SMARTForest

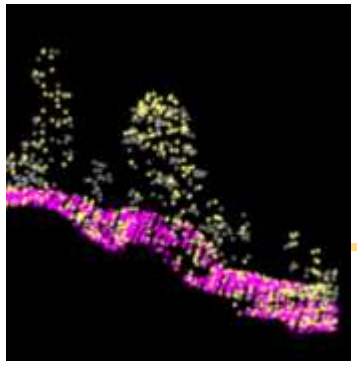
The digital forest: opportunities for innovation and improved forest management

Rasmus Astrup, NIBIO

sfi Centre for Research-based Innovation
The Research Council of Norway

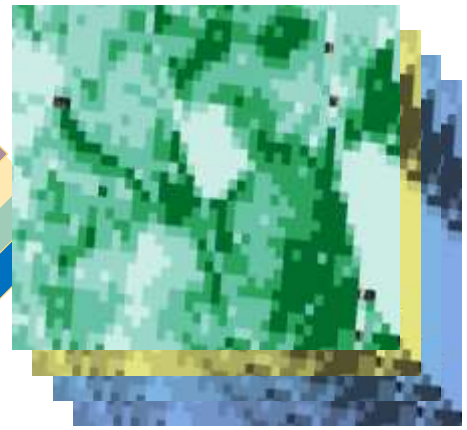
Background Norway: State of forest information

National LIDAR campain

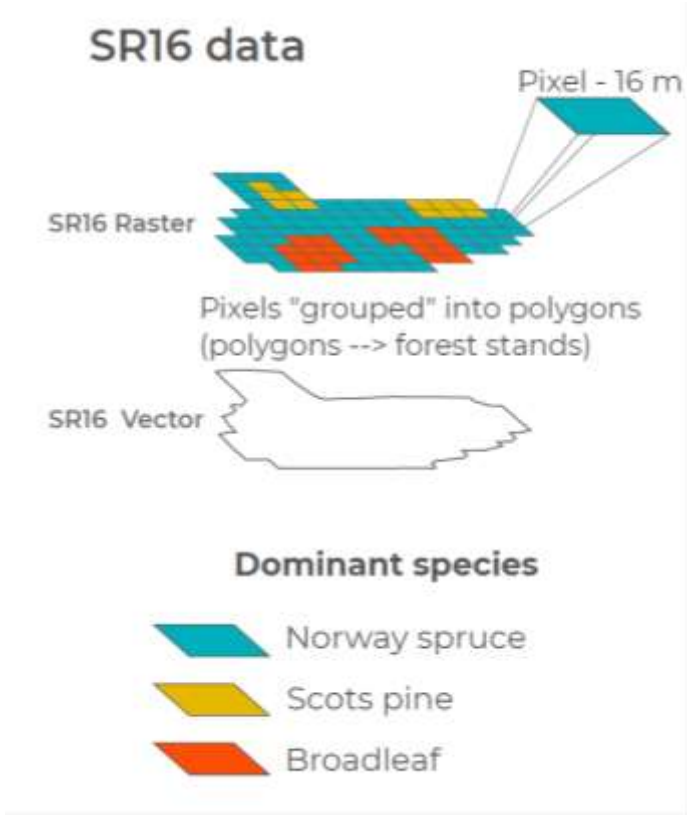


NFI
3 by 3 km systemtic grid

$y = f(\beta, X, \gamma) + \varepsilon$



National free froest resource map SR16



Astrup et al. 2019; Hauglin et al. 2021; Schumacher et al. 2022; Anton-Fernandez et al. 2023

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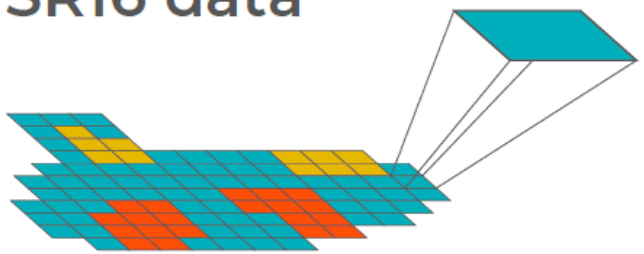
Pixel-level information we are using:

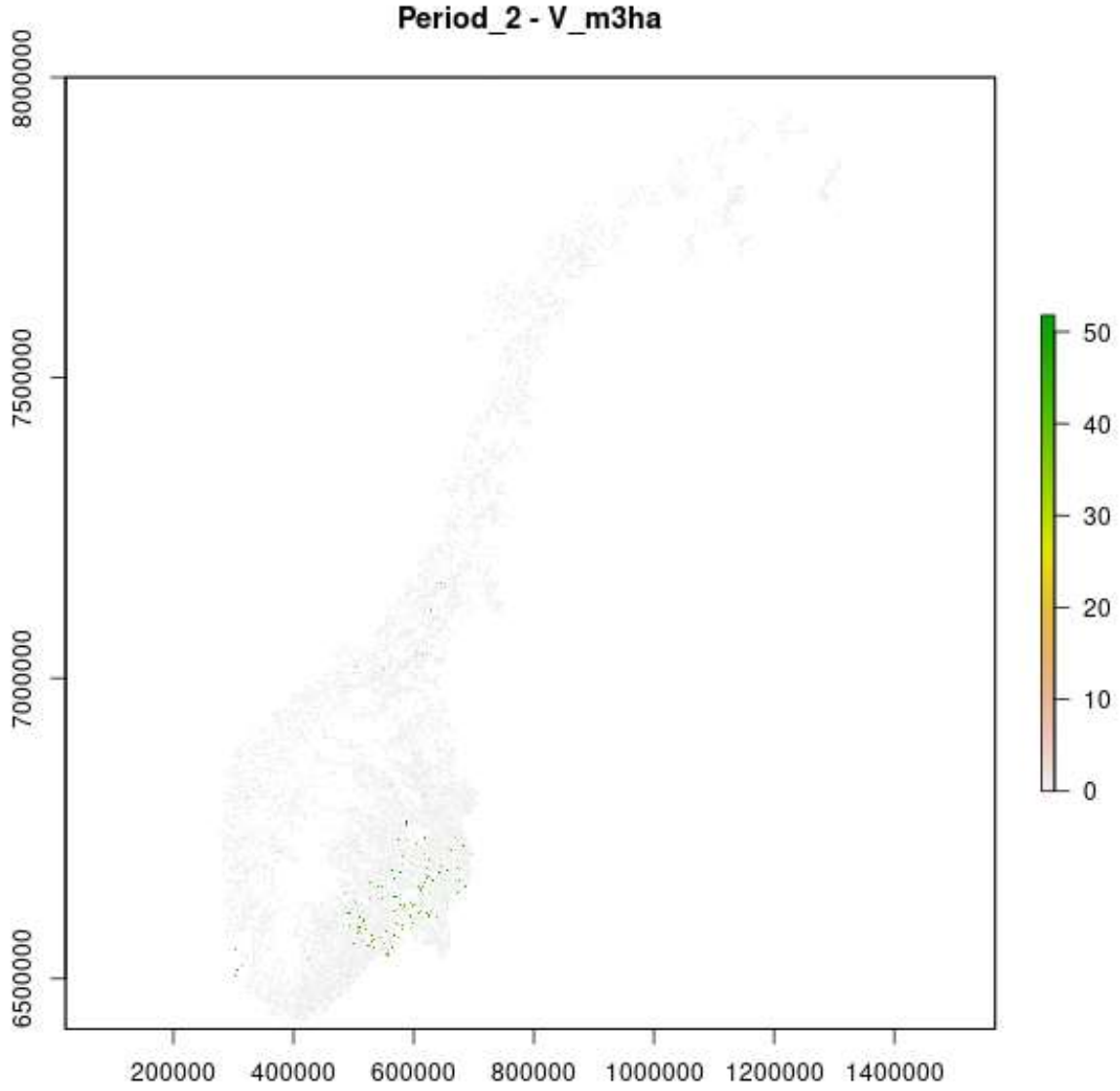
SR16 data



- Site index (m, age 40)
- Number of trees per ha
- Basal area (m2/ha)
- Dominant height (m)
- Stand volume (m3/ha)

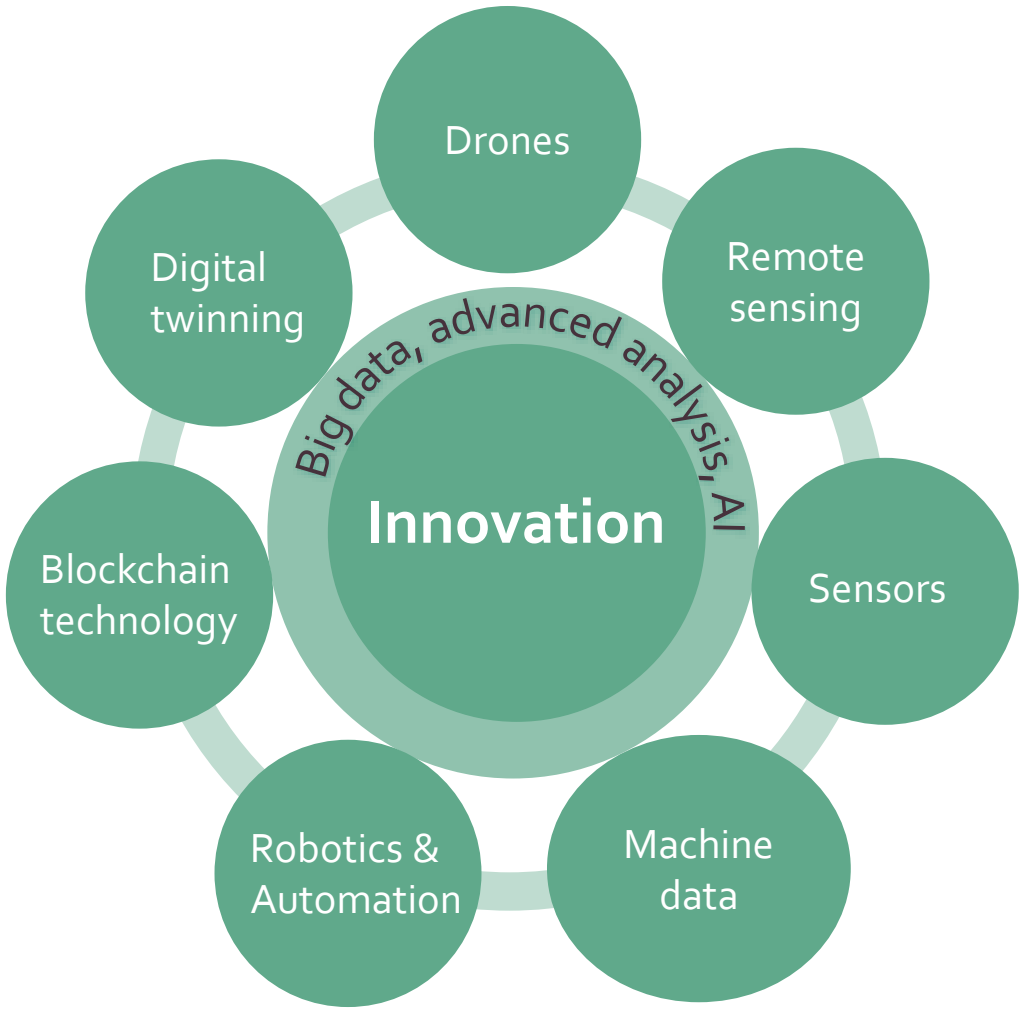
Extra info

- Distance to the nearest road
- Pixel insde MiS (Miljøregistrering i skog)
- Elevation, slope
- ...



Cattaneo et al. (in review)

NIBIO



How can we use emerging technologies to improve sustainable forest management?

