TreeTalker Cyber: A Multi-Sensor, Low-Cost IoT Platform for Real-Time Monitoring of Tree Ecophysiology

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Session Date and Time:
EGU2025; 1 May 2025; [G1.3] 16:15–17:55 (CEST)

Critical infrastructures

Urban areas

Temperature reduction and other microclimatic effects

Removal of air pollutants

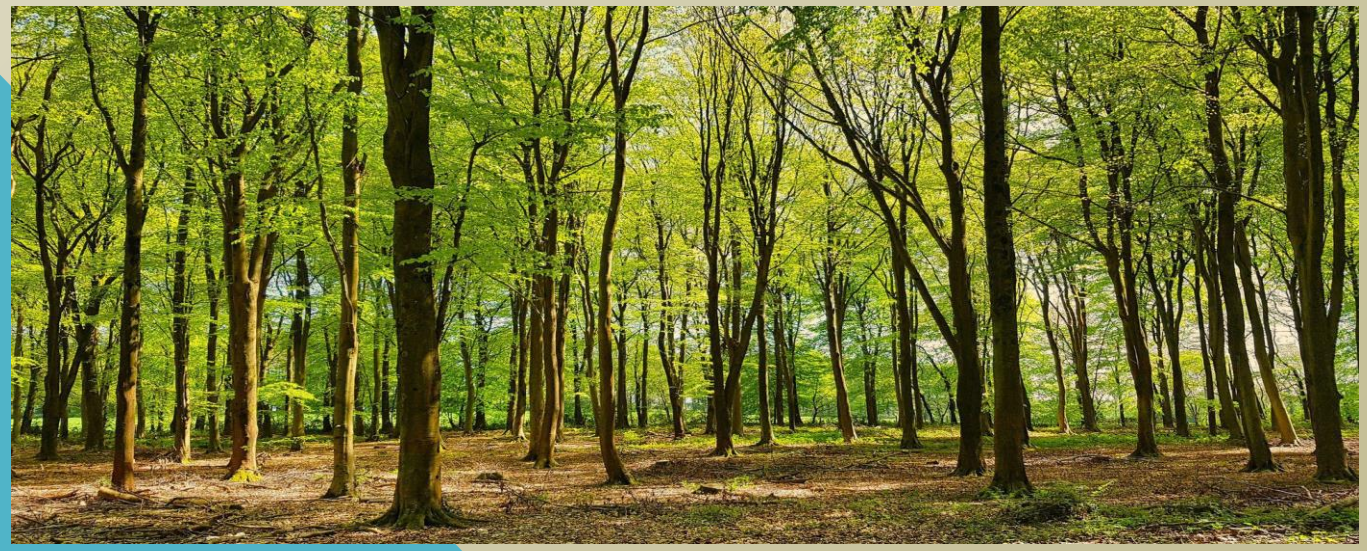
Energy effects on buildings

Enhancement of human mental health

Stormwater runoff management

Forests and rural areas

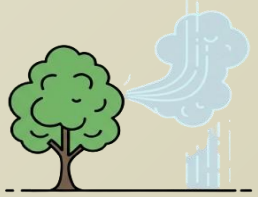
Carbon sequestration
Water Management
Natural Disaster Mitigation
Soil Conservation
Water filtering



