ODYSSEA

Creating products and knowledge
for the Mediterranean

ΔΗΜΟΚΡΙΤΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΡΑΚΗΣ | DEMOCRITUS UNIVERSITY OF THRACE

WELCOME TO THE ODYSSEA FINAL CONFERENCE

ODYSSEA Final Conference

Nov 3, 2021 09:00-16:15 CET

Georgios Sylaios

Democritus University of Thrace

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727277

Scope

ODYSSEA

The purpose of this conference is to present the final results to key target audiences: partners, the scientific community, marine-based industry (including SMEs), policymakers, public authorities, media, consumer organizations and the general public.
The conference has been arranged into 6 specific areas of focus:

1. Capacity-building around the Mediterranean, Europe, Israel and North Africa.
2. Marinomica – the data visualisation platform & data harmonisation.
3. Development of Marinomica products and services.
4. Observatories – the new Med observatories.
5. Contribution to Policy-making.
6. Impacts and the future
    1. Blue growth
    2. Continued operation of Marinomica
    3. Continued operation of the Observatories
    4. EcoScope – fisheries management
    5. Iliad – The EU's digital twin of the ocean

Agenda

09:00 – 09:45 (CET) - Professor Georgios Sylaios (DUTH), Project Coordinator
Welcome and introduction to project achievements
09:45 – 10:30 (CET) - Daniel Cebrian (SPA-RAC)
Capacity-building around the Mediterranean, Europe, Israel and North Africa
10:30 – 10:45 (CET) **Break**
10:45 – 11:30 (CET) - Simon Keeble (Blue Lobster) & Nicolas Grainier (CLS)
Marinomica – the data visualisation platform & data harmonisation
11:30 – 12:30 (CET) - Lorinc Meszaros and Ghada El Serafy (Deltares)
Development of Marinomica products and services
12:30 – 13:30 (CET) **Break**
13:30 – 14:30 (CET) - Hussein Nibani (AGIR)
Observatories – the new Med observatories
14:30 – 14:45 (CET) **Break**
14:45 – 15:15 (CET) - Claire Dufau (CLS) and Laura Friedrich (UNEP-WCMC)
End-User Services and Contribution to policy processes
15:15 – 15:45 (CET) - Simon van Dam (Agora)
Impacts and the future (Blue growth, Continued operation of Marinomica, Continued operation of the Observatories, EcoScope – fisheries management, Iliad – The EU's digital twin of the ocean
15:45 -16:15 (CET) - **Discussion and feedback**
16:15 (CET) – **Close -** Professor Georgios Sylaios (DUTH), Project Coordinator & Simon van Dam (Agora)

ODYSSEA

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AN OVERVIEW OF THE ODYSSEA PROJECT

ACTIVITIES, ACHIEVEMENTS, CHALLENGES

ODYSSEA Final Conference

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4 ½ year earlier…

ODYSSEA

ODYSSEA

The ODYSSEA Consortium was awarded an EU Grant for a proposal submitted to Call

BG-12-2016: Towards an integrated Mediterranean Sea Observing System

HORIZON 2020

Basic Call Requirements

ODYSSEA

Develop a new Mediterranean Sea Observing Platform to

- ✓ describe the functions of vulnerable marine ecosystems
- ✓ support biodiversity conservation
- ✓ forecast and manage risks and emergencies
- ✓ place the above within the context of sea-related activities and economic sectors

Basic Call Requirements

ODYSSEA

- The developed platform should **integrate information from existing platforms** and systems already in operation in the Med, as:

✓ EMODNet

✓ Copernicus

✓ GEOSS

✓ GOOS

✓ ESFRI

EMODnet
European Marine Observation and Data Network

Copernicus
Europe's eyes on Earth

GEO GROUP ON EARTH OBSERVATIONS | GEOSS Portal
Discover, Access, Contribute
Earth Observations, Information and Services

esa

Information in these systems is fragmented and difficult to access

Research Infrastructures

The Global Ocean Observing System
GOOS

Basic Call Requirements

ODYSSEA

We need to conduct research and innovation activities **to address and fill in observational gaps** in the Med, in particular those related to the *in-situ* component of the observation system.

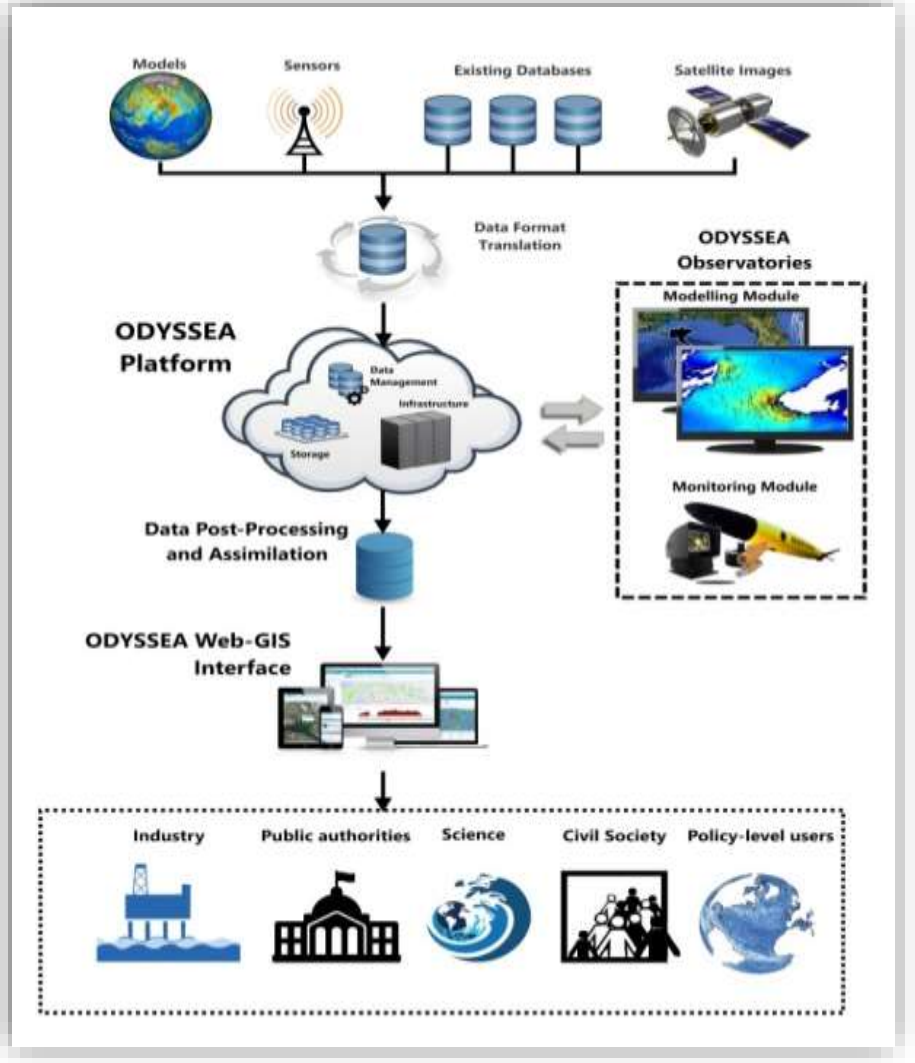
We need to

- ✓ Improve existing **in-situ operational systems**
- ✓ Expand towards **new ocean observation technologies**
- ✓ Integrate the **biological dimension** into sea observing systems
- ✓ To build **cost-effective in-situ systems**
- ✓ Utilize the information collected to **calibrate and validate models and satellites** (Sentinel, Earth Explorer)

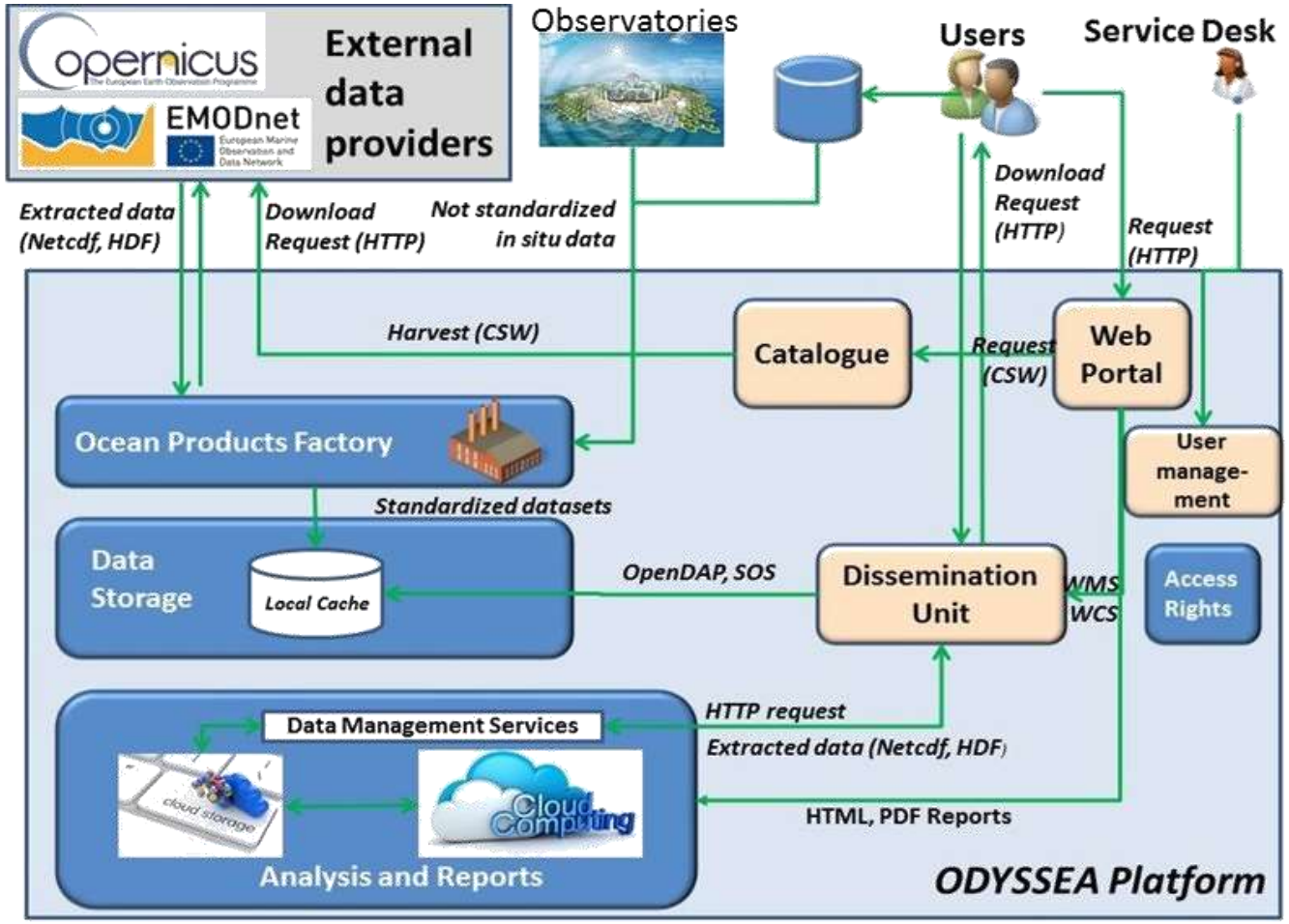
ODYSSEA Conceptualization

- ODYSSEA is a system bridging the gap between operational oceanography capacities and the need for information on marine conditions from the community of end-users.

- ODYSSEA's ambition is to develop an **interoperable, fully-integrated and cost-effective multiplatform network of observing and forecasting systems** across the Mediterranean basin, addressing both the open sea and the coastal zone.



ODYSSEA Conceptualization



Data Storage Component – Local storage for ODYSSEA OBS data, end-users uploaded data, and end-users ordered data, Data will be **standardized** through the OPF.

Catalogue

An interface for CSW-based catalogue services following OGC guidelines,

Users Management Component

Deals with user access to the platform

Dissemination Unit Component

Produce and supply data in common formats to platform front-ends and services,

OpenDAP for data in Grids, SOS for data for time-series and WMS-t for data in Maps, NetCDF, ODV, etc.

Gridded data - THREDDS and open source MOTU Components

In-situ data - Oceanotron Component

Ocean Products Factory Component

Providing new tailor-made sea products acting as an advanced data broker,

Data production **by selecting variables, space and time frame** from metadata products in the ODYSSEA catalogue,

Process data from Monitoring and Modelling Modules from each ODYSSEA OBS,

Offer new standardized and catalogued products

ODYSSEA's Central Objective

ODYSSEA is a user-centred project aiming to make Mediterranean marine data easily accessible and operational to multiple end-users, by

- harmonizing existing Earth Observing systems,
- upgrading operational oceanographic capacities,
- supporting EU policy implementation,
- improving interoperability in monitoring,
- fostering blue growth jobs creation, and
- opening participation to non-EU member states.

ODYSSEA Specific Objectives

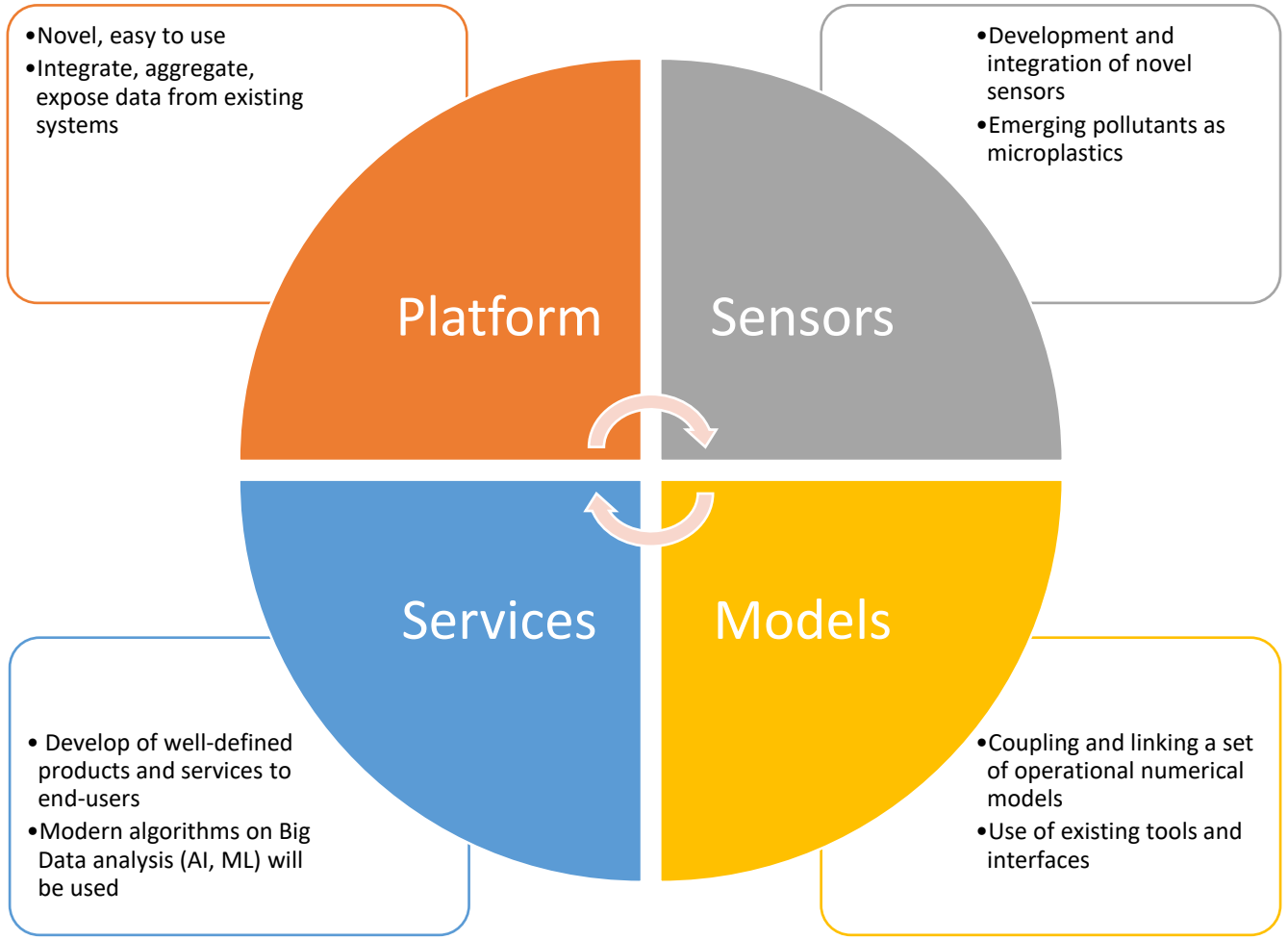
1. Develop a platform to discover, integrate and process datasets obtained from an expanded range of existing observation platforms
2. Fill-in data gaps & increase spatial and temporal resolution by establishing ODYSSEA Observatories
3. Develop a prototype ‘chain’ of models providing data never previously reported
4. Expand existing operational monitoring systems capacity
5. Emphasize on biological datasets
6. Combine data to extract secondary indicators
7. Link indicators to EU policies
8. Involve end-users on platform design, data collection and day-to-day operations
9. Train and educate policy-makers and end-users on platform usage
10. Improve professional skills and competences - focus on Northern Africa capacity building

