



KAPPAZETA

Existing services, 3D-SAR mission and future

Kaupo Voormansik
OÜ KappaZeta

Eesti Kaugseirepäev 14. November 2024 | Tõravere

Outline

1. Company background
2. Existing KappaZeta services and company today
3. Why we do it and how it started
4. Markets and demand
5. The requirements
6. The concept as of phase 0
7. Consortium for phase A and way forward

BACKGROUND

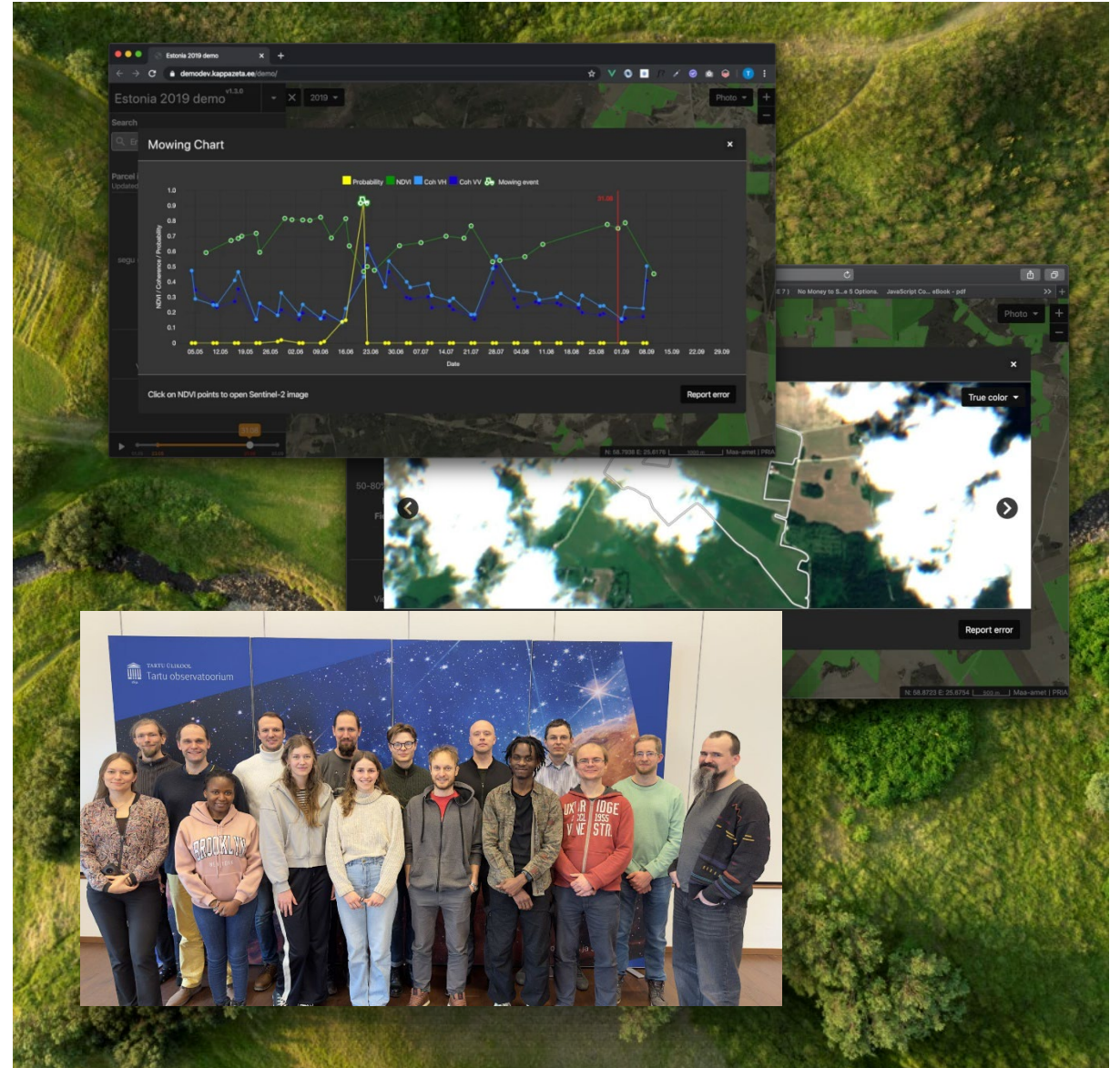
Earth Observation service provider

Founded in 2015

Employing 20 people, October 2024

Agricultural subsidy checks service provider for Estonian (prime) and Danish government (via subcontract with DHI)

