A small, blue, stylized robot character is positioned on the left side of the slide. It has a rounded body, a single antenna on its head, and a friendly-looking face with a large eye.

Assessing the accuracy of automated large-scale ALS single tree classification and modelling

dr. Klemen Čotar, Blaž Šušteršič, Günther Bronner

What is FLAI ?

- Web cloud-based AI driven platform for point cloud processing -> flai.ai
- Automation of all key processing steps

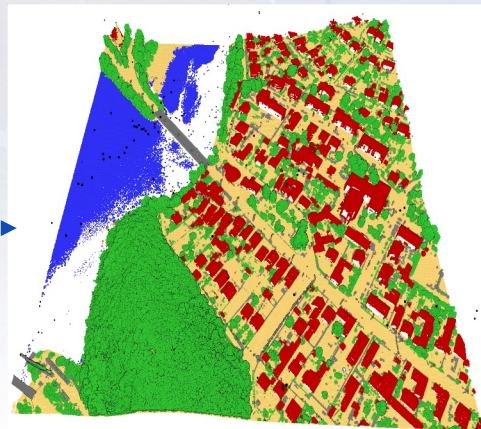


Point clouds and imagery

Raw data



Processed data



From:

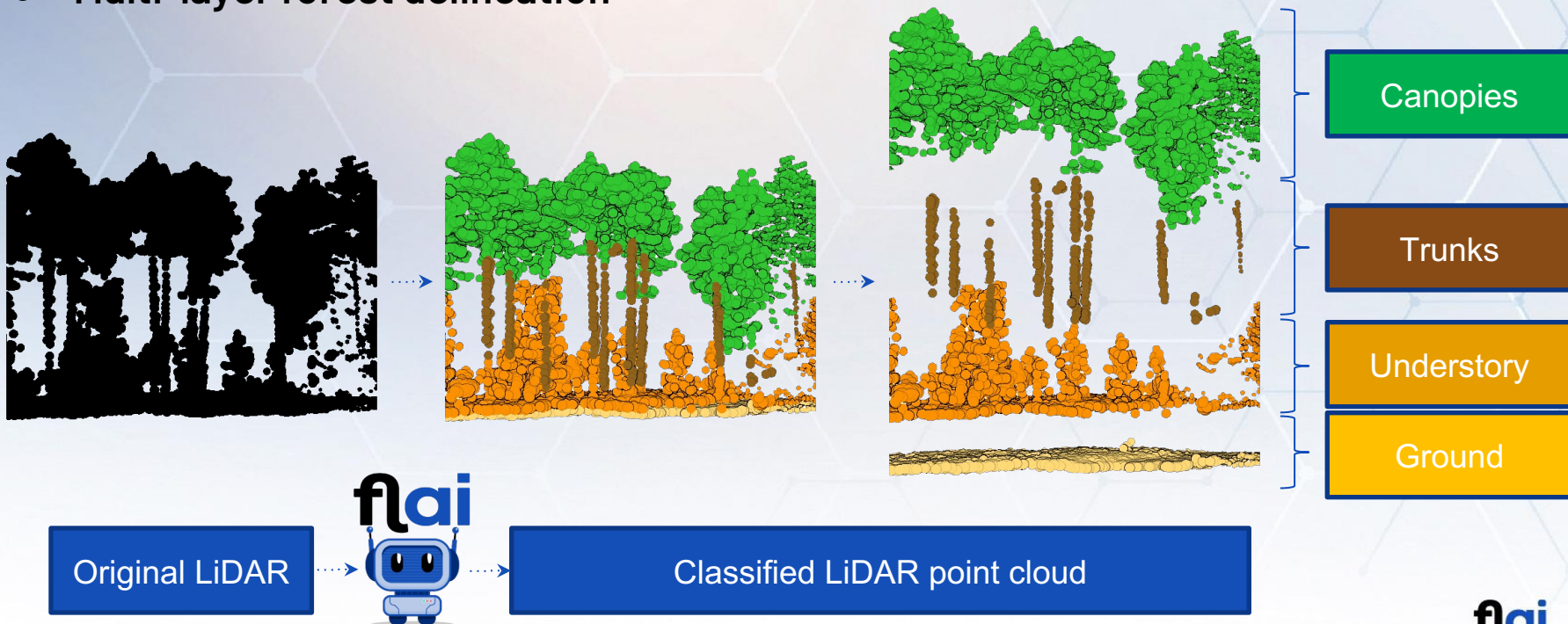
Manual
Time consuming
Expensive
Not Scalable
Complex

