



Copernicus

Europe's eyes on
Earth



Copernicus EU



Copernicus EU



Copernicus EU



www.copernicus.eu

Space



Copernicus

Why Copernicus ?

The Union Earth Observation and monitoring programme

Increase general knowledge
on the state of the Planet



Protect people
and assets



Improve environmental
policy effectiveness



Facilitate adaptation
to climate change



Monitor
the environment



Foster downstream
applications in
a number of fields



Help managing emergency
and security related situations



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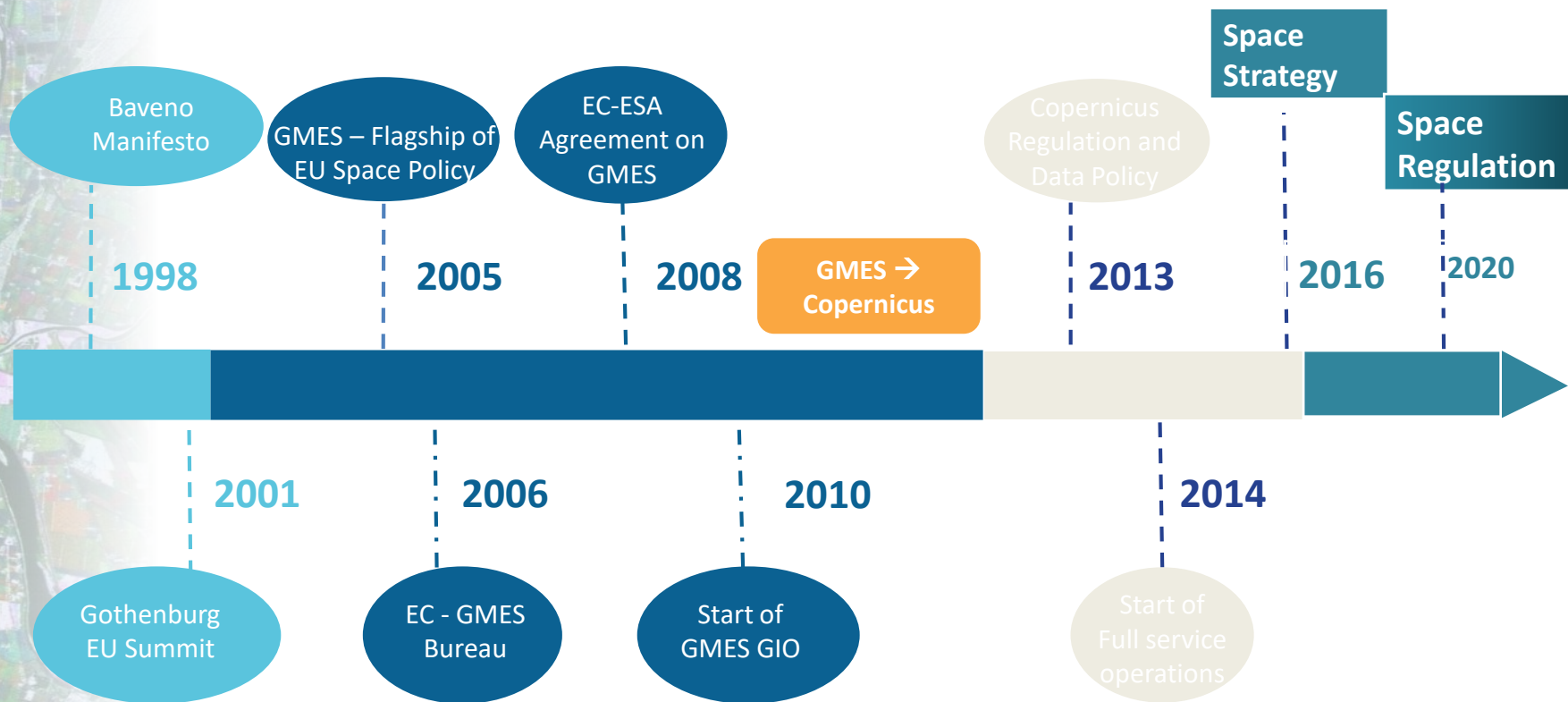
C O P E R N I C U S I N B R I E F

- **The Copernicus programme** [\(REGULATION \(EU\) No 377/2014\)](#) is a cornerstone of the European Union's efforts:
 - To monitor **the Earth**, its environment and ecosystems
 - To ensure its citizens are prepared and protected for **crises, security risks** and **natural or man-made disasters**
- Places a world of insight (data and information) about our planet at the disposal of citizens, public authorities and policy makers, scientists, entrepreneurs and businesses on a **full, free and open basis**
- Is a tool for **economic development** and a driver for the **digital economy**



