CONFERENCE
ARTIFICIAL INTELLIGENCE AND ECOSYSTEMS MANAGEMENT

17-21 April 2023

AI4TREES - AI for climate sensitive tree growth modeling

Anita Zolles

Project Infos

- **Start:**
  01.04.2022
- **Runtime:**
  3 years
- **Main Goal:**
  Build a model that predicts tree growth
- **Side Goals:**
  Compare AI and statistical model, calculate single tree competition from TLS Data, automated data preparation …

Project Partners:

AIT Austrian Institute of Technology – Tomorrow Today	Projekt coordination, Explainable artificial intelligence
BFW Bundesforschungszentrum für Wald	Tree growth sensor data
umweltdata	Laser Scanning, Point cloud monitoring
Know Center	Probabilistic learning, Data science
E.C.O. Institut für Ökologie	Model evaluation, Error analysis, Validation
GeoVille	Earth Observation for vegetation and change detection

The developments described are carried out within the AI4Trees research project funded by the Austrian Research Promotion Agency (FFG) in the frame of the Research, Technology & Innovation (RTI) initiative "AI for Green".

FFG Promoting Innovation.

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie

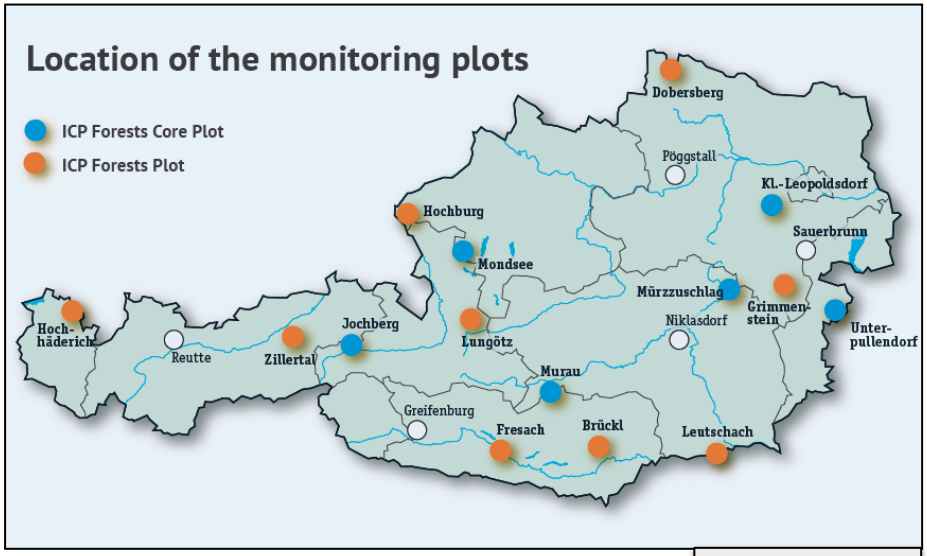
Data Overview

Growth Data from ICP Forests

- High Frequency
  ~10 trees per plot (blue)
  ~from 2011 on each hour

- Mid Frequency
  ~20 trees per plot (blue)
  ~from 2011 on every 2 weeks

- Low Frequency
  ~100 trees per plot (blue+orange)
  ~from 1994 on every 5 years



