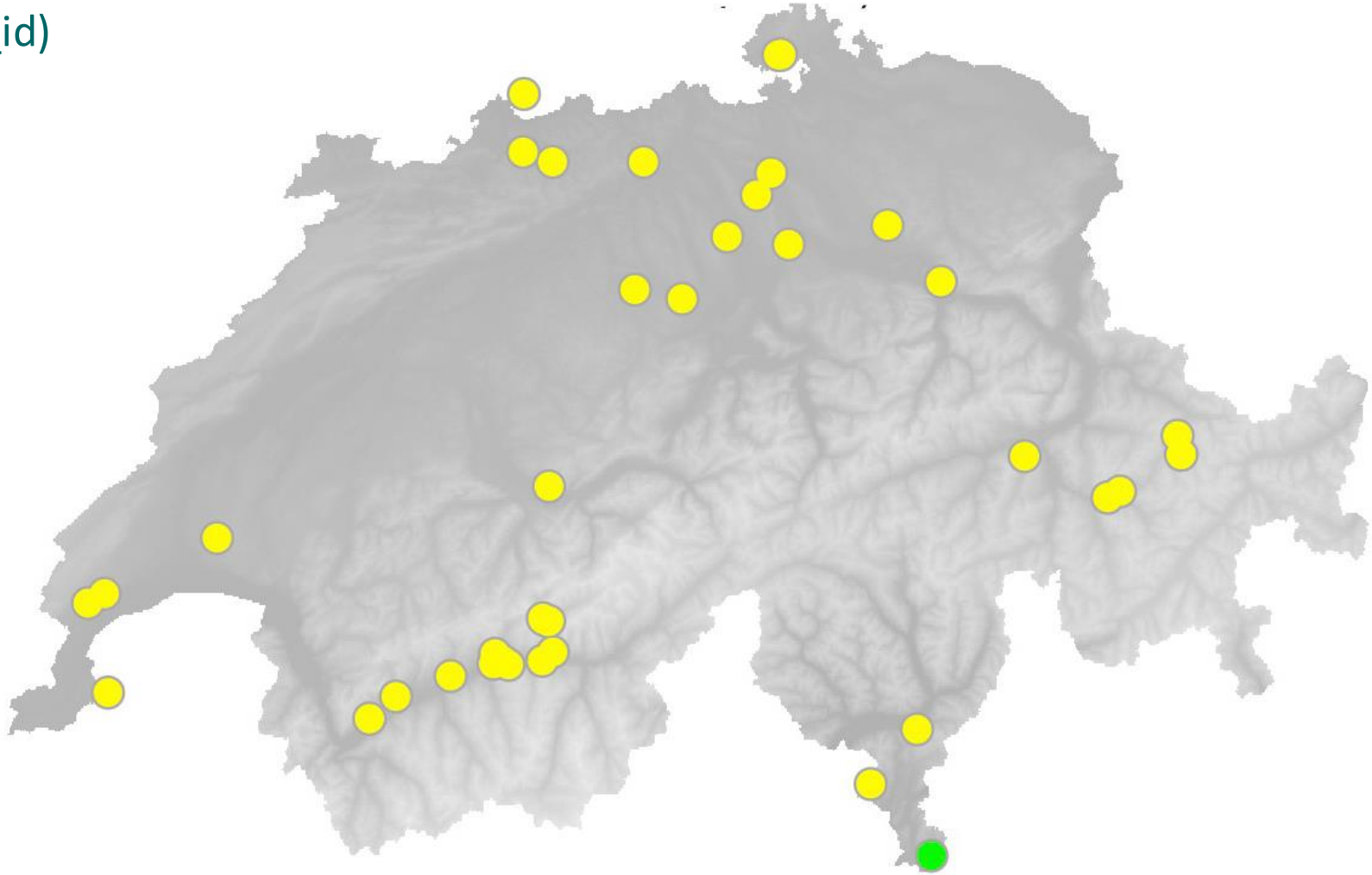






TreeNet Sites 2025 Switzerland

(site_id)



100 sites in total
86 are active

Sites are measurement plots with specific conditions in air and soil

e.g. different expositions
e.g. treatments

TreeNet Sensors Switzerland 2025

Dendrometers active:	611
Temp/RelH (in the forest):	78
Soil Temp/WP:	201
Others:	ca. 50

TreeNet-CH Partners 2025

Contact	Site_affiliation	Site_all
Roman Zweifel/ Andreas Rigling	BLS	7
Nina Buchmann	ETHZ_Grass	2
Marius Floriancic	ETHZ_IEE	1
Andrea Carminati	ETHZ_Soil	9
HemauerKeller	HK	2
Sabine Braun/Sven Hopf	IAP	10
Ansgar Kahmen	UniBasel	2
Beni Stocker	UniBern	2
Roman Zweifel	WSL_TN	3
Eric Gehring	WSL_ComE	1
Patrick Fonti	WSL_Dendro	16
Nina Buchmann	WSL_ETHZ_Grass	1
Arthur Gessler/Marcus Schaub	WSL_LWF	18
Martina Peter	WSL_Myko	3
Alessandro Bottero	WSL_SLF	2
Lorenz Walthert	WSL_Soil	4
Marcus Maeder	HSLU	3
Total (per year)		**86**

Current projects with TreeNet involvement

LWF (WSL, BAFU)
Interkantonale Walddauerbeobachtung (IAP, BAFU)
ICOS (SNSF, EU RI project)
SwissCanopyCrane II (SNFS, BAFU)
VPDrought – Pfynwald (SNFS, WSL)
UPSCALE (SNSF-Sinergia)
FORWARDS (EU-project)
BLS - Klimaangepasste Baumarten im Schutzwald der BLS Südrampe (BLS)
SwissPhenocam - country-scale automated phenology tracking from imagery (GCOS)
Fore(st)cast (WSL, SDSC)
NCCS – FORTE APP (WSL, BAFU)
Stillberg (SLF)
Silva/Acla Soundscape (Science-Art project, ZHdK, Kt GR)
Waldlabor (ETH)
FOREMA GIS WSL/DRAINS (WSL)
FLAME - Future resiLient forest in a chAnging climate (Uni ZH)
Art projects Bellinzona and Zürich (studio hemauer and keller)
INETFLUX_CH-CZ (ETHZ, WSL, CzechGlobe)
PhenoRoot (WSL)
PhD and Msc projects with ETH, EAWAG, EPFL, Uni Basel, Uni Zürich

TreeNet-EU Partners FORWARDS project 2025

Netherlands: WUR
Italy: EURAC
Austria: European Environment Agency

… more to come soon

Hardware and central data treatment is standardized

Near real-time data transfer

- LORA/GSM
- 10 min

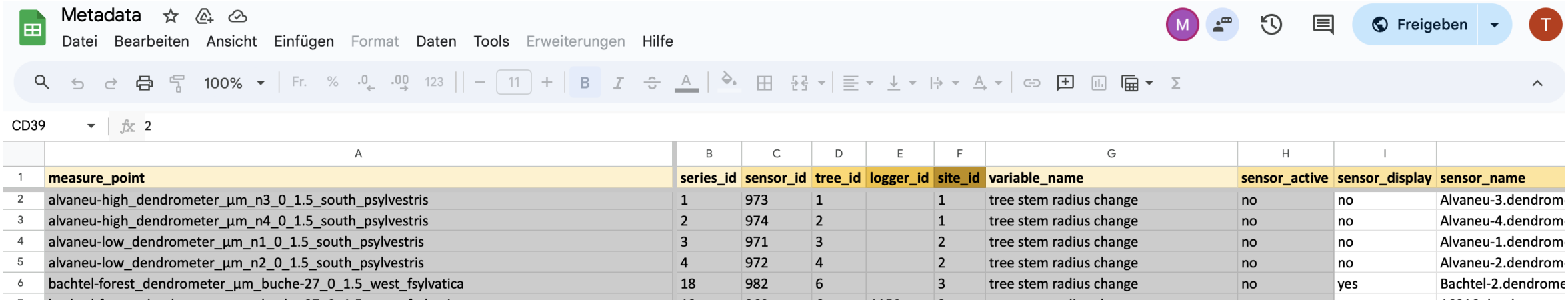
Data server

- Raw data (InfluxDB, Decentlab, partner server)
- Processed data (PostgreSQL, TreeNet, WSL)
- Metadata (PostgreSQL, TreeNet, WSL)

Processing

- Dendrometer data: treenetproc (R package)
- Nowcasting: treenetweb (R package)
- Data portal: ShinyApp

Metadata – key to organise and connect data


Metadata

Datei Bearbeiten Ansicht Einfügen Format Daten Tools Erweiterungen Hilfe

Freigeben

CD39 | fx 2

	A	B	C	D	E	F	G	H	I	
1	measure_point	series_id	sensor_id	tree_id	logger_id	site_id	variable_name	sensor_active	sensor_display	sensor_name
2	alvaneu-high_dendrometer_µm_n3_0_1.5_south_psylvestris	1	973	1		1	tree stem radius change	no	no	Alvaneu-3.dendrom
3	alvaneu-high_dendrometer_µm_n4_0_1.5_south_psylvestris	2	974	2		1	tree stem radius change	no	no	Alvaneu-4.dendrom
4	alvaneu-low_dendrometer_µm_n1_0_1.5_south_psylvestris	3	971	3		2	tree stem radius change	no	no	Alvaneu-1.dendrom
5	alvaneu-low_dendrometer_µm_n2_0_1.5_south_psylvestris	4	972	4		2	tree stem radius change	no	no	Alvaneu-2.dendrom
6	bachtel-forest_dendrometer_µm_buche-27_0_1.5_west_fsylvatica	18	982	6		3	tree stem radius change	no	yes	Bachtel-2.dendrome

TreeNet metadata - Each timeseries has 108 metadata entries!

