

Copernicus thematic workshop: compliance assurance

20/06/2024 - online

Catharina Bamps, Earth Observation unit, Directorate-General for Defence Industry and Space,
European Commission

Copernicus
Europe's eyes on Earth

Space

Copernicus EU
Copernicus EU
Copernicus EU
www.copernicus.eu

Copernicus

Copernicus

Copernicus, the Earth Observation and Monitoring flagship programme of the European Union

Monitors the Earth, its environment and ecosystems

Full, free and open data and information policy *(Delegated Regulation (EU) No 1159/2013)*

Operational and long term **sustainability** *(Regulation (EU) 2028/xxx – in preparation)*

Coordination by **European Commission/DG DEFIS** & implemented with **Delegated Entities**

CHAPTER I

General provisions

Article 49

Scope of Copernicus

1. Copernicus shall be implemented building on prior investments, including by stakeholders such as ESA and EUMETSAT and, where appropriate and cost-effective, drawing on the national or regional capacities of Member States and taking into account the capacities of commercial suppliers of comparable data and information and the need to foster competition and market development, while maximising opportunities for European users.

2. Copernicus shall deliver data and information building on the needs of the Copernicus users and based on a free, full and open data policy.

3. Copernicus shall support the formulation, implementation and monitoring of the Union's and its Member States' policies in particular in the fields of the environment, climate change, marine, maritime, atmosphere, agriculture and rural development, preservation of cultural heritage, civil protection, infrastructure monitoring, safety and security, as well as the digital economy with the aim to further reduce the administrative burden.

4. Copernicus shall comprise the following elements:

(a) data acquisition, which shall include:

  (i) development and operations of the Copernicus Sentinels;

  (ii) access to third party space-based Earth observation data;

  (iii) access to in-situ and other ancillary data;

(b) data and information processing through Copernicus Services, which shall include activities for the generation of value-added information to support environmental monitoring, reporting and compliance assurance, civil protection and security services;

(c) data access and distribution, which shall include infrastructure and services to ensure the discovery, viewing, access to, distribution and exploitation and long-term preservation of Copernicus data and Copernicus information, in a user-friendly manner;

(d) user uptake, market development and capacity building in accordance with Article 28(6), which shall include relevant activities, resources and services to promote Copernicus, Copernicus data and Copernicus Services, as well as related downstream applications and their development at all levels to maximise socio-economic benefits, as referred to in Article 4(1), as well as the collection and analysis of Copernicus users' needs.

5. Copernicus shall promote the international coordination of observation systems and related exchanges of data in order to strengthen its global dimension and complementarity taking account of international agreements and coordination processes.

REGULATION (EU) 2021/696

Copernicus Europe's eyes on Earth

European Commission

Copernicus supports the Green Deal and other EU policies

- **Environmental monitoring**
- **Emergency management**
- **Security**



[Carbon neutrality and net zero emissions]



[Climate change monitoring and adaptation]



[Civil Protection and disasters management]



[Environmental protection and biodiversity]



[Sustainable Agriculture, food security and water management]