What is ODYSSEA

ODYSSEA is a Mediterranean-focused research project funded by EU Research and Innovation Program Horizon 2020

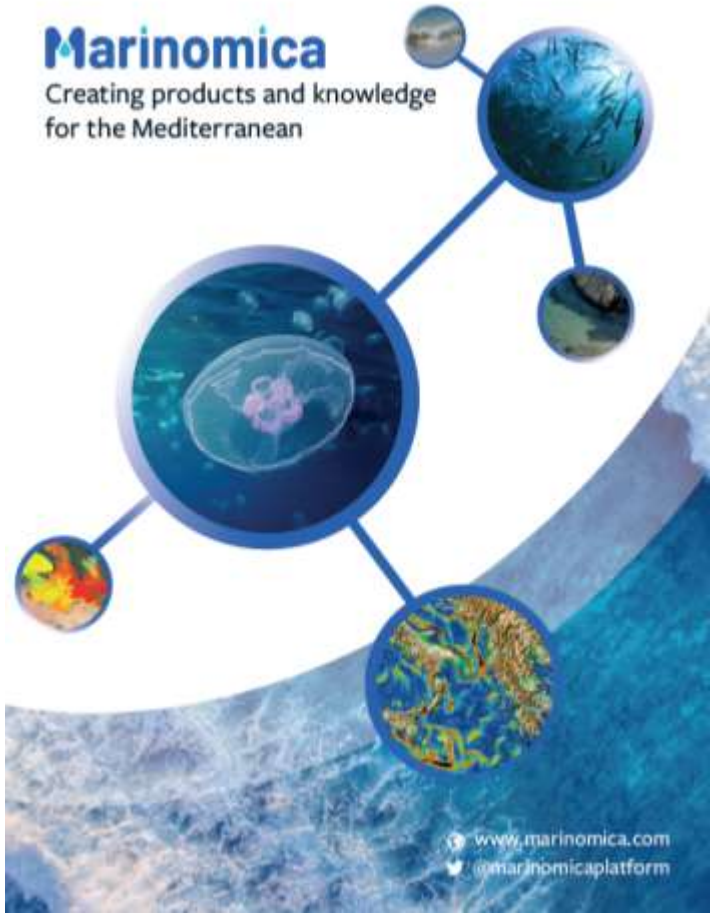
- 28 partners from 14 countries (6 non-EU)
- 8.398 Meuros budget
- 54 months duration
- Starting date 1st June 2017
- Ending date 30th November 2021
- 932 PMs in total
- 7 Advisory Board Members

ODYSSEA Components



Introducing “Marinomics”

ODYSSEA

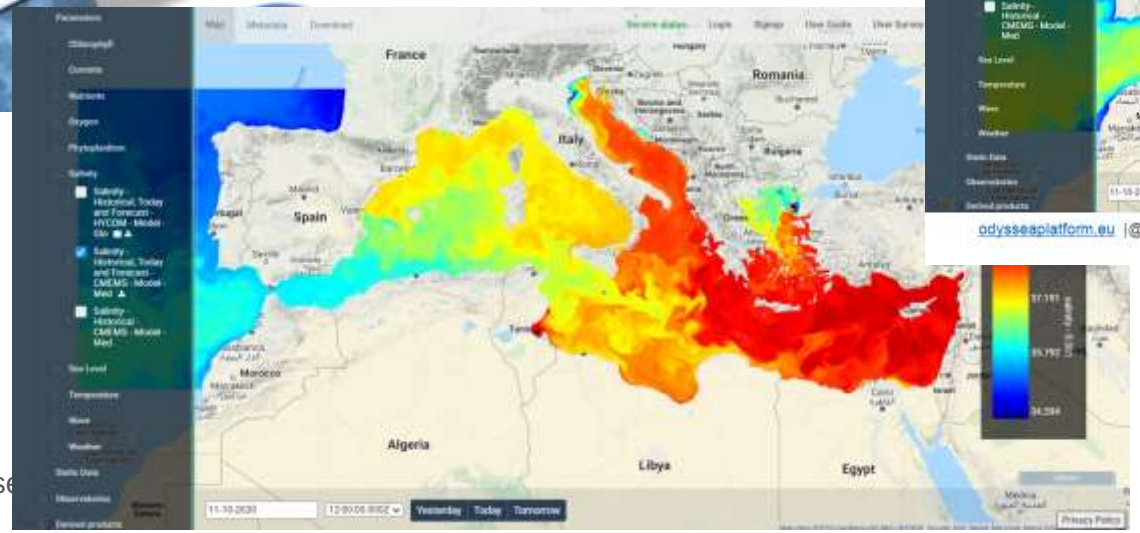


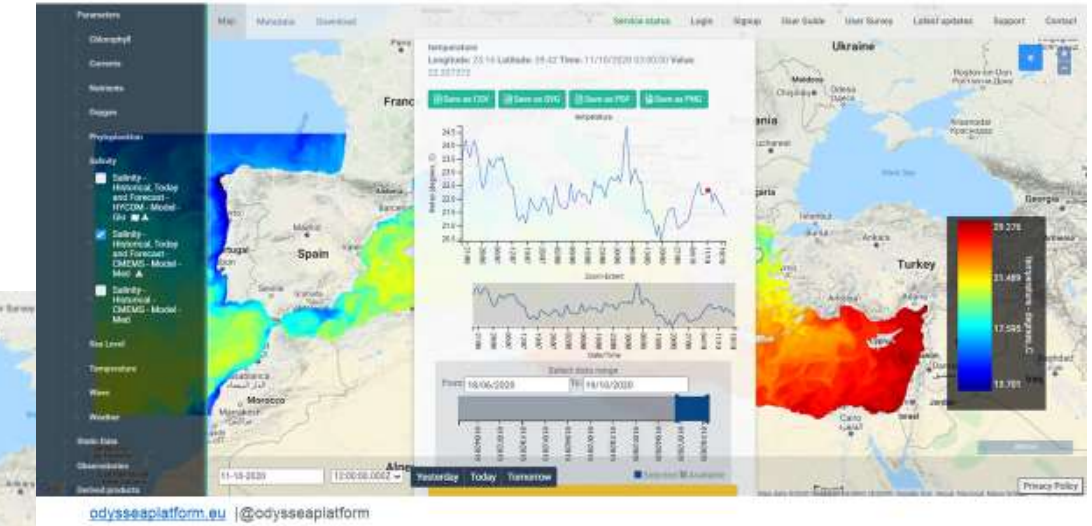
Noun /məˈriːnˈnɒmɪks/

1. The science of decision making in the marine environment.
2. The branch of knowledge concerned with the production, consumption, and transfer of wealth in the marine environment.

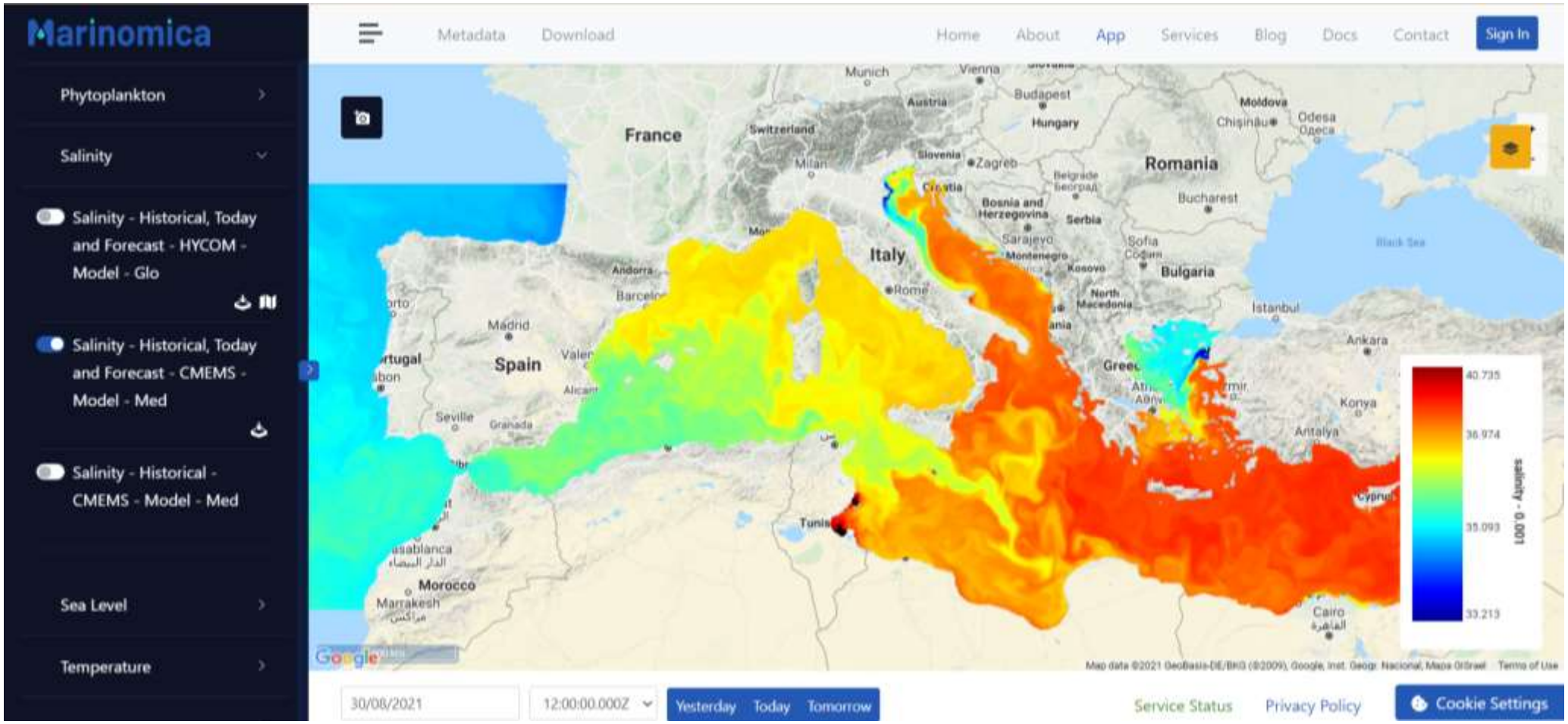
Marinomics is a new multidisciplinary scientific topic adopting the novel approaches of Earth Big Data to provide Services within the concept of Blue Economy and Growth. Marinomics aims to improve decision-making and operations in the multitude of users operating at sea, protect the marine environment and support marine and maritime sustainable development.