- Sensor type, mounting location, IDs, units
- Owner ships, affiliation, coordinates
- Species, forest type, soil type
- Site, climate, and tree characteristics
- Physiological characteristics (GRO, TWD, GRO period, …)
- Processing variables

-> heart of processing platform

-> start of physiological knowledge

Access to TreeNet data

	Accessible for …
-> Data repositories (Pangea, EnviDat, others)	**Everybody**
-> TreeNet data portal (ShinyApp) with login -> all levels of data	**Everybody with credentials**
-> R-package: *treenetproc* access to DB -> all levels of data -> restricted to WSL resp. VPN users	**With WSL credentials**
-> API data exchange (near real-time) -> all levels of data	**Customized solution**

TreeNet data levels

L0: raw data
L1: aligned data (10-minute resolution)
L2: auto cleaned time series (GRO, TWD, growth start/end) -> nowcasting data (daily processed)
L2_now: Daily indices for growth and drought stress (nowcast)

LM: manually checked and corrected -> scientific data (annually processed)
Metadata: tree-specific physiological characteristics

L3: gap-filled data (ML products under construction)
L4: gridded data (ML products under construction)
…

Near real-time

Post-processed

To be defined

From raw … … to physiological

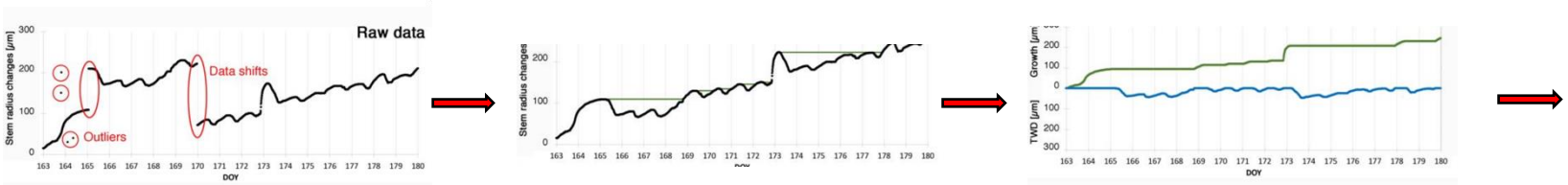
Nowcasting

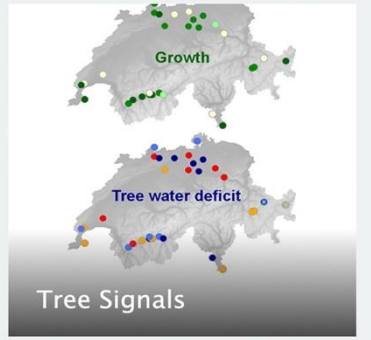
Attempt to interpret current data in a historical context in near real-time

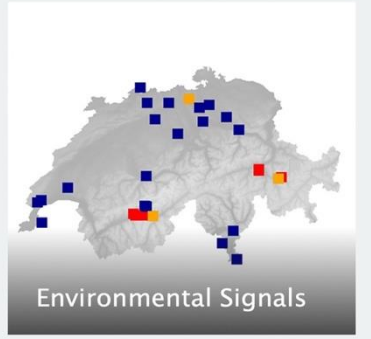
- From meteorology
- Needs historic data, a model to clean actual data and a function to set the two into relation

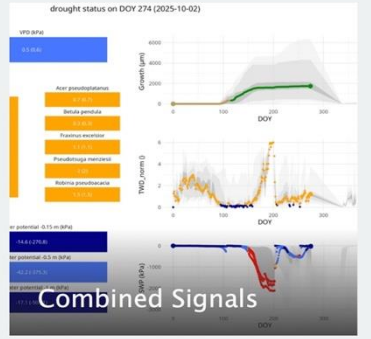
Attempt to give (raw) data a meaning -> signal

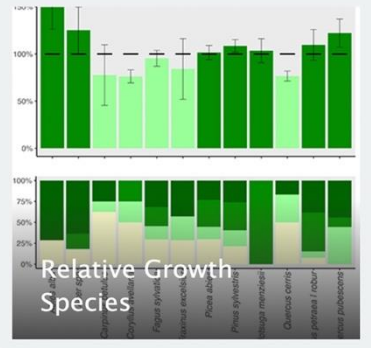
- Drought stress signal
- Growth performance signal





