

Marine Monitoring


Copernicus Marine Service

Plans for Copernicus 2 with a focus on the coastal zone

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European Commission | Copernicus | Implemented by | MERCATOR OCEAN INTERNATIONAL




Marine Monitoring

OUTLINE



1. Copernicus Marine Service as of today
2. Drivers for service evolution
3. Plans for Copernicus 2
4. Plans for the coastal zone



Copernicus | European Commission



Marine Monitoring

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The Copernicus Marine Service

CMEMS: An operational state of the art user and policy driven EU marine service

Ocean Information

OCEAN PRODUCTS

Ocean product catalogue, to download or visualize data across more than 40 variables, including historic, current and forecasted data.

DATA

OCEAN MONITORING INDICATORS

Essential variables monitoring the health of the ocean


TRENDS


OCEAN STATE REPORT

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

EXPERTISE


User & Policy driven





29,000

User Support



#CMEMSTraining

WORKSHOPS

OUTREACH

SERVICE DESK

Applications

ENVIRONMENT

POLAR ENVIRONMENT
MONITORING

OCEAN HEALTH

CLIMATE & ADAPTATION

MARINE CONSERVATION & BIODIVERSITY

SOCIETY

POLICIES & OCEAN GOVERNANCE & MITIGATION

EDUCATION PUBLIC, HEALTH & RECREATION

SCIENCE & INNOVATION

EXTREMES, HAZARDS & SAFETY

ECONOMY


COASTAL SERVICES

MARINE FOOD



NATURAL RESOURCES & ENERGY

TRADE & MARINE NAVIGATION


2



Marine Monitoring

Drivers for Copernicus Marine Service Evolution










Copernicus Marine Service - Drivers


The ocean = food, energy , global economy

Face strong pressures due to climate change and other human activities

Increasing needs of ocean monitoring and prediction capabilities from global to coastal scales:

- 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 Political Agenda

EU framework:

- Stronger integration into EU policies: Green Deal, Digital Strategy, CFP, Arctic Policy, MSFD, MSP, International Ocean Governance.

International framework:

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



17 SUSTAINABLE GOALS



United Nations Decade of Ocean Science for Sustainable Development 2021 - 2030



EU Arctic policy



Proposed Mission: **Mission Starfish 2030: Restore our Ocean and Waters**







G7 FUTURE OF THE SEAS AND OCEANS (FSOI)



International Ocean Governance



opernicus
Europe's eyes on Earth




European Commission

CFP

Marine knowledge

MSFD MSP



User and Policy Needs

EU INSTITUTIONS

EUROPEAN COMMISSION

Brussels, 25.10.2019
SWD(2019) 194 final

COMMISSION STAFF WORKING DOCUMENT
Expression of User Needs for the Copernicus Programme

User requirements for Copernicus 2 detailed in the EC Staff Working Document (SWD, 2019) based on marine user requirements gathered by EC and CMEMS



User and Policy Driven


Green Deal, Space Policy, Digital Strategy, Arctic Policy, Marine Strategy, Maritime Spatial Planning, UN Biodiversity Convention, UNFCC, Paris Agreement,...

Fishery, aquaculture, marine renewable energy, maritime transport & safety, climate and climate adaptation, coastal zone management

Coastal, high resolution, climate projection, biology (plankton to fish, scenarios) & biodiversity


