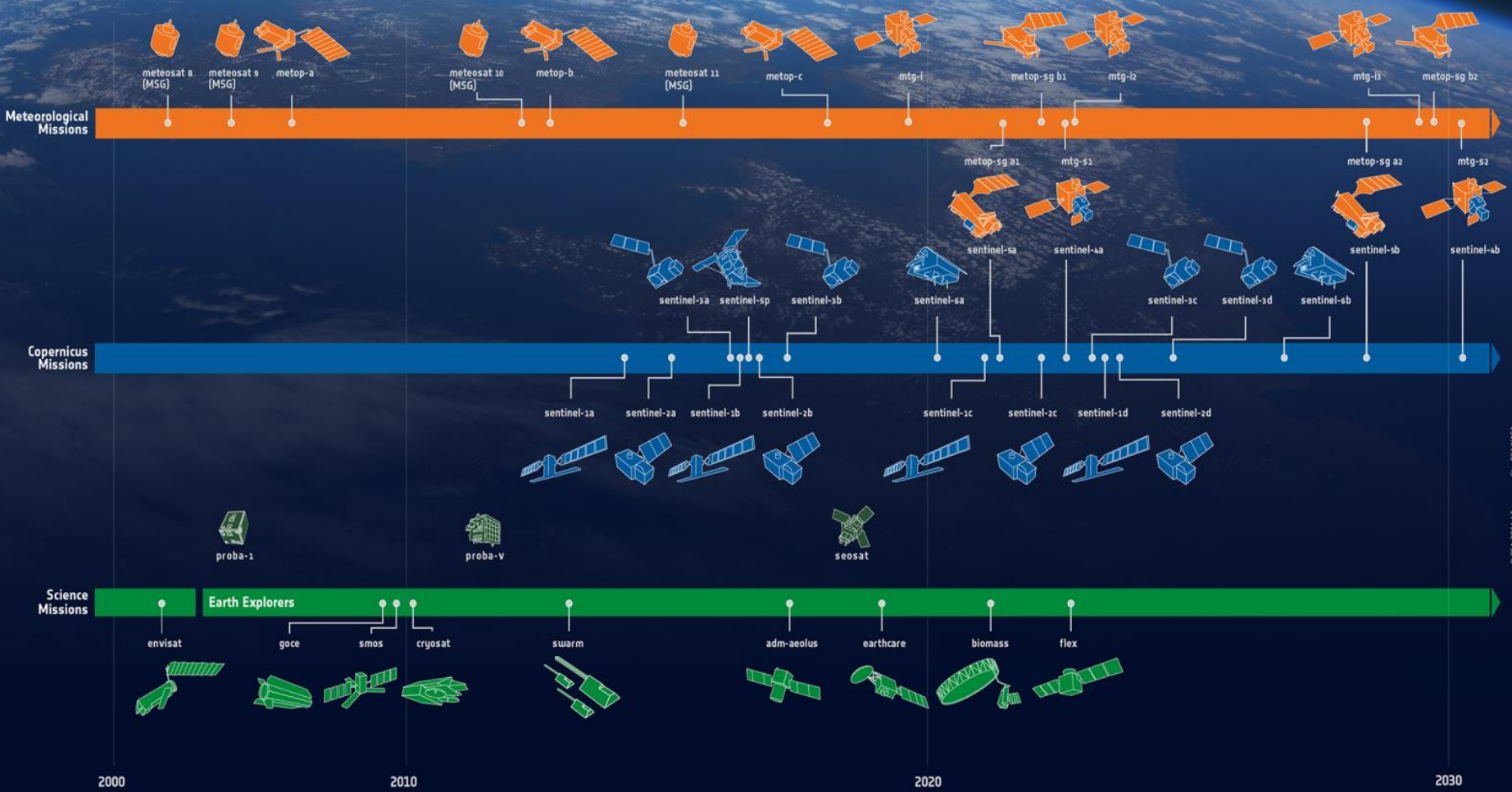


ESA EO Programmes EOEP-4 and EOEP-5 2017 to 2021 Perspective

Earth observation @ ESA
Opportunities for Slovenia
Ljubljana, 8 June 2016

→ ESA-DEVELOPED EARTH OBSERVATION MISSIONS



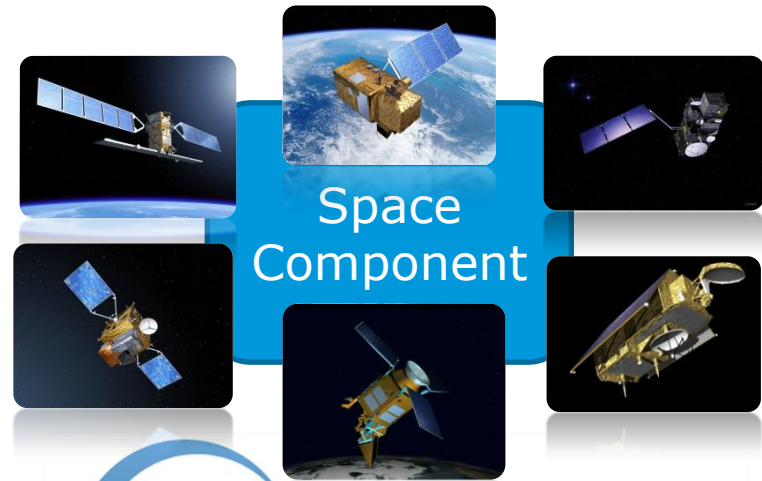
© ESA 2016 | Image credits: ESA/NASA

Copernicus: A Space Flagship Programme

Copernicus is a space flagship programme of the European Union.

