

Sentinel-1 Mission Status

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European Space Agency

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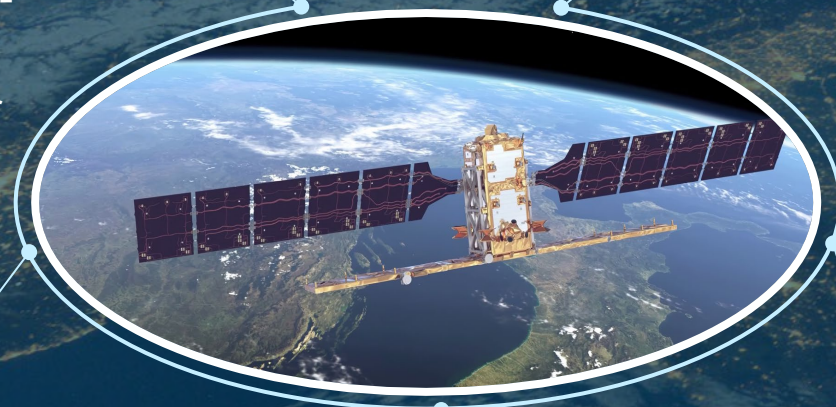
MISSION PROFILE

- ❖ Constellation of two identical SAR C-band (5.405 GHz) satellites: (C&A → C&D units)
- ❖ Near-Polar, sun-synchronous (dawn-dusk) orbit at 698 km altitude
- ❖ 7.25 years lifetime (consumables for 12 years)
- ❖ 12-day repeat cycle (each satellite), 6 days for the constellation

CAPACITY

- ❖ Systematic SAR data acquisition using a predefined observation scenario
- ❖ Duty cycle: 30 min/orbit in High Bit Rate modes and 75 min/orbit in Wave

Full, Free and Open



PAYLOAD

- ❖ C-Band SAR
 - Centre frequency: 5.405 GHz
 - Polarizations: HH, VV, HH/HV, VV/VH
 - Incidence angle: 20° - 45°
 - **Radiometric accuracy: 1 dB (3σ)**
 - **INSAR capacity**
 - **NESZ: -22 dB**
 - DTAR: -22 dB
- ❖ AIS Instrument marine surveillance (for S-1 C and D)

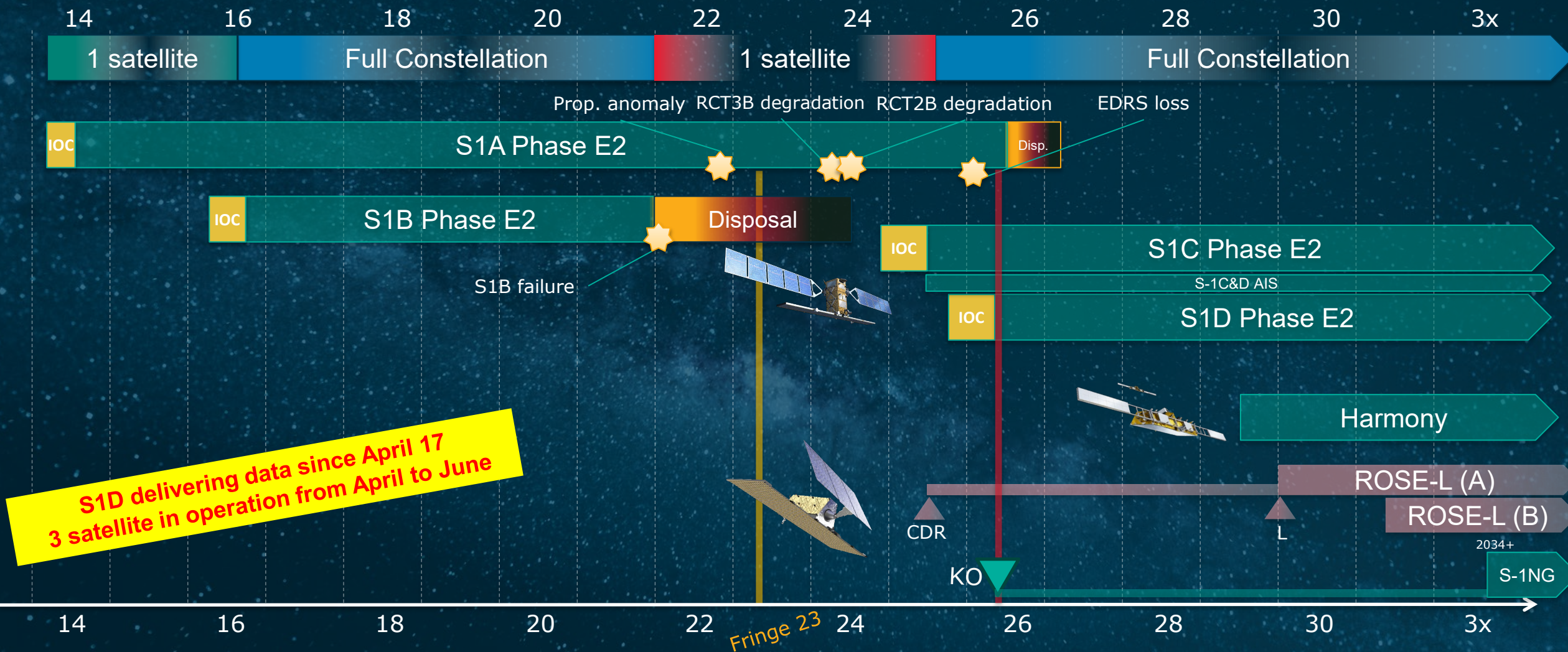
IMAGING MODES

- ❖ Strip Map Mode: 80 km swath and 5x5 m (range x azimuth) resolution
- ❖ **Interferometric Wide-Swath Mode: 250 km swath, 5x20 m resolution**
- ❖ Extra-Wide-Swath Mode: 400 km swath and 20x40 m resolution
- ❖ Wave Mode: 5x5 m resolution, leap-frog sampled images of 20x20 km

