



Marine Monitoring

# A digital dive into sustainable use of the Ocean: the Copernicus Marine Service

Cecilia Donati, 24 January 2019,  
Southampton



Implemented by



# 1

## Ocean: a new digital global context

- In the last 20 years, a constant growth of the Ocean importance in the political agenda

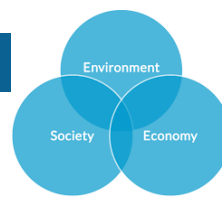


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# OCEANS: AN UNPRECEDENT GROUNDSWELL



POLICY MAKERS,  
INSTITUTIONS



BLUE GROWTH,  
BLUE ECONOMY



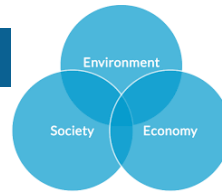
OCEAN LITERACY,  
ENGAGEMENT





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# OCEANS: AN UNPRECEDENT GROUNDSWELL



## POLICY MAKERS, INSTITUTIONS



## BLUE GROWTH, BLUE ECONOMY

 **500 billions € revenue**  
**5 million jobs**

**2010 Worldwide:**  
**1 500 Billions US\$ Added Value**  
**31 Million Direct FT jobs**

**2030 Worldwide:**  
**3 000 Billions US\$ Added Value**  
**43 Million Direct FT jobs (business as usual scenario)**  
+ strong performance expected from Marine Renewable Energy & Marine BioTechnology