Copernicus Europe's eyes on Earth

European Commission

Copernicus

COPERNICUS DATA

- SENTINEL MISSIONS
- EXPANSION MISSIONS

THIRD PARTY DATA

CONTRIBUTING MISSION DATA



THIRD PARTY DATA

IN SITU DATA

FFO: full, free and open

L/U: licensed or provided for use in Copernicus

COPERNICUS INFORMATION

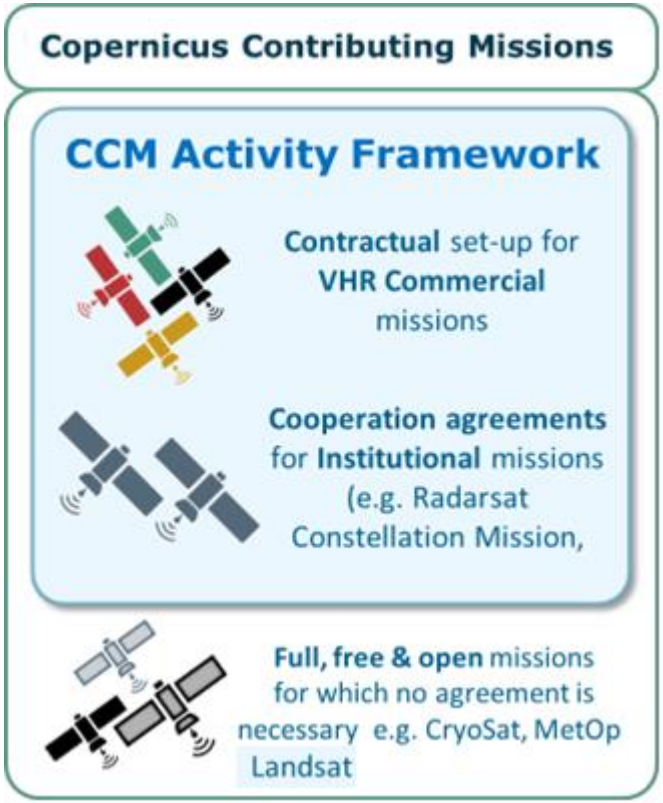
VALUE ADDED SERVICES AND APPLICATIONS

European Commission

The Copernicus Contributing Missions' Activity

- The CCM activity allows for the inclusion of EO data from commercial and non-commercial/institutional missions (e.g. national missions) in the Copernicus programme via contractual and cooperation agreements.

- The CCM activity provides VHR EO data complementing the Sentinels which are essential for the Copernicus services.

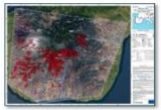


COPERNICUS SERVICES' EO DATA NEEDS AND REQUIREMENTS

Regular/yearly user needs consultations: satellite Data requirements exercise (ESA-COM-Copernicus services)

1.Respond to existing and future user needs

Existing data requirements of the Copernicus services for Copernicus contributing missions



Systematic

Regular, planned coverages and acquisitions;

Pre-defined areas of interest;



Main characteristics: (data) quality (assurance), completeness (avoidance redeliveries) and interoperability;

On-Demand

Unplanned, acquired mostly *in rush mode;*

Not pre-defined areas of interest affected by natural and man-made disasters or crisis situations;

Main characteristics: timeliness!, i.e. get the data as soon as possible,quality, spatial resolution,

Future user needs - new instruments and platforms - Hyperspectral data to prepare for the uptake of Copernicus Hyperspectral Imaging Mission, Thermal-Infrared…

VHR optical and SAR + 'other' data to answer to existing and future user needs: consultations Copernicus services

Copernicus services: Potential needs for data from new instruments and platforms

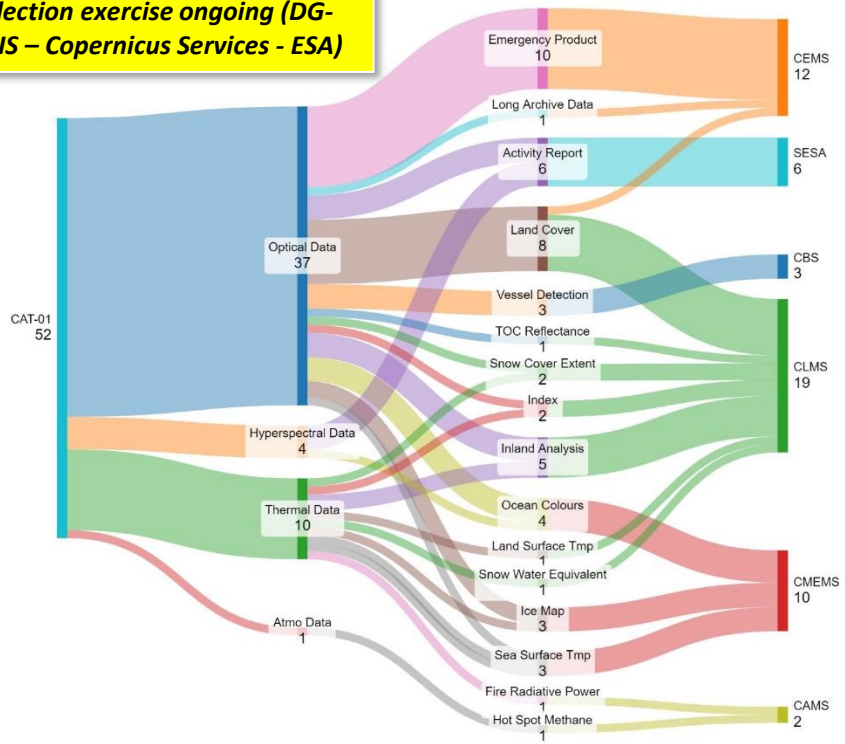
- Hyperspectral data to prepare for the uptake of Copernicus Hyperspectral Imaging Mission.
- Manned/unmanned aircraft and high altitude pseudo-satellites
- LiDAR
- Automatic Dependent Surveillance Broadcast or Radio frequency signals detection
- Independently geolocated AIS (Automatic vessel Identification System)

