

Big Data from Space 2025, Riga, Latvia

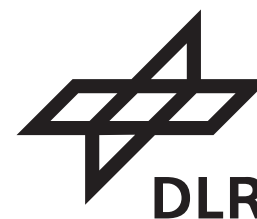
Preparing for a three-dimensional Sentinel-1: towards high-accuracy forest monitoring via bi- static SAR methods

Anton Kostiukhin

Martin Jussi

Tauri Tampuu

Assoc. Prof. Alexander Knoch



Our collective problem – forest monitoring

News

Opinion

Sport

Culture

Lifestyle

☰

The Guardian

Eur

World UK **Climate crisis** Ukraine Environment Science Global development Football Tech Business Obituaries

The age of extinction
Carbon offsetting

The age of extinction is supported by



About this content

Patrick Greenfield

Wed 18 Jan 2023 15:00 CET

Share

Revealed: more than 90% of rainforest carbon offsets by biggest certifier are worthless, analysis shows

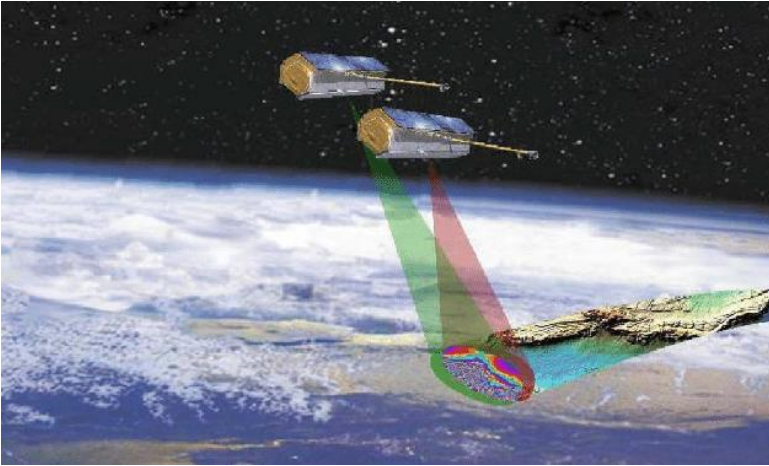
Investigation into Verra carbon standard finds most are 'phantom credits' and may worsen global heating

- 'Nowhere else to go': Alto Mayo, Peru, at centre of conservation row
- Greenwashing or a net zero necessity? Scientists on carbon offsetting
- Carbon offsets flawed but we are in a climate emergency



📍 The Alto Mayo protection forest in Moyobamba, Peru, was supposed to be a flagship offsetting project but has faced human rights issues. Composite: Guardian Design/AFP/Getty Images

State of bi-static SAR



- large scale monitoring with ease;
- doesn't depend on the weather;
- SAR is useful for forest height estimation across different forest types, including boreal, temperate, and tropical;

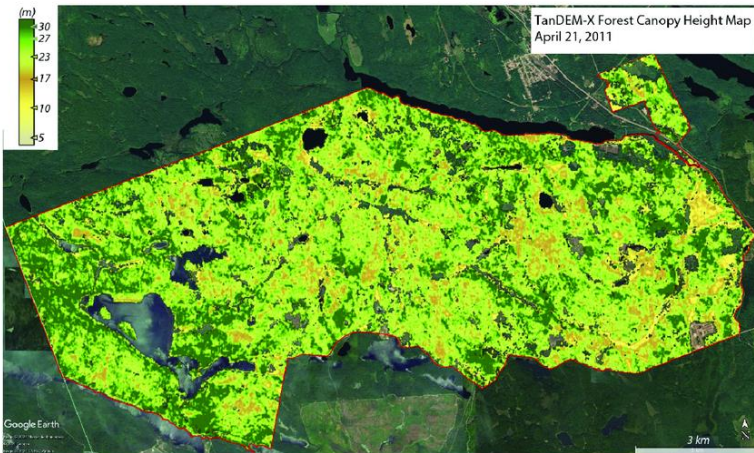


Image Credits: DLR / Chen et al. 2021

However, publications often omit critical details making methodology obscure.

(data used, processing steps, forest properties – height, density, etc.)

