Copernicus
the EU's Earth Observation Programme

Jean-Luc Bald
Space Counsellor
EU Delegation to the United States

Presentation at National Academies

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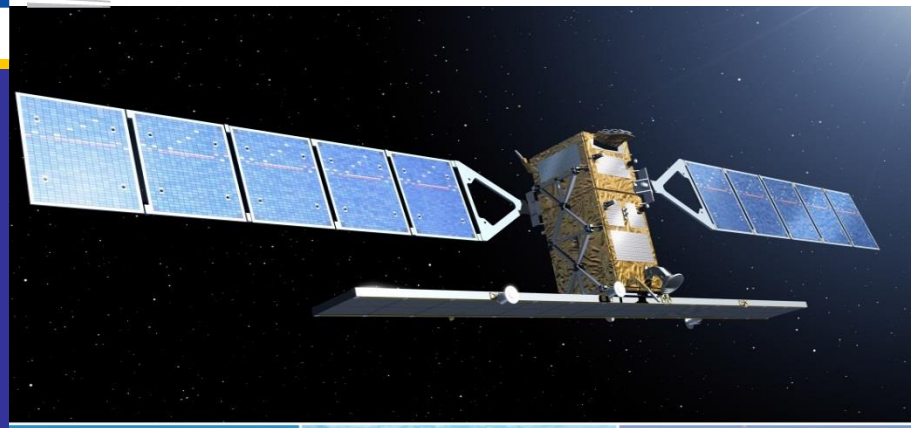
1. Objectives and architecture
2. Copernicus services
3. Data access and program evolution



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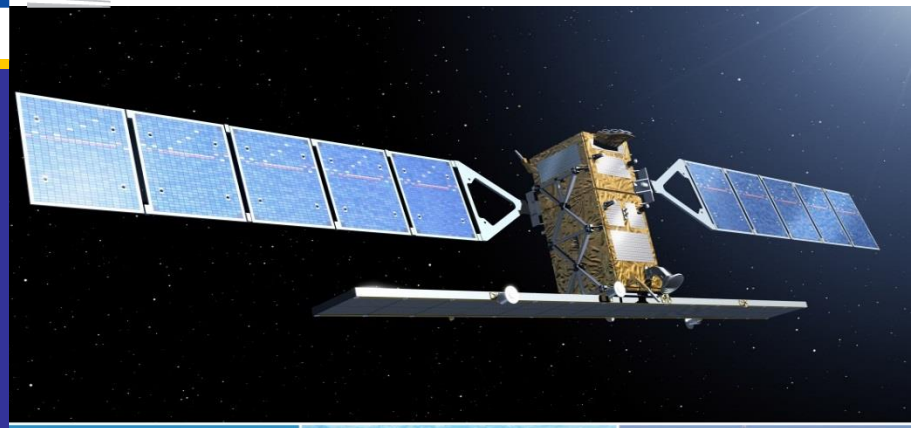
1. Objectives and architecture



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Objectives

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"The Union Earth observation and monitoring programme"

Protect people and assets

Increase general knowledge on the state of the Planet

Monitor the environment

Improve environmental policy effectiveness

Facilitate adaptation to climate change

Foster downstream applications in a number of fields

Help managing emergency and security related situations

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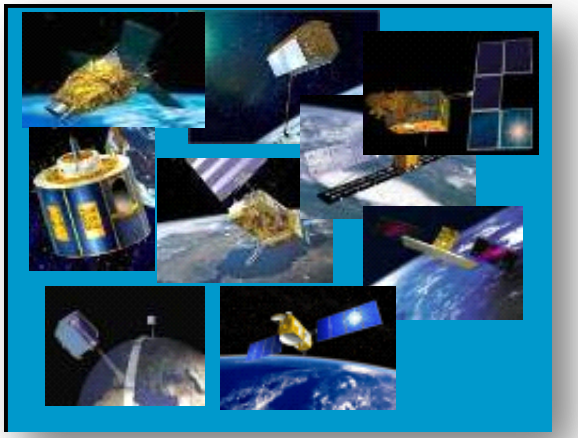
Copernicus architecture

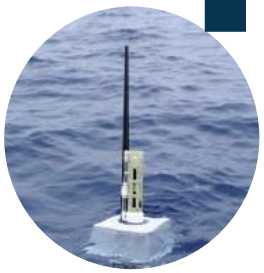
European Commission

6 services use Earth Observation data to deliver …



Sentinels

Contributing missions



…added-value products

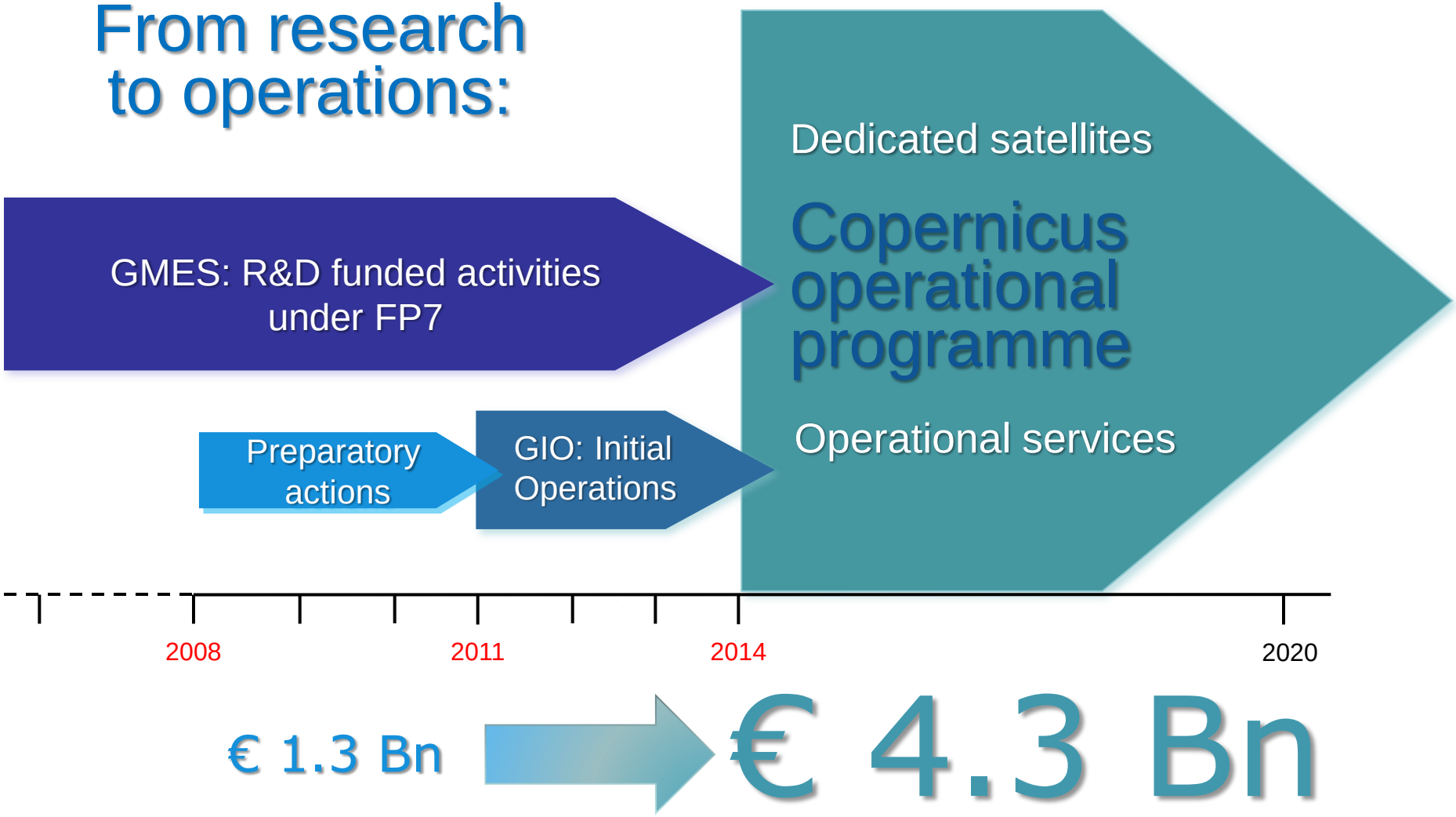
in-situ

Copernicus Funding

European Commission

Copernicus

From research to operations:



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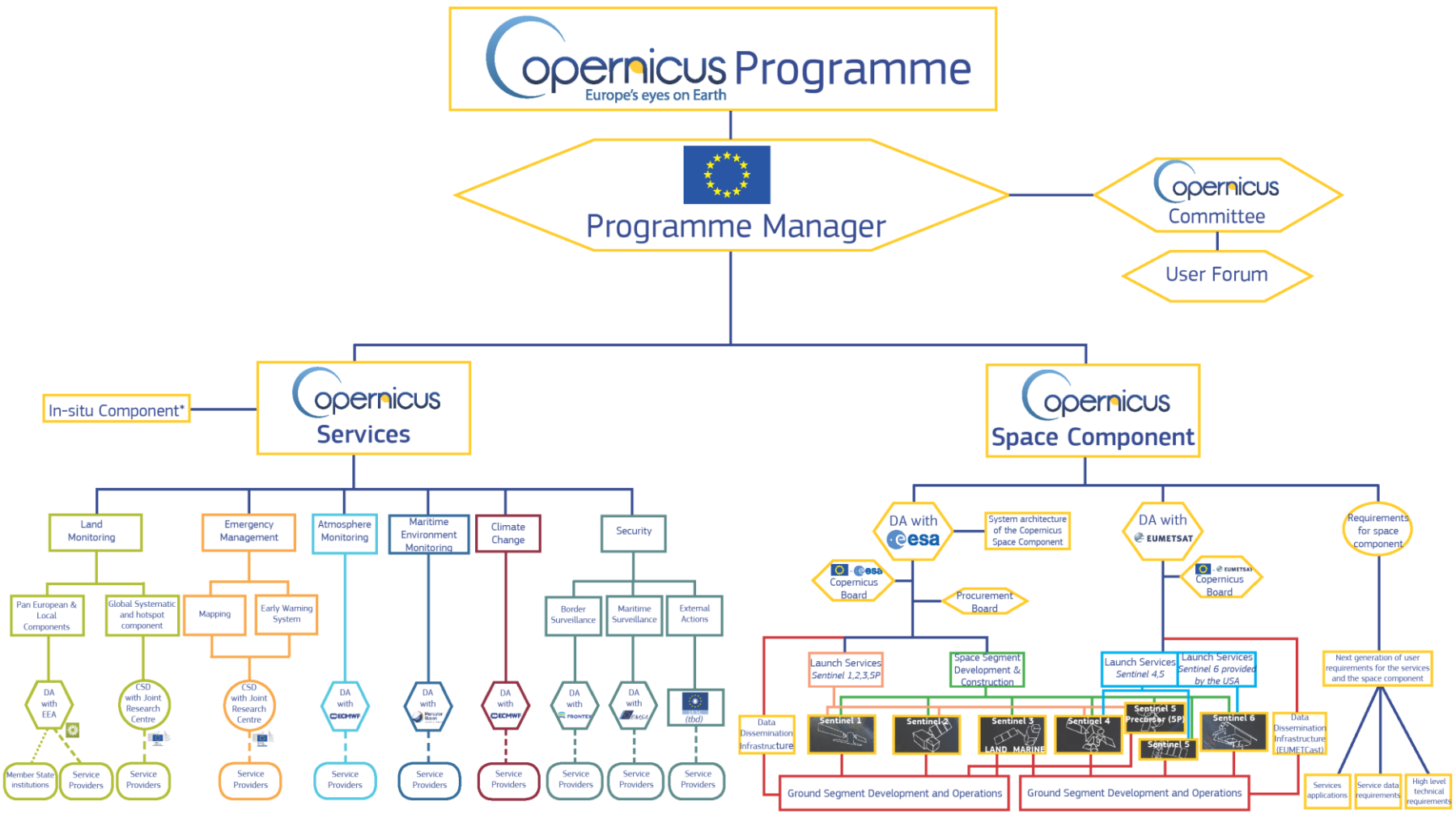
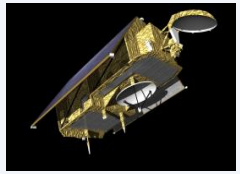
Governance structure



Copernicus Space Component: Dedicated Missions



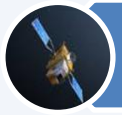



S1: Radar Mission


S2: High Resolution Optical Mission


S3: Medium Resolution Imaging and Altimetry Mission


S4: Geostationary Atmospheric Chemistry Mission

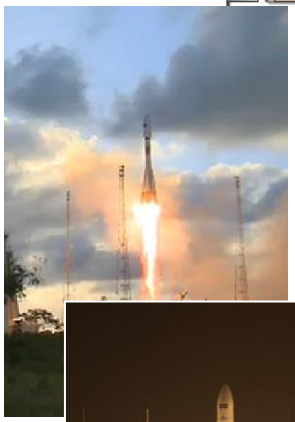

S5P: Low Earth Orbit Atmospheric Chemistry Precursor Mission

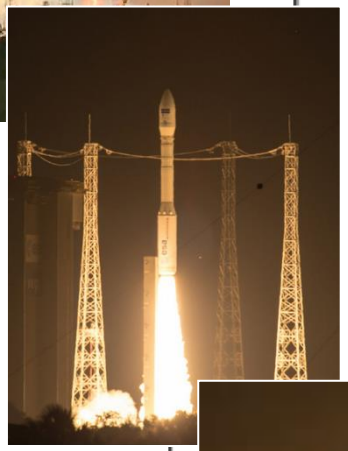

S5: Low Earth Orbit Atmospheric Chemistry Mission

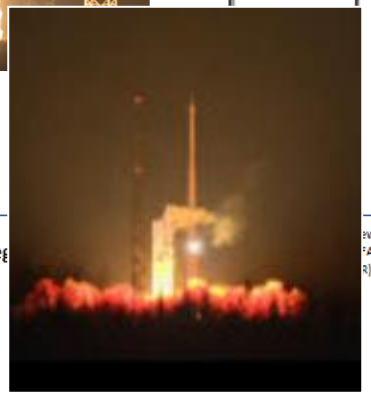

S6 (Jason-CS): Altimetry Mission

Deployment schedule

European Commission







2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027

FAR Sentinel 1A

FAR Sentinel 1B (recurrent)

FAR Sentinel 1C (recurrent)

FAR On-ground Storage Sentinel 1D (recurrent)

QAR Sentinel 2A

FAR Sentinel 2B (recurrent)

FAR On-ground Storage Sentinel 2C (recurrent)

FAR On-ground Storage Sentinel 2D (recurrent)

QAR Sentinel 3A

FAR Sentinel 3B (recurrent)

FAR On-ground Storage Sentinel 3C (recurrent)

FAR On-ground Storage Sentinel 3D (recurrent)

Sentinel 4A delivery to MTG-S1 (tbc) Integration FAR Sentinel 4A (on MTG-S1)

Sentinel 4B delivery to MTG-S2 (tbc) Integration PSR (tbc) Sentinel 4B - On-ground Storage (FAR Q1/2029)

FAR Sentinel 5 Precursor

Sentinel 5A delivery to MetOp-SG Integration FAR Sentinel 5A (on MetOp-SG A)

Sentinel 5B delivery to MetOp-SG (tbc)

FAR Sentinel 6A

PSR On-ground Storage FAR Sentinel 6B

Leg ew (QAR) FAR) or R) On-ground Storage Tentative launch date In-orbit Commissioning

Status: 19 January

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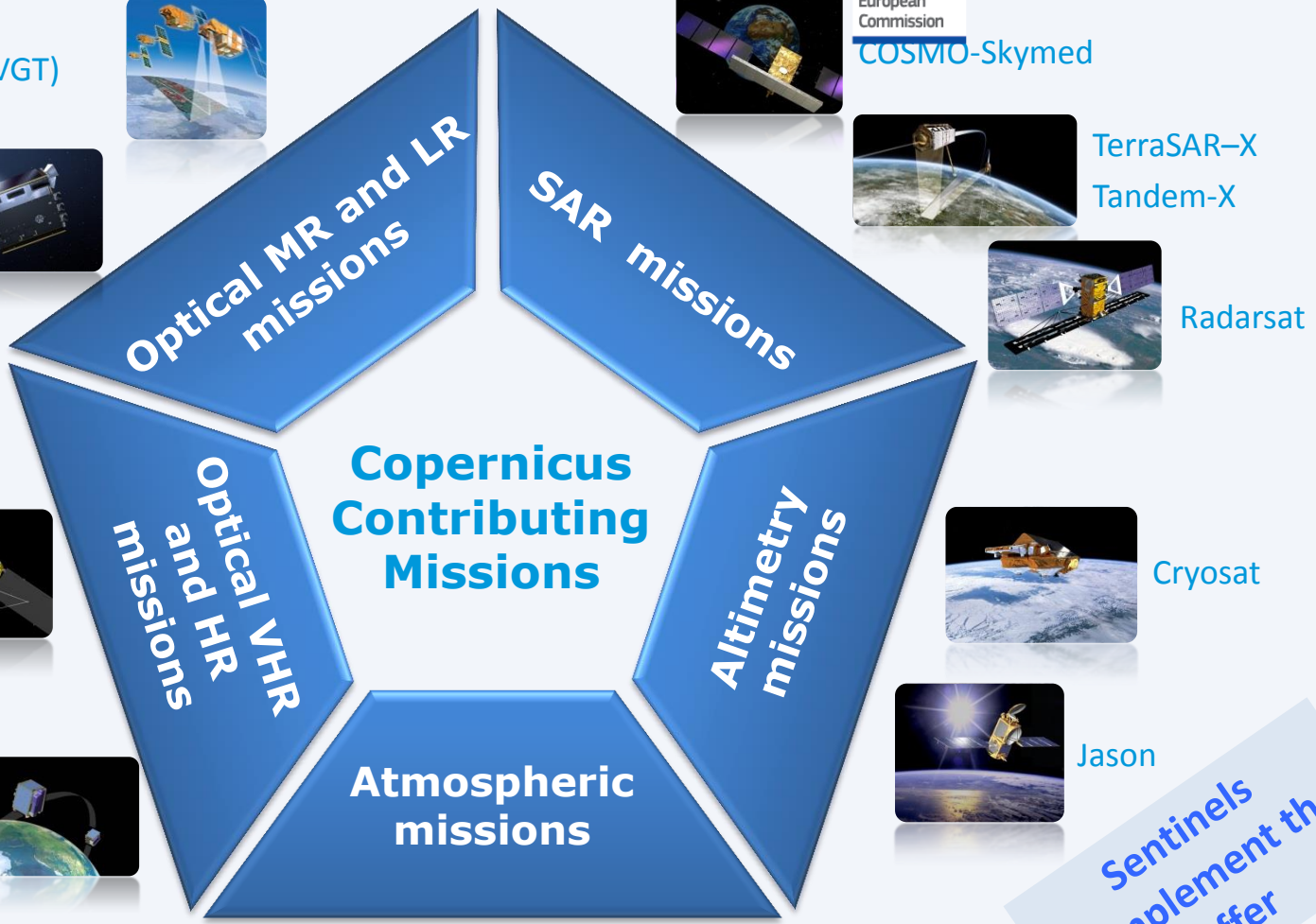
Copernicus Contributing Missions



