COPERNICUS (Programma di Osservazione della Terra dell'Unione Europea)

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Place and date (Example : *Todi, Italy, 21 August 2023* or *Orvieto , Italy, 22 August 2023*

Outline

1. The Copernicus program

- The EU Earth Observation Program: Copernicus
- From technology push to market pull

2. The Governance

- From Copernicus 1.0 to 2.0
- The Uptake strategies

3. Copernicus and the space economy

- Methodology for the collection of users's needs
- Gap Analysis

4. New Space Economy

- Earth Observation Next Generation Funding

COPERNICUS IN BRIEF

No1 in the world in environmental monitoring and terrestrial ecosystems

It is a tool for economic development, a key to the digital economy

Free, total and free data access

3rd largest data provider

+300,000 registered users

COPERNICUS OBJECTIVES

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

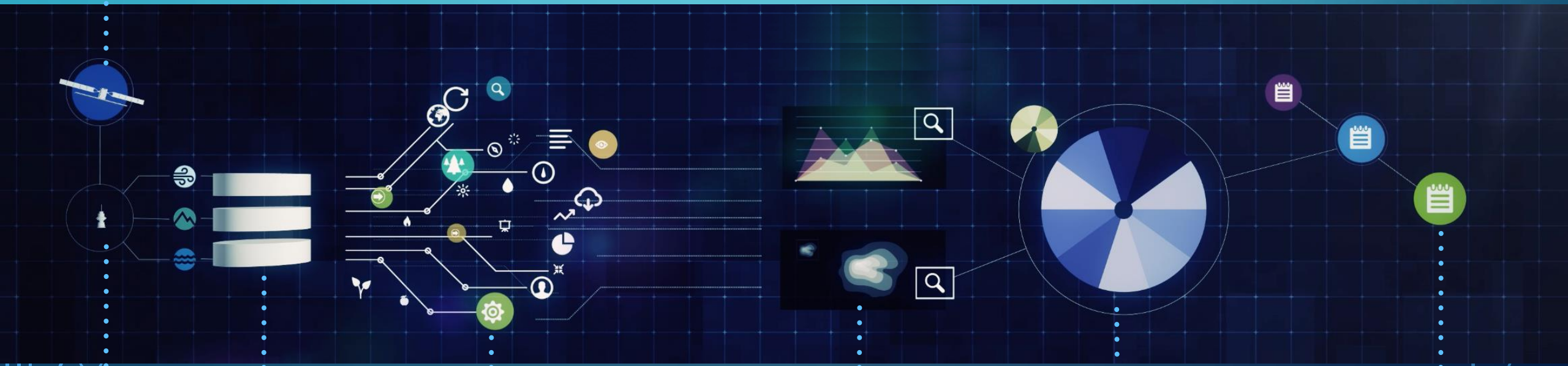
Foster downstream applications in a number of fileds

Help managing emergency and security related situations

COPERNICUS COMPONENT

FROM GLOBAL TERRESTRIAL OBSERVATION DATA TO LOCAL INFORMATION AND APPLICATIONS

SENTINEL SATELLITE & CONTRIBUTING MISSION



IN SITU SENSORS DATA SERVICES INFORMATION CUSTOM PROCESSES PRODUCTS

NUMBERS OF COPERNICUS

Nº1 al mondo nel monitoraggio ambientale e degli ecosistemi terrestri

Contribuisce al soft power dell'UE a livello globale

É uno strumento per lo sviluppo economico, chiave per l'economia digitale

Accesso ai dati libero, totale e gratuito

3º piu grande fornitore di dati

+300,000 utenti registrati

- over 600 operational products
- over 30 PBytes of data and information per quarter, 350.000.000 Megabytes per day!!!
- 2014 – 2020: 5 bilioni di Euro + 2021 – 2027: 5 bilioni di Euro

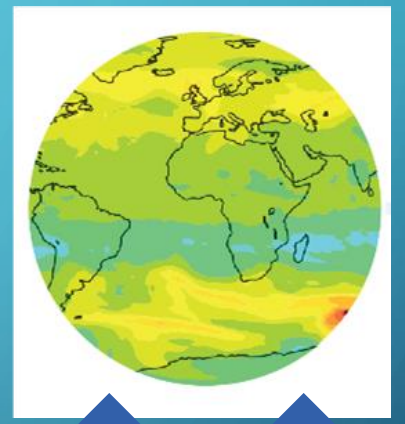
The Copernicus program

The EU Earth Observation Program: Copernicus Regolamento 2021/696

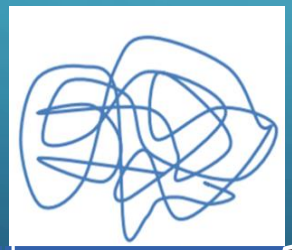
Copernicus space and in situ data

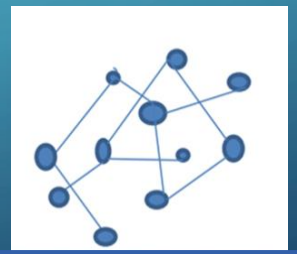
Copernicus services

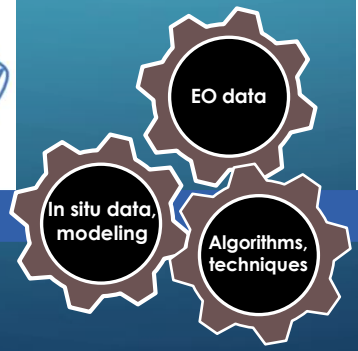
Downstream services "Copernicus Economy"



User uptake measures







Institutional user

Information needs

Product for decisions

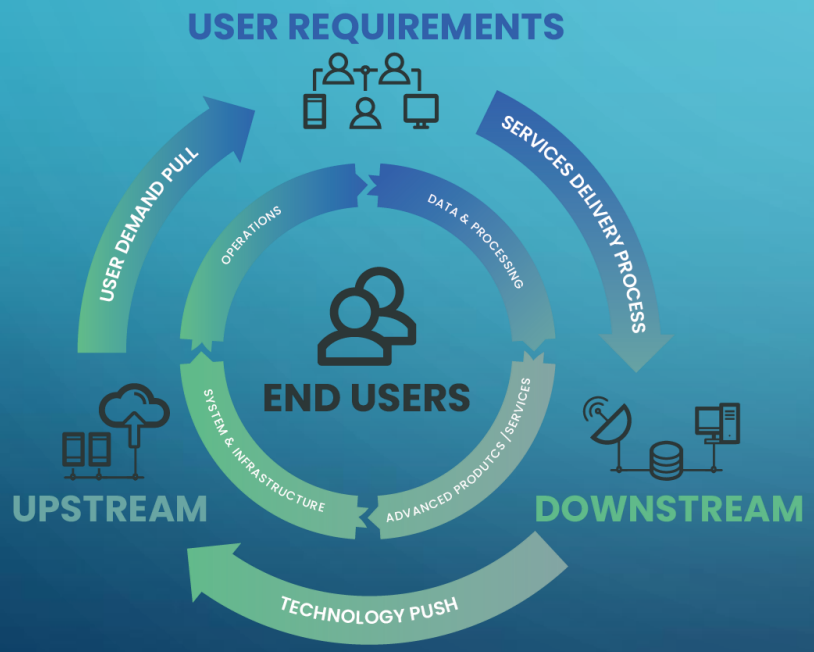
Institutional user

The Copernicus program

A change of paradigm in the investment of scientific challenges and technological development.

The Copernicus space economy value chain is evolving in a **user-driven approach**, covering more and more companies from multiple sectors.

A CHANGE OF **PARADIGM**



opernicus
Europe's eyes on Earth

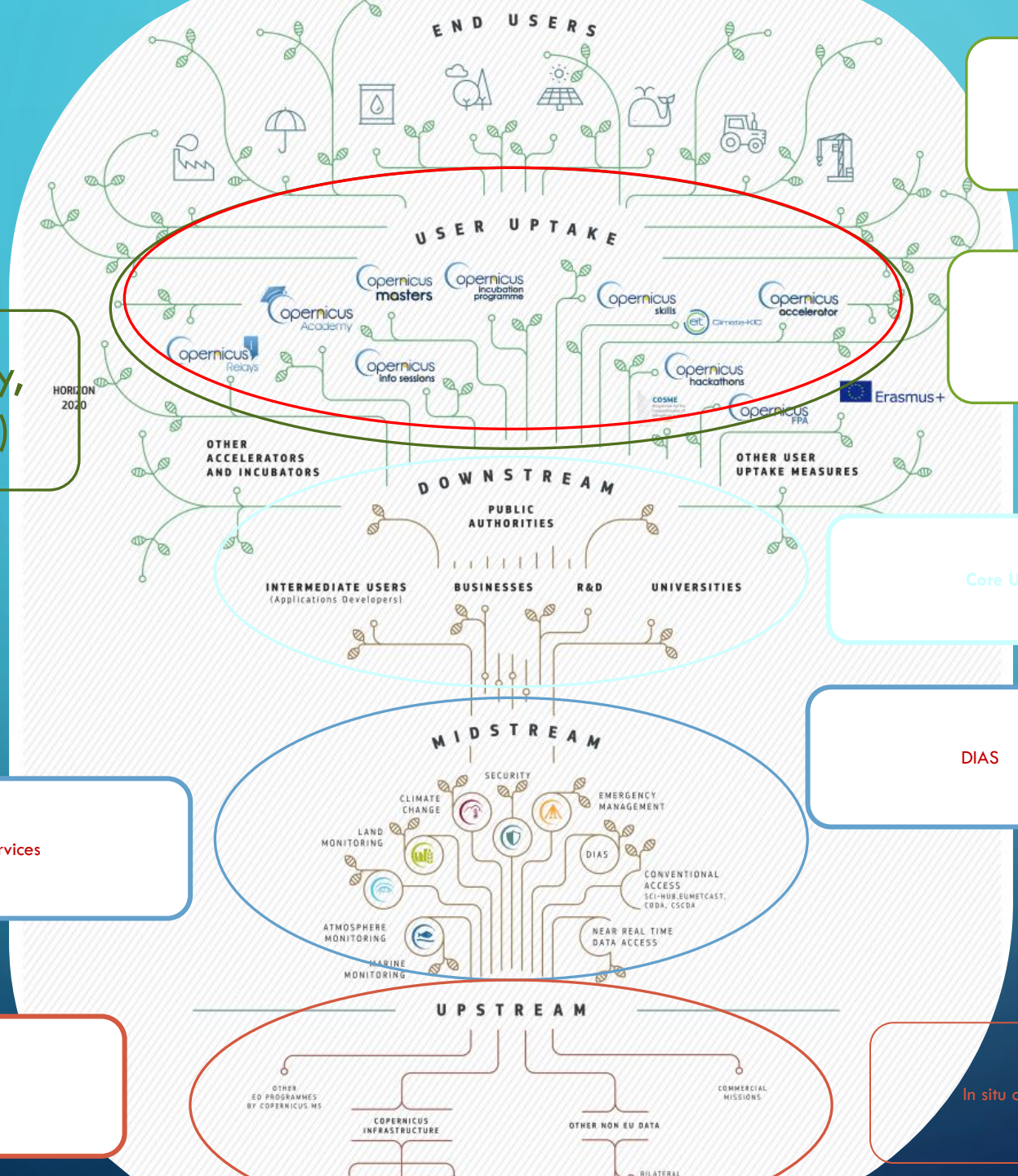
EUROPEAN & NATIONAL INSTITUTIONS

RESEARCH INSTITUTES

INDUSTRY: LARGE COMPANIES, SMEs, MICRO COMPANIES

PUBLIC & PRIVATE PARTNERSHIP

User Uptake (Academy, FPA, Relays…)



MS and EU policies

Technology transfer

Core User Group

DIAS

Copernicus Services

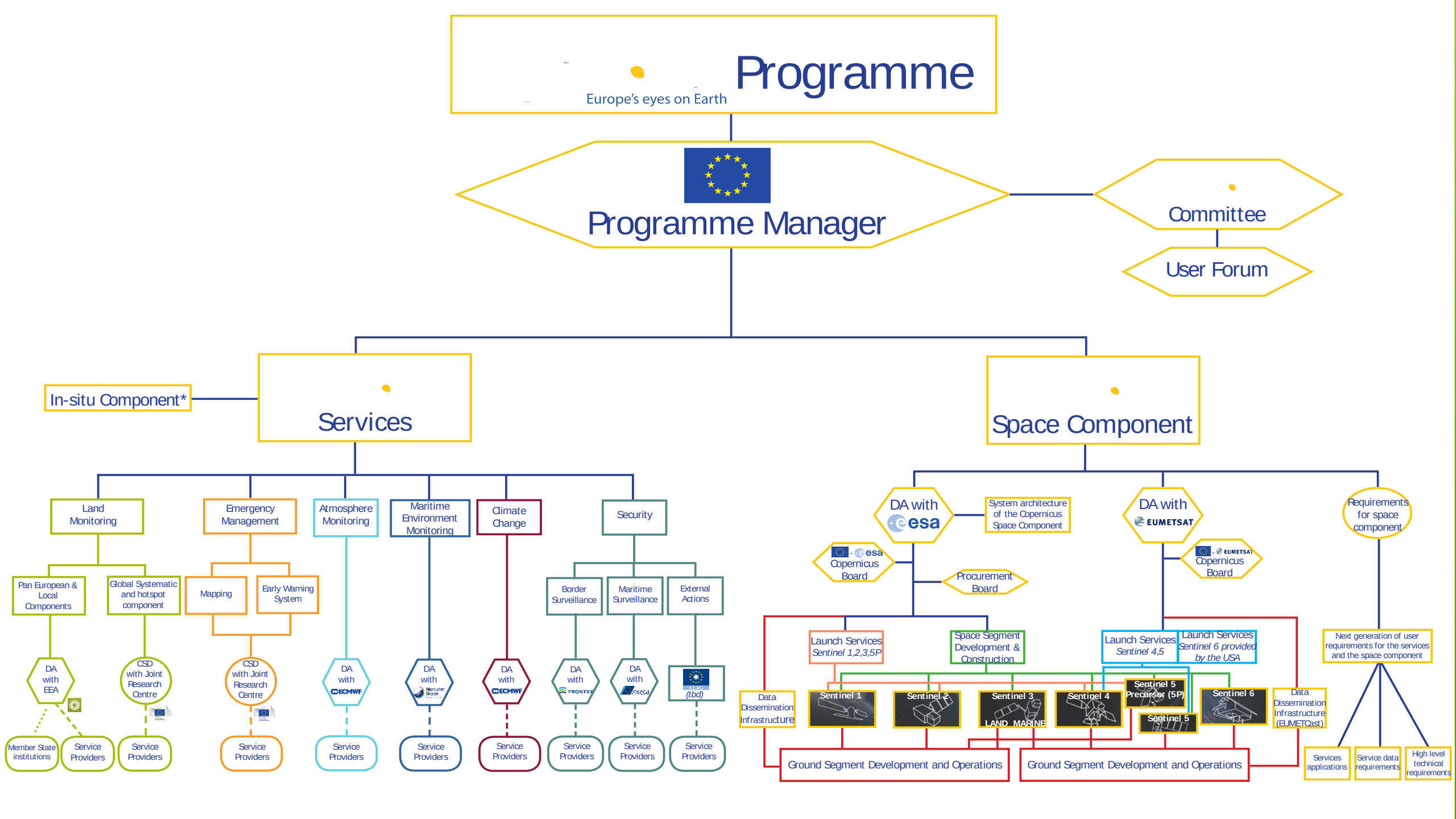
Sentinels

In situ obs. providers

Research projects

International

Higher education


Programme
Europe's eyes on Earth
Programme Manager
Committee
User Forum
In-situ Component*
Services
Space Component
Land Monitoring
Emergency Management
Atmosphere Monitoring
Maritime Environment Monitoring
Climate Change
Security
Pan European & Local Components
Global Systematic and hotspot component
Mapping
Early Warning System
Border Surveillance
Maritime Surveillance
External Actions
DA with EEA
CSD with Joint Research Centre
CSD with Joint Research Centre
DA with ECMWF
DA with
DA with ECMWF
DA with FRONTEX
DA with EMSA
(tbd)
Member State institutions
Service Providers
Service Providers
Service Providers
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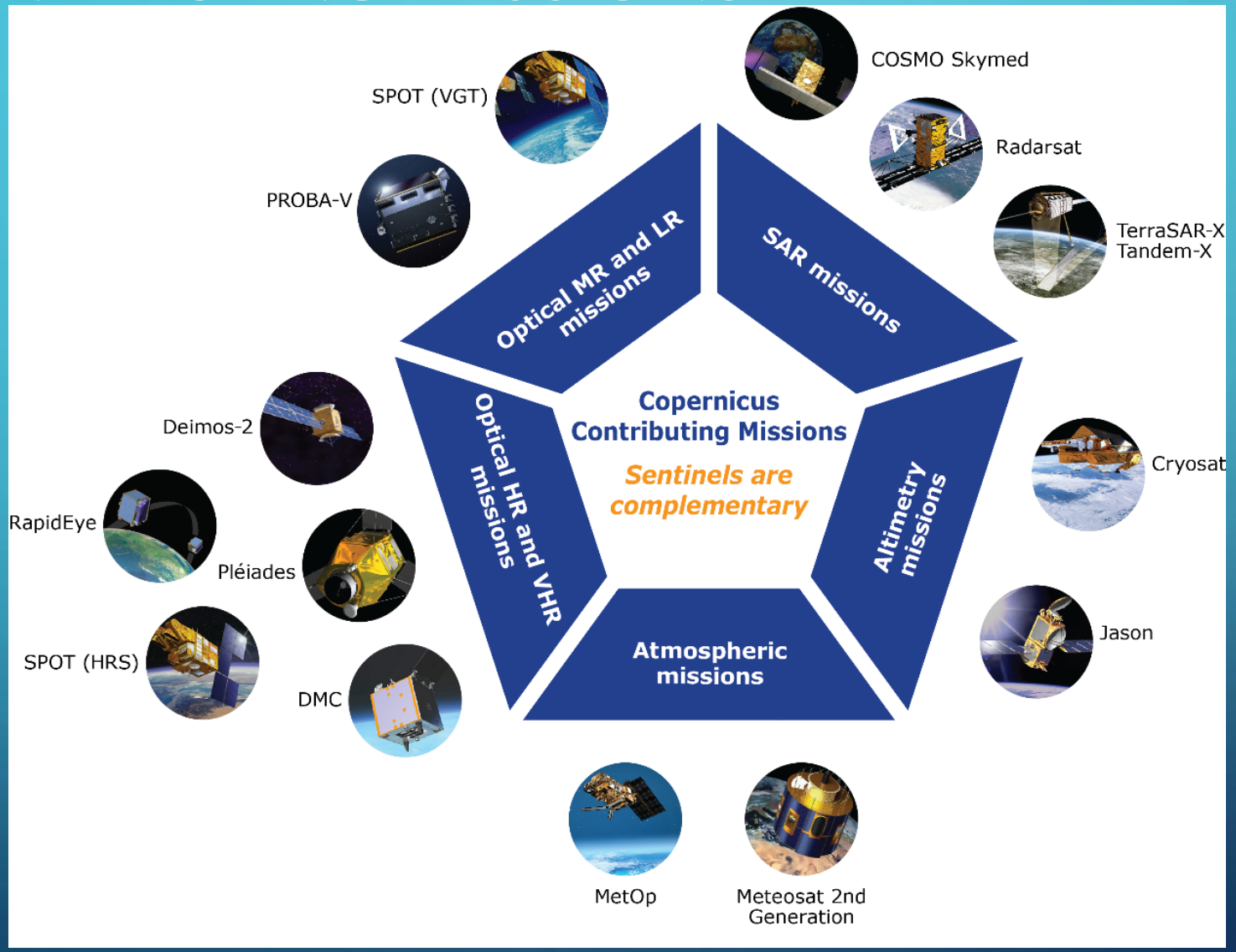
System architecture of the Copernicus Space Component
esa Copernicus Board
Procurement Board
DA with EUMETSAT
EUMETSAT Copernicus Board
Requirements for space component
Launch Services Sentinel 1,2,3,5P
Space Segment Development & Construction
Launch Services Sentinel 4,5
Launch Services Sentinel 6 provided by the USA
Next generation of user requirements for the services and the space component
Data Dissemination Infrastructure
Sentinel 1
Sentinel 2
Sentinel 3
LAND MARINE
Sentinel 4
Sentinel 5 Precursor (5P)
Sentinel 5
Sentinel 6
Data Dissemination Infrastructure (EUMETCast)
Ground Segment Development and Operations
Ground Segment Development and Operations
Services applications
Service data requirements
High level technical requirements

THE SENTINELS

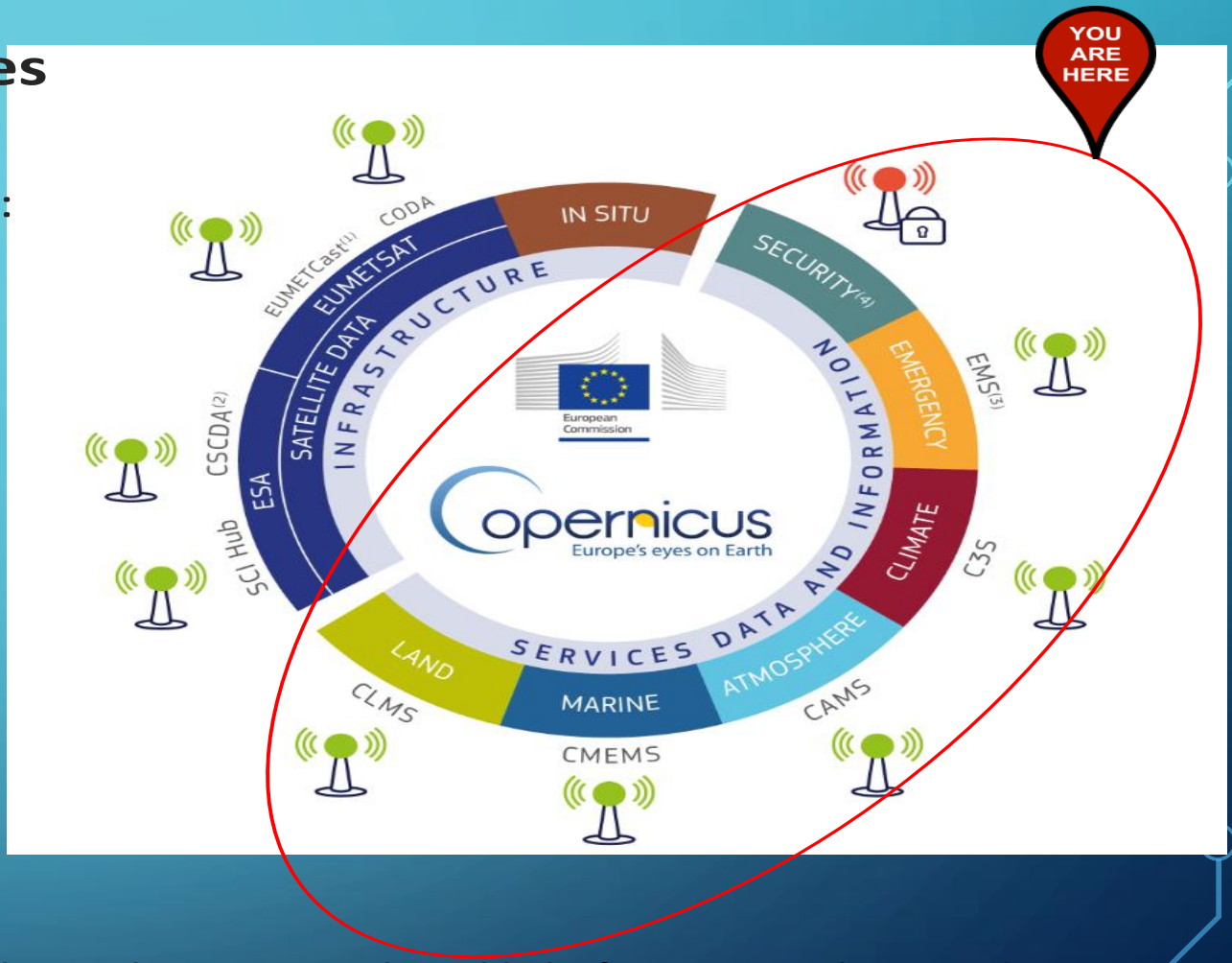
 **Sentinel 1:** Radar Mission	polar-orbiting, all-weather, day-and-night radar imaging
 **Sentinel 2:** High Resolution Optical Mission	polar-orbiting, multispectral high-resolution imaging
 **Sentinel 3:** Medium Resolution Imaging and Altimetry Mission	multi-instrument mission monitoring sea- and land-surface key parameters
 **Sentinel 4:** Geostationary Atmospheric Chemistry Mission	payload for atmospheric monitoring on board a MTG-S
 **Sentinel 5p:** Low Earth Orbit Atmospheric Chemistry Precursor	satellite mission developed to reduce data gaps between Envisat, and S-5
 **Sentinel 5:** Low Earth Orbit Atmospheric Chemistry Mission	payload to monitor the atmosphere from polar orbit on board a MetOp 2nd Gen
 **Sentinel 6:** Altimetry Mission	radar altimeter to measure sea-surface height globally

THE CONTRIBUTING MISSIONS



… Access to Services Data and Information …

- **6 Thematic Copernicus Services**
- 5 are under Full, free and open access:
  - Land
  - Marine
  - Atmosphere
  - Climate
  - Emergency
- 1 has restricted access
  - Security



Copernicus "Core" Services transform data, collected from satellites and in situ, into value-added information: analyzing and processing it, integrating it with other sources, and finally validating the results obtained. Data sets acquired over years and decades are indexed and made comparable thus ensuring that changes are monitored; structural models are examined and used to increase forecasting capacity, for example, in ocean and atmospheric analysis.
Maps are created from satellite images, features and anomalies are identified, and statistical information is extracted.