About 1 M€ turnover in 2024



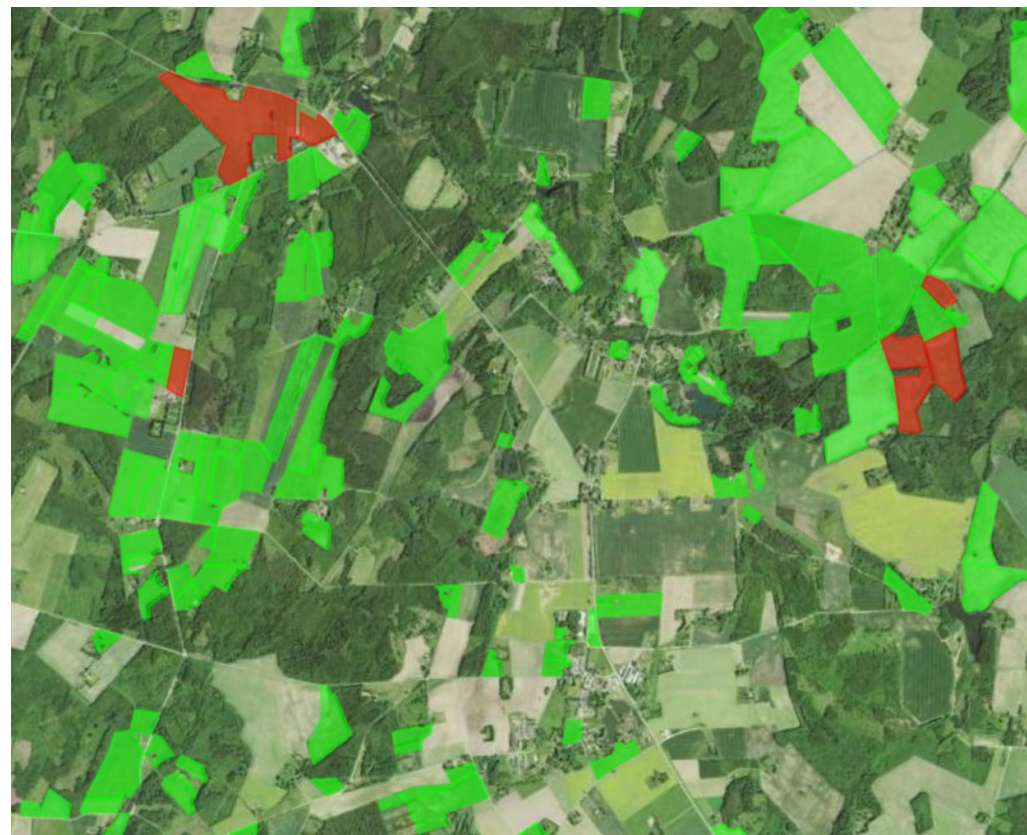
REPUBLIC OF ESTONIA
ENVIRONMENT AGENCY



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

Existing services

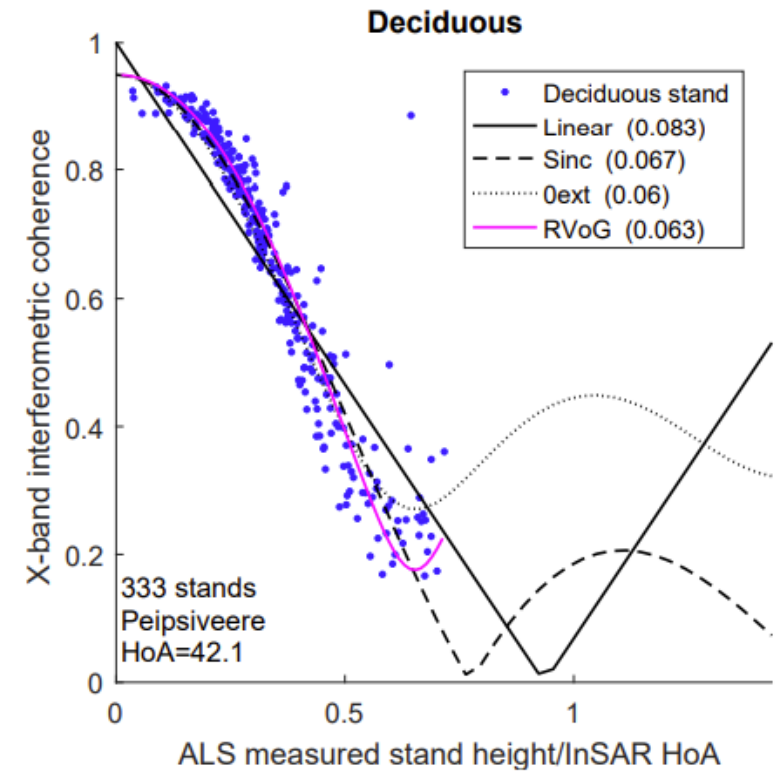
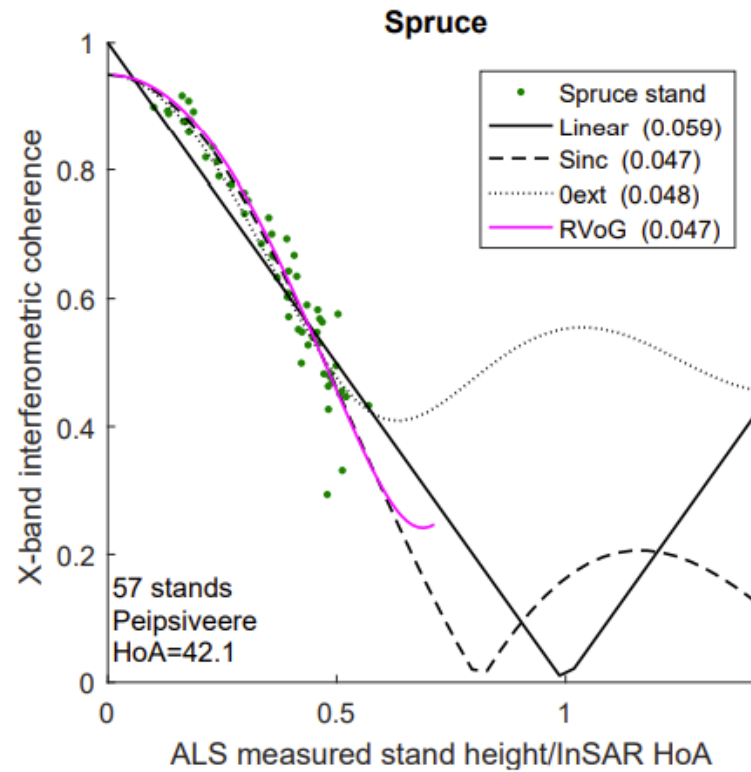