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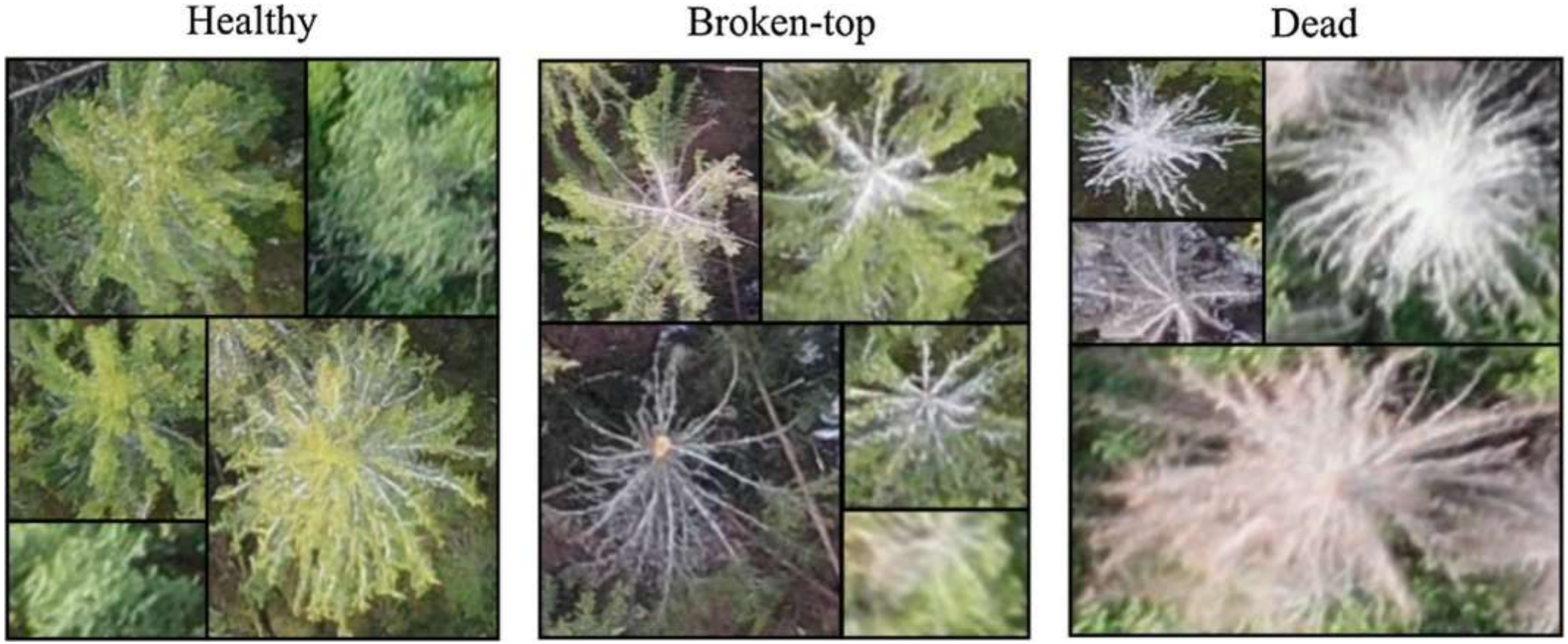
Forest inventory

Silviculture

Harvesting

Wood supply

SMARTForest



Puliti and Astrup (2022)

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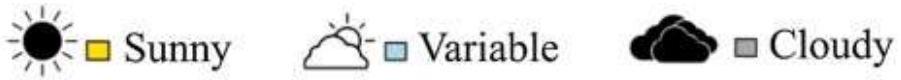

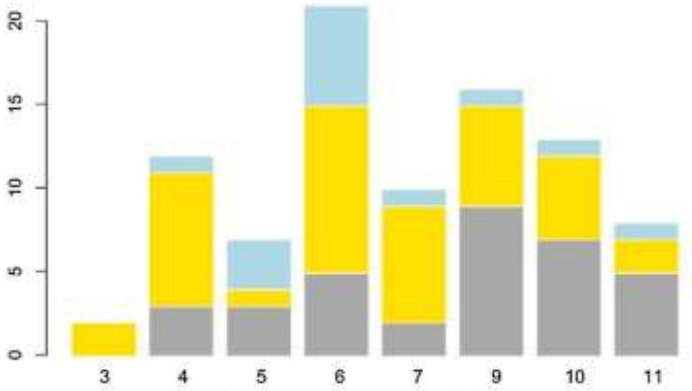

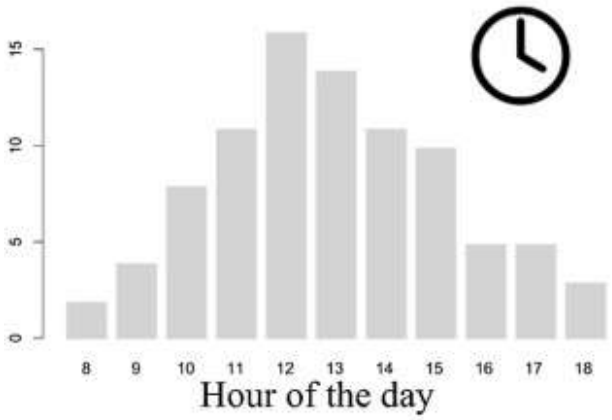

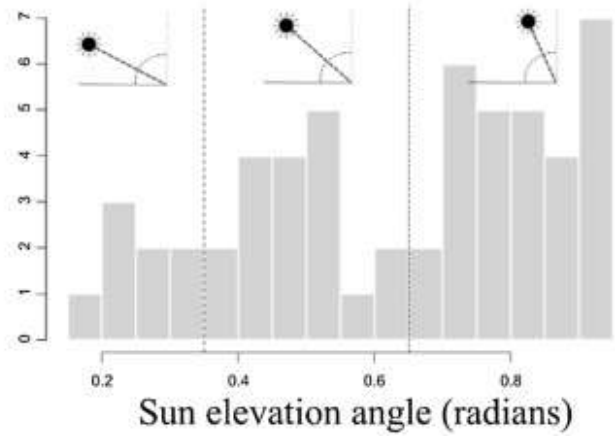

The training set was composed of 65 UAV acquisitions, 479 tiles, 40 697 trees, out of which 16 % were damaged by snow.

Puliti and Astrup (2022)

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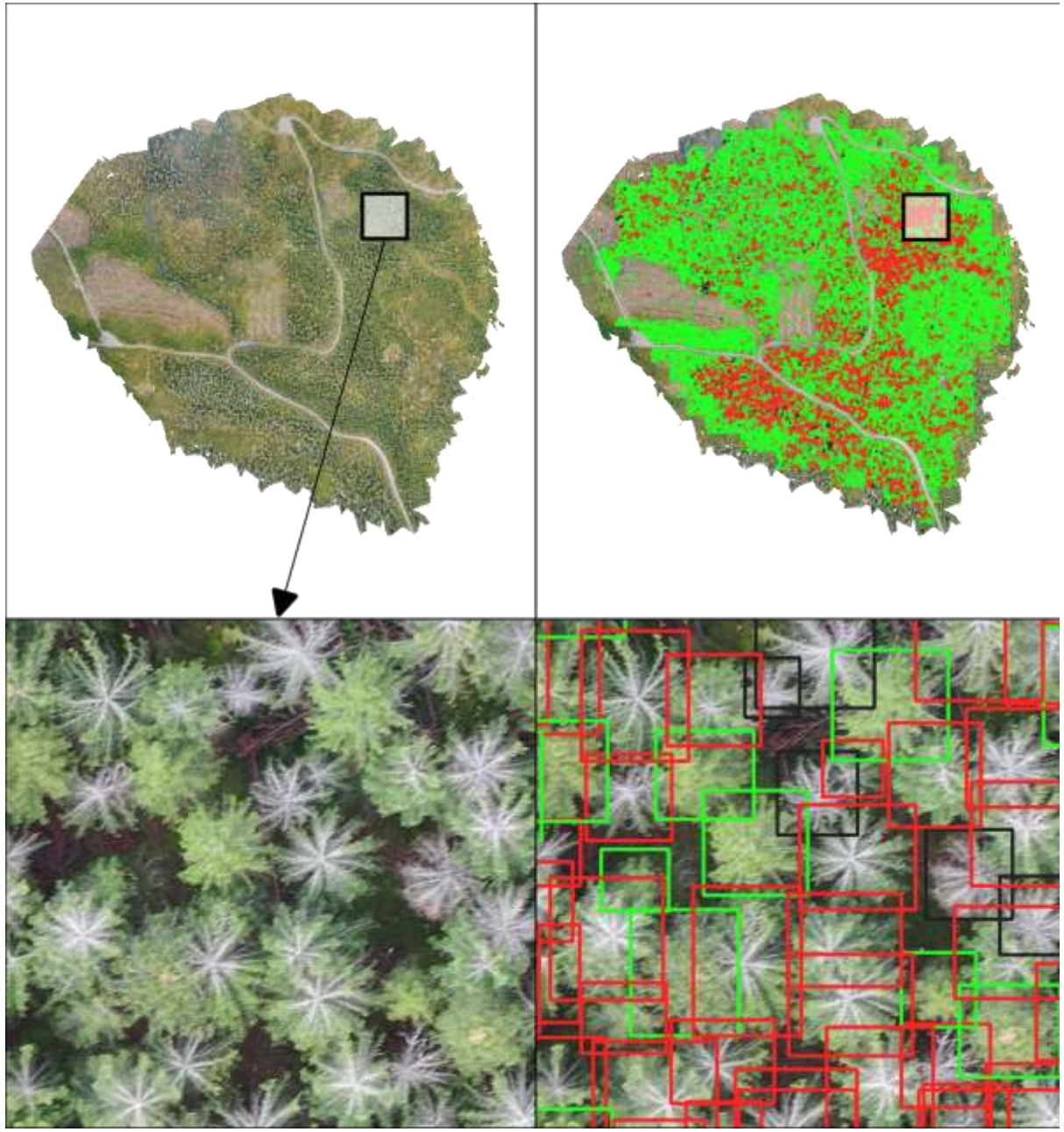
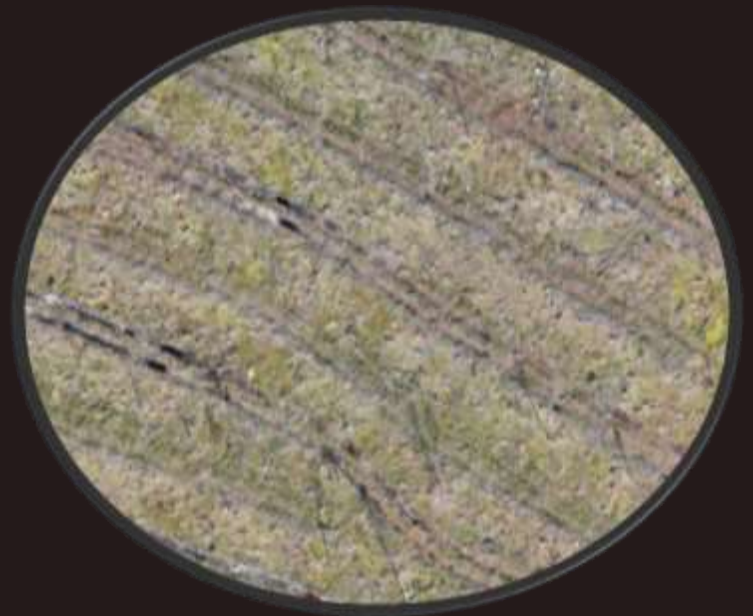
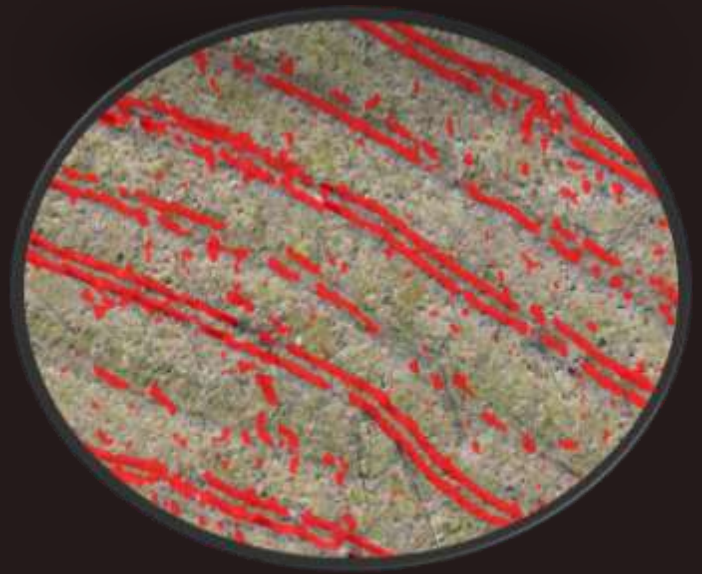


