



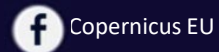
The Copernicus perspective (2021-2027)

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Directorate-General for Defence Industry and Space
European Commission



Space



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EU SPACE PROGRAMME OVERVIEW



COPERNICUS

Earth Observation (EO) and monitoring based on satellite and non-space data

Nr.1 world provider of space data and information



GALILEO

Global satellite navigation and positioning system (GNSS)

10% of the EU GDP enabled by satellite navigation



EGNOS

Reliable navigation signals for safety of life use

Operational in 360+ airports & helipads in 23 countries



SSA

Space situational awareness monitoring and protecting space assets

Providing surveillance and tracking services to 210+ satellites

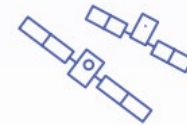


GOVSATCOM

Secure satellite communications for EU security actors

Delivering rapid support over crisis areas

AN INVESTMENT IN A FUTURE READY EUROPE



Competitive edge

Completing current satellite constellations, developing and launching the next-generation of satellites



Research innovation

Ambitious research and innovation programme benefiting from Horizon Europe



Fighting Climate Change

Monitoring biodiversity, environmental compliance and CO2 emissions (Paris Agreement)



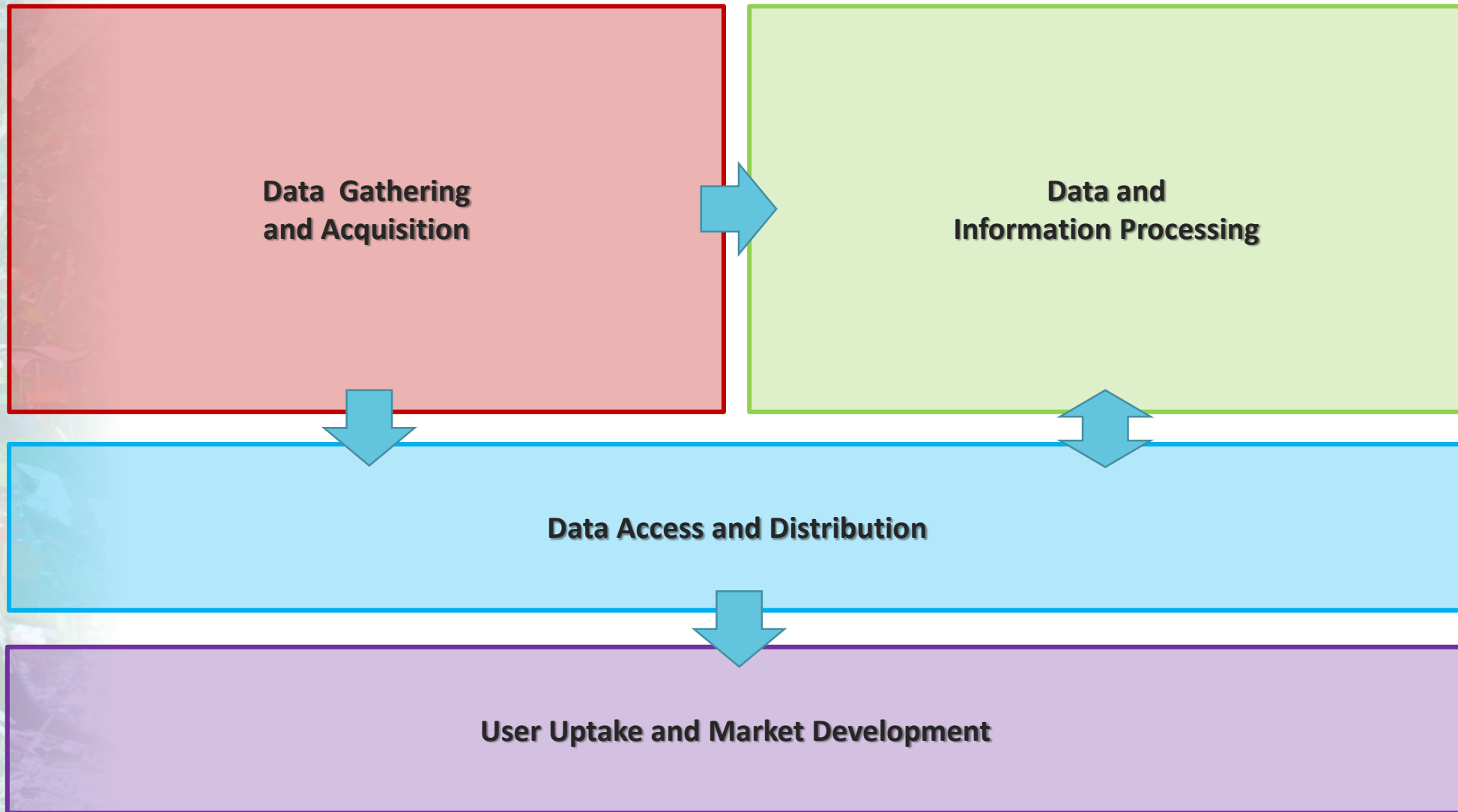
EU as a global actor

Supporting disaster relief, humanitarian assistance and security operations



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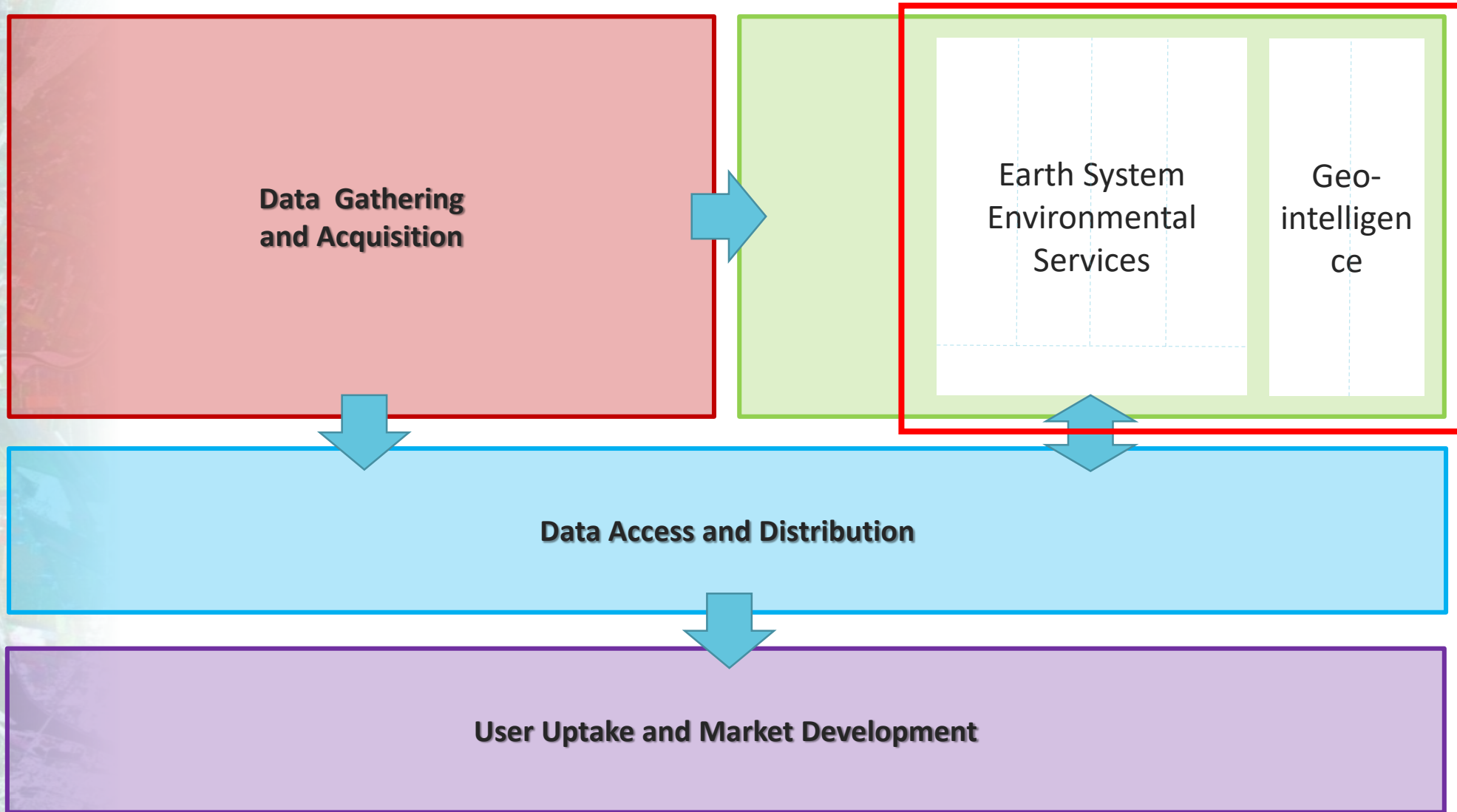
Copernicus : Overview on Functional Blocks





