Terrestrial Laser Scanning Has Potential to Support Cal/Val Activities of Radar Biomass Estimates

Wouter A.J. Van den Broeck; Wout Cherlet; Zane Cooper; Mathias Disney; Niall Origo; Ludovic Villard; Kim Calders

POLINSAR & BIOMASS 2023

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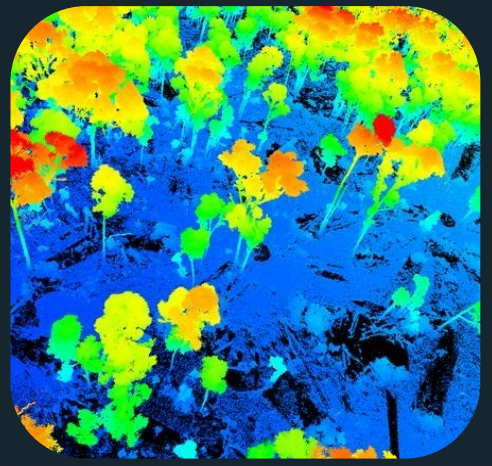
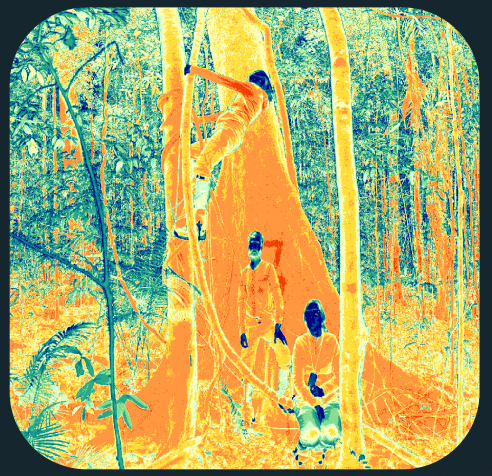
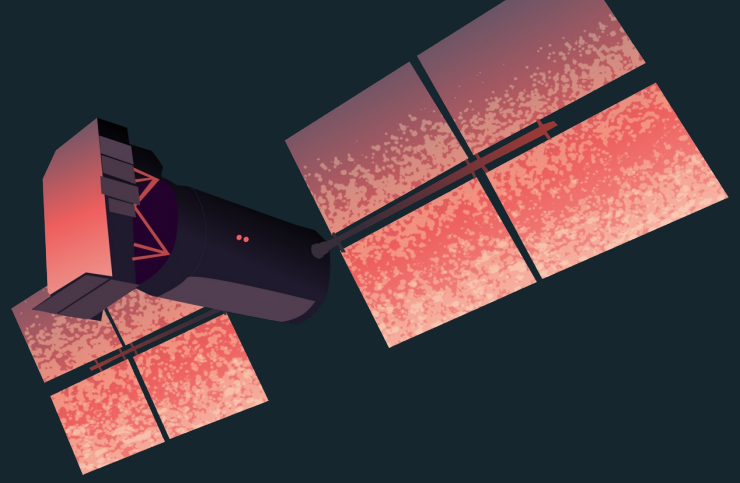
CAVELAB

FACULTY OF BIOSCIENCE ENGINEERING







1. TLS as reference for AGB
2. TLS for spaceborne cal/val through RTM
3. TLS for microwave RTM
4. The SPACETWIN project

OUTLINE

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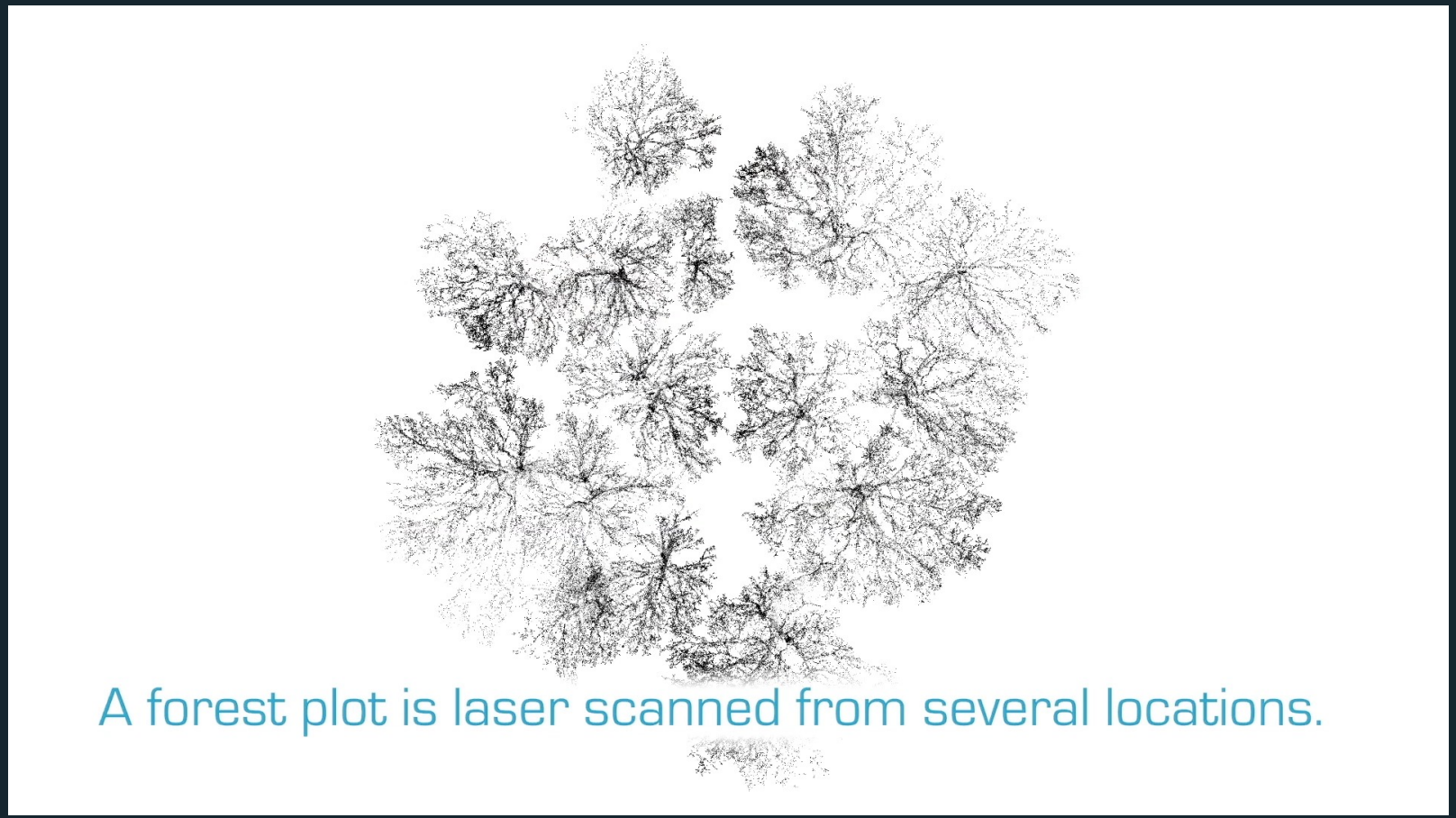
Terrestrial Laser Scanning (TLS) for forest monitoring