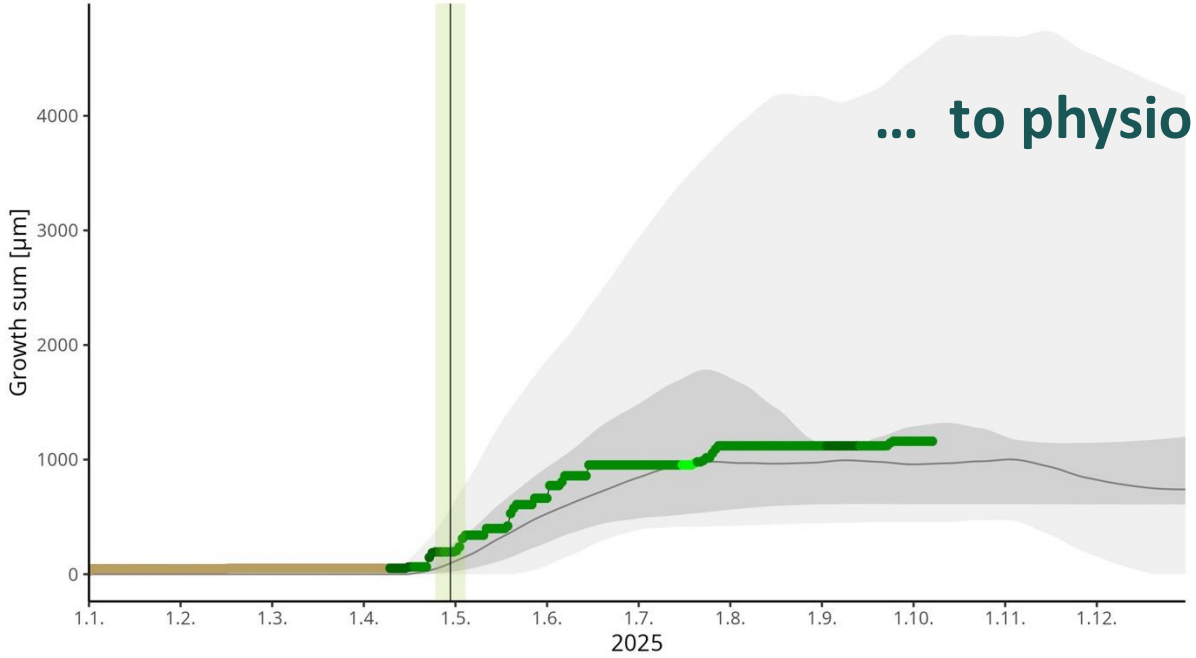


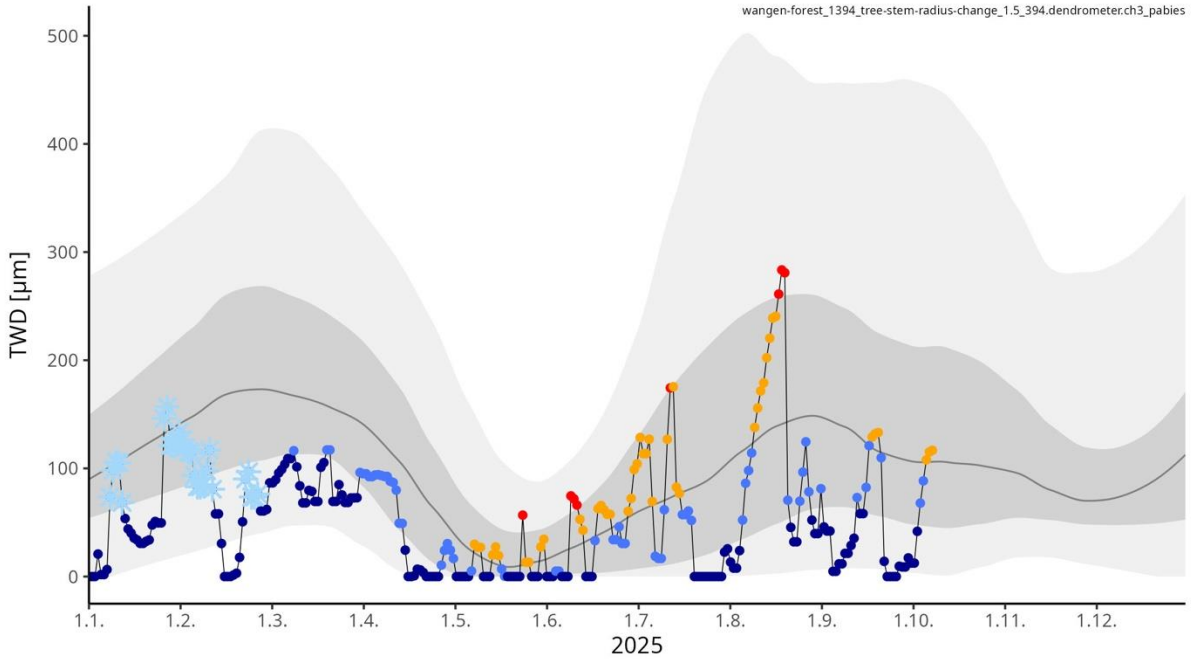




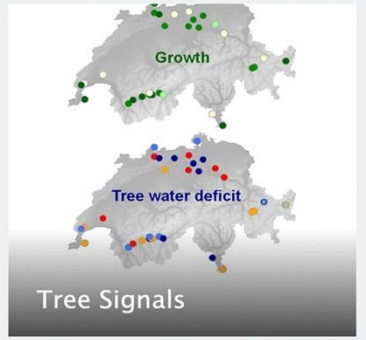
From raw …

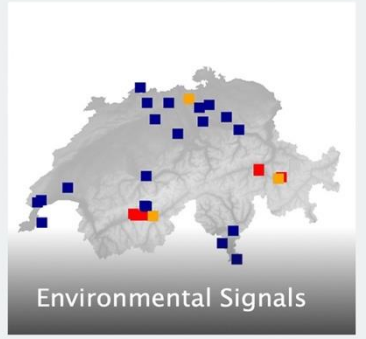
Nowcasting

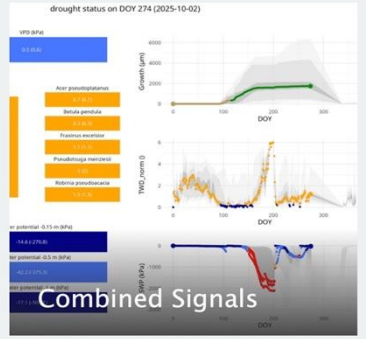


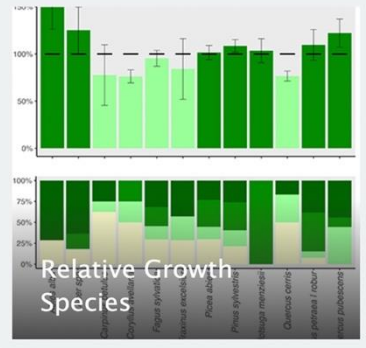


… to physiological







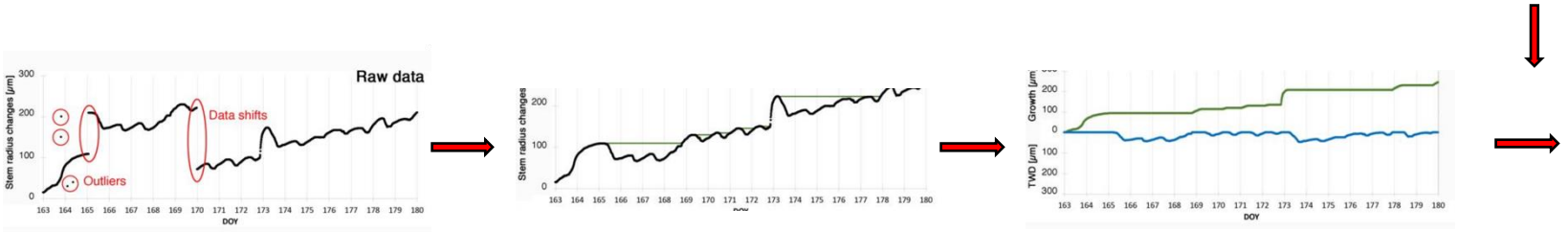


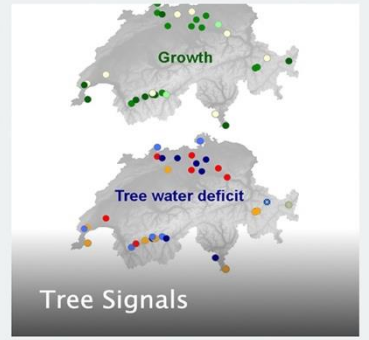
From raw …

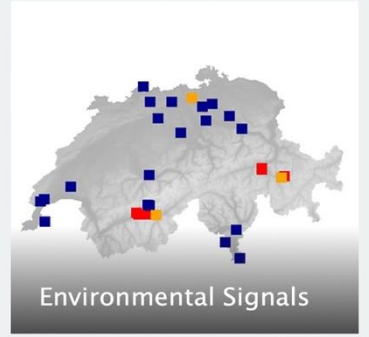
… to physiological

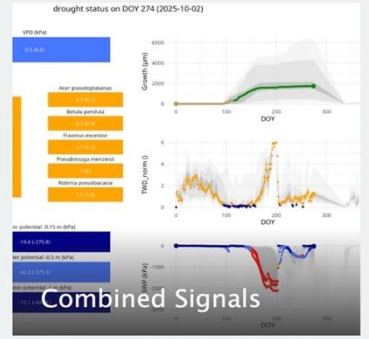
Nowcasting means that

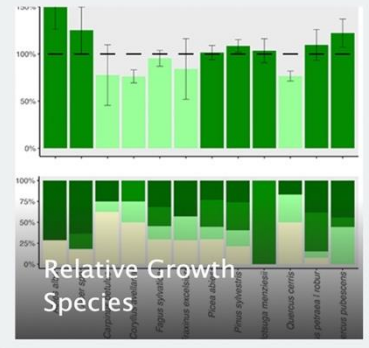
each time series is analysed relative to its own history



