ODYSSEA

Creating products and knowledge for the Mediterranean

ΔΗΜΟΚΡΙΤΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΡΑΚΗΣ | DEMOCRITUS UNIVERSITY OF THRACE

ODYSSEA
OVERVIEW, CURRENT STATUS AND CHALLENGES

RV1 Review Meeting, 13 February 2019, REA, Brussels

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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
- 118 researchers involved
- 7 Advisory Board Members

Objective

ODYSSEA

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

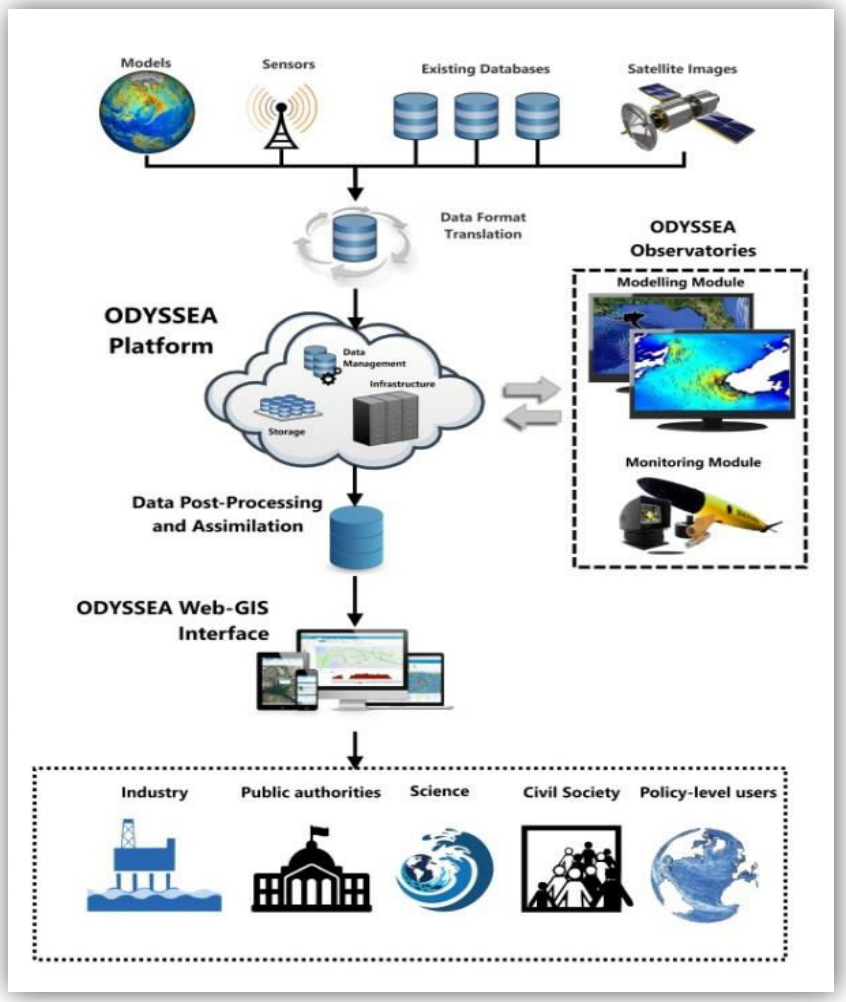
To achieve this we aim to

- harmonize existing Earth Observing systems,
- upgrade operational oceanographic capacities,
- support EU policy implementation,
- improve interoperability in monitoring,
- foster blue growth jobs creation, and
- open participation to non-EU member states.

Ambition

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.