PRIMARY USERS

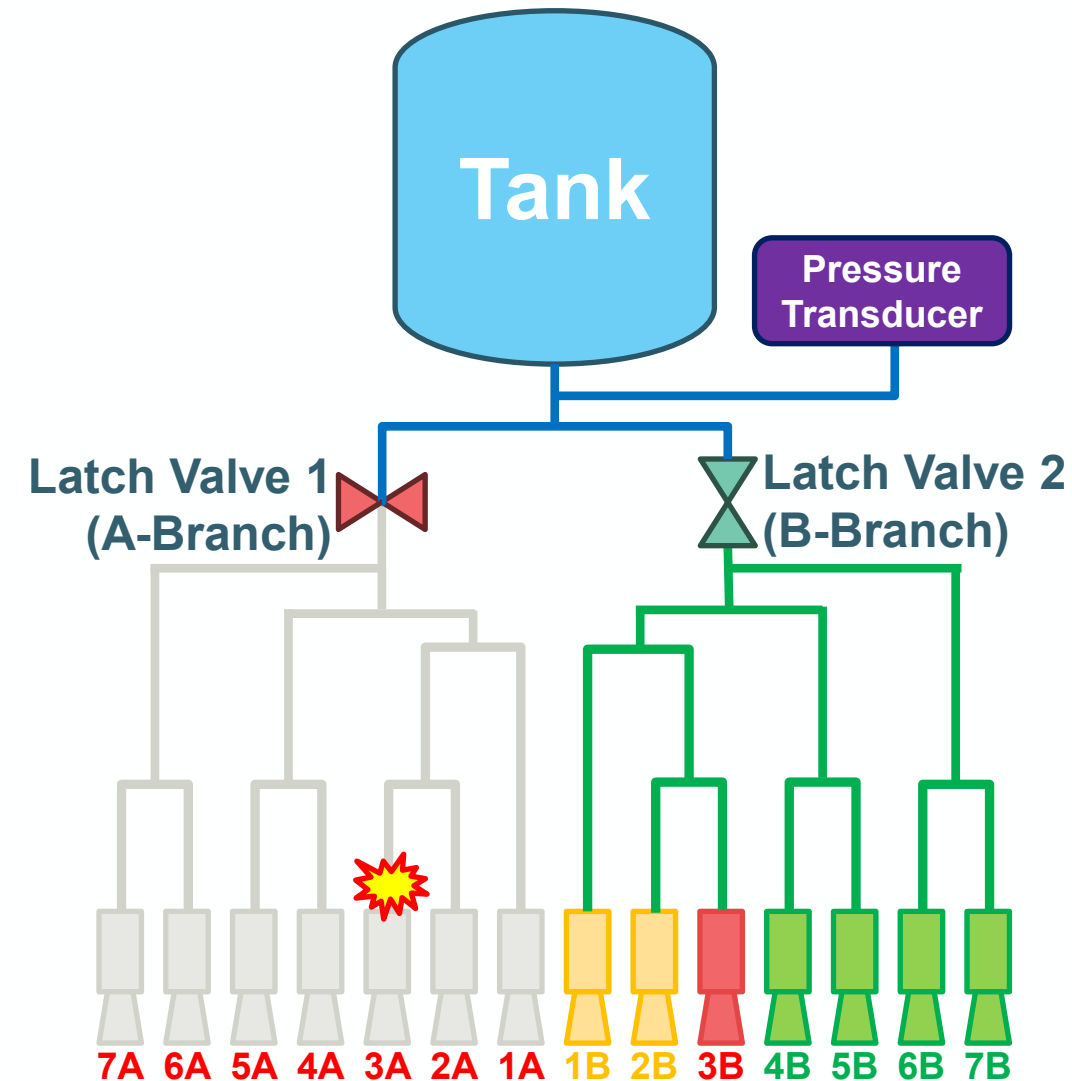


Sentinel-1 first generation timeline



S-1A Propulsion System Status

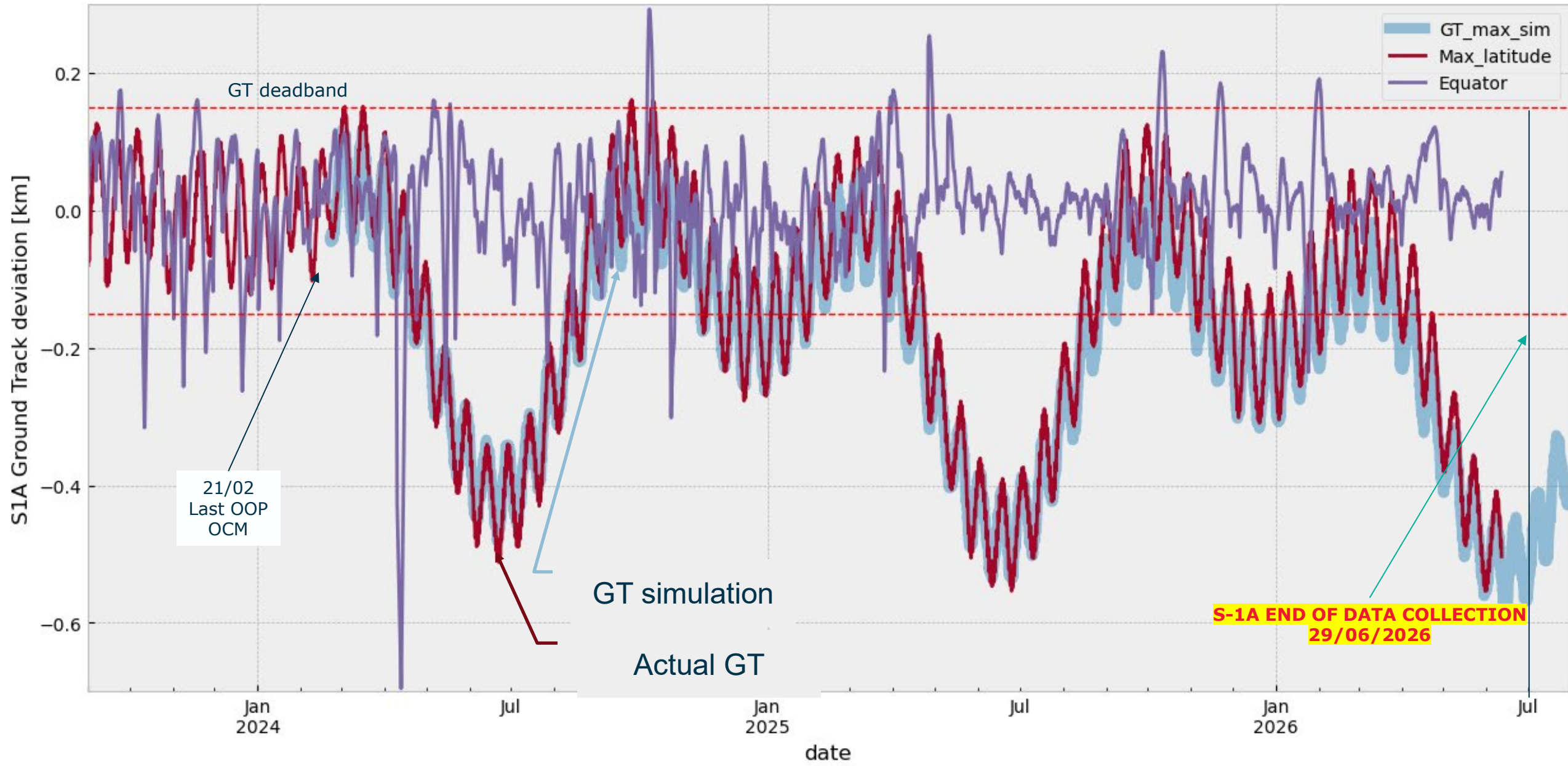
- Branch A Status:
 - Isolated since 14/10/22 due to suspected leak near RCT-3A (AR GS1_SC-304)
- Branch B Status:
 - *IP Retrograde (RCT-1B)*: Agreed as outcome of AR GS1_SC-329 to minimise usage to preserve thruster life. Only used for CAMs and (if needed) for eccentricity correction.
 - *IP Prograde (RCT-2B)*: Performance reducing and erratic behaviour observed (AR GS1_SC-329). In routine use but under close monitoring, max burn durations being adapted as necessary.
 - *OOP (RCT-3B)*: Usage suspended following sudden 25% drop in performance on 13/02/24 (AR GS1_SC-325)
- Impacts on routine orbit maintenance:
 - **No redundancy available in propulsion system**, loss of function of any further thrusters would severely limit ability to perform orbit control or collision avoidance
 - **No out-of-plane manoeuvres possible**, causing seasonal violation of deadband at maximum latitude
- Impacts on eventual deorbit operations:
 - RCT-1B still usable for initial orbit clearance (~2 km lowering)
 - Bulk orbit lowering only possible using B-Branch Z-RCTs, as opposed to A/B Z-RCTs and A/B RCT-3 on Sentinel-1B. Assuming similar thrust imbalance issues will eventually occur, **significantly less orbit lowering expected than S1B.**



