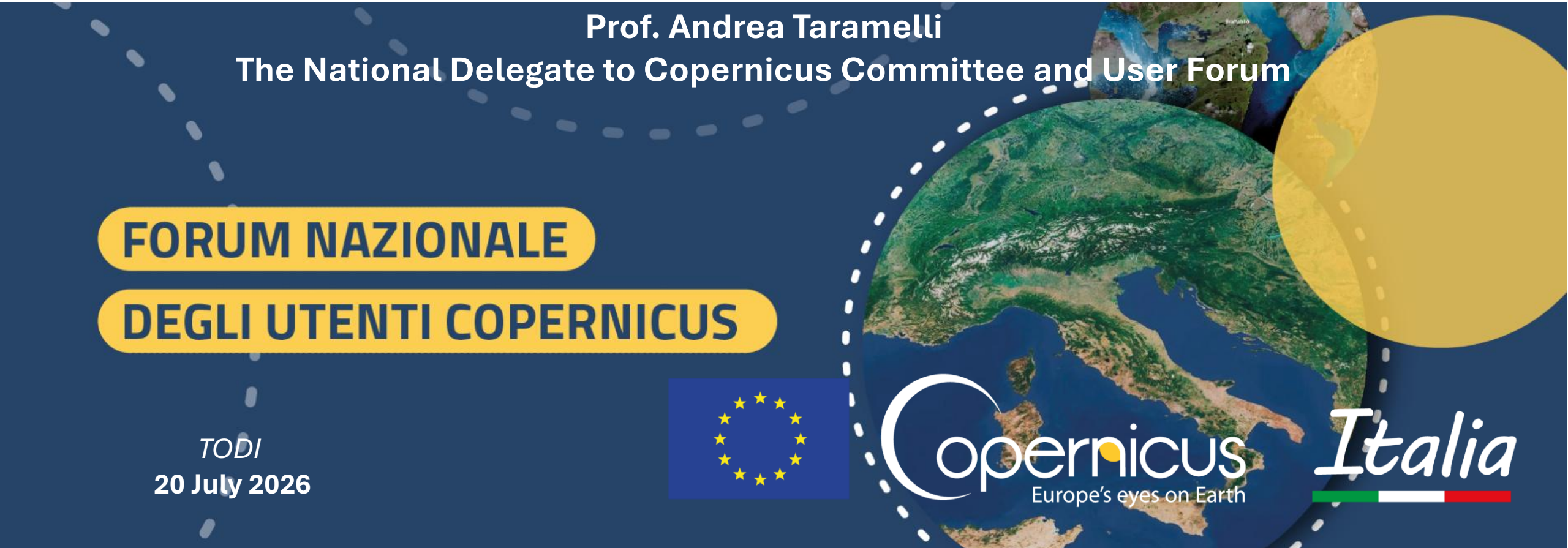
Fourth Edition

"NATURAL HAZARDS AND CULTURAL HERITAGE"
PRESERVATION STRATEGIES
19 - 26 July 2026

Il mercato dei servizi di Earth Observation

Prof. Andrea Taramelli
The National Delegate to Copernicus Committee and User Forum

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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

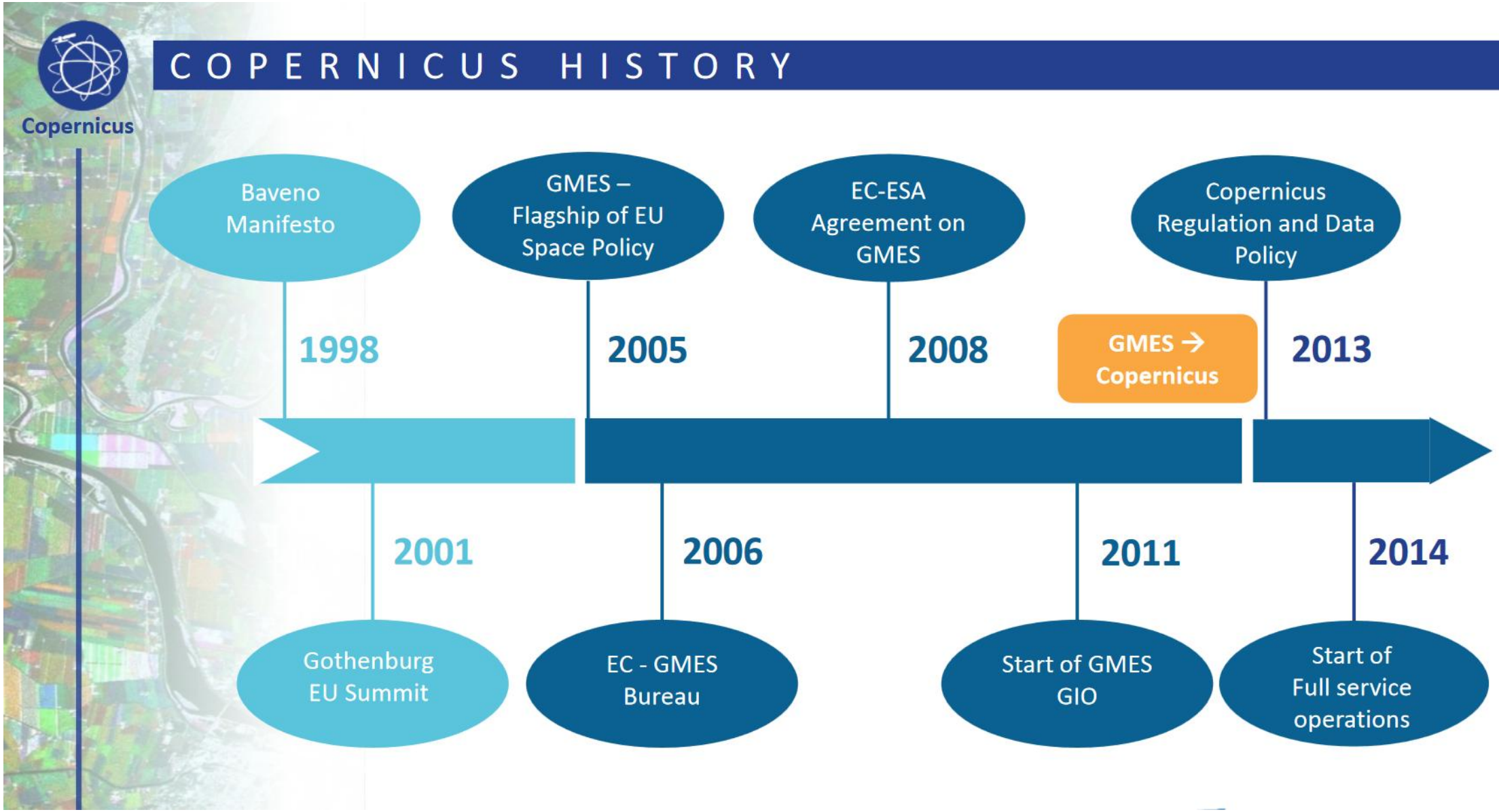
Monitor the environment

Facilitate adaptation to climate change

Foster downstream applications in a number of fileds

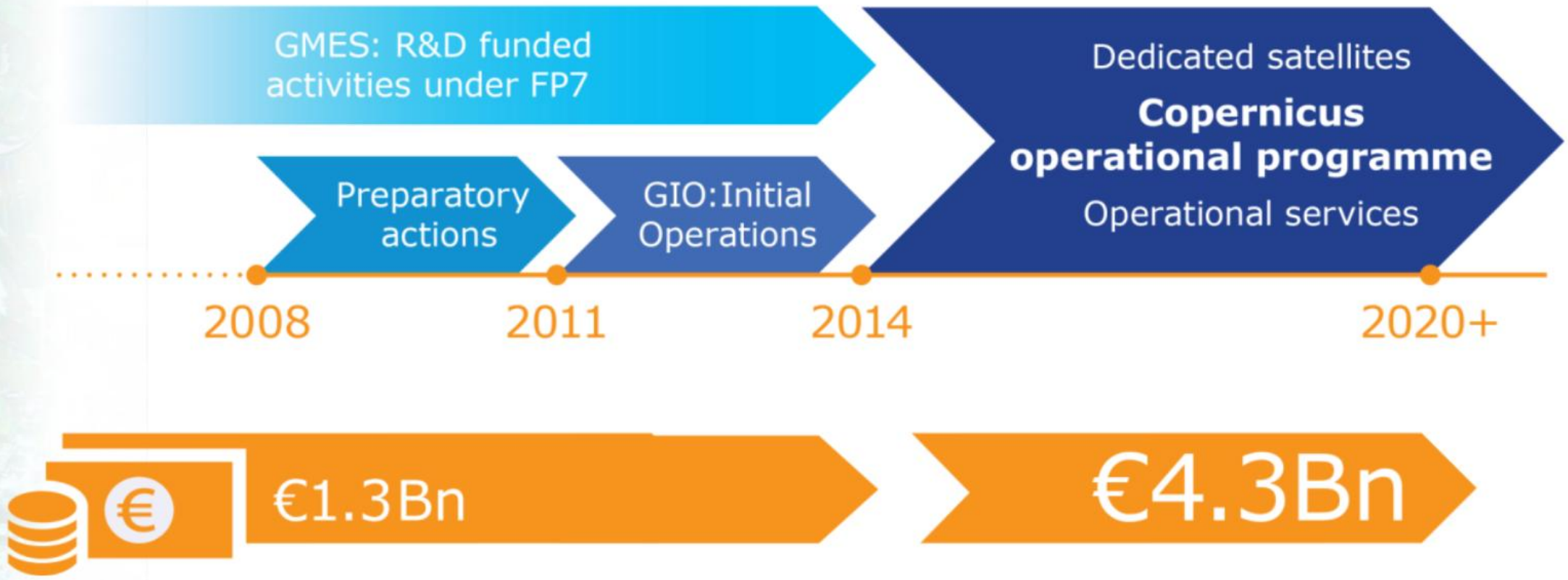
Help managing emergency and security related situations

History of Copernicus



COPERNICUS FUNDING

From research to operations



I NUMERI DI COPERNICUS

Copernicus è un successo mondiale !!!!

- oltre 600 prodotti operativi
- oltre 30 PBytes di dati e informazioni a trimestre, 350.000.000 Megabyte al giorno!!!
- 2014 – 2020: 5 bilioni di Euro + 2021 – 2027: 5 bilioni di Euro

COPERNICUS IN BREVE

Nº1 al mondo nel monitoraggio ambientale e degli ecosistemi terrestri

Contribuisce al soft power dell'UE a livello globale

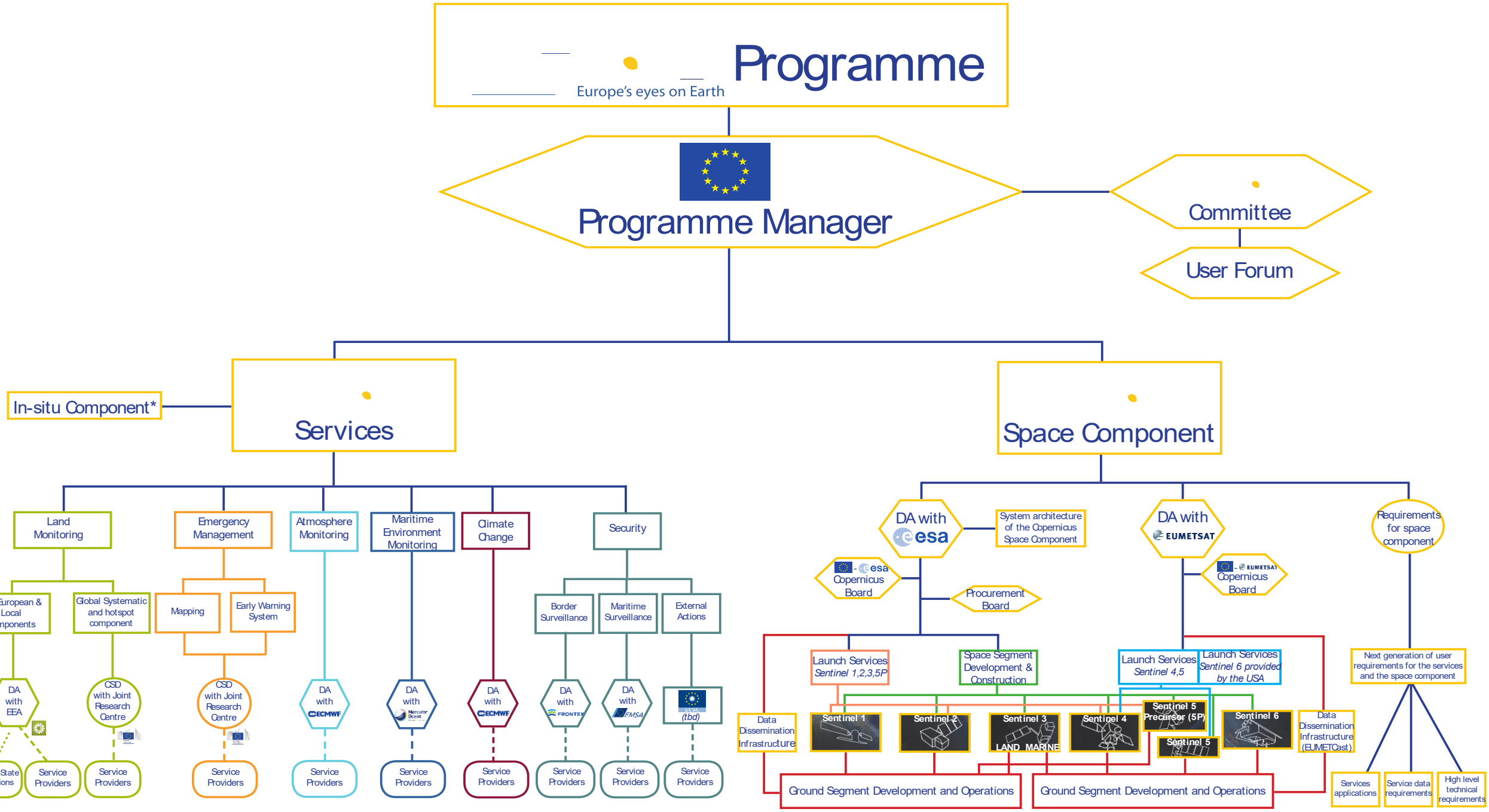
É uno strumento per lo sviluppo economico, chiave per l'economia digitale

Accesso ai dati libero, totale e gratuito

Il piu grande fornitore di dati

+300,000 utenti registrati

European Union Copernicus Governance


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
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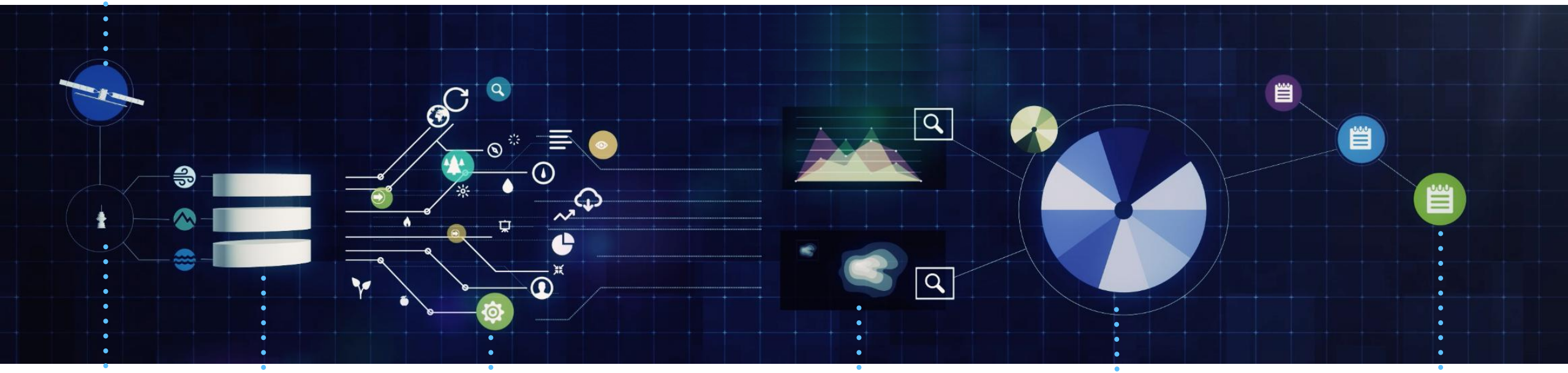
Service Providers
DA with esa
System architecture of the Copernicus Space Component
esa Copernicus Board
Procurement Board
DA with EUMETSAT
EUMETSAT Copernicus Board
Requirements for space component
Launch Services Sentinel 1,2,3,5P
Space Segment Development & Construction
Launch Services Sentinel 4,5
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

LE COMPONENTI DI COPERNICUS

DAI DATI GLOBALI DI OSSERVAZIONE TERRESTRE A INFORMAZIONI E APPLICAZIONI LOCALI

SATELLITI SENTINELLA & MISSIONI CONTRIBUTRICI



SENSORI IN SITU | DATI | SERVIZI | INFORMAZIONI | PROCESSI PERSONALIZZATI | PRODOTTI

The Copernicus program

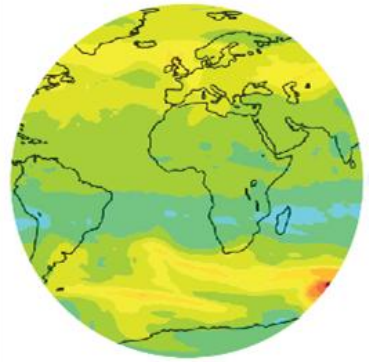
The EU Earth Observation Program: Copernicus Regolamento 2021/696

Copernicus space and in situ data

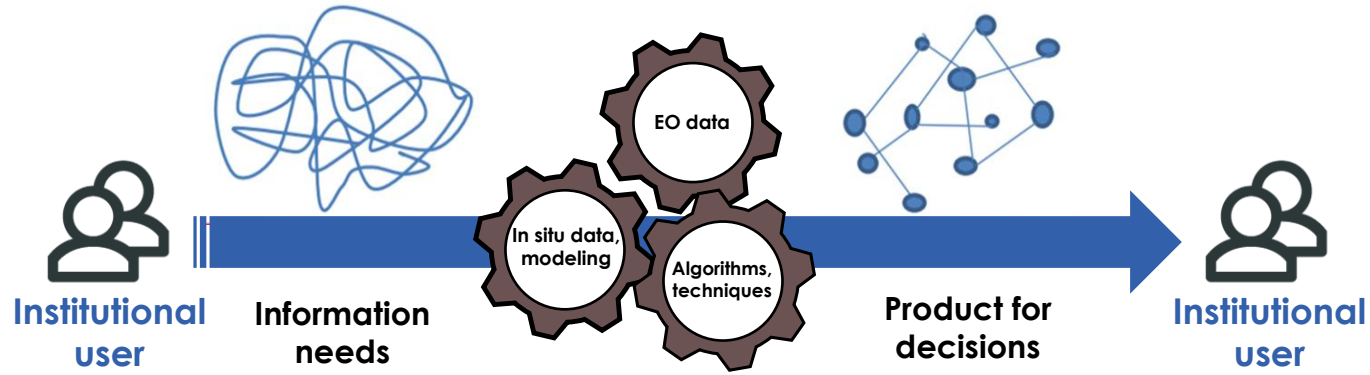
esa EUMETSAT EEA

Copernicus services

Downstream services "Copernicus Economy"



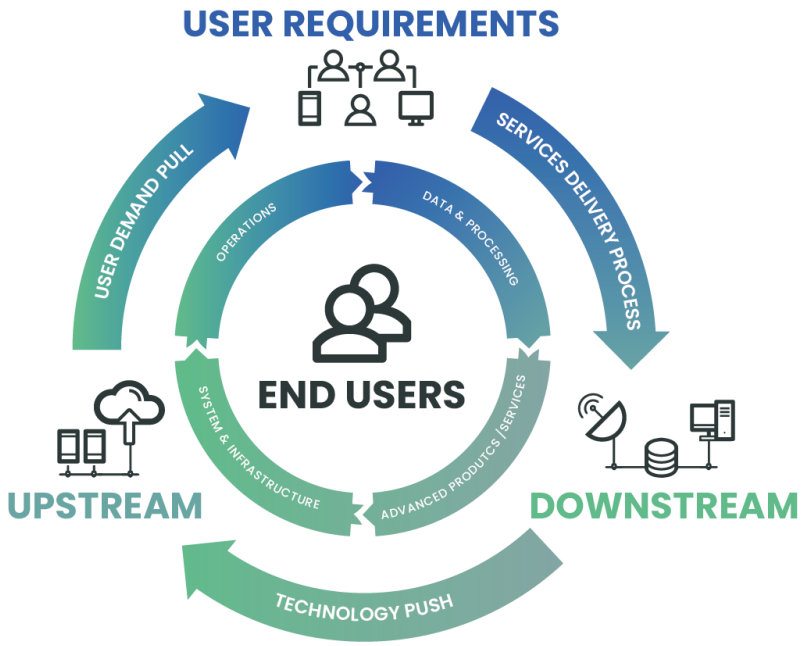
User uptake measures



The Copernicus program

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

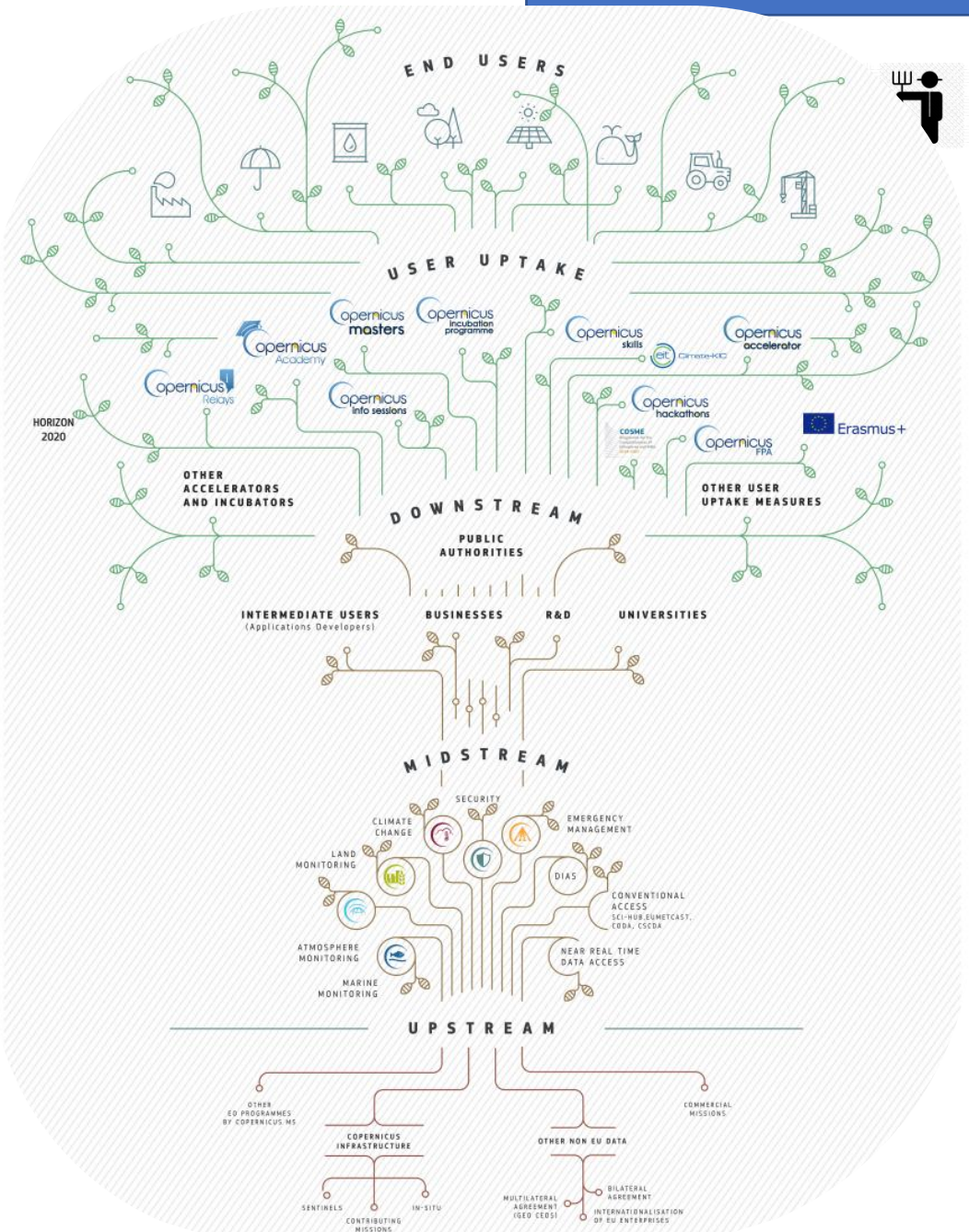
A CHANGE OF **PARADIGM**



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

opernicus
Europe's eyes on Earth

Copernicus value Chain



Il sistema Copernicus

End users

User fora and events

Core User Group

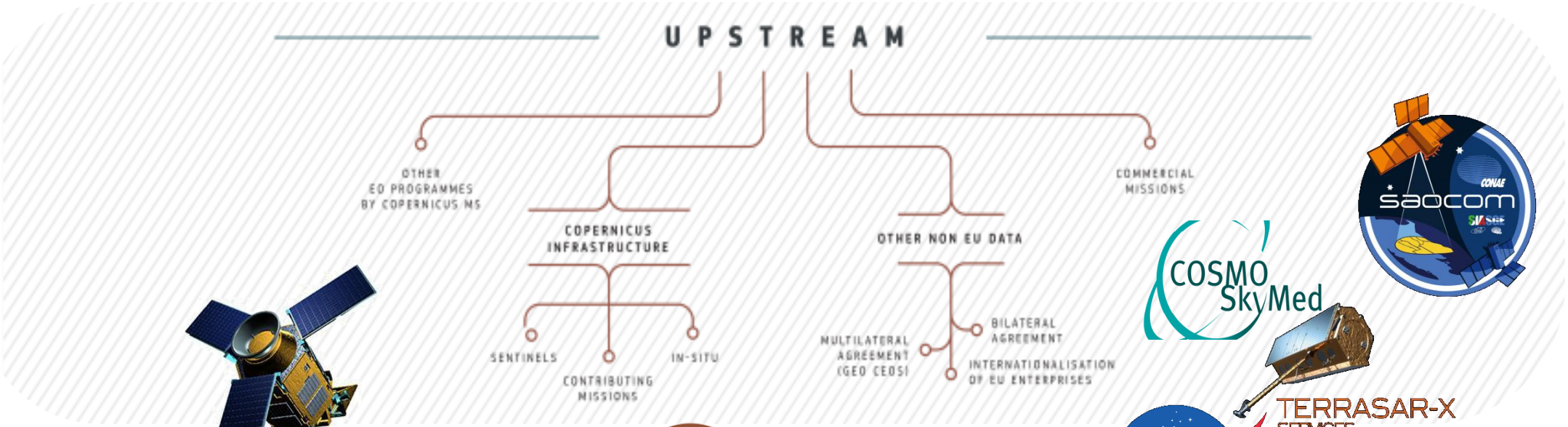
DIAS

Copernicus Services

In situ obs. providers

Sentinels

Il sistema Copernicus: usptream



Sentinels

In Situ

COPERNICUS IN SITU COMPONENT
State of Play: Understanding in situ data

In situ observation providers

TERRASAR-X
SERVICES

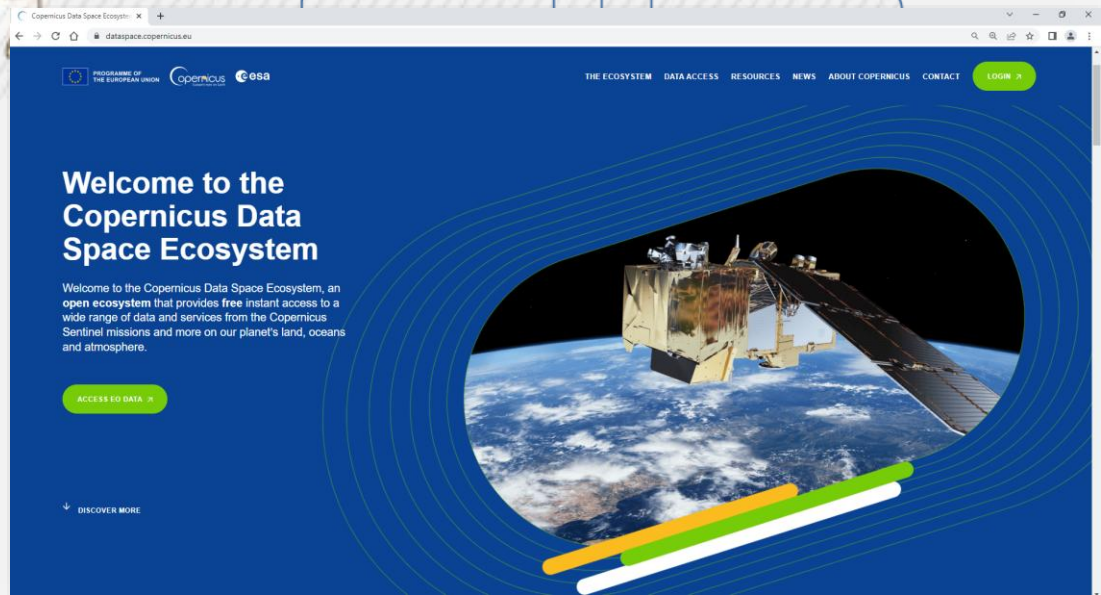
NASA

Commercial providers and non-EU data

Copernicus value Chain

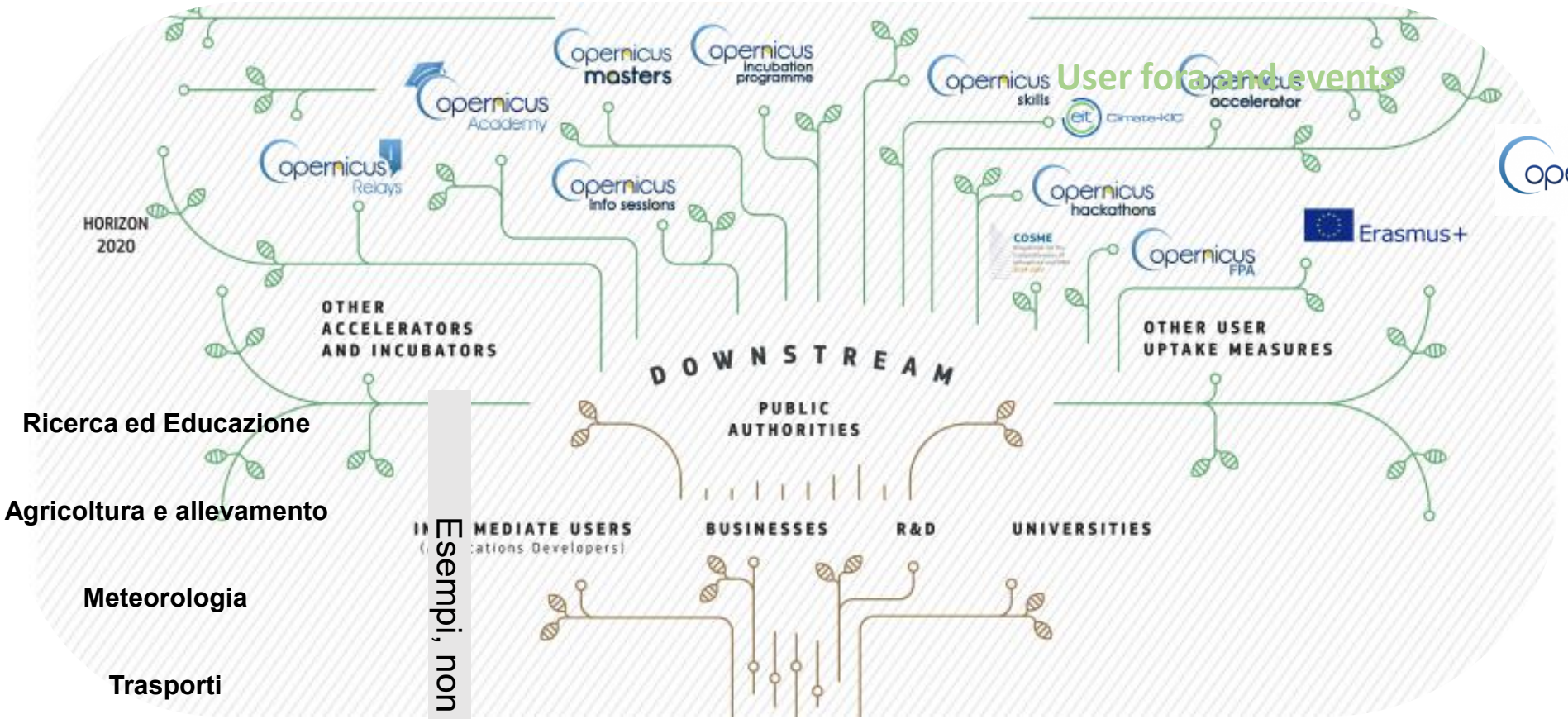
Il sistema Copernicus: midstream

Space data ecosystem



Copernicus value Chain

Il sistema Copernicus: downstream



User fora and events

Core User Group

Copernicus Relays

Copernicus Academy

Applicazioni

- Ricerca ed Educazione
- Agricoltura e allevamento
- Meteorologia
- Trasporti
- Sfruttamento risorse naturali
- Telecomunicazioni e trasmissioni TV
- Difesa ed Intelligence

