KAPPAZETA

Adding dimensions to Sentinel-1 data:

Constellation of passive receiver satellites flying in formation with Sentinel-1 for operational applications

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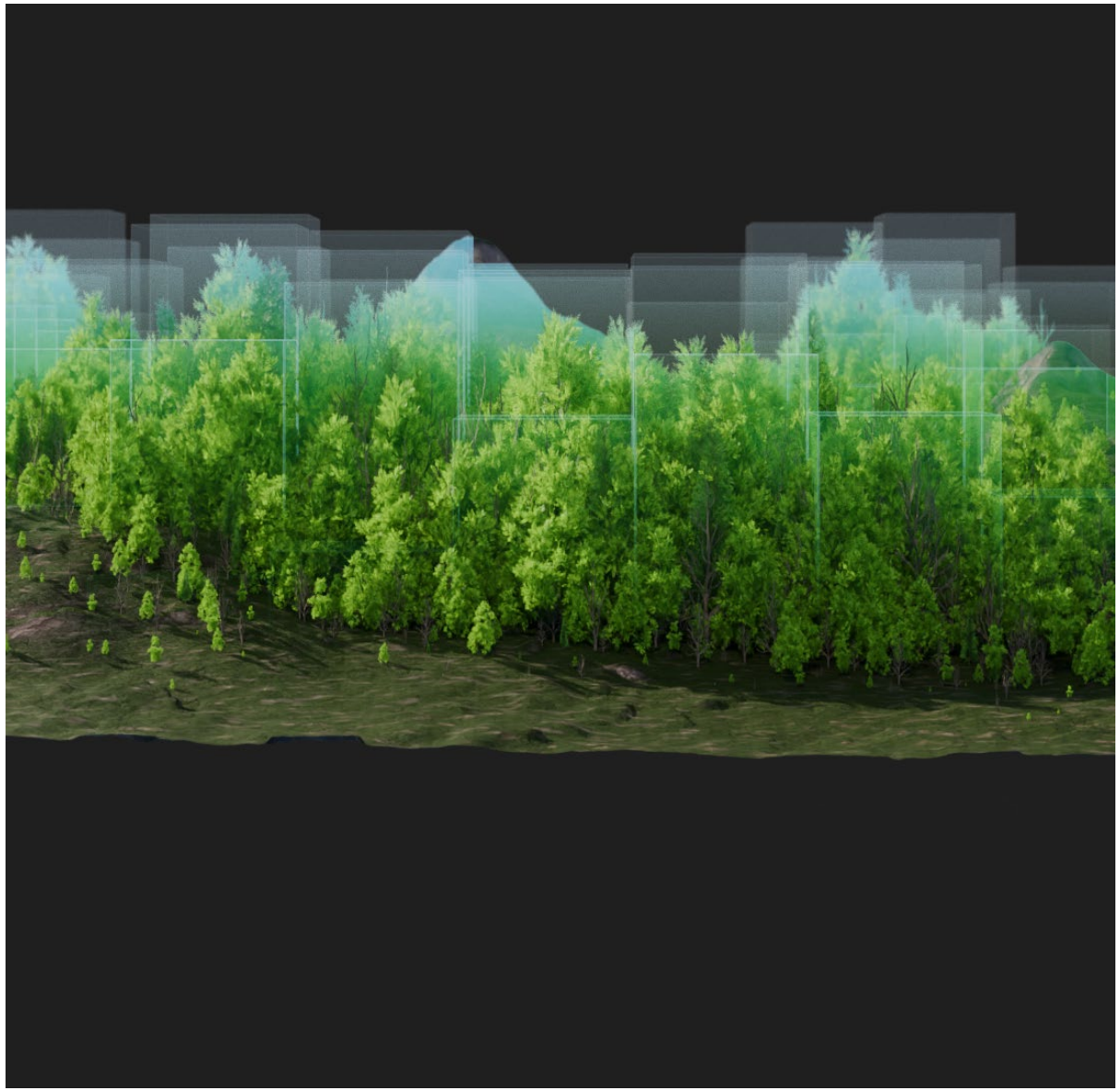
AGENDA

