



Creating products and knowledge  
for the Mediterranean  
**Marinomica**

**Deltares**

# DEVELOPMENT OF MARINOMICA PRODUCTS AND SERVICES

ODYSSEA Final Conference

3<sup>rd</sup> November, 2021

Deltares

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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



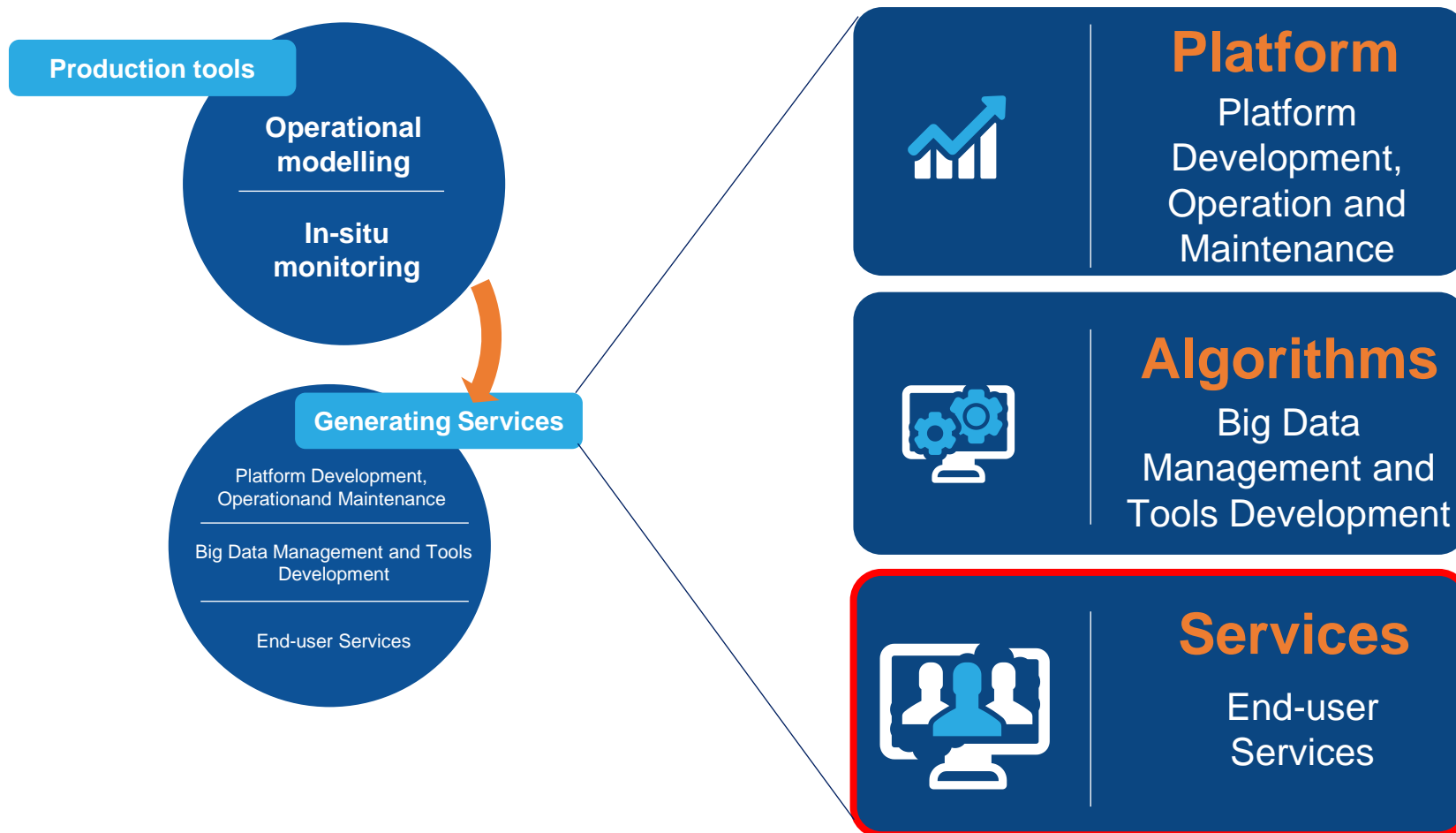
**“Simple to use, easy to interpret user-friendly products”**



# Services development



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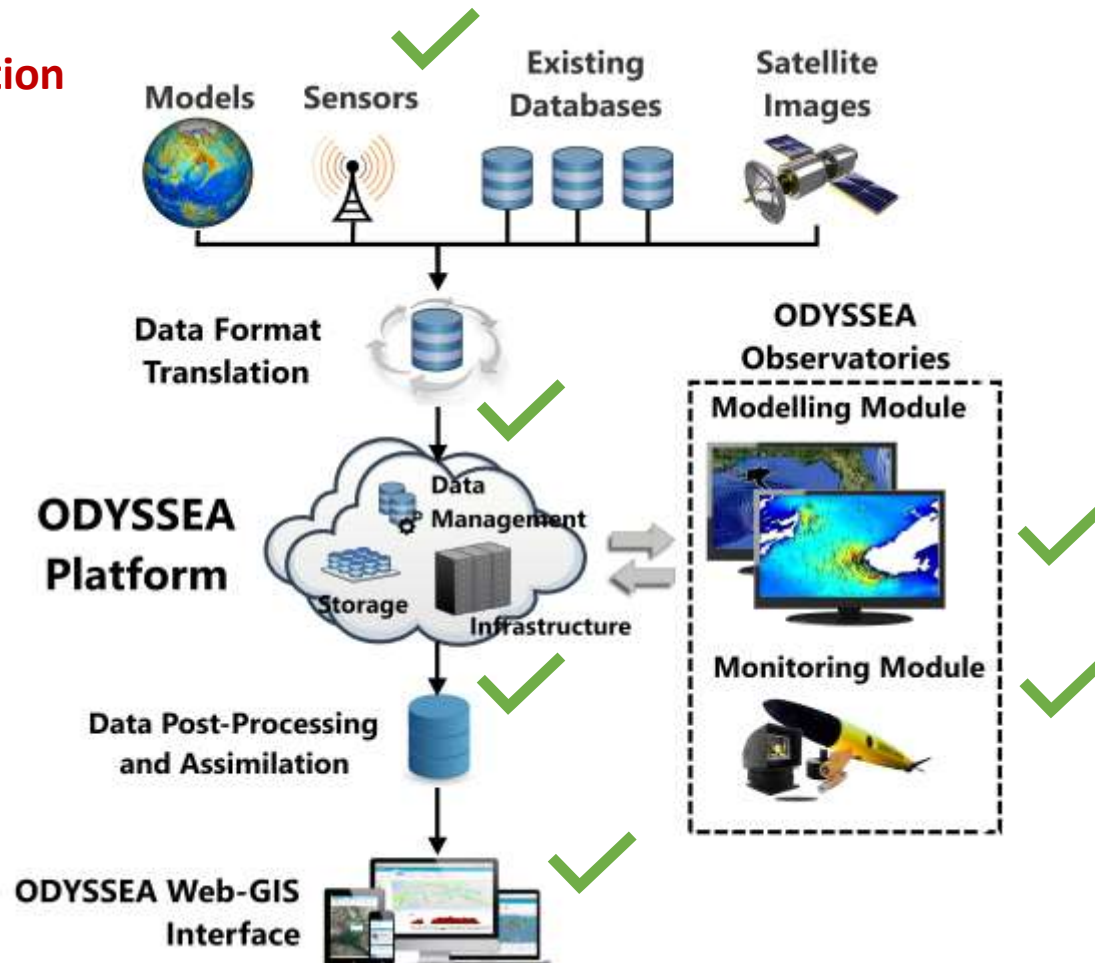