TanDEM-X data

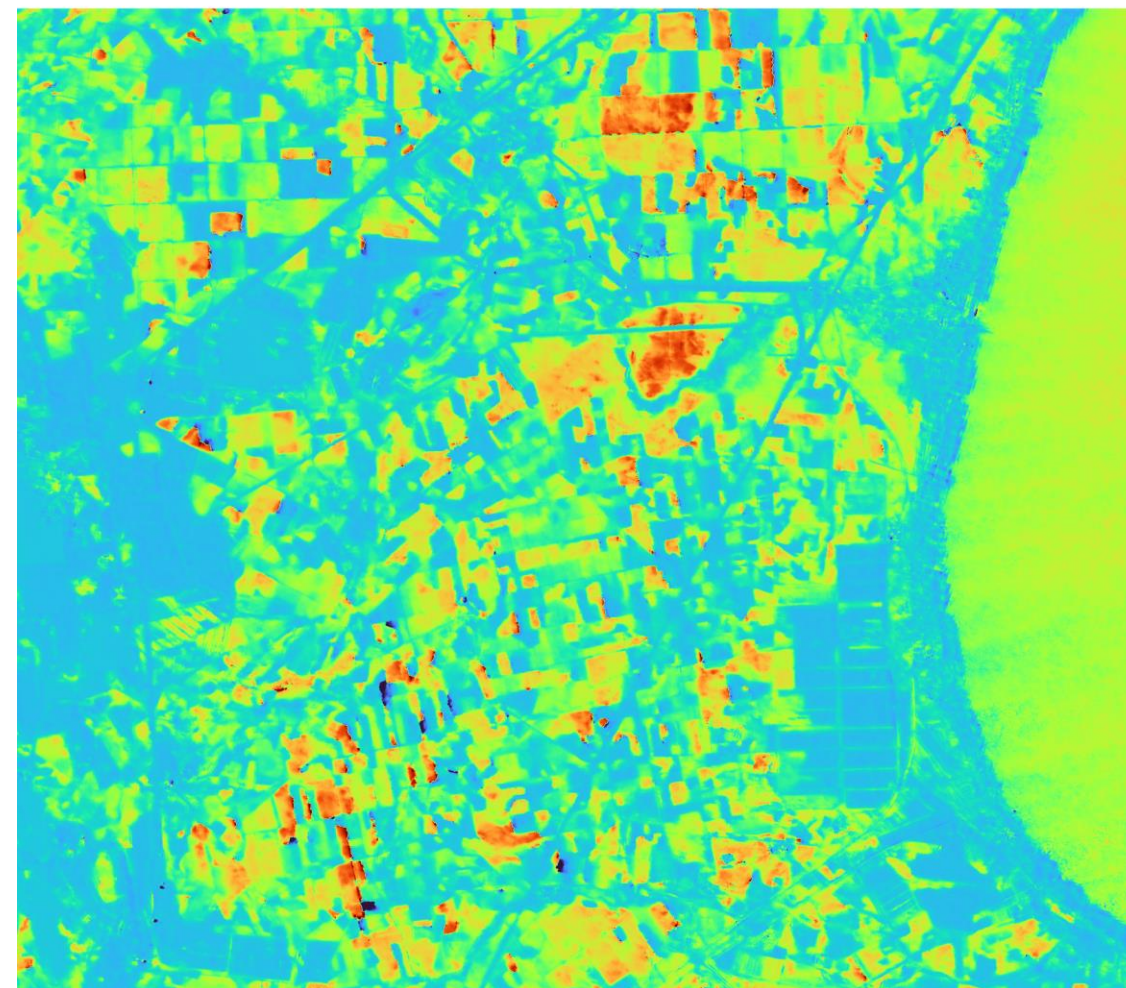
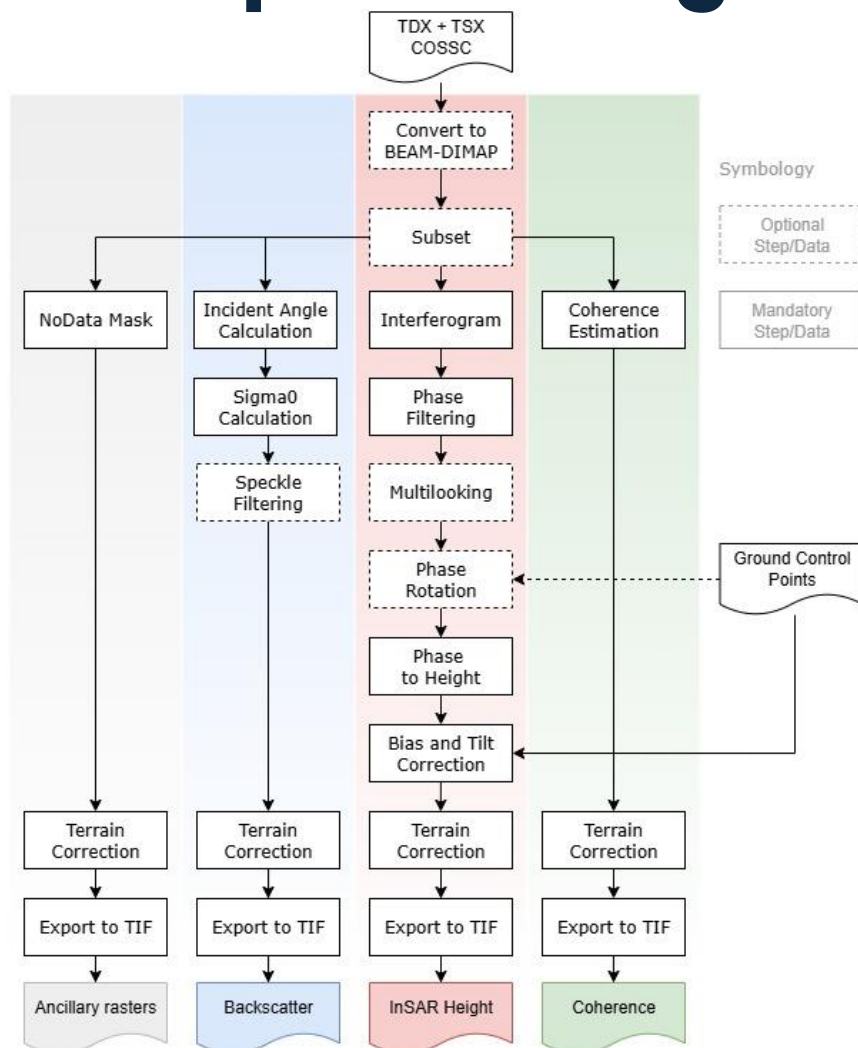
A Estonia



