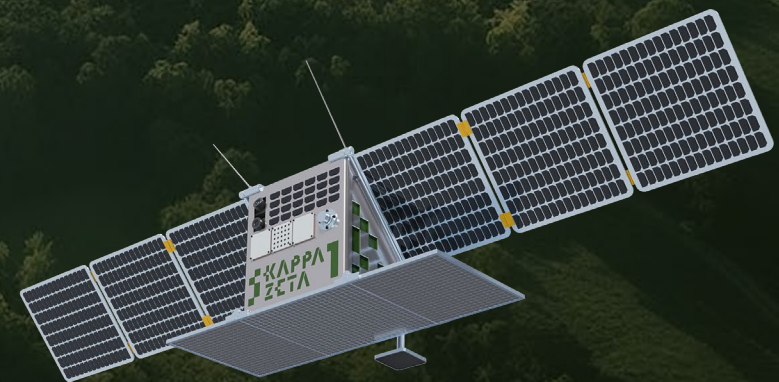


KAPPAZETA

**“Latvade taga paistavad puud: metsade kolmemõõtmeline kaardistamine tehisava-
radarsatelliitidega”**

Martin Jüssi
KappaZeta OÜ
ESTGIS aastakonverents 2025
28.10.2025 Tallinn



Kappazeta OÜ

Juhtiv Eesti kaugseire-ettevõtte

- Loodud 2015
- Maailma esimene avaliku põldude kaugseire teenuse pakkuja
 - Eestis alates 2019
 - Taanis alates 2023
 - Kolmandas Euroopa riigis alates 2025
- Metsakaugseire teenusepakkuja Keskkonnaagentuurile
- T&A-tööd ESA ja Euroopa Komisjoniga



PÕLLUMAJANDUSE REGISTRITE
JA INFORMATSIOONI AMET



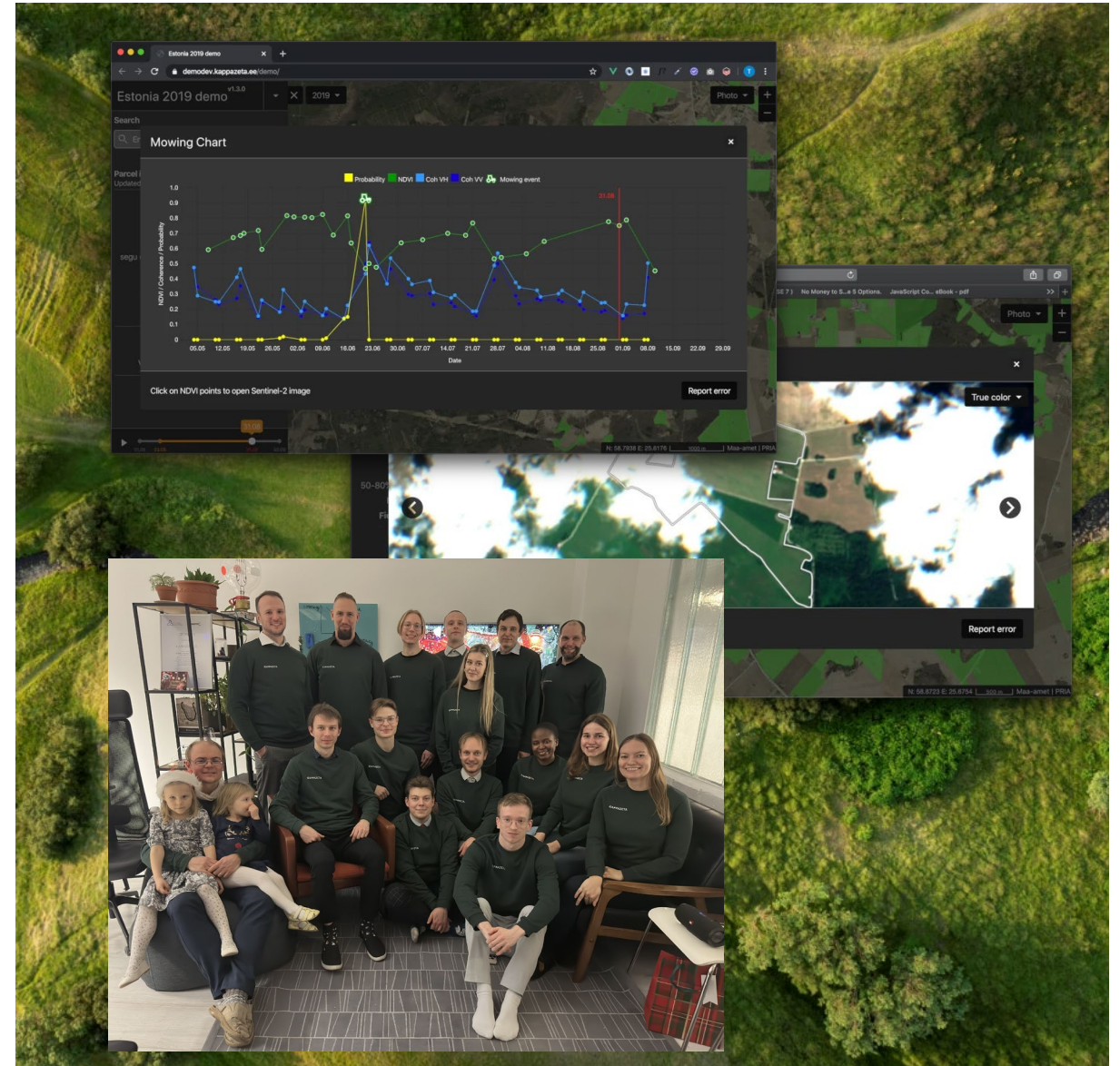
Ministry of Food, Agriculture
and Fisheries of Denmark
Danish Agricultural Agency



REPUBLIC OF ESTONIA
ENVIRONMENT AGENCY



CASSINI
Business Accelerator



PROBLEEM?

KLIIMAKRIIS ja INFOSULG!

Globaalselt miljonite hektarite kaupa registreerimata metsaraiet

Kas me teame, kui palju on hetkel Eestis tegelikult metsa? Baltikumis? Euroopas?

Kuidas me selle info saame?