Role of ESA (entrusted by EU and ESA Member States):

- Coordinator and system architect of the Space Component
- Coordination and data procurement from Copernicus Contributing Missions
- Develops the Sentinels (incl. co-funds for dev. units)
- Operates Sentinel 1, 2, 3Land and 5P

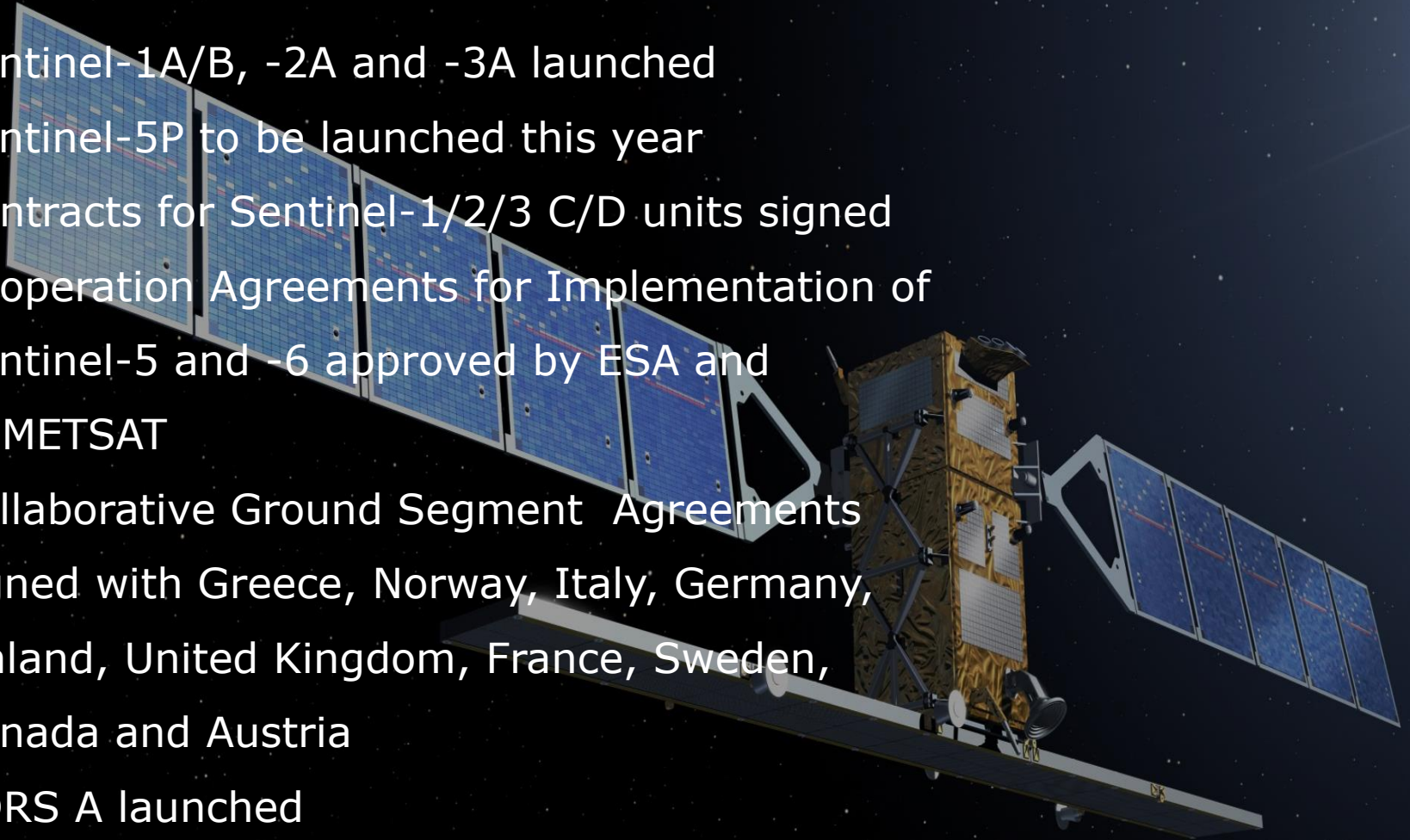


Copernicus

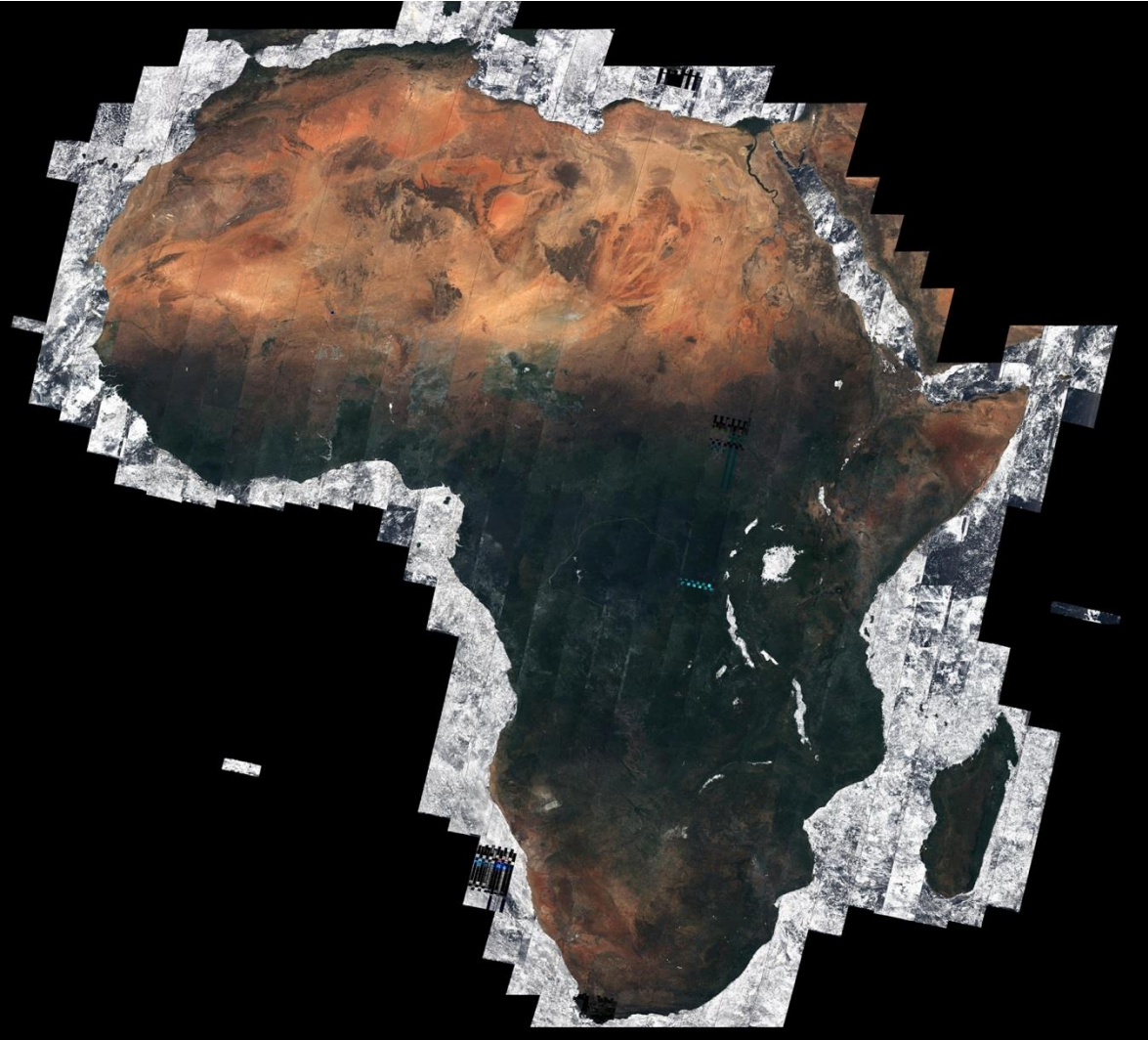


Copernicus – Current Status

- Sentinel-1A/B, -2A and -3A launched
- Sentinel-5P to be launched this year
- Contracts for Sentinel-1/2/3 C/D units signed
- Cooperation Agreements for Implementation of Sentinel-5 and -6 approved by ESA and EUMETSAT
- Collaborative Ground Segment Agreements signed with Greece, Norway, Italy, Germany, Finland, United Kingdom, France, Sweden, Canada and Austria
- EDRS A launched



