European Ocean Observing System

Strategy 2023-2027 launch

Observations feeding models

P.Y. Le Traon

Mercator Ocean International

Thursday March 2, 2023

Organised by:

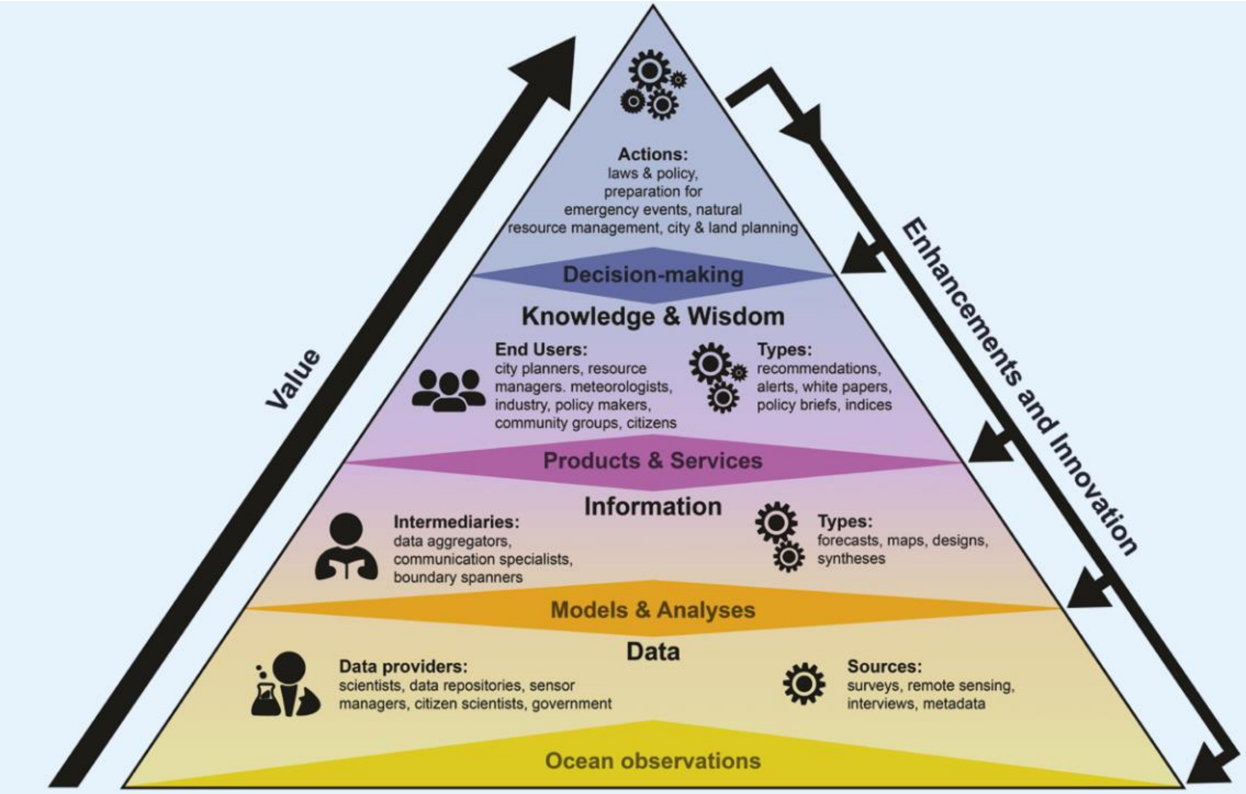
EuroGOOS European Global Ocean Observing System

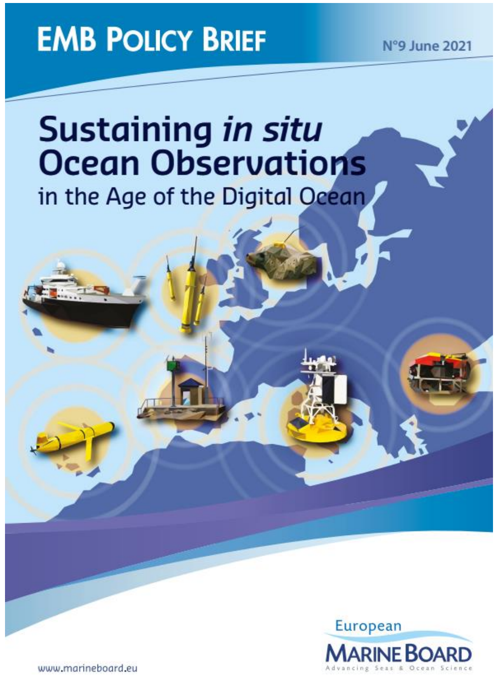
European Marine Board Advancing Seas & Ocean Science