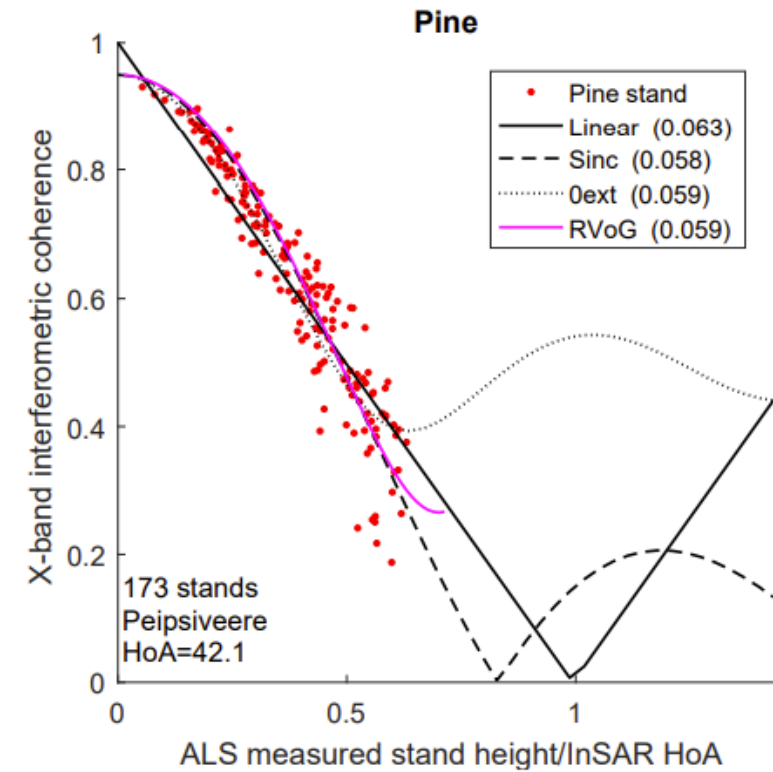
1. Agricultural subsidy checks (incl. crop type detection, mowing detection, harvesting detection).
2. KappaMask free and open cloud mask for Sentinel-2.
3. Forest clearcut detection pilot (Valgamaa and Läänemaa).