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COPERNICUS HISTORY



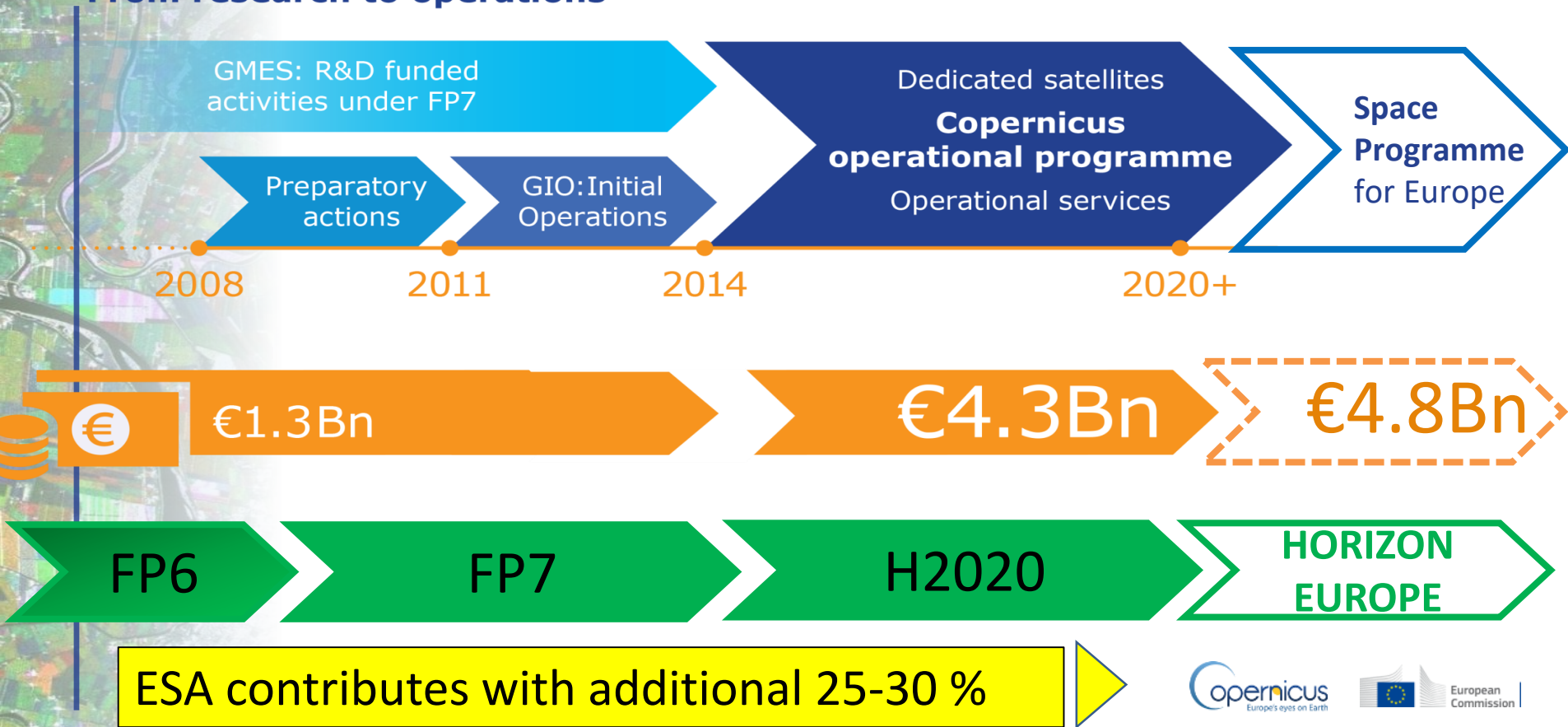
GIO = GMES Initial Operation



Copernicus timeline... an other perspective

Copernicus

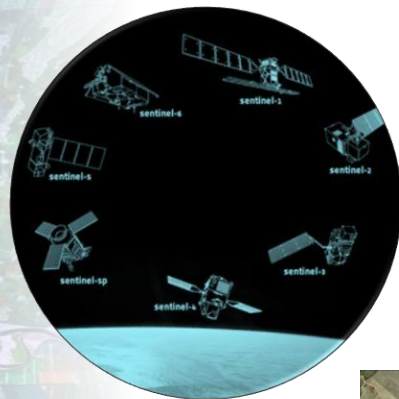
From research to operations



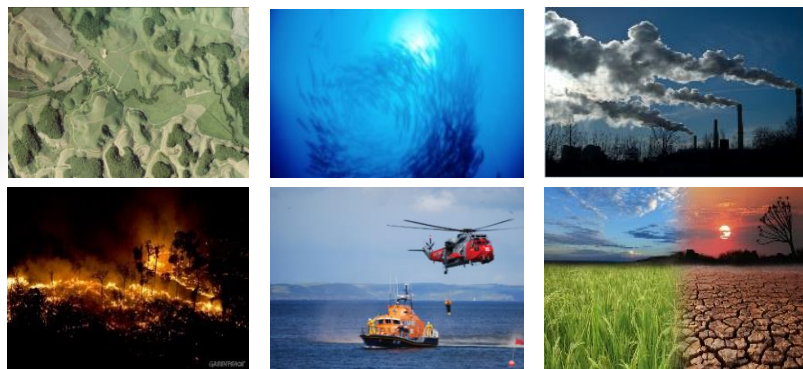


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COPERNICUS ARCHITECTURE



Sentinels

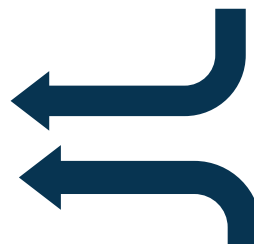


added-value products

6 services use Earth Observation data to deliver



Contributing missions



In Situ

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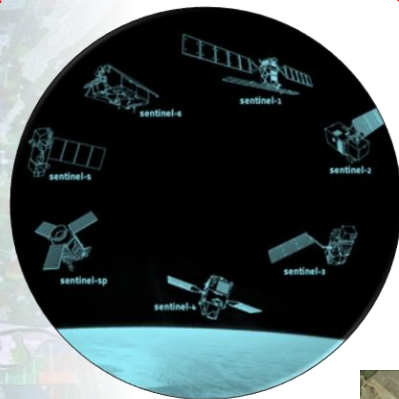
COPERNICUS INFRASTRUCTURE

- Space
- In-situ



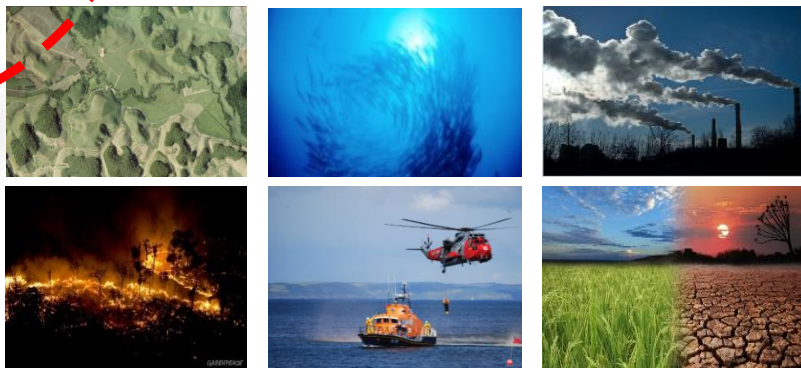
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COPERNICUS ARCHITECTURE



Sentinels

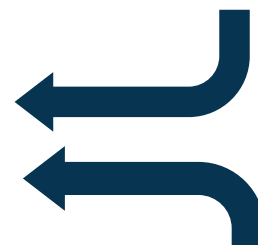
6 services use Earth Observation data to deliver



added-value products



Contributing missions



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THE SENTINELS

Sentinel Mission and Status

Key Features

**FULL, FREE
AND OPEN**



SENTINEL-1:
4-40m resolution, 3 day revisit at equator

2 Sats in orbit

Polar-orbiting, all-weather, day-and-night radar imaging



SENTINEL-2:
10-60m resolution, 5 days revisit time

2 Sats in Orbit

Polar-orbiting, multispectral optical, high-res imaging



SENTINEL-3:
300-1200m resolution, <2 days revisit

2 Sat in Orbit

Optical and altimeter mission monitoring sea and land parameters



SENTINEL-4:
8km resolution, 60 min revisit time

1st Launch in 2023

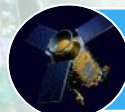
Payload for atmosphere chemistry monitoring on MTG-S



SENTINEL-5p:
7-68km resolution, 1 day revisit

1 Sat in Orbit

Mission to reduce data gaps between Envisat, and S-5



SENTINEL-5:
7.5-50km resolution, 1 day revisit

1st Launch in 2023

Payload for atmosphere chemistry monitoring on MetOp 2ndGen



SENTINEL-6:
10 day revisit time

1st Launch in 2020

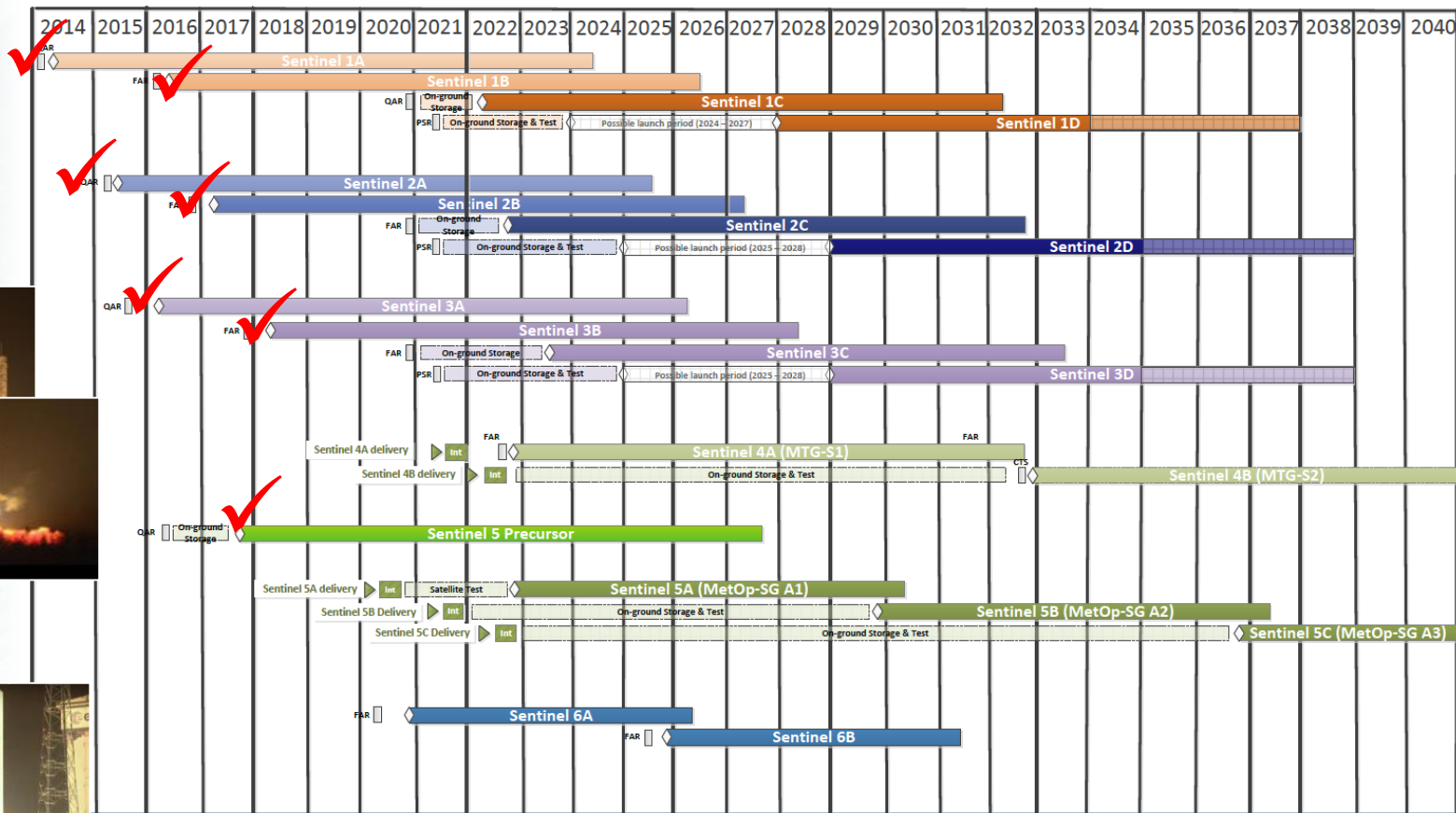
Radar altimeter to measure sea-surface height globally