Models: an essential link in the value chain/loop going from observations to information and action

European Ocean Observing System

Models with data assimilation transform sparse in situ and surface satellite observations into 4D ocean fields and forecasts at high space/time resolution

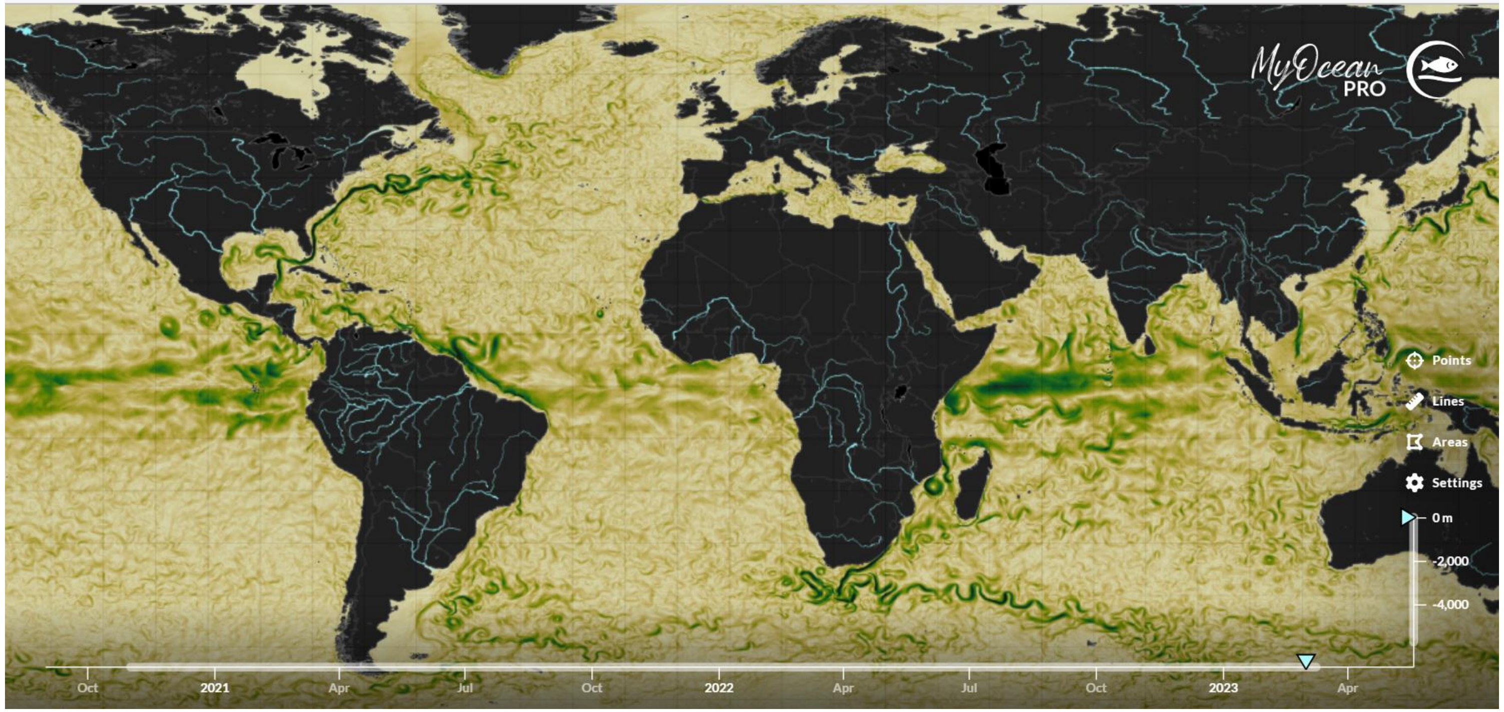




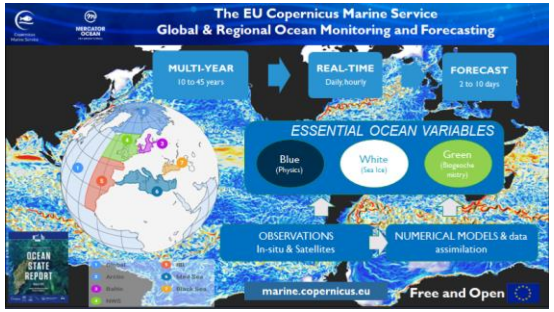
https://www.marineboard.eu

Observations feeding models
The Copernicus Marine perspective

European Ocean Observing System



Surface current forecast for March 2, 2023 from the Mercator Ocean global Copernicus Marine Monitoring and Forecasting Center