Tree Species:
-) Spruce
-) Beech
-) Oak

Other Data Sources

- TLS Scannings
- Satellite Data
- Other ICP Forests Data

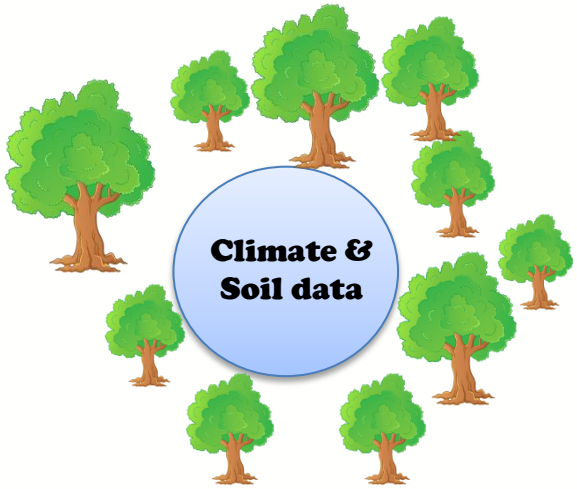
Part 1:
High Frequency Growth Data

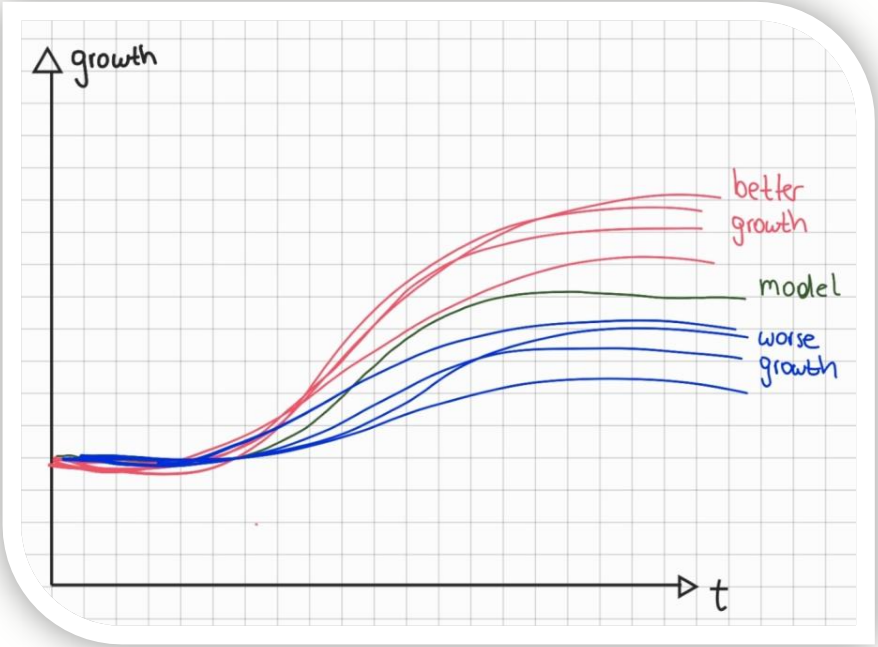
Model types
- Long short-term memory (LSTM)
- Statistical Model

Data input
- Climate data
- Soil data (moisture, temperature)

What we can't do:
- Predict growth for individuals

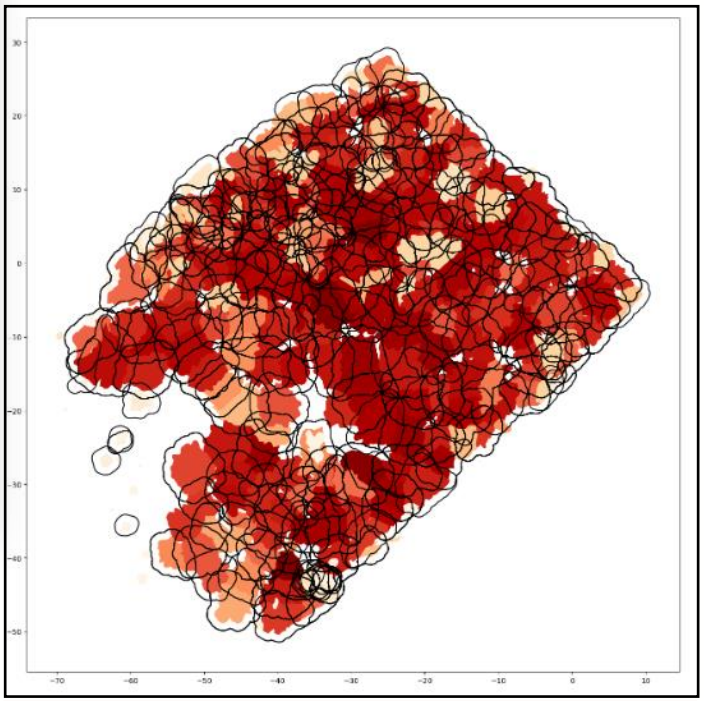
Main Output
- Growth on-/offset
- Duration of the growing period
- Good/Bad years