The Marinomica Platform



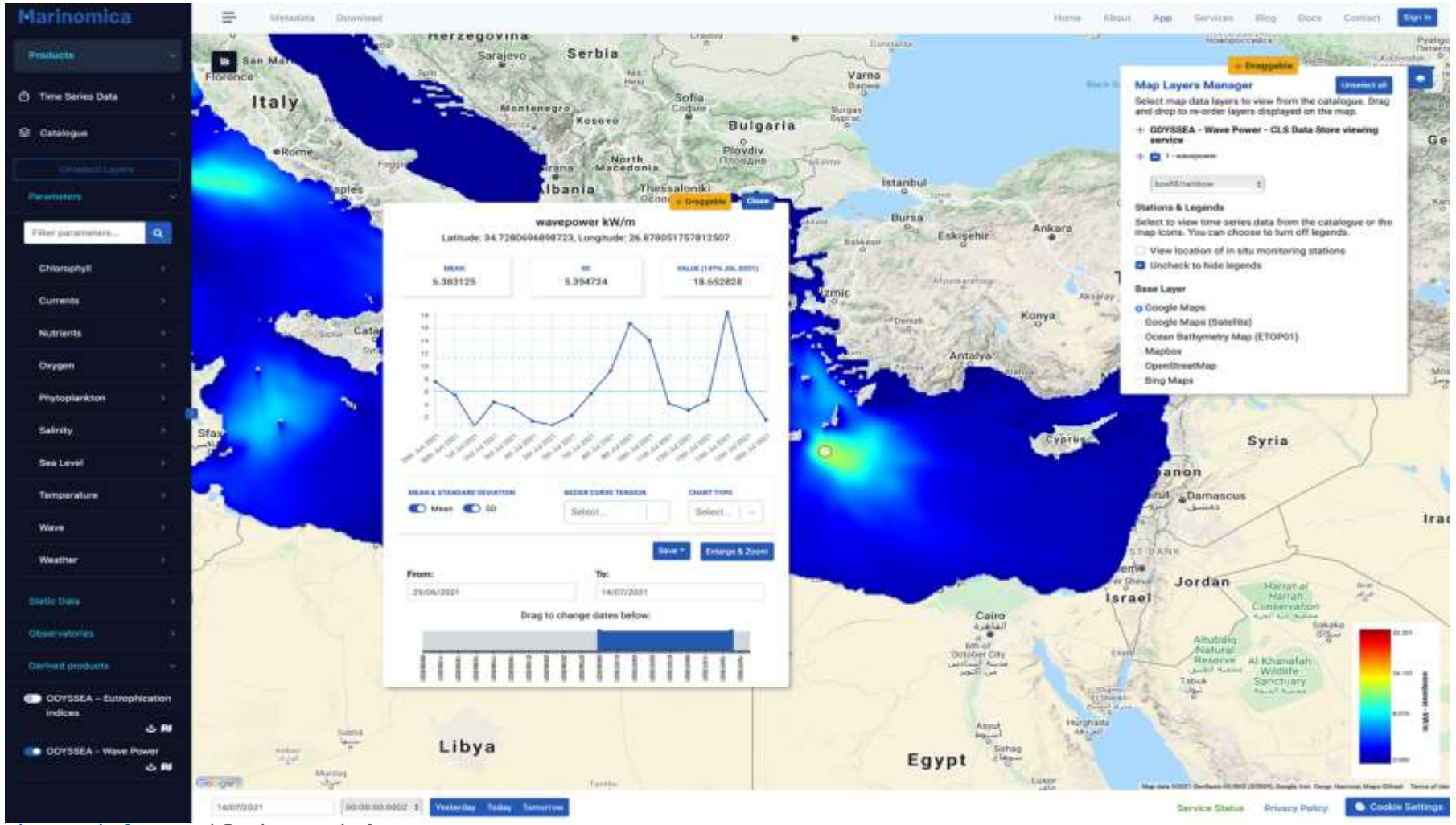


The Marinomica Platform



odysseaplatform.eu |@odysseaplatform

The Marinomica Platform



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The Marinomica Data Centre

ODYSSEA

From Marinomica to the Digital Twin

ODYSSEA

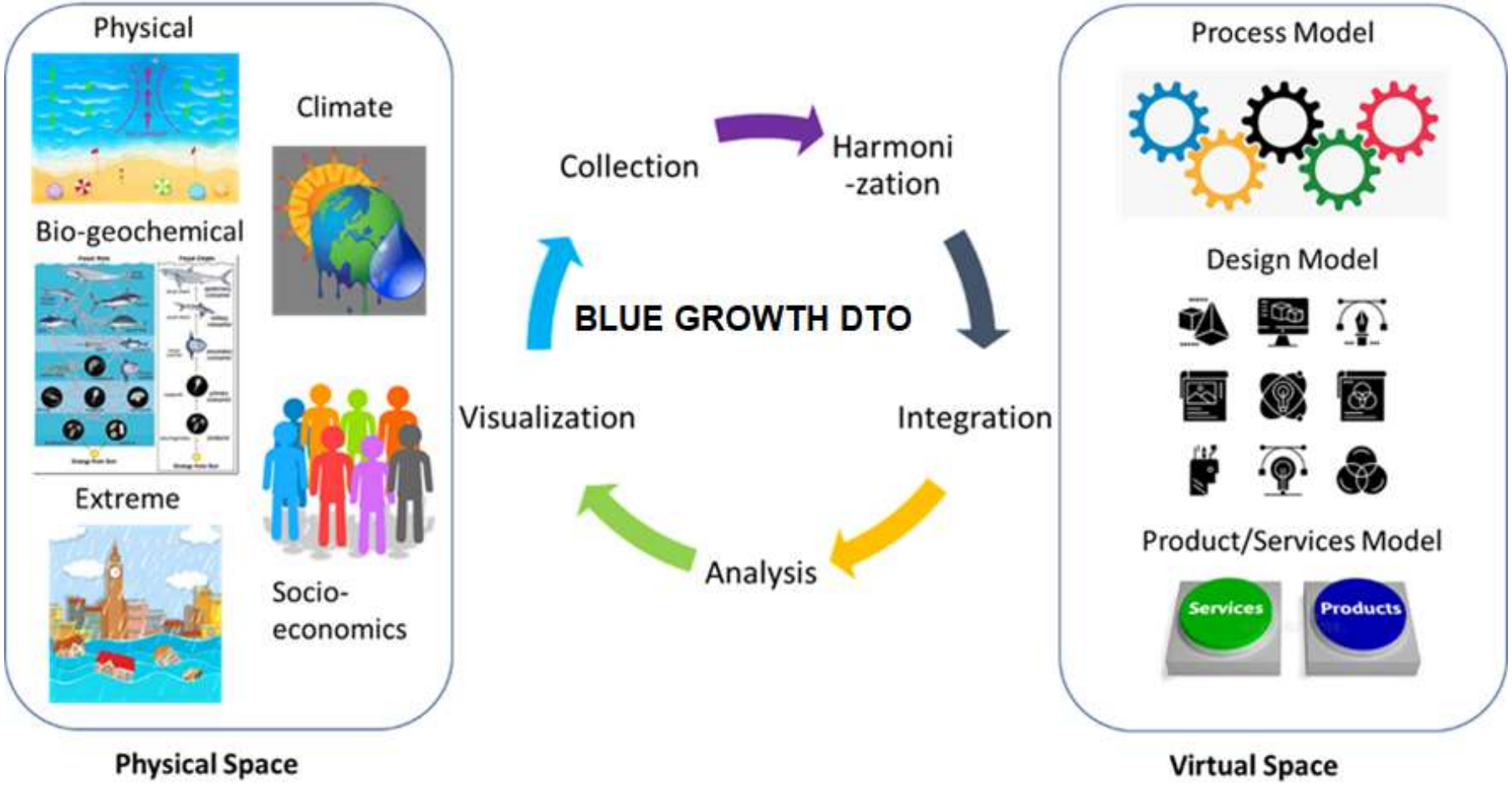
Utilize

- the “flood” of available digital data from different EO sources,
- modern computing infrastructure (IoT, social networks, Big Data, cloud computing)
- run advanced forecasting algorithms,
- explore spatio-temporal utilizing pattern recognition tools,

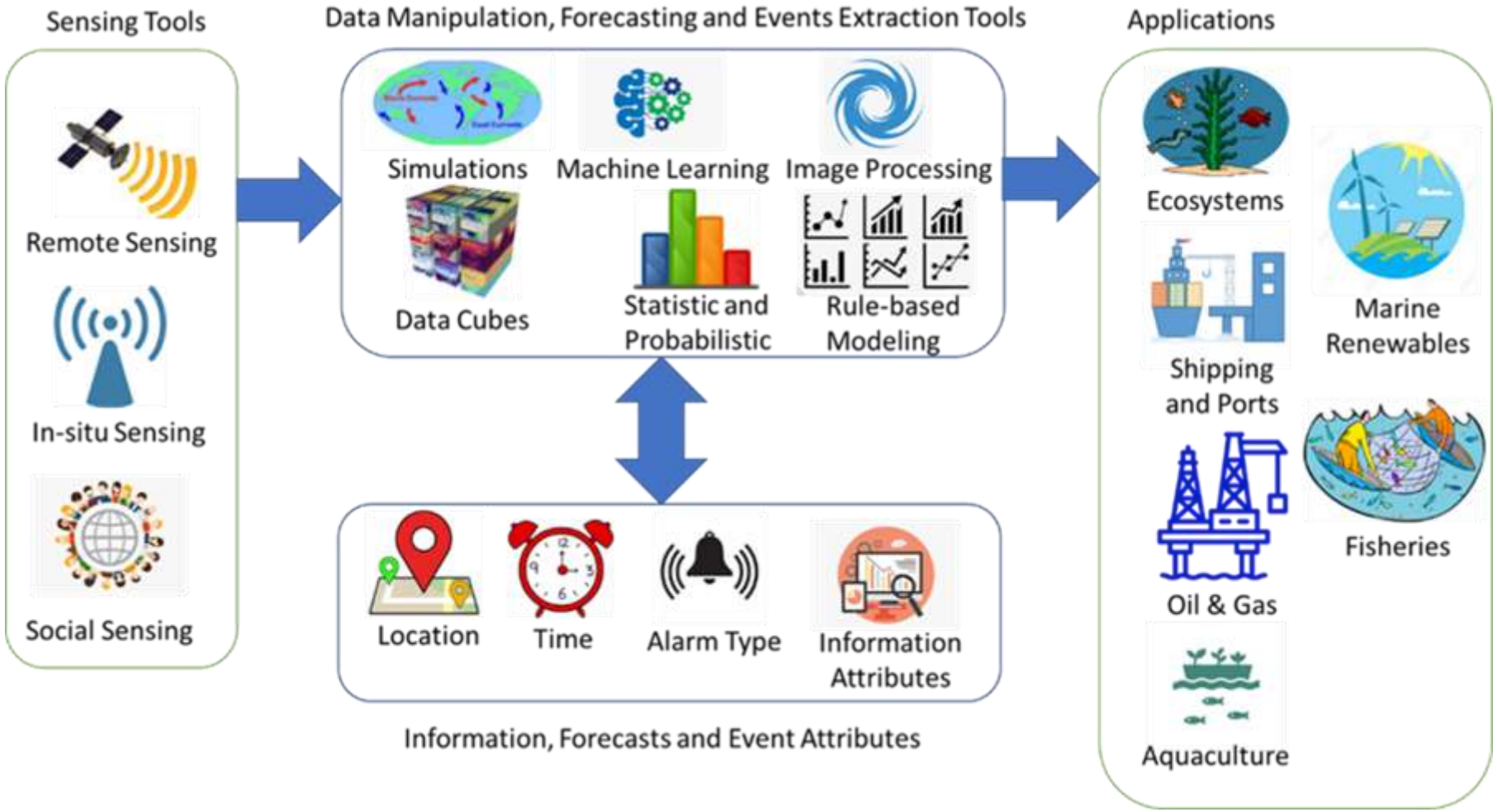
aiming to

- to address computationally all Earth Data challenges,
- predict extreme events
- produce RT/NRT digital replicas of the ocean
- support smart products and services design, thus improving lives, works and prosperity throughout the EU.

Blue Growth DTO



The Marinomica DTO



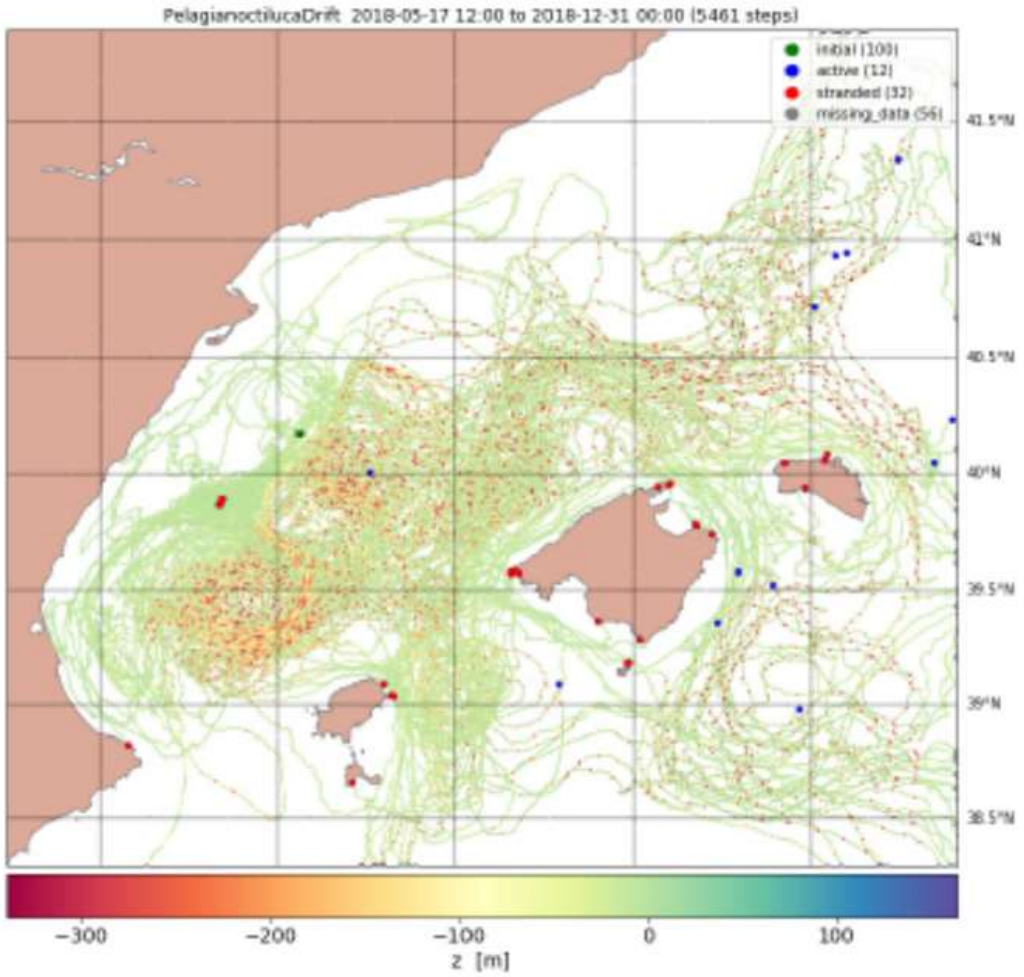
The Marinomica Platform

ODYSSEA

Present Datasets: CMEMS, HYCOM, AVISO+, CLS models, Sentinels, ECMWF, NOAA, EMODnet habitats

Upcoming Datasets: OneGeology, Fishbase, UNEP-WCMC, CORDEX CC, e-Hype

The Marinomica Services



Nine ODYSSEA Observatories

Mapping User Needs

ODYSSEA

Table 4: Examples of potential use cases, for each of the 12 sectors considered

Sector	Use case (short) name and ID number	ODYSSEA Observatory	Extent of end-user engagement	Narrative
Fishing	#067 Fish nursey areas in Gökova	Gulf of Gökova	End-user engagement	*As a fisher, I need to know the location of nursery areas in the Gulf Gökova, especially for the endanger species*
Aquaculture	#011 Mussel farmers, Keramoti Bay, Kavala Gulf	North Aegean/Thracian Sea	End-user engagement	*Daily meteorological and oceanographic information provide to mussel farmers via social media, with explanation text in Greek*
Oil and gas	#016 Oil and gas extraction in Israel	Israeli Coast	End-user engagement	*Gas extraction companies and the Ministry of Energy need better meteorological and current information and forecasting for safe operations*
Renewable energy	#023 Offshore wind farm development	N/A	Existing example	*Offshore wind and wave farm operators and developers need wind and wave data to be able to plan their operations and developments*
Shipping	#029 Shipping routes, Greece/entire Mediterranean	North Aegean/Thracian Sea	Identified need	*Port authorities, cargo and cruise operators need forecast data to optimize shipping routes to enhance safety and reduce fuel consumption*
Other marine industries	#039 Data for marine mining	N/A	Existing example	*Marine mining operators receive texts with early warnings of poor weather conditions*
Coast guard operations	#032 Reach and rescue operations	N/A	Existing example	*Real-time, accurate spatial data on conditions informs decisions on where to employ reach and rescue resources*
Policy and governance	#045 National pollution an biodiversity monitoring, Israel	Israeli Coast	End-user engagement	*The ministry of environmental protection and the Israeli Oceanographic Institute need microplastic concentration data for national pollution monitoring programmes*
Environment and biodiversity management	#077 Reporting on EU Marine Directive Descriptor 2	Gulf of Gökova	End-user engagement	*As a national government employee, I need to know the impact of invasive species on ecosystem in Gökova MPA, for reporting under Descriptor 2 of the EU Marine Directive*

Building Customized Sensors

Surface system

Lander

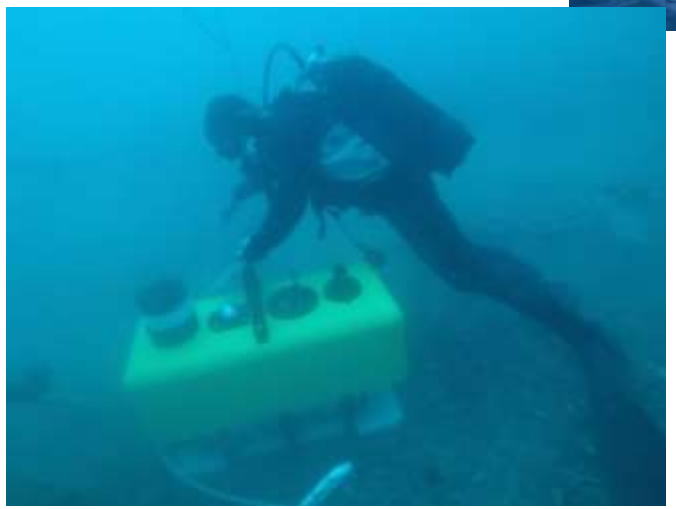
The DEVELOGIC Landers and Surface Buoys, measuring:
T, S, DO, Turbidity, CDOM, Chl-a, MPS
Landers: + Waves, Currents, MPS

MPS pack

Deployments of Fixed Systems

ODYSSEA

Observatories	Surface	Lander
Thracian Sea	1	1
Gokova	1	
Arzew Bay/Stora Gulf		
Al-Hoceima	1	1
Israel	1	
Ghabes Gulf	1	
Nile ROFI		



Data collected by ODYSSEA are transferred to MonGOOS, CMEMS and EMODnet through INSITU-TAC.

