Copernicus
A success story in the global context

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Head of Copernicus
Directorate-General for Internal Market, Industry, Entrepreneurship and SME
European Commission
1998
Raveno Manifesto
(first reference to Global Monitoring for Environmental Security)

2001
Gothenburg EU Summit
(first EC involvement in establishing European capacity for monitoring the environment from space)

2005
GMES flagship of EU Space Policy
ESA approves GMES Space Component Programme

2008
EC-ESA agreement on GMES signed
GMES services presented at Lille Forum

2011
Start of GMES Initial Operations (GIO) phase

2012
GMES renamed "Copernicus"

2013
EC proposed Copernicus Regulation
Delegated act on Copernicus Data Policy

2014
Start of Copernicus full operations phase

2006
EC dedicated unit (GMES Bureau) in charge of Programme development and implementation
6 services use Earth Observation data to deliver ...

Sentinels → Contributing missions

...added-value products
Observation infrastructure
6 services use Earth Observation data to deliver ...
<table>
<thead>
<tr>
<th>SENTINEL Mission and Status</th>
<th>Key Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SENTINEL-1:</strong> 4-40m resolution, 3 day revisit at equator</td>
<td>Polar-orbiting, all-weather, day-and-night radar imaging</td>
</tr>
<tr>
<td><strong>SENTINEL-2:</strong> 10-60m resolution, 5 days revisit time</td>
<td>Polar-orbiting, multispectral optical, high-res imaging</td>
</tr>
<tr>
<td><strong>SENTINEL-3:</strong> 300-1200m resolution, &lt;2 days revisit</td>
<td>Optical and altimeter mission monitoring sea and land parameters</td>
</tr>
<tr>
<td><strong>SENTINEL-4:</strong> 8km resolution, 60 min revisit time</td>
<td>Payload for atmosphere chemistry monitoring on MTG-S</td>
</tr>
<tr>
<td><strong>SENTINEL-5p:</strong> 7-68km resolution, 1 day revisit</td>
<td>Mission to reduce data gaps between Envisat, and S-5</td>
</tr>
<tr>
<td><strong>SENTINEL-5:</strong> 7.5-50km resolution, 1 day revisit</td>
<td>Payload for atmosphere chemistry monitoring on MetOp 2ndGen</td>
</tr>
<tr>
<td><strong>SENTINEL-6:</strong> 10 day revisit time</td>
<td>Radar altimeter to measure sea-surface height globally</td>
</tr>
</tbody>
</table>

**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**
Operational predictability & continuity allows business plans to emerge.
Number of registered users

A monthly average of 7 PBytes of data downloaded by users

Statistics at mid March 2019

Registered Users: 210,914
6 services use Earth Observation data to deliver...

...added-value products

Sentinels

Contributing missions
THE CONTRIBUTING MISSIONS

Copernicus Contributing Missions

Sentinels are complementary

Optical MR and LR missions

SAR missions

Atmospheric missions

Optical HR and VHR missions

Altimetry missions

- SPOT (VGT)
- PROBA-V
- Deimos-2
- RapidEye
- Pléiades
- SPOT (HRS)
- DMC
- COSMO Skymed
- Radarsat
- TerraSAR-X Tandem-X
- Cryosat
- Jason
- MetOp
- Meteosat 2nd Generation

Subject to Data Owner’s Data Policy
6 services use Earth Observation data to deliver ...

Contributing missions

...added-value products
**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
6 services use Earth Observation data to deliver ...

Contributing missions

...added-value products
Monitoring the State of the Earth System Environment...

