ESA Earth Observation Programme Proposal for CM25

Belgian CM25 Event

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Eleni Paliouras
Head of the Strategy, Programme and Coordination Office, Earth Observation Directorate, ESA
Dirk Bernaerts
Earth Explorers Missions Programme Manager, Earth Observation Directorate, ESA

Key Strategic Objectives for ESA Earth Observation @ CM25

EO programmes provide critical information to understand and address major challenges such as climate, environment & natural resource crises at global, regional and citizen levels

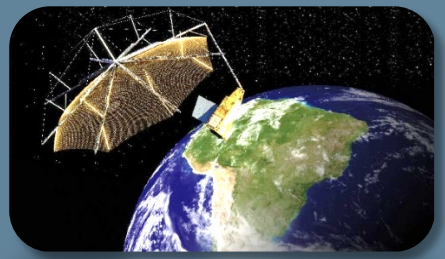
This is the starting point for the EOP key strategic objectives:

1. Strengthen **science excellence** and **worldwide leadership** in EO **infrastructure**
2. Promote **European industrial competitiveness** – both upstream and downstream – in the worldwide EO market
3. Ensure **operational mission continuity** and lead on **uptake of technology innovation** and **synergies with other digital domains**
4. Foster uptake of **valorised EO data & information products** to better understand – and more fully address – climate, environmental and natural resources crises
5. Develop **new space solutions to enable Earth action**, addressing sustainability, food security, regulatory enforcement, SDGs, water & carbon management