# Production Chain Elements



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All service production chain elements in place

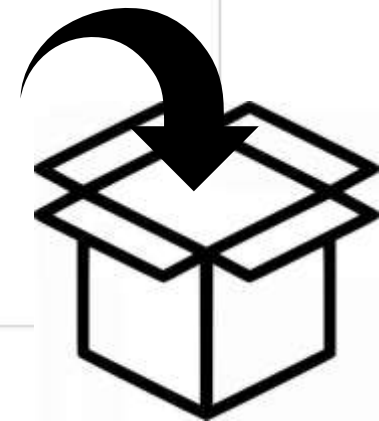


# Technological Perspective of services

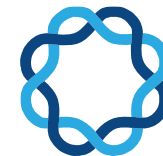


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	 In-situ measurements	 Coastal models	 External Earth Observation datasets	 Citizen Science	 Algorithms
<b>OBSERVING/MODELLING PLATFORM</b>	<ul style="list-style-type: none"> <li>- <b>Develogic Modular Surface Sensor</b> (fluorometer + hydrophone + submerged camera + microplastics sensor)</li> <li>- <b>Develogic Deep Water Sea Lander</b></li> <li>- <b>Alseamar SeaExplorer glider:</b> <ul style="list-style-type: none"> <li>▪ Payload 1: GPS, CTD, DO, Phyto, CDOM, Turbidity,</li> <li>▪ Payload 2: Passive Acoustic Monitoring (hydrophone),</li> <li>▪ Payload 3: CTD and microplastics</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- <b>Hydrodynamic model:</b> Delft3D-FLOW, MOHID</li> <li>- <b>Wave model:</b> Delft3D-WAVE, SWAN</li> <li>- <b>Biogeochemical model:</b> Delft3D-WAQ, MOHID</li> <li>- <b>Oil spill model:</b> MEDSLIK-II</li> <li>- <b>Mussel farm model</b></li> <li>- <b>Ecosystem model:</b> ECOPATH</li> <li>- <b>Jellyfish model:</b> Delft3D-PART, OpenDrift</li> </ul>	<ul style="list-style-type: none"> <li>- CMEMS</li> <li>- GEOSS</li> <li>- EMODnet</li> <li>- NOAA</li> <li>- ECMWF</li> <li>- GOOS</li> <li>- MonGOOS</li> <li>- SeaDataNet</li> <li>- UNEP-WCMC</li> </ul>	<ul style="list-style-type: none"> <li>- Twitter</li> <li>- Marine LitterWatch App</li> <li>- Pangaea</li> </ul>	<ul style="list-style-type: none"> <li>- Algorithm for Eutrophication Index in sea water</li> <li>- Algorithm for TRophic IndeX in sea water</li> <li>- Algorithm for UNscaled TRophic IndeX in sea water</li> <li>- Algorithm for Efficiency Coefficient in sea water</li> <li>- Algorithm for wave power</li> </ul>
<b>ESSENTIAL OCEAN VARIABLES (EOVs)</b>	<p><b>Physics:</b></p> <ul style="list-style-type: none"> <li>- Sea state</li> <li>- Sea surface height</li> <li>- Sea surface temperature</li> <li>- Subsurface temperature</li> <li>- Surface currents</li> <li>- Subsurface currents</li> <li>- Sea surface salinity</li> <li>- Subsurface salinity</li> <li>- Ocean surface heat flux</li> </ul> <p><b>Biogeochemistry:</b></p> <ul style="list-style-type: none"> <li>- Oxygen</li> </ul> <p><b>Biology and Ecosystems:</b></p> <ul style="list-style-type: none"> <li>- Phytoplankton biomass and diversity</li> <li>- Fish abundance and distribution</li> <li>- Marine turtles, birds, mammals abundance and distribution</li> </ul> <p><b>Cross-disciplinary:</b></p> <ul style="list-style-type: none"> <li>- Ocean colour</li> <li>- Ocean sound</li> </ul>	<p><b>Physics:</b></p> <ul style="list-style-type: none"> <li>- Sea state</li> <li>- Ocean surface stress</li> <li>- Sea surface height</li> <li>- Sea surface temperature</li> <li>- Subsurface temperature</li> <li>- Surface currents</li> <li>- Subsurface currents</li> <li>- Sea surface salinity</li> <li>- Subsurface salinity</li> <li>- Ocean surface heat flux</li> </ul> <p><b>Biogeochemistry:</b></p> <ul style="list-style-type: none"> <li>- Oxygen</li> <li>- Nutrients</li> <li>- Inorganic carbon</li> <li>- Dissolved organic carbon</li> </ul> <p><b>Biology and Ecosystems:</b></p> <ul style="list-style-type: none"> <li>- Phytoplankton biomass and diversity</li> <li>- Fish abundance and distribution</li> </ul>	<p><b>Physics:</b></p> <ul style="list-style-type: none"> <li>- Sea state</li> <li>- Ocean surface stress</li> <li>- Sea surface height</li> <li>- Sea surface temperature</li> <li>- Subsurface temperature</li> <li>- Surface currents</li> <li>- Subsurface currents</li> <li>- Sea surface salinity</li> <li>- Subsurface salinity</li> <li>- Ocean surface heat flux</li> </ul> <p><b>Biogeochemistry:</b></p> <ul style="list-style-type: none"> <li>- Oxygen</li> <li>- Nutrients</li> </ul> <p><b>Biology and Ecosystems:</b></p> <ul style="list-style-type: none"> <li>- Phytoplankton biomass and diversity</li> </ul> <p><b>Cross-disciplinary:</b></p> <ul style="list-style-type: none"> <li>- Ocean colour</li> </ul>	<p><b>EOVs:</b> None</p> <p><b>Non-EOVs:</b></p> <ul style="list-style-type: none"> <li>- Jellyfish, invasive species</li> <li>- Pollution sources</li> </ul>	<p><b>Physics:</b></p> <ul style="list-style-type: none"> <li>- Sea state</li> </ul> <p><b>Biogeochemistry:</b></p> <ul style="list-style-type: none"> <li>- Oxygen</li> <li>- Nutrients</li> </ul> <p><b>Biology and Ecosystems:</b></p> <ul style="list-style-type: none"> <li>- Phytoplankton biomass and diversity</li> </ul>



# Tailored marine and coastal information services



**ODYSSEA**

“ Instant access to forecasting and simulations enable decision making and expand knowledge concerned with the production, consumption, and transfer of wealth in the marine environment. ”