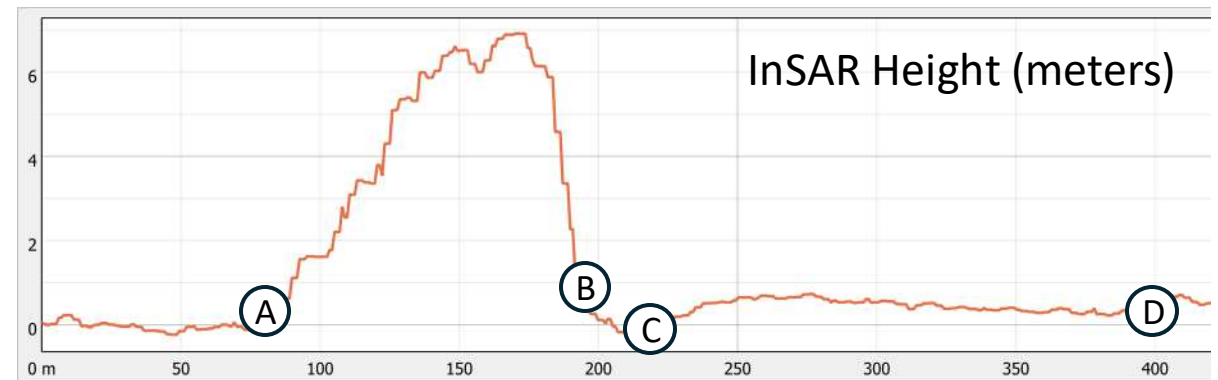
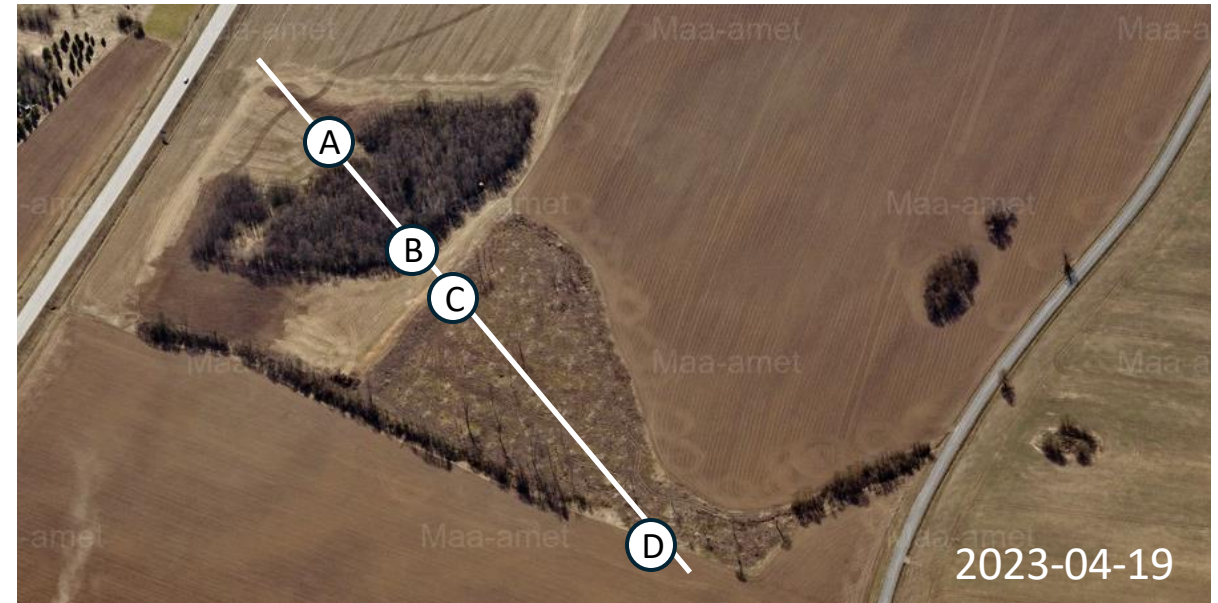
