From observation to information
The Copernicus Marine Service perspective

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OceanObs19 CWP

Systematic Review Article, Front. Mar. Sci., 22 May 2019, https://doi.org/10.3389/fmars.2019.00234

Outline

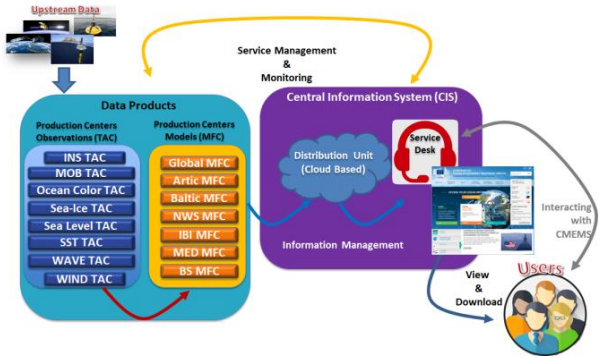
The Copernicus Marine Service today

The Copernicus Marine Service OceanObs19 CWP: overview and recommendations

The Copernicus Marine Service - Today

A state of the art, innovative and user driven Copernicus service

- ✓ Operational and scientifically assessed
- ✓ Observations and models - Physics and Biogeochemistry
- ✓ Assessments : Ocean State Report and OMIs.
- ✓ A network of European producers
- ✓ A unique catalogue: Worldwide and European-wide.
- ✓ A central information system to search, view, download products and monitor the system
- ✓ A service desk with a network of technical&marine experts
- ✓ Generic to serve a wide range of downstream applications. More than 17 000 subscribers.
- ✓ Preparing the future / digital ocean – cloud infrastructure and interfaces with Copernicus DIAS platforms (WEkEO).



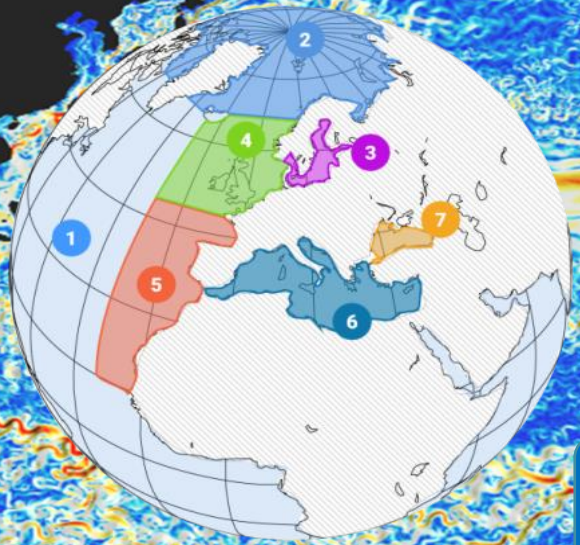
The Copernicus Marine Service

Monitoring and forecasting the ocean

MULTI-YEAR
10 to 45 years

REAL-TIME
Daily, hourly

FORECAST
2 to 10 days



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

ESSENTIAL MARINE VARIABLES

- Blue (Physics)
- White (Sea Ice)
- Green (Biogeochemistry)

OBSERVATIONS
In-situ & Satellites

NUMERICAL MODELS
Data Assimilation

Open and Free access

Copernicus Marine Service organisation

ESA and Eumetsat

EEA, EuroGOOS and EMODnet

Other Copernicus Services

Marine Environment Monitoring

Entrusted entity: MERCATOR OCEAN INTERNATIONAL

Scientific and Technical Advisory Committee

Champion Users Advisory Committee

CROSS-CUTTING COORDINATION
CENTRAL USER SERVICE

System | Service | Outreach | Science

CMEMS OPERATIONS PRODUCTION AND SERVICE

Service desk and service operations
Central Information System

Monitoring and Forecasting Centres (Models)

ARC	BAL	BLACK	IBI	MED	NWS	GLO

Thematic Assembly Centres (Observations)

SEA LEVEL	IN SITU	OCEAN COLOR	SST	SEA ICE	WIND	Multi OBS	WAVE

CMEMS EVOLUTIONS AND USER UPTAKE

Additional activities complementing CMEMS operations

Service Evolution

User Uptake

CMEMS, now in its 5th year of operations

Today

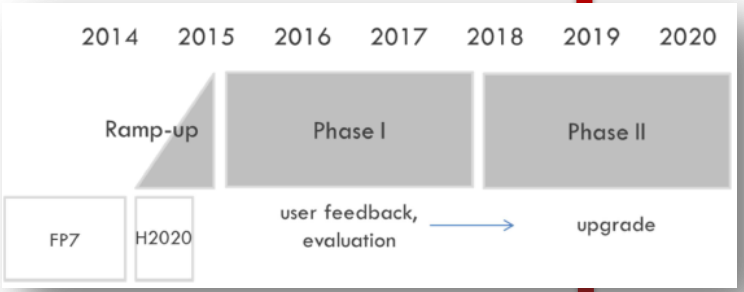
2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2028

CMEMS Implementation

1st year of operations | 2nd year of operations | 3rd year of operations | 4th year of operations | 5th year of operations

CMEMS operations

Phase 1 | Phase 2



CMEMS is doing well. Very good KPI in service availability, product quality and user satisfaction, a constant growth in user uptake, and regular updates of the service offer.

