Marine and Coastal ecosystems

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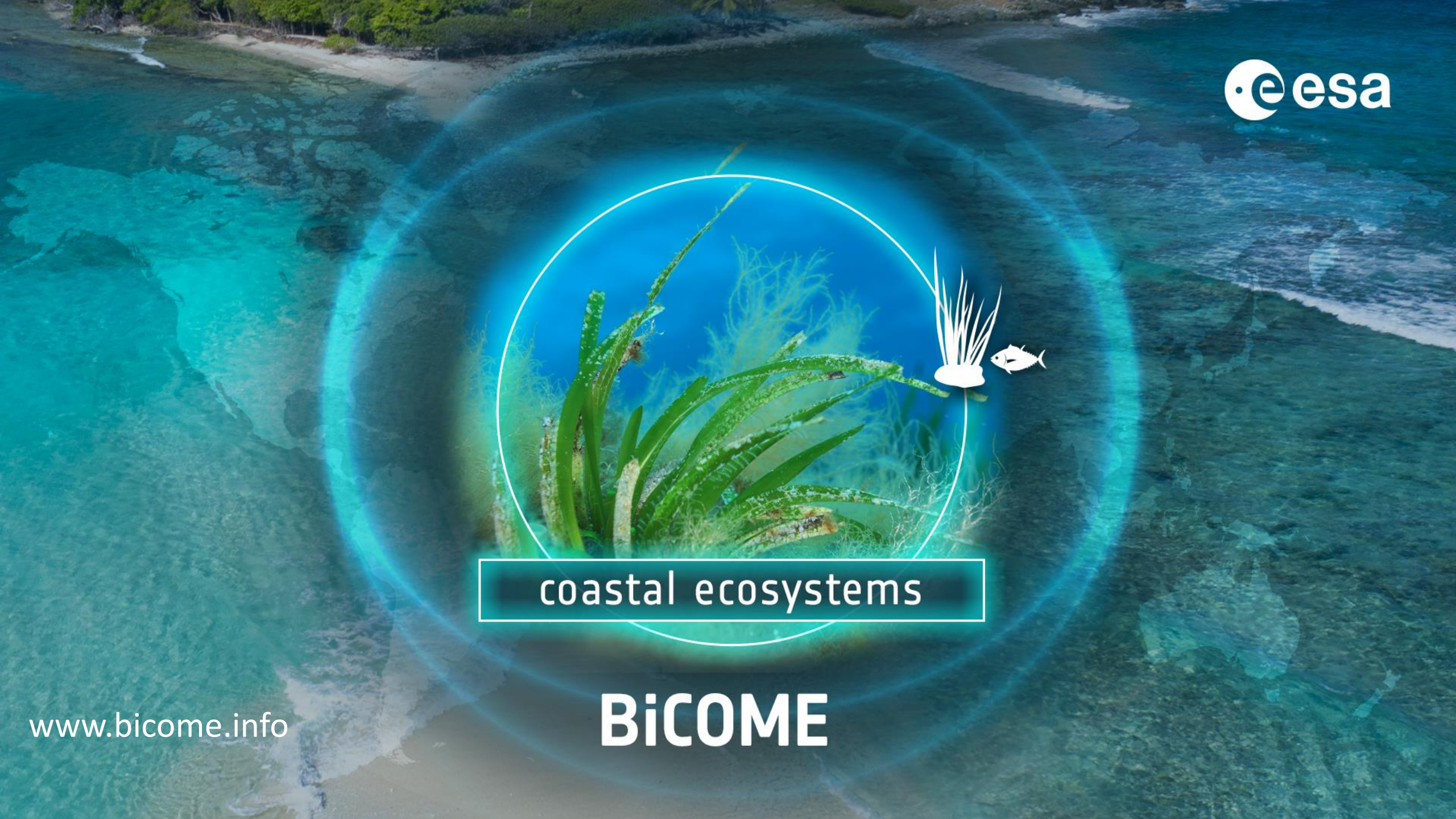
Marine and Coastal Ecosystems

EO-based information products, for **ecosystem mapping applications for conservation/restoration purposes**.

Some relevant past and on-going projects

- Coastal Biodiversity (Bicome)
- Open Ocean Biodiversity (BOOMS)
- Coral Reef
- Coastal Erosion
- Water Quality
- Marine heatwaves
- Acidification

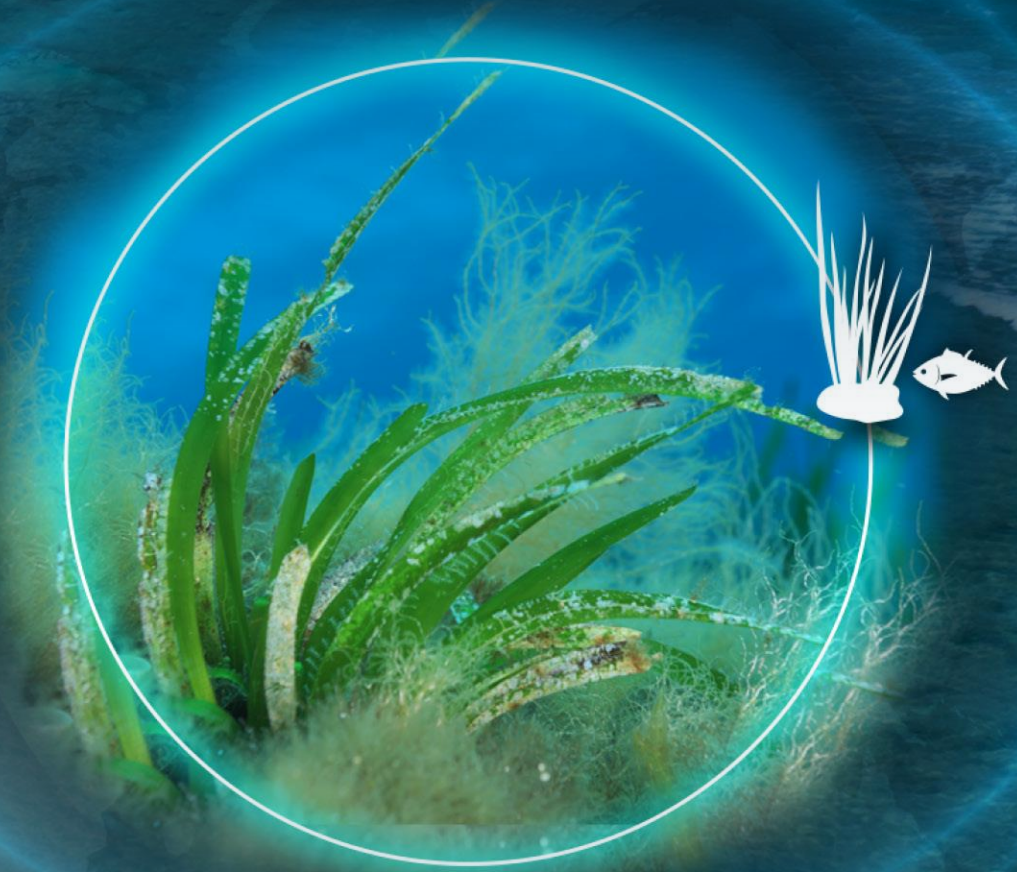
Upcoming projects


esa
coastal ecosystems
BiCOME
www.bicome.info

BiCOME - Biodiversity of the Coastal Ocean: Monitoring with Earth Observation

Aims:

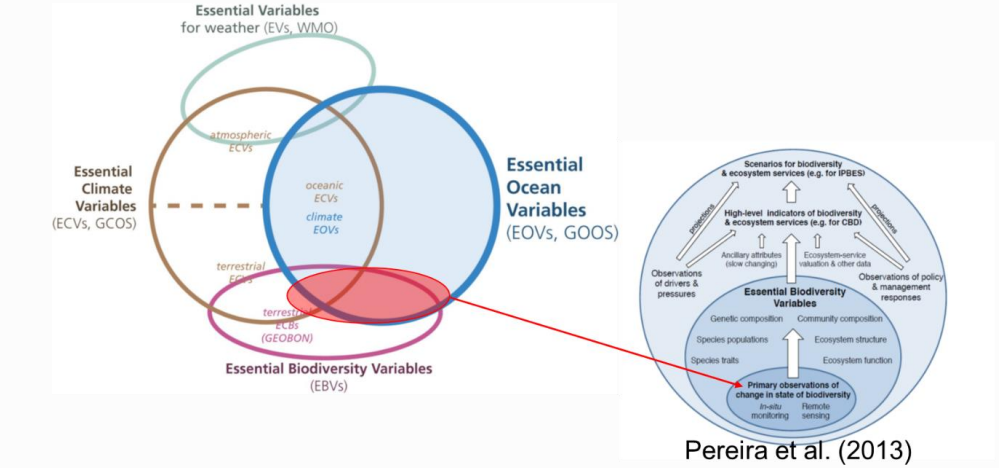
- Develop biodiversity relevant products from remotely sensed reflectance
- Demonstrate in scientific and societal applications



www.bicome.info | @BicomeProject

esa BiCOME is funded by the European Space Agency (ESA)

BiCOME - Biodiversity of the Coastal Ocean: Monitoring with Earth Observation



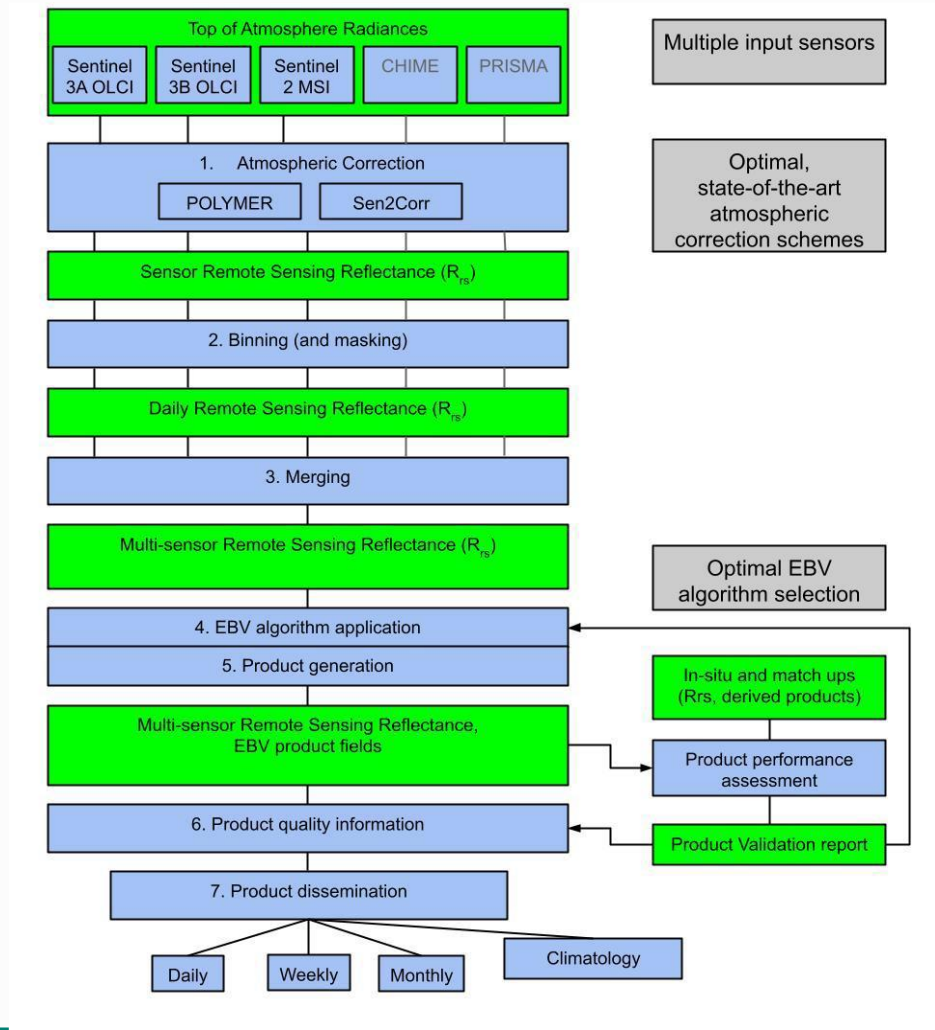
Pereira et al. (2013)

Summary of EBVs with potential for radiometric satellite detection in the coastal ecosystems to be considered in BiCOME. This table expands in more detail Fig.2 in Muller-Karger et al. (2018).

EBV class	EBV	Intertidal benthic communities in sediment shores (beaches, estuaries, mudflats)					Subtidal benthic communities	Pelagic communities	
		Seagrass	Macroalgae	Microphytobenthos	Oyster reef	Polychaetes reef	Seagrass	Phytoplankton blooms	Floating macroalgae
Genetic composition	Population genetic diversity								
Species populations	Distribution								
	Abundance								
	Size/Vertical distribution								
Species traits	Pigments				photosythetic epibionts	photosythetic epibionts			
	Phenology								
Community composition	Taxonomic diversity								
Ecosystem structure	Functional type								
	Fragmentation/heterogeneity								
Ecosystem function	Primary production estimates				NA	NA			

Not yet proven
Some examples proven
Not likely

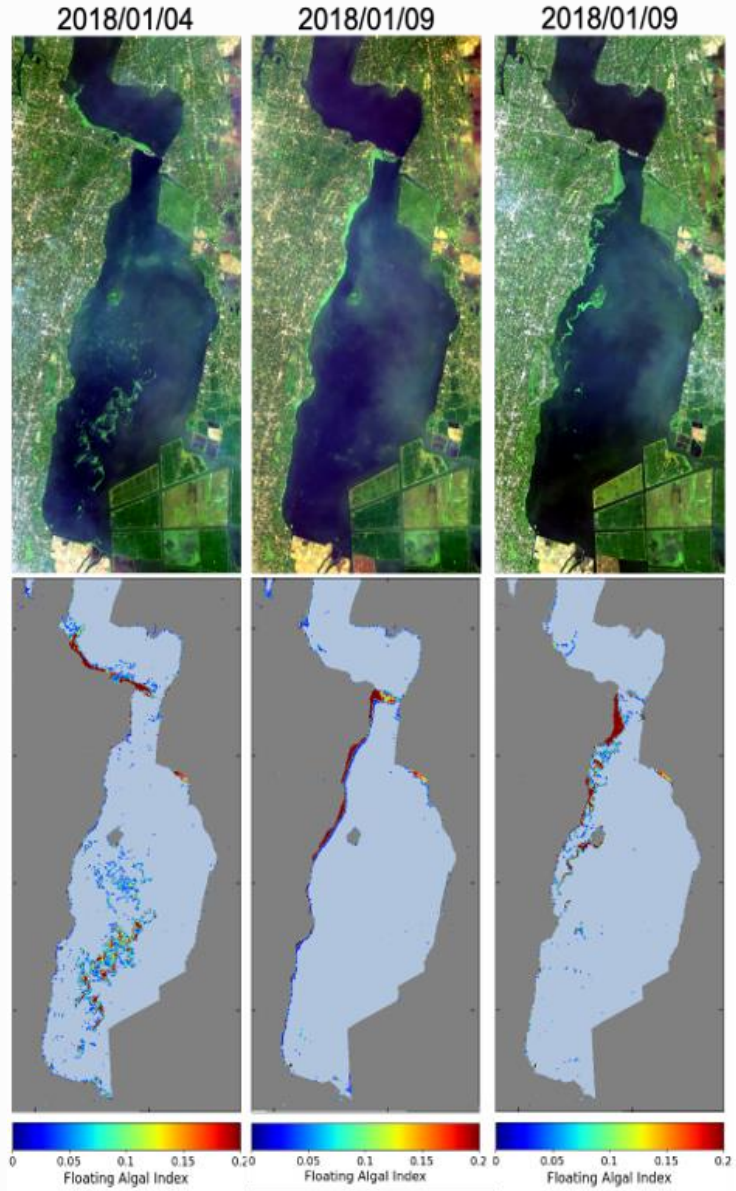
Overview of modular processing system for EBV production, similar in construction to that used to generate the OC-CCI ECV. The processor will be designed to be extensible for the future inclusion of sensors such as CHIME or PRISMA or EnMAP