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Deployment Schedule

Continuity up to 2030 and beyond



and:

Qualification Acceptance Review (QAR)
Flight Acceptance Review (FAR)
PreStorage Review (PSR)
Consent to Ship (CTS)

On-ground Storage & Test
Satellite Test

Satellite On-ground Storage & Test
Satellite Assembly, Integration & Test

Int Integration
Tentative launch date

Date: 8 October 2018

MAIN USES OF COPERNICUS SENTINELS



SENTINEL-1

All-weather, day and night observations to support services for sea-ice monitoring, marine environment surveillance, ship detection, land-surface motion risks, mapping of forest, water and soils, humanitarian aid and crisis management

SENTINEL-2

Agriculture/vegetation monitoring, soil and water cover, forest management, border and maritime surveillance, emergency management: floods, fires

SENTINEL-3

Ocean forecast, climate change and **operational oceanography**: sea surface height, ocean color, oceanic carbon fluxes, monitoring river or lakes level

SENTINEL-4

Continuous monitoring of **atmospheric composition** focused on air quality over Europe, with main products Ozone (O₃), Nitrogen Dioxide (NO₂), Sulphur Dioxide (SO₂), Formaldehyde (HCHO) and aerosol properties

SENTINEL-5

(Precursor of Sentinel-5) daily global monitoring of the main **atmospheric pollutants** (CH₄ and O₂ NO₂ CO₂ HCHO, SO₂) and two major **greenhouse gases** (CH₄ and tropospheric O₃)

SENTINEL-5P

Daily global monitoring for **climate, air quality and ozone/surface UV applications**, with key parameters O₃, NO₂, SO₂, HCHO, CHOCHO, Aerosols, CH₄ and stratospheric Ozone

SENTINEL-6

Ocean forecast, climate change and **real time ocean topography**: wave height, ocean surface, wind speed



Copernicus

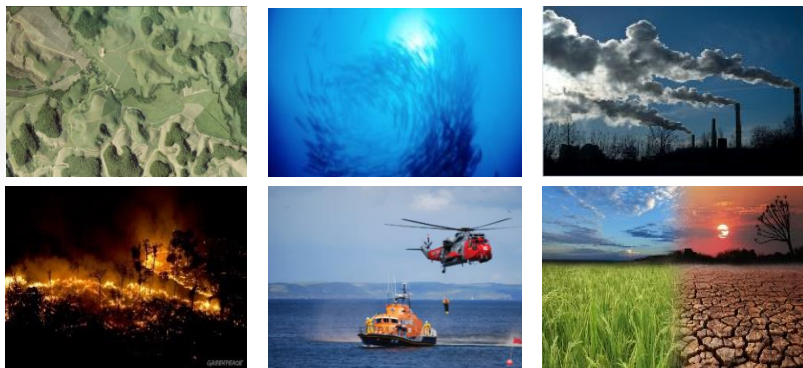
COPERNICUS ARCHITECTURE



Sentinels



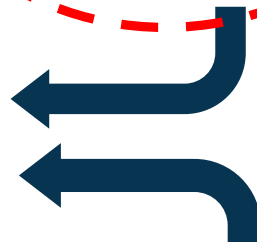
6 services use Earth Observation data to deliver