KappaZeta today

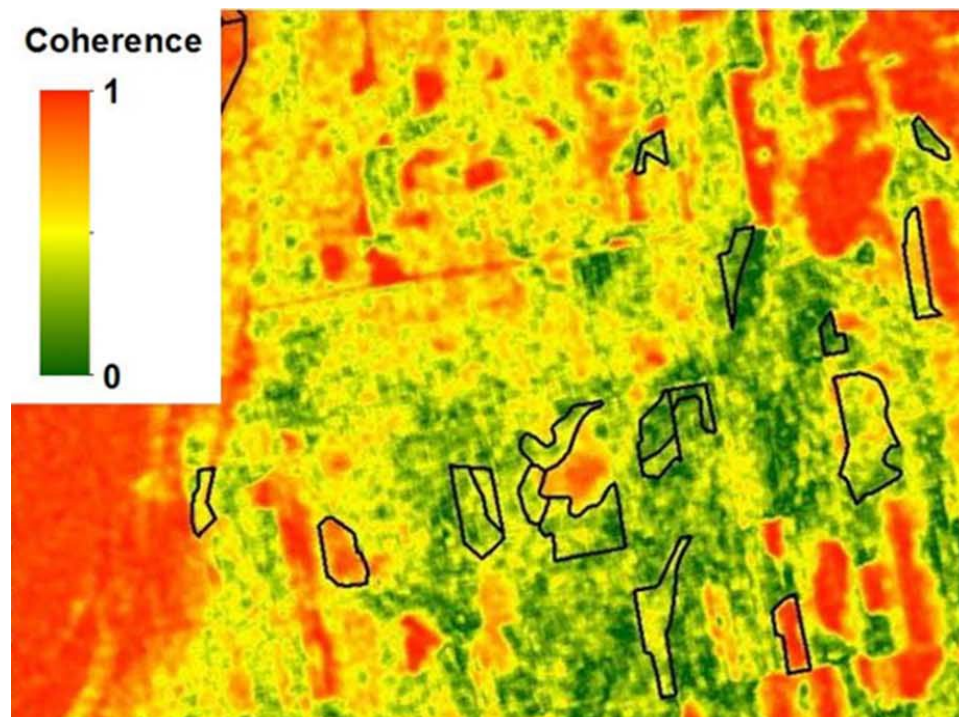
1. Hiring 7 more people, growing to 27 by spring 2025.
2. Board of advisors started to work (Mart Noorma, Andreas Veispak & Priit Salumaa).
3. Structure reform, leadership & communication training to be ready to grow.

TanDEM-X volume coherence vs LiDAR derived tree height

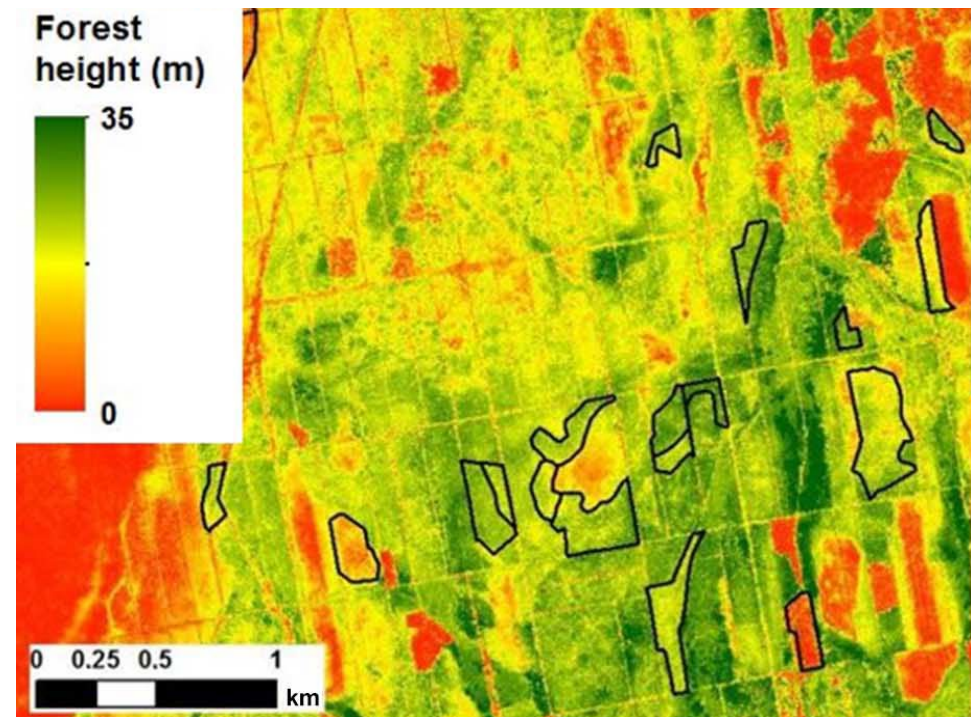


Source: Olesk et al. 2016

TanDEM-X volume coherence vs LiDAR derived tree height



TanDEM-X coherence



LiDAR

Source: Olesk et al. 2015

More this data please!

Volume coherence is a great variable for tree height estimation in temperate and boreal forest.

“For sure someone is going to build it!” (in 2016)

Discussion with Gordon Campbell in January 2022.

Objective

Build a mission for measuring global vegetation height (by adding passive receivers to an existing SAR mission to keep the cost down).

Forest carbon stock and stem volume estimation as primary end products.

Concentrate on this across-track InSAR application and don't blur the focus of other "interesting and nice" pilots and experiments.

Create a data factory – systematic and continuous data takes 2028 - ... (minimum experimentation of modes and orbital configuration).

Build the team and go for it!