To:

Automatic
Time efficient
Affordable
Scalable
Easy to use

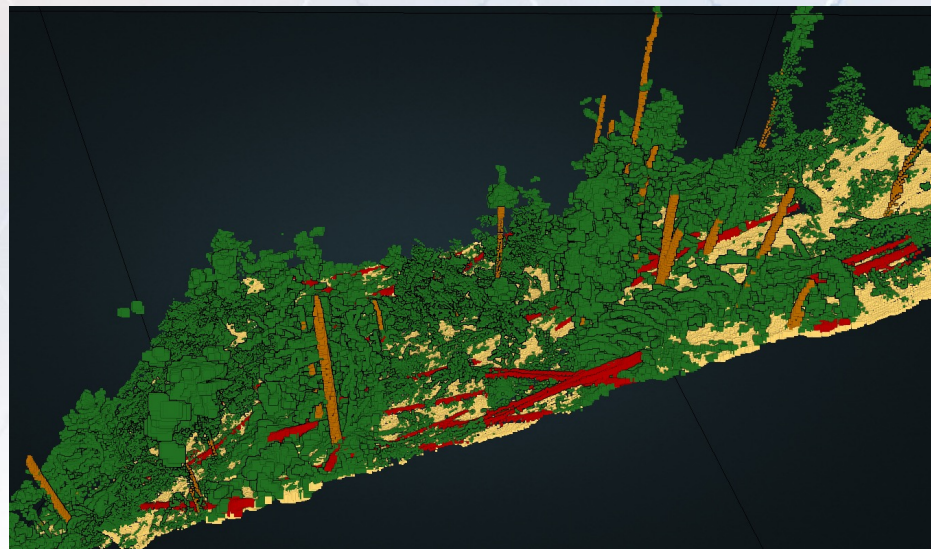
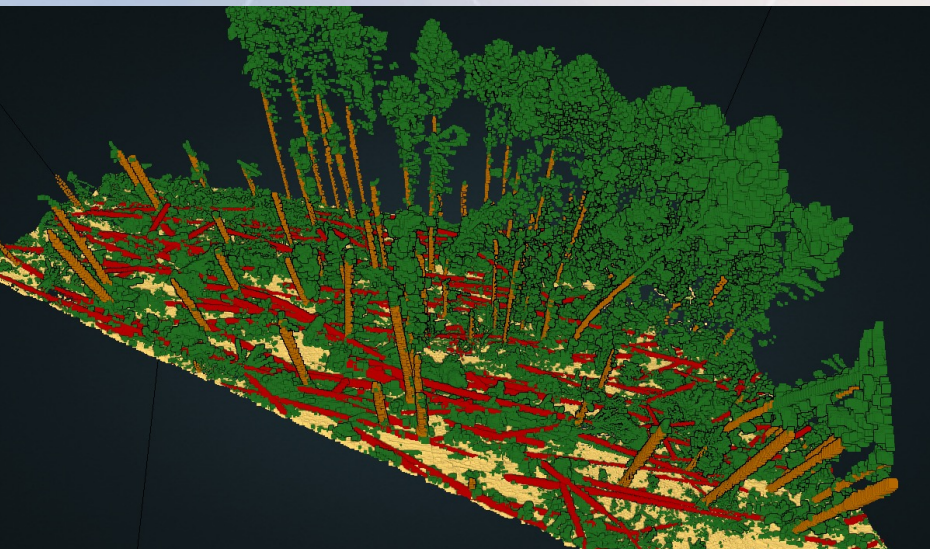
LiDAR point cloud classification – tree inventories