6 operational Services

Monitoring the State of the Earth System Environment …

… cross-cutting Thematic Services

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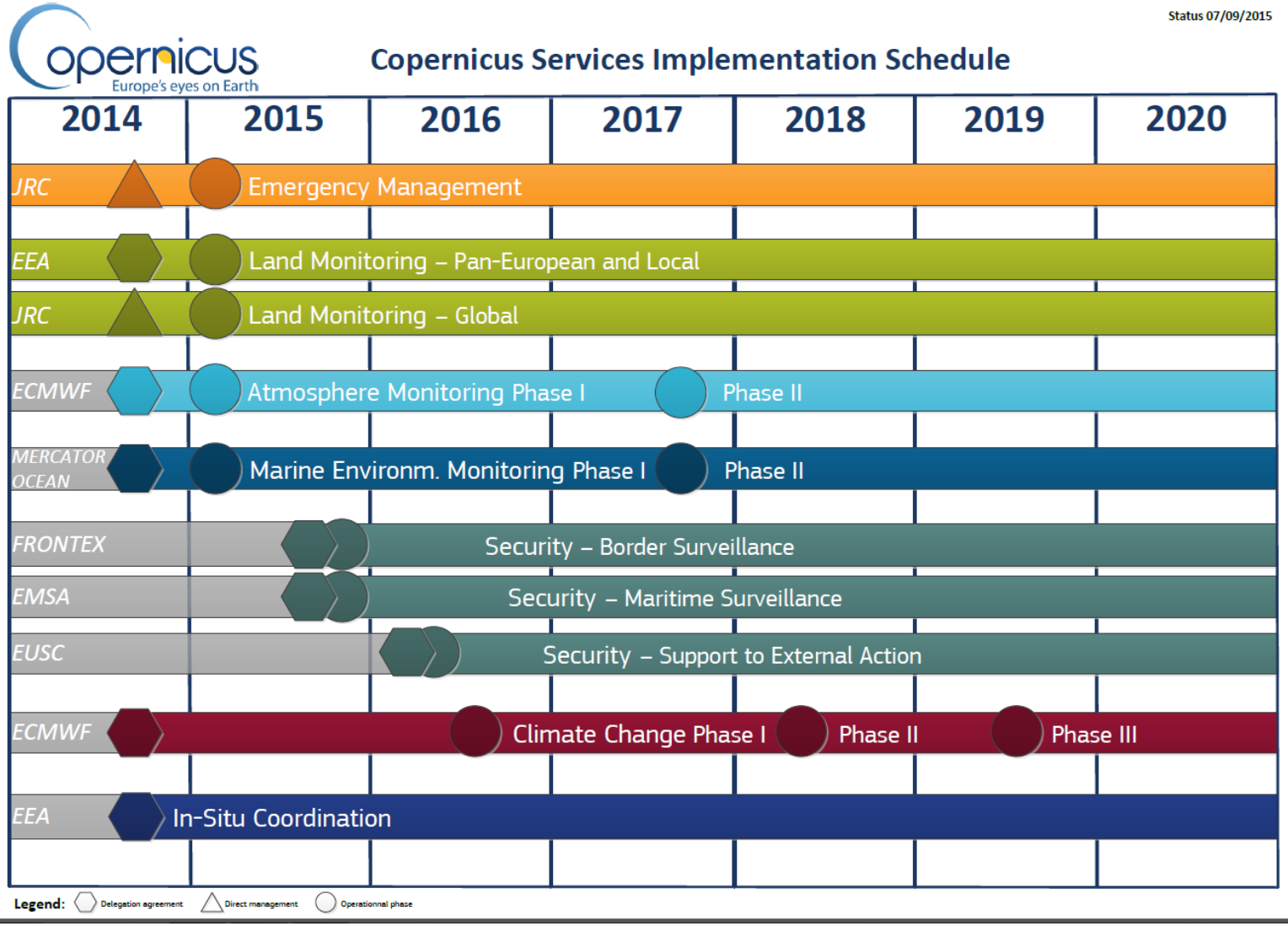
Services Deployment



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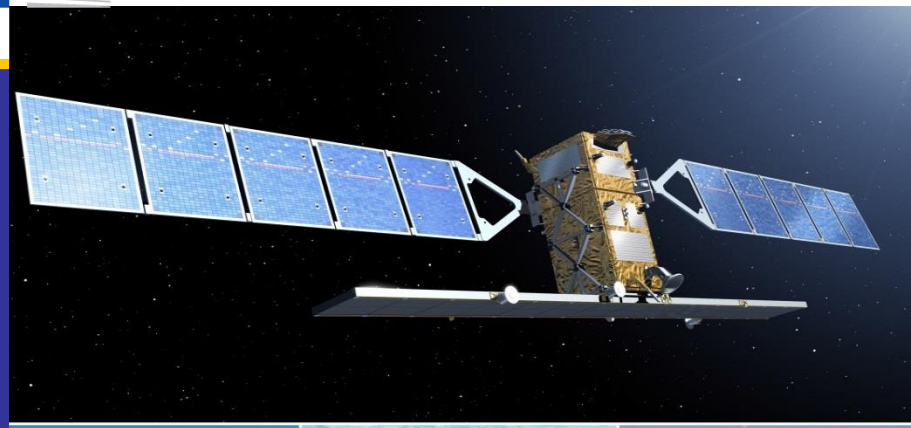
2. Copernicus services



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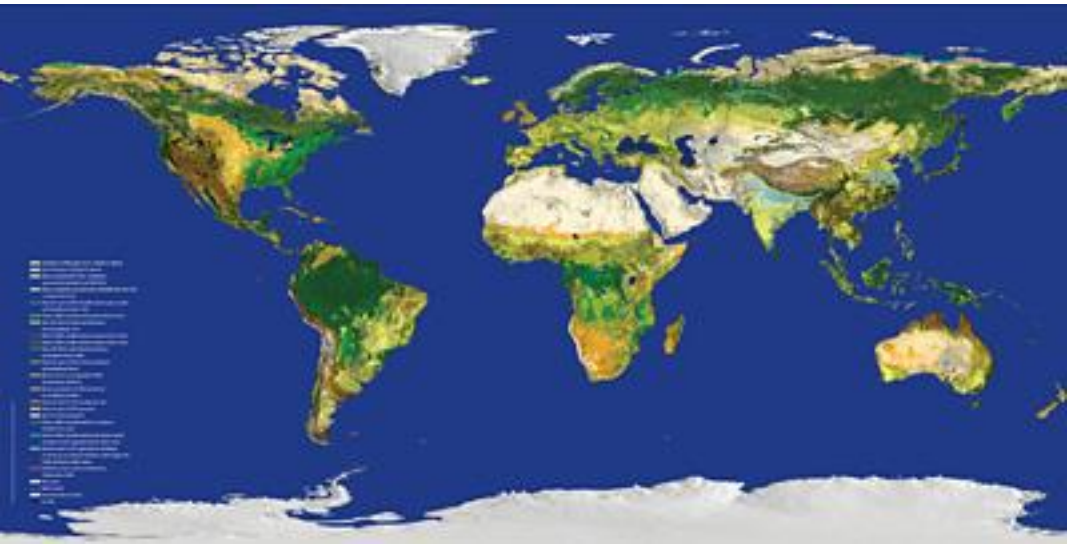
Copernicus Land Monitoring Service

Land Monitoring Service

European Commission

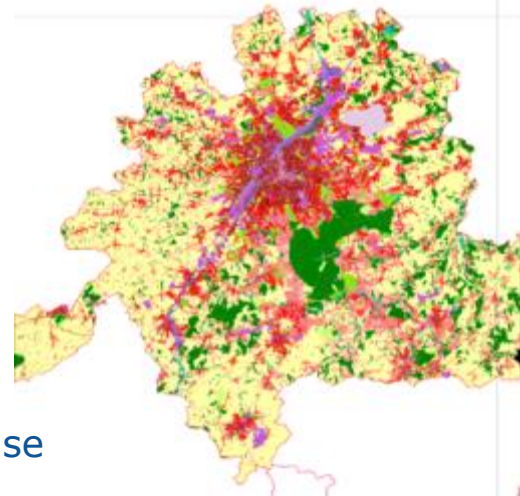


From global...

e.g. Vegetation dynamics, Bio-physical parameters, energy balance

...to pan-European...