A wide range of applications and users

MARKETS

Copernicus Marine Service supports all sectors of the blue economy

http://marine.copernicus.eu/markets/

1. SEA ICE MONITORING
2. MARINE CONSERVATION & POLICIES
3. SCIENCE & CLIMATE
4. NATURAL RESOURCES & ENERGY
5. WATER QUALITY
6. COASTAL MONITORING
7. SOCIETY & EDUCATION
8. MARINE FOOD
9. MARINE NAVIGATION
10. SAFETY & DISASTER

how Copernicus Marine service data is used:

[Use cases page]

[Use cases books]

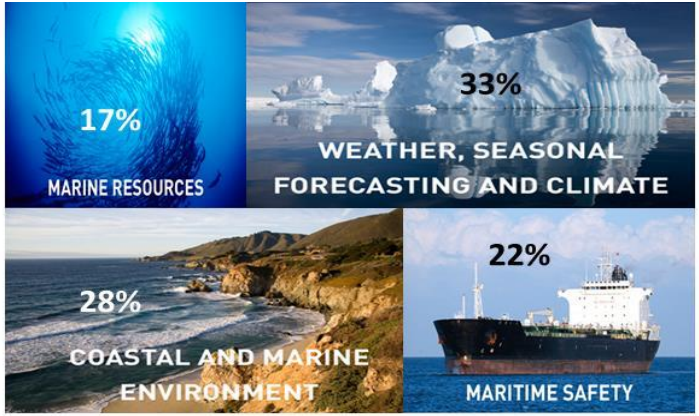
[Use cases demo page]

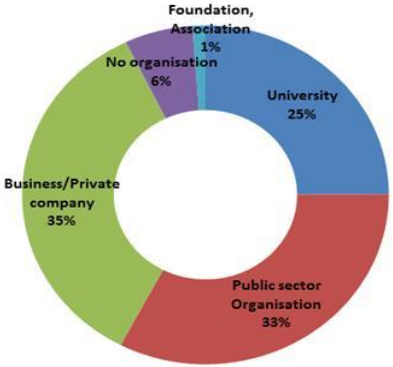
Copernicus Marine Service applications and users

More than 17 000 subscribers

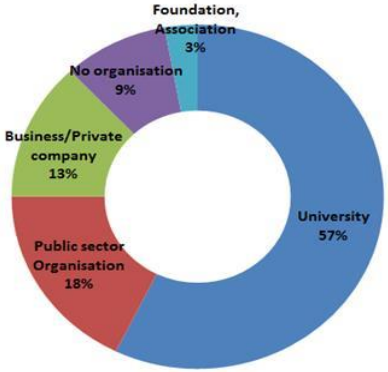
Steady increase of users (+ 300 per month)

Business companies = 1/3 of downloads





User statistics: based on number of downloads



User statistics : based on number of users

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From observations to information and users
A complex value chain / Copernicus Marine

Observations (satellite, in-situ)

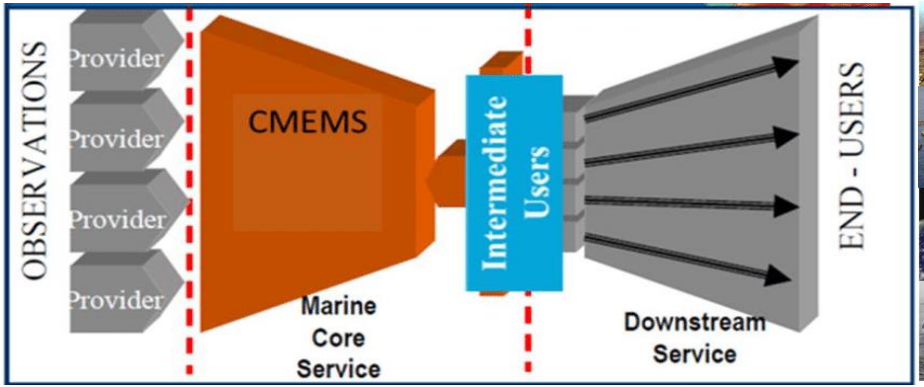
Modelling/data assimilation (incl. ocean forecasts)

Ocean Monitoring Indicators – Ocean State Reports - Assessment

The service layer (user desk, user support, user interaction)

Core (generic & European added value) and Downstream services

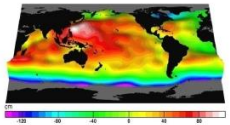
EU Copernicus Satellite Component (Sentinels)
EU in-situ observing system (EOOS)
International networks and organizations (GOOS, JCOMM, CEOS)



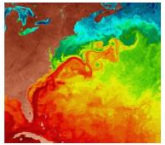
The essential role of observing systems

The Copernicus Marine Service offer is highly dependent on the satellite and in-situ observing capabilities (validation, assimilation).

