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The future of Ocean Forecasting The Copernicus Marine Perspective



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Intergovernmental
Oceanographic
Commission



2021
2030 United Nations Decade
of Ocean Science
for Sustainable Development

Connecting the world around Ocean Prediction: *A vision for the Decade and Beyond* – 8 April 2024

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 OCEAN



Physics

WHITE OCEAN



Sea Ice

GREEN OCEAN



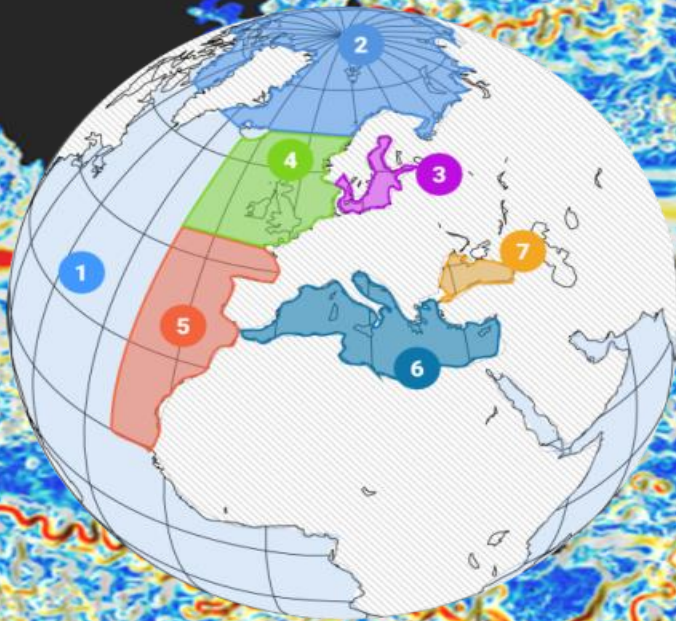
Biogeochemistry

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

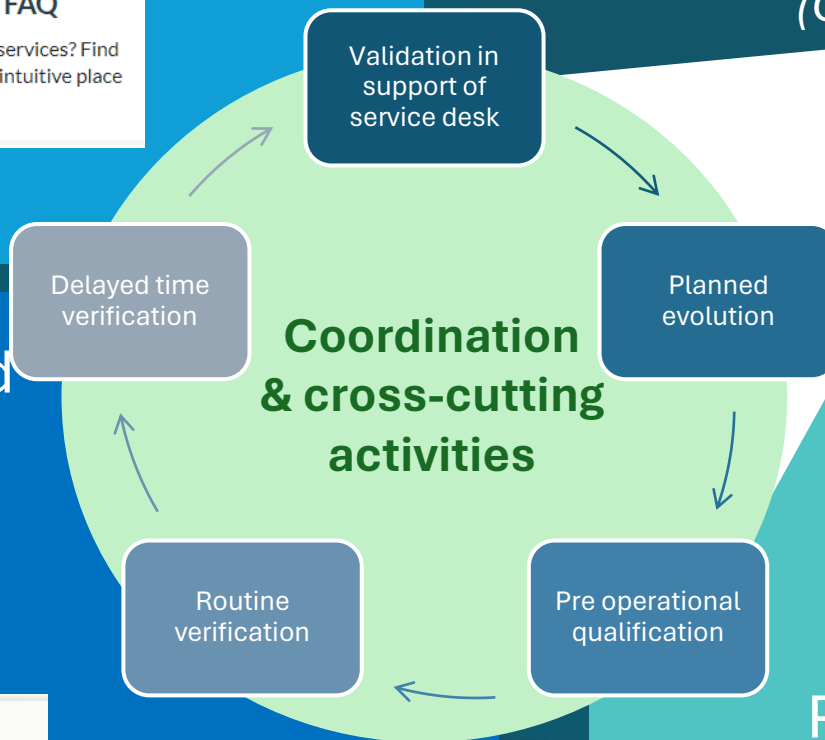


MyOcean
by Copernicus Marine Service

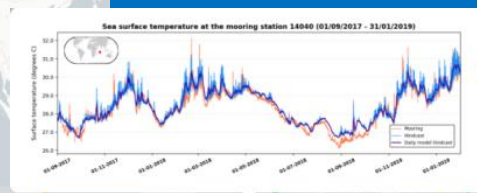
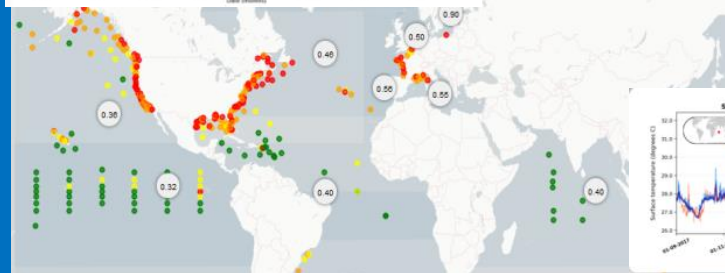
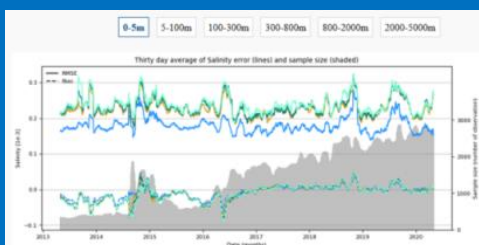


Help Center & FAQ
Have a question about our services? Find everything gathered in one intuitive place online.

CONSISTENT PRODUCT QUALITY INFORMATION
Internationally agreed validation metrics
(Ocean Predict programme)



Product quality dashboard



Description	
Notifications	
Data access	
Contacts	
DOCUMENTATION	
Quality Information Document	
User Manual	
Licence	
How to cite	
DOI	
10.48670/moi-00235	

Marine Data Store

Peer reviewed publications

Ocean Science
An interactive open-access journal of the European Geosciences Union

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Special issue | The Copernicus Marine Environment Monitoring Service (CMEMS): scientific advances

around



A user and policy driven service with a large uptake from all sectors

CHAPTER 1 Copernicus Marine Users