Presentation Outline

1. KappaZeta introduction
2. Motivation for looking towards multistatic SAR
3. 3D-SAR mission overview
4. Call to action



KAPPAZETA

BACKGROUND

Leading EO Service Provider from Estonia

Founded in **2015**

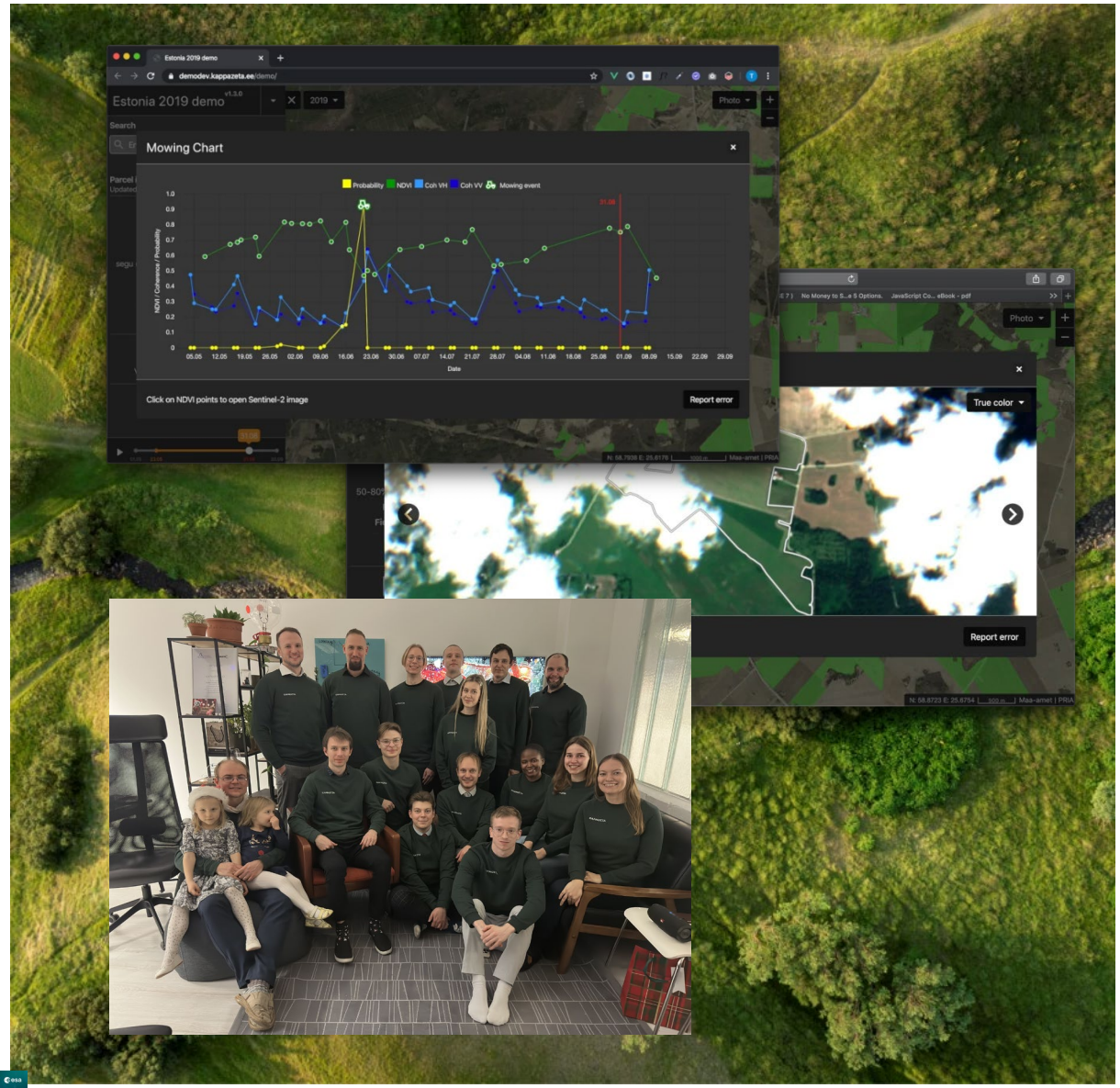
University of Tartu SAR research group spin-off

Employing **28** people

Core business: Agricultural, Forestry and Defence applications

R&D with **European Space Agency** and **European Defence Fund**

~2M€ revenue in 2025



esa

Republic of Estonia Agricultural Registers and Information Board

Ministry of Food, Agriculture and Fisheries of Denmark
Danish Agricultural Agency