EO Delivers together with European Industry and Institutes

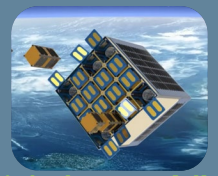
esa

11 Satellites (9 Launches) in 2025



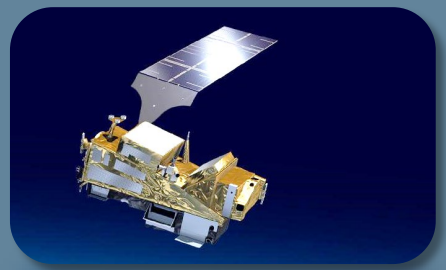
May: *Biomass*

July: *MTG-S1 & S4*



14 Jan.: *AIX*

14 Jan.: *Hive*



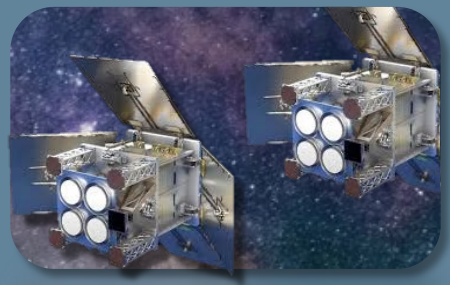
August: *MetOp-SG A1 & S5*

November: *Sentinel 6B*

14 Jan.: *Forest-3*

June: *Hyperfield*

November: *Sentinel 1D*



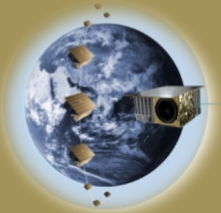
Q4: *HydroGNSS*

'25: *UKKO*

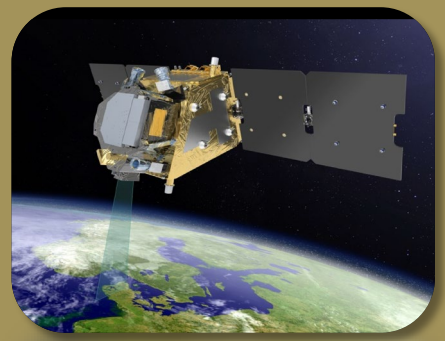
5 Satellites in 2026

Q2-Q3 2026
MTG-I2

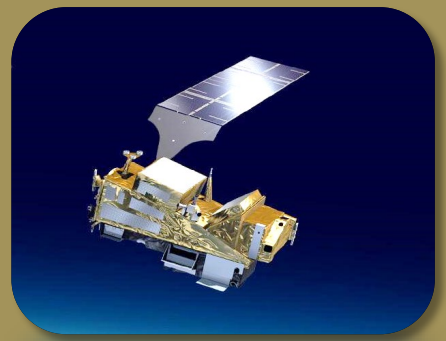
Q3 2026
Sentinel-3C



Q1 2026:
SEMOViS



Q3 2026
FLEX



Q3-Q4 2026
Metop-SG B1

Q4 2026:
TALISMAN

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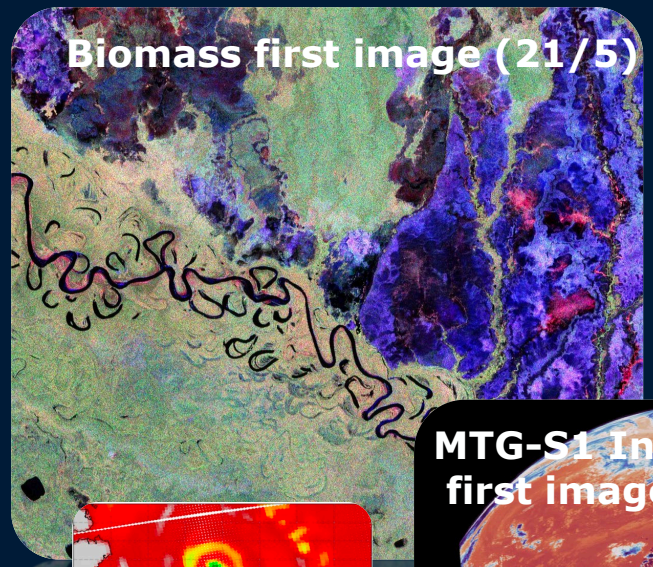
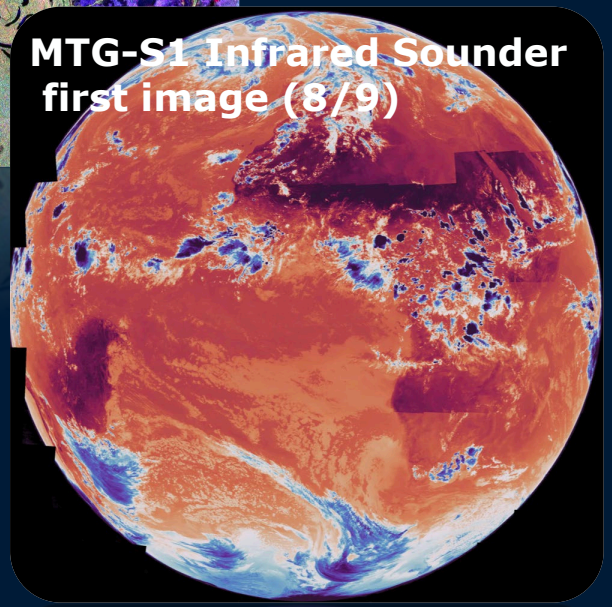
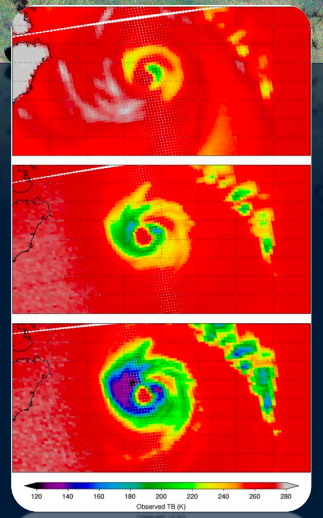
From initial data ...

