ESA Agency Report

WGISS#55 Meeting
18-20 April 2023, Cordoba (Argentina)
Mirko Albani, ESA/ESRIN
The ESA Council Ministerial Meeting 2022 (CM22) took place on 22-23 November in Paris (France). Decision to increase ESA’s budget by 17% compared to the last Ministerial meeting in 2019.
Total Subscriptions 16.9 B€
Mandatory Activities and CSG for 5 years

- Human and Robotic Exploration: 2,707 M€ (16%)
- Space Safety: 731 M€ (4%)
- Space Transportation: 2,835 M€ (17%)
- Earth Observation: 2,692 M€ (16%)
- Navigation: 351 M€ (2%)
- Telecommunications and Integrated Applications: 1,894 M€ (11%)
- Technology: 542 M€ (3%)
- Commercialisation: 118 M€ (1%)
- Basic Activities: 1,629 M€ (10%)
- Scientific Programme: 3,186 M€ (19%)
- PRODEX: 237 M€ (1%)
ESA-Developed Earth Observation Missions
Copernicus is the largest producer of EO data in the world.

All global landmass is observed every 5 days at 10m resolution.

25 TB of Daily Data Production by Sentinels.

300 TB of Daily Sentinel Products Disseminated for Services to Society.

Copernicus > 650,000 Registered Users.
Copernicus Missions Currently Operated at ESA

Sentinel missions are operated in full operations capacity

- Sentinel-1A  →  nominal operations
- Sentinel-2A and Sentinel-2B  →  nominal operations
- Sentinel-3A and Sentinel-3B  →  nominal operations
- Sentinel-5P  →  nominal operations

- Copernicus Contributing Missions
  →  with established and emerging data suppliers
Turkey Earthquake, Multiple Products from Same S-1 Data

Radar Interferometry by the DIAPASON InSAR processing service (CNES developed)

Deformation map by Radar Signal Shift Products Service (DLR developed)
Applications: Sentinel-1

Eruption of Mauna Loa (Hawaii) started on 28 November 2022

Mauna Loa

sentinel-1a

SAR interferogram

Processed by: Adriano Nobile - KAUST

Copyright: Contains Copernicus Sentinel data (2022)

THE EUROPEAN SPACE AGENCY
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Copernicus Space Component – Evolution

+ Next Generation Sentinels for data continuation and enhanced observations
The Copernicus Data Space Ecosystem is the next step in the evolution of Earth observation data access.

- Immediate cloud access to large amounts of open & free EO data from the Sentinel satellites, for both new and historical Sentinel images, as well as Copernicus Contributing Missions.
- Supporting users in accessing, viewing, using, downloading, and analysing data.
Science: Earth Explorers

- **forum**: ESA's Thermal Radiation Mission (2026)
- **smos**: ESA's Water Mission (2009–present)
- **cryosat**: ESA's Ice Mission (2010–present)
- **swarm**: ESA's Magnetic Field Mission (2013–present)
- **aeolus**: ESA's Wind Mission (2018–present)
- **biomass**: ESA's Forest Mission (2023)
- **earthcare**: ESA's Cloud, Aerosol & Radiation Mission (2023)
- **flex**: ESA's Photosynthesis Mission (2024)
Status of ESA Earth Explorers Operational Missions

CryoSat / SMOS Sea Ice Thickness
Weekly averaged product of Arctic Sea Ice thickness
CryoSat / SMOS
Sea Ice thickness
product released weekly
Right: Difference compared to the previous week
Visualization by Zachary Labe

Aeolus: Re-entry of the satellite is being prepared

SWARM reveals Earth’s magnetic field is exceptionally dynamic, moving at a speed of 50km/year
New Earth Explorers Development

**earthcare**

**ESA’s Cloud, Aerosol and Radiation Mission**

**Aim** The largest and most complex Earth Explorer to date, EarthCARE will advance:
- our understanding of the role that clouds and aerosols play in reflecting incident solar radiation back into space
- trapping infrared radiation emitted from Earth’s surface