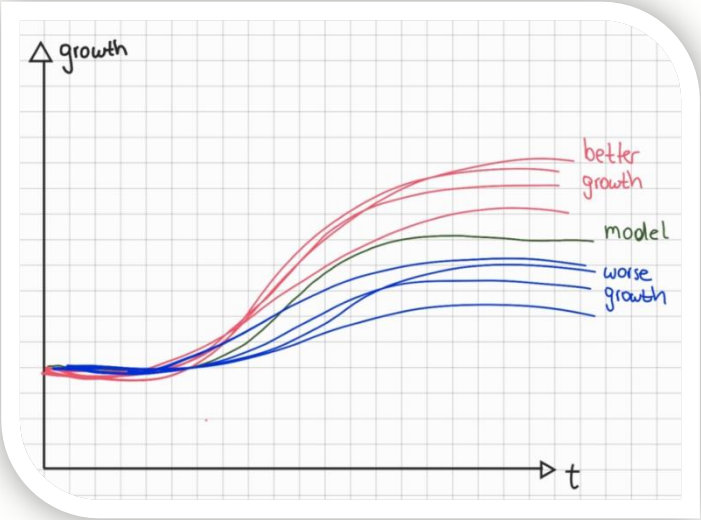
Part 2:
Terrestrial Laser Scanning

- Calculate different (combinations of) competition parameters
- Compare accuracy of TLS and manual measurement (mid frequency)
- Create a growth model that only uses competition (using mid frequency measurements)

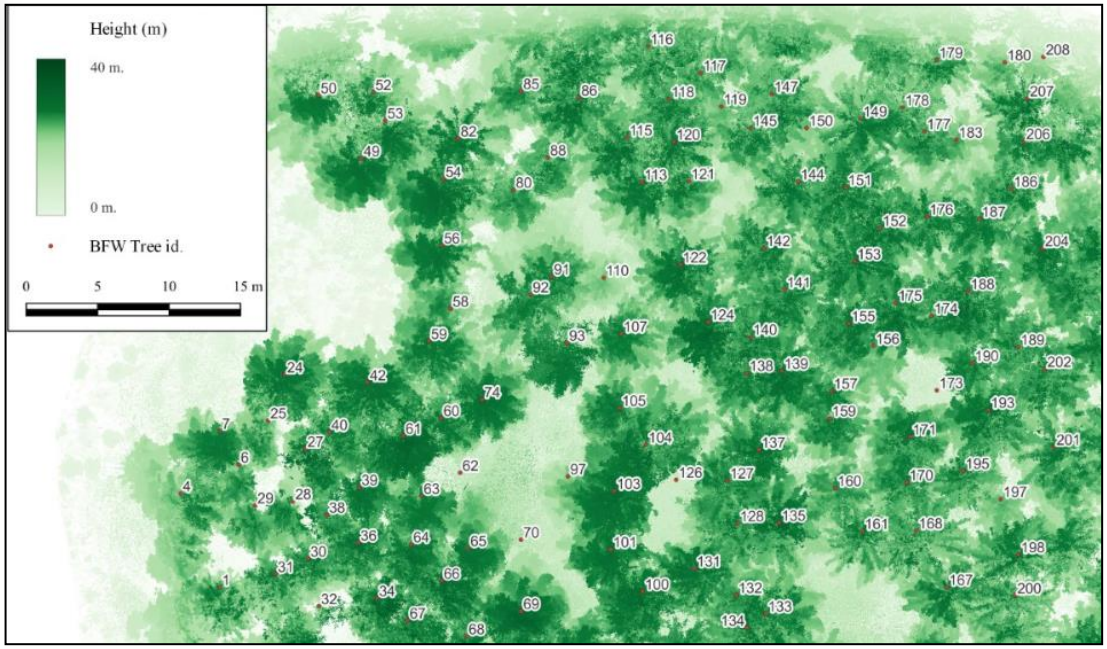


Projected tree crowns with 1m buffer zone from LIDAR Scan

Part 2:
Error analysis



Over-/Underperforming trees?
Important competition indicators?