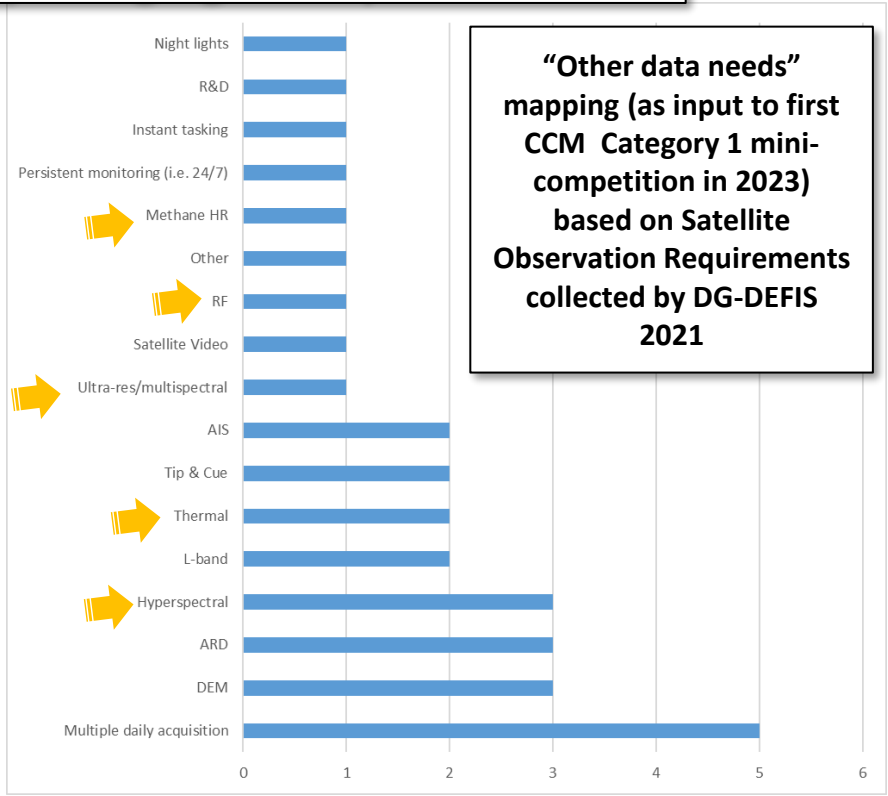
Copernicus services: Potential needs for products and services

- 3D models
- To further improve the overall Copernicus information timeliness, data value-adding such as automated feature extraction and change detection e.g. Activity/change reporting
- SAR coherence change detection
- need to increase the possibility of agile observations, improving the probability of getting agile acquisitions in uncertain weather conditions as discontinuous cloud cover
- Possibility of direct Tasking e.g. a direct tasking API with the data providers? (control quota or streaming?)
- Multiple acquisitions per day (subscription fee system?)
- Analysis Ready Data

COPERNICUS SERVICES' EO DATA NEEDS AND REQUIREMENTS – Other data needs (emerging CCMs)

2024 Satellite Observation Requirements collection exercise ongoing (DG-DEFIS – Copernicus Services - ESA)





"Other data needs" mapping (as input to first CCM Category 1 mini-competition in 2023) based on Satellite Observation Requirements collected by DG-DEFIS 2021

Copernicus Contributing Missions activity

Dynamic Purchasing System (DPS)

Category 1: European Earth Observation Emerging Data Suppliers

European missions under development or in their initial operations phase.

Anchor customer contracts with European New Space start-ups: use-cases and data demonstration activities with the Copernicus services (possibly also Horizon Europe projects), subject to Copernicus high quality standards.

Copernicus contributing missions

- European emerging data suppliers (New Space start-ups)

Multispectral data: ice edge detection, iceberg detection in polar regions, illicit crop monitoring, logging detection, wildfire, flooded areas, earthquakes, coastline monitoring, coastal ocean color, bathymetry, biochemical state of coastal waters,...

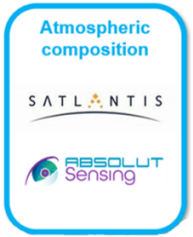




Thermal Infra Red: heat urban mapping, early detection of crop stress for drought monitoring, thermal water pollution monitoring, night boat detection, arctic ice monitoring ,...