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Copernicus : Overview on Functional Blocks



THE SENTINELS

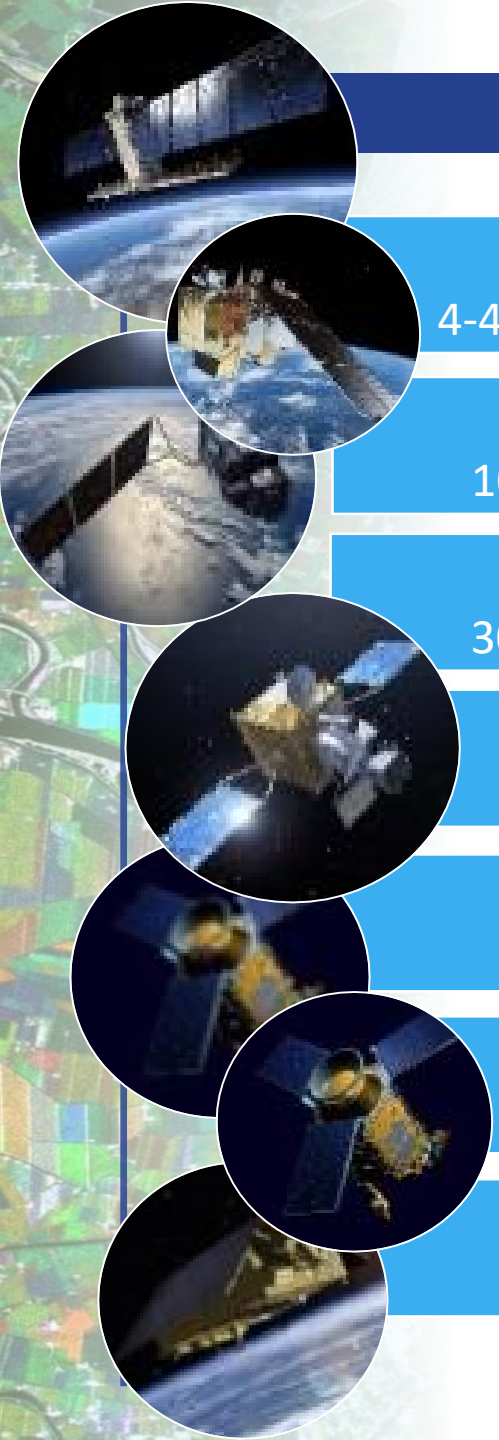
Full, free and open data policy

Sentinel Mission and Status

Key Features

| Sentinel Mission and Status | |
|---|--------------------|
| SENTINEL-1: 4-40m resolution, 3 day revisit at equator | 2 Sats in orbit |
| SENTINEL-2: 10-60m resolution, 5 days revisit time | 2 Sats in Orbit |
| SENTINEL-3: 300-1200m resolution, <2 days revisit | 2 Sats in Orbit |
| SENTINEL-4: 8km resolution, 60 min revisit time | 1st Launch in 2023 |
| SENTINEL-5p: 7-68km resolution, 1 day revisit | 1 Sat in Orbit |
| SENTINEL-5: 7.5-50km resolution, 1 day revisit | 1st Launch in 2023 |
| SENTINEL-6: 10 day revisit time | 1 Sat in Orbit |

- ▶ Polar-orbiting, all-weather, day-and-night radar imaging
- ▶ Polar-orbiting, multispectral optical, high-res imaging
- ▶ Optical and altimeter mission monitoring sea and land parameters
- ▶ Payload for atmosphere chemistry monitoring on MTG-S
- ▶ Mission to reduce data gaps between Envisat, and S-5
- ▶ Payload for atmosphere chemistry monitoring on MetOp 2ndGen
- ▶ Radar altimeter to measure sea-surface height globally





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High Priority Candidate Missions (Sentinel expansion missions)