## OCEAN LITERACY, ENGAGEMENT

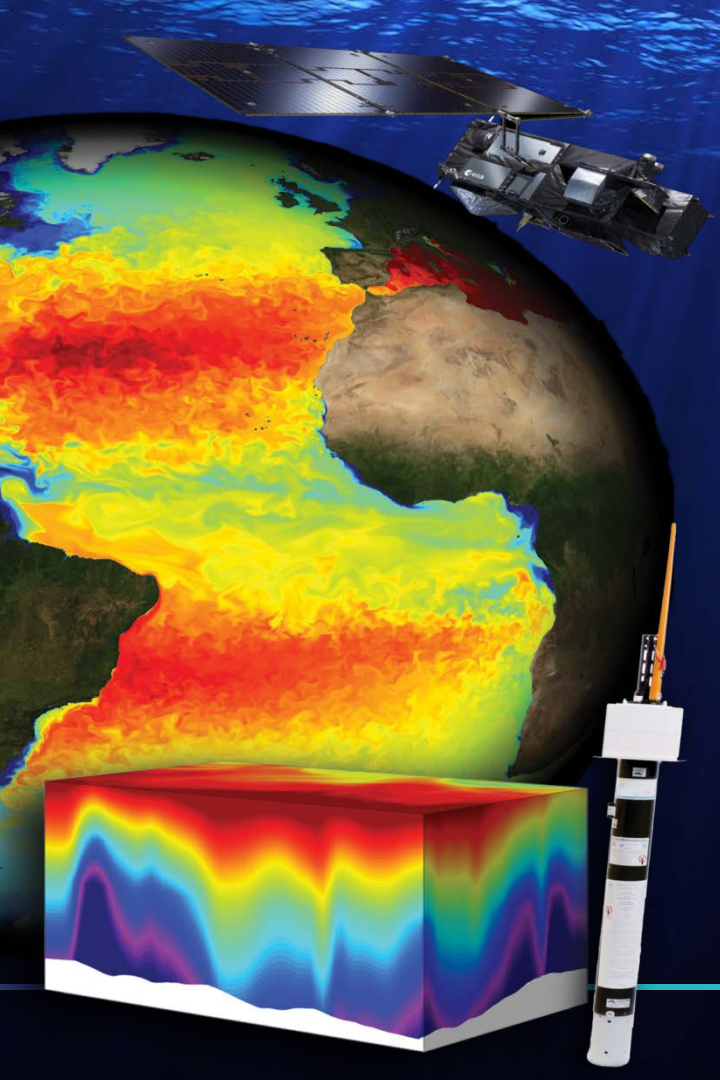


G7 Oceans Youth Innovation Challenge



**2014** : 50 Ocean-related NGOs  
**2018** : 100 NGOs only against plastic pollution

# BUILDING A REALISTIC DIGITAL OCEAN



Satellite-based data  
InSitu Data  
3D Models

Blue Ocean  
White Ocean  
Green Ocean

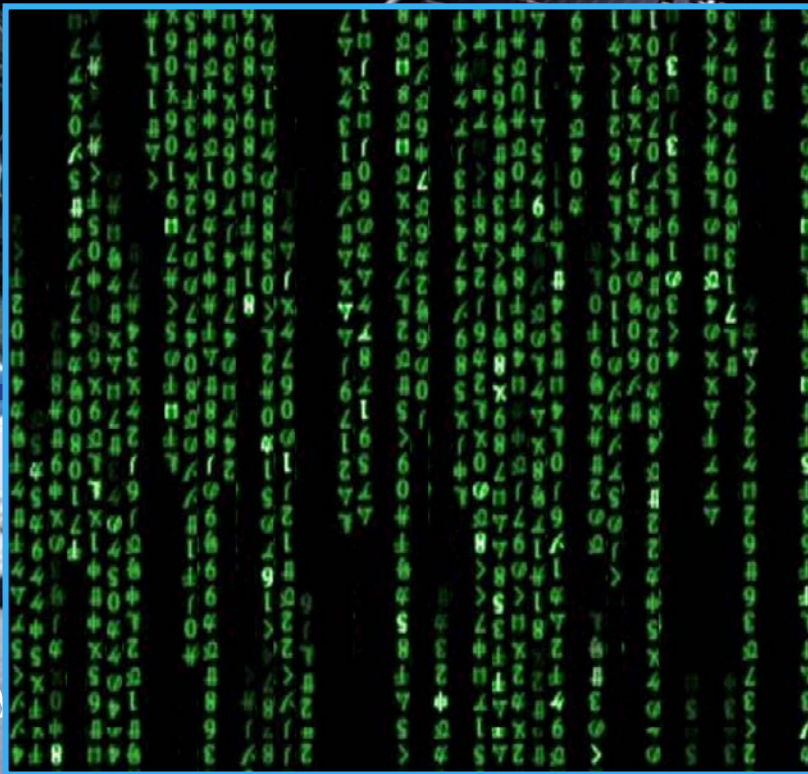
Past  
Present  
Future

## SPACE DATA

- Surface Data
- Space community
- Highly qualified engineering

## IN SITU DATA

- Water Column Data
- Seafarer community
- Fragmented datasets



## MODEL DATA

- 3D and 4D data
- Marine modelling
- Specific skills
- High computing costs

# 2

## The EU leverage

# The Copernicus Marine Service Offer and Ecosystem

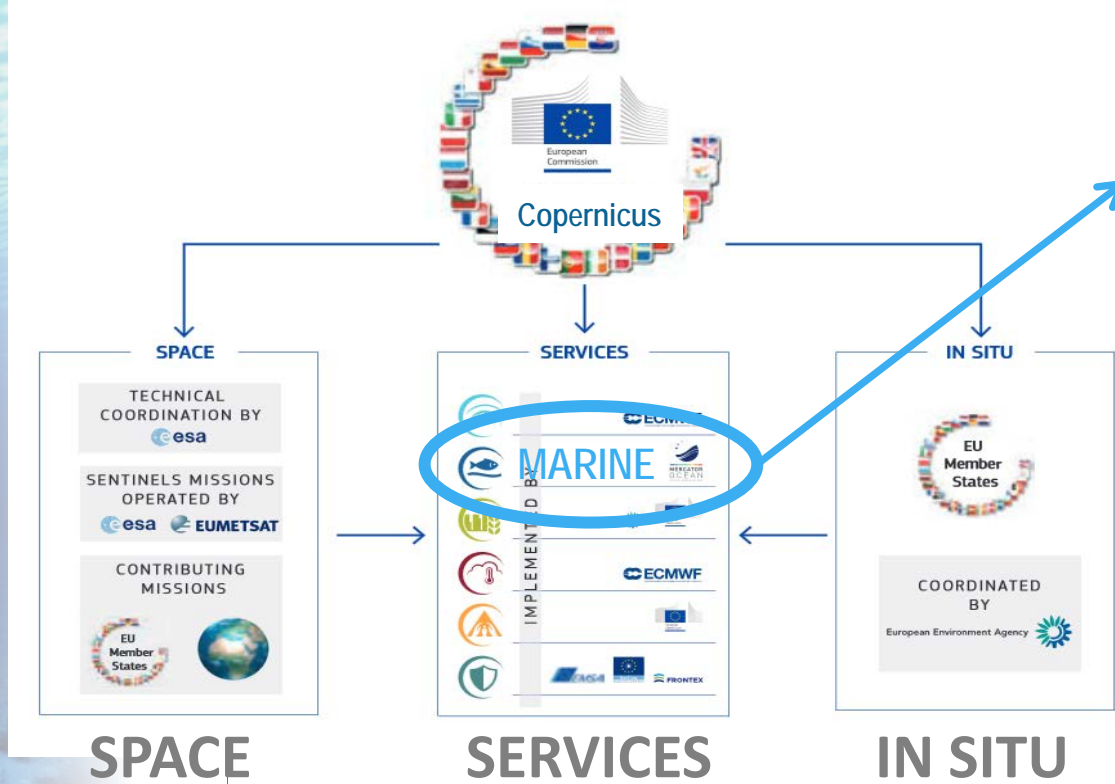


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# COPERNICUS, EUROPEAN UNION PROGRAM



Mercator Ocean International is entrusted by the EU to implement Copernicus Marine Service



~700 M€/year invested by EU to monitor the Earth and develop the use of environmental data

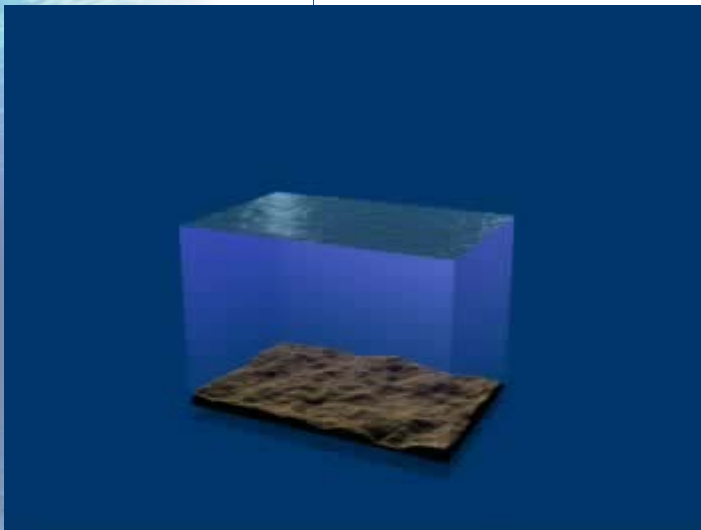






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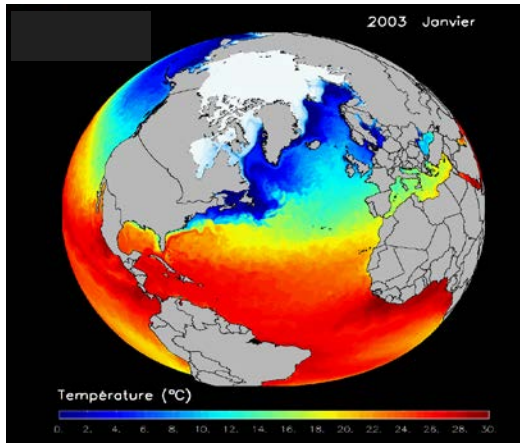
# COMBINING THE BEST SOURCES OF INFORMATION



1. Satellite



2. In situ



3. Modelling





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# COPERNICUS, A STRUCTURING VALUE CHAIN



**Space Infrastructure**  
Manufacturing of satellites, ground systems, launchers, ground operations

**Data Sales**  
Data acquisition  
Data processing  
Data archiving  
Data distribution and delivery

**Value-adding services**  
Data processing, adaptation to users' need, integration with data from other sources

**End markets**  
(transport, energy, health, ...)

OBSERVATION

CORE SERVICE OPERATORS



SPECIALISED SERVICE PROVIDERS

**Copernicus**  
3rd EO provider in the world





# WHAT OCEAN DATA DO WE PRODUCE ?

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Blue  
Ocean



White  
Ocean



Green  
Ocean





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# HOW DO WE DISSEMINATE ?

marine.copernicus.eu

**COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE**  
Providing PRODUCTS and SERVICES for all marine applications

European Commission

ABOUT US | MARKETS & BENEFITS | NEWS | SCIENCE & MONITORING | TRAINING & EDUCATION | SERVICES PORTFOLIO

SEARCH terms  OK

SHORT-CUT TO SERVICES

- REGISTER NOW!
- SCIENTIFIC QUALITY
- ONLINE TUTORIALS
- COLLABORATIVE FORUM

LATEST NEWS FLASH  
CMEMS:8633  
Delay in the update of ARCTIC PHY and BIO forecast production cycles on 2018-10-24  
**RESOLVED**

2018 24 OCT.

**ACCESS YOUR OCEAN INFORMATION**

GETTING STARTED →

- OCEAN PRODUCTS**  
Ocean product catalogue, to download or visualize data across more than 10 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 →

28 MONDAY EVENTS AGENDA

PARTNERS AND STAKEHOLDERS

FOCUS ON

TRAINING AGENDA

**OUR OCEAN CONFERENCE, 29-30 OCTOBER IN BALI**

Policy and decision makers, scientists, experts and business people will meet for the 2018 edition of the Our Ocean Conference, from 29 to 30 October in Bali, Indonesia. The Copernicus Programme and Marine Service will be presented to illustrate how ocean observation and analysis are vital to meeting the global environmental and economic challenges of today and tomorrow.

READ MORE

OUR OCEAN  
BALI, 29-30 OCTOBER 2018

- OCEAN PRODUCTS**  
Ocean forecasts
- OCEAN INDICATORS**  
Ocean Reanalyses
- OCEAN STATE REPORT**  
Ocean metrics

Free , Open, Assessed



# WHO DO WE DELIVER ?

RELIABILITY

INNOVATION

GLOBAL SOURCING

AVAILABILITY

EASY ACCESS

SUSTAINABILITY



BUSINESS  
20%



GENERAL PUBLIC  
10%



GOV SERVICES  
20%



RESEARCH  
50%

More than **16 000 subscribers**  
(~ 2/3 active USERS)

Atlantic Ocean

Pacific Ocean

AFRICA

Indian Ocean



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# Ecosystem: MARINE STAKEHOLDERS IN EUROPE

- Governmental Bodies, Operational Centres, Research Centres
- IT and space Industry, Service providers, SMEs, entrepreneurs, large companies

## CMEMS SUPPLIERS

- 100+ operational suppliers (production centres)
- 50+ innovation partners (service evolution and uptake)





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# Ecosystem: MERCATOR OCEAN INTERNATIONAL

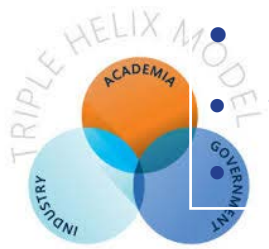


- CMEMS entrusted entity
- Ocean Forecasting centre

- General interest / non-for-profit
- Public shareholders
- European governance



- Worldwide service
- for gov, industry, academia with Science, Service, Partnerships



3

## CMEMS impacts: Our value for sustainable Ocean



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- Earth monitoring
- Socio-economy
- Industry
- Policies
- International





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## Value for POLICY MAKER

- Indicators and trends
- Synthetic information for evidence-based policies



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# ADDRESSING SDG 14.3



→ Ocean PH and acidity indicators **eurostat** 





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# SYNTHETIC EXPERT INFORMATION



Taylor & Francis  
Taylor & Francis Group



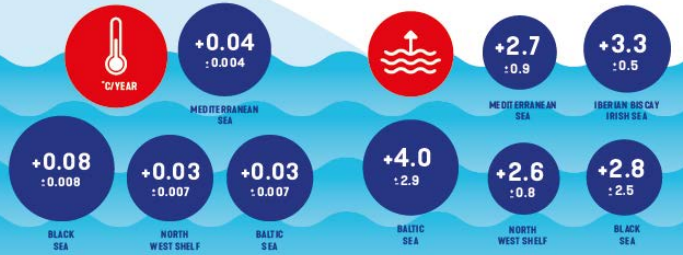
## IN THE LAST QUARTER OF A CENTURY

### GLOBAL THERMOSTERIC SEA LEVEL IS RISING



Sea level rise is mainly due to melting ice & thermal expansion (water expands when heated), a phenomena referred to as thermosteric rise. About 30% of contemporary sea level rise can be attributed to this thermal expansion.