Sentinel-1A Orbit Control Results



PROGRAMME OF
THE EUROPEAN UNION

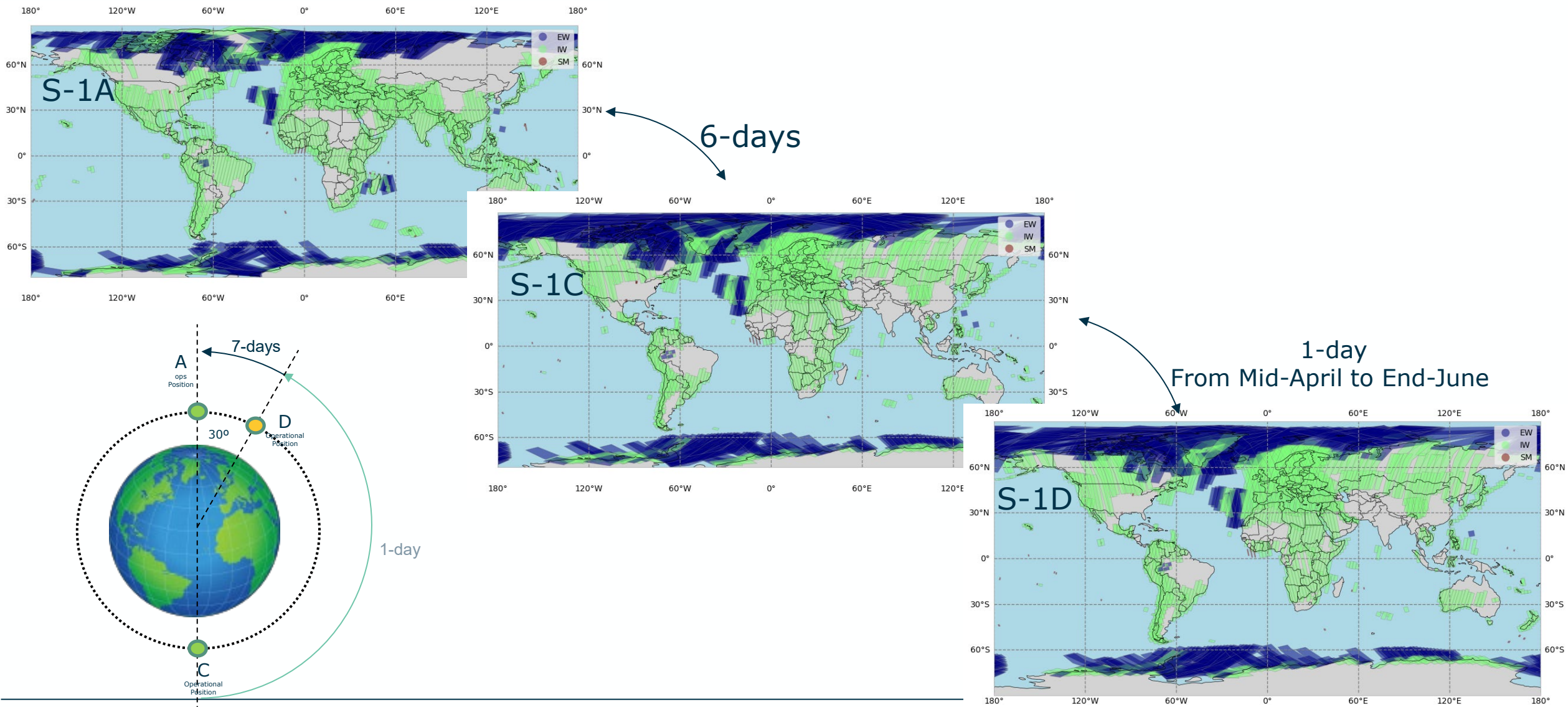


The diagram illustrates the Earth's orbit around the Sun. A dashed line represents the Earth's axis, passing through the center of the Earth. A dotted circle represents the Earth's orbit. A solid green circle represents the Earth's surface. A dashed line from the center of the Earth to the Sun is labeled "7-days". A solid green line from the center of the Earth to the Sun is labeled "1-day". The angle between the dashed line and the solid green line is labeled "30°". The Earth's surface is divided into two regions: "ops Position" (top) and "Operational Position" (bottom). The "Operational Position" is further divided into "A" and "C". The "ops Position" is further divided into "D" and "Operational Position".

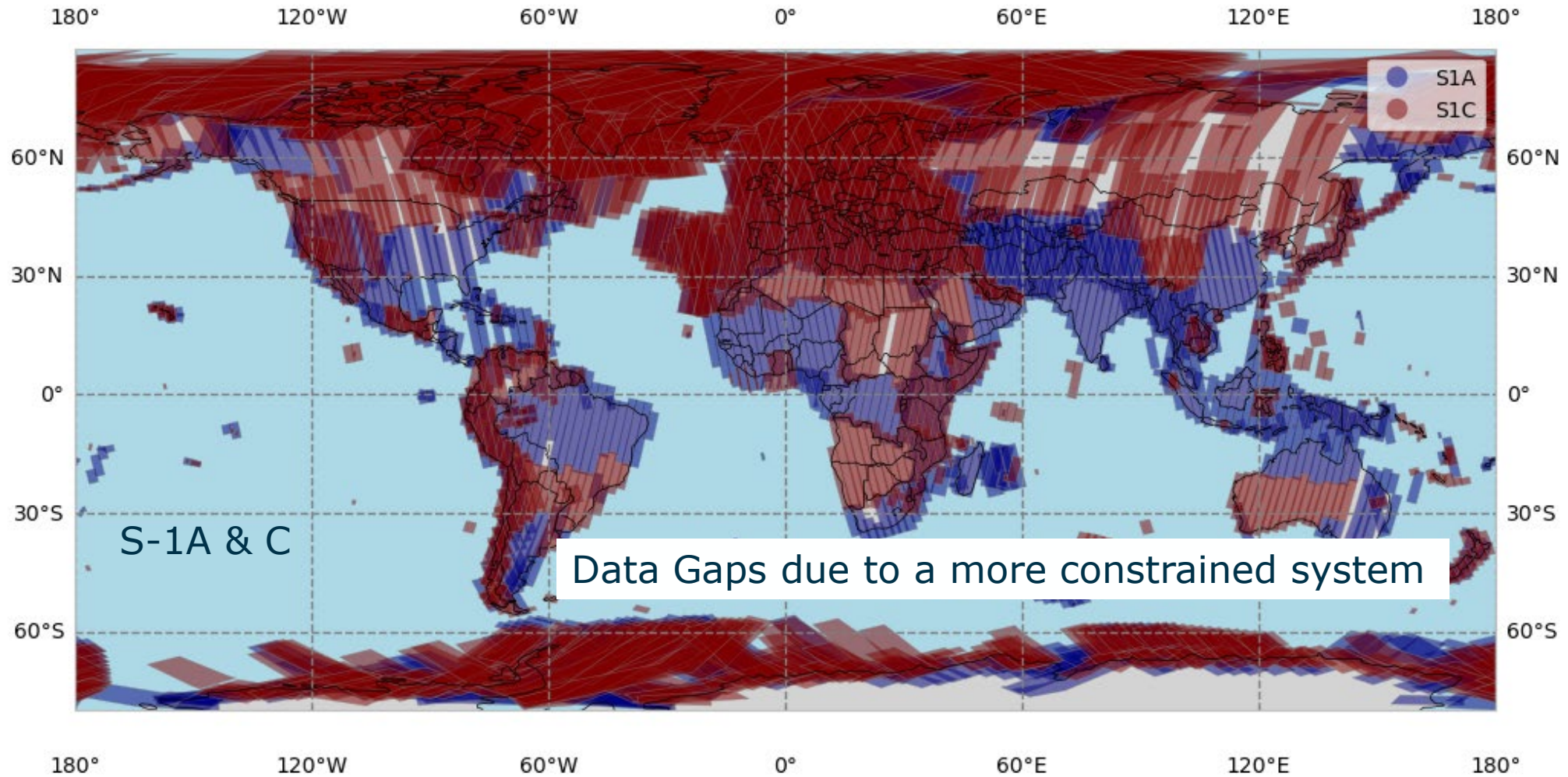
Diagram illustrating the timing of the mission relative to Earth's orbit around the Sun. The Earth is shown with a dashed line representing the orbital path. A solid line indicates the 6-day mission duration, and a curved arrow indicates the 7-day period from the start of the mission to the end of the mission. The mission starts at position A (IOSB Position) and ends at position D (Operational Position). Position C is also marked as an Operational Position. A red dashed line and arrow indicate the time taken for the mission to reach position C.