A Sea of Platforms
An Ocean of Datasets

ODYSSEA

EMODnet
European Marine Observation and Data Network

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

NASA

JAXA

EGO

Copernicus
Europe's eyes on Earth

USGS
science for a changing world

OneGeology

AquaMaps

ECMWF

BirdLife
INTERNATIONAL

COCO
NET

BODC
British Oceanographic Data Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Euro Argo

emso
ERIC
EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

General Bathymetric Chart of the Oceans
GEBCO

JRC
EUROPEAN COMMISSION

FixO3
FIXED-POINT OPEN OCEAN OBSERVATORIES

Geo-Seas

GFCM
CGPM

mongoos

SeaDataNet

UNEP
MAP

Many Platforms
Too few people Informed

ODYSSEA

1. Systems are disparate
2. Inhomogeneous Datasets (formats, types)
3. Difficult to access multiple datasets
4. Data stored and maintained by various agencies
5. In some cases, data access requires authorization by agencies
6. Gaps in datasets, especially chemistry and biology
7. Gaps along N. African Middle East Coastlines
8. Mostly static data, collected from past cruises, lack in reporting parameters as micro-pollutants, fisheries, etc., limited satellite data, no meteorological/hydrologic data
9. Lack on data transformation to information
10. Datasets are not linked to EU policy instruments
11. Limited end-users involvement and training

Specific Objectives

ODYSSEA

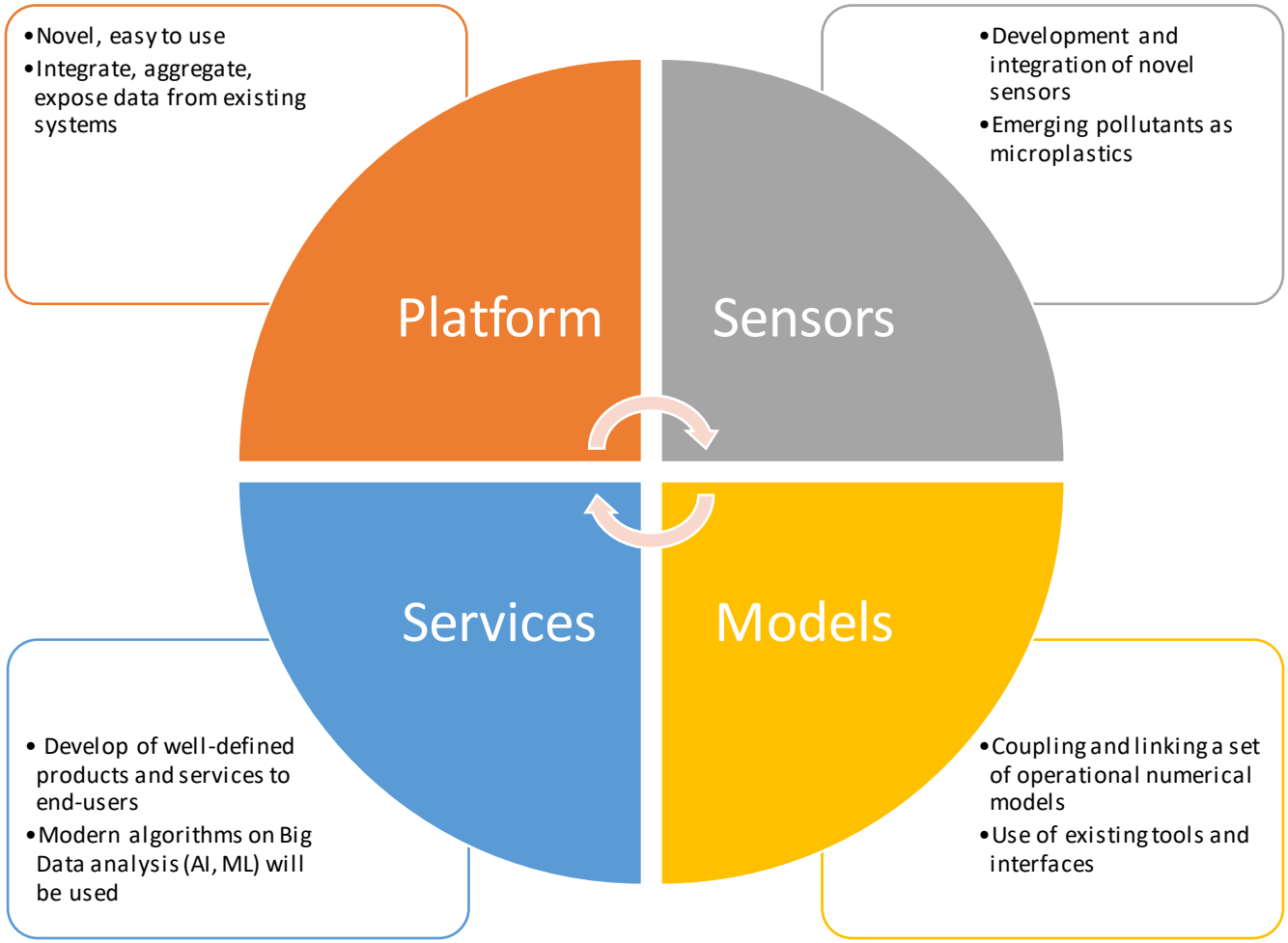
1. Develop a platform to discover, integrate and process datasets obtained from an expanded range of existing observation platforms
2. Fill-in data gaps & increase spatial and temporal resolution by establishing ODYSSEA Observatories
3. Develop a prototype ‘chain’ of models providing data never previously 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