## Sensing Tools



Remote Sensing



In-situ Sensing



Social Sensing

## Data Manipulation, Forecasting and Events Extraction Tools



Simulations



Machine Learning



Data Cubes



Statistic & Probabilistic



Image Processing



Rule-based Modelling

## Applications



Ecosystems



Oil & Gas



Marine Renewables



Image Processing



Shipping & Ports



Aquaculture

## Information, Forecasts and Event Attributes



Location



Time



Alarm Type



Information Attributes



# Tailored to user sectors and needs



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## Profile

Profile Information

Update Password

Select country:

Netherlands

Select sector:

- Maritime transport
- Ship building
- Food & nutrition
- Ecosystem services
- Aquaculture
- Energy
- Raw materials
- Oil & gas
- Recreational
- Resident
- Small and medium-sized enterprises (SMEs)
- Coastal zone management
- Policy
- Coastal protection
- Sustainable exploitation
- Education
- Research
- Ocean modelling and forecasting
- Marine data management

Save

region

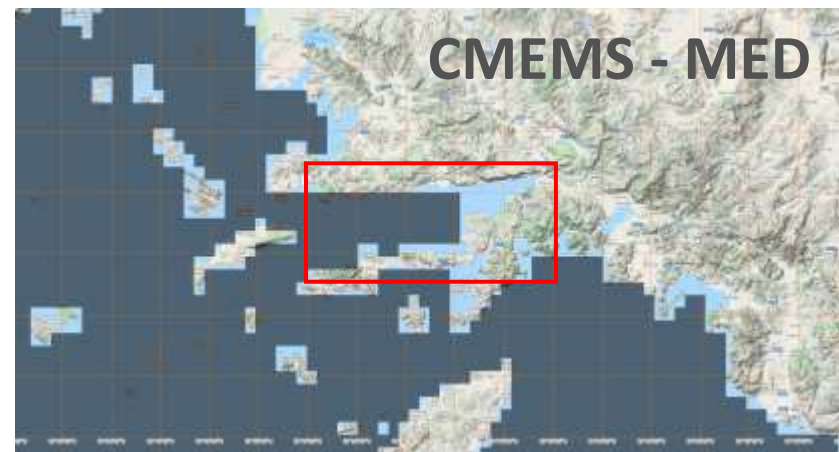
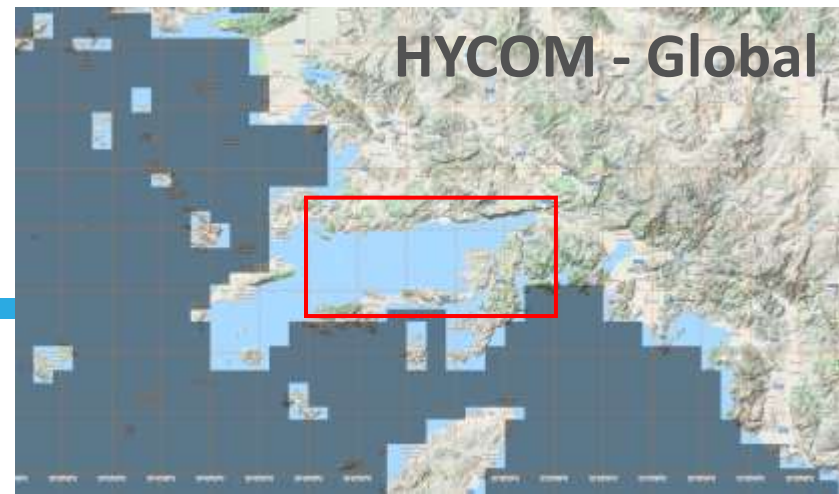
sector



# Tailored marine and coastal information services

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**“Filling in coastal gaps at environmentally / economically important areas”**





# User Perspective – Service portfolio

## Application/theme



### Jellyfish Swarm Forecast

Marinomica services include early warnings of jellyfish blooms and potential stranding locations. Historical data, real-time and forecasting data are presented in maps for each pixel point of coastline, near- and offshore areas.



### Ocean Energy Potential

Wind and wave energy potential mapping and forecasts; forces exerted on piles and platforms; extreme events analysis; potential for H2 production from H2S.



### Maritime Safety

Vessel routes optimisation; dispersion of both accidental and non-accidental oil spill releases; dispersion of accidental litter release. Definition of areas in which ballast water exchange and/or open loop scrubber effluent discharge is allowed and defining "same location" as defined by the BWMC.



### Aquaculture & Algae

Analysis on probability of occurrence of storm events, extreme waves and surges; Recommendations on cage siting, configuration and anchoring. Analysis on probability of occurrence of eutrophication incidents; early-warnings on algal blooms and toxic blooms.

## Information attributes



### Fisheries Exploitation

Marine safety and security of fishers; dynamic estimation of the probability of occurrence of certain species; stock assessments and management recommendations; probability of occurrence of invasive species.



### Ports

High resolution weather and waves forecasts; incident wave energy on coastal structures; Port basin pollutants' renewal/residence time; environmental conditions inside port; dispersion accidental oil spillage.



### Plastic Pollution Monitoring

Potential to identify sources of rubbish and locate and map polluted stretches of the sea and coastline. Will provide permanent and real-time access to information and data from noval plastic monitoring sensors and (in the future) reported sightings and incidents.



### Leisure & Tourism

Historic and forecast shoreline erosion/deposition changes; Coastal Vulnerability Indices; metocean conditions monitoring and forecasting for safe leisure activities; potential jellyfish outbreak forecasts and tracking.

# Service portfolio – cont.



## Ballast water monitoring

Understand & forecast ocean behaviour & climate change, sea level rise and extreme values in coastal environments.



## Marine Cultural Heritage

Mapping and classifying sensitive marine cultural heritage; analyses and assessment of the impact of major stressors (natural and anthropogenic pressures) on underwater archaeological sites; recommendations of protective measures; dissemination of maritime heritage information at regional, national and EU scale; high resolution weather/waves forecast during surveys.



## Oil Spills

Can provide historical, real-time and forecast data for each pixel point of coastline, near and offshore areas tracking dispersal of accidental oil spills. Can send early warning signals to fishers, aquaculture, local and port authorities to minimise impact.



## Land and river based services

Inland surface water mapping and periodicity; phenological cycle estimation; land cover/use changes; effluents' changes to sea. Recommending optimal siting for fish and mussel cultures; fish and mussel growth forecast; mean fish and mussel length and dry weight per species; expected fish and mussel production; ingestion and excretion rates and more.



## Metocean hind-, now-, and forecast

Provides historical, real-time and forecast Metocean conditions including wind speed/direction, wave speed, height and direction, storm surges. Important for planning, development and protection of infrastructure and businesses. Potential alerts of threat to human life.



## Coastal Erosion

Identifies coastal erosion 'hotspots' in specific areas along the shoreline and obtain forecasts about potential coastal retreat and loss of land. Results are presented in maps. Historical data, real-time and forecasting data for each pixel point of coastline, near- and offshore areas.



## Sighting and Alert Services

Marinomica Mobile Application - delivers early warnings to users according to their location and settings (e.g. storm surge, jellyfish bloom). The app enables users to report sightings e.g. plastic pollution. Reported sightings are displayed on maps.