Credit: Markku Akerblom

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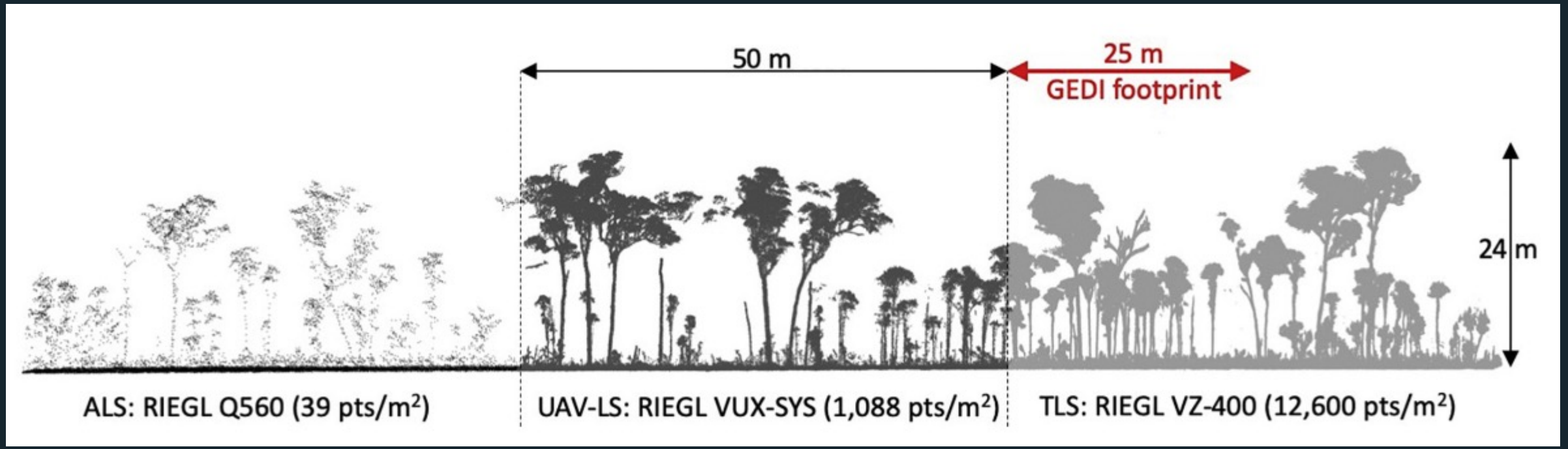
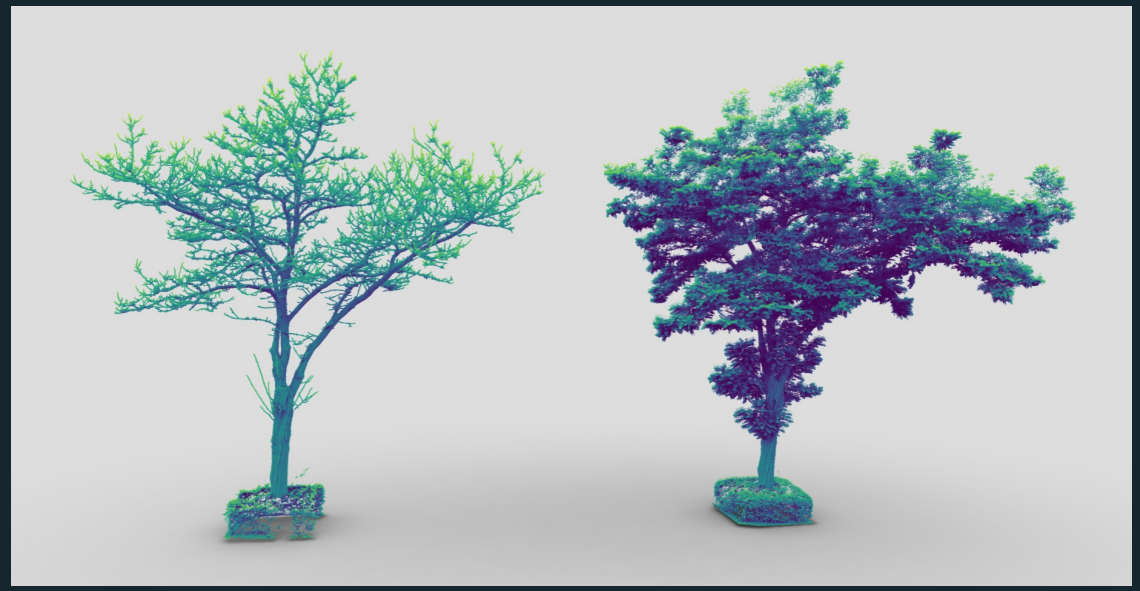
Terrestrial Laser Scanning (TLS) for forest monitoring



Calders *et al.* (2020)

Terrestrial Laser Scanning (TLS) for forest monitoring



https://sketchfab.com/CAVElab_UGent

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Terrestrial Laser Scanning (TLS) for forest monitoring

Applications

- Plant functional trait analysis
- Plant area index (PAI) estimation
- Gap fraction analysis
- Metabolic scaling theory
- Aboveground biomass (ABG) estimation
- …

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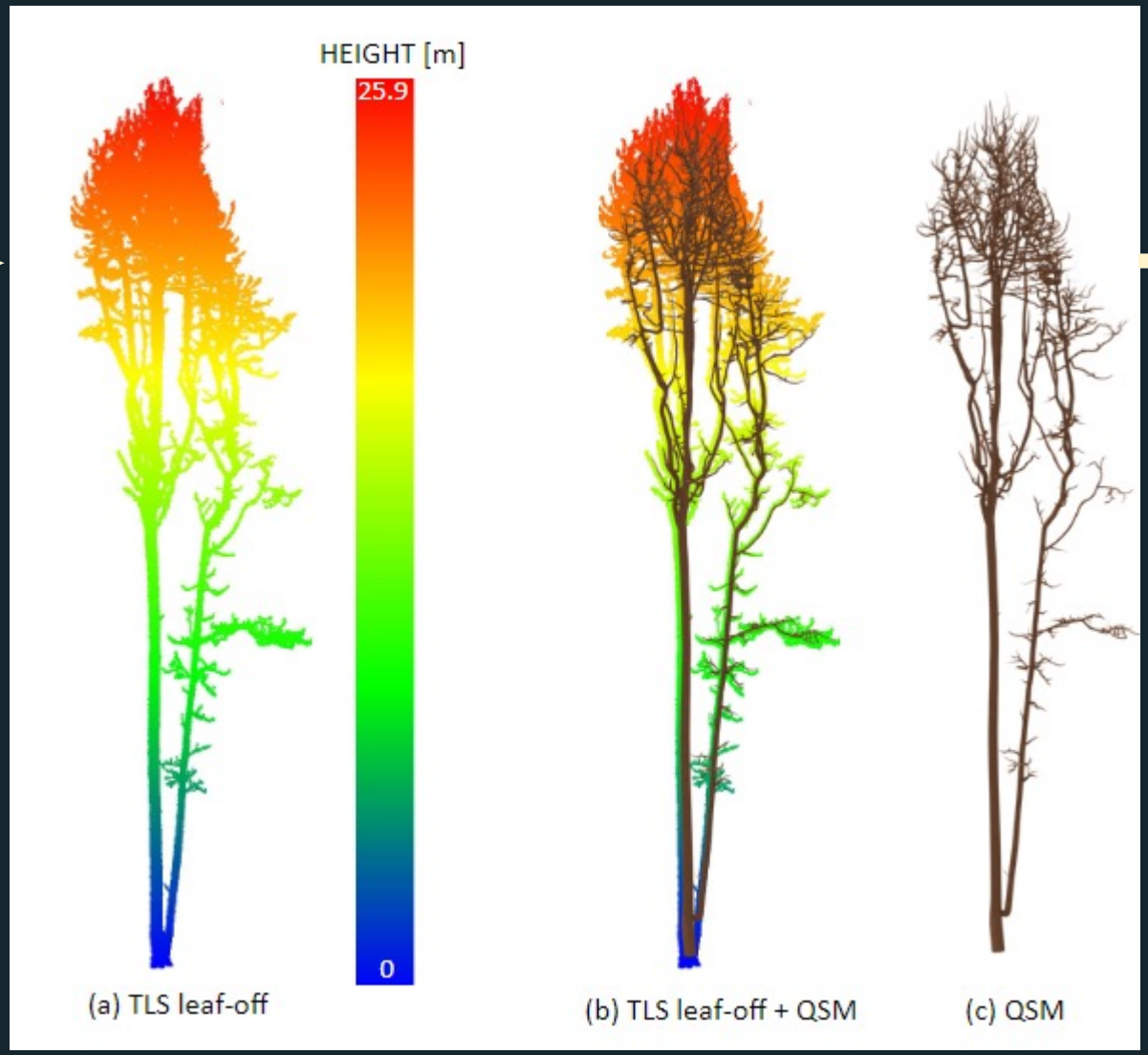
TLS as reference data for AGB measurements

Point cloud →



→ Quantitative Structure Model

↓

Volume

Density → ↓

AGB

Calders *et al.* (2015)