### GLOBAL SEA LEVEL IS RISING



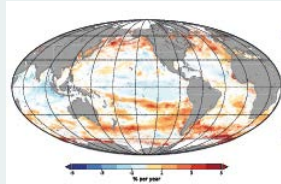
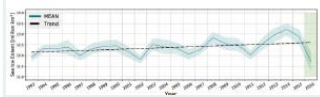
Implemented by



## Introduction



## Chapter 1 Essential Variables



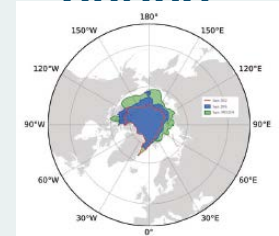
## Chapter 2 Changes in ocean climate



## Chapter 3 Changes in the regional European seas



## Chapter 4 Remarkable events during



From OSR1 to OSR2:

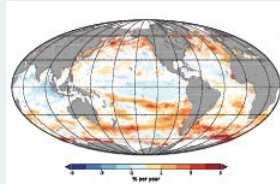
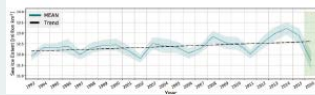
- Four additional essential variables & seven new topics for ocean climate
- Eight new European ocean indicators & increased collaboration of European research institutions



## Introduction



## Chapter 1 New ocean monitoring indicators

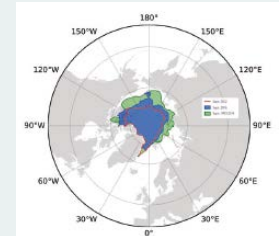
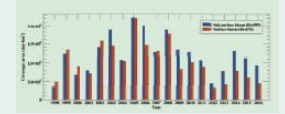


## Chapter 2 Case studies at the science/policy science/societal science/economy interfaces



## Chapter 3 Specific events during the year 2018 in European regional seas and the global ocean

## OMI Atlas



➔ Topical highlights such as ocean acidification, tropical and mid-latitude storms, coral bleaching, eutrophication, ...



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# MONITORING THE ARCTIC

NORTHERN  
HERMISPHERE

ARCTIC



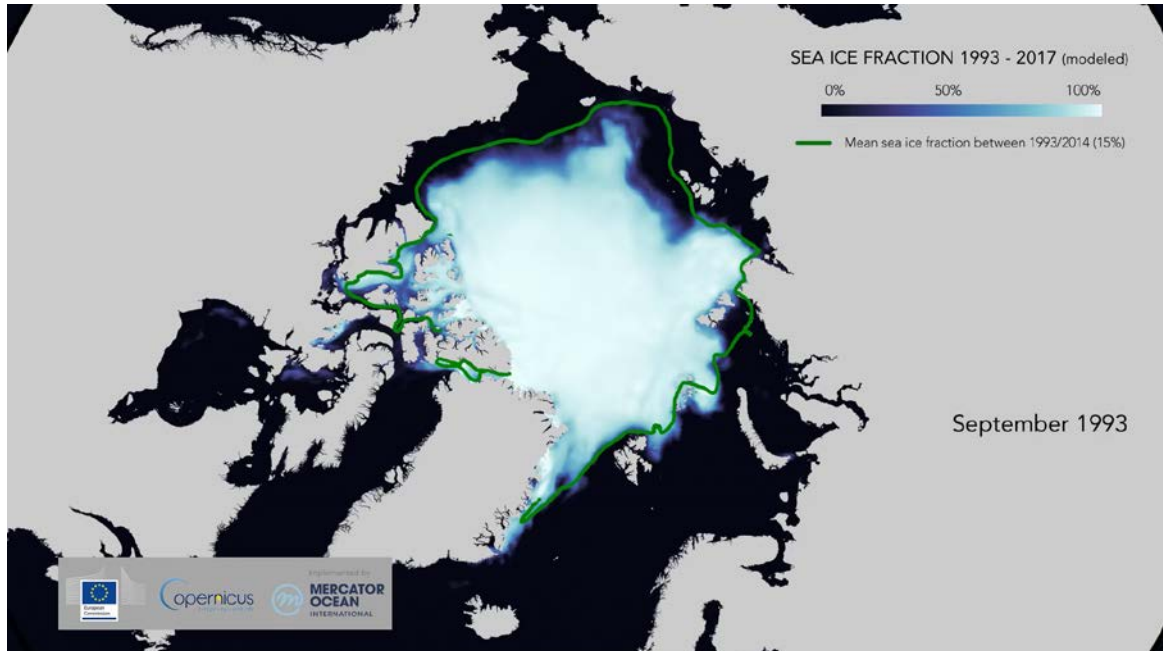
-6.2%

sea ice extent loss at a  
rate per decade (1993-2016)



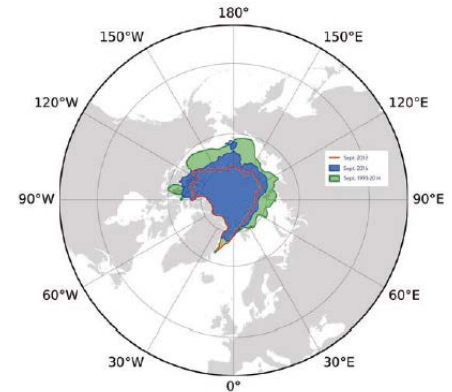
-780 000 km<sup>2</sup>

per decade of sea ice extent loss (1993-2016)  
Uncertainty: ± 70 000 km<sup>2</sup>/decade



Ten of the lowest  
Arctic summer sea  
ice extent values took  
place in the last ten  
years.\*

\* Ever observed on record  
by satellites



Copernicus  
Europe's eyes on Earth

MERCATOR OCEAN  
INTERNATIONAL



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# The Copernicus Marine Ocean Monitoring Indicators

## VISUALISATION



## DOCUMENTATION



## DATA DISTRIBUTION



<http://marine.copernicus.eu/science-learning/ocean-monitoring-indicators/>



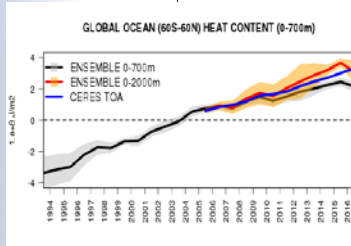


# The Copernicus Marine Ocean Monitoring Indicators

## IMPLEMENTED SINCE 2018 IN THE CMEMS CATALOGUE



### OCEAN HEAT CONTENT



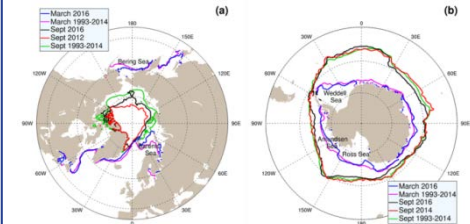
- IPCC
- GCOS in support of UN SDG framework
- Climate research
- Climate variability (e.g. ENSO, hurricanes)