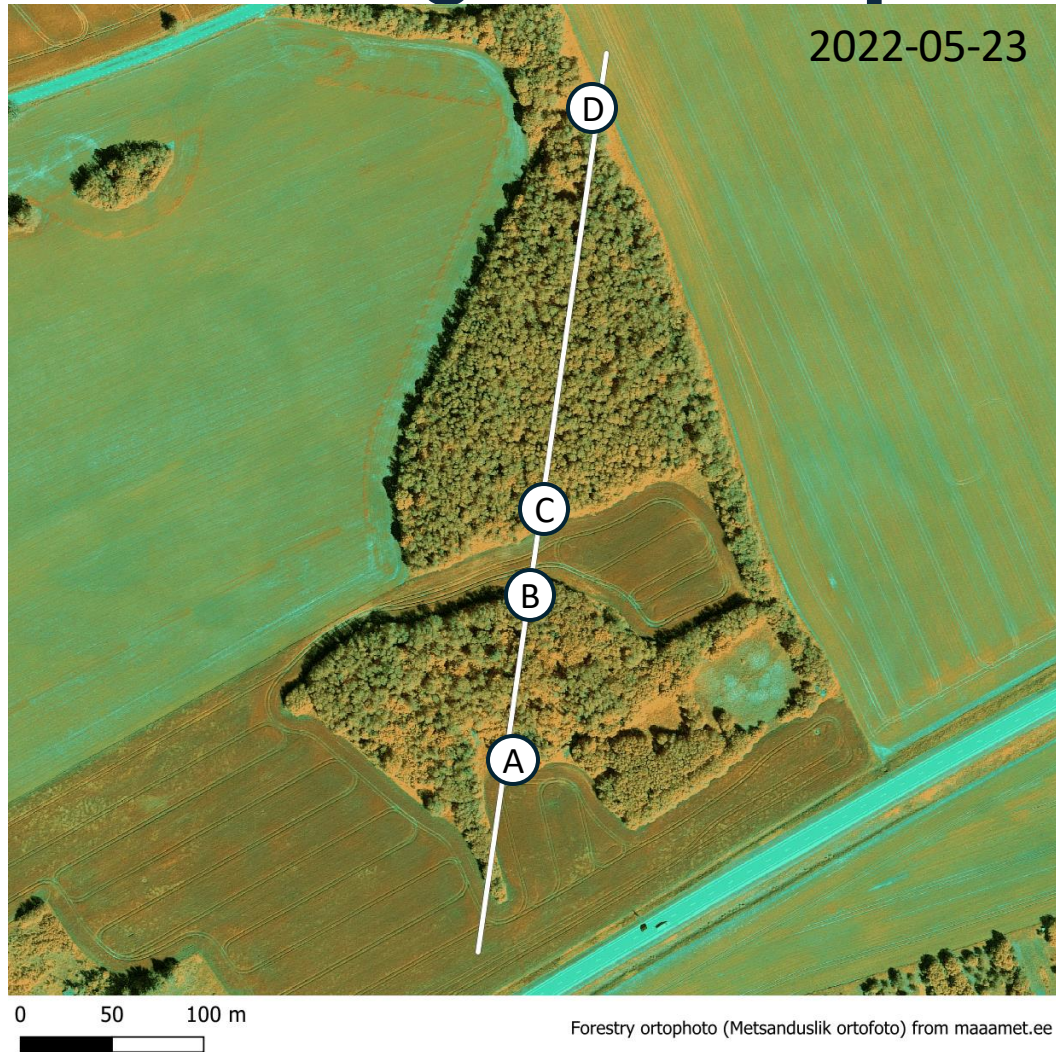
B Study sites