- Multi-layer forest delineation



LiDAR point cloud classification – natural disasters

- Fallen tree detection
- Analysis – density, locations, tree sizes



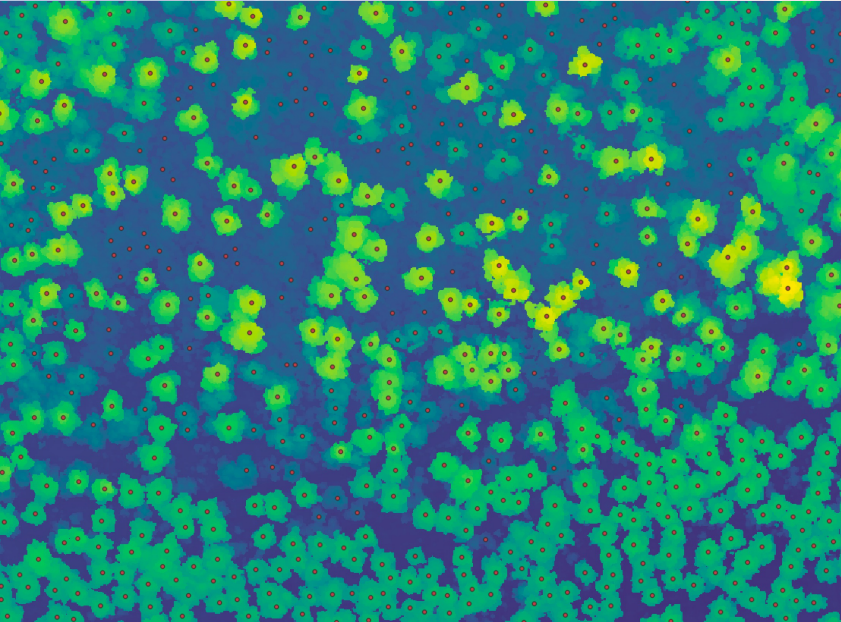
LiDAR point cloud instance classification

- Identify individual trees in point cloud
- Easier post-analysis of a single tree
- Enables species identification and classification