Hyperspectral data: crop monitoring, harmful algae bloom monitoring, permafrost monitoring, sea ice monitoring, rediscovery of vessels, off-shore marine chemical pollution, methane release monitoring, gas or chemical leaks,...



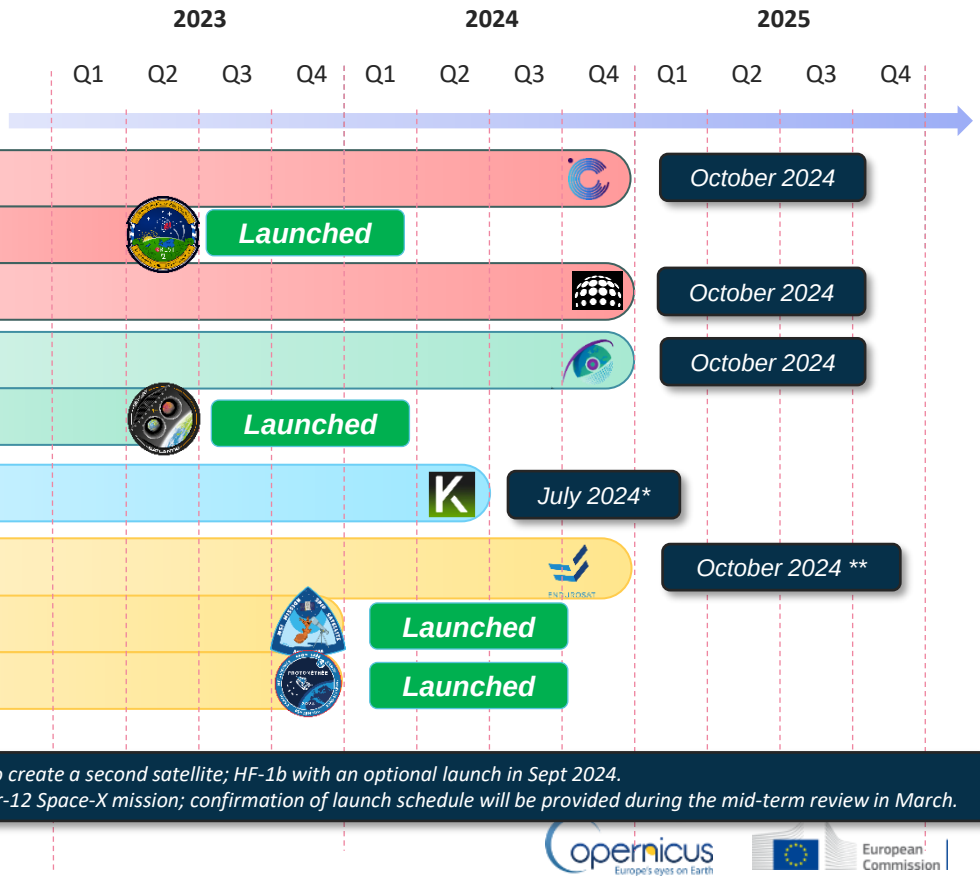


Atmospheric composition: methane concentration measurements (ship releases, gas leaks, volcanic eruptions, fires, illegal waste...),

Copernicus Contributing Missions

Space Component

Launch schedule of current Emerging European CCMs (Cat.1)



** Spare parts will be used to create a second satellite; HF-1b with an optional launch in Sept 2024.*
*** The launch of Balkan-1 is postponed to October on Transporter-12 Space-X mission; confirmation of launch schedule will be provided during the mid-term review in March.*

opernicus Europe's eyes on Earth

European Commission

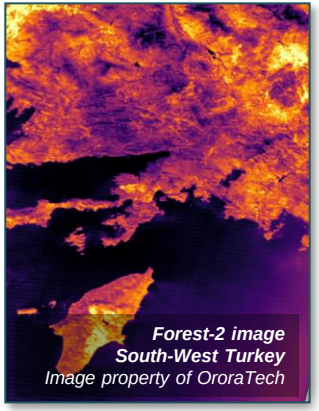
Copernicus Contributing Missions

Space Component

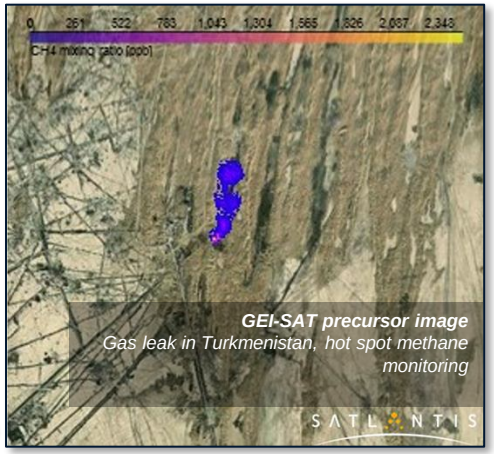
First images from current Emerging European CCMs