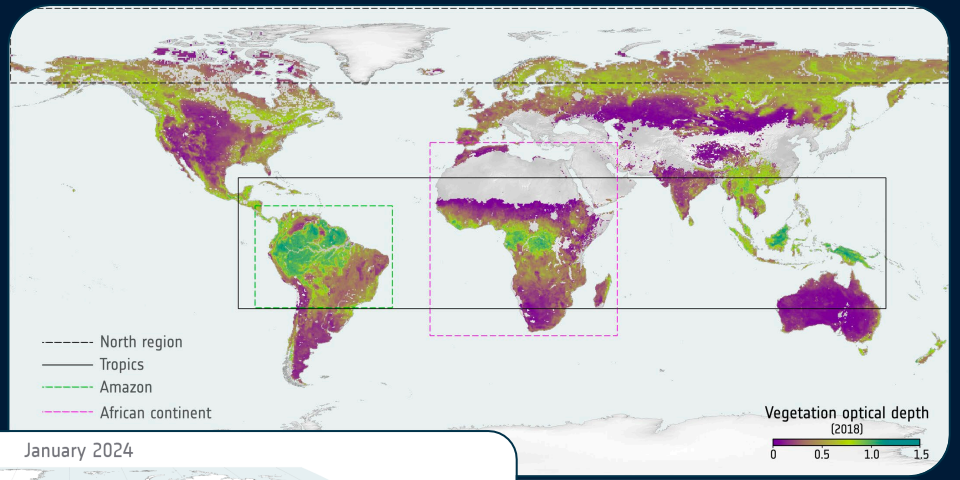


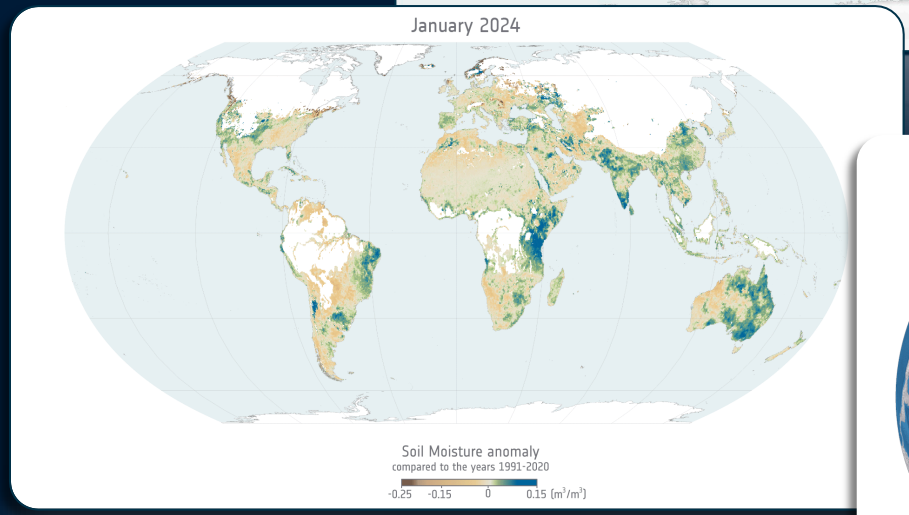


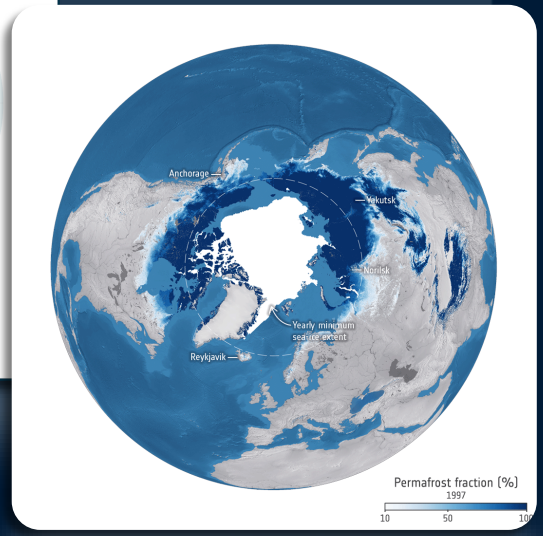


AWS view on cyclones

... to long-term trends...



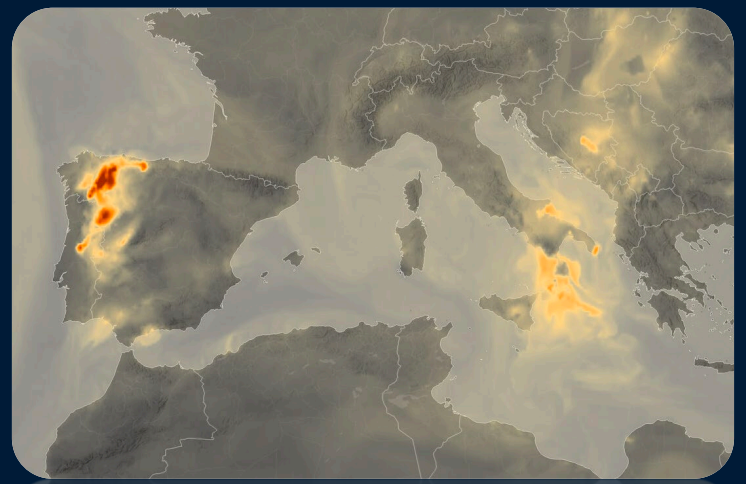




EO Delivers together with European Industry and Institutes

… to actionable data and applications

Simulation of 2021 Liege flood

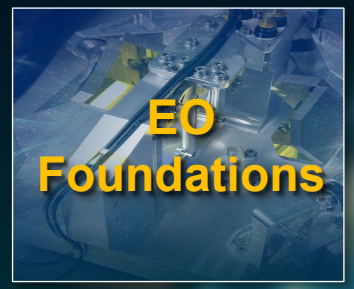


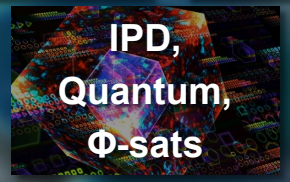
Sentinel-3, Sentinel-5p & Sentinel-2 views of wildfires on Iberian Peninsualy (8/2025)

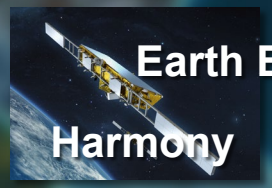
Earth Observation Programmes @ CM25

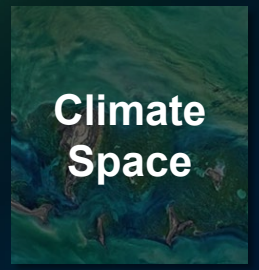
CM25: A Set of EO Programmes to Tackle Global Challenges