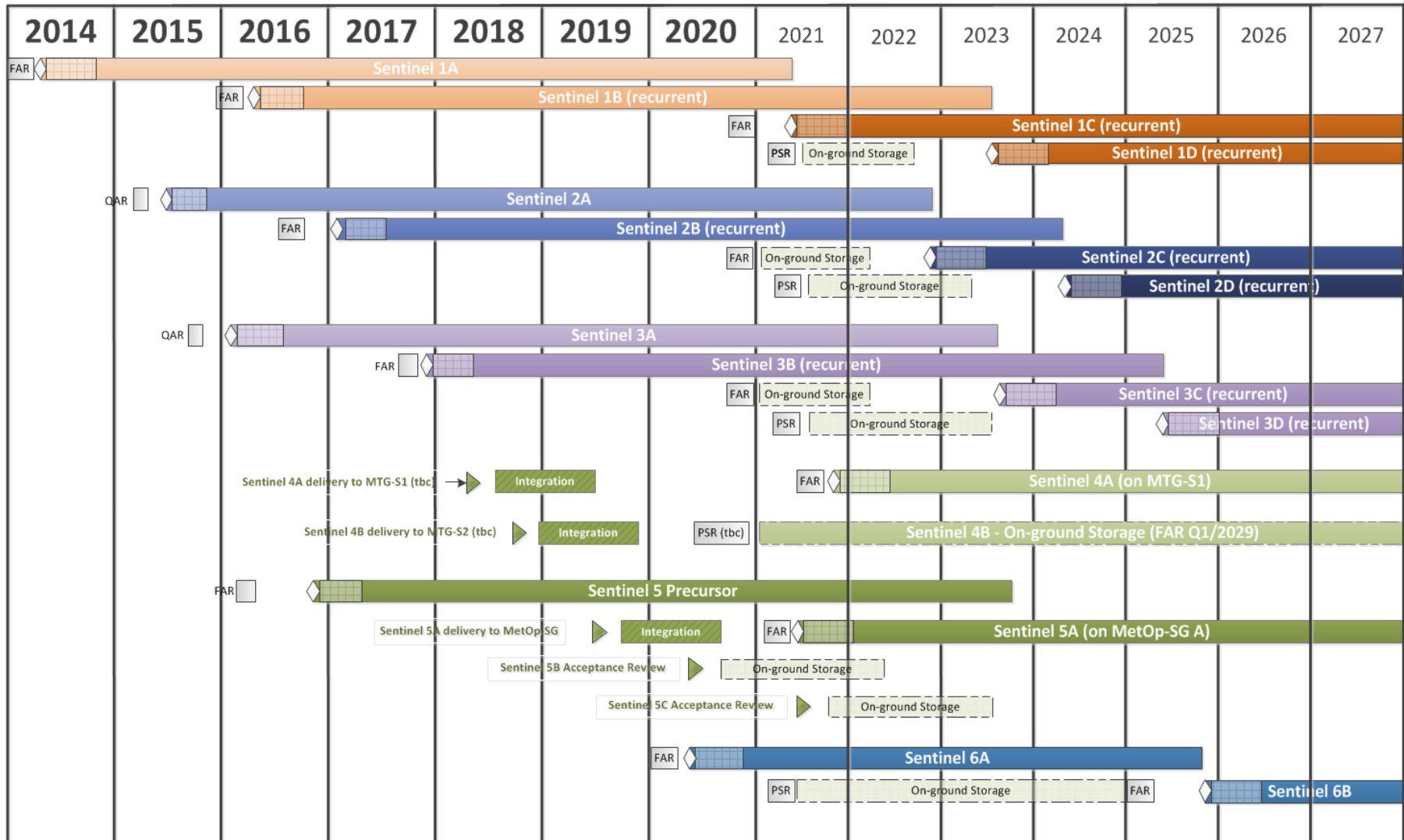
African Mosaic with S2



ESA UNCLASSIFIED - For Official Use



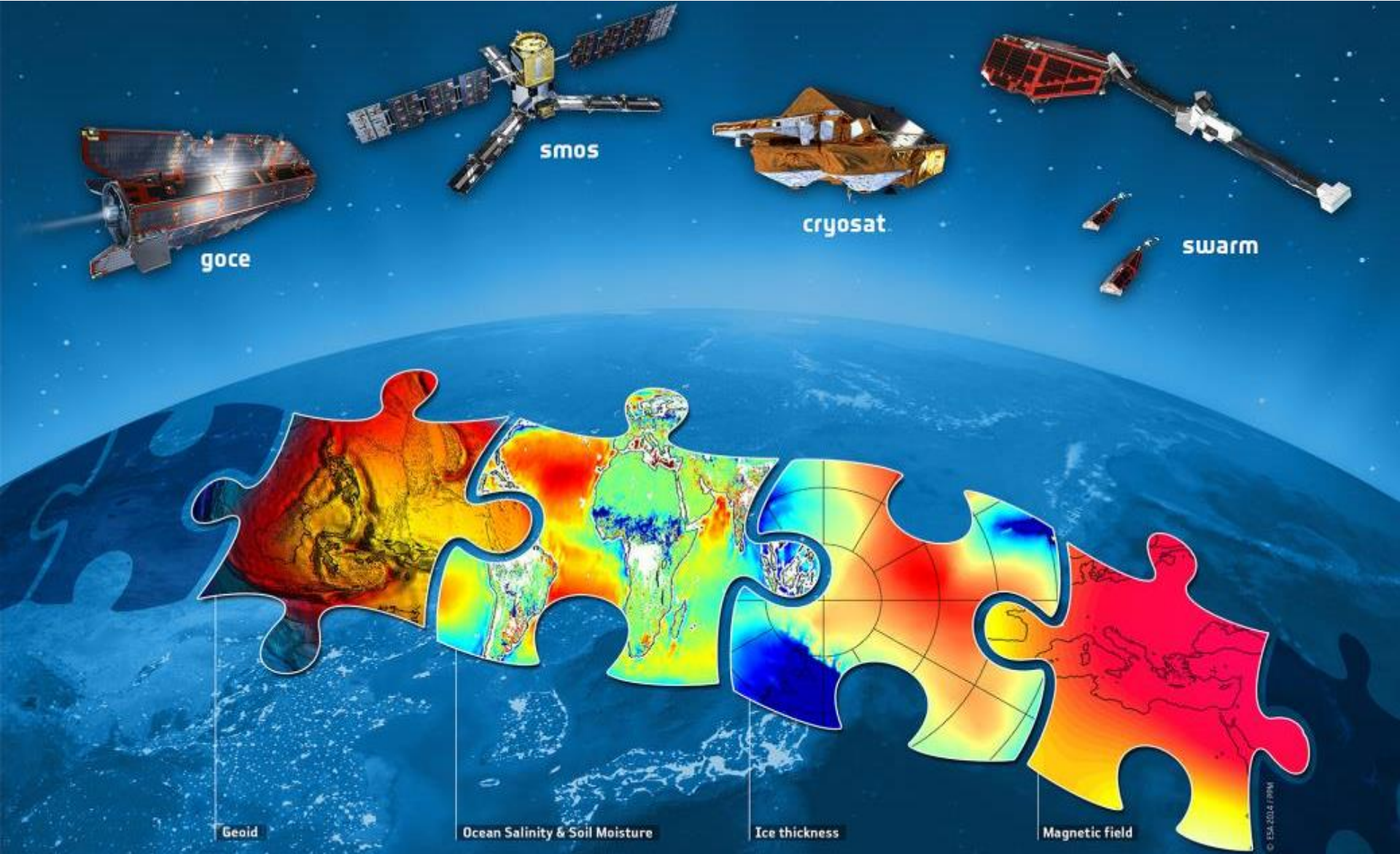
Tentative Sentinel Schedule



Legend:

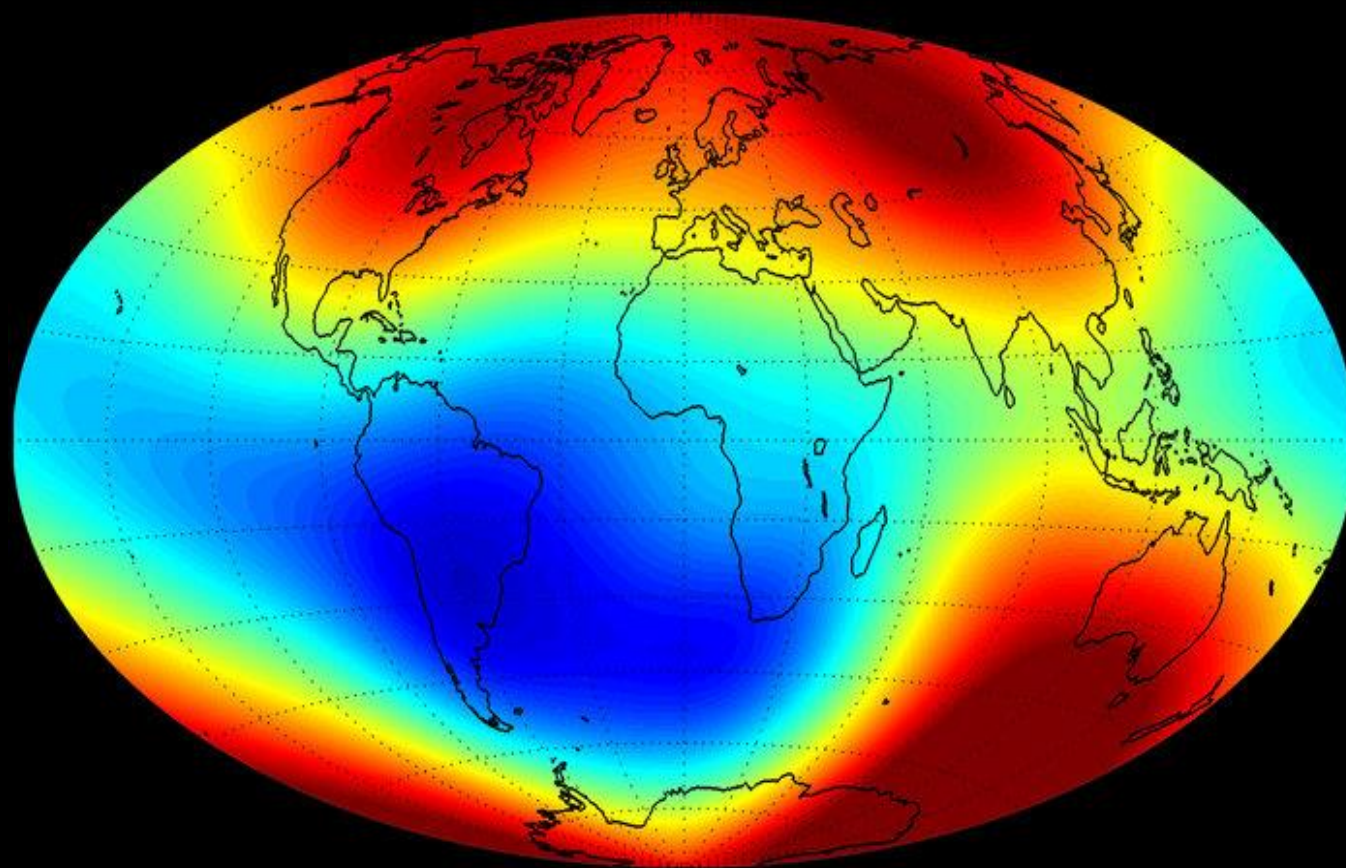
- Qualification Acceptance Review (QAR)
- Flight Acceptance Review (FAR) or PreStorage Review (PSR)
- On-ground Storage
- Tentative launch date
- In-orbit Commissioning