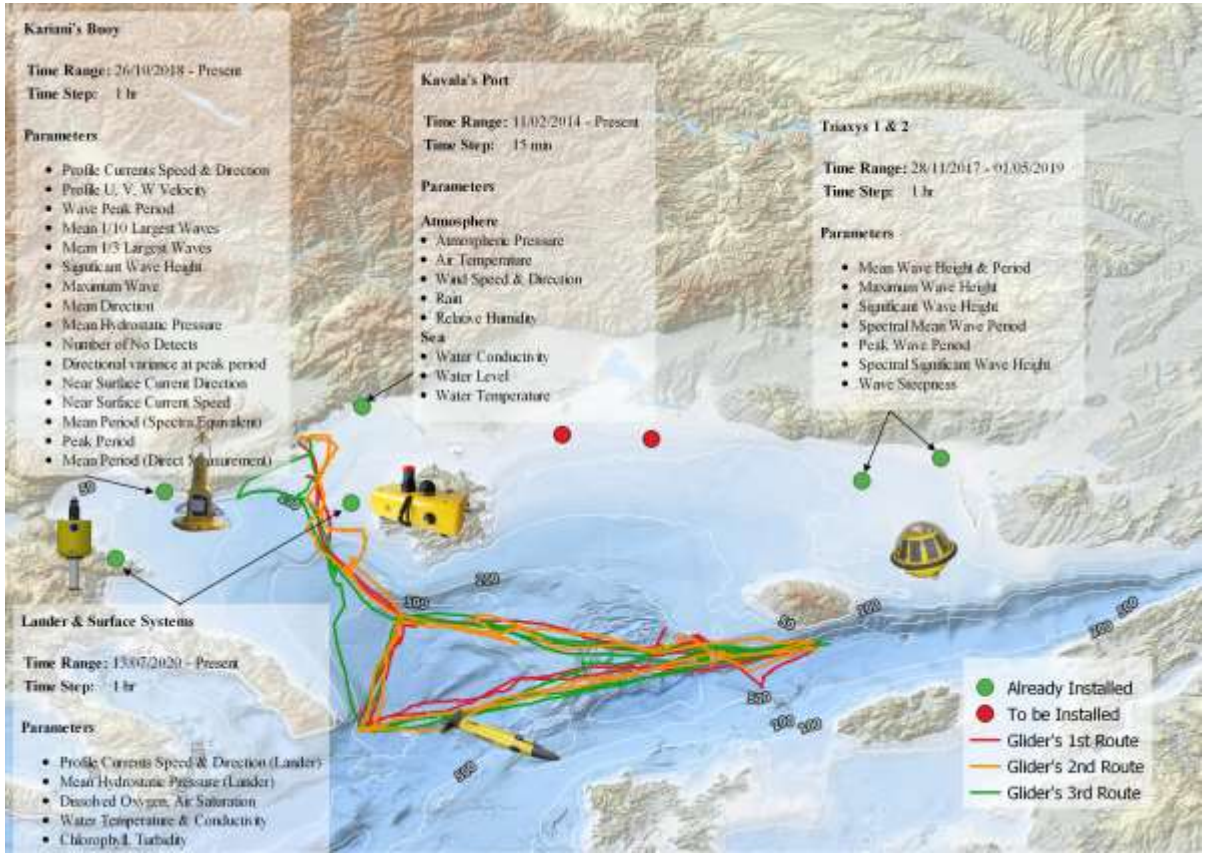
Glider Missions in the Med

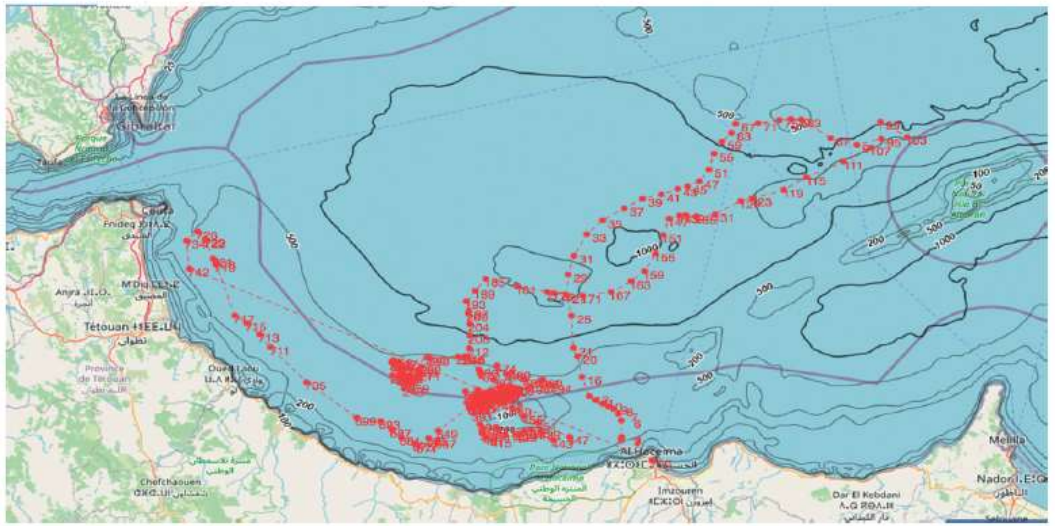
ODYSSEA

- 2 SEAEXPLORER GLIDERS
- 3 sensor payloads:
  - ❖ Payload 1
    - ✓ Temperature, salinity, pH, dissolved oxygen, chlorophyll-a, turbidity, CDOM
  - ❖ Payload 2
    - ✓ Passive Acoustic Monitoring (PAM)
  - ❖ Payload 3
    - ✓ Temperature, salinity, microplastics

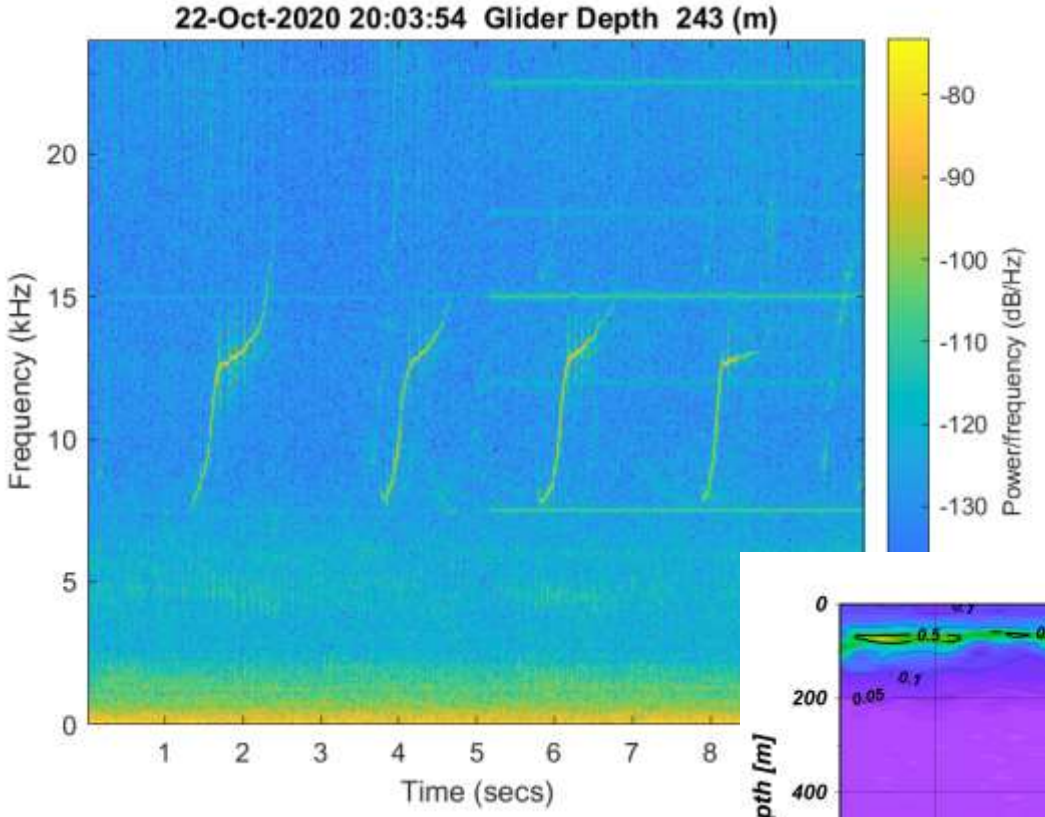
Observatories	Glider Missions
Thracian Sea	3
Gokova	
Arzew Bay/Stora Gulf	
Al-Hoceima	2
Israel	2
Ghabes Gulf	1
Nile ROFI	

Glider Missions in the Med

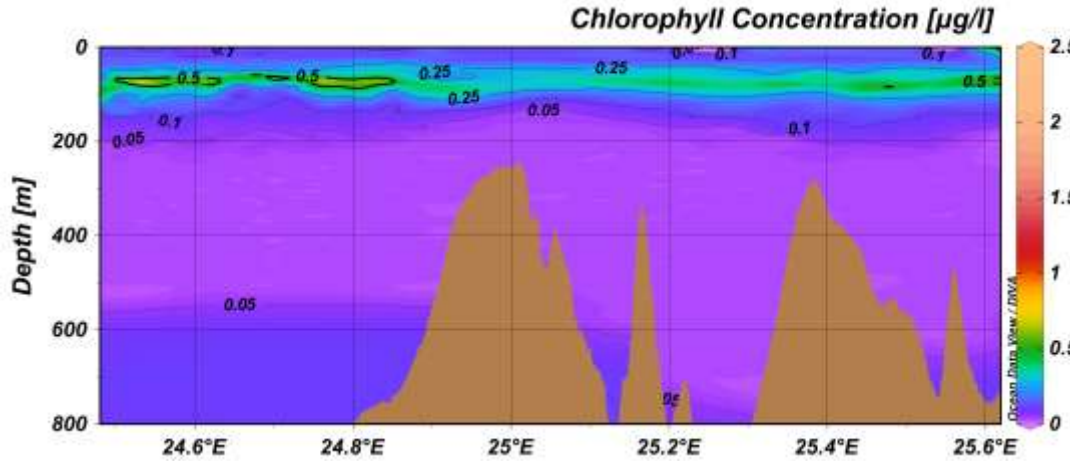


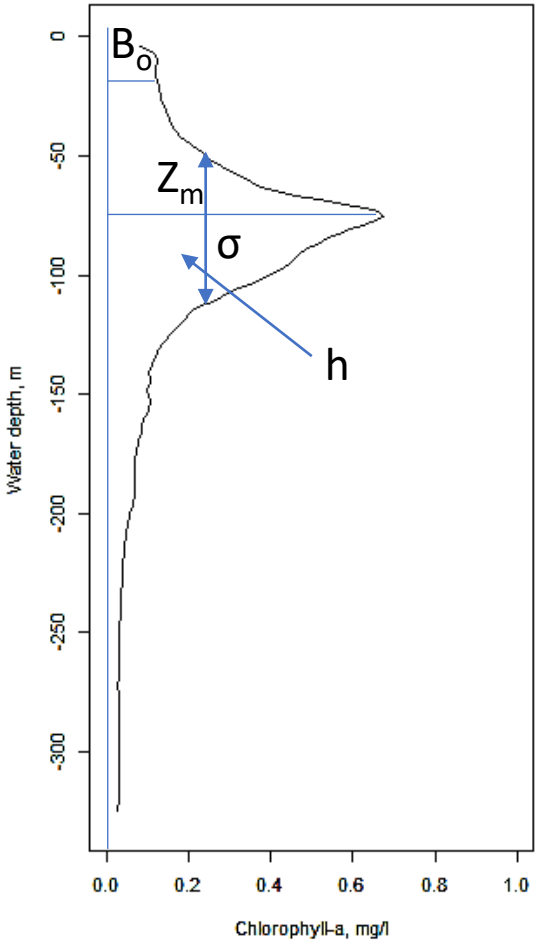


Glider Results



Striped Dolphins

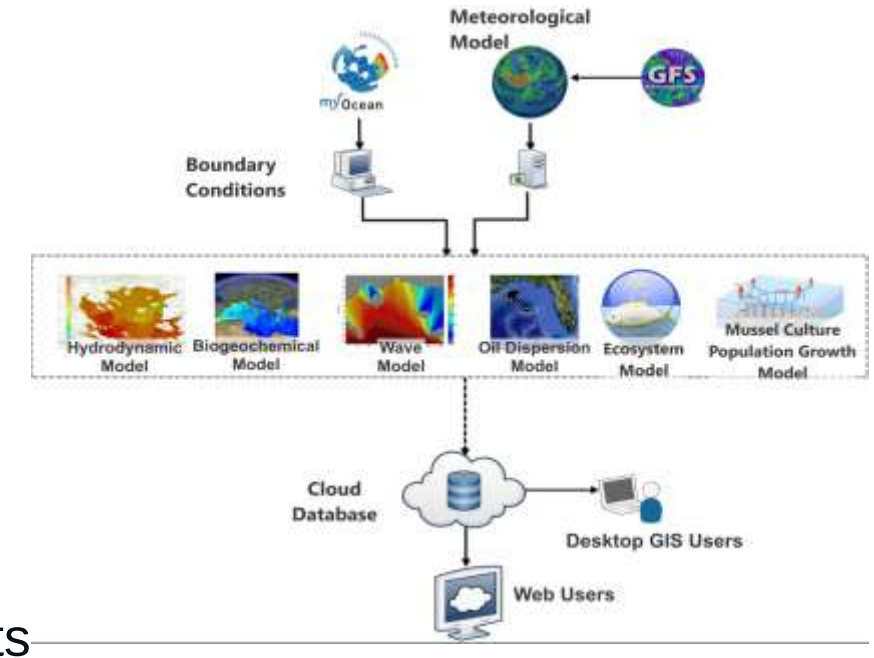


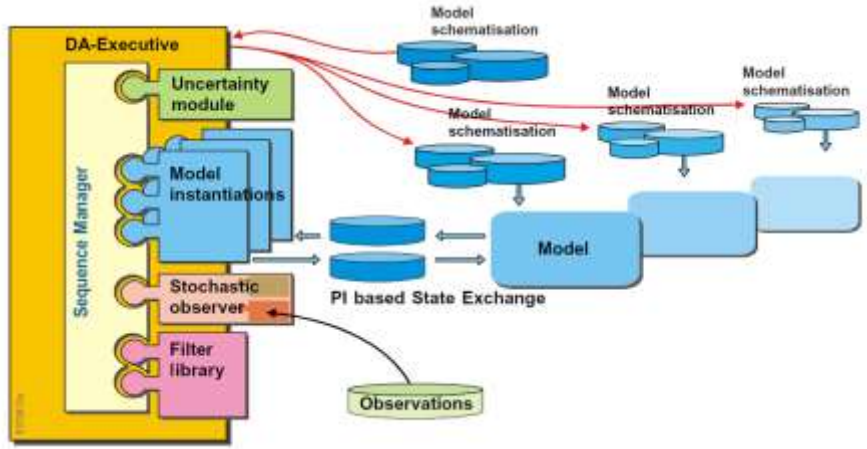


The Marinomica Downscaled Models

ODYSSEA

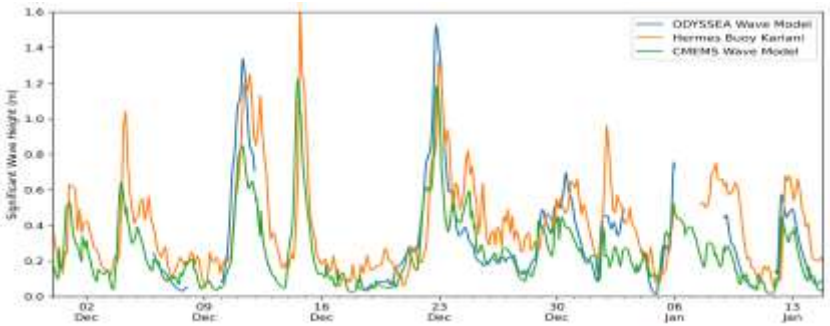
- ✓ A prototype ‘chain’ of operational models will be developed,
- ✓ Link models to existing databases,
- ✓ Provide short- and long-term prognostic results,
- ✓ Manage risks and emergencies in coastal and offshore areas,
- ✓ Meet the requirements of various end-user groups,

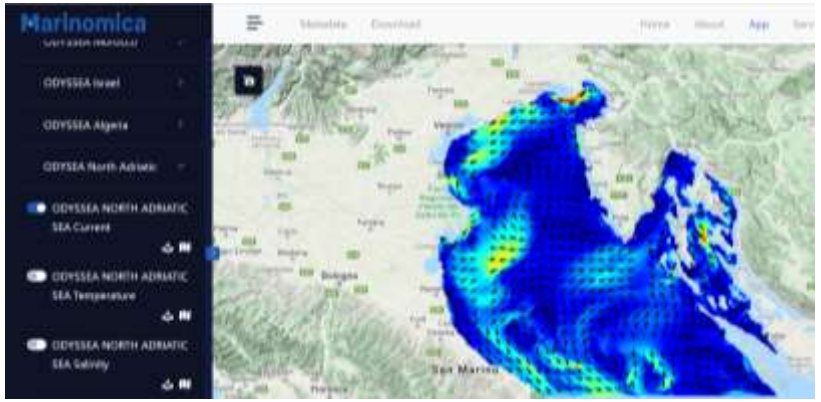


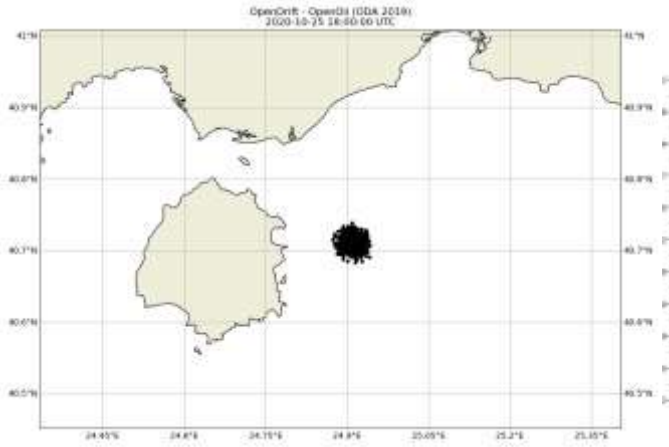


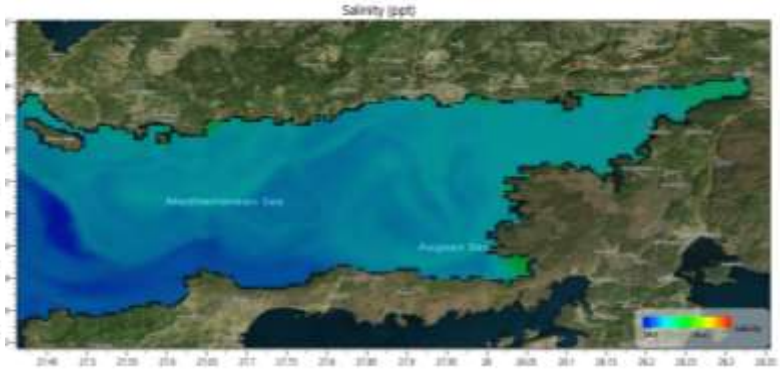
FEWS & Aquasafe: a) automatized data import, storage and pre-processing (from in-situ sensors, remote sensing, etc.); b) linking models to databases for initial and boundary conditions; c) scheduling of tasks to run the series of coupled numerical models; d) models calibration and validation; e) data assimilation, and f) post-processing modules results and transferring data to the Marinomica platform.