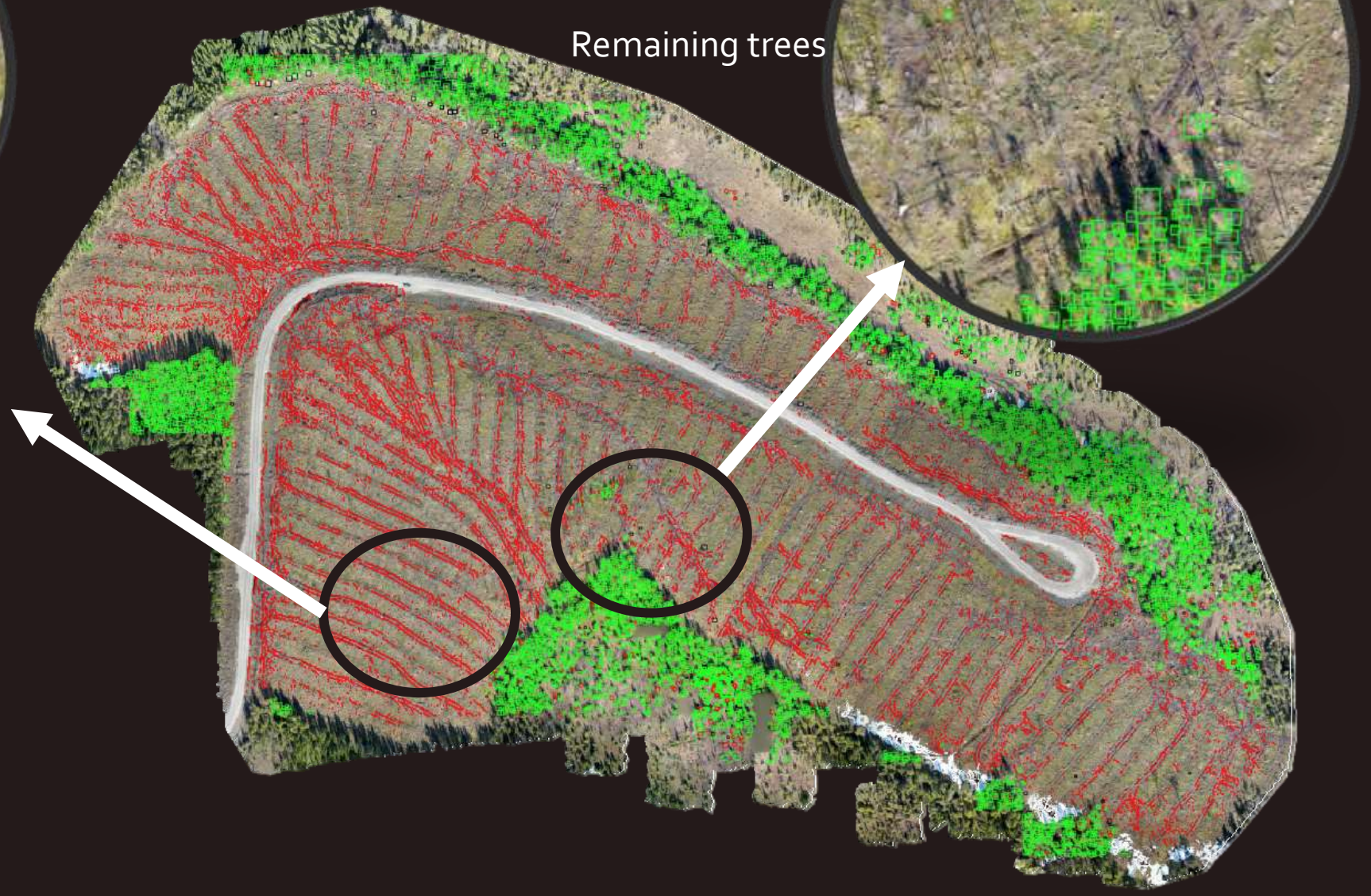
Puliti and Astrup (2022).

Post Harvest assessment



Wheel-ruts

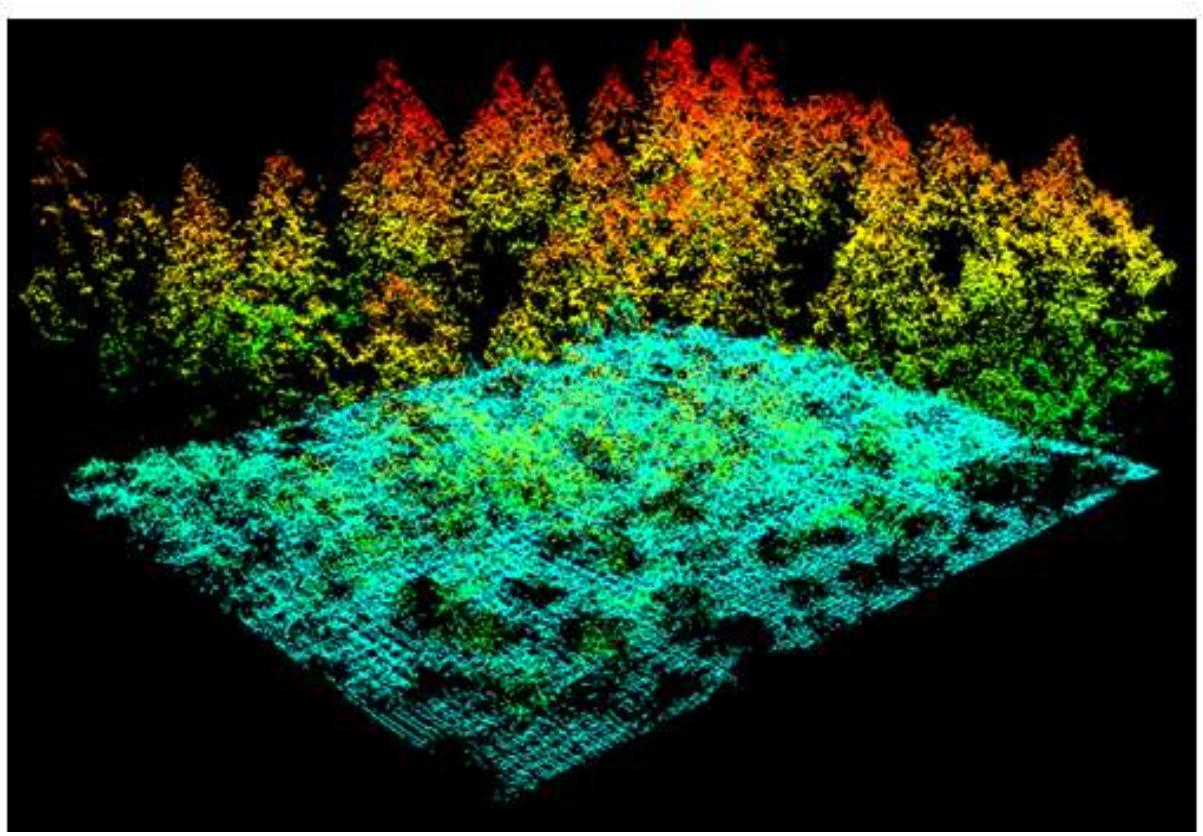


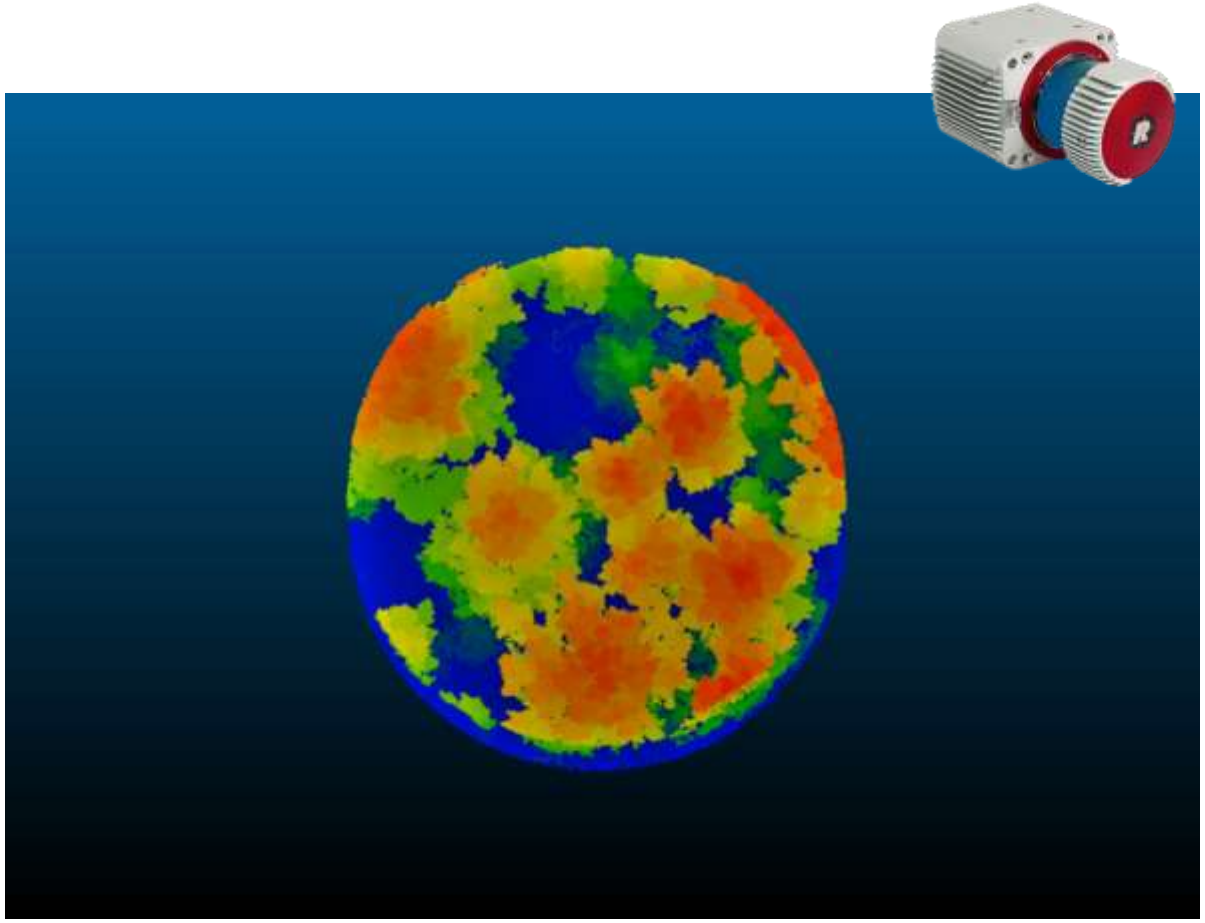


Remaining trees

Bhatnagar et al. (2022)

3D data: from operational low density point clouds to ultra high resolution





Puliti et al. 2021.

