

The Copernicus Marine Service Achievements and Future Plans

P.Y. Le Traon, P. Bahurel and MOi teams
Mercator Ocean International



**Copernicus : an
EU asset to
increasing
needs for ocean
information**

Increasing & pressing needs of improved ocean monitoring and prediction capabilities :

- To understand and predict the weather and climate evolution
- To develop sound mitigation and adaptation to climate change
- For a sustainable management of the oceans and its resources
- For the development of a sustainable blue economy
- To better protect marine ecosystems and biodiversity



Ocean in the European and international political agenda

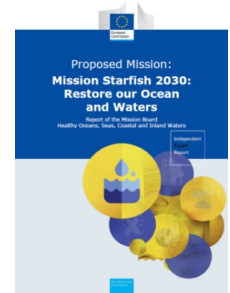
**The Ocean
higher than ever
in the political
agenda**

EU framework:

- ❑ EU policies: Green Deal, Digital Strategy, Mission Ocean, Arctic Policy, CFP, MSFD, MSP, International Ocean Governance

International framework:

- ❑ Ocean Decade, G7 FSOI, UN/SDG, GEO, IPCC, UNFCCC, CBD, Sendai



LISBON
27 JUNE -
1 JULY
2022

The EU Copernicus Marine Service Global & Regional Ocean Monitoring and Forecasting

MULTI-YEAR
10 to 45 years

REAL-TIME
Daily, hourly

FORECAST
2 to 10 days

ESSENTIAL OCEAN VARIABLES

Blue
(Physics)

White
(Sea Ice)

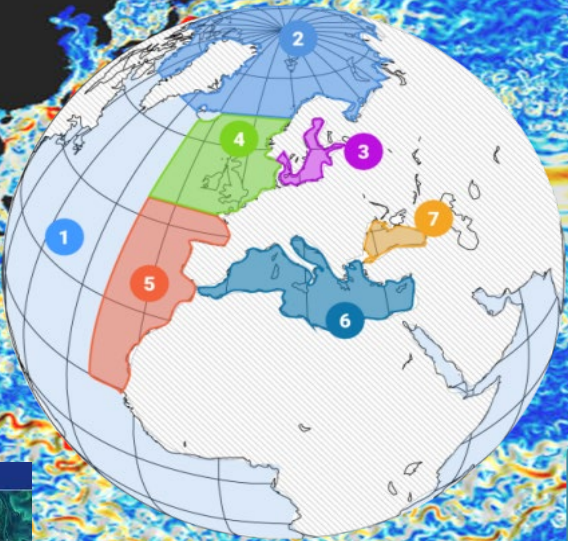
Green
(Biogeochemistry)

OBSERVATIONS
In-situ & Satellites

NUMERICAL MODELS & data
assimilation

marine.copernicus.eu

Free and Open



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





Copernicus Marine Service

Providing free and open marine data and services to enable marine policy implementation, support Blue growth and scientific innovation.

Access Data >

DATA

OCEAN PRODUCTS

A robust ocean data catalogue, to download or visualise data including hindcasts, nowcasts and forecasts.

EXPERTISE

OCEAN STATE REPORT

Extensive annual analysis on the state of the ocean over nearly 20 years and severe/notable annual events.

TRENDS

OCEAN MONITORING INDICATORS

Essential variables monitoring the health of the ocean over the past quarter of a century.

EXPLORATION

OCEAN VISUALISATION

Dive into our 4D digital oceans through our 3 visualisation tools for beginner, intermediate and advanced users

A wide range of applications (environment, society, economy) Support to EU policies (Green Deal)

>41,000
subscribers
(+ 30% per year)

