



PROGRAMME OF THE EUROPEAN UNION



# The future of biodiversity monitoring: New Earth Observation missions and Initiatives from Space Agencies

## Radar Imaging Missions - SAR

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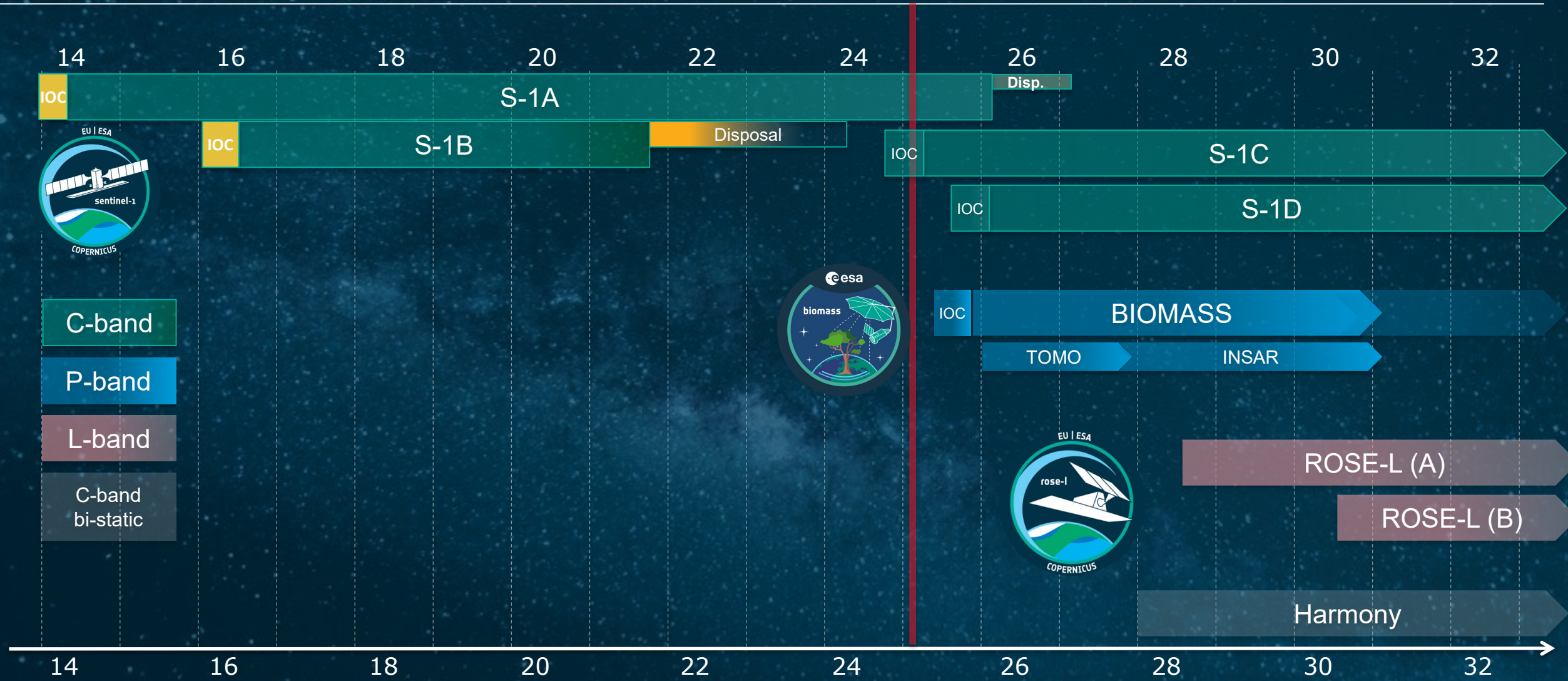
Nuno Miranda, Sentinel-1 Mission Manager