COPERNICUS SERVICES

Monitoring the State of the Earth System Environment …

6 Services

… Access to Services Data and Information …

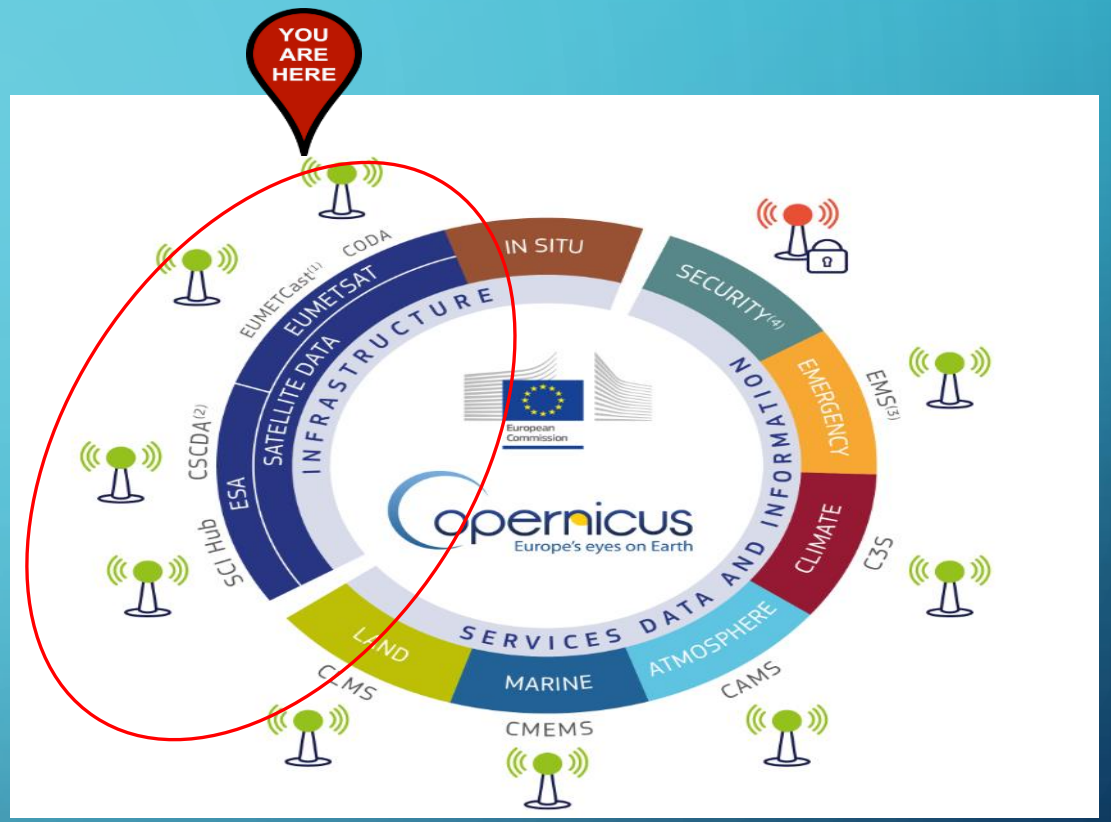
4 Satellite data Access Points:

2 managed by ESA:

- Open Access Hub
- Copernicus Space Component Data Access (CSCDA)

2 managed by EUMETSAT

- EUMETCast
- Copernicus Online Data Access (CODA)



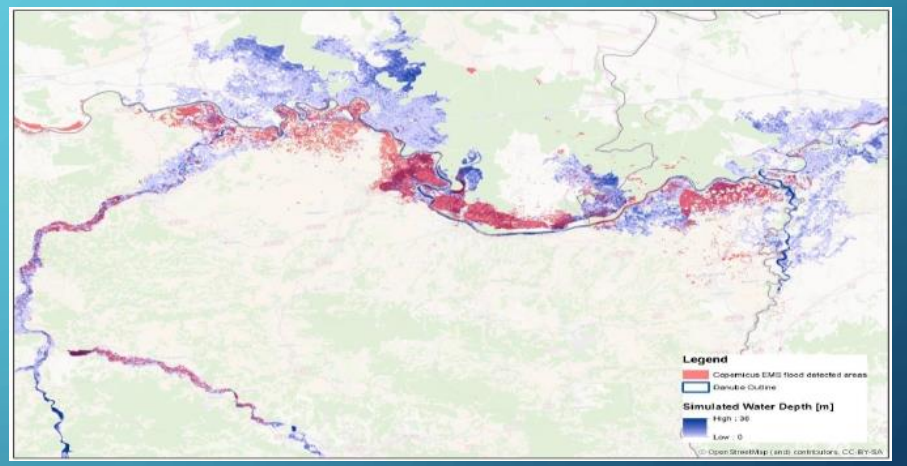
COPERNICUS DATA ACCESS TO DATE

HOW TO ACCESS DATA FROM THE CSC?

4 dedicated data access infrastructures, i.e.

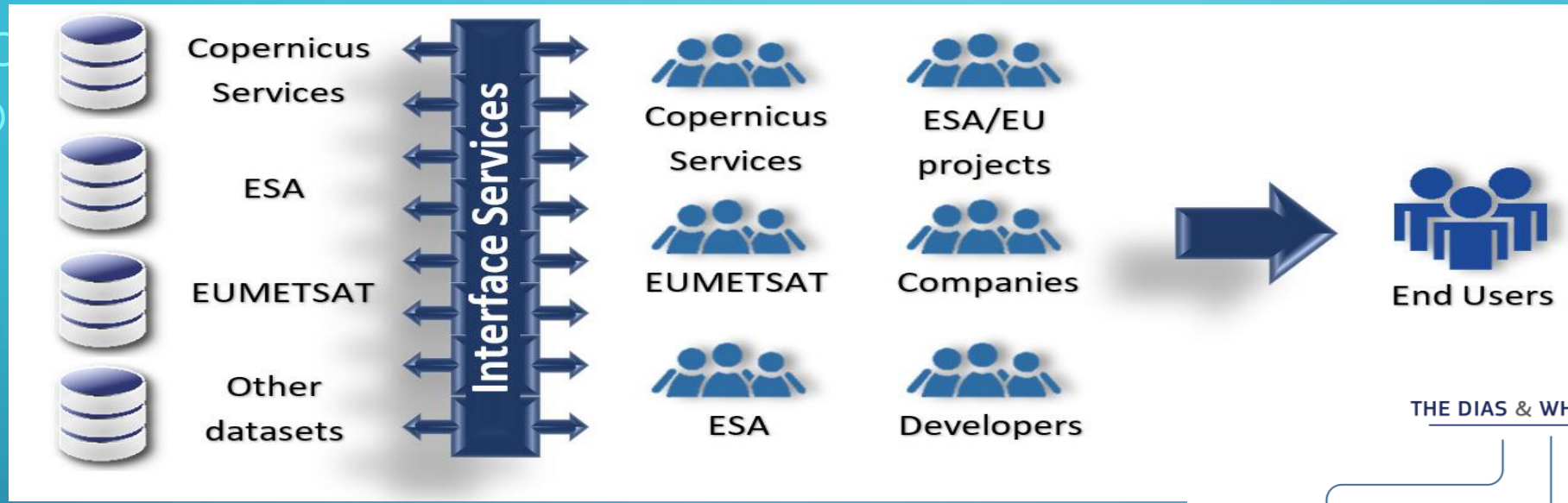
- Sentinel Data Hub
- Coordinated Data Access System (for access to Contributing Missions data)
- Collaborative Data Hub (Collaborative Ground Segment)
- Internatio[illegible]partners)

HOW TO ACCESS DATA AND INFORMATION FROM THE SERVICES?

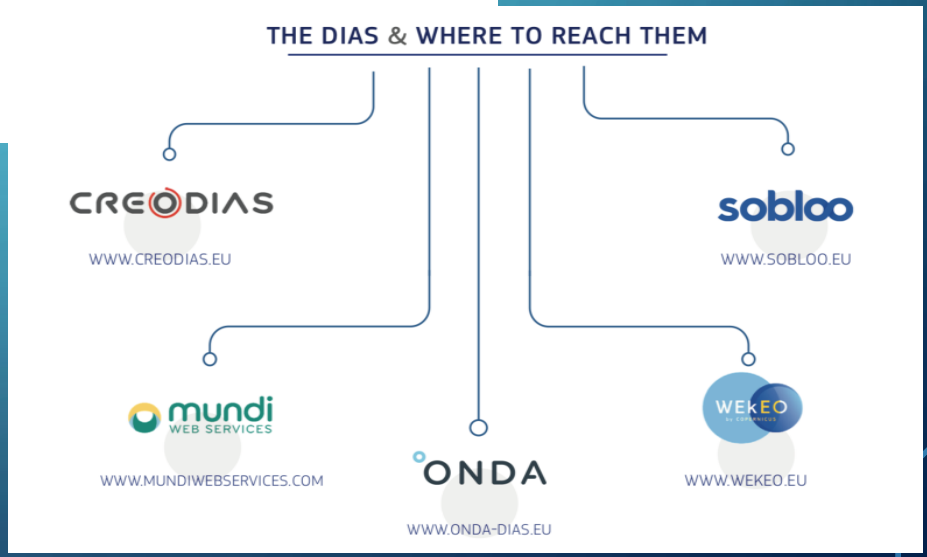


http://www.copernicus.eu/main/data-access

DIAS: A game changer for accessing and processing Copernicus data and information ...



- **'Creodias – http://www.creodias.eu' :** Creotech (PL) with cloud provider CloudFerro (PL)
- **'ONDA – http://www.onda-dias.eu' :** Serco (IT) with cloud provider OVH (FR)
- **'SOBLOO** – http://www.sobloo.eu' : Airbus (FR) with cloud provider Orange (FR)
- **'Mundiwebservices – www.mundiwebservices.com' :** ATOS (FR) with cloud provider T-Systems (DE)
- **'WeKEO – http://wekeo.eu' :** EUMETSAT, with Mercator Ocean and ECMWF



RELEVANT FOR MANY SECTORS!

MAIN DOWNSTREAM INDUSTRIES END USERS BASED ON THE EARSC TAXONOMY

- Security, defence 
- Environment, pollution and climate 
- Oil and gas 
- Maritime 
- Agriculture 
- Fisheries 
- Emergency services 

- Utilities (water, electricity, waste) 
- Forestry 
- Minerals and mining 
- Local and regional planners 
- Humanitarian Operations & Health 

- Communications 
- Insurance and finance 
- Real estate management 
- Construction 
- Alternative energy 
- Retail and geo-marketing 
- Travel, tourism, and leisure 
- News and media 
- Education, training and research 
- Transportation 

9.751.756.800 MB

COPERNICUS DATA POLICY

DIFFERENT TYPES OF DATA POLICIES:

- SENTINELLE SATELLITE DATA (FREE, FULL AND TOTAL ACCESS)
- COPERNICUS SERVICES (FREE, FULL, AND UNRESTRICTED ACCESS)
- CONTRIBUTING MISSIONS (ACCESS SUBJECT TO DIFFERENT POLICIES)

ACCESS TO SECURITY SERVICE PRODUCTS IS LIMITED TO AUTHORIZED USERS TO PROTECT THE INTERESTS OF THE EU AND MEMBER STATES

COPERNICUS SOCIO-ECONOMIC BENEFITS

- Copernicus is expected to generate significant socio-economic benefits
- Driver for research, innovation and the creation of highly skilled jobs, with direct and indirect benefits for the EU economy

Key Figures

Cost per EU citizen = **~€1.07/year**

Every **€1** spent generates a return of **~€3.2**

Min. financial benefits on EU GDP = **~€30bn** by 2030

~50.000 jobs maintained/ created in the next 15 years

COPERNICUS BENEFITS

KEY INSTRUMENT FOR RESEARCH, INNOVATION AND CREATION OF SPECIALIZED WORKS

REVENUES

Copernicus impact for intermediate users of the 10 selected value chains

Enabled revenues for intermediate users in Europe (EUR million)

Expected average annual growth rate up to 2020

Average penetration of Copernicus data with regards to EO data

COPERNICUS UPTAKE (2017)

72 %
+6 pts / 2016
Proportion of EO companies exploiting **Copernicus data** in Europe

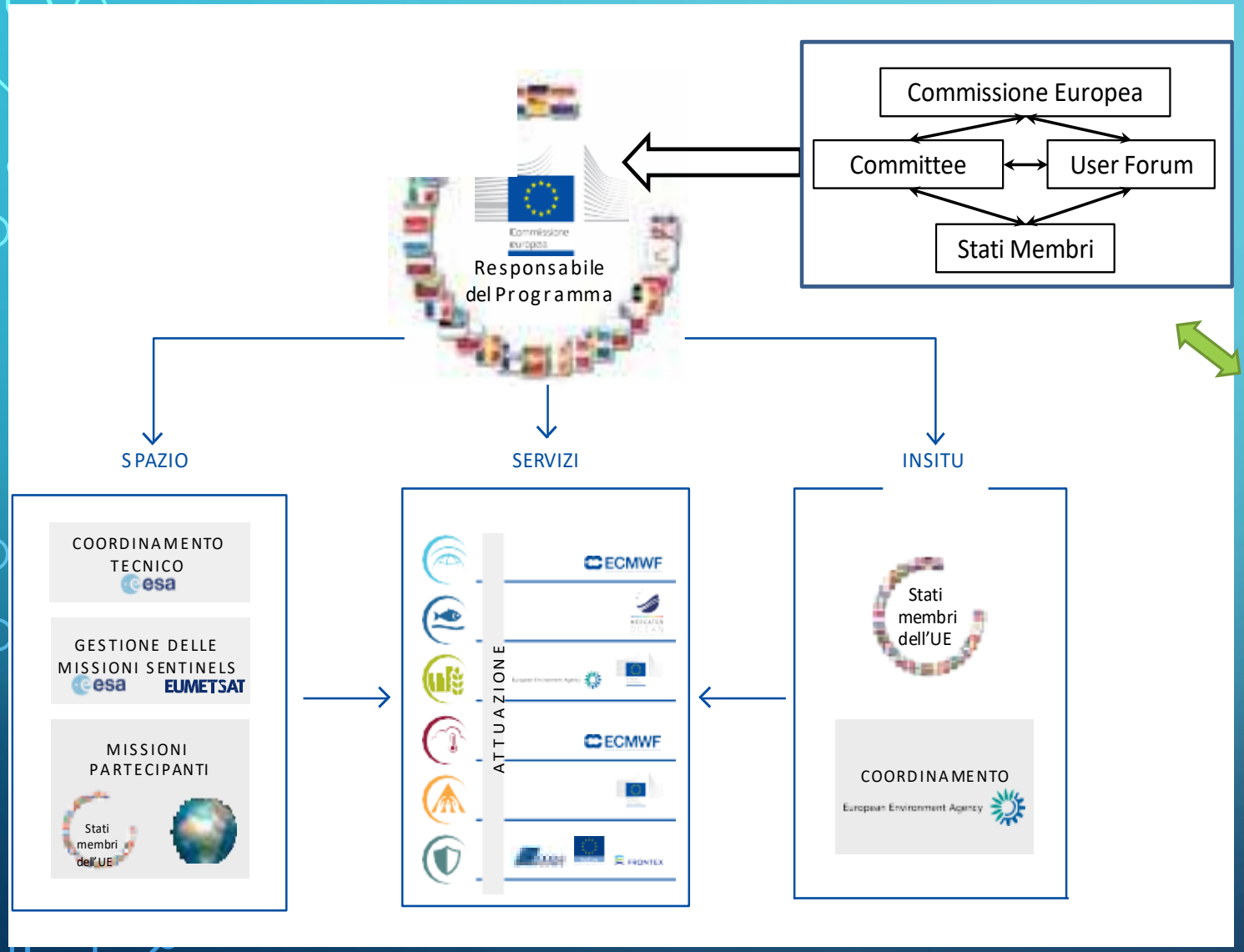
38 %
+11 pts / 2016
Proportion of EO companies exploiting **Copernicus services** in Europe

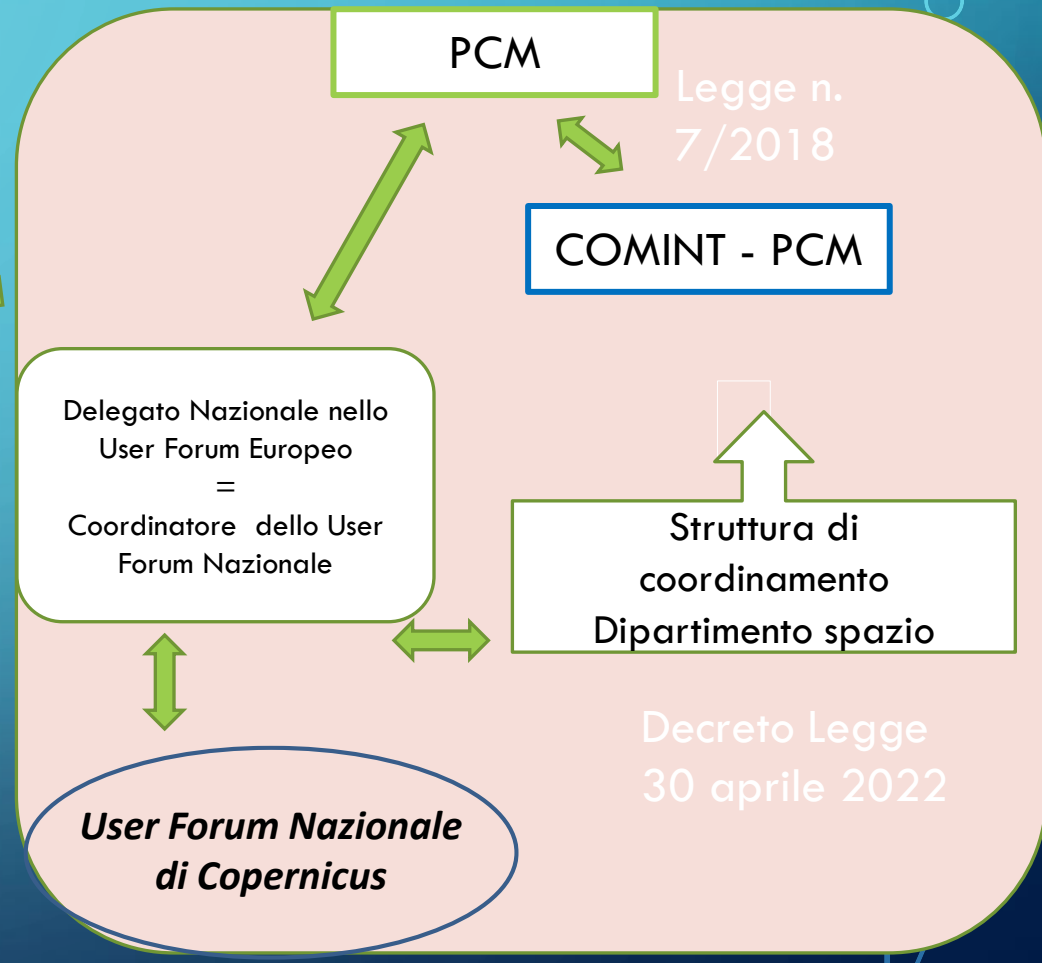
28 TB
+133 % / 2016
Volume of downloads from the Data Access Systems

300,000
(by end 2018)
+44% / Q1 2018
overall **registered users on the different hubs (ESA, EUMETSAT, ECMWF, EEA, Mercator and JRC)**

STRATEGY: MAXIMIZING THE GROWTH OF AN ECO-SYSTEM OF USERS THAT TRANSFORMS COPERNICUS DATA INTO FINAL PRODUCTS

La Governance di Copernicus europea e nazionale





Lo User Forum Nazionale, le Comunità degli utenti

THE NATIONAL COPERNICUS USER FORUM

The National Copernicus User Forum (UFN) is the core of the User Uptake Strategies

• The birth

Formally constituted in December 2014 (EU Regulation 377/2014, nowadays Reg. EU 696/2021), to support an Inter-ministerial Working Group aimed **to identify a number of programmatic initiatives to maximize the national returns of operational services offered by the Copernicus Programme.**

- *The event launching the National User Forum was a **Copernicus National Workshop** (27 June 2014), aimed to analyse the National and European state of-the-art of the Copernicus Programme as a whole, with a focus on the Italian effective user needs.*

The need and the goal

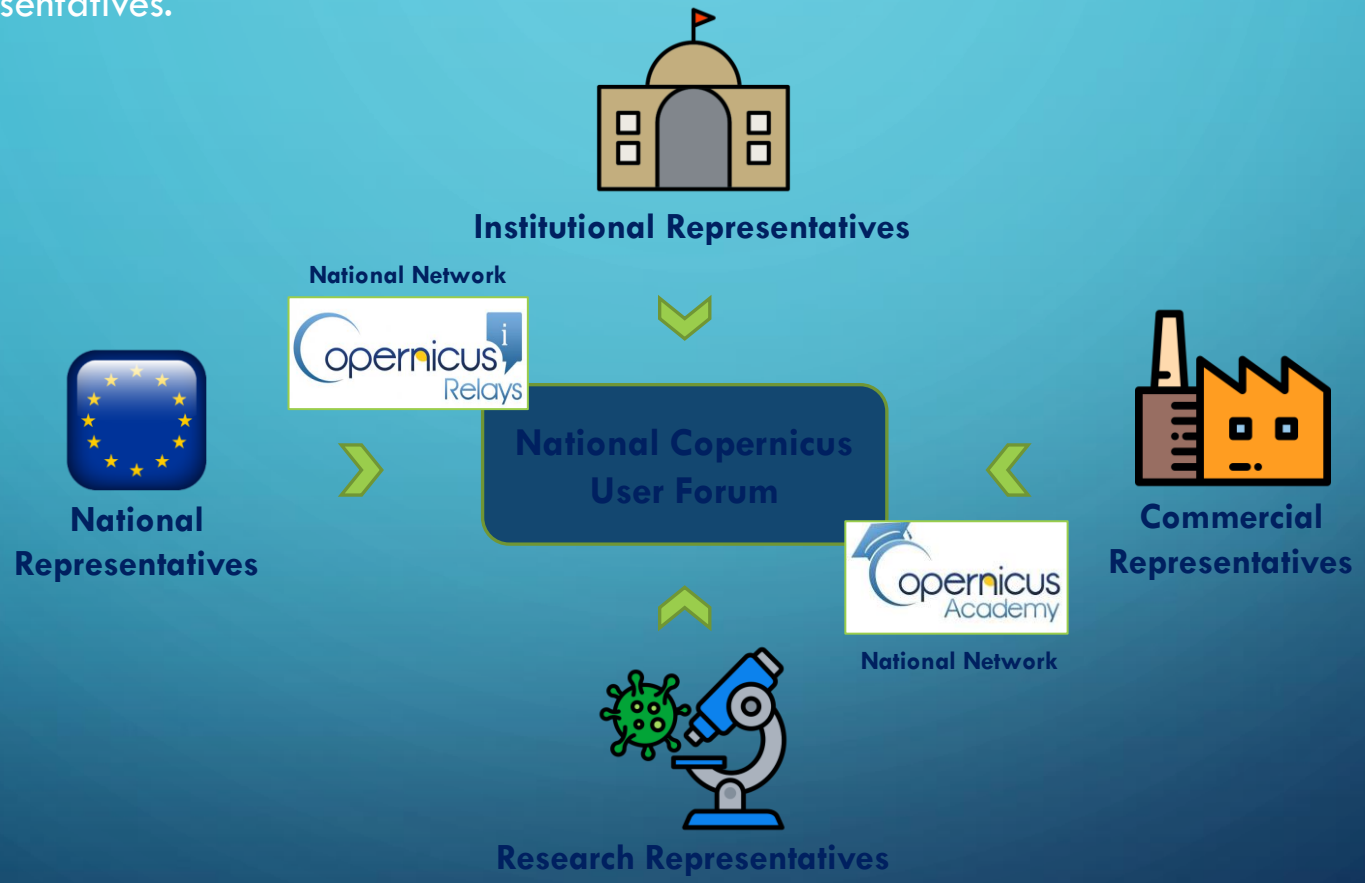
- **To prepare together to and to disseminate information about the ongoing and foreseen activities of Copernicus Bodies** (Committee, User Forum and Security Board);
- **to collect in coordinate way national user communities needs, troubles, expectation** vs. Copernicus Programme;
- **to stimulate a qualified, authoritative and coordinated national use of all Service offered by the Programme;**
- **to support an user-driven approach respect to national and European space-based developments.**

UFN strategic role has been confirmed by actual COMINT

THE NATIONAL COPERNICUS USER FORUM

The structure

National Copernicus User Forum is composed by Public, Research and Commercial (Industries and Enterprises) User Communities Representatives.



National Copernicus User Forum bodies

European and National Governance

Consultation Boards

- Security
- Infrastructure & Transports
- Cultural Heritage
- Agriculture
- Environmental protection
- Coastal
- Dissemination
- Valorization - Industry and Enterprises
- Emergency

National Boards

contributing to the user requirement coordination

- Operational Geology
- Operational Hydrology
- Operational Climatology
  - *Air quality*
  - *Climate*
  - CO_2
- GREEN-NET

Copernicus Networks

- Copernicus Academy
- Copernicus Relays

More than 900 participants

- ***40*** *Institutional and non representatives*
- ***645*** *in consultation boards*
- ***75*** *in National Academy Network*
- ***10*** *in National Relays Network*
- ***172*** *in Operational Geology and Climatology National Boards*

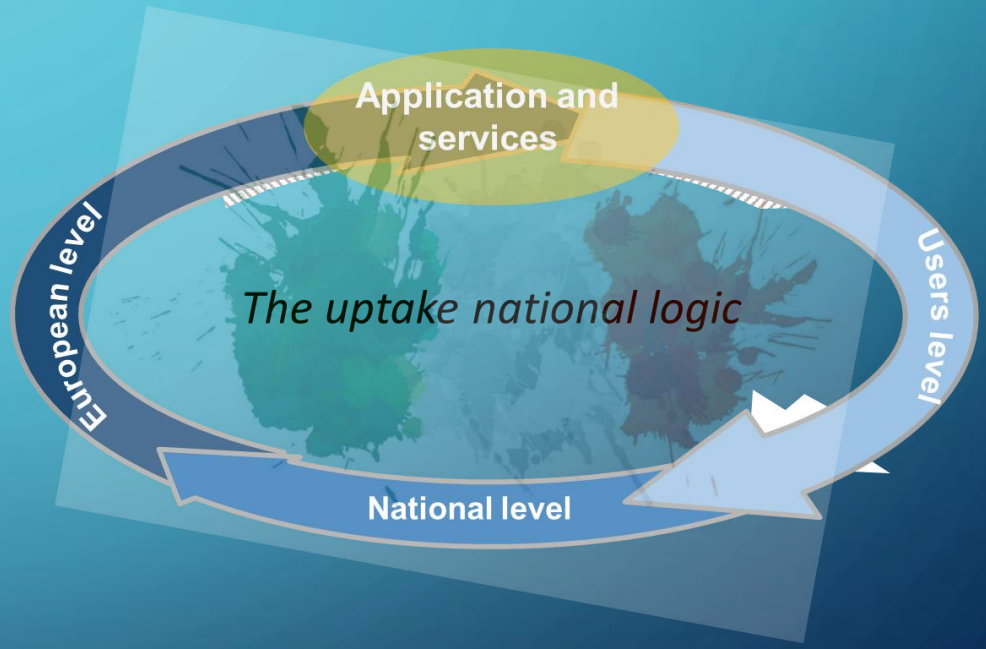
UFN Consultation Boards

The activities

Nowadays the UFN leverage on **13 consultation boards.**

The needs collection's activities developed in the frame of the National User Forum by means of the boards are related to:

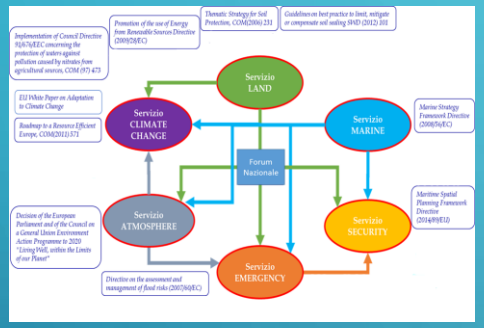
- National and European obligations
- National Space Economy and policy
- Scientific & Technologic Innovation applied to monitoring requirements
- Market Uptake



UFN Consultation Boards

Scientific & technologic innovation applied to monitoring requirements

The role of the research community is to accompain the user to refine the requirement on top of the most advanced technology, even at projectual/experimental phases.