Satellite (Sentinels) and in-situ observations are integrated with models (data assimilation) to describe and forecast the state of the ocean

PROGRAMME OF THE EUROPEAN UNION

implemented by MERCATOR OCEAN INTERNATIONAL

In Situ data feeding models

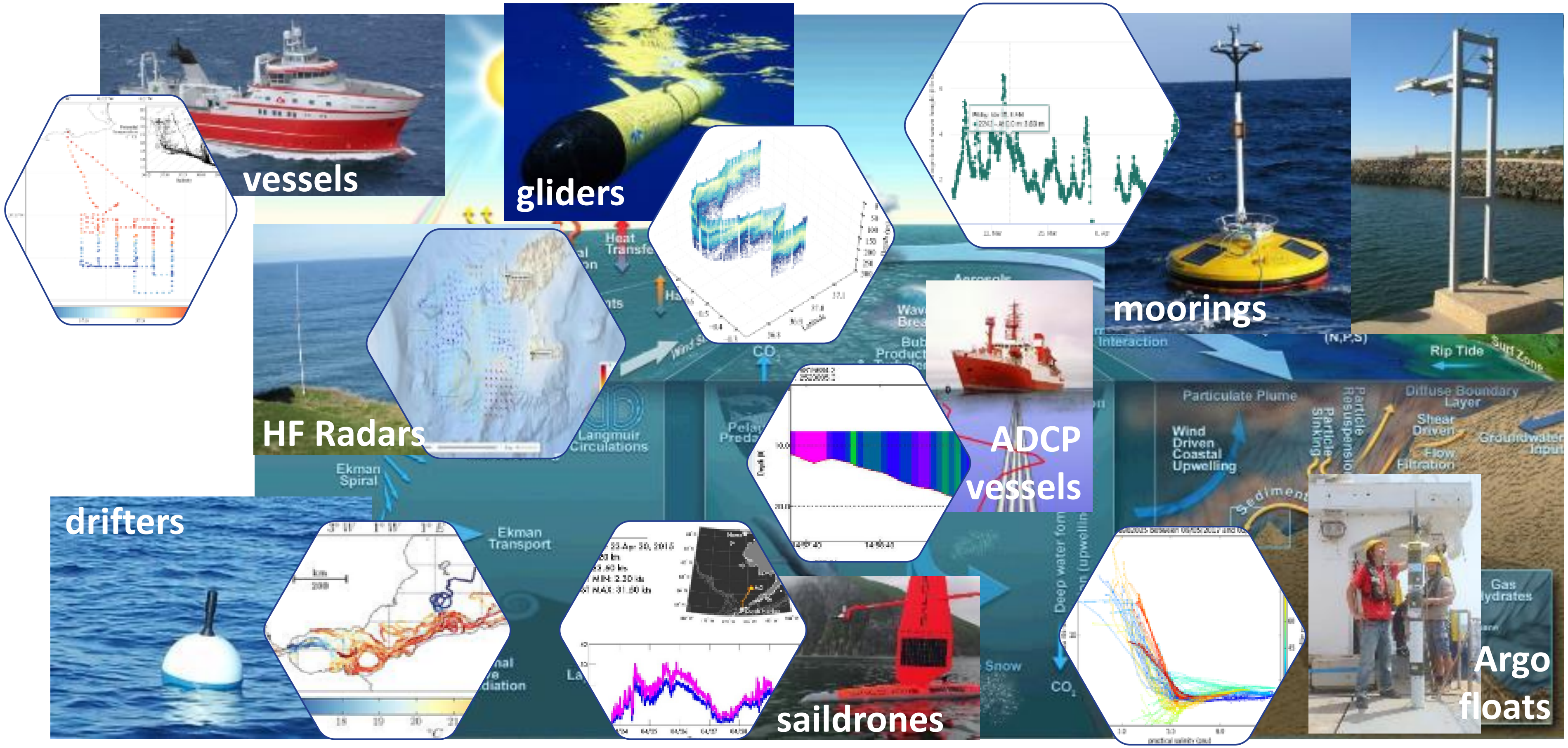
EOOS European Ocean Observing System

~7200 active platforms in real time data ~60, 000 platforms integrated ~320 providers