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→ THE EUROPEAN SPACE AGENCY

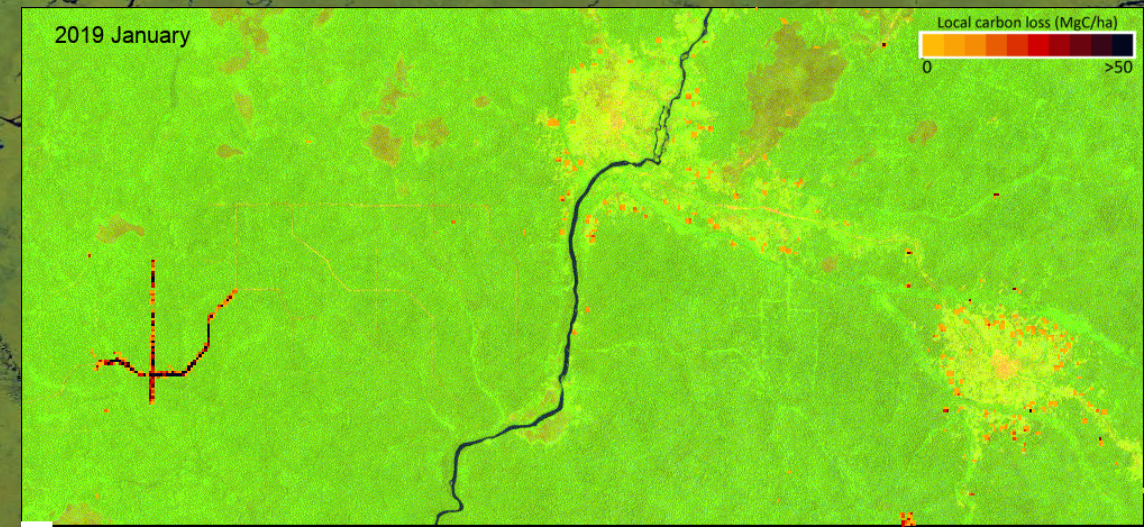
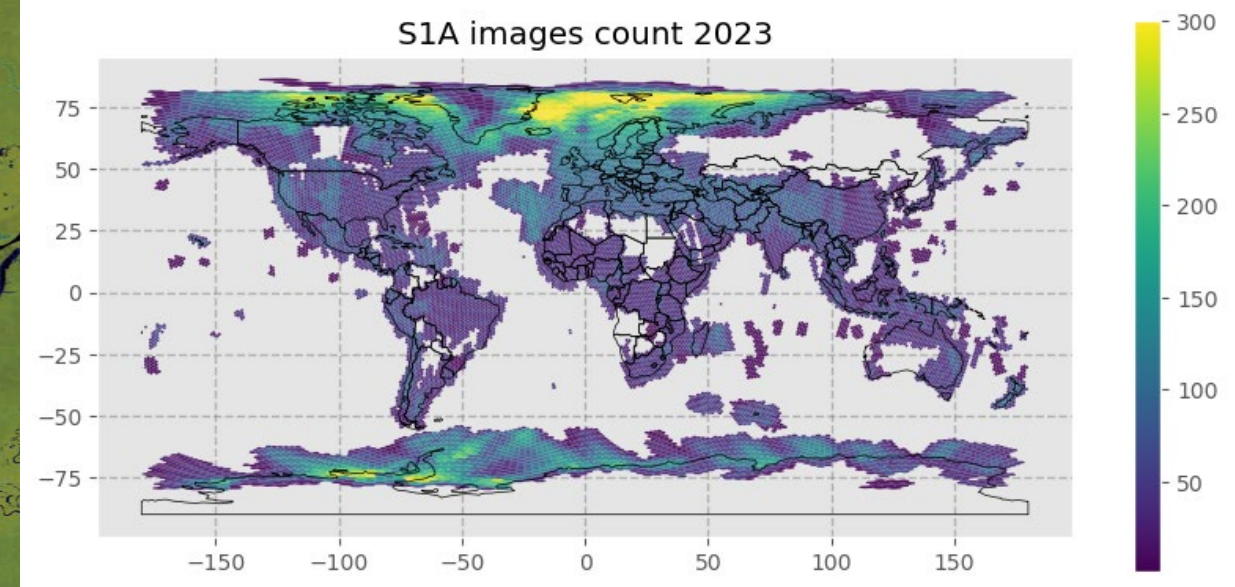
# Timeline