Artist impression about the mission



Image: Taavi Torim and European Space Agency

The market

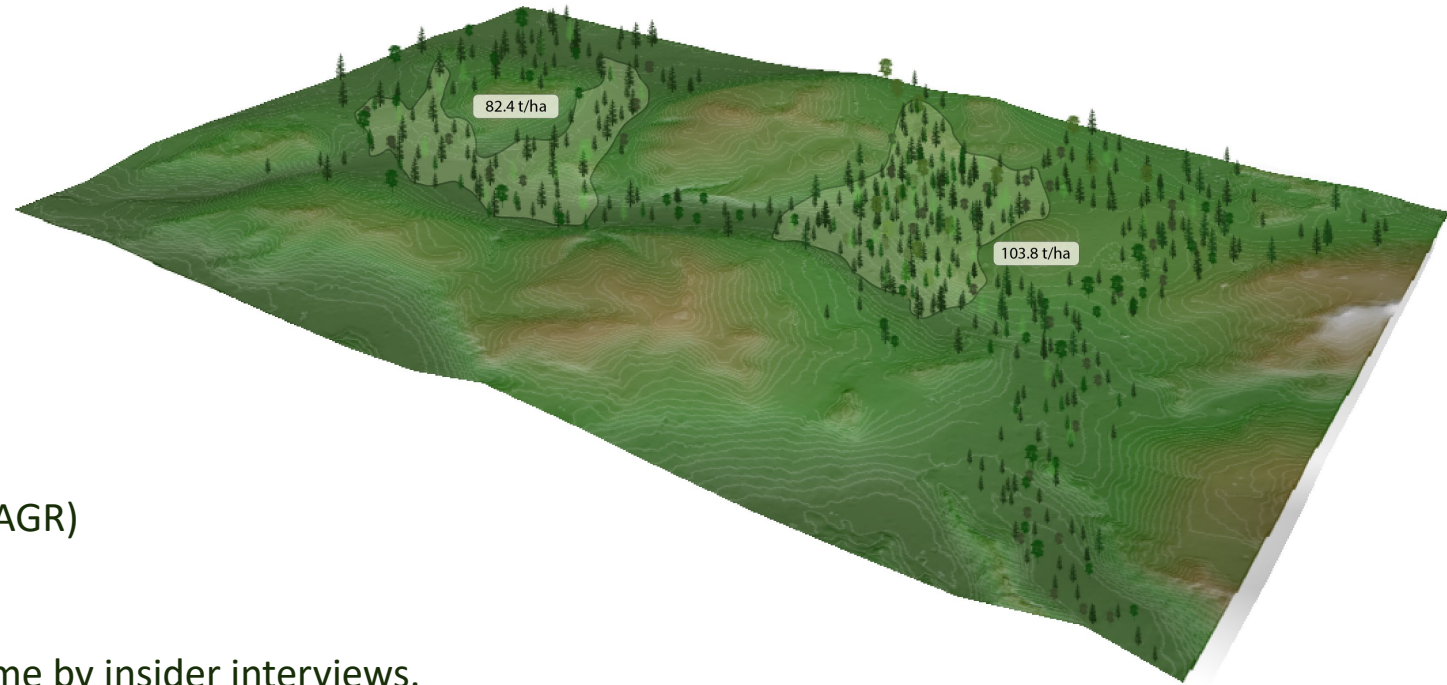
Global carbon markets:

Compliance market: 95.3B€ in 2023,
estimated 302.7B€ by 2032 (14.7% CAGR)