European obligations

Scientific & Technologic Innovation

Coast and marine monitoring	Air Quality	Ground motion	Monitoring of land cover and use
Hydro-meteorology climate service	Water resources	Emergency services	Security services

National Monitoring Operational Services

Space Economy

Market uptake and Downstream development

User requirements in the Copernicus program

Methodology for the collection of users's needs

From the collection of needs to the definition of operational services

Methodology

USER REQUIREMENTS COLLECTION

- Institutional user community identification
- EU and National policy identification
- Interaction matrix definition and dissemination
- Feedback collection from users

USER REQUIREMENTS ANALISYS AND CLUSTERIZATION

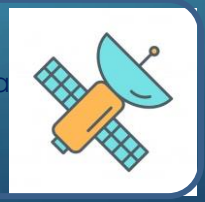
- User requirements analisys
- Parameters ranking
- Informations need clusterization

PRODUCT GAP ANALYSIS AND OPERATIONAL SERVICES DEFINITION

- Match between user requirements and available products
- Future operational services individuation

GAP FILLING AND TECHNICAL REQUIREMENTS IDENTIFICATION

- Data integration for the development of a not-existing services



Results

- Identification of institutional user requirements and information needs
- Definition of national operational services
- Definition of specific services innovative requirements
- Prototype of a specific service

UFN Activities: Geological Operational Services Board

Copernicus Geological Operational Services (CGOS) Board

Established in 2016, It is coordinated by ISPRA - Geological Survey of Italy and the technical structures within Regional Authorities with a geological mandate and a responsibility for geohazard at local level.

The core activity has been **the collection of user requirements for a national ground motion service** to be realized within National Space Economy Plan.

CGOS Board is represented in the EGMS Advisory Board and contributes to the definition of users requirements for the implementation of a pan-European GM service under coordinated by EEA.

CGOS actions related to Copernicus Users Uptake

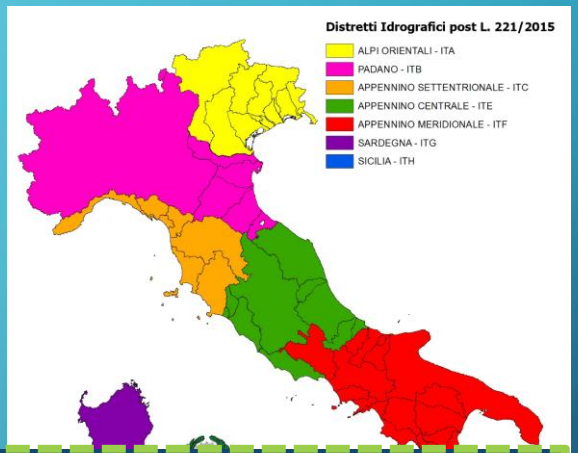
- Organization of the **International Training Workshop "Copernicus Ground Motion Services for Geohazard Monitoring"** (FPCUP 2019, action 2-46)
- 5 informative and training webinars from 30 Sept. to 29 Oct.

UFN Activities: Operational Hydrological Services Board

National Board on Operational Hydrological Services

National Board led by **ISPRA** and in coordination with the **7 River Basin District Authorities.**

Since 2013, the boards works on operational **hydrological services,** including **hydro-meteorological monitoring,** and **integrated water resource management,** federating 21 regional hydrological offices and 3 national Entities (ISPRA, DPC, MeteoAM) responsible for operational hydrological services at local and national levels.



Main activities

- ***National coordination on:***
  - *Hydro-meteorological monitoring;*
  - *Data publication (Yearbook) and sharing (HIS Central – Hydrological Information System);*
  - *Data quality control (National Guidelines)*
  - *Strengthening streamflow discharge monitoring and the update of stage-discharge rating curves;*
  - *User-driven requirements on Earth Observation and innovative operational services integrating in-situ data, RS data and forecasts.*
- ***Sharing of best practices***, ***training courses*** *(e.g., 1° Rally Nazionale di idrometria, 2019), dissemination,* ***workshops and technical meetings*** *at national and local levels, with the involvement of Institutional Entities, Research Institutes and Academia.*
- *Development of operational tools and services (e.g.,* ***ANÁBASI*** *for data statistical analysis,* ***BIGBANG*** *for hydrological water balance and HIS Central).*

UFN Activities: Operational Climatology Board

Climate Group – Survey on climate services

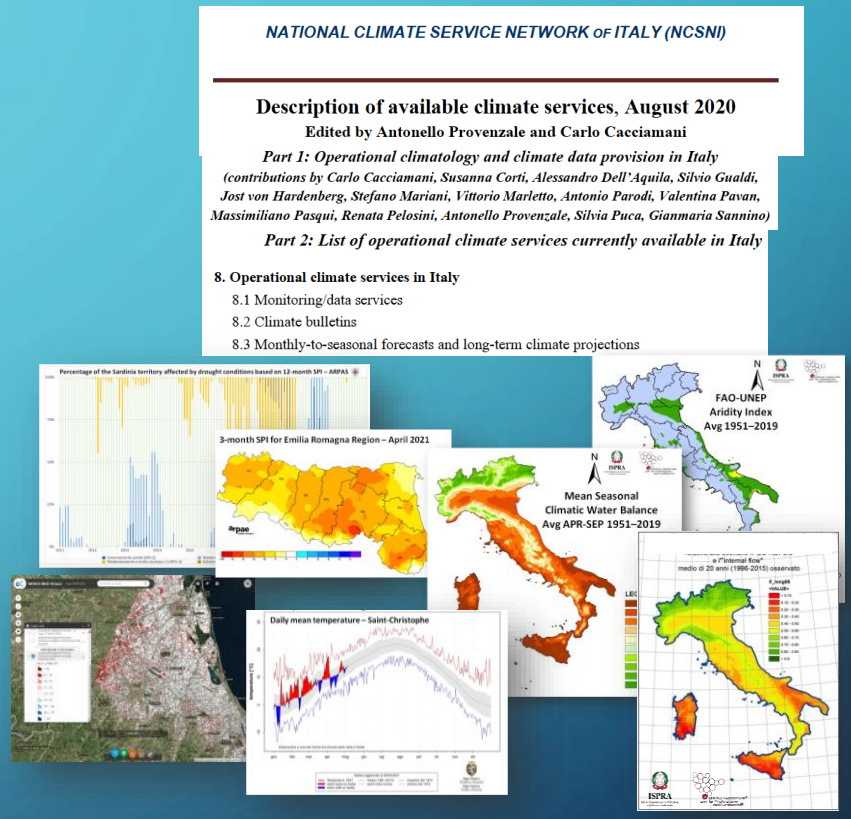
Results:

A wide range of operational climate services are available at national level, covering horizontal scale from local to national and temporal scale from real-time to multi-ten-year, in order to:

- *monitor hydro-meteorological and climate trends and fluctuations;*
- *evaluate climate change impacts; and*
- *support decision makers (in the field of civil protection, water management, environment, air quality, etc.).*

Climate indicators are mainly based on in-situ data (regional data networks) and/or on reanalysis fields.

The use of information derived by satellite data, seasonal forecasts and climate projections are however highly increased in the last period, although the potential usefulness of these data is not yet fully exploited.



UFN Activities: Atmospheric Board

GREEN-NET: the proposal for the Italian network for GHGs and ECVs monitoring

National Network for Greenhouse Gases Monitoring, supported by CNR, ENEA, INGV, Universities and other public Institutions, in the framework of the Global Atmosphere Watch (GAW) program of the World Meteorological Organization (WMO), and other international programs.

Actions related to Copernicus Users Uptake

The CO_2 White Paper

- addressed to a large set of users and stakeholders (*institutions, universities, companies, non-governmental organizations, citizens*);
- describe the national institutional framework in relation to the activities of reporting GHG emissions and removals, projecting their future changes, updating the related policies and measures;
- provides consistent information on the available operational GHG monitoring products in Italy.

CO_2 White Paper

- *The framework of the institutional arrangements on GHG and climate change*
- *National emissions inventory reporting on CO2 and other GHGs and ECVs*
- *The new National Climate Monitoring Network*
- *Inverse modelling tools and climate-altering compounds source emissions*
- *Proposal for activities*

UFN Activities: Agricultural Board

Agricultural Board

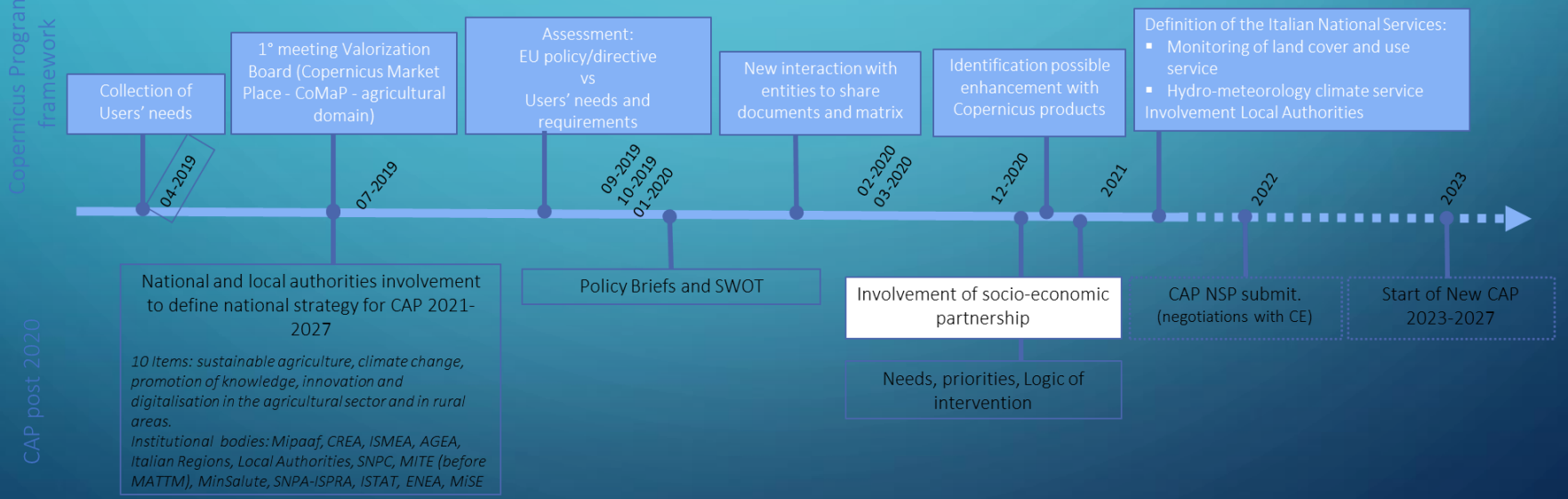
The board is chaired by **MIPAAF (Ministry of Agricultural, Food and Forestry Policies)** and it's composed by national/local institutions, research centers, payment agencies, farmers' organizations.

Actions related to Copernicus Users Uptake

Needs Analysis of the Buyers Group *in relation to the hydro-meteo-climate service and monitoring of land cover and use service within the Mirror Copernicus Program (National Space Economy Plan).*

Monitoring of land cover and use

Hydro-meteorology climate service

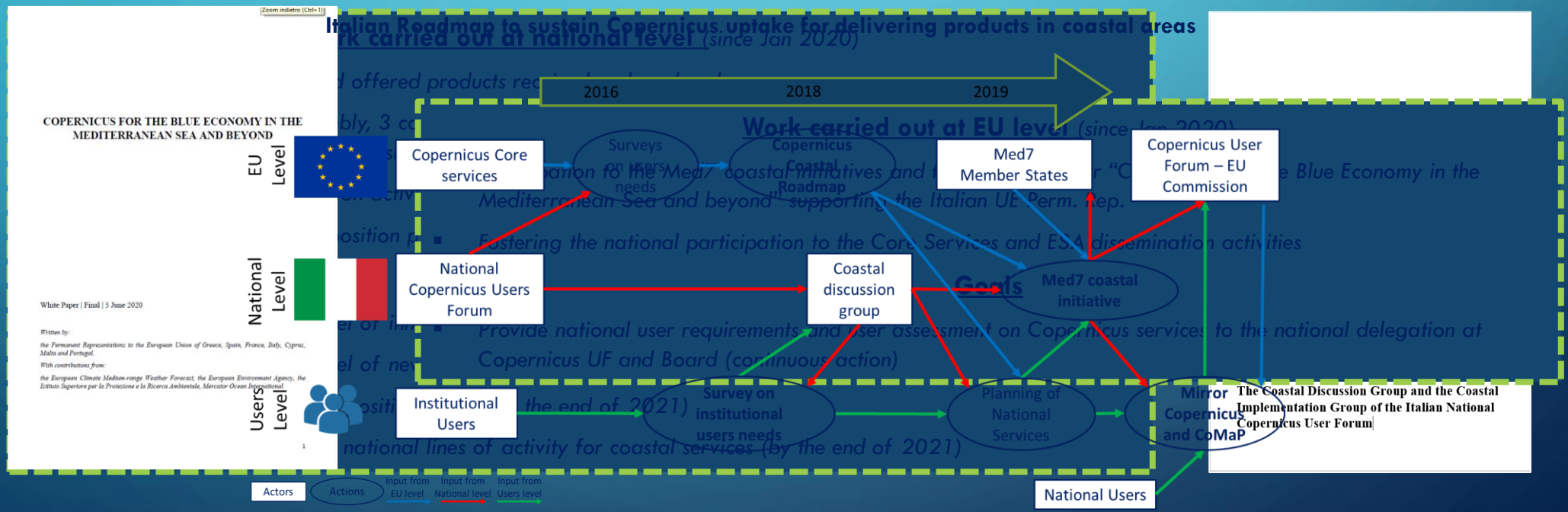


UFN Activities: Coastal Board

Coastal discussion group

Composed of about 80 representatives of public and private coastal stakeholders (central/local governments, public bodies, research institutes, universities and private companies). The coastal group is also part of the "coastal implementation group" of the national Copernicus user forum.

Actions related to Copernicus Users Uptake

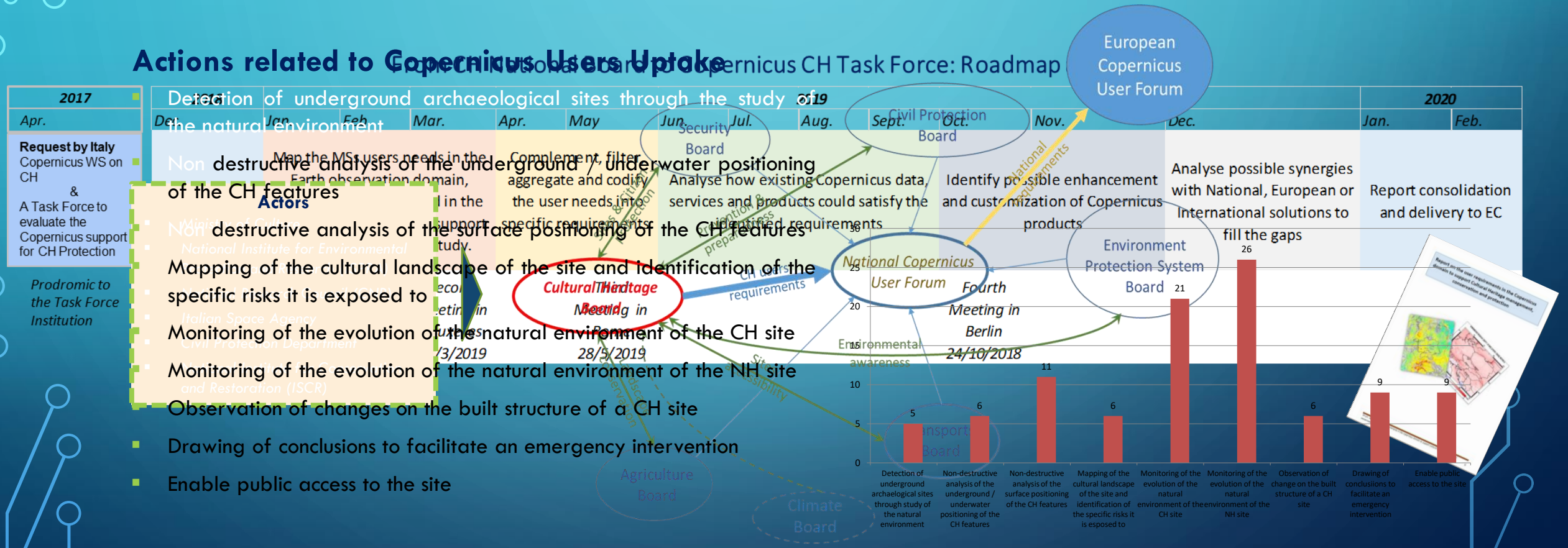


UFN Activities: Cultural Heritage Board

Cultural Heritage Board

The board is chaired by **MIC (Ministry of Culture)** and it's composed by national institutions and research centers.

Actions related to Copernicus Users Uptake



Actors

- Detection of underground archaeological sites through the study of the natural environment
- Non destructive analysis of the underground / underwater positioning of the CH features
- Non destructive analysis of the surface positioning of the CH features
- Mapping of the cultural landscape of the site and identification of the specific risks it is exposed to
- Monitoring of the evolution of the natural environment of the CH site
- Monitoring of the evolution of the natural environment of the NH site
- Observation of changes on the built structure of a CH site
- Drawing of conclusions to facilitate an emergency intervention
- Enable public access to the site

UFN Activities: National System for the Environmental Protection Board

The National System for the Environmental Protection Board

The **National System for the Environmental Protection (SNPA)** is composed by ISPRA and 21 Regional Environmental Agencies; it is officially in charge of the public monitoring, controlling and assessing the state of the environment and its evolution in Italy.

Actions related to Copernicus Users Uptake

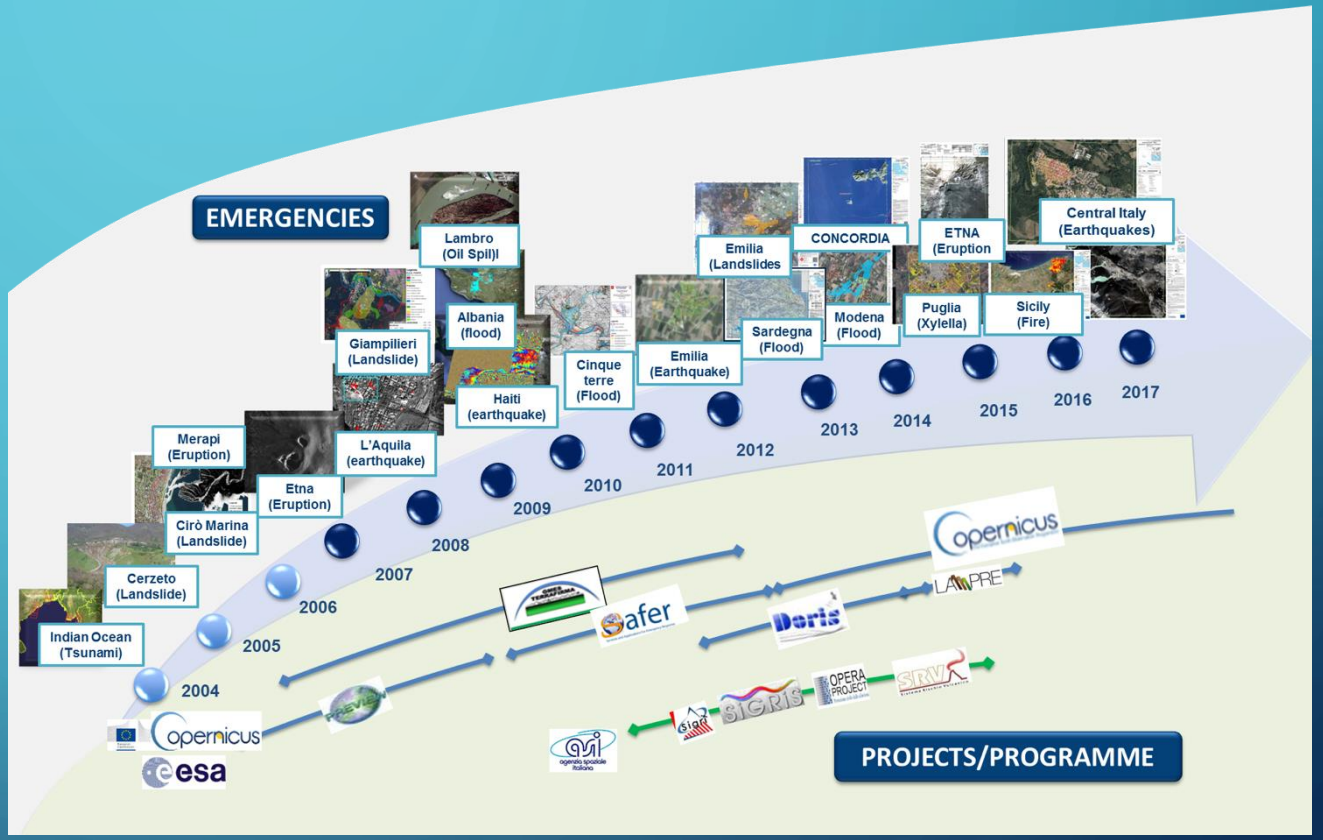
- Collection of needs and requirements of some of the largest users communities in Italy (e.g. Civil Protection, Agriculture). The needs and requirements analysis is also used for the implementation of the **National Space Economy – Mirror Copernicus**.
- SNPA Board has submitted a **FPCUP project WP2020**, approved and close to financing, to broaden and increase the knowledge and effective use of Copernicus Programme within the SNPA (around 10.000 employees) with training activities on the Core Services and DIAS.
- Provide Copernicus with information and data in situ through the **EIONet** (European Environment Information and Observation Network) of the EEA (European Environment Agency).
- Participating in planning activities of Uptake of Geo-Intelligence services in the Copernicus area (FP-CUP Program), with the aim of combating crimes and environmental crimes.

UFN Activities: Emergency Board

Emergency Board

The board is chaired by **DPC (Civil Protection Department)**. The operational uses of satellite data by this national institution includes:

- European Copernicus EMS service - response service to emergencies application cases in emergency and post-emergency;
- emergency activations in collaboration with Italian space Agency + Competence Centers;
- supply chain in real time for the use of products satellite interferometers.



National Copernicus Academy

Copernicus Academy National Coordination and Network

The **National Copernicus Academy Coordination** has been set up in order to:

- foster, support and coordinate the National Copernicus Academy Network activities;
- assure the Copernicus Academy National members collective representative and participation in the CNUF actions;
- ensure relations, including operational ones, with other Europe
- promote the admission of new national members to the Europ

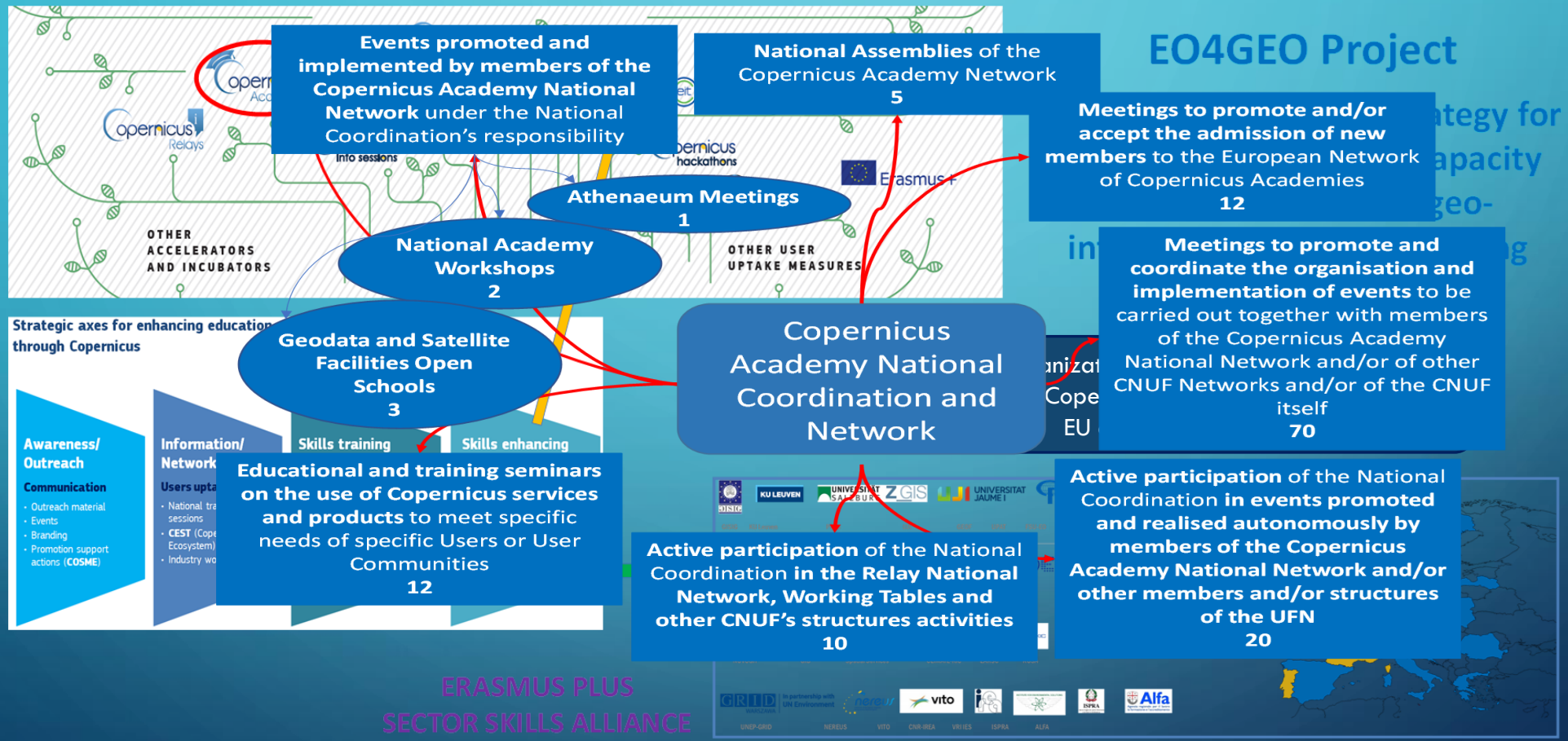
The National Copernicus Academy Network (NCAN) involves the main Italian Universities and other academic bodies, representative of the academic community at the regional level at least, as the focal joints of the network, in order to define, support and implement along with other public and private subjects, its mission.