Pilot 1

Pelagic ecosystems

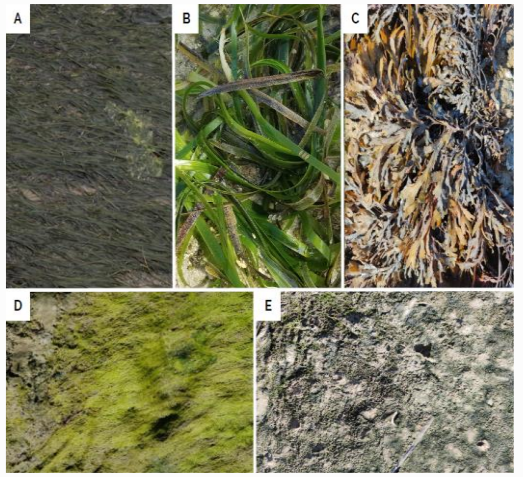
- Mapping of pelagic biodiversity: phytoplankton diversity and floating macro-algal vegetation
- Seascape mapping (Optical water Types)
- Impact of land use
- Early adopters: India and Caribbean

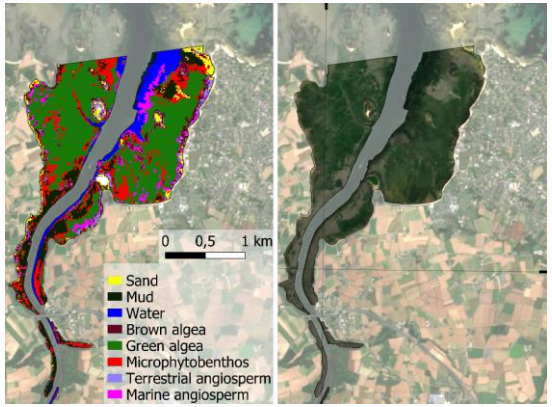


Pilot 2

Intertidal ecosystems

- **Intertidal habitat mapping (seagrass, microphytobenthos , macroalgae, oyster reefs, and polychaetes reef)**
- **Impact of anthropogenic pressures**
- **Case study: Atlantic coast, France and Portugal**

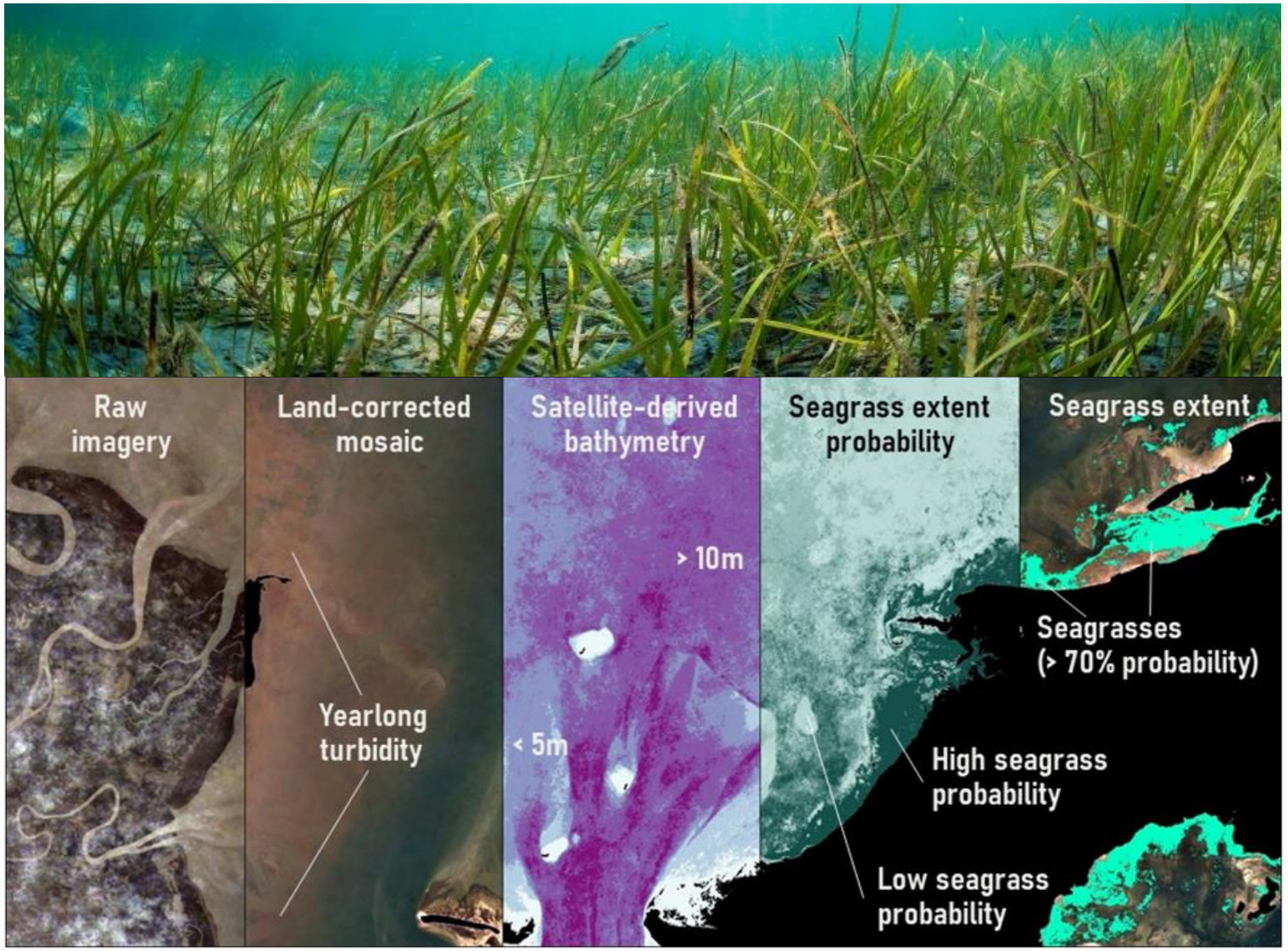




Pilot 3

Subtidal ecosystems

- Measure the extent of seagrass meadows and assess their changes over time
- Estimation of carbon sequestration
- Early Adopters: Mozambique and Indonesia