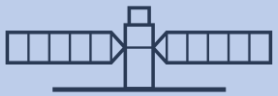
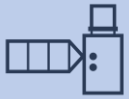
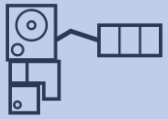
Esempi, non esaustiva

THE SENTINELS

SENTINEL-1: 4-40m resolution, 3 day revisit at equator	*2 Sats in orbit*	Po… day-and…
SENTINEL-2: 10-60m resolution, 5 days revisit time	*2 Sats in Orbit*	Polar-orbiting, mult… optical, high-res imaging
SENTINEL-3: 300-1200m resolution, <2 days revisit	*2 Sats in Orbit*	Optical and altimeter mission monitoring sea and land parameters
SENTINEL-4: 8km resolution, 60 min revisit time	*1st Launch in 2022*	Payload for atmosphere chemistry monitoring on MTG-S
SENTINEL-5p: 7-68km resolution, 1 day revisit	*1 Sat in Orbit*	Mission to reduce data gaps between Envisat, and S-5
SENTINEL-5: 7.5-50km resolution, 1 day revisit	*1st Launch in 2022*	Payload for atmosphere chemistry monitoring on MetOp 2ndGen
SENTINEL-6: 10 day revisit time	*1 Sat in Orbit*	Radar altimeter to measure sea-surface height globally

Full, free and open data policy

CARATTERISTICHE E USI DEI SATELLITI SENTINELLA



SENTINEL-1

Radar - Permette di osservare la Terra in tutte le condizioni climatiche sia di notte che di giorno

- sorveglimonitoraggio dei ghiacci
- anza in mare
- identificazione di imbarcazioni
- rilevamento di movimenti della superficie terrestre
- mappatura di aree forestali
- gestione di crisi umanitarie …

SENTINEL-2

Ottico – 13 bande spettrali per monitorare

- attivitá agricole e tipo di vegetazione
- copertura del suolo
- gestire le risorse forestali
- sorvegliare i confini
- identificare attivitá illecite in mare
- supportare in caso di emergenze (inondazioni, incendi)…

SENTINEL-3

Diversi strumenti permettono di monitorare oceani, terra, superfiici ghiacciate e atmosfera della Terra per comprendere le dinamiche globali su larga scala.

- altezza della superficie marina
- Colore della superficie
- Flussi carbonici
- Livello di fiumi e laghi

SENTINEL-4

Monitoraggio continuo della composizione atmosferica focalizzato su

- qualitá dell'aria
- monitoraggio di Ozono (O3), diossido di azoto (NO2), anidride solforosa(SO2), Formaldeide (HCHO) ecc

SENTINEL-5

Monitoraggio quotidiano globale di gas inquinanti (CH4 andO2 NO2 CO2 HC HO, SO2) e gas a effetto serra (CH4 and tropospheric O3)

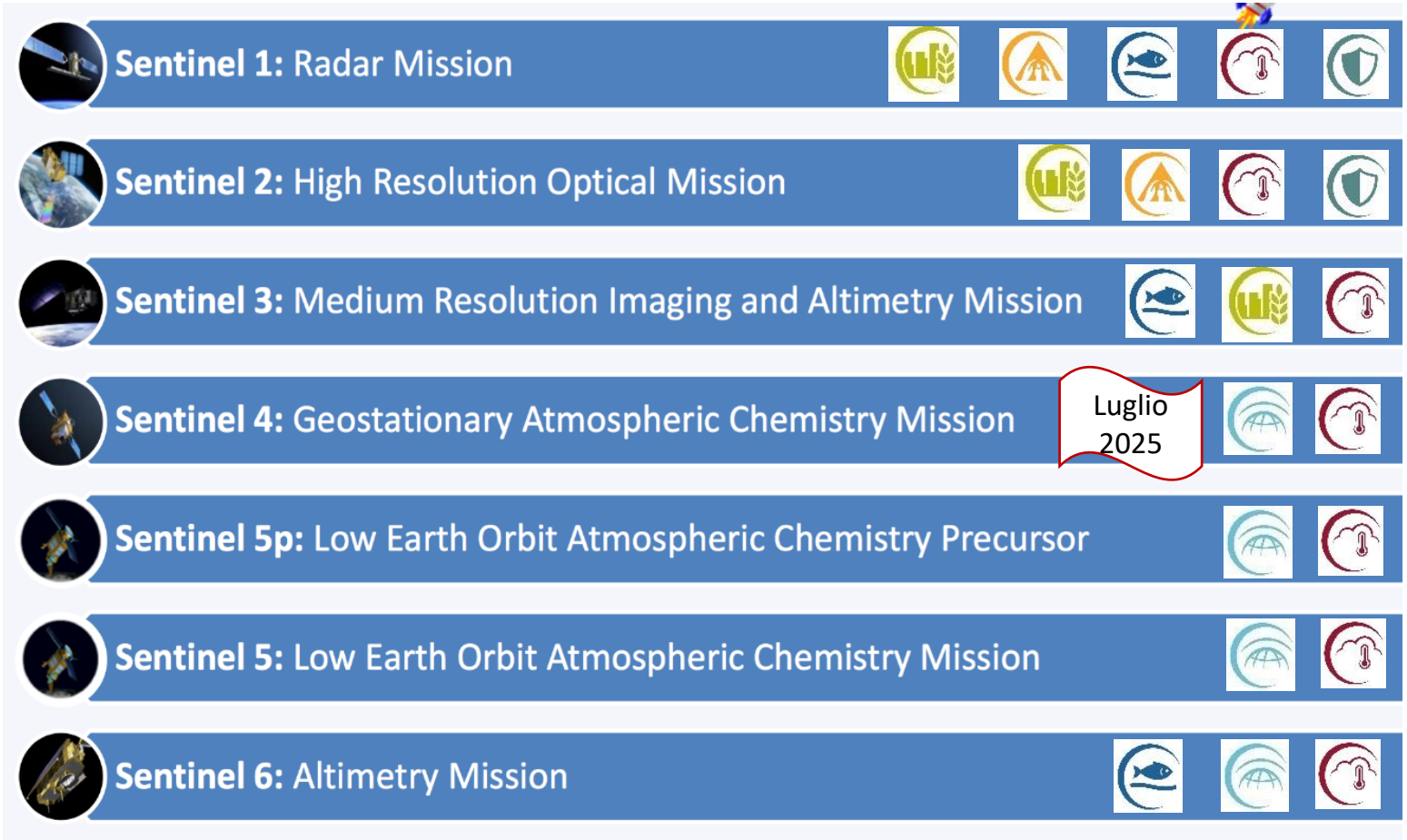
SENTINEL-5P

Osservazione quotidiana **clima**, **qualitá dell'aria** e **superficie Ozono**

SENTINEL-6

Previsioni marine, **topografia oceanica in real time** : altezza onde, superficie oceanica, velocitá del vento

Componenti Upstream: SENTINEL



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

polar-orbiting, multispectral high-resolution imaging

multi-instrument mission monitoring sea- and land-surface key parameters

payload for atmospheric monitoring on board a MTG-S

satellite mission developed to reduce data gaps between Envisat, and S-5

payload to monitor the atmosphere from polar orbit on board a MetOp 2ndGen

radar altimeter to measure sea-surface height globally

Il Programma Spaziale di Osservazione della Terra dell'Unione Europea

Contributing Missions

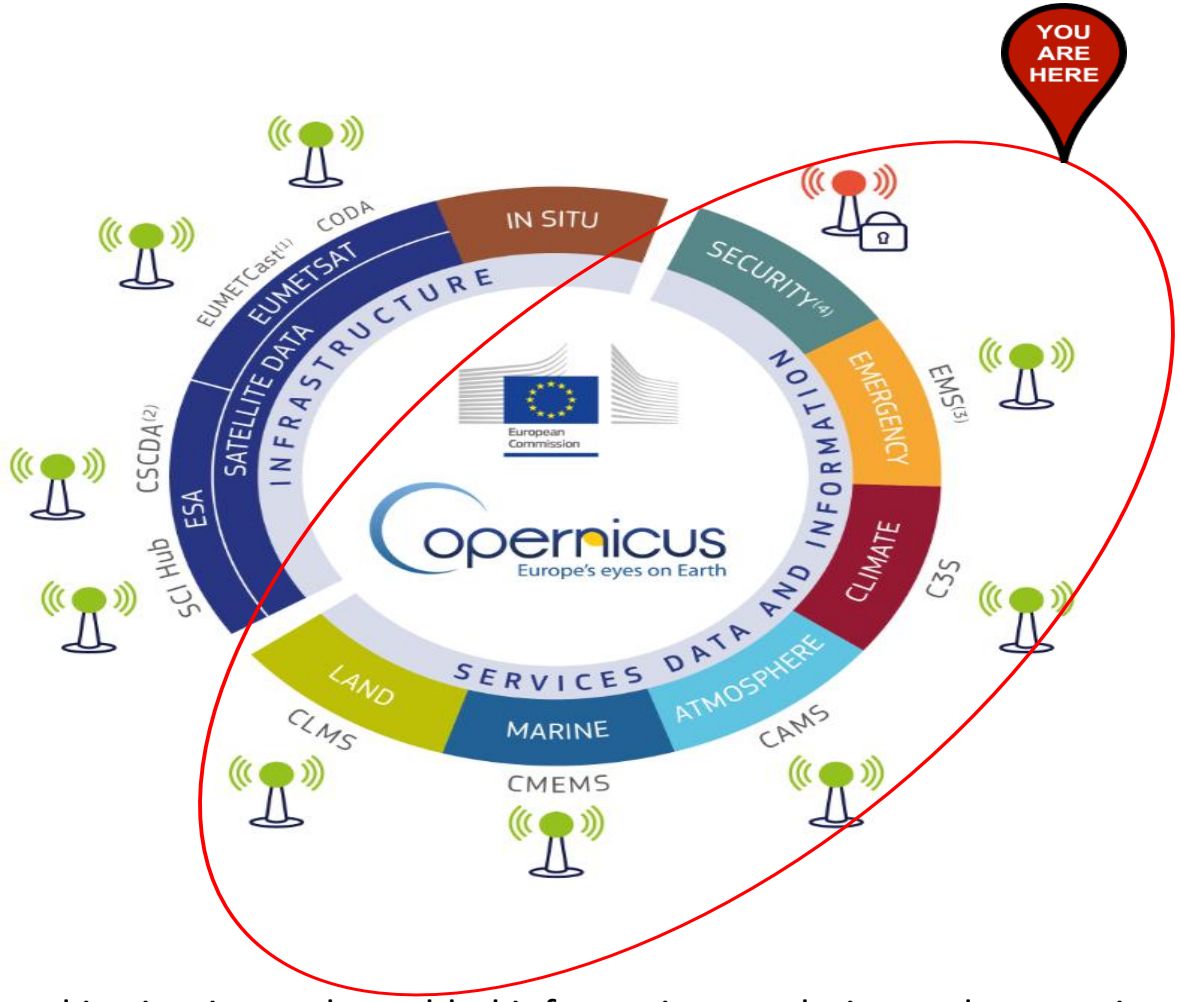
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Copernicus_Contributing_Missions

… 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

Benefit areas and products examples

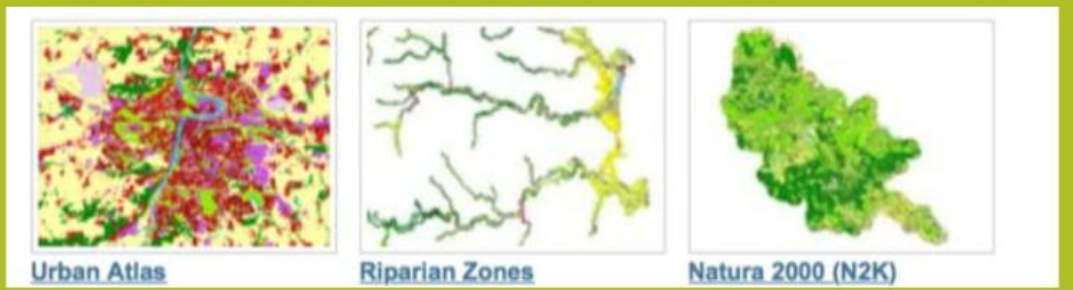
Copernicus

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

Global

Pan-European

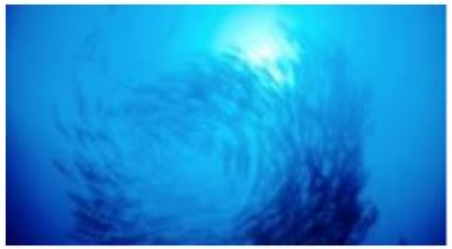
Local



Copernicus

Benefit areas and products examples

- Marine safety
- Marine resources
- Coastal and marine environment
- Climate and meteorological forecasting
- Other: Transport, Tourism, Environment, Pollution, Energy, etc.



- Sea Level
- Ocean Salinity
- Ocean Temperature
- Sea Ice
- Wind
- Ocean Currents
- Ocean Colour / Biogeochemistry (e.g. optics, chlorophyl, biology, chemistry)

Copernicus

Benefit areas and products examples

- Health
- Environment
- Pollution
- Climate
- Renewable Energy

Air Quality and Atmospheric Composition	
Climate forcing	
Ozone layer & UV	
Solar radiation	
Emissions and surface fluxes	

Copernicus

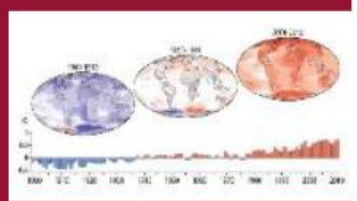
Benefit areas and products examples

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

Consistent Estimates of the Essential Climate Variables (ECVs)

Support to Mitigation and Adaptation Strategies

Global and Regional Reanalyses



Seasonal Forecasts And Climate Projections

Copernicus

Benefit areas and products examples

Disaster Emergency Situations

Humanitarian Crises

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

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

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

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

Copernicus

Benefit areas and products examples

Border Surveillance

- Coastal monitoring
- Pre-frontier monitoring
- Reference mapping

Maritime Surveillance

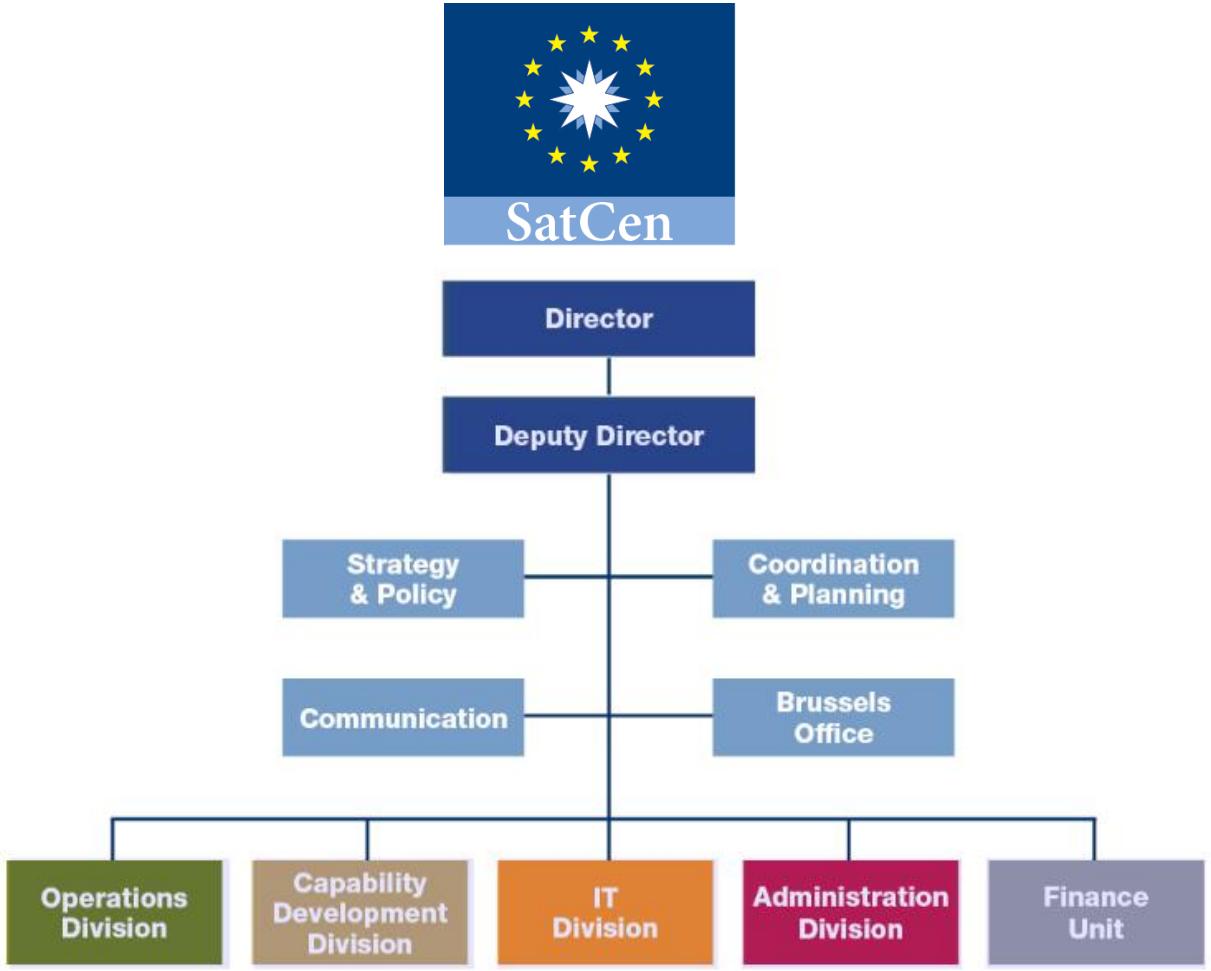
- Maritime surveillance of an area of interest
- Vessel detection
- Vessel tracking and reporting
- Vessel anomaly detection

Support to EU External Action

- Road network status assessment
- Conflict damage assessment
- Critical infrastructure analysis
- Reference map
- Support to evacuation plans
- Crisis situation map
- Border map
- Camp analysis

Sostegno all'UE Azione esterna e di sicurezza (SESA)

Entrusted Entity: European Union Satellite Centre (SatCen)



Servizio europeo di informazione geospaziale che assiste la dell'UE e dei suoi Stati membri nel quadro delle politiche e la legislazione dell'Unione:

- Azione esterna a sostegno dell'Unione e dei suoi Stati membri
- Sfide in materia di sicurezza
- Monitoraggio dell'attuazione del diritto dell'UE

Il European Union Satellite Centre (SATCEN) è stato incaricato dal Commissione nel 2016.

Il 29 agosto 2023 la Commissione e il SATCEN firmato un nuovo accordo di contribuzione per l'attuazione del servizio di sicurezza Copernicus SESA.

Sostegno all'UE Azione esterna e di sicurezza (SESA)

Copernicus SESA fornisce prodotti geospaziali progettati su misura basati sull'analisi di immagini satellitari.

https://youtu.be/E_pKeQ6DBSo

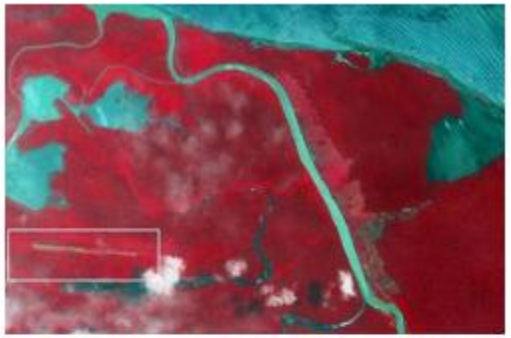
Sostegno all'UE Azione esterna e di sicurezza (SESA)

Entrusted Entity: European Union Satellite Centre (SatCen)

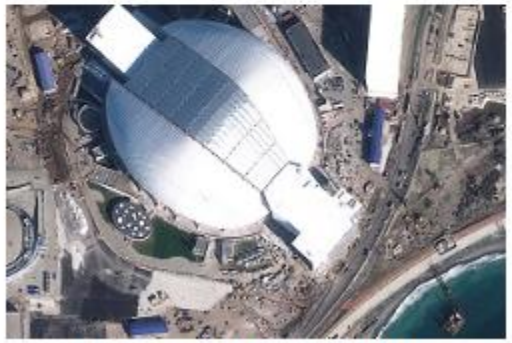
SatCen

HUMANITARIAN AID

CONTINGENCY PLANNING



GENERAL CRIME AND SECURITY SURVEILLANCE



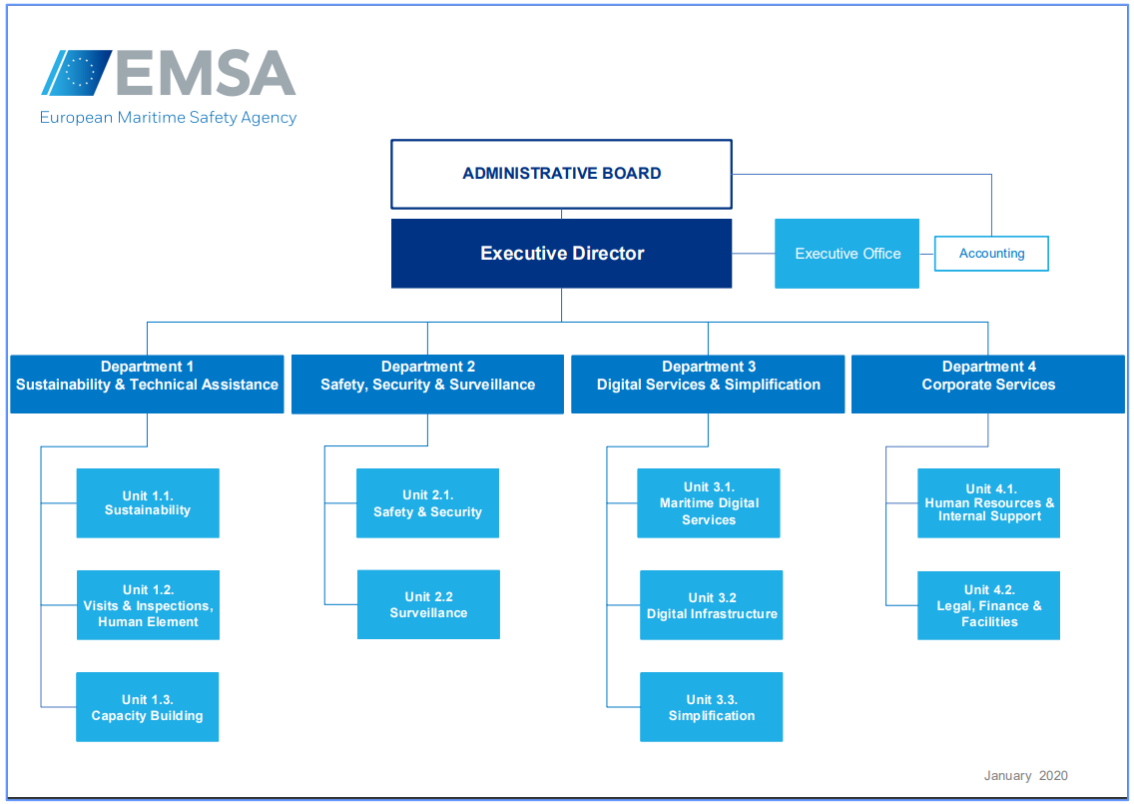
CRITICAL INFRASTRUCTURE

MILITARY CAPABILITIES

WEAPONS OF MASS DESTRUCTION

Supporto alla Sorveglianza Marittima

Entrusted Entity: European Maritime Safety Agency (EMSA)



Servizio di sorveglianza marittima Copernicus per supportare i propri utenti fornendo una migliore comprensione e migliorare il monitoraggio delle attività in mare che hanno un impatto sicurezza marittima:

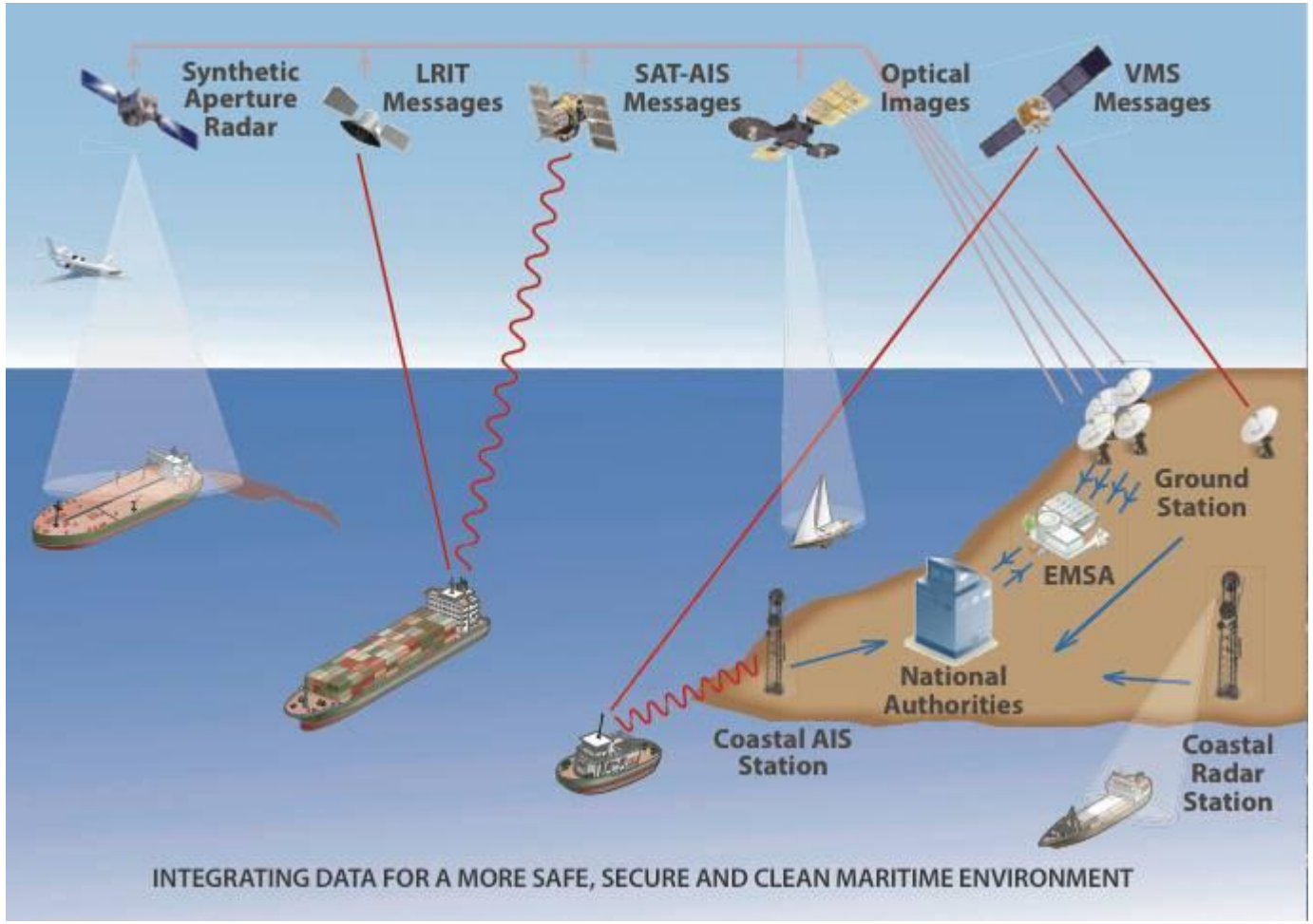
- controllo della pesca,
- inquinamento marino,
- Controlli doganali
- applicazione del diritto europeo
- interessi economici dell'UE.