Copernicus Marine In-Situ Thematic Assembly Center

Dealing with the complexity of in situ observing system

Cooperation with EMODnet



Copernicus Marine Service

COPERNICUS MARINE USERS AND APPLICATIONS

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

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

COPERNICUS MARINE
USER UPTAKE AND USER BEHAVIOR

Copernicus Marine Service

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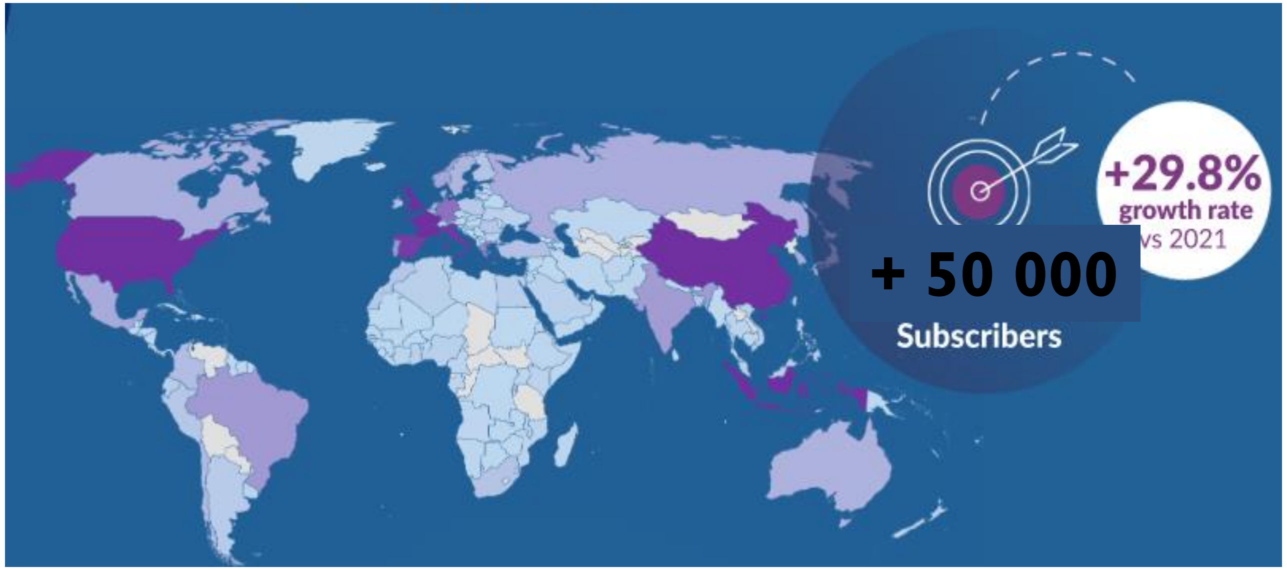

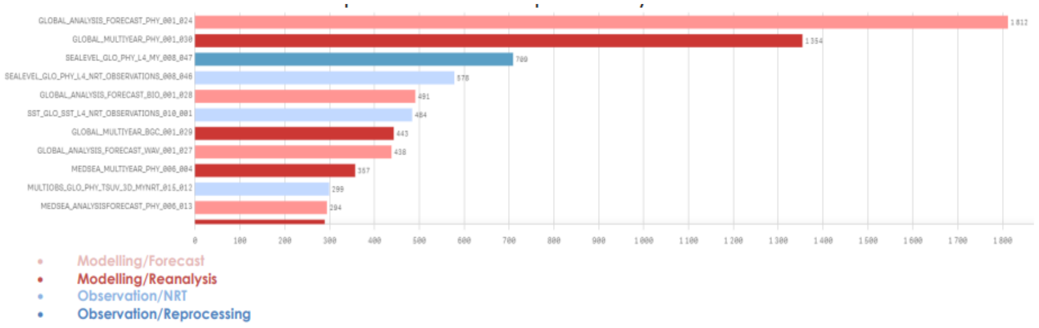

Among the 11 most downloaded products over the last quarter of 2022, 7 are model products