### SEA LEVEL



- Agencies
- IPCC & climate science
- Flooding
- Impact on land use
- Coastal erosion

### SEA ICE



- Agencies
- IPCC & climate science
- Shipping routes





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# WATER QUALITY ANALYSIS

Partner to downscale « our » regional ocean to coastal and nearshore regions

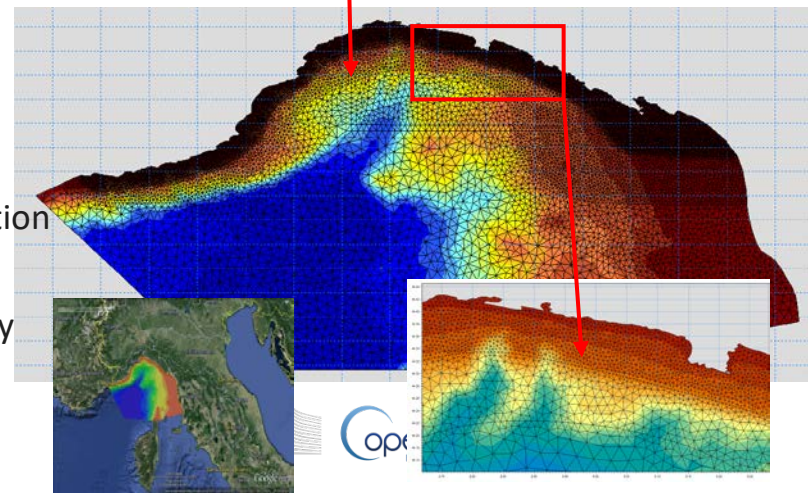
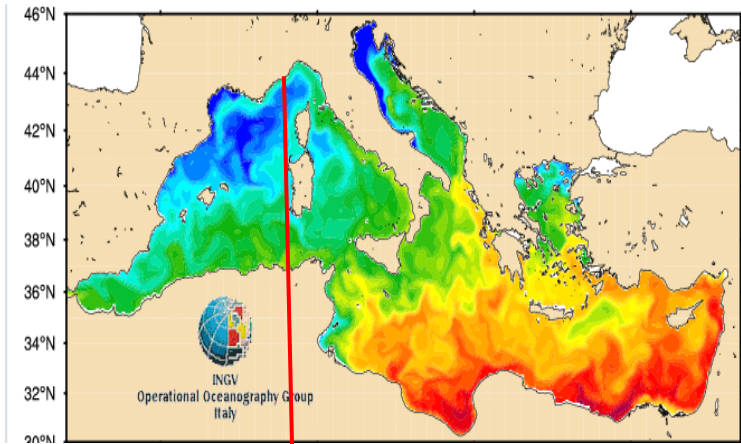
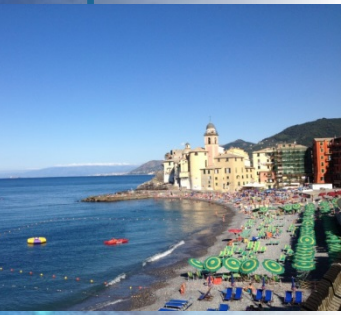
## SUEZ

- For the Authorities:
  - ❖ nearshore water quality
- For the General Public:
  - ❖ Smartphone App



IT Regional Env Agency / DHI

- ❖ Quality of **swimming water** – Tourism
- ❖ Transport of **sediment and mud** – Ports operation
- ❖ **Oil spill** – Maritime Safety
- ❖ Operation of **Search&Rescue** – Maritime Safety





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# SUPPORT MSFD REPORTING



**MARINE STRATEGY FRAMEWORK DIRECTIVE :**

- ENVIRONMENT MEASUREMENT and MONITORING PROGRAMME / **11 INDICATORS** TO ACHIEVE GOOD ENVIRONMENTAL STATUS(GES) BY 2020

1. Biological diversity
2. Non-indigenous species
3. Population of commercial fish / shell fish
4. Elements of marine food webs
5. Eutrophication
6. Sea floor integrity
7. Alteration of hydrographical conditions
8. Contaminants
9. Contaminants in fish and seafood for human consumption
10. Marine litter
11. Introduction of energy, including underwater noise

*Ocean Colour,  
Chlorophyl A*

*Currents*

*Currents and  
Temperature*



Deltares





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## Value for INDUSTRY & SERVICES

- **Operational data for decision-making support**
- **Timeliness, reliability**
- **System-to-system, interoperability**

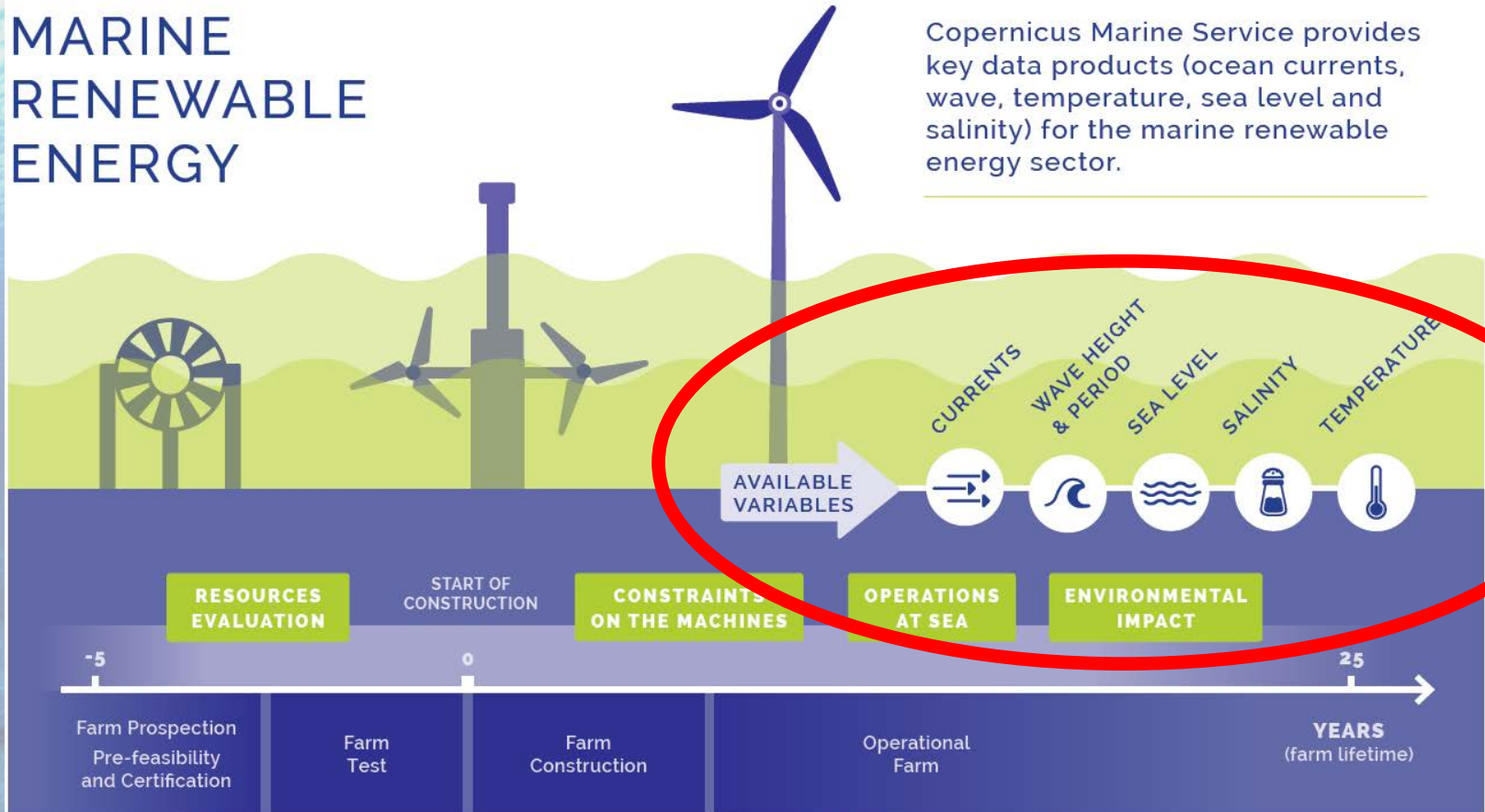


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# MARINE RENEWABLE ENERGY

## MARINE RENEWABLE ENERGY

Copernicus Marine Service provides key data products (ocean currents, wave, temperature, sea level and salinity) for the marine renewable energy sector.