The Copernicus Marine community continues to grow, reaching nearly 66 000 users by the end of 2023. The increase in the number of visits is significant and indicates growing interest in the new content disseminated on the website.

A / Overview of Copernicus Marine subscribers

Subscribers: 1, 4000, 8000+

65 952 Subscribers

+25.9% growth rate vs 2022

Distribution of the subscribers by Blue Markets in 2023

Trade & Marine Navigation	19%
Climate & Adaptation	19%
Coastal Services	6%
Education, Public Health & Recreation	4%
Extremes, Hazards & Safety	3%
Marine Conservation & Biodiversity	3%
Science & Innovation	3%
Polices & Ocean Governance & Mitigation	16%
Public Environment Monitoring	5%
Ocean Health	5%
Natural Resources & Energy	5%
Marine Food	2%

Number of countries in 2023: **235**

Number of organisations: **8 236**

CHAPTER 1 Copernicus Marine Users

B / Copernicus Marine Community on marine.copernicus.eu

+ 42% growth rate vs 2022

7.4 Actions per visit

Average visit duration
 5:58 min returning visitor, 3:06 min new visitor


Website traffic
987 835 visits

1 593 457 unique pageviews


Copernicus Marine and the UN Decade of Ocean Science

Aligning efforts towards the ocean we want


- ❑ Copernicus Marine contributes to almost all outcomes of the UN Decade with a focus on the predicted ocean and accessible ocean outcomes
- ❑ Similarly Copernicus Marine answers to almost all its challenges with a focus on challenges 6 (marine hazards), 7 (ocean observing system) and 8 (digital representation of the ocean)




A clean ocean
where sources of pollution are identified and reduced or removed.



A healthy and resilient ocean
where marine ecosystems are understood, protected, restored and managed.




A productive ocean
supporting sustainable food supply and a sustainable ocean economy.