Images acquired during on-going commissioning phase

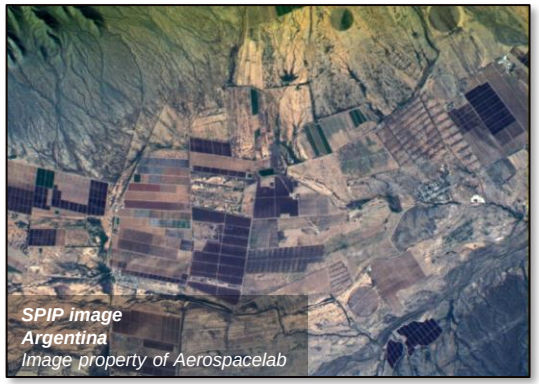
OroraTech	FOREST-2	Launched	
Satlantis	GEI-SAT	Launched	
Aerospacelab	SPIP	Launched	
Promethee	ProtoMéthée / Japetus	Launched	



Forest-2 image
South-West Turkey
Image property of OroraTech



GEI-SAT precursor image
Gas leak in Turkmenistan, hot spot methane monitoring



SPIP image
Argentina
Image property of Aerospacelab



ProtoMéthée image
Suez Canal
Image property of Prométhée Earth Intelligence

Examples use-cases/data demonstrations with Copernicus Services

European Emerging CCMs	CAMS	CEMS	CLMS	CMEMS
ConstellR	*No data demonstration activity is planned so far within the Phase II of the CCM Category I contract*	**Demonstrator Heat Stress in Urban Areas** Thermal remote sensing data is leveraged to monitor LST in urban environments, contributing to improved urban planning, energy efficiency, and climate adaptation.	**Inland Water Management** Data science-powered monitoring of inland waters using HR thermal and optical satellite data.	**Coastal SST** Detect and monitor sea surface temperature anomalies in coastal areas; **Sea Ice Temperature Monitoring** Monitor sea ice temperature anomalies in polar area
Ororatech	**Fire Radiative Power measurements** Detect and monitor the fire radiative power	**Fire Detection and Monitoring** Automatic Early detection of forest fires. Support for monitoring and defining forest areas affected by fire	*No data demonstration activity is planned so far within the Phase II of the CCM Category I contract*	**Sea Surface Temperature** Detect and monitor sea surface temperature
Aistech Space	**Gas Flaring** To demonstrate capability to support gad flaring product	*No data demonstration activity is planned so far within the Phase II of the CCM Category I contract*	*No data demonstration activity is planned so far within the Phase II of the CCM Category I contract*	**Sea Surface Temperature** Detect and monitor sea surface temperature

European Emerging CCMs	CAMS
Absolut Sensing	**Methane Hot Spots** Data demonstrator based on satellite methane measurement data; data will be delivered to CAMS for testing the production of hotspot emission estimates.
Satlantis	**Methane Hot Spots** The data demonstration activity consists of combining GEISAT Precursor with Sentinel 5P; low-resolution data from Sentinel 5P triggers the acquisition of GEISAT Precursor, providing a more precise location of the source and enabling a detailed assessment of primary methane emission sources.