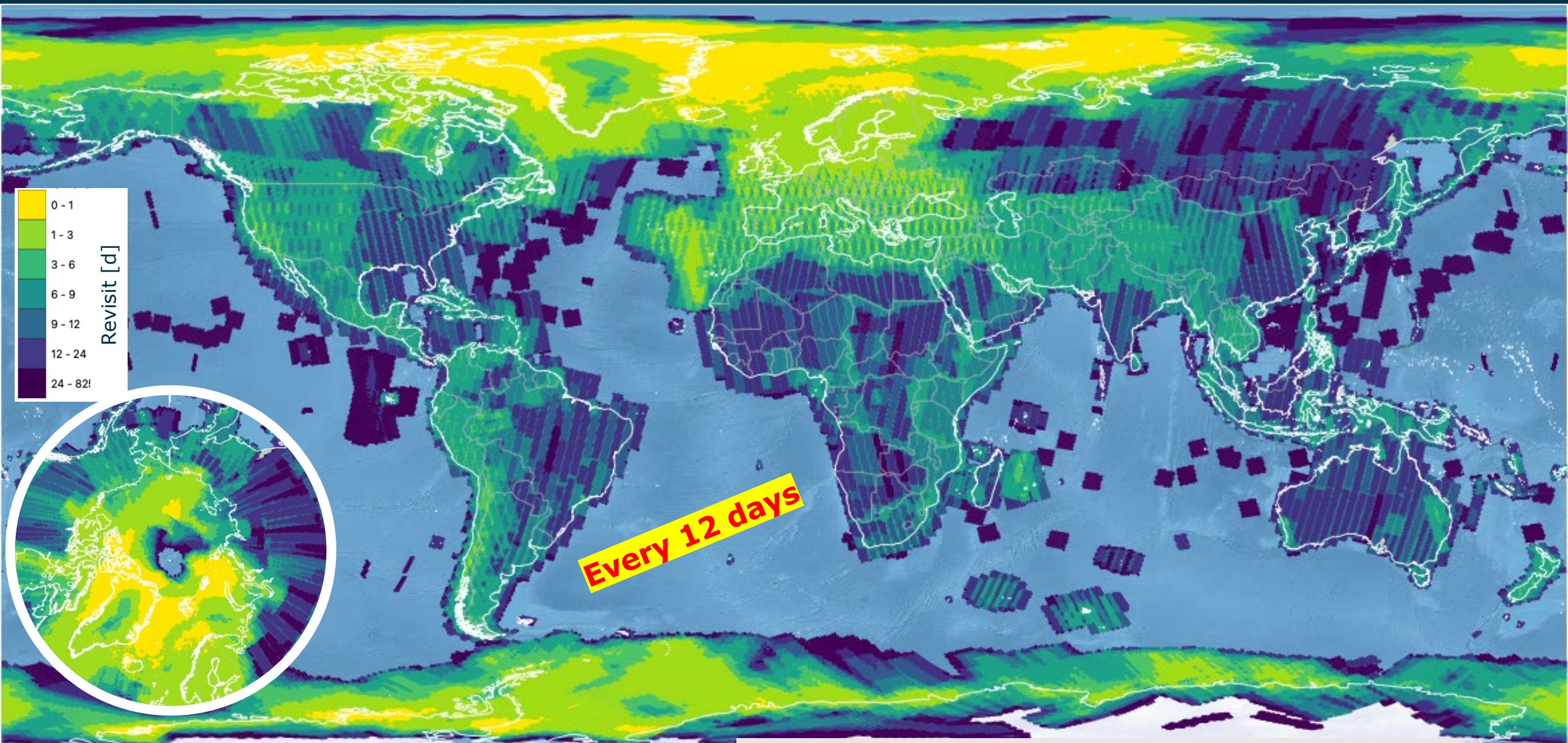
Three satellites in operations



Three satellites in operations



Sentinel-1: The Game Changer

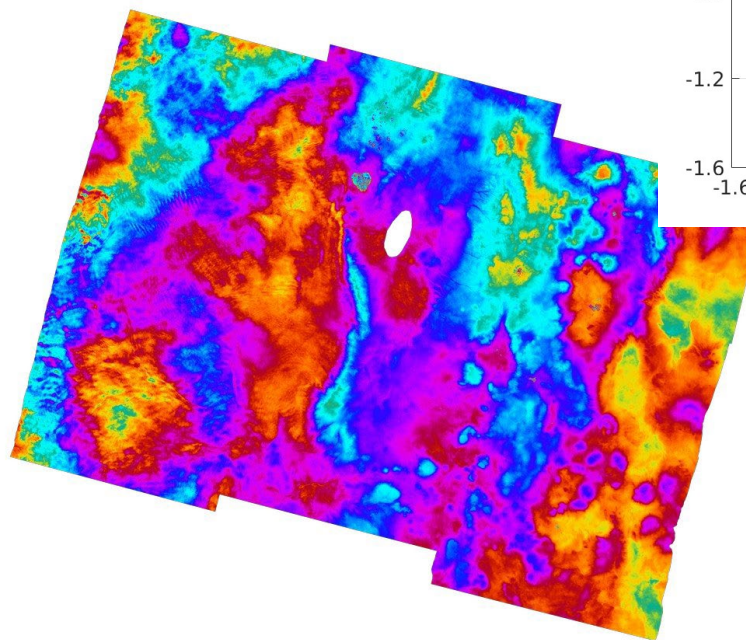
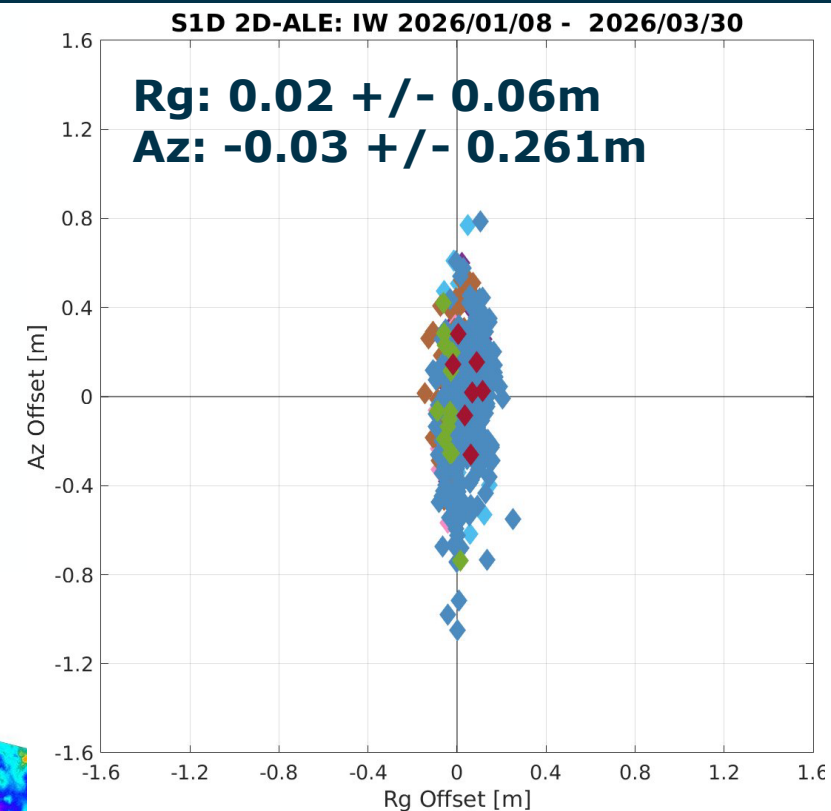
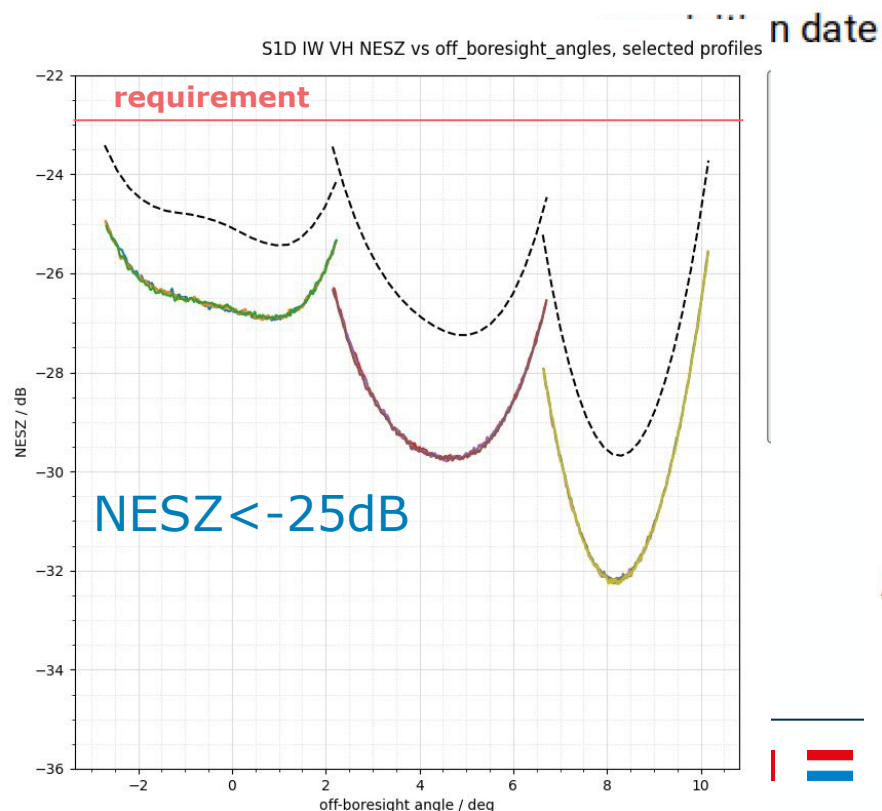
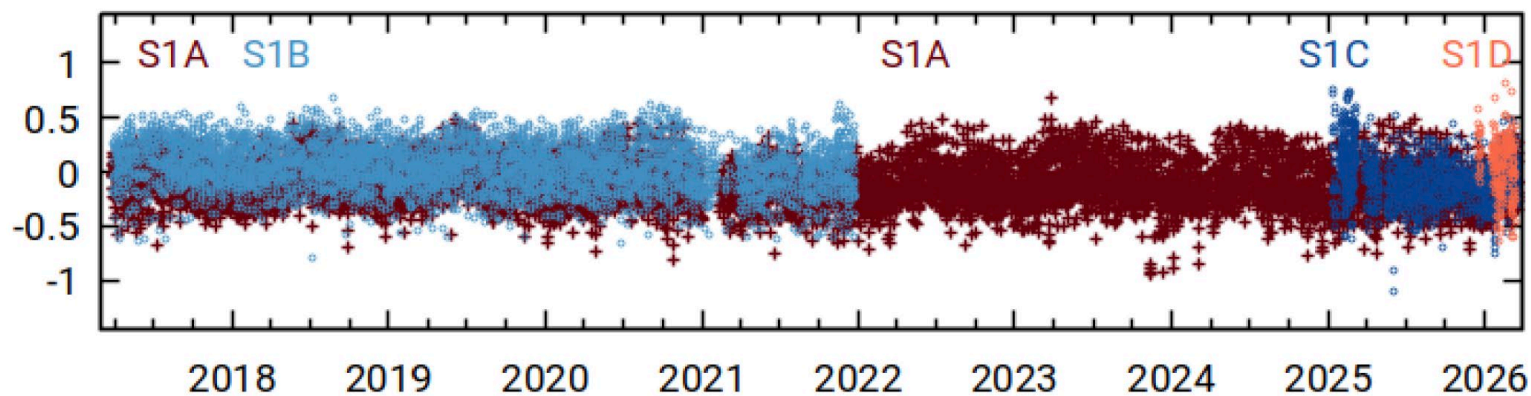