added-value products



Contributing missions



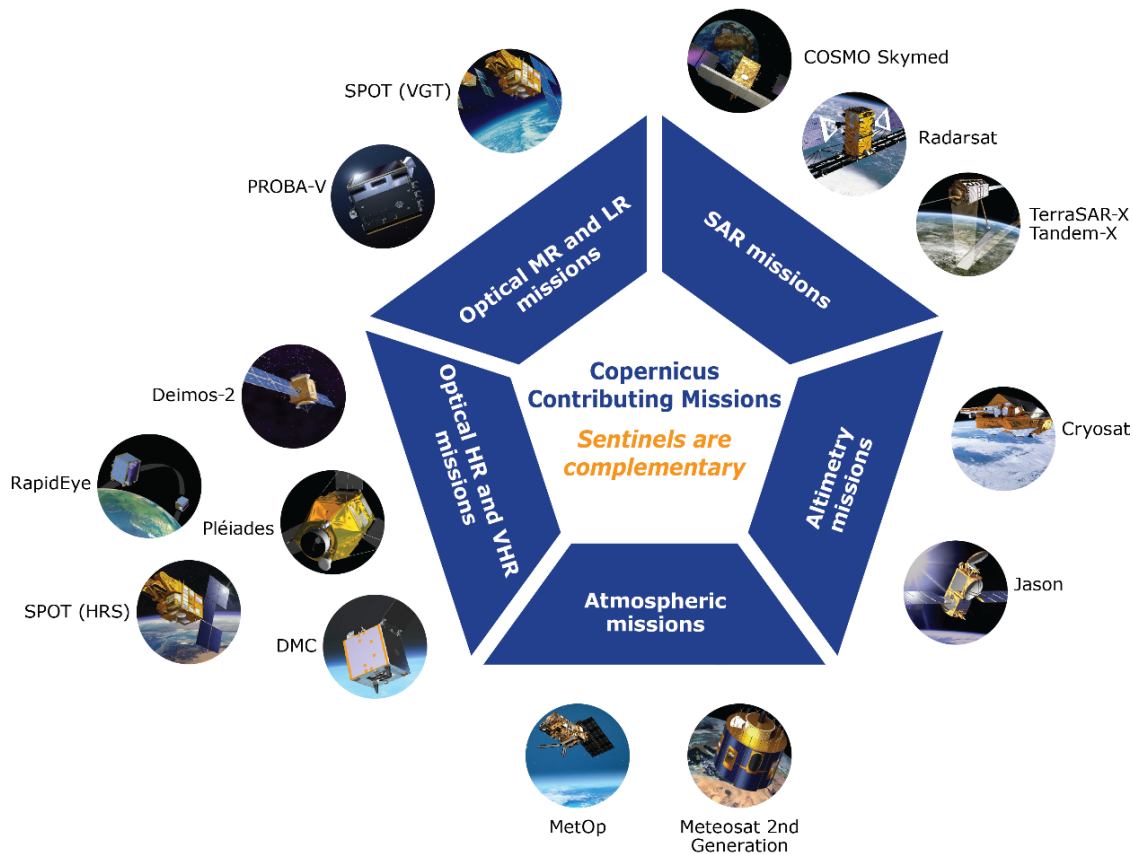
In Situ





Copernicus

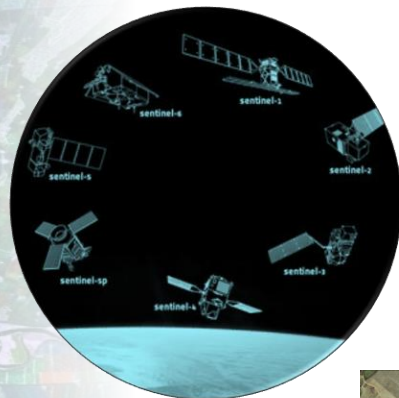
THE CONTRIBUTING MISSIONS



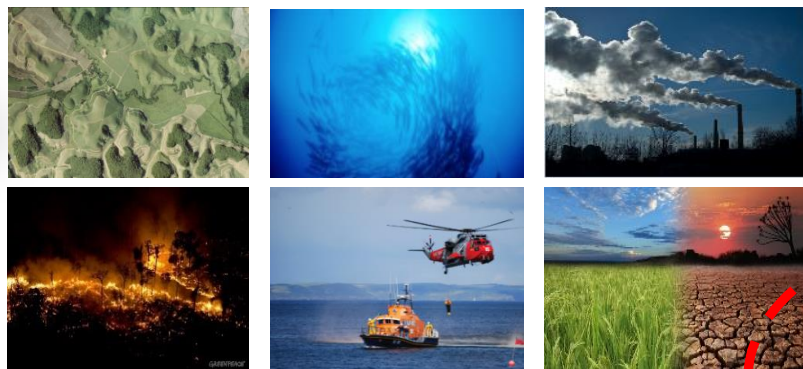


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COPERNICUS ARCHITECTURE

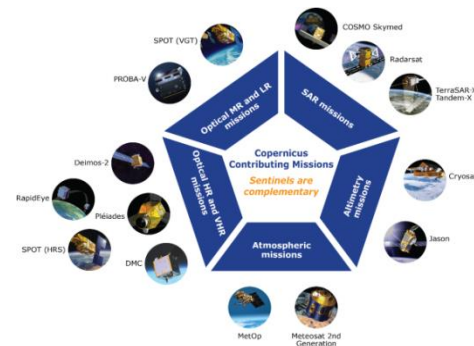


Sentinels

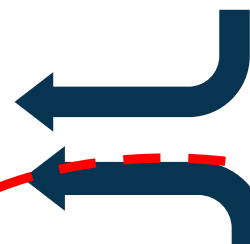


added-value products

6 services use Earth Observation data to deliver



Contributing missions



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In situ

IN - SITU COMPONENT: OVERVIEW

- *In situ* data = "observation data from ground-, sea-, or air-borne sensors, reference and ancillary data licensed or provided for use in Copernicus" (*Copernicus regulation – article 3*)
- Use of *In situ* data:
 - Validate & calibrate Copernicus products
 - Reliable information services





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COPERNICUS SERVICES



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COPERNICUS ARCHITECTURE



Sentinels

6 services use Earth Observation
data to deliver



added-value products



Contributing missions



In Situ





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COPERNICUS SIX SERVICES



With thanks and acknowledgements to ESA, EUMETSAT and Copernicus services



Land Monitoring Service (pan-EU & local)

JRC

Land Monitoring Service (global)



Marine Environment Monitoring Service



Atmosphere Monitoring Service



Climate Monitoring Service

JRC

Emergency Management Service



Security Service (Border surveillance)



Security Service (Maritime Surveillance)



Security Service (Support to External Action)



In-situ Coordination



Land
Monitoring

Global Land: Benefit areas and products examples

Ecosystems

Biodiversity

Agriculture

Forestry

Energy

Natural Resources

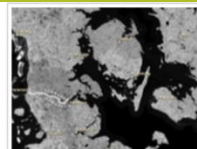
Water

Urban planning

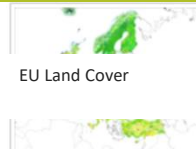
Global



Pan-European



[Image Mosaics](#)



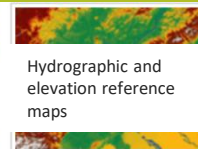
EU Land Cover

[CORINE Land Cover](#)



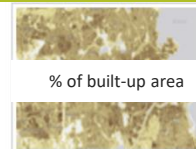
Specific land cover info

[High Resolution Layers](#)



Hydrographic and
elevation reference
maps

[Reference Data](#)



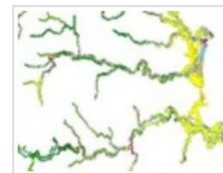
% of built-up area

[Related Pan-European
products](#)

Local



[Urban Atlas](#)



[Riparian Zones](#)



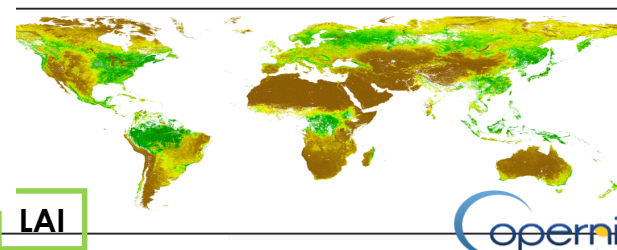
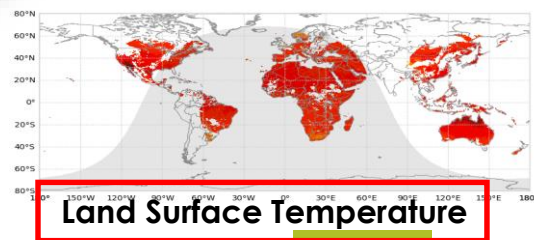
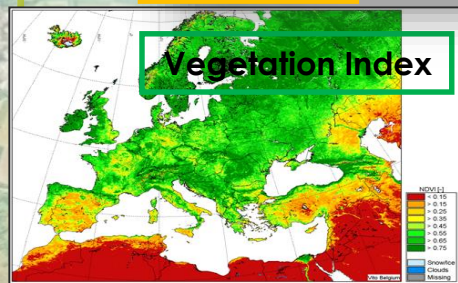
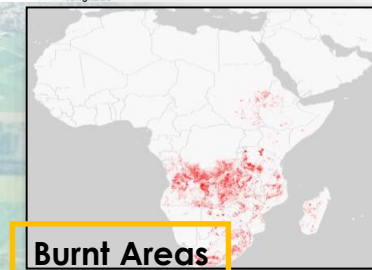
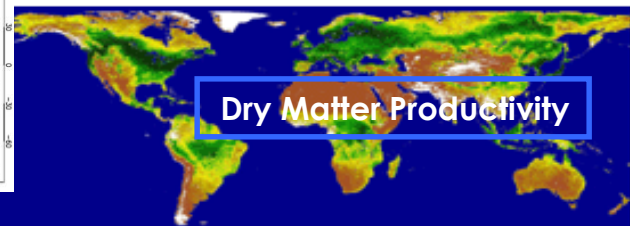
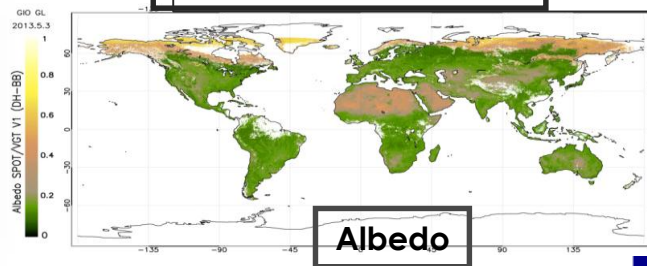
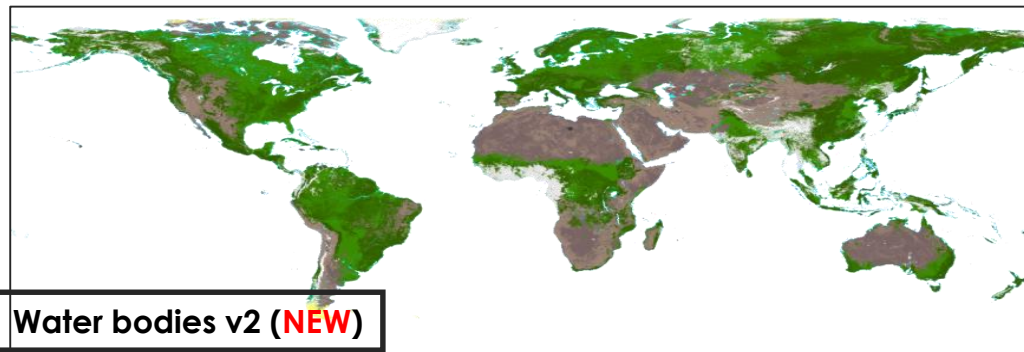
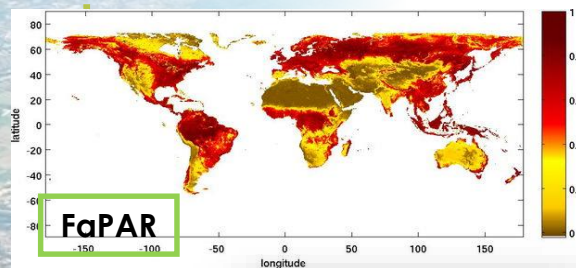
[Natura 2000 \(N2K\)](#)