450,000
single visitors
per year on the
web portal in 2021

ENVIRONMENT				SOCIETY				ECONOMY			
POLAR ENVIRONMENT MONITORING	MARINE CONSERVATION & BIODIVERSITY	OCEAN HEALTH	CLIMATE & CLIMATE ADAPTATION	POLICIES & OCEAN GOVERNANCE & MITIGATION	EDUCATION, PUBLIC HEALTH & RECREATION	SCIENCE & INNOVATION	EXTREMES, HAZARDS & SAFETY	COASTAL SERVICES	MARINE FOOD	NATURAL RESOURCES & ENERGY	TRADE & MARINE NAVIGATION
Arctic policy, MSFD, MSP, WFD, Habitat Directive, Bird Directive, Natura 2000, the Convention on Biological Diversity, WMO/UNFCCC, IPCC, the Paris agreement / global stocktake, SDG 13, 14, 15				Arctic Policy, MSFD, MSP, WFD, IOG, The Sendai Framework for Disaster Risk Reduction, SDG 1, 2, 3, 4, 5, 6, 7, 9, 11 and 16, 17				Space policy, Flood Directive, Green Deal, Energy Policy, Air Quality Directives, SDG 8, 9, 10, and 12, 17			

- 1 POLAR ENVIRONMENT MONITORING
- 2 CLIMATE & ADAPTATION
- 3 OCEAN HEALTH
- 4 MARINE CONSERVATION & BIODIVERSITY

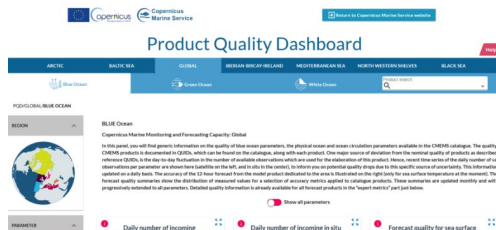
- 5 SCIENCE & INNOVATION
- 6 POLICIES & OCEAN GOVERNANCE & MITIGATION
- 7 EDUCATION, PUBLIC HEALTH & RECREATION
- 8 EXTREMES, HAZARDS & SAFETY

- 9 MARINE FOOD
- 10 COASTAL SERVICES
- 11 TRADE & MARINE NAVIGATION
- 12 NATURAL RESOURCES & ENERGY

Achievements - Copernicus Marine (2015-2021)



- ✓ Operational and robust service
- ✓ Scientifically validated.
- ✓ Continuously upgraded.
- ✓ Uptake of Sentinel missions (S1, S2, S3)
- ✓ Improved product quality and product quality assessment
- ✓ New parameters (e.g. waves, pH and carbon, icebergs), higher resolution, longer time series.
- ✓ Indicators/Ocean State Report.
- ✓ User uptake/user engagement
- ✓ International Impact

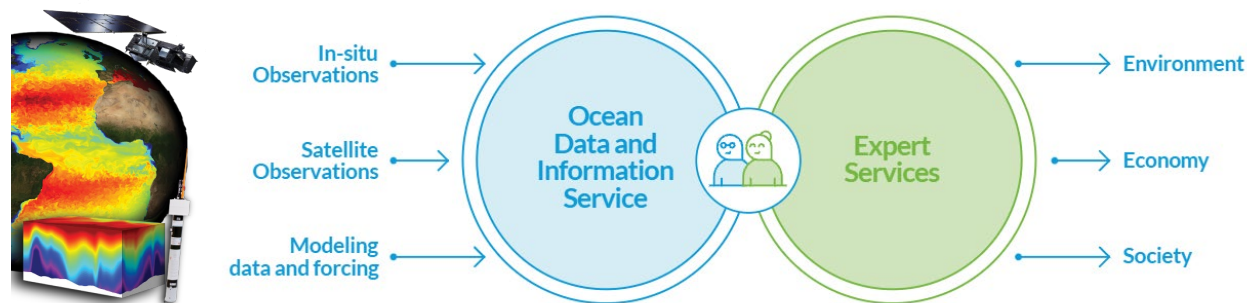


Copernicus Marine 2 – 2021-2028

**Building on
Copernicus
Marine 1
successes for a
new ambition**

We plan a competitive Copernicus Marine based on (1) continuity, (2) enhanced information & service (3) digital integration, (4) re-enforced links with the other Copernicus services (land, climate, emergency, CO2) and EMODnet (5) stronger governance (marine stakeholder committee).

User/policy needs, observation/science/technology advances





BLUE OCEAN

Currents, temperature,
waves, sea level, ...



WHITE OCEAN

Ice coverage, velocity,
concentration, Icebergs ...



GREEN OCEAN

CO₂, nutrients, oxygen,
primary production, ...