Sentinel-1A&C Acquisitions



A few performance indicators

absCal deviation [dB]

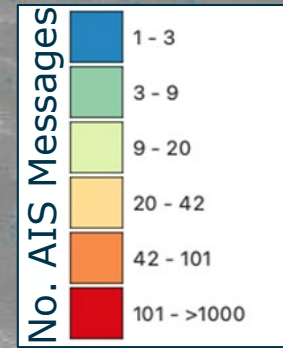
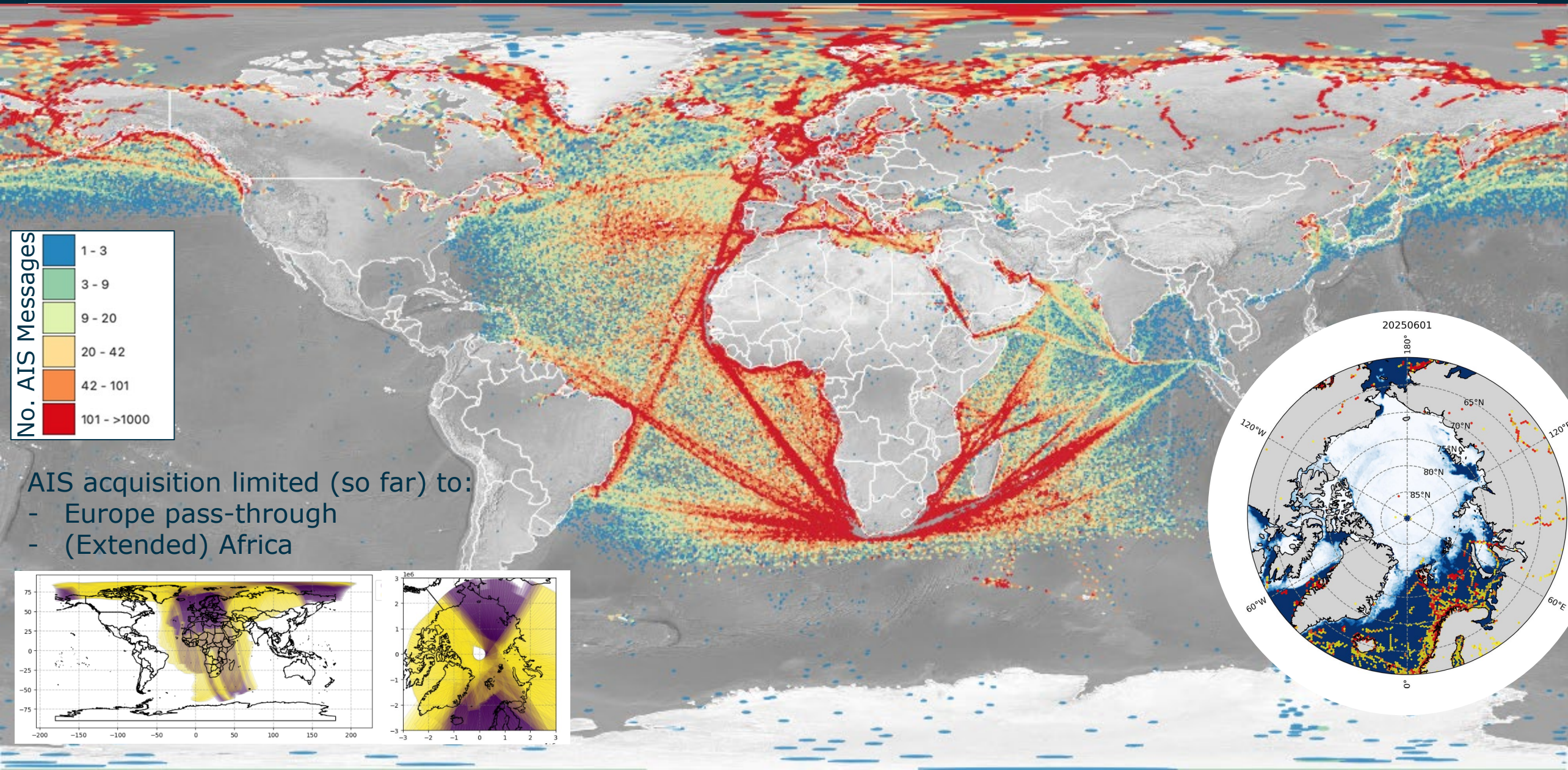