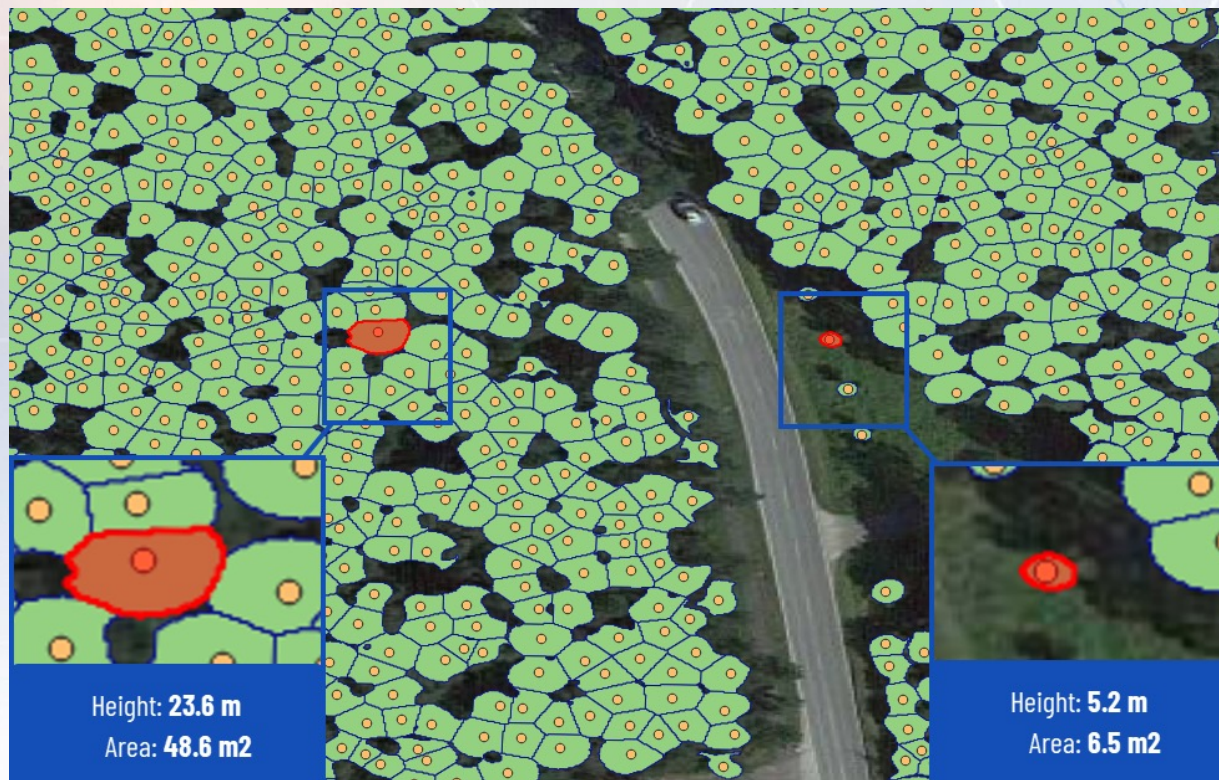
Single tree - tree top detection

- Automatic detection of the highest point of trees
- Peaks in CHM



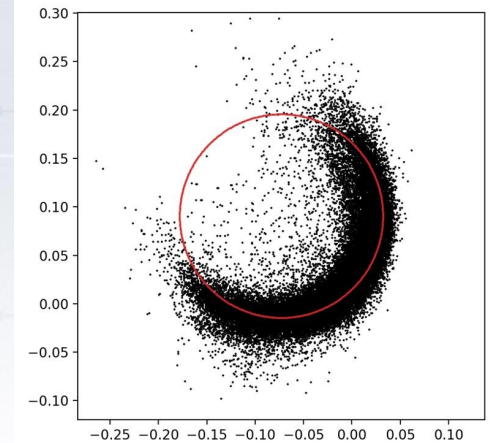
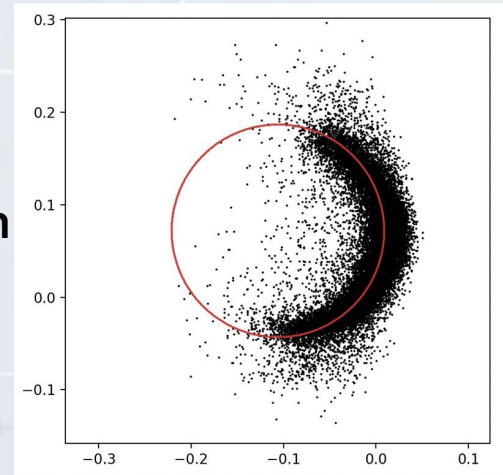
Tree crown segmentation and attributes

- Area
- Height
- Distribution of points inside canopy

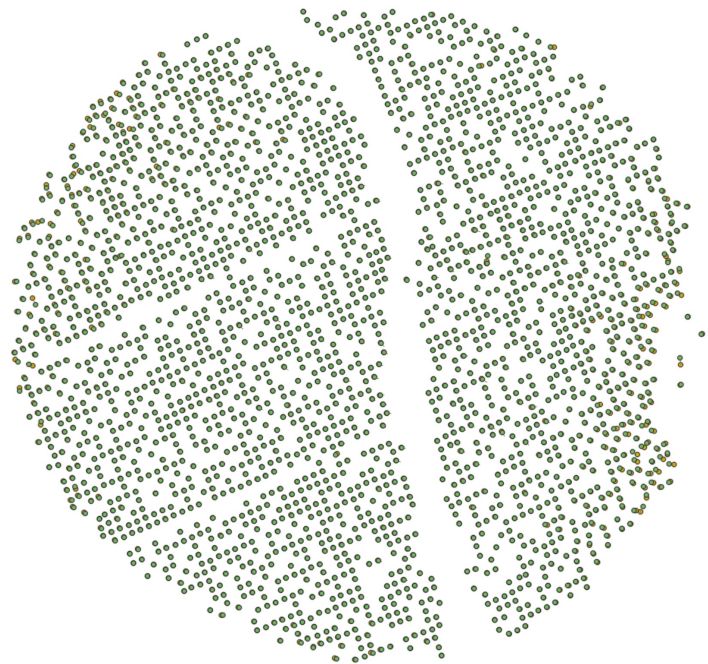


Single tree - trunk extraction

- Automatic detection of tree trunks, branching detection
- Reconstruction with a fitted linear line
- Diameter measurements at multiple heights
- Trunk straightness