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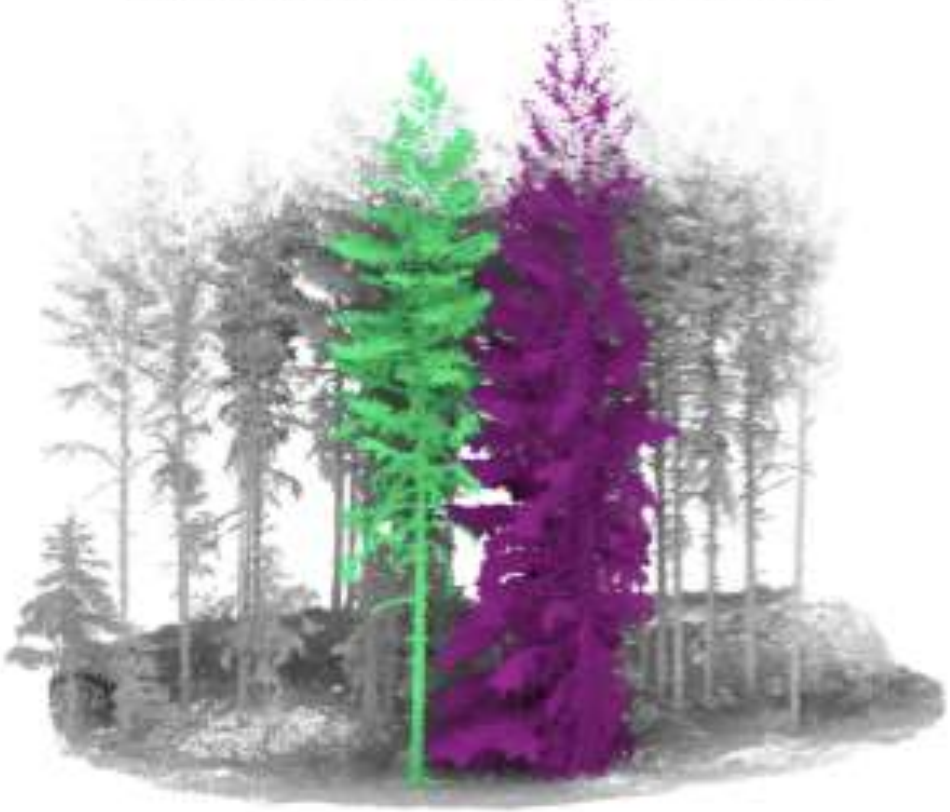
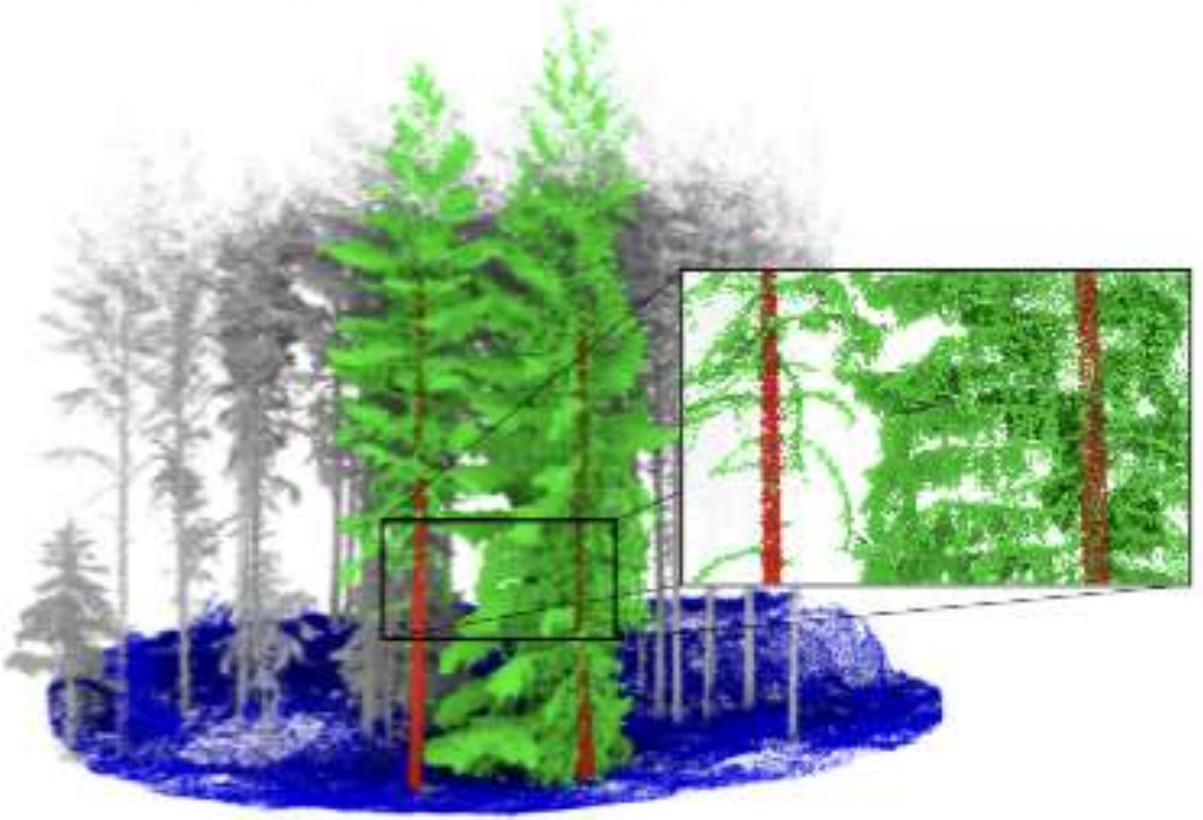
Instance annotation

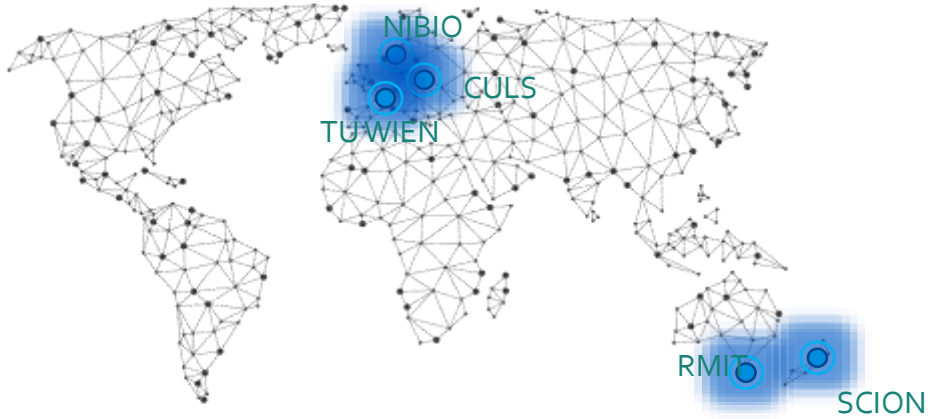


Semantic annotation

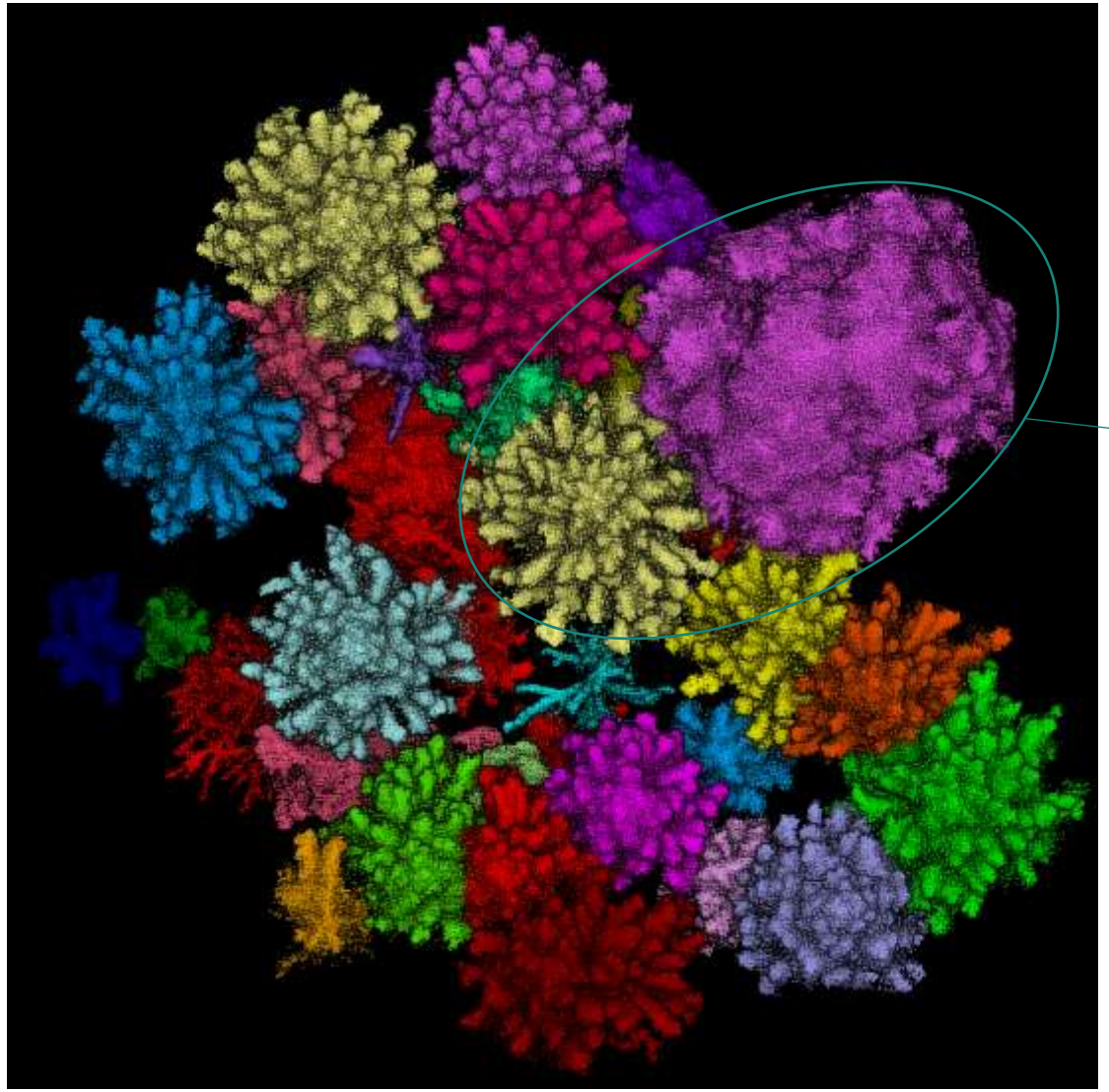


A UAV lidar benchmark dataset for forest instance segmentation and measurement biophysical properties

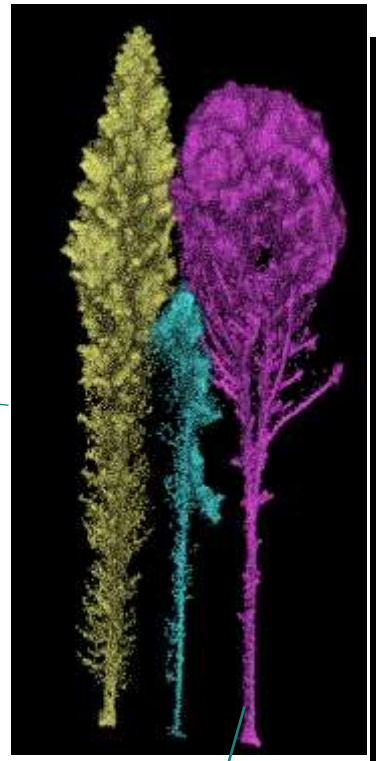
Puliti, S., Pearse, G.D., Watt, M.S., Mitchard, E., McNicol, I., Bremer, M., Rutzinger, M., Surovy, P., Wallace, L., Hollaus, M., and Astrup, R.