ODYSSEA's Main Novelties

- Both primary data and on-demand derived data services will be made available and accessible through **a single command and via a single public portal**.
- The platform will allow to **search, collect, retrieve and integrate datasets** obtained from an expanded range of existing observational systems.
- To reduce costs and ensure active participation of end-users on ODYSSEA platform, **existing facilities (onshore and offshore)**, such as oil and gas terminals and rigs, mariculture installations, ports and harbours, **will be used to deploy static sensors**.
- Gliders will **integrate marine microplastics sensor and novel sensors** for real-time biological monitoring.
- Operational models will be coupled and running in each Observatory providing forecasts and **informing end-users on emergencies and risks**.
- Local/regional/national policy-makers and end-users will be **trained on the optimal platform usage**.

ODYSSEA Pillars

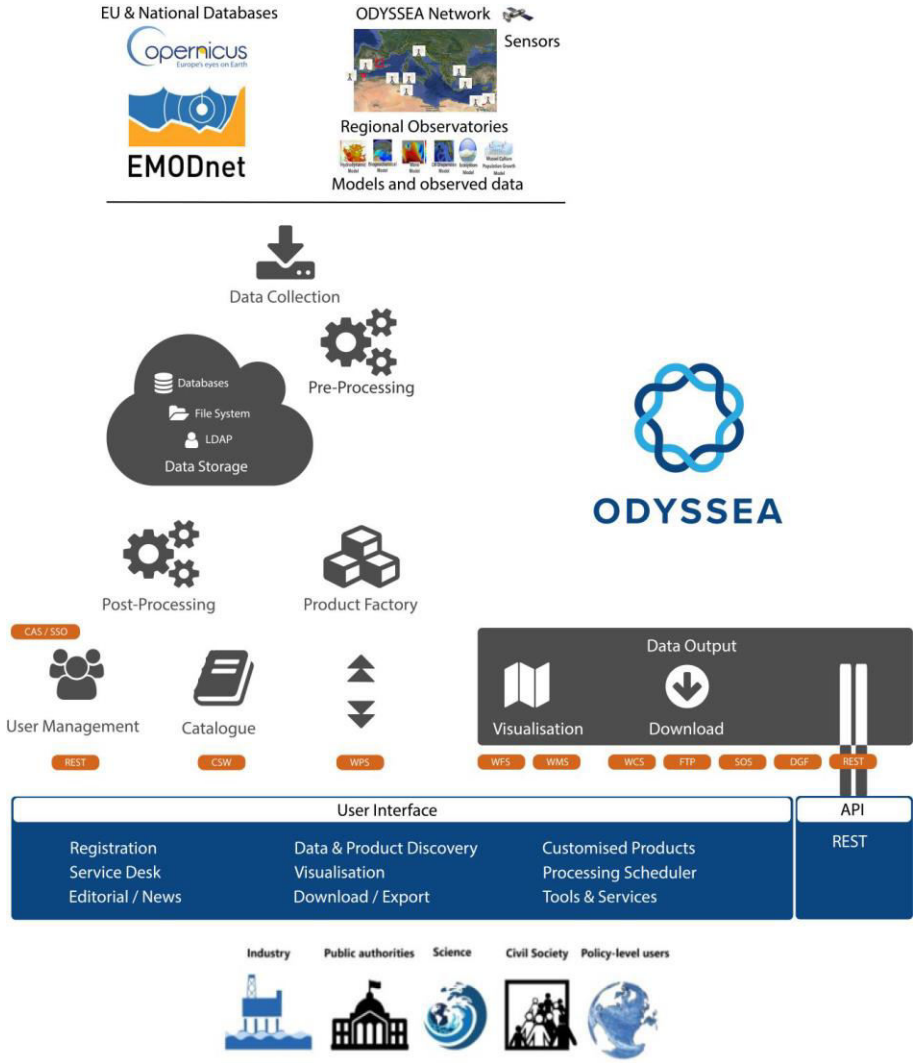
ODYSSEA



The Platform

ODYSSEA

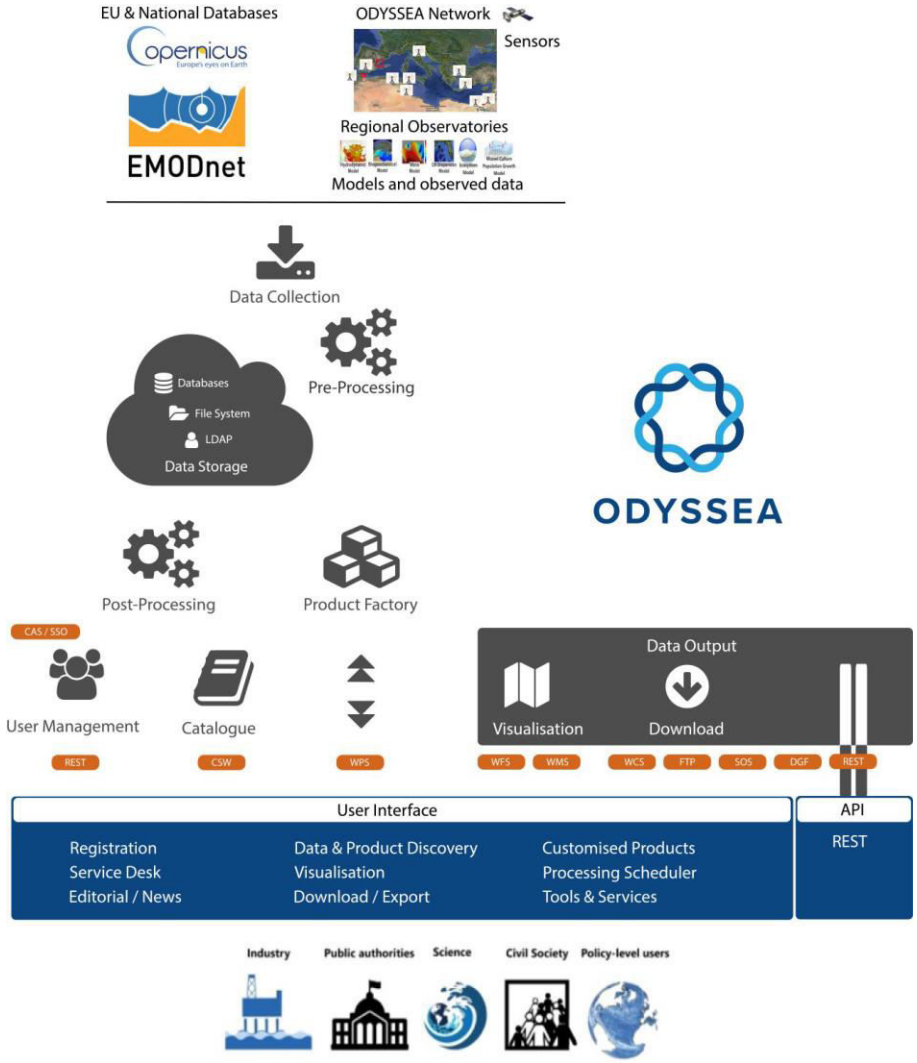
1. Integrate marine data from existing databases maintained by Earth Observing facilities,
2. Receive and process novel newly produced datasets (through models, remote sensing and on-line sensors) from nine prototype Observatories,
3. Transform marine data into meaningful information, ultimately developing, testing, validating and disseminating marine data products and services to end-users,
4. Stimulate Blue Growth throughout the Mediterranean basin, creating businesses, advancing science and supporting the societal use of digital information