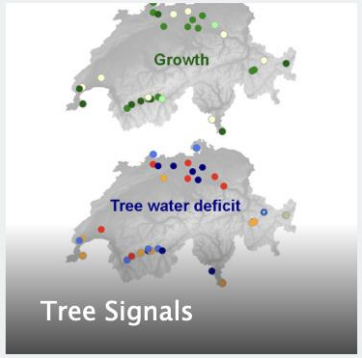


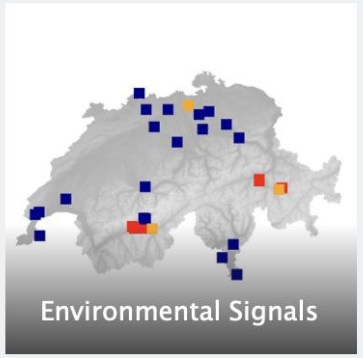


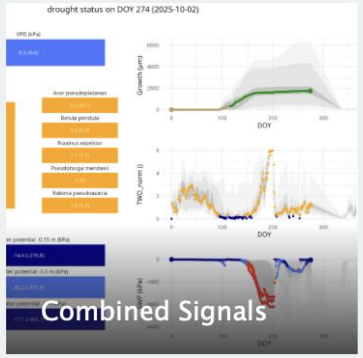


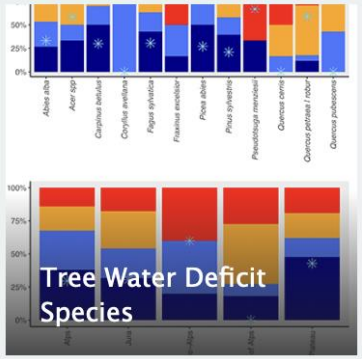


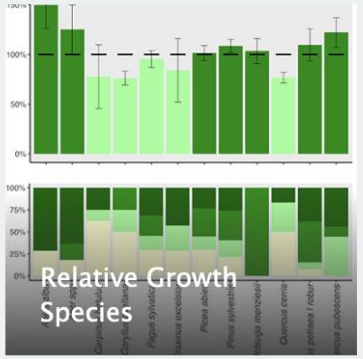
TreeNet Nowcasts

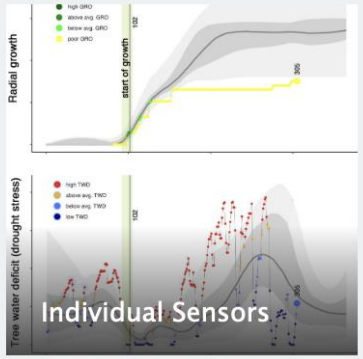


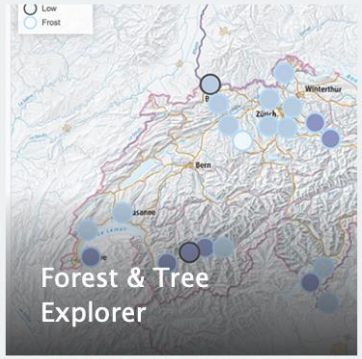


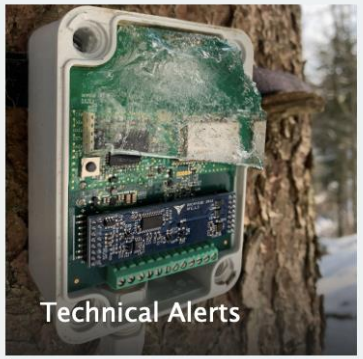






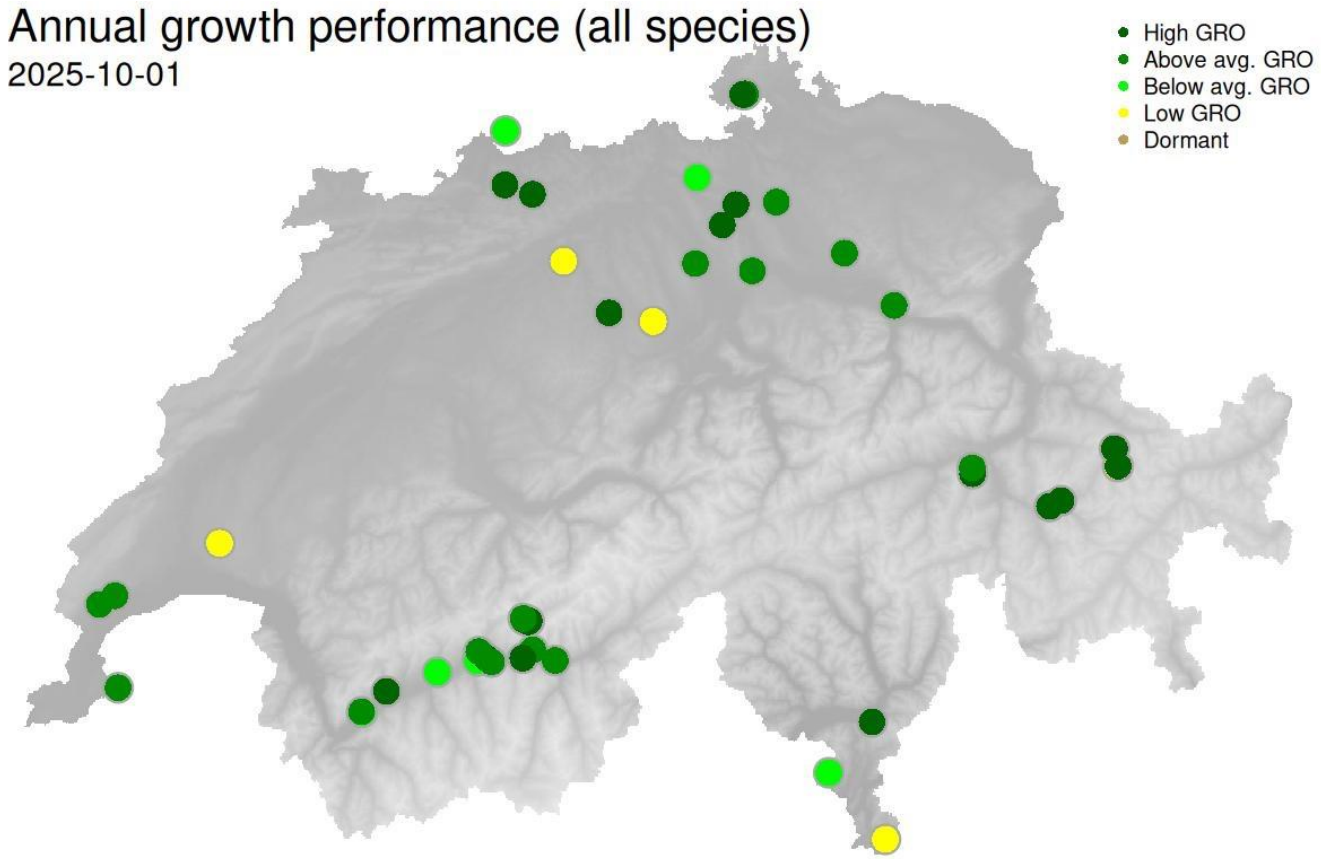




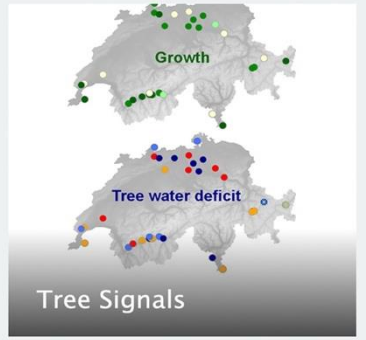


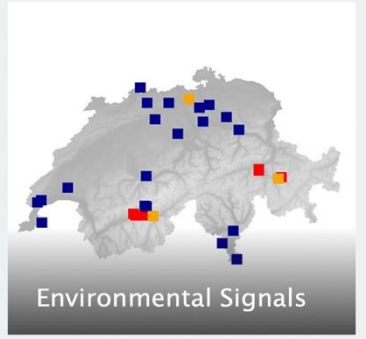
www.treenet.info/nowcasts

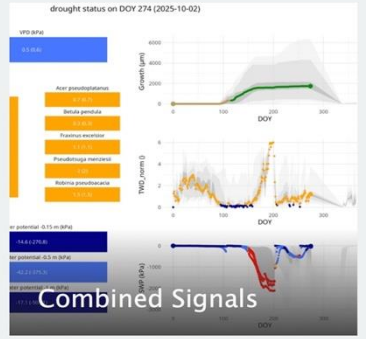
Nowcasts – Growth signal (rel. to historic data)