Single tree forest inventory

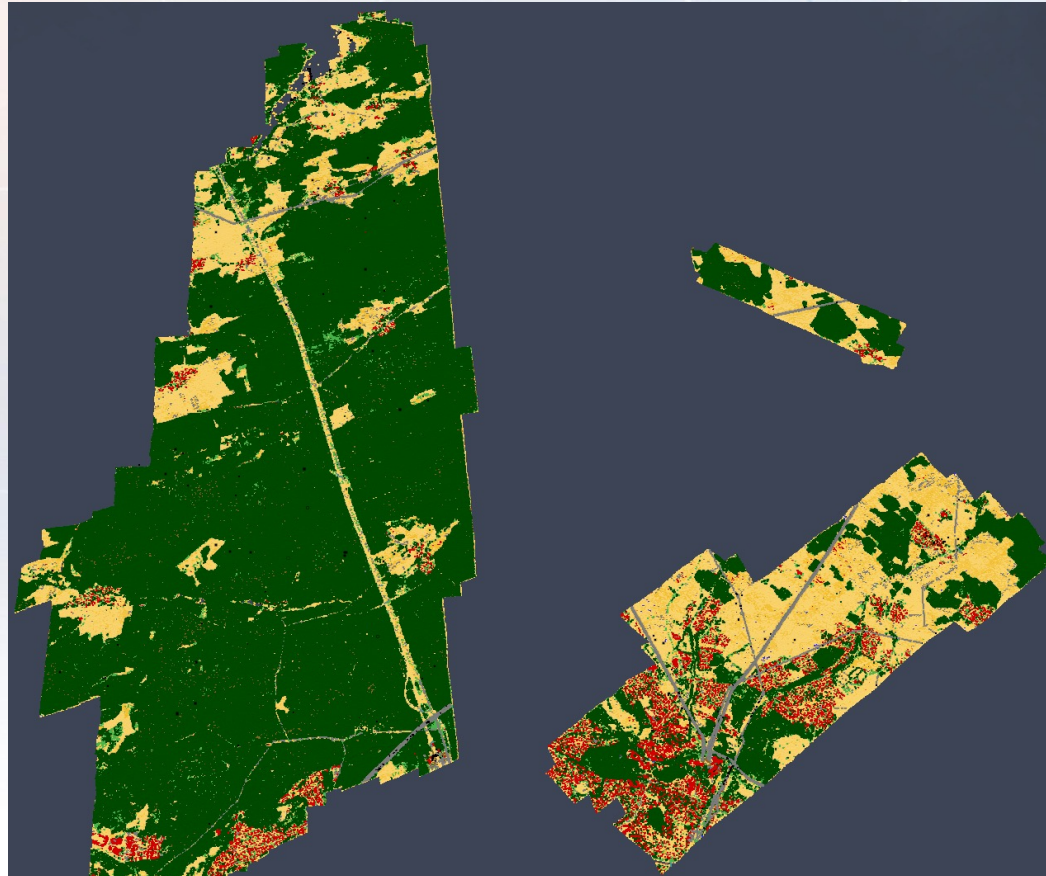


- Location
- Height
- Area under canopy
- Trunk fitted vector
- Trunk length and multiple diameters