Manual annotation



Single trees



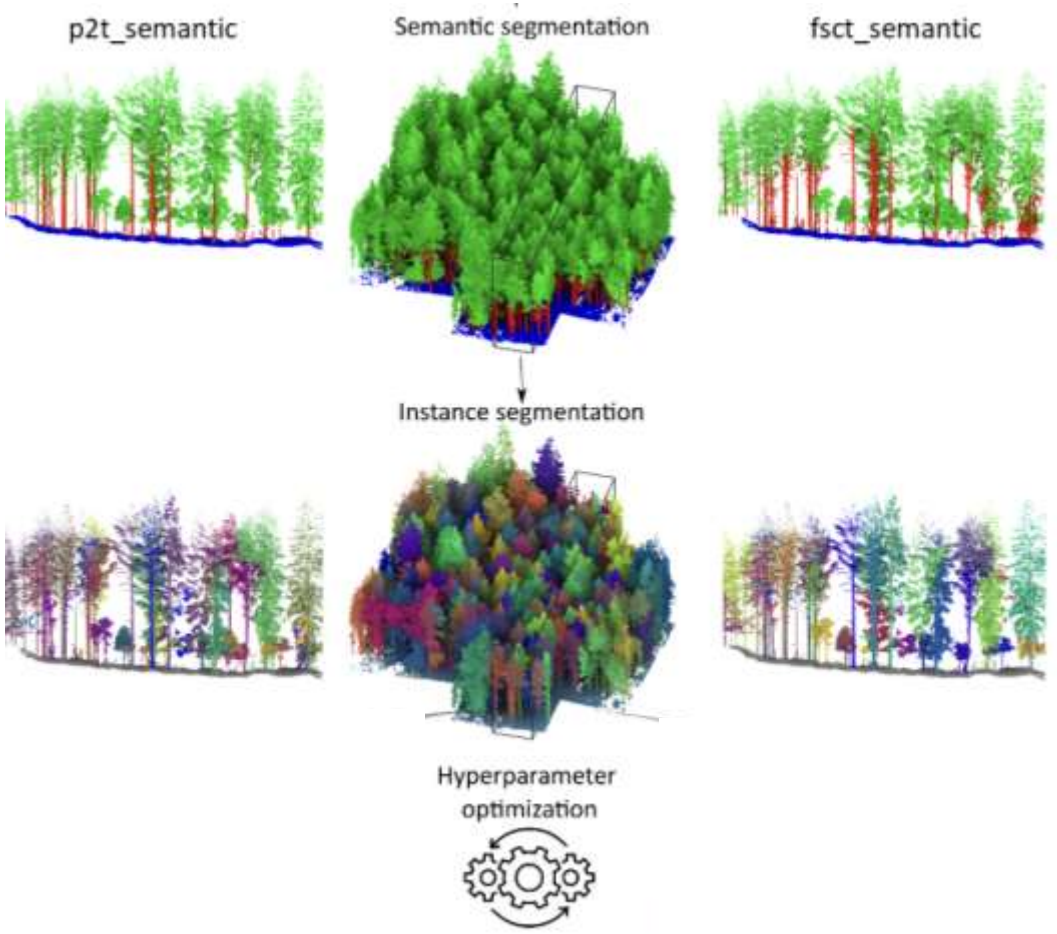
Stem
Live and dead
Branches

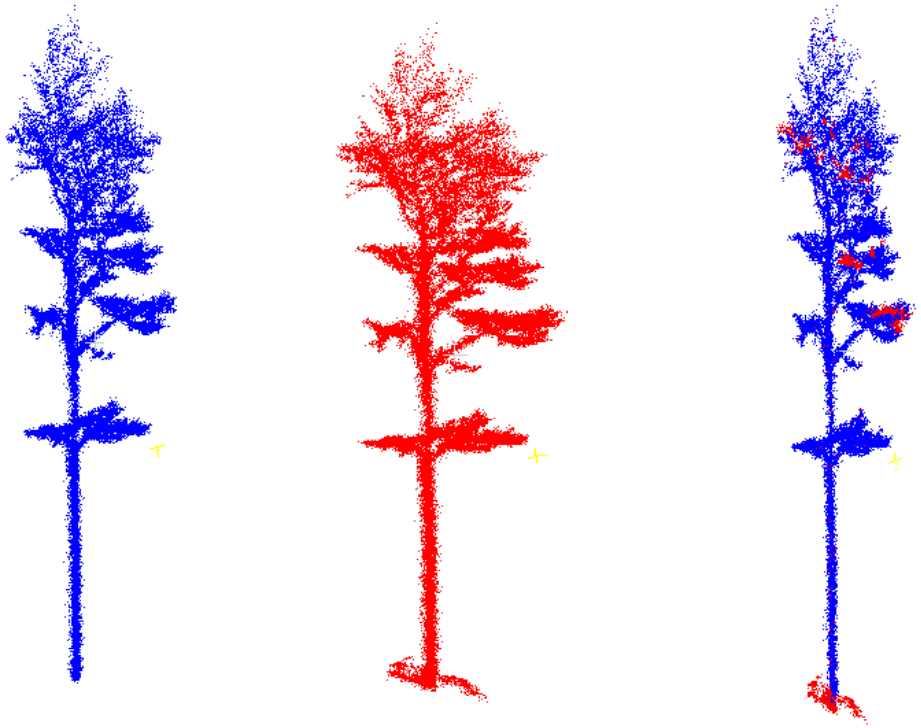
Horizonthal slice at DBH

Vertical slice spruce tree-top

Vertical slice spruce dead crown

Point2Tree (P2T) - framework for parameter tuning of semantic and instance segmentation





Manual (red) and Predicted (blue) for precision=0.99, recall=0.90, f1=0.94, IoU=0.89 on LAUTx (Tockner et al. 2022)

Wielgosz et al. (in review)

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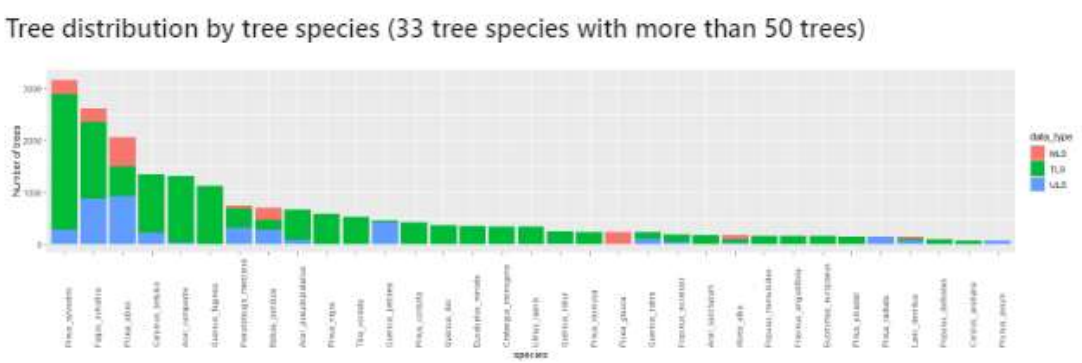
Benchmarking dataset for sensor-agnostic tree species classification using proximal laser scanning (TLS, MLS, ULS) - 20 000 individual point clouds

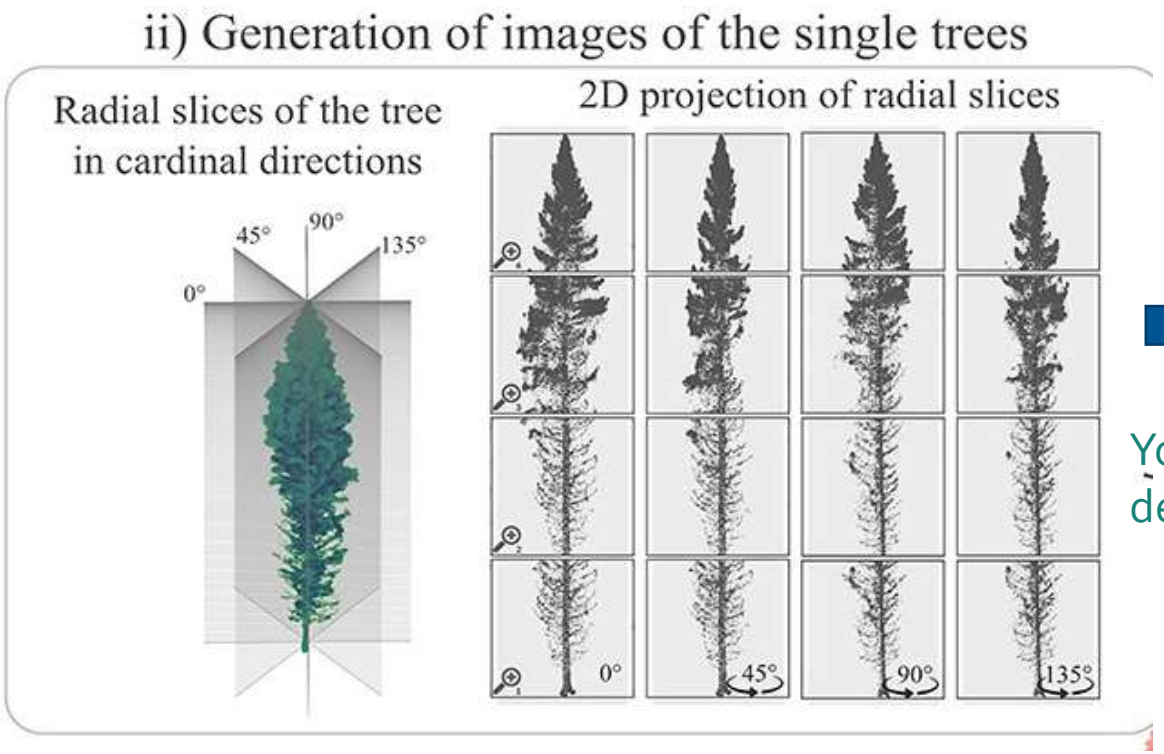


COST Action CA20118

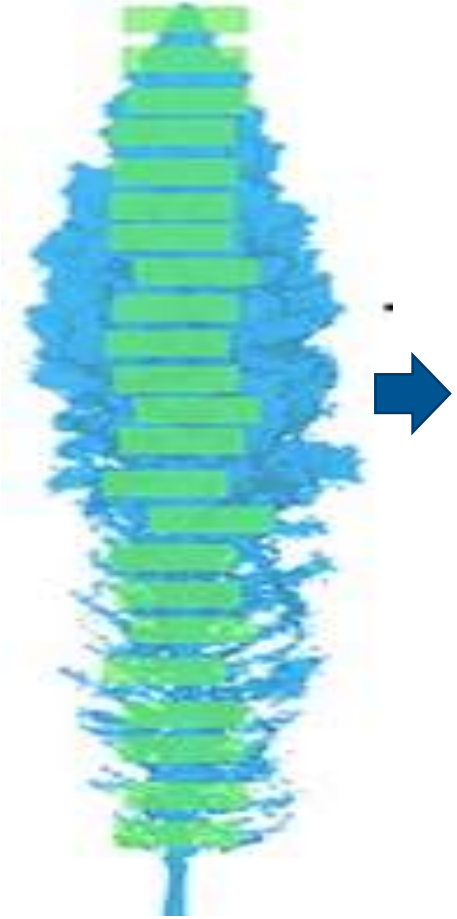
3DForEcoTech

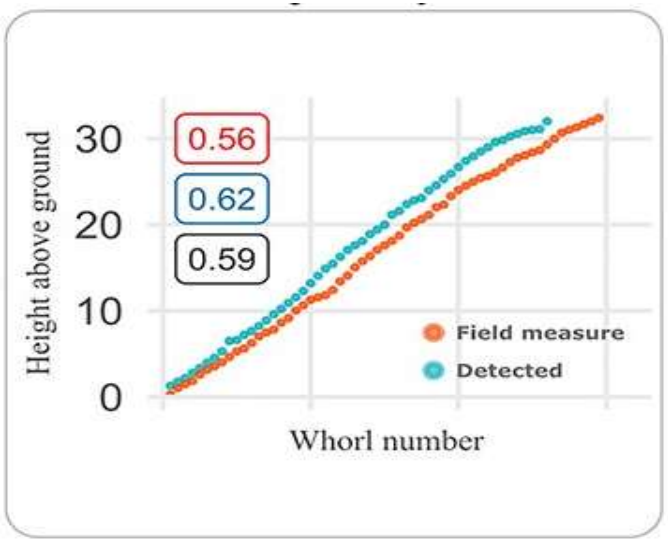
Three-dimensional forest ecosystem monitoring & better understanding by terrestrial-based technologies