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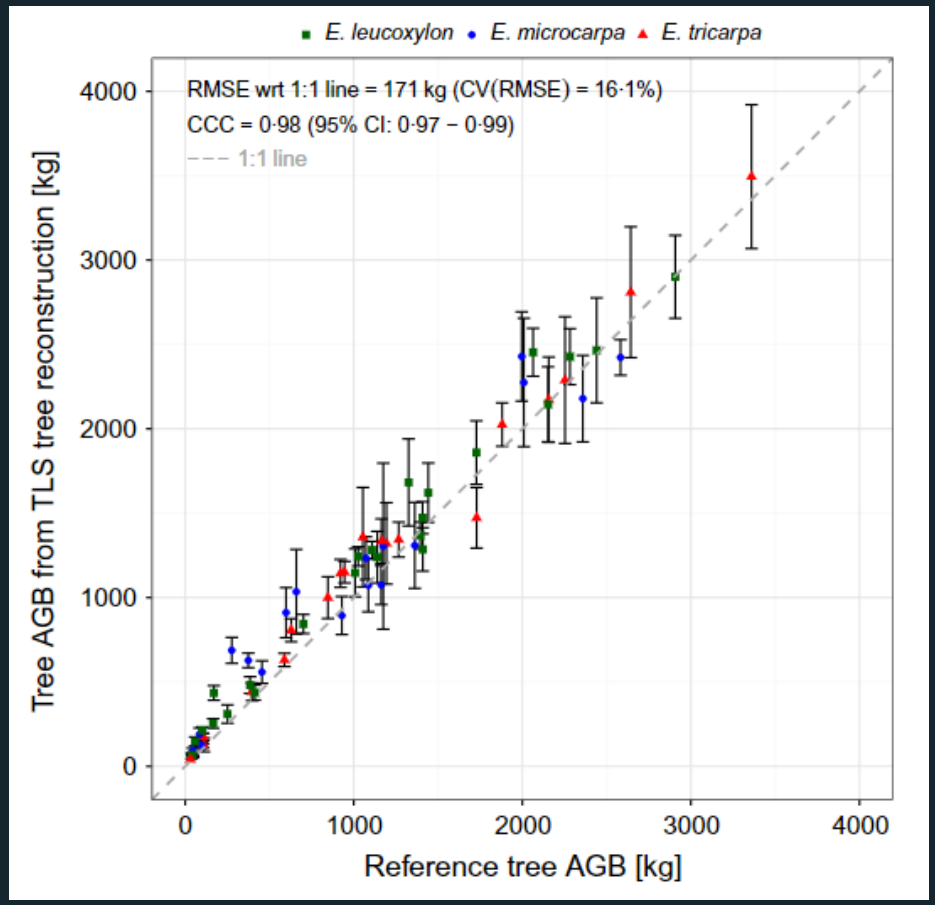
TLS as reference data for AGB measurements

TLS AGB



Reference AGB

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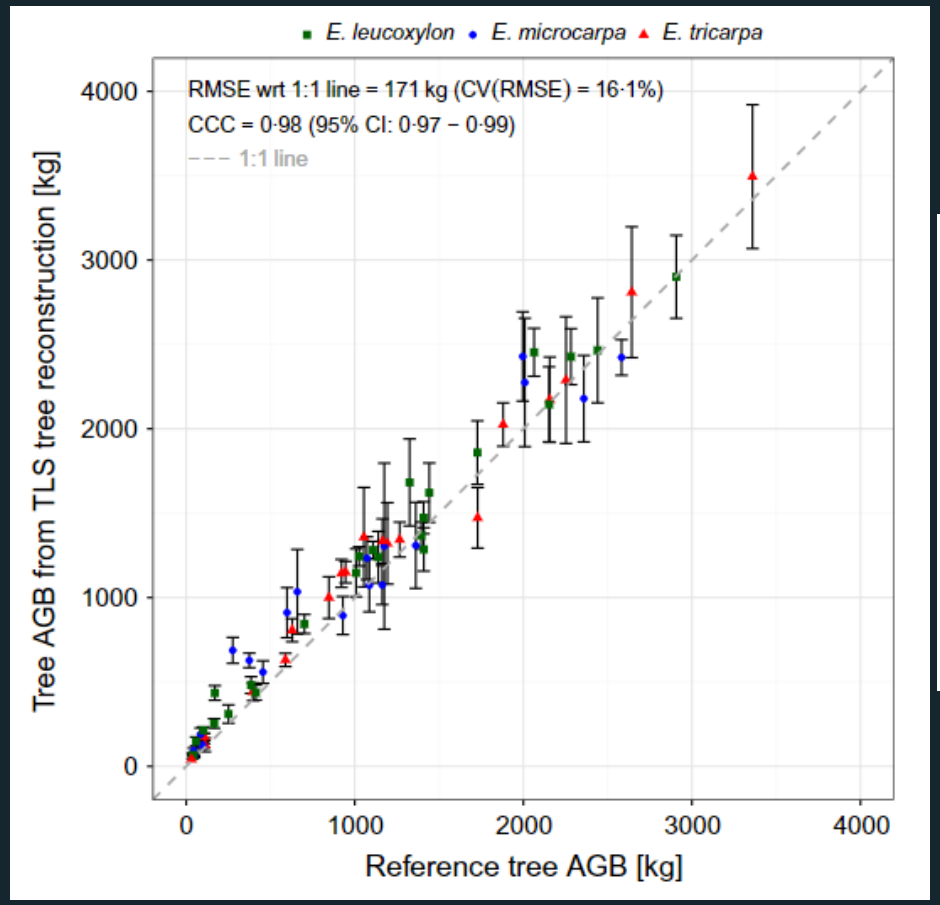
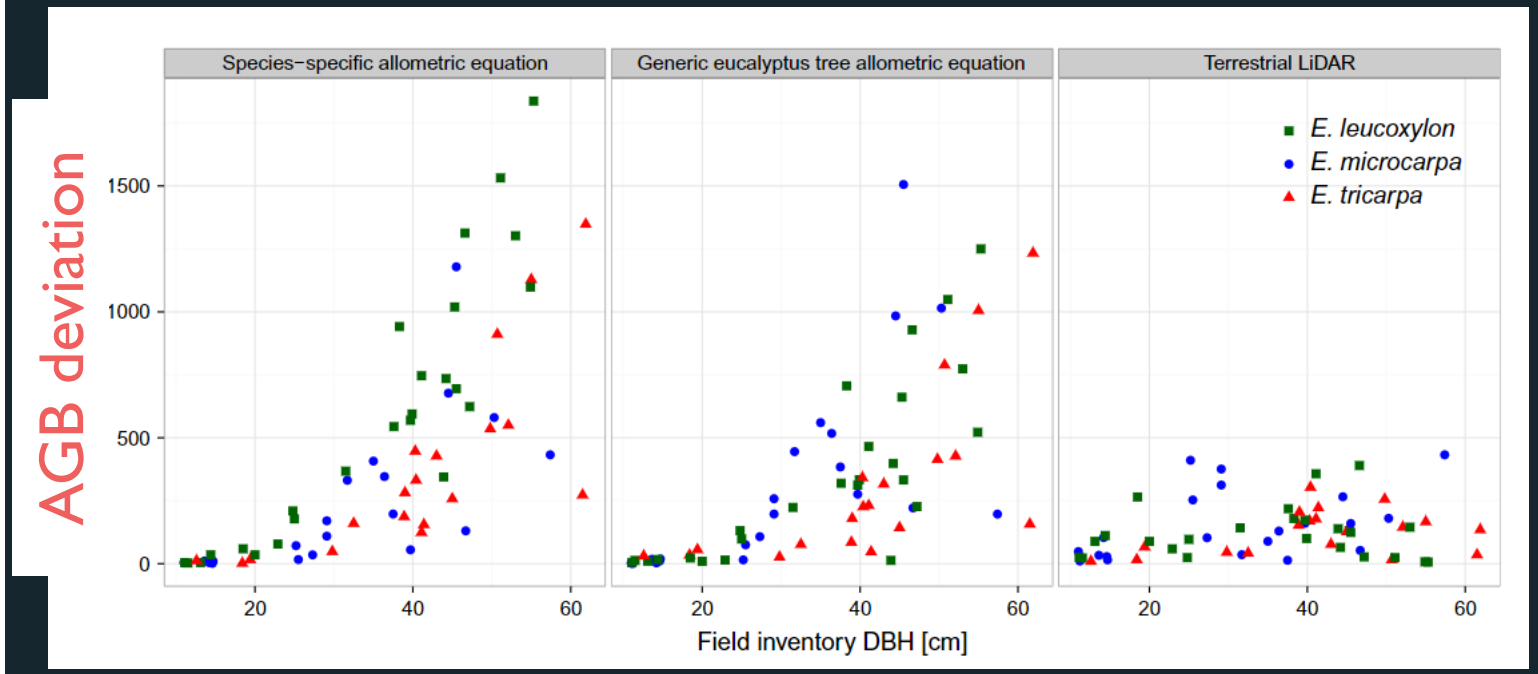
TLS as reference data for AGB measurements