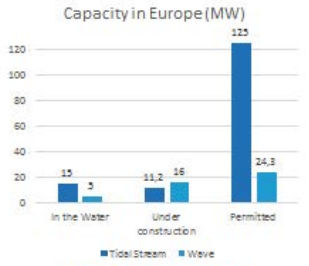




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# PARTNERSHIP WITH OCEAN ENERGY EUROPE

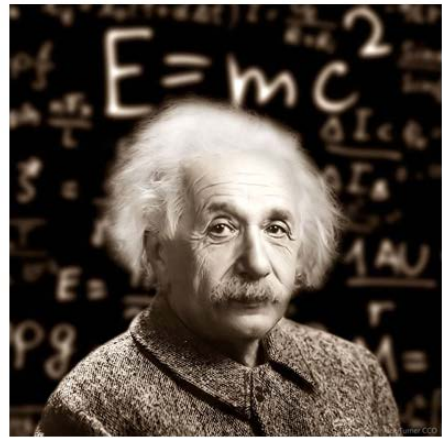
## 2017 Ocean Energy is setting sail



2050: 10% of EU electricity, 400.000 jobs

@eueos www.oceanenergy-europe.eu

## Why we need Copernicus... Europe's eyes on Earth



20% increase in current accuracy

=

50% increase of electricity production

=>

Data precision is key!

## Ocean Energy Europe



118 members - Lead Partners:



Yesterday @MercatorOcean signed a partnership w @OceanEnergyEU to foster the #uptake of @CMEMS\_EU products in the #oceanenergy sector&industry! It is a promising #bluegrowth sector and @CMEMS\_EU is a good tool to support its #marketdevelopment!





# MARITIME TRANSPORT

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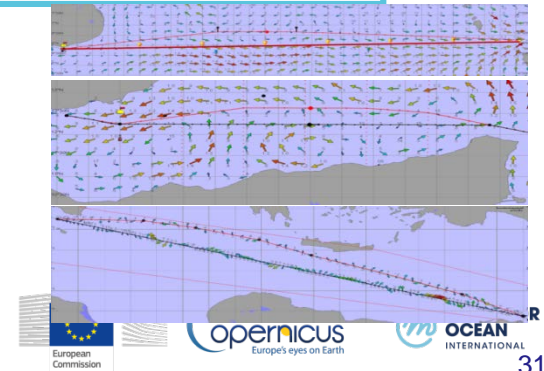
To reduce fuel consumption for ecological & economical reasons

3 options:

- ✓ Optimize engines, propellers, hulls...
- ✓ Improve organization...
- ✓ Take benefit of Meteorology/ Operational Oceanography( current observations and forecast)

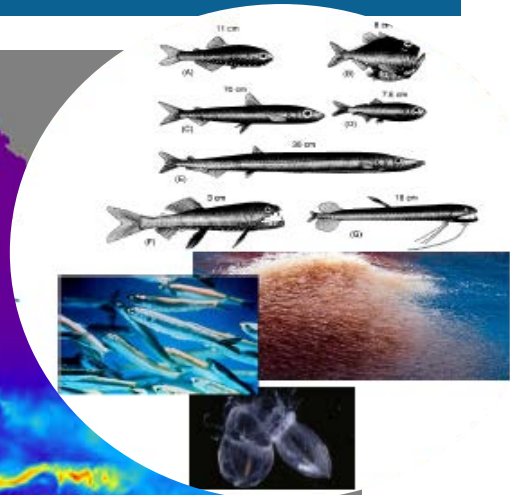
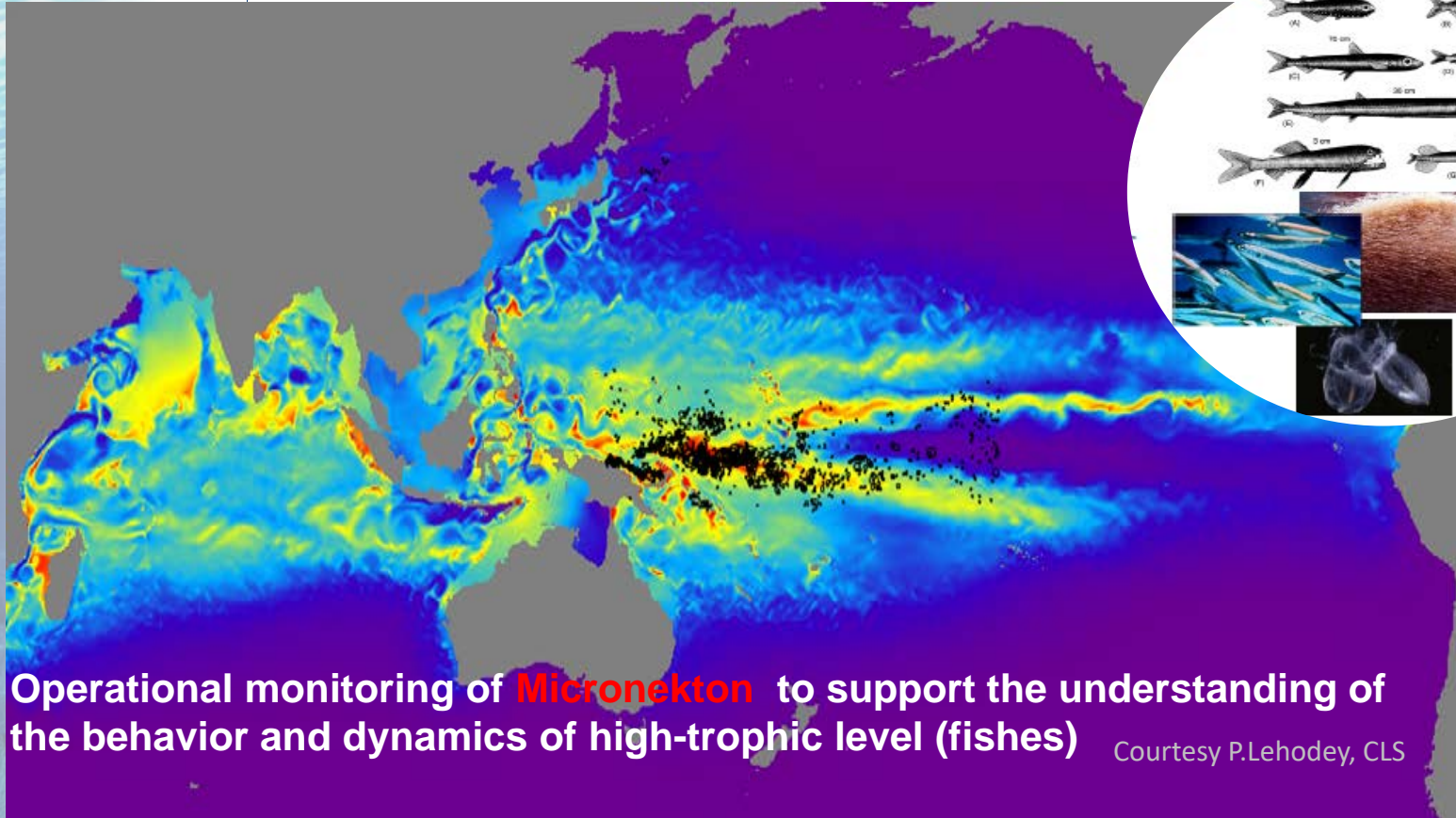
0,4 % = Average level of savings thanks to « current routing »  
(Line Europe-China Q2 2015)

**Target :** To save 1% thanks « current routing » ( current forecast reliability) would lead to 60 000t fuel saving for the whole fleet so as 180 000t CO2.