Data processing



InSAR Height forest profile



Random Forest

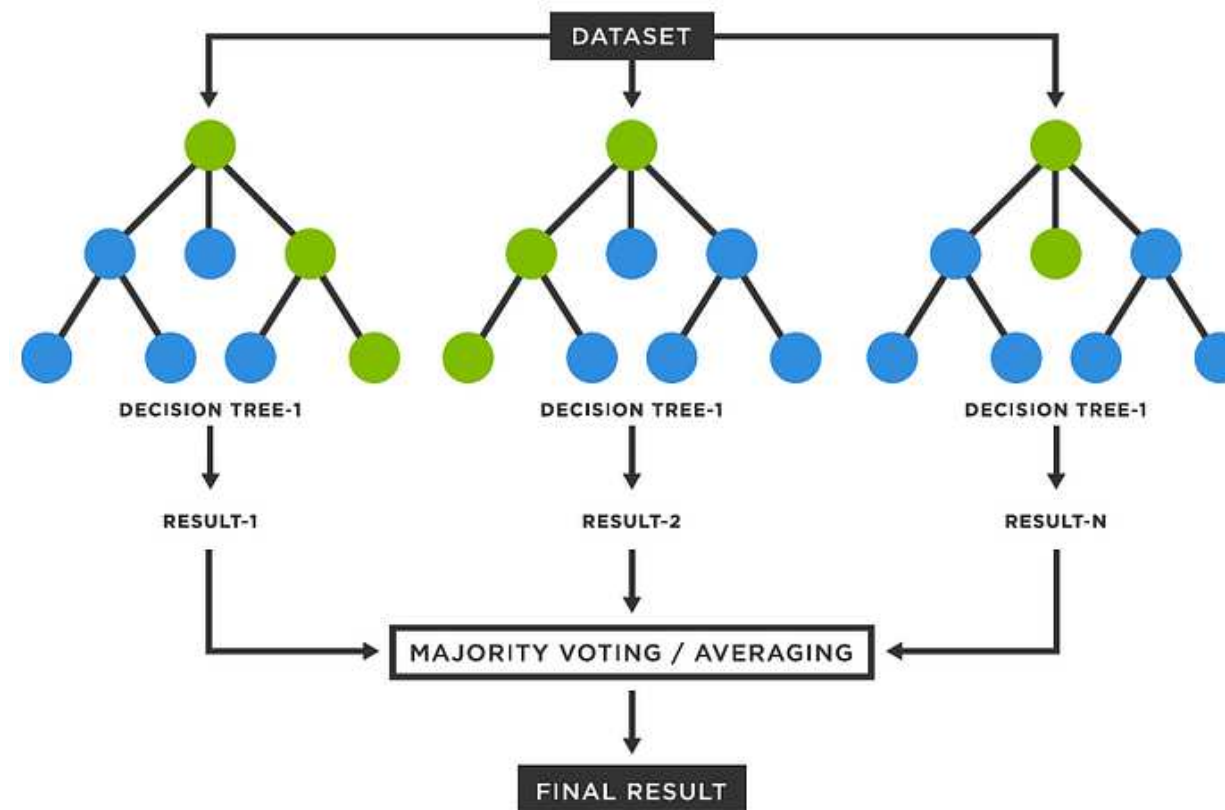


Image Credit: <https://medium.com/@denizgunay/random-forest-af5bde5d7e1e>

Random Forest to predict Lidar Canopy Height

Ancillary

- Latitude
- Longitude
- Aspect
- Oriented Aspect
- Local Incidence Angle
- Ellipsoid Incidence Angle
- Elevation
- Slope
- Height of Ambiguity (HOA)