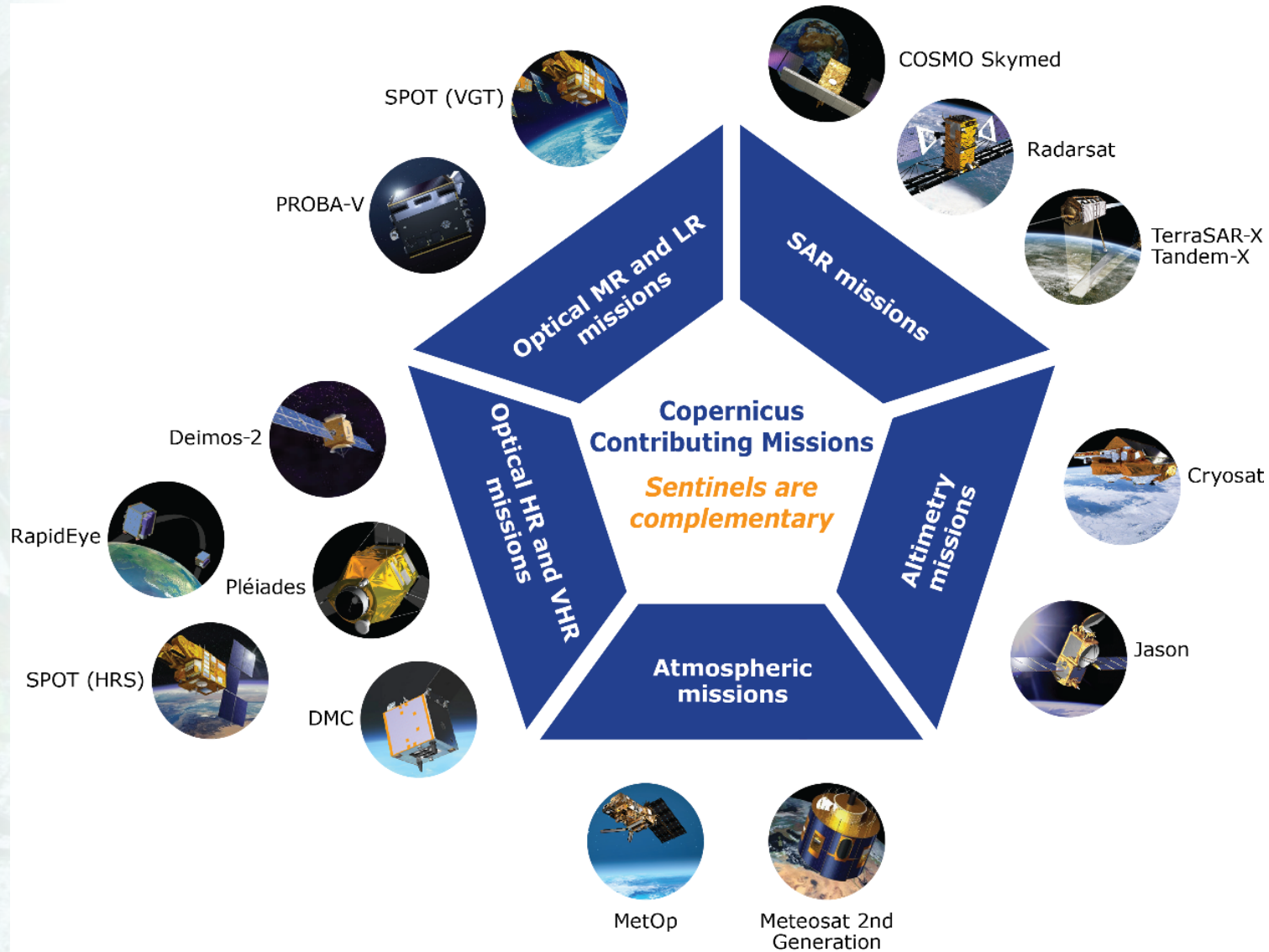
Full, free and open data policy

| Proposed Mission | Primary Observation Requirements to be addressed | |
|---|---|---------|
| CO2 | Monitoring of anthropogenic CO2 emissions at country/regional and megacities scale (priority mission, responding to the Paris Climate Agreement) | CO2M |
| Changes in the Arctic: Passive Microwave Radiometer | Sub-daily monitoring of Sea Ice concentration in the Arctic @ minimum 15KM ² resolution in support of ship navigation | CIMR |
| Thermal Infrared | Crop-water use in support of agricultural production, Food security, water management and water abstraction policies | LSTM |
| Polar Ice and Snow topography mission | Land ice elevation and sea-ice thickness and snow loading in support of climate change applications | CRISTAL |
| L-Band SAR Mission | Measurements of forest cover, Ground movement and deformation | ROSE-L |
| Hyperspectral measurements | Sustainable use of natural resources, i.e. in Agriculture (nutrients, water, soil properties), exploration of raw materials and mine environment management | CHIME |