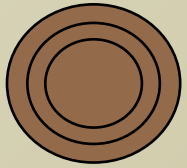
Impact on water management

Canopy interception of rainfall 

Enhancement of water infiltration through root systems

Evapotranspiration 

Depending on

Age/Size 

Canopy density/Leaf Area Index

Health/Vitality 

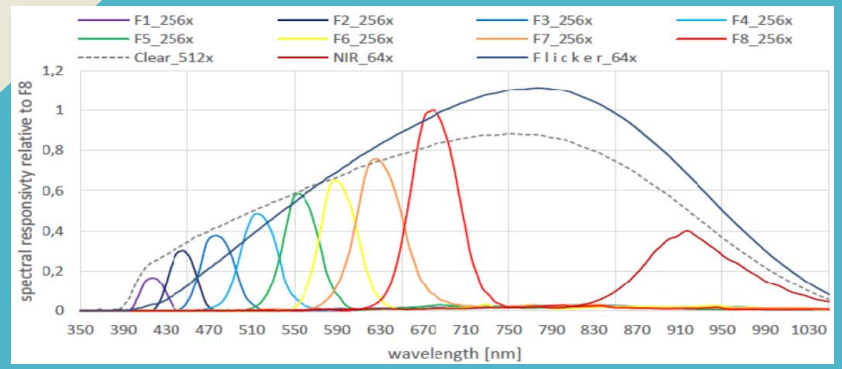
Solar radiation

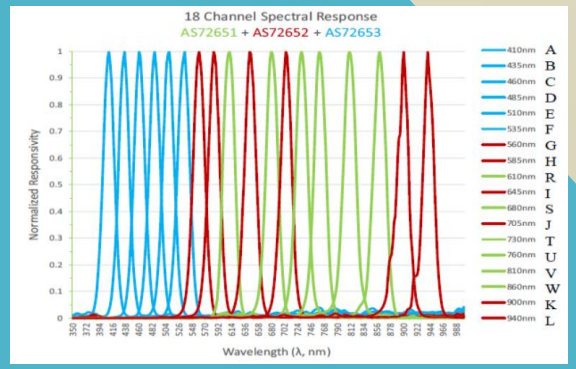
TreeTalker Cyber

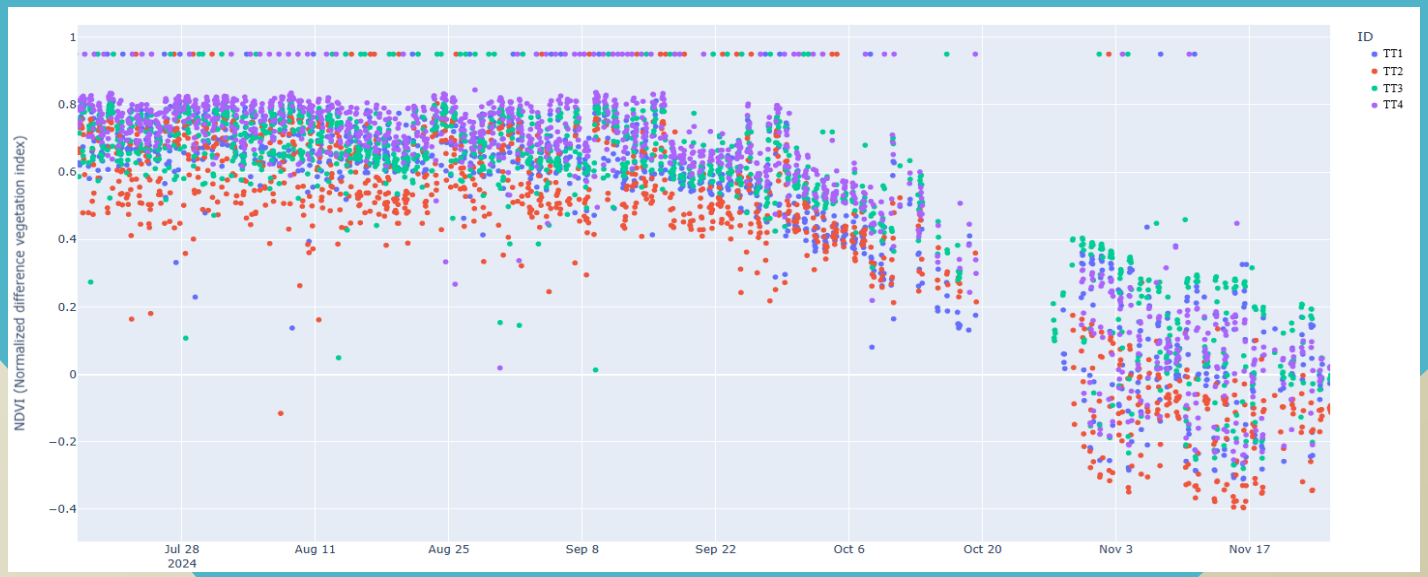
IoT platform for the measurement of trees ecophysiological parameters for the measurement of:

- Spectral radiation intensity below the canopy
- Sap velocity
- Growth rate
- Microclimate data
- Trunk inclination
- LoRa or NB-IoT connectivity

Solar radiation below the canopy



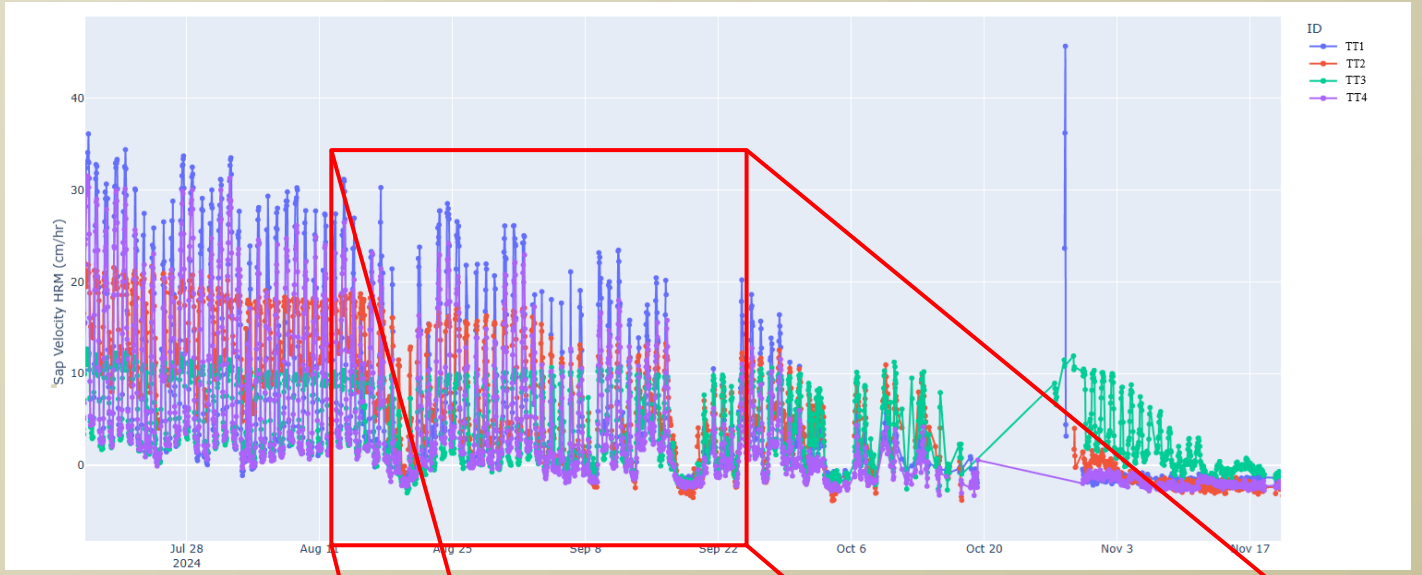


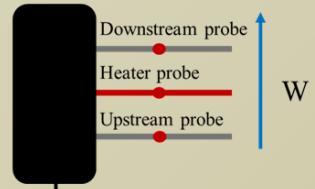


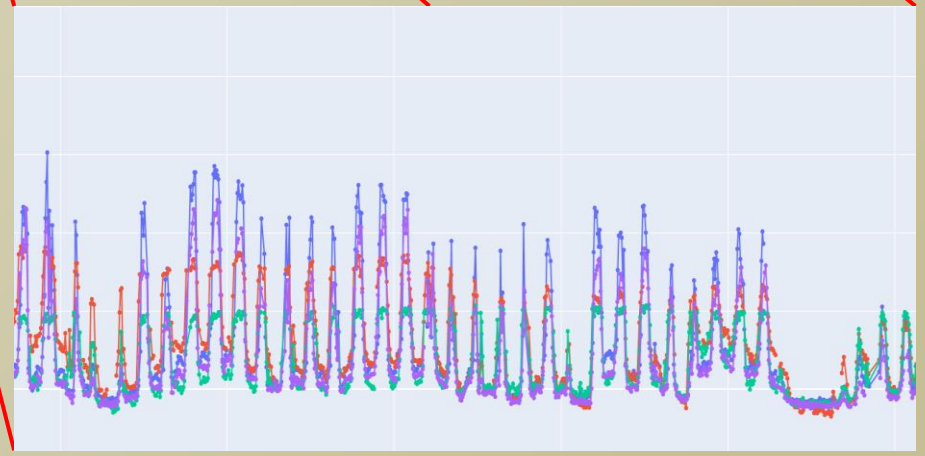
- 26 spectral bands
- Measure the intensity of the light transmitted by the leaves