Earth Explorers launched so far

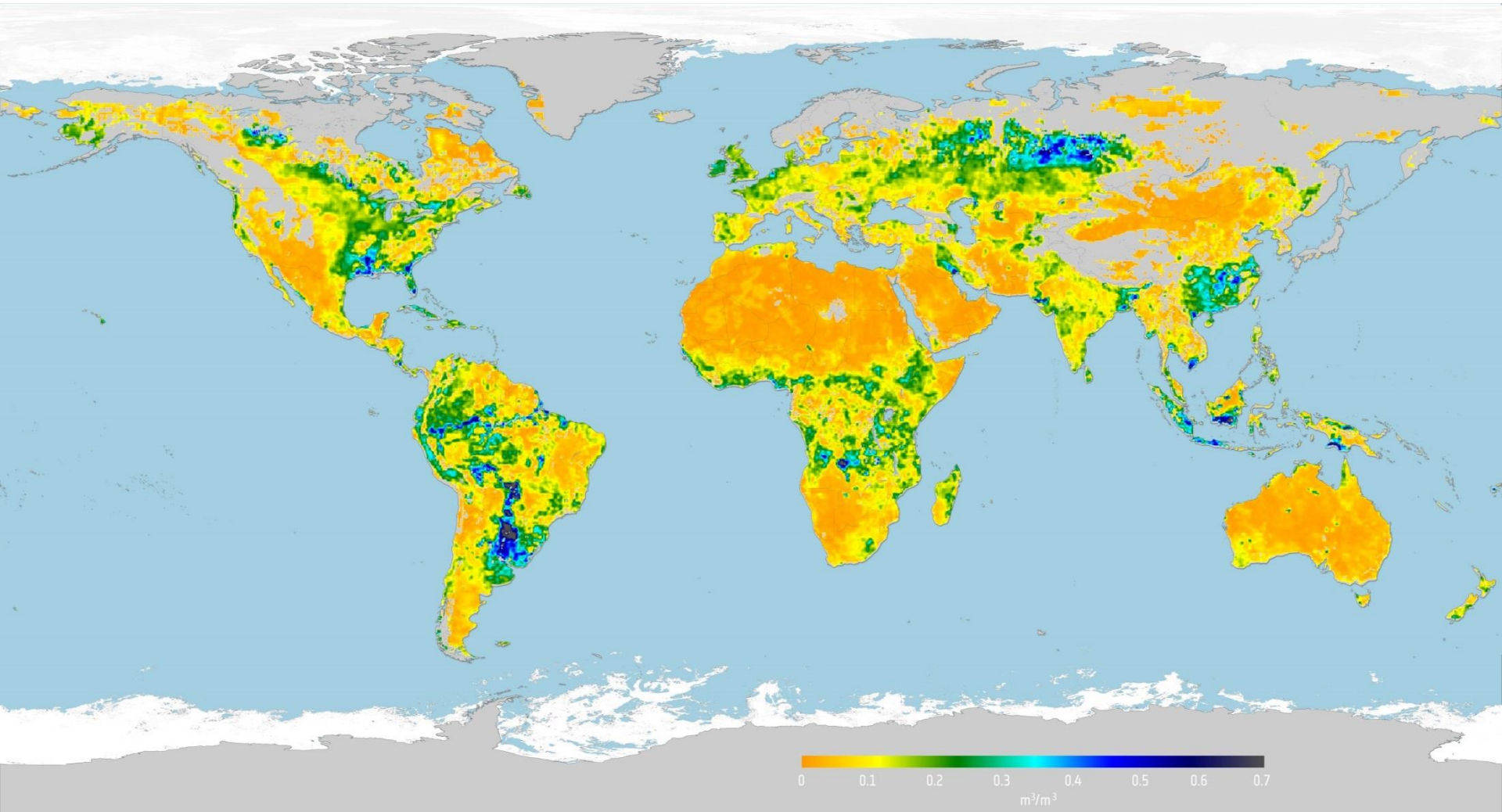


Earth's Magnetic Field from Swarm Data

© ESA/DTU



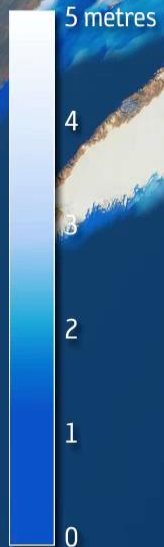
SMOS: Root Zone Soil Moisture



Cryosat and the Arctic