Copernicus Marine Service in COPERNICUS 2 :

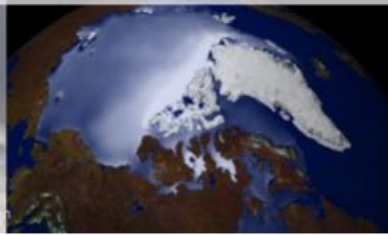
Continuity of the Blue/White/Green Offer

+ a series of major evolutions developed depending on priorities & budget

Coastal



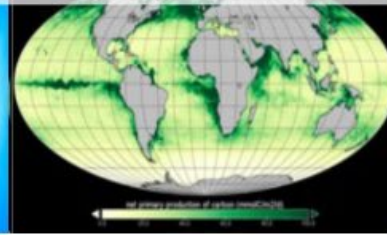
Arctic



Marine Biology



Ocean Climate



Digital services

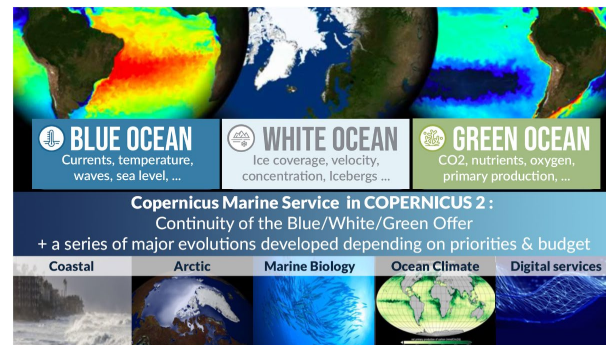


BLUE / WHITE / GREEN Offer: observations and models GLOBAL AND REGIONAL

Expert assessments / Ocean State Report

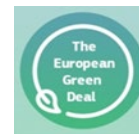
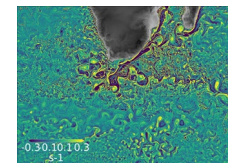
National Uptake, International impact

- **Regular incremental evolutions (products and services)**
 - ✓ Improved product quality and product quality assessment
 - ✓ Marine Data Store and WEkEO platform / cloud services
 - ✓ Dedicated sectorial offers per applications & policies
 - ✓ Training and capacity building
- **Integration of Sentinels 1,2,3 C/D and 6 A/B + in situ (eg BGC Argo)**



To better answer user needs, keep the service at the state-of-the-art and to meet the new ocean monitoring & forecasting challenges required by European policies and users

- **Higher resolution and ensemble forecasts (enhanced continuity)**
- **Arctic (enhanced continuity)**
- **Coastal (new service with member states)**
- **Marine biology (new service)**



These evolutions will be developed through precursor projects (H2020, Horizon Europe) and depending on priority and budget constraints.