NCAN main goals

- *analyzing the existing curricula offered by universities and high schools in the different areas where Earth Observation matters, may have a positive impact and assess how Copernicus products and services can contribute to such existing curricula;*
- *promoting the identification, approval and development of new and innovative skills, linked to new occupational profiles, in the EO, GGI and ICT sectors*
- *informing and training the academic and educational bodies members, authorities officials, professionals, entrepreneurs and citizens, about Copernicus and how its services, products, information and data can be used, through a wide offer of coordinated events, new educational training and training paths and processes, at university and/or higher education level, according to shared formats.*

National Copernicus Academy

Actions related to Copernicus Users Uptake



National Copernicus Relays

Assumed that the general aims of Copernicus Relays at national level, as established at European one, is to promote at local level Copernicus and its Services as a source of complete, free, open and reliable data and information:

- to meet the needs of public administrations;
- for the development of value-added services to be offered on the market by private enterprise.

Copernicus Relays Coordination and Network

The **National Copernicus Relays Coordination** has been set up in order to:

- promote and support in a synergic and coordinated way the activities carried out by the national Copernicus Relays at the national level, also through a National Action Plan (individual meetings, national assembly)
- ensure a collective representation and participation in the activities of the UFN;
- to ensure relations, also operational, between the activities of Copernicus Relays and those promoted in other actions of User Uptake

National Copernicus Relays Network main activities

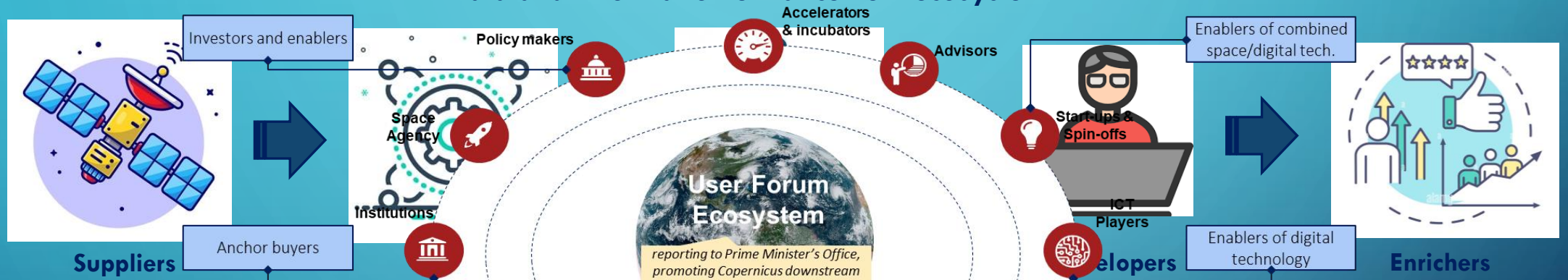
- *Coordination and animation of local and regional networks*
- *Communication and dissemination of information material*
- *Copernicus one-stop information shop, helpdesk at local level*
- *Promotion and organization of information events*
- *In collaboration with **Copernicus Academy members**, promotion of training sessions.*
- *Contribution to the National Action Plan prepared in the framework of the Coordination of Copernicus relays*
- *In agreement with the Coordinator of the National User Forum, dissemination of knowledge and promotion of the national policy in Copernicus*

UFN Activities: Valorization Board

Valorization Board

The board is composed by research centers, universities, big companies, SMEs.

Data and information enhancement ecosystem



Source: Politecnico di Milano, Osservatori Digital Innovation; PwC Strategy& analysis

>180 PLAYERS BETWEEN COMPANIES AND OTHER ENTITIES ARE ALREADY CONTRIBUTING TO THE ACTIVITIES OF «*TAVOLO DI VALORIZZAZIONE*»

Participants to «Tavolo di Valorizzazione» related to climate change thematic areas

Working group focused on energy/agriculture sector

e-geos · SITAEL · planetek italia · RSE · AON · AGRICOLUS · Gter Innovazione in Geomatica, Gnss e Gis · STUDIOMAPP · TELESPAZIO a LEONARDO and THALES company · serco · CGI · CRS4 · GEOsmartcampus · aiko · GMATICS · Raptech · TRE ALTAMIRA · EPSILON Italia · CONSORZIO LaMMA · GReD · centrale valutativa · MEEO Meteorological Environmental Earth Observation · bluFactory · RINA

ANBI · POLITECNICO MILANO 1863 · imaa istituto di metodologie per l'analisi ambientale · Consiglio Nazionale delle Ricerche · Fondazione Politecnico di Milano · INRiM · ifac istituto per il rilevamento elettromagnetico dell'ambiente

>30

Fascia Costiera

RSE · Deep Trace Technologies · aiko · colomboSky · ANBI · MEEO Meteorological Environmental Earth Observation · RINA · B-Open

Beni Culturali

RFI Rete Ferroviaria Italiana · AON · Deep Trace Technologies · CRS4 · MEEO Meteorological Environmental Earth Observation · nais · GEOsmartcampus · Fondazione Politecnico di Milano · ISAC

Insight Situational Awareness

RFI Rete Ferroviaria Italiana · Digital Innovation Hub Vicenza · ANBI · CRS4 · aiko · GReD · Fondazione Politecnico di Milano · AGRICOLUS · RINA · ISAC

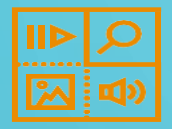
Notes: 1) Universities, foundations, research institutes, associations
Source: Responses to the survey "Copernicus User Forum - Request for participation to 'Implementation Groups'"

Companies · Other entities[1]

Space industry value chain is evolving, increasingly covering companies from multiple industries (incl. Energy & Utilities)

Space industry value chain

Upstream



Downstream

End Users

System & infrastructure → Operation → Data & Processing → Advanced products/services

User demand pull – Services

- Launch systems and vehicles
- Satellite AIT and manufacturing
- Ground systems and net. equipment
- Launch service provision, satellite and ground segment operation

Example of companies (non-exhaustive)

- Data and satellite services
- Value-added services
- User equipment

Example of companies (non-exhaustive)

- Consumer, industry, governments, non-profit organisations
- Multiple sectors (energy, infrastructure, agriculture, marine, defence and security, etc.)

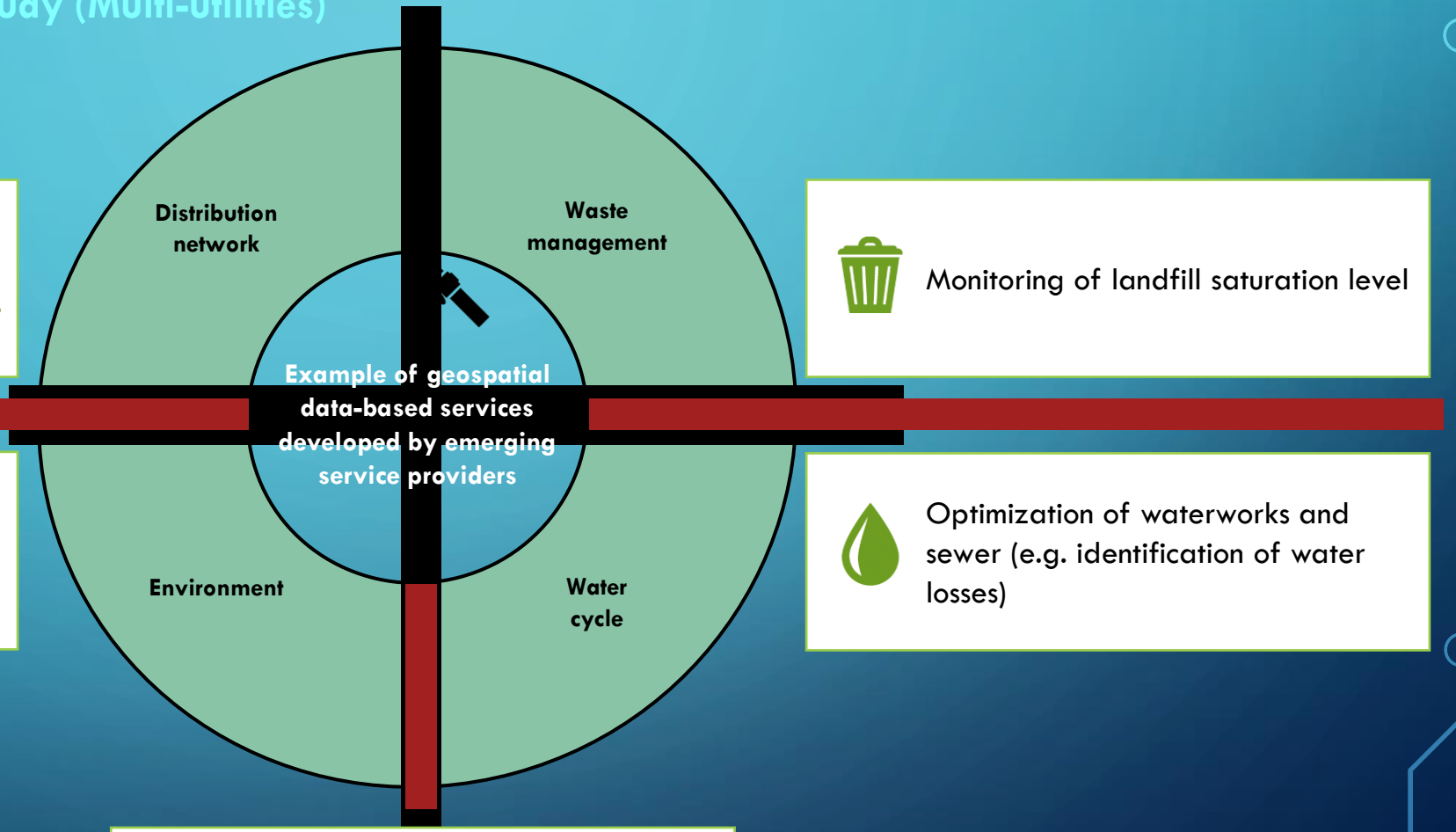
Examples (non-exhaustive)

Example of applications for Energy&Utility in next slide

EMERGING SERVICE PROVIDERS ARE DEVELOPING DIFFERENT SERVICES BASED ON GEOSPATIAL DATA, TOGETHER WITH GIS COMPANIES, STARTUPS AND SMES

Emerging service providers case study (Multi-utilities)

Tracking of power grids, gas pipelines, district heating network



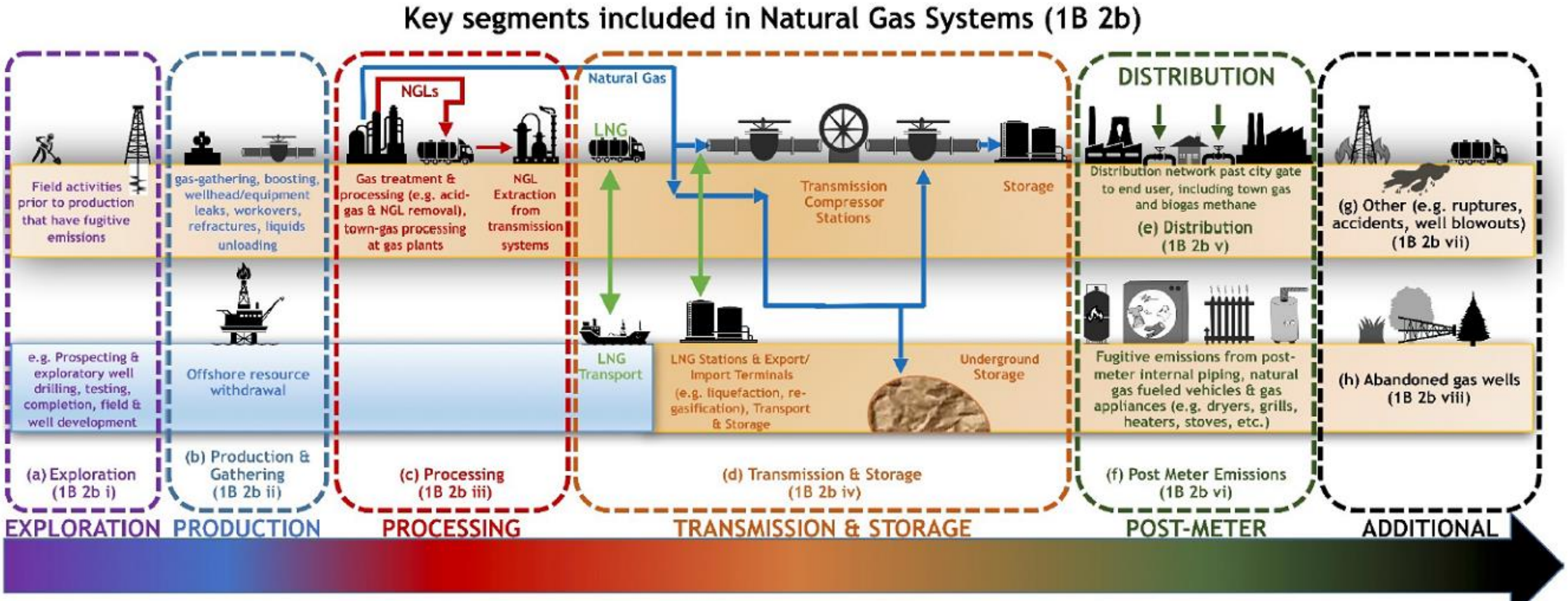
Monitoring of landfill saturation level

Monitoring of light pollution, air pollution, material pollutants mapping (e.g. asbestos)

Optimization of waterworks and sewer (e.g. identification of water losses)

Operating vehicles routes and usage optimization

Identification of the multiutility user needs, of the specific use cases and of the innovative EO based solutions



Siti di stoccaggio

Oil spill

Monitoraggio movimenti del terreno in corrispondenza di strutture/infrastrutture

Monitoraggio delle reti/condotte

Monitoraggio emissioni liquide/gassose

Discariche/ incidenti

EXAMPLE: MULTIPLE SERVICES BASED ON SPACE DATA ARE ADOPTED IN THE ENERGY & UTILITY INDUSTRY, GENERATING BENEFITS FOR PLAYERS

Non exhaustive

Use cases of Space-related services for E&U players

Application	Company Benefit	Case Study
Anomalies identification • Early detection and **monitoring of natural changes** (e.g. soil movement) and **abnormal events** (e.g. oil spills)	• Protection of assets from hazards generating potential risks • Compliance with environmental legislation	• Identification of **water pipelines failures** and predictive maintenance *(utility player)* • Monitoring of **lighting networks** and planning of maintenance interventions *(utility player)* • Monitoring of **ground deformations** across **natural gas storage** areas *(O&G player)* • Prevention, tracking and management of **oil spills** from ports/offshore sites *(O&G player)*
Monitoring & Maintenance • **Monitoring of assets** and identification of **leakages** (e.g. pipelines, storage areas, plants) • **Predictive maintenance**	• Efficient monitoring of large scale areas • Timely identification of leakages and area of intervention	
Field Exploration • **Identification of convenient location** and conditions for plants/facilities and detection of oil seeps	• High confidentiality of exploration activities[1] • Identification of productive sites	• Assessment of energy efficiency level of residential buildings *(utility player)* • Validation of **solar cell** and **off-shore wind farms** operations *(utility player)* • **Forecast** of **power production** based on Global Horizontal Irradiance variable and alignment with network manager information requirements *(Photovoltaic plant owner)*
Energy Production Optimization • **Monitoring of energy production** (e.g. power production forecast) and enhancement of energy production efficiency	• Early and cost-effective detection of failure • Efficient power production monitoring and forecasting	

Possible Applications

- **Network** *(water, gas, district heating)*
- **Waste**
- **Energy generation**

Additional use cases to be identified with players involved in *"Tavolo di Valorizzazione"*

E.g. Potential geomarketing applications

Source: Copernicus Market Report - European Commission (2019); secondary research; PwC Strategy& Analysis

SATELLITE DATA CAN DRASTICALLY IMPROVE THE ACCURACY OF GROUND DEFORMATIONS MONITORING IN AREAS WHERE NATURAL GAS IS STORED

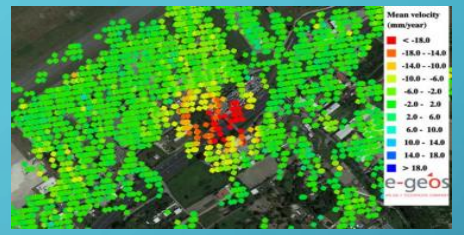
Use case – Monitoring infrastructure in the case of natural gas storage

Challenge faced by industry players

- **Natural gas** is typically **stored into natural underground hollows,** where the gas is injected in warm seasons and extracted in cold seasons
- Gas **injection** may have an **effect on the surface,** typically covering **very wide areas,** that therefore requires a **constant monitoring**

Advantages of using satellite data

- Satellite data are used to **generate interferometric analysis** of the area subjected to the injection/extraction, process providing a **better understanding of the area impacted**
- **InSAR analysis** helps to **monitor slow deformations with very high accuracy** (millimeter measurements) over very wide areas and **extract the evolution of the deformation**

Illustrative Output	 • *InSAR analysis derived by Sentinel-1 data* • *Red points represents movements with high velocity (>18 mm/year)*
Solutions providers	e-geos AN ASI / TELESPAZIO COMPANY · AIRBUS · bird.i · planet.
Additional Data Sources	• Remotely Piloted Aircraft Systems (RPAS) data • Internal data from the oil and gas company • Ground data • Marine data • Meteorological data
Target Customers	• Oil & Gas players • Utility companies • Energy infrastructure managers

Source: Copernicus Market Report - European Commission (2019), e-Geos, PwC Strategy& Analysis

SATELLITE DATA CAN BE LEVERAGED TO ACCESS SOLUTIONS THAT PREVENT, TRACK AND HELP TO MANAGE OIL SPILLS FROM OFFSHORE AND PORTS

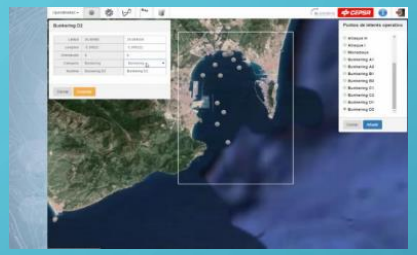
Use case – Preventing and managing oil spills

Challenge faced by industry players

- **Oil companies** are often **legally responsible** for ensuring their operations **do not contaminate the surrounding environment**
- When working in offshore locations or in ports, it is **essential** for the companies to **monitor for leaks,** especially when performing loading and unloading operations

Advantages of using satellite data

- Possibility to leverage accurate data to **generate oil spill forecast** and **backtracking system** with real time short-term oil spill trajectories and weather forecasting and backtracking
- Possibility to develop planning systems capable to estimate the **probability of contamination** from the critical scenarios identified, arrival of pollution at the coast

Illustrative Output	 • *InSAR analysis derived by Sentinel-1 data* • *Red points represents movements with high velocity (>18 mm/year)*
Solutions providers	CEPSA, IH cantabria INSTITUTO DE HIDRÁULICA AMBIENTAL UNIVERSIDAD DE CANTABRIA
Additional Data Sources	• Near-real-time short term (5-day) forecast for currents, waves and other oceanographic variables • Oil spill models
Target Customers	• Oil & Gas players • Transport companies • Energy infrastructure managers • Port authorities

Source: Copernicus Market Report - European Commission (2019), e-Geos, PwC Strategy& Analysis

SATELLITE DATA CAN IMPROVE THE ACCURACY OF PHOTOVOLTAIC POWER PRODUCTION FORECASTS AND EVENTUALLY LEAD TO SAVINGS FOR PLANT OWNERS

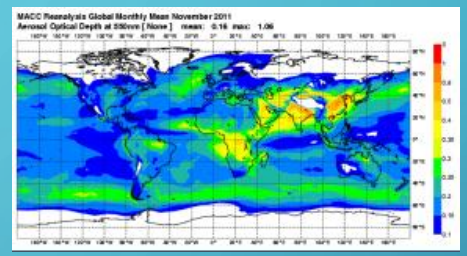
Use case – Forecasting photovoltaic (PV) power production

Challenge faced by industry players

- Photovoltaic **power plant owners sell PV electricity** produced to the local **network manager** and the production is then bought by a utility
- **Network managers require** precise power **production forecasts** to plant owners and, in case forecasts are **not respected, penalties are applied** (typically in case of error >8%)

Advantages of using satellite data

- The use of satellite data and weather models allows to **accurately estimate the GHI variable** (Global Horizontal Irradiance), that is eventually converted into a **power production variable** according to PV plant characteristics
- An accurate forecast of photovoltaic power production can lead to relevant **savings** for power plants owner in terms of **lower penalties to be paid**

Illustrative Output	 • *Forecasts of total aerosol optical depth (left) and monthly mean of total aerosol optical depth (right)*
Solutions providers	Reuniwatt, steadysun, Raptech
Additional Data Sources	• Climate aerosol mean models computing • Plants output data • In situ data • High-end climate modeling and
Target Customers	• Large energy companies • SMEs operating photovoltaic plants

Source: Copernicus Market Report - European Commission (2019), CAMS, PwC Strategy& Analysis

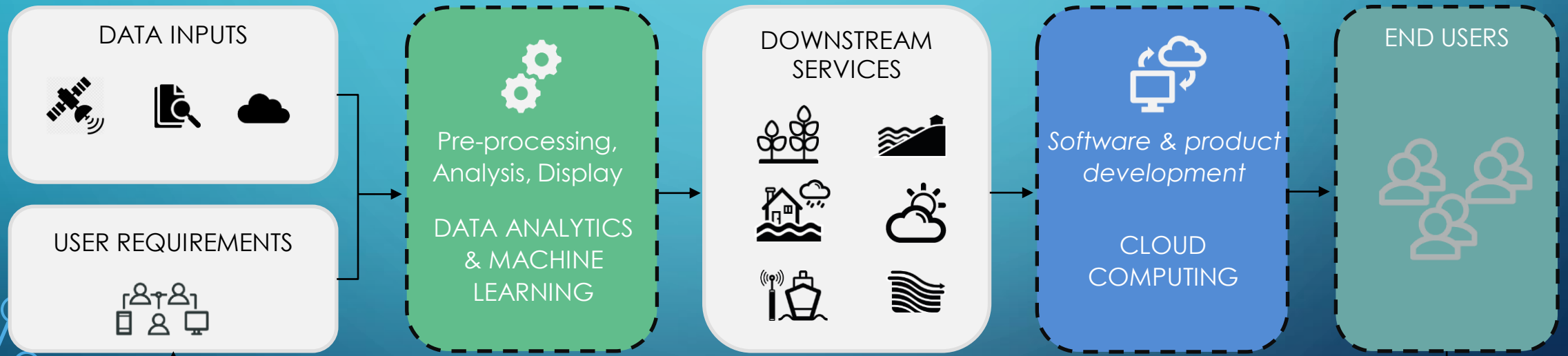
The Copernicus program: The New Space Economy

Scientific and Technological Innovation

Earth Observation Systems allow integration of huge amounts of data - **BIG Data** from heterogeneous platforms

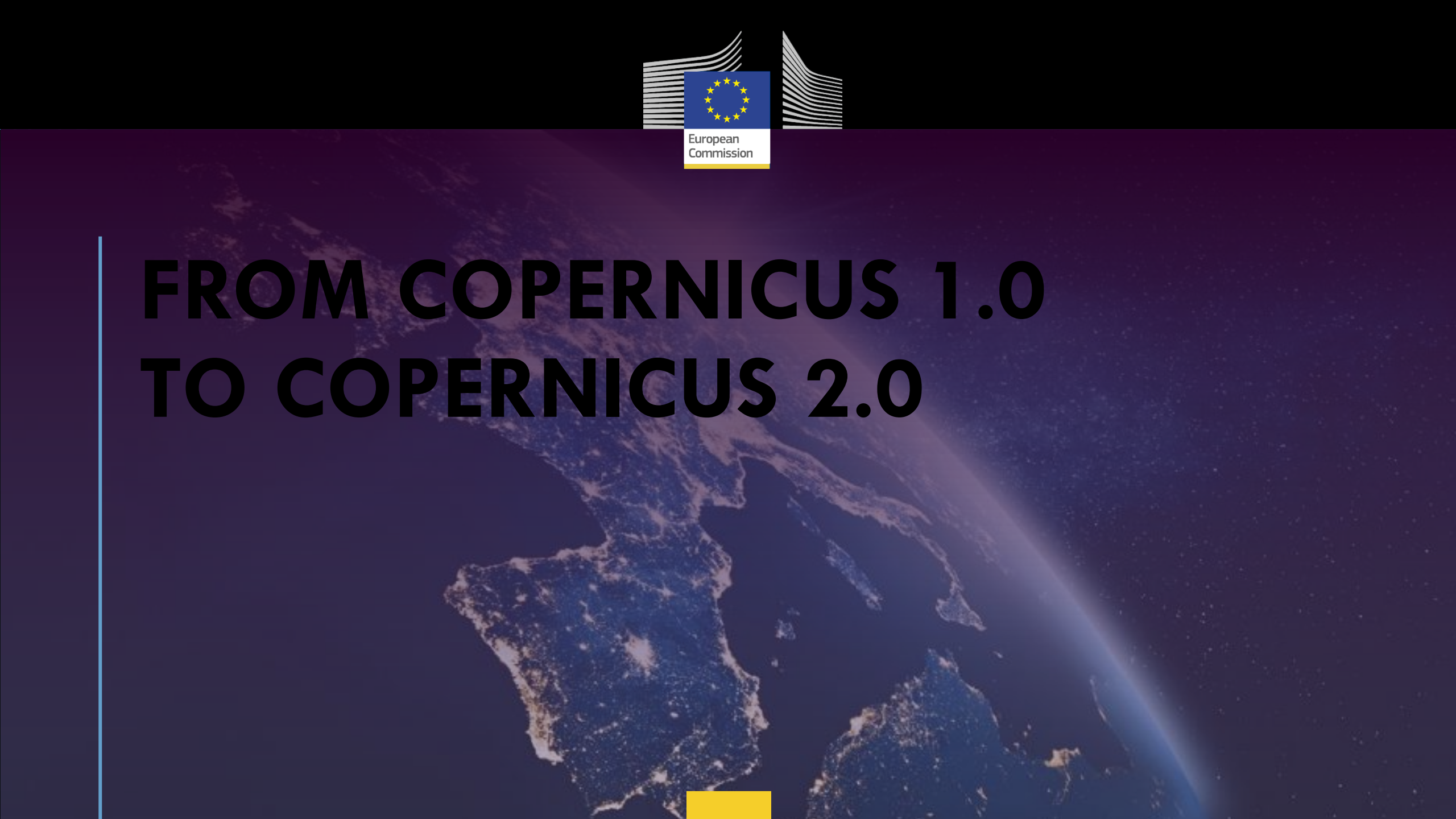
Radical innovation in geo-spatial services