Riiklikul tasemel otsused sünnivad vanade andmete põhjal

Süsinikuturul on oht saada naljanumbriks

- 2023 Verra skandaal: \$90M väärtuses krediite sisutühjad

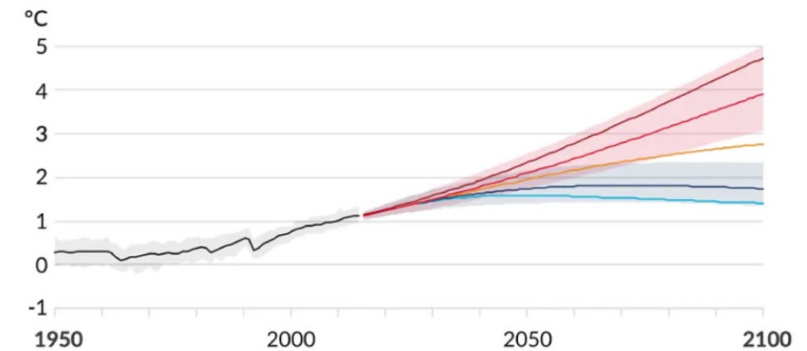


easyJet



ΚΑΡΡΑΖΕΤΑ

Projected Temperature Increase (°C)



Five Scenarios of Fossil Fuel Burning

- Highest CO₂ amounts
- Medium to high CO₂ amounts
- Medium CO₂ amounts
- Smaller CO₂ amounts, then no increase in CO₂ late in the 21st century
- No increase in CO₂ beginning in 2050

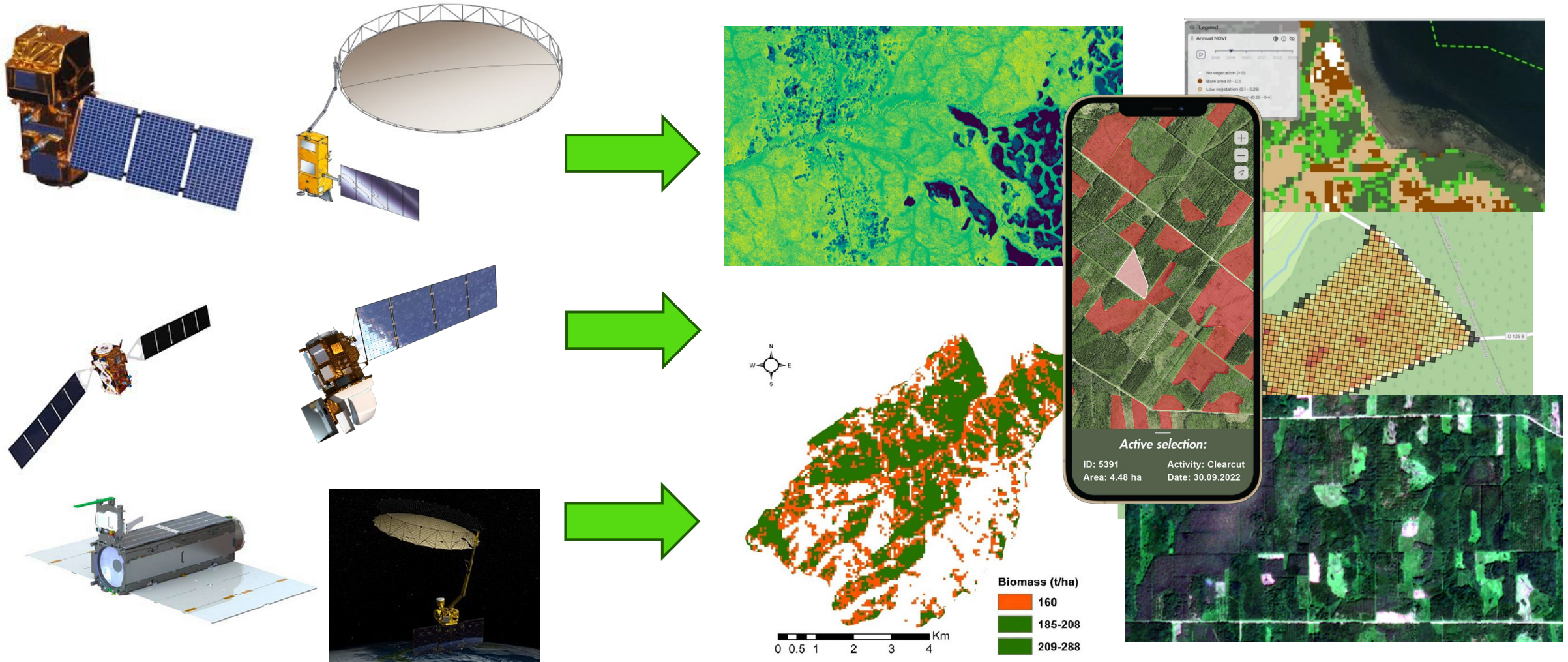
Revealed: more than 90% of rainforest carbon offsets by biggest certifier are worthless, analysis shows

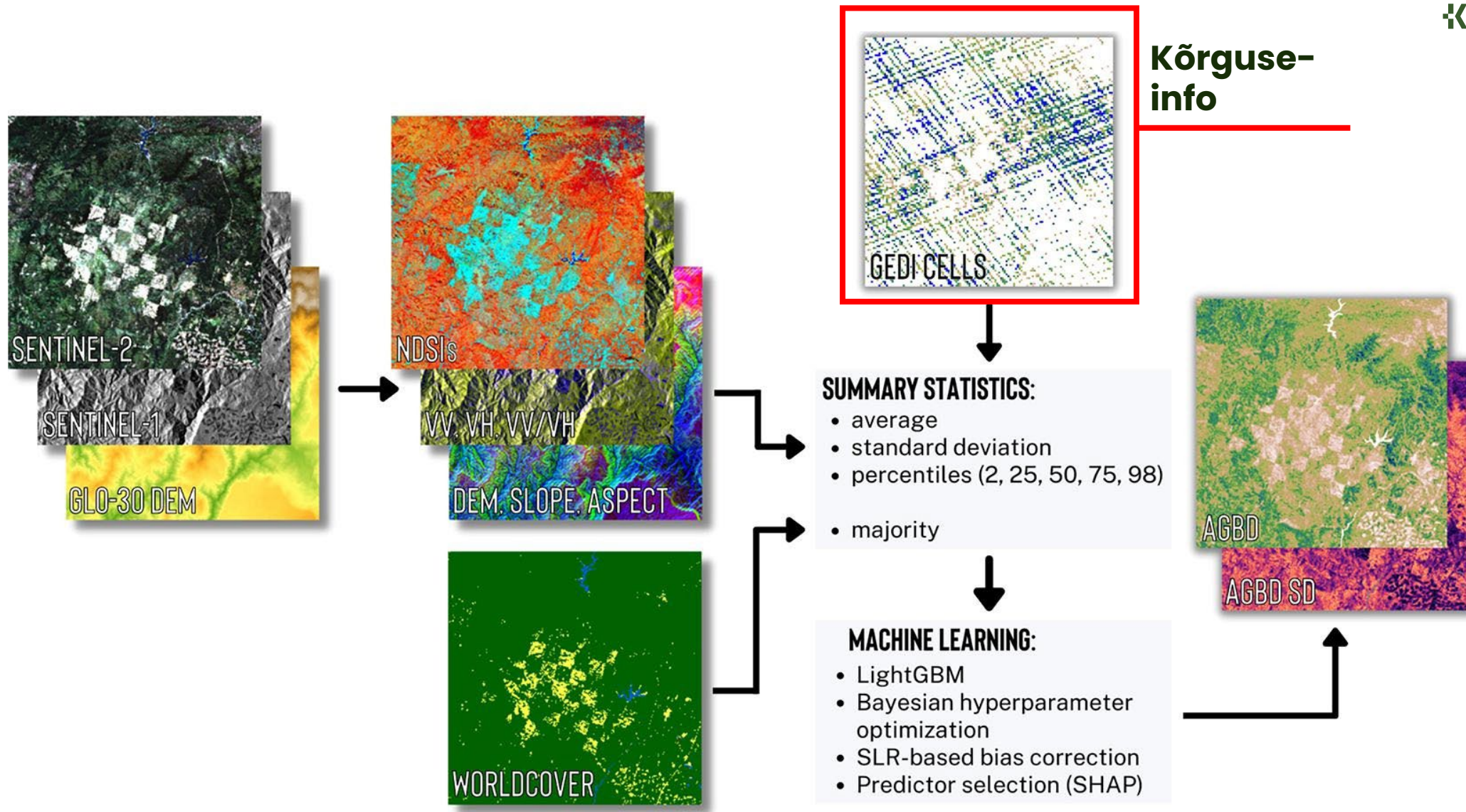
Investigation into Verra carbon standard finds most are 'phantom credits' and may worsen global heating