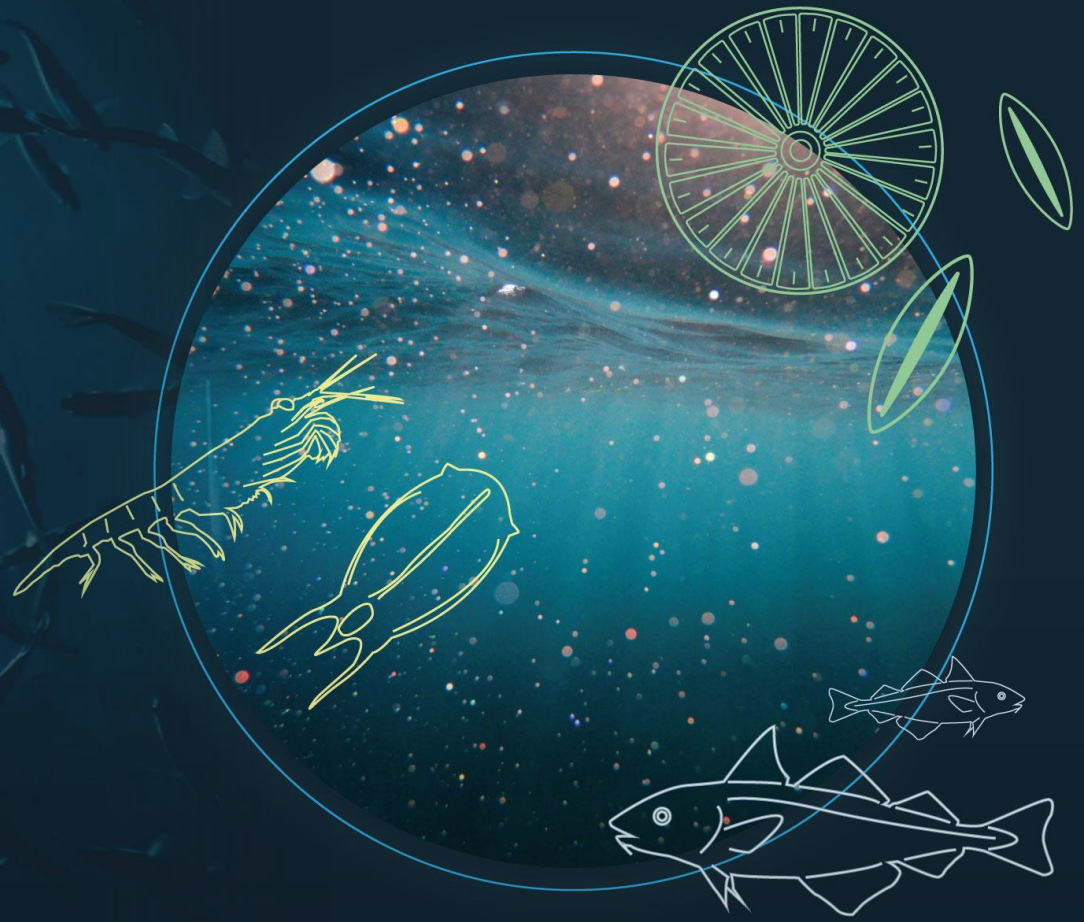


BOOMS - Biodiversity in the Open Ocean: Mapping, Monitoring and Modelling

Aims:

- Develop biodiversity relevant products (dynamic seascapes) from multi-sensor algorithms

- Demonstrate in scientific and societal applications

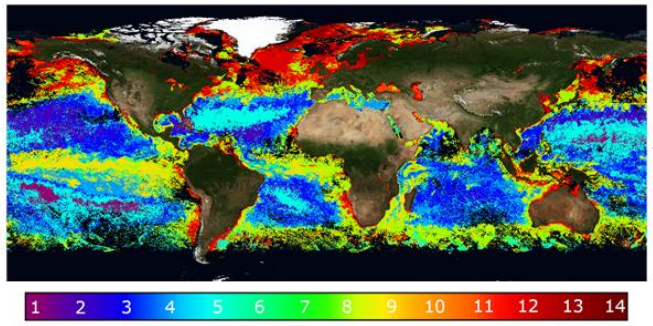


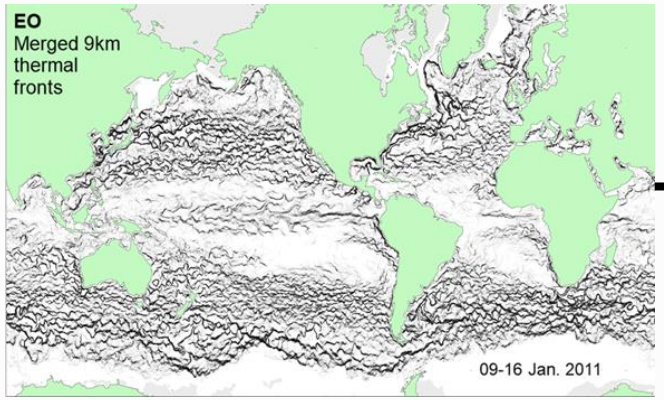
www.booms-project.org

The BOOMS project is funded by the European Space Agency (ESA)
ESA contract no. 4000137125/22/I-DT

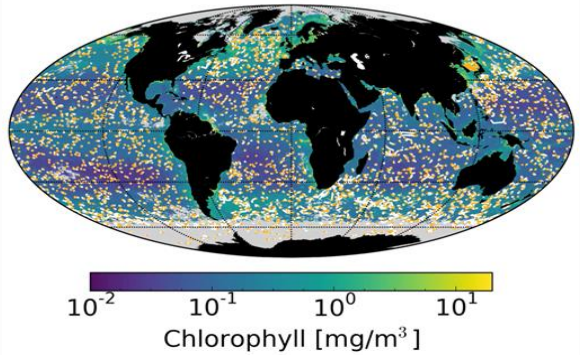
Funded by The European Space Agency

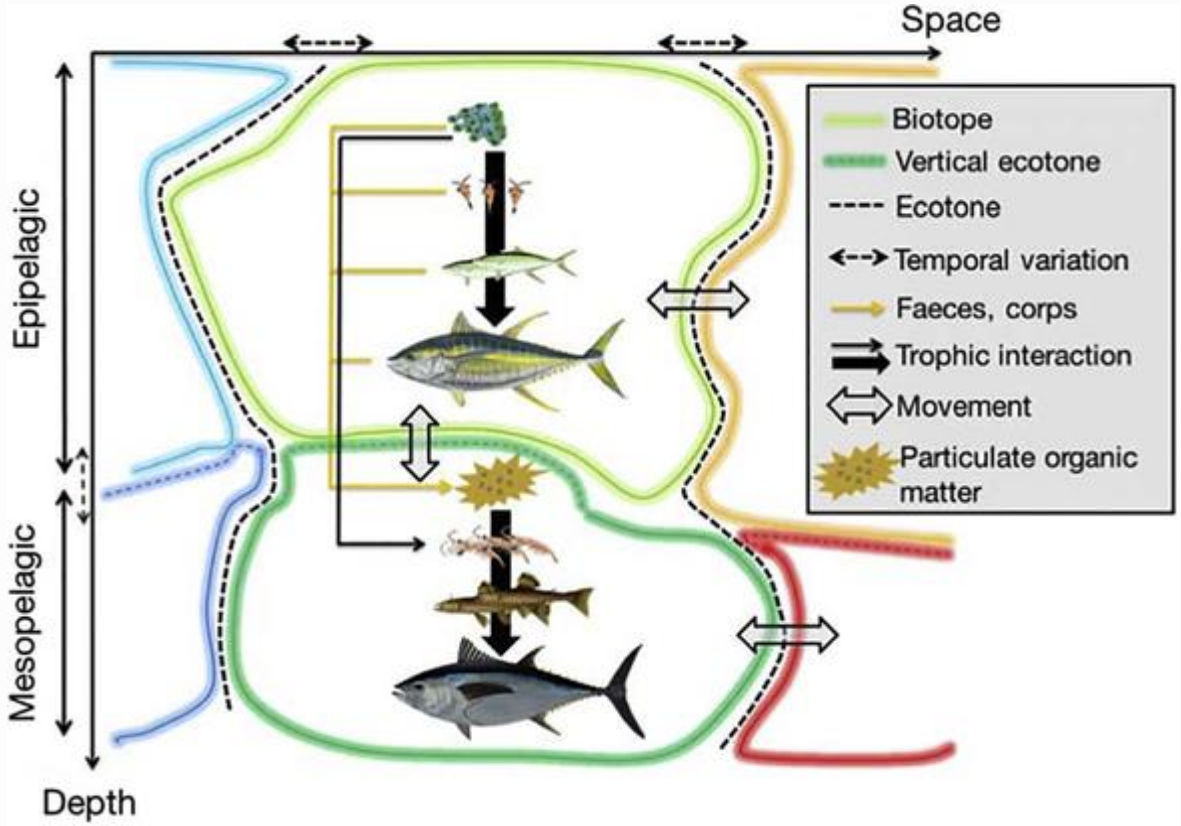
Development of advanced seascapes as a tool for biodiversity management in Areas Beyond National Jurisdiction





