

Copernicus

General Overview



Copernicus
Europe's eyes on Earth

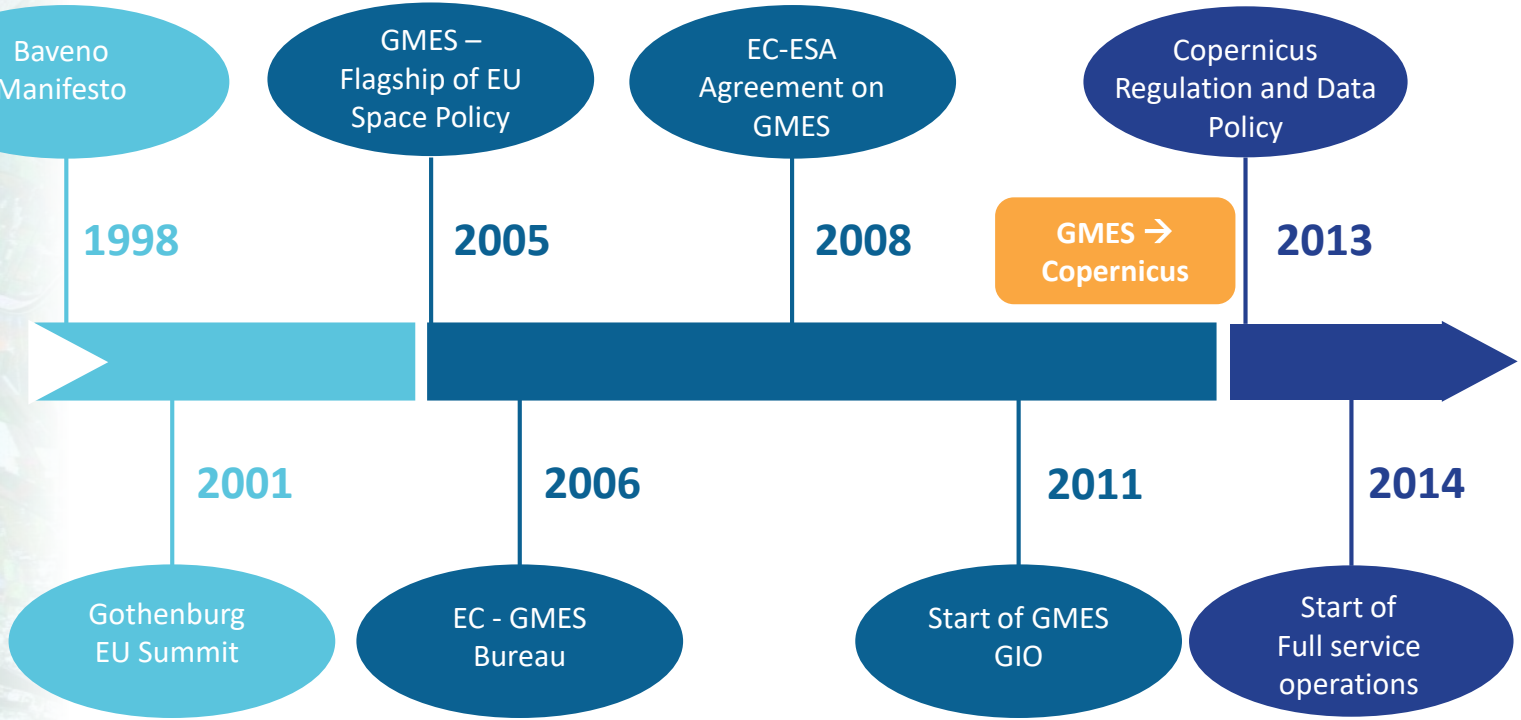
Space

Copernicus EU
Copernicus EU
Copernicus EU
www.copernicus.eu

COPERNICUS IN BRIEF

- **Copernicus is a flagship programme** of the European Union:
  - Monitors **the Earth,** its environment and ecosystems
  - Prepares for **crises, security risks** and **natural or man-made disasters**
  - Contributes to the **EU's role as a global soft power**
- a **full, free and open data policy**
- Is a tool for **economic development** and a driver for the **digital economy**