- '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



Kaugseiretehnoloogia päeva päästma...

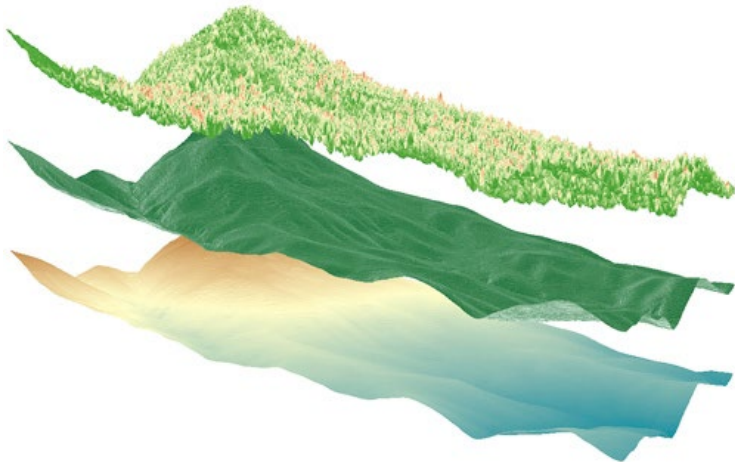
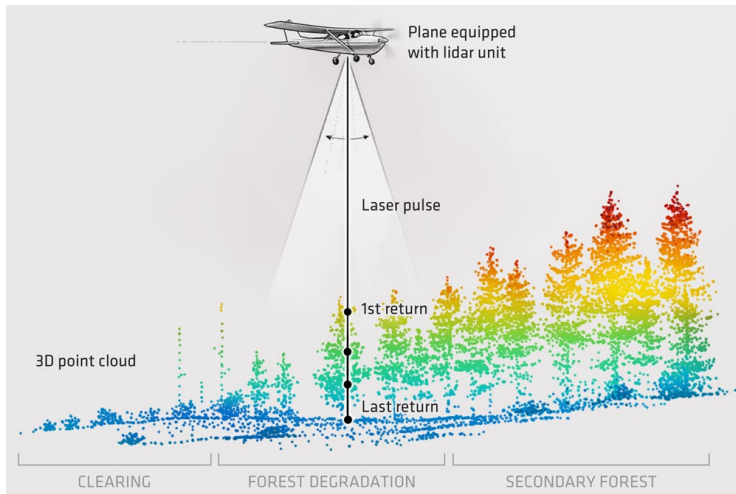




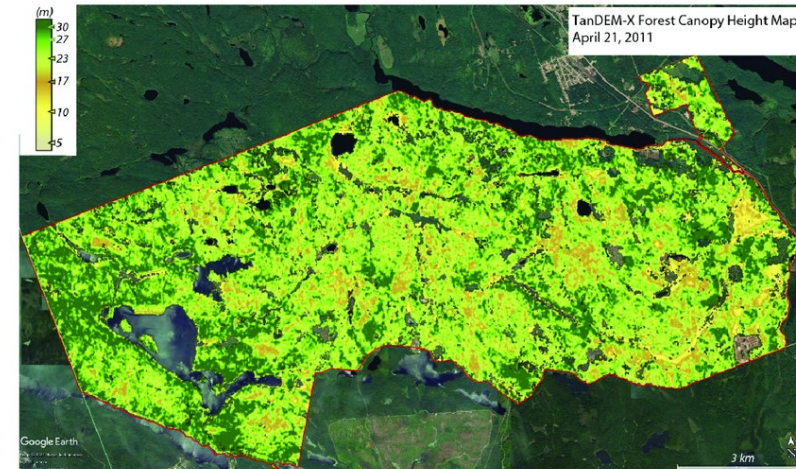
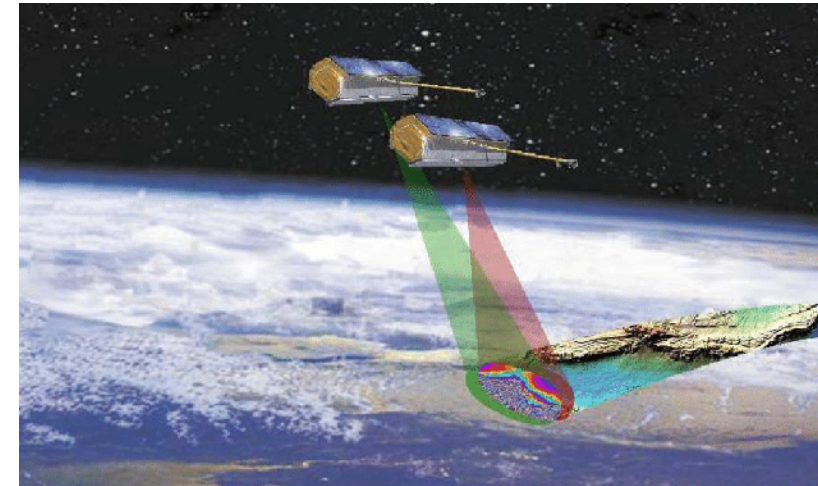
Source: Shendryk, Yuri. "Fusing GEDI with earth observation data for large area aboveground biomass mapping." *International Journal of Applied Earth Observation and Geoinformation* 115 (2022): 103108.