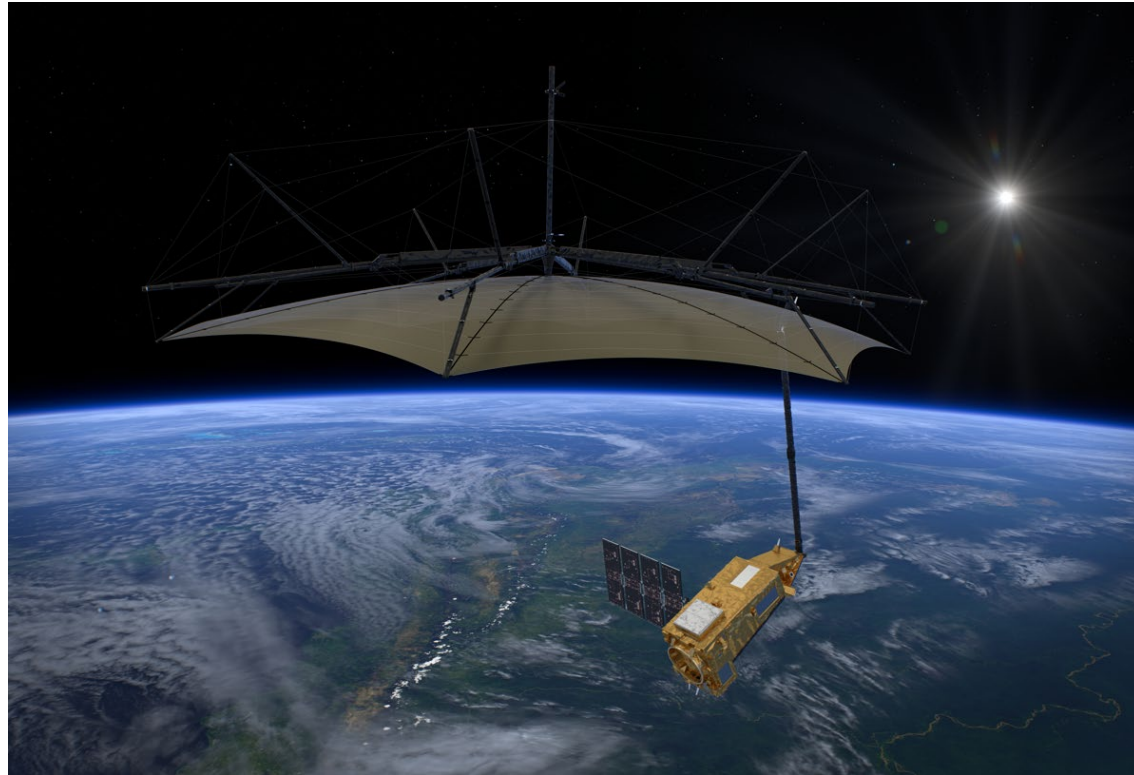
# Sentinel-1



- Sentinel-1 is the backbone mission for SAR based EO over the last decade
- Observation scenario allows to study most of the biomes and ecosystems at high resolution and with polarisation diversity
- Sentinel-1C will fill the gap left by the loss Sentinel-1B since december) → global coverage recovered and increased revisit
- Sentinel-1C IOCR in may 2025 with a potential preliminary release to the users by end of March, “use-as-is”
- Sentinel-1D launch end of 2025