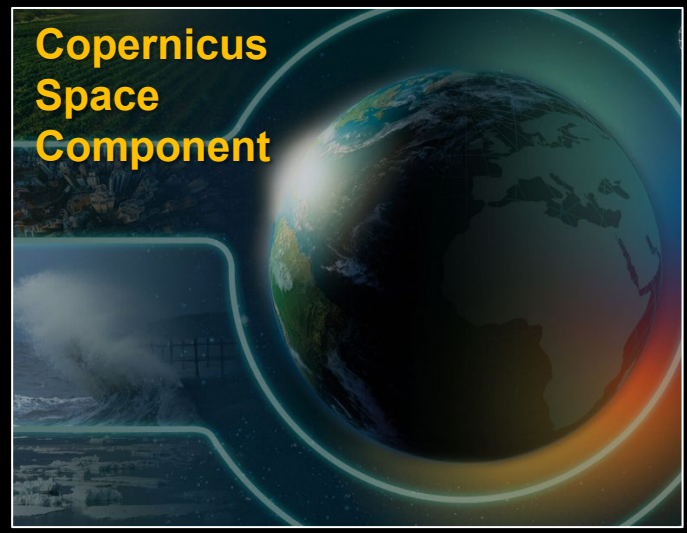
FutureEO

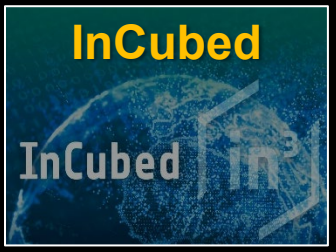






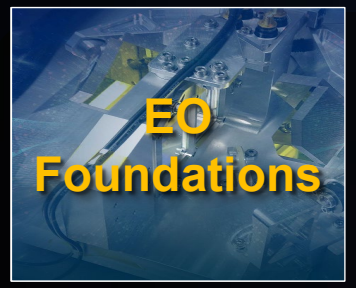






Details on FutureEO and Opportunities

FutureEO @ CM25: EO Foundations Pillar



Full spectrum of preparatory activities required for all ESA EO missions

- Mission concept identification and elaboration, preliminary definition
- EO-science: from strategy to mission specific
- Technology developments and risk reduction

1. **Generic preparatory and pre-Phase 0 activities**: identify, explore, map, prepare future mission concepts and architectures
2. **Mission Definition and concept studies**
   - Phase 0 studies: Earth Explorer 13 (4 candidates), Meteosat 4th Generation, Mission of Opportunity with international partner
   - Phase A studies: Earth Explorer 12 (2 candidate missions)
   - Copernicus Sentinel-6 NG PhA/B1
   - 3rd Scout cycle (ITT and consolidation phase for 4 mission concepts)
   - Φ-sat-3 (ITT release, concept phase and implementation phase for the selected mission)
   - Preparation and definition phase of EO Stepping Stones
3. **Innovation for EO systems and instruments** to develop new capacities for systems and sensors
4. **Frequency management activities** to protect frequency allocations for EO sensors
5. **Standardized EO Technology Development** to derisk, reduce cost, increase competitiveness

Opportunities in FutureEO – EO Foundations Pillar

FutureEO – Future Missions Preparation

- Earth Explorer 12 Phase A – Cryorad and ECO Science Studies if selected on VNIR/SWIR and TIR payload, SAR electronics and HPA analysis if Hydroterra+ is selected; UV-VIS spectrometer if Keystone is selected
- Earth Explorer 13 Phase 0 - opportunities for optical instruments
- New mission of Opportunity Phase 0 - opportunity for Risk Retirement activities on Optical Payload
- 3rd Scout Cycle - opportunities at mission and instrument level
- Opportunities for BE industry in platform technology development, standardisation/industrialisation activities for mid-size platforms, preparation and definition phase of EO Stepping Stones.
- Opportunities for studies and technology pre-development of innovative instrument concepts and enabling technologies, e.g. for compact optical instruments and optical detectors
- Opportunities for science institutes for science studies (e.g. NEOMI) and campaigns

FutureEO – SCOUT Missions

Agile development and good value for money

- Agency's response to a quickly evolving scientific and technological environment in the EO sector
- Reduction of time & cost to deliver demonstrations of novel EO techniques & results in Earth sciences
- Easily scalable if successful

Characteristics

Operational missions designed to deliver science in orbit

Based on SmallSat/CubeSat format

Strict cost and schedule boundaries

- 3 years from Kick-Off to launch
- Maximum 35 M€ industrial cost

Innovative implementation

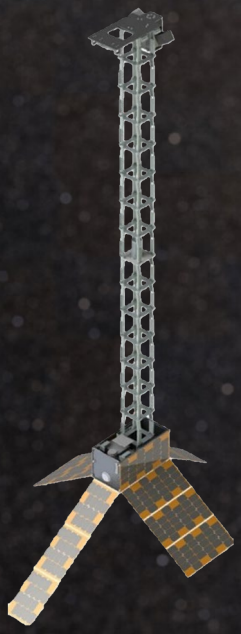
- Service contracts to provide scientific data
- ESA role focused on critical risks with higher delegation to industry in direct contact with institutes and labs
- Application of NewSpace standard