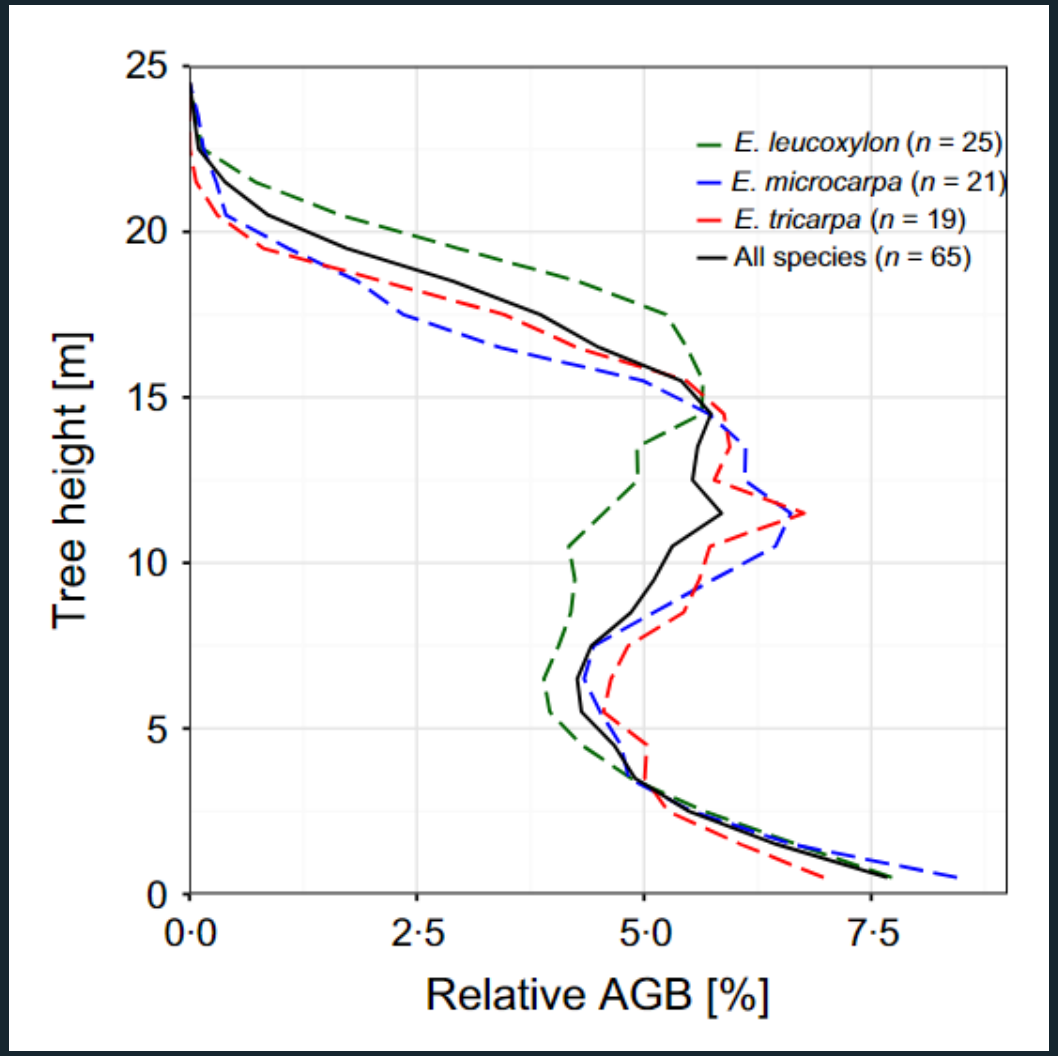




Allometric equations

TLS

TLS as reference data for AGB measurements



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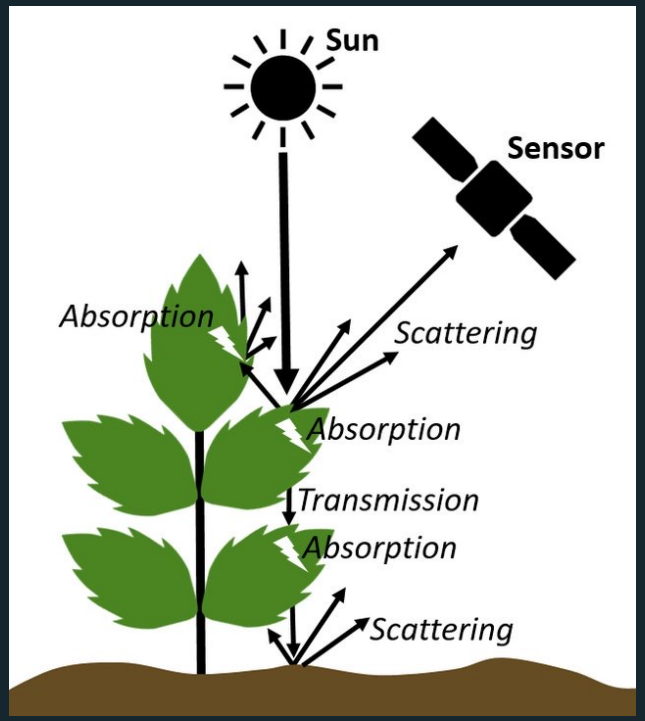
Radiative Transfer Modelling (RTM)

Link between in situ measurement and satellite observations ??

→ RTM = Tool to simulate the interaction between EM waves and a 3D scene based on physics

- Radiative budget
- Test/simulate hypotheses
- Simulate sensor acquisition
- Generate synthetic data
- Model inversion



(Source: Teja Kattenborn)

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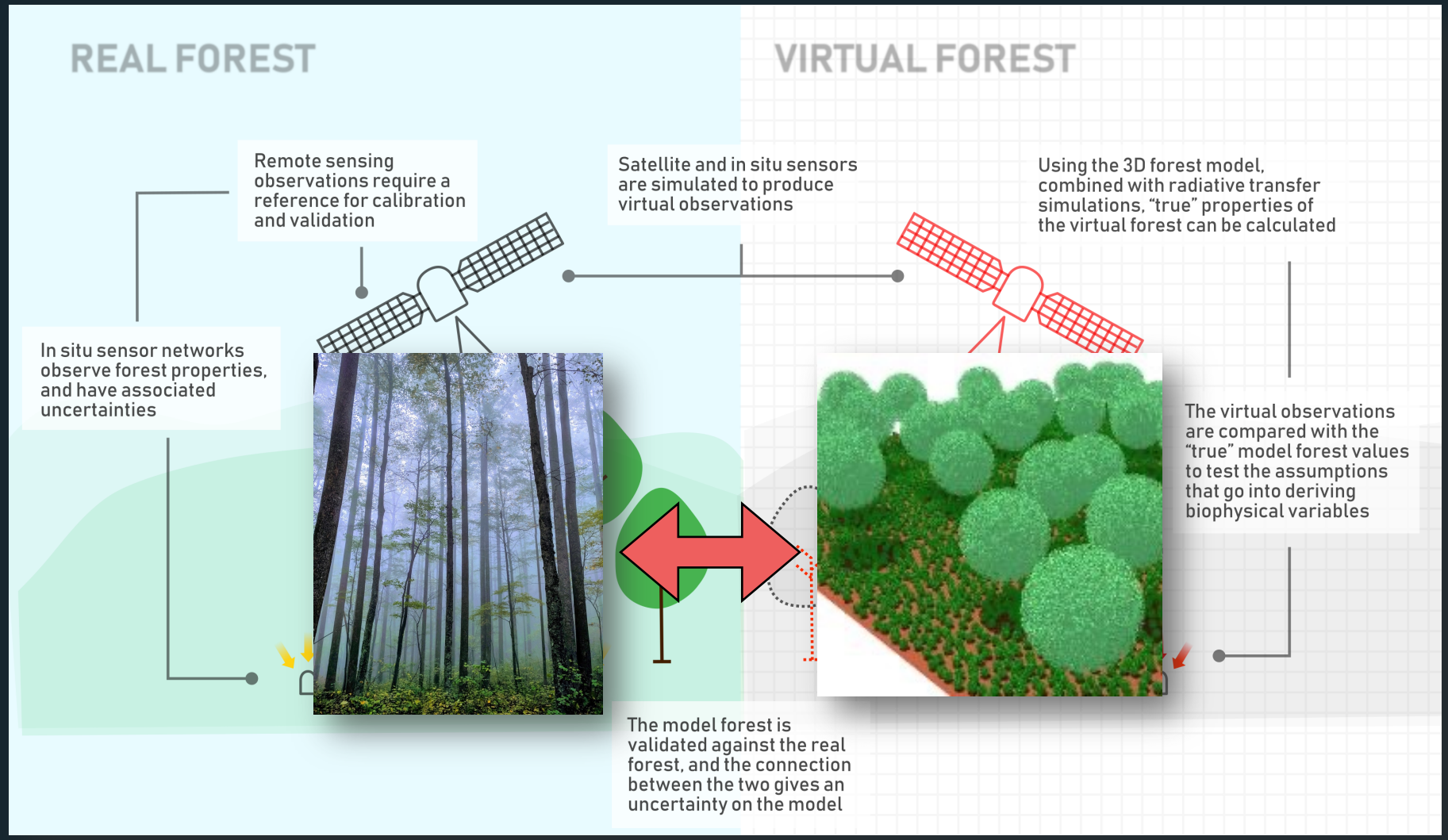
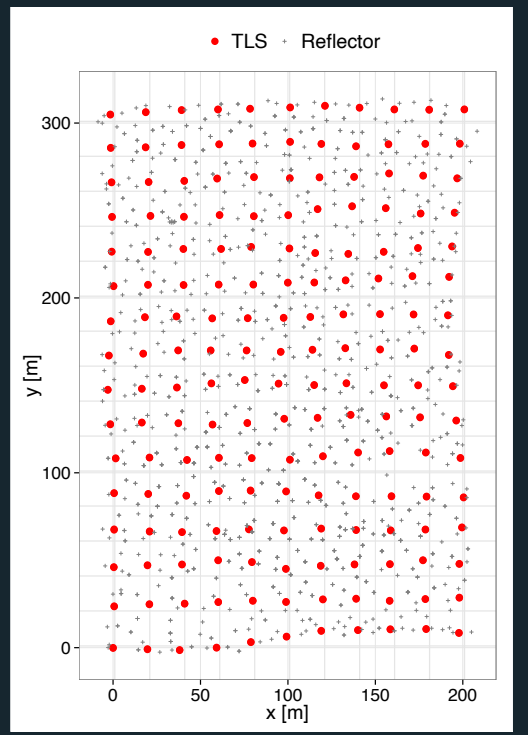
Radiative Transfer Modelling (RTM)