EARTH OBSERVATION

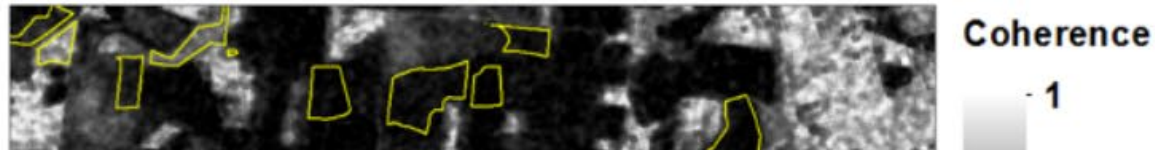
Kõrgusdimensioon: kriitiline komponent



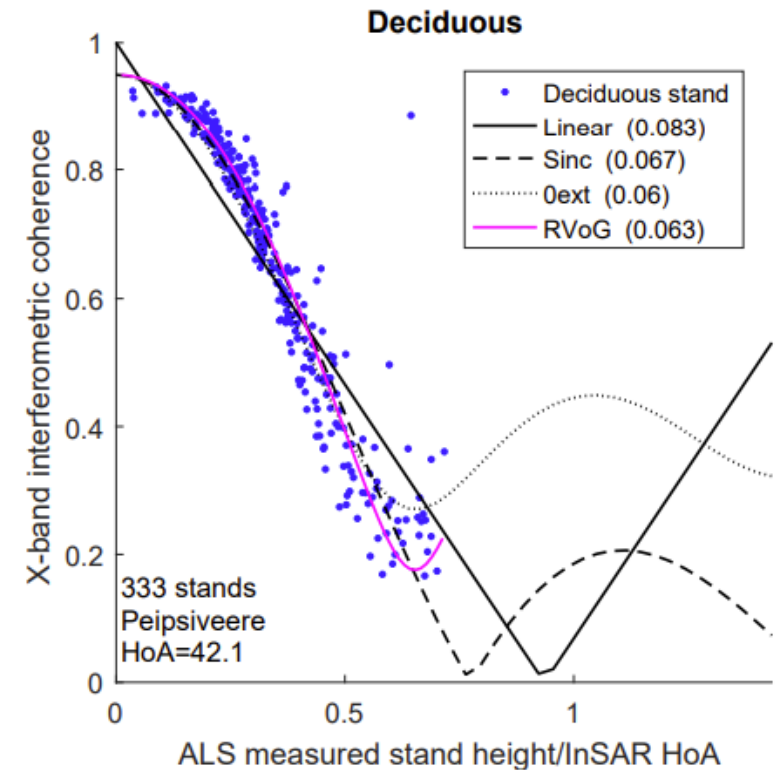
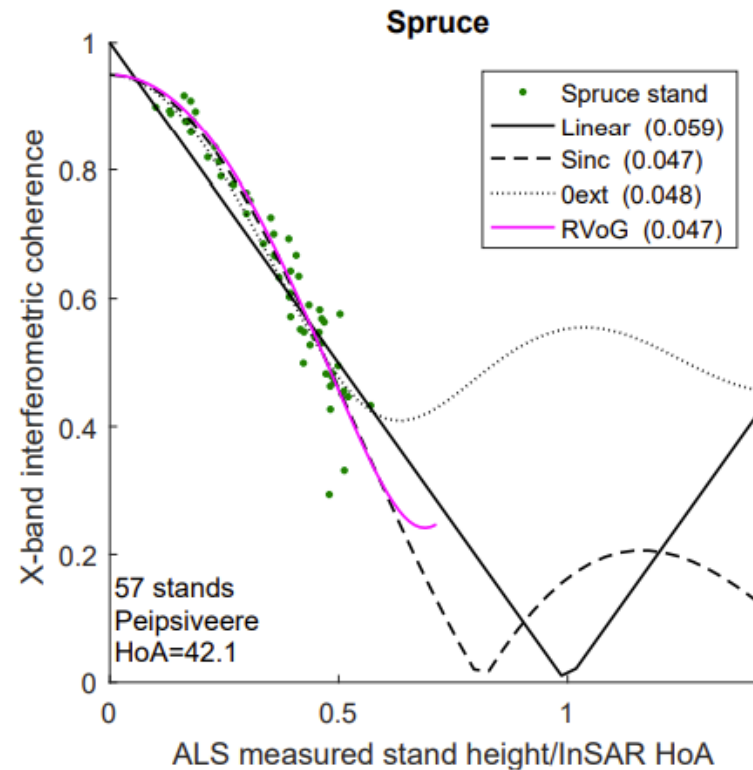
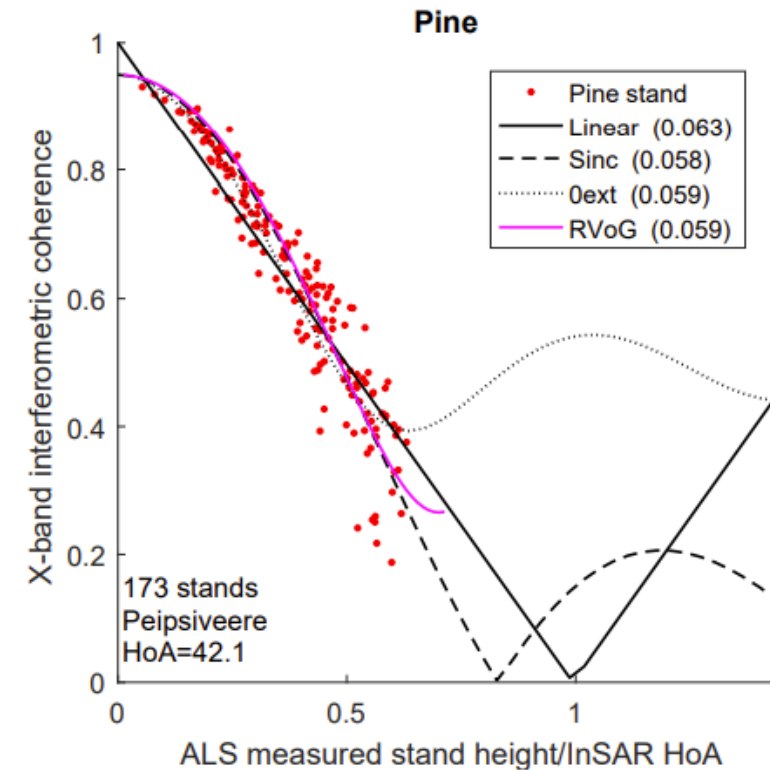
või