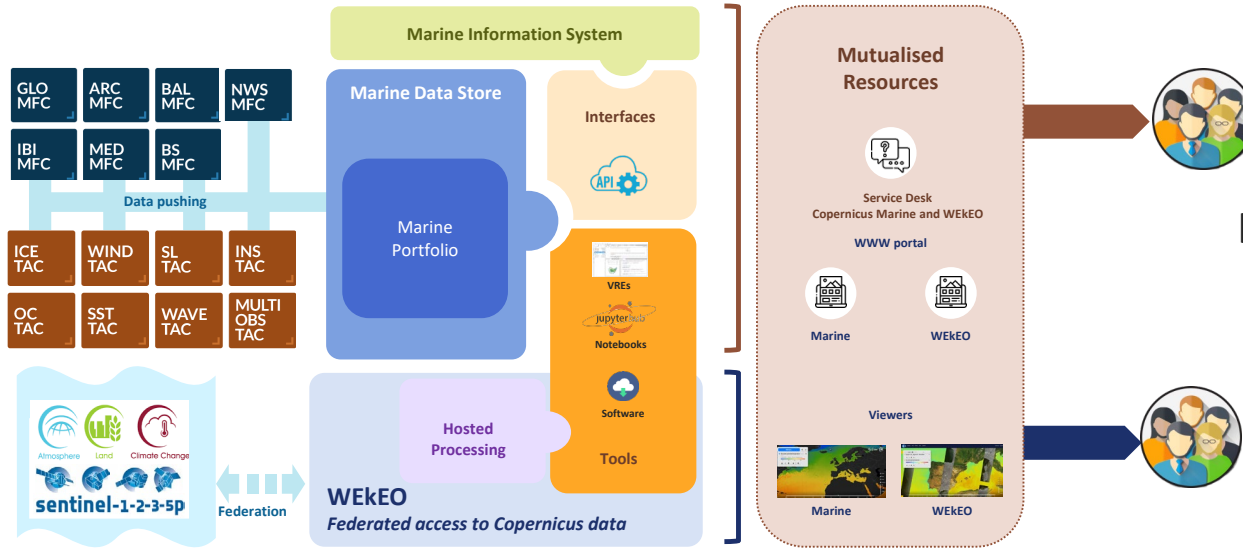
Copernicus
Marine Service



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An integrated Copernicus Marine / WEkEO platform and service

Embrace new capabilities of digital services



Copernicus Marine and WEkEO in Copernicus 2:
Integration of WEkEO services in the Marine services (VREs, Notebooks), mutualization of development (www, Viewers) and of the user support



In synergy with **Digital Twin Ocean** and **Destination Earth** initiatives



PROGRAMME OF
THE EUROPEAN UNION

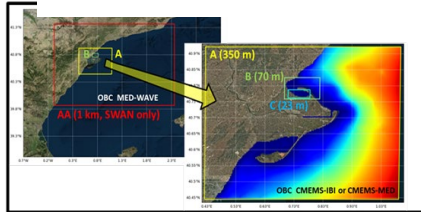


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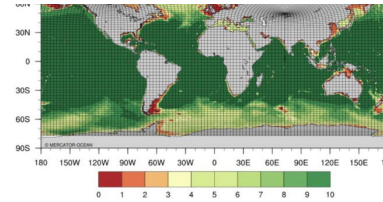


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Essential to maintain systems at state-of-the-art and respond to evolving user needs:
observation, modelling, assimilation, artificial intelligence, product quality, user tools and user services...



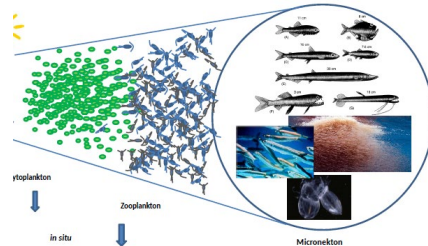
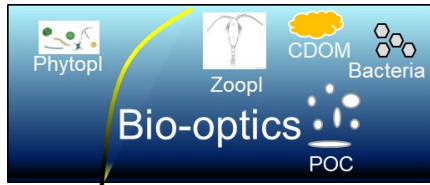
Coastal ocean, rivers
Coupling with open ocean & hydrology



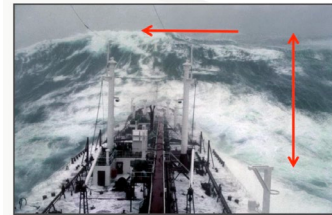
New generation of ocean models, HPC infrastructure



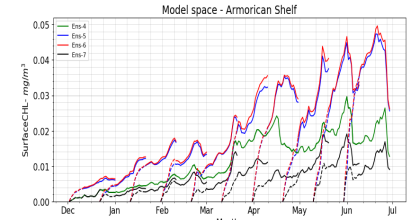
Cloud, Big Data and AI
User tools



Improved BGC modelling & assimilation capabilities, high trophic levels



Ocean/Wave/Atmosphere
interactions & coupling



Ensemble forecasting
Data assimilation

Copernicus Marine Evolution : the 3 Tiers of R&D

2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027

Operations

Copernicus 2

Phase 1

Phase 2

R&D

Tier 1
(1yr)

Tier 1 R&D

Tier 2
(2yrs)

Tier 2 R&D call

Tier 3
(>3yrs)