Voluntary market: 2.2B€ in 2023;
estimated 15B€ to 250B€ in 2030

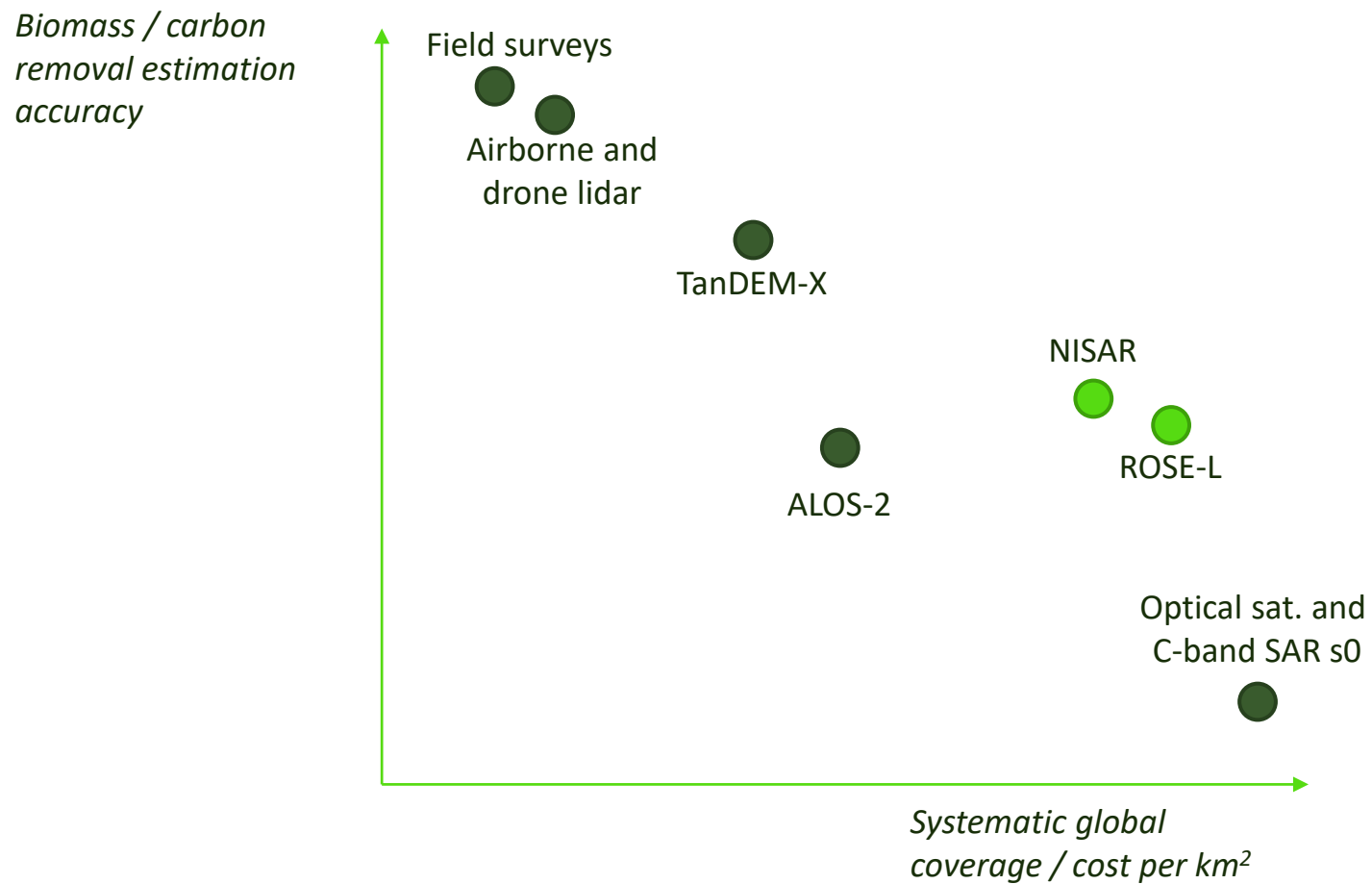
Global logging market:

322B€ in 2024, estimated 437B€ in 2029 (6.3% CAGR)



- Information services 4-10% from total market volume by insider interviews.
- Carbon markets + logging combined: 420B€ to 990B€
- Assuming 5% for the info services: 21B€ to 50B€ Total Available Market
- Assuming we can capture 5% of it, we are still in billions. -> This is a relevant topic!

Accuracy vs. availability vs. cost



The requirements

3DSAR-MIS-0010	The primary objective of the mission is to measure volume of vegetation, specifically forests, and determine timber and carbon stock from space.
3DSAR-MIS-0020	The vegetation height shall be measured on all the continents, except for small remote islands and Antarctica and Arctica.
3DSAR-MIS-0030	The primary forests under interest shall be temperate and boreal forests.
3DSAR-MIS-0070	The vegetation stem volume measurement error shall be <20%.
3DSAR-MIS-0090	The vegetation height measurement error shall be <10% or <1m, whichever is smaller.
3DSAR-MIS-0100	The minimal area for forest height measurement error of <10% or <1m shall be 1 ha (100x100 meters).