TanDEM-X signaali koherentsus



LiDAR-i põhine kõrguskaart



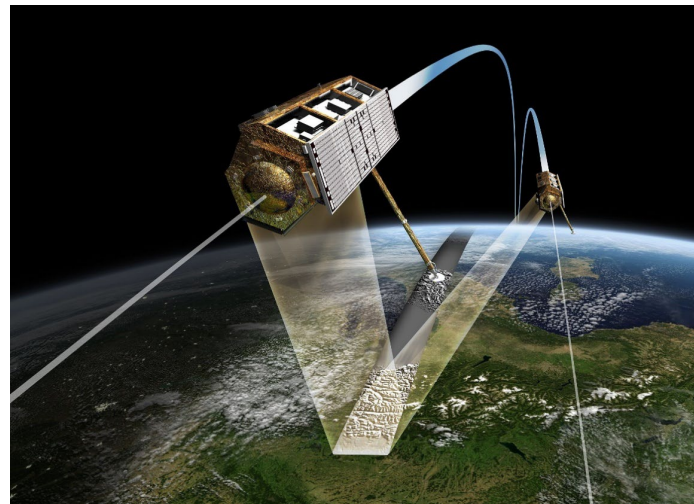
Bistaatilisi andmeid maailmas käputäis!

**Ostame andmeid
turult?**

Väga vähe valikuid

Ostame või rendime satelliidid?

Kaks või rohkem radarit
(COTS, rent või arendus)



Täiendame “üksikut” radarit

Radarivastuvõtjad “parvena”
lendama





Metsa kõrguse ja mahu mõõtmised. Igakuiselt. Globaalselt.

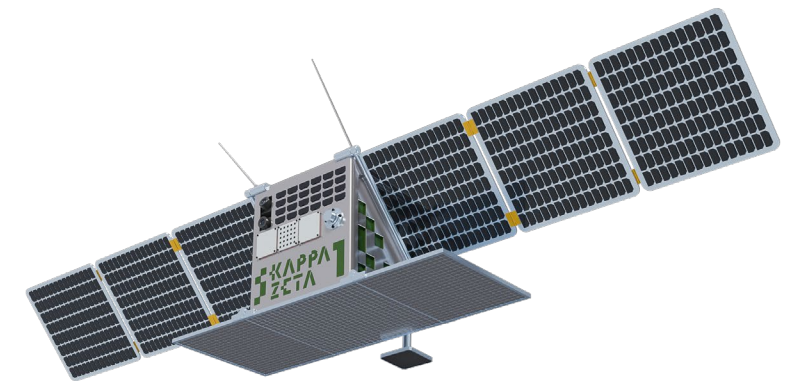
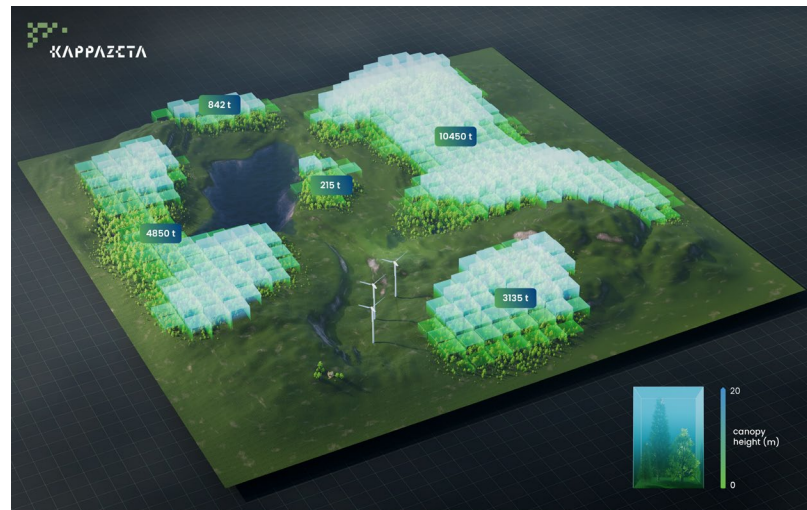
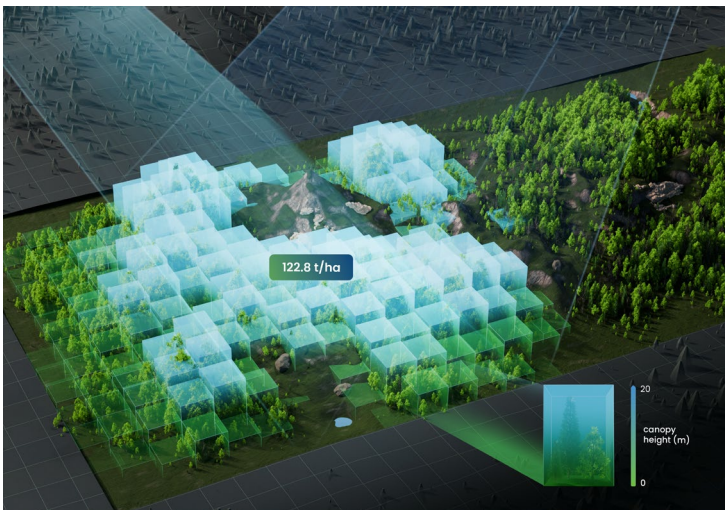
Sentinel-1 signaali “täiendamine” vastuvõtjatega