2D image analysis for 3D point clouds



Yolo whorl detector





Puliti et al. 2023

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Forest inventory

Silviculture

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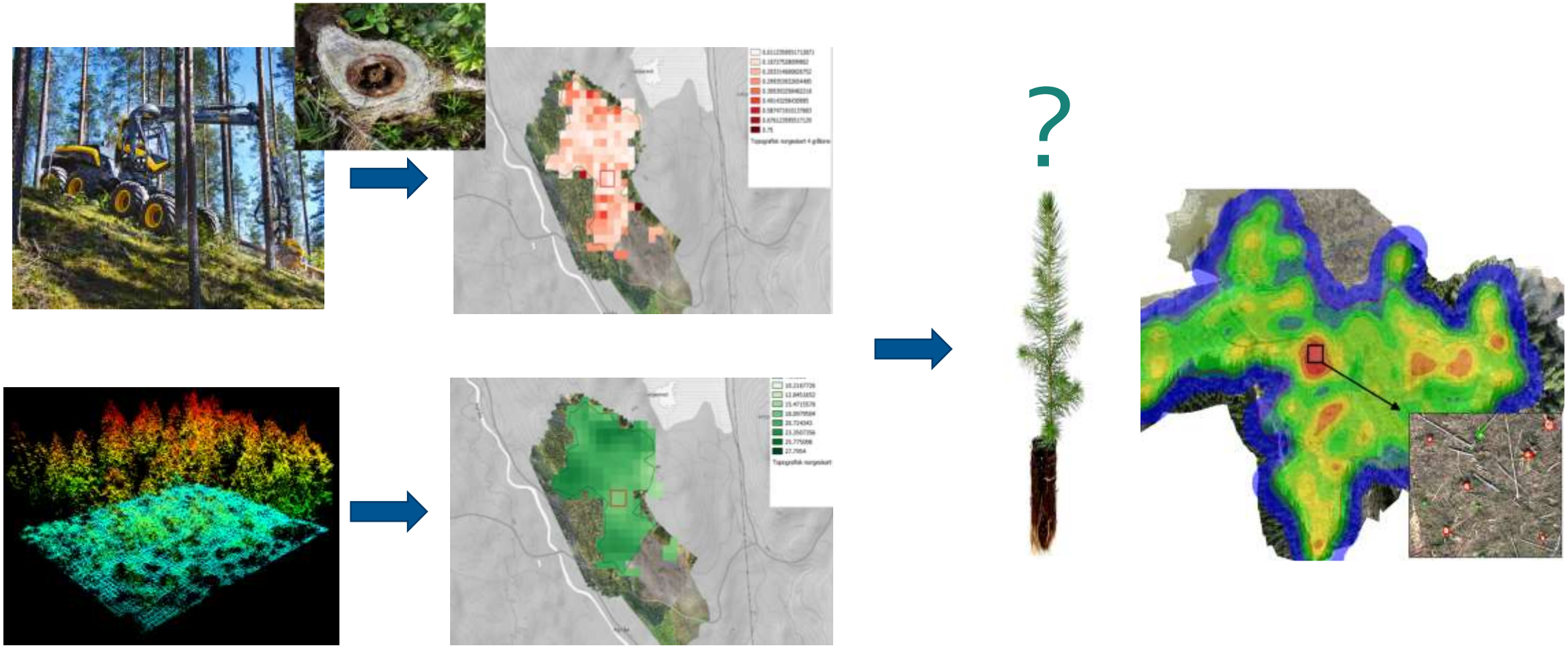
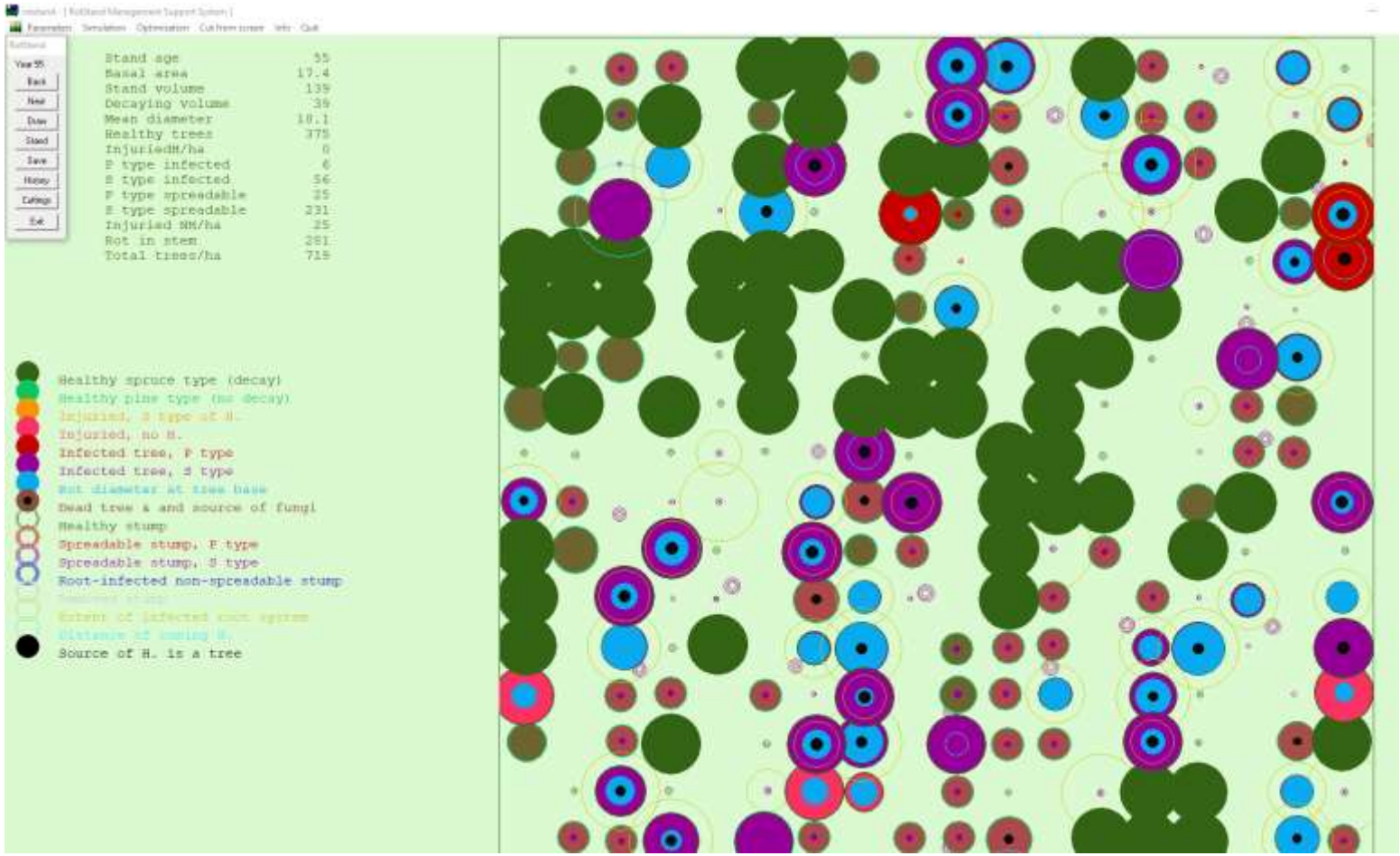
Wood supply

Precision silviculture



Aza et al. (2022)

Rotstand



Aza et al. (2022)

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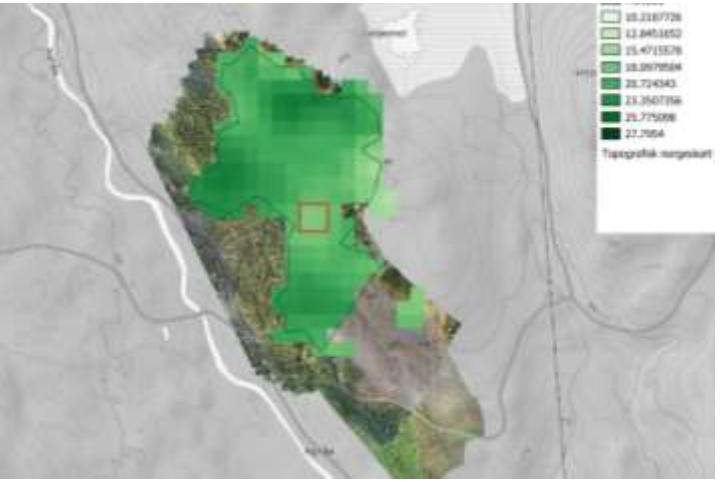
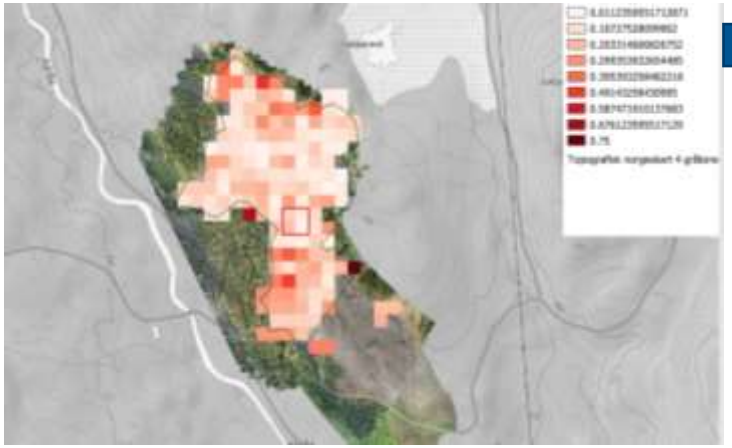
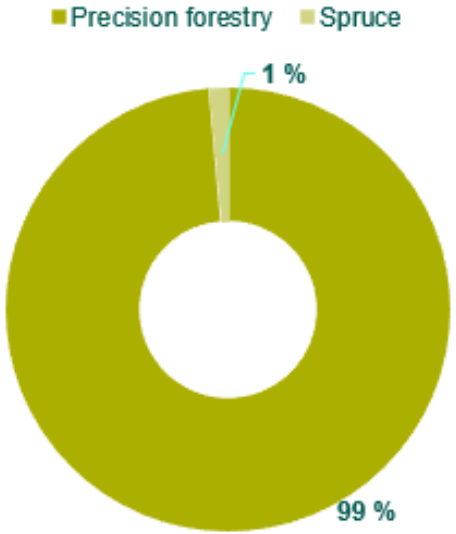
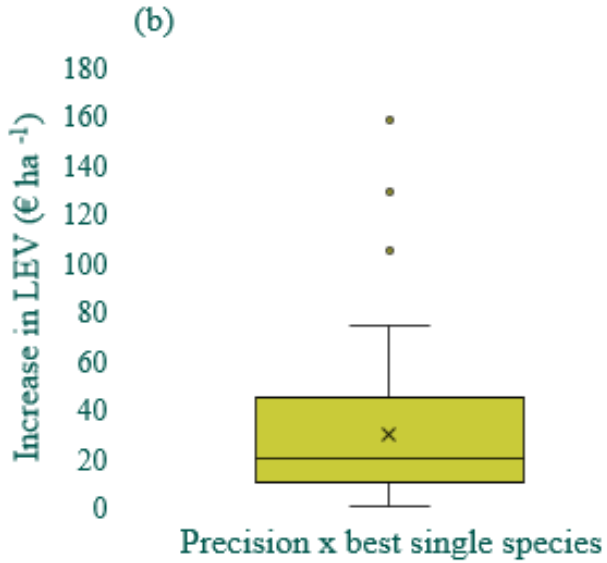
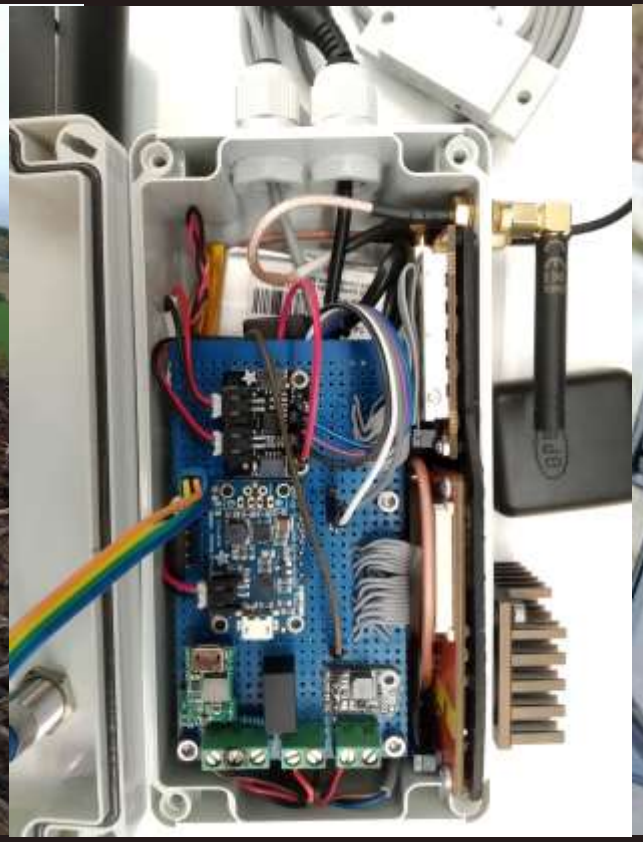
Precison forestry versus BAU