CASSINI Business Accelerator

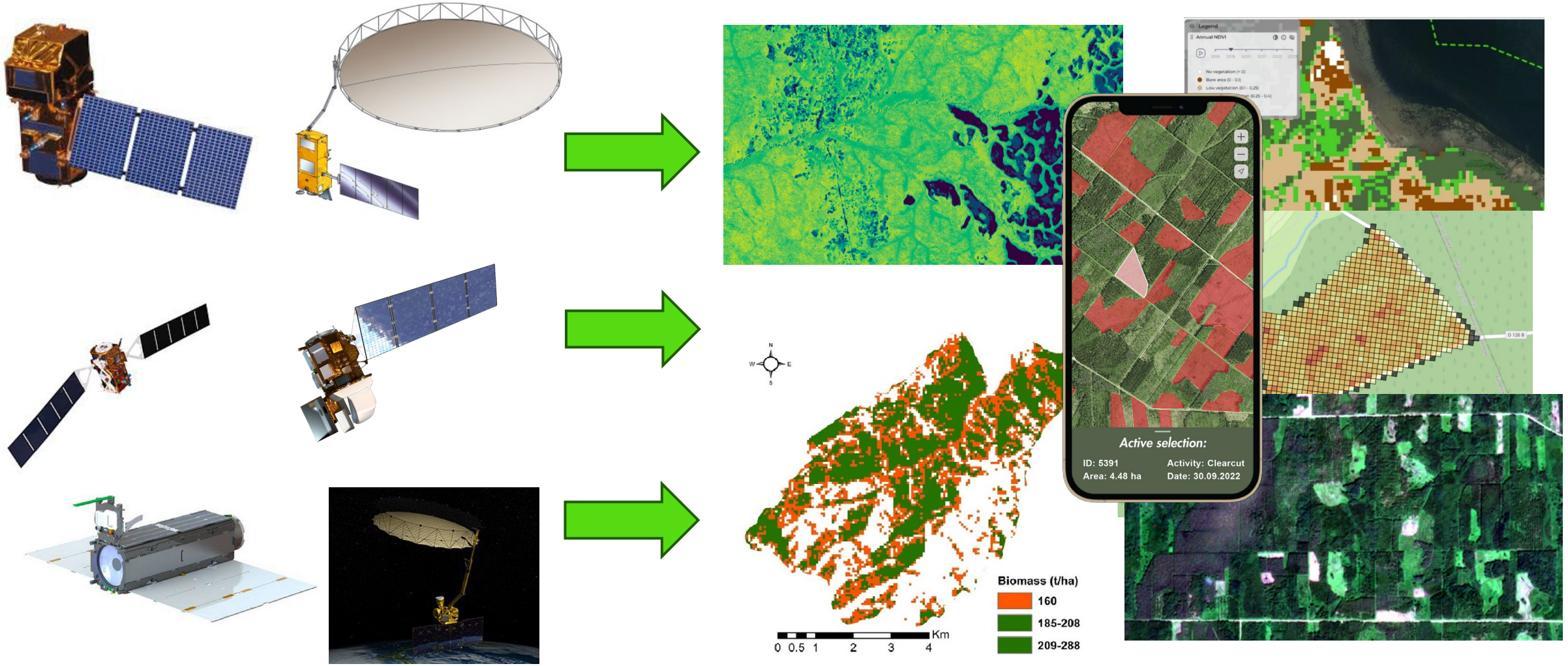
Republic of Estonia Defence Forces

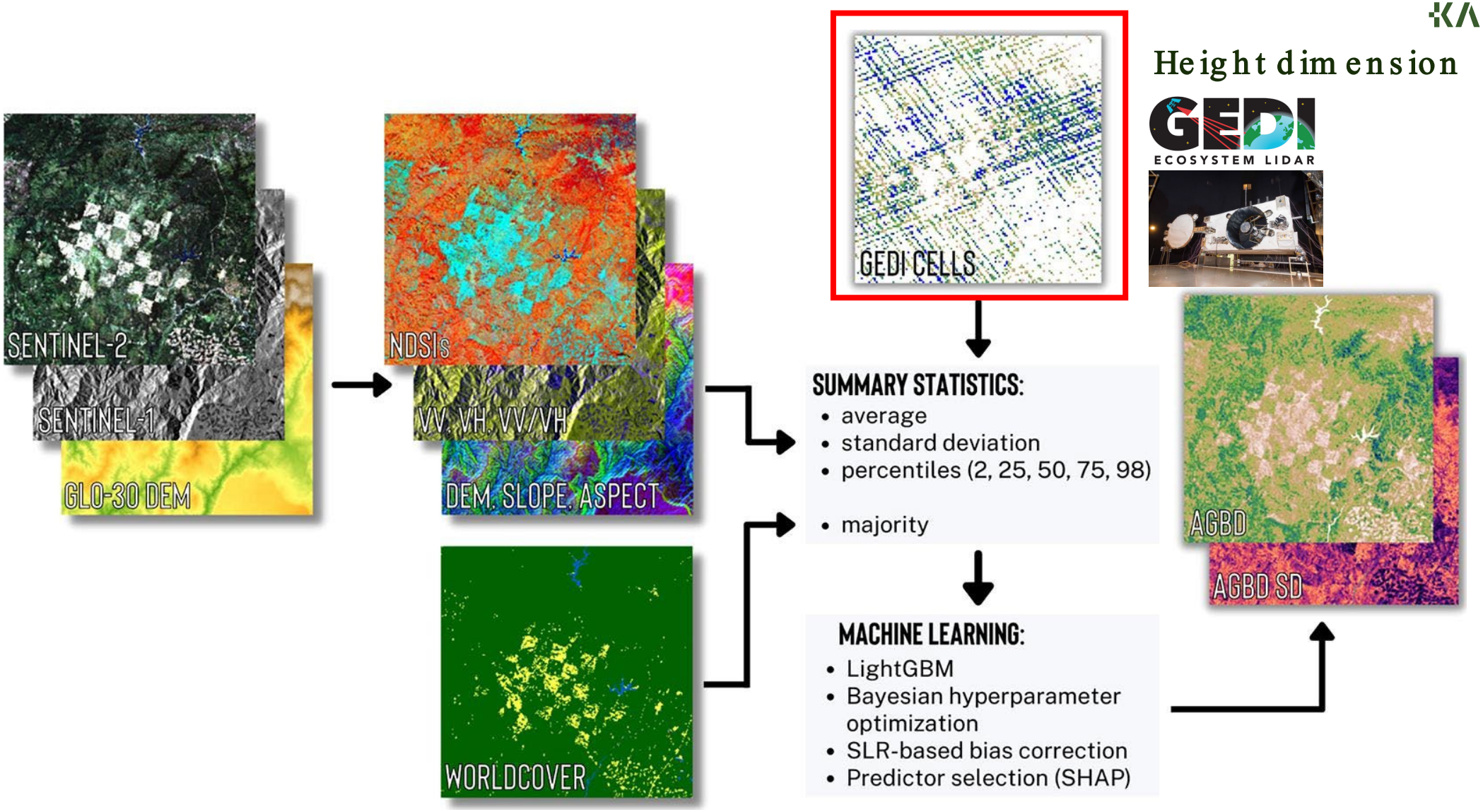
Republic of Estonia Environment Agency

CommEO AWARD

Motivation

Earth Observation for forestry...