The Maritime Component



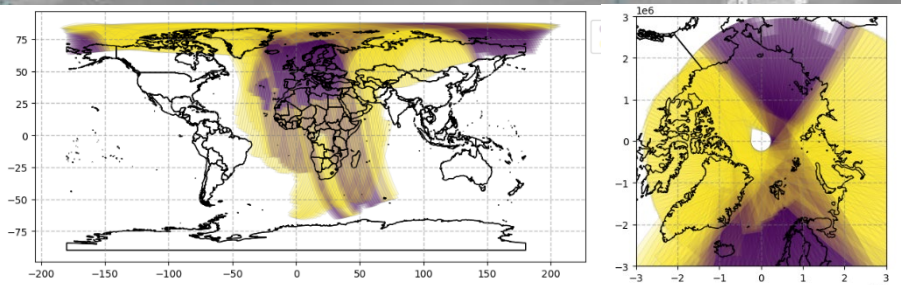
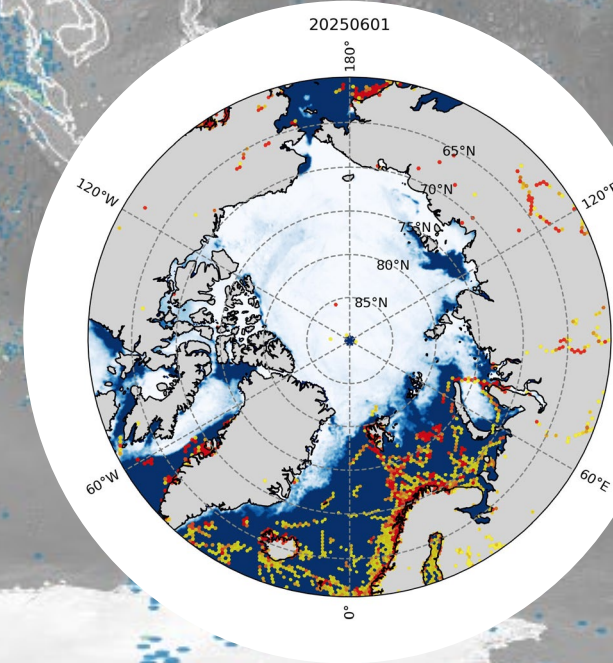
PROGRAMME OF THE
EUROPEAN UNION

copernicus
Europe's eyes on Earth



AIS acquisition limited (so far) to:

- Europe pass-through
- (Extended) Africa



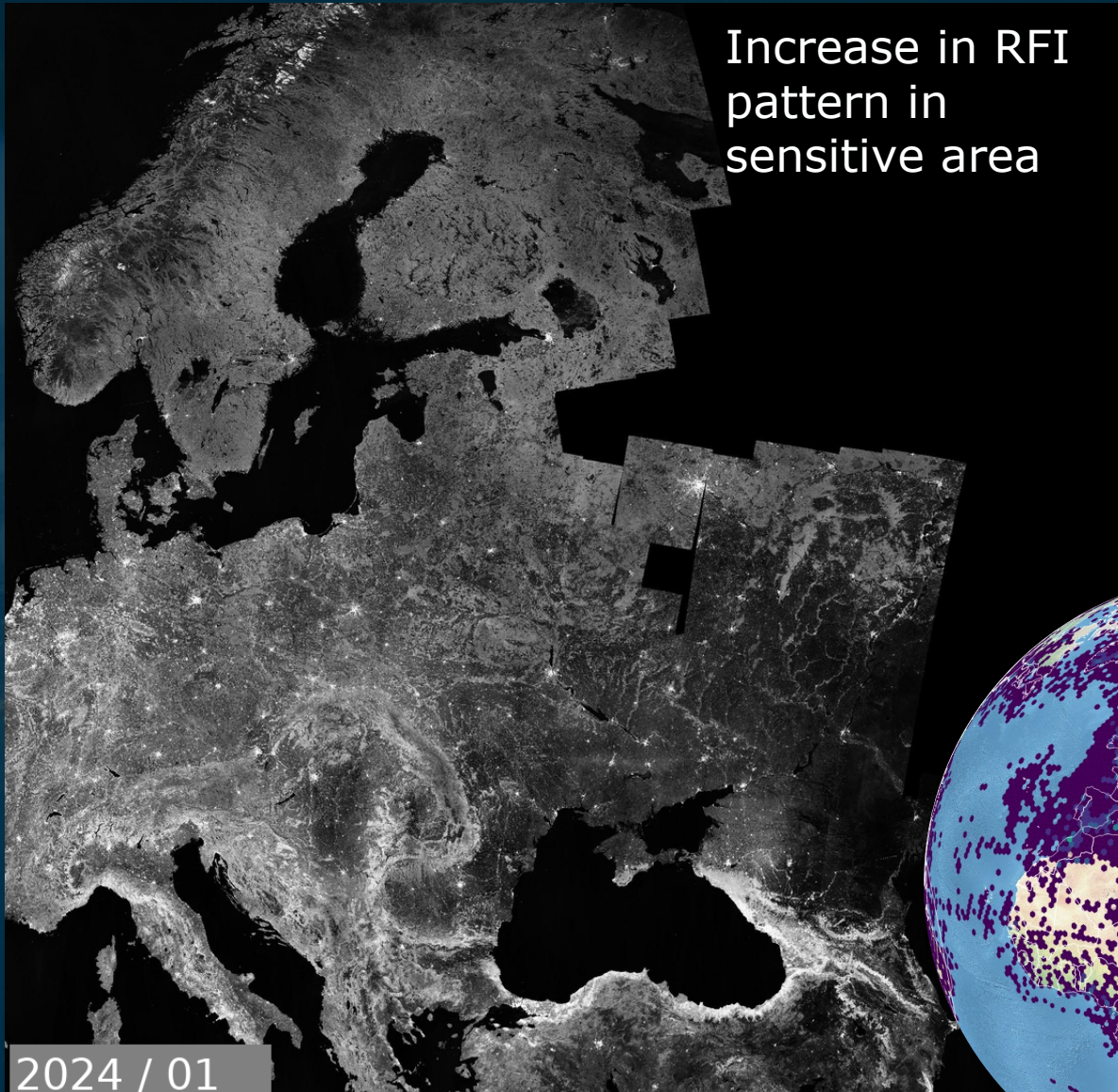
Sentinel-1 residual RFI

Tuesday, June 9

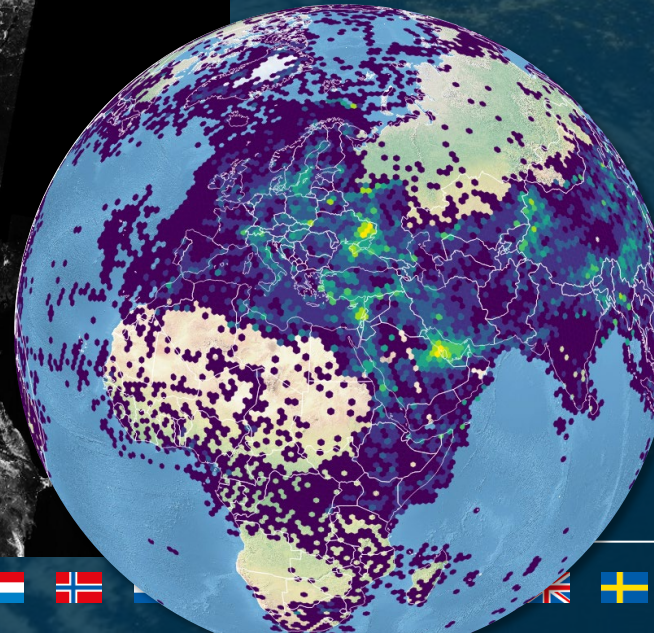
16:10 – 17:50

16:50

Sentinel-1 Radio Frequency Interference mitigation, characterization and localization