L'EMSA offre un'ampia gamma di servizi di informazione alle autorità del settore marittimo.

L'EMSA è stata nominata entità delegata del programma Copernicus Servizio di Sorveglianza Marittima, responsabile per conto del Commissione per l'attuazione di tutte le misure tecniche e operative attività per la durata dell'Accordo di Contribuzione rinnovato (2021-2028).

Supporto alla Sorveglianza Marittima

L'Agenzia fornisce immagini radar e satellitari ottiche quasi in tempo reale, in particolare in risposta a specifiche operazioni in mare o a sostegno di emergenze.



EMSA
European Maritime Safety Agency

Supporto alla Sorveglianza Marittima

Entrusted Entity: European Maritime Safety Agency (EMSA)

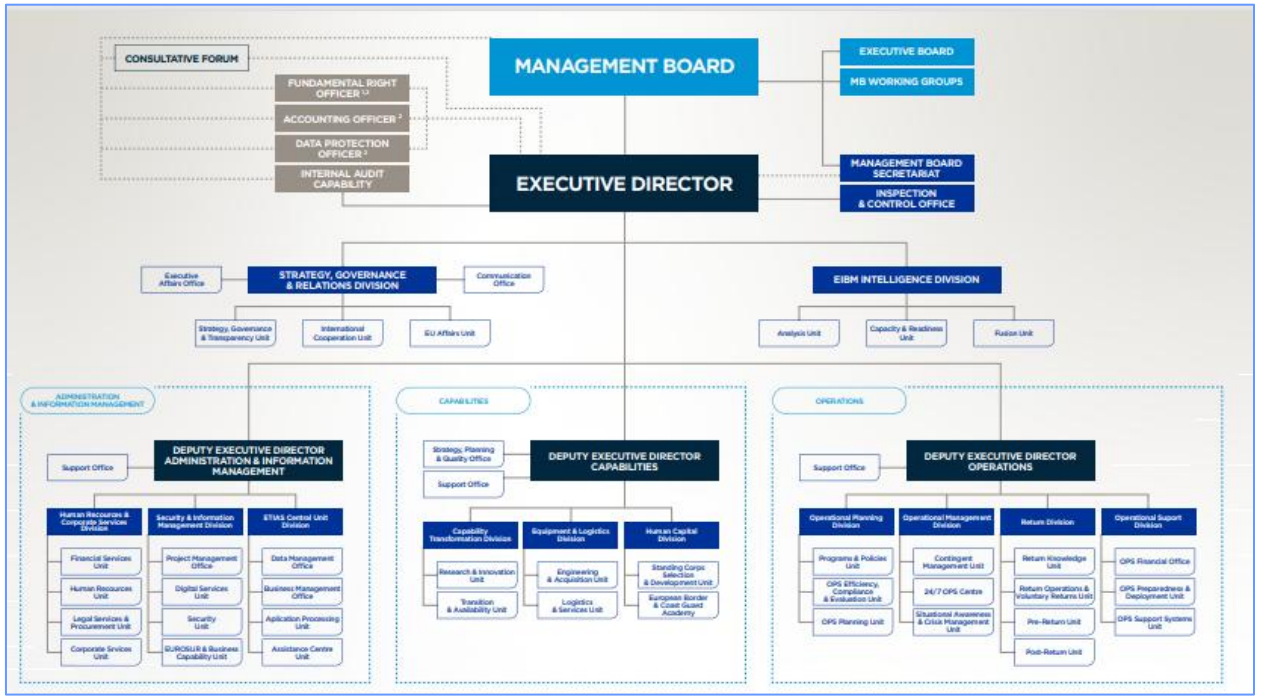
EMSA
European Maritime Safety Agency

https://youtu.be/pFAxZTkA_dk

Supporto alla Sorveglianza dei Confini

Entrusted Entity: Frontex

FRONTEX
EUROPEAN BORDER AND COAST GUARD AGENCY



EUROSUR: *framework* per lo scambio di informazioni migliorare la gestione delle frontiere esterne dell'Europa.

Il servizio contribuisce a migliorare il quadro situazionale a Livello delle frontiere esterne e zone prefrontaliere dell'Unione europea.

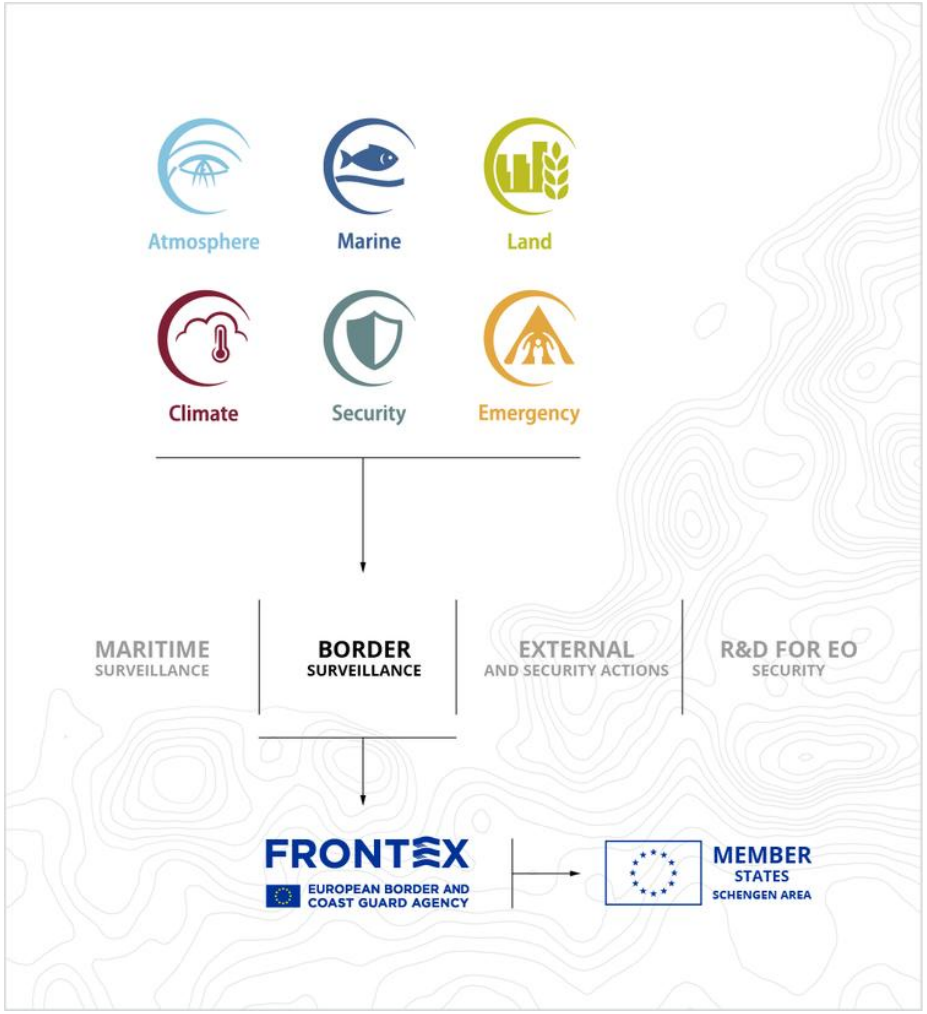
Frontex è disciplinata dal regolamento (UE) 2019/1896 del 13 novembre 2019 sulla Guardia di Frontiera e Costiera Europea (GU L 295 del 14.11.2019, pag. 1).

Firma di un nuovo Accordo di Contributo per la fornitura di servizi nel periodo 2021-2028.

Supporto alla Sorveglianza dei confini

Frontex fornisce nuovi prodotti Copernicus per la sorveglianza delle frontiere, come relazioni e mappe, e prodotti cartografici, digitali e interattivi.

FRONTEX
EUROPEAN BORDER AND COAST GUARD AGENCY



IN-SITU: OVERVIEW

- *In situ* data = observation data from ground-, sea-, or air-borne sensors, reference and ancillary data licensed for use in Copernicus
- Use of *In situ* data:
  - Validate & calibrate Copernicus products
  - Reliable information services
- Implementation in two tiers:
  - Tailored *in situ* data for each Copernicus service level
  - Cross-cutting coordination across services by the EEA





ACCESSO AI DATI COPERNICUS AD OGGI

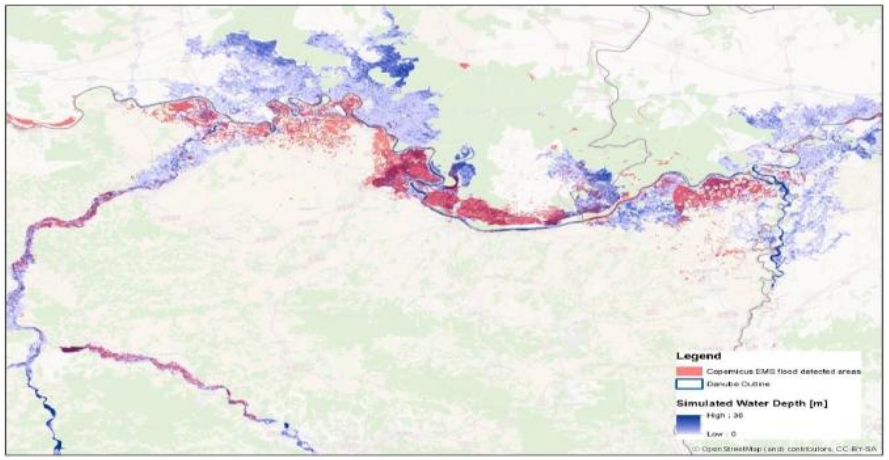
COME ACCEDERE AI DATI DEL CSC?

4 infrastrutture dedicate per l'accesso ai dati, i.e.

- Sentinel Data Hub
- Coordinated Data Access System (for access to Contributing Missions data)
- Collaborative Data Hub (Collaborative Ground Segment)
- International Data Hub (for international partners)

https://dataspace.copernicus.eu/explore-data

COME ACCEDERE AI DATI E ALLE INFORMAZIONI DEI SERVIZI?



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

APPLICAZIONI DI COPERNICUS

AGRICOLTURA

DISASTRI NATURALI

SICUREZZA

ENERGIE RINNOVABILI

QUALITÁ DELL'ARIA

MONITORAGGIO FORESTALE

MONITORAGGIO URBANO

OIL & GAS

SFRUTTAMENTO E CONSERVAZIONE DELLE RISORSE MARINE

9.751.756.800 MB

COPERNICUS DATA POLICY

DIVERSI TIPI DI DATA POLICY:

- DATI SATELLITI SENTINELLE (ACCESSO LIBERO, TOTALE E GRATUITO)
- SERVIZI COPERNICUS (ACCESSO LIBERO, TOTALE E GRATUITO)
- MISSIONI CONTRIBUTRICI (ACCESSO SOTTOPOSTO ALLE DIVERSE POLICY)

L'ACCESSO AI PRODOTTI DEL SERVIZIO SICUREZZA É LIMITATO A UTENTI AUTORIZZATI PER PROTEGGERE GLI INTERESSI DELL'UE E DEGLI STATI MEMBRI

BENEFICI DI COPERNICUS

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

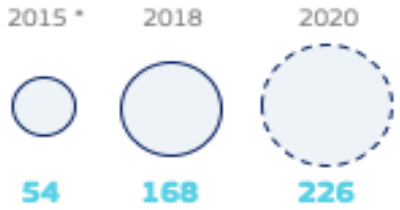
BENEFICI DI COPERNICUS

STRUMENTO CHIAVE PER RICERCA, INNOVAZIONE E CREAZIONE DI LAVORI SPECIALIZZAT

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)**

STRATEGIA: MASSIMIZZARE LA CRESICTA DI UN ECO-SISTEMA DI UTENTI CHE TRASFORMI I DATI COPERNICUS IN PRODOTTI FINALI

Relevant for many sectors!

MAIN DOWNSTREAM INDUSTRIES END USERS BASED ON THE EARSC TAXONOMY

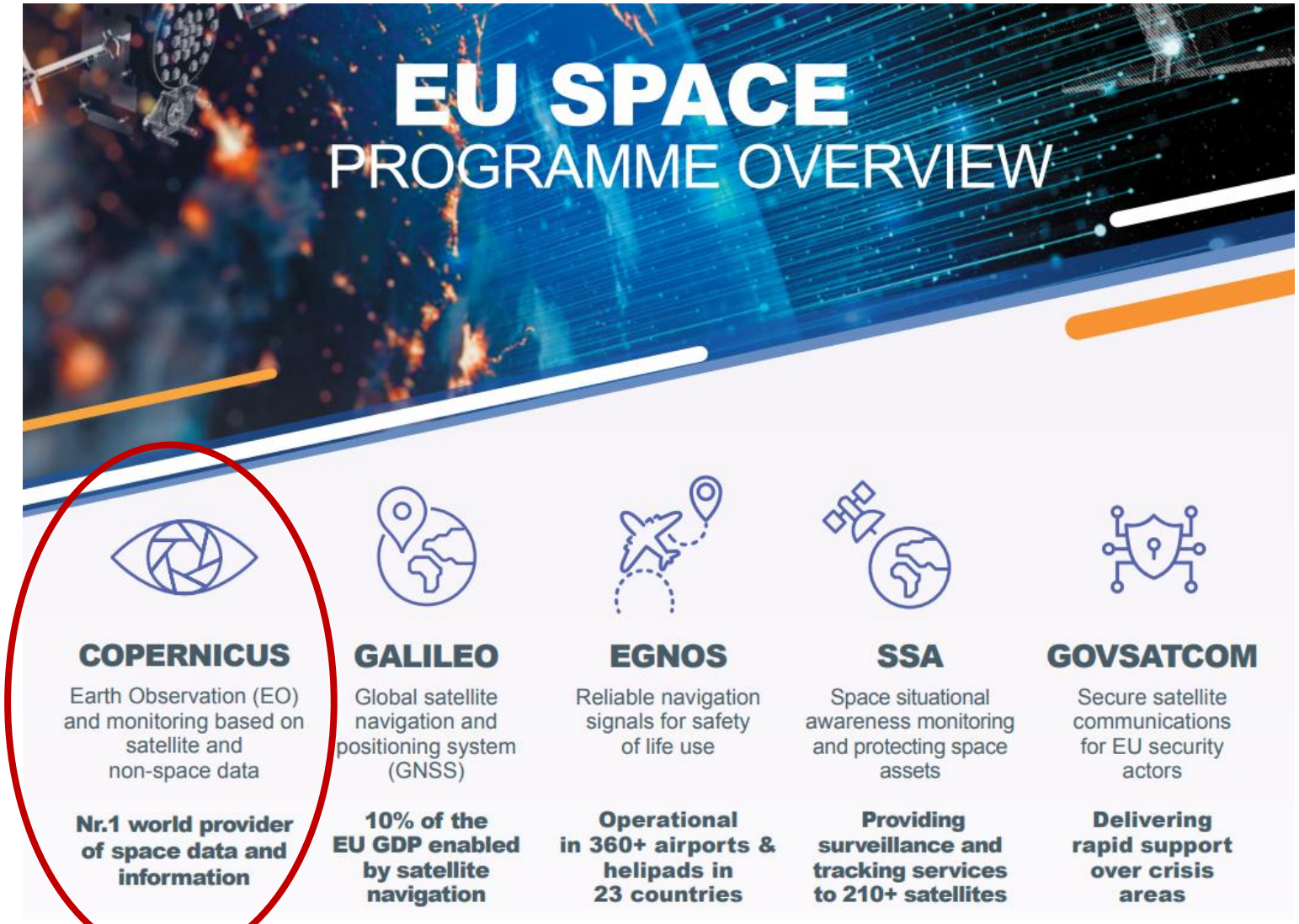
- Security, defence 
- Environment, pollution and climate 
- Oil and gas 
- Maritime 
- Agriculture 
- Fisheries 
- Emergency services 

- 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 

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**

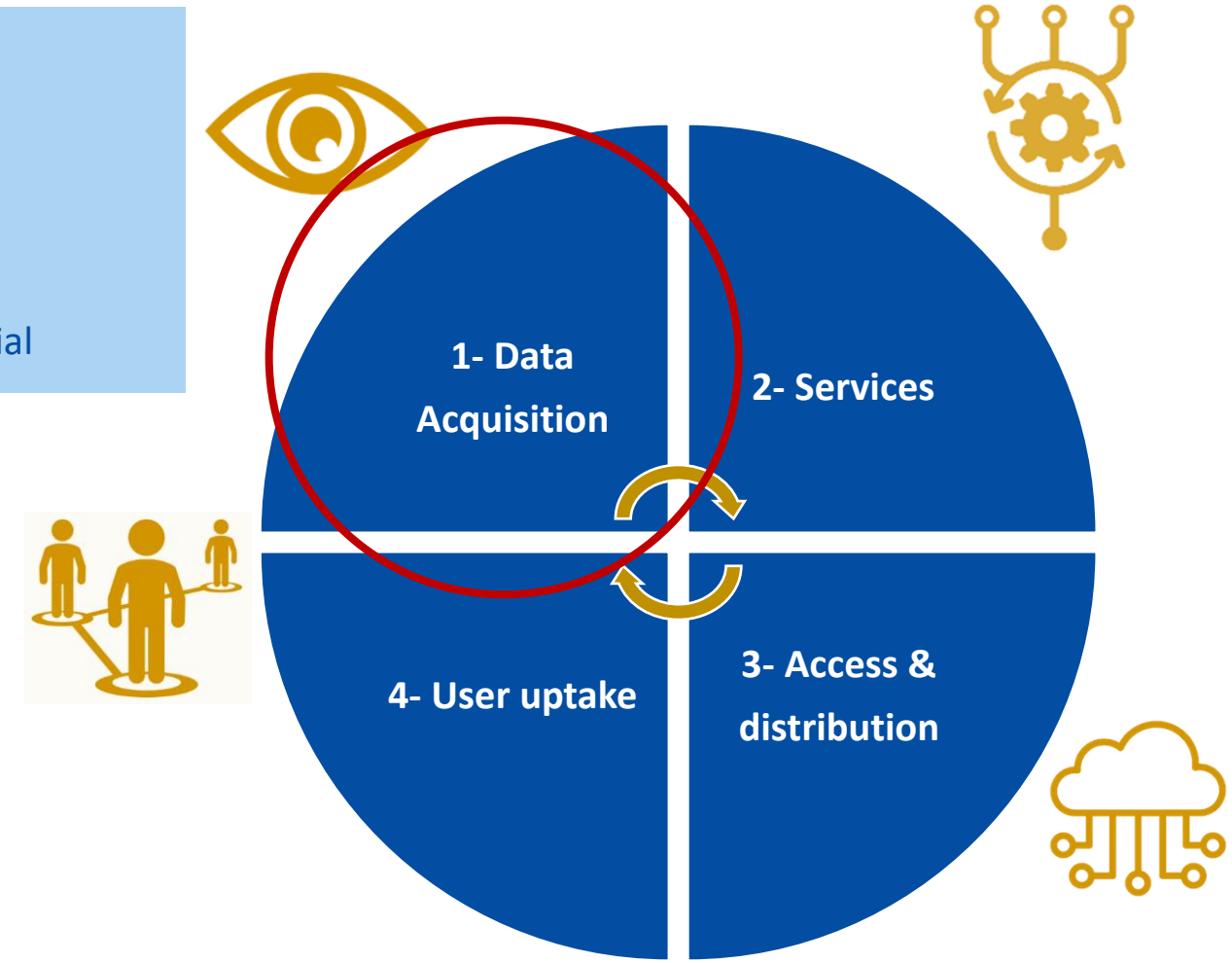
Supporting disaster relief, humanitarian assistance and security operations

Four dimensions of Copernicus

Continuation of data +

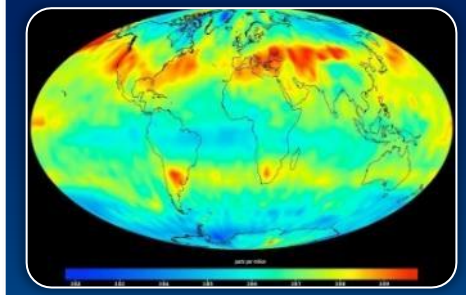
Agile observation

- Enhance performance
- Reduce dependencies
- Amplify observation potential



Block 1:data acquisition - new missions

CO2M, 2 satellites by 2026
All missions develop and launch to be scheduled after 2024 decision point



CO2M
optical

Copernicus Anthropogenic CO2 Monitoring

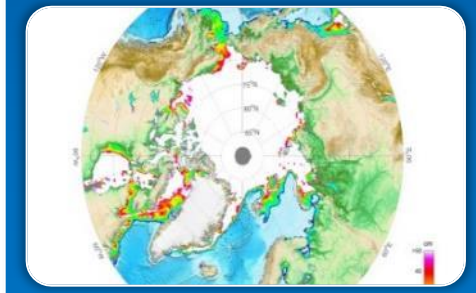
CO_2, NO_2, Aerosols Imaging Spectrometer (VNIR/SWIR), Polarimeter

CRISTAL

Copernicus Polar Ice & Snow Topography

Radar altimeter

HR microwave radiometer

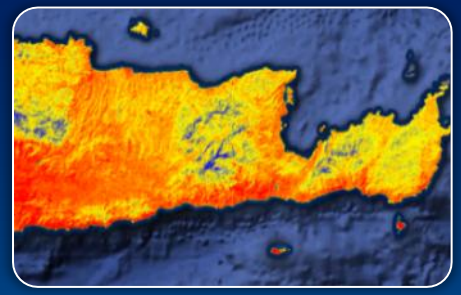


CIMR

Sea-ice, sea surface temperature, salinity

Copernicus Imaging Microwave Radiometer

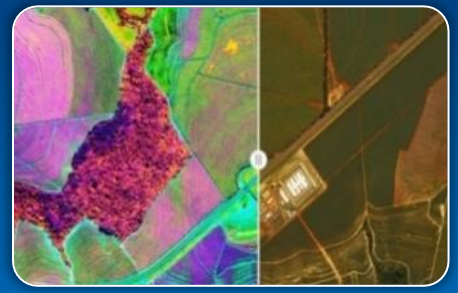
Multi-frequency L-band Radiometer



LSTM
optical

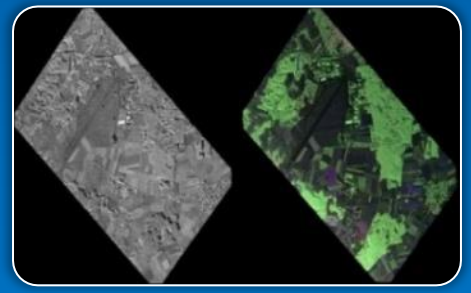
Land Surface Temperature Monitoring

VNIR/TIR scanning radiometer



CHIME
optical

Copernicus Hyperspectral Imaging Mission for the Environment (VNIR/SWIR)



ROSE-L

Observation under vegetation, cryosphere, soil

L-band SAR

NEW SPACE

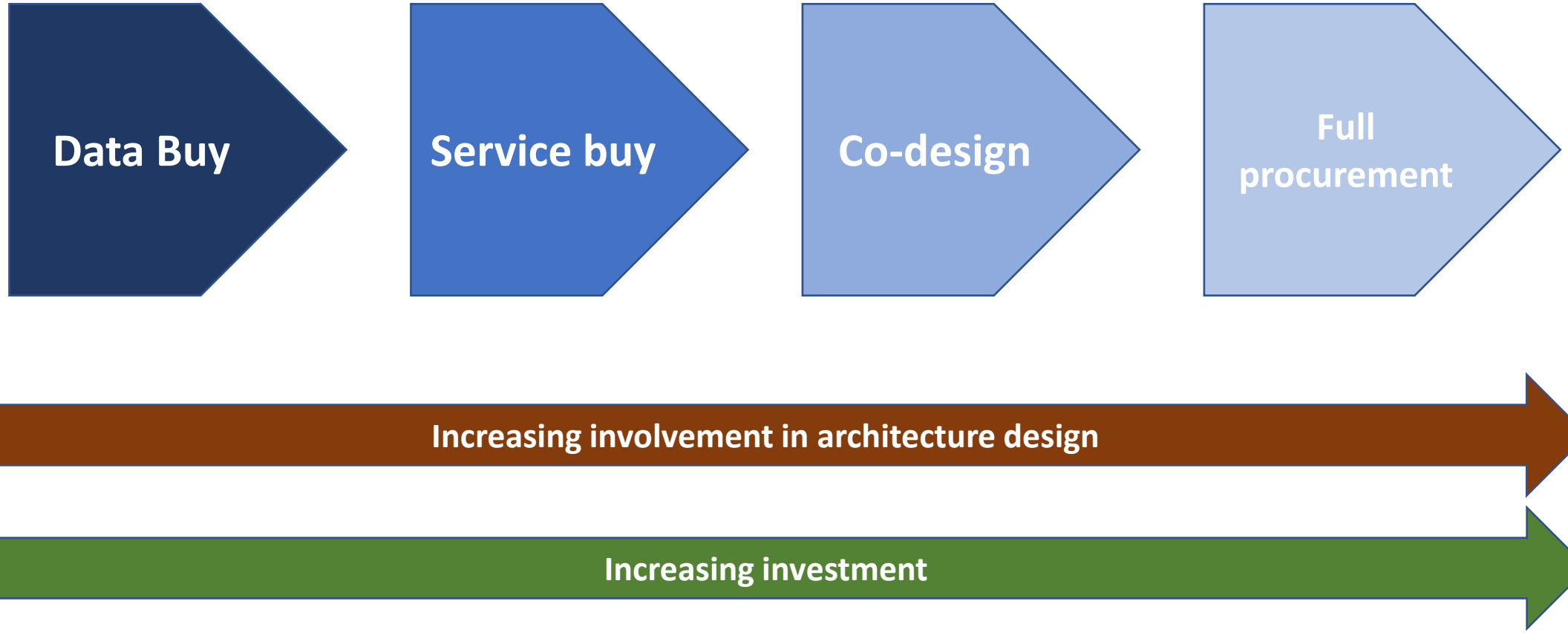
NewSpace is a global trend encompassing a series of technological and business model innovations leading to a reduction in costs, shorter lifecycles and a bolder approach to risk taking in the space sector.

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.