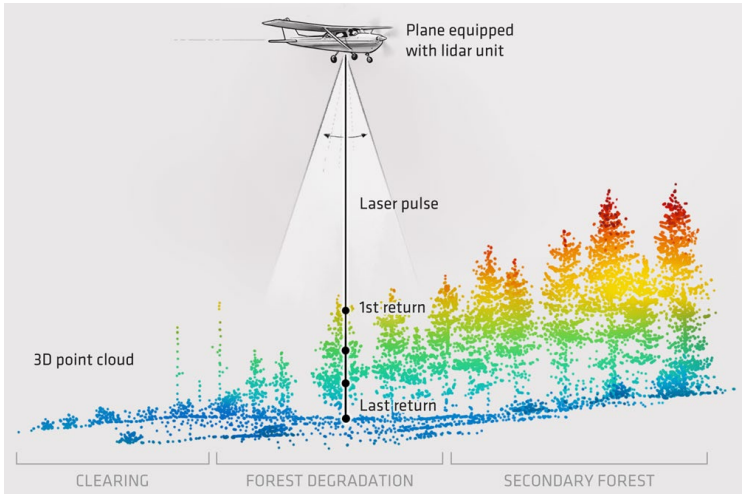


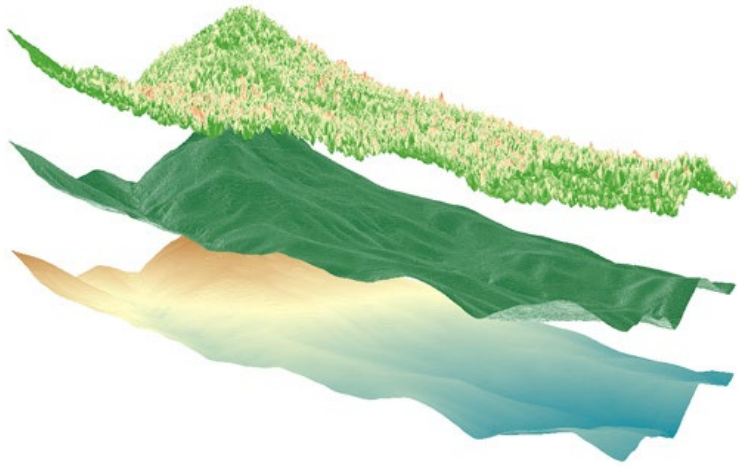


Source: Shendryk, Yuri. "Fusing GEDI with earth observation data for large area aboveground biomass mapping." *International Journal of Applied Earth Observation and Geoinformation* 115 (2022): 103108.

EARTH OBSERVATION

Height dimension: the critical component





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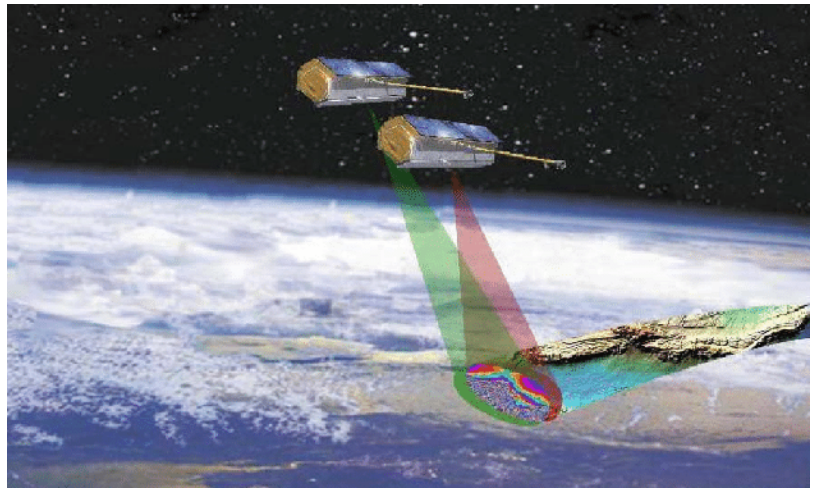