50,000 subscribers

700,000 single visitors per year on the web portal in 2022

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

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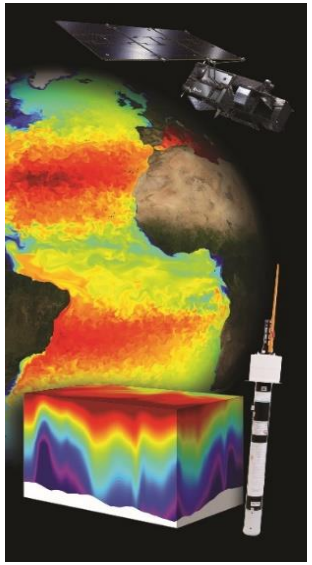
The Copernicus Marine Service is highly dependent on the satellite (Sentinels) and in-situ observing capabilities



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 Sentinel Expansion Missions (Arctic Ocean / CIMR, CRISTAL, ROSE-L). Support the EC for New Generation Sentinel mission design (post 2030).

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.

Copernicus Marine requirements for the evolution of the ocean observing system

Requirements both for in-situ and satellite observations (Sentinels) defined and regularly revised.

Based on impact assessment (OSEs/OSSEs) and expert analyses.

User needs => integrated system evolution (modelling) => observation requirements

Major gaps for the in-situ observing system (sustainability, biogeochemistry, Arctic, coastal)

PROGRAMME OF THE EUROPEAN UNION copernicus Europe's eyes on Earth implemented by MERCATOR OCEAN INTERNATIONAL

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

Front. Mar. Sci. | doi: 10.3389/fmars.2019.00234

From observation to information and users: the Copernicus Marine Service perspective

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Observations feeding models : assessing the impact of observations – Argo

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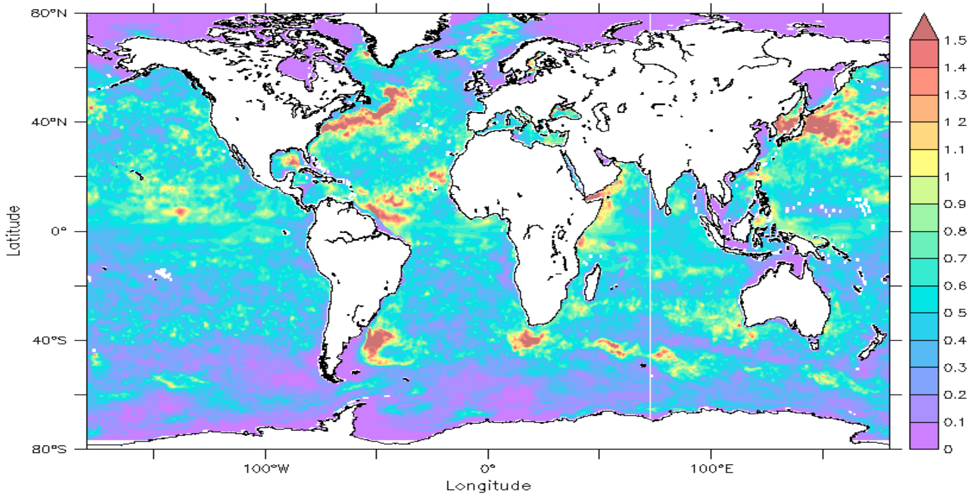
All Copernicus Marine models rely on Argo observations. Strong complementarity with satellite altimetry. Impact fully demonstrated through Observing System Evaluations.



RMS of 0-300 m temperature differences between Run-Ref and Run-NoArgo

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Temperature and Salinity 7-day forecast errors are reduced by 20% to 60% when Argo data are assimilated (Turpin et al., 2016)

Observations feeding models
What and where do we need observe ?
Observing System Simulation Experiments