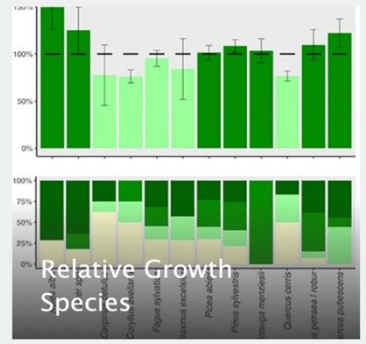


www.treenet.info/nowcasts

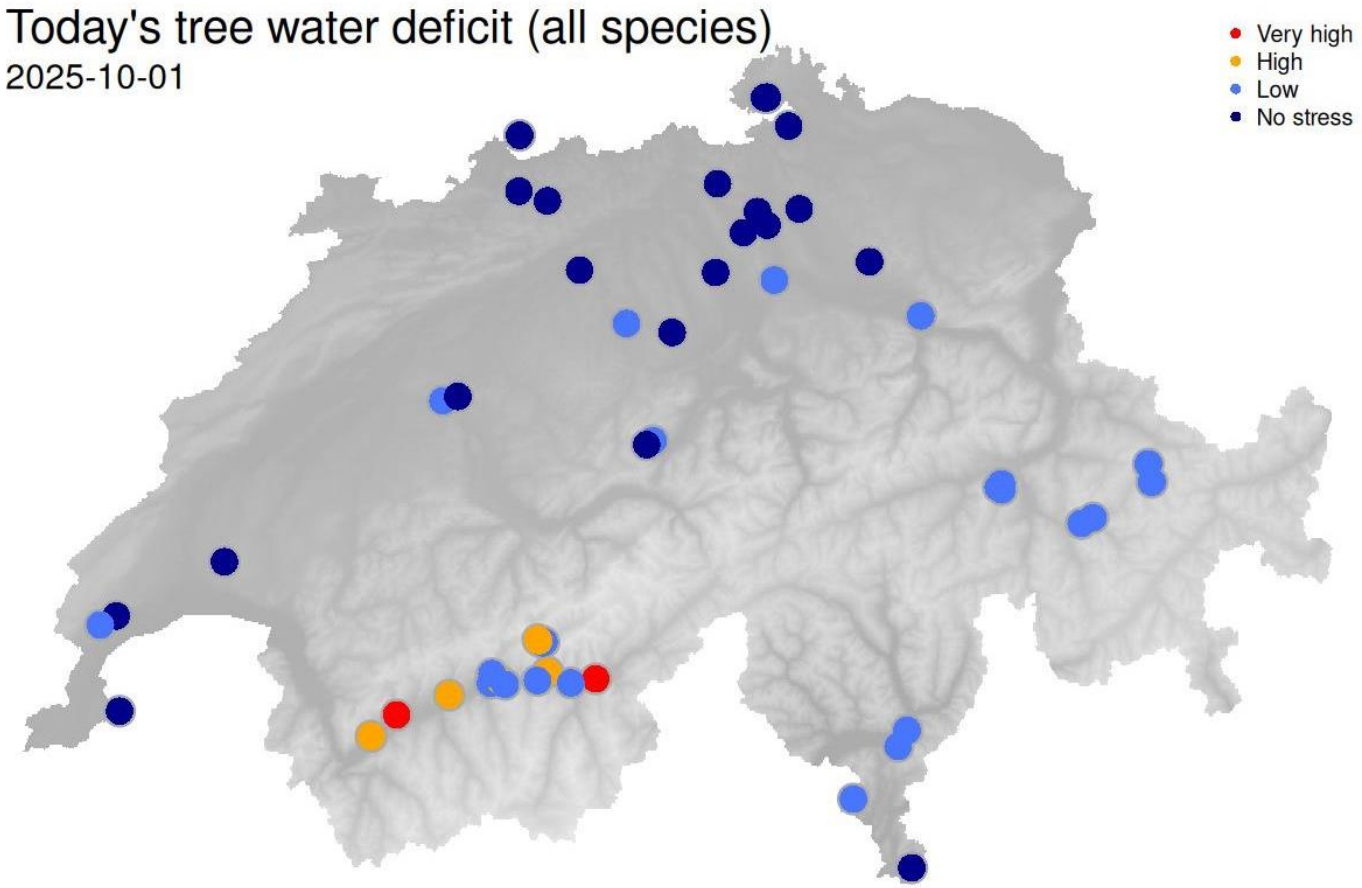




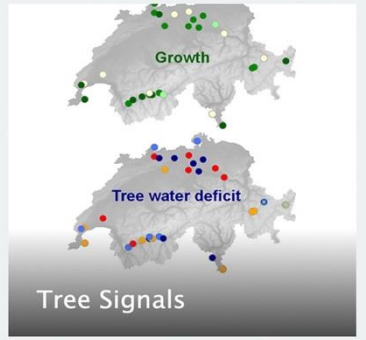


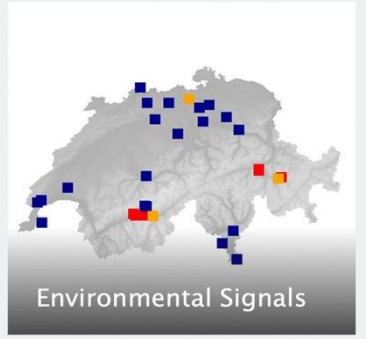


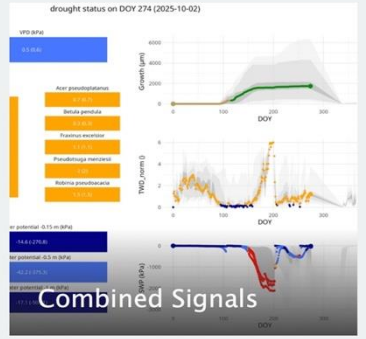
Nowcasts – Tree water deficit signal (rel. to historic data)