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THE CONTRIBUTING MISSIONS



Subject to Data
 Owner's Data
 Policy



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IN-SITU: OVERVIEW

- *In situ* data = observation data from ground-, sea-, or air-borne sensors, reference and ancillary data licensed for use in Copernicus
- Use of *In situ* data:
 - Validate & calibrate Copernicus products
 - Reliable information services
- Implementation in two tiers:
 - Tailored *in situ* data for each Copernicus service level
 - Cross-cutting coordination across services by the EEA

Subject to Data
Owner's Data
Policy





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COPERNICUS SERVICES

Full, free and open data policy

Monitoring the State of the Earth System Environment ...

Land Monitoring

Marine Environment Monitoring

Climate Change

Atmosphere Monitoring

Emergency Management

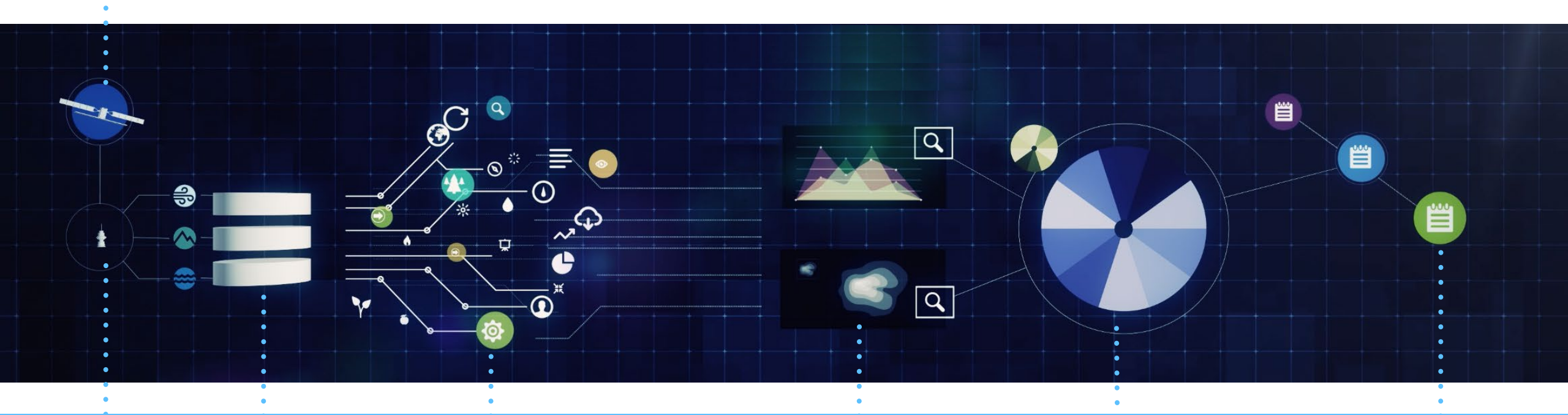
Security

... Six cross-cutting Thematic Services

COPERNICUS COMPONENTS