OFFER (vertical) vs APPLICATIONS (horizontal)	ENVIRONMENT	SOCIETY	ECONOMY
ENVIRONMENT	CLIMATE CHANGE ADAPTATION	COASTAL ZONE MANAGEMENT	PLANNING AND MANAGEMENT OF A SUSTAINABLE AND RESILIENT OCEAN
SOCIETY	COASTAL ZONE MANAGEMENT	PLANNING AND MANAGEMENT OF A SUSTAINABLE AND RESILIENT OCEAN	COASTAL ZONE MANAGEMENT
ECONOMY	CLIMATE CHANGE ADAPTATION	PLANNING AND MANAGEMENT OF A SUSTAINABLE AND RESILIENT OCEAN	PLANNING AND MANAGEMENT OF A SUSTAINABLE AND RESILIENT OCEAN
SUPPORT TO POLICIES	Blue Economy, SDG 14, SDG 13, SDG 11, SDG 12, SDG 15, SDG 17, SDG 8, SDG 9, SDG 10, SDG 7, SDG 6, SDG 5, SDG 4, SDG 3, SDG 2, SDG 1, SDG 16, SDG 18, SDG 19, SDG 20, SDG 21, SDG 22, SDG 23, SDG 24, SDG 25, SDG 26, SDG 27, SDG 28, SDG 29, SDG 30, SDG 31, SDG 32, SDG 33, SDG 34, SDG 35, SDG 36, SDG 37, SDG 38, SDG 39, SDG 40, SDG 41, SDG 42, SDG 43, SDG 44, SDG 45, SDG 46, SDG 47, SDG 48, SDG 49, SDG 50, SDG 51, SDG 52, SDG 53, SDG 54, SDG 55, SDG 56, SDG 57, SDG 58, SDG 59, SDG 60, SDG 61, SDG 62, SDG 63, SDG 64, SDG 65, SDG 66, SDG 67, SDG 68, SDG 69, SDG 70, SDG 71, SDG 72, SDG 73, SDG 74, SDG 75, SDG 76, SDG 77, SDG 78, SDG 79, SDG 80, SDG 81, SDG 82, SDG 83, SDG 84, SDG 85, SDG 86, SDG 87, SDG 88, SDG 89, SDG 90, SDG 91, SDG 92, SDG 93, SDG 94, SDG 95, SDG 96, SDG 97, SDG 98, SDG 99, SDG 100	Blue Economy, SDG 14, SDG 13, SDG 11, SDG 12, SDG 15, SDG 17, SDG 8, SDG 9, SDG 10, SDG 7, SDG 6, SDG 5, SDG 4, SDG 3, SDG 2, SDG 1, SDG 16, SDG 18, SDG 19, SDG 20, SDG 21, SDG 22, SDG 23, SDG 24, SDG 25, SDG 26, SDG 27, SDG 28, SDG 29, SDG 30, SDG 31, SDG 32, SDG 33, SDG 34, SDG 35, SDG 36, SDG 37, SDG 38, SDG 39, SDG 40, SDG 41, SDG 42, SDG 43, SDG 44, SDG 45, SDG 46, SDG 47, SDG 48, SDG 49, SDG 50, SDG 51, SDG 52, SDG 53, SDG 54, SDG 55, SDG 56, SDG 57, SDG 58, SDG 59, SDG 60, SDG 61, SDG 62, SDG 63, SDG 64, SDG 65, SDG 66, SDG 67, SDG 68, SDG 69, SDG 70, SDG 71, SDG 72, SDG 73, SDG 74, SDG 75, SDG 76, SDG 77, SDG 78, SDG 79, SDG 80, SDG 81, SDG 82, SDG 83, SDG 84, SDG 85, SDG 86, SDG 87, SDG 88, SDG 89, SDG 90, SDG 91, SDG 92, SDG 93, SDG 94, SDG 95, SDG 96, SDG 97, SDG 98, SDG 99, SDG 100	Blue Economy, SDG 14, SDG 13, SDG 11, SDG 12, SDG 15, SDG 17, SDG 8, SDG 9, SDG 10, SDG 7, SDG 6, SDG 5, SDG 4, SDG 3, SDG 2, SDG 1, SDG 16, SDG 18, SDG 19, SDG 20, SDG 21, SDG 22, SDG 23, SDG 24, SDG 25, SDG 26, SDG 27, SDG 28, SDG 29, SDG 30, SDG 31, SDG 32, SDG 33, SDG 34, SDG 35, SDG 36, SDG 37, SDG 38, SDG 39, SDG 40, SDG 41, SDG 42, SDG 43, SDG 44, SDG 45, SDG 46, SDG 47, SDG 48, SDG 49, SDG 50, SDG 51, SDG 52, SDG 53, SDG 54, SDG 55, SDG 56, SDG 57, SDG 58, SDG 59, SDG 60, SDG 61, SDG 62, SDG 63, SDG 64, SDG 65, SDG 66, SDG 67, SDG 68, SDG 69, SDG 70, SDG 71, SDG 72, SDG 73, SDG 74, SDG 75, SDG 76, SDG 77, SDG 78, SDG 79, SDG 80, SDG 81, SDG 82, SDG 83, SDG 84, SDG 85, SDG 86, SDG 87, SDG 88, SDG 89, SDG 90, SDG 91, SDG 92, SDG 93, SDG 94, SDG 95, SDG 96, SDG 97, SDG 98, SDG 99, SDG 100
BLUE OCEAN	Climate Change Adaptation	Coastal Zone Management	Planning and Management of a Sustainable and Resilient Ocean
GREEN OCEAN	Climate Change Adaptation	Coastal Zone Management	Planning and Management of a Sustainable and Resilient Ocean
WHITE OCEAN	Climate Change Adaptation	Coastal Zone Management	Planning and Management of a Sustainable and Resilient Ocean