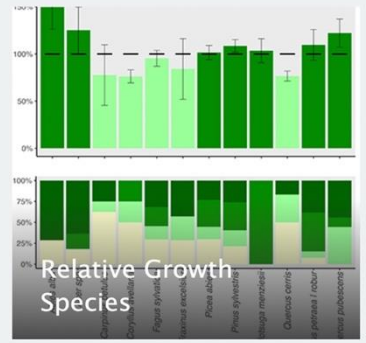


www.treenet.info/nowcasts

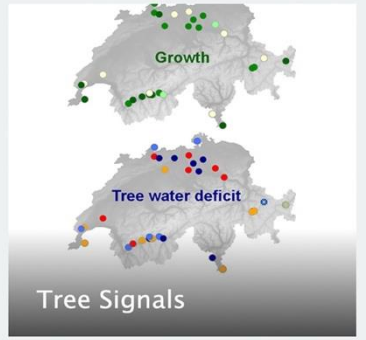


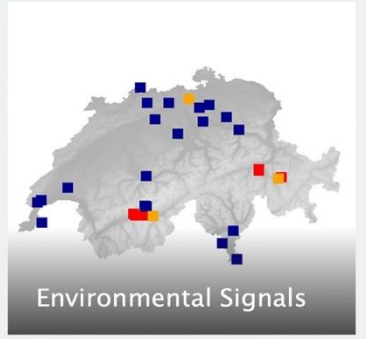


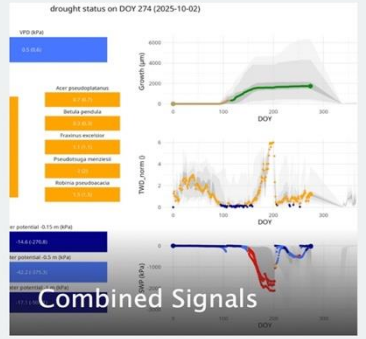


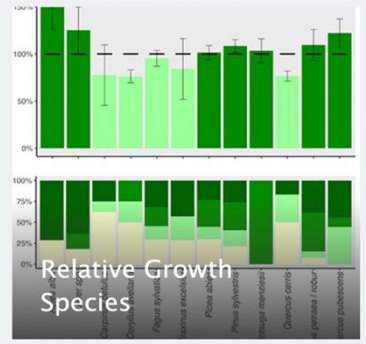


Nowcasts – Technical Alerts

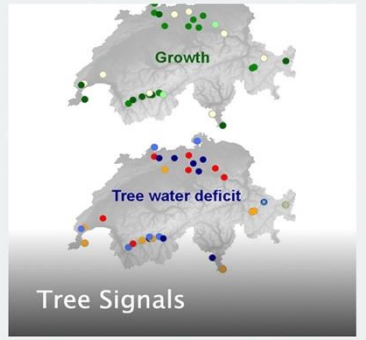


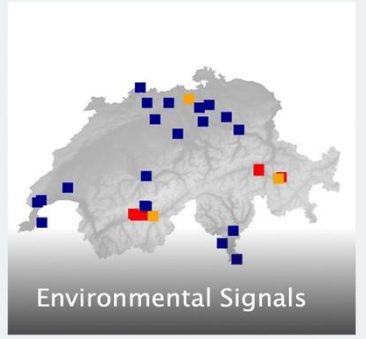


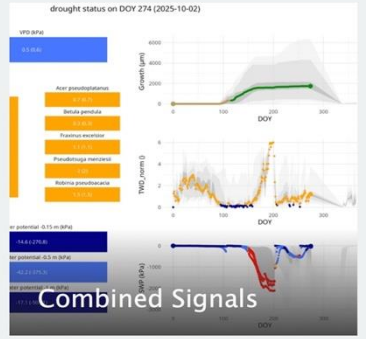


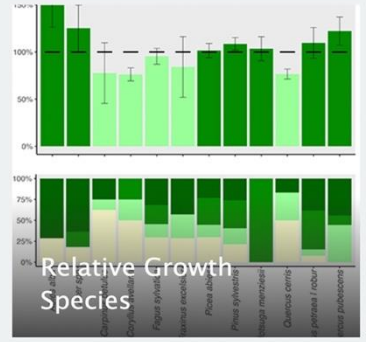


Most recent TreeNet products





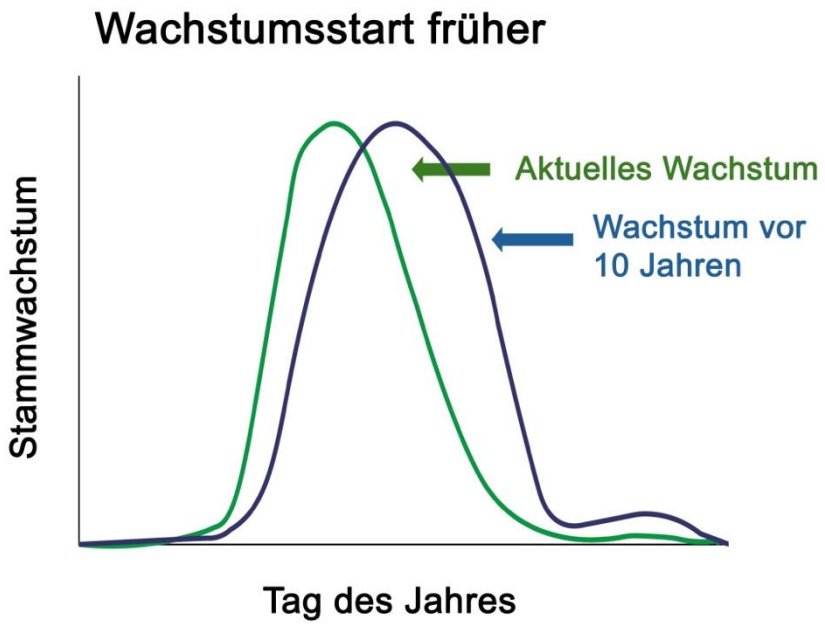


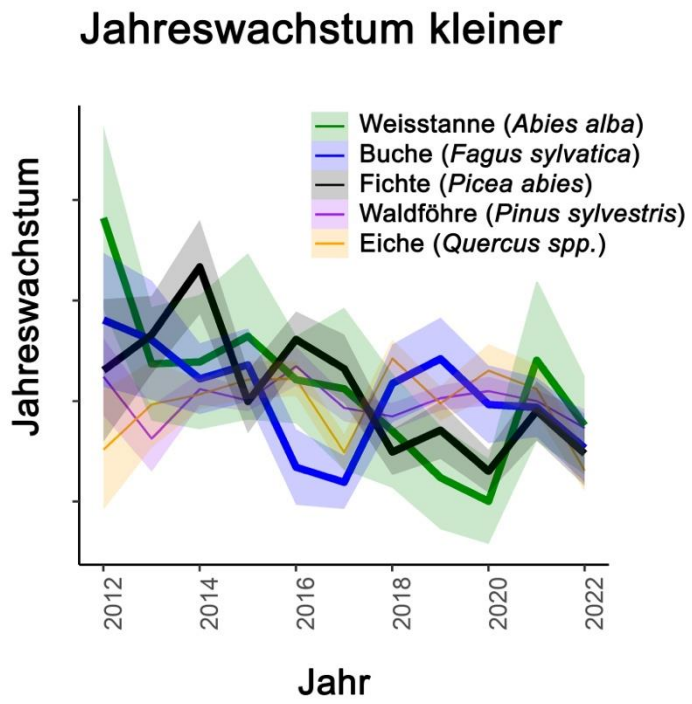


Decreasing Stem Growth in Common European Tree Species Despite Earlier Growth Onset

Arun K. Bose[1,2] | Sophia Etzold[1] | Katrin Meusburger[1] | Arthur Gessler[1,3] | Andri Baltensweiler[1] | Sabine Braun[4] | Nina Buchmann[5] | J. Julio Camarero[6] | Matthias Haeni[1] | Ansgar Kahmen[7] | Richard L. Peters[8] | Frank J. Sterck[9] | Simon Tresch[4] | Lorenz Walthert[1] | Roman Zweifel[1]

Global Change Biology





- TreeNet trees start growing 5 to 10 days earlier than 10 years ago
- Nevertheless, annual growth is decreasing (significant for beech, fir and spruce)
- Main reason is the reduced number of days with growth

➢ The extended vegetation season has no positive effect on tree growth and can not compensate for the drier summers

Ecological Indicators
Volume 177, August 2025, 113757

Towards near real-time drought stress assessment in Europe's temperate forests – comparing remote sensing time series with continuous in-situ tree-level measurements

Colin K. Bloom et al.

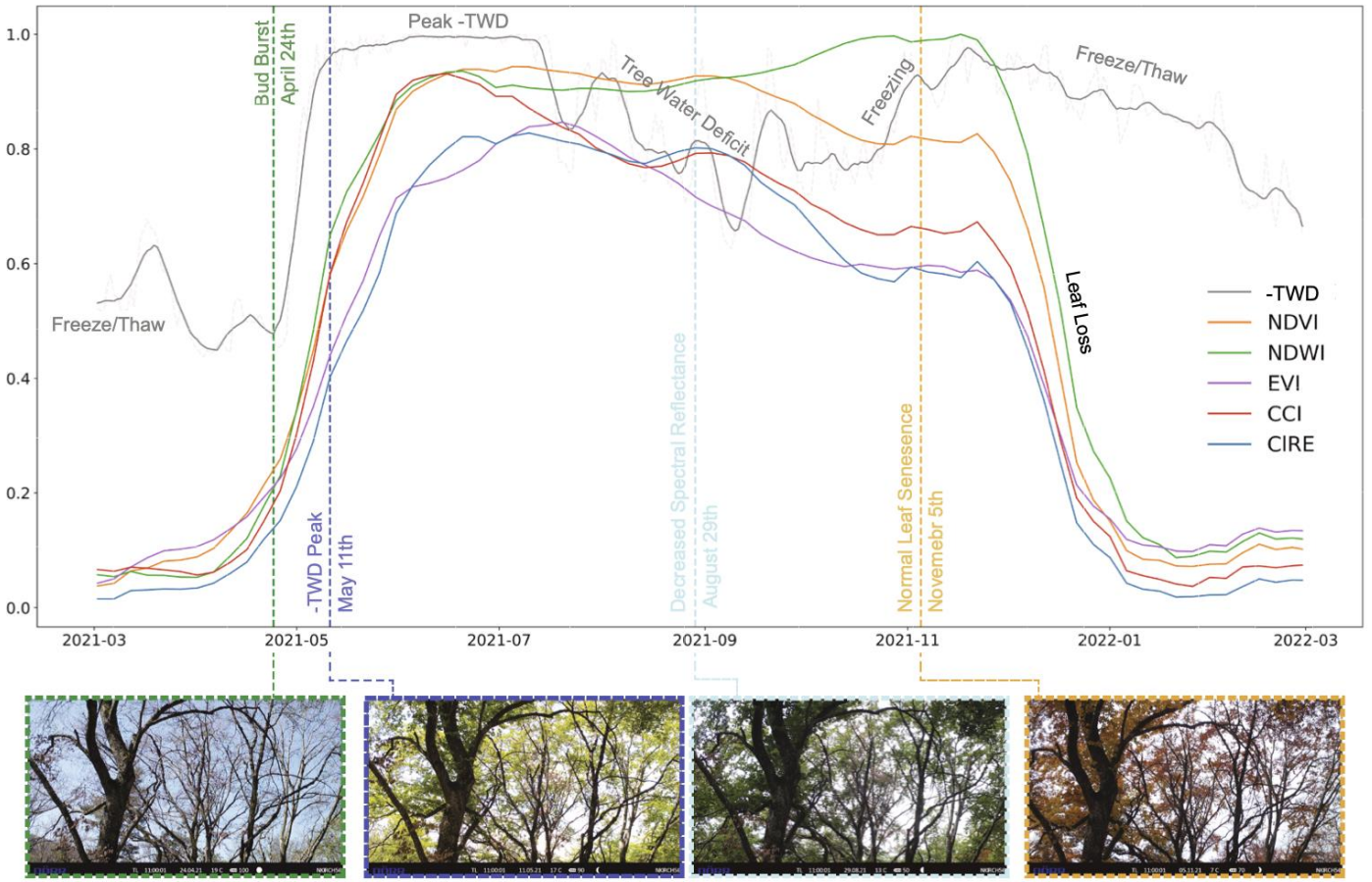


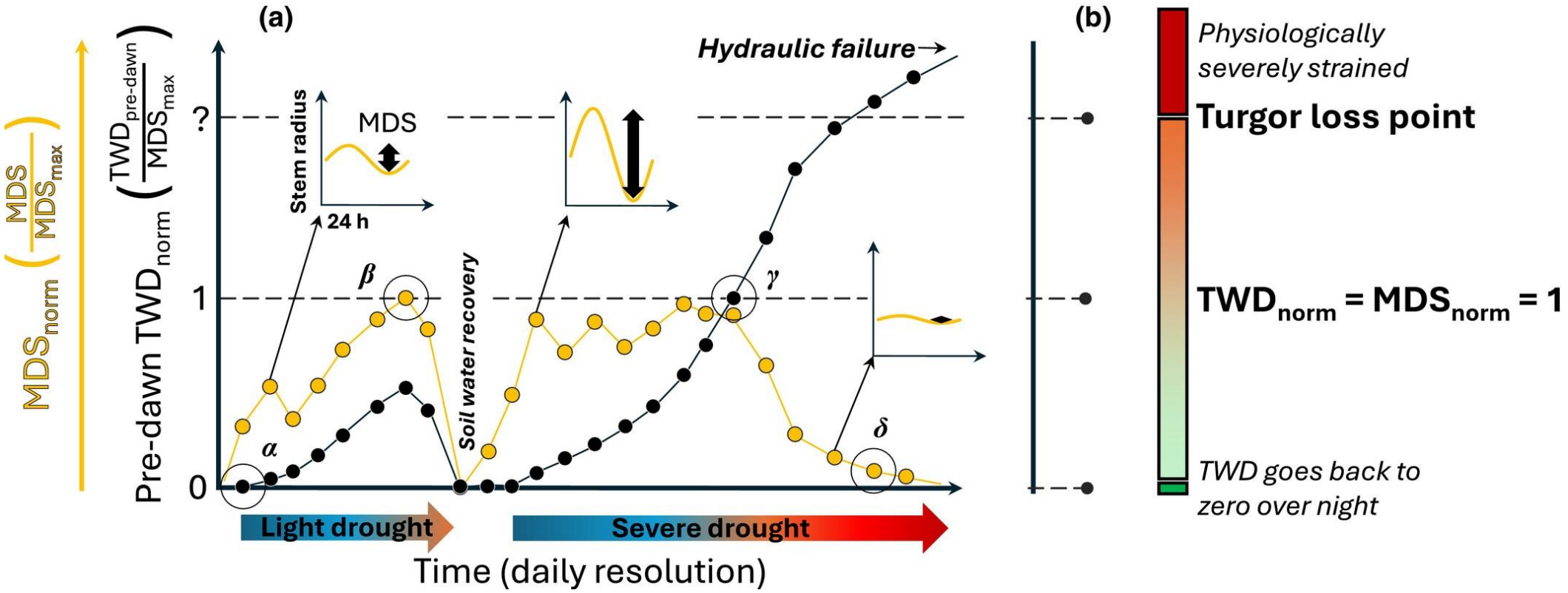
Fig. 3. An example time series from a European Beech tree in 2021. Vertical dashed lines indicate the date at which the corresponding photos of the canopy were collected. Grey annotations on the time series refer to the –TWD time series, while black annotations correspond to the vegetation index time series.