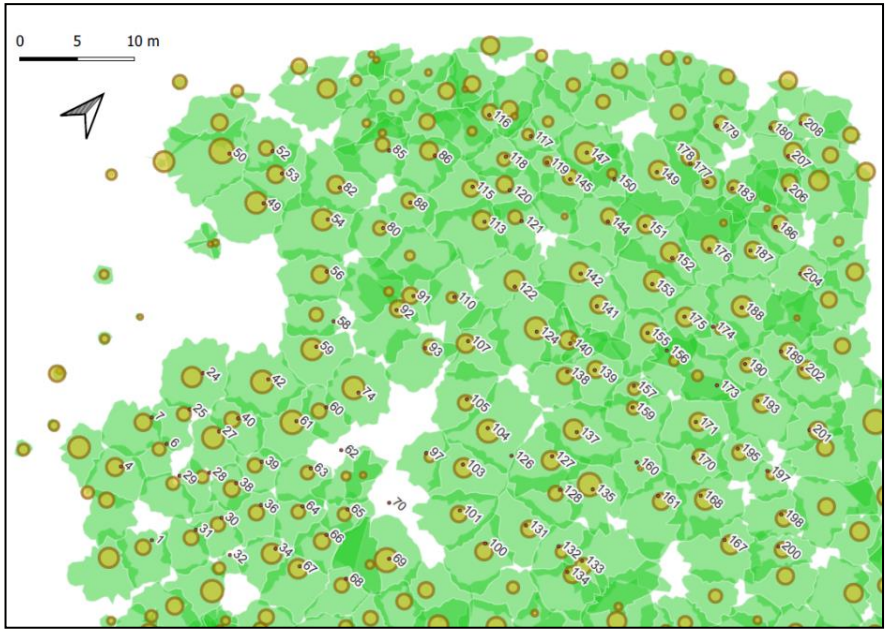


Part 3:
Low Frequency Growth Data

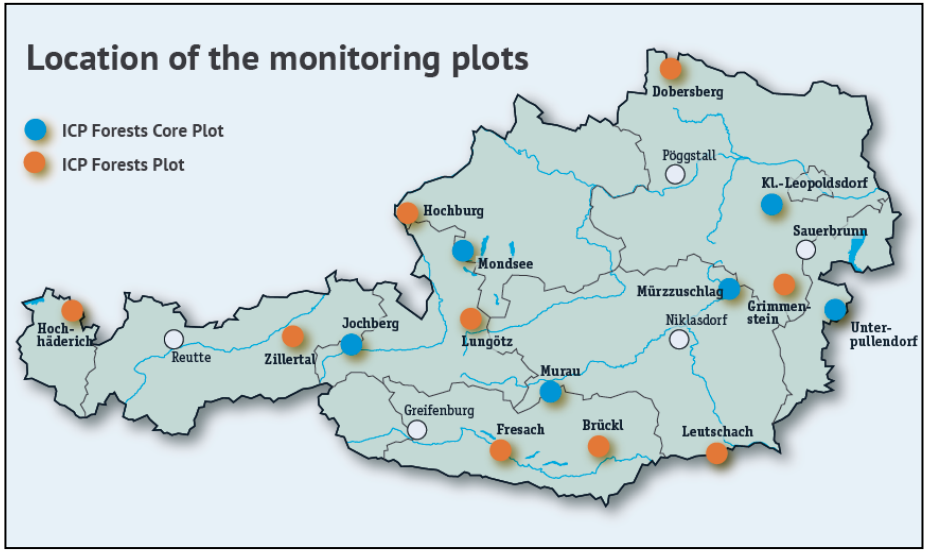
Model that uses TLS data as input

Model that only uses automated data as input

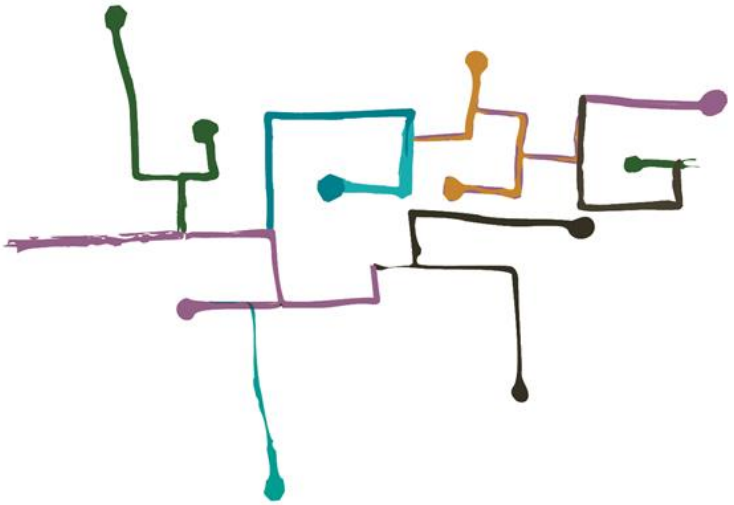
Model that contains automated and TLS Data
Trained and tested on high- and mid- frequency growth data