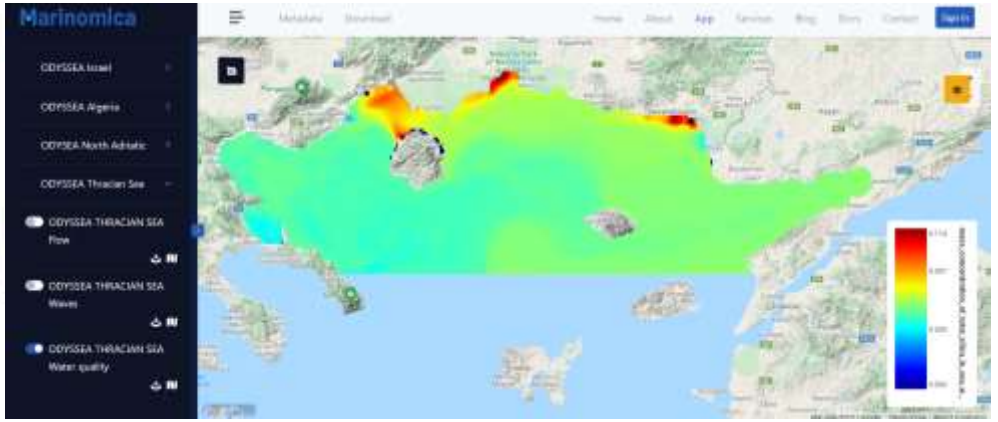
The Marinomica Downscaled Models







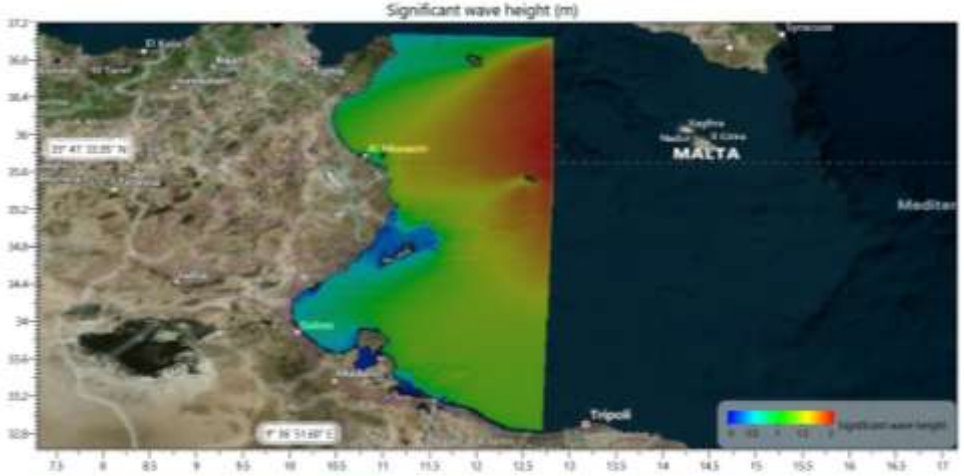




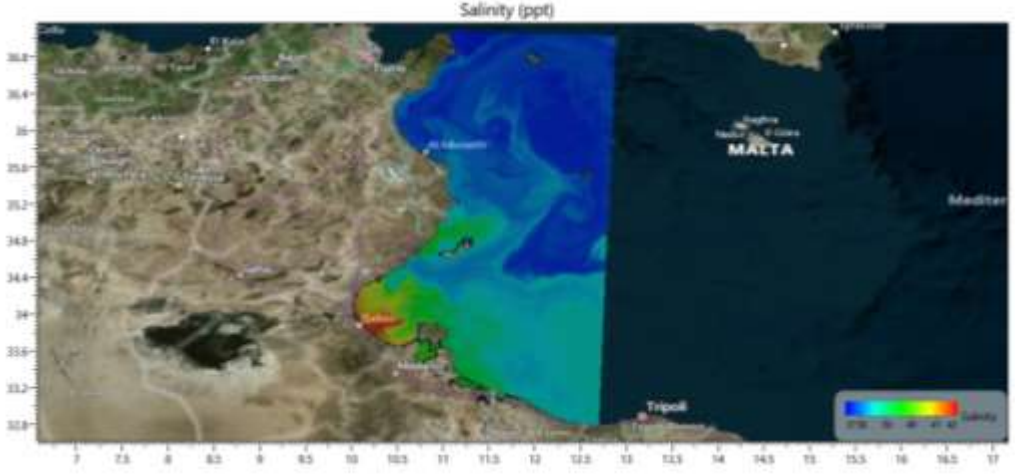
The Marinomica Downscaled Models

ODYSSEA

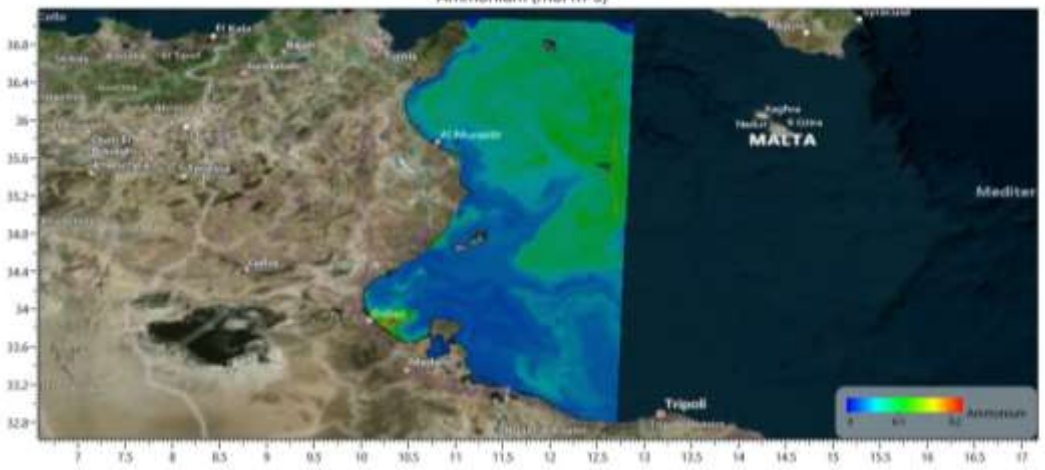
Significant wave height (m)



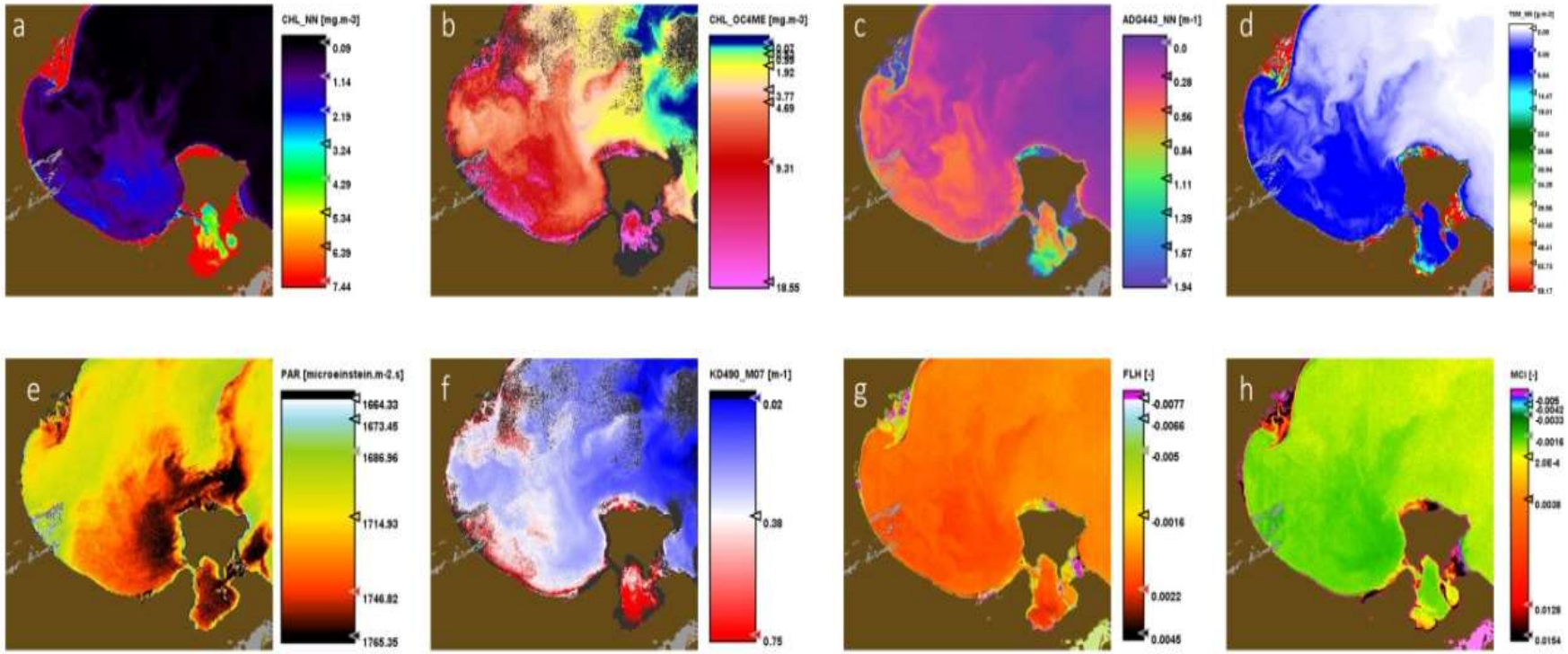
Salinity (ppt)



Ammonium (mol m-3)

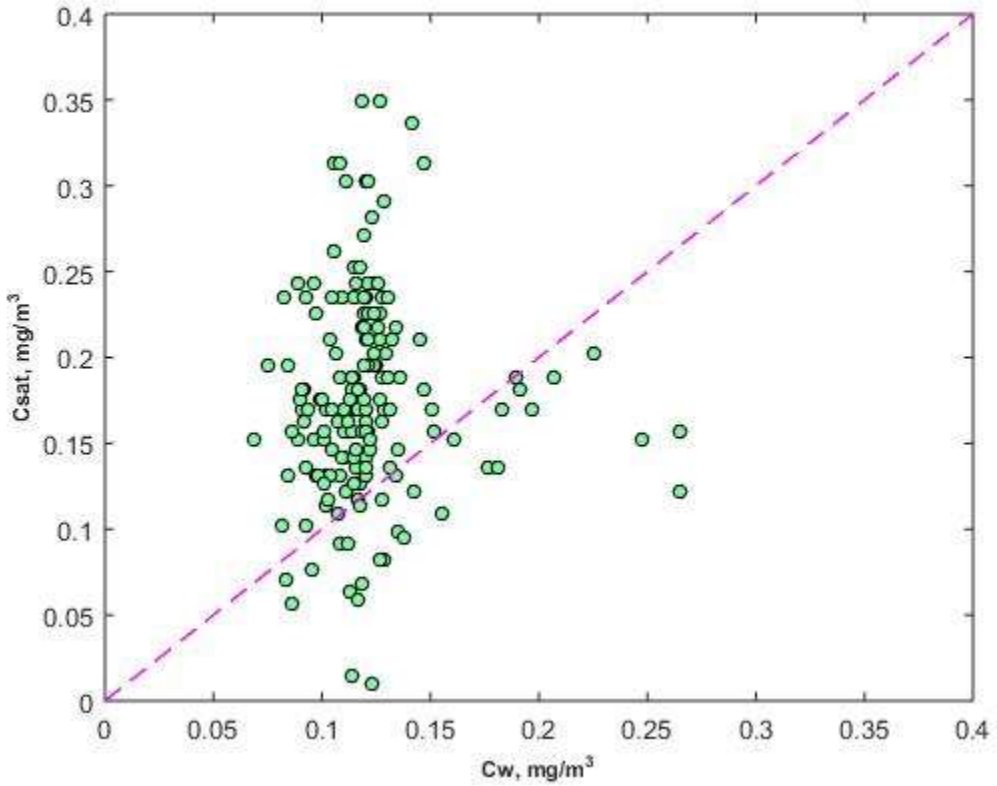


Remote Sensing



Sentinel-3 Level2 spatial distributions of a) chlorophyll-a conc (mg m^{-3}) Oc4me algorithm, b) chlorophyll-a conc (mg m^{-3}) chlnn neural network algorithm, c) absorption of CDOM at 443 nm (m^{-1}), d) TSM concentration (gm^{-3}), e) PAR in the spectral range 400-700 nm (µEinstein m^{-2} s^{-1}), f) diffuse attenuation coefficient at 490 nm (m^{-1}), g) fluorescence line height and h) max chlorophyll index at Gulf of Gabes.

Sentinel Calibration using glider data



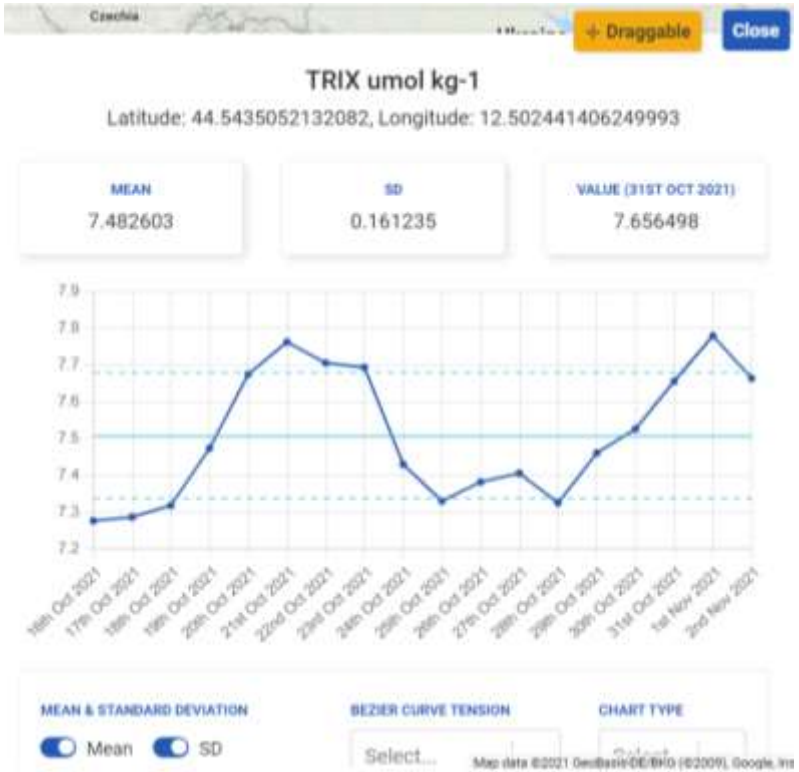
1) From each glider Yo the (lon,lat) were retrieved, representing the glider profile. Overall, 508 Yo's were collected.
2) Depth-integrated Chl-a conc was calculated based on euphotic zone depth.
3) These Chl-a values were correlated to Sentinel 3A data on a pixel-by-pixel basis.
4) Bias= 0.0551; Bias_log= 0.3251; **There exists an overestimation of Sentinel 3A Chl-a compared to in-situ data by 45.59% .**