Backscatter

- Sigma0

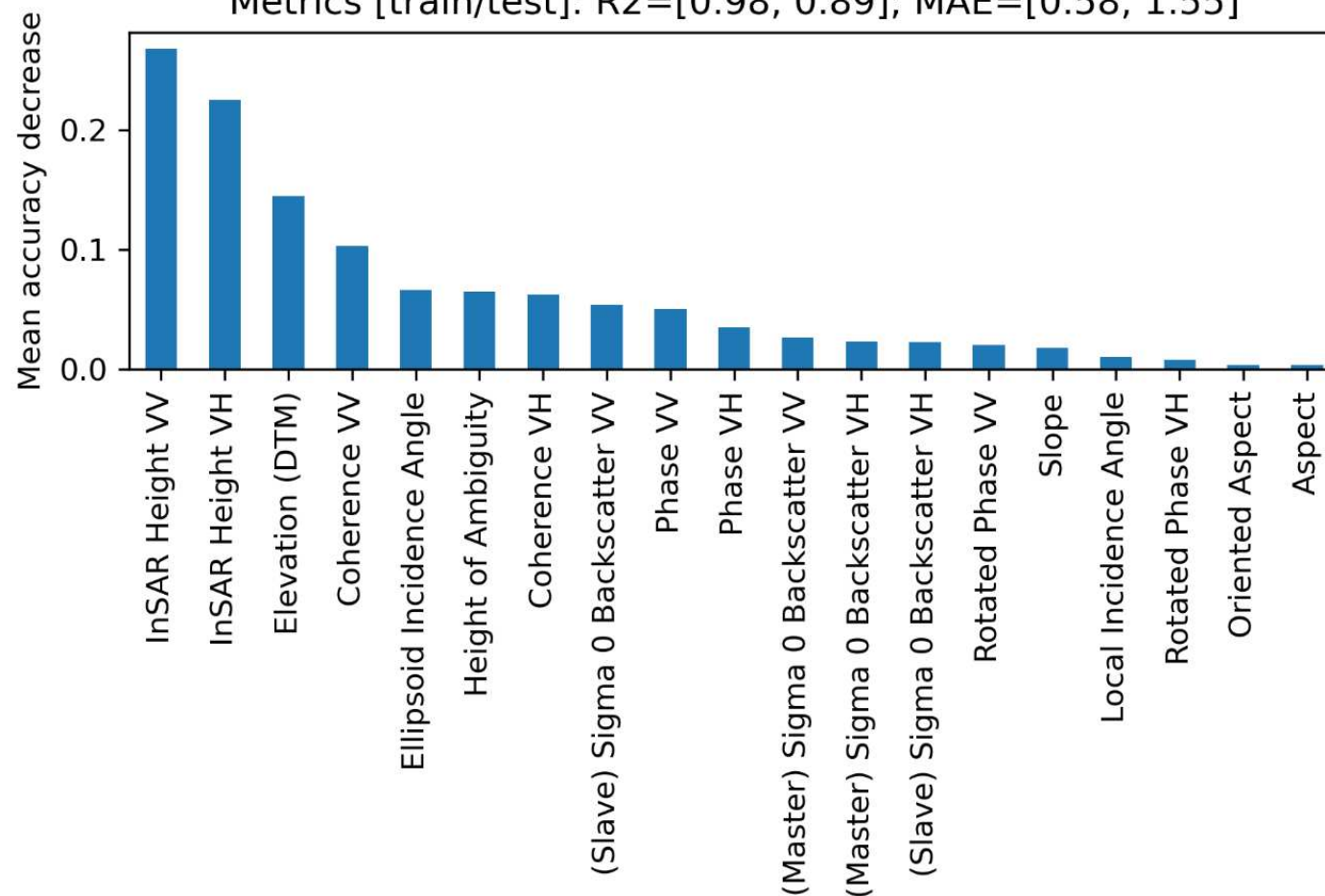
InSAR Height

- Phase
- Rotated Phase
- InSAR Height

Coherence

- Coherence

Permutation feature importance for Random Forest (birch compartments).
TDM1_SAR_COS_BIST_SM_D_SRA_20240805T045035_20240805T045041
Metrics [train/test]: R2=[0.98, 0.89]; MAE=[0.58, 1.55]



Random Forest to predict Lidar Canopy Height

Ancillary

- Latitude
- Longitude
- Aspect
- Oriented Aspect
- Local Incidence Angle
- Ellipsoid Incidence Angle
- Elevation
- Slope
- Height of Ambiguity (HOA)