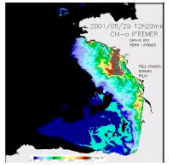
Present and future requirements both for in-situ and satellite observations (Sentinels) have been defined (technical reports and OceanObs19 CWP).



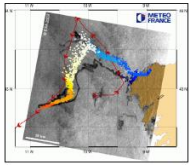
Altimetry and gravimetry
(sea level and ocean currents)



Sea Surface Temperature

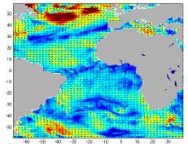


Ocean Colour
(Chl-a, SPM)

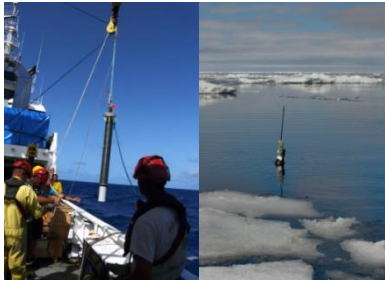


Surface roughness from SAR
(e.g. waves, winds, oil slicks)

Sea Ice (concentration, drift, thickness)



Winds
(speed and direction)



SYSTEMATIC REVIEW ARTICLE Provisionally accepted The full-text will be published soon. Notify me

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Recommendations (1/3)

General requirements: added value chain and user interaction from CMEMS perspective

- **User requirements should drive service evolution requirements which in turn should drive observation requirements.**
- **Transforming user needs into observation requirements requires a good understanding of the value chain: observations, integration in data assimilation systems, intermediate users (e.g. downstream/specialized service providers) and end users.**
- **Gathering user feedback is essential. This is best done at the level of intermediate users. Important to interact with users on future service capabilities: user pull and science/technology push (observations, modelling, service).**
- **Observations are a fundamental pillar of the value chain and operational oceanography is highly dependent on the timely availability of comprehensive satellite and in situ observations.**
- **Use of model and data assimilation is an essential step that transforms sparse in situ and surface satellite observations into 4D ocean fields and forecasts (information). Such a science based and state of the art approach is required to best serve applications and users.**

Recommendations (2/3)

CMEMS requirements for the evolution of the global and regional observing systems

- Same backbone system but OO has specific requirements (e.g. timeliness, resolution).
- Continuity of the present capability of the Copernicus Sentinel missions should be ensured.
- On the mid-term (2025), need a European passive microwave mission (CIMR). Continuity with improvements of Cryosat-2 (CRISTAL). Fly SKIM to demonstrate its potential (surface currents)
- On the longer term (2030), new capabilities for operational wide swath altimetry and geostationary ocean colour mission over Europe should be developed.
- Critical sustainability and sampling gaps for in-situ observations. Major gaps for BGC EOVs.
- Consolidation of the Argo core mission (T&S–0-2000 m) incl. sampling of polar and marginal seas and developing its two major extensions (BGC Argo, Deep Argo) is a very high priority for CMEMS.
- Reference measurements from long time series at fixed points from moorings and ship based hydrographic surveys with the best quality standards (GO-SHIP) standards.
- Improving European ROOSes and key regional/coastal observing systems such as ferry-boxes, gliders, tide gauges and HF Radars are strong priorities. Specific effort for the Arctic region required.
- In-situ data (FRMs) (Cal/Va) for all variables estimated by the Copernicus Satellite component.

Recommendations (3/3)

CMEMS requirements for the evolution of the global and regional observing systems

- **Open data policy, real time data delivery (< 1-2 days) should become a standard for all in-situ and satellite EOVs.**
- **The delayed mode high quality data processing systems should be closely coordinated with the real time data processing systems.**
- **Interaction with and feedback from modelling and data assimilation systems should be part of the routine activities of data and forecasting centers.**
- **It is essential to strengthen CMEMS and OO capabilities to assess the impact of present and future observations to guide observing system agencies but also to better use observations in models (OSEs and OSSEs). Need stronger partnerships between modeling/data assimilation and observation experts (from physics to biology).**
- **These activities should be developed further in Copernicus 2.0 (post 2021) in cooperation with international partners (e.g., GODAE OceanView/OceanPredict programme).**

Main messages

- Complex value-added chain from observations to information & users
- Ocean observations play a fundamental role
- Synergies and complementarities in-situ, satellite observations & models
- Integration physics, biogeochemistry and biology
- Development of the global ocean observing system should be jointly organized with the development of operational oceanography (feedback, requirements, impact and sustainability).
- Strengthen OSEs/OSSEs capabilities in CMEMS and OO centers and develop strong partnerships with the observing communities (e.g. joint task team GOOS/OceanPredict). One important recommendation for OceanObs19.

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