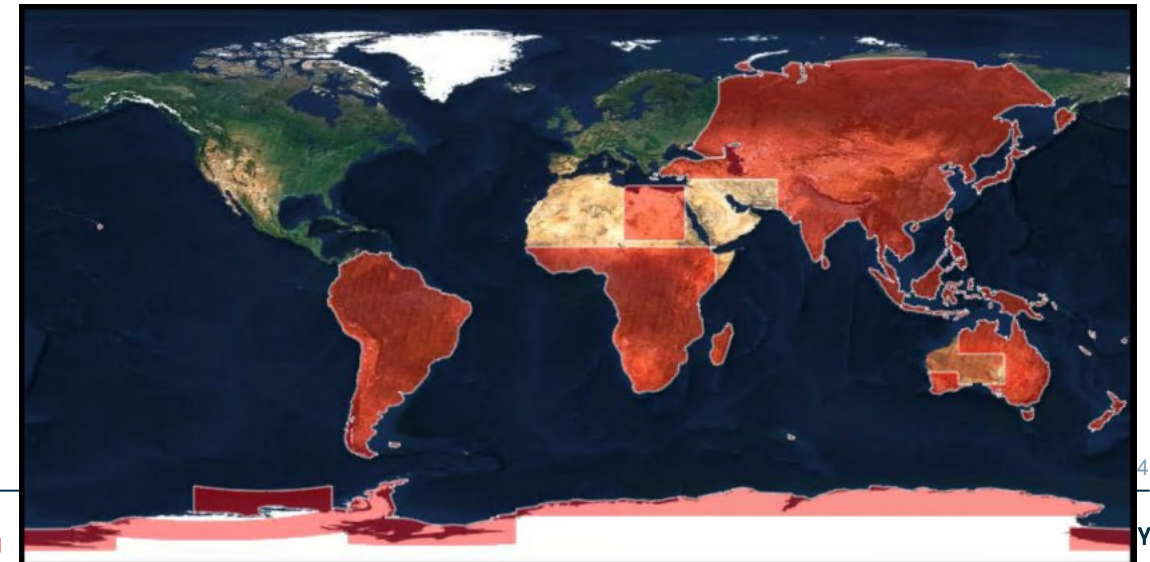


# Biomass Mission



**ESA's 7<sup>th</sup> Earth Explorer to be launched 11<sup>th</sup> April 2025**  
**The first P-band SAR in space**  
**Designed to observe forest structure (height and biomass)**

- Synthetic Aperture Radar
- Full polarimetric, P-band (at 435 MHz with 6 MHz bandwidth)
- Two mission phases: TomoSAR (stack of 7 images) and PolInSAR (stack of 3 images)
- Multi-repeat pass interferometry with a 3 days repeat cycle
- 5 years lifetime

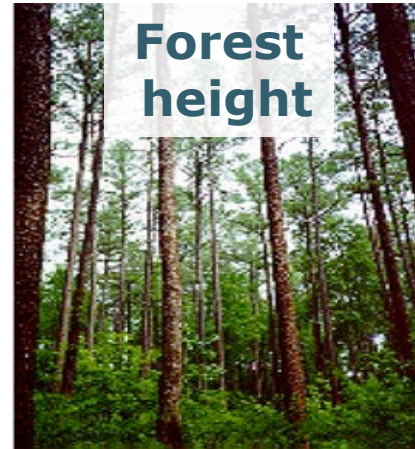




**Forest biomass**

**Above-ground biomass  
(tons/hectare)**

- 200 m resolution
- accuracy of 20%, or 10 t ha<sup>-1</sup> for biomass < 50 t ha<sup>-1</sup>