Backscatter

- Sigma0

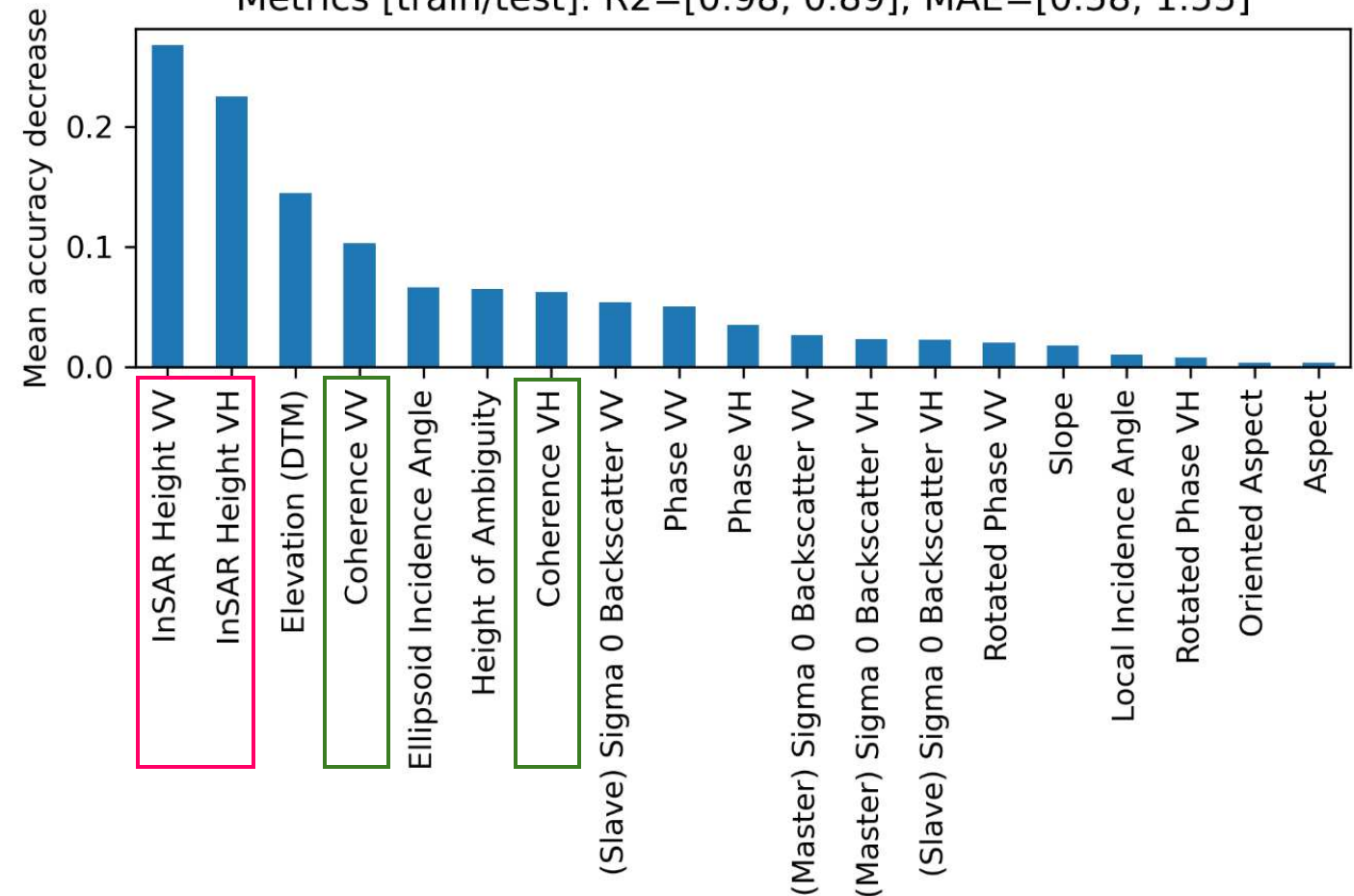
InSAR Height

- Phase
- Rotated Phase
- InSAR Height

Coherence

- Coherence

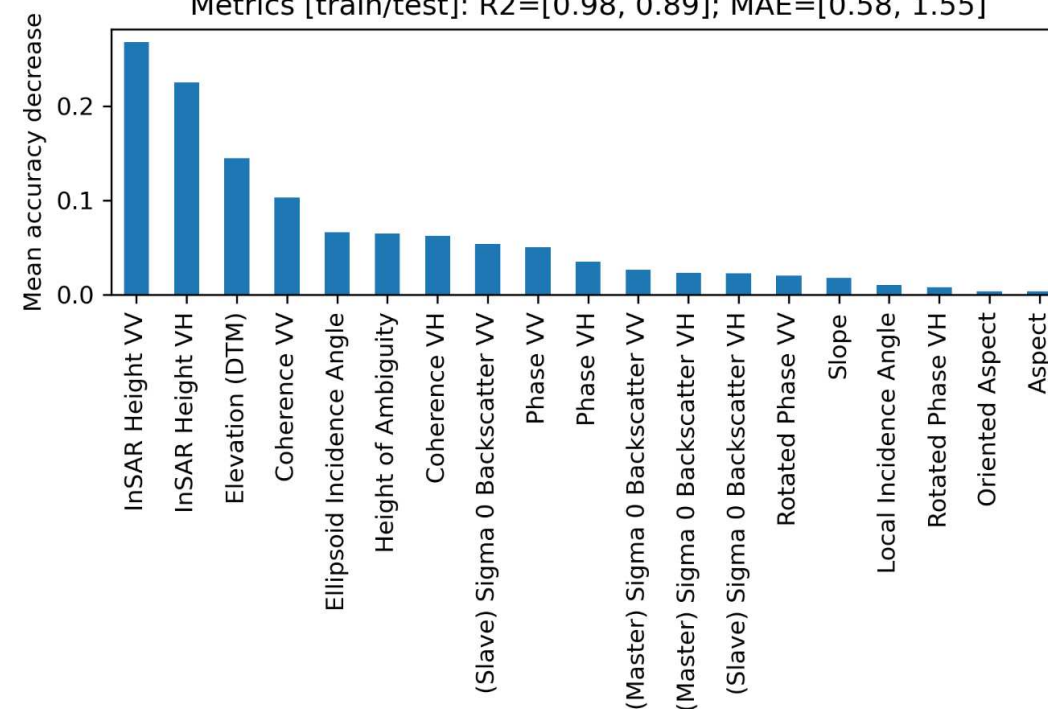
Permutation feature importance for Random Forest (birch compartments).
TDM1_SAR_COS_BIST_SM_D_SRA_20240805T045035_20240805T045041
Metrics [train/test]: R2=[0.98, 0.89]; MAE=[0.58, 1.55]



Random Forest – towards high-accuracy modelling

- More robust sampling technique;
- Employ forest properties (tree types, height, density);
- Pixel vs. Compartment-based model;
- Bigger and more diverse area of interest;