Global Land



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Commission

Monitoring





Marine
Monitoring

Marine Monitoring: Benefit areas and products examples

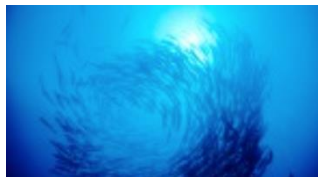
Marine safety

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, chlorophyll, biology, chemistry)



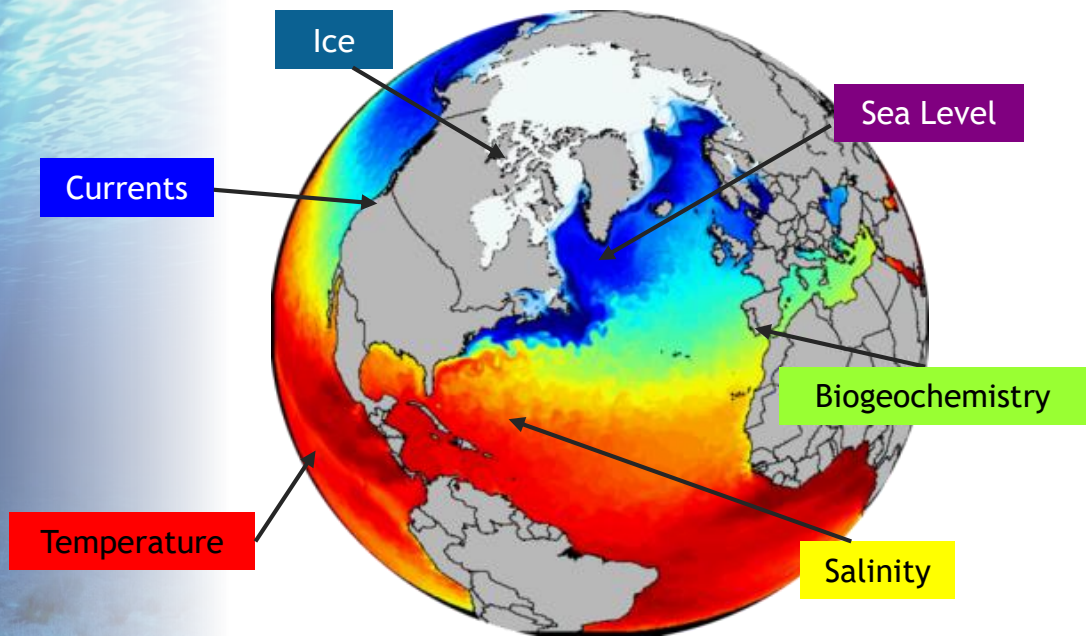
European
Commission

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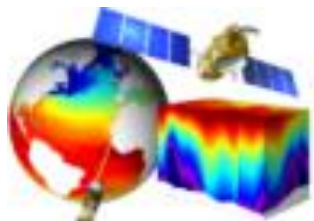


Marine
Monitoring

Marine Environment Monitoring Service



**A 3D and consistent
estimation of the
ocean state**



- 1. Global
- 2. Arctic
- 3. Baltic
- 4. NWS
- 5. IBI
- 6. Med Sea
- 7. Black Sea

- **Global and Regional**
- **Real time and Reanalyses**
- **Satellite & In Situ obs. and Models**



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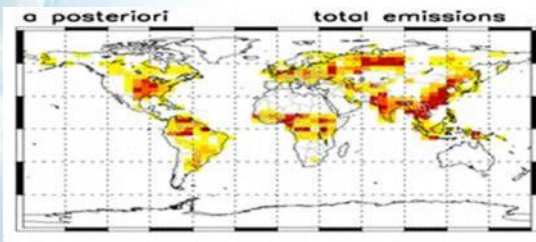


Atmosphere
Monitoring

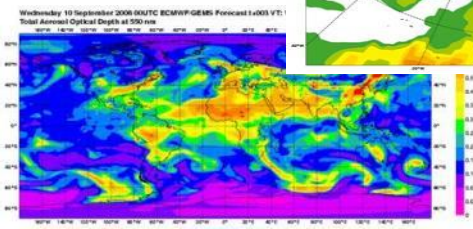
Atmosphere Monitoring Service



Emissions

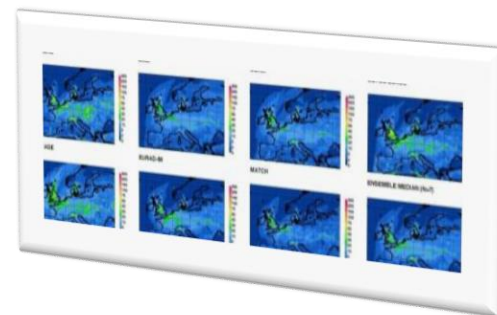


*Global
Forecasts*



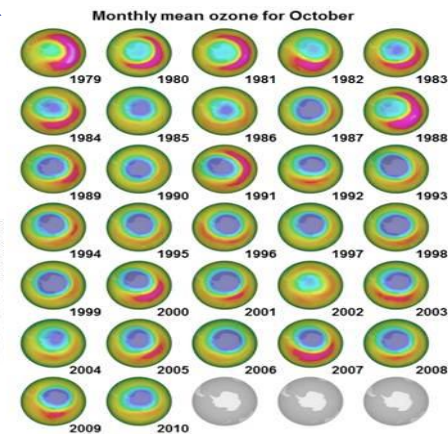
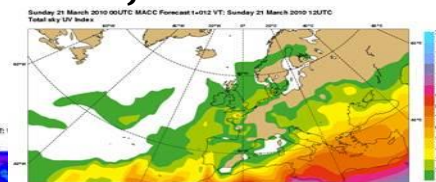
*Air Quality
forecast*

*and
(Re-)Analysis*



*Stratospheric
Ozone*

UV Information



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Climate
Change

Benefit areas and products examples

Climate change

**Mitigation and
adaptation**

Weather forecast

Pollution

Environment

Health

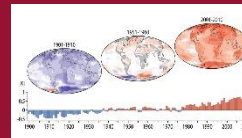
**Consistent Estimates of the
Essential Climate Variables (ECVs)**



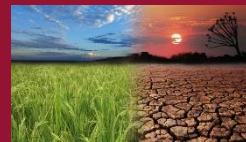
**Support to Mitigation and
Adaptation Strategies**



**Global and Regional
Reanalyses**



**Seasonal Forecasts
And Climate Projections**

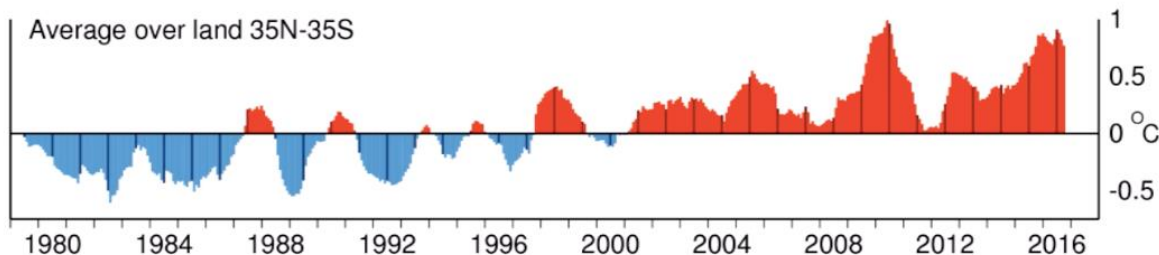
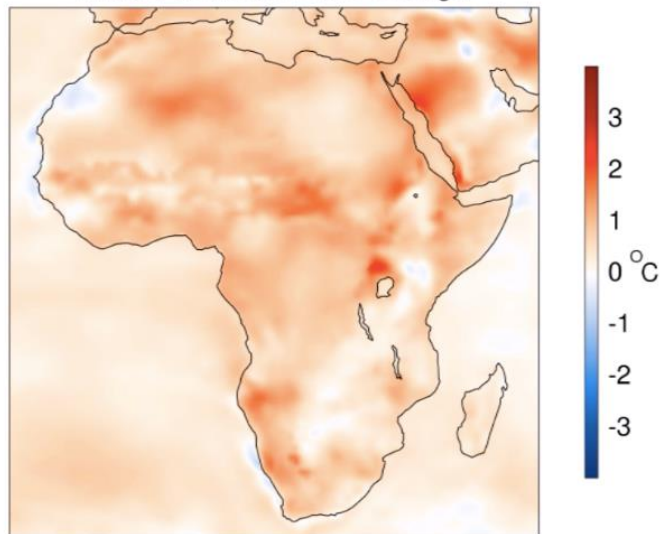