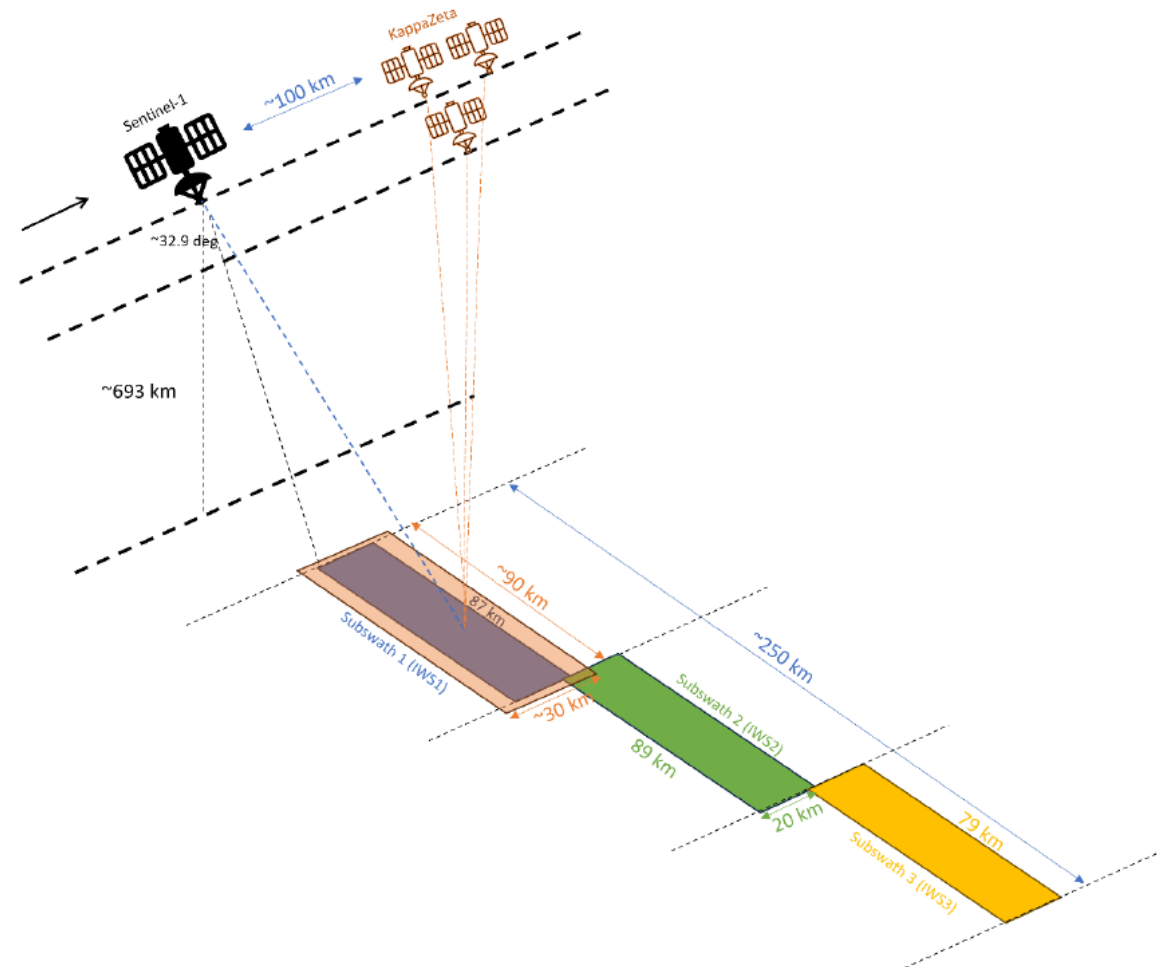
The concept as of phase 0

Three passive receivers orbiting in formation with Sentinel-1C

Same orbital plane, ~100 km ahead of the mother satellite.

Minimum along-track baselines (<1600 m) between the receiver satellites.

Perpendicular across-track baselines corresponding to Height of Ambiguity 30-100 m.



The concept as of phase 0

Three satellites – trade-off between cost, reliability and flexibility (advantages of long and short baselines simultaneously, capability to have more latitudes with reasonable baseline).

Launch target – 2028.

New Space approach, maximum use of COTS components.

Total cost ~ €40M.