COPERNICUS HISTORY



GIO = GMES Initial Operation

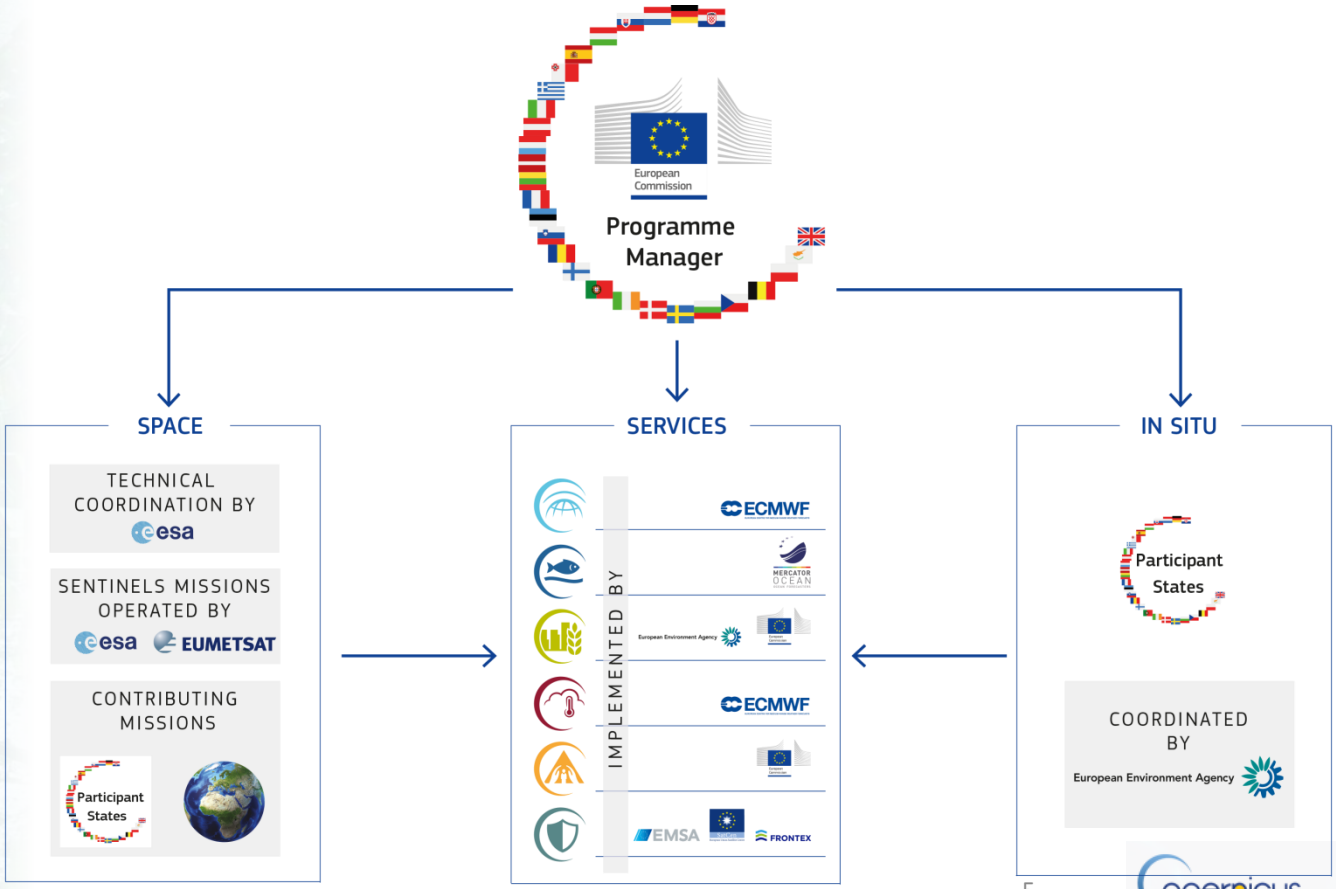
COPERNICUS FUNDING

From research to operations

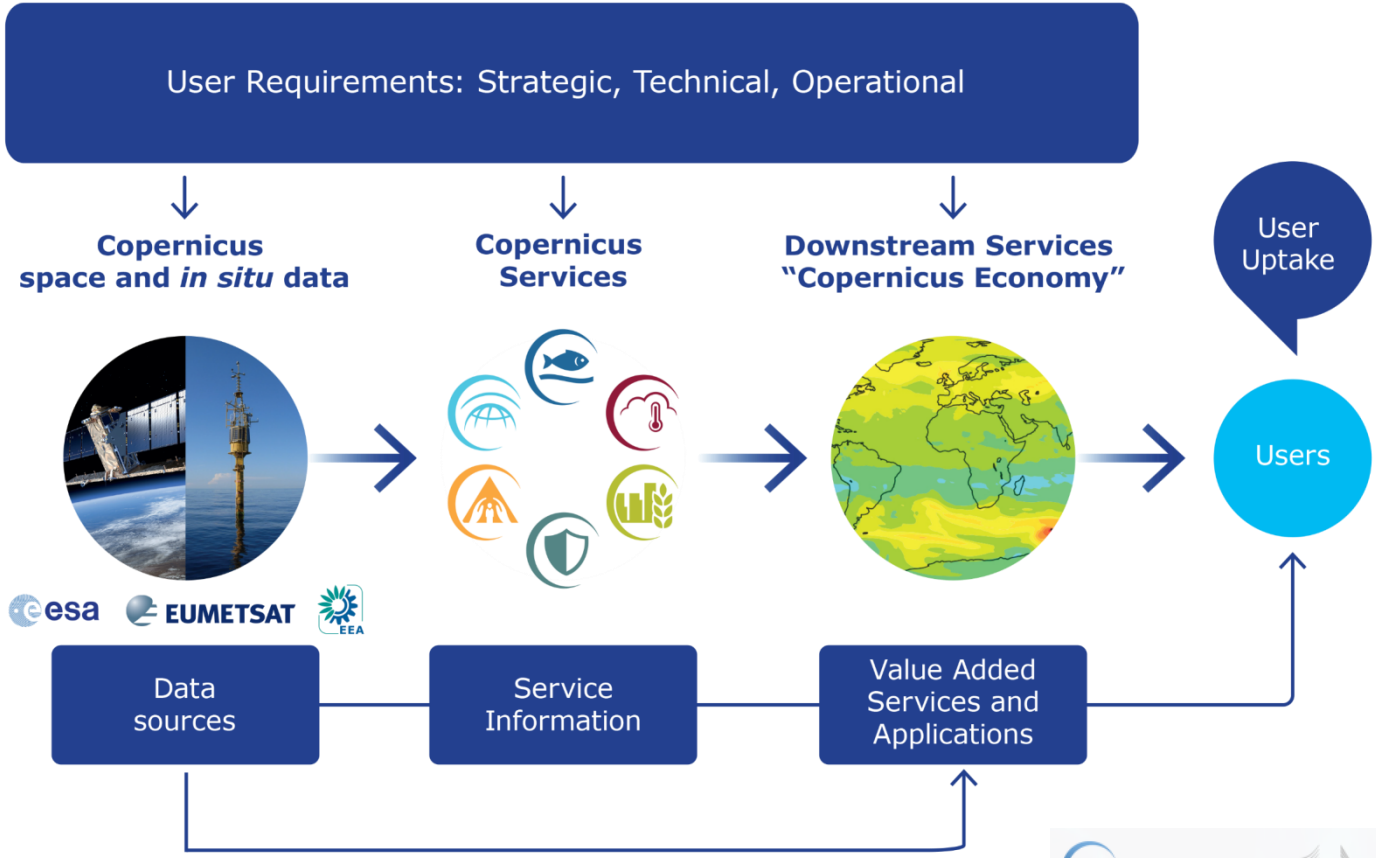




COPERNICUS GOVERNANCE



COPERNICUS IS DRIVEN BY THE USERS



THE SENTINELS

		Key Features
 SENTINEL-1: 4-40m resolution, 3 day revisit at equator	***S1A and 1B in orbit***	Polar-orbiting, all-weather, day-and-night radar imaging
 SENTINEL-2: 10-60m resolution, 5 days revisit time	***S2A and 2B in orbit***	Polar-orbiting, multispectral optical, high-resolution imaging
 SENTINEL-3: 300-1200m resolution, <2 days revisit	***S3A in orbit*** *S3B Spring 2018*	Optical and altimeter mission monitoring sea and land parameters
 SENTINEL-4: 8km resolution, 60 min revisit time	*1st Launch 2020*	Payload for atmosphere chemistry monitoring on MTG-S
 SENTINEL-5p: 7-68km resolution, 1 day revisit	***S5P launched 13/10/2017***	Mission to reduce data gaps between Envisat, and Sentinel 5
 SENTINEL-5: 7.5-50km resolution, 1 day revisit	*1st Launch 2021*	Payload for atmosphere chemistry monitoring on MetOp 2nd Gen
 SENTINEL-6: 10 day revisit time	*1st Launch 2020*	Radar altimeter to measure sea-surface height globally

SENTINEL-1

Space Component



Key Features:

- SAR sensor - All-weather, day-and-night
- 9-40m resolution, 6 days revisit time at equator
- 2 launched on 3/4/2014 and 25/4/2016, 2 ordered

Contributes to:

- Copernicus Land Monitoring Service
- Copernicus Marine Environment Service
- Copernicus Emergency Management Service