# Dedicated dashboards



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geographic area

topic of interest

indicators

Marinomica

- Products
- My Dashboards
- New Dashboard
- Time Series Data
- Catalogue

**Egypt**

### Background

The problem of **eutrophication** on the **Egyptian** Mediterranean coast is mainly due to large amounts of wastewater discharged by land-based effluents from the Nile River, agriculture and sewage water directly or indirectly linked to the Mediterranean coastal region via coastal lakes.

The coastal area of Egypt on the Mediterranean Sea extends for about 1,200 km, it hosts a number of important residential and economic centres, like the cities of Alexandria, Port Said, Damietta, Rosetta, Matruh, and Al-Arish. The coastal strip between Alexandria and Matruh hosts tens of tourist villages, which are usually crowded by visitors during summer. Many activities are known in the coastal area, including fishing, industrial, tourism, trading and agricultural, oil and gas production, and transportation. There are five large ecologically different coastal lagoons connected to the sea coast, representing together about 25% of the total area of the Mediterranean wetland. These lagoons are considered as reservoirs for agricultural, industrial, and municipal wastes, which are discharged from surrounding cities and cultivated lands. The Egyptian Mediterranean coast receives huge volumes of wastewaters every year through the coastal lagoons and from other land-based effluents. These wastes are loaded by variable amounts and types of pollutants, in addition to great amount of nitrogenous and phosphorous compounds, which in turn cause high level of eutrophication along a significant part of the Mediterranean coast, particularly of both the Nile Delta region and Alexandria coast. Eutrophication is an unfortunate problem to the Egyptian Mediterranean coast, resulting in fundamental changes in the structure of the planktonic and benthic communities as well as fish mortality. Eutrophication was accompanied by the appearance of several harmful algal species at several hot spots along the coast. The level of eutrophication demonstrated wide variation along the Egyptian coast relative to the variations in the volume and contents of discharged wastes.

Read this paper

Eutrophication, dark side of 'greenness'

To place an image use this code and replace the image address:

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### Image

Chlorophyll *a* concentration pattern

### Oxygen time series

o2

Latitude: 31.57286255072041, Longitude: 30.697174072265632

MEAN	SD	VALUE (O2M FUL 0070)
234.814158	17.045947	253.331950

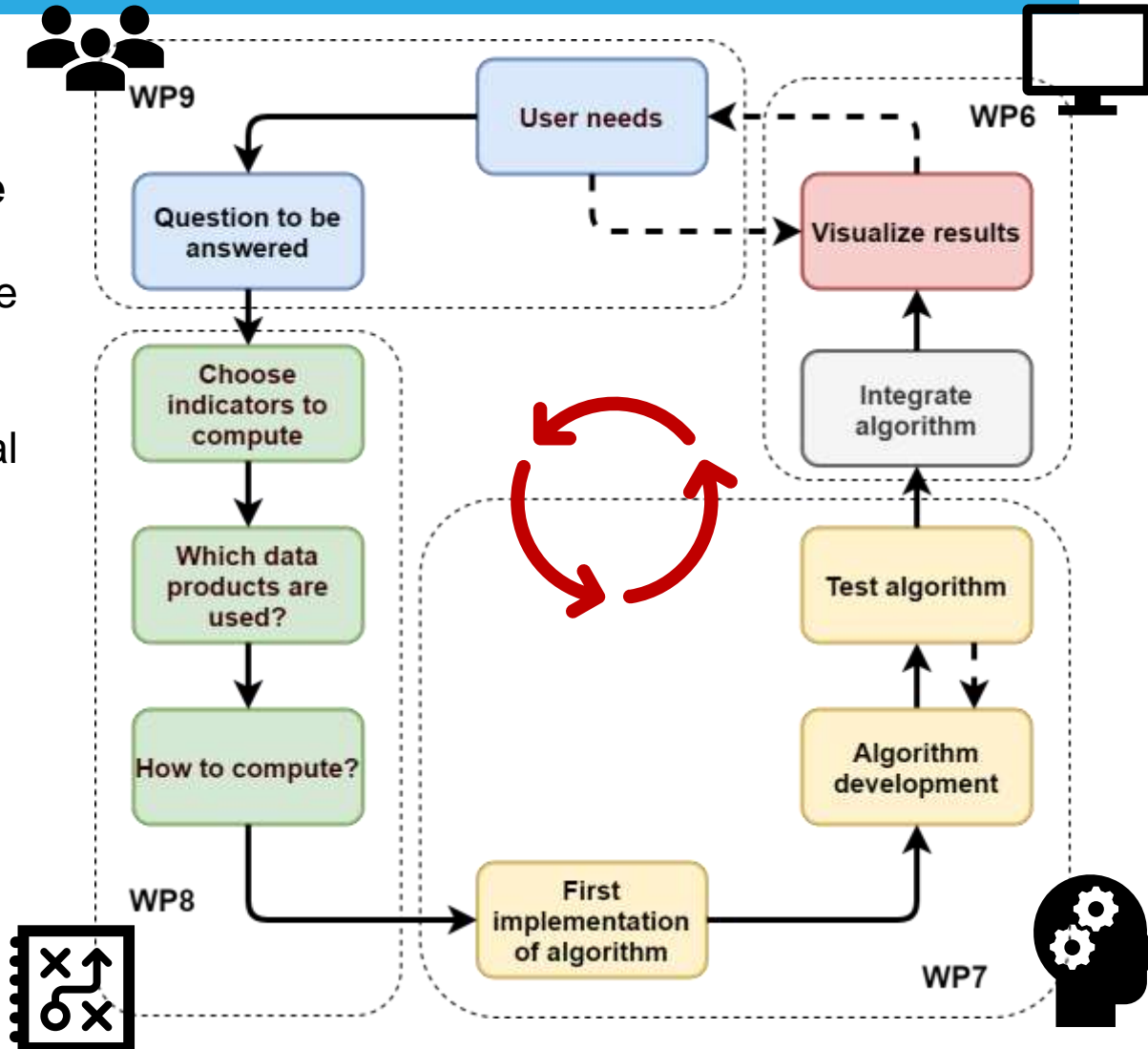
### Oxygen map

# Services Development Cycle



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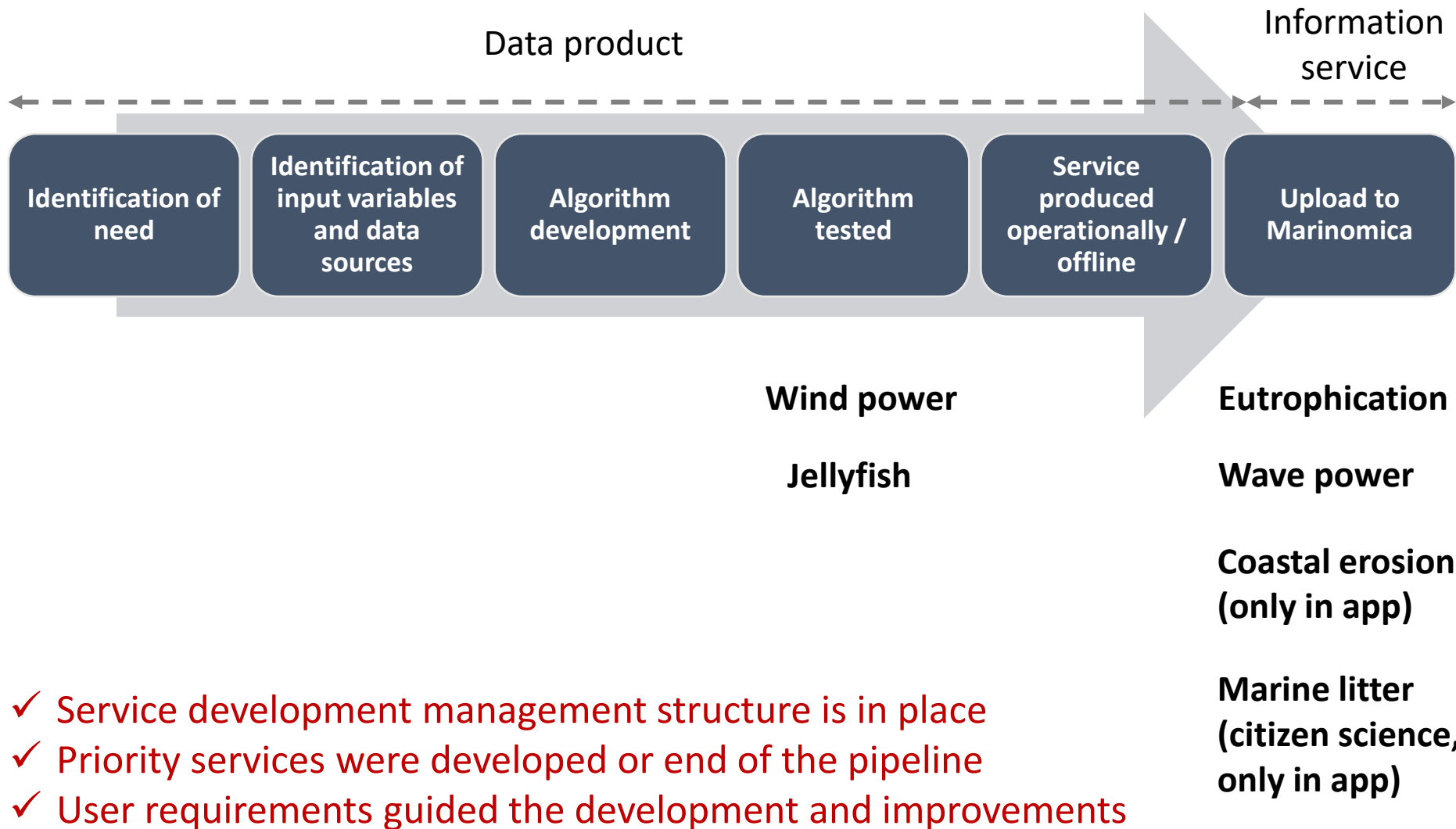
- Product owners steer the development
- Users are involved to define and update requirements
  - Type of visualization (time series, maps, text messages, etc.)
  - Expected spatial/temporal resolution
  - Time window (historical, real-time, forecast)
  - Etc.



# (Priority) Services Status



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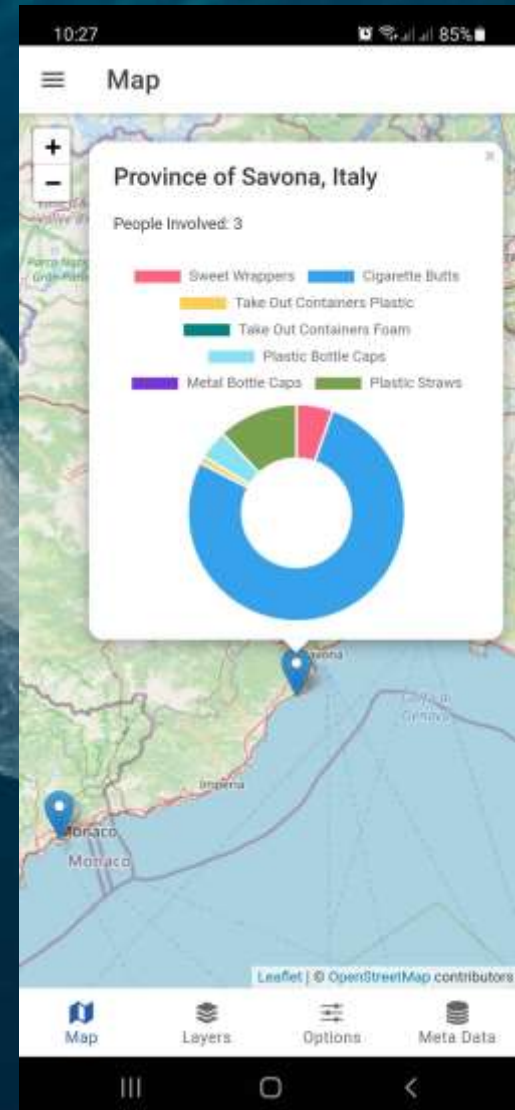
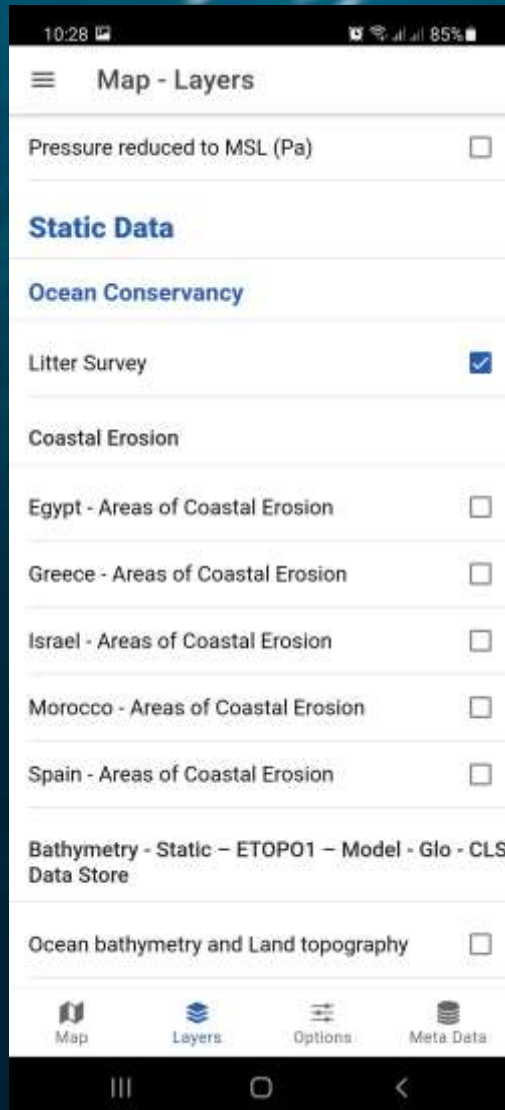