**Forest height**

**Upper canopy height (meter)**

- 200 m resolution
- accuracy of 20-30%



**Disturbances**

**Areas of forest clearing  
(hectare)**

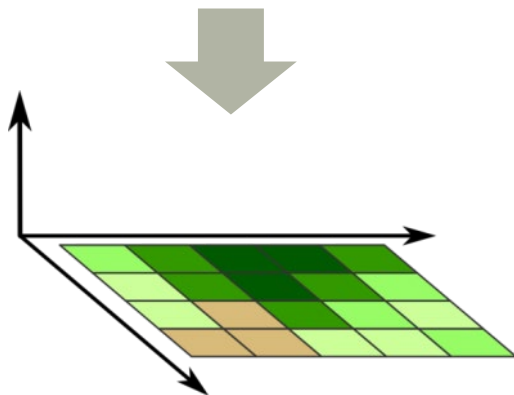
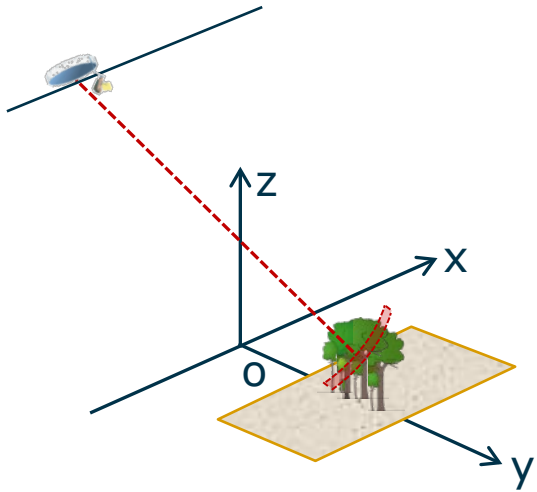
- 50 m resolution
- 90% classification accuracy

• 1 map every 8 months of all forested areas (excl. SOTR region)

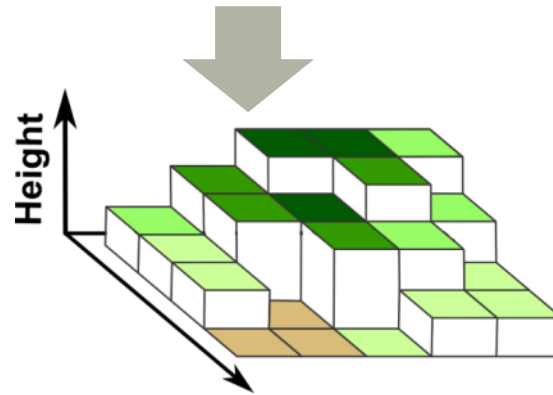
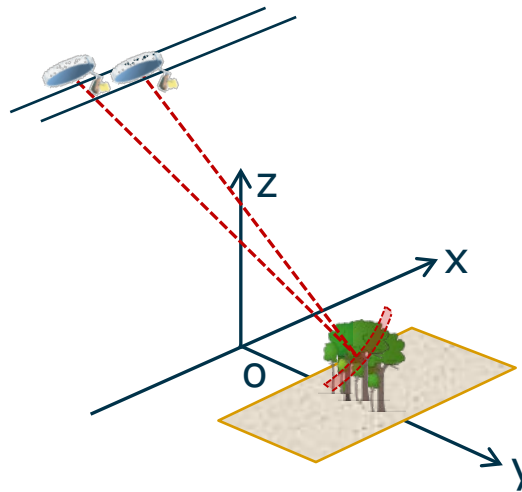
# BIOMASS capability to observe forest structure



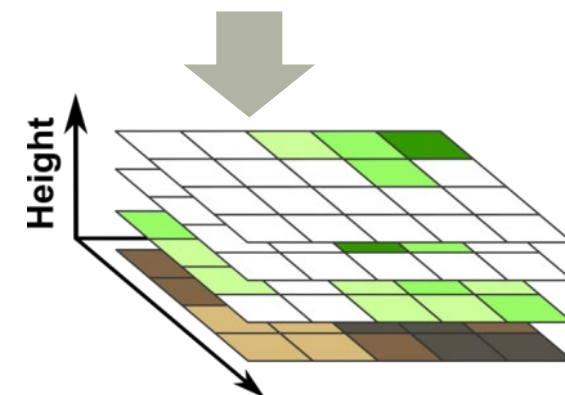
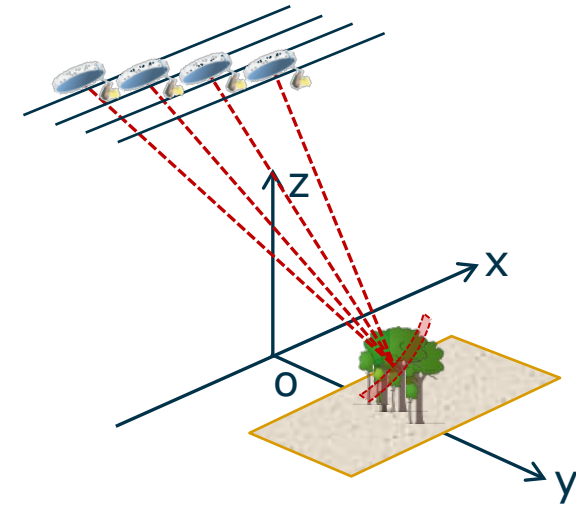
**PolSAR**  
(SAR Polarimetry)