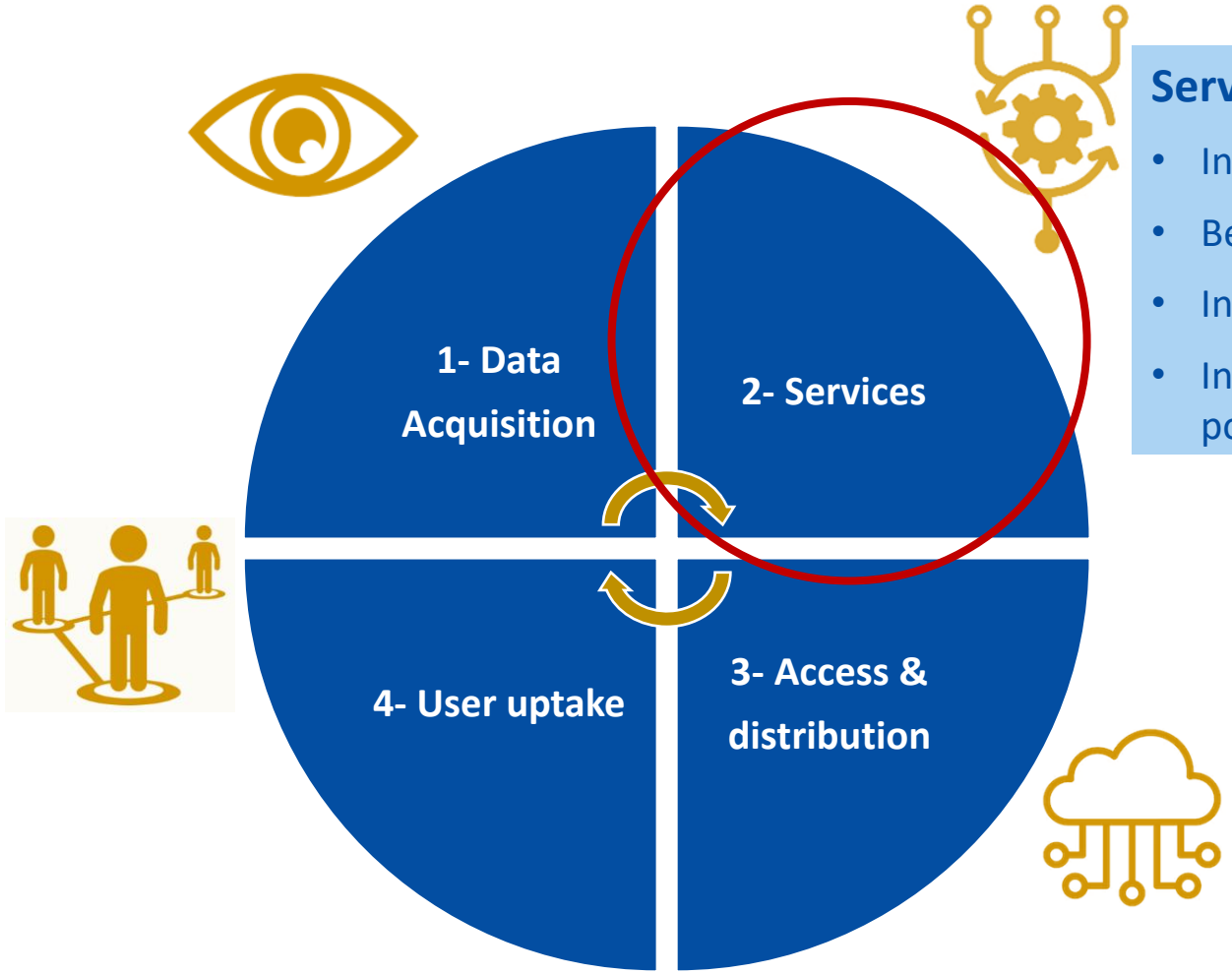
Source: : EU Space Economics in the global context study – SpaceTec Partners for DEFIS, 2021

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

Block 2 – Data and services processing - evolution

TARGET - CREATE NEW SERVICES INNOVATIVE, ON-DEMAND, REAL-TIME FOR PUBLIC

NEW CONTENT

- **Enhanced information services on high priority topics**
- **New service element for CO2 monitoring**
- **More cross –services application domains**
- **Knowledge Centre for Earth Observation**

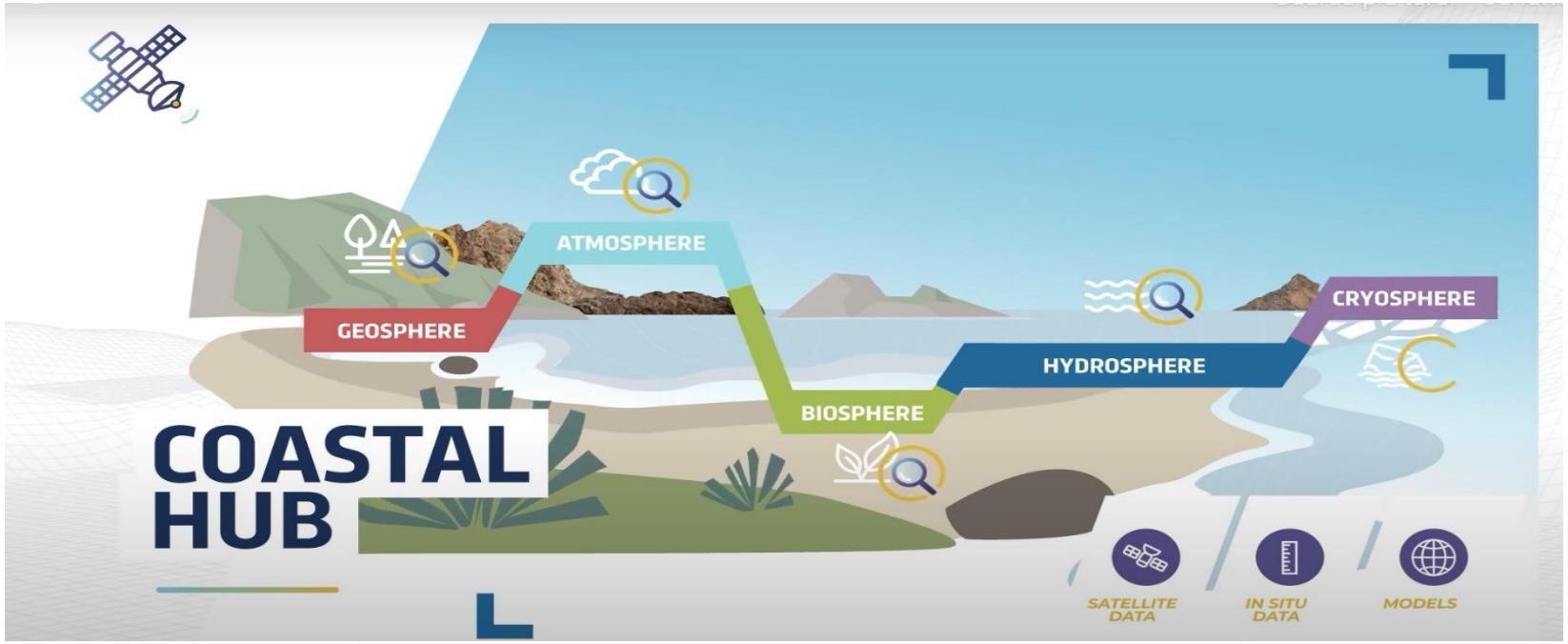
DIGITAL INNOVATION

- **Budget constraints – innovate in co-design and collaborative thinking**
- **Work differently with our users**
  - Extensive data sharing
  - Collaborative virtualized development platforms
  - Co-production of services with Member States/3rd countries

THEMATIC HUBS

DIGITAL CO-DESIGN

Servizi Copernicus: Portale Coastal Hub

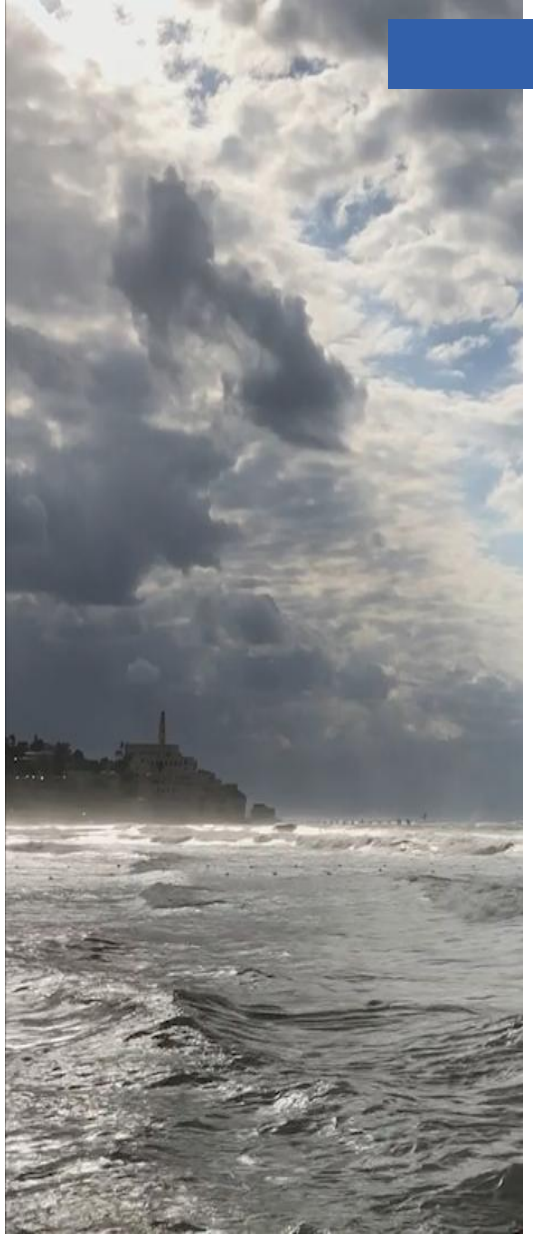


Cos'è il Coastal Hub?

Il Coastal Thematic Hub è un portale web di Copernicus che fornisce dati e informazioni sulle coste. Include mappe interattive e offre dati Copernicus a supporto di processi decisionali basati su dati concreti e pratiche di gestione sostenibile

Perchè è stato creato?

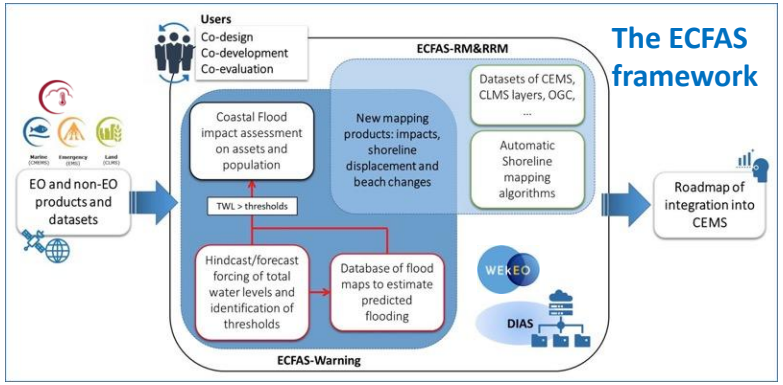
Il Coastal Hub è stato creato dalla Commissione europea nell'ambito del programma Copernicus per fornire un archivio centrale di dati e informazioni relativi alle aree costiere. L'obiettivo dell'hub è sostenere un processo decisionale basato su dati concreti e promuovere pratiche di gestione sostenibile degli ecosistemi costieri.



Proof Of Concept di servizi marino-costieri

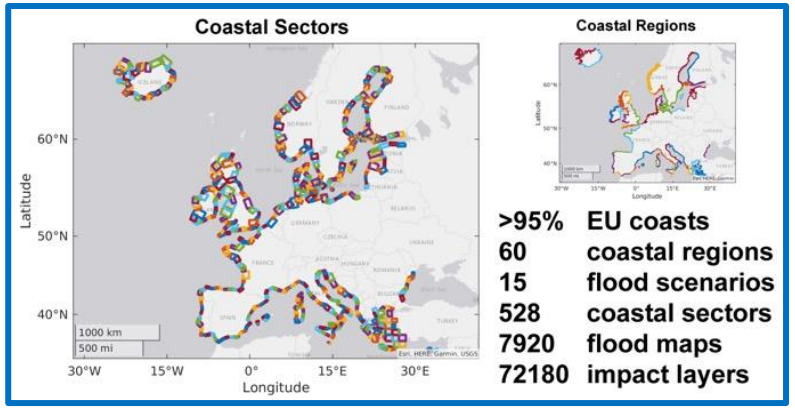
This project has received funding from the European Union's Horizon 2020 programme under Grant Agreement No 101004211

Valutazione delle inondazione costiere



Un Proof-Of-Concept per l'implementazione di un **E**uropean **C**oastal **F**lood **A**wareness **S**ystem (EC H2020)

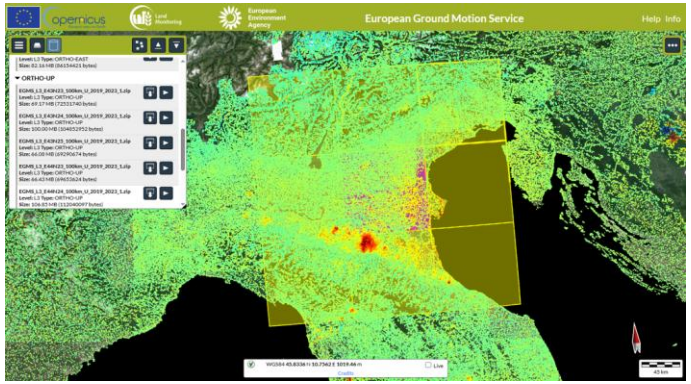
ECFAS mira a sviluppare prodotti e strumenti per l'evoluzione del servizio **Copernicus Emergency Management** nelle aree costiere.



La componente di allerta comprende informazioni pan-UE sulle **mappe di inondazione** (profondità e velocità) associate a diverse combinazioni di 5 livelli totali dell'acqua e durata delle mareggiate, e gli strati di impatto (potenziale) associati.

Proof Of Concept di prototipi di servizi marino-costieri

This project is funded by the European Union – Next Generation EU, component M4C2, in the framework of the Research Projects of Significant National Interest (PRIN) 2022 National Recovery and Resilience Plan (PNRR) Call, project SubRISK+ (grant id. P20222NW3E; https://www.subrisk.eu/), 2023–2026 (CUP B53D23033400001).



https://egms.land.copernicus.eu/

Valutazione del rischio di subsidenza

Migliorare la comprensione del RISCHIO di subsidenza indotto dallo sfruttamento delle acque sotterranee per uno sviluppo urbano sostenibile

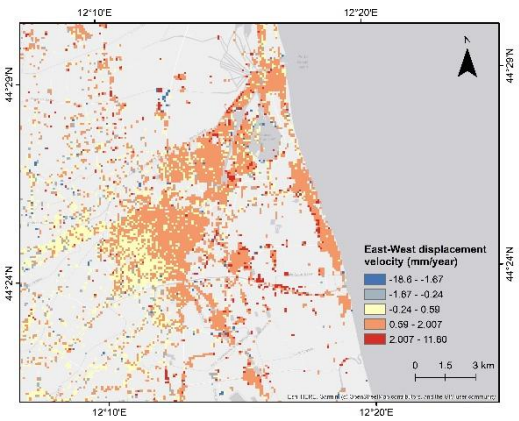
Subrisk+ mira a:

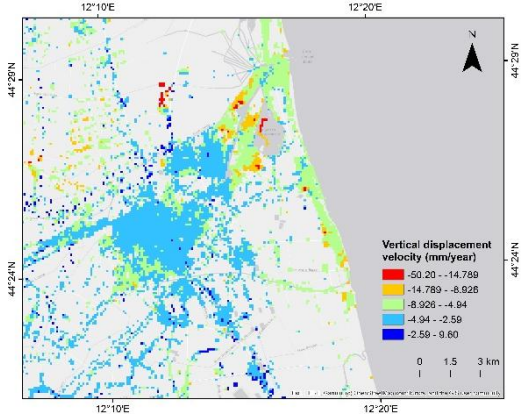
- Identificare e mappare gli hotspots di spostamento del territorio
- Mappatura del rischio di spostamento differenziale attraverso la sintesi di Pericolo ed Esposizione-Vulnerabilità

Copernicus European Ground Motion Services (EGMS), fornisce lo spostamento del suolo basato sull'elaborazione InSAR delle immagini radar di Copernicus Sentinel-1.

Include lo spostamento lungo le direzioni su-giù (verticale) e est-ovest (orizzontale), derivato dalla combinazione di orbite ascendenti e discendenti dei set di dati calibrati EGMS.

Velocità verticale e est-ovest (mm/anno) lungo la zona costiera di Ravenna



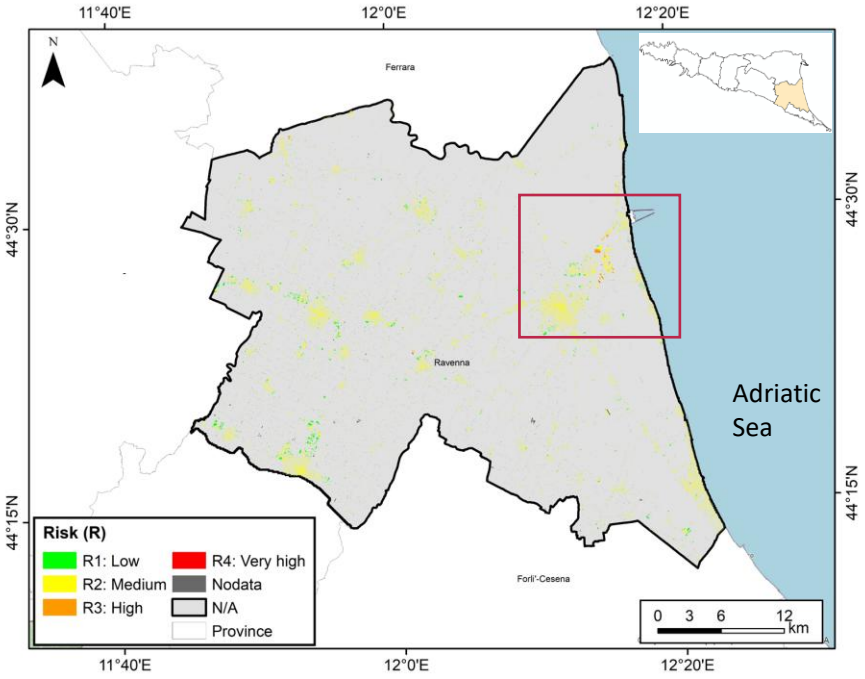


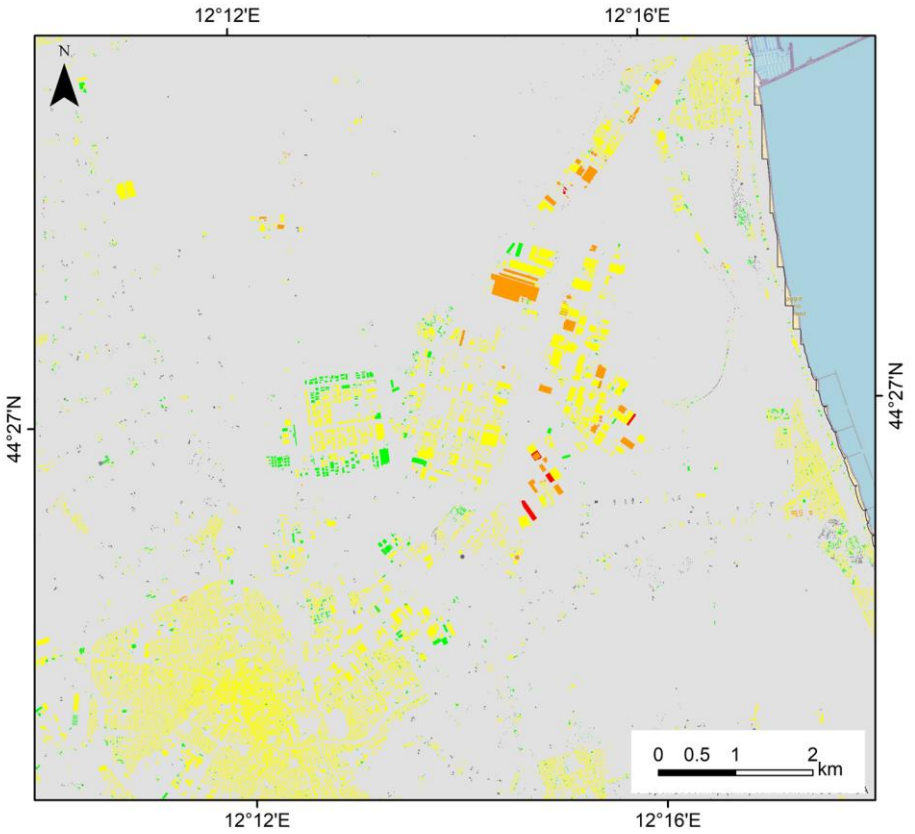
Proof Of Concept di prototipi di servizi marino-costieri

Il livello di rischio da spostamento differenziale è correlato alla combinazione delle classi di pericolosità e di esposizione-vulnerabilità utilizzando un approccio a matrice di rischio.

I livelli di pericolosità indotti dallo spostamento differenziale sulle infrastrutture urbane sono stimati attraverso il calcolo della distorsione angolare (β) e della deformazione orizzontale (ε) derivate dai dataset EGMS Ortho.

Estensione delle quattro classi di rischio: Provincia costiera di Ravenna



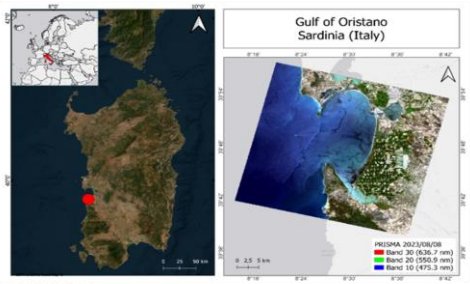


Boni, R., Goliraeisi, L., Sapio, S., Taramelli, A., Cigna, F., Paranuzio, R. & Teatini, P. (2025) PRIN 2022 PNRR SubRISK+ Deliverable DEL 3.3: Driving and condition factors of the land subsidence in Emilia Romagna region, Version 1.0, Issue date: 31/01/2025.

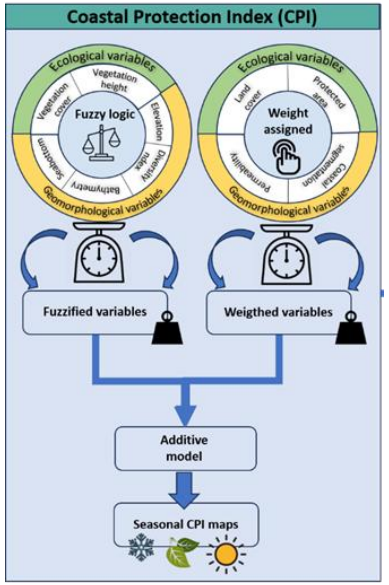
Goliraeisi, L., Bonì, R., Taramelli, A., Cigna, F., Teatini, P., Paranuzio, R., and Zoccarato, C. (2025) Integration of Earth Observation data into land subsidence risk mapping: the Emilia Romagna region case of study (Italy), EGU General Assembly 2025, Vienna, Austria, 27 Apr–2 May 2025, EGU25-16710, https://doi.org/10.5194/egusphere-egu25-16710.2025

Proof Of Concept di prototipi di servizi marino-costieri

prismascienza
OVERSEE
GLOBAL ECV MULTISENSOR MAPPING FOR COASTAL ECOSYSTEM SERVICES PROTECTION



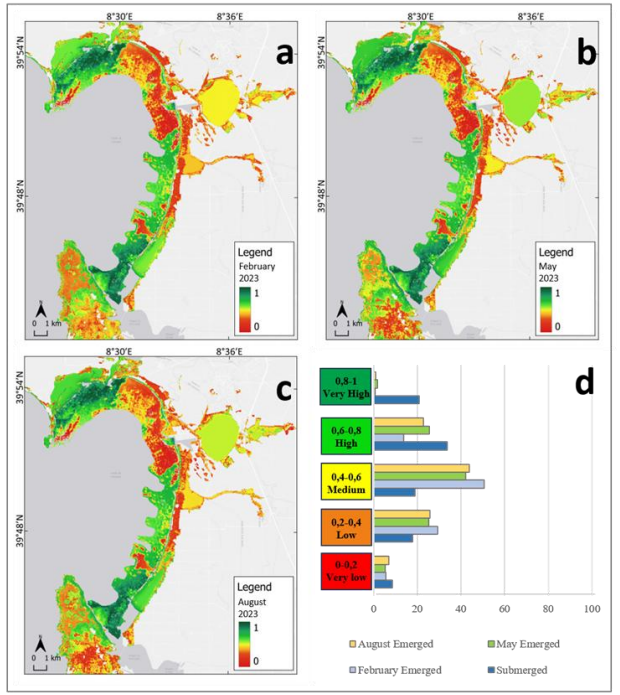
STUDY AREA: Gulf of Oristano, Sardinia, Italy – In this area, landscape changes and increasing urbanization have intensified anthropogenic pressure, leading to a reduction in freshwater supply and terrigenous sediment input, thereby increasing vulnerability to erosion and the degradation of ecosystem services (Righini et al. 2023). By 2100, sea level rise - projected to reach up to 949 mm - could partially flood some areas and compromise adjacent agricultural and fishing zones, further exacerbating the region's vulnerability (Antonioli et al. 2017).



Servizio Ecosistemico di regolazione: Protezione Costiera

Nelle zone settentrionali e centro-orientali del Golfo di Oristano presentano **ALTO GRADO DI PROTEZIONE.** La presenza di coperture a *P. oceanica* nella parte sommersa e delle wetland in quella emersa ha un ruolo rilevante nel modello di calcolo (additivo-pesato).

Le aree con i **VALORI PIÙ BASSI DI PROTEZIONE** sono situate nella zona centro-settentrionale del Golfo (Torregrande) ed includono zone lagunari, questo perché alcune zone umide del Gofo di Oristano hanno diversa natura ecologica, distanza dalla costa e grado di protezione.

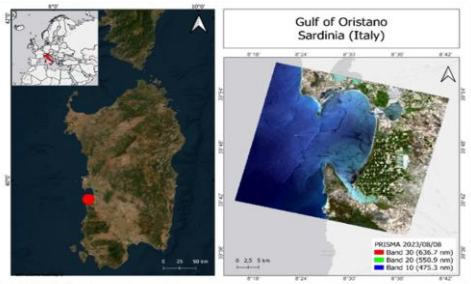


Paper in preparazione:
E. Valentini, C. Marinelli, A. Troccoli, M. Righini, M. Bresciani and A. Taramelli (2025). Coastal wetlands as nature based solutions under sea level rise scenarios in Mediterranean Islands: geospatial feedbacks of landscape and geomorphology. Landscape Ecology.

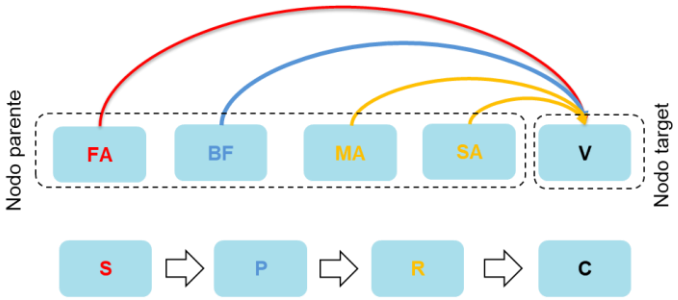
Proof Of Concept di prototipi di servizi marino-costieri

prismascienza
OVERSEE
GLOBAL ECV MULTISENSOR MAPPING FOR COASTAL ECOSYSTEM SERVICES PROTECTION

Valutazione della vulnerabilità costiera



STUDY AREA: Gulf of Oristano, Sardinia, Italy – In this area, landscape changes and increasing urbanization have intensified anthropogenic pressure, leading to a reduction in freshwater supply and terrigenous sediment input, thereby increasing vulnerability to erosion and the degradation of ecosystem services (Righini et al. 2023). By 2100, sea level rise - projected to reach up to 949 mm - could partially flood some areas and compromise adjacent agricultural and fishing zones, further exacerbating the region's vulnerability (Antonioli et al. 2017).



(modificato da Taramelli et al. 2020)

Source – **P**athway – **R**eceptor - **C**onsequence (ENG)

Sorgente - **P**ercorso - **R**ecettore - **C**onseguenza (ITA)

- The low level of vulnerability is prevalent in the present scenario (45%).

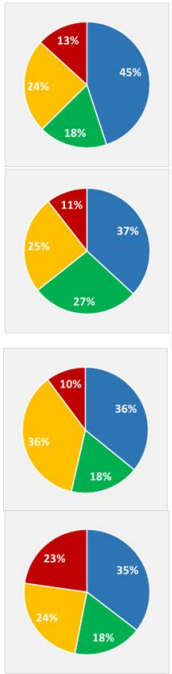
PRESENT
SLR = 0.00 cm

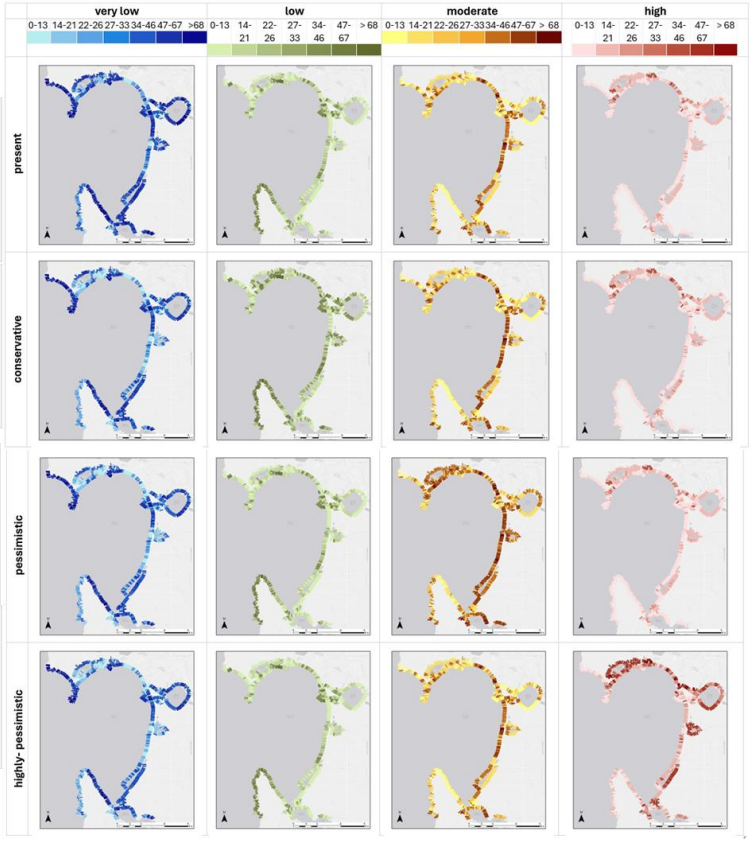
CONSERVATIVE
SLR = 53 cm

PESSIMISTIC
SLR = 97 cm

- The high level of vulnerability is prevalent in the highly pessimistic scenario (23%).