Horizon-EU

SE Call 1

SE Call 2

IMMERSE

SEAMLESS

HORIZON EUROPE-SPACE

ESA R&D projects, national projects



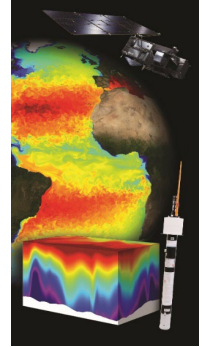
Copernicus
Marine Service



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The fundamental role of the Sentinel missions and in-situ observing system in the Copernicus Marine Service value chain

The Copernicus Marine Service is **highly dependent on** the satellite (Sentinels) and in-situ observing capabilities



From integration of S1, 2, 3 A & B in Copernicus 1 to S6 A&B and S1,2 , 3 C & D in Copernicus 2. **Preparing for expansion missions (in particular Arctic Ocean).** Support the EC for **New Generation Sentinel** mission design.



Working with EEA, EuroGOOS and EOOS to **strengthen in situ coordination and the development of the in situ observing system.** International cooperation (GOOS) and UN Decade of Ocean Science.



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THE EUROPEAN UNION



implemented by

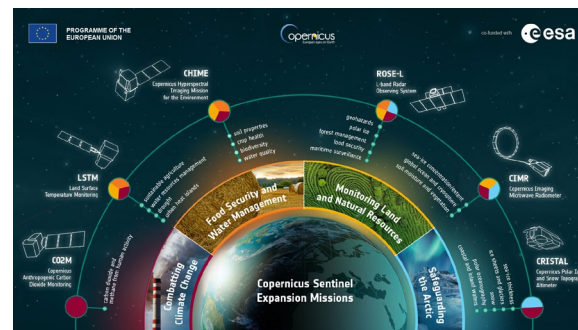


Integration of Sentinel missions (S1, S3, S2 and S6) in Copernicus Marine catalogue. Impact more than 80% of the Copernicus Marine catalogue.

Regular assessment of the impact of Sentinel missions on Copernicus Marine (observations/TACs and models/MFCs).

Preparing future missions – requirements, expert analyses and simulations through Observing System Simulation Experiments.

Unique capabilities and expertise among Copernicus Marine expert centers.



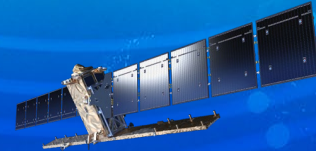


Copernicus
Marine Service



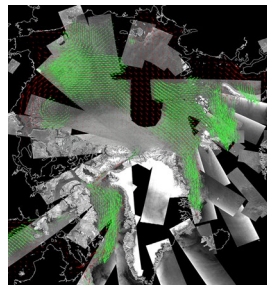
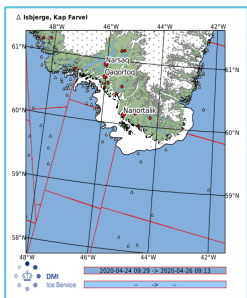
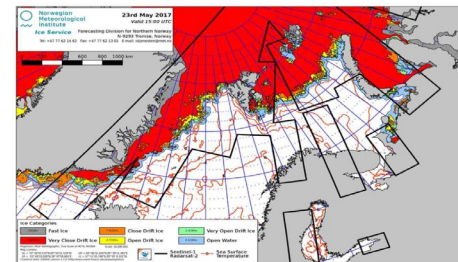
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Impact of Sentinel 1



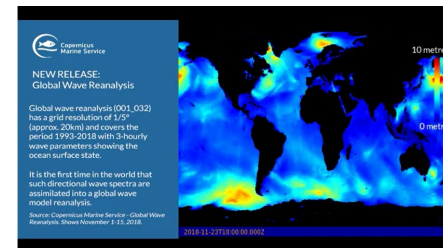
Sentinel-1, with its good daily coverage, has been very important for the quality of the ice charts for tactical navigation.

Very high quality iceberg products from both EW and IW acquisition modes.