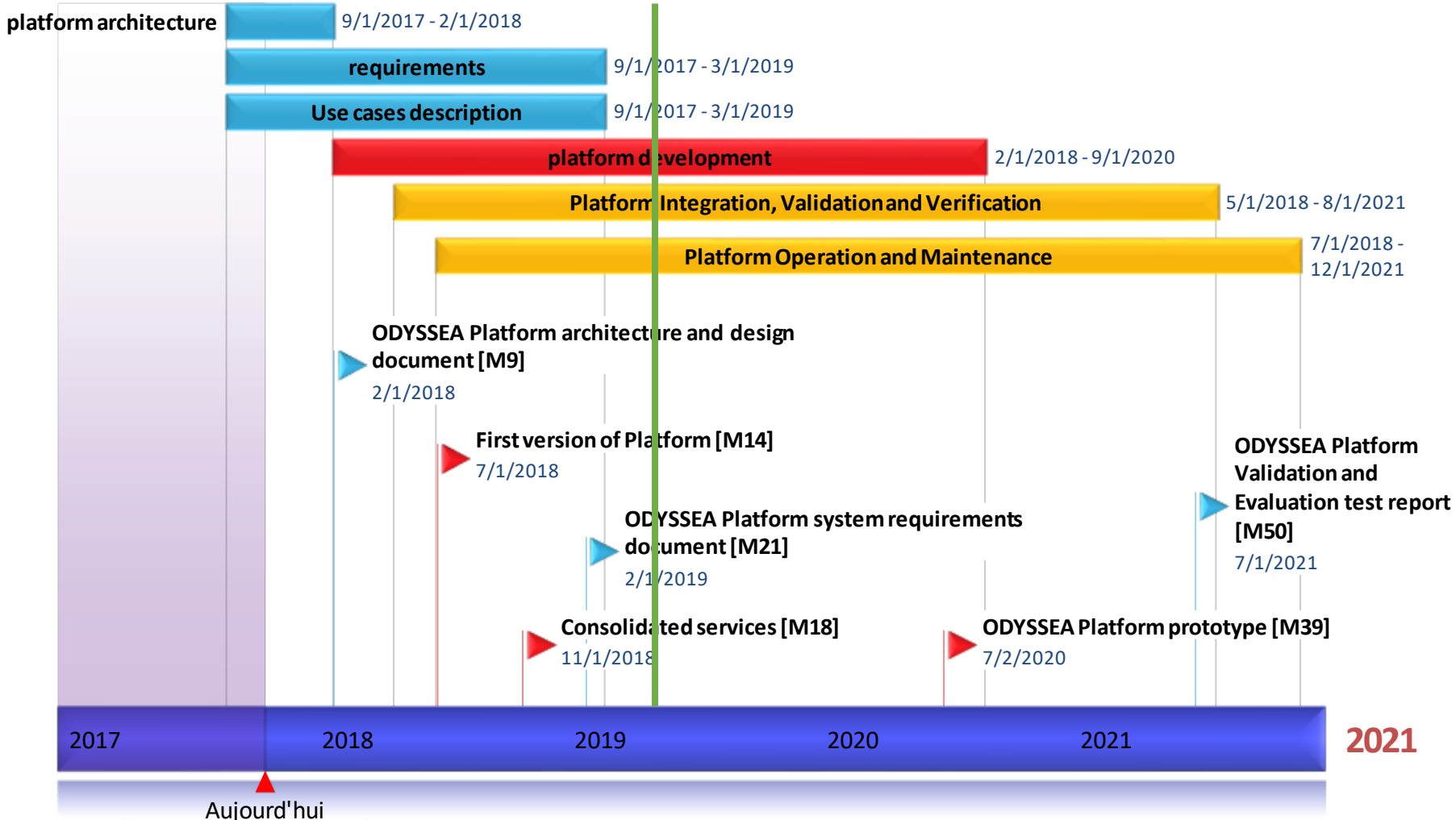
The Platform

ODYSSEA

- ✓ Have a modular and highly versatile structure,
- ✓ Collect, process and homogenize datasets,
- ✓ Provide geo-referenced datasets in common formats,
- ✓ Allow indexing, storage, documentation, presentation and exchange of geospatial datasets,
- ✓ aggregate physical, chemical geological, biological, biodiversity and fishery datasets,
- ✓ follow an ontology approach and apply semantic information fusion to provide functionalities and services.