e.g. bio-diversity, water bodies, land-use, land change

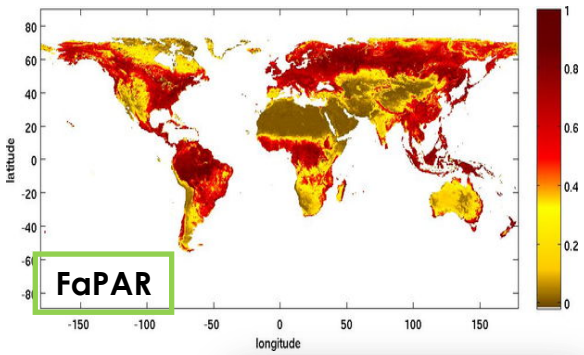


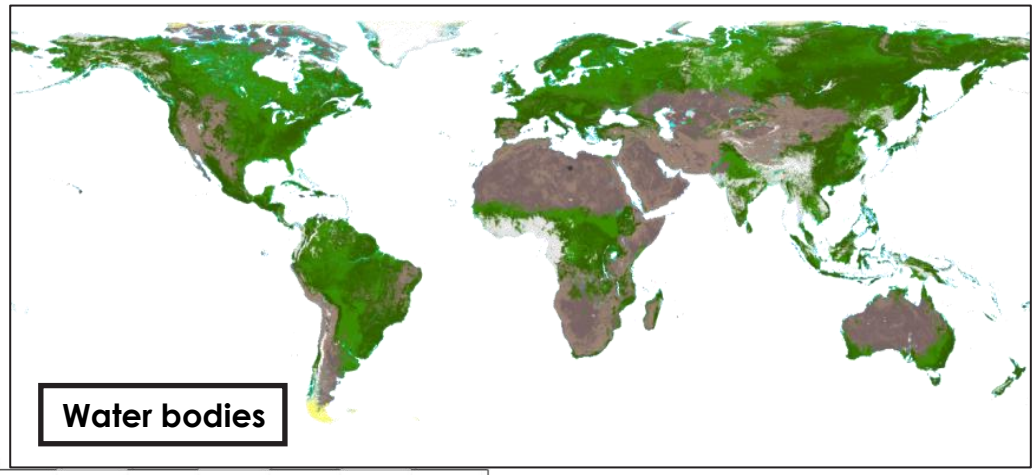
...to local

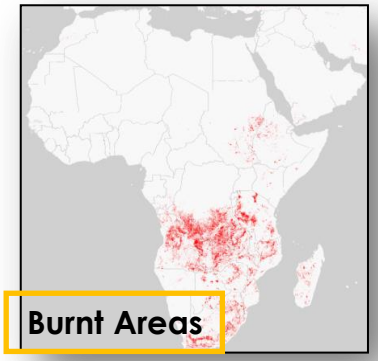
e.g. urban land-use

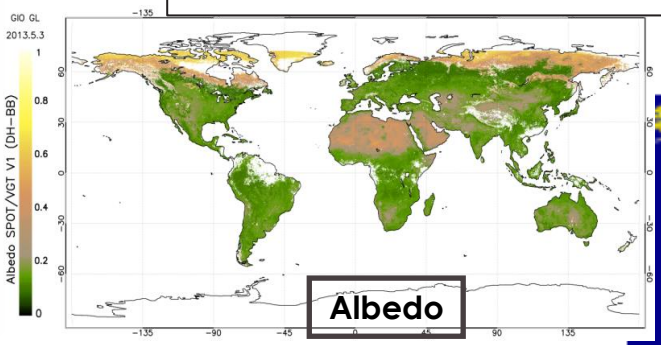
Global Land

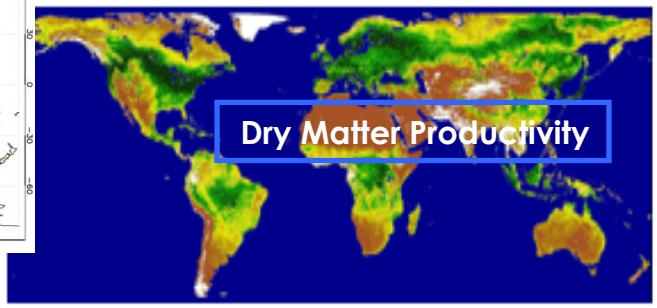
European Commission

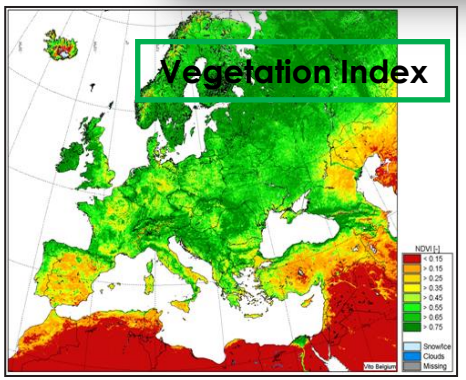


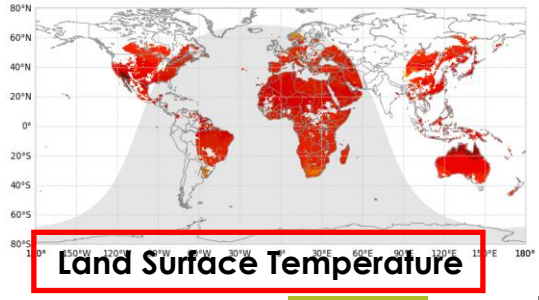


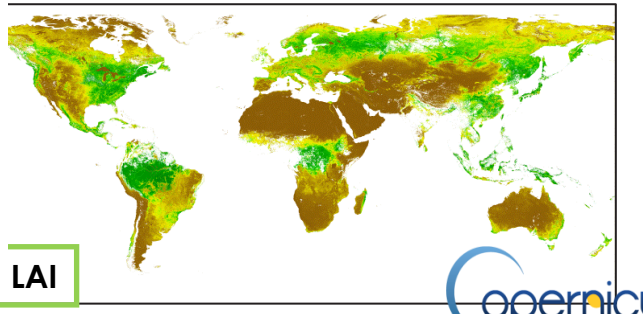












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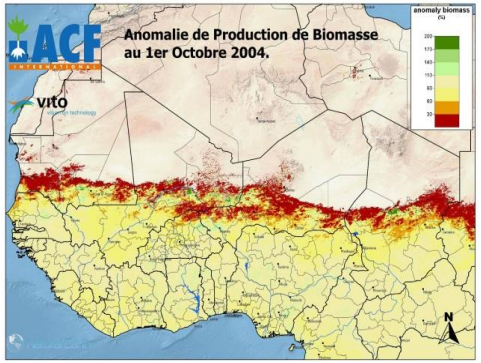
Application fields (examples)

European Commission

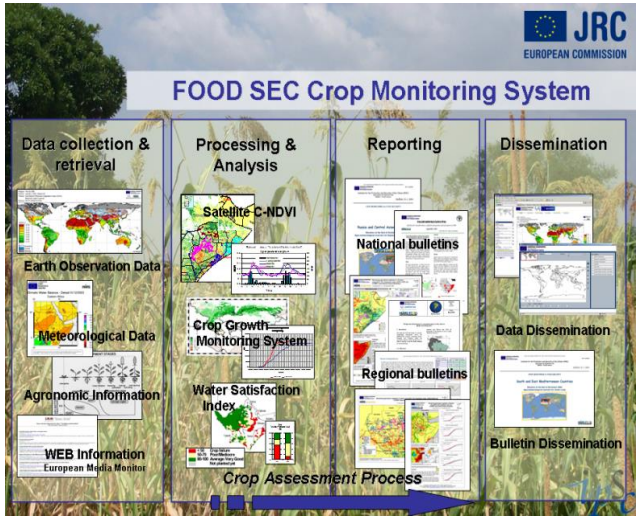
Land information to Climate change

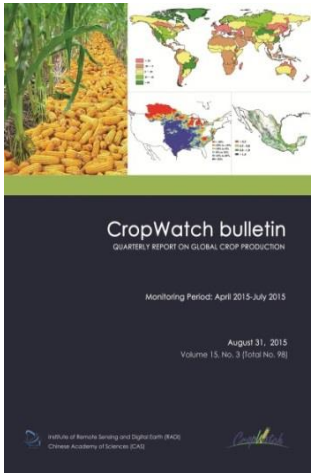
- Carbon flux forecast
- Fire management

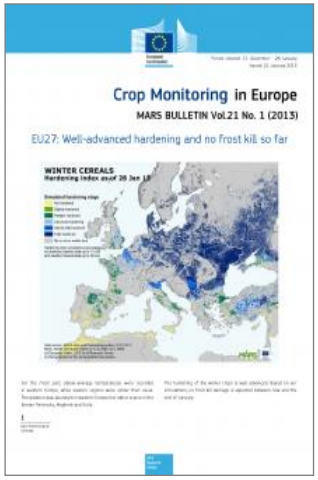


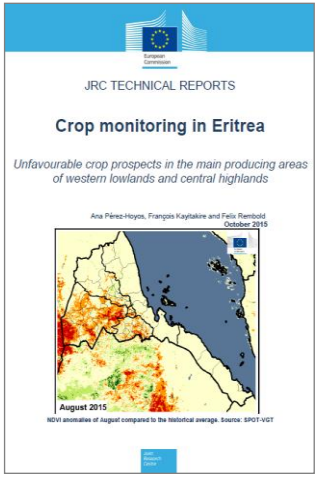
Agriculture

- Crop monitoring
- Yield forecasting
- Biomass conditions









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Application fields (examples)