Examples use-cases/data demonstrations with Copernicus Services

European Emerging CCMs	CAMS	CEMS	CLMS	CMEMS
Endurosat	*No data demonstration activity is planned so far within the Phase II of the CCM Category I contract*	Emergency Map Support **Test BALKAN-1 data and delivery service for its suitability to contribute to products generated at longer time scales such as the "Standard" package from the "Risk and Recovery Mapping" service.**	Update Land Use / Land Cover HR product **Evaluate the applicability of the mission to contribute to the generation of systematic datasets for predefined large coverages at national scale. Within the scope of the first pilot activity is the acquisition of images over a small set of sample sites.**	Sea Ice monitoring; Costal Monitoring; **The objective of the data demonstration is to assess the data quality and performance to support finer scale monitoring of the biochemical state of coastal waters and complement Sentinel 2 observations.** Ocean colour **Evaluate the fitness of BALKAN data for the generation of Copernicus Marine Ocean Colour High Resolution products for European sea coastal zones.**
Aerospacelab	*No data demonstration activity is planned so far within the Phase II of the CCM Category I contract*	*No data demonstration activity is planned so far within the Phase II of the CCM Category I contract*	VHR Coverage / S2 Interoperability **This activity will focus on three elements, first to consolidate a Sentinel-2 data inter-operability report with the SPIP mission/MSI Constellation and second to provide the Belgium VHR coverage under the requirements of the "VHR Coverage over Europe" with SPIP. Thirdly analyse the MSI constellation capability to consolidate the VHR Coverage over Europe.**	Ice Edge detection **The main goal is the acquisition of certain polar regions glaciers;** Water Turbidity and Bathymetry **The data demonstration aims to analyse water coulor, spectral indices and bathymetry;** S2 interoperability **Demonstration of the interoperability of SPIP and Sentinel-2 over water.**
Prométhée	*No data demonstration activity is planned so far within the Phase II of the CCM Category I contract*	Emergency Map Support **The objective is to define a procedure to integrate new MS satellite data into the value chains of rapid mapping components.**	Update Land Use / Land Cover HR product **Improve the thematic accuracy of productive land use and particularly in land cover. Thanks to the number of steps and the size of the pixel, it will be possible to better define the forest classes and their perimeter**	Bathymetry; Iceberg detection **The data demonstration will cover Coastal line Monitoring (short-term) and bathymetry/coastal risk (long-term) applications needs. The monitoring also allows the detection of icebergs**

European Emerging CCMs	CLMS	CMEMS
Kuva Space	Crop Identification and Monitoring **Providing information about crop health, growth stage, and yield forecast.**	Ocean Colour; Sea Ice Artic Monitoring **The hyperspectral data will be used to: Improve albedo (reflectivity) estimates of sea ice surfaces; improved measurements of seawater's optical properties, quality, and bathymetry; improved detection and monitoring of the position and dynamics of the sea ice edge; enhanced estimates of sea ice thickness by analyzing the penetration of light through the ice; detecting microplastic pollution in Sea Ice.**

Copernicus Contributing Missions activity

Dynamic Purchasing System (DPS)

Category 2: European Earth Observation Established Data Suppliers

Commercial contracts including multi-year **subscription schemes**, to satisfy the majority of the on-demand EO data needs from the Copernicus Services. The objective is to buy increasingly more European data in line with the EU Space regulation on Strategic Autonomy.

Category 3: Earth Observation Data Suppliers for miscellaneous data needs

Commercial contracts including multi-year **subscription schemes** with companies offering data from non-European missions to complement the Category 2 (and Category 1) data offer.

Envisaged new features:

- ✓ data subscription scheme with level of subscription strongly linked to data demand and improved performances of data providers;
- ✓ use of API-based interfaces for integration with CCM 'Rapid Response Desk service';
- ✓ increased level of pro-active tasking and parallel tasking (' background mission')

Copernicus data and information in support of compliance assurance

Copernicus Services combined play an essential role in monitoring the different facets of climate change and provide a wealth of information on our path to climate neutrality

C3S is specifically dedicated to provide unique climate information, covering the past, present and future; provides the interactive “European Climate Data Explorer” with many climate indices.

C3S publishes the annual “European State of the Climate” report.

CAMS implements the Copernicus CO2 Monitoring and Verification Support capacity coupling anthropogenic emissions with the atmospheric patterns in greenhouse gas concentrations.

CLMS provides essential input for the updated LULUCF Regulation, as a substantial percentage of GHG emissions come from Land Use, Land Use Change and Forestry

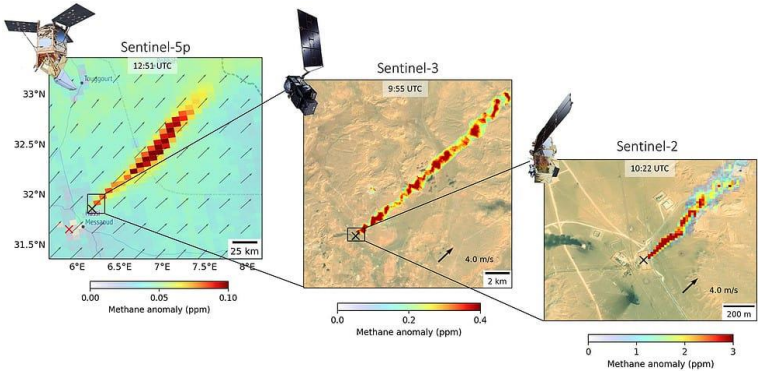
CMEMS provides oceanographic data and information on the marine heatwaves, wind, waves, currents and sea ice cover vital for planning renewable energy projects.