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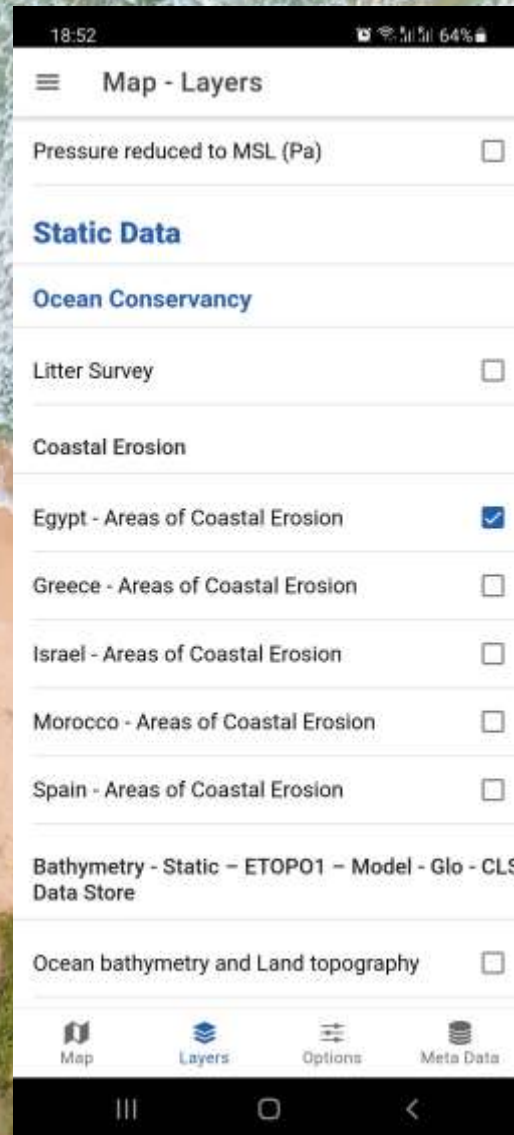
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# Examples of Services