Scout Missions to Date

Tango

HydroGNSS

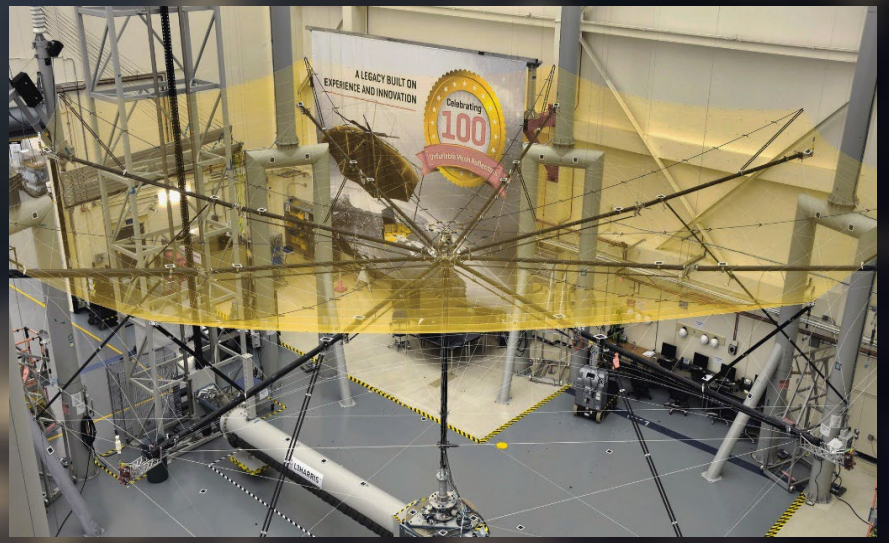
NanoMagSat

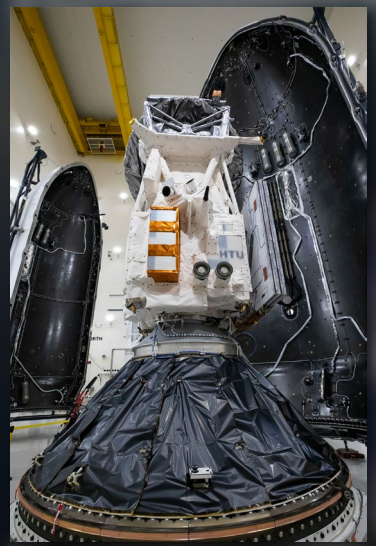


FutureEO @ CM25: EO Missions and Data Pillar

- EO Missions and Data Pillar embraces all activities in implementation, launch, mission and data management
- FutureEO-1 Segment 3 aims to deliver:
  - **Harmony** ensuring overlap with Sentinel-1 1st Gen by covering all remaining activities up to end Ph.E1
  - **WIVERN** mission development → funding coverage of remaining pre-dev activities & implementation until PDR
  - **NGGM** ensuring overlap with GRACE-C → funding coverage of phase B2/C & critical instrument activities
  - **Scouts 5 and 6** ensuring fast implementation cycle by covering all activities up to end of PhE1
  - Mission and data management of the **most diverse and thus far largest fleet of EO research satellites** (SMOS, CryoSat, Swarm, EarthCare, Biomass, Φ-Sat-2, and planned operations of Scouts, FLEX, FORUM) as well as **data quality activities**

Satellite Development Success Example – EarthCARE & Biomass





EarthCARE's and Biomass's development were complex collaborations at many levels, each involving a consortium of over 75 companies across Europe. Participation of Belgian industry and institutes in these and upcoming Earth Explorers, helping the achievement of ground-breaking science by these and future Earth Explorer missions !

Opportunities in FutureEO – Missions and Data Pillar (1/3)

FutureEO – Mission Implementation

- Earth Explorer 11 - WIVERN: platform equipment (f.i. PCDU, X-band transponder), instrument elements (e.g. ICU, OBC, application software), Ground Support Equipment, Testing and Calibration, ground segment elements: software, simulators. Science studies and applications.

- Next Generation Gravity Mission NGGM: strong BE involvement in instrument (LTI) with additional opportunities in space and ground segment, testing and science/applications.

- SCOUT – 2nd Cycle: candidate with strong BE involvement in hardware development, simulators and science.

Opportunities in FutureEO – Missions and Data Pillar (2/3)

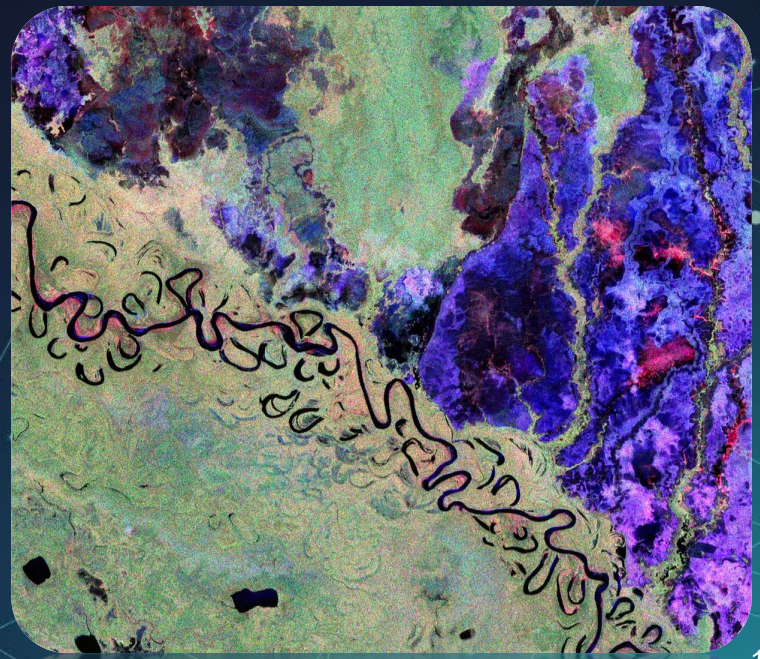
FutureEO – EO Mission and Data Management