HIGHLY PESSIMISTIC
SLR = 140 cm





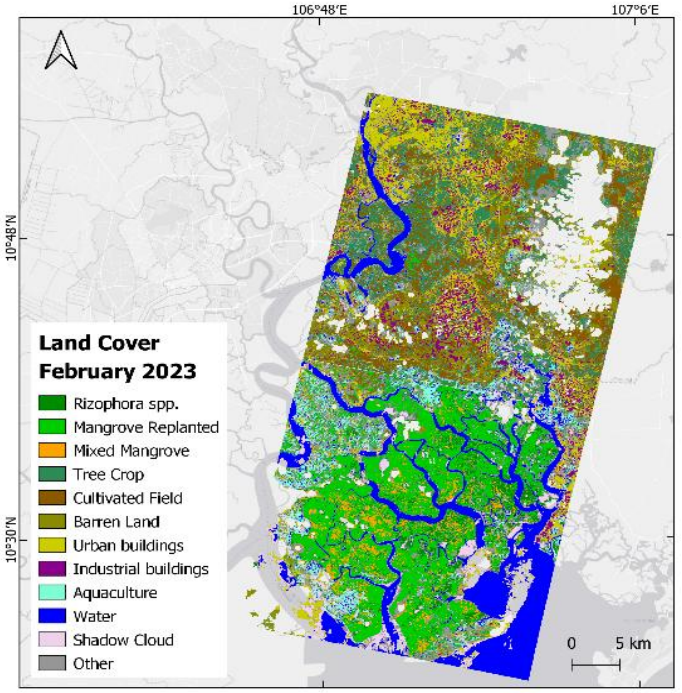
Paper in preparazione:
I. Gatti, E. Valentini, L. Goliaeisi, A. Troccoli, S. Geraldini, M. Pinardi and A. Taramelli (2025). Multi-sensor-based assessment in coastal regions. Enhanced value offerings for a possible new Earth Observation ecological vulnerability service focused on coastal areas. International Journal of Disaster Risk Reduction (IJDRR).

Proof Of Concept di prototipi di servizi marino-costieri

prismascienza
OVERSEE
GLOBAL ECV MULTISENSOR MAPPING FOR COASTAL ECOSYSTEM SERVICES PROTECTION

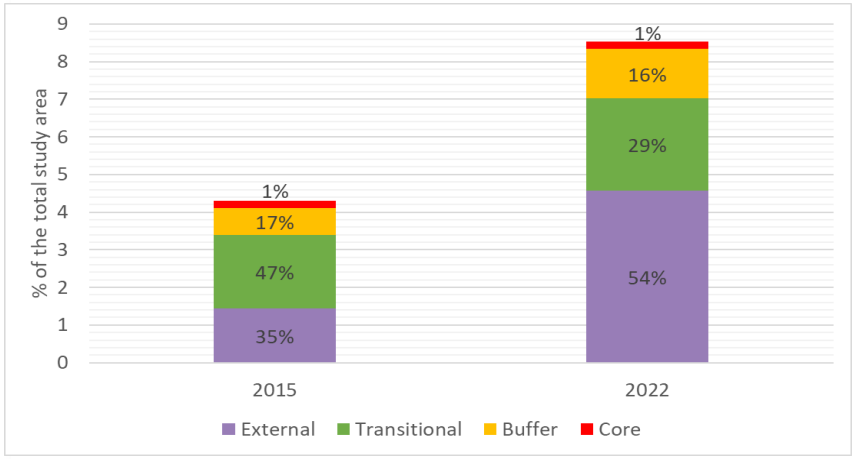
Riserva della biosfera delle mangrovie Cần Giờ

Sinergie con i dati radar (COSMO-SkyMed)



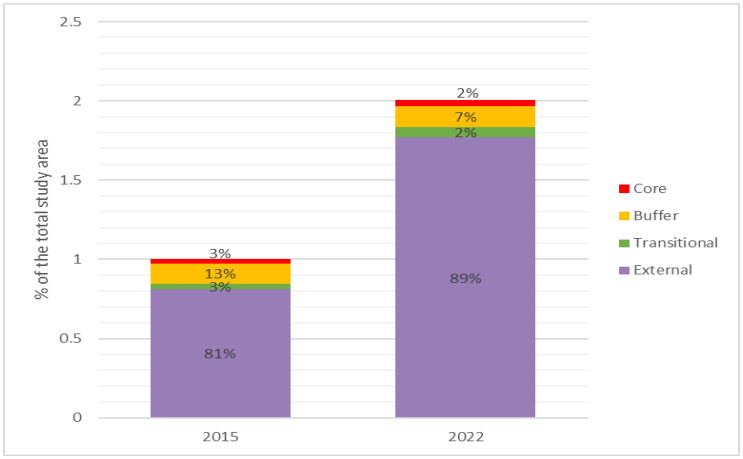
Estremo tasso di cambiamento dell'uso del suolo (LU): la Riserva della Biosfera delle Mangrovie di Cần Giờ ha subito grandi cambiamenti negli ultimi decenni e ora sta vivendo una significativa frammentazione a causa di:

Conversione dell'acquacoltura



All'interno della Riserva, le zone di transizione, buffer e centrale rappresentano rispettivamente il 29%, il 16% e l'1% dell'acquacoltura totale. Nel 2015, l'area esterna alla Riserva comprende il 35% dell'acquacoltura totale. All'interno della Riserva, le zone di transizione, cuscinetto e nucleo rappresentano rispettivamente il 47%, il 17% e l'1% dell'acquacoltura totale.

Sviluppo urbano



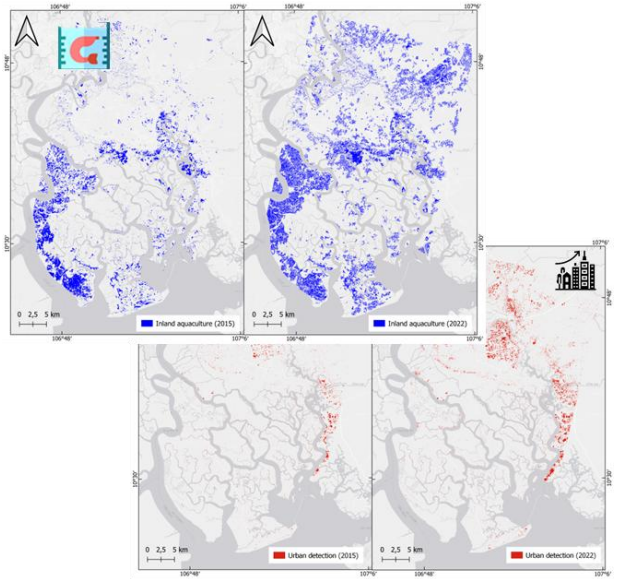
La classificazione urbana ottenuta da S1 mostra che la superficie coperta da infrastrutture è l'1% della superficie totale nel 2015 e il 2% nel 2022. Le superfici urbane si sono diffuse soprattutto nell'area esterna alla Riserva, passando dall'81% all'89% della superficie urbana totale, mentre sono rimaste quasi invariate all'interno della Riserva.

Valentini, E., Righini, M., Sapio, S., Liburdi, S., Cima, V., Nghiem, S. V., & Taramelli, A. (2023, July). SAR Data for Monitoring Rapidly Changing Ecosystems: Aquaculture and Urbanization in the Cần Giờ Mangrove Biosphere Reserve, South Vietnam. IGARSS 2023 - 2023 IEEE International Geoscience and Remote Sensing Symposium, Pasadena, CA, USA, 2023, pp. 1424-1427, doi: 10.1109/IGARSS52108.2023.10282251

Proof Of Concept di prototipi di servizi marino-costieri

STRENGTH outcomes

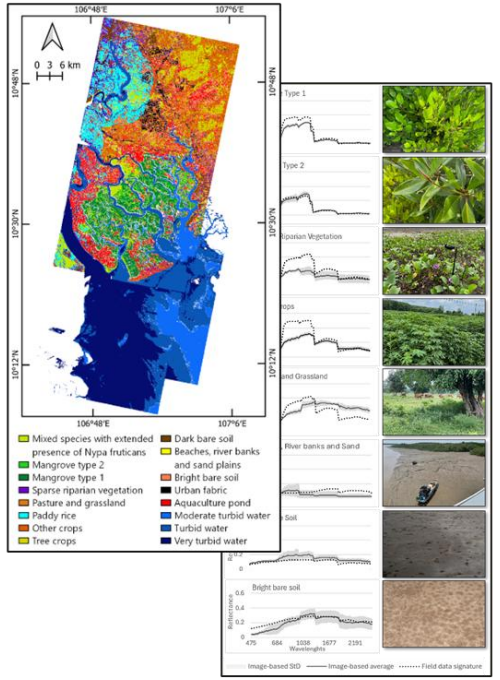
Oltre all'espansione urbana, **l'area costiera** è stata caratterizzata da un forte cambiamento di uso del suolo, dall'agricoltura all'acquacoltura, guidato principalmente dall'intrusione salina marina, evidente nei cambiamenti dell'evapotraspirazione negli ultimi 30 anni.



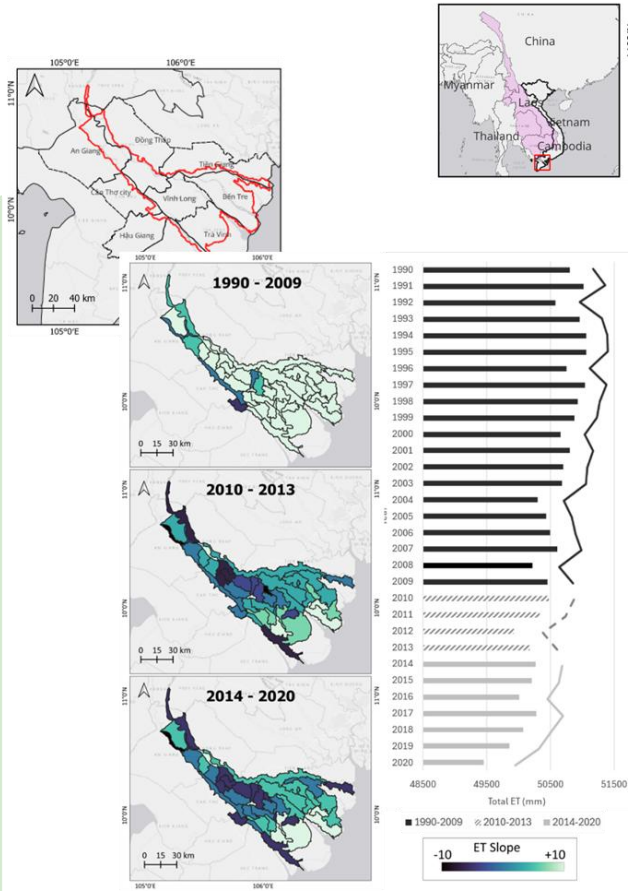
SAR Data for Monitoring Rapidly Changing Ecosystems: Aquaculture and Urbanization in the Cần Giờ Mangrove Biosphere Reserve, South Vietnam

Publisher: IEEE Cite This PDF

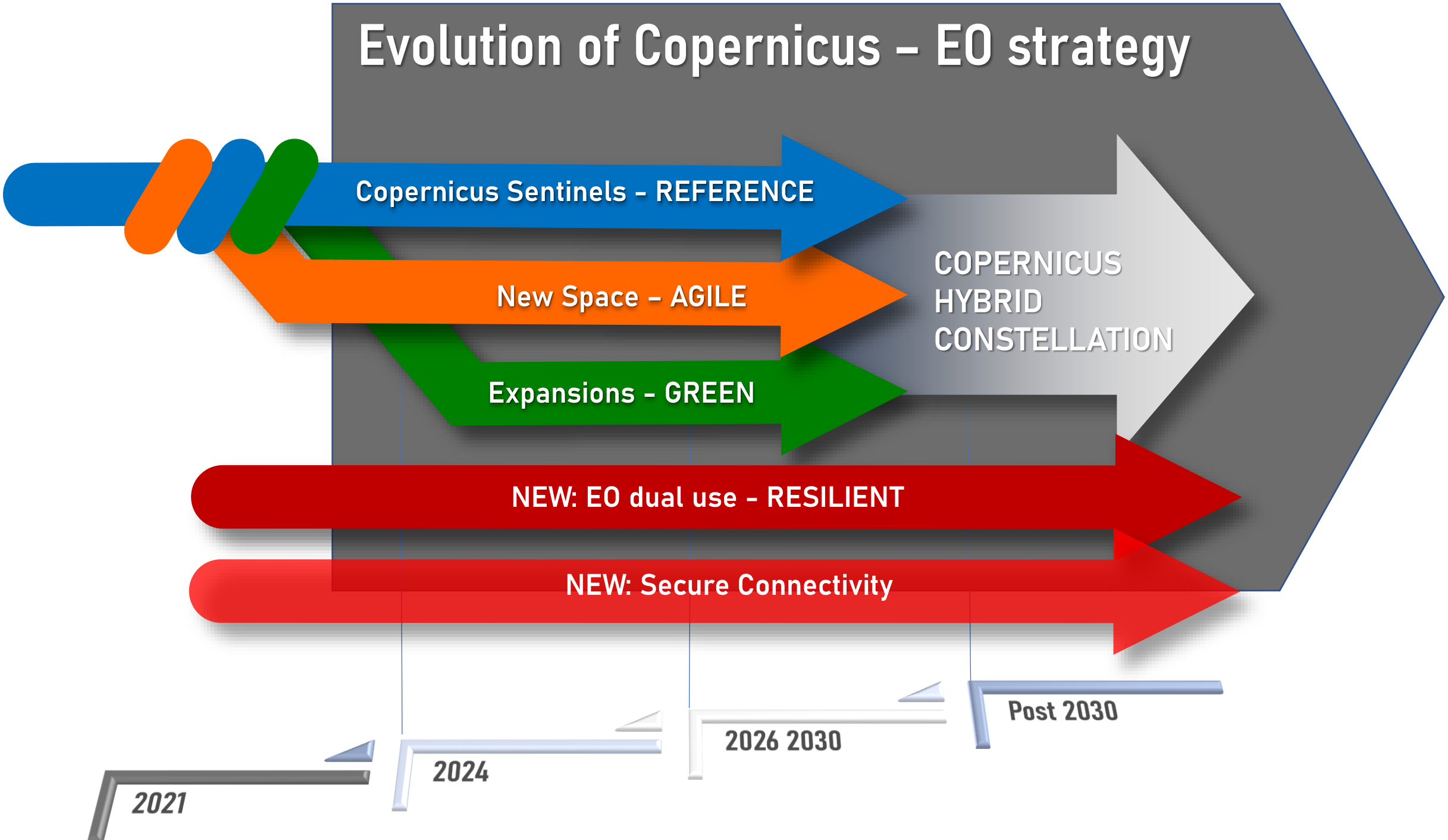
Emiliana Valentini ; Margherita Righini ; Serena Sapio ; Sara Liburdi ; Valentina Cima ; Son V. Nghiem All Authors



Valentini E., Nghiem S. V., Mai Thy P. T., Sapio S., Bresciani M., Giardino C., Boschetti M., Nutini F., Pellegrino A., Le Trung C. & Taramelli A. Mapping of Land Use/Land Cover pattern with optical and radar satellite data in Cần Giờ Mangrove Biosphere Reserve, South Vietnam. to "Satellite Remote Sensing for effective Natural Resource management" Journal of Selected Topics in Applied Earth Observations and Remote Sensing, JSTARS-2024(02205) – Under review



Valentini E., Sapio S., Nghiem V. S., Kim S. H., Taramelli A. (2025). Interannual changes in evapotranspiration pattern in Mekong delta as consequence of natural and anthropogenic Land use/Land Cover changes. Enviromental Research Letters.


Evolution of Copernicus – EO strategy
Copernicus Sentinels - REFERENCE
New Space – AGILE
Expansions - GREEN
COPERNICUS
HYBRID
CONSTELLATION
NEW: EO dual use - RESILIENT
NEW: Secure Connectivity
2021
2024
2026 2030
Post 2030

Increased probability of major cross-sectoral crises, shocks and disruptions occurring simultaneously

- Instability and conflict
- Hybrid campaigns
- Fragmenting global order
- Weaponisation
- Economic security

Geopolitics

- Extreme weather events
- Displacement and migratory issues
- Natural resources
- Energy transition

Climate

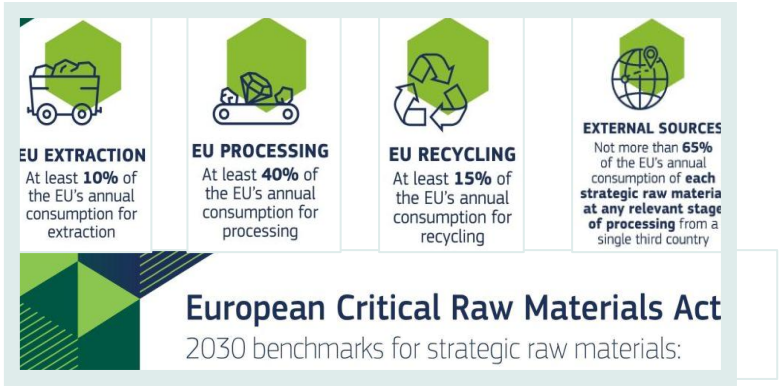
- Opportunity and challenge
- Strategic competition
- Digitalisation
- Dual-use
- Supply chain dependencies
- Technological sovereignty

Technology

Evolution of EU legal and policy framework

Dual use evolution

- Space strategy for security and defence (2023)
- Space Act Proposal (2025)
- Competitiveness Compass and European Competitiveness Fund (2025)



Civil security and resilience

- Use of satellite data, in particular from Earth Observation constellations, for civil protection and crisis management - Council conclusions (23 May 2025), RAW MATERIAL ACT, Copernicus polar roadmap for service evolution

DUAL USE

Security and defence

- The Space Strategy for security and defence proposes the evolution of the EU space programme to maximize the use of space for security and defense purposes for dual-use services.

The legal and investment framework capacity to bolster European competitiveness in dual use technologies and strategic sectors critical to the EU competitiveness

EU Space Strategy for security and defence (2023) - Minacce nel dominio spaziale

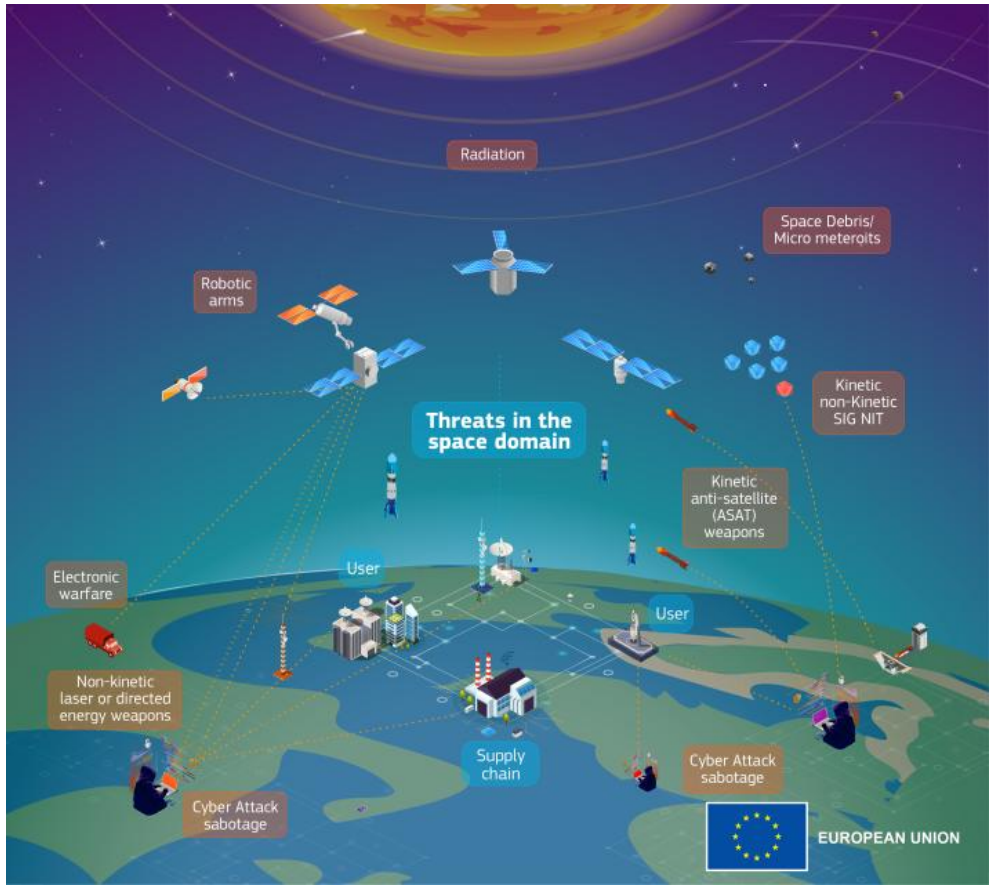
Space threats: intentionally hostile activities through counterspace capabilities.

Counterspace: directed to space assets in orbit, their supporting ground infrastructure, and the data links between them.

Effects of counterspace: intentionally disrupt, degrade, destroy, deceive, or deny the use of space systems.

Impacts: reversible or irreversible.

Space infrastructures are particularly vulnerable to cyberattacks.



EU Space Strategy for security and defence (2023) – Autonomia Strategica

Autonomia Strategica

Resilienza e la protezione dei sistemi e dei servizi spaziali dell'UE

Sovranità tecnologica del settore spaziale dell'UE

Sviluppo di capacità, compreso l'accesso autonomo dell'UE allo spazio, per aumentare la resilienza

Sistemi e servizi spaziali dell'UE a sostegno della sicurezza e della difesa:

1. Posizionamento, navigazione e misurazione del tempo (PNT),
2. Osservazione della Terra,
3. Comunicazione sicura,
4. Space Situational Awareness,
5. Innovazione e competitività,
6. Competenze ed istruzione

EO Services Evolution: Strategic Research & Innovation Agenda

Short-term R&D requirements for CSS (SRA-CSS V1.0 Aug. 2023):

- **Action A**: **Advancing Data Integration and AI-driven Processing**
- **Action B**: **Expanding Service Outreach and Regional User Support**

Medium to long-term priorities (2026+):

- Integration of New Space Sensors and Heterogeneous Data Sources (EO and Non-EO)
- Boosting Data Processing Capabilities (Data Fusion, Automation, Proactive Tasking, AI)
- Strategic Autonomy, Innovation, and System Security, Including Emerging Security Threats
- Improved Service Access and Service Delivery

Long-term priorities:

- Strategic autonomy,
- Integration of emerging sensing technologies,
- AI-driven data fusion,
- Resilience of CSS against evolving security threats.

The Copernicus Security Service Strategic Research Agenda sets the objectives for the EO evolution. By identifying priority research areas and technological developments, it bridges capability gaps and recommends the testing, validation and integration of innovative technology for enhanced operational responsiveness and EU resilience.

References: Copernicus Security Service Strategic Research Agenda (2025) - draft v1.0

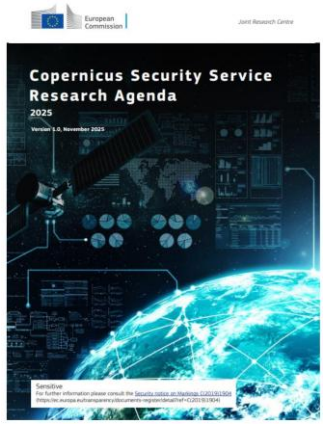
Safer Together Strengthening Europe's Civilian and Military Preparedness and Readiness Report (2024)

Boost and better coordinate situational awareness, anticipation, and foresight

Set up an EU Earth-Observation governmental (EOGS) service for enhanced situational awareness

Tool for situational awareness in support of the preparedness, decision-making and action

Earth Observation Services Evolution: From EU to National level



Copernicus Europe's eyes on Earth

Atmosphere | Marine | Land | Climate Change | Security | Emergency

iride

GOVERNO ITALIANO | ASI | ESA

EUROPEAN LEVEL

Copernicus

References

Copernicus Security Services, Strategic Research Agenda CSS-SRA, 2023-2025

ERS

References

ESA European Resilience from Space – Earth Observation (ERS-EO) Programme Proposal

EOGS

References

EOGS High-Level Needs Document 2025

Industrial Studies – Telespazio and OHB

NATIONAL LEVEL

Hybrid Constellations (IRIDE)

References

- Piano Nazionale per lo sviluppo di capacità di Osservazione della Terra (PNOT)
- Annex II – Buyers Group Needs Analysis: identification of thematic reference services (produced by UFN)

Emergency & Security services: Emergency

SERVICES

PRODUCTS

ENTRUSTED ENTITIES

Copernicus Europe's eyes on Earth

Emergency Management

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

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

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

Joint Research Centre JRC

PROVIDER SERVIZIO COPERNICUS EMERGENCY MANAGEMENT SERVICE

S7 Emergency services

MAIN GEOSPATIAL PRODUCTS OF THE SERVICE VALUE CHAINS

Rapid Delineation Maps

Detailed Grading Damage Maps

NATIONAL INSTITUTIONS AND USERS

PROTEZIONE CIVILE

Emergency & Security services: Security

SERVICES

Copernicus Europe's eyes on Earth

Security

PRODUCTS

- Coastal monitoring
- Pre-frontier monitoring
- Reference mapping

- Maritime surveillance of an area of interest
- Vessel detection
- Vessel tracking and reporting
- Vessel anomaly detection

- Road network status assessment
- Conflict damage assessment
- Critical infrastructure analysis
- Reference map
- Support to evacuation plans
- Crisis situation map
- Border map
- Camp analysis

ENTRUSTED ENTITIES

FRONTEX EUROPEAN BORDER AND COAST GUARD AGENCY

EMSA European Maritime Safety Agency

SatCen

PROVIDER SERVIZIO COPERNICUS SECURITY SERVICE

S8 Security services

SERVICE VALUE CHAINS

HR and VHR monitoring maps

Monitoring maps of human settlements

Maritime Surveillance maps for oil spill detection

Maritime surveillance: vessels tracking and S&R Support Services

Risk Analysis on critical areas

Cross Border and pre-frontier surveillance service

Environmental Intelligence Services

INATIONAL INSTITUTIONS AND USERS

MINISTERO DELLA DIFESA

MINISTERO DELL'INTERNO

CAPITANERIE DI PORTO 1865 GUARDIA COSTIERA

MINISTERO DELL'AMBIENTE E DELLA SICUREZZA ENERGETICA

PROTEZIONE CIVILE Presidenza del Consiglio dei Ministri Dipartimento della Protezione Civile

ISPRA Istituto Superiore per la Protezione e la Ricerca Ambientale

Sistema Nazionale per la Protezione dell'Ambiente

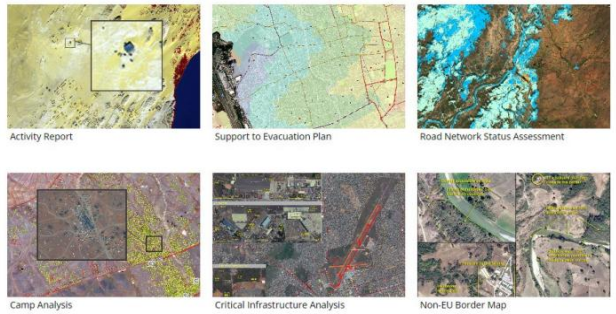
Method – Gap Analysis between demand and offer for the definition of Use cases

From the user needs and requirements analysis to the state-of-the-art of existing products: Definition of use cases for security, defence, and civil protection

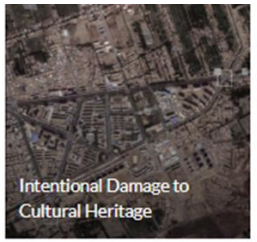
To what extent are the EOGS use cases aligned with needs? Innovative compared to the existing products and services?