- Copernicus Climate Change Service
- Copernicus Security Service

Copernicus Europe's eyes on Earth
European Commission

SENTINEL-2

Space Component



Key Features:

- Multispectral optical sensor
- 10-60m resolution, 5 days revisit time
- First unit launched on 22/6/2015
- Second launched on 7/03/2017
- 2 more units are ordered

Contributes to:

- Copernicus Land Monitoring Service
- Copernicus Emergency Management Service
- Copernicus Climate Change Service
- Copernicus Security Service

Copernicus Europe's eyes on Earth
European Commission

SENTINEL-3

Space Component



Key Features:

- Medium resolution imaging and altimetry
- 300-1200m resolution, <2 days revisit time
- Monitors Sea and Land Surface Parameters
- First unit launched on 16/2/2016
- Second unit to be launched in Spring 2018
- 2 more units ordered

Contributes to:

Copernicus Land Monitoring Service

Copernicus Marine Environment Service

Copernicus Climate Change Service

opernicus Europe's eyes on Earth
European Commission

SENTINEL-4

Space Component



Key Features:

- Onboard MTG-S
- Atmospheric Chemistry Mission
- 8km resolution, 60 min revisit time
- To be launched in 2022

Contributes to:

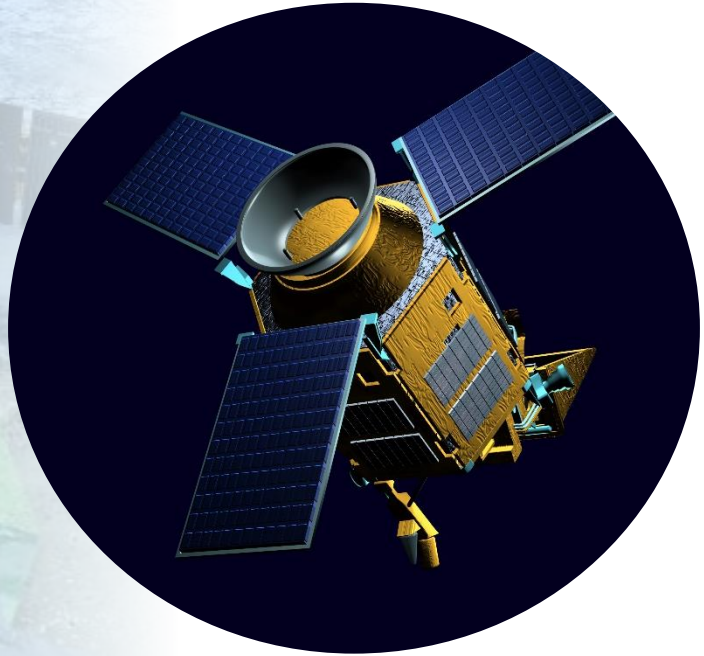
Copernicus Atmosphere Service

Copernicus Climate Change Service

opernicus Europe's eyes on Earth
European Commission

SENTINEL-5p

Space Component



Key Features:

- Precursor of Sentinel-5
- Atmospheric Chemistry Mission
- 7-68km resolution, 1 day revisit time
- Launched on 13 October 2017

Contributes to:

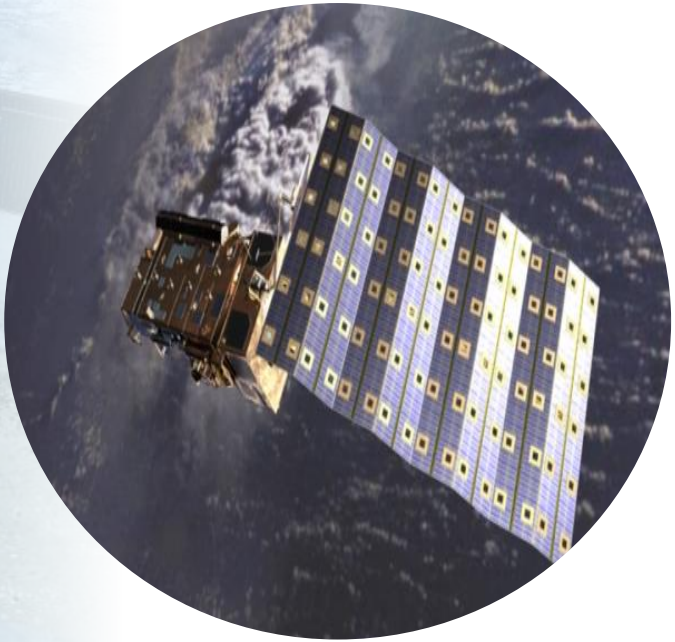
Copernicus Atmosphere Service

Copernicus Climate Change Service

opernicus Europe's eyes on Earth
European Commission

SENTINEL-5

Space Component



Key Features:

- Onboard MetOp 2nd Gen
- Atmospheric Chemistry Mission
- 7-50km resolution, 1 day revisit time
- To be launched in 2021

Contributes to:

Copernicus Atmosphere Service

Copernicus Climate Change Service

opernicus Europe's eyes on Earth
European Commission

SENTINEL-6

Space Component



Key Features:

- Radar Altimeter
- Measures sea-surface height
- 10 days revisit time
- To be launched in 2020

Contributes to:

Copernicus Marine Environment Service

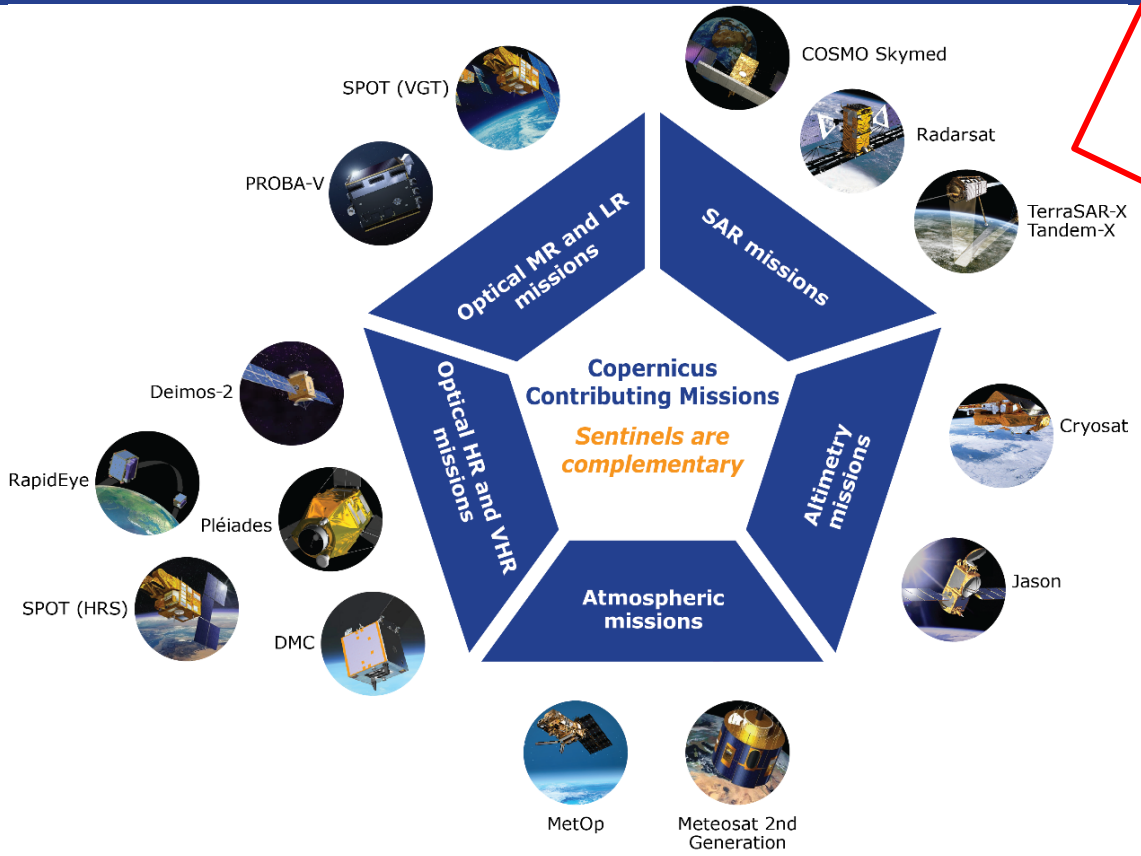
Copernicus Atmosphere Service

Copernicus Climate Change Service

opernicus Europe's eyes on Earth
European Commission

THE CONTRIBUTING MISSIONS

Space Component



Subject to Data Owner's Data Policy

opernicus Europe's eyes on Earth
European Commission

THE CONTRIBUTING MISSIONS

Space Component



Subject to Data Owner's Data Policy

opernicus Europe's eyes on Earth
European Commission

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







Copernicus Europe's eyes on Earth
European Commission

COPERNICUS SERVICES

Copernicus

Monitoring the State of the Earth System Environment …



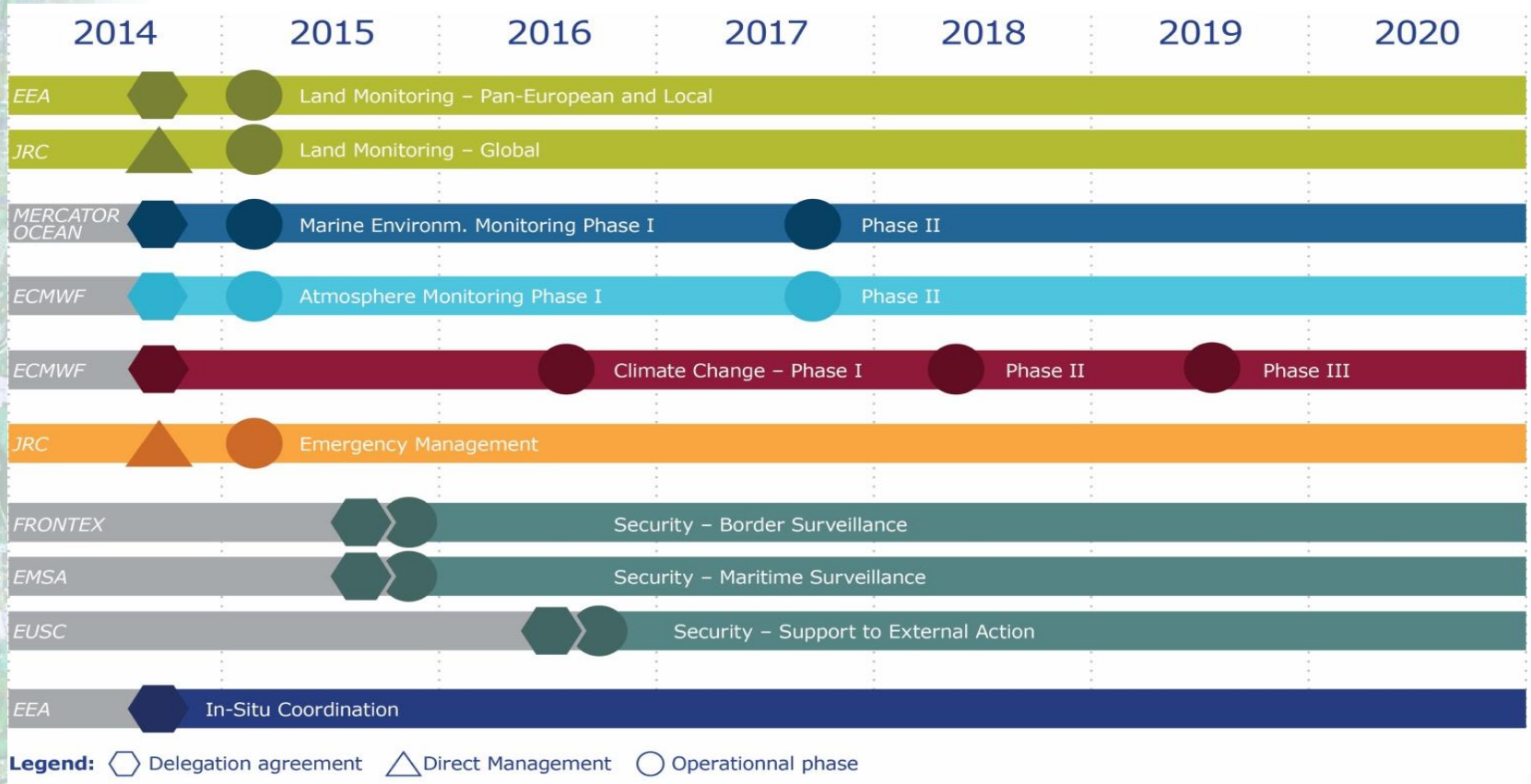
… Six cross-cutting Thematic Services

Copernicus Europe's eyes on Earth

European Commission

Copernicus

SERVICES IMPLEMENTATION SCHEDULE



opernicus Europe's eyes on Earth
European Commission

Land Monitoring

Benefit areas and products examples

- Ecosystems
- Biodiversity
- Agriculture
- Forestry
- Energy
- Natural Resources
- Water
- Urban planning

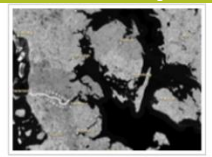
Global







Pan-European

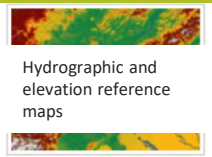

Image Mosaics


EU Land Cover

CORINE Land Cover


Specific land cover info

High Resolution Layers


Hydrographic and elevation reference maps

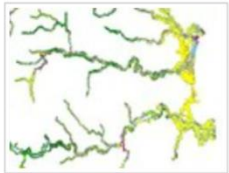
Reference Data


% of built-up area

Related Pan-European products

Local


Urban Atlas


Riparian Zones


Natura 2000 (N2K)

Copernicus Europe's eyes on Earth

European Commission

Marine Monitoring

Benefit areas and products examples

Marine safety

Marine resources

Coastal and marine environment

Climate and meteorological forecasting

Other: Transport, Tourism, Environment, Pollution, Energy, etc.