Main drivers guiding CMEMS long term evolutions

Policies, Users and markets



C) Developing UPTAKE

B) Producing core DATA

A) Valuing INPUT data




Marine Service

Partnership & Co production


Observations & Research

Copernicus Marine Environment Monitoring Service											
ENVIRONMENT				SOCIETY				ECONOMY			
POLAR ENVIRONMENT MONITORING	MARINE CONSERVATION & BIODIVERSITY	OCEAN HEALTH	CLIMATE & CLIMATE ADAPTATION	POLICES & OCEAN GOVERNANCE & MITIGATION	EDUCATION, PUBLIC HEALTH & RECREATION	SCIENCE & INNOVATION	EXTREMES, HAZARDS & SAFETY	COASTAL SERVICES	MARINE FOOD	NATURAL RESOURCES & ENERGY	TRADE & MARINE NAVIGATION
<small>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</small>				<small>Arctic Policy, MSFD, MSP, WFD, ICG, The Sendai Framework for Disaster Risk Reduction, SDG 1, 2, 3, 4, 5, 6, 7, 9, 11 and 16, 17</small>				<small>Space policy, Food Directive, Green Deal, Energy Policy, Air Quality Directives, SDG 6, 9, 10, and 12, 17</small>			

- The Ocean **higher than ever** on the **political agenda**
- **Increasing user&policy needs**
- Users calling for a consistent **BLUE /WHITE/GREEN** offer
- **Continuity of service with incremental evolutions**
- **Coastal, Arctic, Marine Biology & Climate** calling for more
- **Integration of WEkEO/Cloud based digital approaches**
- **Strengthen links between the different Copernicus Services**







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Marine Monitoring

Copernicus Marine Service : Plan for Copernicus 2



Marine Monitoring

An ambitious plan for 2021 - 2027

An ambitious 7-year plan that allows a staged implementation depending on budget implementation, user needs and priorities and feasibility/maturity

3 levels of implementation : baseline, enhanced continuity, new services

Products versus Users and Policy Needs

OFFER (vertical) vs APPLICATIONS (horizontal)	ENVIRONMENT			SOCIETY			ECONOMY		
	Climate	Marine	Coastal	Health	Quality of life	Employment	Productivity	Trade	Energy
SUPPORT TO POLICIES	[Detailed grid of implementation status]								
BLUE OCEAN	[Detailed grid of implementation status]								
GREEN OCEAN	[Detailed grid of implementation status]								
WHITE OCEAN	[Detailed grid of implementation status]								

Baseline, enhanced continuity

OFFER (vertical) vs APPLICATIONS (horizontal)	ENVIRONMENT			SOCIETY			ECONOMY		
	Climate	Marine	Coastal	Health	Quality of life	Employment	Productivity	Trade	Energy
SUPPORT TO POLICIES	[Detailed grid of implementation status]								
COASTAL OCEAN	[Detailed grid of implementation status]								
BLUE OCEAN	[Detailed grid of implementation status]								
GREEN OCEAN	[Detailed grid of implementation status]								
WHITE OCEAN	[Detailed grid of implementation status]								