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Seedling positioning

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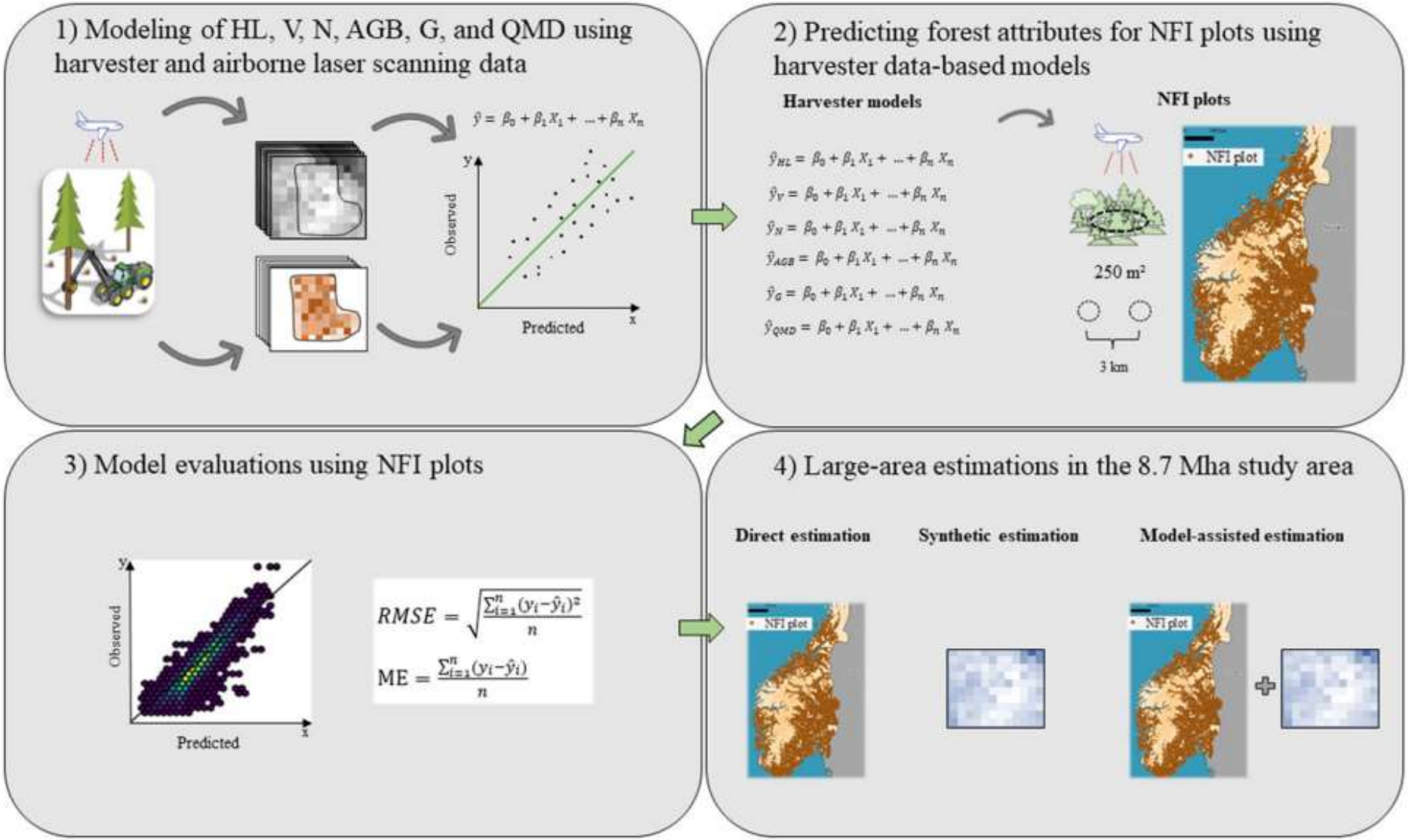
Forest inventory

Silviculture

Harvesting

Wood supply



Ratty et al. (2022)

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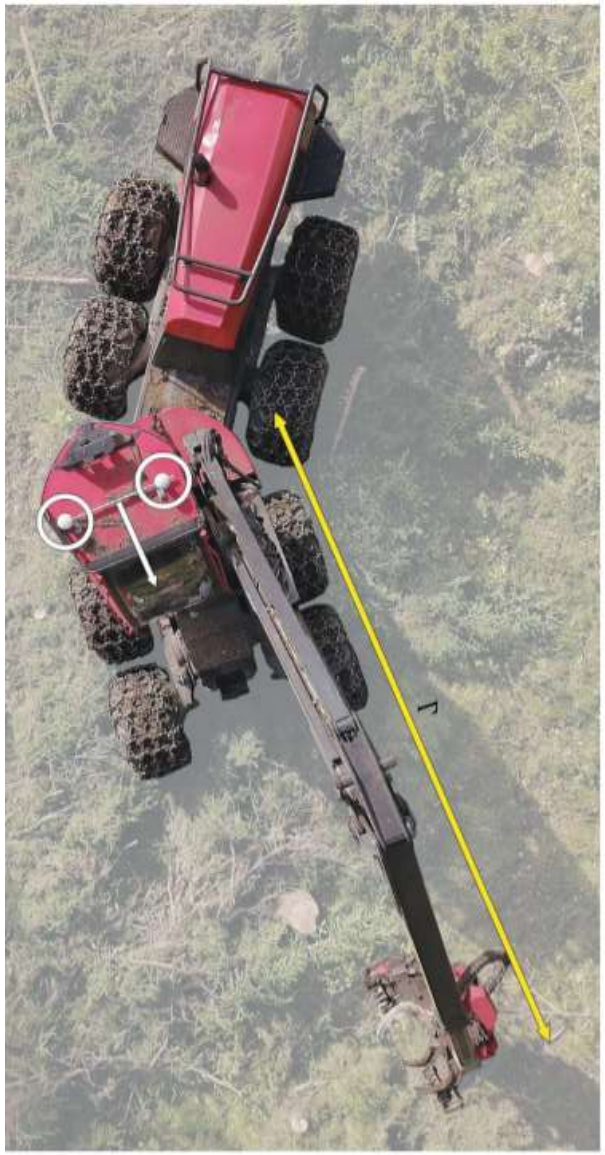

Noordermer et al. 2021. IJFE.

Horvat et al. (in prep)

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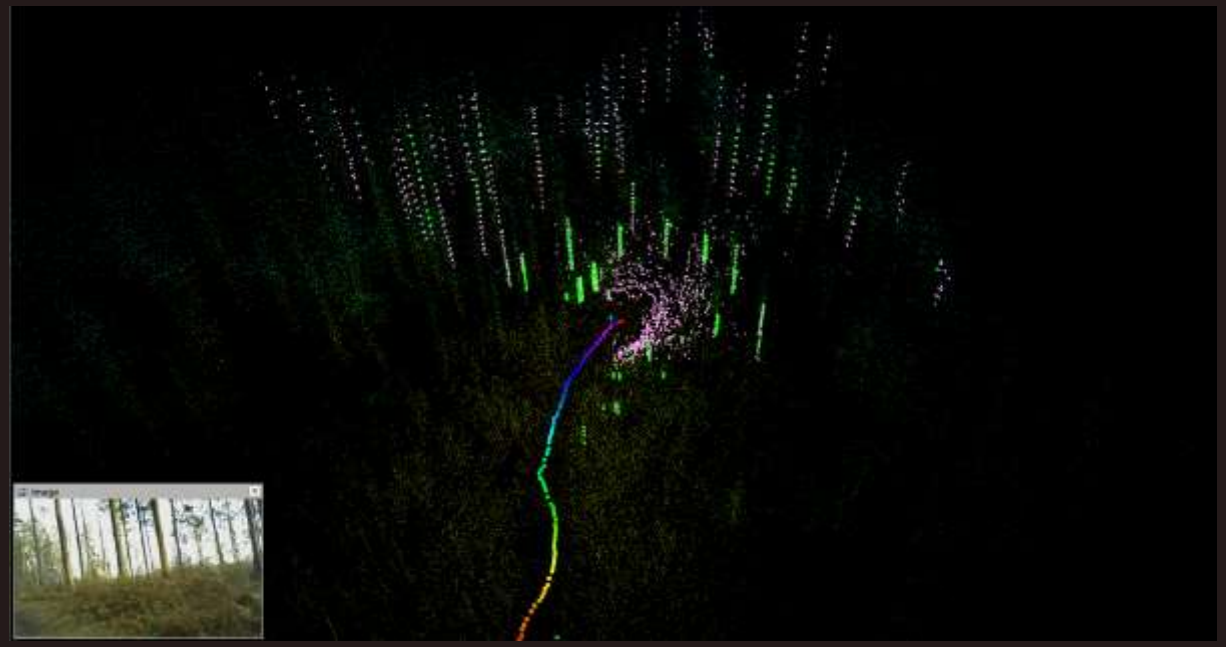
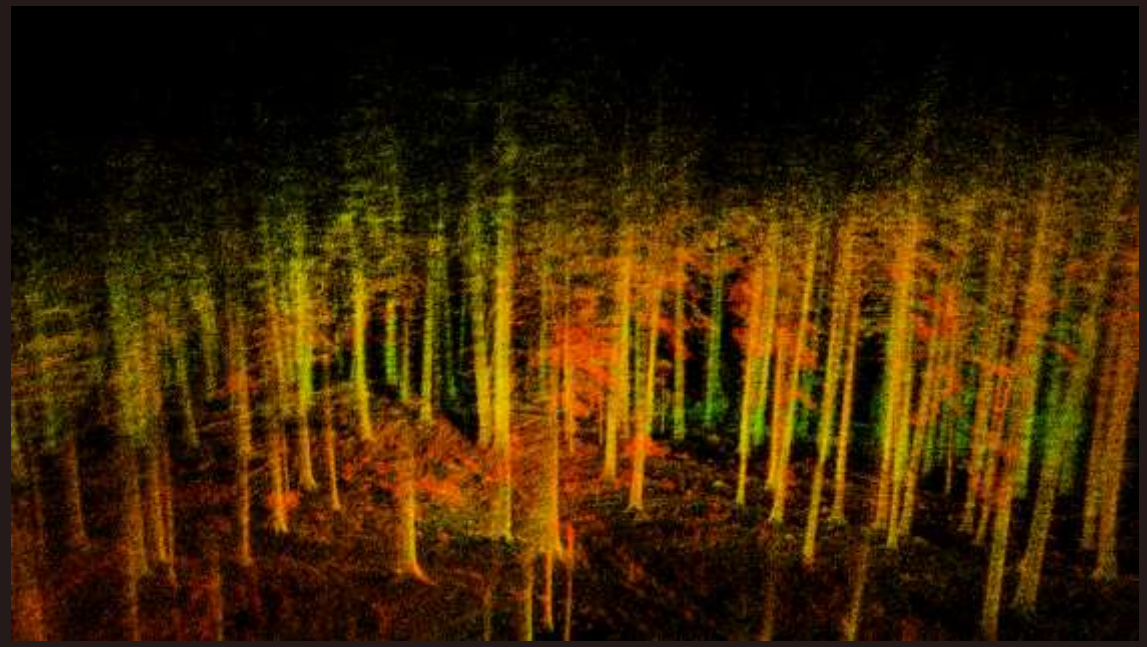
Mapping





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HarvestSens: Harvester head tracking and positioning