Sea Level

Ocean Salinity

Ocean Temperature

Sea Ice

Wind

Ocean Currents

Ocean Colour / Biogeochemistry
(e.g. optics, chlorophyil, biology, chemistry)

opernicus Europe's eyes on Earth
European Commission

Atmosphere Monitoring

Benefit areas and products examples

- Health
- Environment
- Pollution
- Climate
- Renewable Energy

Air Quality and Atmospheric Composition



Climate forcing



Ozone layer & UV



Solar radiation



Emissions and surface fluxes



Copernicus Europe's eyes on Earth

European Commission

Benefit areas and products examples

Climate Change

- Climate change
- Mitigation and adaptation
- Weather forecast
- Pollution
- Environment
- Health

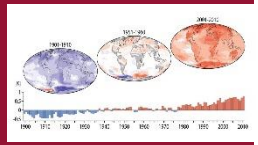
Consistent Estimates of the Essential Climate Variables (ECVs)



Support to Mitigation and Adaptation Strategies



Global and Regional Reanalyses



Seasonal Forecasts And Climate Projections



opernicus Europe's eyes on Earth
European Commission

Benefit areas and products examples

Emergency Management

Disaster Emergency Situations

Humanitarian Crises



Risk & Recovery Mapping:
- Reference Maps
- Pre-disaster Situation Maps
- Post-disaster Situation Maps

Rapid Mapping:
- Reference Maps
- Delineation Maps
- Grading Maps

Early Warning:
- Floods: EFAS
- Forest Fires: EFFIS

EFAS = European Flood Awareness System;
EFFIS=European Forest Fire Information System

Copernicus Europe's eyes on Earth | European Commission

Security

Benefit areas and products examples

Border Surveillance	• Coastal monitoring • Pre-frontier monitoring • Reference mapping
Maritime Surveillance	• Maritime surveillance of an area of interest • Vessel detection • Vessel tracking and reporting • Vessel anomaly detection
Support to EU External Action	• Road network status assessment • Conflict damage assessment • Critical infrastructure analysis • Reference map • Support to evacuation plans • Crisis situation map • Border map • Camp analysis



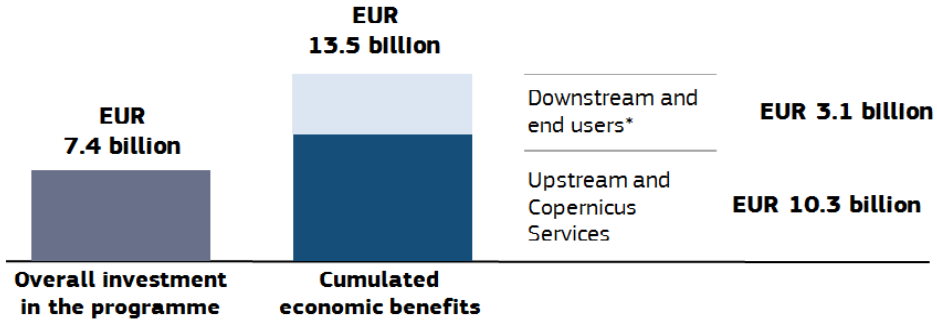




opernicus Europe's eyes on Earth
European Commission

COPERNICUS MONETARY BENEFITS

Estimated direct monetary benefits between 2008 and 2020



12,450 job years supported in the downstream and end user markets

15,580 jobs years supported in the upstream

Examples of existing Copernicus benefits

70% Cost reduction of a precision farming service in Austria, thanks to Copernicus

€ 60k Yearly savings for each construction company using a work progress monitoring app

60% Higher accuracy for analysis of the impact of trans-boundaries pollutants on air quality

5% Productivity gain for fish farmers, by monitoring toxic algal blooms

50% Copernicus-based forecasts generate 50% more benefits to solar energy producers than traditional forecasts

€ 186M Benefits of Copernicus on the insurance market in 2015

* The Downstream and end user analysis includes only 8 value chains: Agriculture, Forestry, Urban Monitoring, Insurance, Ocean Monitoring, Oil & Gas, Renewable Energies and Air Quality. Estimates for end users were only calculated for Insurance, Oil&Gas and Urban Monitoring. The estimates of downstream and end user benefits should be seen as extremely conservative because they were calculated a year after the launch of the first Sentinel satellite. Benefits are likely to increase significantly as more Sentinels become operational.

COPERNICUS BROADER BENEFITS

- Climate change & Environment
- Development & Cooperation
- Security & Defence
- Tourism
- Health
- Insurance & Disaster management
- Blue economy
- Urban planning…
- Energy & Natural resources
- Forestry…

EXAMPLE OF COPERNICUS BENEFITS



Pipeline Infrastructure Monitoring in the Netherlands

Benefits for the Netherlands: €15 to €18 M/year



Forest Management in Sweden

Benefits for Sweden: €16 to €22 M/year



Winter Navigation in the Baltic

Benefits for Sweden and Finland: €24 to €106 M/year

Source: EARSC

User Uptake

Agriculture sector: Examples of benefits

*More affordable applications based on **Free Sentinels 1 and 2 Data and the Land Service Products***

- **Precision farming** applications such as yield mapping, input management, farm management recording, etc.
- **Seasonal mappings** of cultivated areas
- **Field scale and crop dynamics** mapping
- **Irrigation management** and drought monitoring
- **Food security** monitoring
- **Agriculture development** in Africa





€78M More efficient use of agricultural inputs

Better quality food production

More efficient and appropriate use of fertilizers

€ Expected Copernicus enabled revenues

Sources: PwC-Strategy& analysis & European Commission

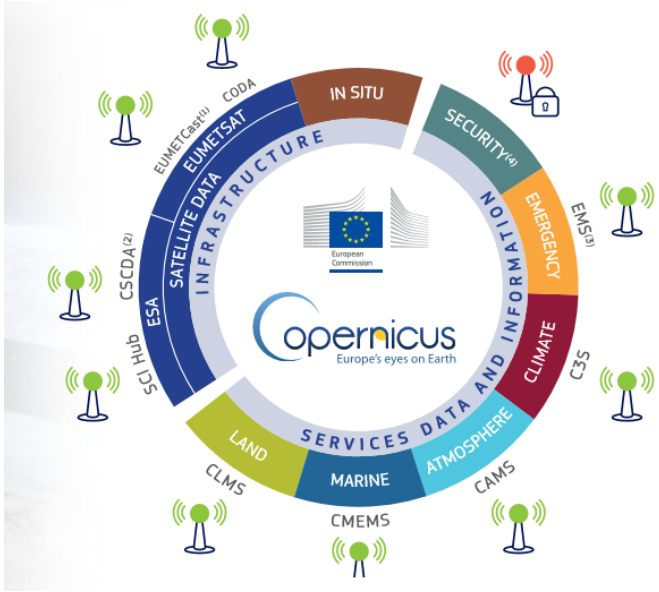
Copernicus Europe's eyes on Earth

European Commission

User Uptake

Copernicus Data Access Overview

- Satellite Data distribution Hubs
  - Sentinels
  - Contributing missions
  - Access to images in NRT
  - Access to archives