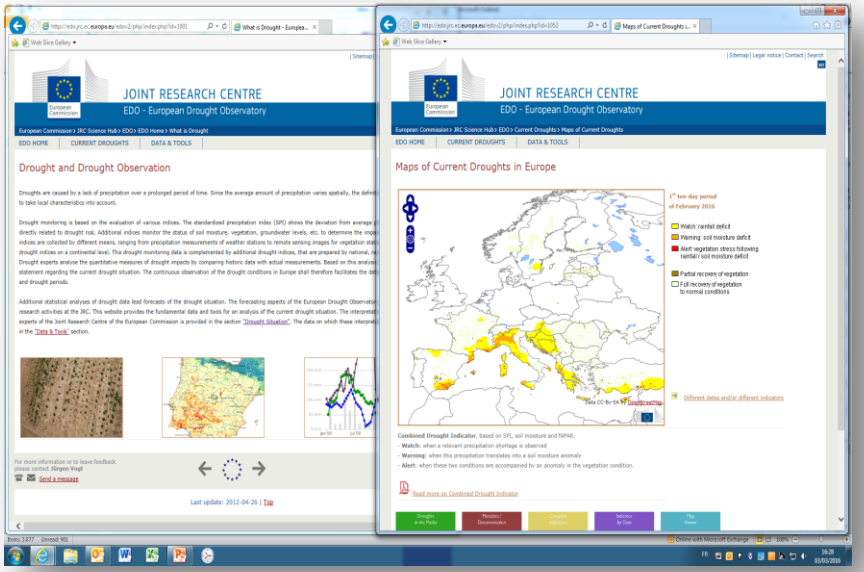
European Commission

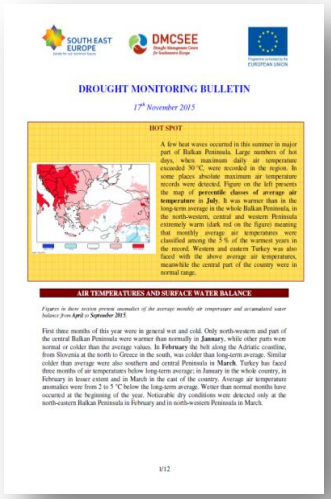
Monitoring extreme events

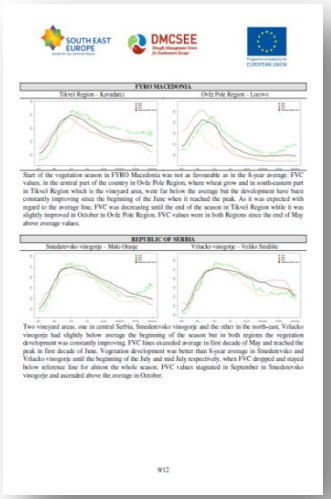
- Droughts
- Frost conditions
- Heat waves

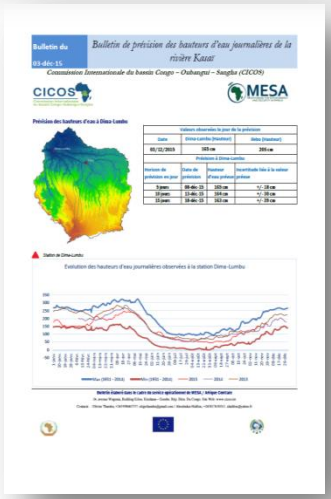
Hydrology

- Water management
- River discharge
- Navigation









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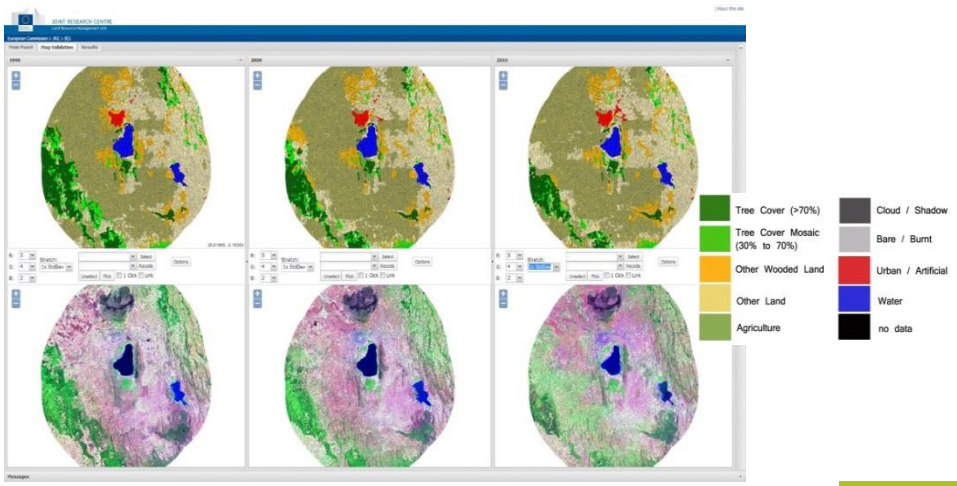
New component in 2016

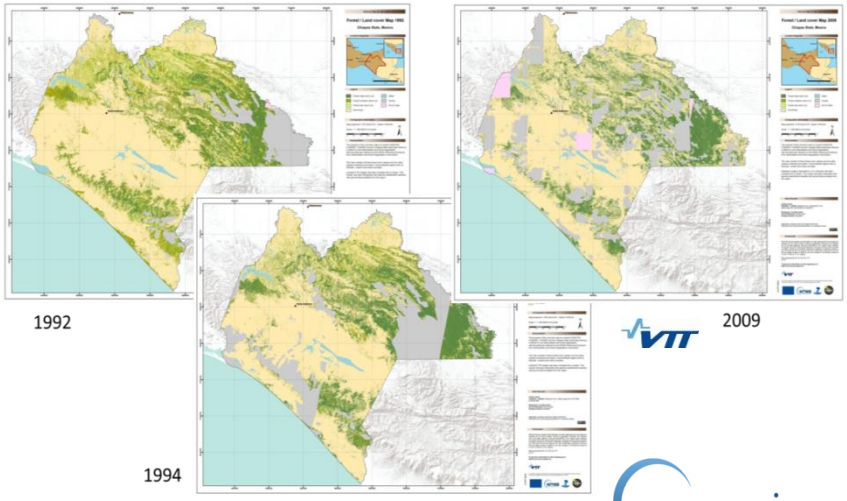
European Commission

Hot Spot monitoring activity

- High and Very High resolution Land cover - land use mapping activity
- Activation of the activity upon specific request to support to specific EU policies or EU projects outside Europe
- Based on the new Sentinel 2 satellite high resolution capacities
- In 2016 : Coverage of Protected Areas in Africa to support the EU Biodiversity Strategy
- In the future : forest monitoring, support to infrastructure studies, support to rural development, conservation of biodiversity …



http://biopama.jrc.ec.europa.eu



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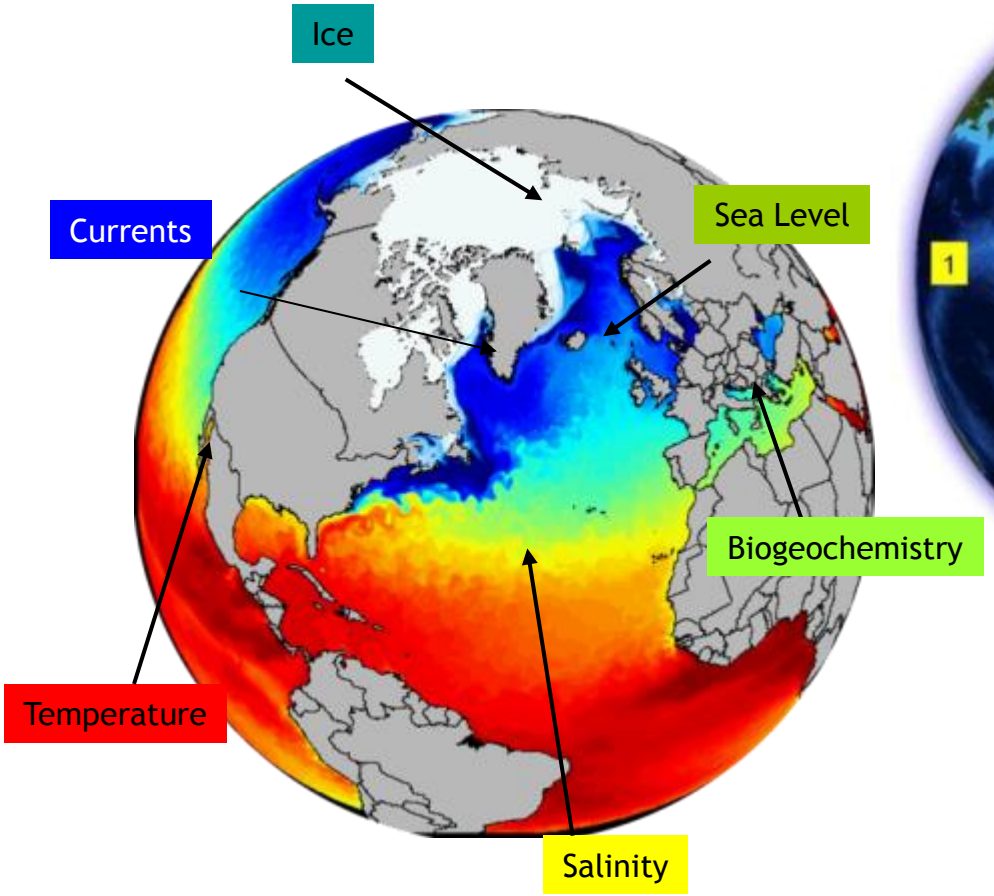
Mercator Ocean
Ocean Forecasters