EO services based on the user's business and tailored needs

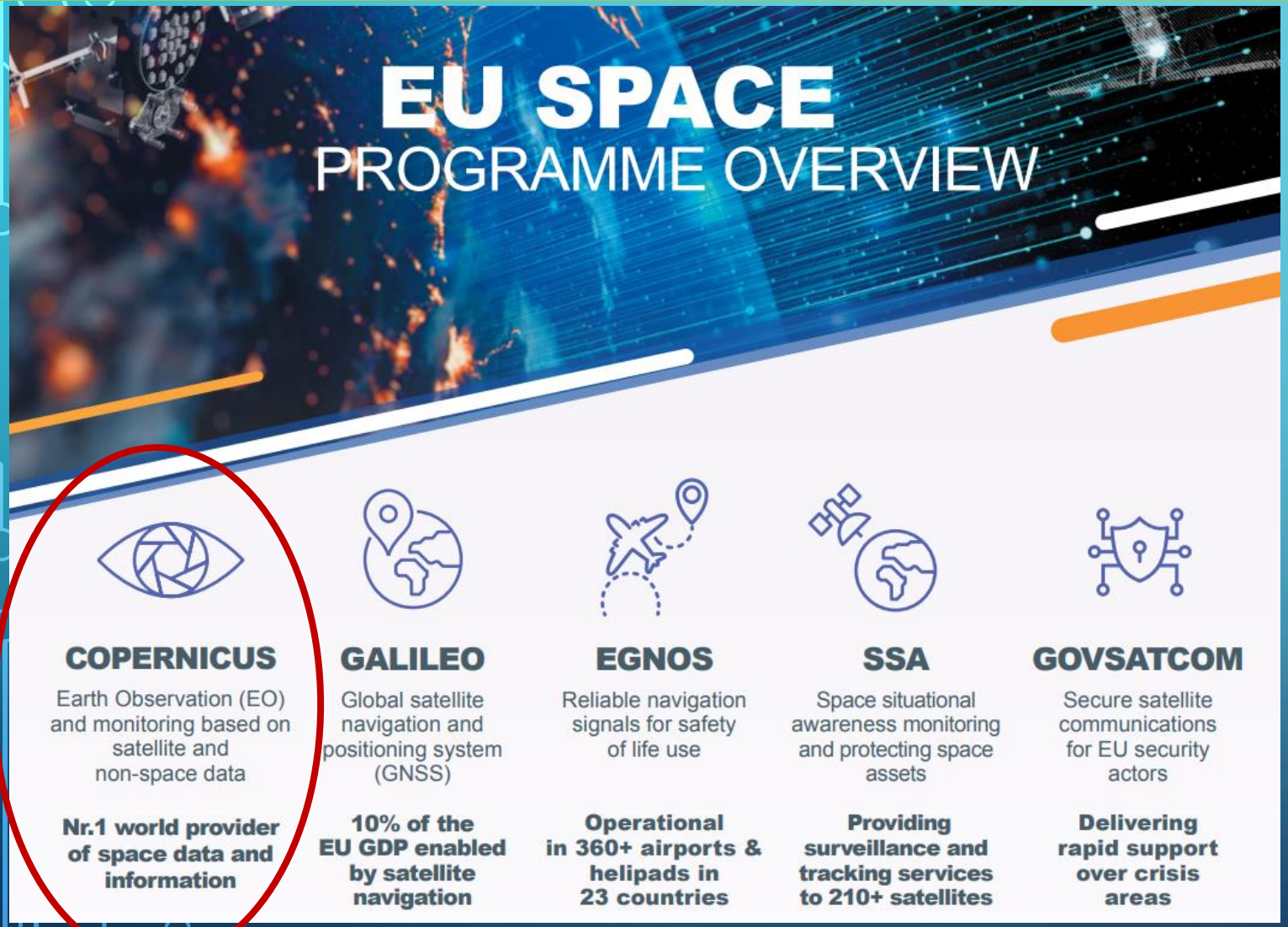


Retrofitting & Improvement

FROM COPERNICUS 1.0 TO COPERNICUS 2.0



The EU Space Programme



AN INVESTMENT IN A
FUTURE READY EUROPE

Competitive edge

Completing current satellite constellations, developing and launching the next-generation of satellites

Research **innovation**

Ambitious research and innovation programme benefiting from Horizon Europe

Fighting Climate Change

Monitoring biodiversity, environmental compliance and CO_2 emissions (Paris Agreement)

EU as a **global actor**

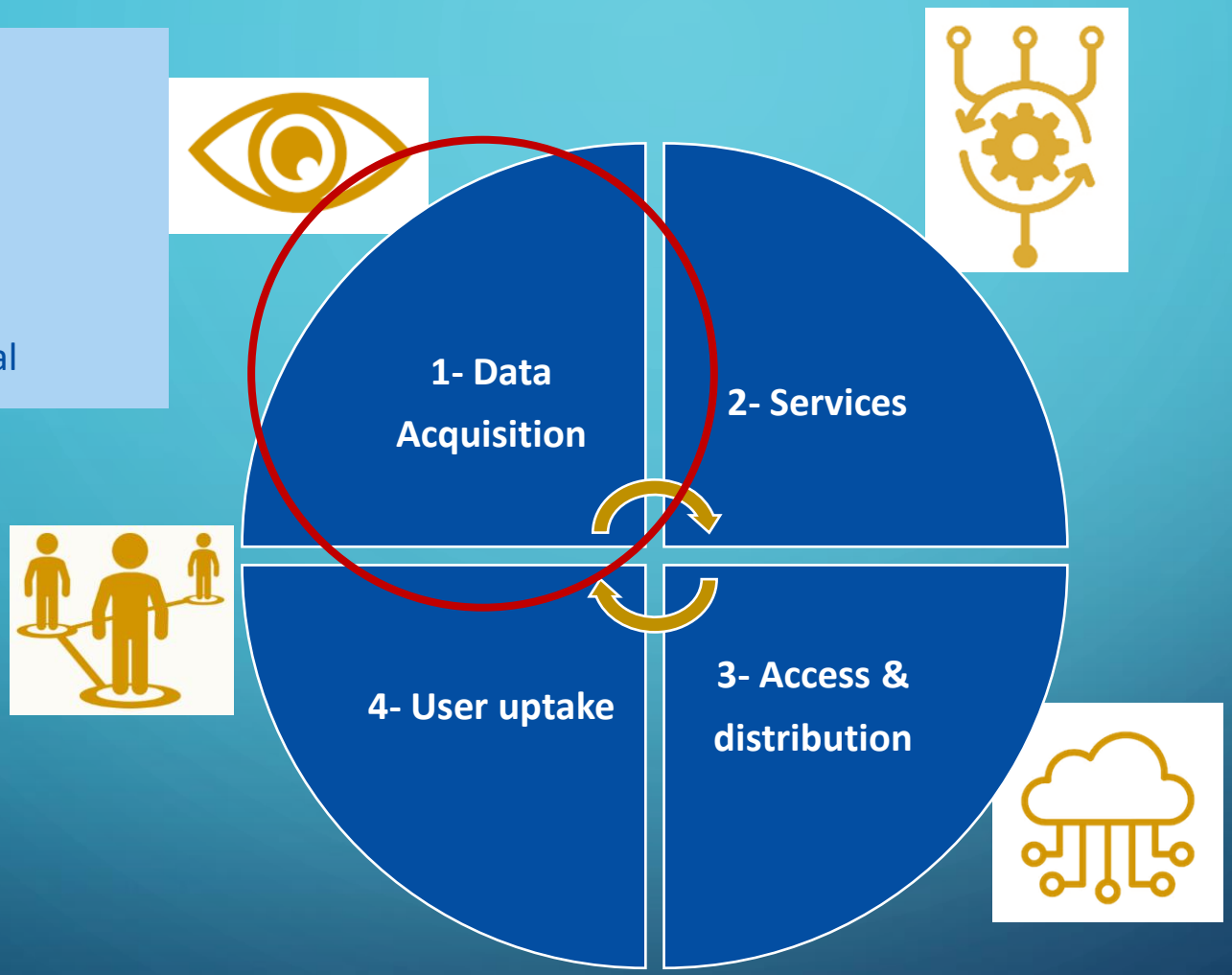
Supporting disaster relief, humanitarian assistance and security operations

Four dimensions of Copernicus

Continuation of data +

Agile observation

- Enhance performance
- Reduce dependencies
- Amplify observation potential



NEW SPACE

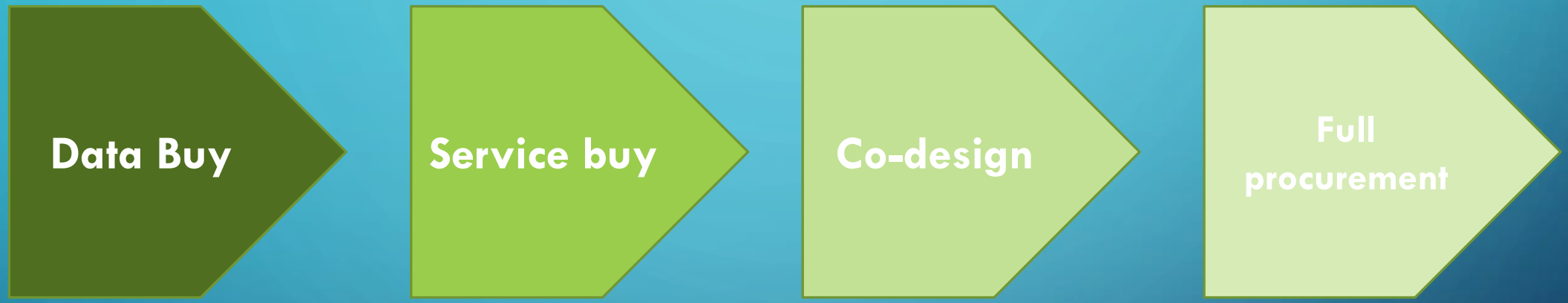
NewSpace is a global trend encompassing a series of technological and business model innovations leading to a reduction in costs, shorter lifecycles and a bolder approach to risk taking in the space sector.

Thus, fostering the development of a private space industry that is primarily driven by commercial motivation and is often backed by risk capital seeking a return, while being supported by an innovative public sector aimed at promoting innovation , competitiveness and business creation.

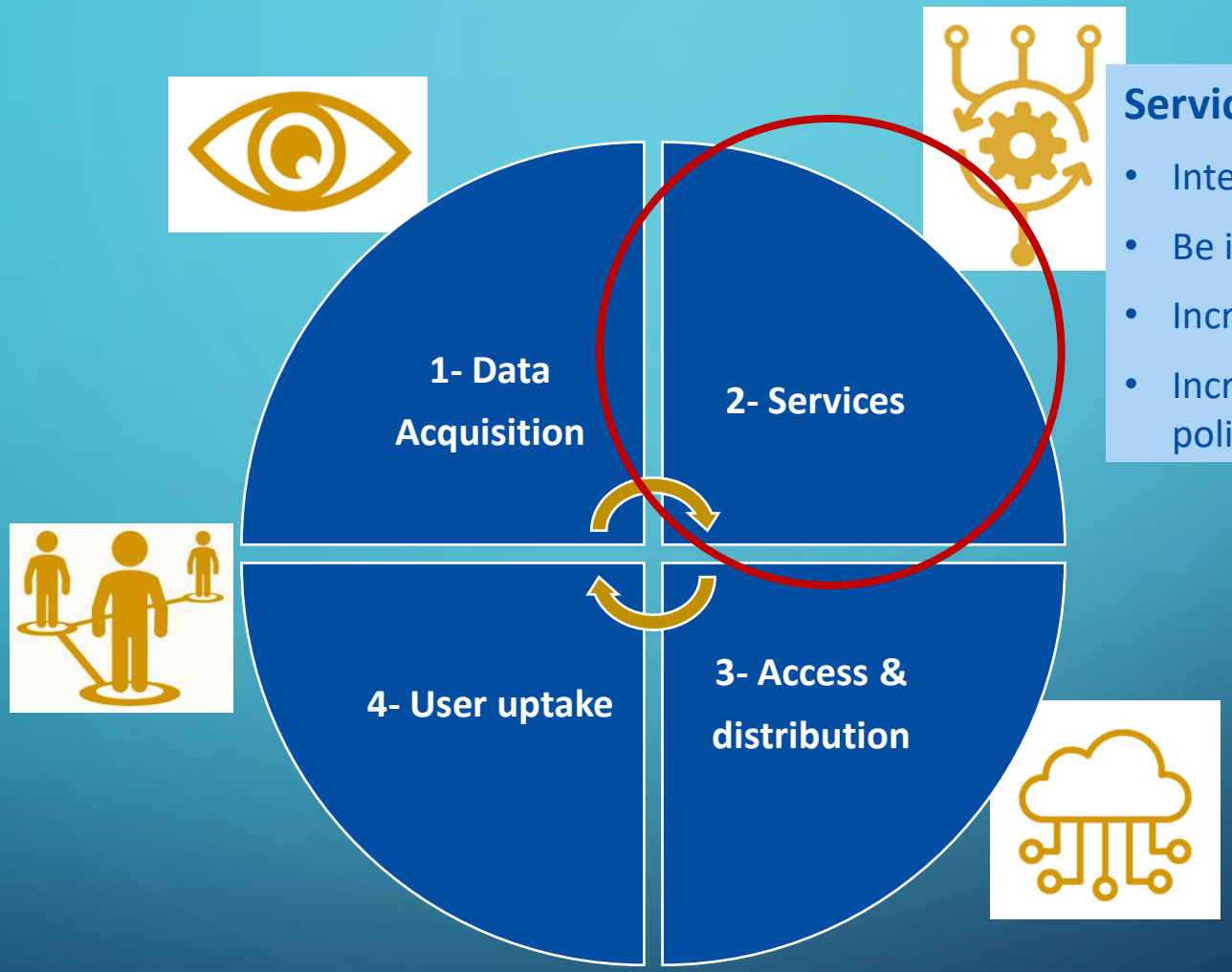
Source: : EU Space Economics in the global context study – SpaceTec Partners for DEFIS, 2021

Interaction with NEW Space

- The interaction can have several degrees of integration



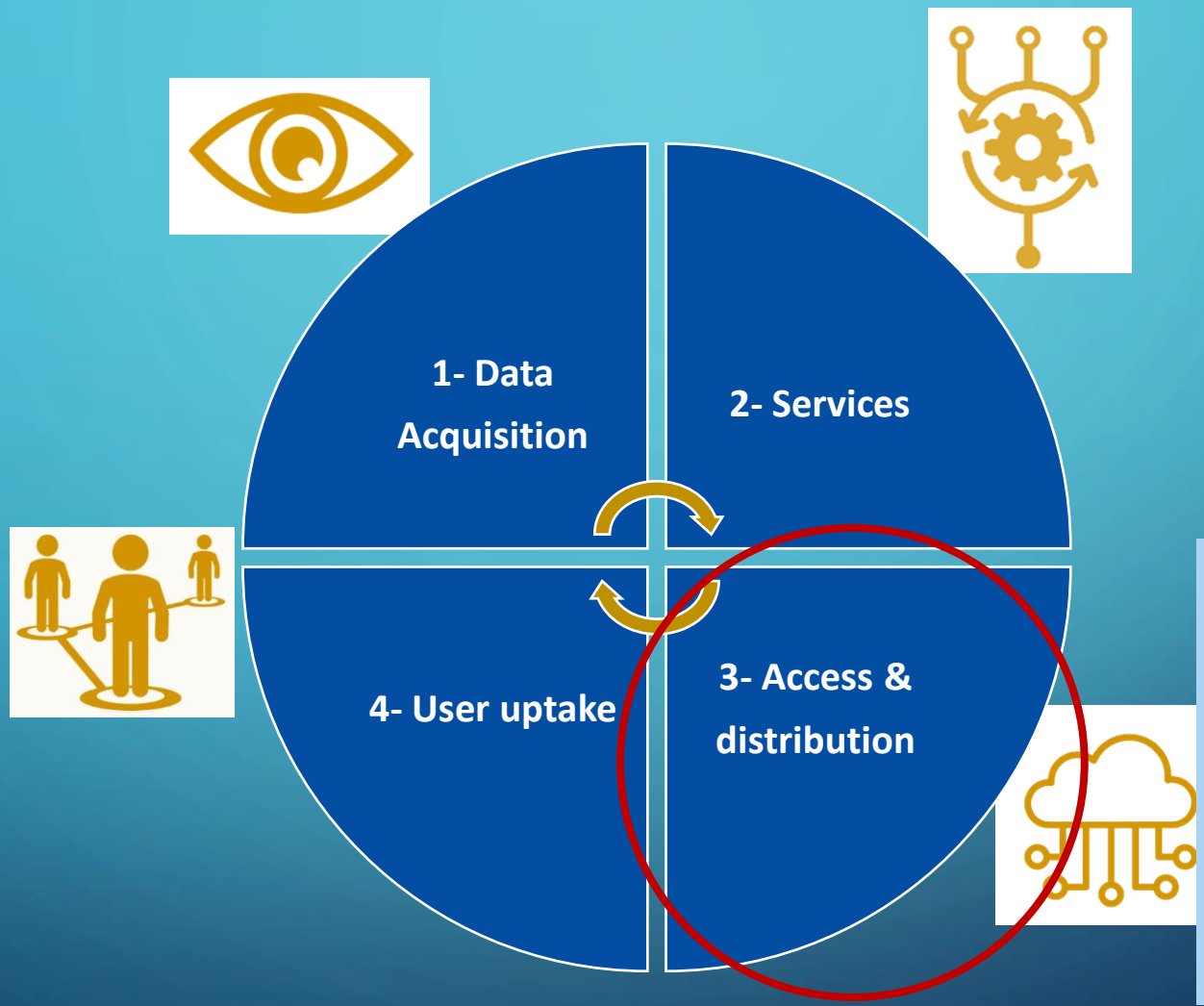
Four dimensions of Copernicus



Service uplifting

- Integrate faster with digital, AI, HPC
- Be instrumental to Green Deal objectives
- Increase support to resilience needs
- Increase support to EU and National policies

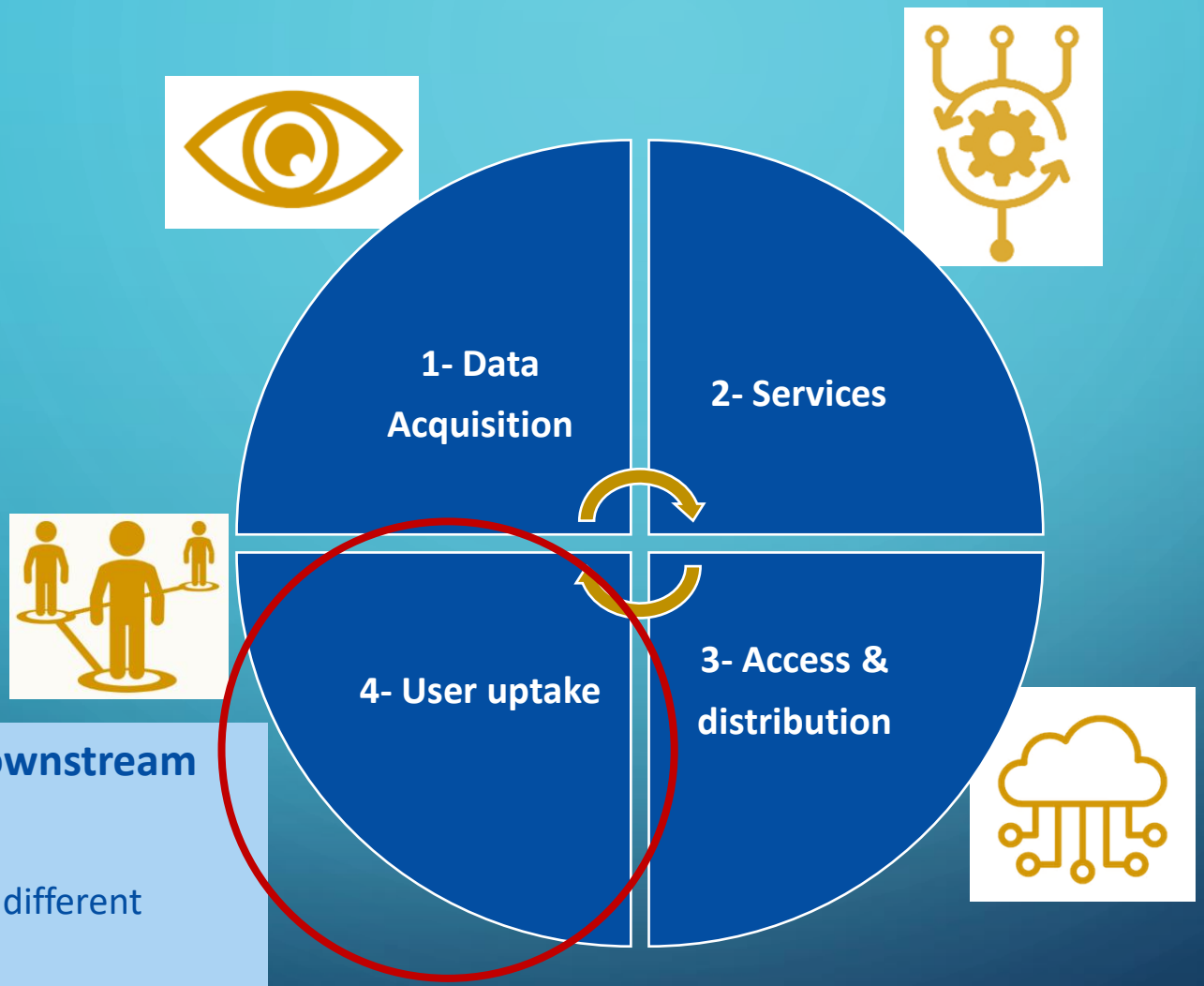
Four dimensions of Copernicus



Boosting EU infrastructures

- Develop Integrated Data Management
- Streamline data platforms
- Develop Data analytics with Destination Earth

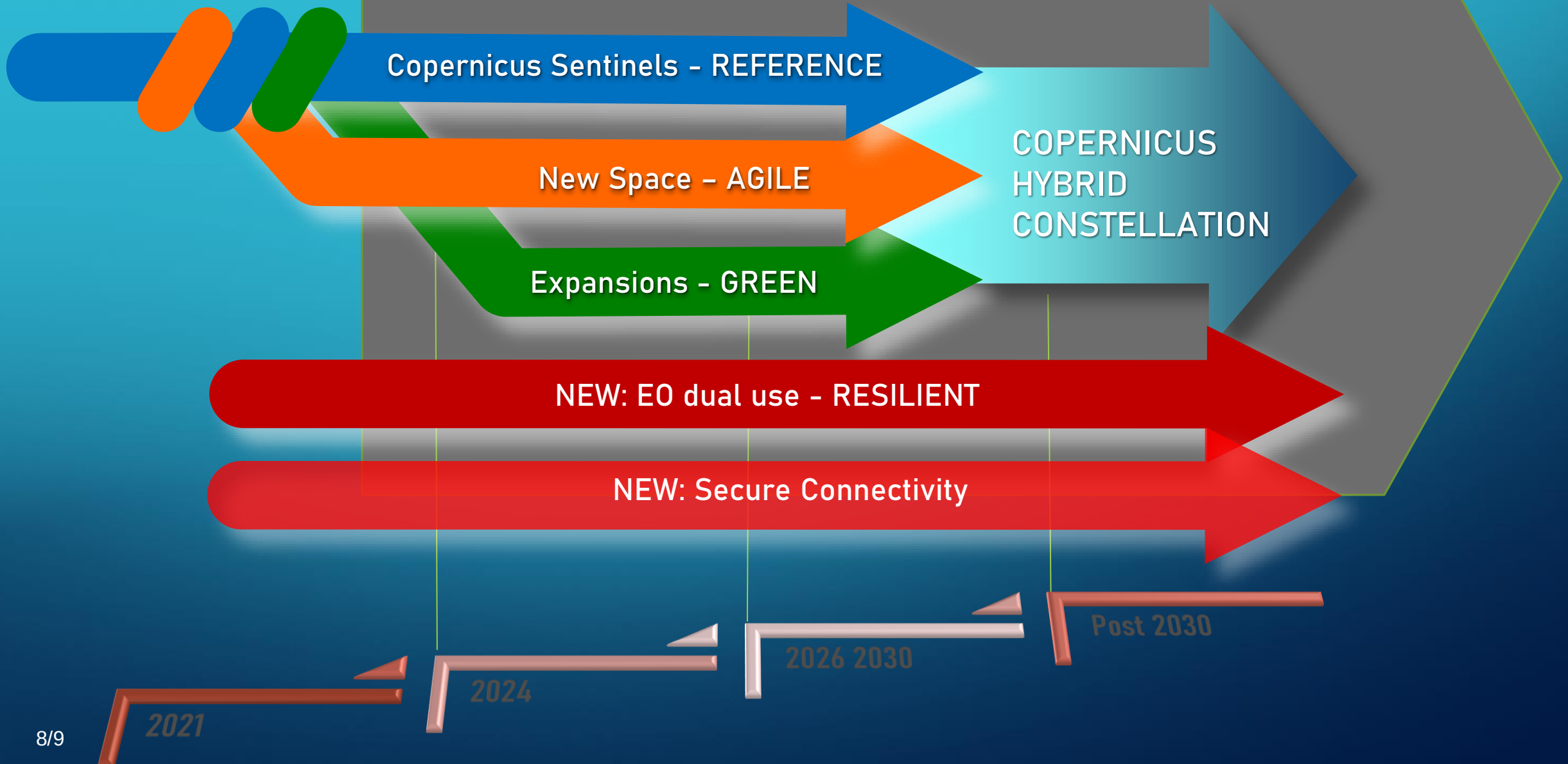
Four dimensions of Copernicus



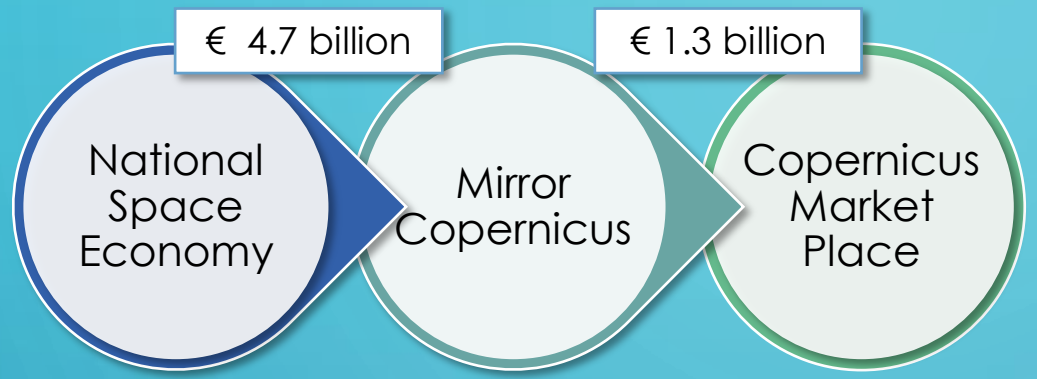
Re-energise Copernicus downstream

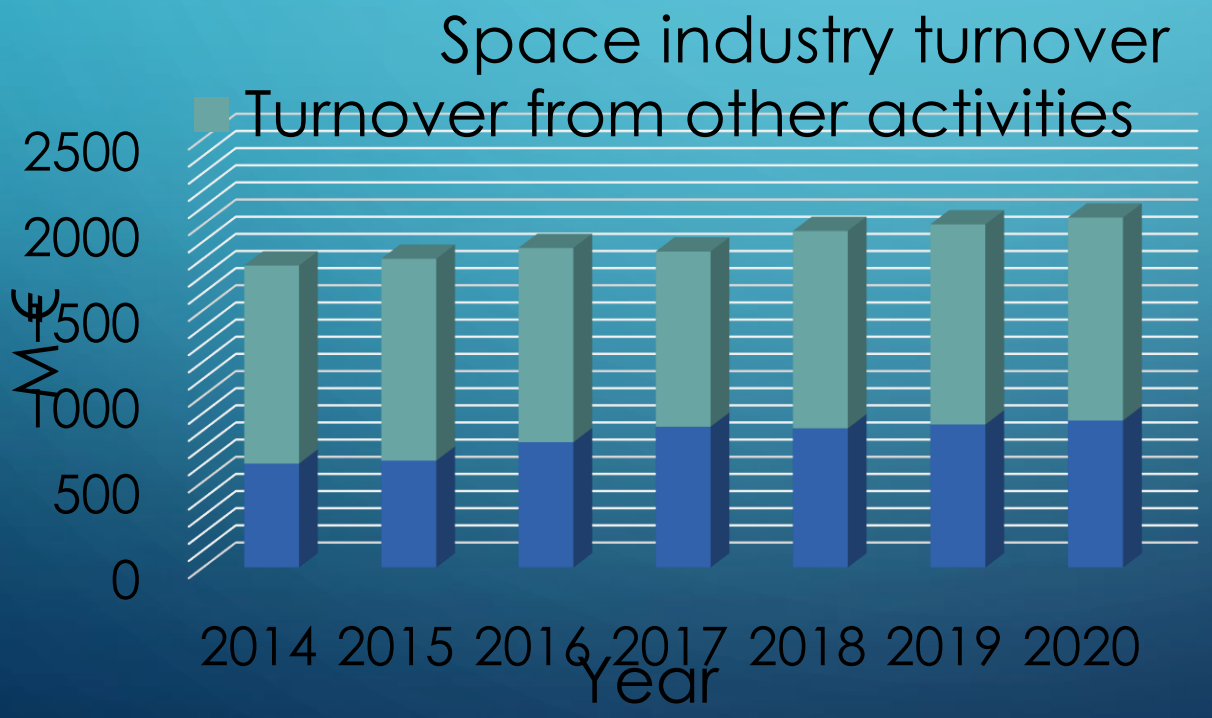
- Anticipate user needs
- Use space data to transform different ecosystems
- Develop innovative tools for greater uptake