R&D for Fiducial Reference Measurements

- Key role of BE in Data Quality activities with world-wide top expertise in Cal/Val
- Framework contract around EO Data Quality (QA4EO-2) → Phase 1 committed in Future EO-1 Segment 2, Phase 2 foreseen in Future EO-1 Segment 3 – involvement of several BE entities
- Fiducial Reference Measurements (HYPERNET, FRM4DOAS, FRM4GHG, FRM4DRONES) – involvement of and long-term cooperation with many BE entities
- Many BE entities significantly involved in R&D activities

Exploitation Phase of Earth Explorer mission and Geophysical products

- EarthCARE: involvement in Data Innovation (processing/quality) and Science
- Upcoming ITTs for Data Innovation and Science Clusters for FORUM and Harmony



Opportunities in FutureEO – Missions and Data Pillar (3/3)

FutureEO – EO Data Generation and Management

- Pre-cursors and preparatory activities for the ESA EO Ground Segment evolution towards the ESA Data and Operations Management Framework for EO Science Missions (EOP-EOS) in development and operations started in Future EO-1 Segment 2
- Evolution of the EO Data and Operations Management into single framework with stronger industrial empowerment in EO services provision: open ITTs to be progressively published and placed in Future EO-1 Segment 3 (2026-2027) → ***major opportunities for continued and enhanced BE involvement***
- These EOF-EOS service contracts for Data Generation and Management cover services such as EO Data access and User services, EO data storage and archival, and Onboarding and Operations Coordination Services of EO Science Missions
- Perspective of increased opportunities in Future EO following significant role in InCubed for newcomers

FutureEO @ CM25: Earth Action Pillar

Address the "triple crisis" – Climate Change, Biodiversity Loss, Pollution/Waste, through actionable climate and environmental information and solutions for society, while fostering disruptive innovations and business ideas

- **Advance fundamental understanding of the Earth-climate system**, its processes and interactions with human activities and ecosystems and support R&D to **develop applications using EO for the benefit of society**

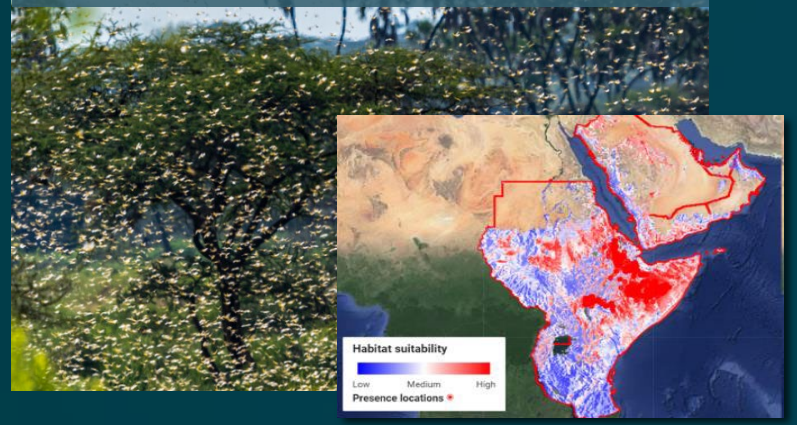
- Deliver efficiency improvements and **impact to the operations of stakeholders in the development assistance community** including through development of new thematic EO information products

- Coordinated activities to **generate robust, long-term, global satellite-derived datasets for key indicators of climate change** known as Essential Climate Variables (ECVs) and to interact with the relevant actors in the domain

FutureEO: Bridging the Gap → From Science to Action

Example: supporting developing-country governments

Agriculture and Fragility



Desert Locust monitoring service to support early warning actions as well as impact assessment of damaged crop areas.

Disaster Resilience

Nature-Based Solutions (NBS) Opportunity Scan for assessing the most impactful EO integration supporting NBS related investments

Climate Resilience

Enhancing climate-smart water resources management in South Sudan by providing flood management data products.