Marinomica Services: The Eutrophication Indices

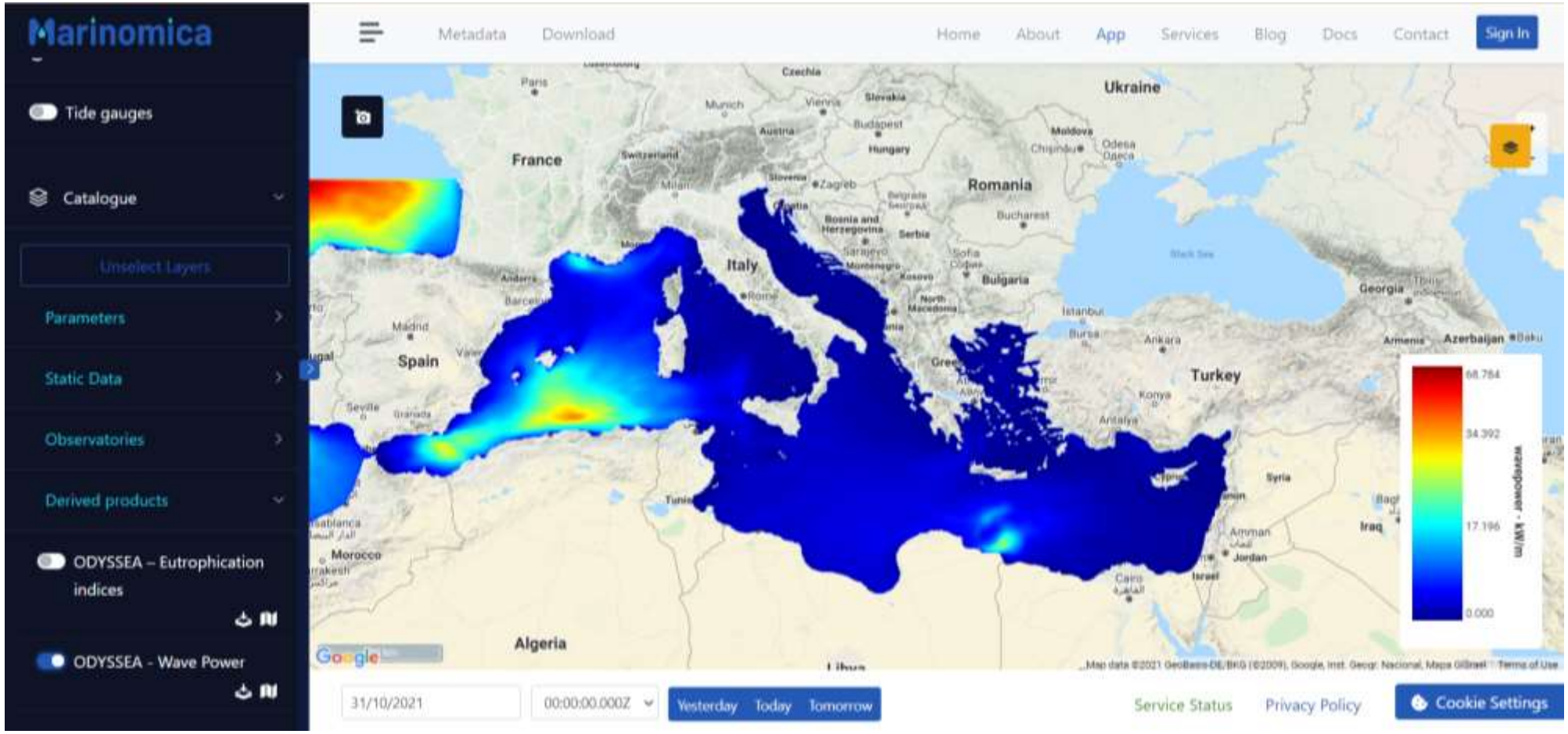
The TRophic IndeX for marine systems (TRIX) (Vollenweider, et al. 1998) is a water quality score characterizing coastal areas.

$$TRIX = \frac{\log(Chl - \alpha \times aD\%O \times DIN \times TP) - (-1.5)}{1.2}$$

UNTRIX, efficient coeff, Trophic State Index



Marinomica Services: The Wave Power



ODYSSEA on Wave Energy Converter

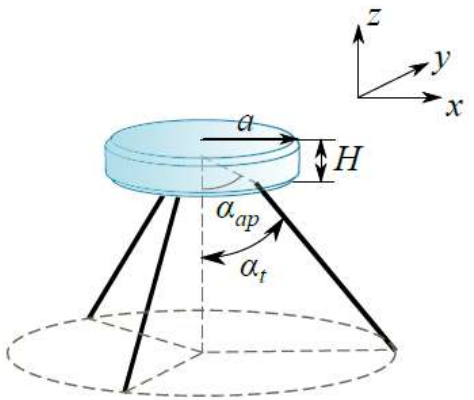
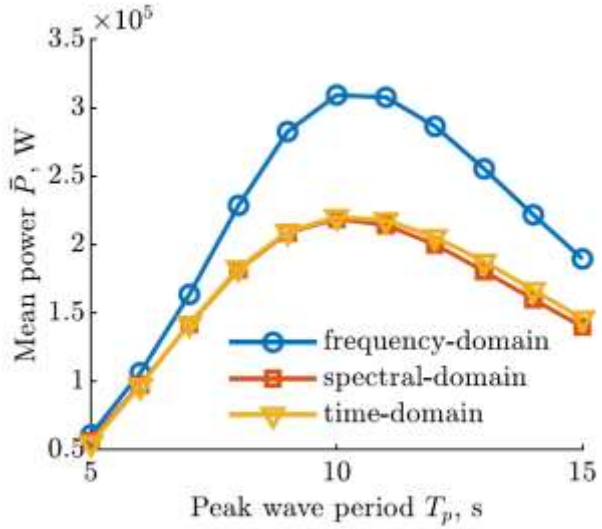
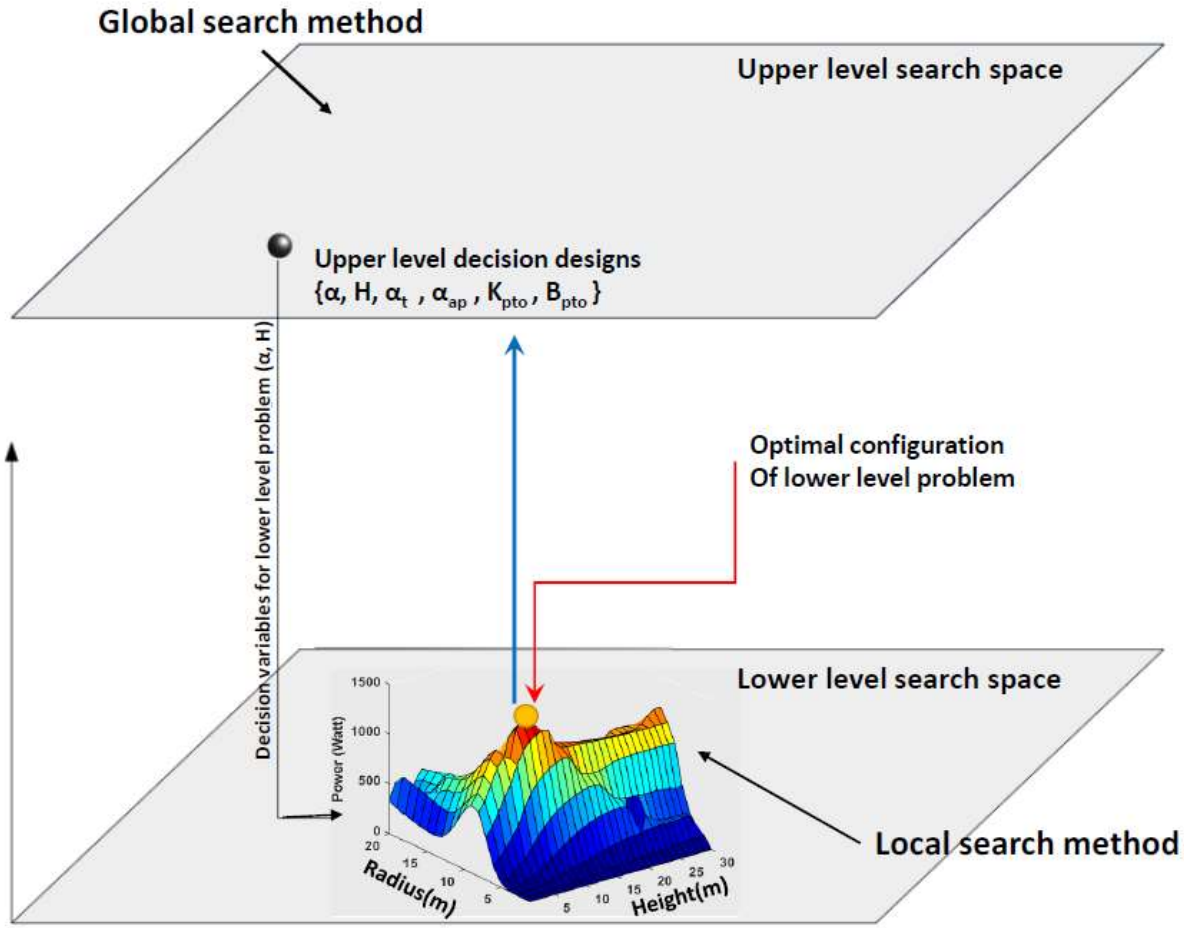


Figure 1. A three-tether wave energy converter.





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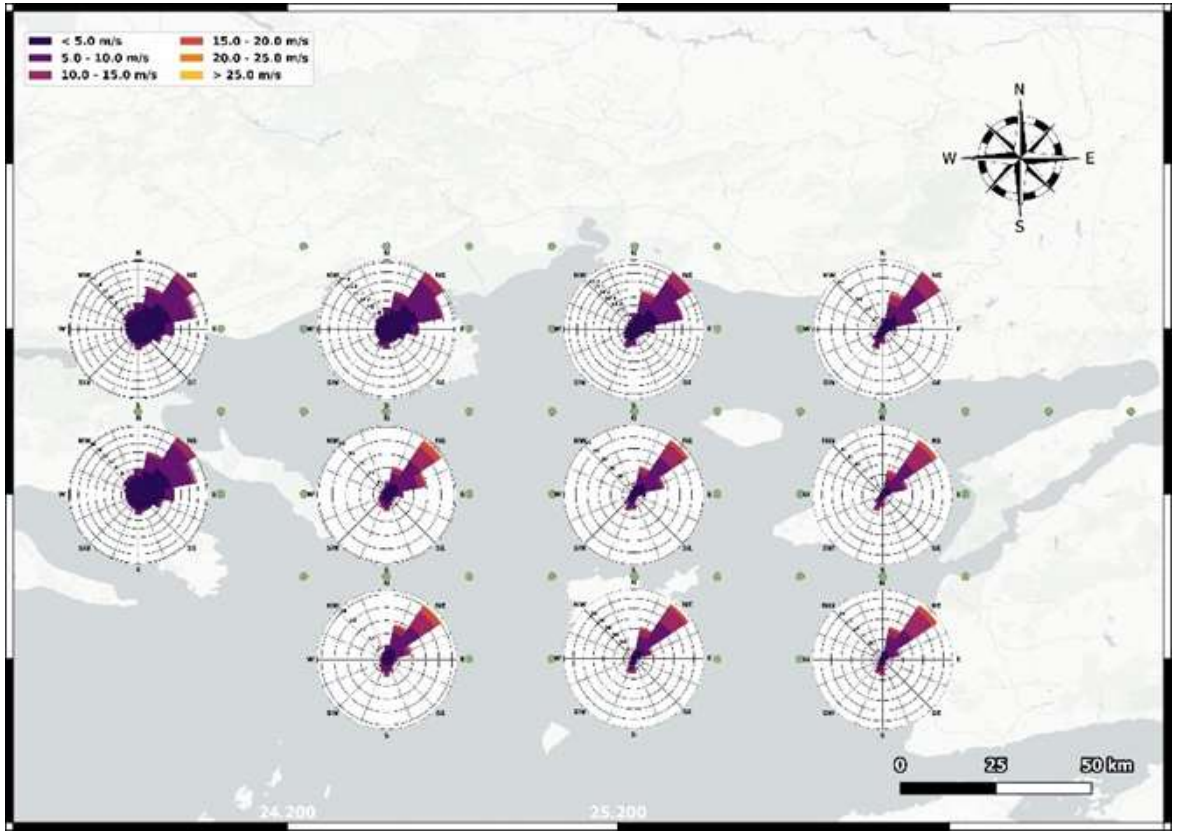
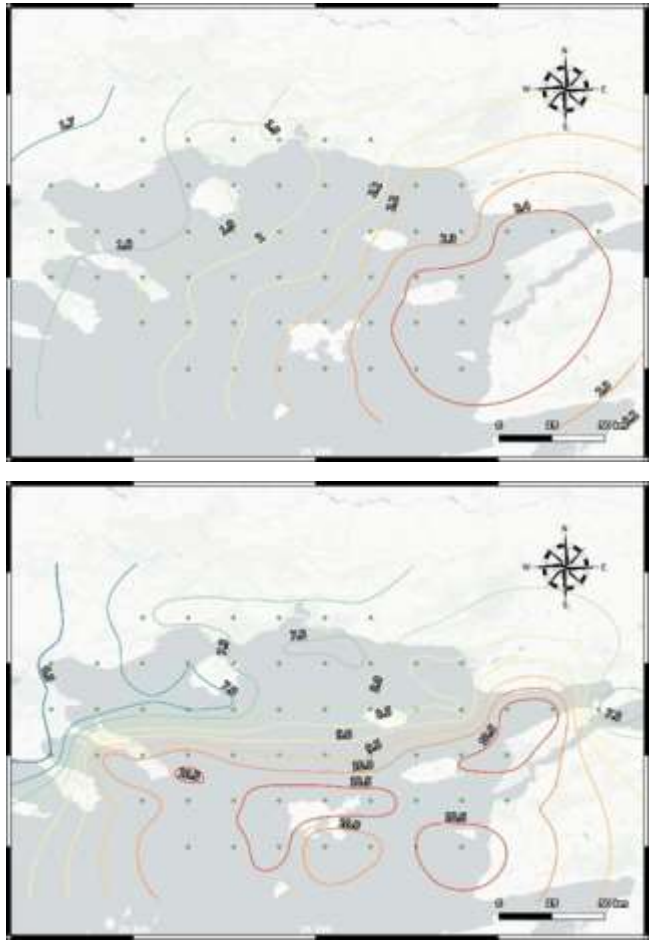
ODYSSEA on Wind Resource Assessment

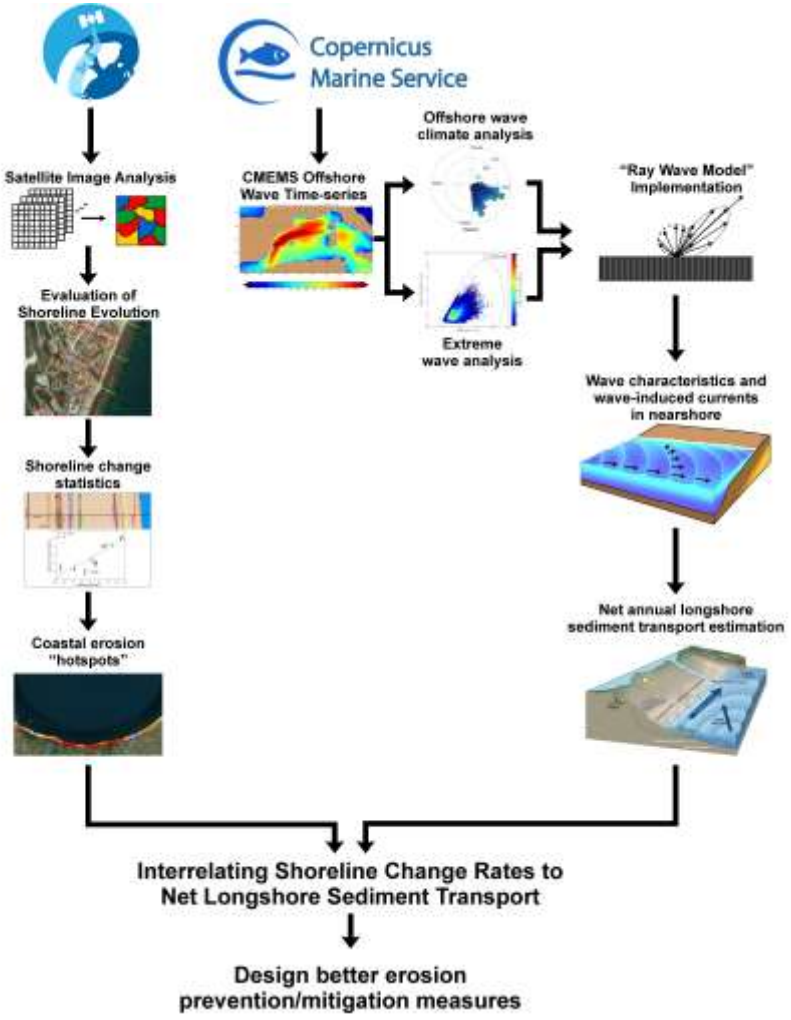


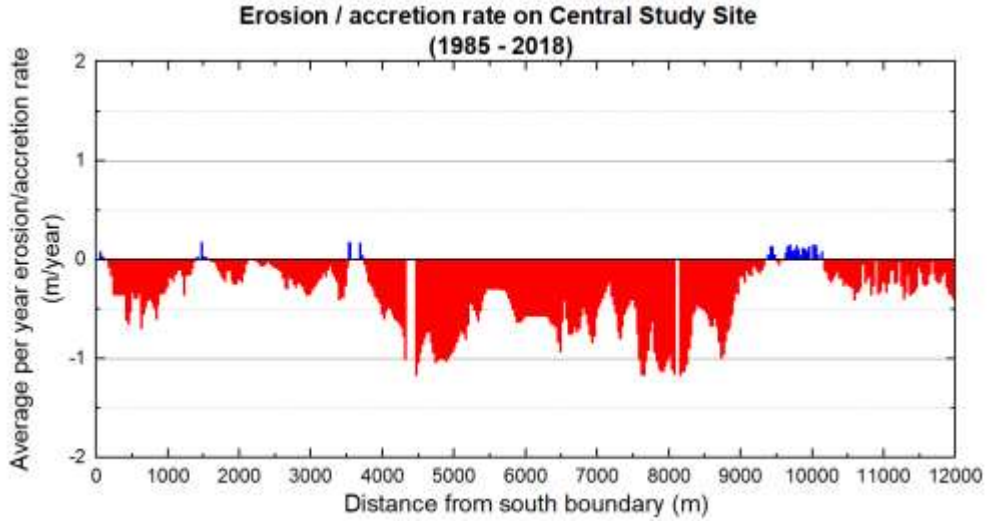
Wind frequency roses at hub height over the study area.