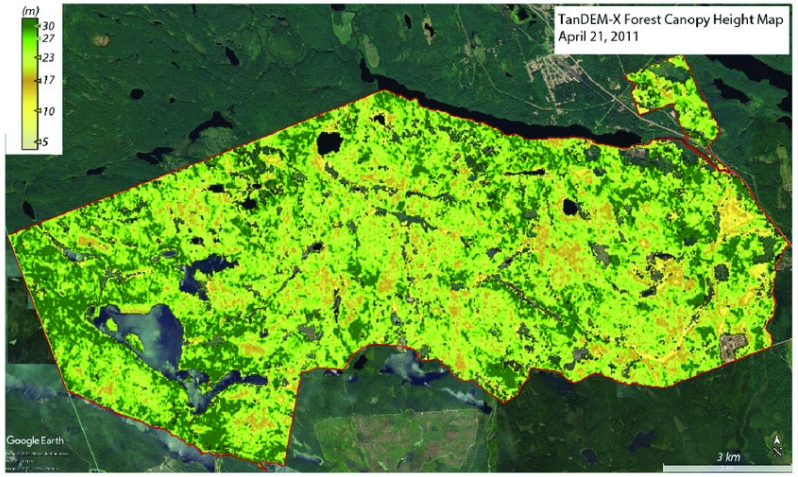


Image Credits: WWF 2024 / Uni. Of California 2024

Image Credits: DLR / Chen et al. 2021

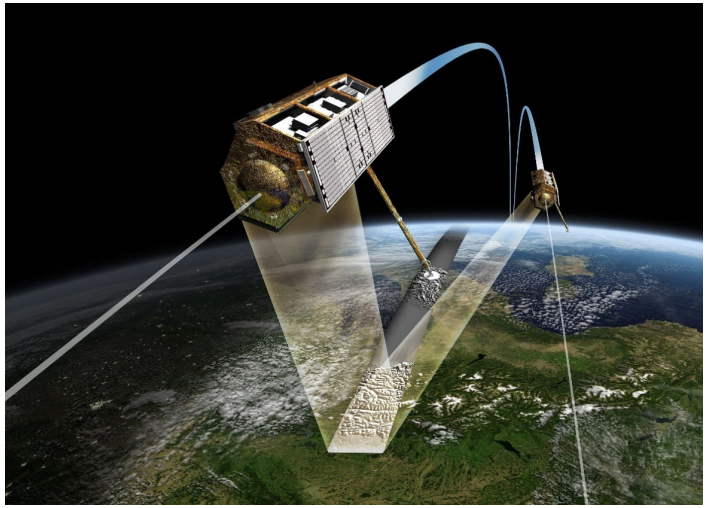
The need for operational forest information led us into researching three paths for bistatic SAR data:

Purchase bistatic data

Very limited options currently

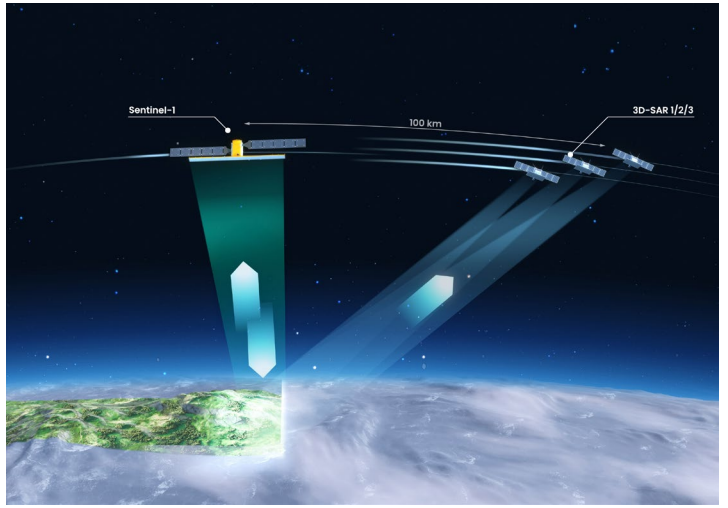
Dedicated mission

A pair of SAR satellites (COTS, rent or custom)



Companion mission

Receive-only SAR satellites to an existing illuminator



THE 3D-SAR MISSION

Enabling forest height and volume measurements from space, globally and bi-weekly

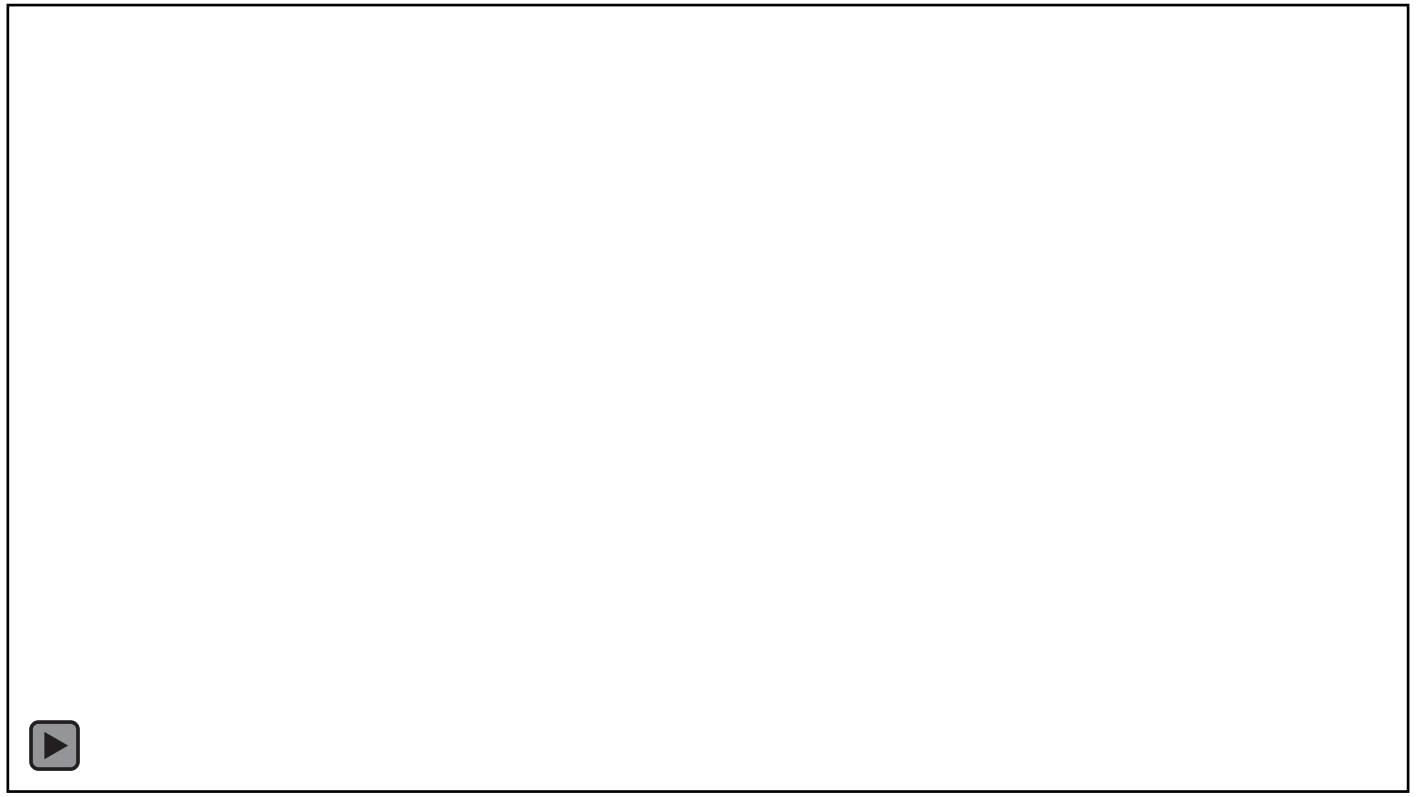
Passive receiver satellites flying in formation with Sentinel-1