- NDVI below the canopy is related to canopy wellbeing
- Canopy coverage is related to Leaf Area index

Sap velocity

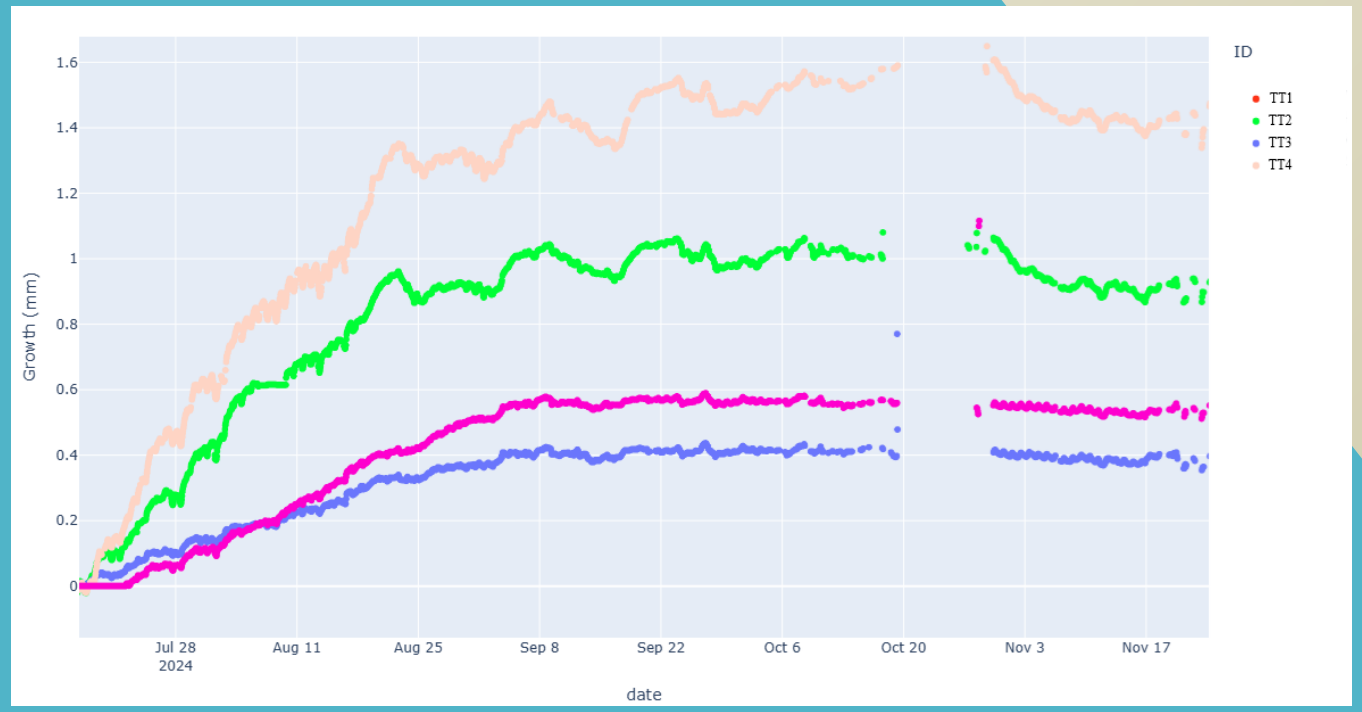
- Sap velocity is calculated using the heat pulse velocity (HPV) method
- Daily pattern as well as seasonal effects can be observed
- The water consumption can be measured directly, allowing also an optimization in the use of the resources