New Phytologist

Research

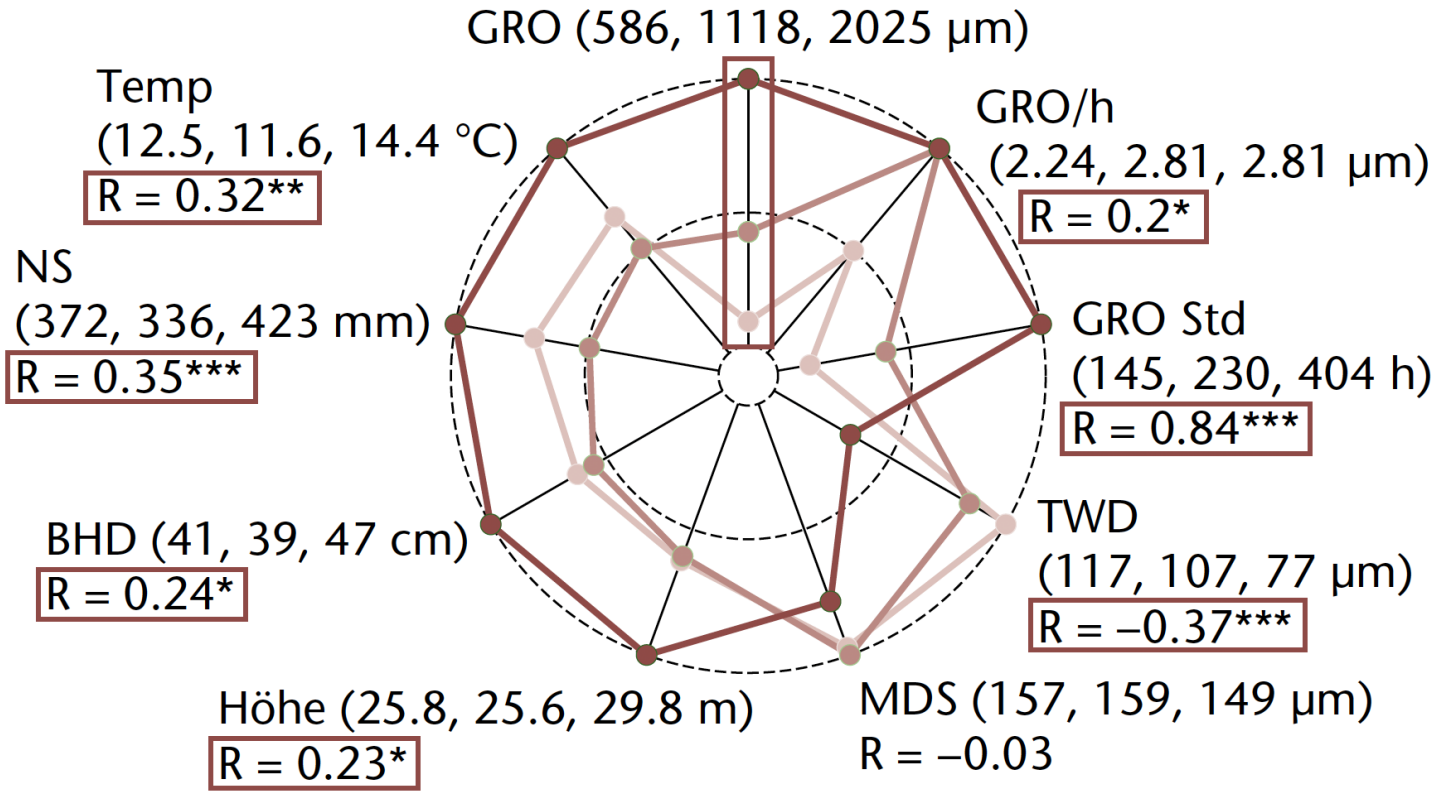
Normalized tree water deficit: an automated dendrometer signal to quantify drought stress in trees

Richard L. Peters[1,2], David Basler[2,3], Roman Zweifel[3], David N. Steger[2], Tobias Zhorzel[2], Cedric Zahnd[4], Günter Hoch[2] and Ansgar Kahmen[2]

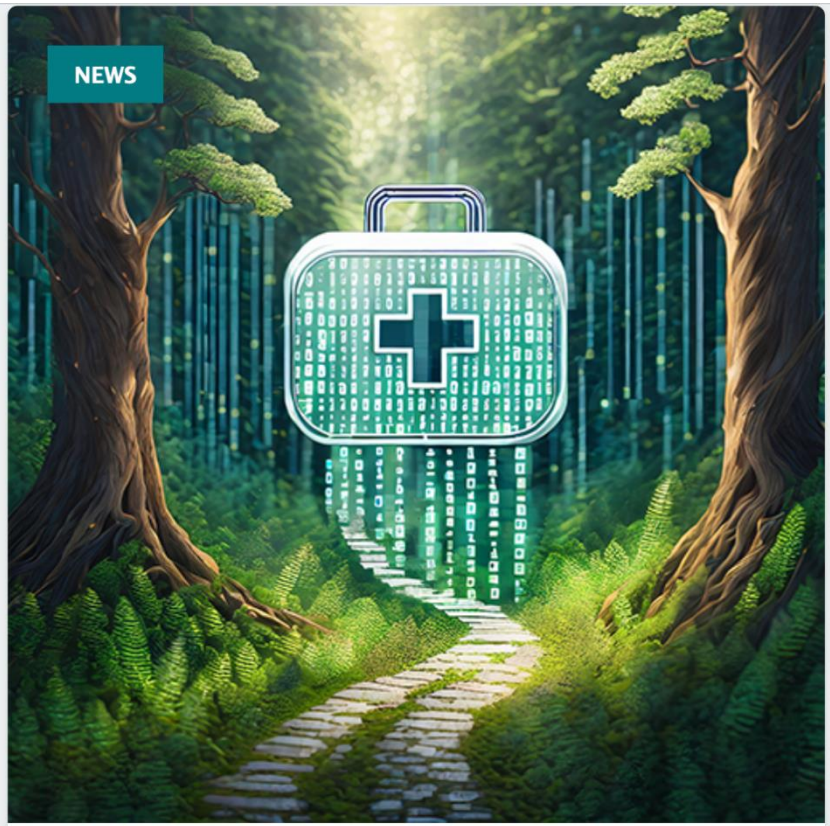


Wachstum und Trockenstress: physiologische Charakterisierung von Schweizer Waldbäumen

Fichte *(Picea abies)*



Zweifel et al. 2025



TreeNetAI – a tool for gap-filling time series data

27. May 2025

TreeNetAI enables the filling of data gaps in time series with machine learning. The Python-based tool is freely available. by…