Best known combination of:

- **Global coverage** – 12 to 36 days revisit
- **High accuracy** – direct height measurements; 90%+ confidence based on TanDEM-X
- **Affordability**

Clever augmentation of existing Copernicus space infrastructure

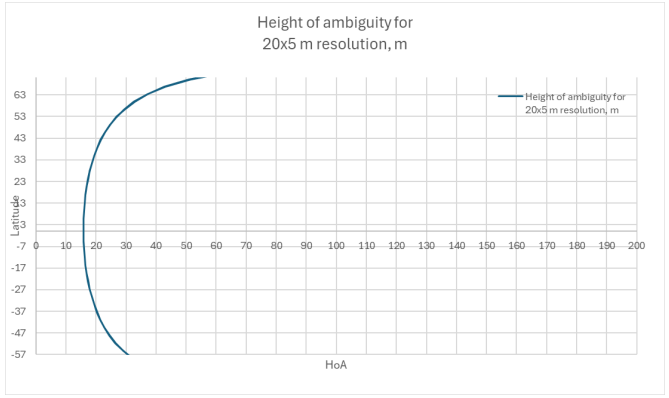
- Sentinel-1 as a “mother” mission
- Fraction of cost to double the value
- Aiming for € 40M mission cost: <20% of one Sentinel-1 satellite