New services



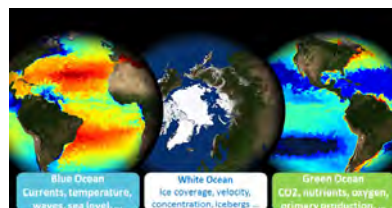
Marine Monitoring

Baseline

Continuity of the current service

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 S1,2,3 & 6 A/B+C/D and in situ (eg BGC Argo)**
- **Governance: Proposition to set up a National Marine Stakeholders' committee**
- **Program consistency: Production of Marine Data for other Copernicus services (C3S, CEMS, ...)**



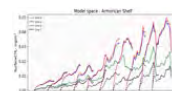
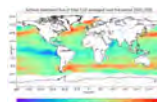
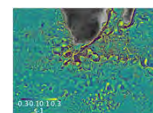


Enhanced continuity

Major product improvements

To better answer user needs and to keep the service at the state-of-the-art:

- Improved digital/cloud services
- Higher resolution
- Ensemble forecasts and extended range forecasts
- Arctic / step changes
- Air/sea CO2 fluxes
- 20th century reanalyses



Enhanced continuity activities will be developed depending on priorities, precursor projects (H2020, Horizon Europe) and budget constraints.

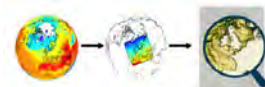
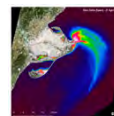


New Services

New and innovative services

To meet the new ocean monitoring & forecasting challenges required by European policies and users and to remain at the fore front of international developments :

- Coastal
- Marine biology
- Climate projections (coastal&ecosystems)



New services will be developed depending on priorities, precursor projects (H2020, Horizon Europe) and budget constraints.



Interfaces with the other Copernicus Services

Specific products will / could be prepared for the other services:

- Climate reprocessing of satellite ocean ECVs at the request of the Climate Change service **(C3S)**.
- European sea level and wave forecasts products as inputs for coastal flooding modelling for the Emergency Service **(CEMS)**.
- Air/sea fluxes of CO2 as required by the **CO2** service .
- Monitoring of tropical cyclones from Sentinel 1 for the Emergency Service **(CEMS)**.

Copernicus Knowledge Hubs (CKHs) :

CKHs will gather the ensemble of information generated by several Copernicus services for a given high level topic. MOi identified to lead a Coastal and an Arctic hub. Use of WEKEO infrastructure.



Blue Ocean
Currents, temperature, waves, sea level, ...


White Ocean
Ice coverage, velocity, concentration, Icebergs ...

Green Ocean
CO2, nutrients, oxygen, primary production, ...



CMEMS 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


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Marine Monitoring

Plans for the coastal zone



Marine Monitoring

Coastal Zone Monitoring: DRIVERS

Coastal zones:

- Tremendous social, economic & biological value but high level of pressure
- User needs for a wide range of applications
- Needs of European Policies (WFD, MSFD, MSP, Green Deal)

ENVIRONMENT

POLAR ENVIRONMENT MONITORING

OCEAN HEALTH

CLIMATE & ADAPTATION

MARINE CONSERVATION & BIODIVERSITY

SOCIETY

POLICIES & OCEAN GOVERNANCE & MITIGATION

EDUCATION, PUBLIC HEALTH & RECREATION

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ECONOMY




COASTAL SERVICES


MARINE FOOD

NATURAL RESOURCES & ENERGY

TRADE & MARINE NAVIGATION

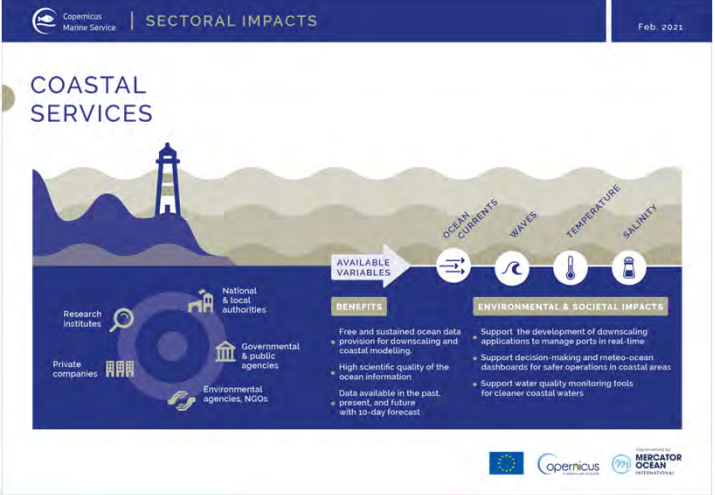













CMEMS and Coastal Users

CMEMS: a core European service that serves many downstream coastal zone applications and European policies (WFD, MSFD, MSP, Green Deal)