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Forest inventory

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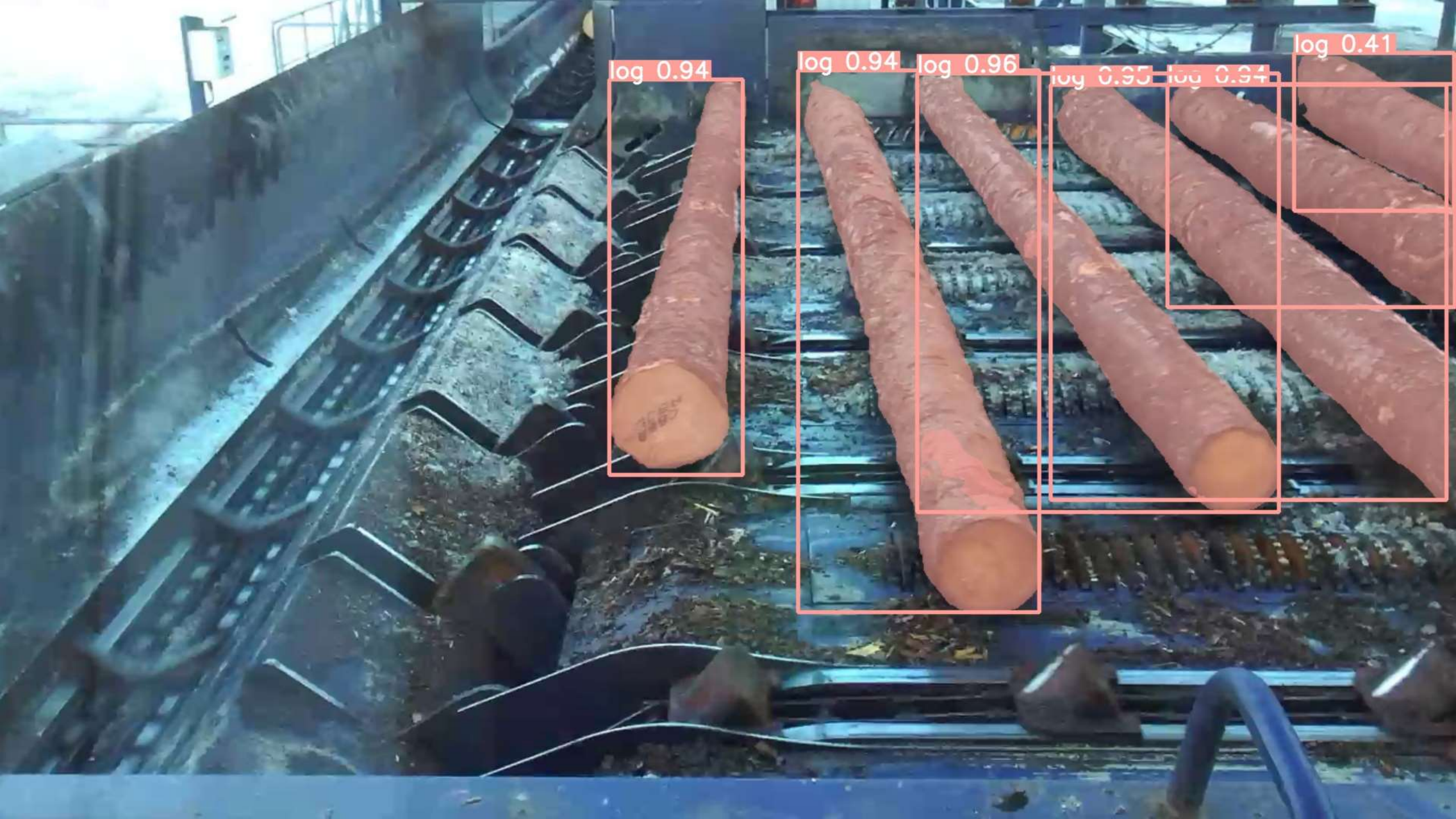
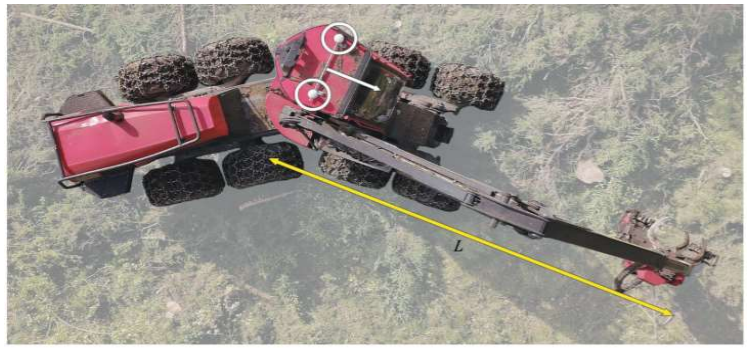
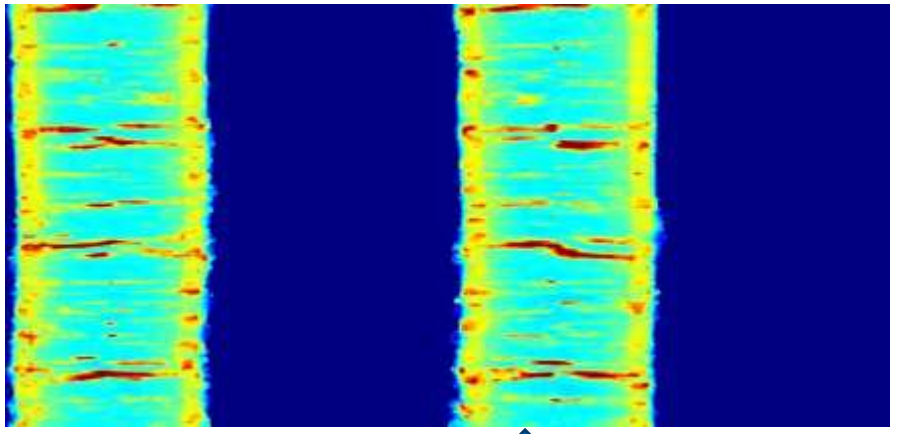
Wood supply


NEXTBASE NBDVR622GW
SMARTForest


HAIS


log 0.94
log 0.94
log 0.96
log 0.41





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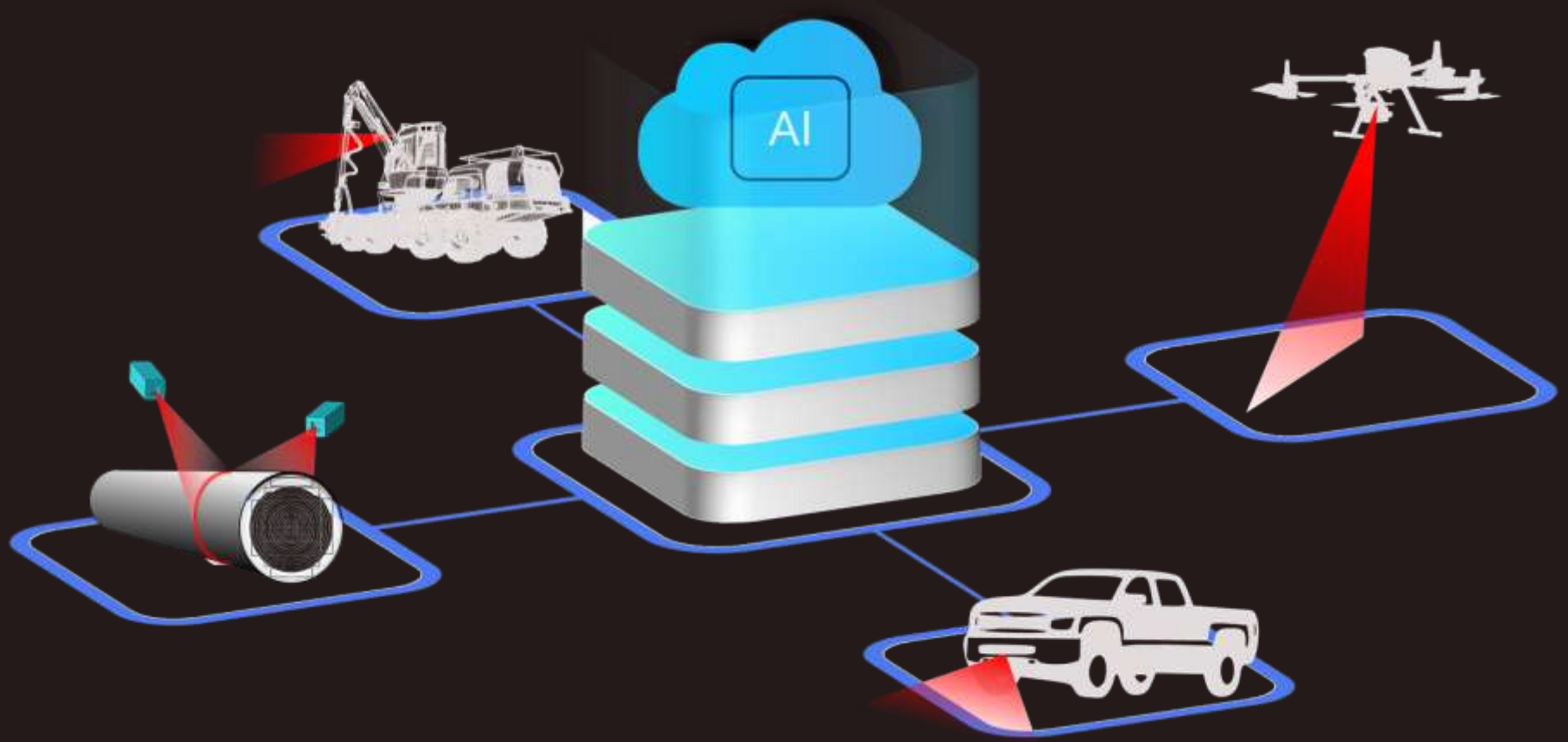
ForestSens



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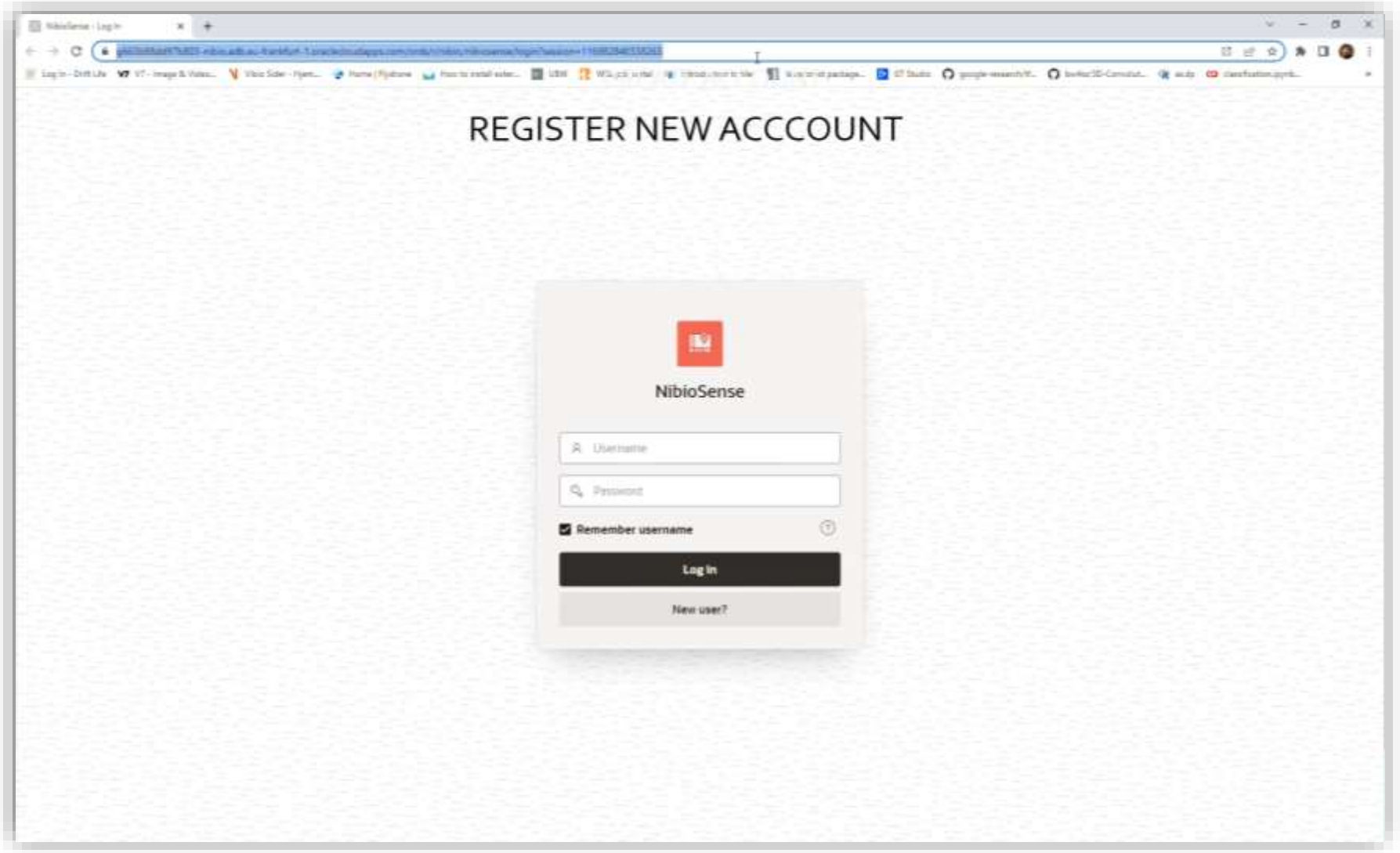
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