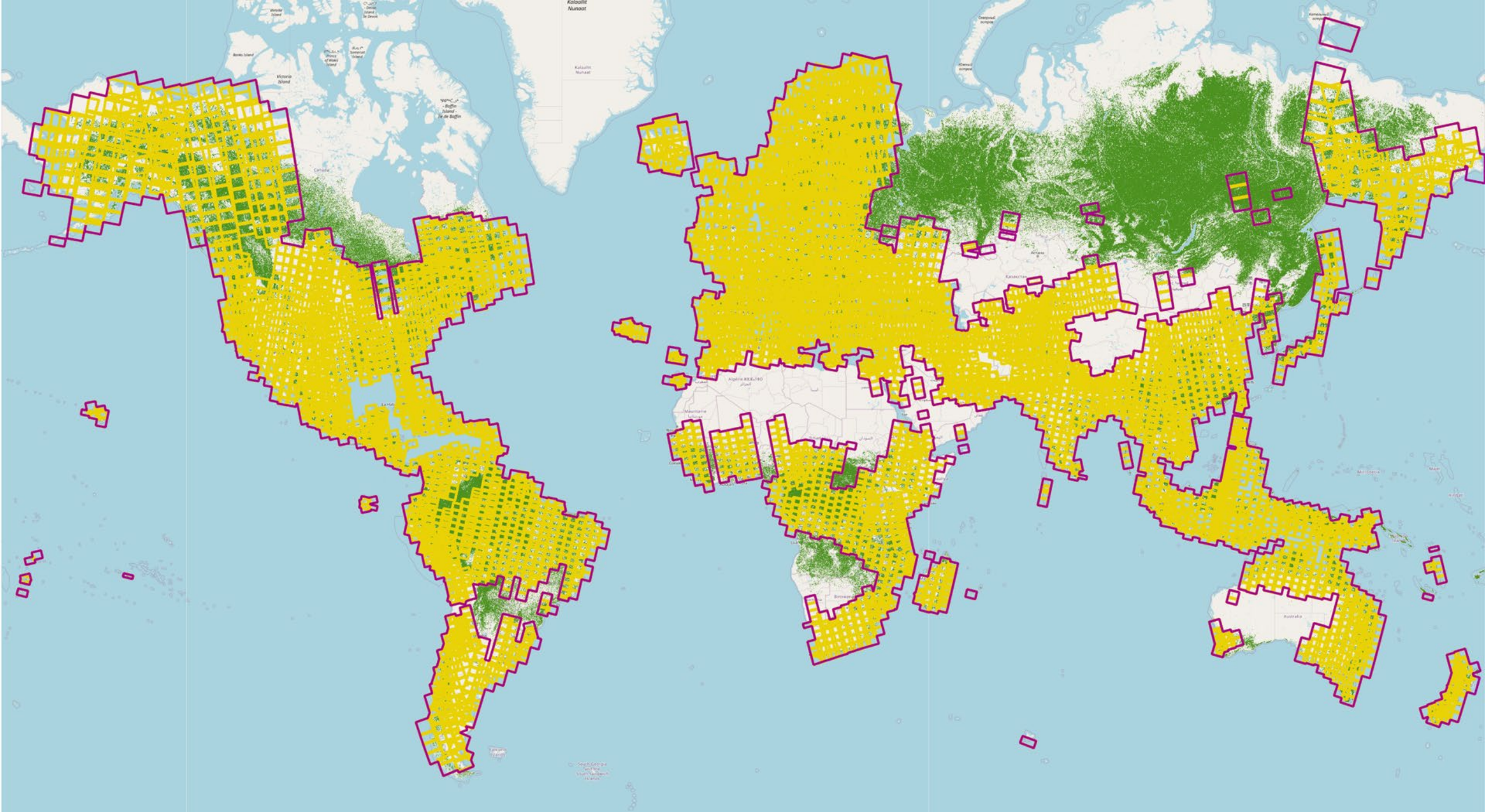
Tulemuseks multistaatilised radariandmed – kõrgusdimensioon

“Kuluefektiivne” lahendus tänu olemasoleva signaali ja infrastruktuuri ärakasutamisele

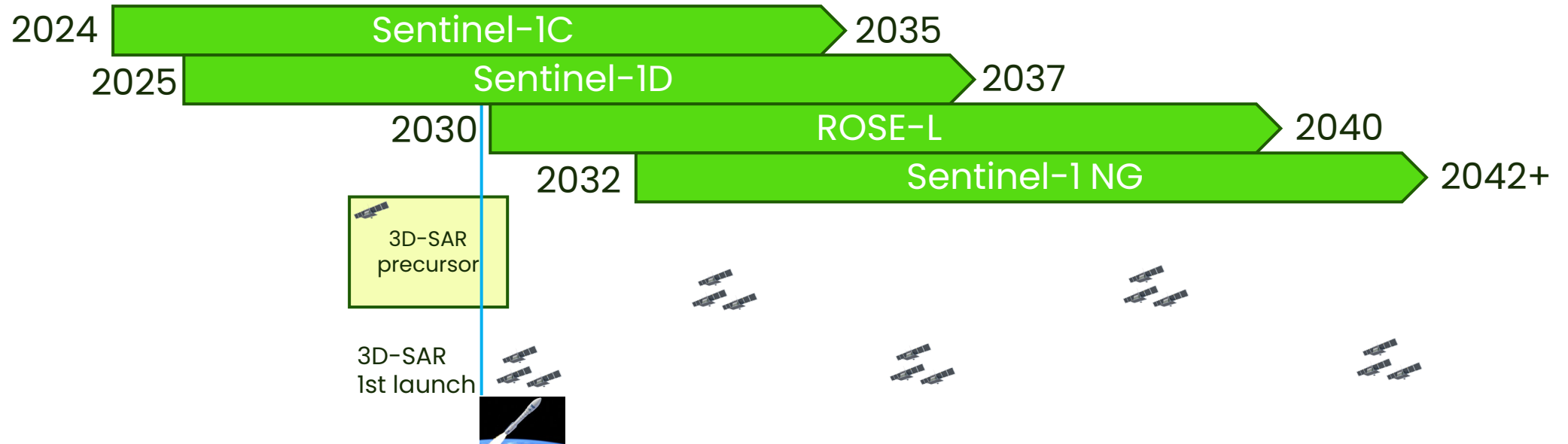
Missiooni maksumus hinnanguliselt €40M: ~20% ühe Sentinel-1 satelliidi maksumusest