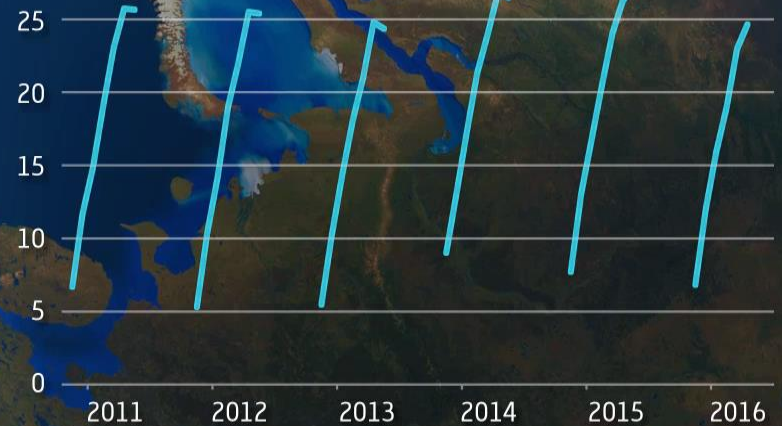


Arctic Sea Ice Thickness



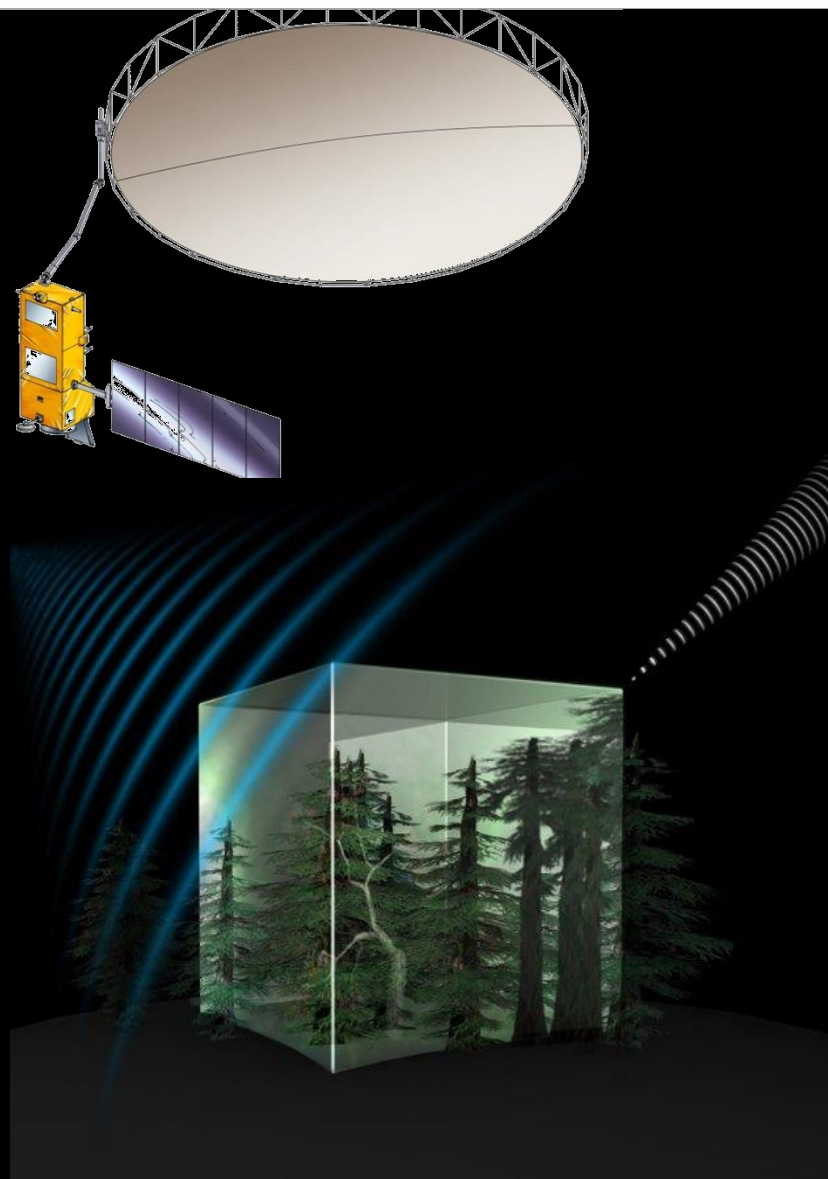
Ice Volume

30 thousand cubic km



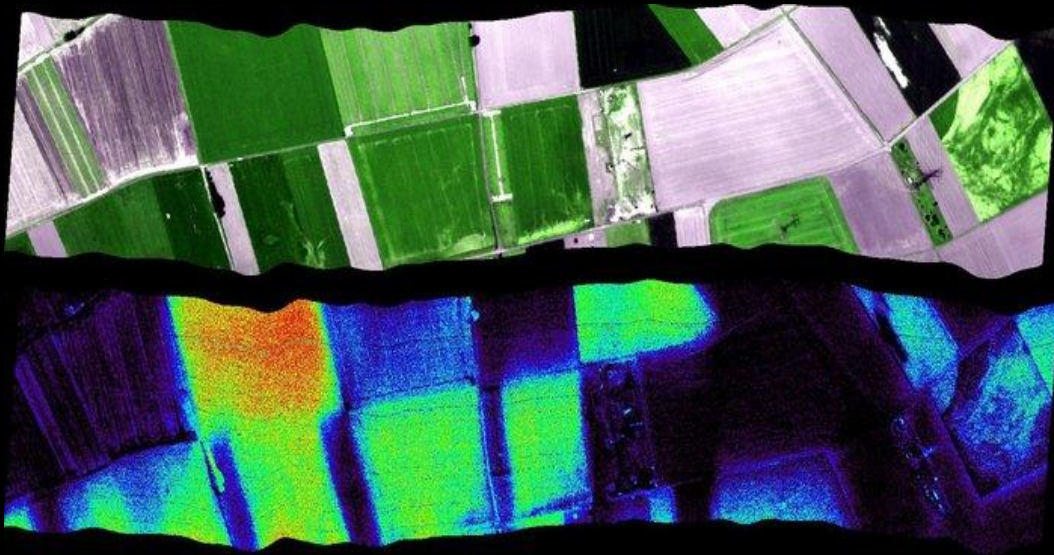
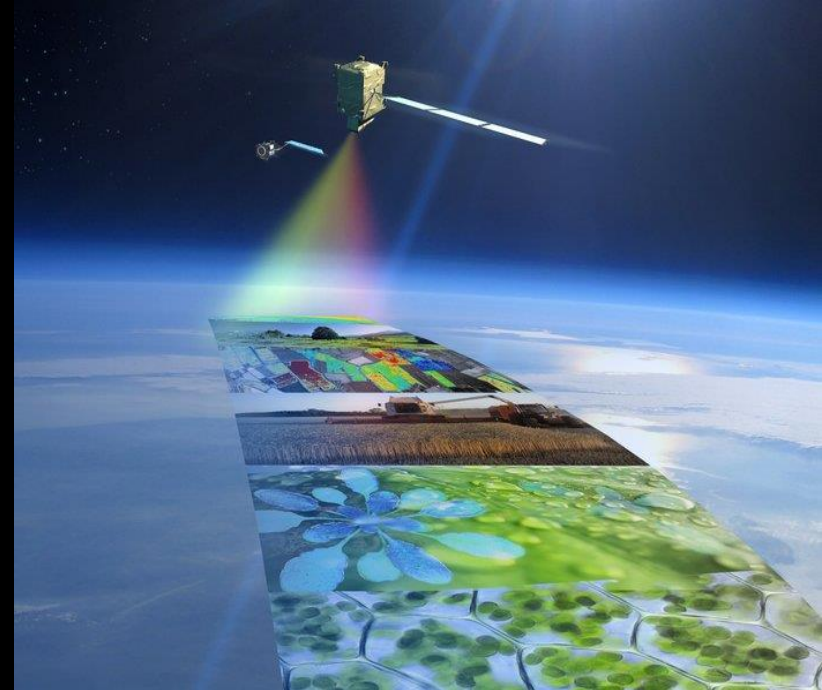
Biomass, the 7th Earth Explorer