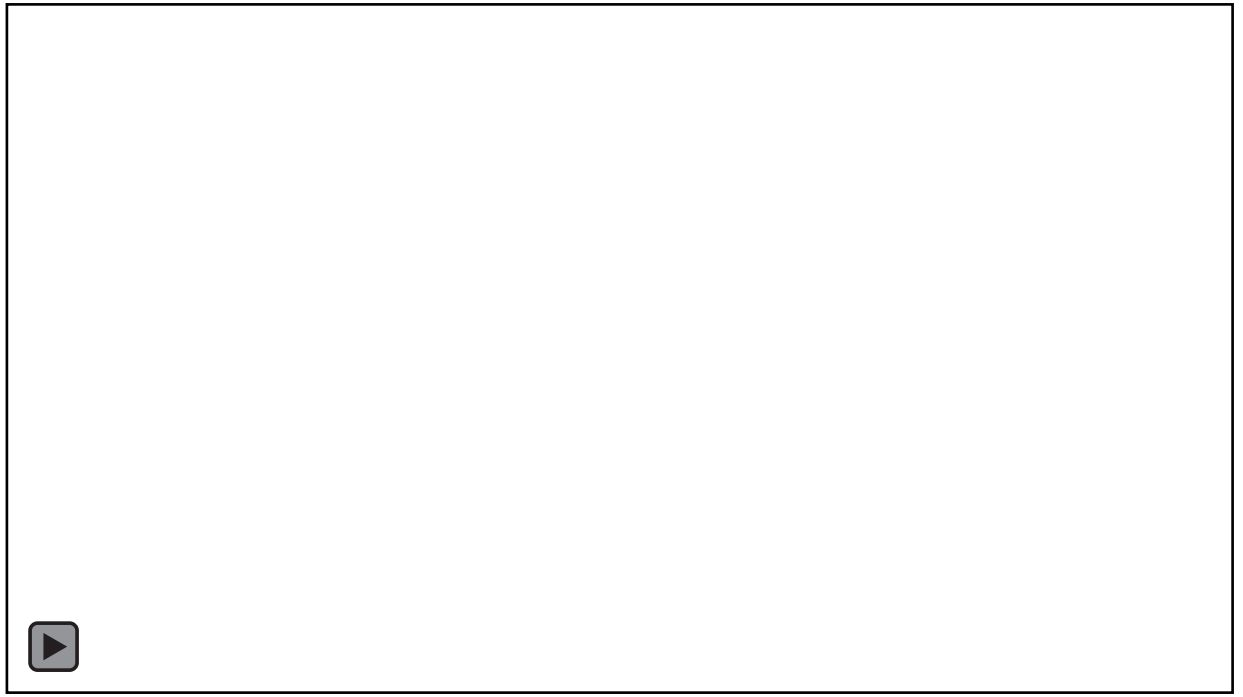


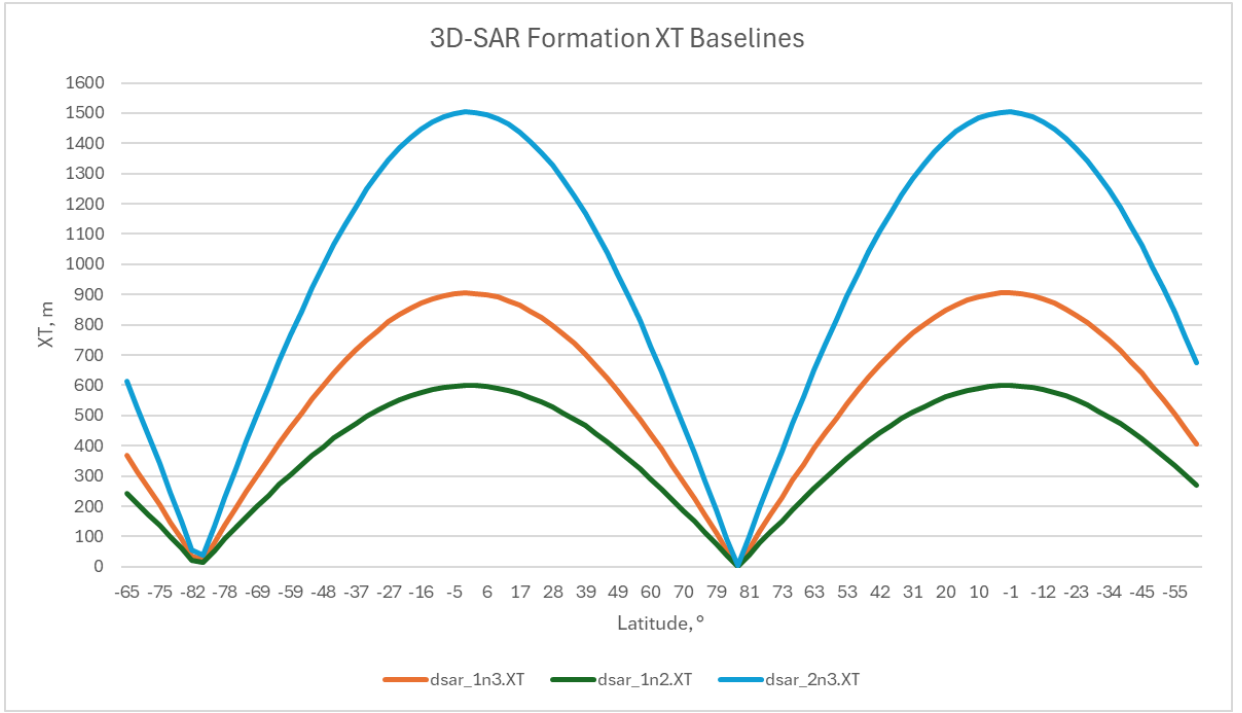
Mission Concept

Across-track interferometry between three receivers

- No fine-time-synchronization nor interferometry planned between Sentinel-1 and 3D-SAR satellites
- Three satellites receiving Sentinel-1 signal → three across-track baselines of 0-1500m
- Aiming for 30-70m HoA over priority areas