Climate
Change

A source for essential climate variables

Surface air temperature averaged from 201604 to 201703
relative to its 1981-2010 average



**How is the
climate
changing?**

*Observations &
Re-analysis*

**What are
the societal
impacts?**

*Climate
indicators &
Sectoral
information*

**What is
the rate of
change?**

*Forecasts &
Projections*



Climate
Change

Sectoral Information System

WHAT WILL THE INFORMATION BE USED FOR?

The wealth of climate information will be the basis for generating a wide variety of climate indicators aimed at supporting adaptation and mitigation policies in Europe in a number of sectors. These include, but are not limited to, the following:



**WATER
MANAGEMENT**



**AGRICULTURE &
FORESTRY**



TOURISM



INSURANCE



TRANSPORT



ENERGY



HEALTH



**INFRASTRUCTURE
DISASTER RISK
REDUCTION**



COASTAL AREAS

1

INFORMING

POLICY DEVELOPMENT TO PROTECT CITIZENS FROM CLIMATE-RELATED HAZARDS SUCH AS HIGH-IMPACT WEATHER EVENTS

2

IMPROVING

PLANNING OF MITIGATION AND ADAPTATION PRACTICES FOR KEY HUMAN AND SOCIETAL ACTIVITIES

3

PROMOTING

THE DEVELOPMENT OF NEW SERVICES FOR THE BENEFIT OF SOCIETY



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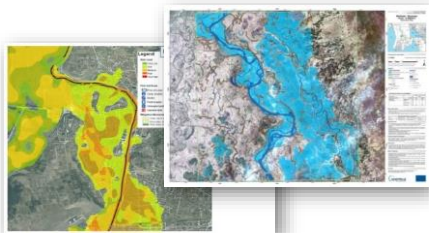
Atmosphere
Monitoring

Emergency Monitoring Service Overview

ON-DEMAND MAPPING

Risk & Recovery Mapping

Rapid Mapping

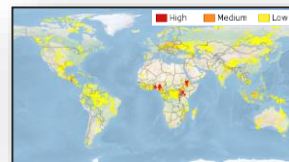
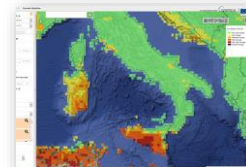


covers entire
DRM cycle



EARLY WARNING & MONITORING SYSTEMS

Forest **Fire**
Information
Systems



Drought
Observatory

Flood
Awareness
Systems



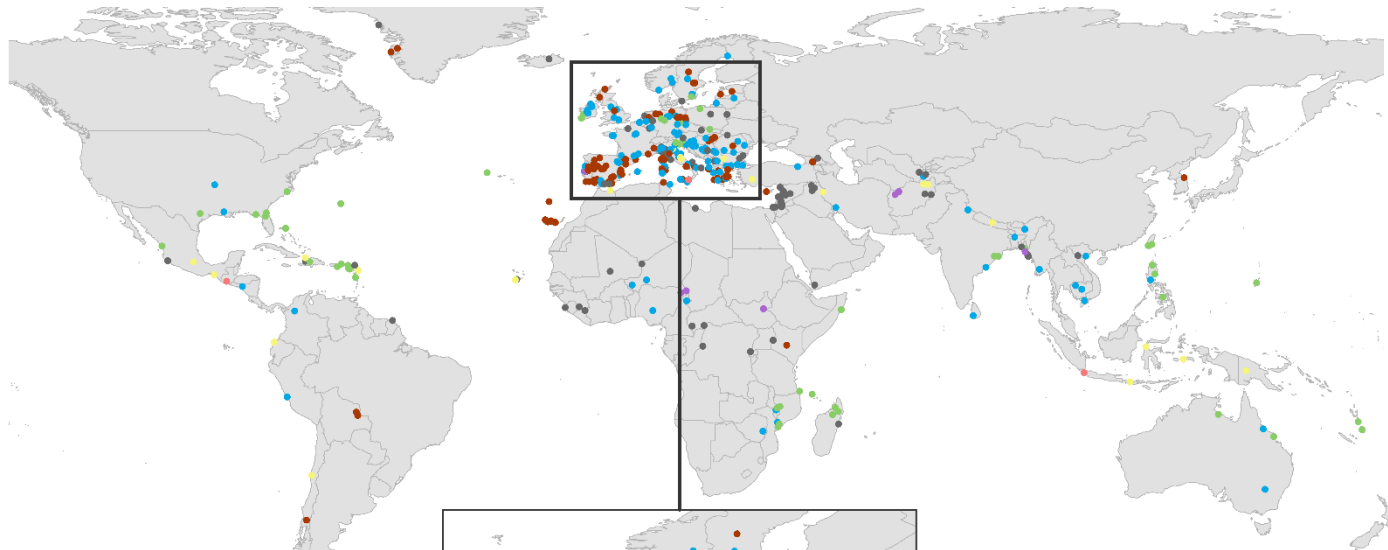
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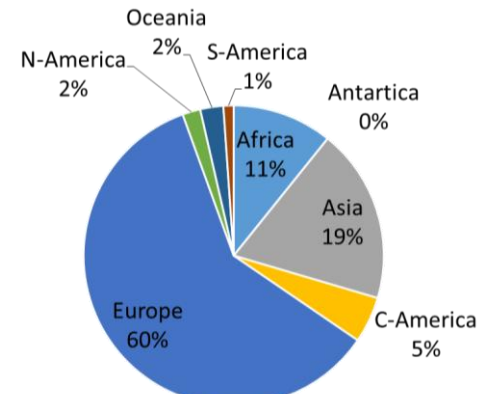
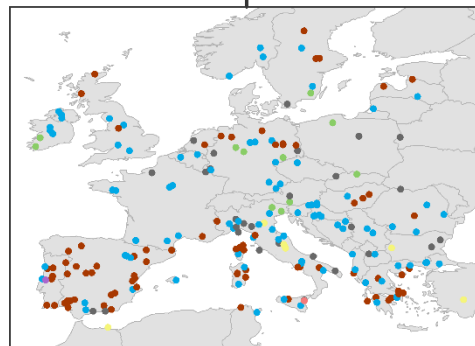
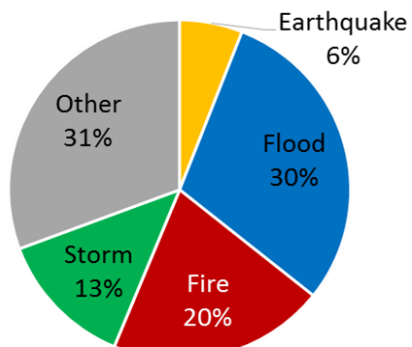
Atmosphere
Monitoring

Rapid Mapping Activations 2012-2019



**EMSR Activations
(03.2012 - 10.2019)**

- Earthquake
- Flood
- Humanitarian
- Other
- Storm
- Volcanic activity
- Wildfire