# Marine Litter [Citizen Science]

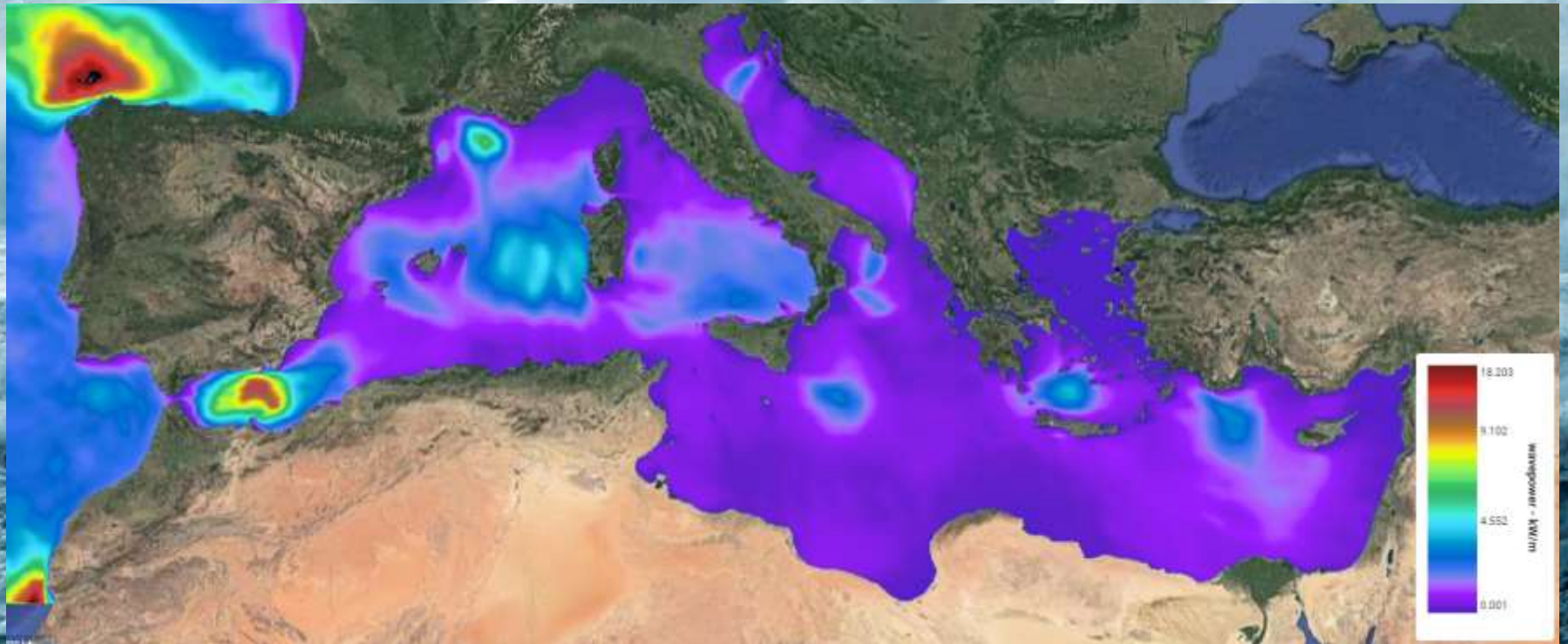


# Coastal Erosion [Algorithm]

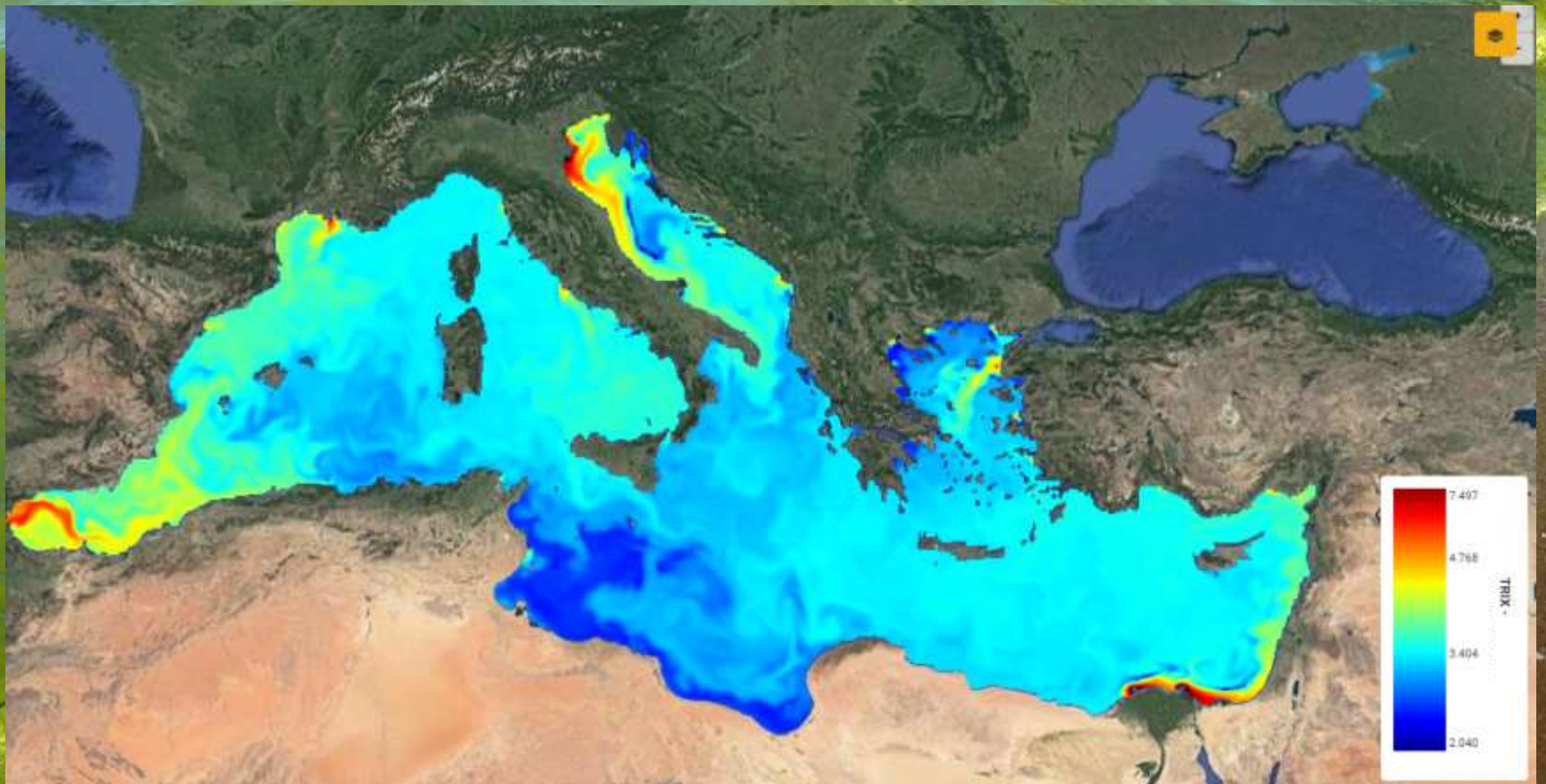




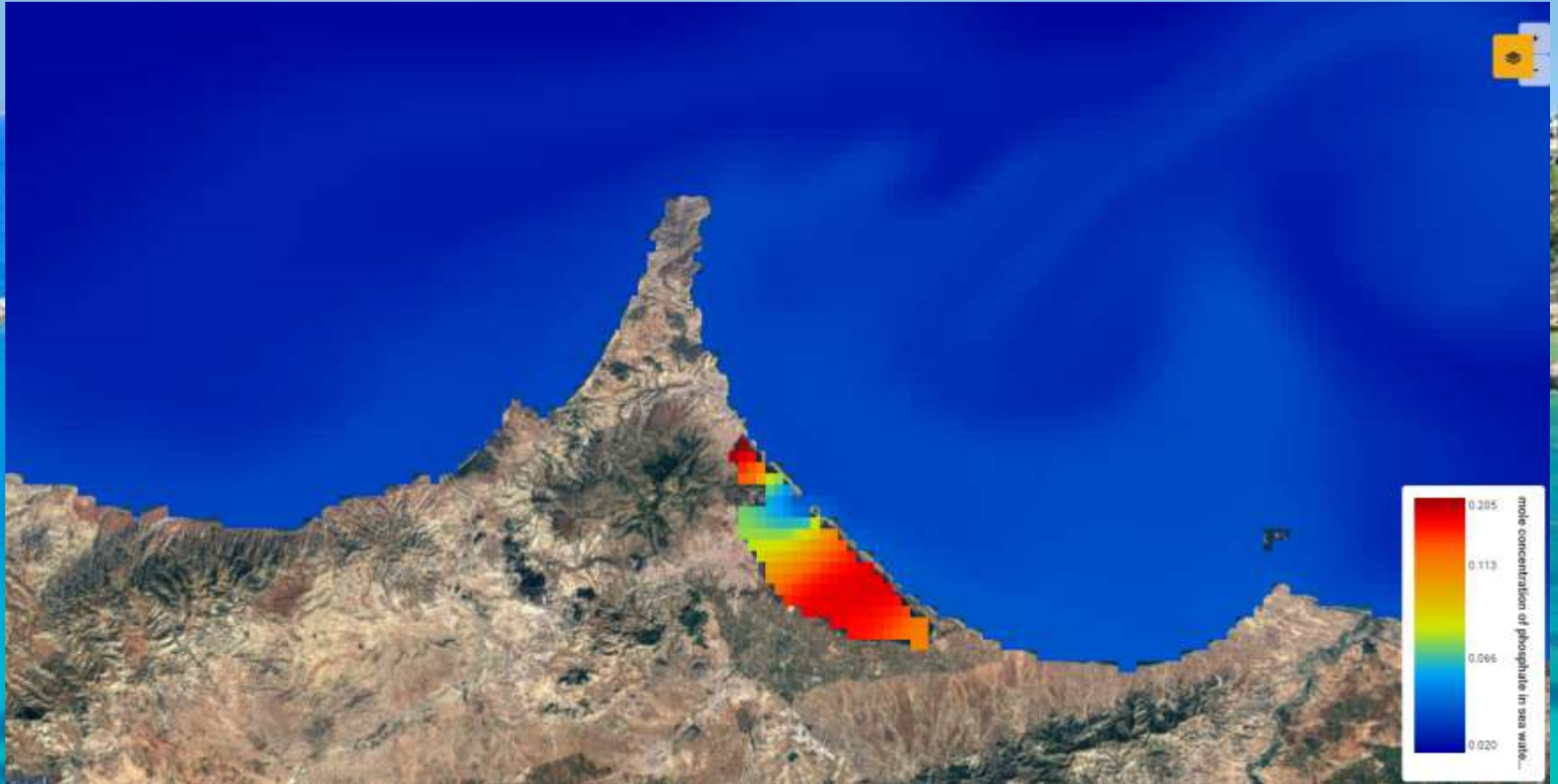
# Wave power [Algorithm]