FROM GLOBAL EARTH OBSERVATION DATA TO LOCAL INFORMATION AND PRODUCTS

SENTINELS & CONTRIBUTING MISSIONS



IN SITU SENSORS

DATA

SERVICES

INFORMATION

TAILORED PROCESSES

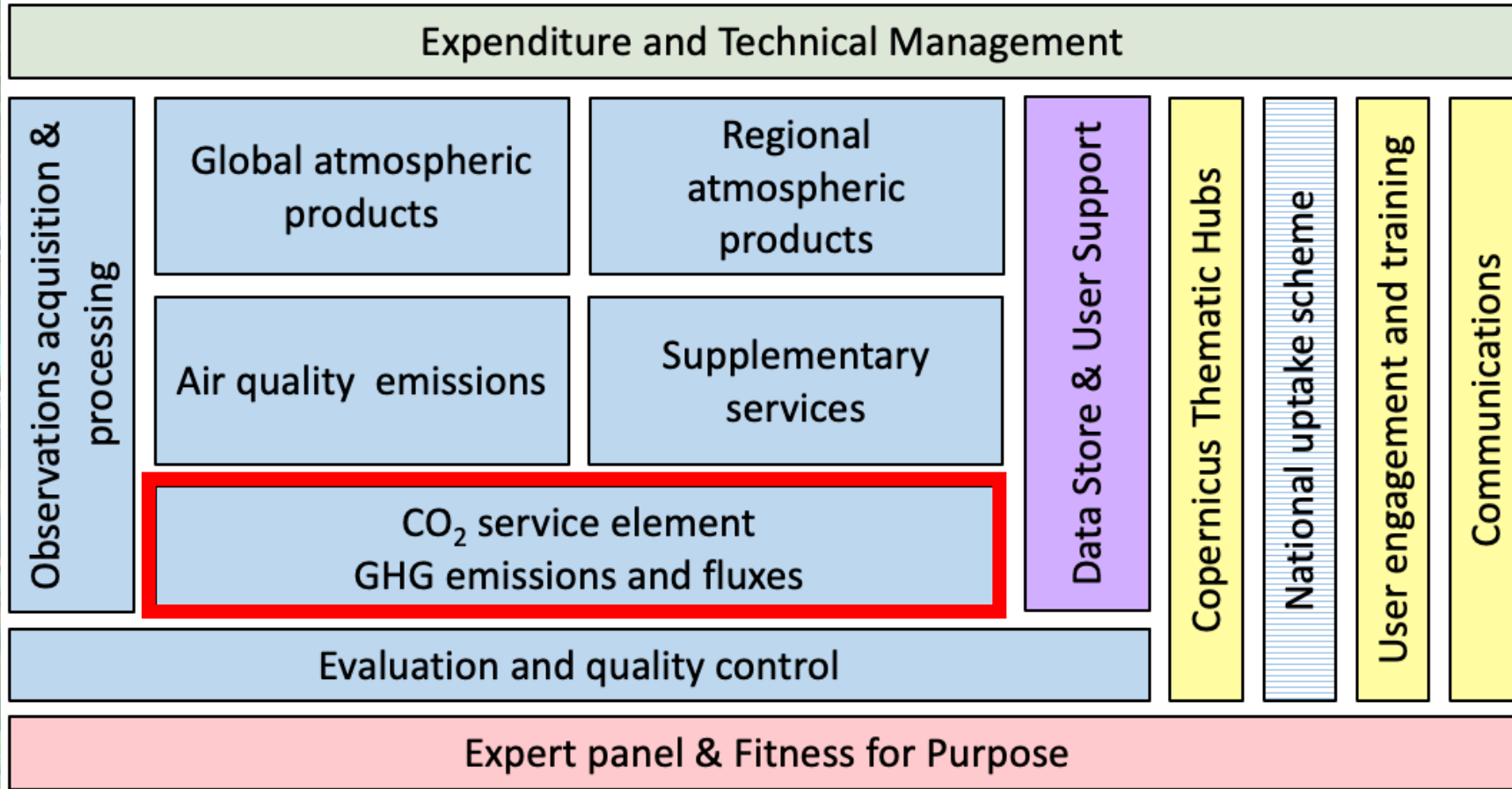
PRODUCTS

European Commission



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Copernicus Atmosphere Monitoring Service



If additional budget will be available:

- **enhanced continuity of global products** (spatial resolution, uptake of non-Europe satellite data input streams for analyses/forecasts and reanalyses, addition of uncertainty).
- **enhanced continuity of regional products** (including regional deposition products and model simulation of future air quality in Europe).
- **a global atmospheric composition reanalysis back to 1979** jointwith C3S, and extension of **regional air quality reanalyses back to 2020** in spite or repeated expressed user requirements.
- **co-funding by CAMS to complement MS's efforts for the national collaboration scheme** maximising the benefits of CAMS/CO₂ policy-relevant products at national level.