# FISHERIES and AQUACULTURE



Operational monitoring of **Micronekton** to support the understanding of the behavior and dynamics of high-trophic level (fishes)

Courtesy P.Lehodey, CLS



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# Bluefin Tuna in the Mediterranean Sea

- Chlorophyll-a,
- Sea Surface Temperature,
- Currents

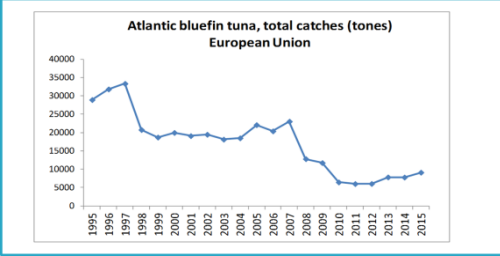
CORE DATA



**SPAWNING AREAS and LARVAL ABUNDANCES INDICES**



**TOTAL ALLOWABLE CATCHES**



EVIDENCE-BASED MANAGEMENT

EXPERT ASSESSMENT

Source : ICCAT







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## Value for SOCIETY

- **Awareness, conservacy**
- **Young generation engagement**



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## SUPPORTING NGOs ACTIONS

Copernicus supports Coral Guardian  
NGO to contribute to coral reef  
restoration in Indonesia



Helene Lepkowski, Coral Guardian, and Philippe Brunet, European Commission , 29 oct 2018, OurOcean2018



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# SUPPORTING PLASTIC POLLUTION COMBAT

eXpedition



# SUPPORTING THE YOUNG GENERATION



cean  
n the ocean  
men,

the ocean,  
ct the



Thomas Lesage

My name is Thomas Lesage. I am 14 years old and I am a world citizen with a mission to protect the ocean. For this reason, I have created an NGO

### Children Of The Oceans

in order to raise awareness among youth worldwide about the importance of protecting the ocean.

## My leaflet to save the Oceans

*« I want to act at my level and increase the awareness of kids from 9 to 11 years on the protection of the ocean. I will board a ship to visit schools worldwide. »*



2021  
2030

United Nations Decade  
of Ocean Science  
for Sustainable Development

# 4

## Value for USERS



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- User Uptake call
- Training
- User workshop



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# ( USE CASES ) SHOWCASING USERS AND USAGES

## SHOWCASING USE CASES ONLINE (marine.copernicus.eu)



**USE CASES**  
See examples of how CMEMS data is used. You can also download all use cases.

Geographical Area:  Area of benefit:  User typology:  Product in use:


**120 use cases available on line since September 2017=**

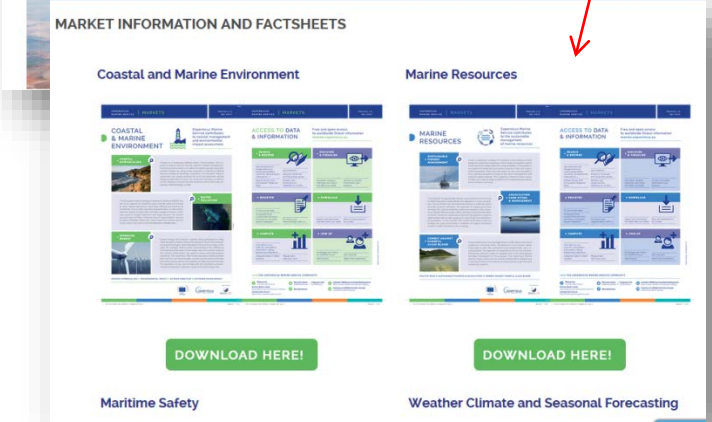
**120 downstream services promoted =**

**120 ideas of usage for prospective users**

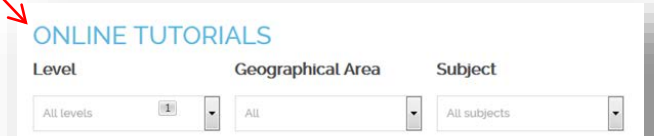


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# ( USER SUPPORT ) MORE MATERIAL AND PRESENCE



**Within 20 months, reaching out directly to more than 1200 people in 6 Member States : ( Private & Public Sectors ) Belgium, Estonia, Italy, Malta, Norway, Portugal, The Netherlands**



**Close to 40 online tutorials since July 2017 for beginners and experts , For users and prospective users**





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# THIR S U S E R U P T A K E C A L L

- Promoting **demonstrations of operational CMEMS downstream services**
- **Developing** the elements needed for the implementation of these services.
- **Coastal or Offshore** on one of the European Sea (5 lots), on the Arctic Ocean (2 lots) or on a part of the **Global Ocean** (5 lots).

## USE CASE DEMOS

The Copernicus Marine Service provides open and free-of-charge services. It is used by a wide range of actors across many marine sectors.

The Copernicus Marine Service **User Uptake** programme aims to reinforce its relationship with users by showcasing how Copernicus Marine Service information can be used, see the Use Case Demonstrations "Use Case Demos" below. This programme funds key players that develop services/applications using Copernicus Marine data and information. These demos serve as exemplary cases to inspire new users. Use Case Demos provide examples of: development of local economies, promotion of sustainable coastal management, and contributions to European Directives.

To learn more about the User Uptake strategy click [here](#).

Please browse the Use Case Demos funded by the **User Uptake** Programme below:

SEE USE CASE DEMOS

- ALL MARKETS
- Energy
- Marine Conservation & Policies
- Marine Food
- Maritime Navigation
- Safety & Disaster
- Water Quality





# 4

## Prospects

- Marine skills and digital
- Coastal, Arctic, Fisheries, Ocean CO2 (?)



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# 2019 CMEMS TRAINING PRELIMINARY AGENDA

In 2019, CMEMS training workshops will take place in various EU Members States



**Romania – Q2 (EU council Presidency)**

**BLACK SEA**



**Azores, Portugal - Q2**

**ATLANTIC  
(global)**



**Italy - Q3**

**MED SEA**



**Finland - Q3 (EU council presidency)**

**ARCTIC**



**Ireland – Marine Energy Q4**

**NWS**



**Sweden - Q4**

**BALTIC SEA**





# WEkEO

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## Welcome to WEkEO!

WEkEO is the EU Copernicus DIAS reference service for environmental data, virtual processing environments and skilled user support. Discover our current offering and roadmap.



Getting started







Access data



Access cloud-based



Contact user support

	ESSENTIAL OFFER	ADVANCED OFFER	FEDERATED OFFER
 <b>ALL COPERNICUS DATA</b> Discover, view & download data	✓	✓	
 <b>VIRTUAL ENVIRONMENT &amp; TOOLS</b> Transform Copernicus Data into your own specific business and promote them		✓	
 <b>USER SUPPORT</b> Benefit from skilled technical and customer support	✓	✓	
 <b>EXPAND YOUR OFFER TO YOUR USERS</b> Share your data & resources with WEkEO to expand your own offer in return			✓

JUNE 2018

DECEMBER 2018

APRIL 2019

**ESSENTIAL OFFER**

**ESSENTIAL OFFER is open to all for free.**

Before Dec 2018, a fragmented portfolio is available including some Copernicus Sentinel Satellite & Copernicus Services data for free download.

To benefit from ESSENTIAL OFFER, visit our website [wekeo.eu](http://wekeo.eu) or contact us at [support@wekeo.eu](mailto:support@wekeo.eu)

**ESSENTIAL OFFER is open to all for free.**

After Dec 2018, the **full comprehensive portfolio** is available for free download including all Sentinels satellite data, contributing missions and Copernicus Services.