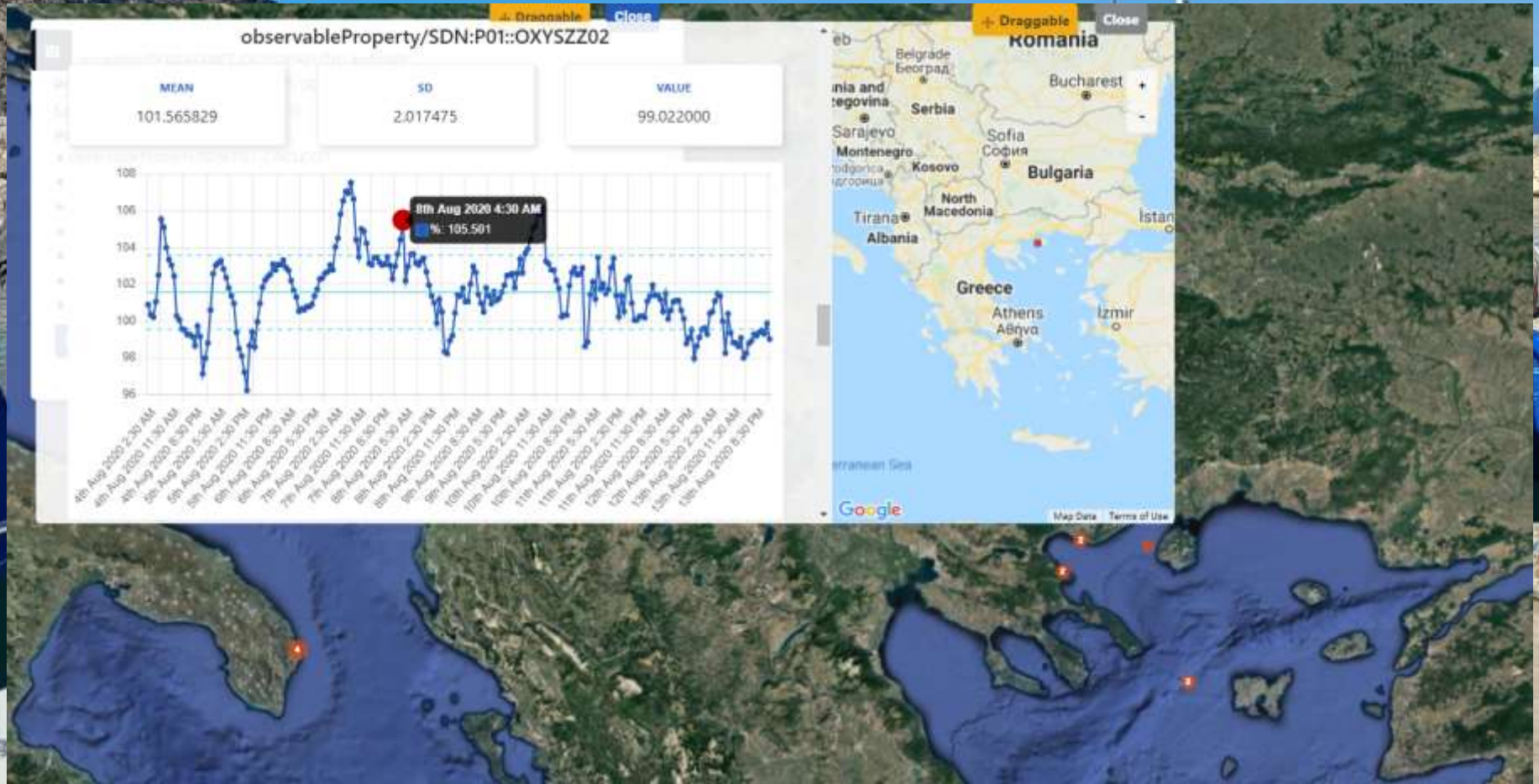
# Trophic index [Algorithm]



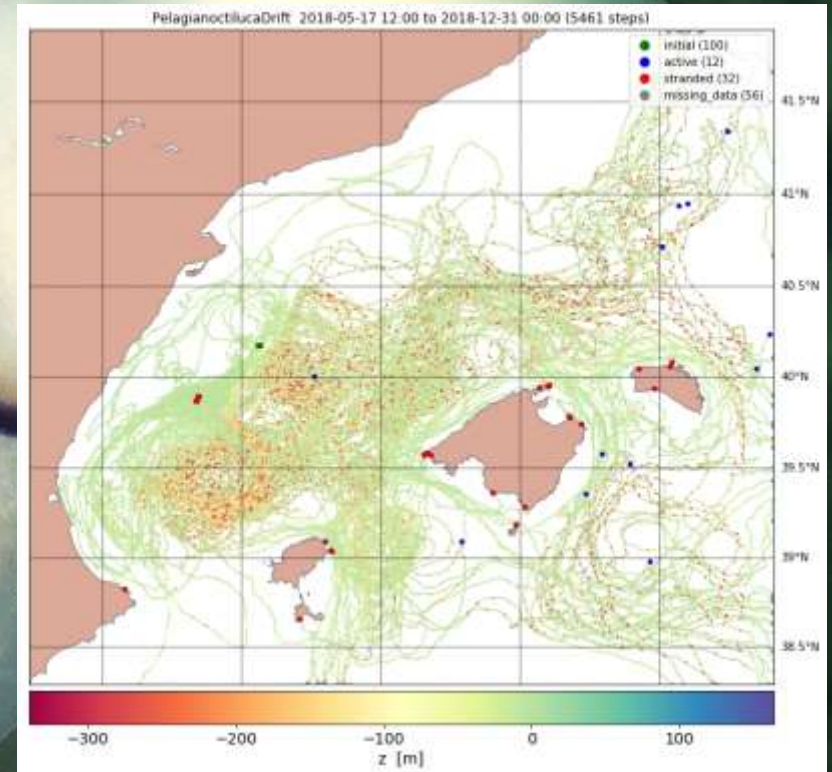
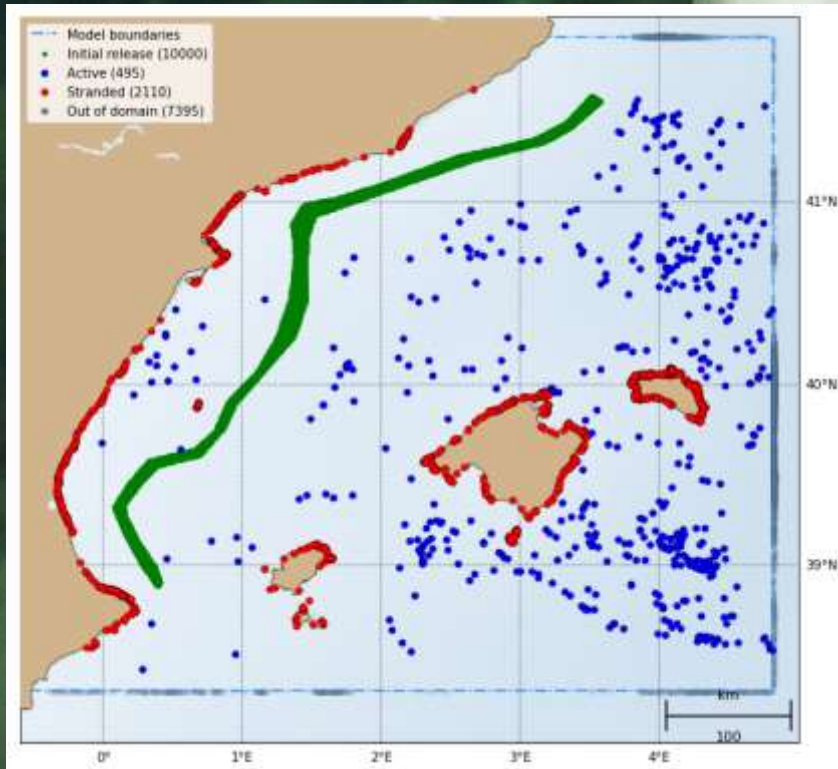
# Nutrient conc. [Coastal model]



# Oxygen level [ODYSSEA Lander]



# Jellyfish occurrence [ODYSSEA model]



# Interactive feedback session



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