TLS to support spaceborne cal/val through RTM

- Case study: Wytham Woods (first TLS derived forest digital twin)



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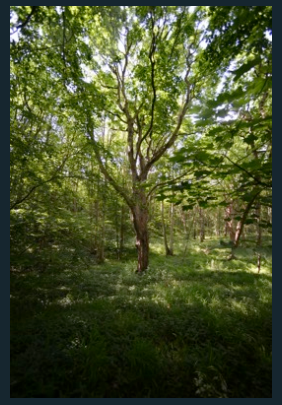
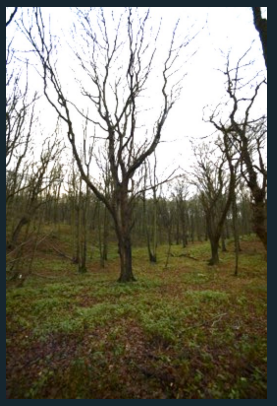
TLS to support spaceborne cal/val through RTM

- Case study: Wytham Woods

Leaf-on



Leaf-off



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TLS to support spaceborne cal/val through RTM

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TLS to support spaceborne cal/val through RTM

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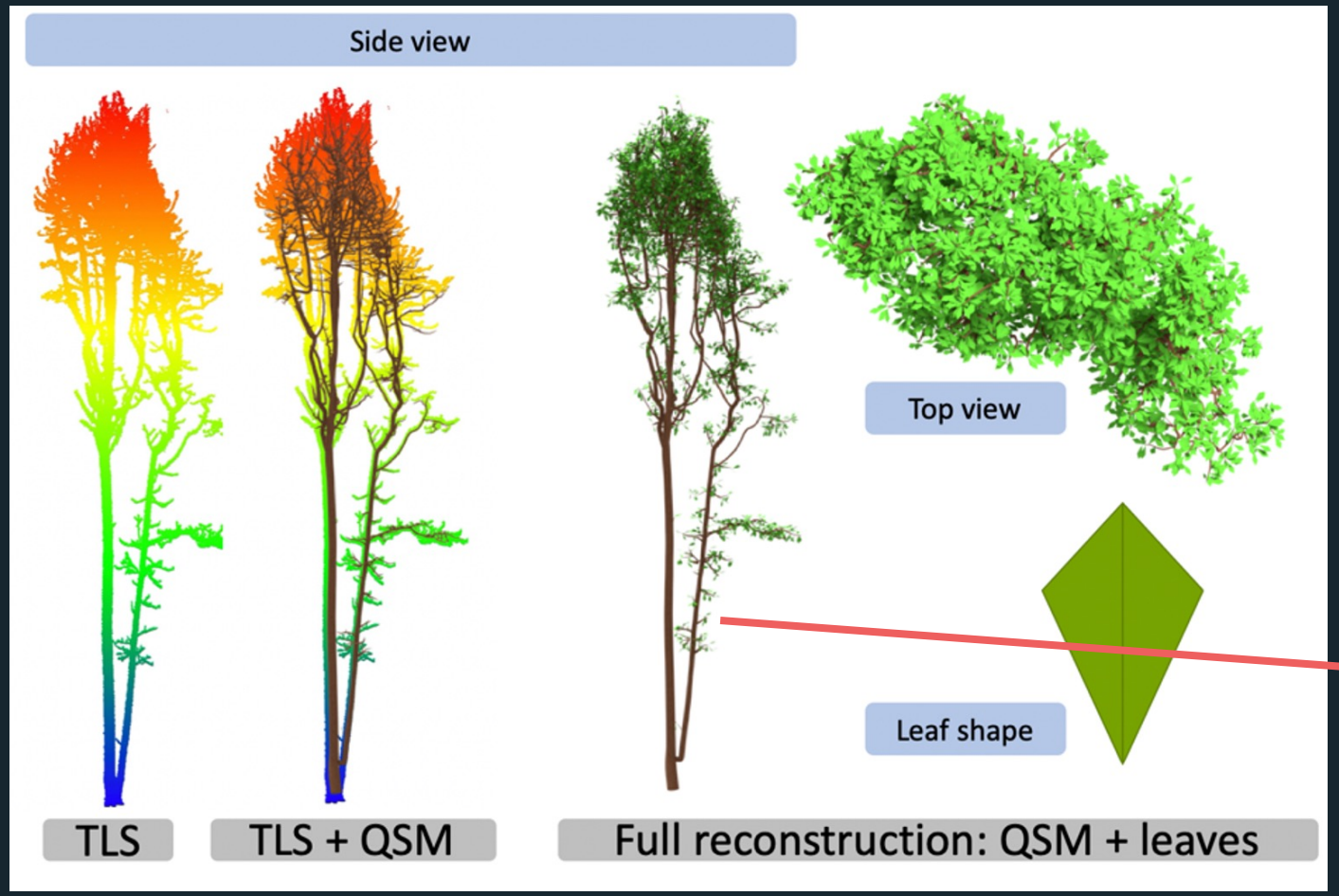

Add foliage:

- Redistribute total leaf area based on branch length
- More leaves towards top
- Leaf size uniform
- Leaf orientation uniform

Attribute optical properties

Åkerblom *et al.* (2018)

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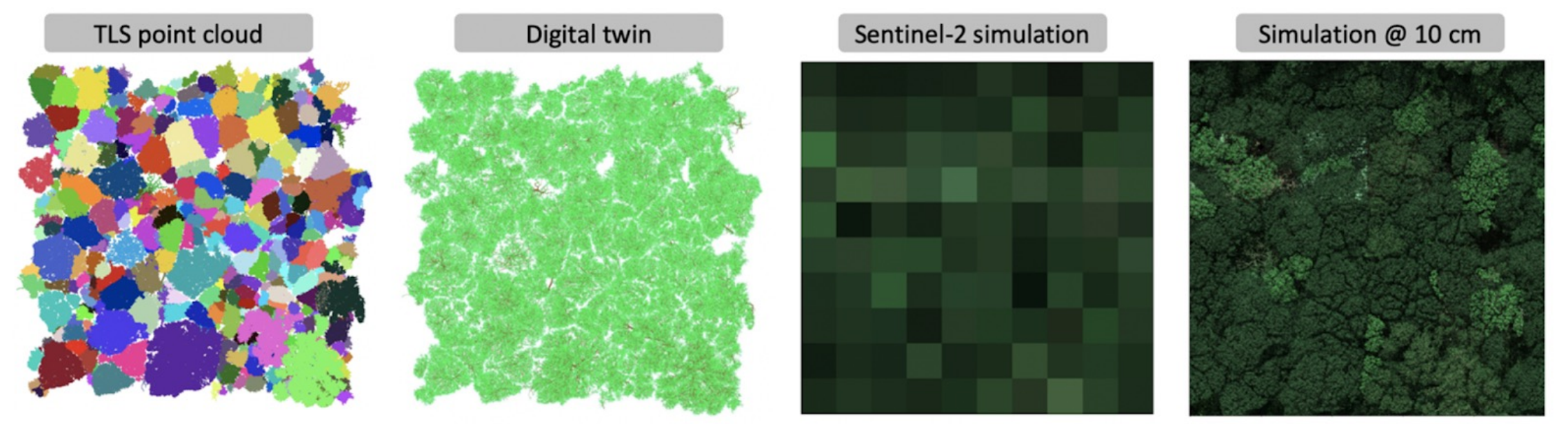
TLS to support spaceborne cal/val through RTM

- Case study: Wytham Woods



Calders *et al.* (2018)

librat

(Future: DART)