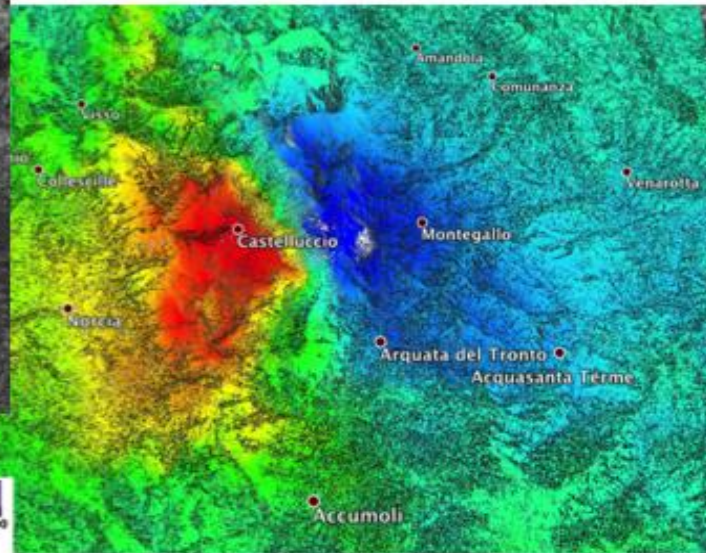
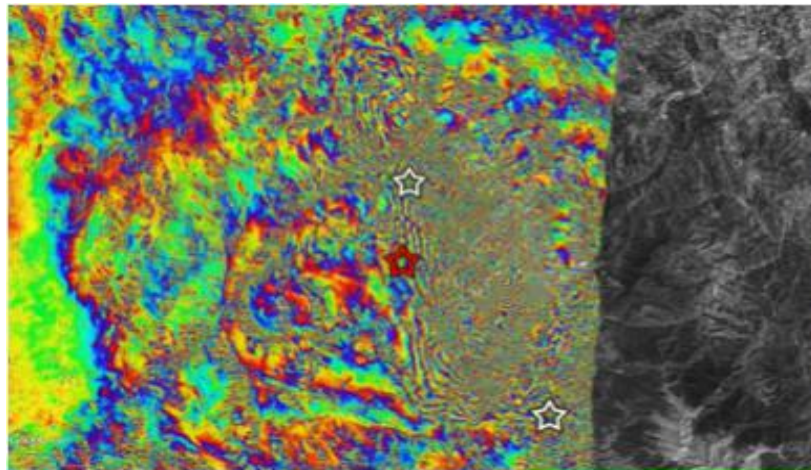




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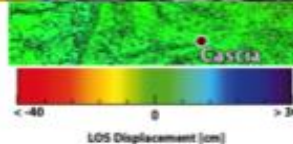
Sentinel-1A and Sentinel-1B combined use

Central Italy M6.5 earthquake, 30 October 2016



Interferogram based on:

- S1A acquisition of 25 Oct 2016
- S1B acquisition of 31 Oct 2016



Ground deformations extending to about **130 sq. km**. **Maximum LOS displacement of at least 70 cm**. Based on interferogram generated with:

- S1B acquisition of 26 Oct 2016
- S1A acquisition of 1st Nov 2016

The Monks of Norcia
@monksdnorcia
Follow
The Basilica of St. Benedict is destroyed, flattened by most recent earthquake.
#Terremoto





Security

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



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Commission





Security



**FRONTEX is the Copernicus
Entrusted Entity for the
implementation of the Copernicus
Border Surveillance Component of
the Security Service**

Since Dec2015

1

Support to Border Surveillance

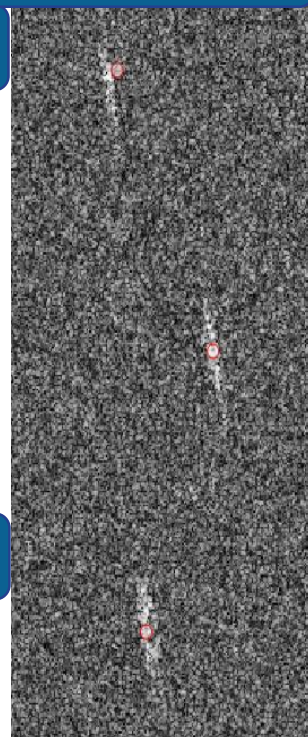
List of Products

On request

- S1 Coastal Monitoring
- S2 Pre-frontier Monitoring
- S3 Reference Mapping
- S4 Surveillance of Maritime Areas of Interest
- S5 Vessel Detection
- S7 Vessel Anomaly Detection

Permanent

- S6 Vessel Tracking and Reporting
- S8 Environmental Assessment



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Commission





Security

Support to Maritime Surveillance



EMSA is the Copernicus Entrusted Entity for the implementation of the Copernicus Maritime Surveillance Service

To support users by providing a better understanding and improved monitoring of activities at sea

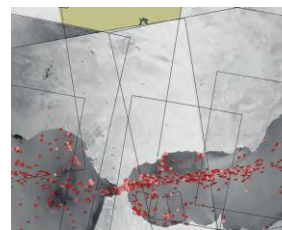
Since Nov 2015

2

List of Products



Fisheries Control



Maritime Safety and Security



Law Enforcement



Customs



Marine Environment Monitoring



Other (defence, anti-piracy)



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Security

Support to EU External Actions



**SATCEN is the Copernicus
Entrusted
Entity for the
implementation of the
Support to EU External Actions
Services**

Since May 2017

3

List of Products



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Climate
Change

THE BIG DATA CHALLENGE

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



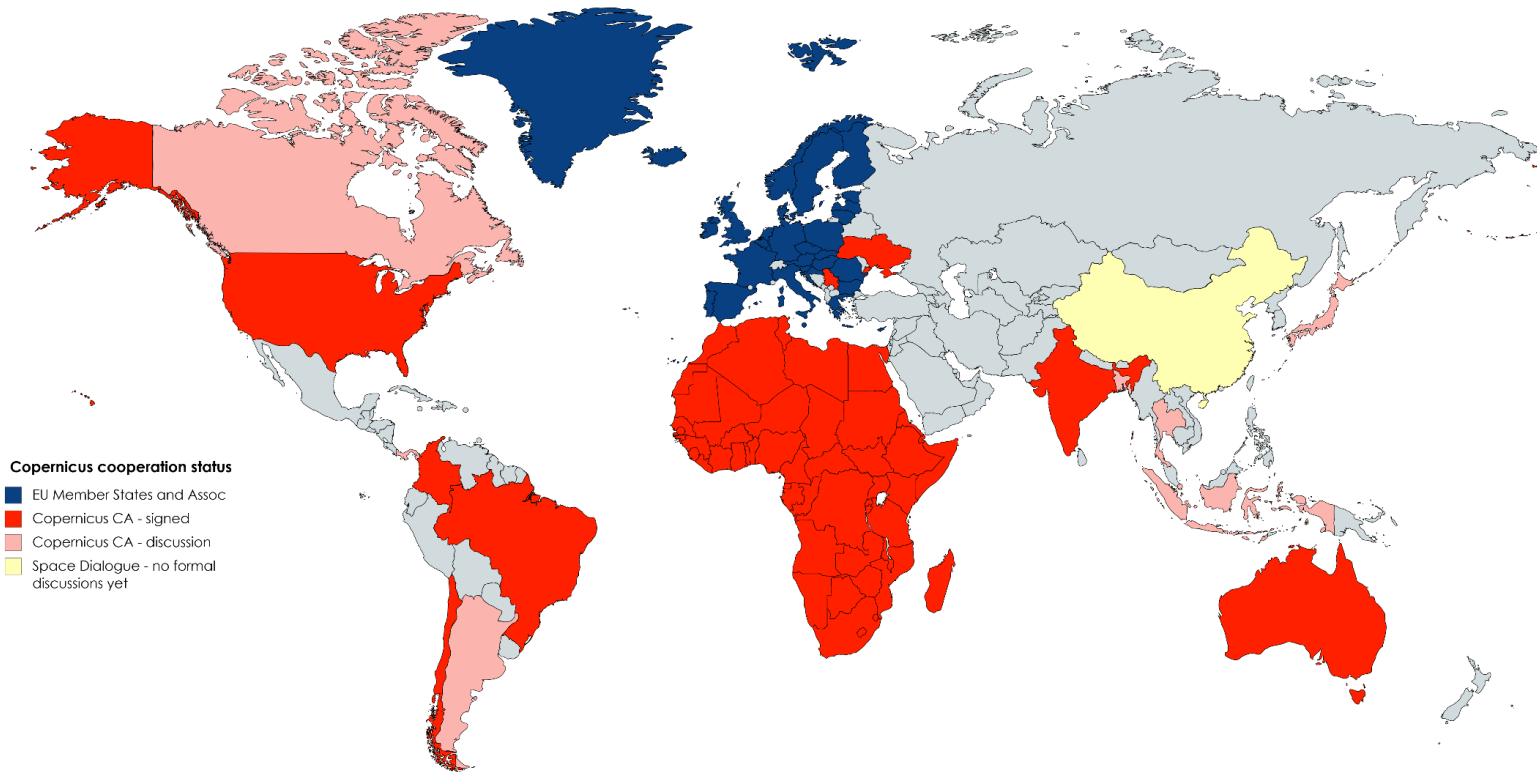
Over 16 TB data / day

- Different types of **dissemination** infrastructures
- Member States Collaborative Ground Segment
- **New technology** developments
- ICT and EO **cross-fertilisation**
- **Interoperability** with non-EO datasets
- Public programmes as enablers
- Growth and jobs in **downstream** sector