A predicted ocean
where society understands and can respond to changing ocean conditions.



A safe ocean
where life and livelihoods are protected from ocean-related hazards.




An accessible ocean
with open and equitable access to data, information and technology and innovation.




An inspiring and engaging ocean
where society understands and values the ocean in relation to human wellbeing and sustainable development.


7 outcomes




Challenge 1
Protect and restore ecosystems and biodiversity
Understand and map land and sea-based sources of pollutants and contaminants and their potential impacts on human health and ocean ecosystems and develop solutions to remove or mitigate them.
[Watch the video](#)




Challenge 2
Understand the effects of multiple stressors on ocean ecosystems, and develop solutions to monitor, protect, manage and restore ecosystems and their biodiversity under changing environmental, social and climate conditions.
[Watch the video](#)




Challenge 3
Sustainably feed the global population
Generate knowledge, support innovation, and develop solutions to optimise the role of the ocean in sustainable feeding the world's population under changing environmental, social and climate conditions.
[Watch the video](#)




Challenge 4
Develop a sustainable and equitable ocean economy
Generate knowledge, support innovation, and develop solutions for equitable and sustainable development of the ocean economy under changing environmental, social and climate conditions.
[Watch the video](#)




Challenge 5
Unlock ocean-based solutions to climate change
Enhance understanding of the ocean-climate nexus and generate knowledge and solutions to mitigate, adapt and build resilience to the effects of climate change across all geographies and at all scales, and to improve services including predictions for the ocean, climate and weather.
[Watch the video](#)




Challenge 6
Increase community resilience to ocean hazards
Enhance multi-hazard early warning services for all geographical, ecological, biological, weather, climate and anthropogenic related ocean and coastal hazards, and mainstream community preparedness and resilience.
[Watch the video](#)




Challenge 7
Expand the Global Ocean Observing System
Ensure a sustainable ocean observing system across all ocean basins that delivers accessible, timely, and actionable data and information to all users.
[Watch the video](#)



Challenge 8
Create a digital representation of the ocean
Through multi-stakeholder collaboration, develop a comprehensive digital representation of the ocean, including a dynamic ocean map, which provides free and open access for exploring, discovering, and visualizing past, current, and future ocean conditions in a manner relevant to diverse stakeholders.
[Watch the video](#)



Challenge 9
Skills, knowledge and technology for all
Ensure comprehensive capacity development and equitable access to data, information, knowledge and technology across all aspects of ocean science and for



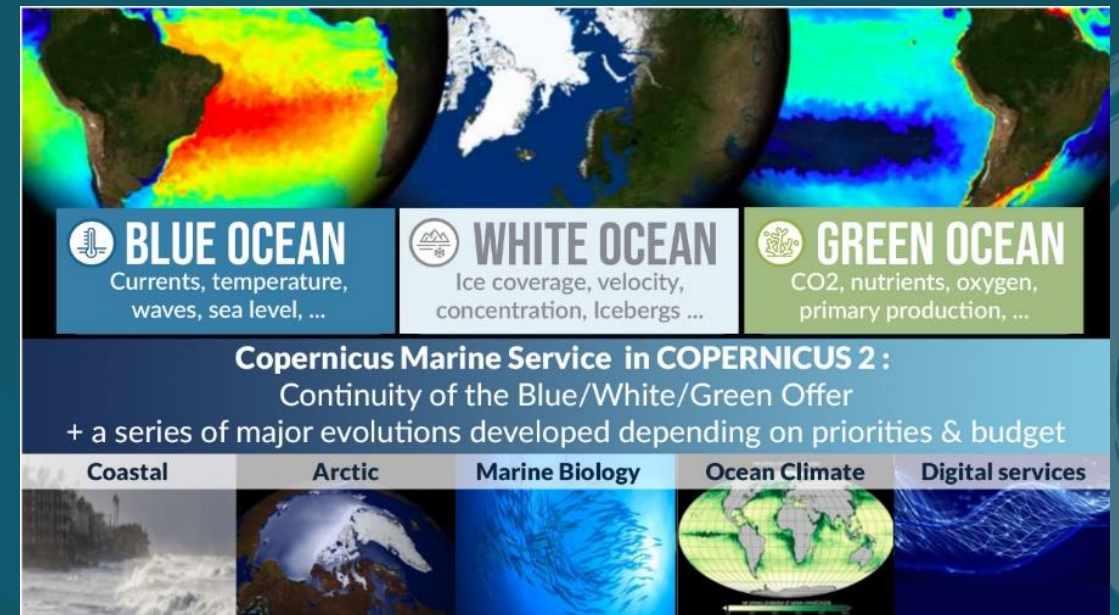
Challenge 10
Change humanity's relationship with the ocean
Ensure that the multiple values and services of the ocean for human wellbeing, culture, and sustainable development are widely understood, and identify and overcome barriers to behaviour change required for a step change in humanity's relationship with the ocean.
[Watch the video](#)