Mirko Lukovic & Roman Zweifel

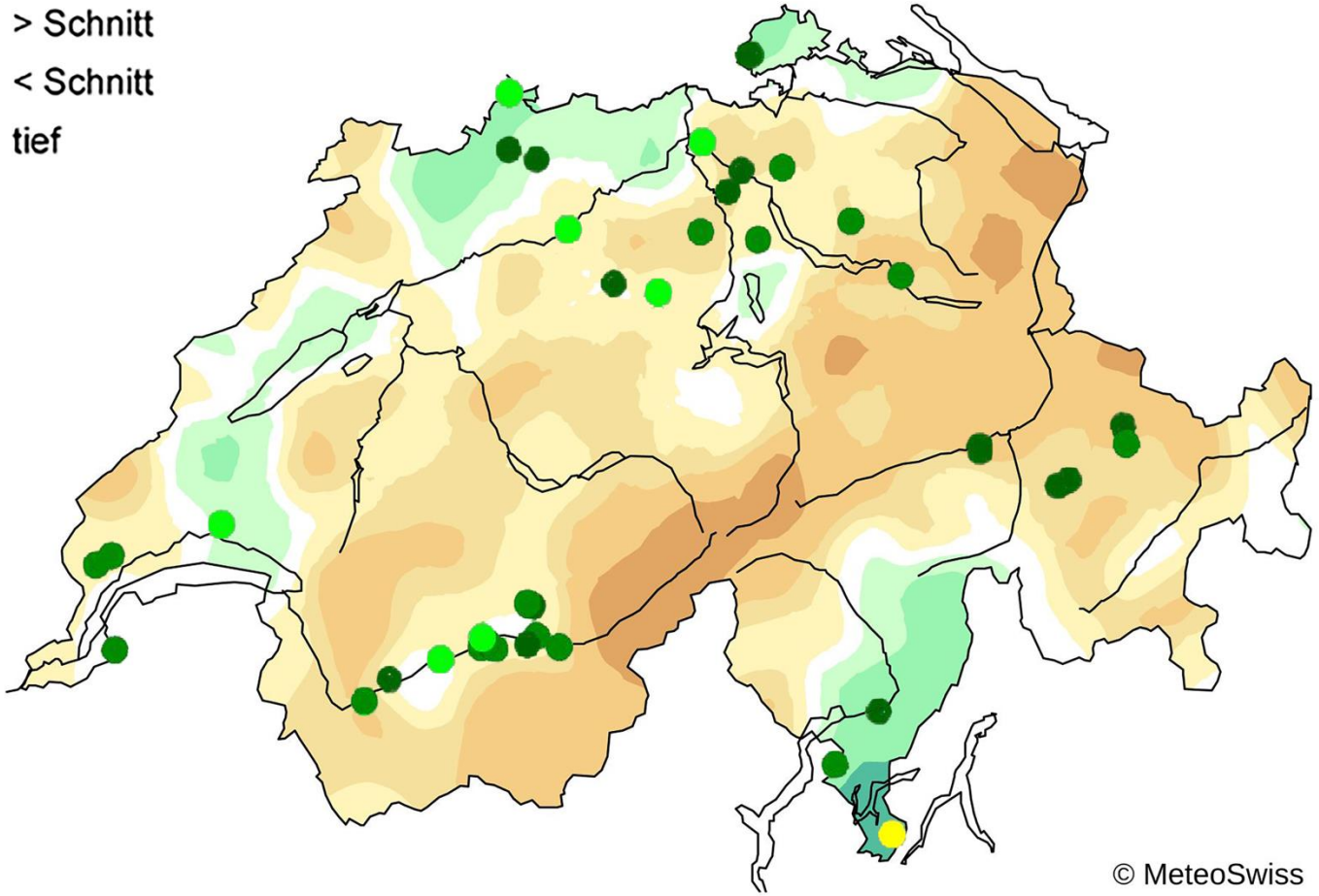
TreeNetAI enables the filling of data gaps in time series with machine learning. **The Python-based tool** is freely available.

➔ **Github**: (https://github.com/treenet/treenetai)
➔ **treenet.info/news**
➔ **EnviDat:**
(https://www.envidat.ch/#/metadata/treenetai)

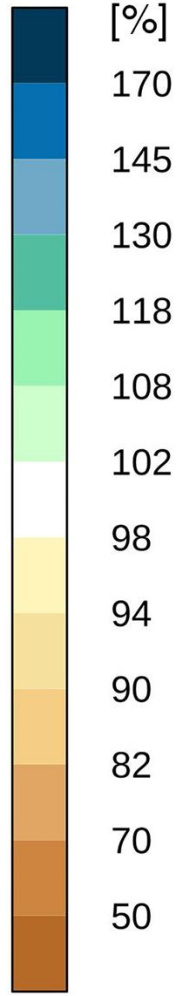
2025

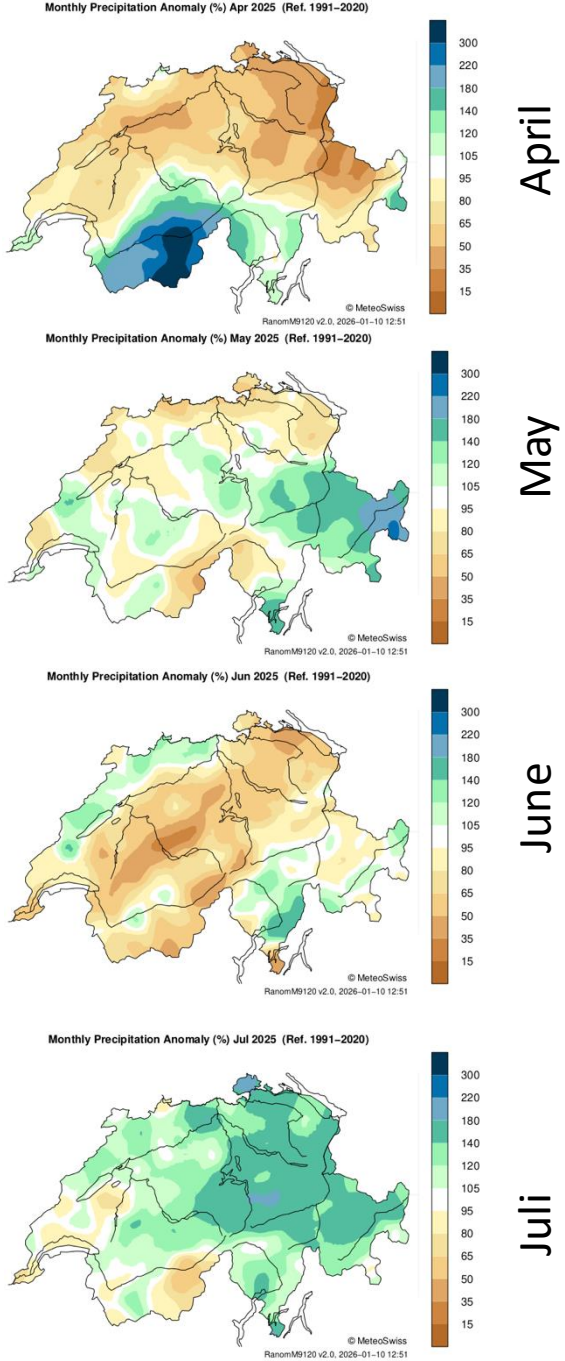
Relatives Baumwachstum

- hoch
- > Schnitt
- < Schnitt
- tief



Niederschlagsanomalie





TreeNet annual meeting – Basel 2026

09:30-10:00	Welcome coffee	
10:00 - 10:30	Roman Zweifel (WSL)	TreeNet Overview
10:30 - 10:50	Sophia Etzold (WSL)	Comparison of 25 years of tree growth and NEP data at a subalpine forest site
10:50- 11:10	Mirko Lukovic (WSL)	Machine learning based L3 processing of dendrometer data
11:10 - 11:30	Capucine Marion (EAWAG)	Dissolved gases in tree sap as new eco-hydrogeological tracers
11:30 - 11:50	Günter Hoch (UniBas)	Low temperature induced hydraulic constraints as a potential driver for the cold distribution limits of temperate trees
11:50 - 12:10	Nina Buchmann (ETHZ)	How atmospheric dryness shapes the global forest carbon sink
12:15 - 13:15	Lunch (Mensa)	
13:20 - 13:50	Stefan Hunziker (WSL)	Manipulating precipitation & atmospheric water demand: Effects on adult Pinus sylvestris in the VPDrought project
13:50 - 14:10	Ansgar Kahmen (UniBas)	Root water uptake depth explains the drought response of temperate tree species
14:10 - 14:30	Jan Svoboda (HSLU)	Forecasting tree water deficit to identify climatological drivers of forest drought using explainable deep learning
14:30 - 14:50	Stefano Martinetti (ETHZ)	Exploring the effect of tree hydraulic capacitance on soil-plant hydraulics and transpiration
14:50 - 15:10	Arun Bose (WSL)	Tree growth under tension: Atmospheric demand, soil water supply, and the physiological bottleneck
15:10 - 15:30	Coffee break	
15:30 - 16:30	TreeNet board meeting	

Thank you!



Sophia Etzold, Dominik Hummel, Micah Wilhelm, Frank Sterck, Sabine Braun, Arthur Gessler, Lorenz Walthert, Nina Buchmann, Susanne Burri, Richard Peters, Matthias Häni, Simon Knüsel, Käthi Liechti, Mirko Lukovic, Jan Svoboda, William Aebersold, Christian Hug, David Basler, Arun Bose, Ansgar Kahmen, Andrea Carminati, Charlotte Grossiord, Andreas Rigling, Tom Wohlgemuth
and many more …