European Commission

Copernicus Marine Environment Monitoring Service

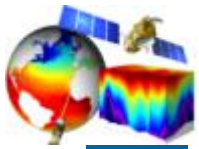
Marine Environment Monitoring Service

European Commission



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

A 3D and consistent estimation of the ocean



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

Mercator Ocean
Ocean Forecasters

Copernicus
Europe's eyes on Earth

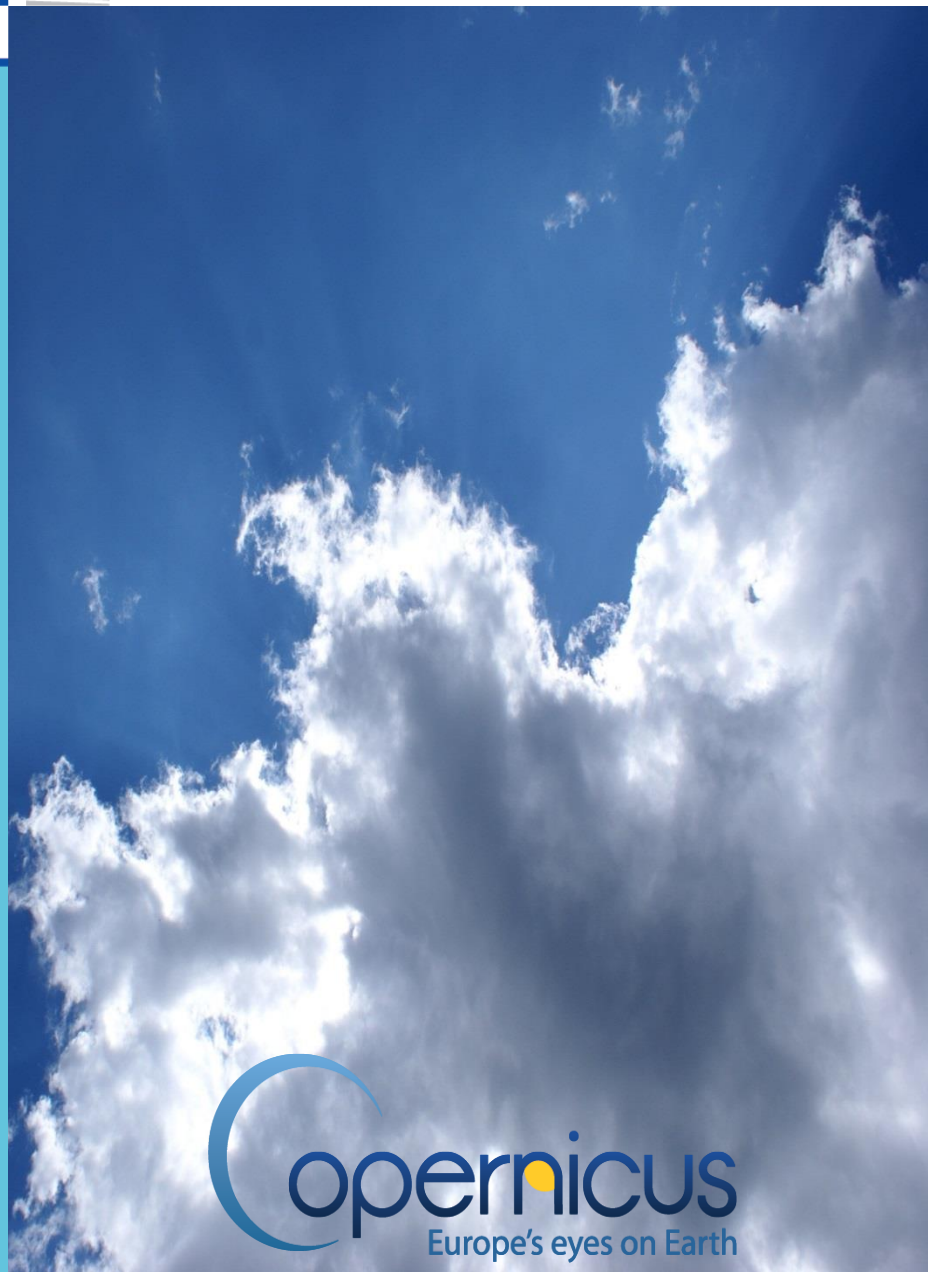
Service portfolio: 11 product groups with ~120 data products covering Ocean state

Product groups	
Analysis and Forecast	Global Ocean
	Arctic Ocean
	Baltic Sea
	Atlantic-European North West Shelf Ocean
	Atlantic-Iberian Biscay Irish Ocean
	Mediterranean Sea
	Black Sea
Observation	Sea Level
	Ocean Colour
	Sea Surface Temperature, Sea Ice, Wind
	In-situ (Temperature, Salinity, Bio)

ECMWF

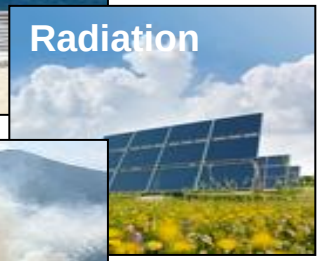
European Commission

Copernicus Atmosphere Monitoring Service



The Copernicus Atmosphere Monitoring Service (CAMS)

Forecasts and informs on impacts



Detects emissions and estimate surface fluxes

Quantifies transport, removal and transformations of atmospheric constituents

CAMS in three figures

280 million observations processed every 12 hours

Data from **70 satellite instruments** are received and used

delivers **everyday 14,000 maps** online

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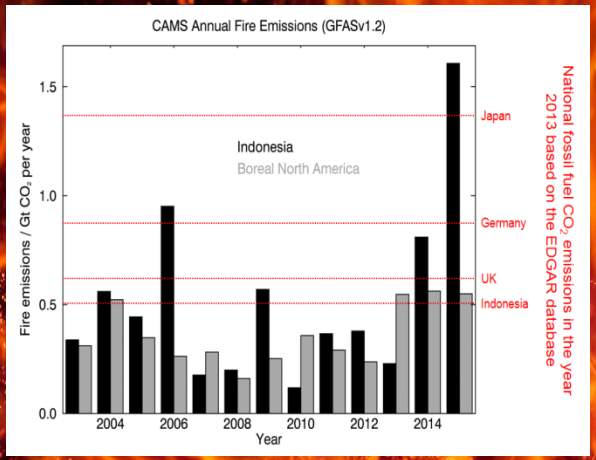
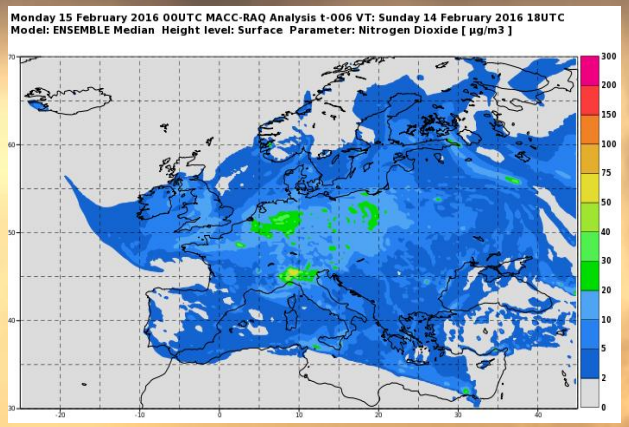
Examples: Fires Industry

Air Quality

Solar

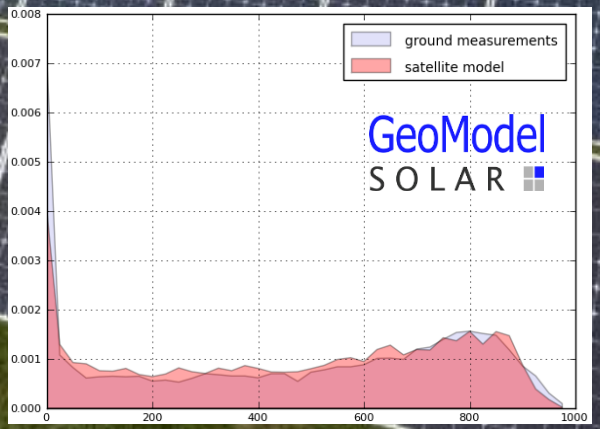
CAMS estimates the emissions from biomass burning daily and globally. A striking figure on the importance of such information for climate: 2015 emissions of CO_2 from fires in Indonesia were higher than (estimated) total annual industrial emissions from Japan or Germany.





CAMS air quality forecasts provide quantitative information on episodes daily and up to 4 days in advance. They support a wide range of applications (apps, press, city-scale downscaling, emissions reduction scenarios…). Long-range transported plumes (volcanoes, desert dust, fires...) are captured by CAMS and can inform national and local authorities.

CAMS information on airborne particles, which affect the amount of solar radiation reaching the surface, is useful to assess the productivity of solar power plants. CAMS has for instance supported GeoModel Solar, a company specialising in site qualification, planning, financing and operation of solar energy systems.