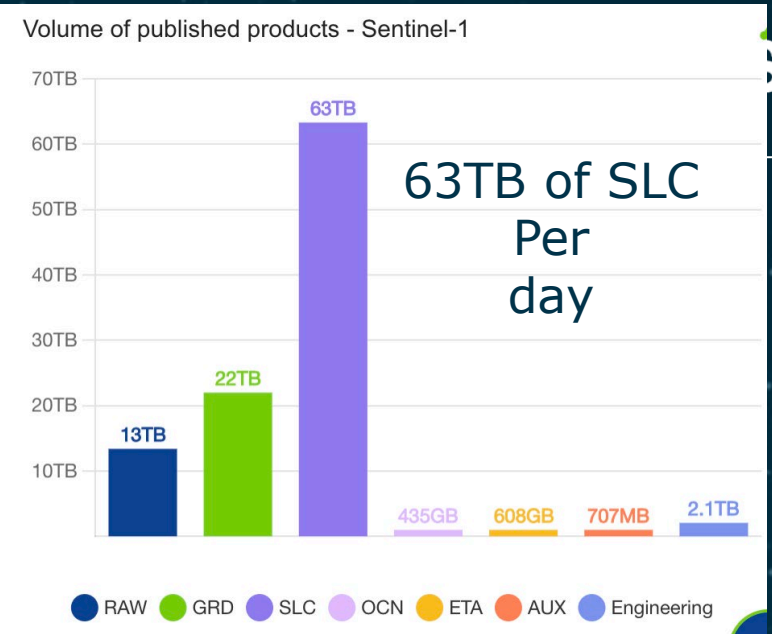
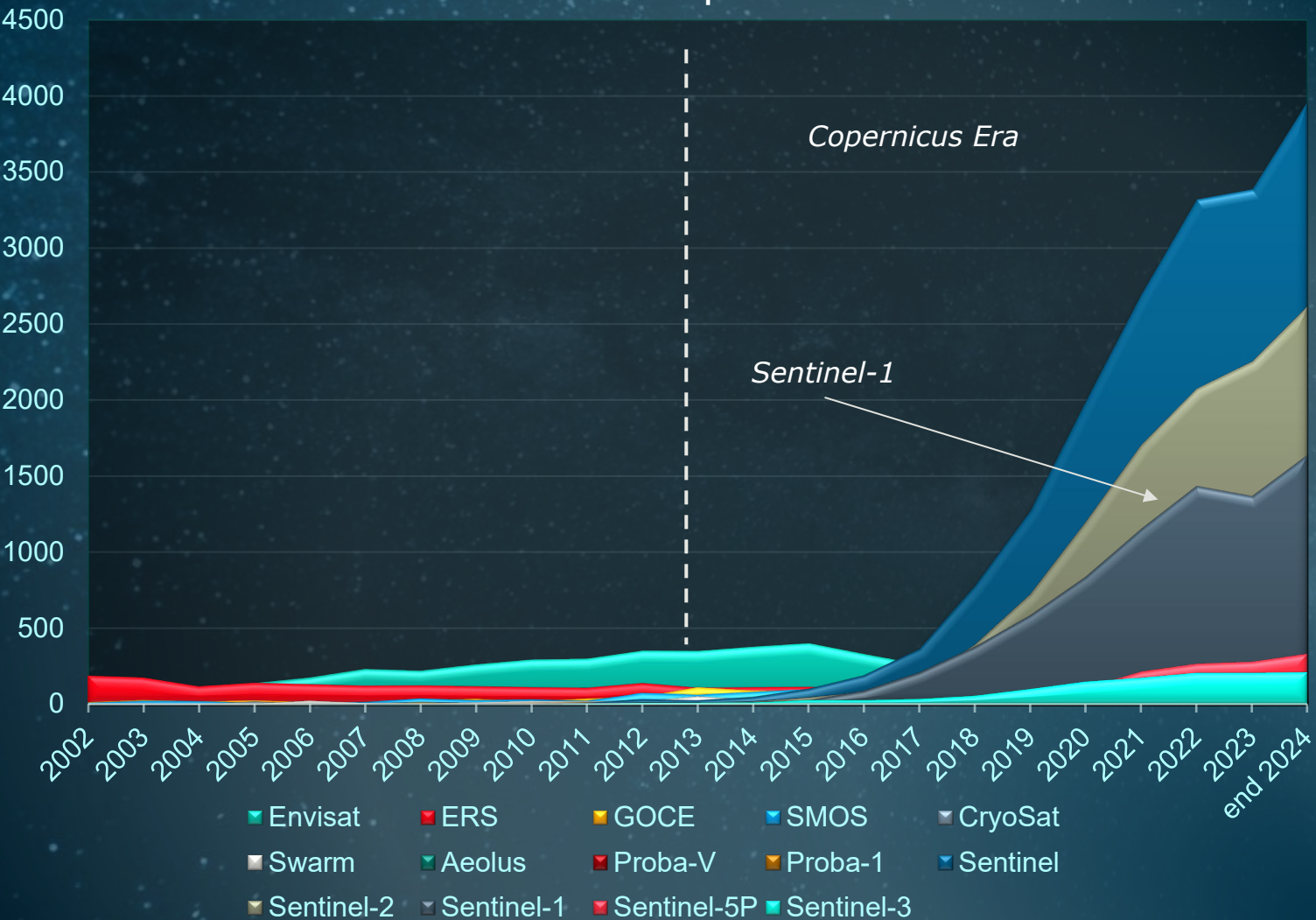
- RFI mitigation in place since 2022.
- The approach relies on pre-screening on a subset of pulses (“noise” pulses) + TD&FD mitigation
- Allow to lower contamination from 20% to <1%
- Uncorrected RFI “residuals”
 - Not seen by the pre-screening
 - Jamming → persistent RFI on specific areas



Sentinel-1 RFI residual map 2025 /
(march) 2026

Copernicus: A Pillar for Science

Number of Scientific publications



timeliness

What is next....

NEW PRODUCTS

- ARD products / Q2 2027:
 - CoSLC & NRB (following ZARR format)



Zarr

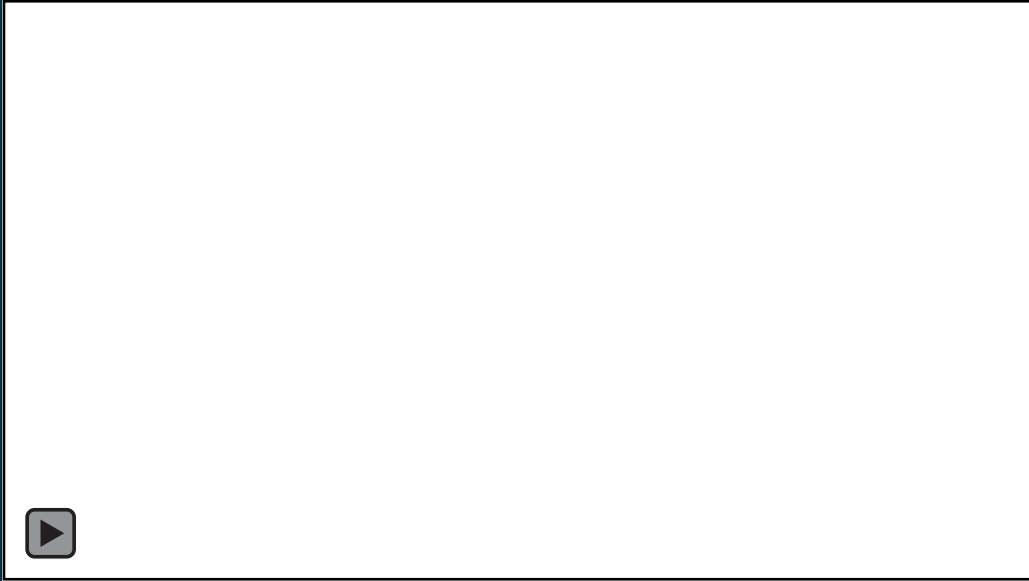
REPROCESSING

- ESA intends to perform a **perform reprocessing** of the entire S1 mission, including new data type and new formats, **starting in the second half of 2027**