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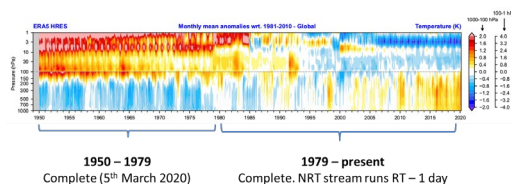
COPERNICUS CLIMATE CHANGE SERVICE

Current portfolio

22 ECV (fit for climate monitoring)

- Atmospheric physics**
 - Precipitation
 - Surface radiation budget
 - Water vapour
 - Cloud properties
 - Earth radiation budget
- Atmospheric composition**
 - Carbon dioxide
 - Methane
 - Ozone
 - Aerosol
- Ocean**
 - Sea surface temperature
 - Sea level
 - Sea ice
 - Ocean colour
- Land hydrology & cryosphere**
 - Lakes
 - Glaciers
 - Ice sheets & ice shelves
- Land biosphere**
 - Soil moisture
 - Albedo
 - Land cover
 - Fraction of absorbed photosynthetic
 - Leaf area index
 - Fire

- **Reanalyses (global & regional)**
ERA5: 1950 to present



Seasonal predictions (6-month, issued monthly)



Climate projections (global & regional)

- Smooth transition from C1.0 to C2.0 ensured
- Some new products and service component dependent on budget availability

TECHNICAL MANAGEMENT

Evaluation & Quality Control

Operational Climate Data Store

Climate Indices Climate Projections In Situ Observations
Satellite Observations Reanalyses Seasonal Forecasts

Sectoral Information System

Tools Applications

Climate Intelligence Communications
User Support Training Engagement

Copernicus Knowledge Hubs

POLICY MAKERS, BUSINESSES & CITIZENS

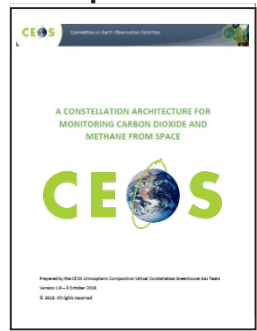
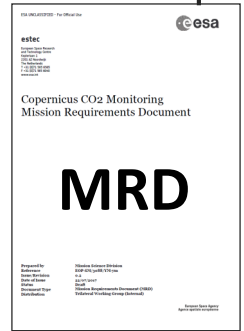
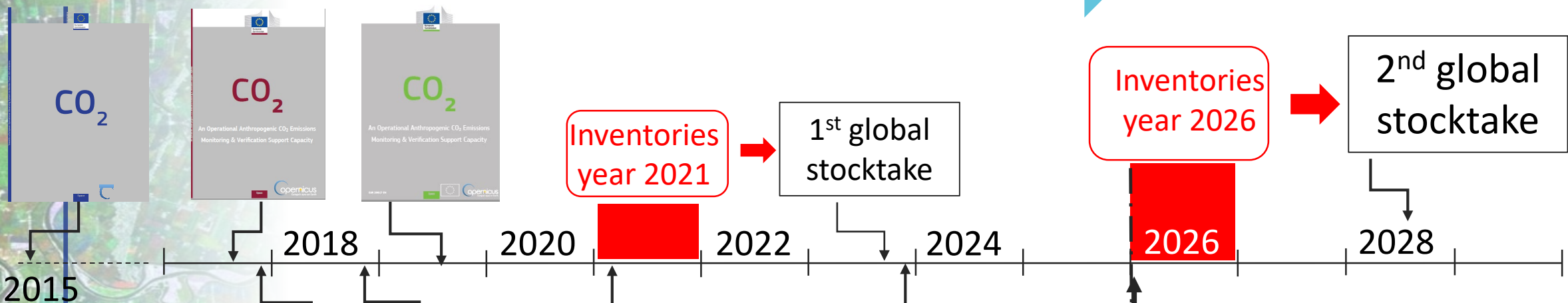
- increasing EVCs (22 → 35)
- extending global reanalysis to 1979 (w/ CAMS)
- full service for decadal predictions
- operational attribution service for extreme events



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Roadmap for an operational CO₂ Monitoring & Verification Support Capacity

CO₂ Monitoring Task Force



Prototyping activities including relevant CO₂ satellites from China, Japan, USA and others

Copernicus service in its full operational capacity with the CO₂ Sentinels constellation

R&D Support Actions (COM, ESA & EUM)



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GCOS and Copernicus

- „Keeper of the grail“ for climate observational requirements
 - Essential Climate Variables
 - Requirements beyond ECV themselves....?
 - Coordinating the global efforts on requirement consolidation....?
- Implementation Plan 2022
 - Support system approach, such as Copernicus CO2 Monitoring and Verification Support (CO2 MVS)
 - Consider EU input on aspects, such as GHG, AFOLU
- GCOS Science Conference 2022



Thank you