**PolInSAR**  
(Polarimetric SAR Interferometry)

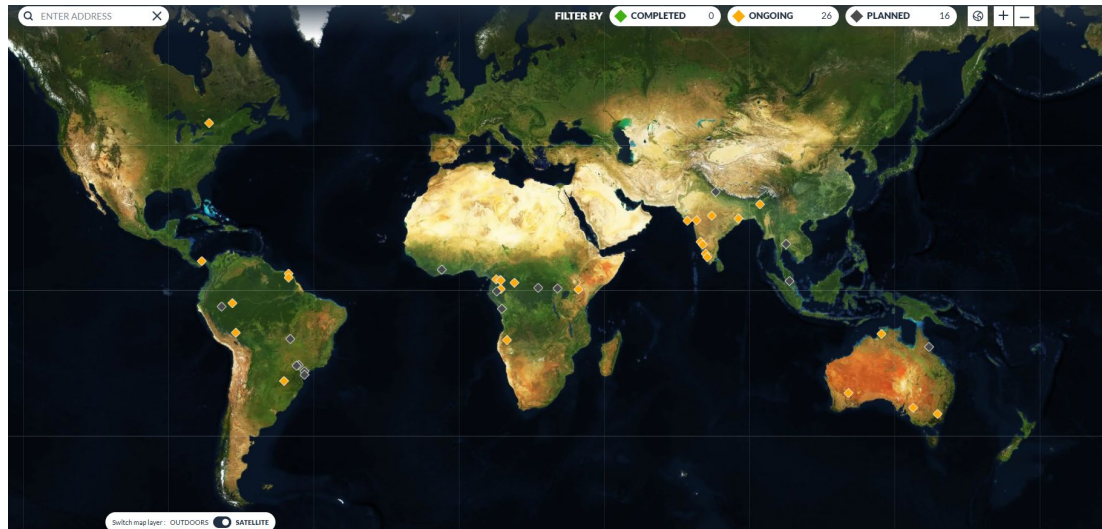


**TomoSAR**  
(SAR Tomography)

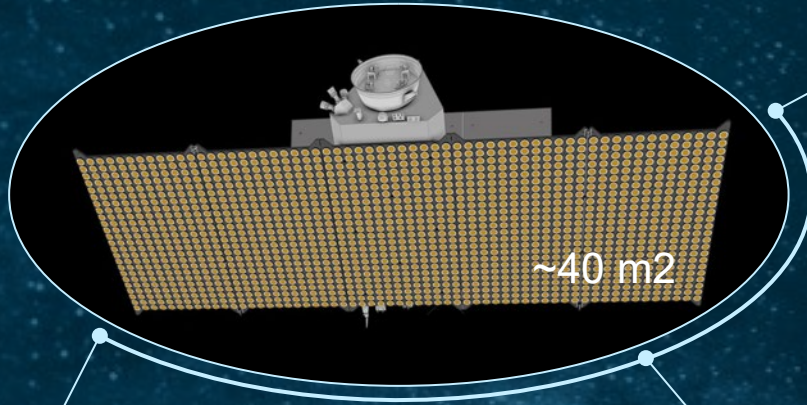


# GEO-TREES a biomass validation network

1. GEO-TREES aims to set up a network of **100 Biomass Reference Measurement site across the tropics.**
2. Measurements include:
  - 10 x 1 ha plots of forest census (diameter at breast height and tree species).
  - 3 x 1 ha plots of Terrestrial Lidar Scans.
  - 10 km<sup>2</sup> of Airborne Lidar Scans.
3. Derived products (biomass and forest height) at 0.25 ha resolution fully free and open.
4. Raw data accessible through network partners and site PIs.