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TLS for microwave RTM

⚠ Clouds ⚠ Spatial coverage

Realistic forest digital twin for optical and LiDAR RTM

Realistic forest digital twin for microwave RTM

~ 3D scene structure

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TLS for microwave RTM

Parameterise RTM with field collected dielectric permittivity

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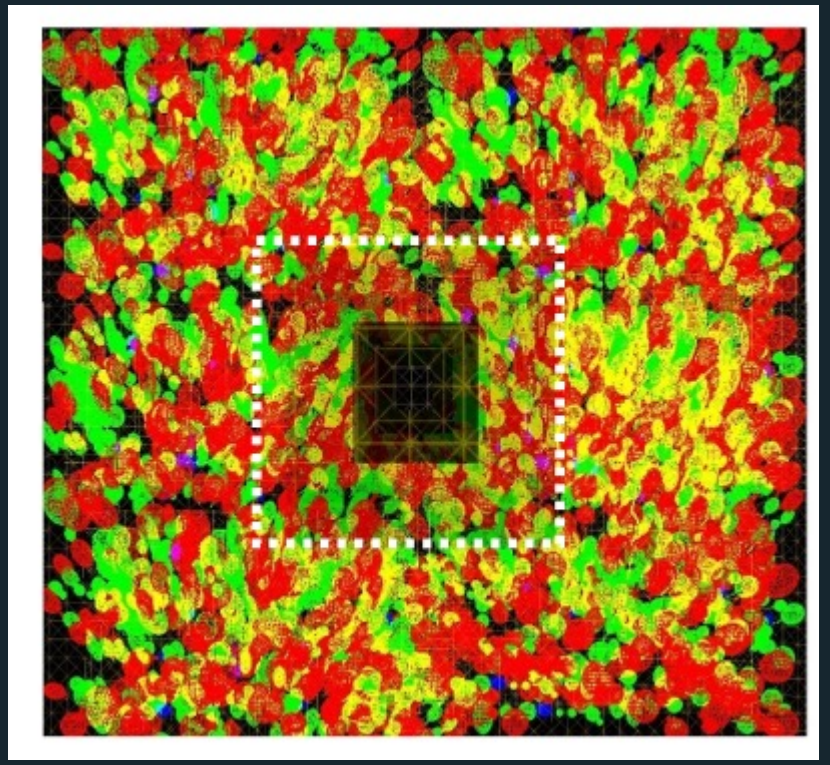
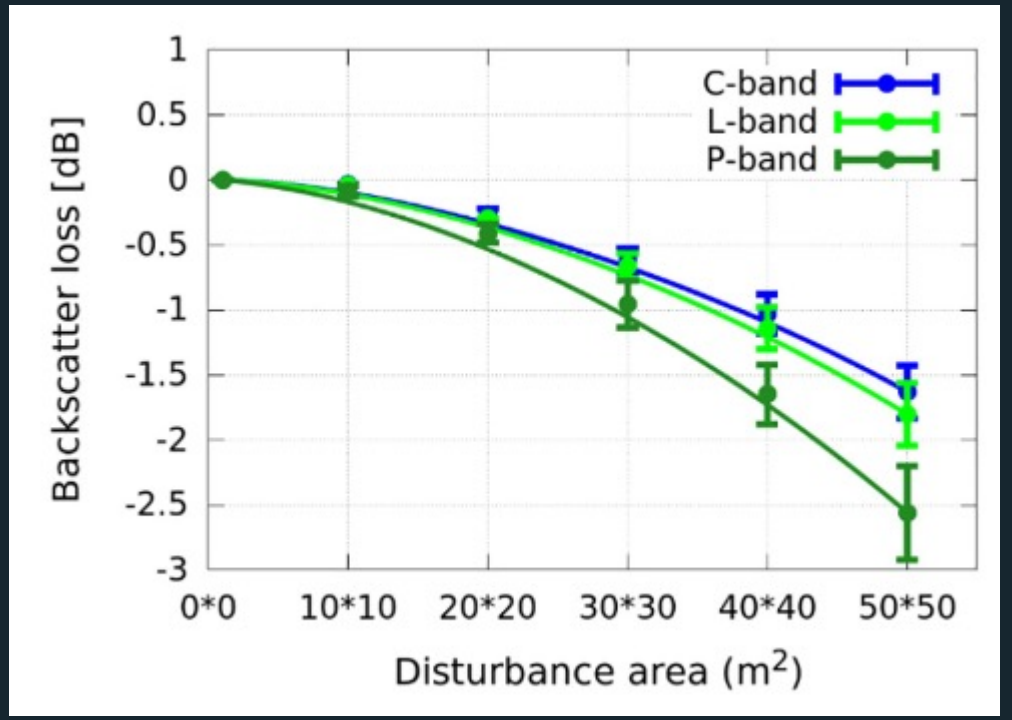
TLS for microwave RTM



Schematic mockup

MIPERS^{4D}



Tanase *et al.* (2019)

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The SPACETWIN project

Understanding forest disturbances and recovery from space

European Research Council
Established by the European Commission

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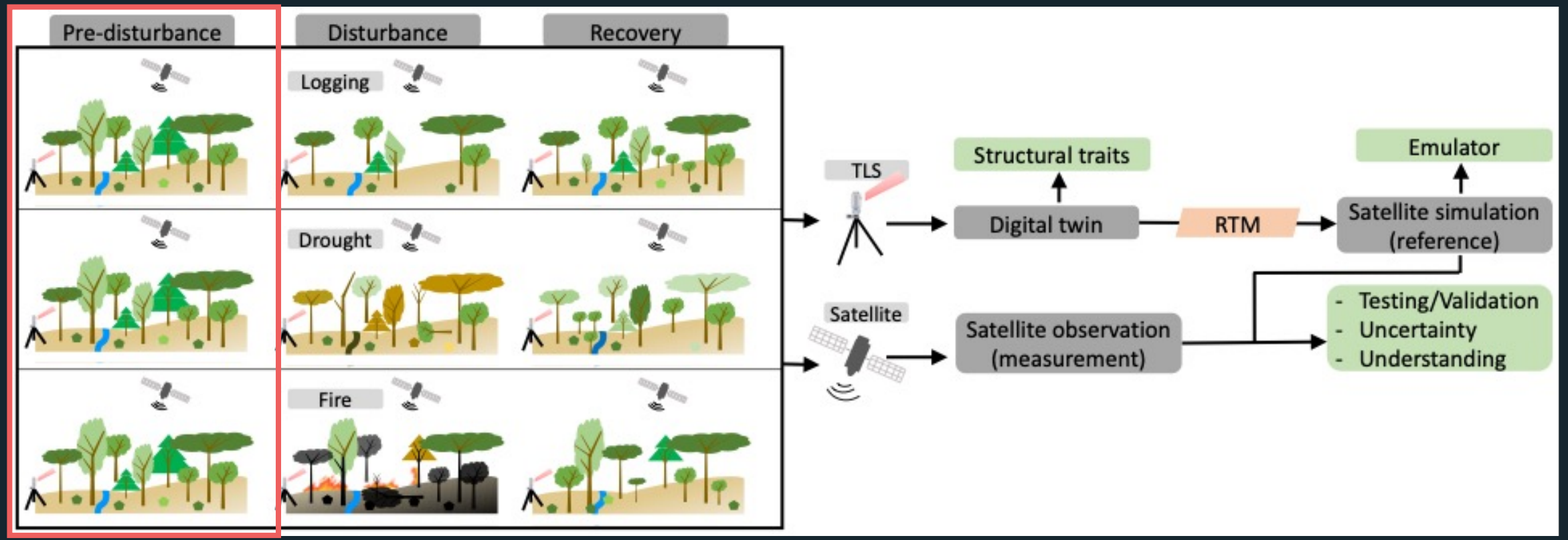
The SPACETWIN project