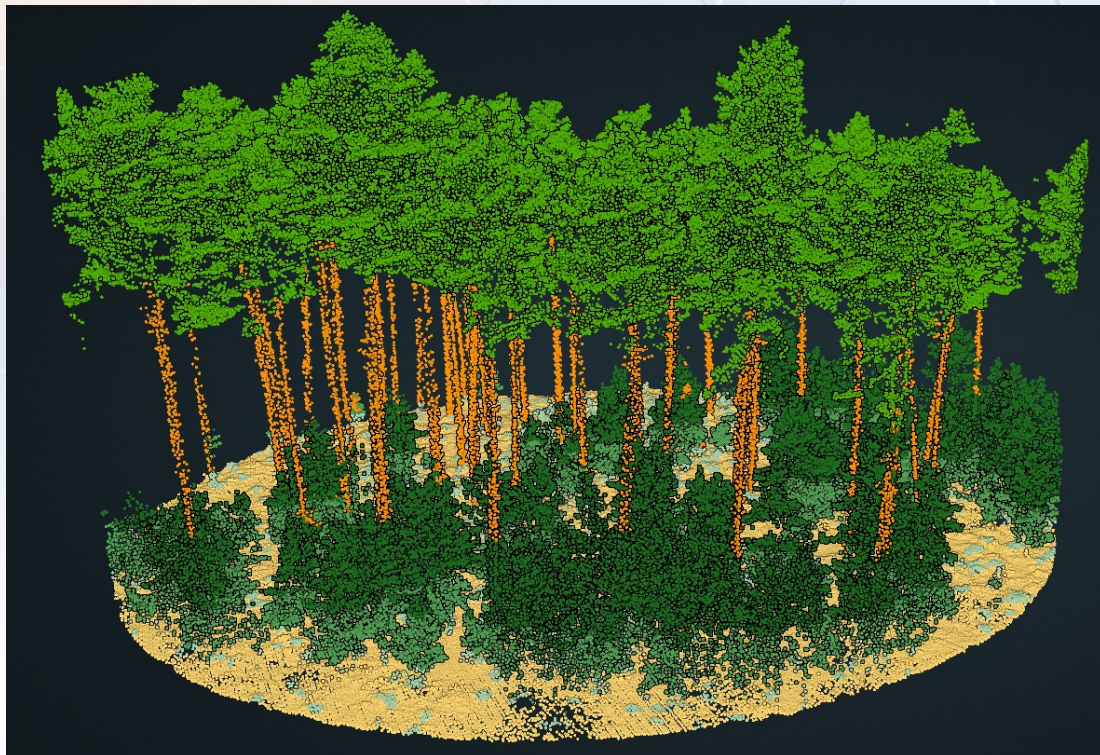
Large-scale ALS processing example

- 4600 ha of forests
- 90 pts/m²
- Different layer configurations
- Mostly coniferous
- Classification run for all possible classes – forestry and geospatial
- 1.7 million tree trunks and tree tops identified



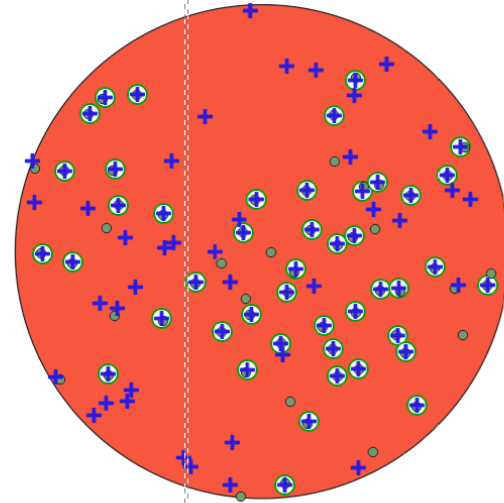
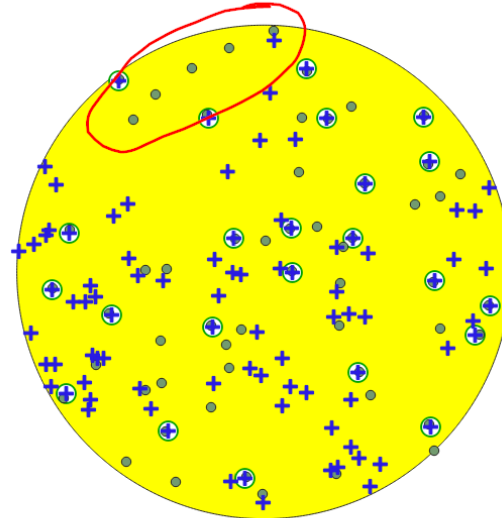
Validation – validation dataset

- 129 TLS plots, diameter of 50 m
- Manual measurements of trees in plots
- More than 13000 trees
- Diverse vegetation
- Different acquisition time than the ALS