10 Challenges

Copernicus Marine evolution plans to address UN decade challenges and its predicted ocean outcome

Prepare the implementation of the next generation of ocean and sea ice monitoring and forecasting systems

Driven by user and policy needs, observation, science & technology advances



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Advancing ocean prediction capabilities

Copernicus Marine Service Evolution activities: 3 Streams defined to support Copernicus Marine R&D activities, with different time horizons, players and objectives



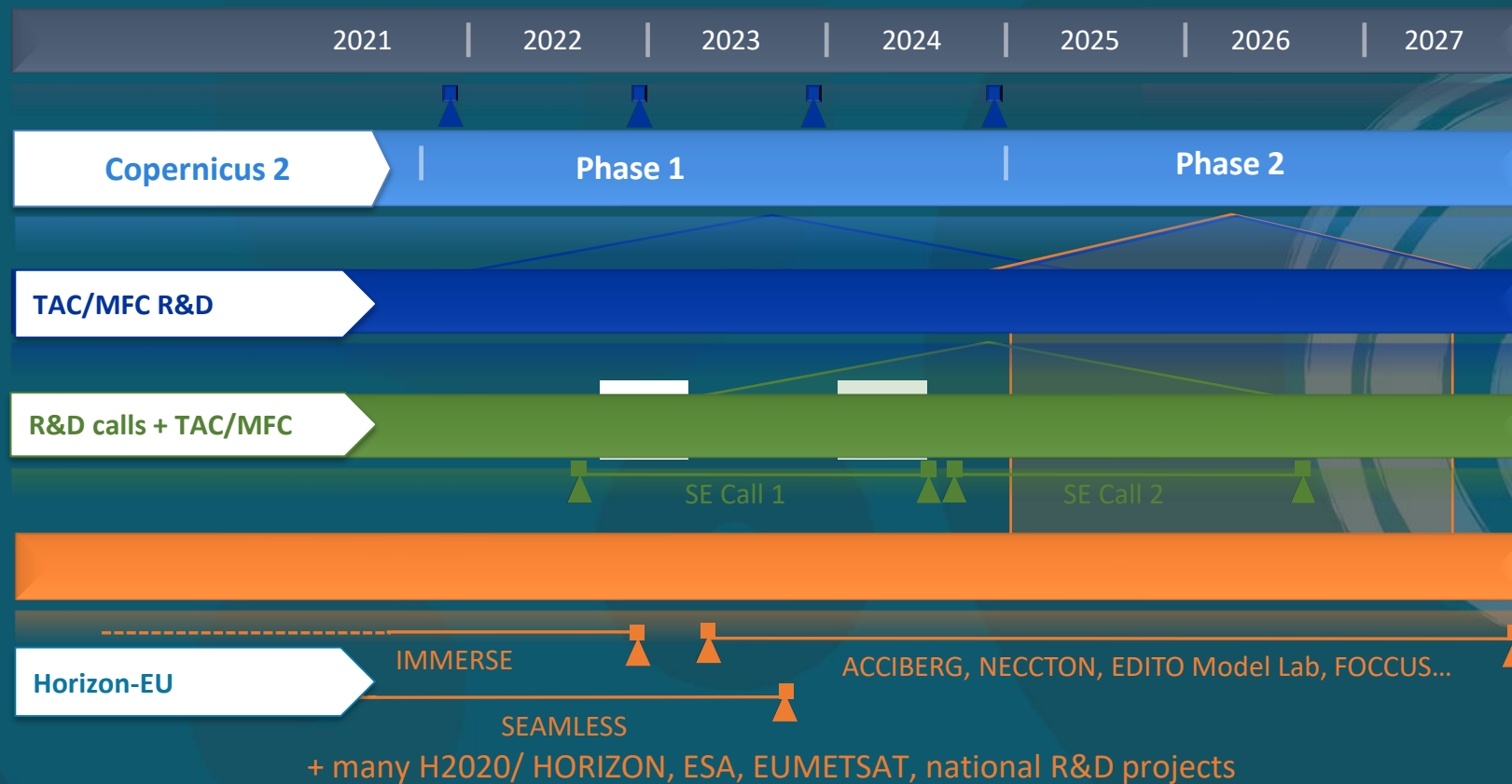
Operations

R&D

Tier 1 (1yr)

Tier 2 (2yrs)

Tier 3 (>3yrs)



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Copernicus Marine 2025-2028 evolution plans / ocean forecasting

- ❑ Integration of new satellite missions (e.g. Sentinels, SWOT) and in-situ data (e.g. BGC Argo), improved coupling, improved data assimilation, higher resolution, increased use of AI (e.g. calibrated forecasts, bias corrections)
- ❑ Addition of an ensemble forecasting service line to improve forecasts and error characterization
- ❑ Observation impact assessment (regular reporting) to be consolidated
- ❑ New service line for the coastal modelling/prediction to be implemented with EU member states
- ❑ Advancing modelling/prediction for biology (higher trophic levels) through the NECCTON HE project.
- ❑ Climate projection: coastal/regional downscaling, biogeochemistry and higher trophic level (R&D)



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Copernicus Marine and the OceanPrediction DCC