- Services Information portals for
  - Added value products, indicators
  - Models
  - Archives, Near Real Time and Forecasts products

Note: *Copernicus in situ component provides in situ data access, serving the Copernicus services. It is not delivering in-situ data to the end-users.*

opernicus Europe's eyes on Earth
European Commission

COPERNICUS DATA ACCESS: KEY LINKS

User Uptake

Access to Satellite data

FULL, FREE AND OPEN

esa sentinel data hub

Scientific and Other Access

https://scihub.copernicus.eu/

esa CSC data access

*Copernicus Space Component Data Access Portal**
CSC-DA

https://spacedata.copernicus.eu/

FULL, FREE AND OPEN

EUMETSAT

- Copernicus Online Data Access (CODA)
- EUMETCast: **www.eumetcast.com**

Needs to get a station and pay a yearly fee

Access to Copernicus Services Data

FULL, FREE AND OPEN

- Land-related data: http://land.copernicus.eu
- Atmosphere-related data: http://atmosphere.copernicus.eu
- Marine-related data: http://marine.copernicus.eu
- Emergency-related data: http://emergency.copernicus.eu
- Climate change-related data: http://climate.copernicus.eu (Beta version)

(*) Includes instructions on how to access Contributing Missions data

THE BIG DATA CHALLENGE

User Uptake

- **Massive amounts of data**
- **Full, open and free-of-charge**



Over 10 Petabyte/year of new data
with just Sentinels-1, -2 and -3 fully operational (data are downloaded **many time over)**

- Different types of **dissemination** infrastructures
- **New technology** developments
- ICT and EO **cross-fertilisation**
- **Interoperability** with non-EO datasets
- Global EO **competition**
- Growth and jobs in **downstream** sector

Copernicus Europe's eyes on Earth
European Commission

COPERNICUS BIG DATA APPROACH

Dual approach:

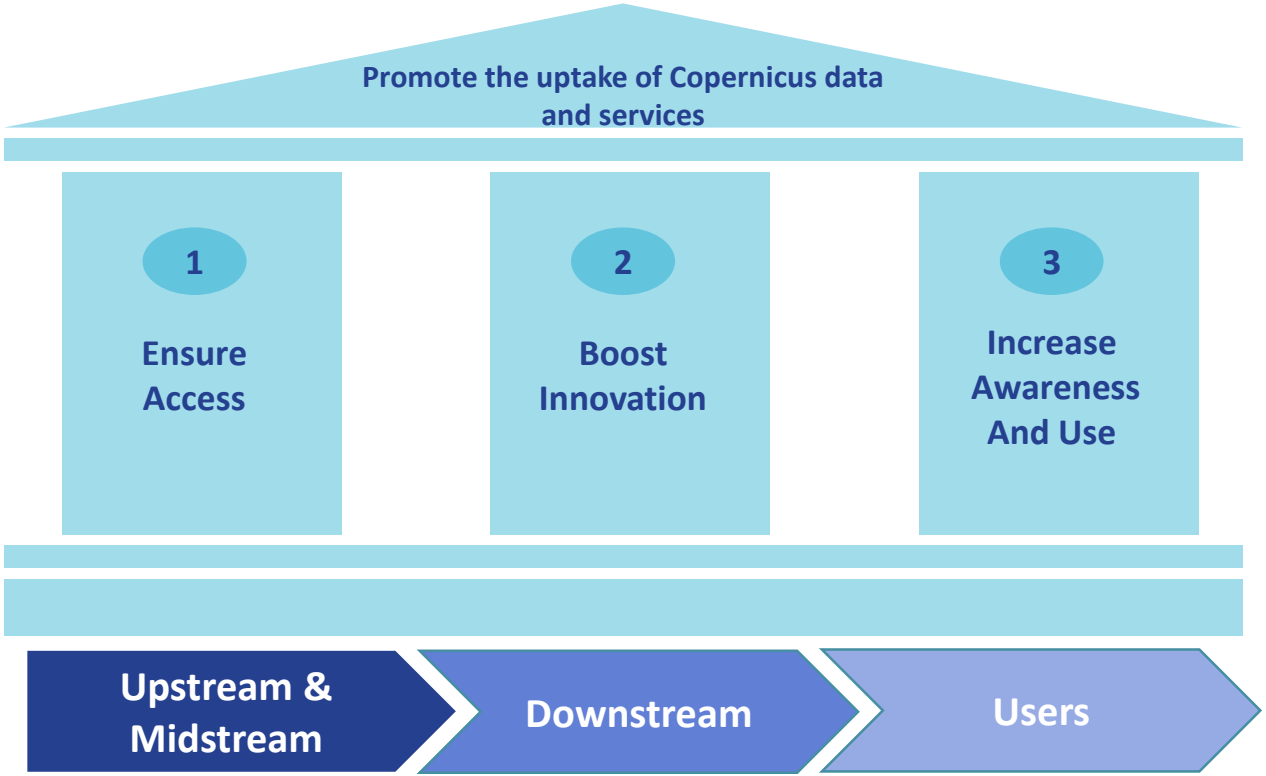
- Strong Copernicus Distribution Services for download
- Imminent launch of several **Data Access and Information Services (DIAS)**
  - **Access to all Copernicus data and information collocated with computing resources**
  - **Big Data analytics without the need to download the data and information**
  - **Data fusion with non-EO data and information**