Evolution of Copernicus – EO strategy



Copernicus and the National space economy





The optimization of the **upstream and downstream** sector is a valuable contribution to the national space economy
and has been growing in the last years.

THE COPERNICUS MARKET PLACE INITIATIVE (COMAP) AIMS AT ACCELERATING THE MARKET UPTAKE PROCESS, MAINLY EXPANDING END-USER BUYER BASE

Operational Copernicus programme

Operational DIAS

DIAS initiatives

DOWNSTREAM SERVICES EVOLUTION

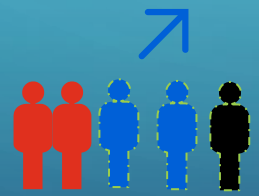
INTERMEDIATE USERS

- Pre-processing
- Analysis
- Access to high and very high resolution imagery
- Value Added Services
- Fusion of EO products
- Display

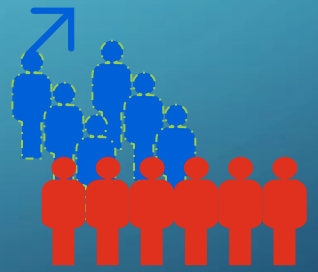
END USERS & BUYERS

- Input EO-based products in their activities
- Very specific operational needs
- Fusion of EO products with other sources of Domain data

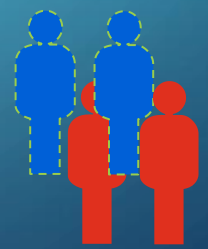
Anchor tenancy



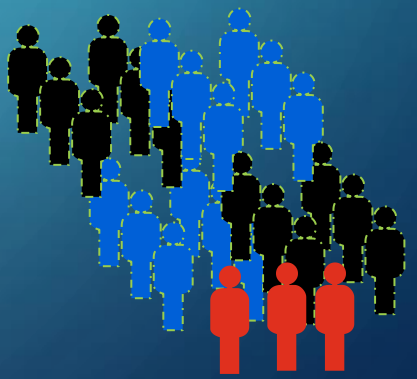
"EO experts"



Experts "Non EO"



"Institutional Buyers"

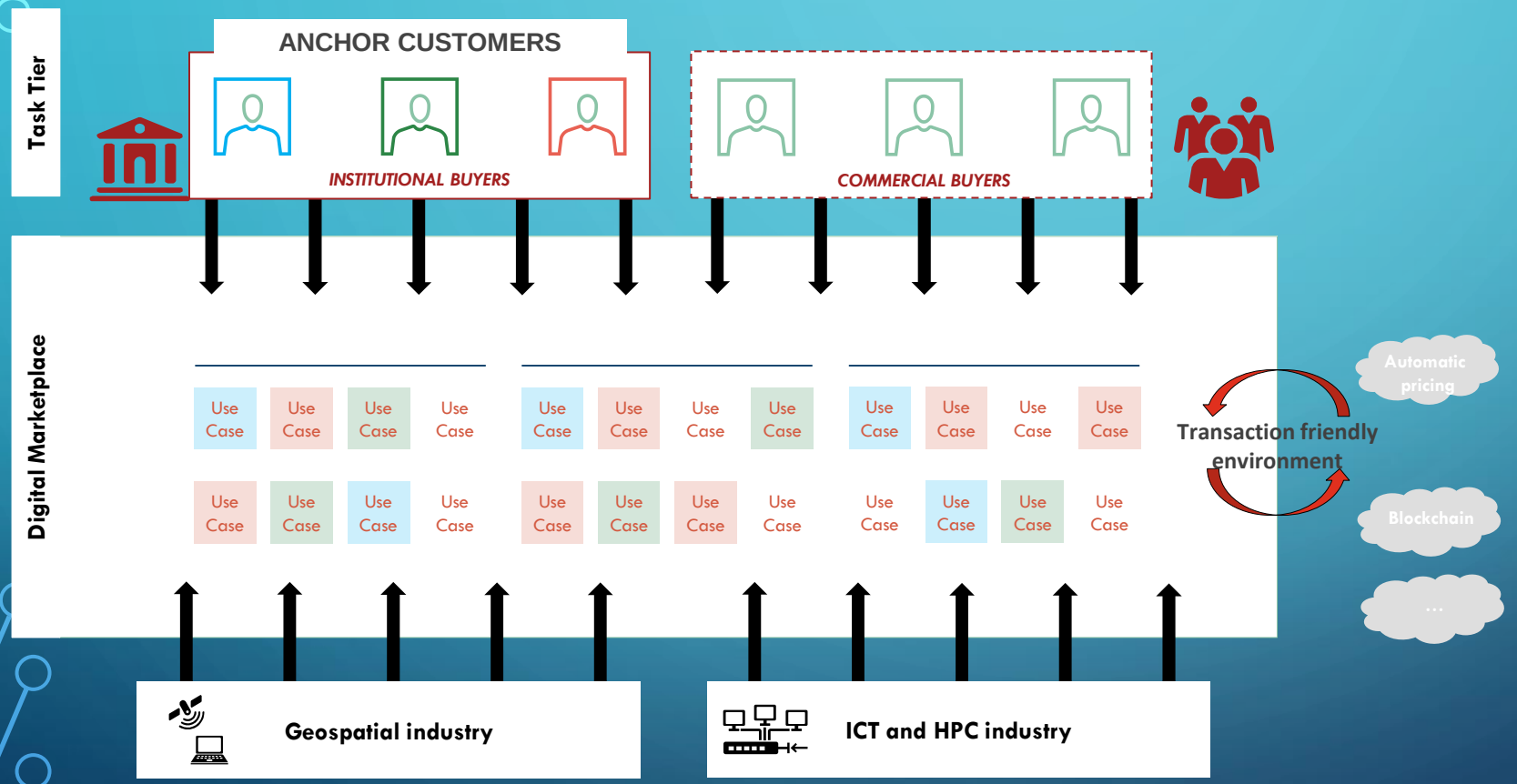


"Commercial Buyers"

CoMaP CoMaP CoMaP CoMaP CoMaP CoMaP

THE COMAP AIMS AT CONSTITUTING A TRANSACTION FRIENDLY DIGITAL MARKET PLACE, USING INSTITUTIONAL DEMAND AS ANCHOR CUSTOMERS

Copernicus Marketplace



SUMMARY

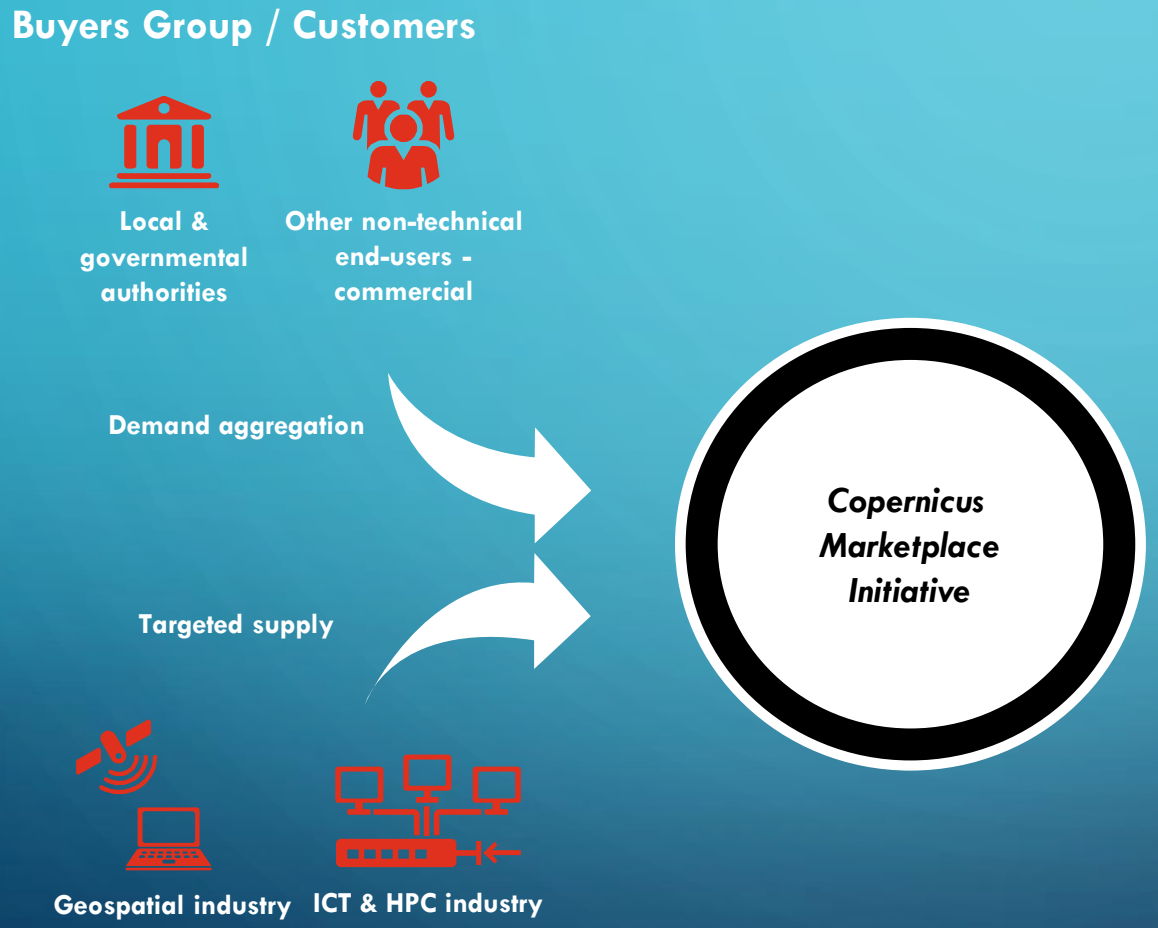
The Copernicus Market Uptake Platform will connect demand and supply of geospatial solutions on **an open and flexible digital marketplace** using **institutional users demand as an anchor customer**. It will support the industry, **especially SMEs**, by developing a market responding to institutional operational needs around specific thematics. Being an anchor customer will allow institutional users to benefit from **cost-effective solutions** designed specifically to respond to their **operational needs**.

The CoMaP should also offer a **highly flexible** digital environment for **real time management of exchanges and easy transaction**, relying on cutting edge block-chain technologies or automatic pricing algorithms, etc.

The anchor customer would allow the development of the platform and facilitate **entrance/penetration for SMEs** that will be able to **access a market formerly too fragmented**.

The CoMaP shall also attract commercial users that could enter the platform to access specific services provided the digital marketplace.

THE COPERNICUS MARKET PLACE (COMAP) INITIATIVE AIMS AT BRINGING TOGETHER NON-TECHNICAL END-USERS AND THE INDUSTRY (GEOSPATIAL & ICT) BY BUILD A WIN-WIN SITUATION THROUGH THE DEVELOPMENT OF A PPP



SUMMARY

The Copernicus Market Place initiative aims at:

1. Providing **end-users** , first and foremost for institutional organisations, support to decision-making and situational awareness **tailored to their operational needs**;
2. **Hosting and making all data relevant for end-users**, including both satellite data and other sources of data, accessible in a **user-friendly** manner;
3. Offering an **open, scalable and interoperable environment** facilitating the development of applications;
4. Favouring the **access "as a service"** of sophisticated **information extraction technologies** (e.g. Big Data analytics, HPC, ICT, etc.);
5. Setting up **a market place** bridging demand and supply of value-added geospatial applications and services.

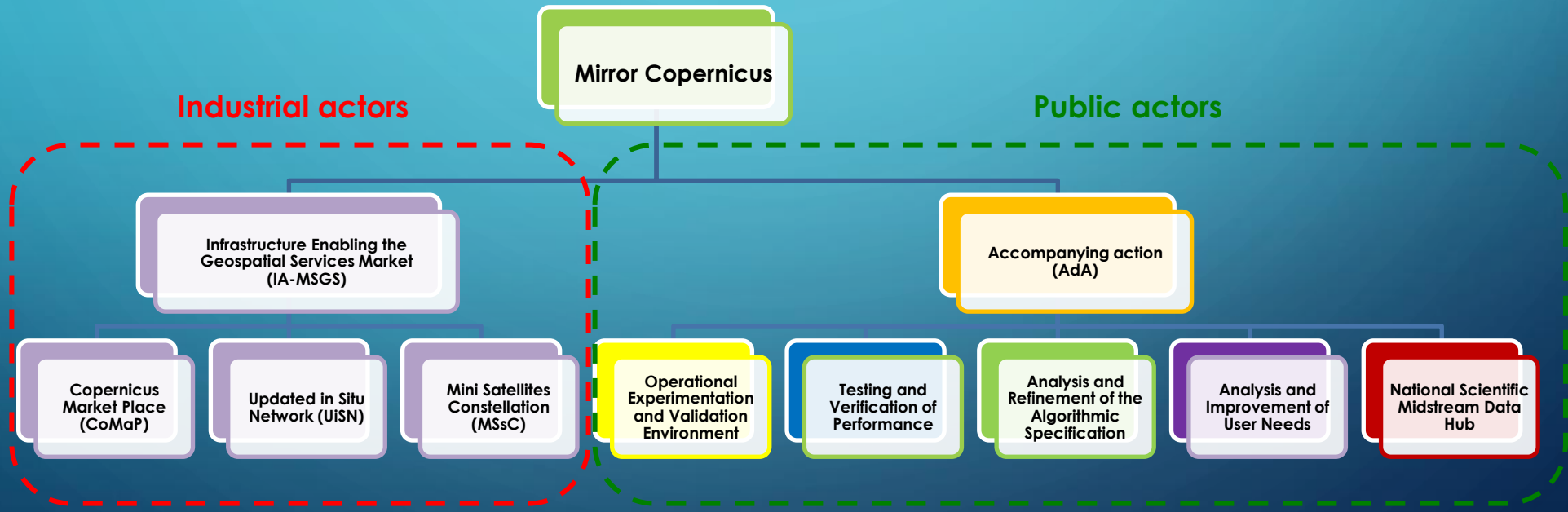
The infrastructure will be **developed by a private operator through a Public Private Partnership (PPP)**.

Copernicus and the space economy

The Mirror Copernicus Programme

The goal

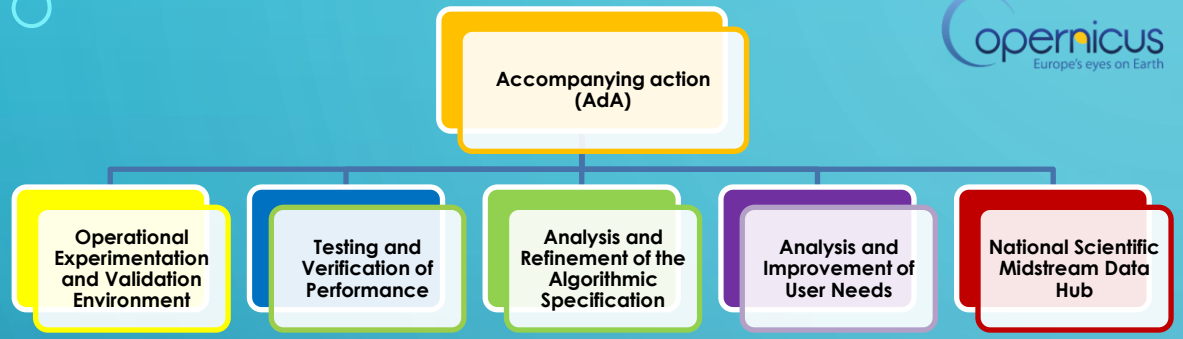
The programme is part of the National Program Space Economy, it aims to strengthen the positioning of the national production system in the emerging European and global market of geo-space services, through the creation, on the national territory and with national leadership, of an innovative infrastructure system, called **Infrastructure Enabling the Geospatial Services Market** (IA-MSGS), open, scalable, interoperable with other similar systems, capable of accelerating its development and increasing its competitiveness.



3. Copernicus and the space economy

The Mirror Copernicus Programme

Accompanying Action



- Carried out by the **Relevant Public Partnership**, with the aim of creating the conditions for the best success of the Copernicus Mirror and maximizing the results of the activities carried out within the program
- Provides assistance in the process of refinement of the technical specification of the needs expressed by the **Buyers Group** (i.e. the purchasing group of large Institutional users who express public demand), contributes to improving the technical specifications of the systems and algorithms proposed by companies, validates the results and measures their performance, as well as provides and maintains prototype chains for benchmarking and pre-operational testing of services and applications essential for the tasks of the Buyers Group

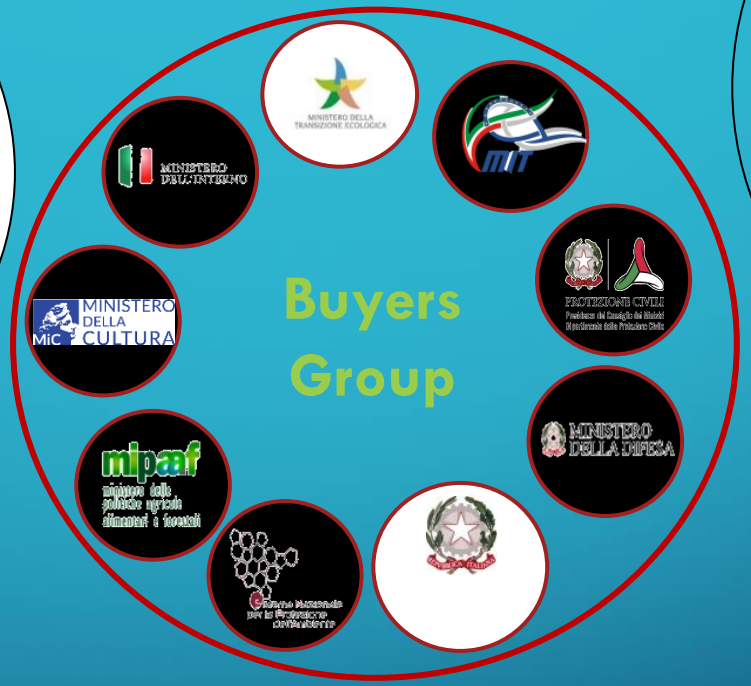
Research and Development

Buyers Group

It offers the technical skills to contribute to the provision of the services required by the Buyers Group

ESA
ASI
MISE

PROJECT MANAGEMENT



Service Engineering Group

Research and development

ECMWF

MARKET UPTAKE ADVISORY

Industry

Establishes the requirements for specific services, grouped into different thematic services, based on their institutional purpose and the provisions of the law

INTERACTION WITH BUYERS GROUPS RESULTED IN THE IDENTIFICATION OF SPECIFIC THEMATIC SERVICES TO BE DEVELOPED

Thematic Services identified

Coast and marine monitoring

Tracking and prediction of waves, coasts geo-morphology, natural habitat and events affecting the marine environment

Air Quality

Mapping of pollutants and dispersion of ash and other materials due to natural and anthropic events

Ground motion

Monitoring of ground motion due to earthquakes, volcanic eruptions, landslides

Monitoring of land cover and use

Mapping of crops, agricolture, forests, volcanic areas, soil consumption

Hydro-meteorology climate service

Hydro-meteorological monitoring and weather forecasting
Climate indicators and projections
Monitoring and forecast of greenhouse gases and other Essential Climate Variables (ECV)

Water resources

Hydromorphological monitoring and river channel dynamics
Hydrological and hydraulic modelling, flood forecasting and sediment management
Integrated water resource management

Emergency services

Identification of critical events such as floods, wildfires, earthquakes and eruptions and mapping of damages

Security services

Maritime surveillance and surveillance of UE external borders

DIFFERENT ORGANIZATIONS DEFINE THEIR REQUIREMENT IN ACCORDANCE WITH THEIR INSTITUTIONAL GOALS AND LEGISLATIVE PROVISION

User's Task Tier

PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

Risk Management	Emergency Contrast	People Relief
Natural catastrophes		
Anthropic-caused disasters		
General Emergencies		

MIT

Tracking	Control	Safety
Land, air, sea infrastructures		
Means of transport		
Environment		

Sistema Nazionale per la Protezione dell'Ambiente

Research	Monitoring	Statistics
Environment		
Ecologic Transition		
Natural Capital		

mipaaf
ministero delle politiche agricole alimentari e forestali

Safety	Production	Protection
Agriculture		
Food		
Forests		

MiC MINISTERO DELLA CULTURA

Preservation	Valorization	Fruition
Archeology		
Tangible Heritage		
Landscape and tourism		

MINISTERO DELL'INTERNO

Correct functioning	Protection	Enforcement
Public order		
Police forces		
Civil rights		

MINISTERO DELLA DIFESA

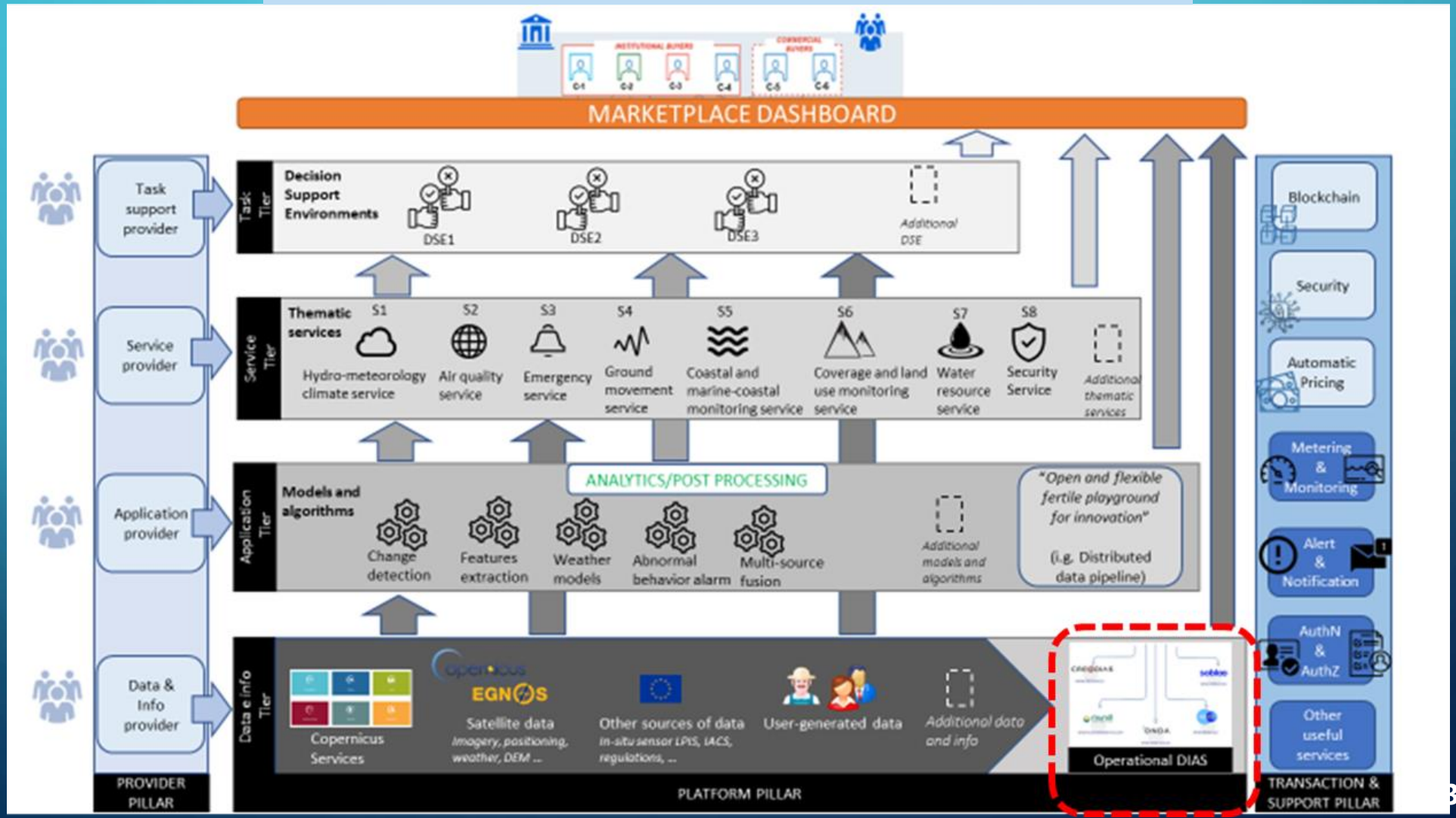
Integrity	Safeguard	Defense
Borders		
National Territory		
Country's vital interests		