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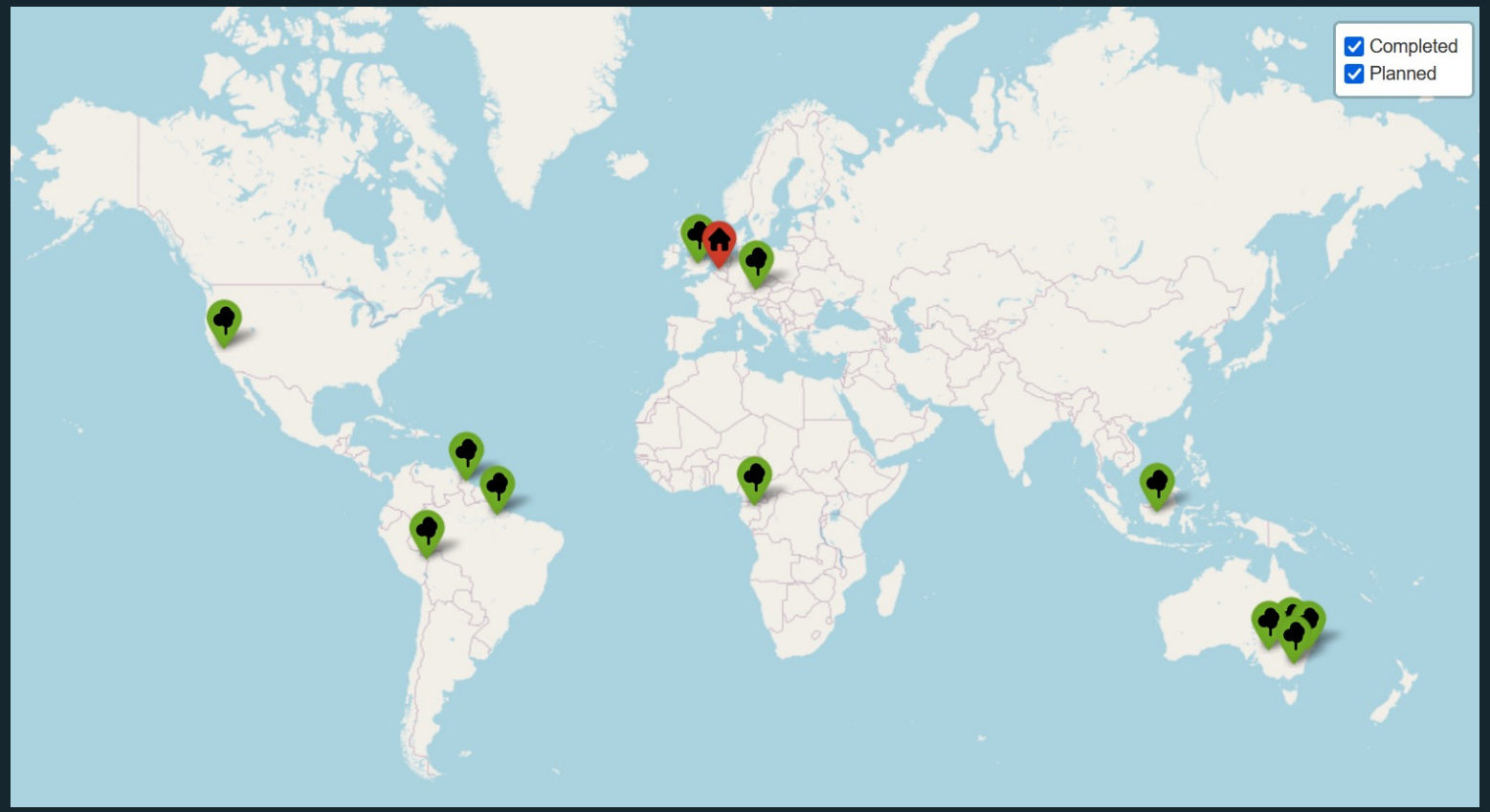
The SPACETWIN project

- Unique globally distributed 4D dataset of disturbed forests



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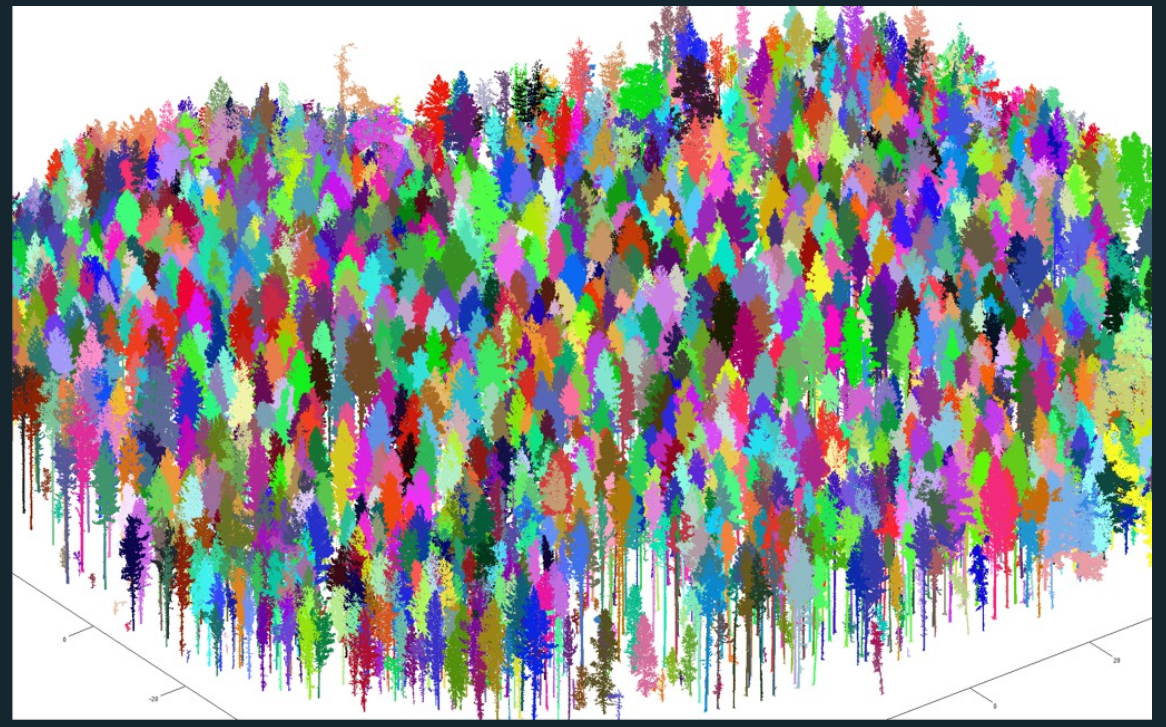
- Unique globally distributed 4D dataset of disturbed forests
- Novel methods for automated processing of large 3D datasets



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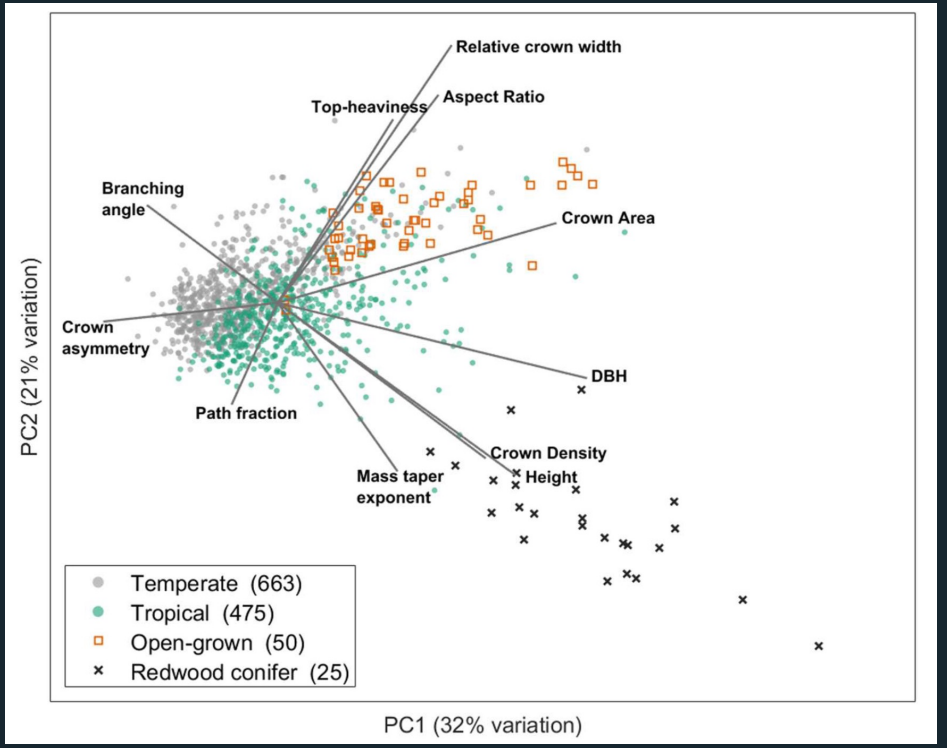
- Understanding structural drivers of forests through time



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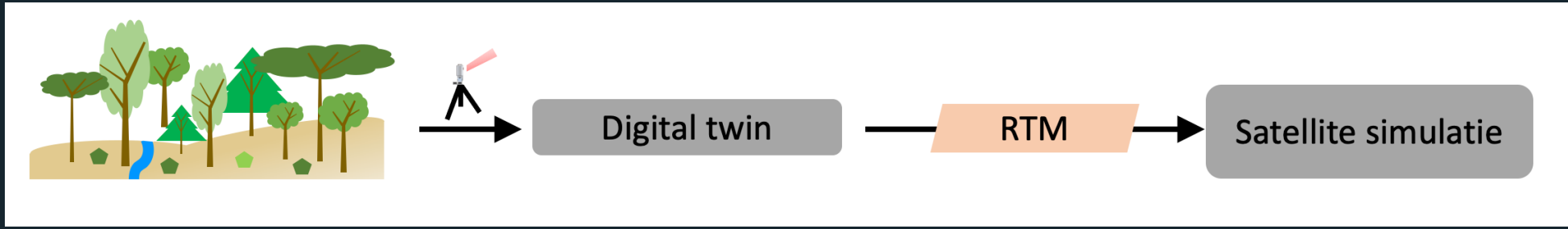
- First implementation of realistic forest digital twins in RTMs for all satellite types