...Six cross-cutting Thematic Services
Benefit areas and products examples

<table>
<thead>
<tr>
<th>Benefit Areas</th>
<th>Global</th>
<th>Pan-European</th>
<th>Local</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystems</td>
<td>Vegetation</td>
<td>EU Land Cover</td>
<td>Urban Atlas</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Energy</td>
<td>Specific land cover</td>
<td>Riparian Zones</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Energy</td>
<td>Hydrographic and</td>
<td>Natura 2000 (N2K)</td>
</tr>
<tr>
<td>Forestry</td>
<td>Energy</td>
<td>elevation reference</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>High Resolution Layers</td>
<td>maps</td>
<td></td>
</tr>
<tr>
<td>Natural Resources</td>
<td>Reference Data</td>
<td>% of built-up area</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>Related Pan-European</td>
<td>products</td>
<td></td>
</tr>
<tr>
<td>Urban planning</td>
<td>Image Mosaics</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Vegetation status (FAPAR)
Snow Water Equivalent

SWE estimate, 20160314

SWE [mm]
<table>
<thead>
<tr>
<th>Benefit areas and products examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine safety</td>
</tr>
<tr>
<td>Marine resources</td>
</tr>
<tr>
<td>Coastal and marine environment</td>
</tr>
<tr>
<td>Climate and meteorological forecasting</td>
</tr>
<tr>
<td>Other: Transport, Tourism, Environment, Pollution, Energy, etc.</td>
</tr>
<tr>
<td>Sea Level</td>
</tr>
<tr>
<td>Ocean Salinity</td>
</tr>
<tr>
<td>Ocean Temperature</td>
</tr>
<tr>
<td>Sea Ice</td>
</tr>
<tr>
<td>Wind</td>
</tr>
<tr>
<td>Ocean Currents</td>
</tr>
<tr>
<td>Ocean Colour / Biogeochemistry</td>
</tr>
<tr>
<td>(e.g. optics, chlorophyll, biology, chemistry)</td>
</tr>
</tbody>
</table>
Sea surface current
Sea surface temperature
<table>
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<tr>
<td><strong>Health</strong></td>
</tr>
<tr>
<td><strong>Environment</strong></td>
</tr>
<tr>
<td><strong>Pollution</strong></td>
</tr>
<tr>
<td><strong>Climate</strong></td>
</tr>
<tr>
<td><strong>Renewable Energy</strong></td>
</tr>
<tr>
<td><strong>Air Quality and Atmospheric Composition</strong></td>
</tr>
<tr>
<td><strong>Climate forcing</strong></td>
</tr>
<tr>
<td><strong>Ozone layer &amp; UV</strong></td>
</tr>
<tr>
<td><strong>Solar radiation</strong></td>
</tr>
<tr>
<td><strong>Emissions and surface fluxes</strong></td>
</tr>
</tbody>
</table>
CAMS regional NO₂ analysis embedded in CAMS global forecast

mass concentration of nitrogen dioxide in air (µg/m³)
## Benefit areas and products examples

<table>
<thead>
<tr>
<th>Climate change</th>
<th>Consistent Estimates of the Essential Climate Variables (ECVs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitigation and adaptation</td>
<td>Support to Mitigation and Adaptation Strategies</td>
</tr>
<tr>
<td>Weather forecast</td>
<td>Global and Regional Reanalyses</td>
</tr>
<tr>
<td>Pollution</td>
<td>Seasonal Forecasts And Climate Projections</td>
</tr>
<tr>
<td>Environment</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td></td>
</tr>
</tbody>
</table>
Access to past, present and future climate information

Projected changes in annual mean temperature (left) and annual precipitation (right)
Emergency: Benefit areas and products examples

Natural & Man-made Disasters

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 & Monitoring:
- Floods: EFAS/GloFAS
- Forest Fires: EFFIS/GWIS
- Drought: EDO/GDO

EFAS = European Flood Awareness System; GloFAS = Global Flood Awareness System
EFFIS = European Forest Fire Information System; GWIS = Global Wildfire Information System
EDO = European Drought Observatory; GDO = Global Drought Observatory
Emergency activations in 2018

Emergency Response Coordination Centre (ERCC) | DG ECHO Daily Map | 18/01/2019

Copernicus Rapid Mapping Service: 2018 overview

Outside Europe
24 activations
416 maps

Inside Europe
50 activations
638 maps

Number of maps produced for the Copernicus Mapping Service in 2018: 1,054

Event type
- Earthquake
- Flood
- Tsunami
- Epidemic
- Mudflow

Environment
- Storm/tropical cyclone
- Volcanic activity
- Wildfire/forest fire
- Civil unrest (population displacement)

Number of activations per country

Copyright, European Union, 2019. Map created by ERCC Analytical Team. Sources: Copernicus (http://emergency.copernicus.eu) and Emergency lids (http://actuations-eids.dg-echo.ec.europa.eu). The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union.