CEMS provides essential information on floods, droughts, wildfires and other disasters by providing timely and accurate data.

CSS supports fisheries control and helps combatting marine pollution.

Mobilising industry for a clean and circular economy

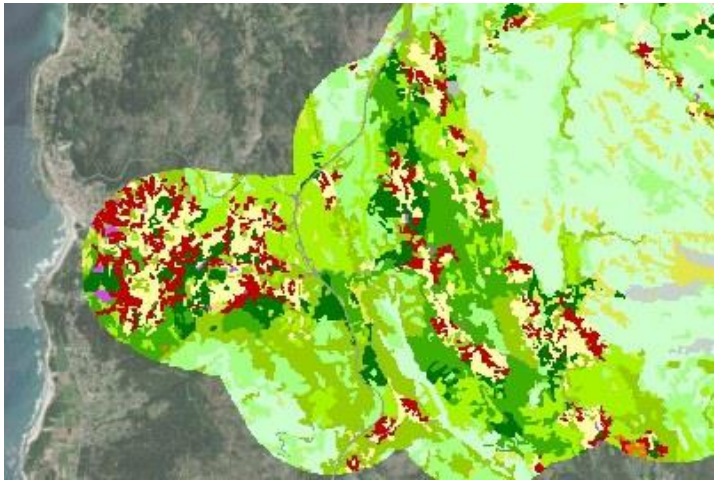
- CAMS provides near real-time detection of unwanted methane leaks
- Sentinel imagery allow waste dumps detection from outgassing
- Future hyperspectral analysis can potentially be used for the localisation of raw materials (Copernicus expansion mission CHIME, Copernicus CCM atmospheric composition data)



European Commission

Preserving and restoring ecosystems and biodiversity

- CLMS provides vegetation indices and phenology to monitor land ecosystems
- Copernicus is essential for the monitoring of Natura2000 sites
- CMEMS water pollution and eutrophication data are used to monitor marine biodiversity (Marine Strategy Framework Directive)
- The EU Forest Strategy highlights the role of Copernicus in ensuring high-quality and timely data on forests
- Copernicus will provide tree cover maps for the EU Observatory on deforestation and forest degradation



European Commission

Copernicus

- Supporting CAP implementation, Crop Monitoring and Forecasting, Monitoring of Climate-Environment Indicators, Monitoring of marine food chain, eutrophication and algae blooms

  - CAP 2023 – 2027 - **Regulation (EU) 2021/2115**: sustainable EU farming model based on delivering performance and results through a monitoring system.

  - Examples Copernicus EO data in support of the CAP:
    - CAP strategic plans: reference to the use of Copernicus Sentinel data and other data with equivalent value (Very High Resolution, geotagged, drones…)

      - Control with Remote Sensing: MS may decide to continue (standalone management) – may use Copernicus Sentinel data

      - Land Parcel Identification System Quality Assessment imagery: EU support Very High Resolution optical data (Copernicus Contributing Missions)

European Commission

Copernicus

- Regulation (EU) 2021/2115 on CAP Strategic Plans

Preliminary assessment: How can EO be used to monitor policy/objectives?
EO has great potential in supporting implementation of the CAP, with particular regard to its climate and environmental objectives. - **Land use and Land cover Monitoring**: EO can provide regular, high-resolution images that help monitor changes in land use and land cover. This can be used to assess compliance with CAP requirements related to land management, including interventions under Articles 12, 31, 70, 71, 72. EO, for example, can assess the implementation of set-aside areas, crop rotation, maintenance and restoration of landscape features. using EO for compliance might improve transparency and reduce the administrative burden for farmers. - **Crop monitoring**: EO can provide detailed information on crop types, growth stage and health. This data can be used in the framework of farm advisory services to optimise crop management practices, including irrigation, fertilisation, and pest control. - **Climate and soil monitoring:** as above, farming can highly benefit from detailed information on (i) temperature, precipitation, soil moisture and other relevant indicators of local and regional climate conditions, and (ii) soil properties, erosion, and degradation. Innovation regarding these aspects can also serve the objective of facilitating climate adaptation in the agricultural sector. - **Water management:** EO can assist in monitoring water resources, including river and lake levels, groundwater and, to a certain extent, also water quality and pollution, including runoffs from agriculture. - **Biodiversity and landscapes:** EO can help assess the extent and status of natural habitats, track changes within protected areas related to agricultural activities, assess the implementation of agroforestry practices,and the presence and changes of landscape features like hedges and buffer strips over time. - **Early Warning**: Earth observation can support early warning systems for agricultural risks, such as droughts, floods, and pest outbreaks, enabling timely response and mitigation. - **CAP Indicators**: the specific indicators as well as the impact and result indicators based on the same data (see Annex I) - can be monitored through EO to be included in decision-making processes and performance frameworks.