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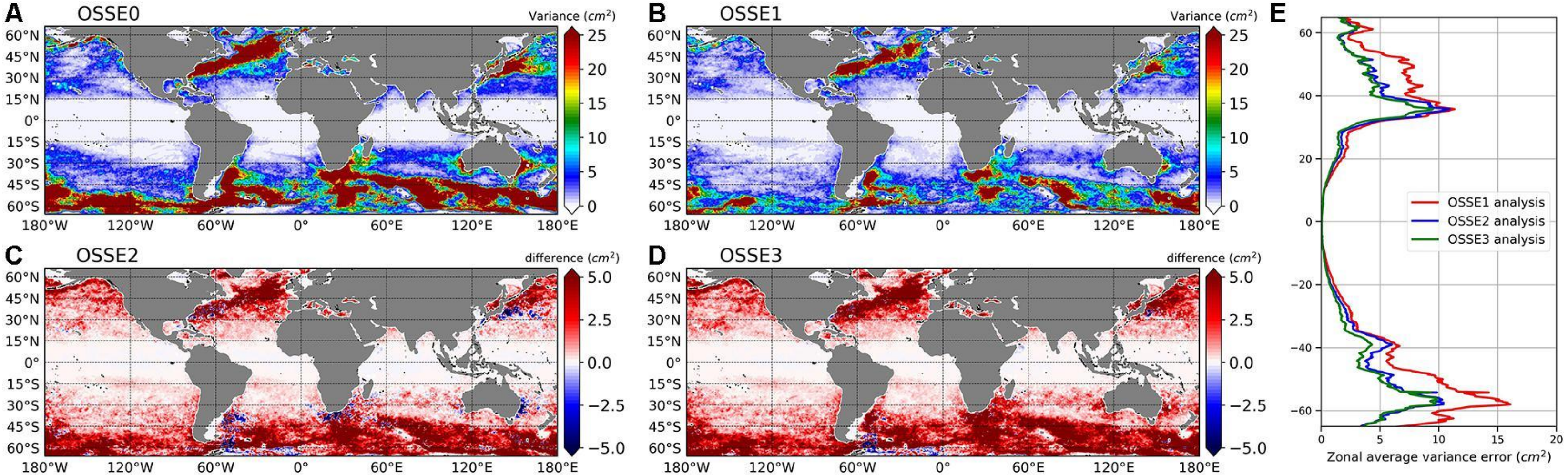
Impact of the SWOT mission on the 1/12° Mercator Ocean global ocean analysis and forecasting system



Sea level error (in cm^2) for mesoscale structures at wavelengths < 200 km.
Adding SWOT (OSSE3) in addition to 3 nadir altimeters (OSSE1) reduces errors up to 40 % outside tropical areas.

ORIGINAL RESEARCH article
Front. Mar. Sci., 22 July 2021 | https://doi.org/10.3389/fmars.2021.691955

Assessing the Impact of the Assimilation of SWOT Observations in a Global High-Resolution Analysis and Forecasting System Part 1: Methods

Mounir Benkiran[1*], Giovanni Ruggiero[1], Eric Greiner[2], Pierre-Yves Le Traon[1,3], Elisabeth Rémy[1], Jean Michel Lellouche[1], Romain Bourdallé-Badie[1], Yann Drillet[1] and Babette Tchonang[1]

ORIGINAL RESEARCH article
Front. Mar. Sci., 26 August 2021 | https://doi.org/10.3389/fmars.2021.687414

Assessing the Impact of the Assimilation of SWOT Observations in a Global High-Resolution Analysis and Forecasting System – Part 2: Results

Babette C. Tchonang[1*], Mounir Benkiran[1], Pierre-Yves Le Traon[1,2], Simon Jan van Gennip[1], Jean Michel Lellouche[1] and Giovanni Ruggiero[1]

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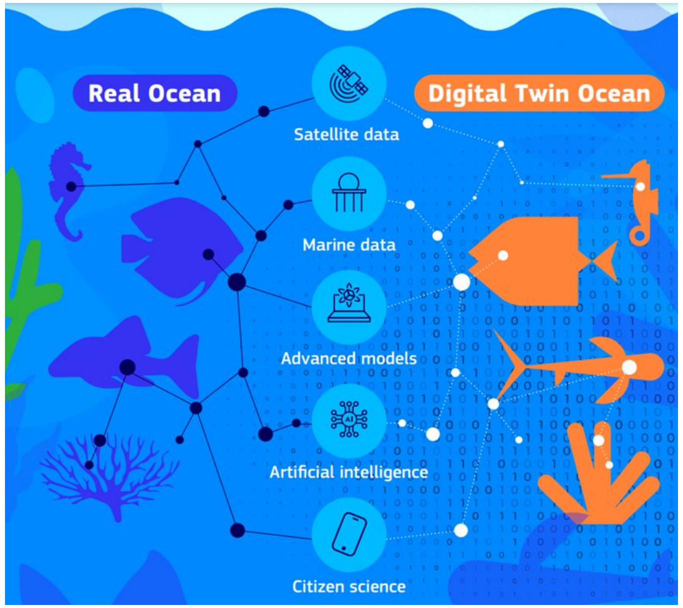
Observations feeding models
The EU Digital Twin of the Ocean perspective