Permutation feature importance for Random Forest (birch compartments).
TDM1_SAR_COS_BIST_SM_D_SRA_20240805T045035_20240805T045041
Metrics [train/test]: R2=[0.98, 0.89]; MAE=[0.58, 1.55]





KappaZeta

Founded in **2015** as University of Tartu SAR research group spin-off. Core business focus on **agriculture, forestry, and defence applications.**

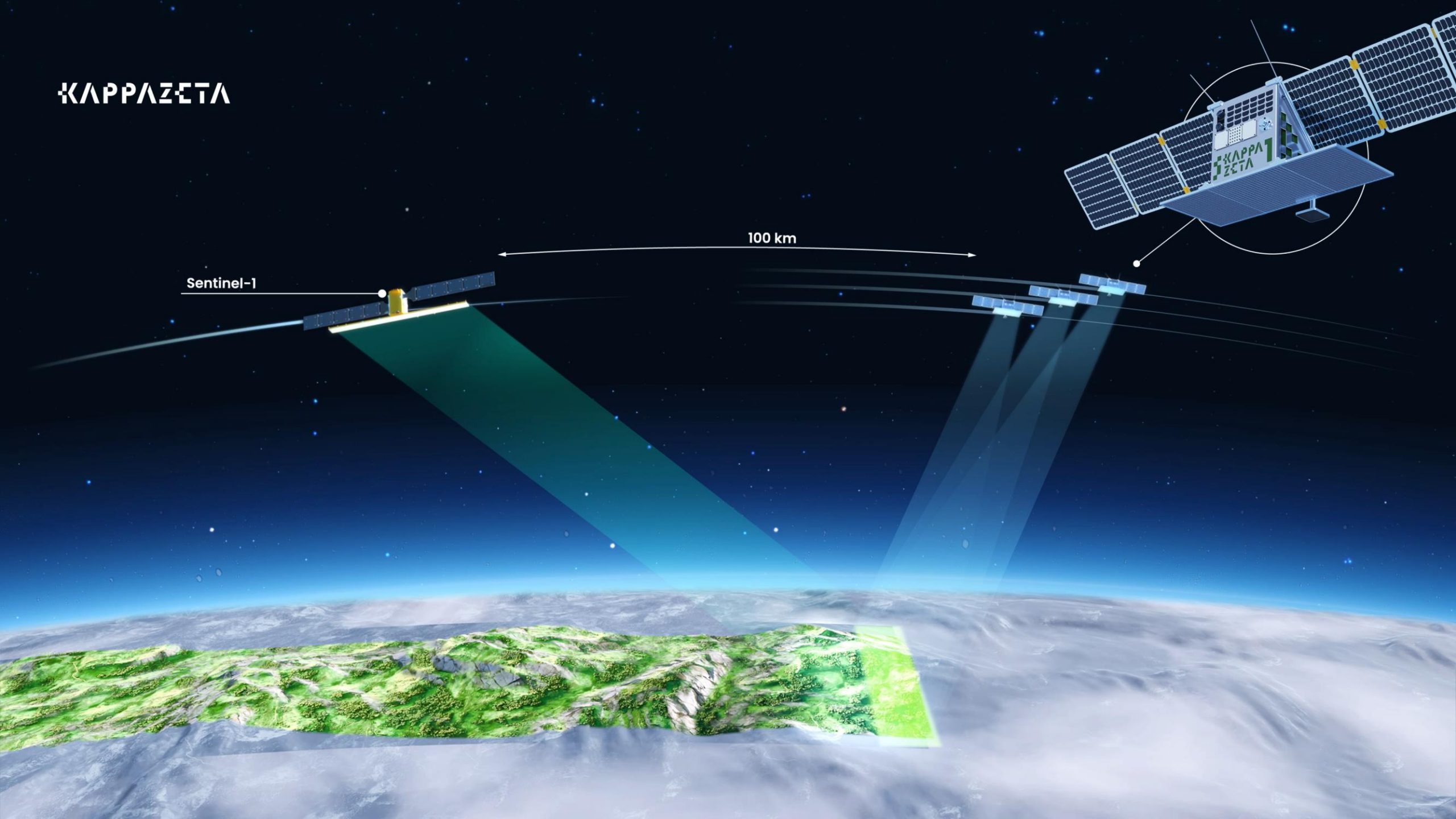


Tartu University Landscape Geoinformatics Lab

Sustainable landscape planning and resource management using **geospatial analysis, machine learning** and **modelling.**



ΚΑΡΡΑΖΕΤΑ



Big Data from Space 2025, Riga, Latvia

Preparing for a three-dimensional Sentinel-1: towards high-accuracy forest monitoring via bi- static SAR methods

Anton Kostiukhin

Martin Jussi

Tauri Tampuu

Assoc. Prof. Alexander Knoch