To benefit from ESSENTIAL OFFER, visit our website [wekeo.eu](http://wekeo.eu) or contact us at [support@wekeo.eu](mailto:support@wekeo.eu).

**ADVANCED OFFER**

**Before April 2019, ADVANCED OFFER is open to selected users for a free 6-month period.**

To benefit from ADVANCED OFFER, contact us at [support@wekeo.eu](mailto:support@wekeo.eu). Approval will be granted after a competent commission has been consulted.

**After April 2019, ADVANCED OFFER is open to all against charges** including a free trial period (with limits on resources). Apply for ADVANCED OFFER at [support@wekeo.eu](mailto:support@wekeo.eu).

**FEDERATED OFFER**

**From June 2018 on, FEDERATED OFFER is open to large data & resources providers and subject to negotiation.**

To benefit from FEDERATED OFFER, contact us at [support@wekeo.eu](mailto:support@wekeo.eu).

Approval will be granted after a competent commission has been consulted.



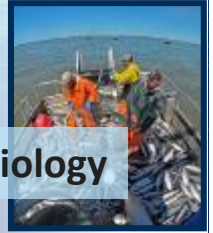


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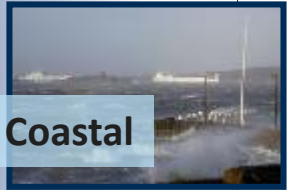
# WHAT THE FUTURE LOOKS LIKE ?



Global Env. Ops.



Biology



Coastal



Assessment

- **Marine Safety** : operational, global, **high-resolution**, consistent; increase product accuracy (regional scales everywhere, incl. Arctic), increase operational data access and user support
- **Marine Resources**: reach for **biology the level of excellence** CMEMS has now for “Marine Physics” : be able to support better fisheries management, development of sustainable aquaculture and living resources protection.
- **Marine & coastal environment** : Encourage **co-creation** between MS services and a re-enforced EU Marine Service
- **Climate & Weather** : Transform the high level CMEMS expertise on the ocean into a **strong assessment capacity on the ocean climate, on CO2 & blue carbon assessment**, propose assessment and projections capacity and propose what-if scenarios





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Monitoring

# CONCLUSION

1. The EU has entrusted Mercator Ocean to implement and operate a full & open access to a fully digitalized dynamic ocean, for a 4D-navigation in confidence : **Copernicus Marine Service**
2. For Copernicus Marine Service, Mercator Ocean has been building for 10 years, the basic components of a virtuous marine value chain : **Ocean Observations -Core Service – Downstream Services – End Users .**
3. By pooling skills and expertise, Copernicus Marine Service can now offer : **Ocean Products, Ocean Monitoring Indicators and an annual Ocean State Report** ( to 16 000 subscribers and 100 000 annual visitors of the portal)
4. With new International Shareholders, **Mercator Ocean International support** paves the European Union in its global leadership (innovation)).



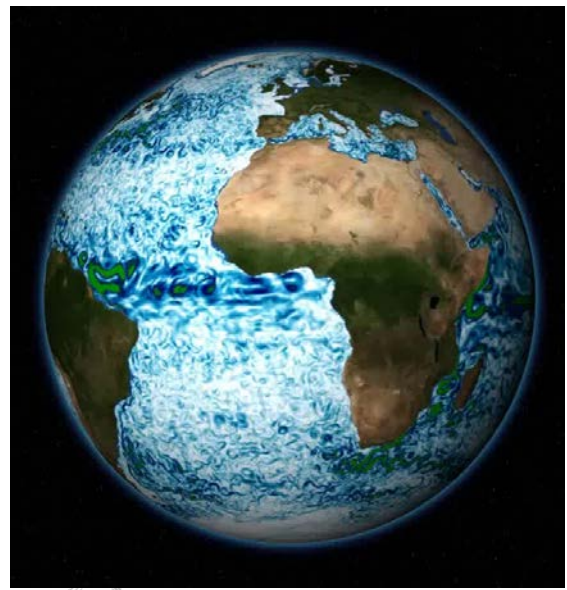


Marine Monitoring

# THANK YOU

Knowing more about :  
the program  
the service  
the entrusted entity

**copernicus.eu**  
**marine.copernicus.eu**  
**mercator-ocean.eu**



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# From "Space to SDGs": Synergy of data

## Environmental monitoring in support of SDGs

GLOBAL CLIMATE OBSERVING SYSTEM  
Remote sensing and in situ data



VALUE-ADDED-INFORMATION  
Products and expert evaluation



REANALYSES  
Joint model and data approach



**Added value chain through a combined use of the global climate observing system, reanalyses and value-added**





Marine  
Monitoring

Copernicus services, driven by user value



**Atmosphere**  
(CAMS)



**Marine**  
(CMEMS)



**Land**  
(CLMS)



**Climate**  
(C3S)



**Emergency**  
(EMS)



**Security**

## CORE APPLICATIONS:

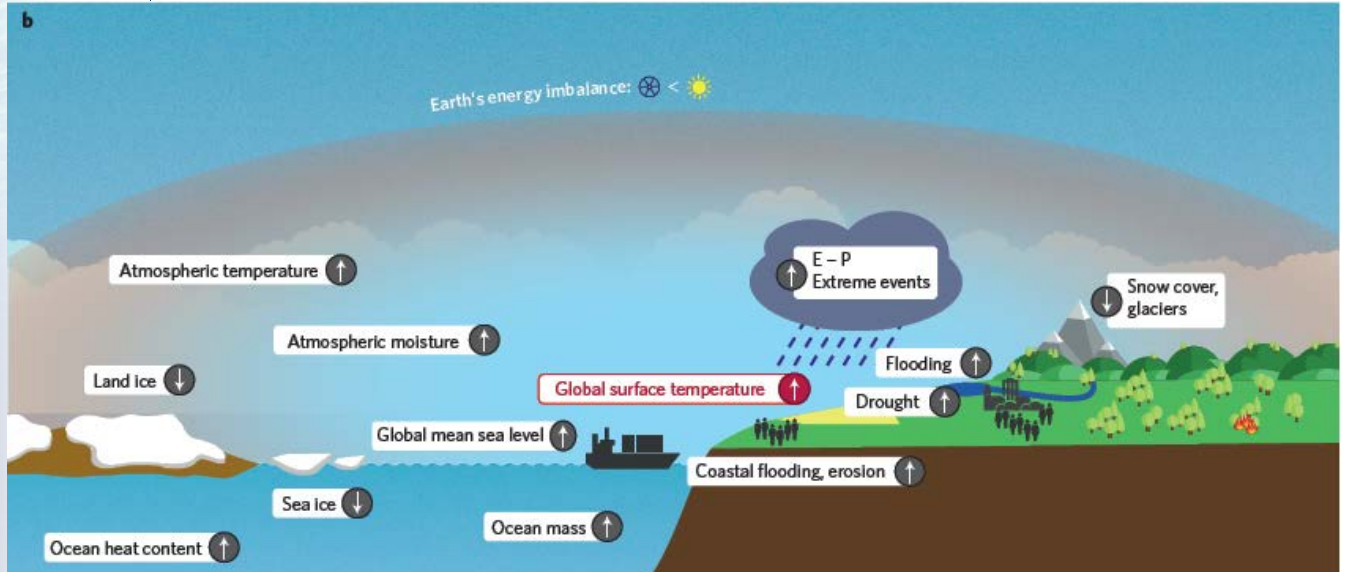
- CLIMATE AND ENERGY
- EMERGENCY RESPONSE AND CRISIS MANAGEMENT
- PUBLIC HEALTH
- URBAN AND REGIONAL PLANNING
- BIODIVERSITY AND ENVIRONMENTAL





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# SYMPTOMS OF EARTH SYSTEM REGULATION