European Commission

Copernicus Emergency Management Service

Mapping Component

Early Warning Component

Space

Emergency Management service

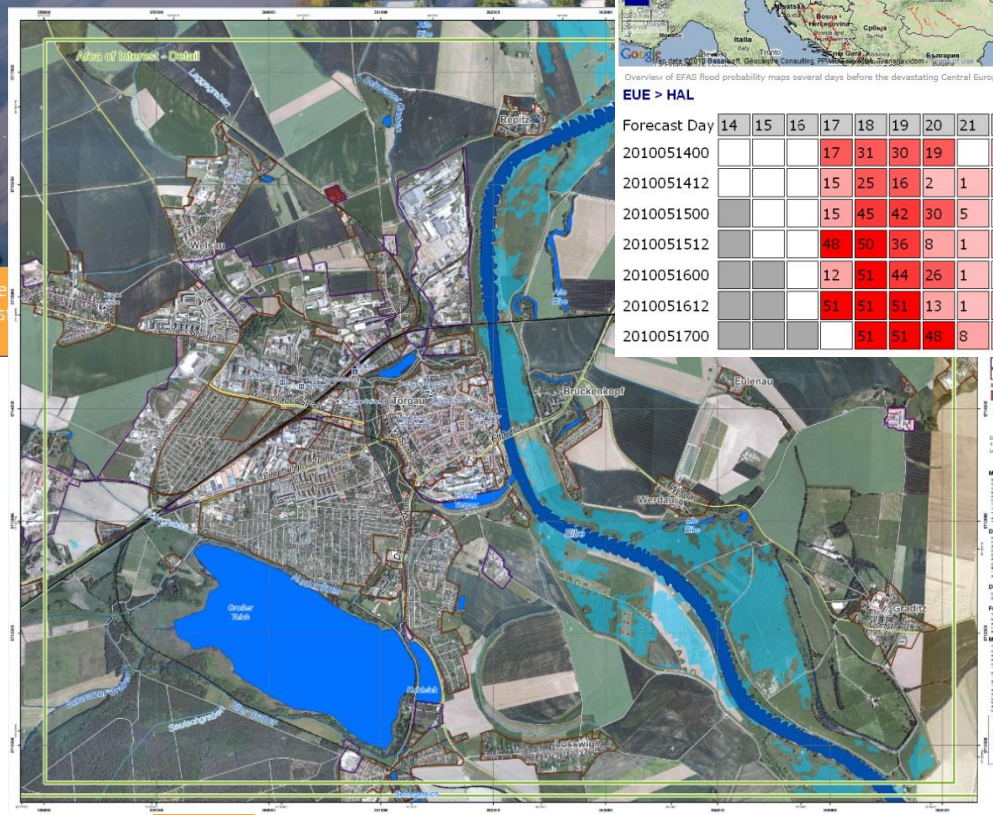
European Commission

Flood and forest fire risk forecasts

Overview of EFAS flood probability maps several days before the devastating Central European floods in May/June 2010.

EUE > HAL

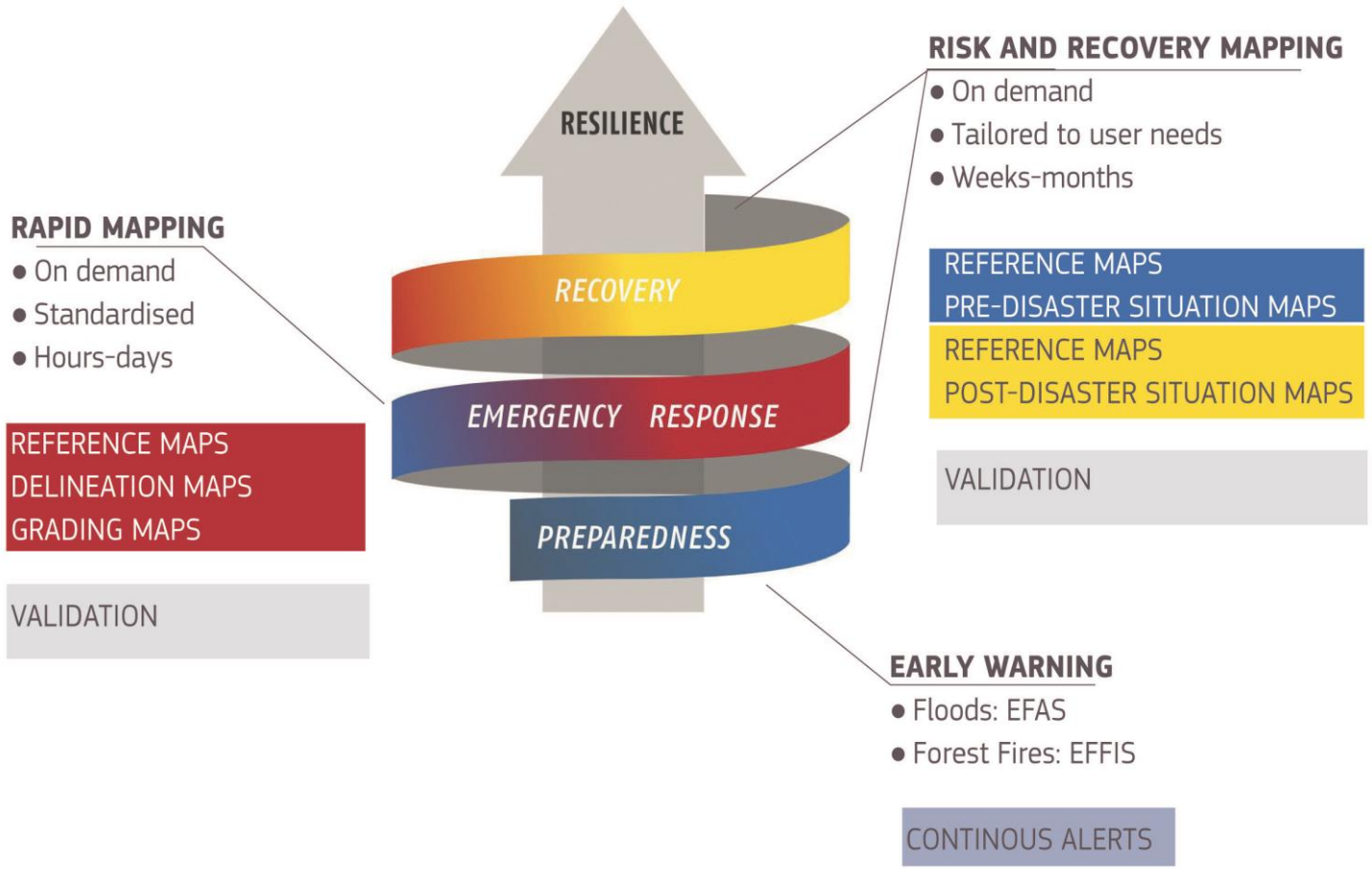
Forecast Day	14	15	16	17	18	19	20	21	22	23	24	25	26
2010051400				17	31	30	19		5	1			
2010051412				15	25	16	2	1	1	1			
2010051500				15	45	42	30	5		2			
2010051512				48	50	36	8	1	1	1			
2010051600				12	51	44	26	1					
2010051612				51	51	51	13	1	2				
2010051700					51	51	48	8	1	1			