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The SPACETWIN project

- Unique globally distributed 4D dataset of disturbed forests
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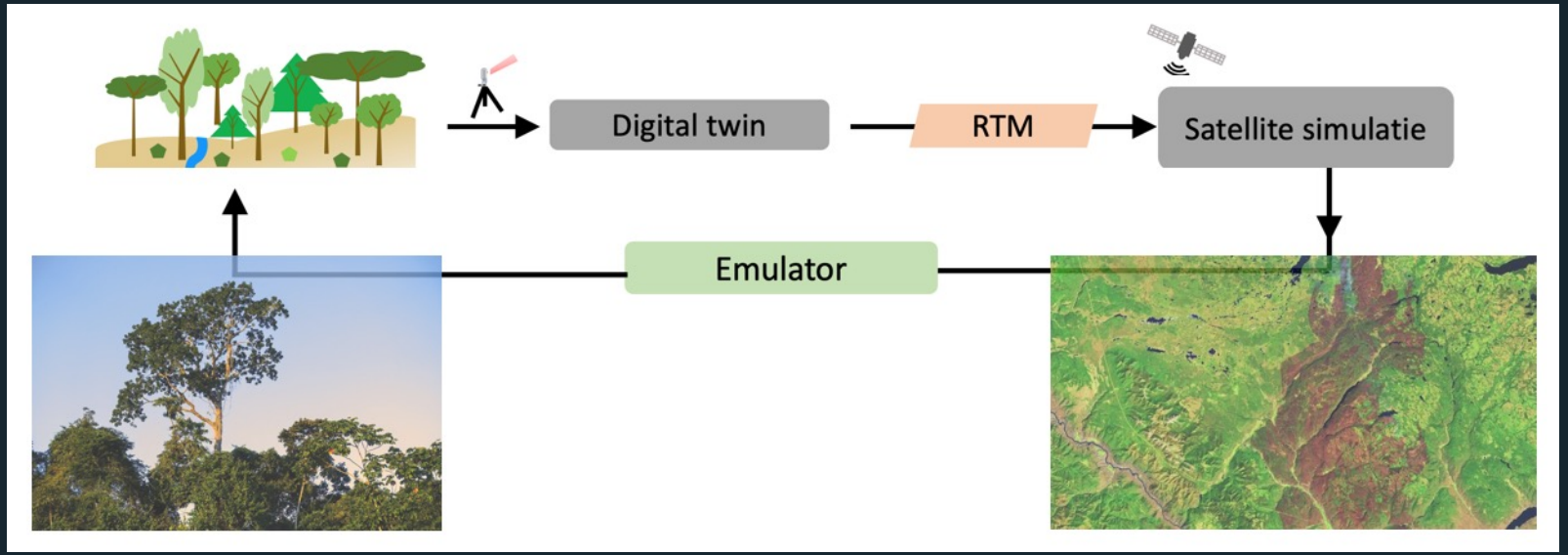
- Near real-time forest disturbance monitoring using satellite data



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- Understanding structural drivers of forests through time
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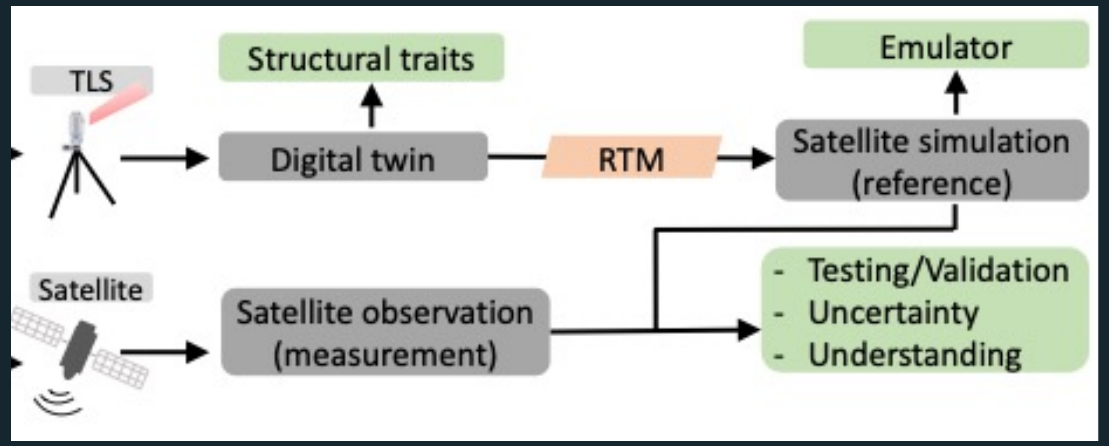
- Near real-time forest disturbance monitoring using satellite data
- Understanding uncertainties in global observations of forest disturbances



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MORE INFO ?

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QUESTIONS?

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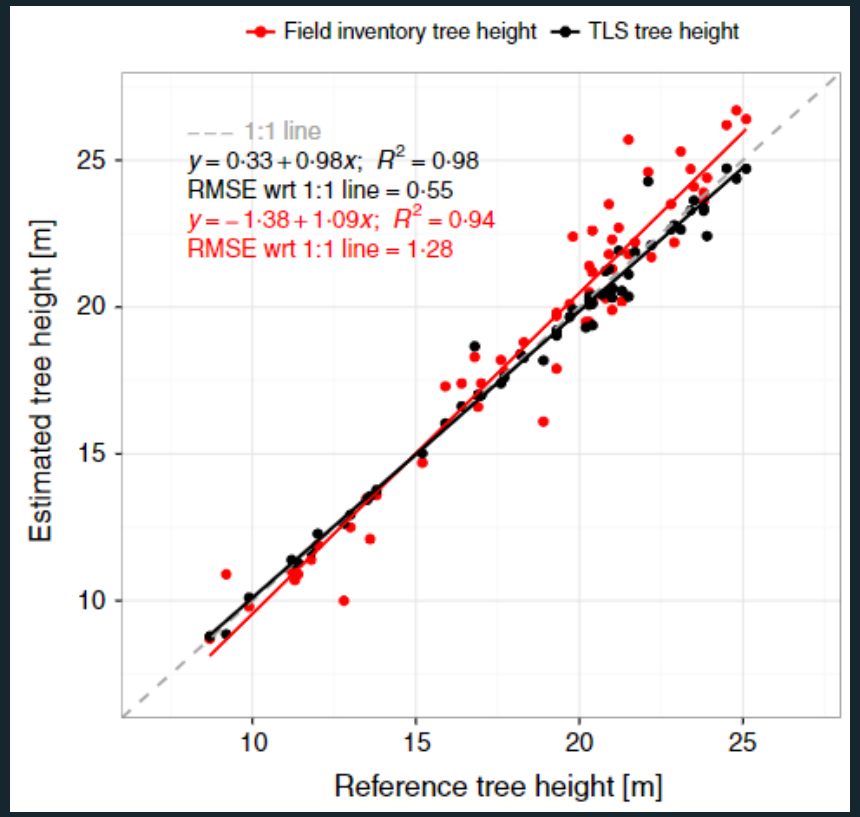
TLS as reference data for AGB measurements



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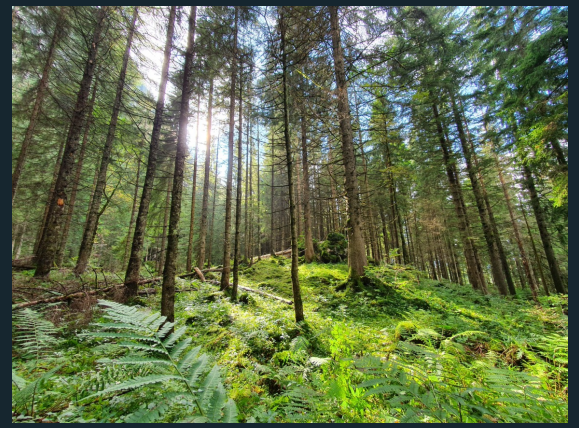
Pictures of forests in the world



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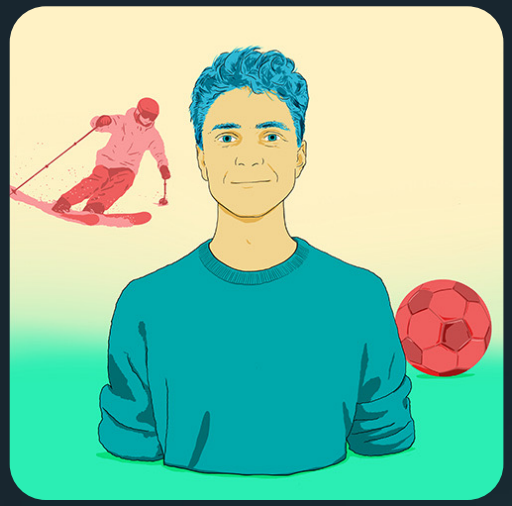
MEET OUR TEAM

Kim Calders
Principal investigator

Wout Cherlet
PhD researcher

Zane Cooper
PhD researcher



Wouter Van den Broeck
PhD researcher

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