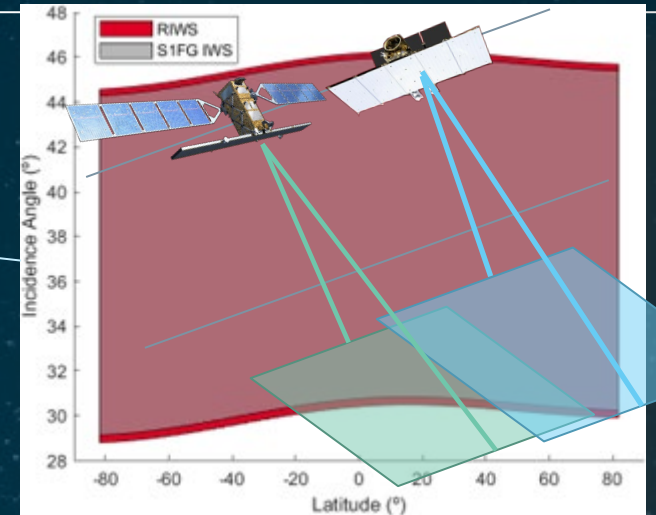


# ROSE-L Mission in Brief



## IMAGING

- ❖ L-Band – 85 MHz ITU allocated band (1.215-1.300 GHz)
- ❖ Dual-Pol mode: RIWS (ROSE-L Interferometric Wide Swath)
- ❖ Support to Quad-Pol mode: QWS (Quad-Pol Wide Swath)
- ❖ Wave mode capability
- ❖ Resolution < 50 m2 (RIWS mode)
- ❖ NESZ < -28 dB
- ❖ DTAR < -23 dB
- ❖ Swath width > 250 km



Phasing with S1. Mission design supports options for:

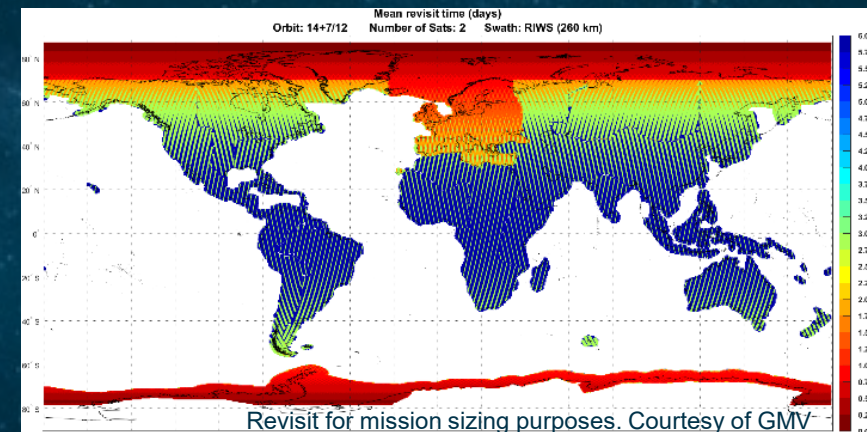
- 1) different orbit phasing for optimized revisit
- 2) convoy with Sentinel-1 (up to a minimum 1min baseline)

## GENERAL

- ❖ Constellation of 2 satellites (PFM & FM2)
- ❖ Consortium led by Thales Alenia Space Italy (TAS-I), involving 29 companies from 15 countries
- ❖ **Currently in Phase C (CDR end 2024)**
- ❖ QAR of PFM expected in 2028
- ❖ FM2 delivery expected in 2029-2030