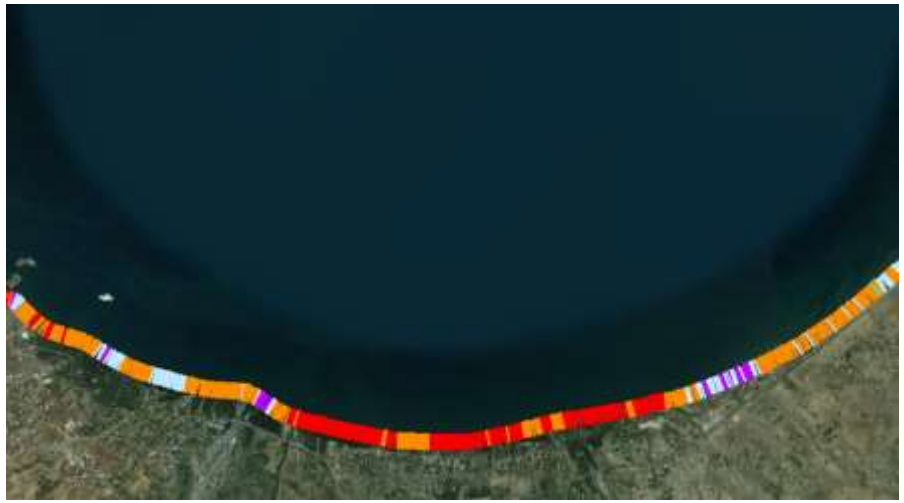


Spatial distribution of the Weibull probability density function parameters at the hub level over the study area.

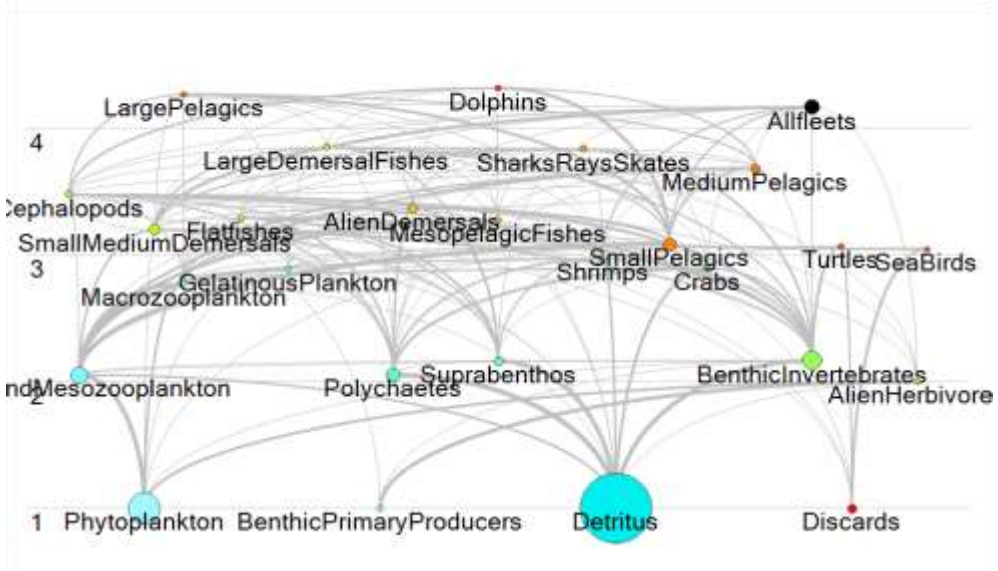
ODYSSEA on Coastal Erosion



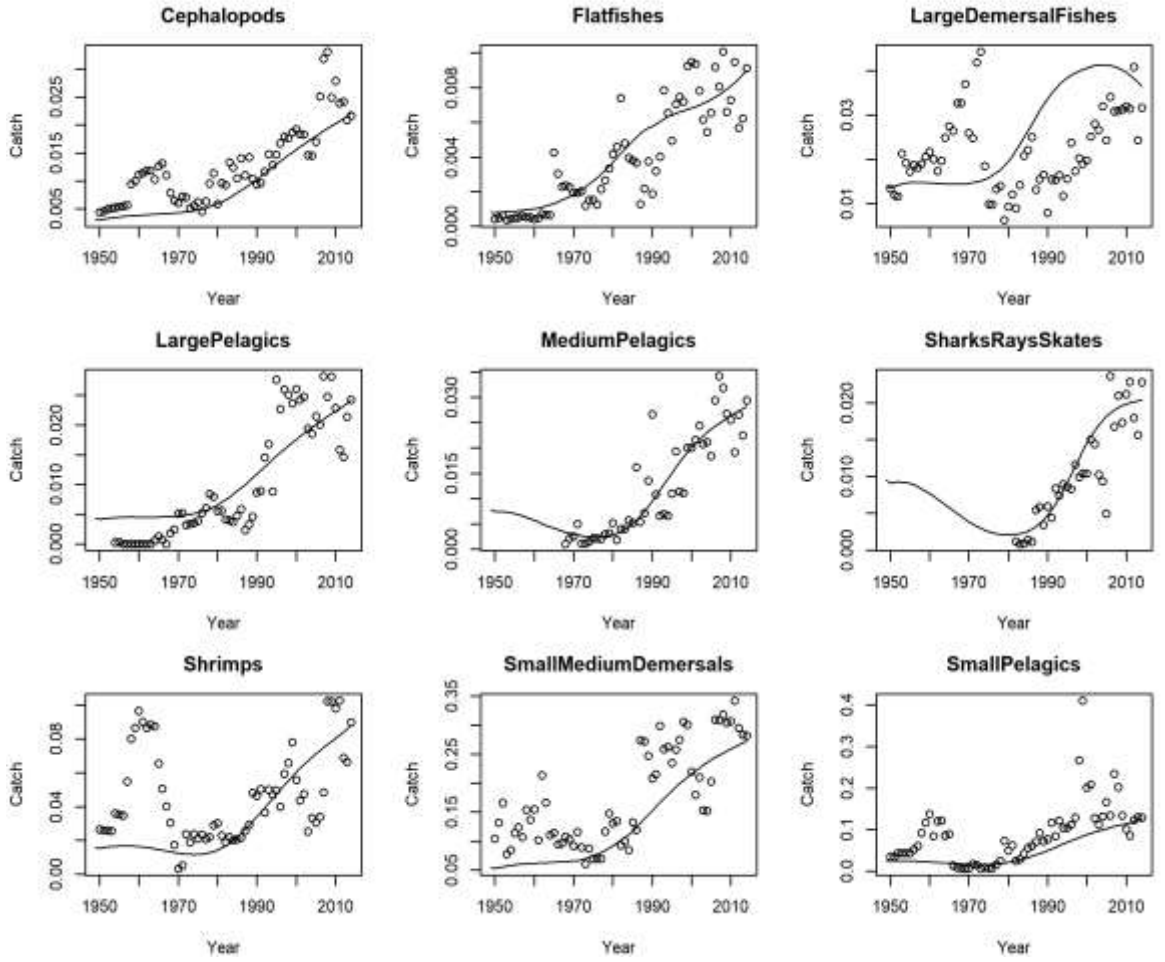




ODYSSEA on Sustainable Fisheries



Ecopath Model for Egypt



Observed catch (dots) and predicted catch from Ecopath for Ecosim (lines) of nine commercial species.

ODYSSEA on Sustainable Fisheries

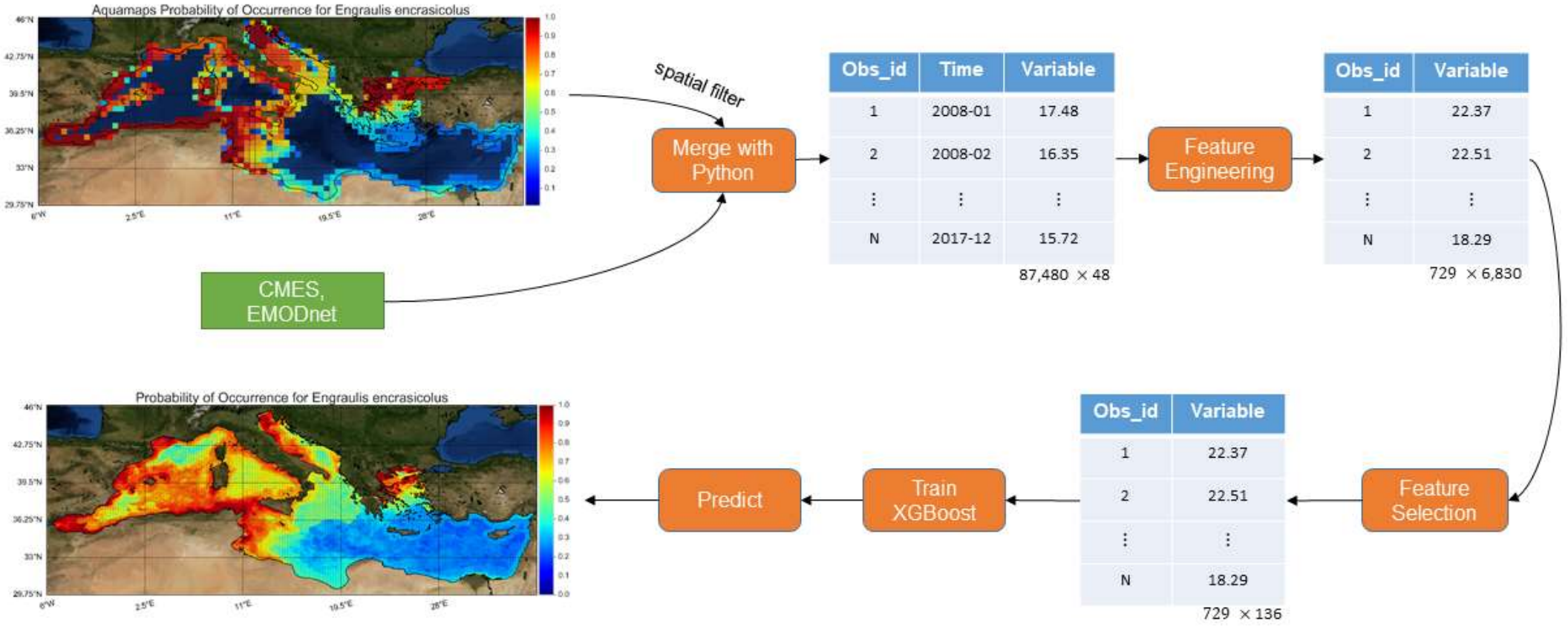
Observatory	Catch	Troph	FiB	EcoInd	Overall
1. North Aegean/Thracian Sea				-	
2. Gulf of Gökova				-	
3. Valencia's regional coastline				-	
4. Northern Adriatic Sea				-	
5. Gulf of Arzew/Stora Bay				-	
6. Gulf of Gabes				-	
7. Israel Coastal				-	
8. National Park of Al-Hoceima					
9. Nile river region					

Comparison of the ecosystem status of all observatories concerning catch based indicators (Catch), trophic level (Troph), Fishing-in-Balance index (FiB) and ecoindicators from EwE ecosystem models (EcoInd) and overall performance (Green: good; Orange: intermediate; Red: bad)

Revealing Fish Species distribution dynamics

ODYSSEA

Apply AI and ML tools for Species Distribution Models



ODYSSEA on Benthic Biodiversity

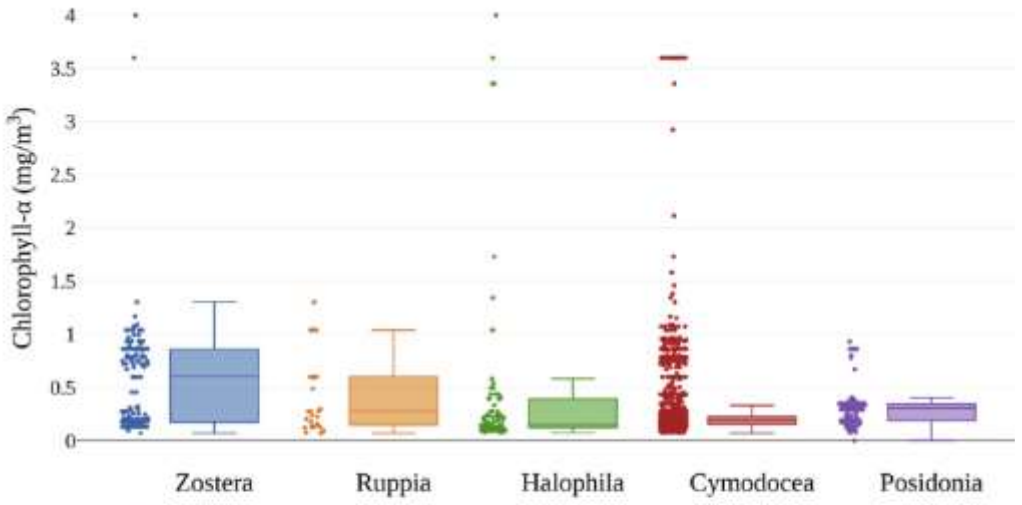


Fig. 9. Distribution of Chlorophyll-α-December values per seagrass family.