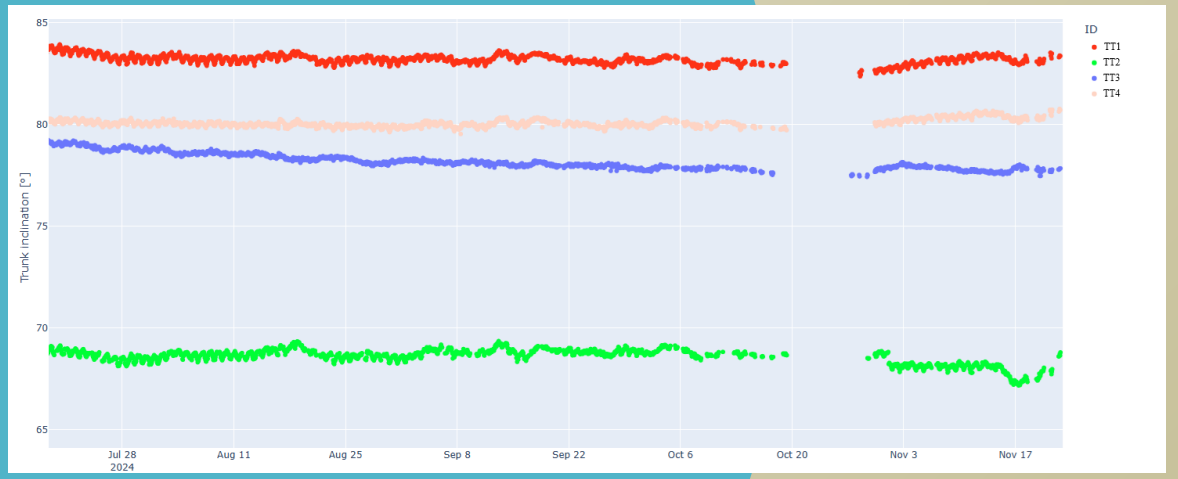
Growth sensor



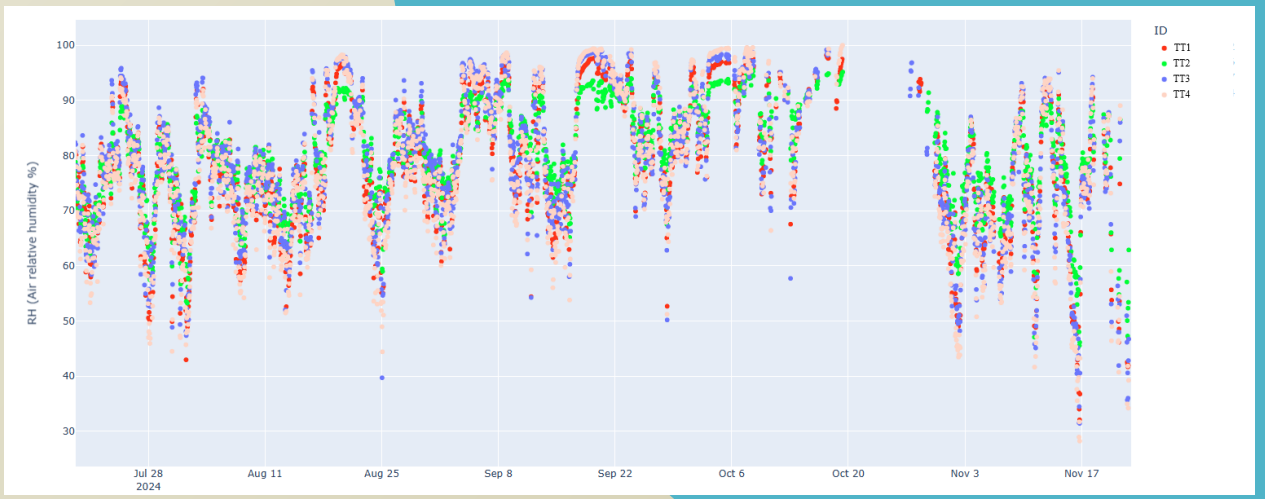
- Radial tree growth is measured with a nominal resolution < 0.5 µm
- The tree growth is required to extend the measurements from the other sensors to the entire tree
- It is also direclty related to the carbon sequestration that is another ecosystem service provided by trees