-) Final test of the model using the low frequency data
-) Test on other sites



https://ai4trees-project.at/

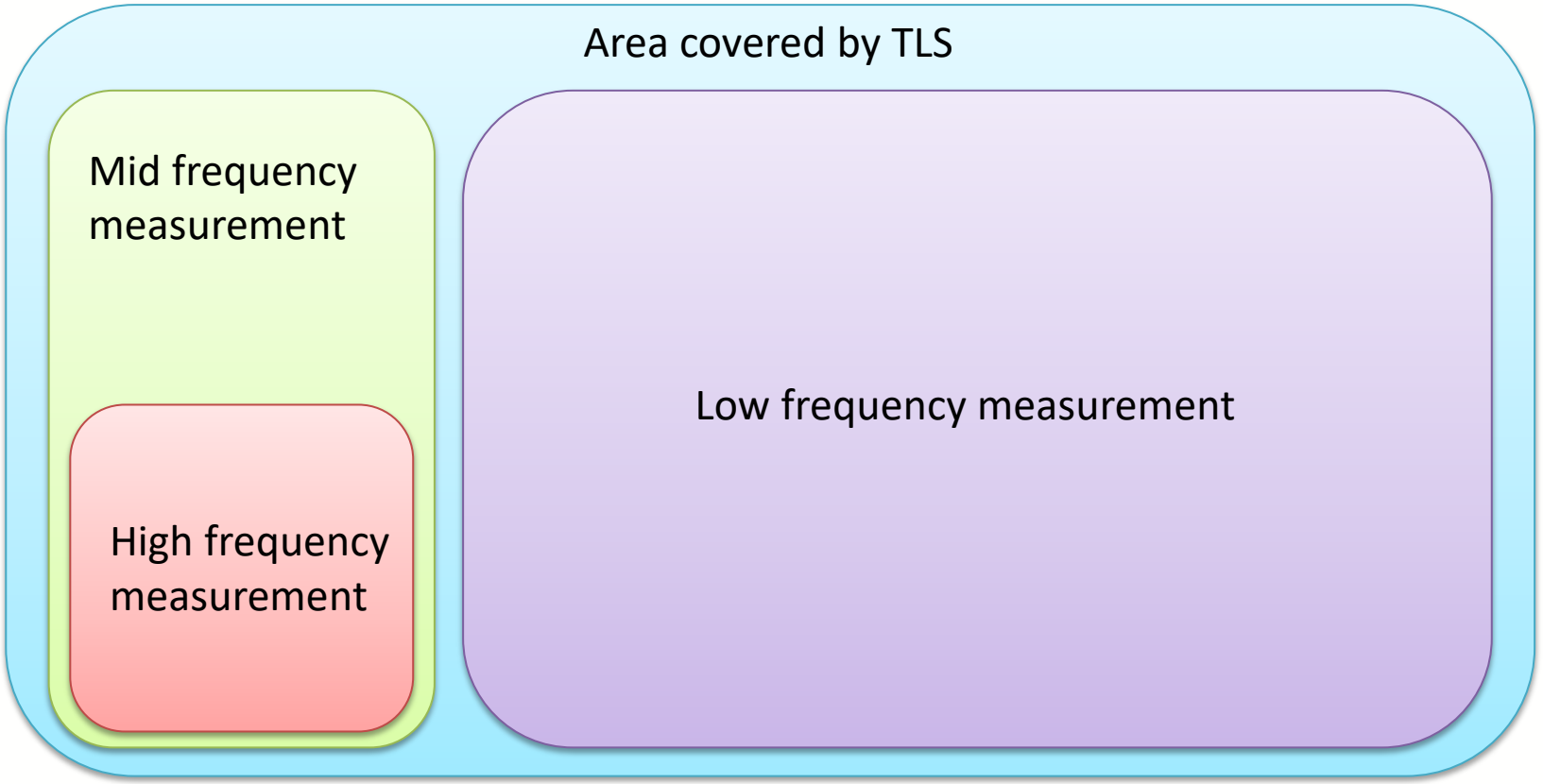


SMART GLOBAL ECOSYSTEMS
Universidad de Valladolid + SNGULAR

Diputación DE PALENCIA

UVa PALENCIA

Set up

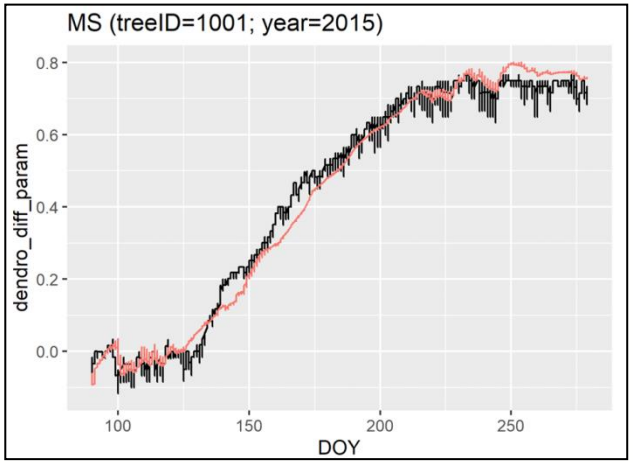

Area covered by TLS
Mid frequency measurement