Overall **ensuring that Copernicus data is easily accessible and used!**



User Uptake

COPERNICUS USER UPTAKE STRATEGY



COPERNICUS USER UPTAKE STRATEGY

Basis
=
Full, free and open data policy

Objective: maximizing the socio-economic benefits of Copernicus

Challenge: geospatial data (including Copernicus) are difficult to use by non-experts

Strategy: support the emerging downstream ecosystem, which use Copernicus data and services to create products for non-experts

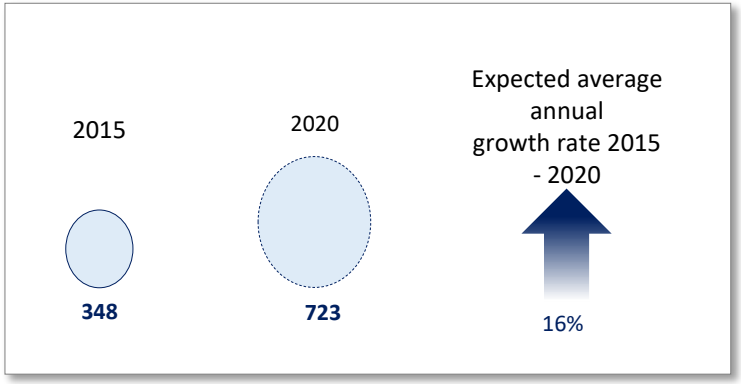
A NEW DOWNSTREAM ECOSYSTEM

User Uptake



Number of Earth Observation companies in Europe

Commercial annual benefits of Copernicus (in EUR million)

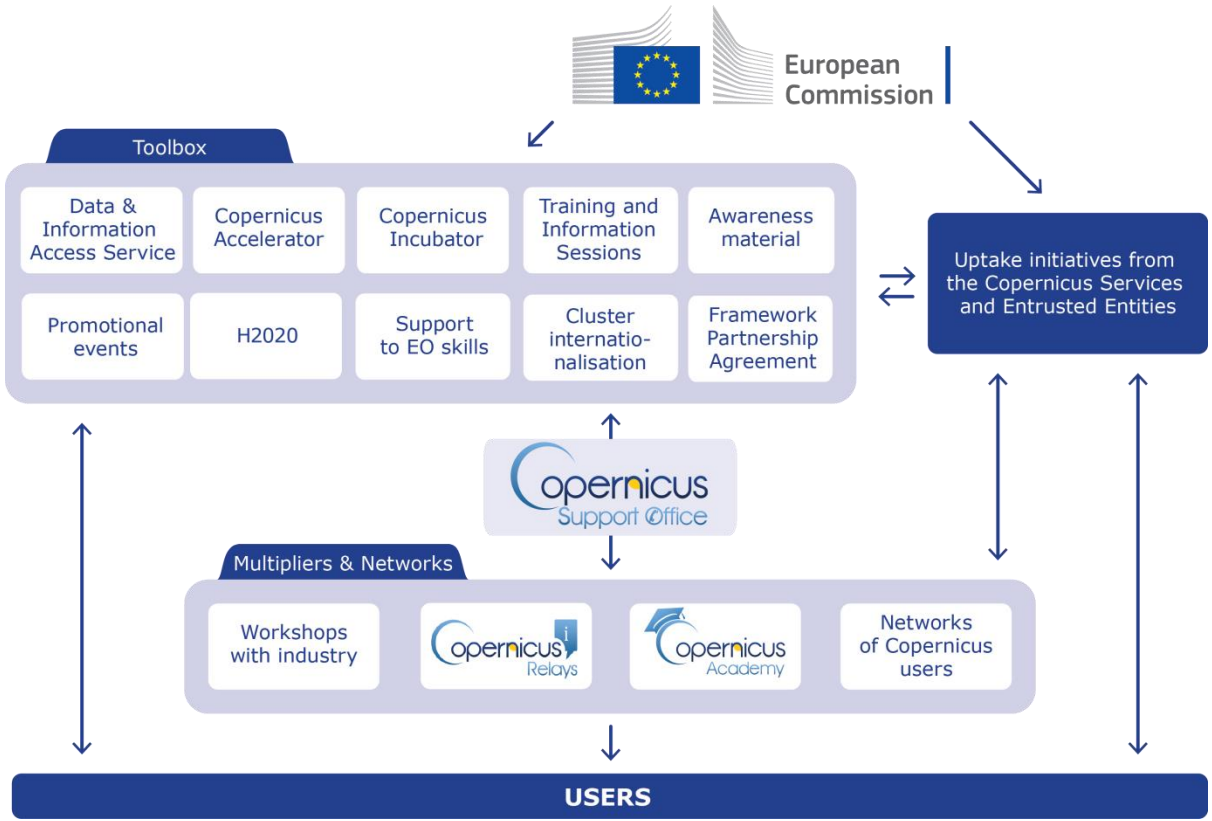


Source: A Survey into the State and Health of the European EO Services Industry, prepared by EARSC for ESA

Copernicus Europe's eyes on Earth
European Commission

User Uptake

COPERNICUS USER UPTAKE INITIATIVES



Copernicus Europe's eyes on Earth
European Commission

CONCLUSIONS

The Union Earth Observation and monitoring programme



Protect people and assets



Increase general knowledge on the state of the Planet



Improve environmental policy effectiveness



Monitor the environment



Facilitate adaptation to climate change



Foster downstream applications in a number of fields



Help managing emergency and security related situations