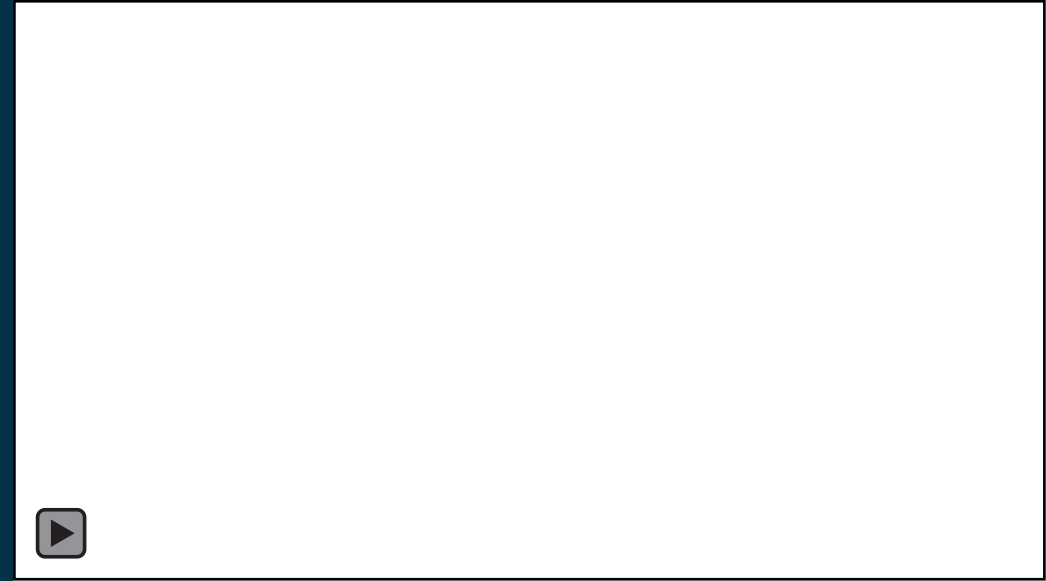
CLOUD OPTIMIZATION

- Transition to ZARR format by 2027 for all products SLC/GRD
- **Sentinel-1 data over Europe** of the current products in the Zarr format accessible via the STAC catalogue [EOPF Sentinel Zarr Samples Service STAC API](#)

Sentinel-1 bistatic opportunity



Harmony Stereo configuration

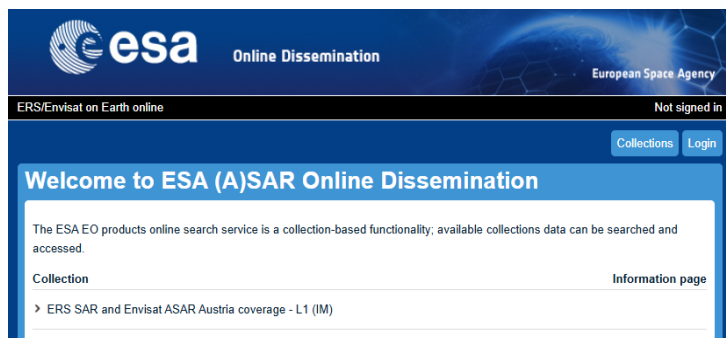


- ESA will dispose S-1A by the end of year
- During the disposal S-1A will enter in bi-static configuration with S-1C
- Bi-static data might be collected at that moment
- Will be made available if deemed useful

All ERS SAR & Envisat ASAR High and Medium Resolution Imagery data available online

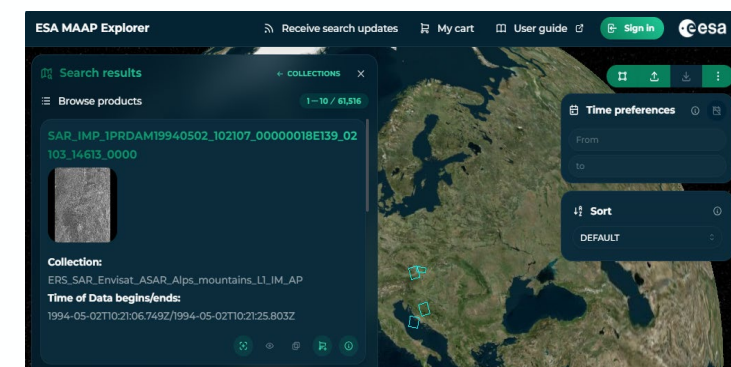


(A)SAR On-The Fly (OTF) service



- **PRI & SLC Level 1 products** -> *Full Mission Archive available via **On-The-Fly** production*
- **Bulk processed Thematic L1 collections** -> *Available via direct download*
- **Bulk processed L1 Medium Resolution datasets** -> *Available via direct download*
- **Level 0 data** -> *Limited yearly quota available upon ESA approval (Restrained dataset)*

ESA multi mission MAAP Explorer



- **Online access** through ESA dissemination systems
- **Open and free** according to ESA EO Data Policy
- User **Registration** and acceptance of Terms and Conditions of use
- Restrained dataset access initiated via **Data Service Requests**

ERS SAR and Envisat ASAR

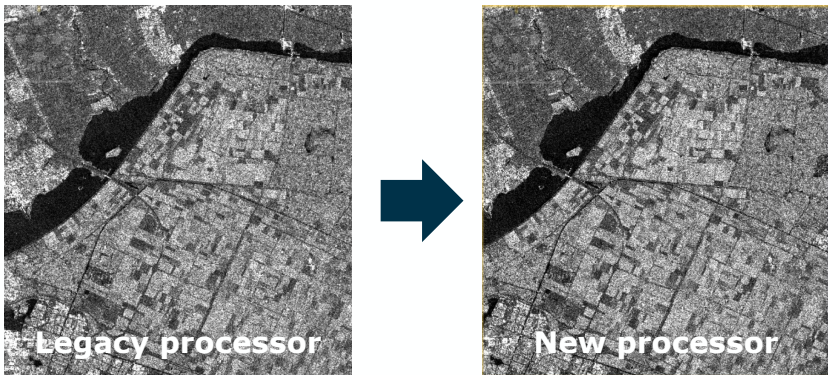
- **Two** decades of global change records - world wide coverage
- More than **1.3 Petabytes** of Level 0 (A)SAR input data
- **~ 6 million** bulk processed Level 1 (A)SAR products
 - **~ 3.1 million** bulk processed Level 1 ERS SAR products
 - **~ 2.9 million** bulk processed Level 1 Envisat ASAR products

HM DATA ACCESS - <https://earth.esa.int/eogateway/missions/heritage-missions>



ERS-1, ERS-2 & ENVISAT SAR: Ongoing activities

- Recovery of additional data to fill gaps and extend ESA data holdings.
- Re-engineering of SAR processors (Open-source and GPU-based):



Acquisition mode	Legacy (full chain)	New processor (full chain)	New processor (without reading-writing)
IMS mode (ERS/SAR)	41 seconds	9-14 seconds	3-5 seconds
IMP mode (ERS/SAR)	36 seconds	4-5 seconds	1 seconds
IMS mode (Envisat/ASAR)	38 seconds	9-14 seconds	3-5 seconds
IMP mode (Envisat/ASAR)	31 seconds	4-5 seconds	1 second

**x3 to x9
faster!**

- Data quality improvements and format alignments with Sentinel-1 (future zarr-based file format).
- Generation under preparation of Analysis Ready Data (NRB – Normalised Radar Backscatter and CB – Composite Backscatter) in alignment with Sentinel-1 (same RTC computation, open-source, Python).
- Bulk processing of (A)SAR data over predefined regions and thematic areas in support to CCI projects (e.g. SNOW, Glaciers etc).

THANK YOU