OC-CCI Chl 20100424 argo floats

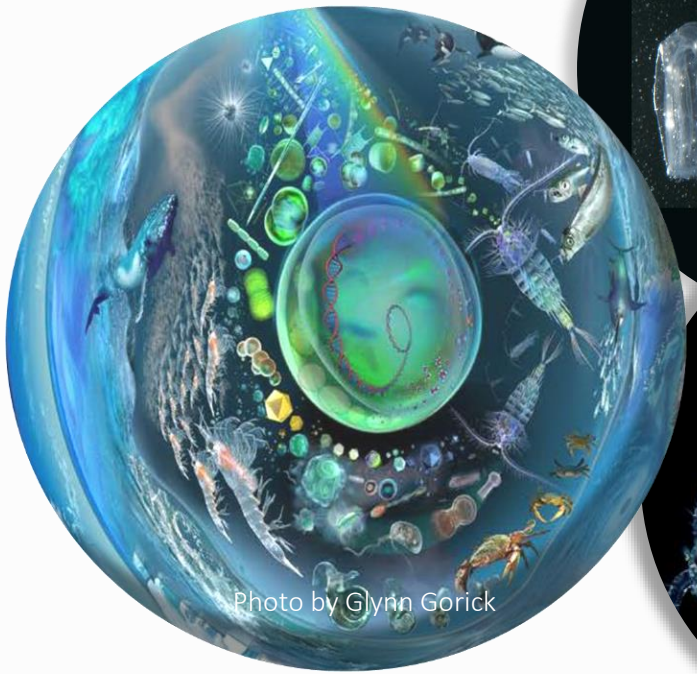




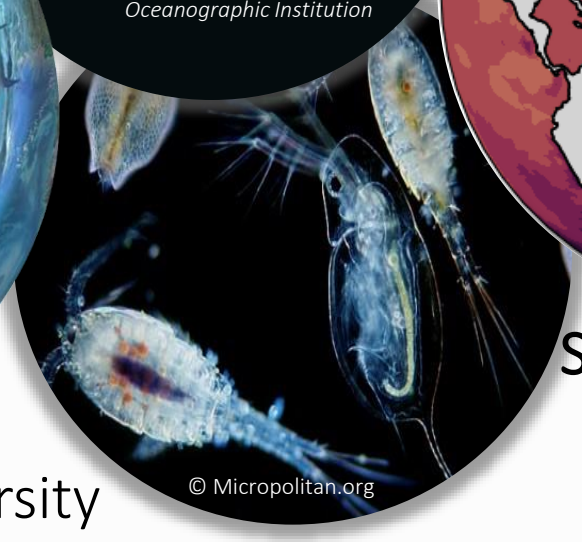
Reygondeau and Dunn (2018)

Funded by The European Space Agency

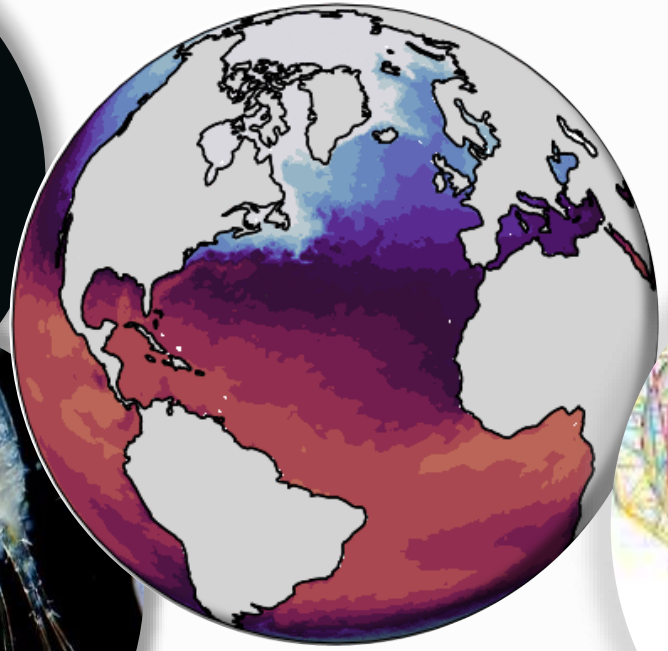
➢ Science cases (SC)



SC 1: Phytoplankton Diversity

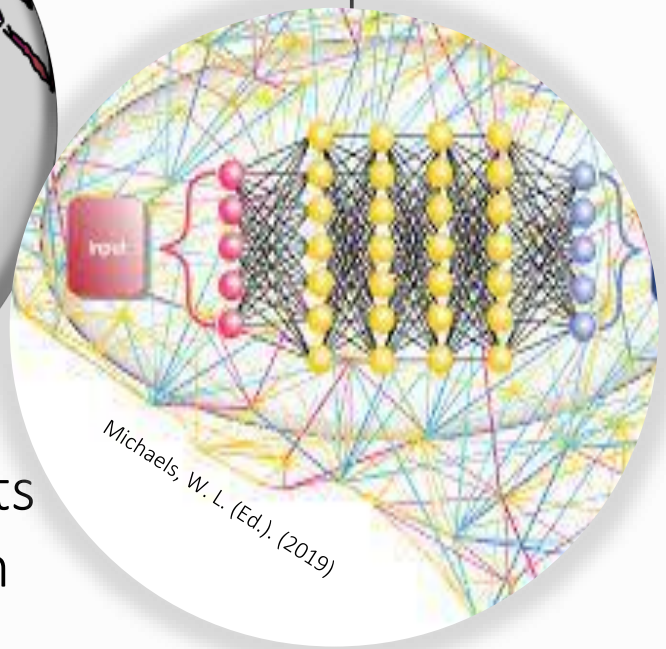


SC 2: Southern Ocean Dynamic Seascapes as habitats of krill/salp/copepods



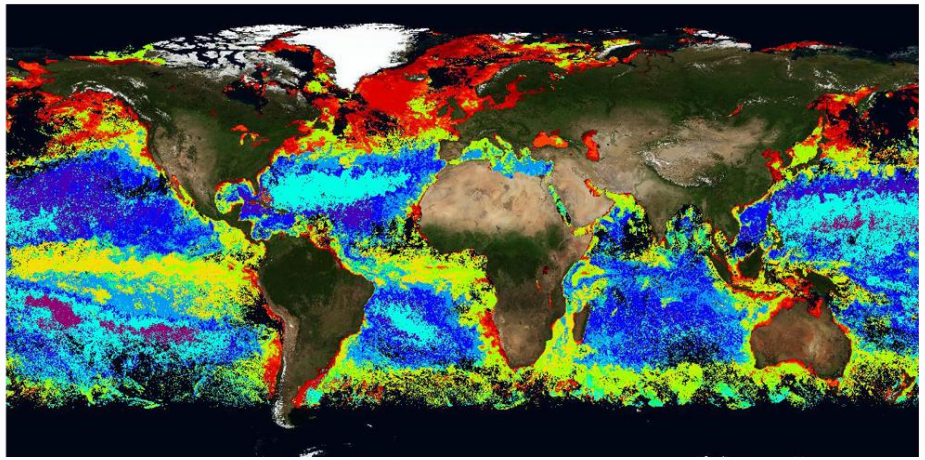
SC 3: MHW impacts on phytoplankton indicators and fisheries