User needs and requirements

Geospatial products



Use cases



IUSS

Method – National Copernicus User Forum for User Requirements Analysis


water
MDPI
Article
User Needs Analysis for the Definition of Operational Coastal Services
Serena Geraldini [1,*], Antonello Bruschi [1], Giorgio Bellotti [2] and Andrea Taramelli [1,3]


sustainability
MDPI
Article
Copernicus in Support of Monitoring, Protection, and Management of Cultural and Natural Heritage
Alessandra Bonazza [1], Nico Bonora [2,*], Benjamin Duke [3], Daniele Spizzichino [3], Antonella Pasqua Recchia [4] and Andrea Taramelli [2,3,4,5]


Journal of Environmental Management
Volume 296, 15 October 2021, 113121
Monitoring environmental and climate goals for European agriculture: User perspectives on the optimization of the Copernicus evolution offer


sustainability
MDPI
Article
Supply and Demand Analysis for Designing Sustainable National Earth Observation-Based Services for Coastal Area Monitoring
Antonello Bruschi [1], Serena Geraldini [1], Manuela D'Amen [1,*], Nico Bonora [2] and Andrea Taramelli [1,3]


CEAS Space Journal (2025) 17:431–451
https://doi.org/10.1007/s12567-024-00573-9
ORIGINAL PAPER
A model-based approach for the preliminary design of the SAR upstream element for the Italian IRIDE EO constellation based on users' demand
Federica Conti [1] · Marco Eugeni [1] · Marco Bove [1] · Paolo Marzioli [1] · Leonardo Marini [1] · Michele Pasquali [1] · Emma Schiavon [2] · Alessandra Nguyen Xuan [2] · Antonella Tornato [2] · Serena Geraldini [2] · Fabrizio Piergentili [3] · Andrea Taramelli [2] · Paolo Gaudenzi [3]


JGR Biogeosciences
RESEARCH ARTICLE
Maximizing Societal Benefit Across Multiple Hyperspectral Earth Observation Missions: A User Needs Approach
Emma Schiavon [1], Andrea Taramelli [1,2], Antonella Tornato [1], Christine M. Lee [1], Jeffrey C. Laval [1], Stephanie Schollaert Uz [1], Philip A. Townsend [1], Valentina Cinu [1], Serena Geraldini [2], Alessandra Nguyen Xuan [2], Emiliana Valentini [2], and Charles E. Miller [1]

Method

PHASE 1
USER REQUIREMENTS COLLECTION

- **S7/S8 National user needs** identification
- **CSS-SRA user needs**
- **EOGS high-level user needs**
- **Interaction matrix** definition

PHASE 2
USER REQUIREMENTS ANALYSIS AND CLUSTERIZATION

- User requirements analysis
- Informations need clusterization
- Parameters ranking (e.g., required sensors)

PHASE 3
GAP ANALYSIS AND OPERATIONAL SERVICES DEFINITION

- **Match** between S7/S8, CSS-SRA, EOGS user needs and available Copernicus/National (IRIDE) **products**
- **Confrontation with EOGS EU Commission and industrial studies**
- Future operational services individuation

PHASE 4
GAP FILLING AND TECHNICAL REQUIREMENTS IDENTIFICATION

- **Data integration** for the development of a non-existing services for EOGS


Piano Nazionale per lo sviluppo di capacità di Osservazione della Terra
A cura del: GRUPPO DI LAVORO OSSERVAZIONE DELLA TERRA (GdL OT)
Roma, Dicembre 2020


Copernicus Security Service Research Agenda
2025

EMSA
European Maritime Safety Agency

FRONTEX
EUROPEAN BORDER AND COAST GUARD AGENCY

SatCen
European Union Satellite Centre

Copernicus
Europe's eyes on Earth
Atmosphere · Marine · Land · Climate Change · Security · Emergency


EUROPEAN UNION SPACE STRATEGY FOR SECURITY AND DEFENCE

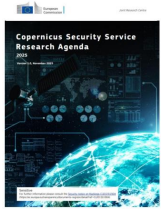
Reference Documentations

- **National Plan for the Development of Earth Observation Capabilities (PNOT)** (Upstream, Midstream, Downstream)
- **CSS-SRA User Needs and operational requirements** expressed by Copernicus Security Services Entrusted Entities (EMSA/Frontex/SatCen)
- **EOGS High-Level Needs Document**
- **Industrial Studies**

Method – Gap Analysis of Technical User Requirements

NATIONAL NEEDS

EUROPEAN NEEDS



UPSTREAM AND PRODUCT/SERVICE ASSESSMENT

NATIONAL PRODUCTS (2026-2028)

EUROPEAN PRODUCTS

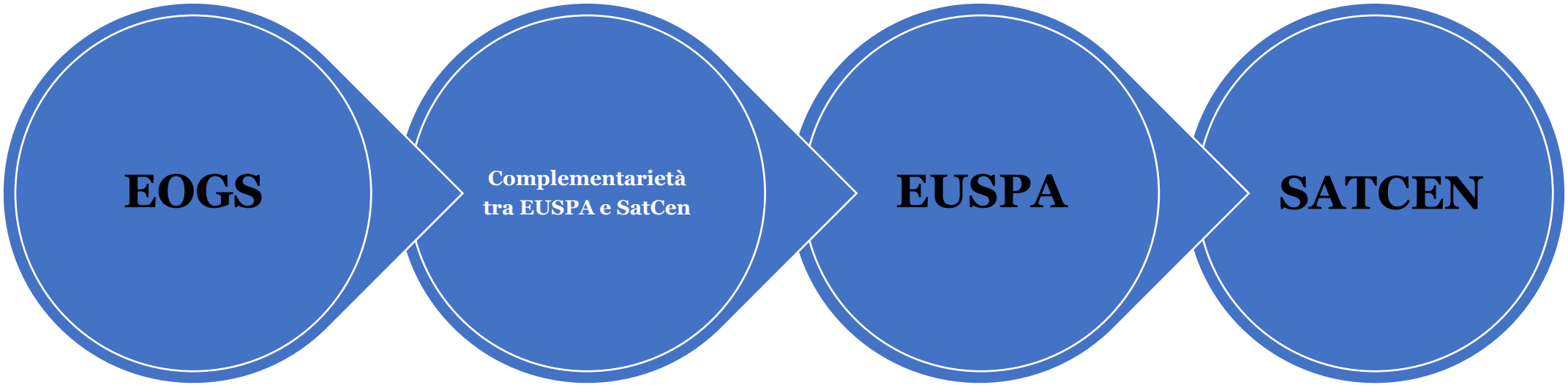
To what extent are the National/CSS-SRA/EOGS User technical requirements, satisfied by the existing Copernicus products/Contributing missions and IRIDE products?

● Requirement fully met

◑ Requirement partially met

○ Requirement not met

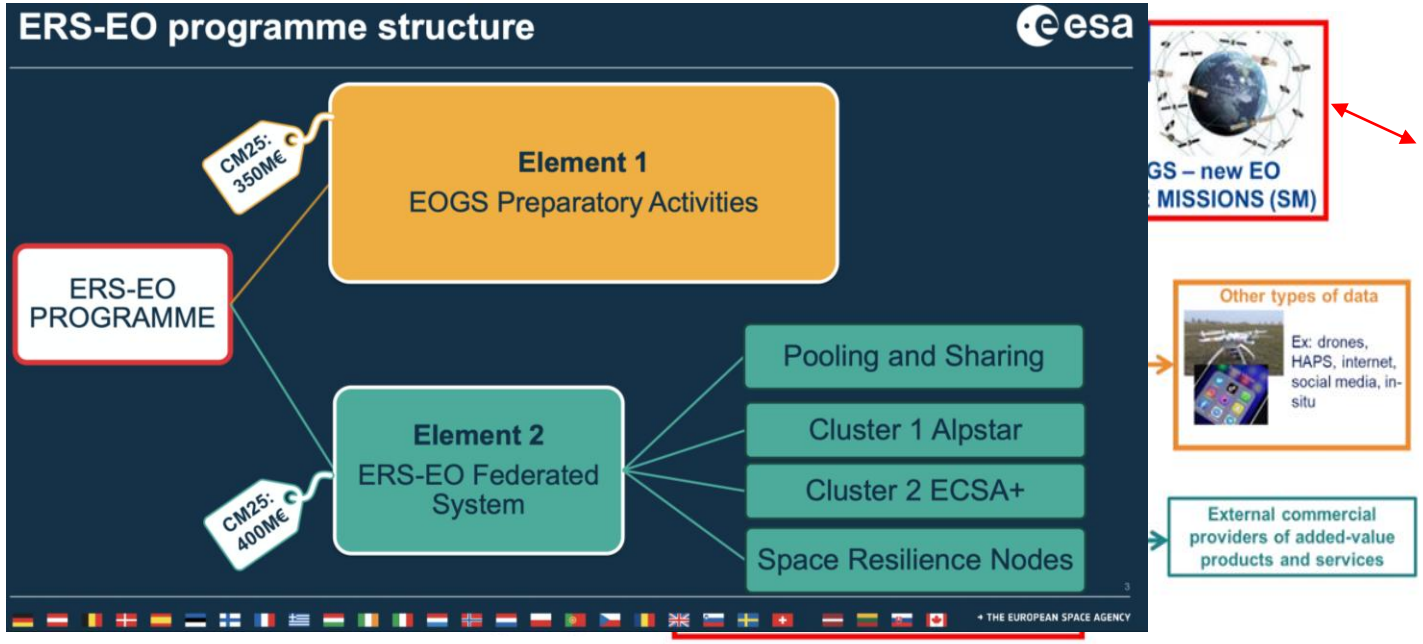
Futuro Servizio Governativo di Osservazione della Terra dell'Unione Europea (EOGS)

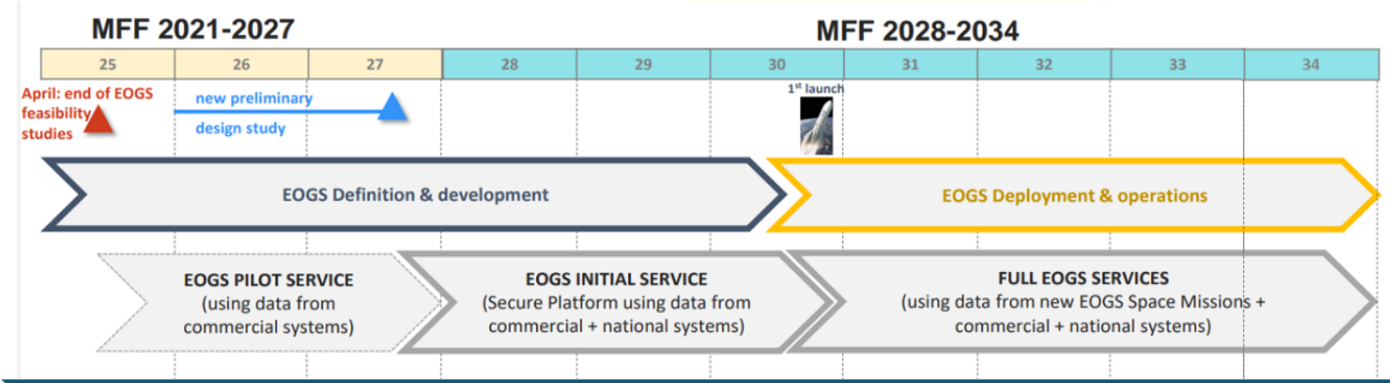


- Accreditamento di sicurezza,
- Monitoraggio della sicurezza
- Contratti.

- Identificazione dei requisiti degli utenti nell'ambito dell'intelligence geospaziale
- Sviluppo di prodotti e servizi sensibili

EU level: Earth Observation Governmental Service (EOGS) and potential Use cases (SatCen)





EOGS POTENTIAL USE CASES

- **PILOT FUNDED BY COPERNICUS:** 2025-2027 (this MFF) : Using commercial data (possibly governmental services)

- **TWO CANDIDATE PILOT EOGS USE CASES IMPLEMENTED BY SATCEN**:

1. **Enhancing monitoring of strategic sites on territory different countries**
2. **Logistic Mobility**

ADDED VALUE:

- Exclusive access to potential new EU EO Secure Satellite Constellations without full dependance on commercial operators and providers.
- EO capabilities: persistent monitoring, high revisit, high reactivity, near-real time acquisitions, and satellite tasking anywhere on Earth.
- Secure access to raw data.
- Satellite resolution enhancement (temporal, spectral, etc.).

Conclusions: The new institutional resilience service for Civil Defence and Civil Security

Legal and economic framework

LAW

- EU Space Law – in elaboration
- National space laws and regulations

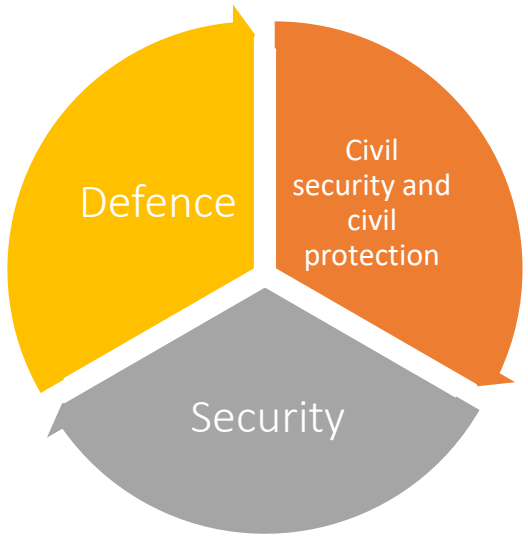
EU POLICIES

- European Competitiveness Fund (ECF'), including the specific programme for defence research and innovation activities, repealing Regulations (EU) 2021/522, (EU) 2021/694, (EU) 2021/697, (EU) 2021/783, repealing provisions of Regulations (EU) 2021/696, (EU) 2023/588, and amending Regulation (EU) [EDIP]. COM/2025/555 final.

FINANCEMENT

- MFF 2028-2034
- Public-Private Partnerships framework?

Operative services for Societal Resilience



Added-value

Provide **complementary and enhanced** situational awareness **capabilities** to EU Member States for resilience applications

Compared to current Copernicus services, it is crucial avoiding duplications compared to exisitng services, for instance thanks to:

- enlarged service scope
- improved security
- additional functionalities (e.g. secure platform, data fusion, artificial intelligence)

Not only data, but information.

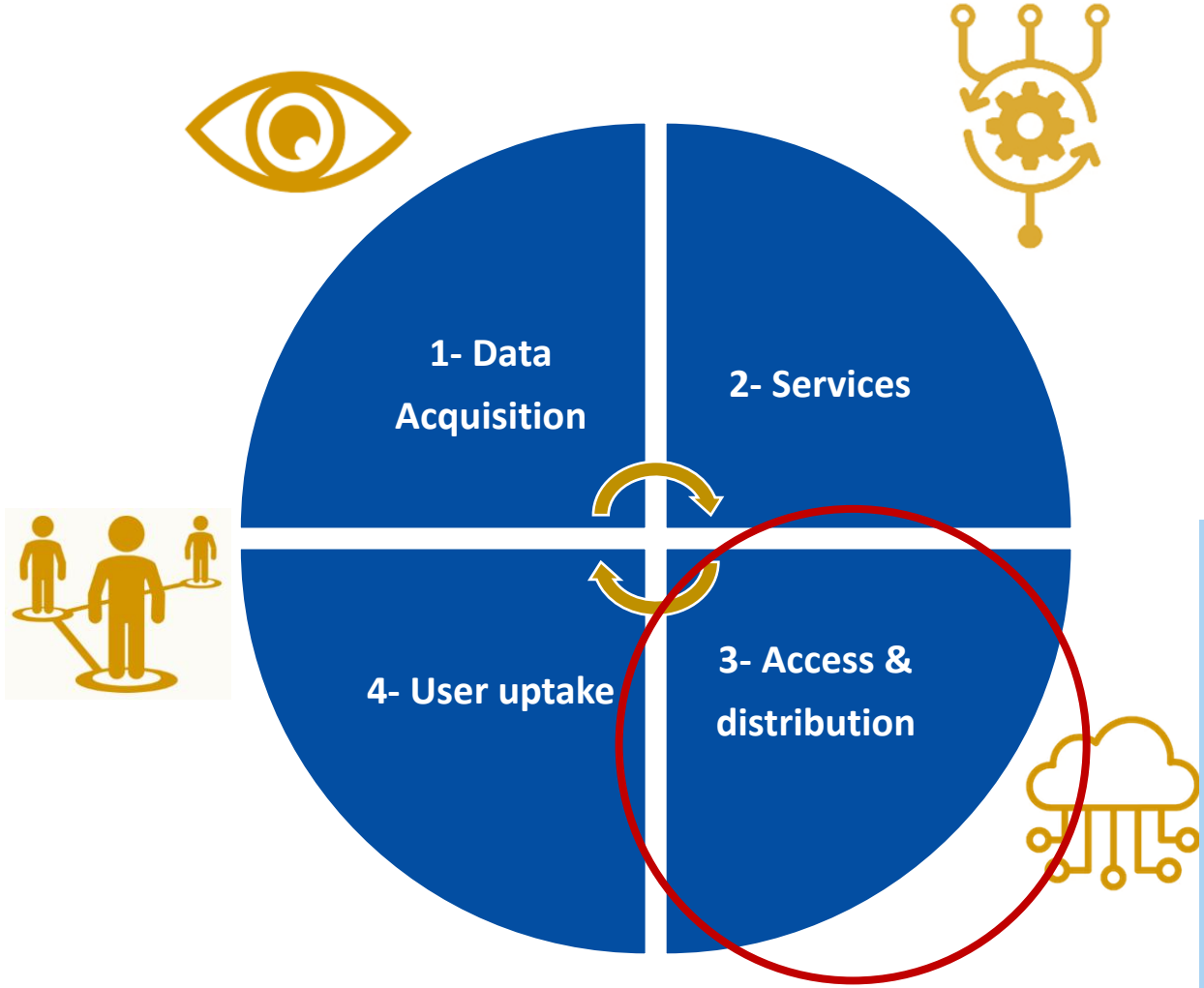
Boost situational awareness, anticipation, definition and foresight of destabilizing events

Set up operational EU service for enhanced situational awareness to monitor potential destabilizing threats

Support preparedness, decision-making and action

Empower and better coordinate EU structural collaboration and governance

Four dimensions of Copernicus

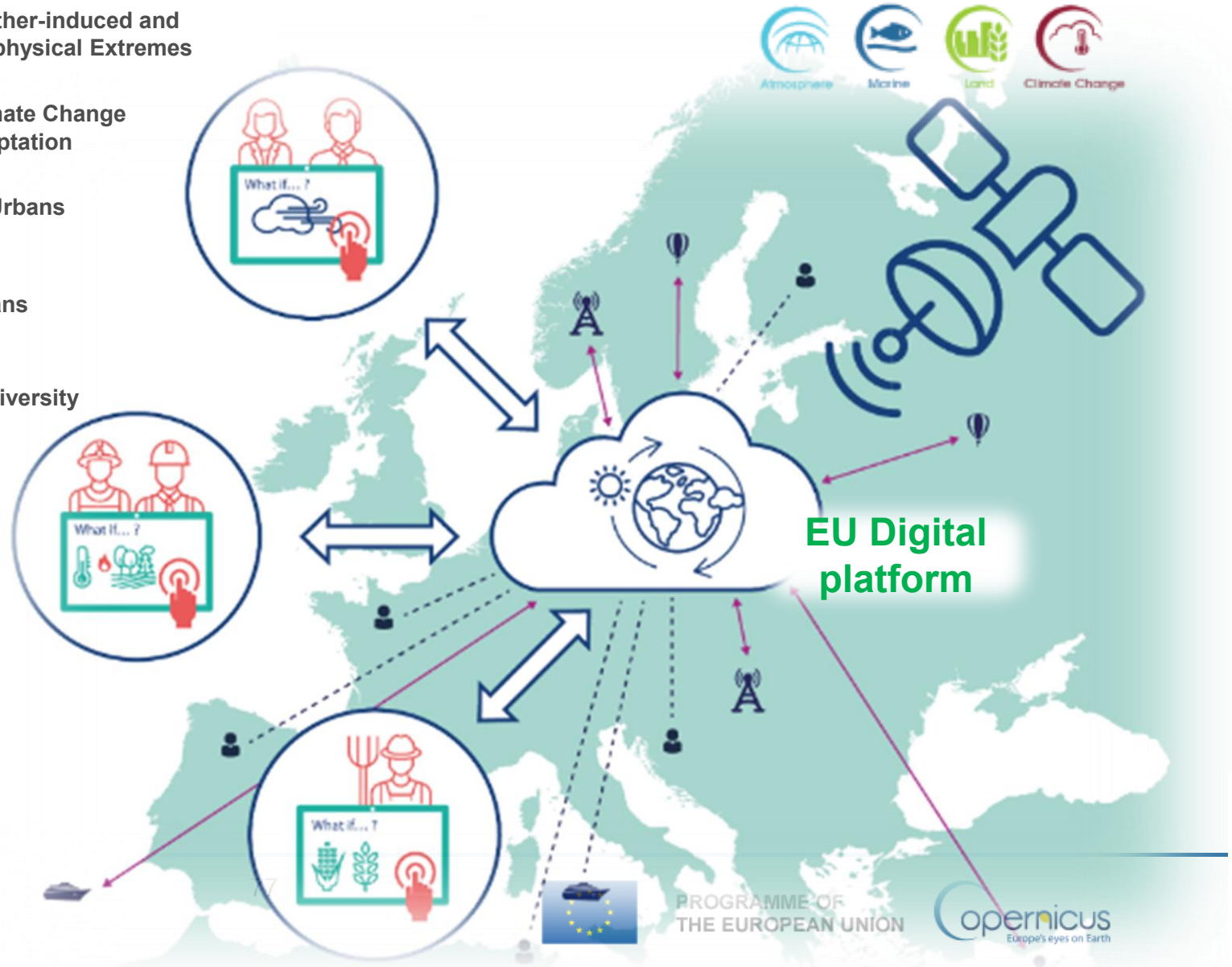


Boosting EU infrastructures

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

Copernicus digital DestinationEarth

- Weather-induced and Geophysical Extremes
- Climate Change Adaptation
- AI Urbans
- Oceans
- Biodiversity



AN INVESTMENT IN A FUTURE READY EUROPE

Competitive edge

Next generation of satellites
New space
Co-designed services
AI, cloud, HPC

Research innovation

Operational services
Rooted in science
benefiting from Horizon Europe

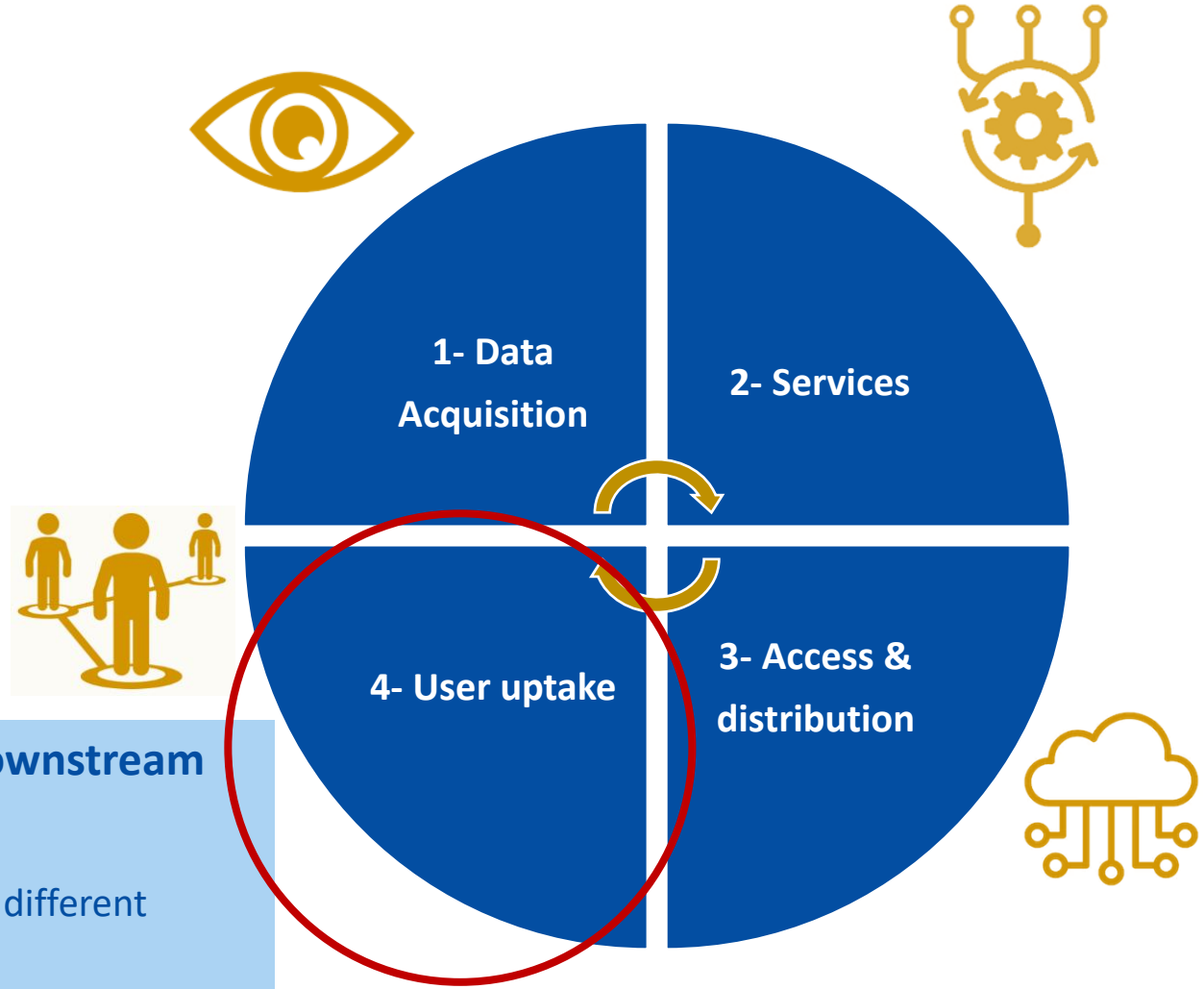
Fighting Climate Change

Monitoring environment routinely
Anticipating Extreme events
Support adaptation and resilience

EU as a global actor

Supporting disaster relief, global reach in climate adaptation, fostering green policies

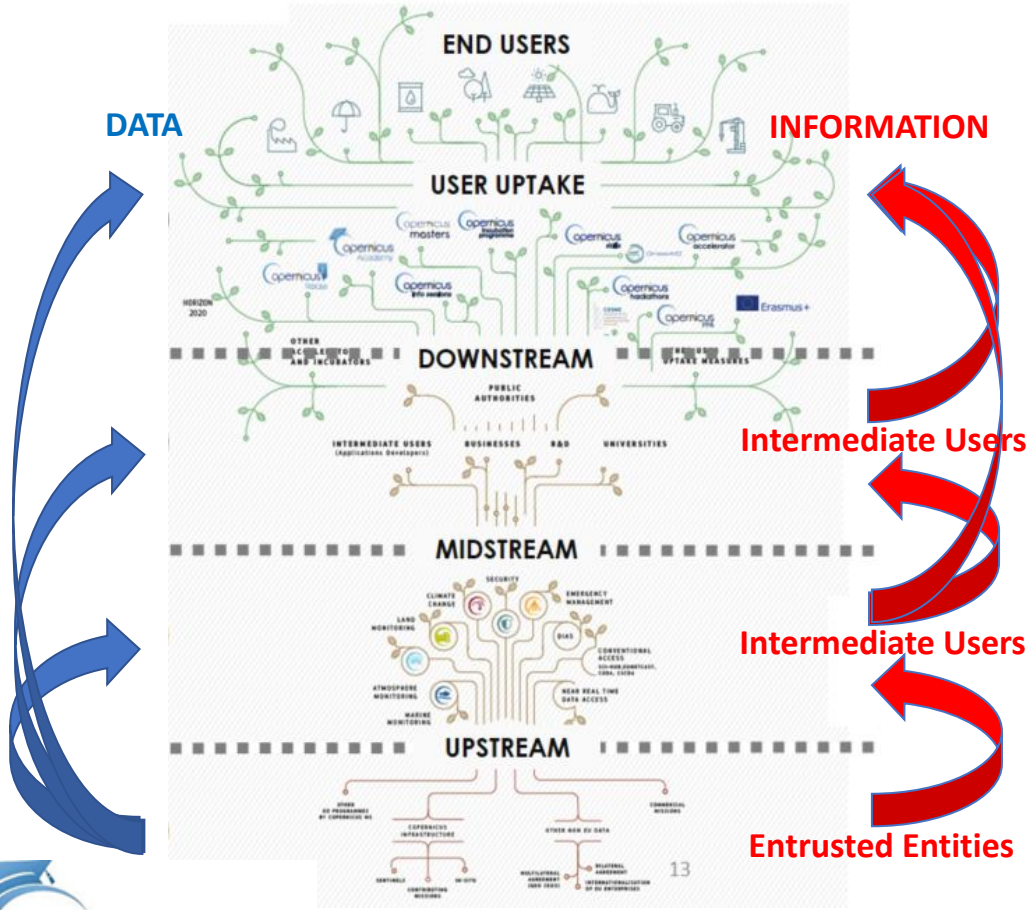
Four dimensions of Copernicus



Re-energise Copernicus downstream

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

COPERNICUS STRUCTURE AND ITS 4° COMPONENT: the User Uptake



It is the **structure of an Earth Observation Program** like Copernicus organized in the sequence of its different Components, that shows how inescapable and fundamental it is to reach and engage “end users” thought the **User Uptake** final Program Component

In **2001** Gèrard Brachet, referring to the GMES Initiative, wrote that "... *GMES is first and foremost an attempt to define a European strategy. It is not a space project, nor even a monitoring programme, but will eventually incorporate an implementation plan* ***which will … entail significant efforts to inform the user communities and to convince them of the relevance and usefulness of this initiative****. ..."*

However, only in **2014**, for the first time, the **activities aimed at raising awareness, training and dissemination are explicitly dictated and funded** and precisely through Art.5.3 of Regulation (EU) No. 377/2014, which establises the Copernicus Program in continuity with the GMES Program .

ECMWF
MERCATOR OCEAN INTERNATIONAL
ECMWF
European Environment Agency
JRC EUROPEAN COMMISSION
EMSA
JRC EUROPEAN COMMISSION

opernicus Europe's eyes on Earth

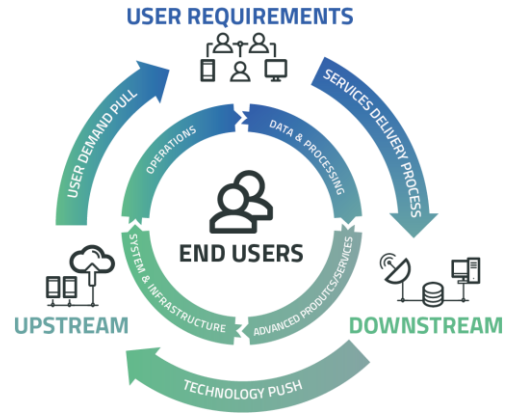
Copernicus is the European Union's Earth Observation and monitoring programme launched in 2014 to establish an operational European capacity to deliver Earth Observation data and related value-added services to benefit all European citizens.