**Innovation** EarthCARE is a joint venture between ESA and JAXA (Japan Aerospace Exploration Agency), and it will employ high-performance lidar and radar technology, which has never been flown in space before

**Curiosity** The largest Earth Explorer to date, at 19 m long with the solar panel deployed

**biomass**

**ESA’s Forest Mission**

**Aim** To provide crucial information about the state of our forests and how they are changing

**Innovation** Its data will be used to further our knowledge of the role forests play in the carbon cycle. Observations from this mission will also lead to:
- better insight into rates of habitat loss, thus the impact this may be having on biodiversity in the forest environment;
- the opportunity to map subsurface geology in deserts and map the topography of forest floors

**Curiosity** Biomass will also provide essential support to UN treaties on the reduction of emissions from deforestation and forest degradation

**flex**

**ESA’s Photosynthesis Mission**

**Aim** To provide global maps of vegetation fluorescence that can reflect photosynthetic activity and plant health and stress

**Benefits** Important for a better understanding of the global carbon cycle, but also for agricultural management and food security

**Innovation** Currently not possible to measure photosynthetic activity from space, but FLEX’s novel instrument will be capable of achieving this

**Curiosity** FLEX will fly in tandem with the Copernicus Sentinel-3 mission, in particular working in combination with the OLCI and SLSTR instruments Sentinel-3 carries

**forum**

**ESA’s Thermal Radiation Mission**

**Aim** To measure the radiation emitted by Earth into space, providing insight into the planet’s radiation budget and how it is controlled

**Benefits** Will allow to better understand the energy balance of our planet, bringing great benefits to climate science

**Innovation** FORUM will measure across the entire far-infrared part of the electromagnetic spectrum, which has previously never been measured. It will allow more accurate tracking of key atmospheric components such as:
- anthropogenic greenhouse gases;
- water vapour and optically thin ice clouds; thus improving the accuracy of climate models
Earth Observation Heritage Missions at ESA
Heritage Missions Data Quality Improvement

Heritage Missions → continuous improvement → climate standard quality

→ Fundamental Data Record (FDR)
→ Analysis Ready Data (ARD)

NEW paradigm for the valorisation of the ESA heritage missions

Generation of FDR for Heritage Missions missions

- generation of a harmonised, unified and coherent multi-instrument long-term time series with enhanced performance
- provide a thorough uncertainty characterization
- Explore the generation of Analysis Ready Data or Thematic Data Products (TDP) targeting new or specific user “niche”
Data Access

Copernicus missions

Sentinel missions
- sentinel-1a
- sentinel-1b
- sentinel-2a
- sentinel-2b
- sentinel-3a
- sentinel-3b
- sentinel-5p

Copernicus Contributing Missions

ESA missions

Earth Explorer missions
- aeolus
- swarm
- cryosat
- smos

Heritage missions
- goce
- envirosat
- ers-1
- ers-2

Proba missions
- proba-v
- proba-1

ESA Third Party missions
- e.g. Iceye, Pleiades, Landsat, …

+ ESA EO campaigns data
Registered Users, total data download and published products since start of operations

Active Users on Copernicus Open Access Hub for the past month: Distribution by continent
Where to get more statistics on Copernicus Sentinel missions data use?

Data access annual reports within Sentinel Online: [https://sentinels.copernicus.eu](https://sentinels.copernicus.eu)

Sentinel dashboard: [https://dashboard.copernicus.eu](https://dashboard.copernicus.eu)
Downloaded data volume by missions (in 2021)

- SMOS: 39%
- Cryosat: 25%
- Envisat: 24%
- Swarm: 5%
- Aeolus: 3%
- TPM: 0.88%
- ERS: 1%
- GOCE: 0.4%

Total downloaded data volume: **1.09 PB (2021)**

Downloaded data volume by location of download (in 2021)

- Europe: 34%
- North America: 22%
- Asia: 20%
- Africa, South America, Oceania: 0.4%
- Unknown: 24%