- Implementation decided by ESA's Earth Observation Programme Board in February 2015
- Biomass estimates based on global interferometric and polarimetric P-Band Radar observations
- Essential to understand the Earth's carbon cycle
- To be launched in 2021



FLEX, the 8th Earth Explorer

- decision by PB-EO in November 2015
- global maps of vegetation fluorescence, which can be converted into an indicator of photosynthetic activity



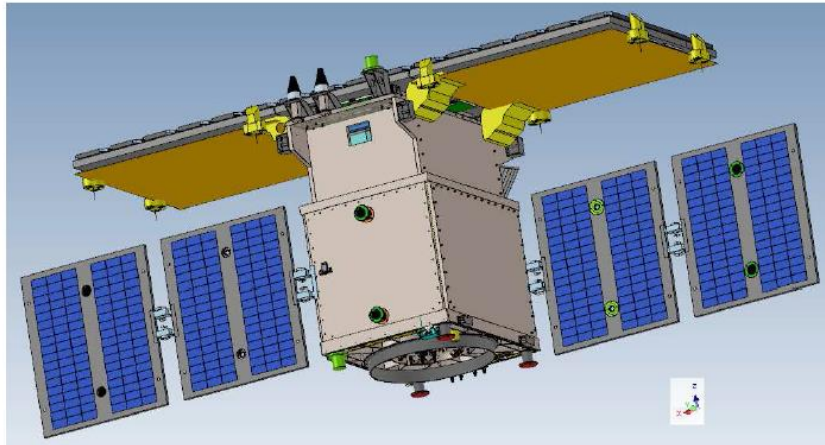
Call for 9th Earth Explorer

- Release of the Call:
23 November 2015
- Deadline for receipt
of full proposals:
24 June 2016
- Announcement of
evaluation results:
December 2016

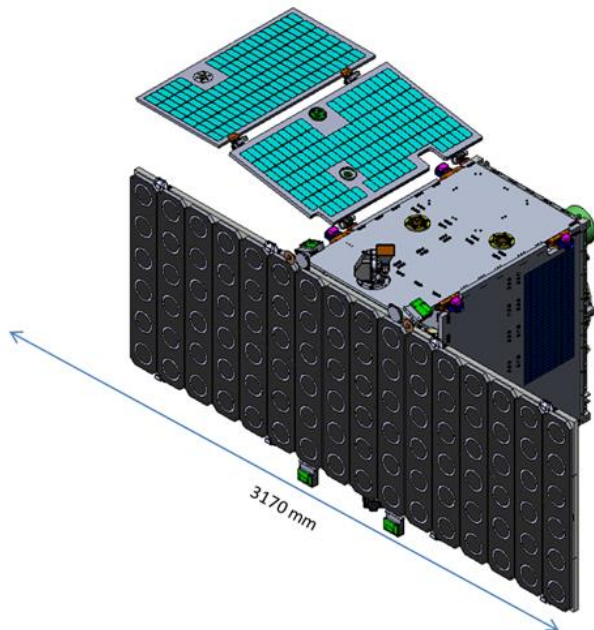
Cost at Completion must
not exceed 120 Mio Euro



SAOCOM-CS Satellite overview: Main features



- Modular design, procurement and testing approach. L-band antenna, radar electronics and platform follow parallel development
- Minimization of interfaces to simplify payload integration and testing
- Existing platforms; payload development based on adaptation of existing equipment
- Concept expandable to other L-band SAR (ALOS, NISAR) adapting centre frequency and bandwidth of sub-array and radar electronics
- Continuous reception allows total independent development from main SAR satellite.
- Enough fuel to comply with de-orbiting and debris mitigation rules, with versatile and long mission profile



EOEP-4 – Facts & Figures

- **4 Explorer missions in operation** during EOEP-4;
- **4 further Explorer missions under development;**
- **>300 industrial/academic teams;**
- **>200 EO Service companies;**
- **>180 public sector and international research organizations** engaged for new EO products;
- **>12,000 registered users;**
- **>2,000 peer-reviewed publications** by ESA investigators;
- **55+ ESA workshops** attended by **~10,300 scientists;**
- **1,700 participants** @ ESA Living Planet Symposium in Edinburgh (2013); **3,300 participants** @ ESA Living Planet Symposium in Prague (2016)



Optional programmes

- **EOEP-5 (new period of an on-going programme)**
- **GMECV+ (extension of on-going element of Earth Watch Programme)**
- **InCubed (new element of Earth Watch Programme)**
- **Altius (new element of Earth Watch Programme)**