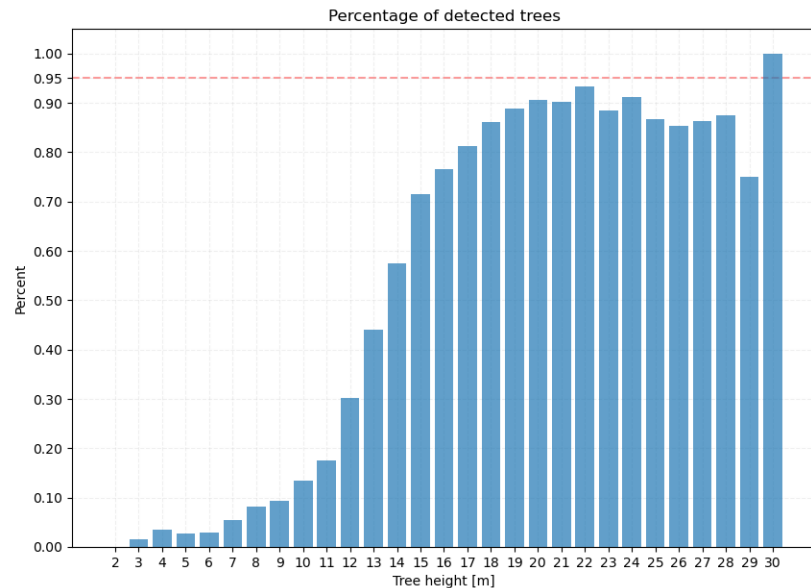
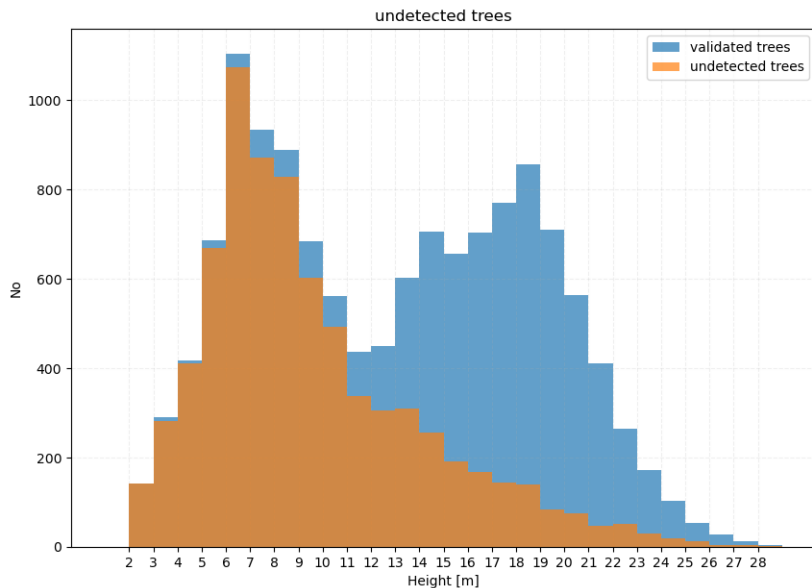
Validation – procedure

- Match measured location and tree fits at breast height
- Allow for 0.5 m displacement
- o -> detected tree
- + -> measured tree
- TP are circled with green circles



Validation – tree trunk location by height

- Recall value: 0.85 above 15 m, 0.46 for all trees



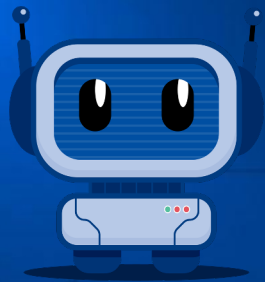
Conclusions

- **ALS data can be used to extract trunk information**
- **Unable to extract trunks in dense understory and for low trees**
- **Possible occlusion problems**

Future work

- **AI model retraining for specific forest cases**
- **Improve fitting for non-straight trunks**
- **Fully implement instance segmentation and species classification**

Thank you for your attention!



flai

klemen.cotar@flai.ai

umwelt  **data**

Klemen Čotar

 **cost**
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

www.cost.eu



**Funded by
the European Union**

This article/publication is based upon work from COST Action CA20118, supported by COST (European Cooperation in Science and Technology).

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.