European Commission

Copernicus

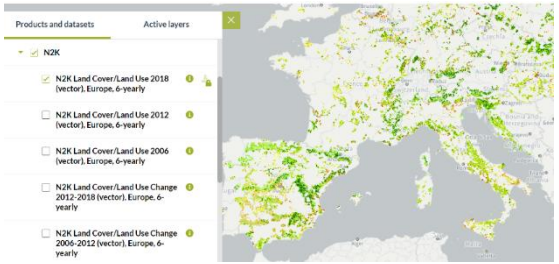
- # Regulation (EU) 2021/2115 on CAP Strategic Plans

Copernicus Land Monitoring Service

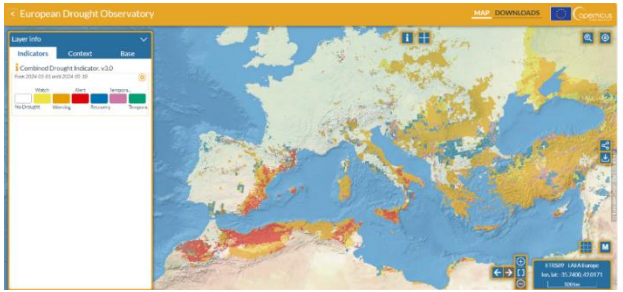
- regular vegetation and crop indices to forecast crop production at EU level, including soil moisture information for agro-meteorological modelling

- High Resolution Layer Vegetated Land Cover Characteristics: annual crop types, agricultural cropping patterns and grassland mowing;

- HRL Phenology, Small and Woody Features, Natura2000…



Copernicus Emergency Management Service: drought observatory.



Copernicus

- Inclusion of LULUCF emissions in 2030 framework - Regulation (EU) 2018/841

Sentinel5-P:
measure globally the levels of the following key trace gases - Ozone (O3), Sulfur Dioxide (SO2), Nitrogen Dioxide (NO2), Carbon Monoxide (CO), Methane (CH4) and Formaldehyde (HCHO) – as well as aerosols in the Earth's atmosphere

2024: New Space Start-ups:
methane emissions' measurement and monitoring

2026: Copernicus CO2 Monitoring Mission: A and B units

Relevant data to be gathered/monitored
Articles 6 - 10. Accounting rules for categories: (i) afforested and deforested land; (ii) managed cropland, grassland and wetlands, (iii) managed forest land, (iv) harvested wood products, (v) natural disturbances exceeding background level. **Annex I**: Greenhouse gasses and carbon pools: A.Greenhouse gases as referred to in Article 2: (a) carbon dioxide (CO2); (b) methane (CH4); (c) nitrous oxide (N2O) shall be expressed in terms of tonnes of CO2 equivalent. B. Carbon pools as referred to in Article 5(4): (a) above-ground biomass; (b) below-ground biomass; (c) litter; (d) dead wood; (e) soil organic carbon; (f) harvested wood products in the land accounting categories of afforested land and managed forest land. **Annex IV**: Calculation of background levels for natural disturbances (exclusion of outliers)

Preliminary assessment: How can EO be used to monitor policy/objectives?
EO can play a critical role in supporting the accounting of LULUCF emissions and the implementation of relevant commitments by EU MSs. In particular: - **Accounting support** : EO satellites equipped with sensors like lidar and multispectral images can provide data on forest cover, health, and carbon content. EO data helps assess forest biomass and changes in land cover that can be attributed to deforestation and afforestation activities, which is crucial data for LULUCF accounting. Similarly, EO services can provide data on cropland, grassland, wetlands and other LULUCF sectors, monitoring their conditions and changes over time. EO can contribute to assessing soil carbon content as well as above-ground biomass (forest and vegetation). - **Compliance check:** EO data can assist the review of the Commission of the MS reporting regarding their emission balance (Article 14), e.g., by providing evidence for verifying emission reductions resulting from reforestation, afforestation and improved land management practices.