Advanced and well-organized network of modelling and forecasting centers (global and regional) for the blue/green/white ocean. Operational interfaces and harmonization with coastal systems from EU member states.

Common and rigorous procedures to manage evolutions, for product harmonization, adoption of standards (formats, validation) and to organize the feedbacks for the observing system evolution.

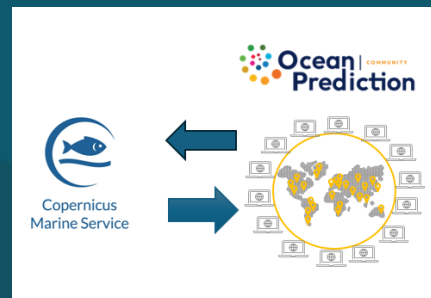
International cooperation as part of the Ocean Predict programme and its task teams and UN Decade programmes and projects (e.g. ForeSea, CoastPredict, Ditto, ObsCode, Marine Life 2030, Synops).



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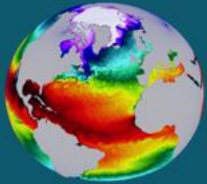
Copernicus Marine can serve as an exemplar for the implementation of a worldwide system as part of the OceanPredict DCC and, in return, is organized to implement international recommendations/guidance from the DCC

2024 OCEAN DECADE CONFERENCE

Connecting the world around
Ocean Prediction:

A vision for the Decade and Beyond

As part of the Ocean Decade Week (8-12 April 2024)



Copernicus Marine and the UN Decade

- ❑ Copernicus Marine is a major asset to contribute to the UN Decade 2030 vision and its “predicted ocean” outcome
- ❑ A powerful European network that benefits to and from international collaboration
- ❑ Fully committed to contribute to the development of a worldwide ocean prediction system as part of the OceanPrediction DCC



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