Main Role | Perimeter of Activity

Copernicus and the space economy

The Mirror Copernicus Programme

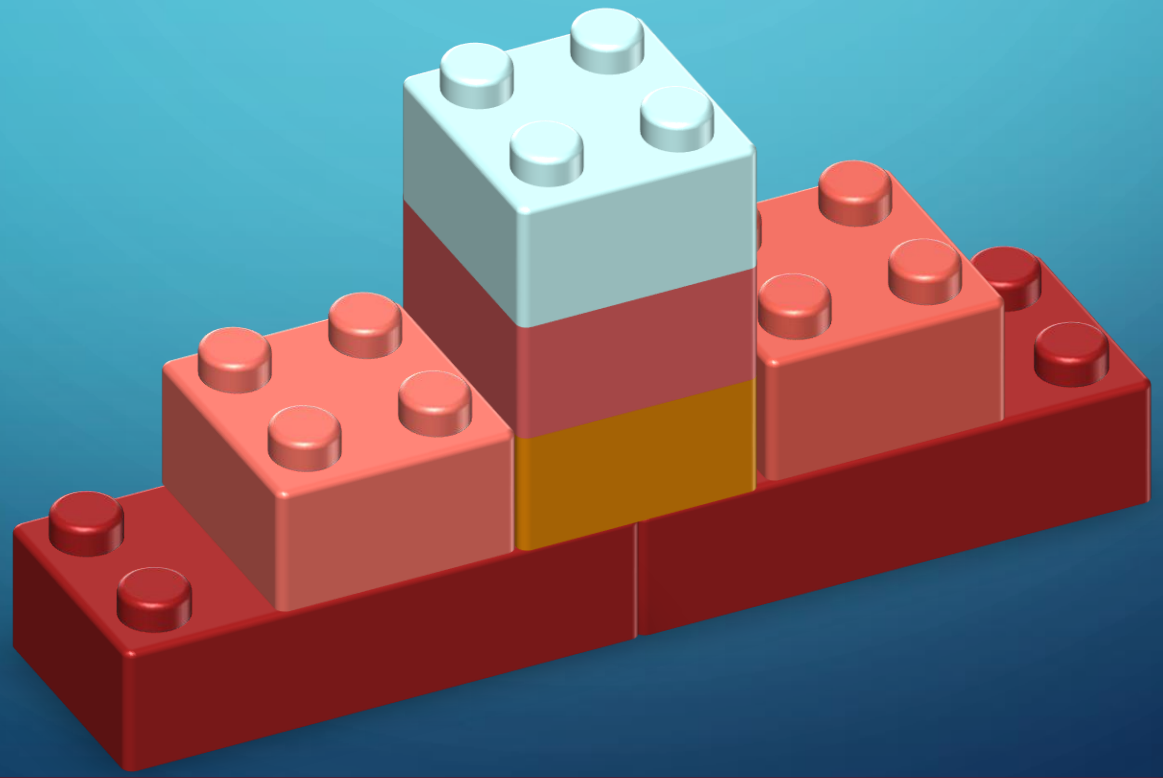
Copernicus Marketplace (CoMaP) architecture



OPERATIONAL SERVICES

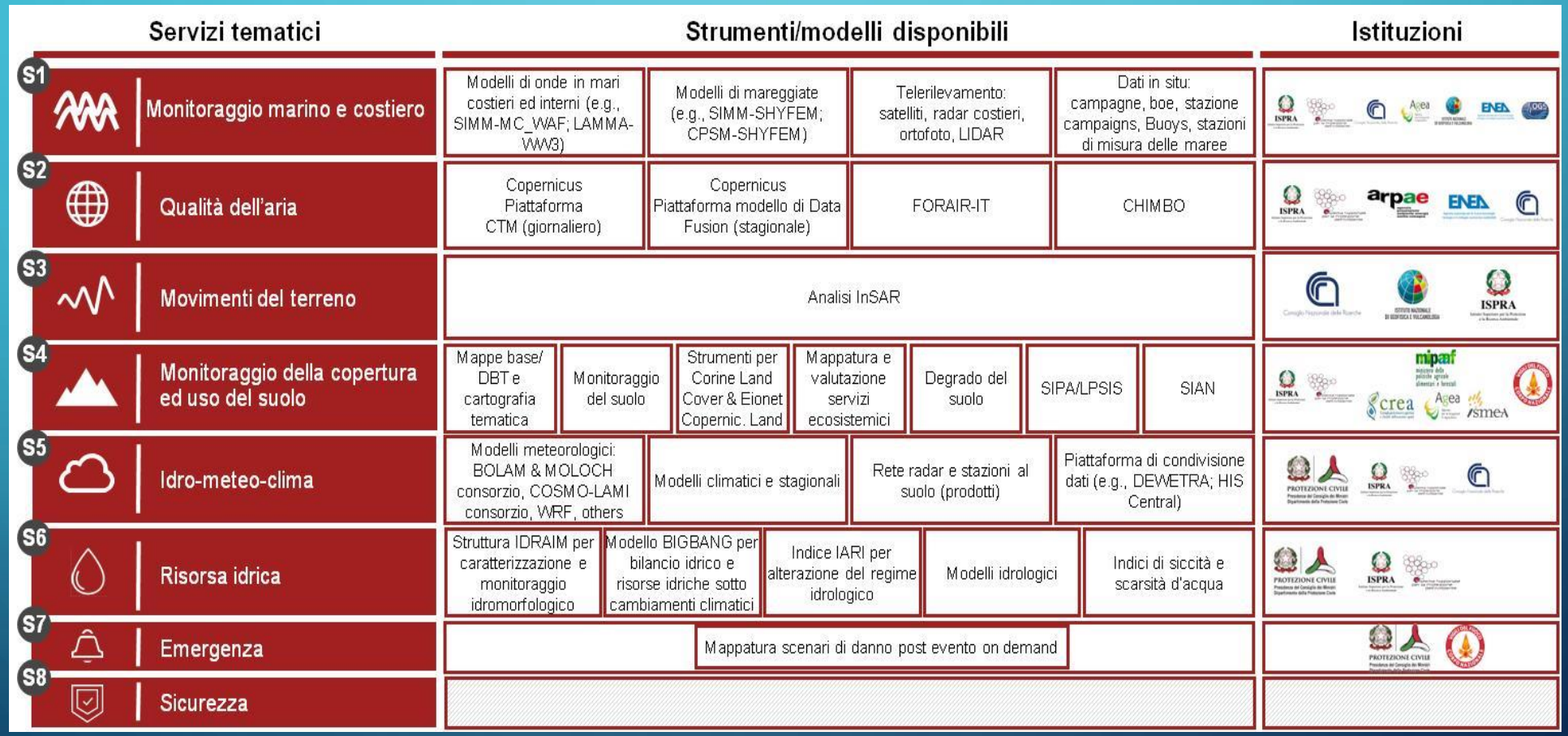
For the 8 thematic reference services identified, operational products/services of national interest were defined for each:

The definition and related functional and operational objectives
The state of the art
The minimum requirements for innovativeness (requirements that cannot be waived)



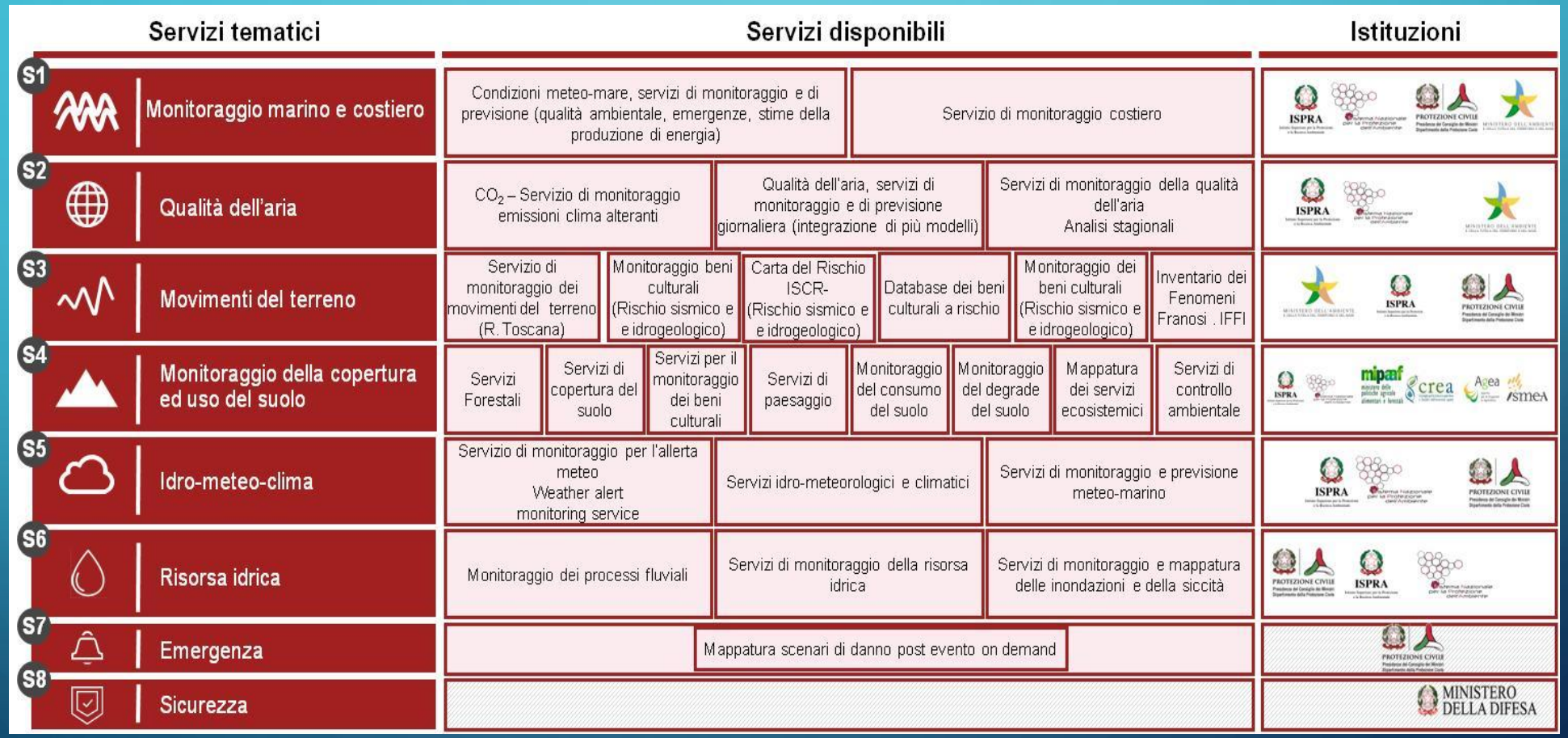
LEGO Logic

Mapping of TOOLS/MODELS based on the use of OT data currently operated by public institutions



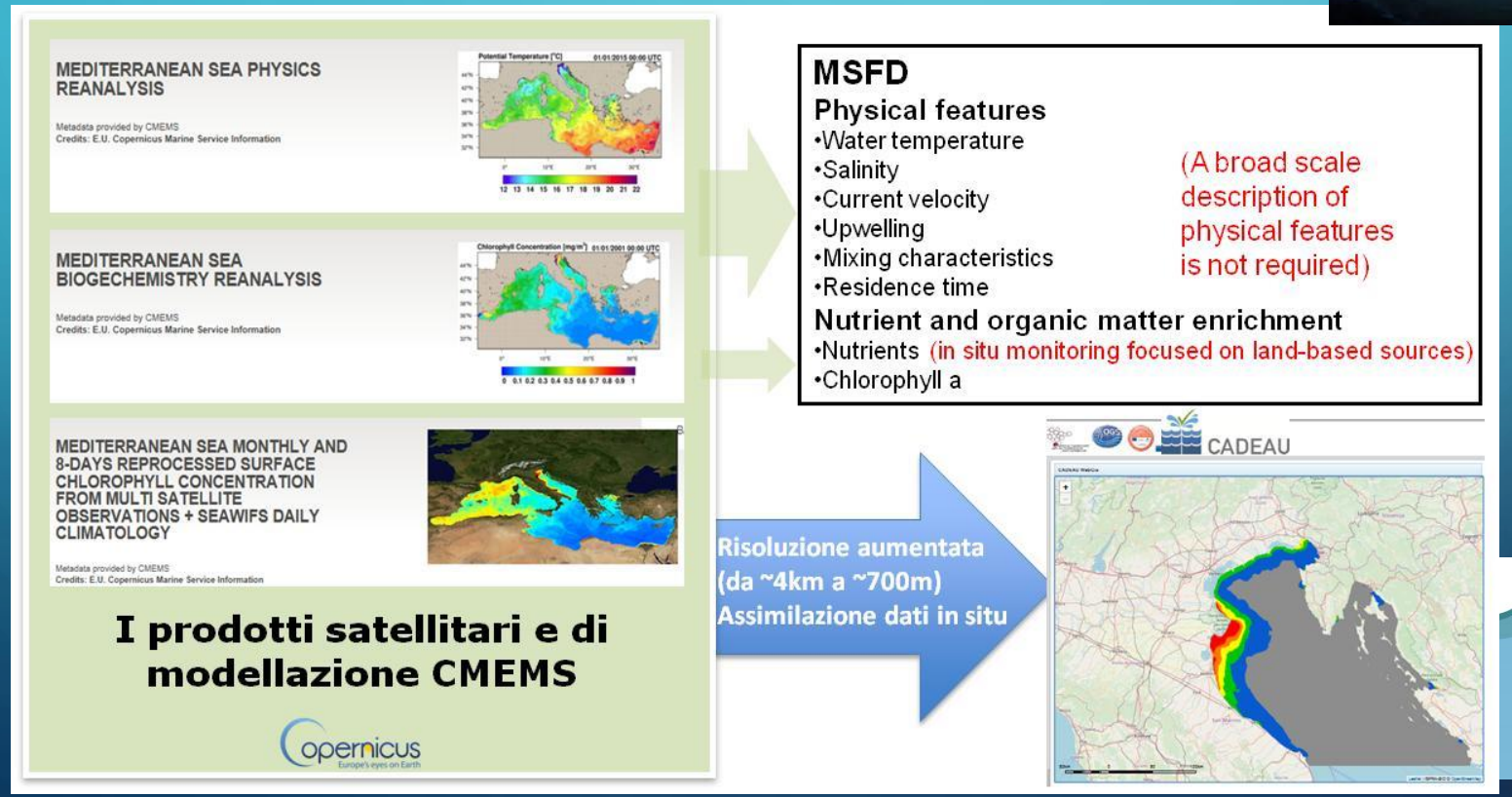
Servizi tematici	Strumenti/modelli disponibili							Istituzioni
S1 Monitoraggio marino e costiero	Modelli di onde in mari costieri ed interni (e.g., SIMM-MC_WAF; LAMMA-WW3)	Modelli di mareggiate (e.g., SIMM-SHYFEM; CPSM-SHYFEM)	Telerilevamento: satelliti, radar costieri, ortofoto, LIDAR	Dati in situ: campagne, boe, stazione campaigns, Buoys, stazioni di misura delle maree				
S2 Qualità dell'aria	Copernicus Piattaforma CTM (giornaliero)	Copernicus Piattaforma modello di Data Fusion (stagionale)	FORAIR-IT	CHIMBO				
S3 Movimenti del terreno	Analisi InSAR							
S4 Monitoraggio della copertura ed uso del suolo	Mappe base/ DBT e cartografia tematica	Monitoraggio del suolo	Strumenti per Corine Land Cover & Eionet Copernic. Land	Mappatura e valutazione servizi ecosistemici	Degrado del suolo	SIPA/LPSIS	SIAN	
S5 Idro-meteo-clima	Modelli meteorologici: BOLAM & MOLOCH consorzio, COSMO-LAMI consorzio, WRF, others	Modelli climatici e stagionali	Rete radar e stazioni al suolo (prodotti)	Piattaforma di condivisione dati (e.g., DEWETRA; HIS Central)				
S6 Risorsa idrica	Struttura IDRAIM per caratterizzazione e monitoraggio idromorfologico	Modello BIGBANG per bilancio idrico e risorse idriche sotto cambiamenti climatici	Indice IARI per alterazione del regime idrologico	Modelli idrologici	Indici di siccità e scarsità d'acqua			
S7 Emergenza	Mappatura scenari di danno post evento on demand							
S8 Sicurezza								

Mapping of SERVICES based on the use of OT data currently operated by public institutions

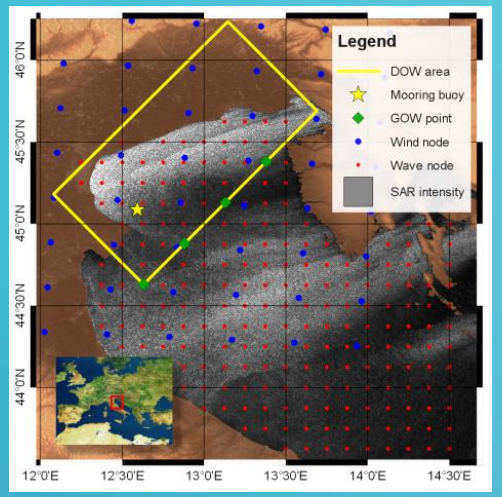


S1 - marine-coastal monitoring service

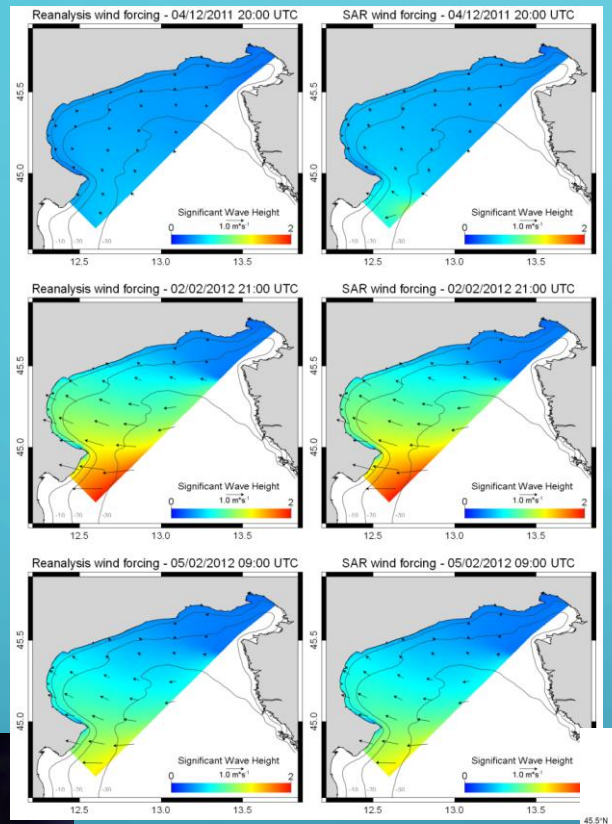
1. Data Store/Platform
2. Coastal marine monitoring and forecasting
3. Identification and prediction of the dynamics of oil spills events
4. Coastal geomorphological monitoring
5. Ecosystems

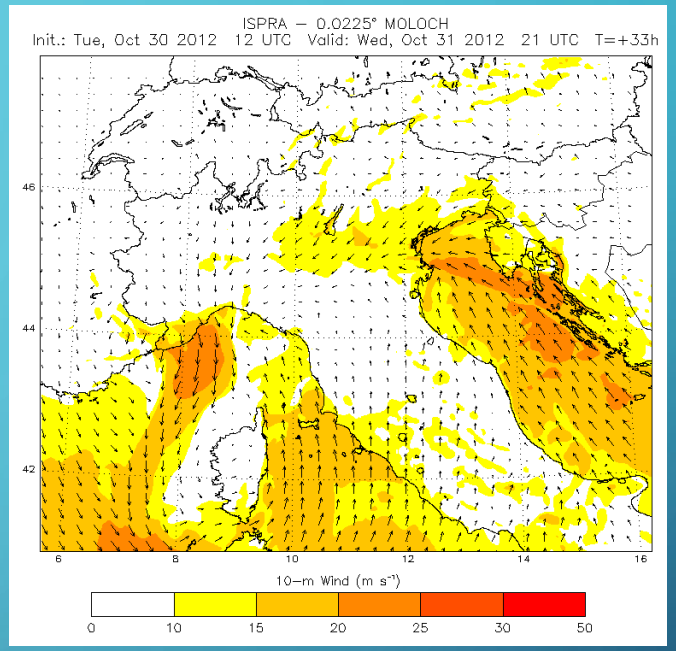


S1.2 Coastal marine monitoring and forecasting



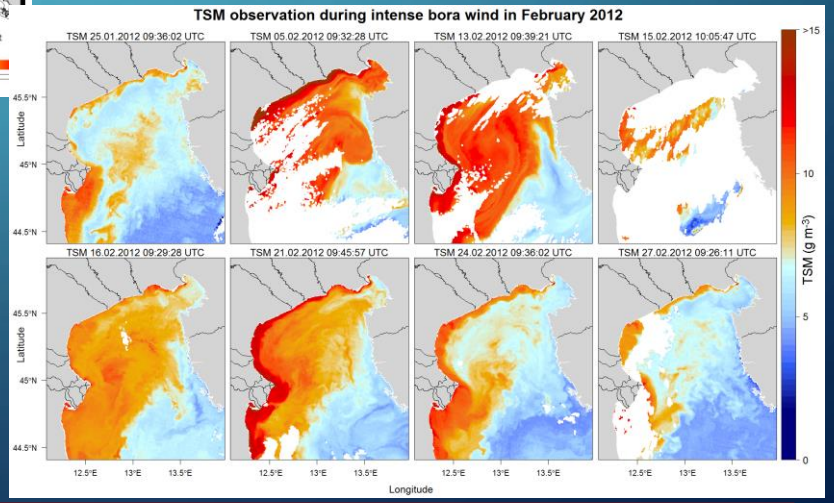
Monitoring extreme event: 'Bora scura' 29 ottobre - 3 novembre 2012



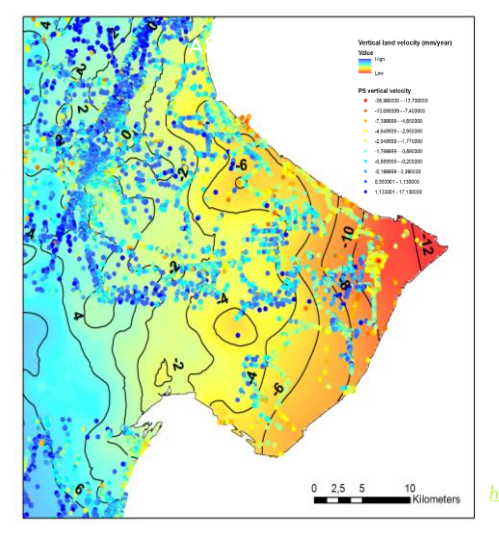


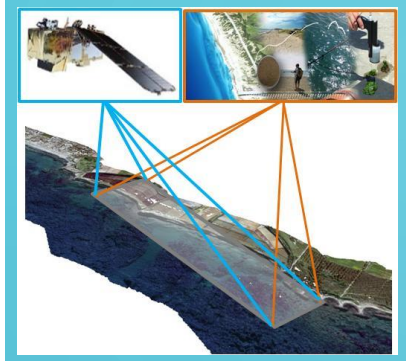
Wave Downscaling of northern Adriatic Sea using Sentinel 1