Võimaldab kõrguse- ja mahuarvutusi metsade mõõtmisel





3D-SAR: operatiivne metsade 3D-monitooringu teenus

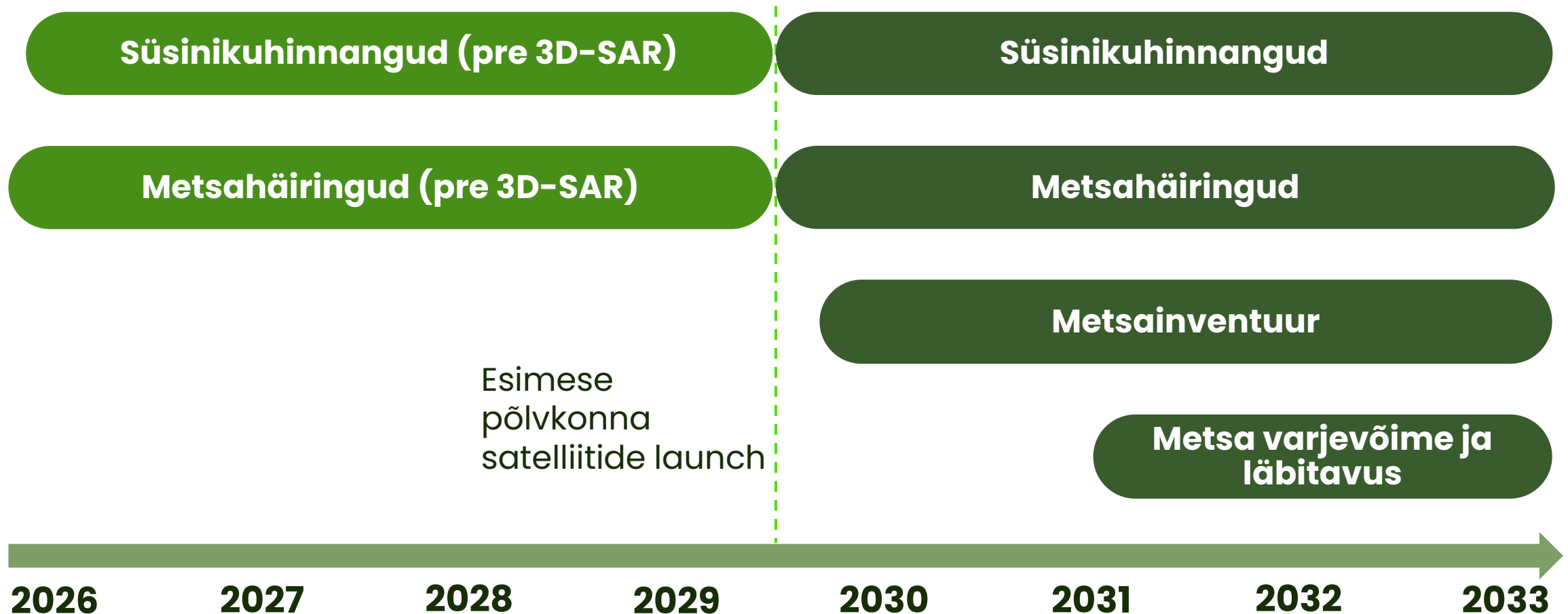


- “Precursor” mission vajalik tehnoloogia valideerimiseks (TRL6+)
 - Sentinel-1’ga formatsioonis lendamine – koordineerimine, manöövrid, pildistamine
 - Space debris mitigation, de-orbiting
- Ühe “parve” soovitatav eluiga hetkel analüüsis: kuluefektiivsus, tehnoloogia järk-järguline parendamine

Teekaart

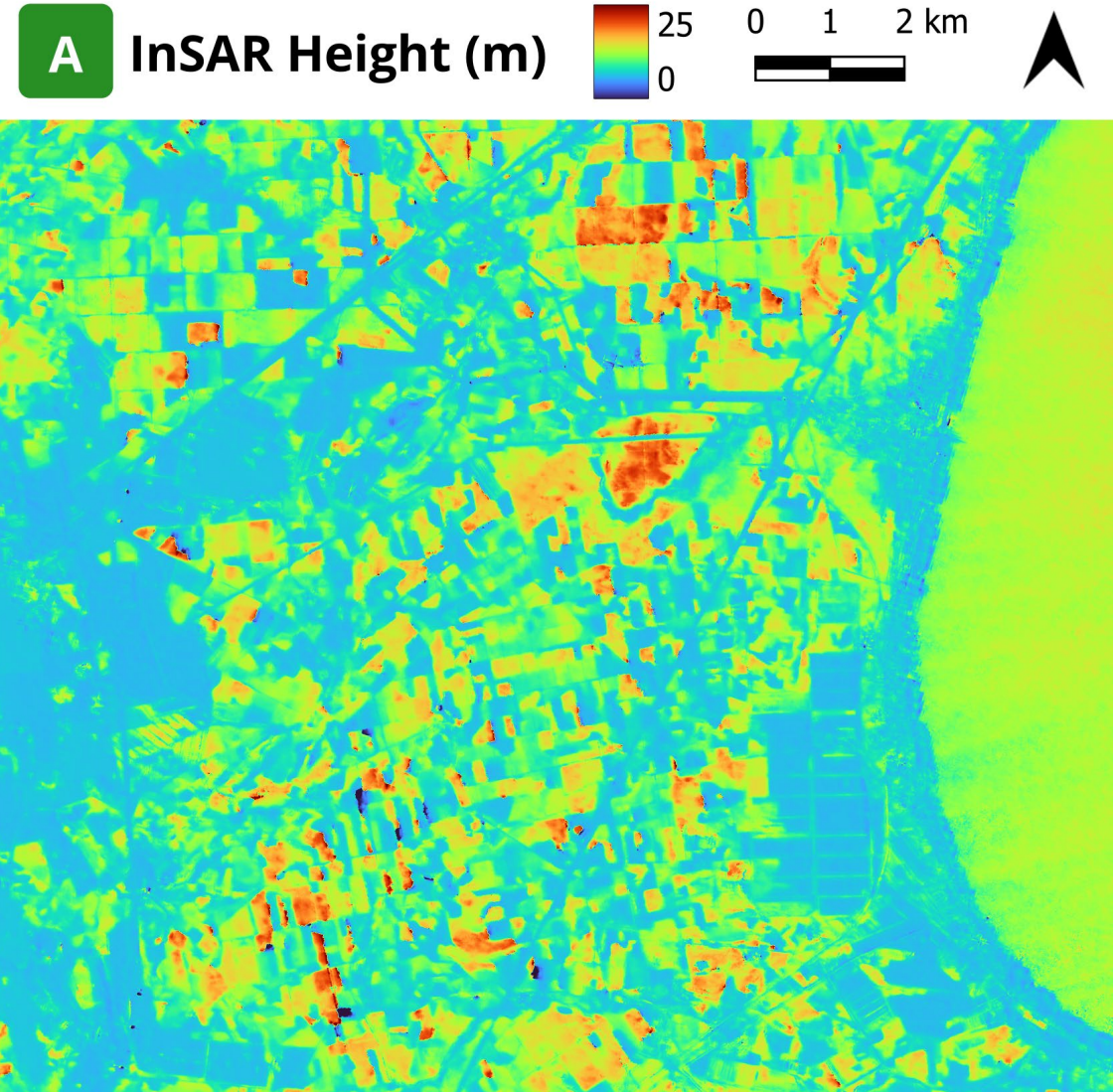
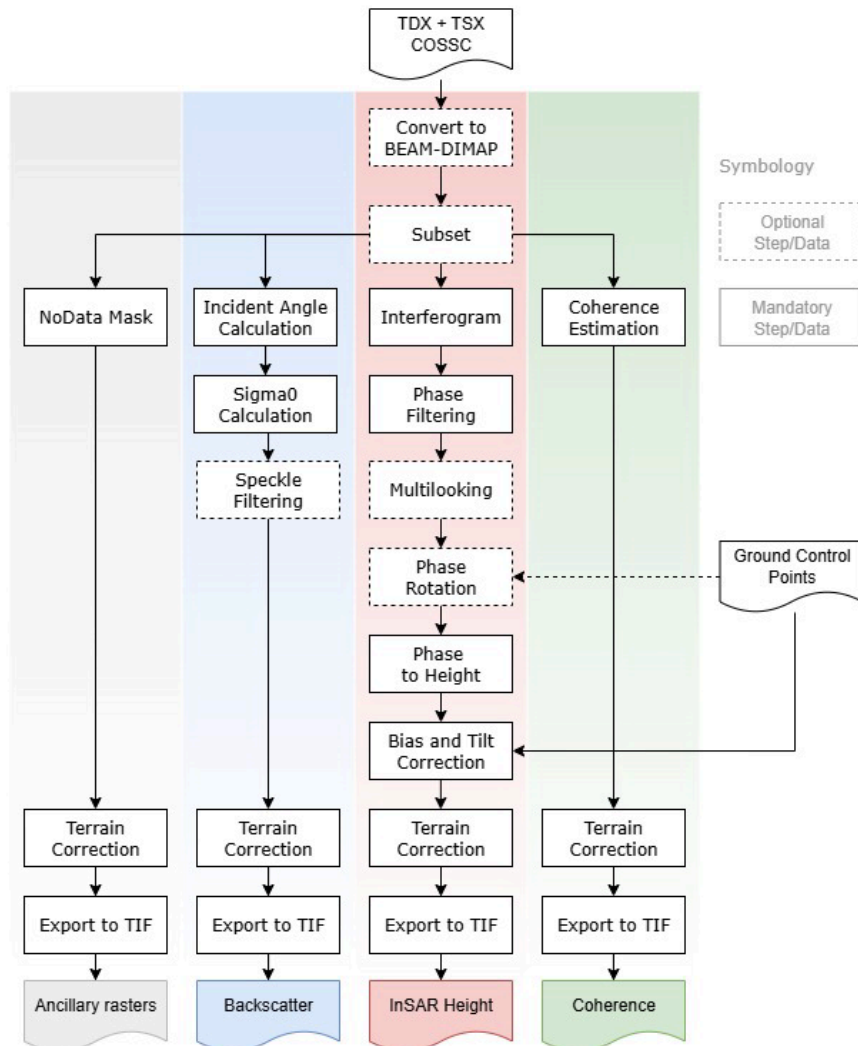
Lõppkasutajatoodete teekaart