Sentinel-1 A+B
HH excellent
quality for ice
drift

Assimilation of Sentinel-1 wave spectra in the global wave model
(now extended to CFOSAT)



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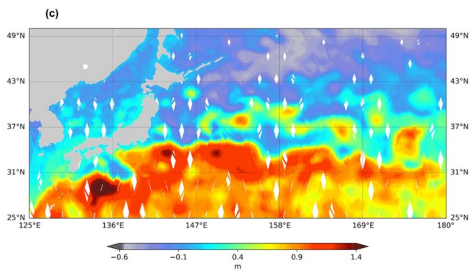
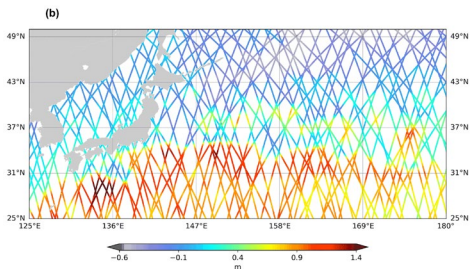


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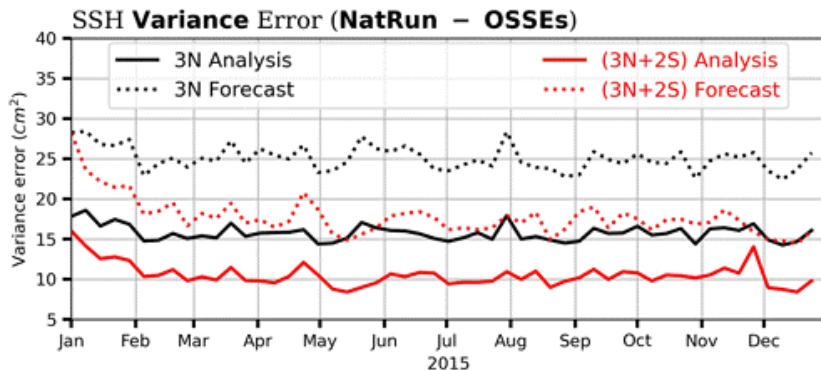


Assessing the impact of future (NG) Sentinel missions

Impact of a constellation of two wide swath altimeters for ocean analysis and forecasting (Benkiran et al., Ocean Science, 2022). Observing System Simulation Experiments (OSSEs) with the global 1/12° MOi/Copernicus Marine data assimilation system.



7-day coverage with 3 Nadir and 2 Wide Swath altimeters



Wrt 3 nadirs, adding two wide swath altimeters will reduce the sea surface height (SSH) 7 day forecast errors by 50%.

Continuity of service with incremental evolutions

Organized with the new consortia set up for the different service elements with the support of our advisory bodies: STAC (Science&Technology) and CUAG (Users)

Reinforced governance (Member States): marine stakeholder committee

Working with EEA (marine policies), Regional Sea conventions, JRC KCEO (fitness for purpose) and EUSPA (User Uptake)

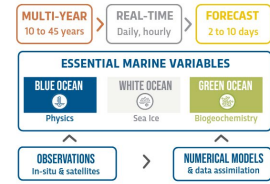
Interfaces/synergies with other Copernicus services and EMODnet

Prepare post 2024 evolutions through our service evolution innovation activities and H2020 and Horizon Europe programmes (mission Ocean)

Integration in the UN Decade of Ocean Science

COPIERNICUS MARINE REGIONAL OCEAN PRODUCT DIVISIONS

- Global Ocean
- Arctic Ocean
- Baltic Sea
- European North West Shelf Seas
- Iberian Biscay Inland Seas
- Mediterranean Sea
- Black Sea



2021
2030 United Nations Decade of Ocean Science for Sustainable Development



**Copernicus
Marine 2 : an
ambition plan
aligned with the
EU Green Deal
and Digital
Strategies**

Conclusion / Copernicus Marine 2021 - 2028

- Remain a **marine reference worldwide**. Foster **User Uptake**.
- Staged **implementation driven by user and policy needs**, observation, science & technology advances :
 - **Continuity of service** with incremental evolution.
 - Embrace the **new capabilities of digital services** in synergy with Digital Twin Ocean and Destination Earth initiatives.
 - Prepare the implementation of the next generation of ocean monitoring and forecasting systems and new services for **Coastal and Biology**.
- Working closely with the Copernicus Space Component to **ensure a smooth integration of Sentinel missions in the service** and contribute to the design of future missions.
- International **cooperation & impact**.