Opportunities in FutureEO – Earth Action Pillar

Applications

- Agriculture and livestock
- Water and wetlands applications
- Forest and peatlands applications
- Ecosystem Accounting
- Soil applications
- Minerals and extractives
- Sustainable Development Goals
- Global development assistance
- Biodiversity and pollution applications
- EO AFRICA 2026-2029

Foresight

- Opening the Black Box: Self-Explainable AI for EO
- Generative AI for EO data
- Virtual Earth Ob Constellation
- Cognitive Cloud Computing in Space for Earth Observation
- EO Foresight Exploratory Sprints

Climate relevant topics

- Build on strong expertise/leadership:
  - Land Cover, vegetation, land evaporation, ozone, aerosol, long-lived GHG, water vapour
  - ECV exploitation (atmospheric science and tipping elements, cities)
- Continuation of Open call mechanism
  - example: Using EO for Climate Change Adaptation opening in October 2025)

Digital Innovation

- Information Factories
- Platforms for Reproducible Science
- Interoperable open-source Building Blocks
- Network of Resources

Details on InCubed, Digital Twin Earth, and Copernicus Space Component Programmes

EOP @ CM25: Details on InCubed

Industry-led, co-funded Earth Observation programme with a clear commercial focus

To develop innovative/novel & commercially viable products and services related to EO data

From building satellites to data platforms and everything in between

Producing a minimum viable product, robust from a technical, commercial, programmatic and financial point of view

EOP @ CM25: Details on Digital Twin Earth

Development of a set of EO Digital Twin Components offering a single-entry point to an advanced “ESA reference” virtual mock-up of the Earth system for open collaborative research and smart application development.

Structured along 3 pillars:

1. ESA DTE Framework:
   DestinE core platform usage customised for ESA programme activities
2. Earth Observation Digital Twin Component
3. National support for interoperability with DestinE

EOP @ CM25: Industry Opportunities in Copernicus

The Copernicus Space Component CSC-4 Phase 3 proposal foresees the implementation of the Phase B2/C/D for the Sentinel-2 Next Generation (S2 NG) and Sentinel-3 Next Generation Optical (S3 NGO) missions

- Each missions comprises a constellation of two identical spacecrafts (A- and B-unit).
- A- and B-units will be procured as part of the same contracts (one contract for S2 NG and one contract for S3 NGO) to be procured in Open competition
- The contracts will be co-funded 50% each by ESA (as part of CSC-4 Phase 3), and EU (as part of MFF 2028-2034).
- The QARs for the A-units are currently foreseen in the timeframe 2033-2034

In addition, there will be Ground Segment development activities related to the Expansion missions and Collaborative Ground Segment activities

BE Opportunities in Copernicus and DTE

Copernicus Sentinel Satellite Development

- **S2 NG main opportunities**: major platform equipment (e.g. Remote Interface Unit, Power Control and Distribution Unit, Reaction Wheels); payload opportunities for the solar diffuser and mirror polishing.
- **S3 NGO main opportunities**: AOLCI sub-assembly supplier, major platform equipment (e.g. Remote Interface Unit, Power Control and Distribution Unit, Reaction Wheels)

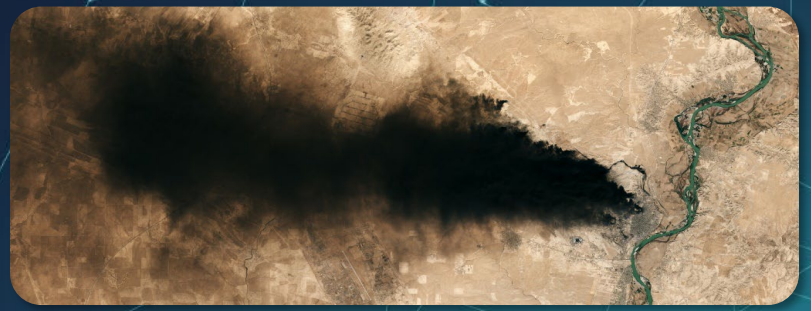
Copernicus Ground Segment Development and Collaborative GS

- Strong expertise in data access APIs → Future opportunities in Expansion and Next Generations missions data definition and processing APIs development
- Future opportunities in architecture and development activities in relation to data management including AI data readiness related activities
- Future opportunities for strengthened federation between national collaborative GS and Copernicus ecosystem framework

Some Details on ERS

New Optional Programme on Security & Resilience

European Resilience from Space (ERS) initiative is focussed on three main programmatic pillars (EO, PNT and Connectivity) and is based on a system-of-systems approach, which structures the overall architecture across the various programmatic pillars.