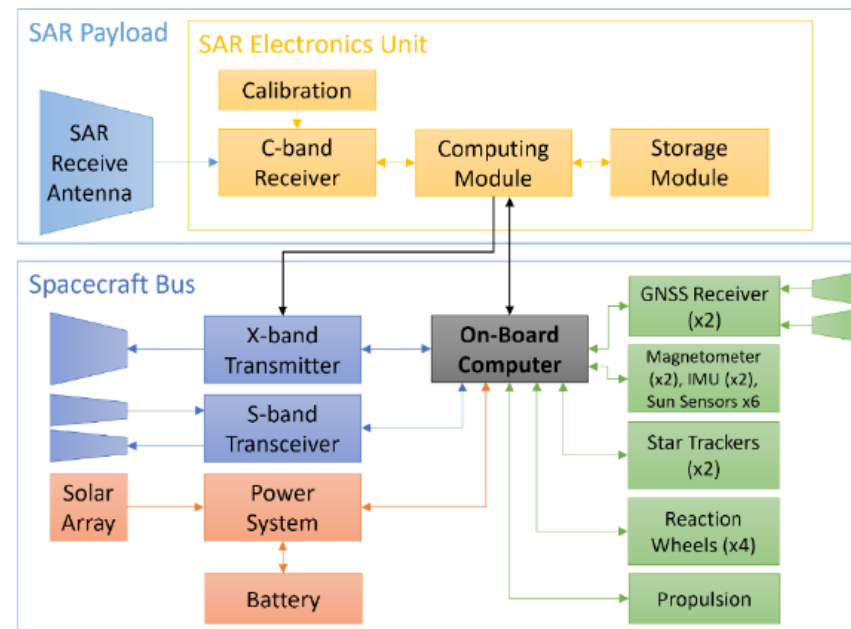
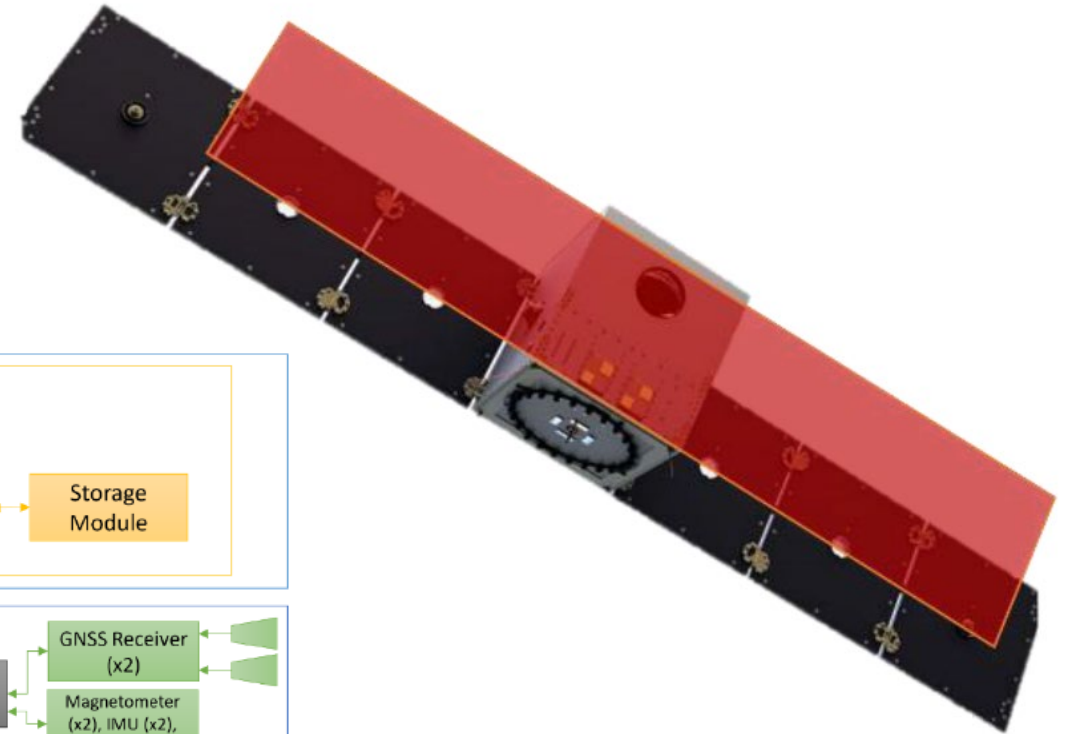
The concept as of phase 0 – the spacecraft

About 100-300 kg mass per spacecraft.

200 cm by 80 cm fixed-beam antenna.

Imaging one Sentinel-1 subswath at a time.

Subswath selection by the roll maneuver of the spacecraft.



The concept as of phase 0

Spacecraft target life-time 5 years.

Ride-share launch preferred.

ROSE-L and Sentinel-1 NG as the target mother missions for the next generation.

The status – early November 2024

Core team formed.

Angel investment round 480 k€ raised
(including Andreas Veispak, ex. head of Copernicus from European Commission).

Phase 0 study with ESA ESTEC (about to finish in November 2024).

Going to start phase A in early 2025.

Seed investment round H1/2025, aiming to raise 5-10 M€ from private investors + 5-10 M€ from governmental programs.

CORE MISSION TEAM

The winning combination of space technology, geography and business expertise



Kaupo Voormansik
CEO and co-founder,
SAR expert, PhD in SAR, Systems
engineer of ESTCube-1,
10+ years in Earth Observation
business



Martin Jüssi
Mission Manager, ex. CGI, MSc in
Space Studies, 10+ years in Earth
Observation business



Erik Kulu
Space Systems Engineer,
ex. Kepler Communications and Clyde
Space, 10+ years of experience in
space hardware business



Karoli Kahn
COO,
10+ years of management experience
in space business



Indrek Sünter
Space Systems Engineer, PhD in
physics, electronics & software
engineer in ESTCube-1 and ESEO
satellites



Tauri Tampuu
Data Product Manager,
PhD in SAR, extensive international
network in scientific community



Tanel Kobrusepp
Sales and Customer Relations, ex.
Flowbase (co-founder), experience
in sales & fund-raising



Paco Lopez Dekker, External Advisor
TU Delft
ESA Harmony mission Lead Investigator, SAR
systems and product engineering support kappazeta.ee

The Consortium for phase A

KappaZeta – prime

TU Delft – SAR instrument and data product simulations

Kongsberg NanoAvionics – spacecraft bus (MP42D bus as a baseline)

Rantelon – antenna and receiver electronics

KAPPAZETA

Let's get to know each other!



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