## COVERAGE

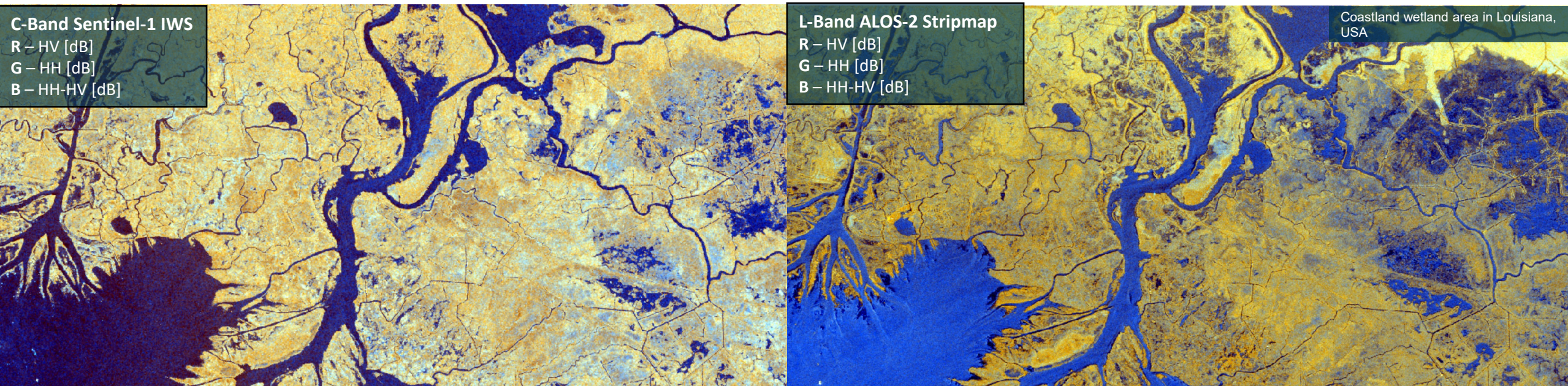
- ❖ Coverage of Global Land (excl. Antarctica and Arctic)
- ❖ Revisit with 2 satellites :
  - 6 days Global Land
  - 3 days Europe
  - 1 day Arctic
- ❖ Repeat cycle of 6 days over Global Land (2 satellites)



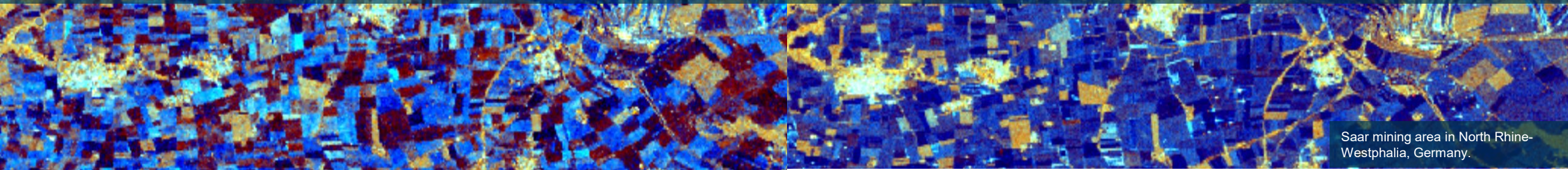
Revisit for mission sizing purposes. Courtesy of GMV



# Biomass, Land Cover and Soil Moisture Monitoring



- **New timely information on above ground biomass (AGB) and biomes structure/type.**
- L-band adding **information on forests with AGB up to 100-150 Mg/ha**, where it can sense the whole structure
- **Enhanced LULC mapping and crop monitoring**, exploiting the dual-wavelength sensitivity and the shorter revisit
- **High-resolution Soil Moisture information (up to ~5 cm depth)** over crops and vegetated land, due to penetration capability
- **Improved Flooding sensitivity in vegetated terrains**, as L-band wavelength can sense the water through the canopy



Thank you