ERS Earth Observation:

- In **cooperation with EC,** activities targeting “dual-use” EO needs and developments towards EO Governmental Service (EOGS) of the EU
- **Complement** existing European backbone EO Programmes such as FutureEO, Copernicus and meteorological programmes in responding to resilience and security challenges
- Provide **a framework** for Participating States **to collaborate** within clusters to develop a sovereign but federated dual use capacity interconnected with other clusters
- **Support civil first responder** through the deployment of Space Resilient Nodes (former CSS programme)
- Integrate relevant **national assets** as contribution to ERS EO

ERS-EO programme structure*

ERS-EO PROGRAMME

Element 1
EOGS Preparatory Activities

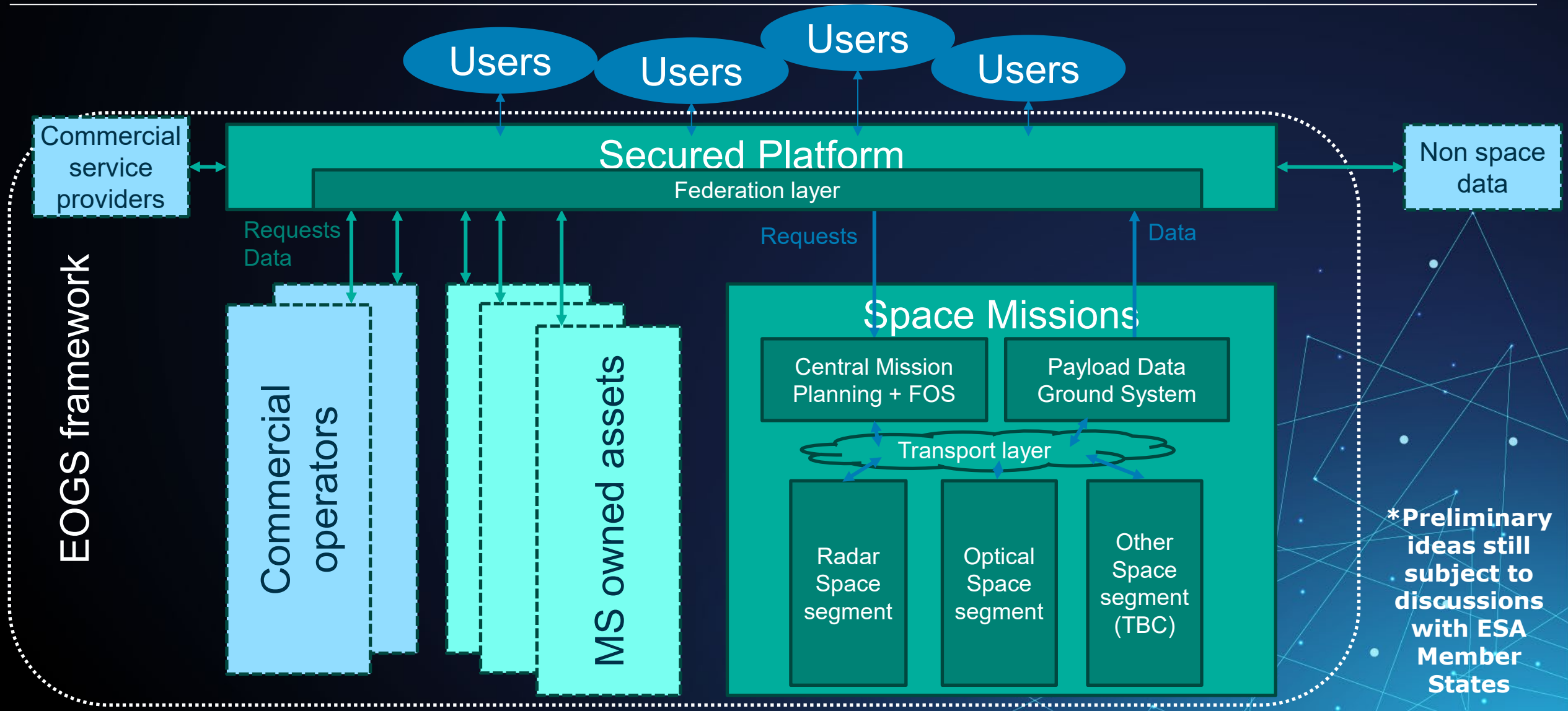
EOGS: Providing highly reactive, dual use, resilient, independent EO capabilities to deliver reliable satellite imagery in fast and secure way

Element 2
ERS-EO Federated System

- Pooling and Sharing
- Cluster 1 Alpstar
- Cluster 2 ECSA+
- Space Resilience Nodes

*Preliminary ideas still subject to discussions with ESA Member States

EOGS architecture*



*Preliminary ideas still subject to discussions with ESA Member States

ERS-EO Structure*

Element 1 – EOGS preparatory activities

Key objective: de-risk and accelerate the implementation phase of the future EOGS programme rather than to develop an initial capacity

- Preparatory activities include IODs and Service proof-of-concept to accelerate implementation of EOGS
- Further clarification of respective roles of ESA and COM

Element 2 – ERS-EO federated system

Key objective: establish a programmatic framework for the development and federation of dedicated assets

- Includes a dedicated activity on Pooling and Sharing: from definition to concrete instantiation as pilot case
- A placeholder for future Clusters is proposed given on-going discussions with several MS
- Space Resilience Nodes for civil security (Civil Security from Space CSS programme)

***Preliminary ideas still subject to discussions with ESA Member States**

ESA Earth Observation