Copernicus "user-driven" approach: its development is based on the expressed requirements of the user communities that benefit from the specific data and products

It requires the continuous involvement of users, such as Union institutions and bodies; European, national, regional or local authorities; the scientific community; the private sector, policy makers, private stakeholders and citizens

Fostering the uptake of Copernicus data and services by various user communities

- User-friendly data access
- Technical user support
- Capacity building and educational activities
- Raising awareness through communication and outreach activities



A gap between Copernicus and end-users has been evidenced

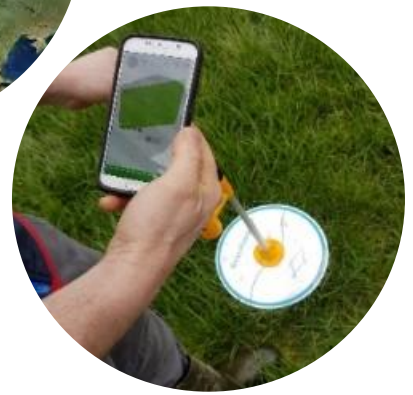
(EU Court of Auditors 2021 and EC 2024)

European Court of Auditors. (2021). Special Report EU space programmes Galileo and Copernicus.
European Commission. (2024). COMMISSION STAFF WORKING DOCUMENT EU - Space Programme User Uptake Status.

NCP Climate Change Service
NATIONAL COLLABORATION PROGRAMME ITALIAN INITIATIVE
NCP Atmosphere Monitoring Service
NATIONAL COLLABORATION PROGRAMME ITALIAN INITIATIVE

Block 4 – Fostering uptake

Re-energise the downstream segment of Copernicus



- **Turn Green Deal and Digital Agenda into business development opportunities**
- **Foster the competitiveness and innovation potential**
- **Establish global leadership in space-based monitoring and decision support products**

HOW

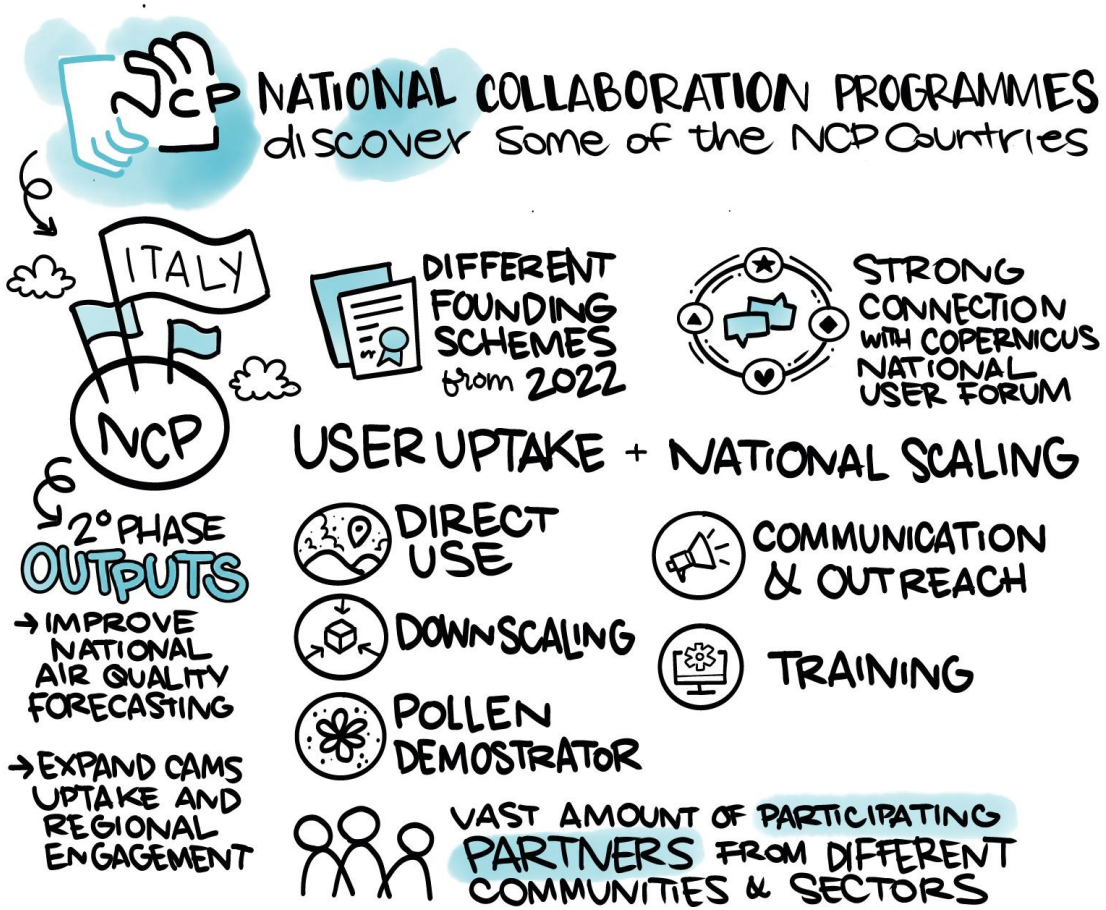
- **EUSPA** supporting and scaling EU public and private sector solutions
  - Global market for EU-developed space-based information products
  - Skilling and capacity building (Copernicus academies, eLearning, structural funds)
- **Copernicus Knowledge Centre on EO** to identify the needs of users
- Research and technology development under **Horizon Europe** Pillar II, Cluster 4 “Digital, Industry and Space”
- **Cassini /EIB** to invest in startups/SMEs and scaling up

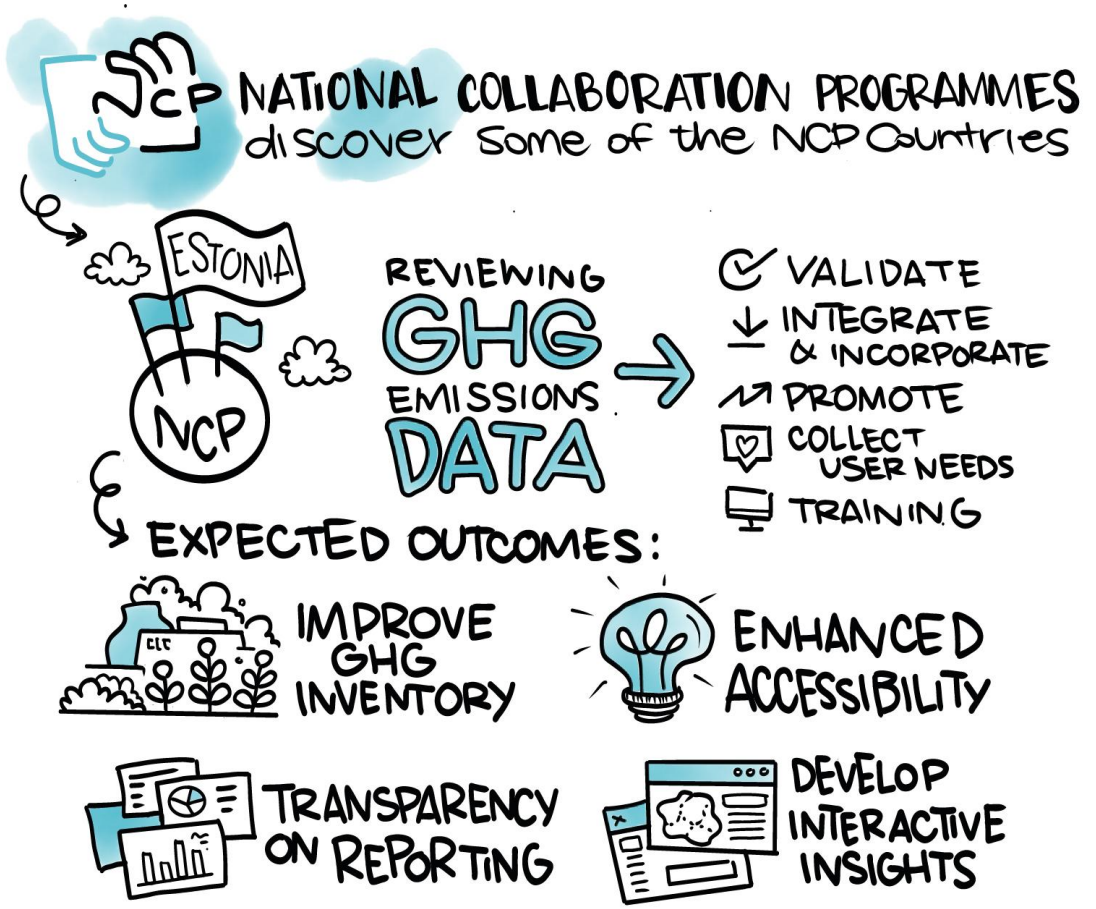
EUSPA

KCEO

Making Copernicus Impact

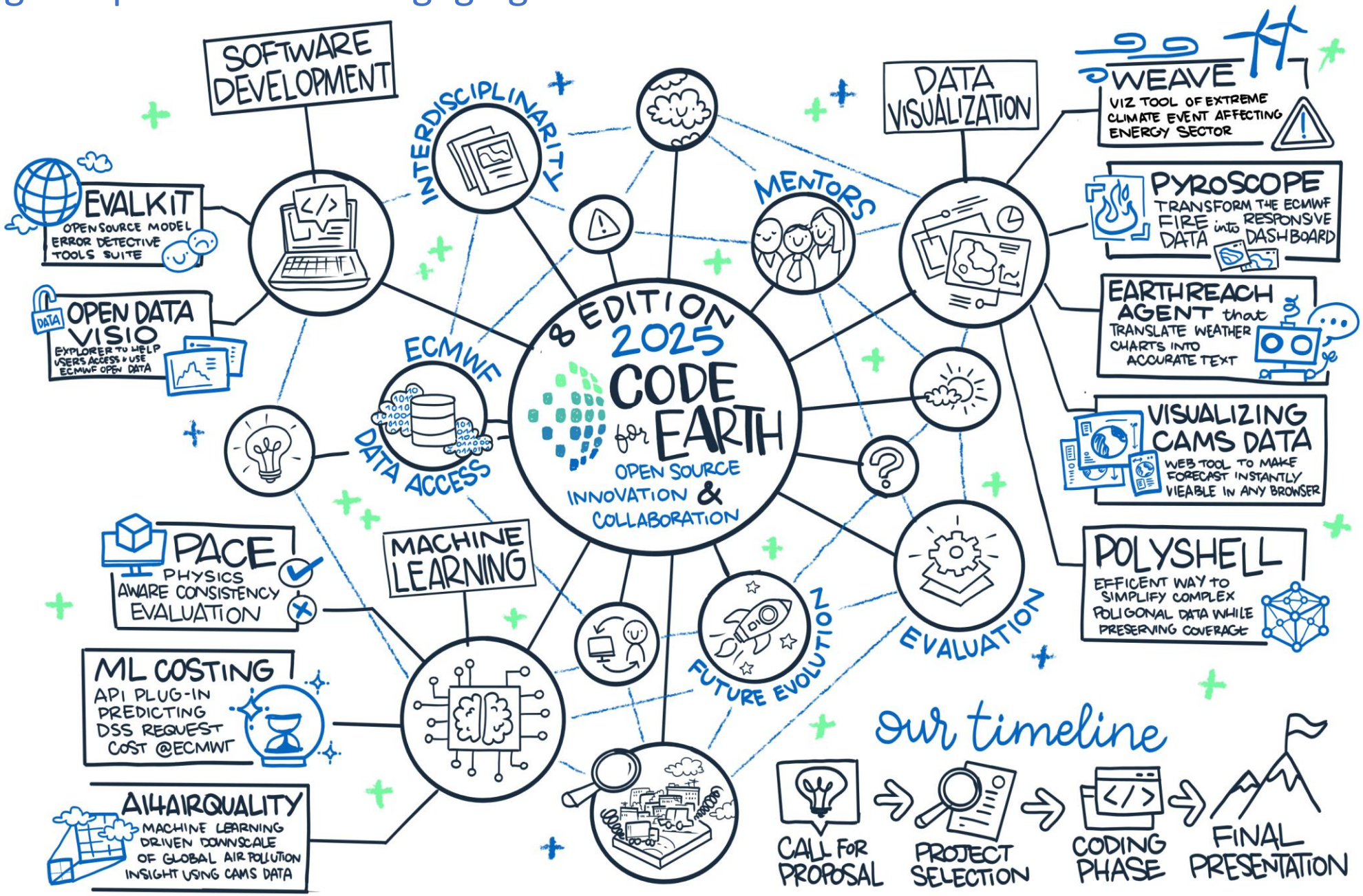
Transforming complex data into engaging stories and tools



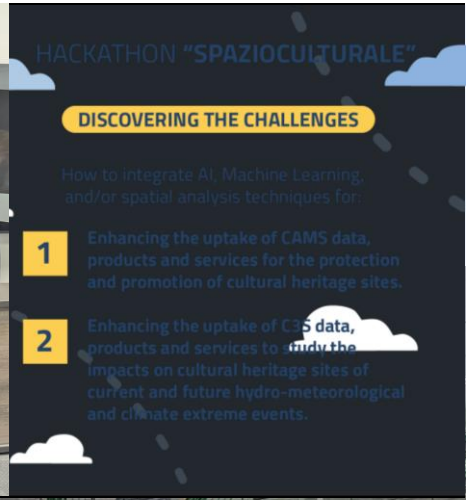


PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
Atmosphere Monitoring Service atmosphere.copernicus.eu
IMPLEMENTED BY ECMWF
NCP

Transforming complex data into engaging stories and tools



New strategies to enhance uptake amog younger generation and students



Copernicus
Europe's eyes on Earth

Italia

The National Copernicus User Forum

Prof. Andrea Taramelli

The National Delegate at Copernicus Comittee and User Forum

Copernicus
Framework Partnership Agreement for Copernicus User Uptake

Copernicus is a **user-driven programme continuous, effective involvement of users** Union institutions and bodies, European, national, regional or local authorities, research entities, the private sector, particularly regarding the definition and validation of service requirements

The Commission and its entrusted entities providing services should **engage closely with Copernicus core users' communities across Europe** in further developing the Copernicus Services and information portfolio

REGULATION (EU) 2021/696 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

The National Copernicus User Forum

the core of the User Uptake Strategies

UFN strategic role has been confirmed by actual COMINT

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 goals

- 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.

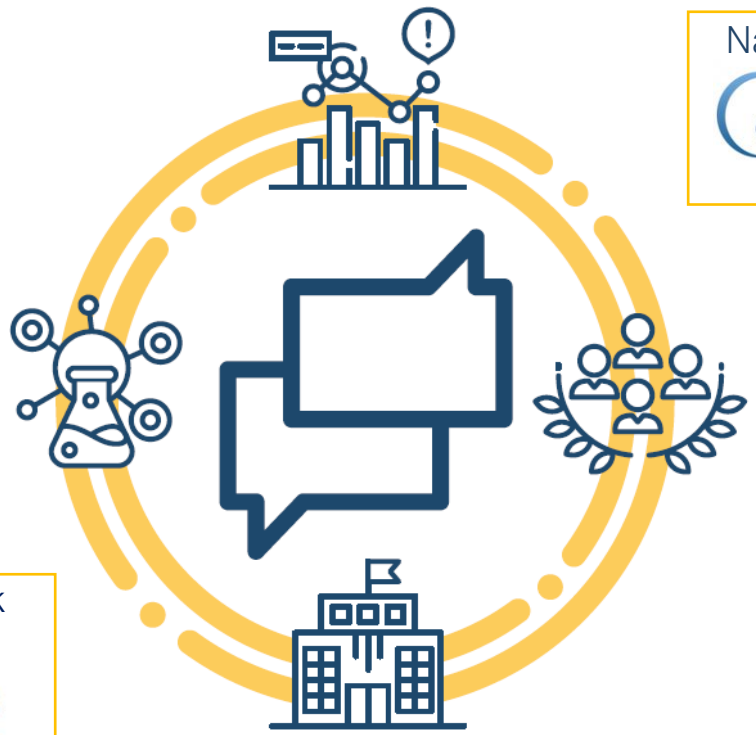
The National Copernicus User Forum

The structure

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

Commercial Representatives

National network
Copernicus Relays



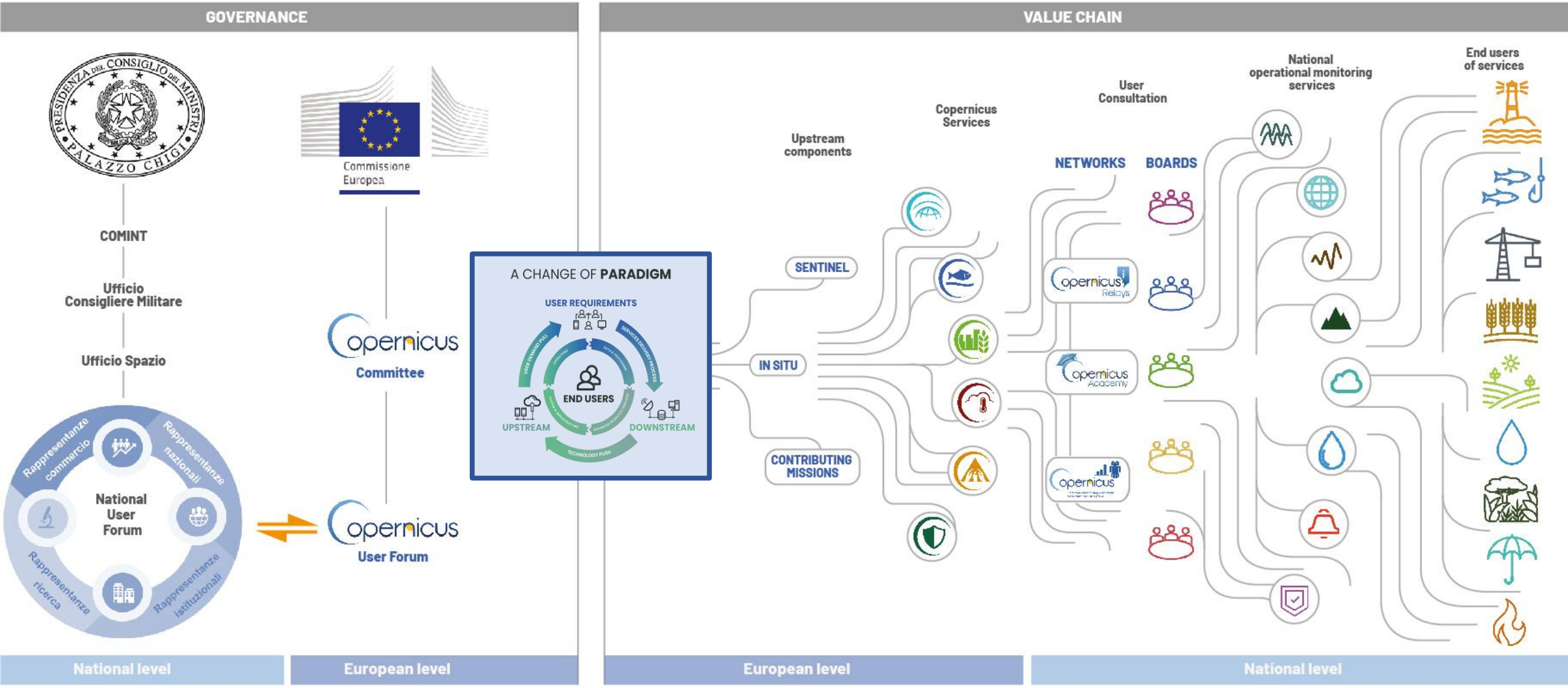
National Representatives into international boards

Research Representatives

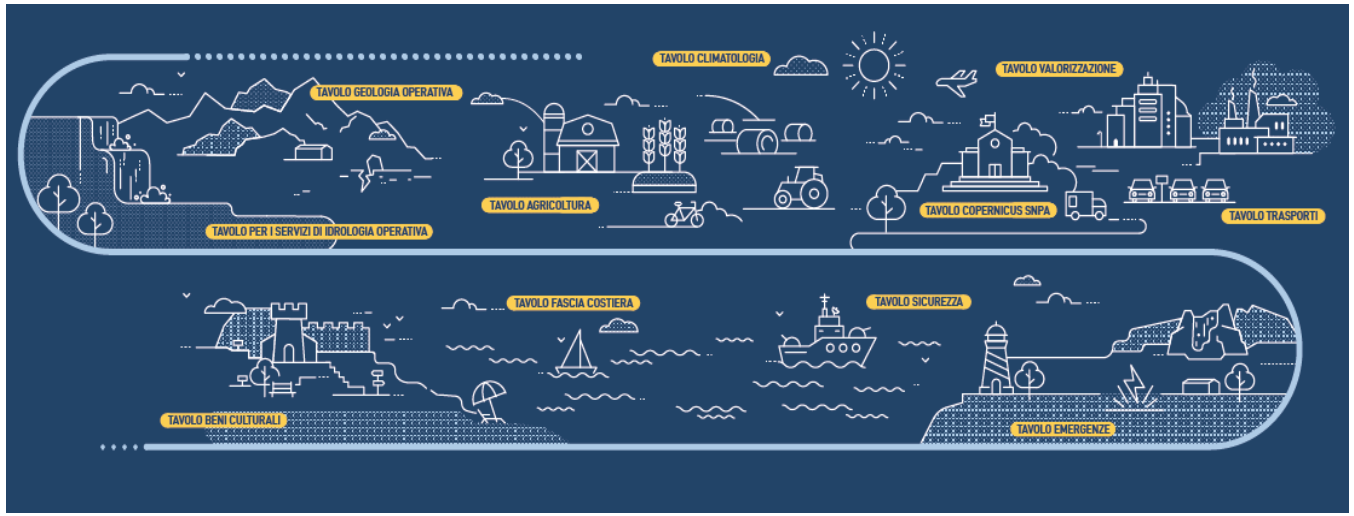
National network
Copernicus Academy

Institutional Representatives

The Space Governance and value chain



The National User Forum leverages of Thematic Users' consultation and national boards



Over 900 participants!

Consultation Boards

- Security
- Infrastructures and Transports
- Cultural Heritages
- Agriculture
- Environmental protection
- Coastal areas
- Valorization - Industry and Enterprises
- Emergency

National boards

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

Copernicus Networks

- Copernicus Academy
- Copernicus Relay

Law n. 7 of 11 January 2018 containing "Measures for the coordination of space and aerospace policy" Earth observation is defined as a national strategic sector, whose satellite services and applications must be used by citizens and enhanced by institutions to implement national policies relating to security (including food), defense, environmental protection, the national cultural and landscape heritage, the continuous monitoring of agricultural, forestry and fishing systems, infrastructures and critical structures and Civil Protection.

Users' consultation: from information needs to technical requirements

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


remote sensing
MDPI
Article
An Interaction Methodology to Collect and Assess User-Driven Requirements to Define Potential Opportunities of Future Hyperspectral Imaging Sentinel Mission
Andrea Taramelli [1,2], Antonella Tornato [1,*], Maria Lucia Magliozzi [3], Stefano Mariani [1], Emiliana Valentini [1], Massimo Zavagli [3], Mario Costantini [3], Jens Nieke [4], Jennifer Adams [5] and Michael Rast [5]


water
MDPI
Article
User Needs Analysis for the Definition of Operational Coastal Services
Serena Geraldini [1,*], Antonello Bruschi [1], Giorgio Bellotti [2] and Andrea Taramelli [1,3]


sustainability
MDPI
Article
Copernicus in Support of Monitoring, Protection, and Management of Cultural and Natural Heritage
Alessandra Bonazza [1], Nico Bonora [2,*], Benjamin Duke [3], Daniele Spizzichino [2], Antonella Pasqua Recchia [4] and Andrea Taramelli [2,3,4,5]


Journal of Environmental Management
Volume 296, 15 October 2021, 113121
ELSEVIER
Monitoring environmental and climate goals for European agriculture: User perspectives on the optimization of the Copernicus evolution offer
Emma Schiavon [a], Andrea Taramelli [a, b], Antonella Tornato [b], Fabio Pierangeli [c]


AGU ADVANCING EARTH AND SPACE SCIENCES
JGR Biogeosciences
RESEARCH ARTICLE
10.1029/2023JG007569
Maximizing Societal Benefit Across Multiple Hyperspectral Earth Observation Missions: A User Needs Approach
Special Section: The Earth in living color: spectroscopic and thermal imaging of the Earth: NASA's Decadal
Emma Schiavon[1], Andrea Taramelli[1], Antonella Tornato[2], Christine M. Lee[3], Jeffrey C. Luvall[4], Stephanie Schollaert Uz[5], Philip A. Townsend[6], Valentina Cima[1], Serena Geraldini[2], Alessandra Nguyen Xuan[2], Emiliana Valentini[7], and Charles E. Miller[3]


Home › CEAS Space Journal › Article
A model-based approach for the preliminary design of the SAR upstream element for the Italian IRIDE EO constellation based on users' demand
Original Paper | Published: 15 November 2024
(2024) Cite this article
CEAS Space Journal
Aims and scope →
Submit manuscript →
Federica Conti, Marco Eugeni, Marco Bove, Paolo Marzioli, Leonardo Marini, Michele Pasquali, Emma Schiavon, Alessandra Nguyen Xuan, Antonella Tornato, Serena Geraldini, Fabrizio Piergentili, Andrea Taramelli & Paolo Gaudenzi

Reference Documentation:

National Plan for the Development of Earth Observation Capabilities (Upstream, Midstream, Downstream)
Annex 1. Roles of National Institutions
Annex 2. Buyers Group Needs Analysis: identification of thematic reference services (produced by UFN)
Annex 3. National Operational Services: constituent elements and products (produced by UFN)

The thematic services defined by institutional users

In Italy, interaction with communities of institutional users and the subsequent analysis of needs have led to the identification of eight key thematic services at the national level, useful for specific institutional tasks in various thematic areas of competence

S1 | Coastal zone and marine-coastal monitoring

- Marine-coastal monitoring and forecasting
- Identification and prediction of the dynamics of Oil Spills events
- Geomorphological monitoring and characterization of the coastal zone
- Monitoring and characterization of coastal habitats and ecosystems

S2 | National Air Quality Service

- Air quality monitoring and forecasting
- High-resolution reanalysis of atmospheric composition
- Monitoring of air pollution episodes caused by natural phenomena and anthropogenic activities (desert dust, volcanic eruptions, fires, accidental industrial releases)

S3 | Ground movements

- Wide area ground motion monitoring in defect time (medium resolution or high resolution)
- Ground motion monitoring over specific areas of interest in near-real time, high resolution

S4 | Land cover and land use

- Monitoring of land cover and land use status/change
- Monitoring of habitats, ecosystems, and related services
- Agriculture
- Forests
- Assessment of disturbances, phenomena, and consequent damage due to anthropogenic or natural causes that alter land cover and/or land use

S5 | Hydrometeoclimate

- Hydro-meteorological monitoring and weather forecasting (nowcasting and short- and medium-term forecasts; weather forecast products)
- Agro-meteorological services
- Climate services (climate indicators, ECVs and greenhouse gases, reanalysis, seasonal
- forecasts and climate projections)
  Lightning network and model

S6 | Water resource

- Hydrological and hydraulic modeling, flood forecasting and sediment management
- Hydromorphological monitoring and riverbed dynamics
- Services for integrated water resource management
- Habitat mapping of target species and environmental status assessment of water

S7 | Emergency

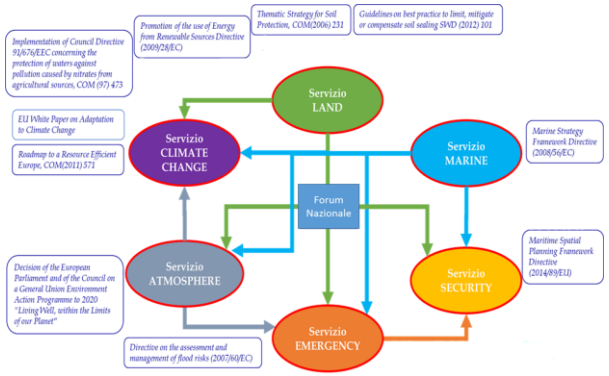
- Seismic Service
- Flood and inundation service
- Volcanic eruption service

S8 | Safety

- High- and ultra-high-resolution monitoring of areas of interest
- Population density maps
- Maritime surveillance: search and rescue services, vessel identification and tracking
- Cross-border and pre-frontier surveillance
- Risk analysis
- Environmental intelligence: accidents and crimes

Scientific & technologic innovation applied to monitoring requirements

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



European obligations

Scientific & Technologic Innovation

National Monitoring Operational Services

Market uptake and Downstream development

La Space Economy è in significativa crescita in Italia e nel mondo e il segmento dell'Osservazione Terra è tra i più rilevanti a livello europeo

Highlights su segmento Osservazione della Terra

L'**Osservazione della Terra**[2] è la principale area di investimento a livello europeo:

- ~**1,7 €/mld** di **risorse annue** allocate dall'**ESA** su tale segmento (prima voce budget su programmi opzionali/non statutari)
- **incremento** della **capacità mediante potenziamento** della parte **upstream** con nuove costellazioni

Il mercato dei **servizi di Osservazione della Terra** (downstream) in **Italia**, **nel 2023**, ha raggiunto i ~**200 Mln€**[5], con un tasso di crescita prospettico pari a 8-10%, trainato principalmente dalla domanda pubblica (~70%)