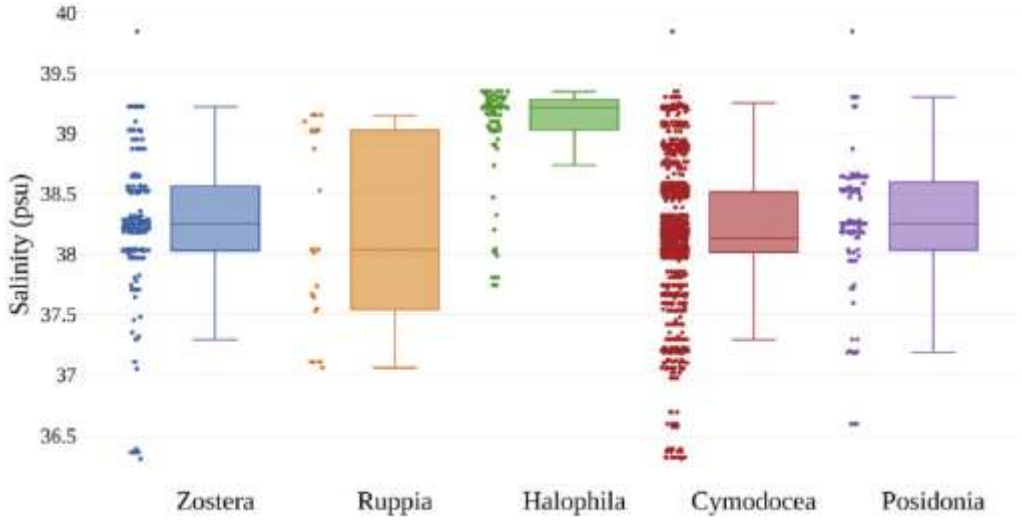
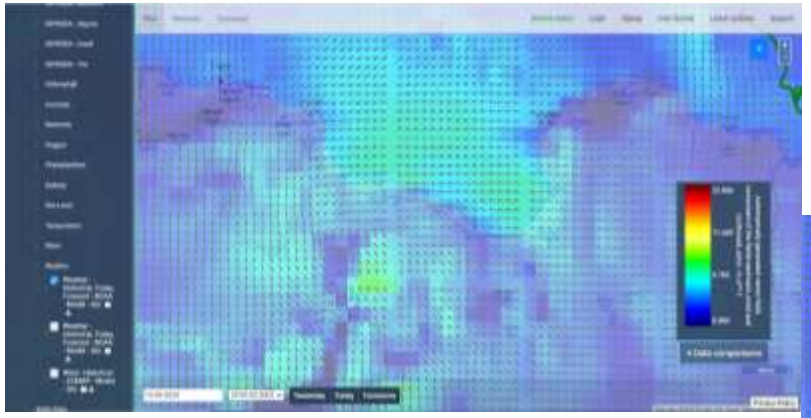


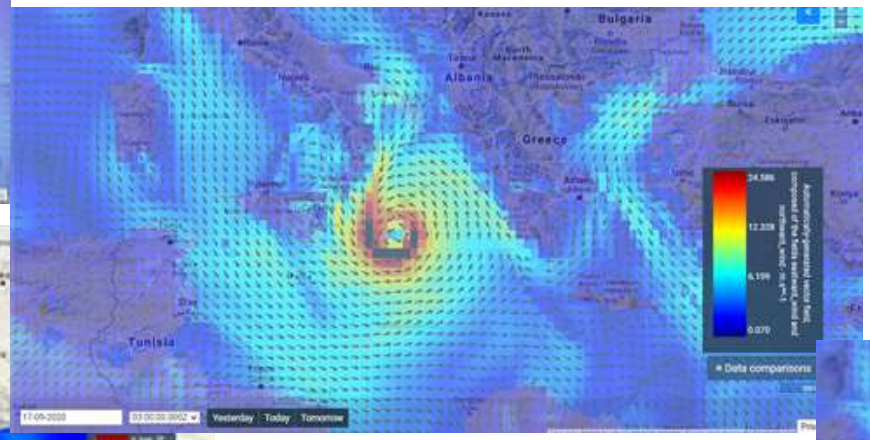
Fig. 10. Distribution of Salinity-December values per seagrass family.

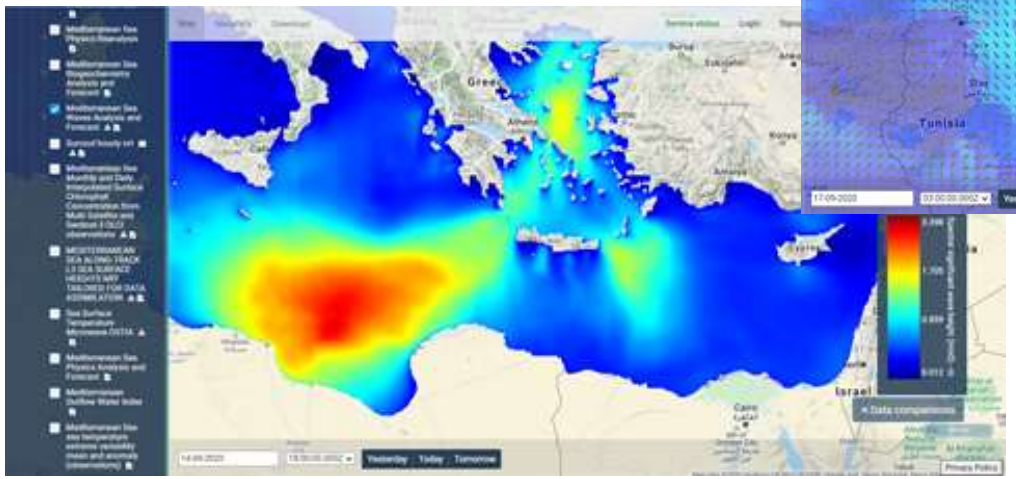
Hidden preferences reveal that Cymodocea and Posidonia favor the low, limited-range chlorophyll-α levels (< 0.5 mg/m³), Halophila tolerates higher salinities (> 39), while Ruppia prefers euryhaline conditions (37.5–39).

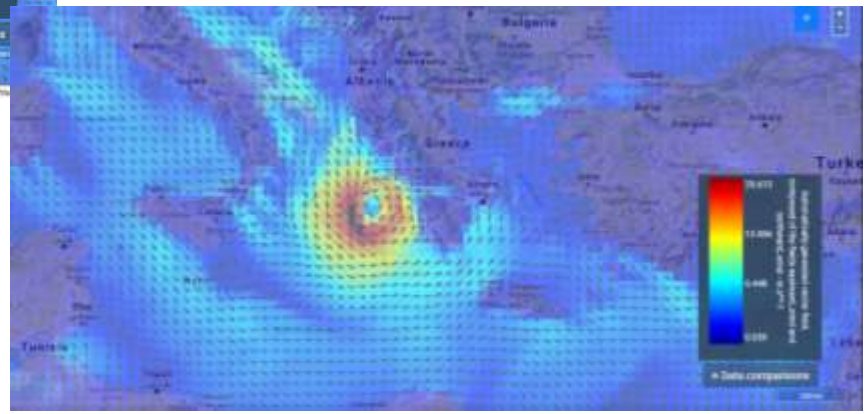
Marinomica tracks Medicanes



IANOS Medicane commenced on 13/9/2020 03:00 am at the inland parts of Libya over Sahara dessert, approx. 40 km east of Ash Shwayrif (starting point 29.926°N, 14.795°E).



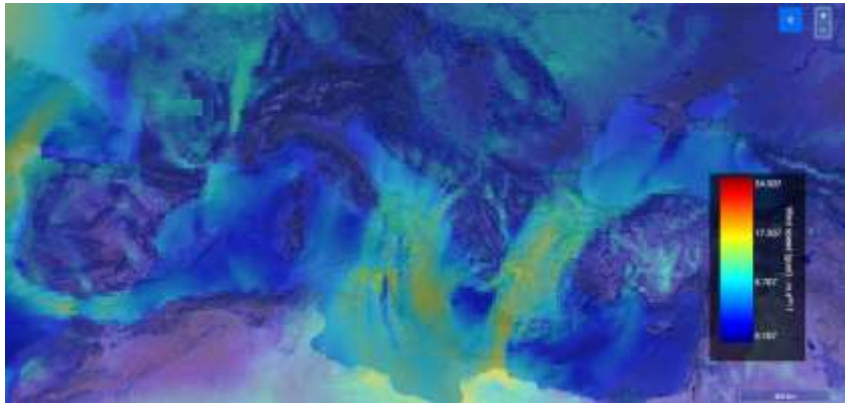




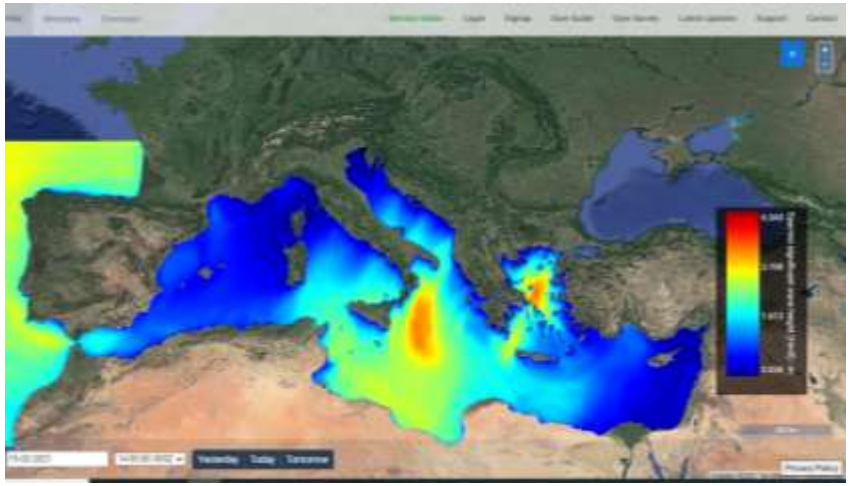
Waves in Libyan Sea
(14/9/2020 18:00, t = +39 hrs)

Marinomica as a Teaching Tool for Metocean Processes

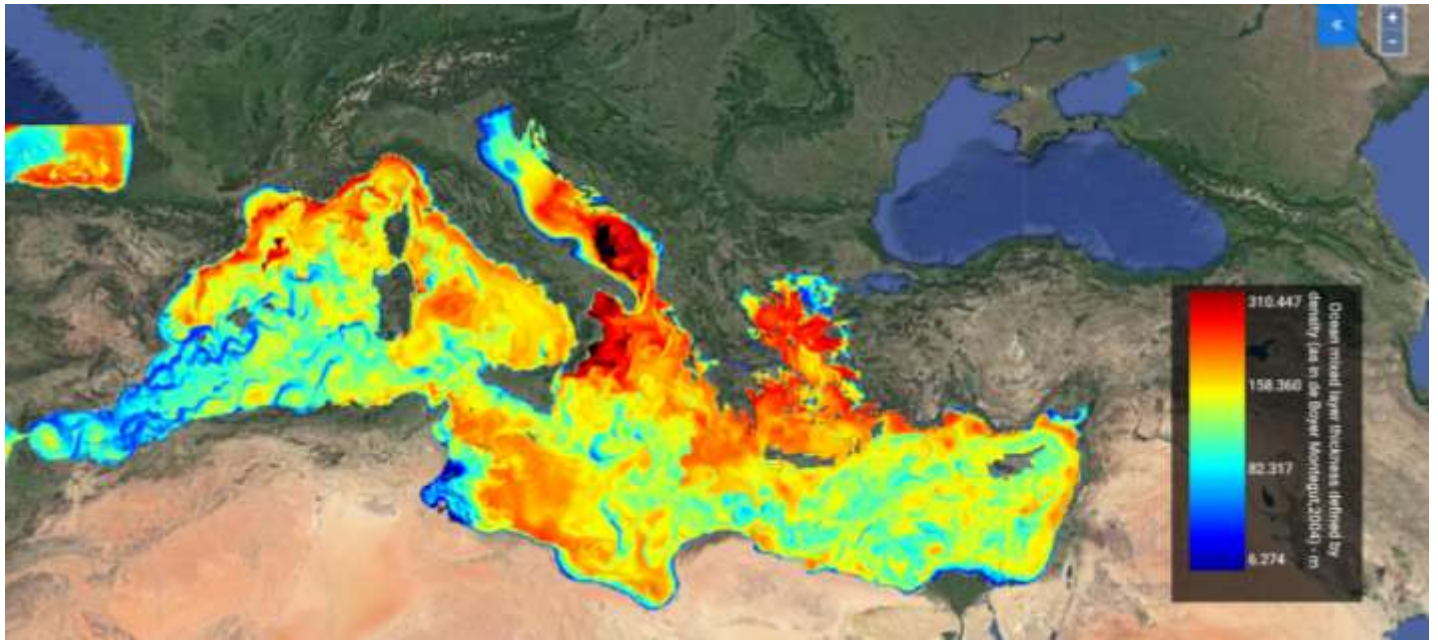
ODYSSEA



Wind Gust over the Mediterranean



Wave Heights across the Mediterranean



Mixing Layer Depth

ODYSSEA Summer Schools

ODYSSEA

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2nd ODYSSEA Summer School
Oceanography and Fisheries in the Mediterranean
Patitiri Village, Alonissos, Greece
2-6 September 2019

View of the main harbor (Patitiri Village) of Alonissos Island, Greece

Co-organized through ODYSSEA Project by:

School of Biology
Aristotle University of Thessaloniki

Department of Environmental Engineering
Democritus University of Thrace

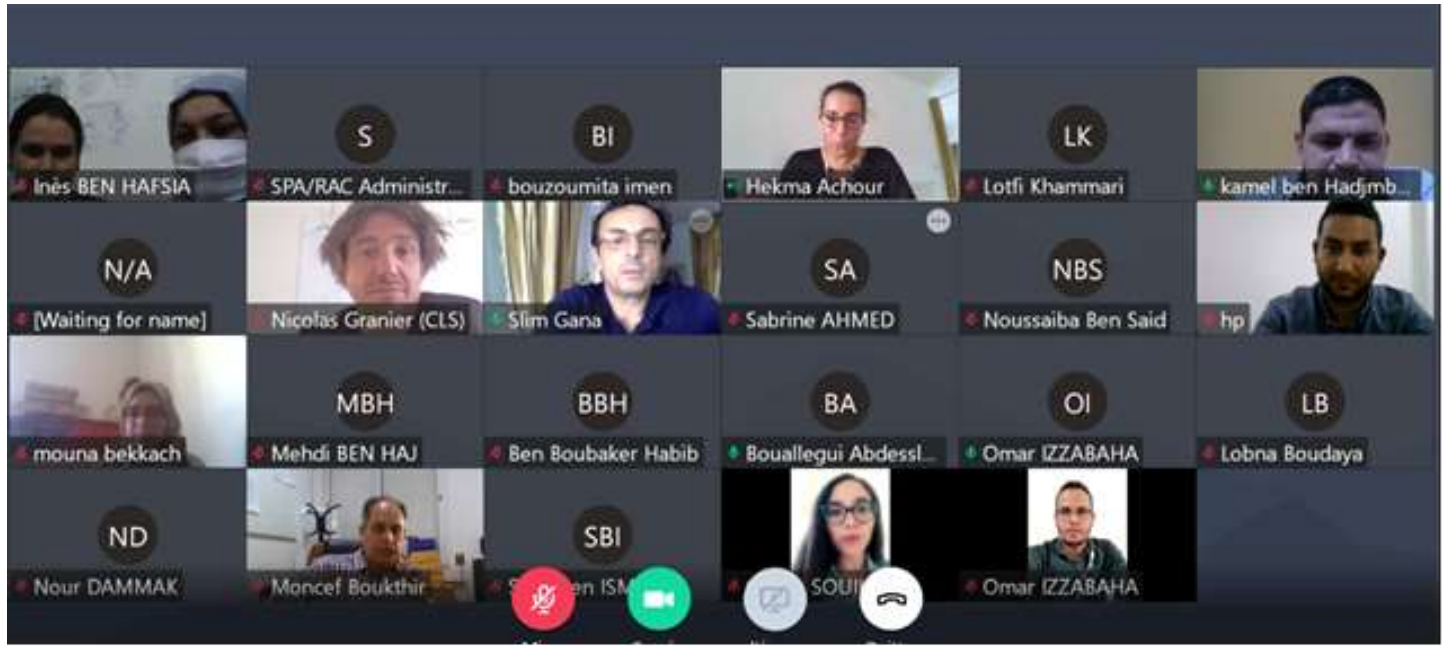
ODYSSEA

Supported by Thalassa Foundation

This project has received funding from the European Union's
Horizon 2020 research and innovation programme under grant agreement No. 727277

ODYSSEA End-User Workshops

ODYSSEA partners developed activities to exchange experiences and collaborate with other European projects and initiatives in the Mediterranean Sea (e.g. ENI SEIS II, Maestrale, LAkHsMI, CLAIM, EuroSea, HiSea, COSPAR Panel for Capacity Building)



Workshop Series on Marinomica Training for North Africa Scientists organized by ODYSSEA Partners SPA/RAC, AGIR, RAED, ANDDCVS.

ODYSSEA End-User Workshops

The ODYSSEA Consortium

ODYSSEA

Knowledge developers

DUTH (GR), FORTH (GR), Technion (IS), Sapienza (IT), Deltares (NL), IU (TR), HCMR (GR), UNIBO (IT), AUTH (GR)

Technology providers

Alseamar (FR), Leitat (SP), Hidromod (PT), Develogic (GER), GTD (SP), CLS (FR), Thales (FR), Edisoft (PT), Blue Lobster (UK)

Policy makers

UNEP-WCMC (UK), UNEP RAC-SPA (TUN)

Service Providers

VPF (SP), AGIR (MOR), NSV (ALG), ANDDCVS (TUN), RAED (EG), EcoOcean (IS), SPNI (IS), Agora (IS)

ODYSSEA

Creating products and knowledge
for the Mediterranean

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THANK-YOU

Prof. Georgios SYLAIOS

Democritus University of Thrace

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727277