Coastal users: The Copernicus Marine Service offer

Available now and in Copernicus 2 baseline

Waves, sea level, sea surface temperature, winds, ocean colour, sea-ice : continuous improvements including for the coastal zone



Evolution of CMEMS for Coastal Users

SATELLITE
Vertical land motion, HFR, Plastic nutrients, HAB, Eutrophication, Shoreline changes, Cliffs erosion

IN SITU OBS.
OCEAN COLOUR, WAVES, WIND, CO₂ Acidification, HEAT TEMPERATURE, SEA LEVEL CHANGES

MODEL
CURRENTS, Ship Incident Oil spill, Warming

Copernicus Marine Service Copernicus Land Service

Evolution of CMEMS for coastal zones

Copernicus Environment Monitoring Service

MERCATOR OCEAN INTERNATIONAL Copernicus European Commission European Environment Agency

Roadmap for the evolution of Copernicus marine and land services to better serve coastal users

+ MED7 White Paper

December 5th, 2018

+ Discussion engaged with

European Commission Copernicus MERCATOR OCEAN INTERNATIONAL

Coastal zone hazards and monitoring

Improving CMEMS offer for Coastal Zone monitoring and forecasting - User & Policy needs
Synergy with other Copernicus Services and EMODnet

Evolution of CMEMS for Coastal Users

Marine Monitoring

Pan-European monitoring of coastal zones : improved and new satellite derived products

New products in Copernicus 1:


- High-resolution (5Hz) along-track altimetry (SLA)
- S2 Turbidity, Chl, SPM, RRS in coastal areas from (May 2021)
- S3 OLCI at full resolution (300m) in coastal zones (May 2021)

Potential new products (concertation with MS):

- Dynamic, time-evolving nearshore bathymetry (link EMODnet)
- High-resolution winds
- In-situ data (JERICO, link EMODnet)
- Spectral wave information in EU coastal zone
- Detection of plastic debris and monitoring of marine litter (depending on R&D advances)

To be developed depending on priorities, precursor projects (H2020, Horizon Europe) and budget constraints.

Copernicus MERCATOR OCEAN INTERNATIONAL




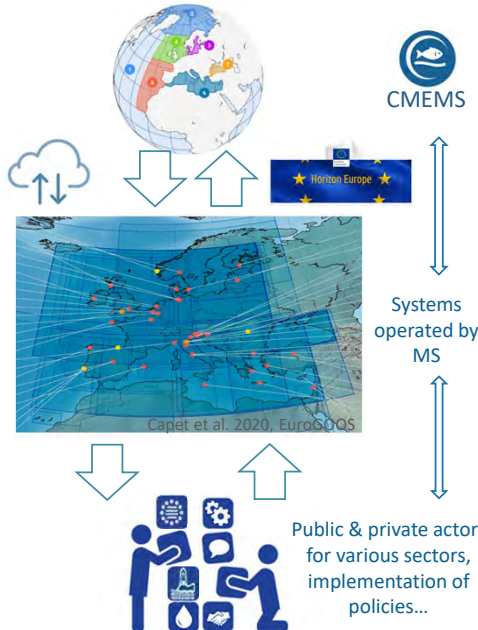
Evolution of CMEMS for coastal users

Co-production of model-derived info between CMEMS & Member States services:


(1) Full coupling between CMEMS & a series of coastal models operated by MS:

- **Co-designed cloud environment & tools for co-production** (Copernicus Marine Data Store)
- **Forcing conditions / Enhanced consistency in represented processes** (physics + bio) between the regional and coastal models:
 - Tides, HF processes, coupling effects, smaller scales....
 - Consistent datasets and forcing fields, operational and flexible interfaces, common standards, ...
 - Standardized methods to couple hydrological models with global, regional and coastal ocean models