## WARMING OF THE OCEANS



## ACIDIFICATION OF THE OCEANS



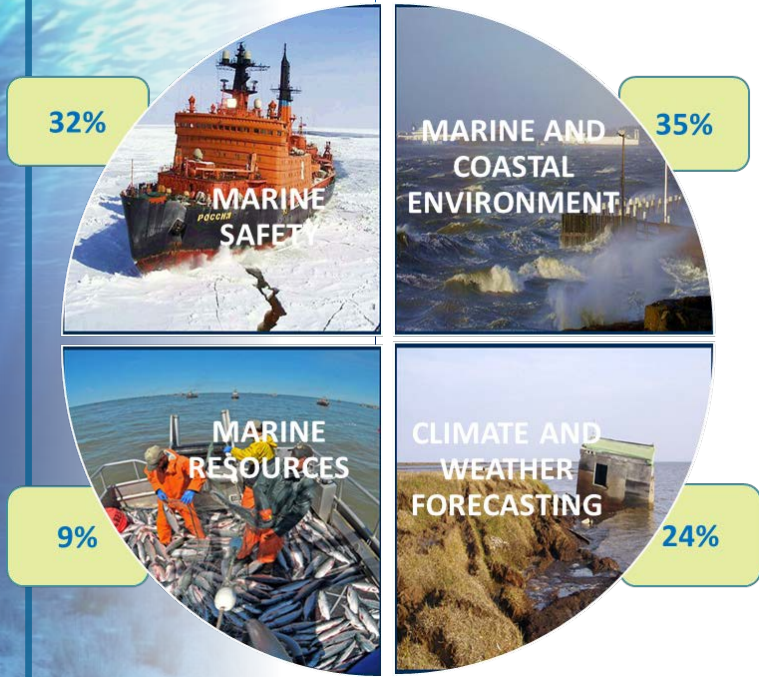
## CHANGES OF OCEAN CRICULATION





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# #3: Foster Industry competitiveness

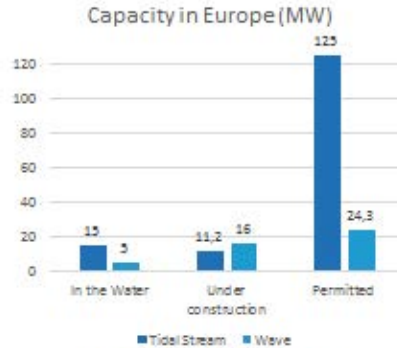


## Commercial Applications (2017)

## CMEMS data: Cost Driver for Industry

Ex: partnership with Ocean Energy Europe

### 2017 Ocean Energy is setting sail



### 2050: 10% of EU electricity, 400.000 jobs

@euoos

www.oceanenergy-europe.eu





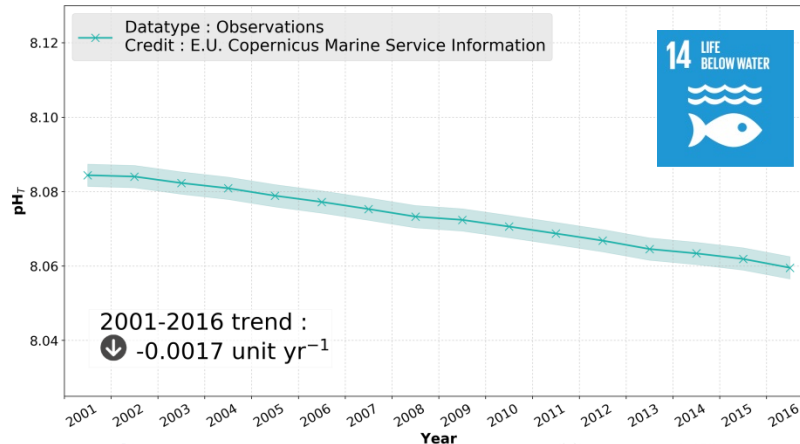
# The Copernicus Marine Ocean Monitoring Indicators

## NEXT STEPS ...



## OCEAN ACIDIFICATION

Yearly Mean Surface Sea Water pH reported on total scale



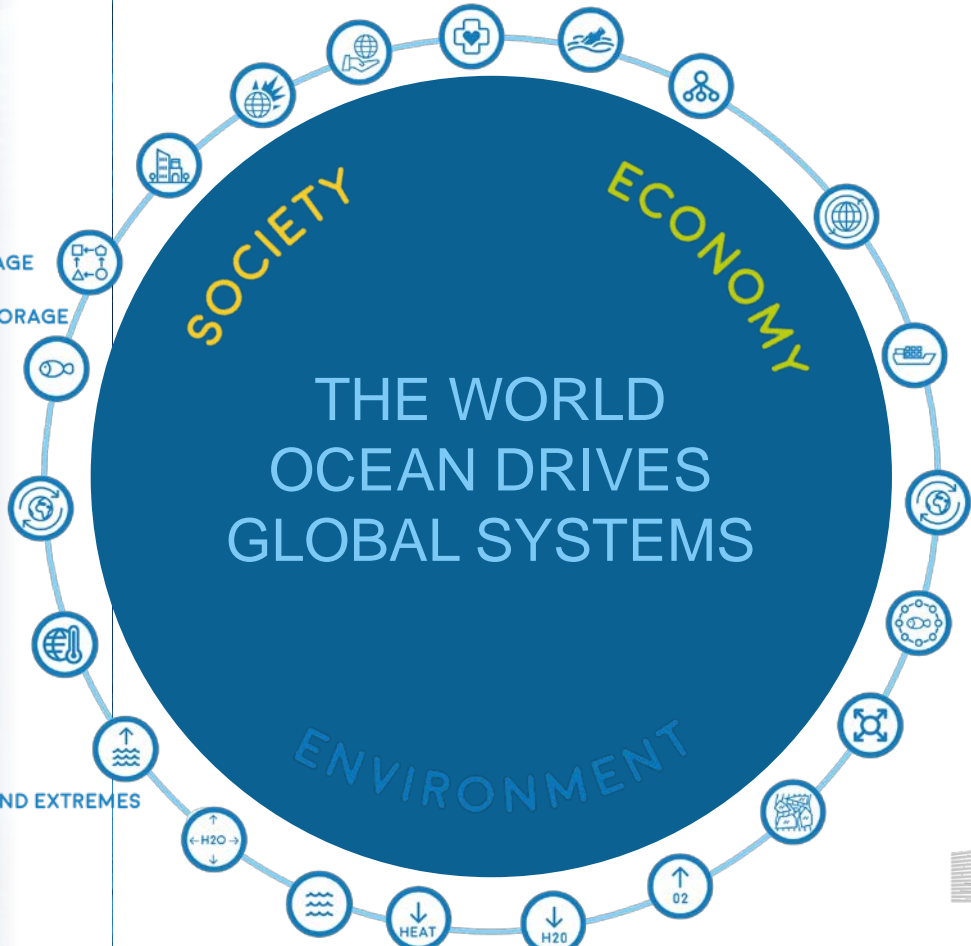
- OCEAN HEALTH
- OCEAN TEMP. & SAL.
- CLIMATE VARIABILITY
- NORTH ATLANTIC MONITORING
- WATER & HEAT EXCHANGE
- CURRENTS
- EXTREME EVENTS



Marine Monitoring

# The world ocean plays a key role in the Earth system

- HEAT UPTAKE & STORAGE
- CARBON UPTAKE & STORAGE
- OCEAN CURRENTS
- O2 RESERVOIR
- H2O RESERVOIR
- BIODIVERSITY
- SEA LEVEL
- SEA ICE
- OCEAN SPACE
- EARTH SYSTEM
- CLIMATE, WEATHER AND EXTREMES



- FOOD SECURITY
- ADAPTATION, MITIGATION
- URBAN AND REGIONAL PLANNING
- DISASTER RISK MANAGEMENT
- ENVIRONMENTAL PROTECTION
- PUBLIC HEALTH AND RECREATION
- MARINE POLLUTION AND WASTE DUMPING GROUND
- OCEAN GOVERNANCE AND LEGAL FRAMEWORKS
- BLUE ECONOMY
- TRADE AND SHIPPING