Providing support to emergency response services

Situation maps, reference information

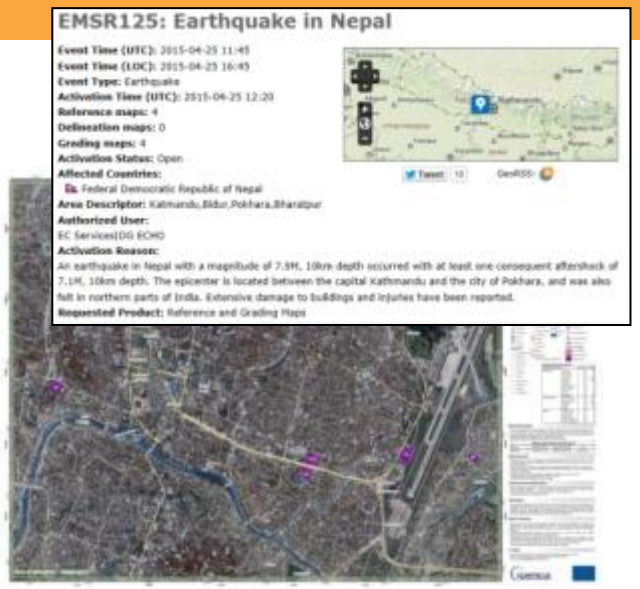
The Emergency Management Service



EMS covers the 3 phases of emergencies: preparedness, emergency and recovery

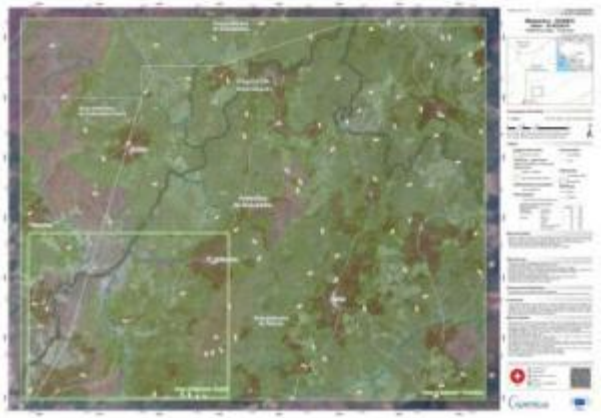
Mapping service

European Commission



Earthquake, Nepal

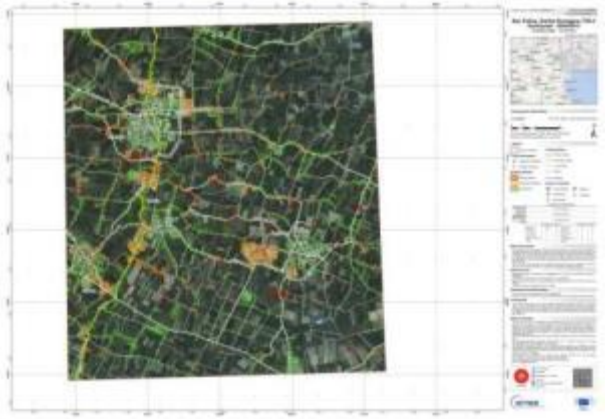
Tropical Cyclone, Vanuatu



Ebola epidemic, Guinea

Refugee Camp, Al Mafraq Jordan

Floods, Ostlandet Norway



Earthquake, San Felice sul Panaro Italy

European Commission

Copernicus Security Service

Space

CSS Moving to Operations

European Commission

Copernicus - Security Implementation Plan

Border Surveillance

(DA) November 2015

Support to EU External Actions

(DA) Early 2016

Maritime Surveillance

(DA) December 2015

FRONTEX

SatCen

EMSA

Inter-Agency cooperation

Industrial Base

Space

opernicus
Europe's eyes on Earth

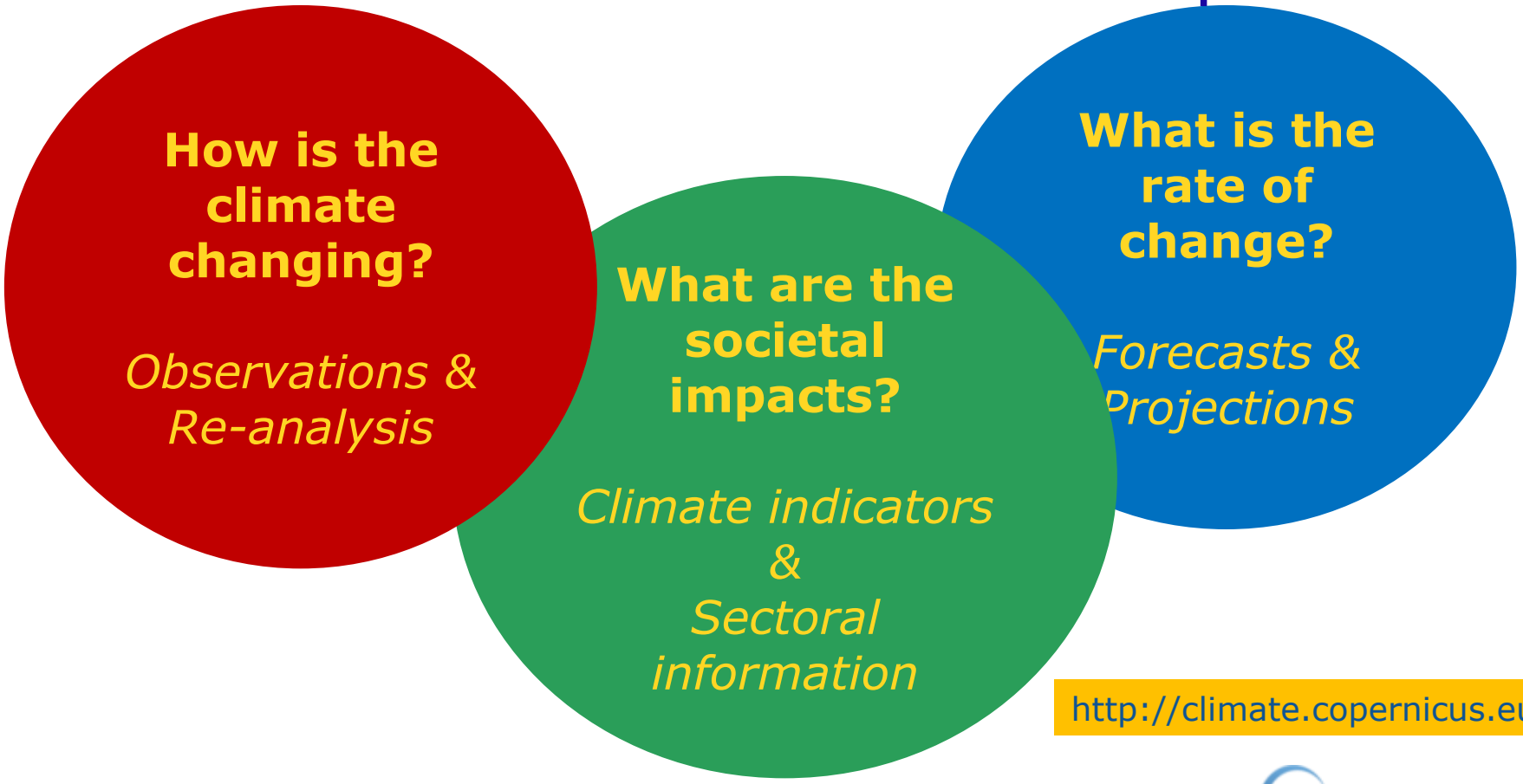
ECMWF

European Commission

Copernicus Climate Change Service

Objectives

to be an authoritative source of climate information for Europe

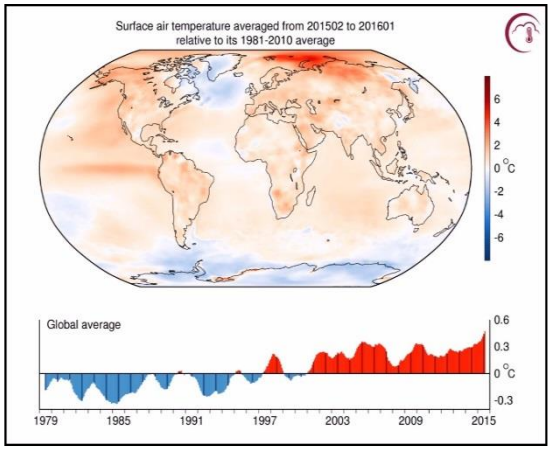


http://climate.copernicus.eu/

Copernicus Climate Change Service (C3S)

C3S: Monitors and analyses the Earth System to build a global picture and provide the data, tools and products needed by policy makers, societal and economic sectors to mitigate and adapt to a changing climate.

- **The climate is changing and with it an increase in extreme weather events such as flooding, heat wave and drought.**

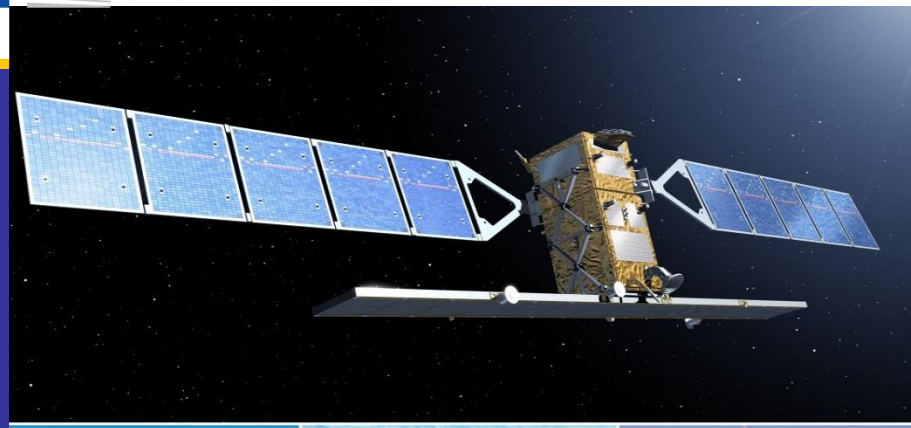


- **The data captured, analysed and tailored by C3S helps sectors affected to identify the risks, to adapt and identify business opportunities.**

- **C3S data provide the evidence.**
- **Released online, the C3S maps show the trends clearly and provide key indicators of climate change.**

Copernicus
the EU's Earth Observation Programme

3. Data access and program evolution



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Big Data challenge

European Commission

Two complementary approaches:

- ★ *Bringing the data to the user*:
  web portal, mirroring of the data – high bandwidth connection needed (e.g. Géant)

- ★ *Bringing the user to the data*:
  cloud computing ('hosted computing') – upgrade of the Copernicus core ground segment needed

Sentinel Data Access

European Commission

Full, free and open Access for everybody

Copernicus Space Component Data Access Portal

sentinels.copernicus.eu

- Copernicus Services Access
- Scientific / Other Access Hub
- Collaborative Access Hub
- International Agreements Access Hub

Credit: ESA

Space

Copernicus | Europe's eyes on Earth

User requirements

European Commission

Next-Generation Copernicus Space Component

- Copernicus already ensures continuity for its users at least until 2030
- However we need to already start collecting user requirements for 2030 onwards. Bear in mind that (when also counting procurement cycles), it can take up to ten years to have a satellite ready for lift-off!
- The Commission has overall responsibility for "collecting the user requirements for the second generation Copernicus Space Component and delivering to ESA a User Requirements Document by **mid-2017**" (EU-ESA Copernicus Agreement, Article 4, point i).
- This is a purely user-driven process. The majority of user needs/reqs already expected by end of 2016.
- High level technical reqs (with ESA & EUMETSAT) due 2nd quarter 2017.

European Commission

Thank you for your attention!

http://www.copernicus.eu/

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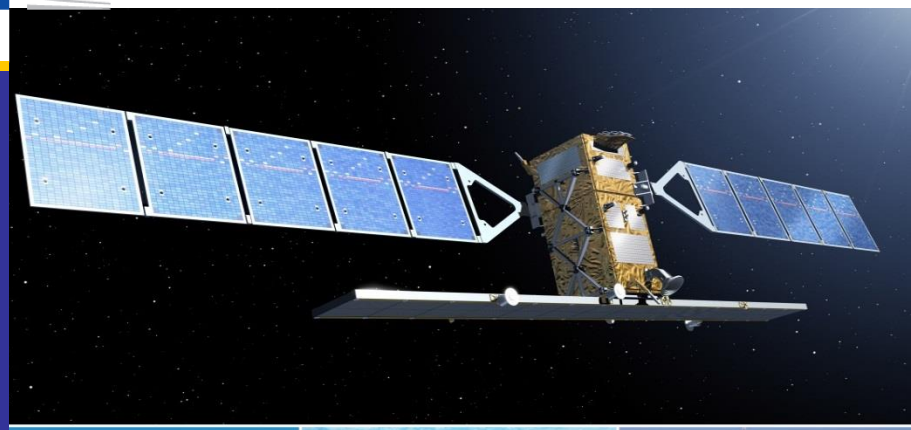

Space