Other variables

Air temperature



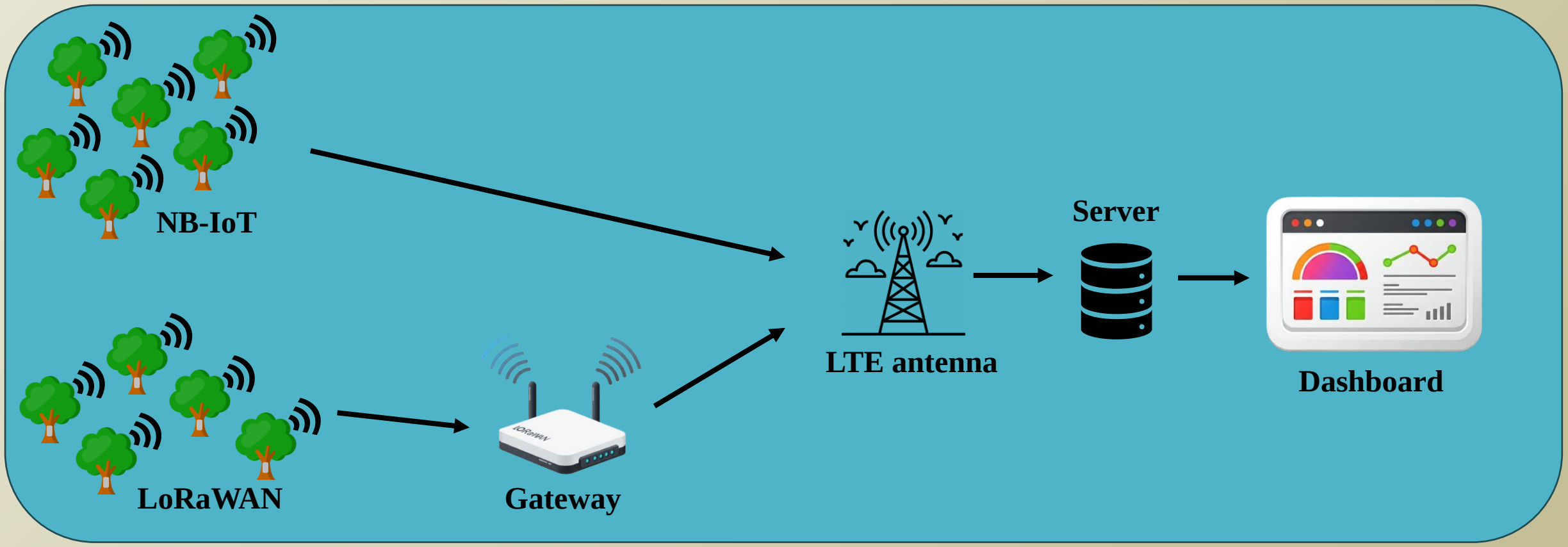
Trunk inclination



Air relative humidity

IoT network

The device network can send data using NB-IoT or LoRa technology. Data are saved on a server for storage and visualization.



Conclusions

- TreeTalker Cyber is an innovative IoT device for the measurement of the main ecophysiological parameters of trees
- The device allows the real-time monitoring of forests, green urban areas, as well as fruit trees, contributing to the enhancement of knowledge on these systems, particularly in remote areas. The device is also contributing to the creation of large datasets, particularly useful in machine learning analysis.
- The platform contribute also in the measurement of the ecosystem services provided by the plant as well as in measuring the required resources and optimize them subsequently

Thank you

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For more information:
https://www.nature4.org