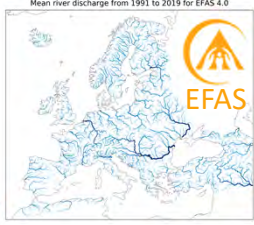
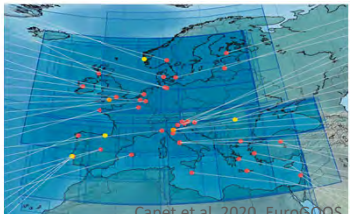
Caplet et al. 2020, EuroGOOS




Evolution of CMEMS for Coastal Users

Co-production of model-derived info between CMEMS & Member States services:


(2) Provision of past-present-forecasted time-series of standardized modelled river discharges (freshwater, nutrients, particulate and dissolved matter)

(3) Integration in CMEMS portfolio of coastal model derived info



To be developed depending on priorities, precursor projects (H2020, Horizon Europe) and budget constraints.





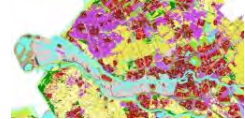
Copernicus Coastal Knowledge Hub – Copernicus 2

Interfaces and synergies between the different Copernicus services will be strengthened in Copernicus 2.

Copernicus Knowledge Hubs (CKH) proposed to regroup under one single entry point the information generated by several Copernicus services for a given high level topic.

- ⇒ Collect and maintain in a single catalogue the relevant products and information.
- ⇒ Harmonize these inputs and provide to users guidance and support with the help of the contributing Copernicus services.

MOi identified to lead a **Copernicus Coastal Knowledge Hub** together with EEA, JRC and ECMWF (marine, land, emergency and climate change services). Use of WEKEO/DIAS infrastructure for the Coastal CKH proposed



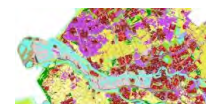
A one-stop coastal portal with a central service desk and an integrated catalogue including products from Copernicus services, Sentinel data and possibly other providers such as EMODnet.



Copernicus Knowledge Hub for Coastal Zones

A Coastal Copernicus Knowledge Hub could progressively offer:

- ✓ **A step-change characterization of coastal zones (land & marine)**, for both its environmental state but also its economic activity, infrastructures, population, and vulnerability: coastal-specific products and high resolution on land cover/land use, bathymetry and topography, ground motion, coast geology, shoreline position / erosion and the marine environment.
- ✓ **Modelling and forecasting of the marine coastal zones:** model products from CMEMS including seamless interfaces with downstream coastal systems.
- ✓ **River monitoring and forecasting** : Improved hydrological observation-based products (topology rivers, lakes, coasts, river discharge), modelled EU river discharges as well as water quality.
- ✓ **Coastal flooding:** hydrological floods and marine flooding from storm surges.
- ✓ **Climate change in the coastal zone and climate resilience** : products on regional marine climate change through the downscaling of global climate projections.





Evolution of CMEMS for Coastal Users / Next steps

Depending on the decision of the EC to start the implementation of Coastal Marine Extensions in Copernicus 2:

- Discussion with member states on first priorities (national marine stakeholder forum) (2021/2022)
- Start the implementation of new “core” European coastal satellite products (from 2022)
- Start the implementation of improvements of interfaces between CMEMS models and coastal systems operated by member states (from 2022)



Depending on the decision of the EC to start the implementation of the Copernicus Coastal Knowledge Hub:

- Start implementing a first version of the Copernicus Coastal Knowledge Hub (from 2022)



Marine
Monitoring

THANK YOU

Discover on



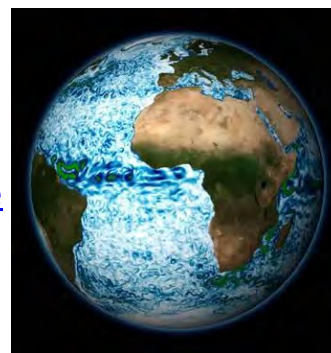
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