Copernicus

International Cooperation



Copernicus cooperation status

- EU Member States and Assoc
- Copernicus CA - signed
- Copernicus CA - discussion
- Space Dialogue - no formal discussions yet

Created with mapchart.net ©



Copernicus

Outlook – Space component 2021 - 2027

Providing long term continuity

2014

Current Sentinel constellation

Sentinel **Expansion**

**Providing new
observation needs**

Both, current and expansion
missions are replaced by NG
missions

Sentinel **Next Generation**

Continuity: strong investment in existing services

Evolution to match the needs: climate change, the arctic and sustainable development; security/defense, IoT

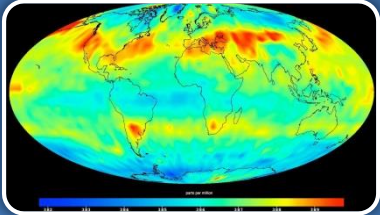
Adaption to new realities: new space, strategic autonomy on key systems, geopolitical realities



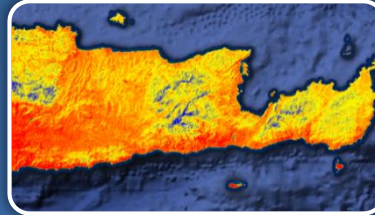
Copernicus

Copernicus Evolution – Expansion phase

6 priority challenges have been identified ...



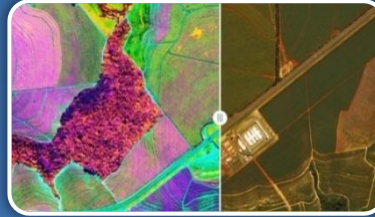
Causes Climate Change



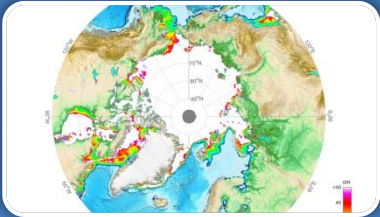
Agriculture & Urban Mgmt.



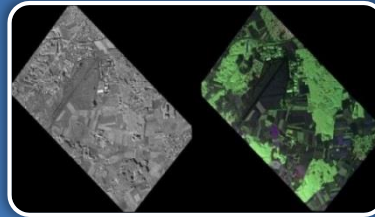
Effects Climate Change



Food Security, Soil & Minerals



Sea Ice & Hydrology



Soil, Vegetation & Ground Motion



Missions vs User needs

Proposed Mission	Primary Observation Requirements to be addressed	
CO2	Monitoring of anthropogenic CO2 emissions at country/regional and megacities scale	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



#vdLcommission



Political Priorities for the next European Commission 2019-2024

1. **A European Green Deal**
2. **An economy that works for people**
3. **A Europe fit for the digital age**
4. **Protecting our European way of life**
5. **A stronger Europe in the world**
6. **A new push for European democracy**



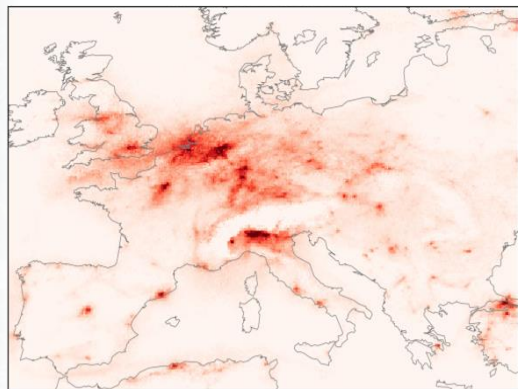


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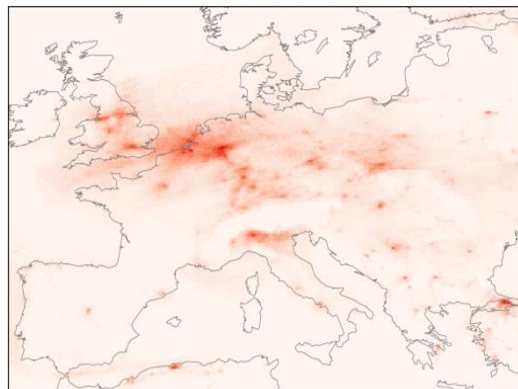
Copernicus and COVID 19

NO₂ Total Column

Mid-March to mid-April 2019



Mid-March to mid-April 2020



S-5P is the 1st satellite to provide credible measurements of air quality.

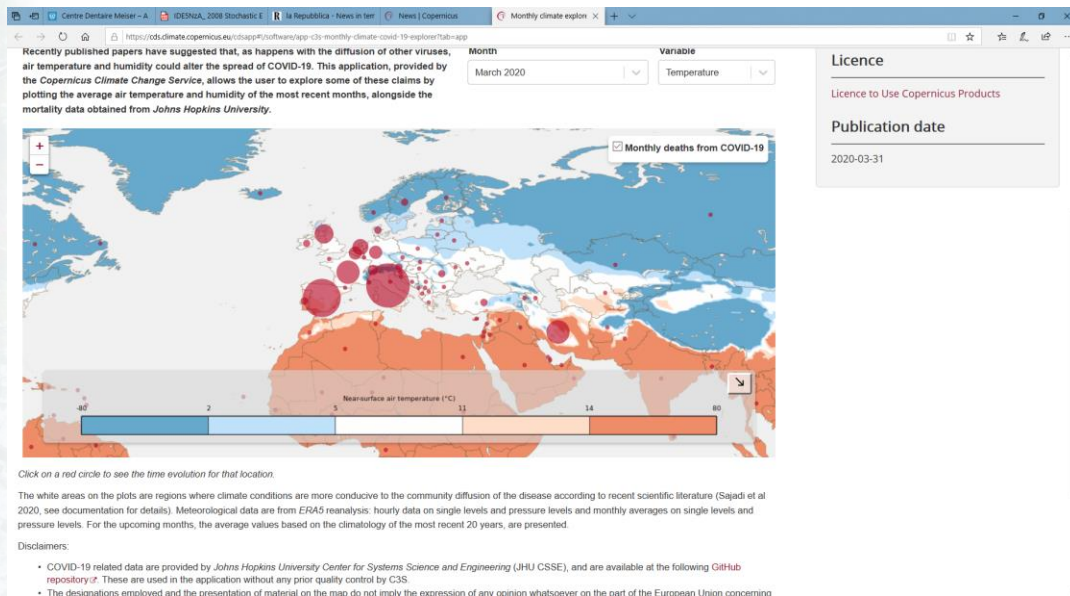


Copernicus and COVID 19

Copernicus C3S helps health experts explore how temperature and humidity affect virus spread

<https://climate.copernicus.eu/c3s-helps-health-experts-explore-how-temperature-and-humidity-affect-virus-spread>

Recent research suggests that the spread of the new coronavirus (SARS-CoV-2) could be affected by temperature and humidity, so the C3S has worked with environmental software experts [B-Open](#) to develop an [application](#) that maps mortalities against temperature and humidity data. The application allows health authorities and epidemiology centres to explore the claims that temperature and humidity could affect the spread of coronavirus





Copernicus

Copernicus and COVID 19



ROME
Easter Morning

2020



2018



Thank you for your
attention

European Commission
www.copernicus.eu