SC 4: AI/ML & Open Ocean Biodiversity Seascapes



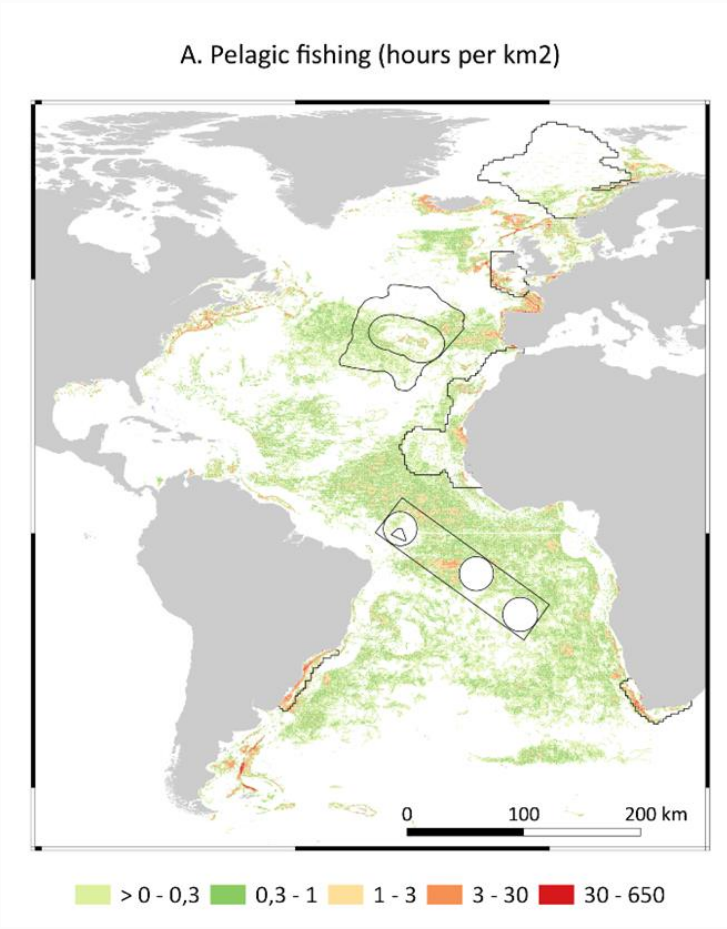
Funded by The European Space Agency

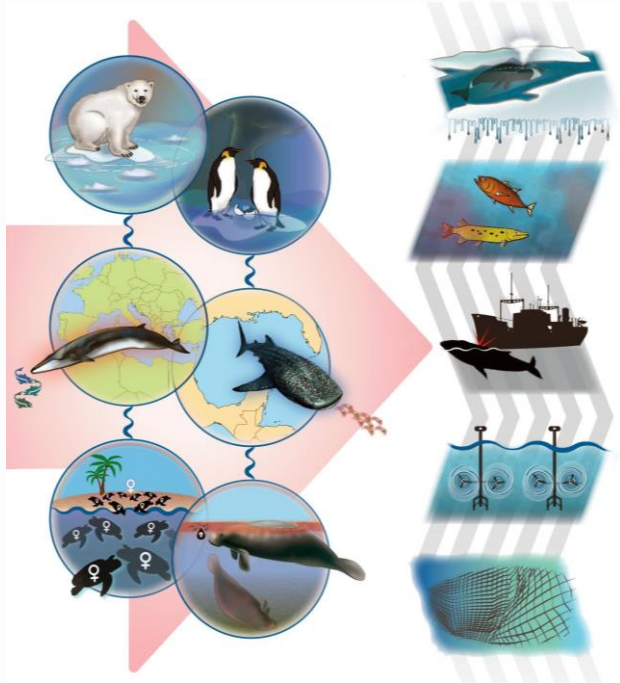
➢ Impact Case studies (IC)



IC 1: Ecosystem Models to study phytoplankton diversity

IC 2: Atlantic fisheries and human impacts





Modified from Grose et al. (2020) Frontiers in Marine Science 7; 547.

IC 3: Dynamic seascapes and top predators

Sen2Coral (2016-2018) Coral Reef monitoring

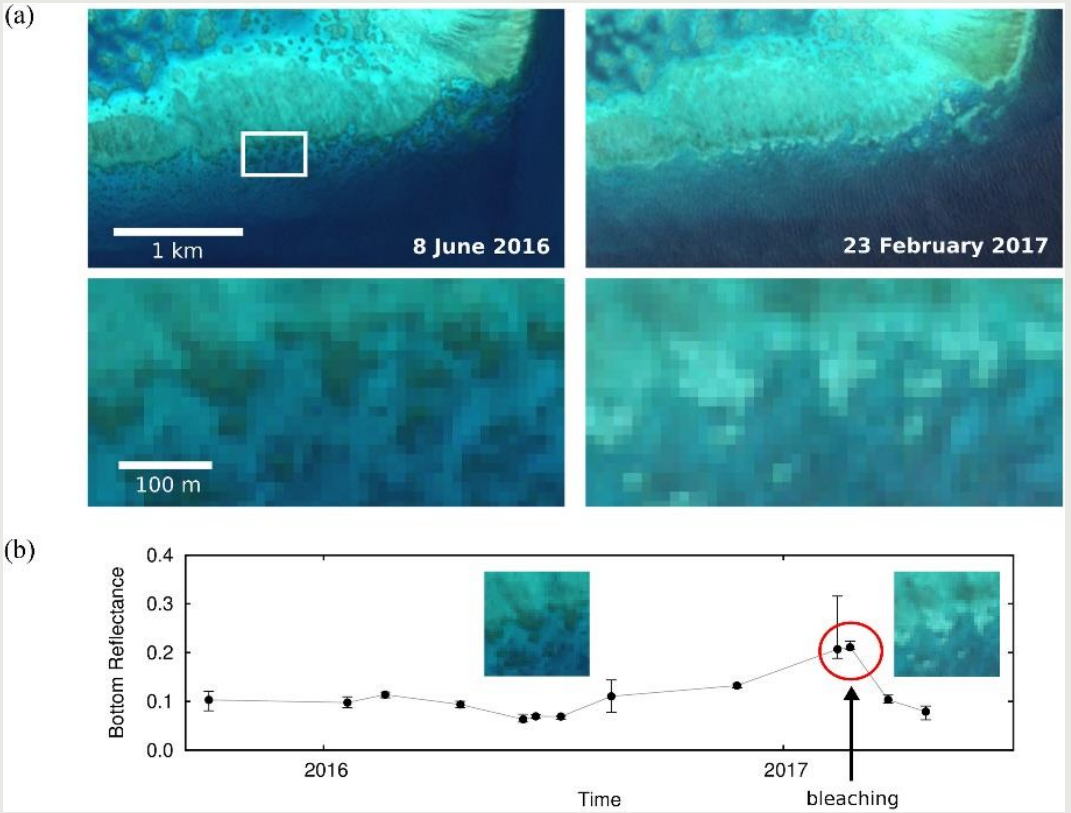
Consortium : Argans Limited (GB), CNR (IT), CS (FR)

Objective: develop and validate new algorithms relevant for coral reef monitoring based on Sentinel-2 observations, including benthic mapping, coral reef health and mortality as well as bathymetry.

Bleaching as visible in Sentinel-2A imagery at Adelaide reef in February 2017, in comparison to June 2016.

Contact point: enquiries@argans.co.uk
Website: https://sen2coral.argans.co.uk/

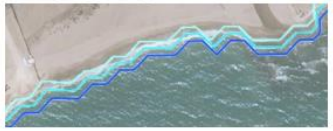
Hedley et al, 2018, RSE



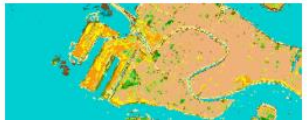
Coastal Erosion -

Optical Waterline

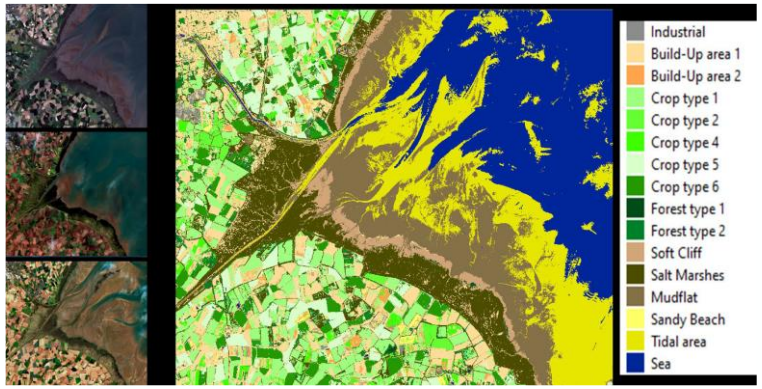
Optical Shoreline



Land use land cover map



Classification Maps



A supervised learning algorithm is used to extract three areas of interest: the backshore, the littoral zone, and the ocean.