*Copernicus: EU programme aimed at developing European information services based on satellite earth observation and in situ (non-space) data. The Copernicus Rapid Mapping Service is part of the Copernicus Emergency Management Service (EMS), which is providing maps and analysis based on satellite imagery (before, during or after a crisis) as well as early warning services for flood and fire risks. (http://emergency.copernicus.eu/mapping/ems/about-copernicus)
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
Users and Value Chain
Copernicus is driven by the users

User Requirements: Strategic, Technical, Operational

Copernicus space and in situ data

Copernicus Services

Downstream Services “Copernicus Economy”

User Uptake

Users

Data sources

Service Information

Value Added Services and Applications

esa
EUMETSAT
EEA
COPERNICUS BROADER BENEFITS

Climate change & Environment

Development & Cooperation

Security & Defence

Tourism

Health

Insurance & Disaster management

Blue economy

Urban planning...

Energy & Natural resources

Forestry...
**COPERNICUS ECONOMIC BENEFITS**

DRIVES RESEARCH, INNOVATION AND THE CREATION OF HIGH-SKILLED JOBS

<table>
<thead>
<tr>
<th>REVENUES</th>
<th>Enabled revenues for intermediate users in Europe (EUR million)</th>
<th>Expected average annual growth rate up to 2020</th>
<th>Average penetration of Copernicus data with regards to EO data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2015 *</td>
<td>2018</td>
<td>2020</td>
</tr>
<tr>
<td>Copernicus impact for intermediate users of the 10 selected value chains</td>
<td>54</td>
<td>168</td>
<td>226</td>
</tr>
</tbody>
</table>

**Copernicus Uptake (2017)**

- **72%**  
  Proportion of EO companies exploiting Copernicus data in Europe
  
- **38%**  
  Proportion of EO companies exploiting Copernicus services in Europe

- **28 TB**  
  Volume of downloads from the Data Access Systems

- **300,000**  
  (by end 2018)  
  # overall registered users on the different hubs (ESA, EUMETSAT, Europol, EEA, MedEA, and JRC)
Data and Information Access
DATA DISSEMINATION MEANS

- HUB TO HUB CONNECTIONS
- EUMETCAST IN AFRICA
- COOPERATION WITH DG CNECT ON SPECIFIC INFRASTRUCTURES
- PARTNERSHIP WITH DIAS
- RED CLARA (SOUTH AMERICA)
- DISTRIBUTION OF COPERNICUS DATA VIA GEANT NETWORK
- TRANSATLANTIC CABLE
COPERNICUS DATA ACCESS OVERVIEW

NO MORE LARGE FILES DOWNLOADS
NO MORE STORAGE ISSUES

THE DIAS & WHERE TO REACH THEM

WWW.CREODIAS.EU  WWW.MUNDIWEBSERVICES.COM  WWW.ONDA-DIAS.COM  WWW.SOBLOO.EU  WWW.WEKEO.EU
COPERNICUS INTERNATIONAL STRATEGY

OBJECTIVES

- Maximise the efficiency of EU investments in all EU policies and serving international partners and/or objectives
- Promote use of Copernicus and access to international markets (reciprocity?) and boost EU data industry abroad
- Agreements signed with USA, Australia, India, Brazil, Chile, Colombia, African Union, Serbia, Ukraine
- Discussions ongoing with ASEAN countries and Singapore, Argentina, Canada, Japan, FAO, UNEP, Holy See
Ex.: UN Sustainable Development Goals:

http://www.stockholmresilience.org
Ex.: Preparing for a Copernicus CO2 emission Monitoring Capacity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776186.
http://www.copernicus.eu/

https://twitter.com/CopernicusEU

https://www.facebook.com/Copernicus

Video: https://youtu.be/MGJss4lDaBo