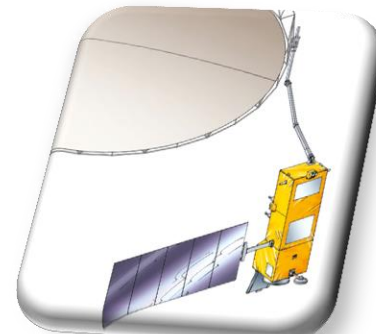
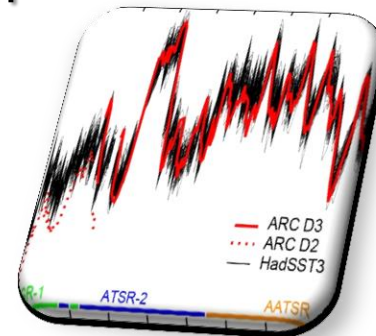
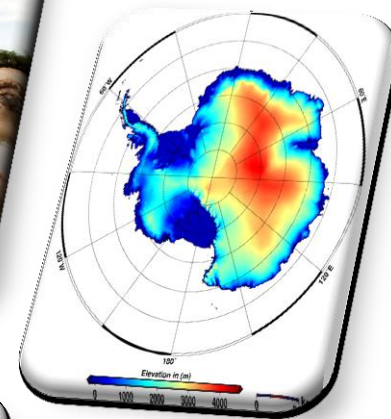
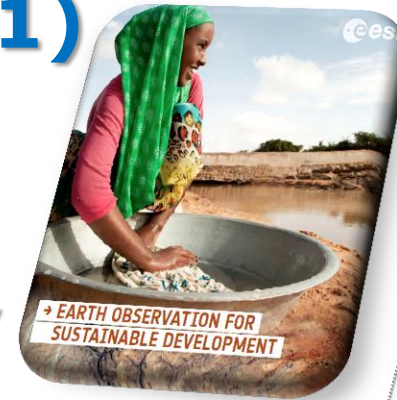
Within General Budget

- **LTDP+ (a.k.a “Heritage Data Programme”, new period of existing programmatic line)**
- **Earthnet (new period of existing programmatic line)**

Earth Observation Envelope Programme - 5 (2017-2021)

EO backbone programme to implement ESA's Space 4.0

- Addresses societal challenges (climate, water, food, SDG, etc.)
- Enhances competitiveness of European space, ground and services industry
- From pre-development to exploitation
- Prepares all future missions
- Drives scientific excellence and innovation
- Improved, user-ready data access
- Brings EO to all levels of society



EOEP-5: List of activities

Four main blocks:

1. Future Missions
2. Mission Development
3. Mission Management
4. EO Science for Society

EOEP-5 - Future Missions (Block 1)



1. Industrial studies on systems & key technologies
 2. End-to-end simulation frameworks and s
 3. Instrument pre-development
- EE10 early phases
 - Copernicus evolution - early phases (new)
 - EO Opportunity Mission - early phases (new)
 - Call for early mission concepts (new)
 - Polaris preparatory activities

EOEP-5 - Mission Development (Block 2)

1. Definition, development, launch, commissioning of Earth Explorers and Missions of Opportunity
2. Copernicus Evolution Instrument Models
3. SAOCOM-CS

- Biomass (EE-7)
- Flex (EE-8)
- EE-9 (under selection)
- Copernicus Evolution: CO₂, TIR, "Cryosat-FO", hyperspectral, "SMOS-FO")



EOEP-5: Mission Management (Block 3)

1. Earth Explorer missions exploitation phase:

- SMOS, CryoSat, Swarm (until 2019)
- ADM-Aeolus, EarthCARE, SAOCOM-CS (until 2021)
- Data access
- Cal/Val

2. Earth Explorer Level-2 products:

- in development and exploitation phases



EOEP-5 Block 4: EO Science for Society



“EO Science for Society” will foster scientific excellence, pioneering new EO applications, stimulating downstream industry growth, and supporting international responses to global societal challenges.

Implementation will be driven by three unifying principles:

- Access and utilization of EO data shall be massively enhanced and democratized by accelerated use of ICT, bringing users to data and scalable hosted processing.
- All activities shall respond to needs of authoritative international user communities and downstream industries, who shall be consulted systematically and participate in co-design, implementation and assessment
- All activities shall be designed to complement, seed, cross-fertilize and enrich relevant activities of ESA Member states’ national programmes, the Research and Innovation framework programme of the European Union, and Copernicus.



EOEP-5 Block 4: "EO Science for Society"

- ❖ Foster scientific excellence
- ❖ Pioneer new EO applications
- ❖ Stimulate downstream industry growth
- ❖ Support international responses to global societal challenges

Scientific Exploitation

EO Exploitation Platforms

EO for Sustainable Development

Expanding Public Sector Benefits

Enabling Industry Growth

Governance & Partnership, Network of EO Platforms, Evolving Technical Capabilities

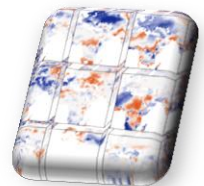
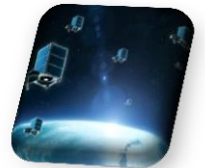
GMECV+: ESA's Climate Change Initiative

- 10 new ECVs
- Science driven, but prepares operational hand-over of all ECVs
- Tightly linked to international climate community
- Supports COP-21 implementation
- Outreach



InCubed - Investing in Industrial Innovation

- PPP's in EO
 - Enhances competitiveness of industry
 - Requested by industry, led by industry
 - Focus on space segment, technology and ground segment ('application PPPs' in IAP)
-
- Activities proposed by industry (AO in 2017)
 - Rapid proposal evaluation (<3 months)
 - Member State endorsement letter
 - Different forms of ESA contribution:
 - Expertise
 - Co-funding / in-kind support
 - validation, testing, link to customers



- EO programmes at ESA are extremely successful
- Very diverse from science, technology, preparation of new missions, development, operation, and exploitation of the data
- Several niche segments for either R&D entities, universities, SME's, and for downstream commercial services
- Tremendous amount of data available with the Sentinels mission
- ESA would be delighted to welcome Slovenia in the EOP programmes