Monitoring Waterline and Shoreline Evolution

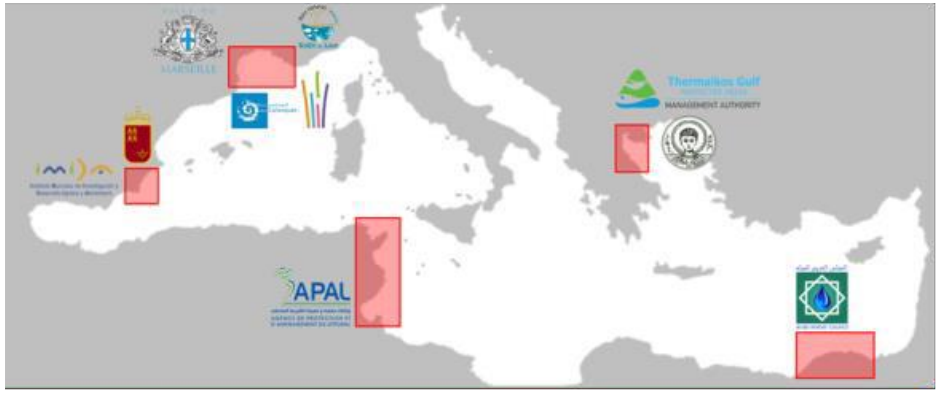
Watching out large-scale shoreline monitoring, the most used coastal indicator by scientists and managers

MEDITERRANEAN Regional Initiative

LAND-BASED POLLUTION ASSESSMENT & MONITORING IN THE MEDITERRANEAN COASTAL WATERS

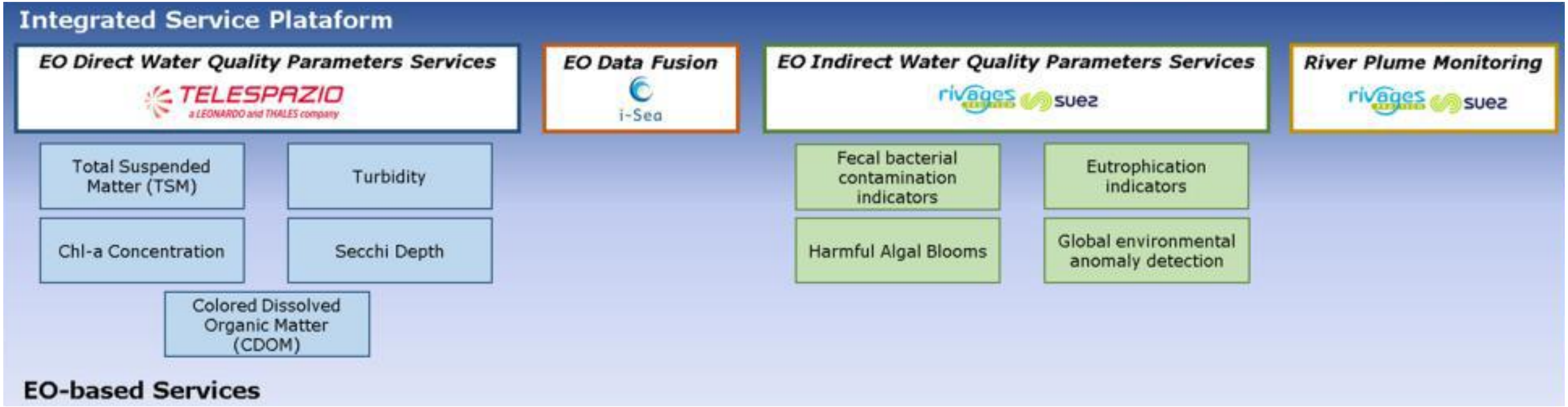
Specific Objective of the project:

Optimize and scale-up the exploitation of EO data for a better characterization and monitoring of the **land-based pollution** threatening the health of the Mediterranean Sea, in support of different relevant actors at local, national and international levels.



Five selected Pilot Areas:

I- Bay of Marseille
II- Thermaikos Gulf
III- Mar Menor
IV Egypt
V- Tunisia



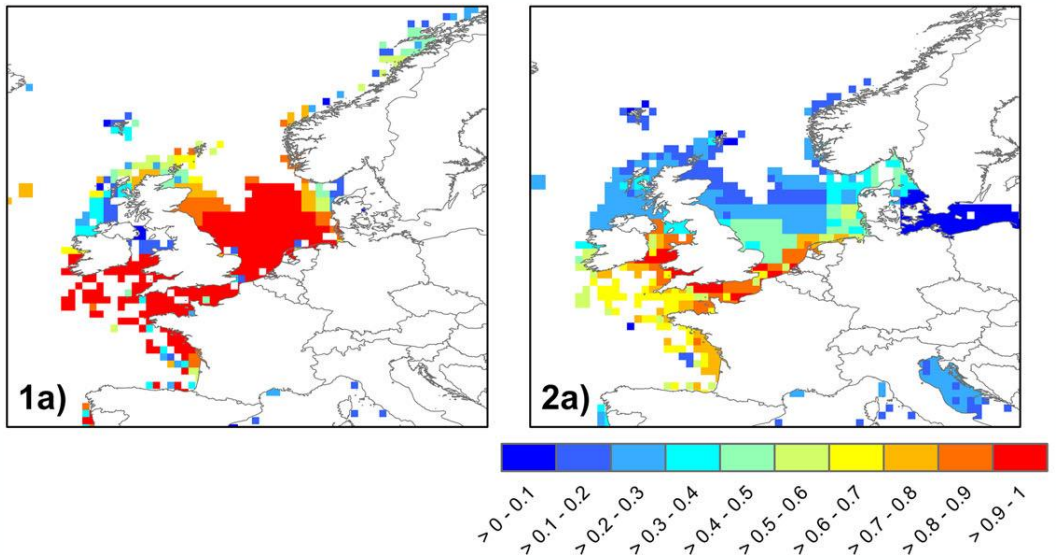
Ocean Acidification from Space

Ocean Health - Acidification

Impact of Ocean Acidification on Marine Ecosystems

Science cases

1. Characterizing global and regional variability
2. Characterizing the impacts of Ocean acidification on a selection of marine species.
3. Characterizing where Ocean Acidification occurs with other stressors (eg warming, eutrophication, deoxygenation).



Predicted distributions of relative habitat suitability for oyster. Predictions made for the Pacific oyster using GFDL Topaz ESM2.1 data and species distribution models (1) AquaMaps (2) Maxent modelling. Jones et al. (2013)

How does adding OA parameters affect the suitable habitat range?

Impact Assessment Use cases (IAUC)

IAUC:

- Policy-makers and elected officials
- Resource managers
- End-users (e.g. Shellfish growers)

Key Early Adopter partners:

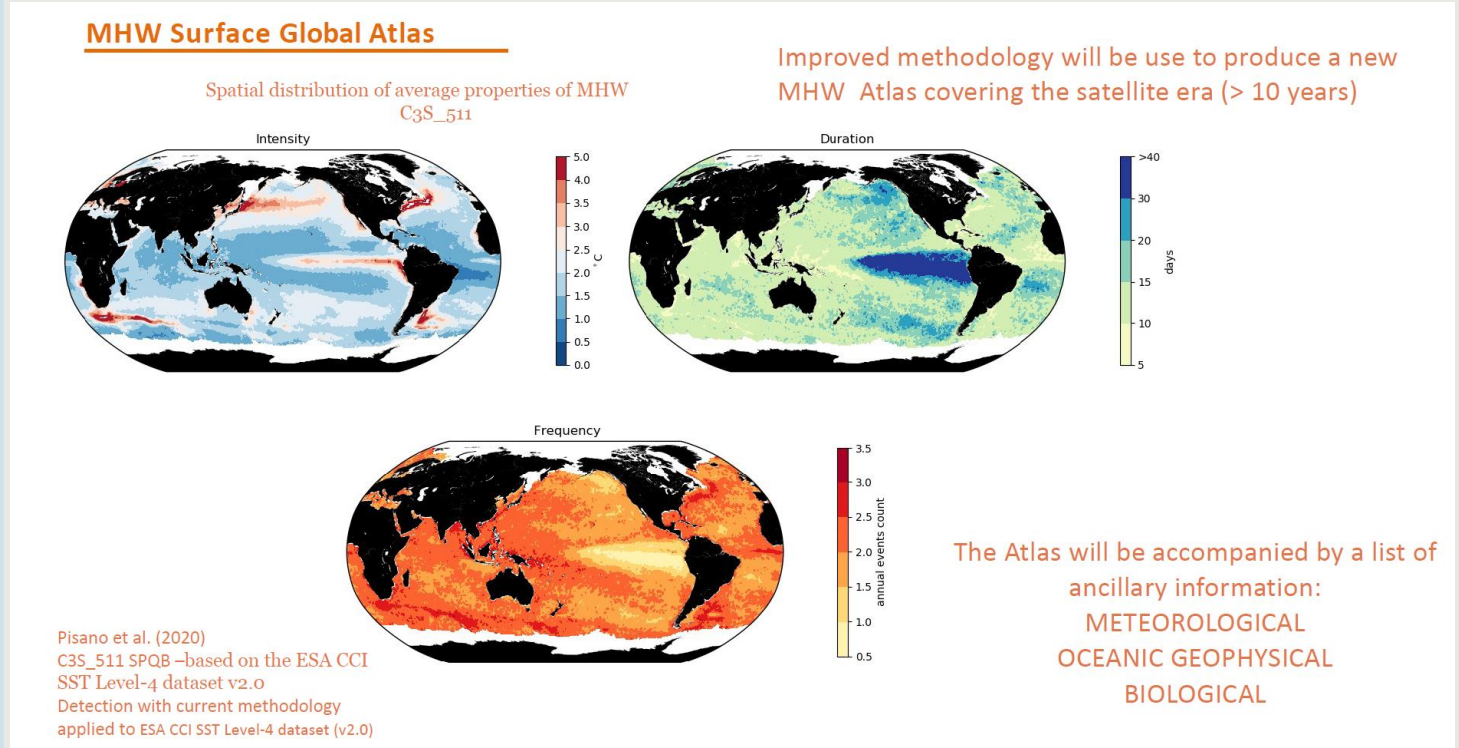
- GOA-ON — Global Ocean Acidification Observing Network
- The Ocean Foundation
- Ocean Conservancy
- OA Alliance — International Alliance to Combat Ocean Acidification

Ocean Health - Marine Heat Waves – CAREHeat

Time Period: March 2022 – March 2024

Project Objectives

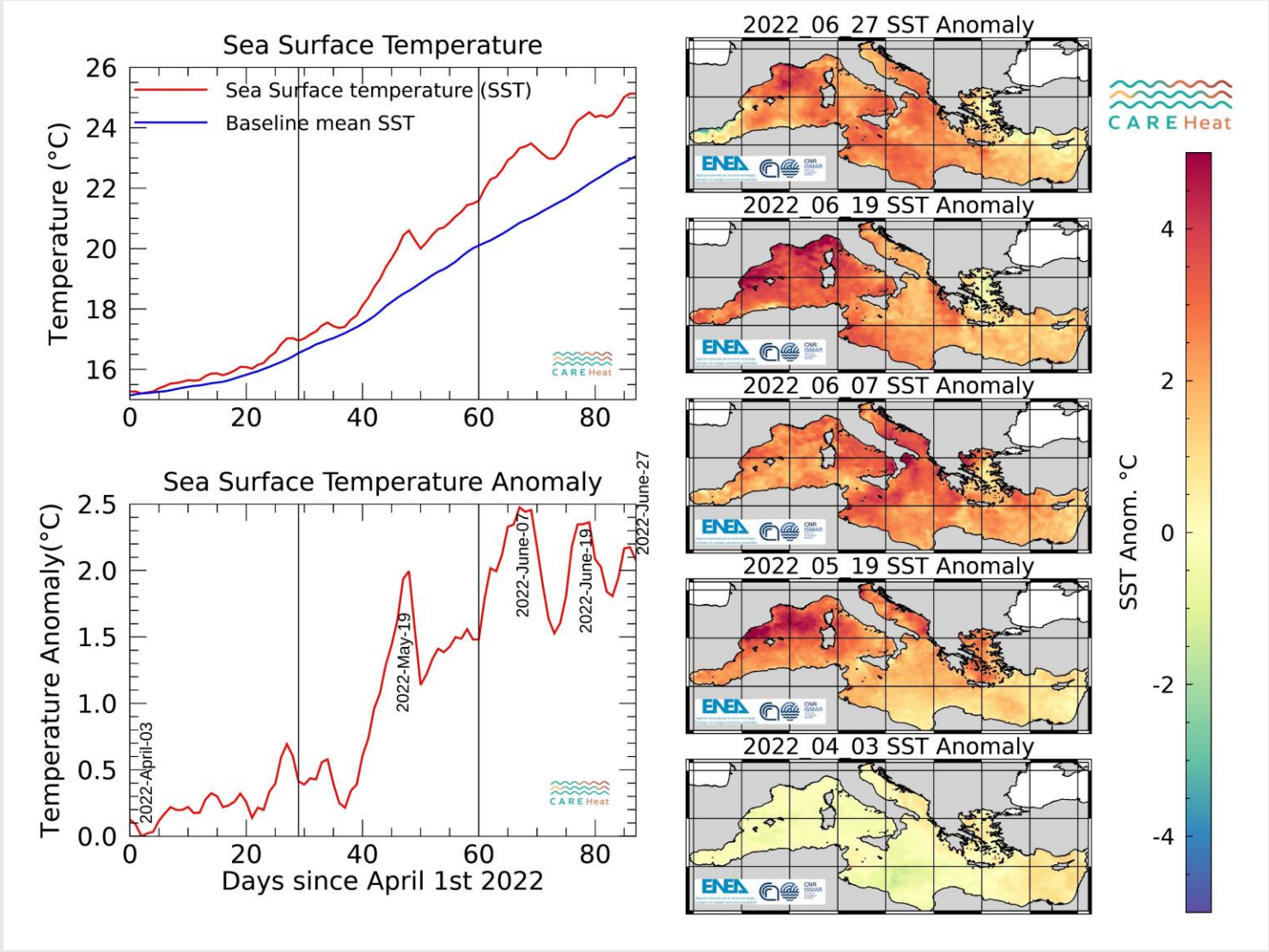
- 4D Reconstruction of Marine Heat Waves
- Development of a Marine Heatwave Atlas
- Assessing the impact of MHW on marine Ecosystems and Biogeochemistry, and Ecosystem Services



On-going Marine Heatwave in the Mediterranean Sea

- The Mediterranean Sea is currently enduring a marine heatwave with temperatures in May 2022 **4°C higher than the average** for the 1985-2005 period.
- Surface water temperature hit peaks of over 23°C.

September ESA News: https://www.esa.int/Applications/Observing_the_Earth/Mediterranean_Sea_hit_by_marine_heatwave



Upcoming relevant ITT (Invitation To Tender):

The Blue Carbon project

Time frame: 2023 – 2025 (ITT Q1 2023)

Objective: The project aims at developing new methods and new EO-based products allowing to improve the estimate and monitor the changes of the **Extent and Carbon Stock of major Blue Carbon coastal ecosystems and major in-land water bodies around the world such as mangroves, tidal and salt marshes, seagrasses, water weeds and algae**

SDG series Eutrophication project

Time frame: 2023 – 2025 (ITT Q1 2023)

Objective: Scaling up on **Coastal eutrophication** for monitoring indicators of coastal waters, which can support countries reducing nutrient pollutions from land-based anthropogenic sources

Upcoming relevant ITT (Invitation To Tender):

Multi-stressors impact on Ocean Health

Time frame: 2023 – 2025 (ITT Q4 2022)

Objective: The project aims at developing new methods and new EO-based products allowing to advance our observational capability and scientific understanding of the **impact of multi stressors events (mainly compounds) on Ocean Health, intended as the capacity of marine ecosystems to provide their services.**

Blue Economy

Time frame: 2023 – 2025 (ITT Q2 2022)

EO in support to Blue Economy related activities (Fisheries, Aquaculture, Renewable Energy) and for the monitoring of related environmental matters.