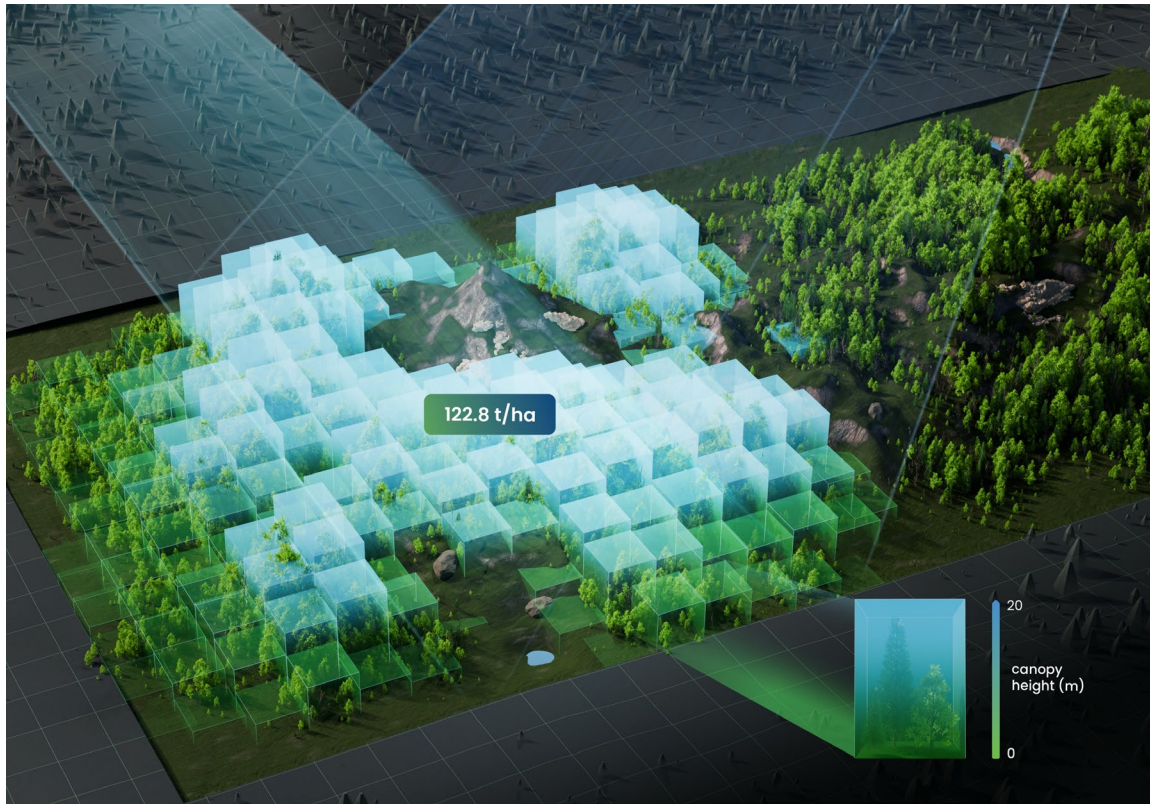
END PRODUCT OFFERING

Directly measured height enables high accuracy in forest monitoring

1. **Forest Disturbances** (floods, storm damage, fires, logging etc)
2. **Forest Height Map**
3. **Carbon Stock Assessment**
4. **Full forest inventory**

Customers

1. **Forest owners & managers** – core information for management and transactions
2. **State agencies** – statistics, policy development, environmental reporting
3. **Environmental boards** – management, reporting



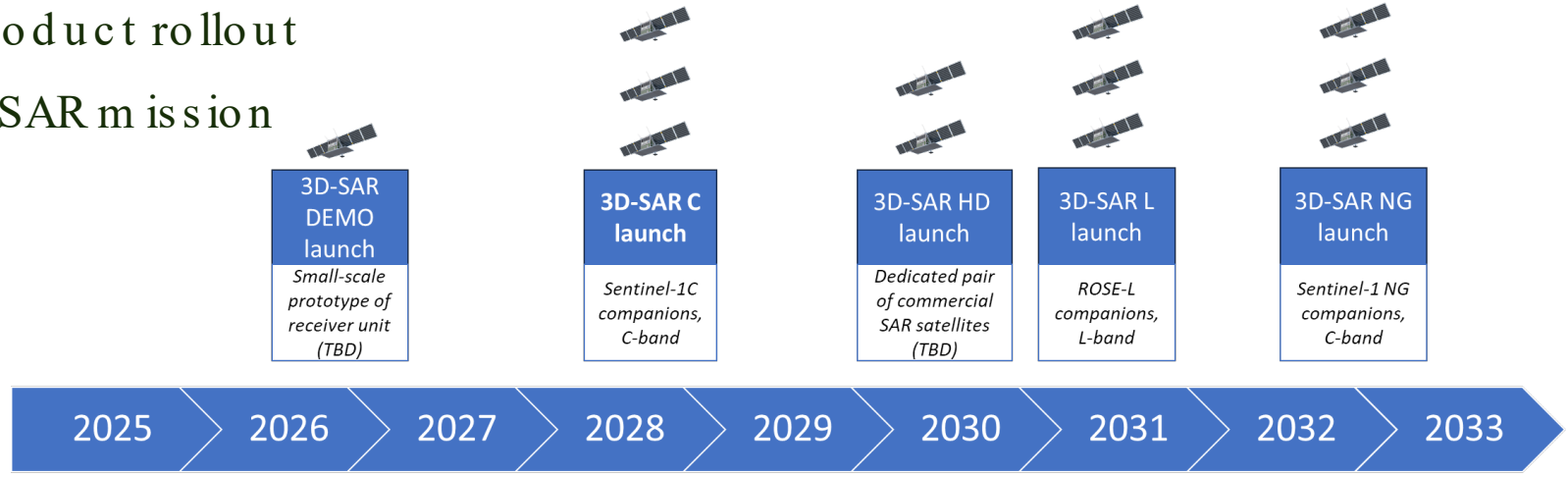
Globally, <36-day revisit

90% accuracy

Areas >0.5ha

Mission Status, Approach & Roadmap

- **2024:** Feasibility study (Phase 0).
- **2025:** Detailed mission study (Phase A-B), TanDEM-X based product development and demonstrations
- **2026:** Preliminary user product launch based on existing data
- **2025-2027:** Mission development, integration, testing
  - Hardware development outsourcing (off-the-shelf bus + custom payload antenna)
- **2028:** 3D-SAR C launch, full product rollout
- **2033...:** Launching a new 3D-SAR mission in every 5 years.



Calls to Action!

Get in touch to collaborate!

Open for collaboration with (multistatic) SAR expert organizations for:

- **Mission phases B2- ..:**
  - Payload hardware and software
  - Ground processing software
  - Constellation modelling, design and operations

- **R&D for:**
  - Enhancing SAR products through combination of single-pass and multitemporal acquisitions
  - Enabling technologies/cost-reduction of “opportunistic” SAR receiver missions

KAPPAZETA

Thank you for your time!

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