Monitoring sediment resuspension during critical events



S1.4 Geomorphological monitoring of the coastal strip



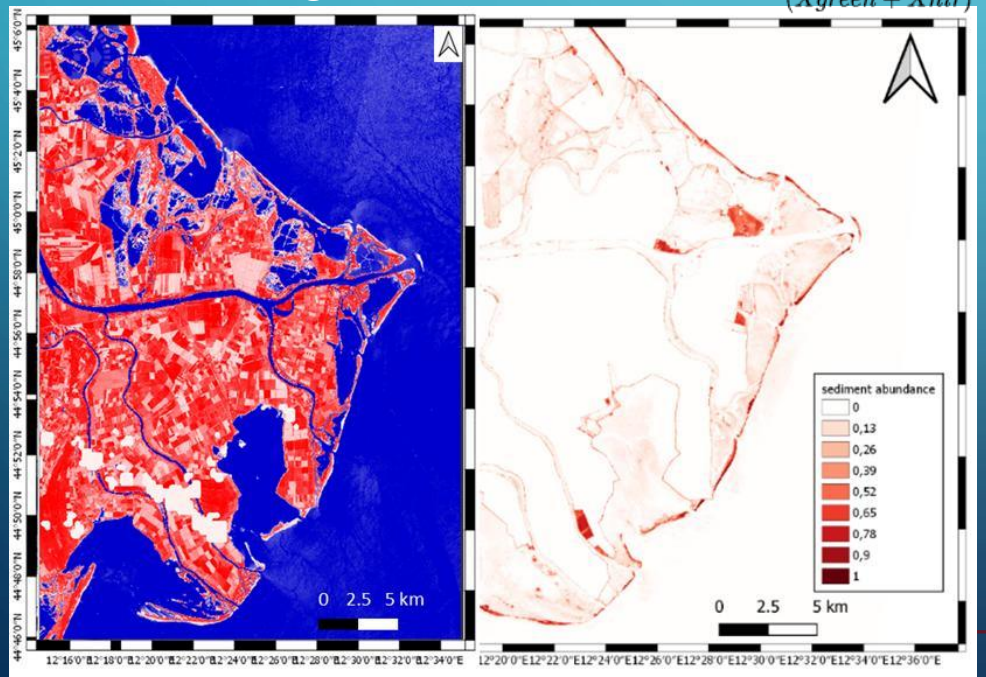


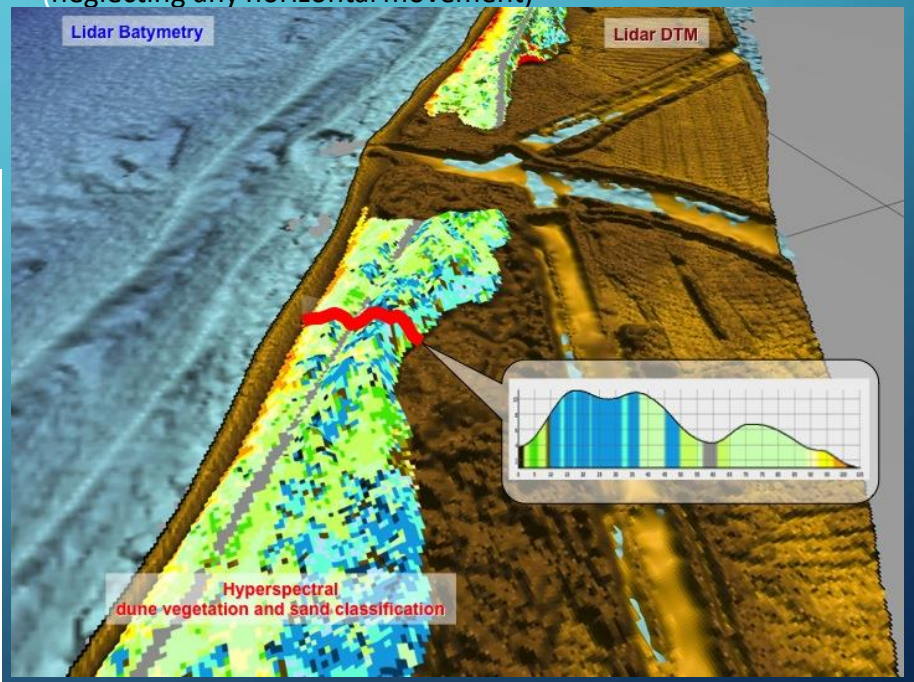
aramelli, A. et Al.. (2015), Temporal evolution of atterns and processes of the coastal area in Bevano stuary (Northern Adriatic) - Italy. Ocean and Coastal Management, 108: 74-88, http://dx.doi.org/10.1016/j.ocecoaman.2014.06.021

- **Forcing source:** anthropic activities a/o natural process (e.g. soil compaction)
- **Data input:** SAR EO data
- **Other data:** Geodetic points, measurements on groundwater withdrawal and gas extraction
- **Technique:** SBAS approach (Hooper, 2008)
- **Product output:** subsidence rate as annual vertical velocity (neglecting any horizontal movement)

Coastline changes over time

$$\mathrm{NDWI} = \frac{(Xgreen - Xnir)}{(Xgreen + Xnir)}$$





Valentini E. et Al.. Exploring the Dunes: The Correlations between Vegetation Cover Pattern and Morphology for Sediment Retention Assessment Using Airborne Multisensor Acquisition. Remote Sens. 2020, 12, 1229. https://doi.org/10.3390/rs12081229

COASTAL HABITAT MAPPING: STATUS

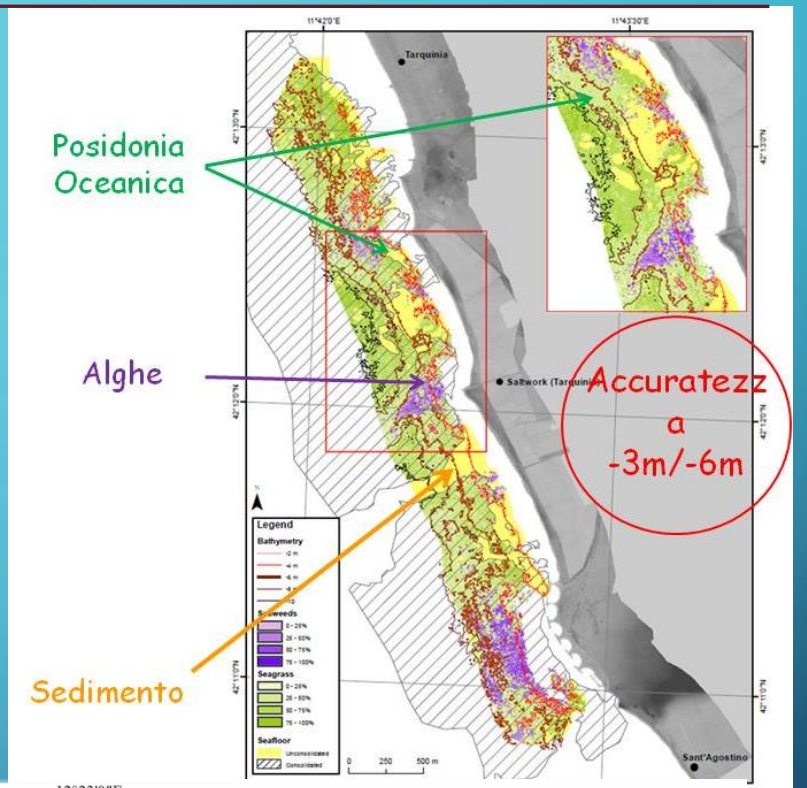
Forcing source/driver of change: marine (sea level, tide, salinity) and climatic (rainfall) processes, anthropic preassures and actions

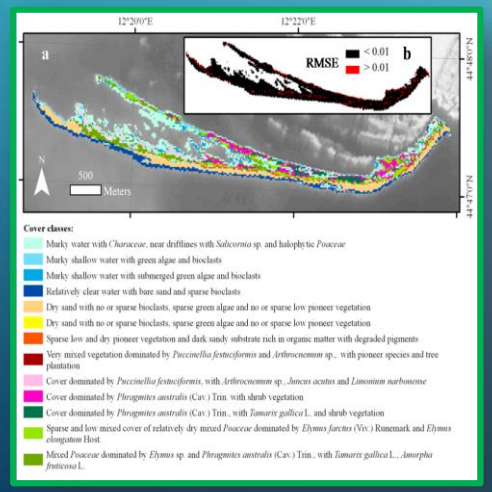
EO Data input: optical

Other data: field radiometry, cartography

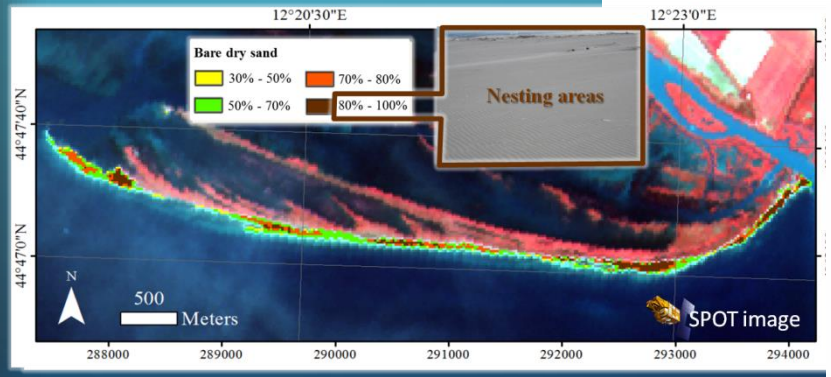
Technique: Principal component analysis, Linear Spectral Mixing Analysis, power law analysis, spatial-temporal analysis

Product output: habitat cover map, vegetation patch size distribution

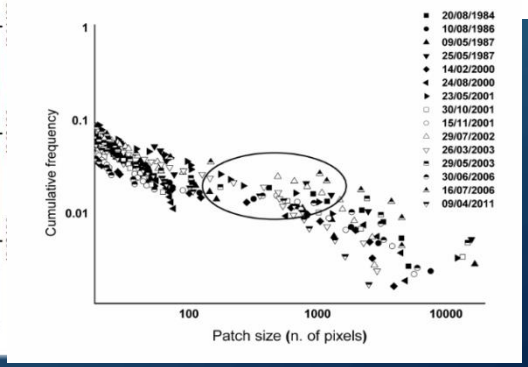




High detailed cover map



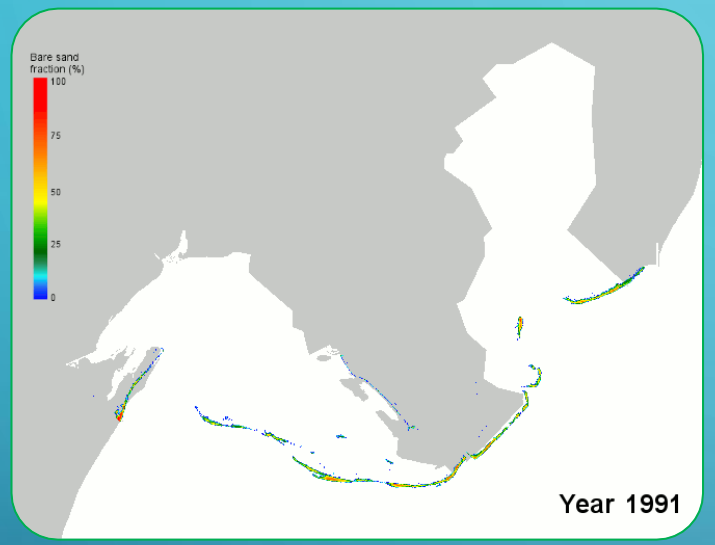
Nesting habitat species specific



Power law patch size distribution for a vegetation class

COASTAL HABITAT MAPPING: CHANGE IN SPACE AND TIME

Multitemporal analysis of habitat fraction abundance maps (patterns and trend)



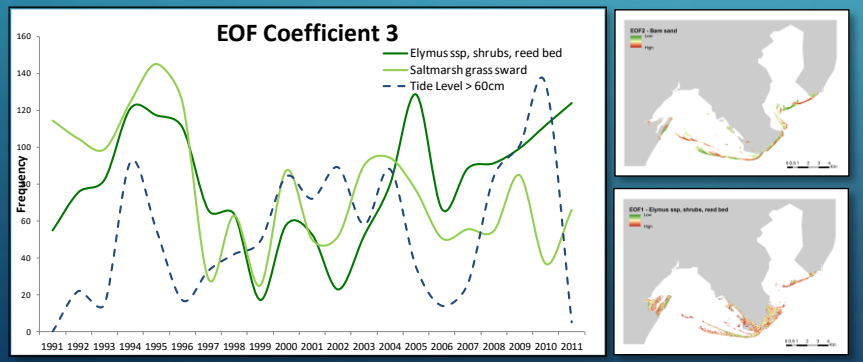
Forcing source: marine (sea level, tide, salinity, waves) and climatic (rainfall) processes, anthropic preassures and actions

Data input: optical EO data

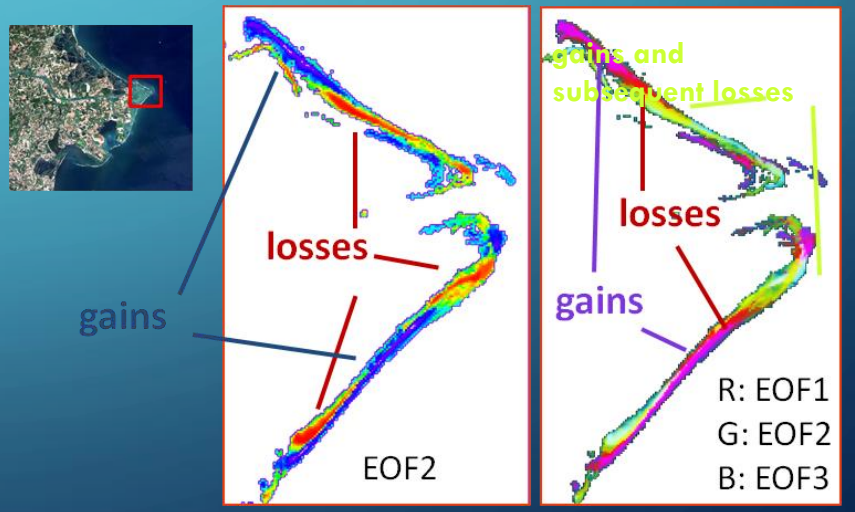
Other data: field radiometry, cartography, tide level

Technique: Principal component analysis, Linear Spectral Mixing Analysis, Empirical Orthogonal Function

Product output: map of change (as gain and loss) of vegetation fraction abundances



EOF3 coefficient (temporal and spatial component)



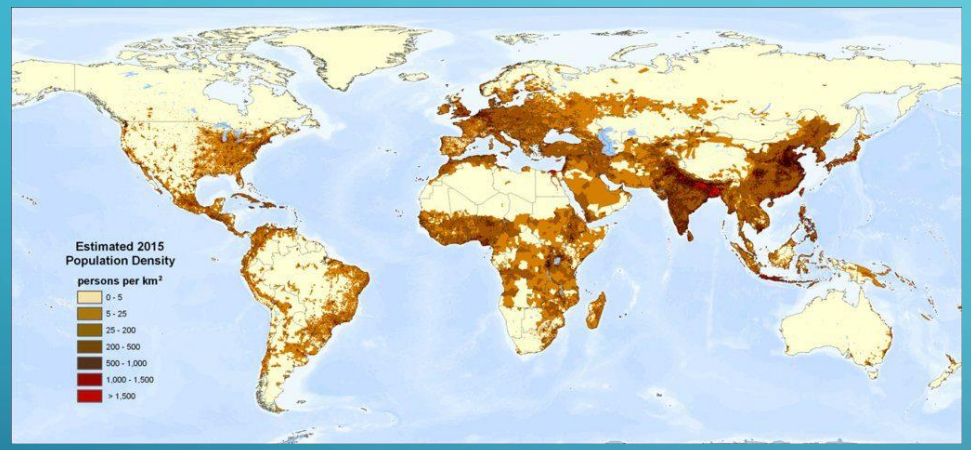
EOFs value (sediment fractions maps 1991-2011)

S8 – Security service

Safety & Securuty:

- Maritime surveillance
- Border surveillance
- Support for EU external actions

1. **Population Density Maps**
2. **Tracking & Survaillance Services**
3. **Risk Analysis Services**
4. **Environmental Crimes**



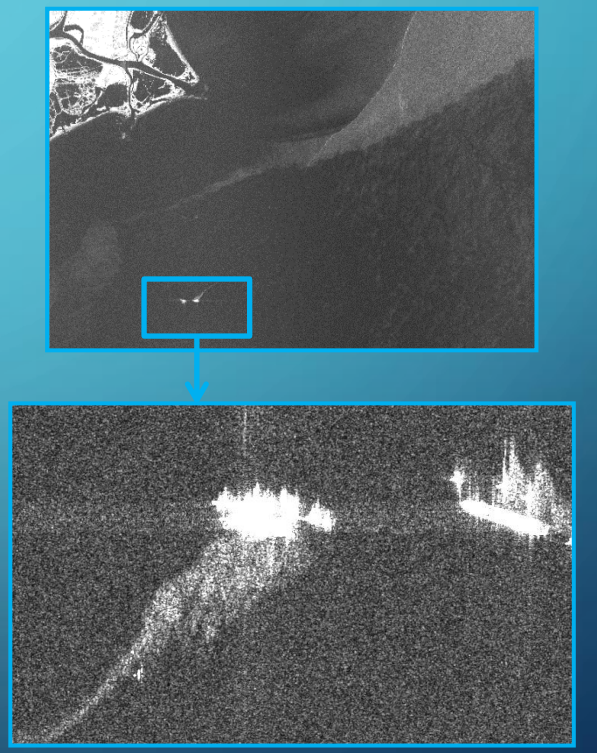
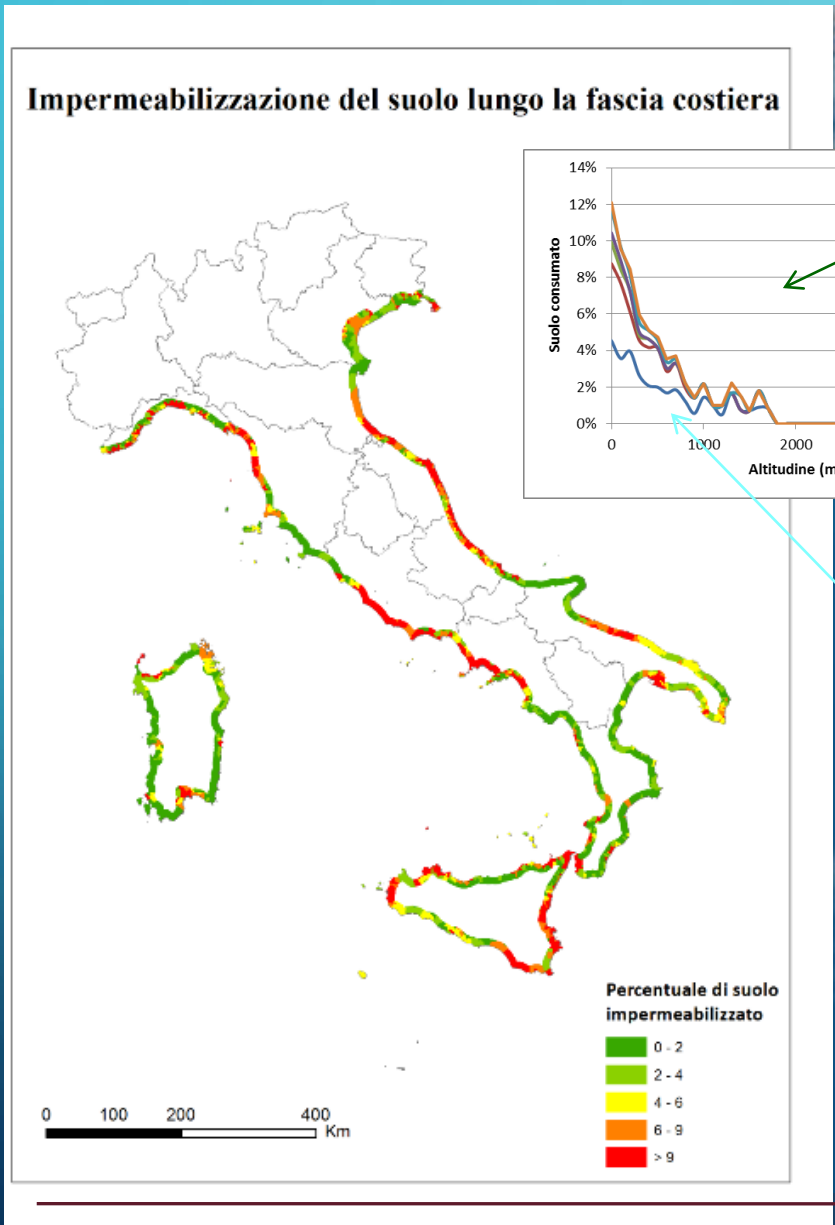
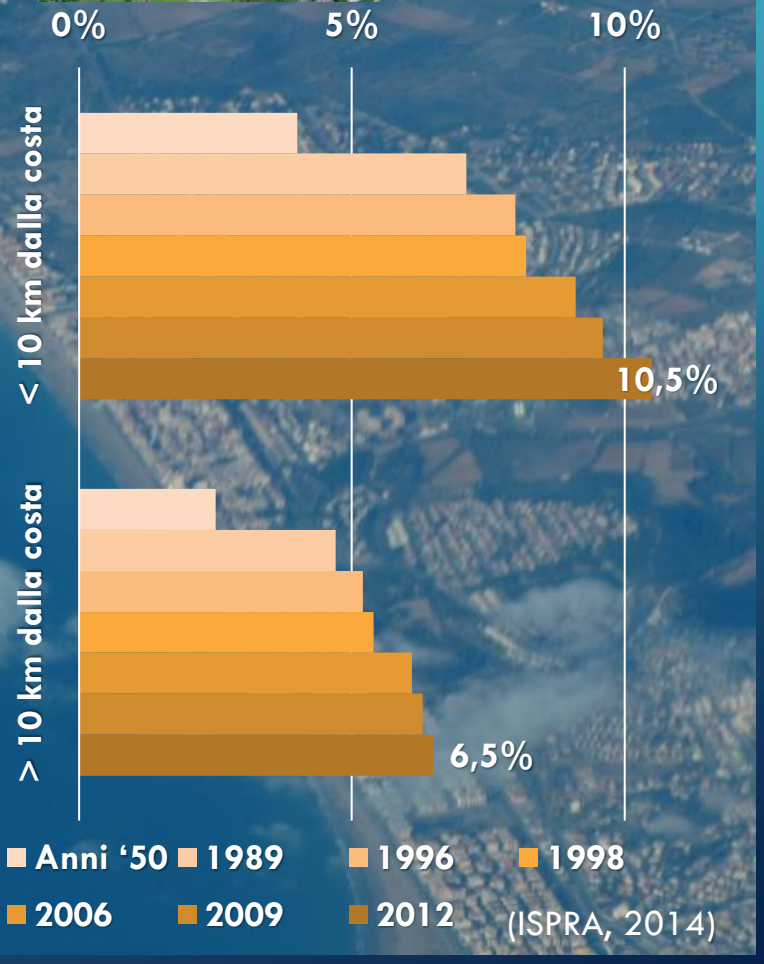


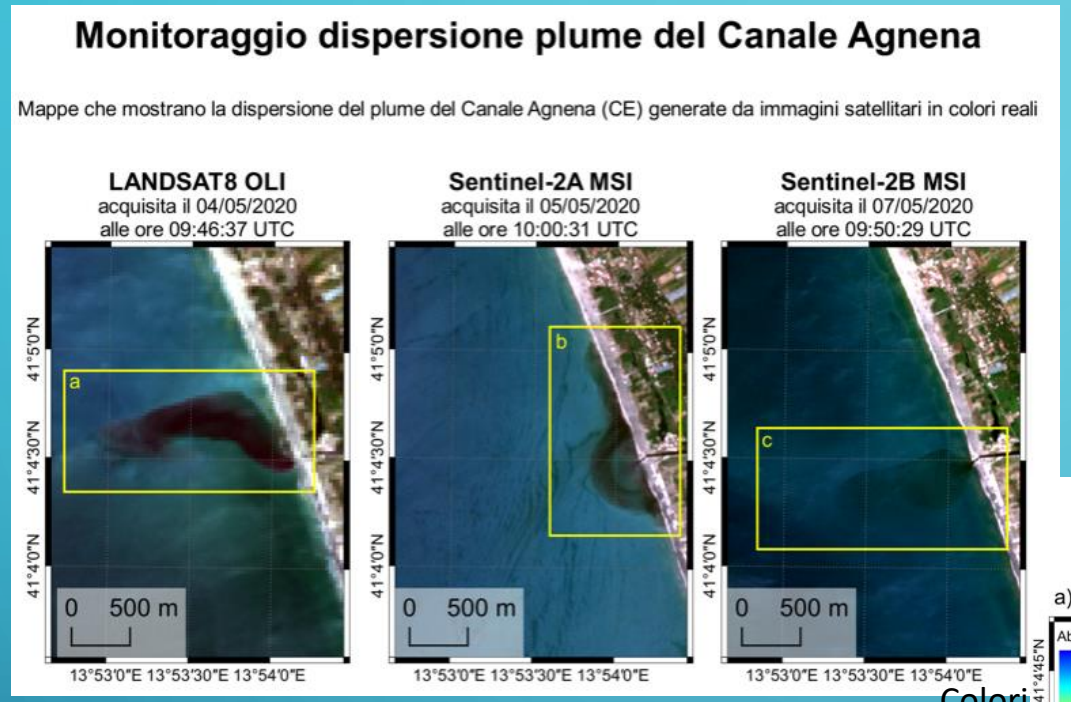
Immagine Cosmo-SkyMed (13/02/2012 - risoluzione 5 metri). Sono visibili diverse densità di superfici (più chiaro e di elevato backscattering).

S4.2: Dynamic monitoring (of the status and changes) of land cover and land use)





Environmental offenses: WATER Pollution



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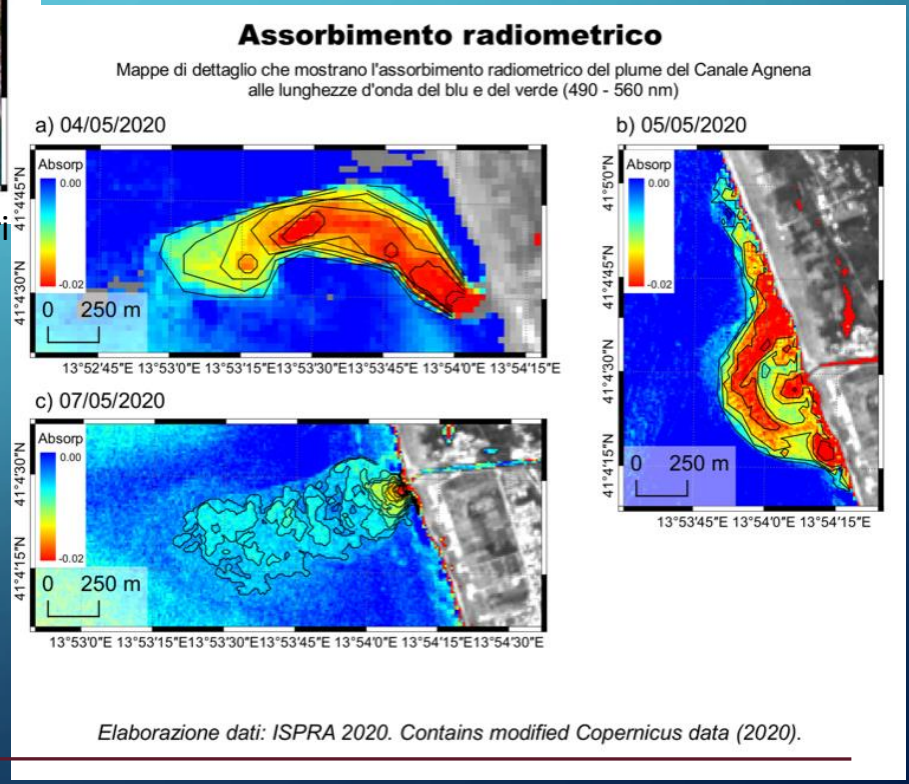

COPERNICUS (Programma di Osservazione della Terra dell'Unione Europea)

Speaker: Prof. Andrea Taramelli
IUSS Pavia

andrea.taramelli@iusspavia.it

Place and date (Example : *Todi, Italy, 21 August 2023* or *Orvieto , Italy, 22 August 2023*