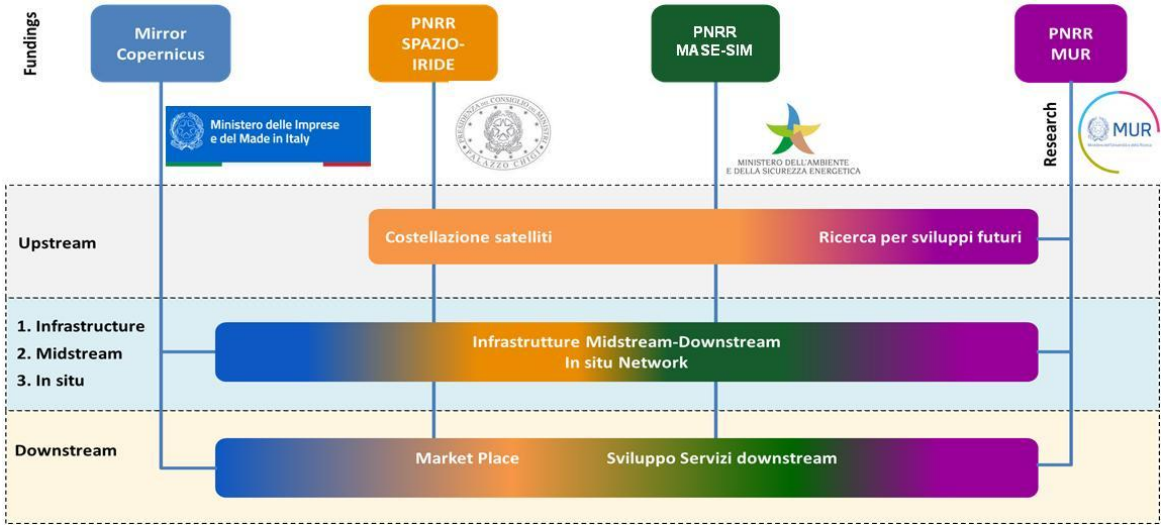
>

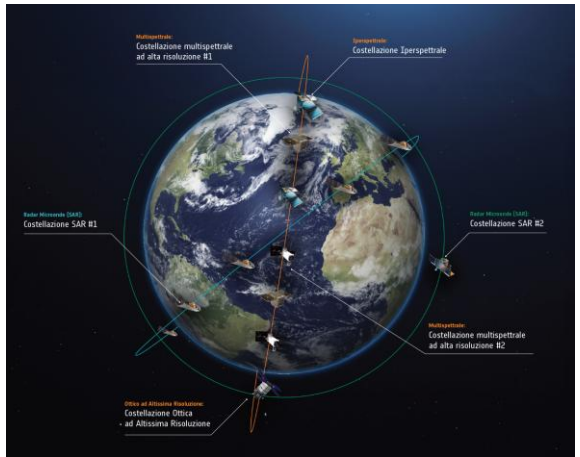
*Comprende **componente spaziale** (sviluppo e lancio in orbita di Sentinelle), **in situ** (sensori a terra per fornire info su superficie) **e servizi** (a copertura globale integrando dati spazio e in situ)*

*Completato entro 2026 (1,07 €/mld PNRR e PNC[3]), realizzerà un **sistema** end-to-end* **focalizzato su necessità utenti** ***con migliore risoluzione dato, possibilità osservazione da più prospettive*** *(SAR su orbite inclinate), sviluppo capacità industria nazionale.*

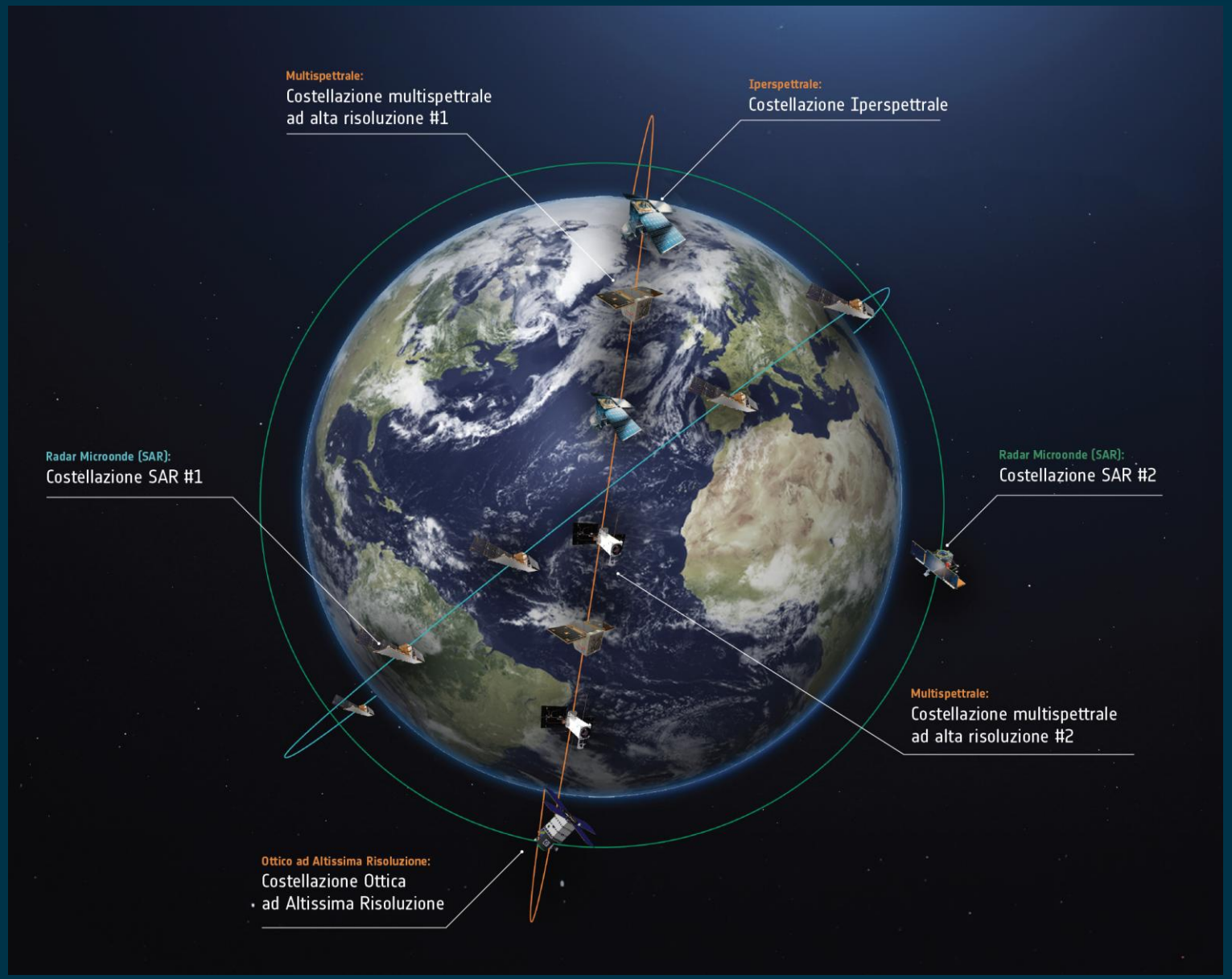
*Completato entro 2026 (1,60 €/mld PNRR e PNC[3]), realizzerà un **sistema HPC e di sviluppo di algoritmica e reti in Situ con possibilità osservazione da più prospettive.***

SIM





IRIDE: A Constellation of Constellations



Architettura del Sistema

IRIDE CONSTELLATION

SAR 1 | SAR 2 | AIS | MS1 | MS2 | HYP | VHR

AOI

ITA12

WORLD

- Complement existing systems (Copernicus)
- Satellite constraints
- Stations locations/selection
- Reduce operation / maintenance costs
- No 1-to-1 correspondence
- No hierarchy among the 8 domains
- Clear observation base for each user (op system)
- … … …

OBSERVATION STRATEGY

Systematic (coverage)

On Demand (revisit/latency)

Fascia costiera e monitoraggio marino-costiero

Qualità dell'aria

Movimenti del terreno

Copertura del suolo

Idrometeoclima

Risorsa idrica

Emergenza

Sicurezza

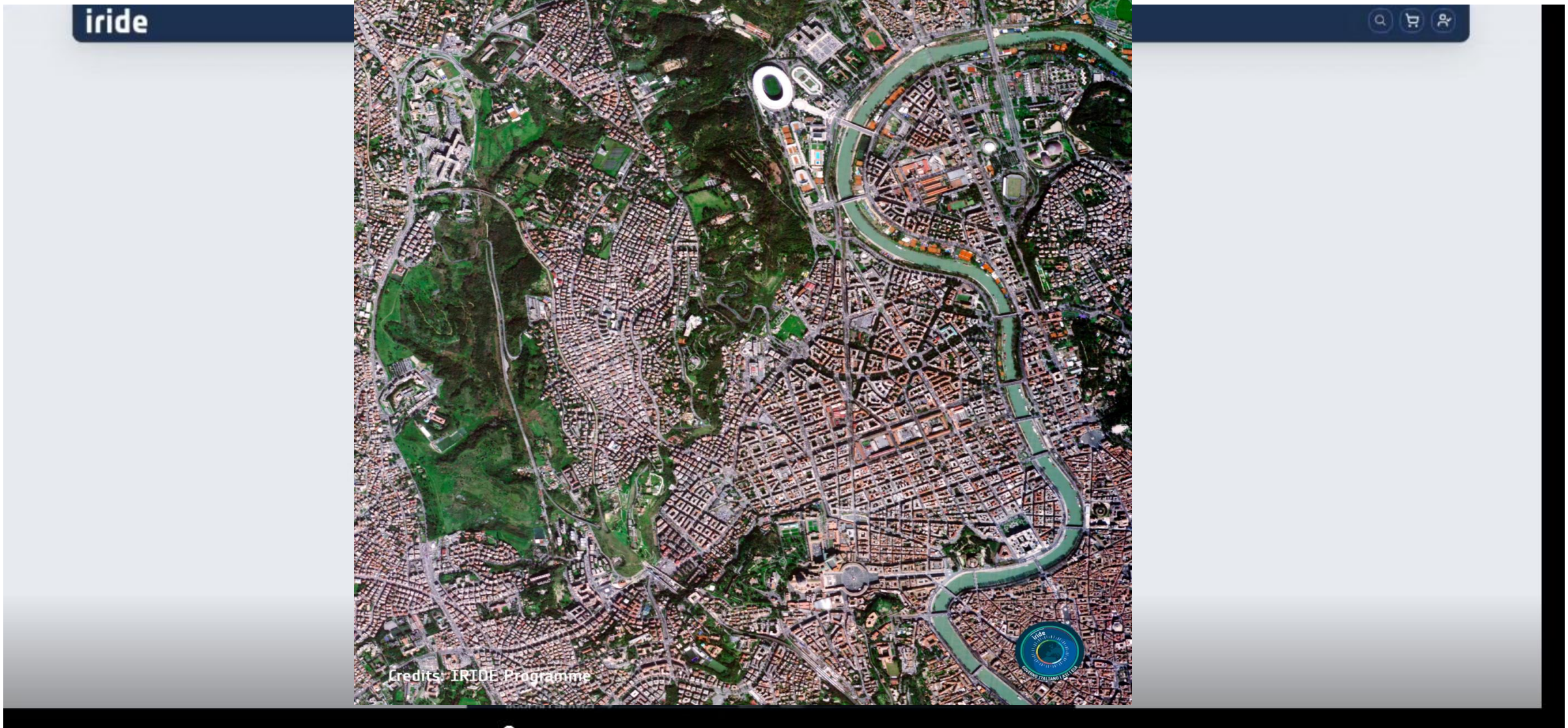
INSTITUTIONAL (8)

COMMERCIAL

USERS

La capacità di elaborazione dei dati mediante algoritmi e di creazione di servizi rappresenta l'attività a maggior valore aggiunto: il ruolo del Market Place di Iride

La capacità di elaborazione dei dati mediante algoritmi e di creazione di servizi rappresenta l'attività a maggior valore aggiunto: il ruolo del Market Place di Iride



La capacità di elaborazione dei dati mediante algoritmi e di creazione di servizi rappresenta l'attività a maggior valore aggiunto

Sistemi satellitari nazionali ed europei

Sistemi satellitari da accordi bilaterali internazionali

Sistemi satellitari da missioni dei Privati

Sistemi e sensori fissi e/o mobili terrestri e aerei

Dati satellitari, terrestri e aerei raw

Estensione perimetro di focus

Data collection

Acquisizione dati grezzi ed eterogenei

Pre- processing dati

Filtraggio, pulizia e correzione dati, per renderli accurati, consistenti ed utilizzabili

Perimetro di core focus

Infrastrutture abilitanti

Computing Elaboration & Data Storage

Multi source processing

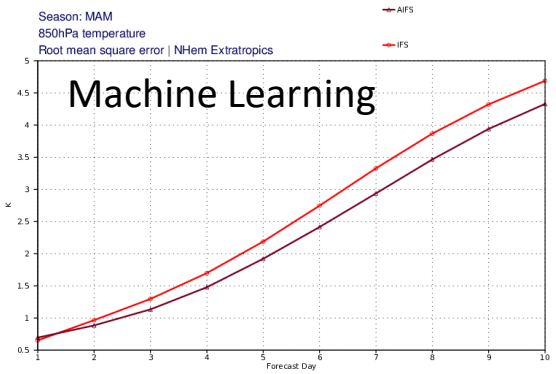
Lavorazione dei dati pre-processati, per ottenere dataset utili a successivo dei modelli, antrainingche in modalità mix satellitari e non satellitari

Algorithms modelization

Scelta e integrazione di diversi modelli (e.g. ML) che rispondono a feature richieste; training algoritmi e elaborazione modello finale

Customization verticale

Sviluppo ed integrazione del verticale finale, rispondendo a esigenze di business e realizzando specifiche immagini grafiche



Potenziale futuro oggetto di commoditization

Alcuni operatori geospaziali, proprietari di sistemi satellitari, vendono già un dato pre-processato

Attività a maggior valore aggiunto

*Integrazione, rispetto al mercato, di competenze **trasversali**, che consentano non solo di lavorare il **dato** ma, prima ancora, di **comprenderne il significato**, al fine di offrire servizio «chiavi in mano» in linea con le aspettative qualitative ed economiche del cliente*

Definizione del modello operativo e di business per la sostenibilità dei servizi

Infrastruttura abilitante con funzione di aggregazione a livello nazionale ed europeo per il mercato dei servizi geospaziali, istituzionale e commerciale

Piattaforma che consente l'accesso a dati, provenienti da diverse fonti, e fornisce i relativi servizi: non garantisce solo l'accesso ai servizi, ma anche la visualizzazione, l'analisi e l'elaborazione dei dati

EUROPEAN & NATIONAL INSTITUTIONS

RESEARCH INSTITUTES

INDUSTRY: LARGE COMPANIE SMEs, MICRO COMPANIES

INVESTITORI PRIVATI

PUBLIC & PRIVATE PARTNERSHIP

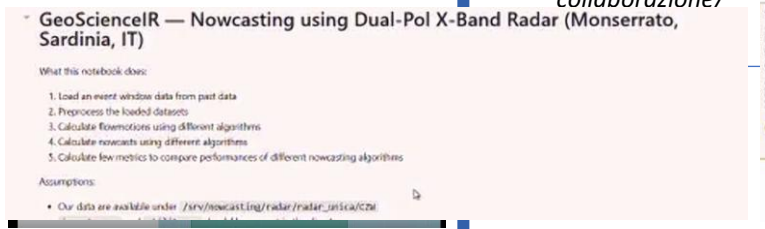
Risorse finanziarie governative, ministeriali ed europee

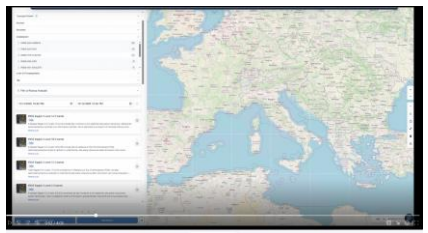
Capitale

Geospatial industry

ICT & HPC industry

Contratti di collaborazione/





Servizi

Utenti Istituzionali (Buyers Group)

Utenti Commerciali

Domanda pubblica come Anchor tenant:
– Ammortizza in parte gli sviluppi industriali che devono garantire i servizi al Buyer Group istituzionale
– A garanzia della sostenibilità economica dell'iniziativa

Contratti di collaborazione elaborazione use case

Corporate (incl. PMI) | **Start up**

Società IT | **Venture Capital**

Contratti di collaborazione supporto sviluppo

Strutture nazionali di competenza (Protezione Civile, Ambientale, ecc.)

Azione di accompagnamento:
- specifica tecnica dei fabbisogni espressi dagli user
- specifiche tecniche di sistemi e algoritmi
- validazione risultati e prestazioni

Copernicus Italia
Europe's eyes on Earth

Training and information activities for Users

REGULATION (UE) 2021/696

(84) To promote and facilitate the use of Earth observation data and technologies by national, regional and local authorities, SMEs, scientists and researchers, dedicated networks for Copernicus data distribution, including national and regional bodies such as Copernicus Relays and Copernicus Academies, should be promoted through user uptake activities.

Copernicus Academy

It aims to train and increase knowledge of Copernicus among potential knowledge developers, service providers and end users (end-users) of the Programme. The Academy operates by organizing specialized courses in universities, summer schools, masters, high education events and professional internships within the framework of the Earth Observational.

Copernicus Relays

Ensure the information and promotion of the Copernicus programme through events as a sustainable source of comprehensive, free, open and reliable information to meet the needs of national regional and local Users

User Uptake Activities

Con il supporto di

Copernicus Relays

Information Events

Dissemination events, tools, and materials

2014 — 2016 — 2018 — 2021 — 2023

Copernicus National User Forum

Training activities

Copernicus Academy

National and international user uptake actions

48 partners of 23 Member States

Copernicus Framework Partnership Agreement for Copernicus User Uptake

REPRESENTATIVE EXAMPLES TO SUPPORT NATIONAL REQUIREMENT COORDINATION AND THE DOWNSTREAM SEGMENT DEVELOPMENT

User uptake in the framework of marine waters including downstream products

MEETING

12	with Regional Agencies and Research Institutes for contributing to the Italian Guidelines on management of **bathing water** work in progress
99	from Entities and Local Administrations representative of different Italian Regions.

PARTICIPANTS

>100	online workshop about **jellyfish** monitoring (youtube channel)
> 150 in EU > 60 in Italy	**aquaculture** workshop

PRODUCTS

2	for bathing water and jellyfish monitoring (TRL 6 at the moment) target TRL 7 in 2023

User uptake on Civil Infrastructures (safety)

30	new institutional users involved in the **requirement definitio**n to support national downstream in the frame of safety of civil infrastructures

Networking: increased participation in the Italian relay network

5	new **Aerospace regional network** included from Emilia Romagna, Veneto, Lombardia, Toscana and Lazio Regions

Copernicus Europe's eyes on Earth | Italia | Copernicus Framework Partnership Agreement for Copernicus User Uptake

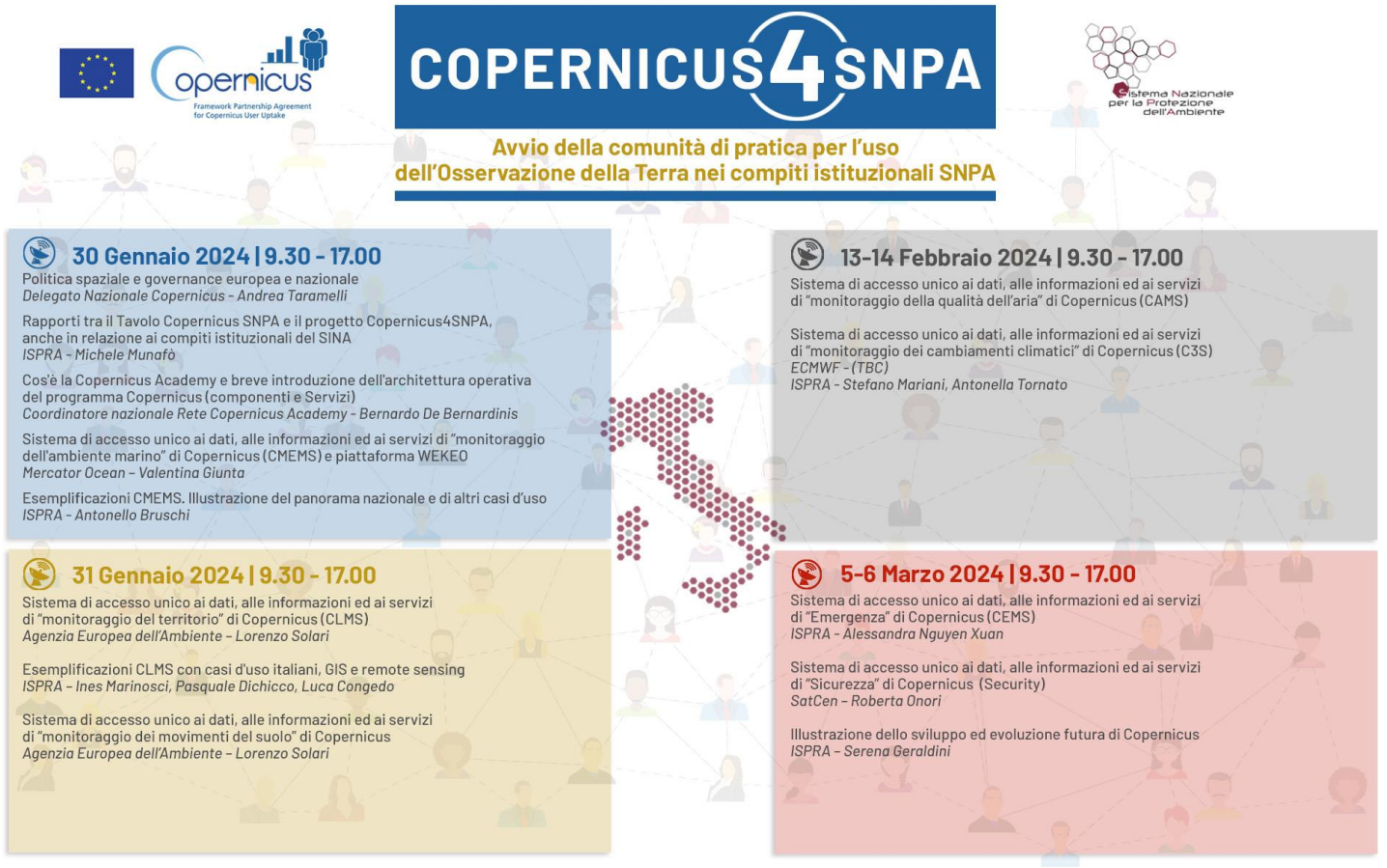
User uptake action towards the National System for the Protection of the Environment

The general aim of the action is to broaden and increase the knowledge and effective use of Copernicus Program within the National System for Environmental Protection (SNPA).

So far, it has been taken:

- **6 introduction days of training** to everyone participating the project (2 participants per Regional Environmental Protection Agency – **40 Participants**);

- **7 over 20 specific trainig** (2 days training on 2 Copernicus Services selected by beneficiaries) – to each Regional Agency – about 50-100 participants per Agency (from 1000 to 2000 participants in total).



About 300h training on Copernicus Services

User Uptake Activities

Con il supporto di

Participation in and organization of events

EARTH TECHNOLOGY EXPO
4 editions

NEWSPACE ECONOMY EUROPEAN EXPOFORUM

ECOMONDO The green technology expo.

MILAN 2024 iac 75th

COP28 UAE
SIDE EVENT

Patrocinio
veneto stars

ASITA

With the involvement of:

ECMWF
MERCATOR OCEAN INTERNATIONAL
JRC EUROPEAN COMMISSION
European Environment Agency
EUMETSAT
EUSPA European Union Agency for the Space Programme

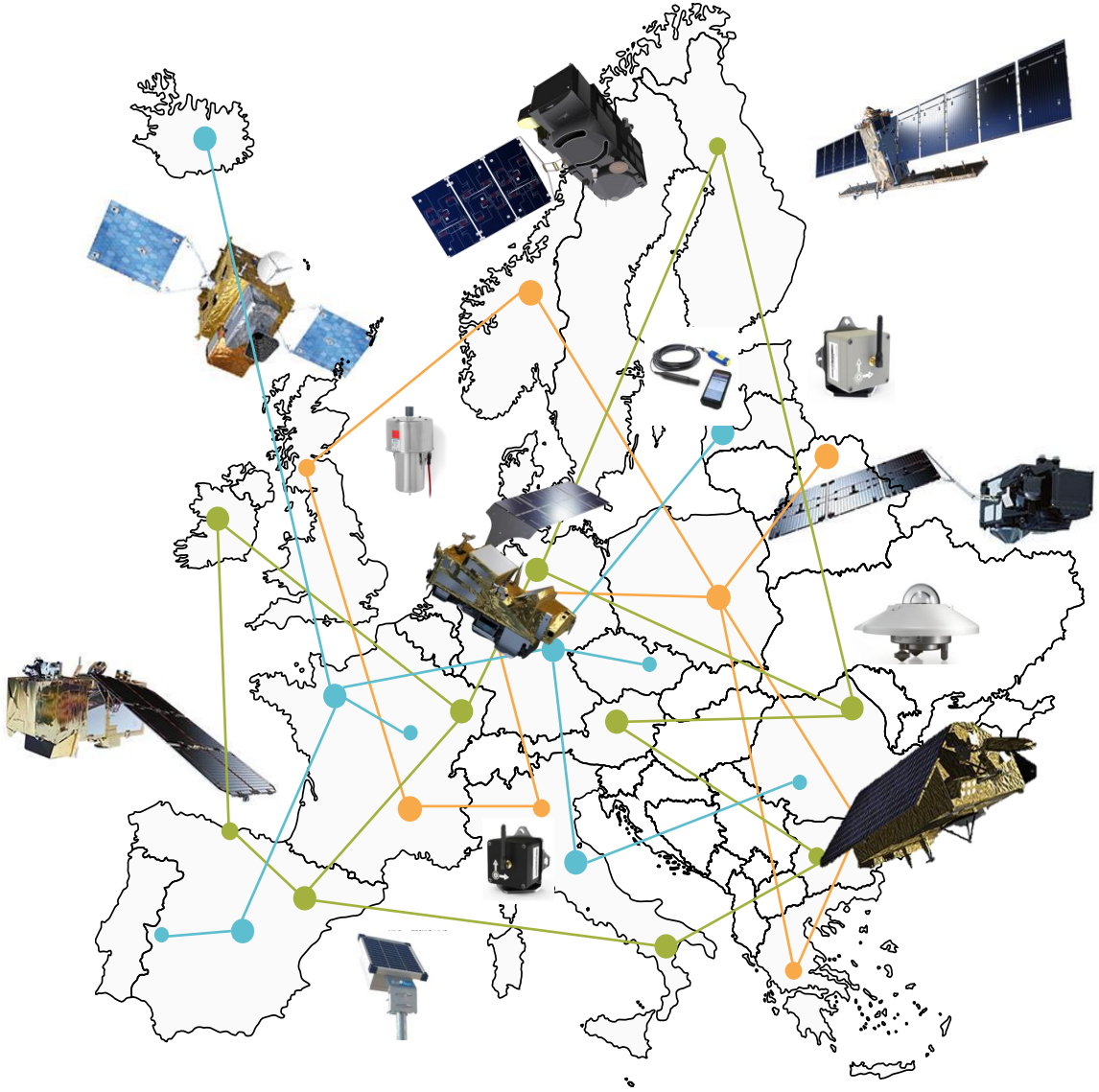
And with Copernicus Support Office

Next events

GEO
GLOBAL FORUM
"The Earth Talks"
ROME, Italy **5-9 MAY, 2025**
HOSTED BY Agenzia Spaziale Italiana
CO-SPONSORED BY European Union

Le sfide dell'osservazione della Terra (OT)

- I rapidi cambiamenti ambientali e climatici richiedono **strumenti di monitoraggio avanzati**: *alta risoluzione spaziale, temporale e spettrale*.
- L'**Intelligenza Artificiale** costituisce un elemento abilitante nei moderni servizi OT, potenziando l'intero ciclo di valore: *acquisizione, pre–processing, analisi e distribuzione dei prodotti*.
- **Integrazione multi-sorgente di dataset eterogenei**: *dati satellitari (ottici, SAR, iperspettrali); piattaforme aeree e UAV; reti in situ; ML/AI per data fusion, feature extraction e modellazione predittiva*.
- Capacità di **elaborare volumi di dati** multi-petabyte con infrastrutture HPC e cloud-native, garantendo velocità, scalabilità e accuratezza.
- **Automazione dei flussi di lavoro** per la detection e il monitoraggio quasi in tempo reale di fenomeni ambientali complessi, inclusa l'estrazione di pattern non visibili all'occhio umano: *Land Cover/Land Use; Ground deformation e analisi interferometrica; Biodiversità e habitat monitoring; Coastal dynamics; Idrologia e modellistica idro-climatica; Clima e qualità dell'aria*.
- **Evoluzione dei servizi di OT** verso architetture interoperabili, in linea con iniziative europee (*Copernicus, DestinE, Galileo, EOGS*) e programmi nazionali (*IRIDE, Cosmo Sky-Med, PRISMA*), per abilitare strategie di gestione del territorio più coordinate, efficienti, prospettiche e scalabili a livello EU.



Copernicus Italia
Europe's eyes on Earth

GRAZIE!

andrea.taramelli@iusspavia.it

copernicusufn@isprambiente.it

https://www.copernicus-italia.it/

www.isprambiente.gov.it/it