EOOS European Ocean Observing System

Digital space providing access to vast amounts of **data, models, artificial intelligence** and other tools, to allow the replication of the properties and behaviours of marine systems and their interaction



Use of **real-time and historical observation data** to represent the past and present, **initialize prediction models** and **improve models** to simulate future / what-if scenarios

Observations feeding models
Use of observations to calibrate and improve models

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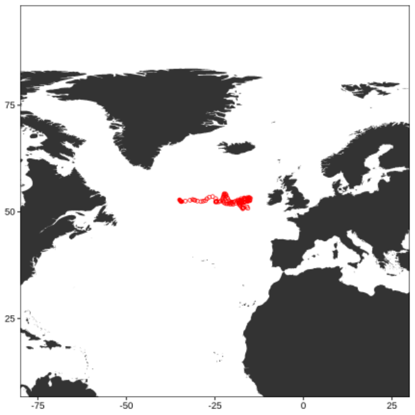
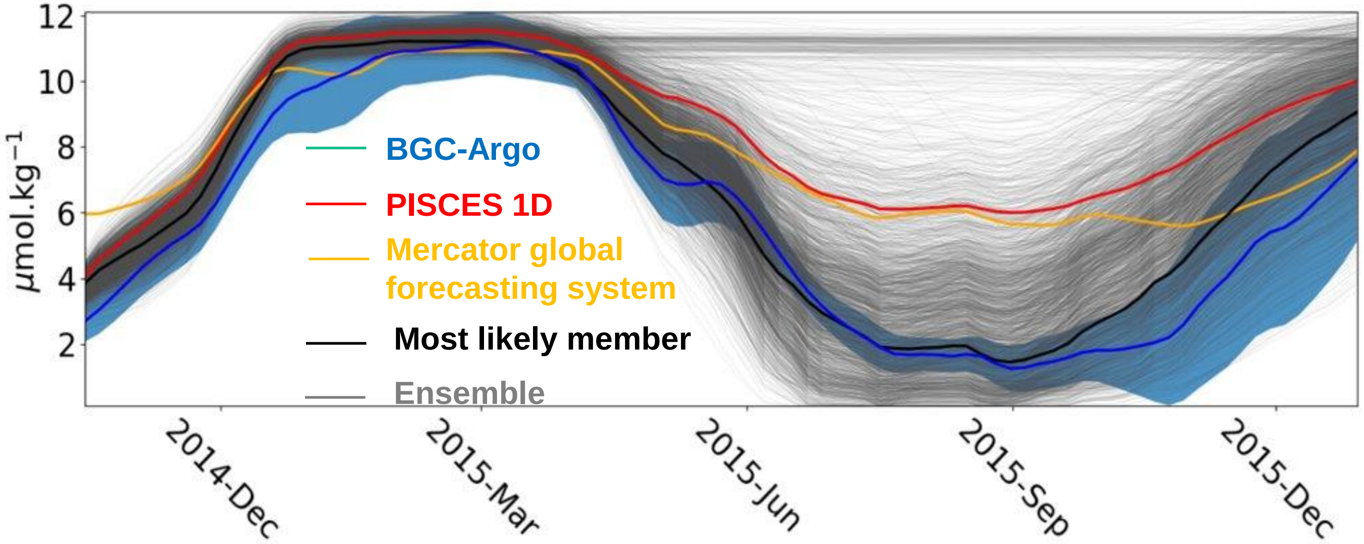
EuroSea

Copernicus Marine global BioGeoChemical model (PISCES)

parameter optimization using BGC-Argo floats using an ensemble approach





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Mignot et al., 2022

Nitrate time evolution for an Argo float in the North Atlantic: observed and modeled estimations

Observations feeding models

Models = **an essential link of the value chain** going from observations to users

Critical **importance of observations to constrain models** that are used operationnally for a **wide range of services** (**Copernicus Marine**)

Observations are also **fundamental to validate and improve models** needed to develop what if scenarios (**Digital Twin Ocean**)

Sustainability and evolution of the **observing system** is thus key. The in-situ observing system **is fragile and has major gaps**

Need an **improved governance**, **improved coordination between Member States and the EC** and **new funding models**

EOOS very much needed !