High frequency measurement
Low frequency measurement

Part 1:
Some results

AI model

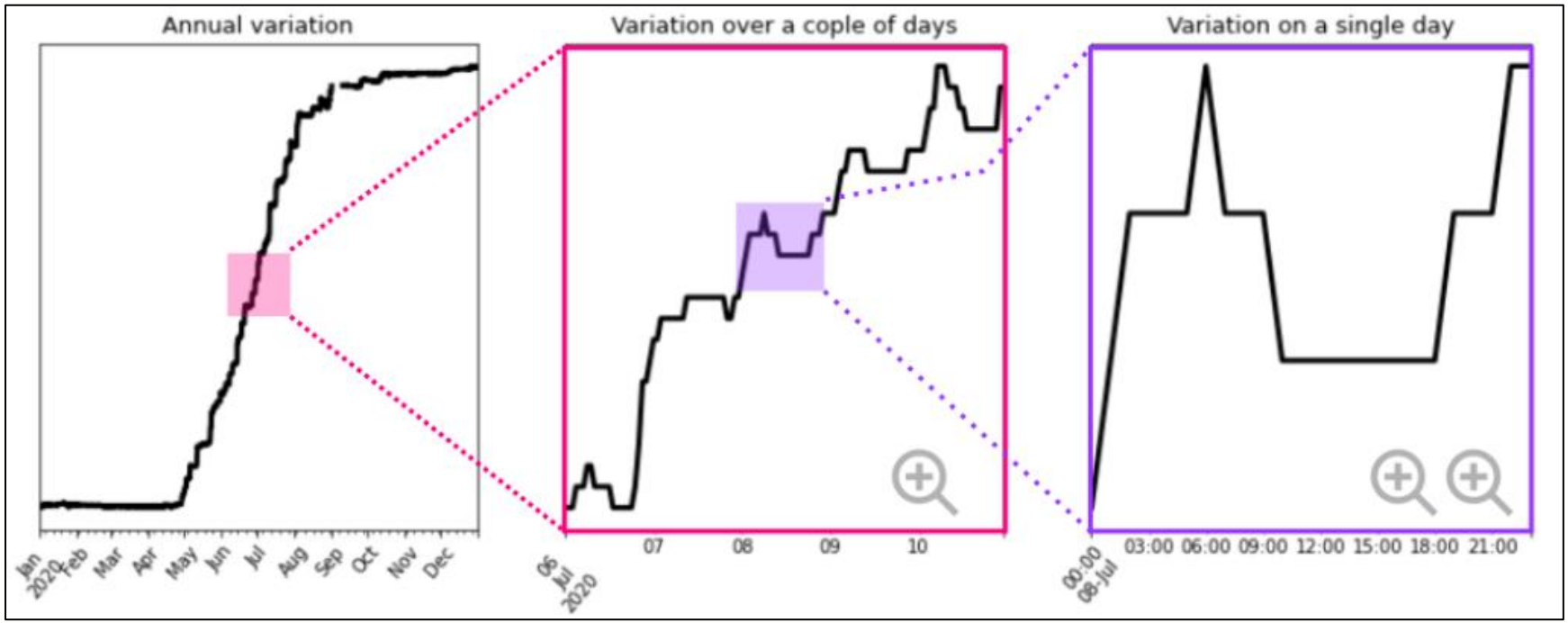
Statistical model

- Using the GAM to identify important parameters and threshholds (without test/train split)



- Running different models to see performance

Dendrometer variation



Other outputs

- Growth onset and satellite data