1. Metsandus -> 2. Süsinik -> 3. Riigikaitse

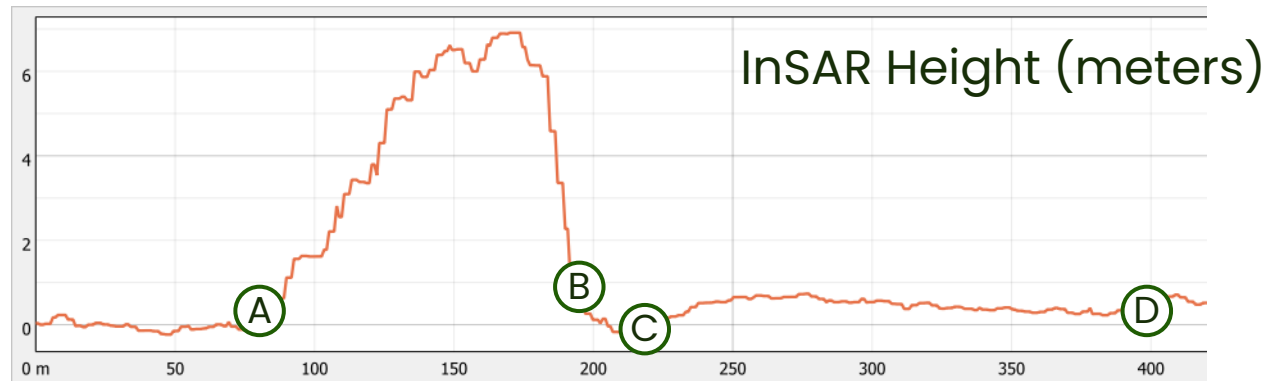
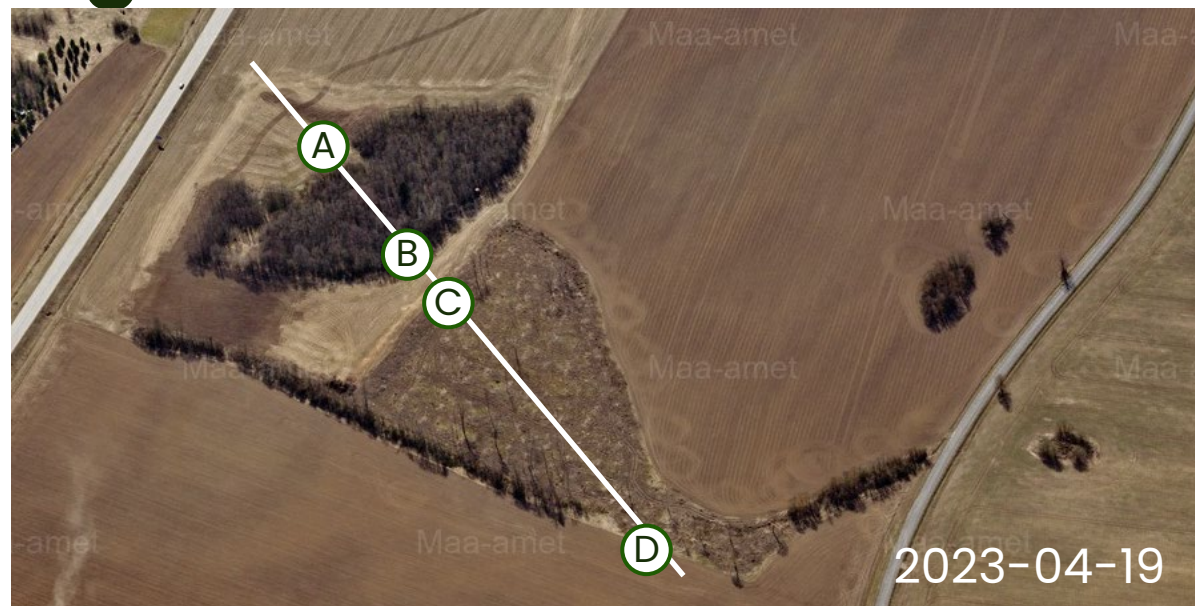




TanDEM-X andmetöötlus



Faasikõrgus vs. metsa kõrgus



0 50 100 m

Forestry orthophoto (Metsanduslik ortofoto) from maaamet.ee

KAPPAZETA

Aitäh kuulamast!



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