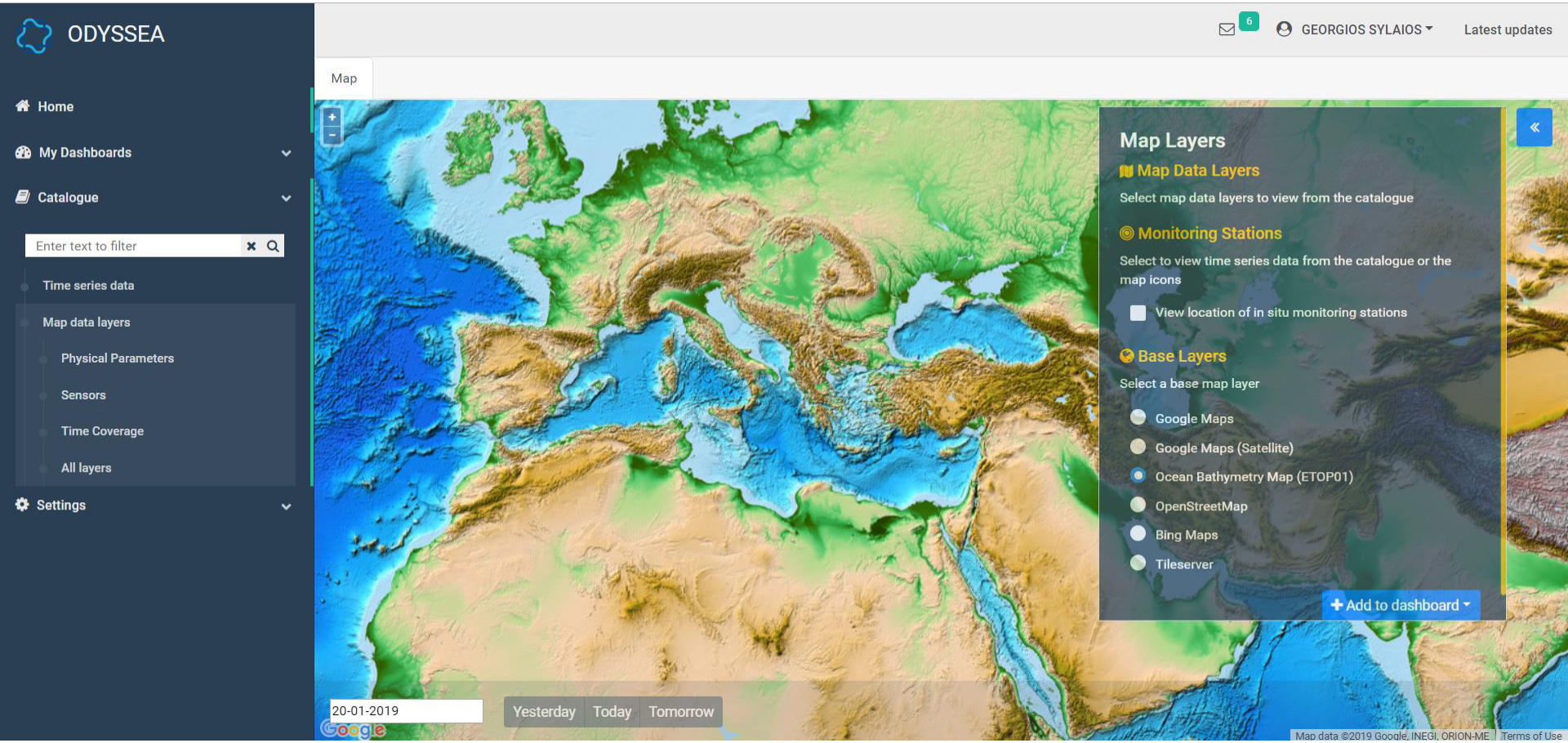
ODYSSEA Platform RoadMap



ODYSSEA Platform v0

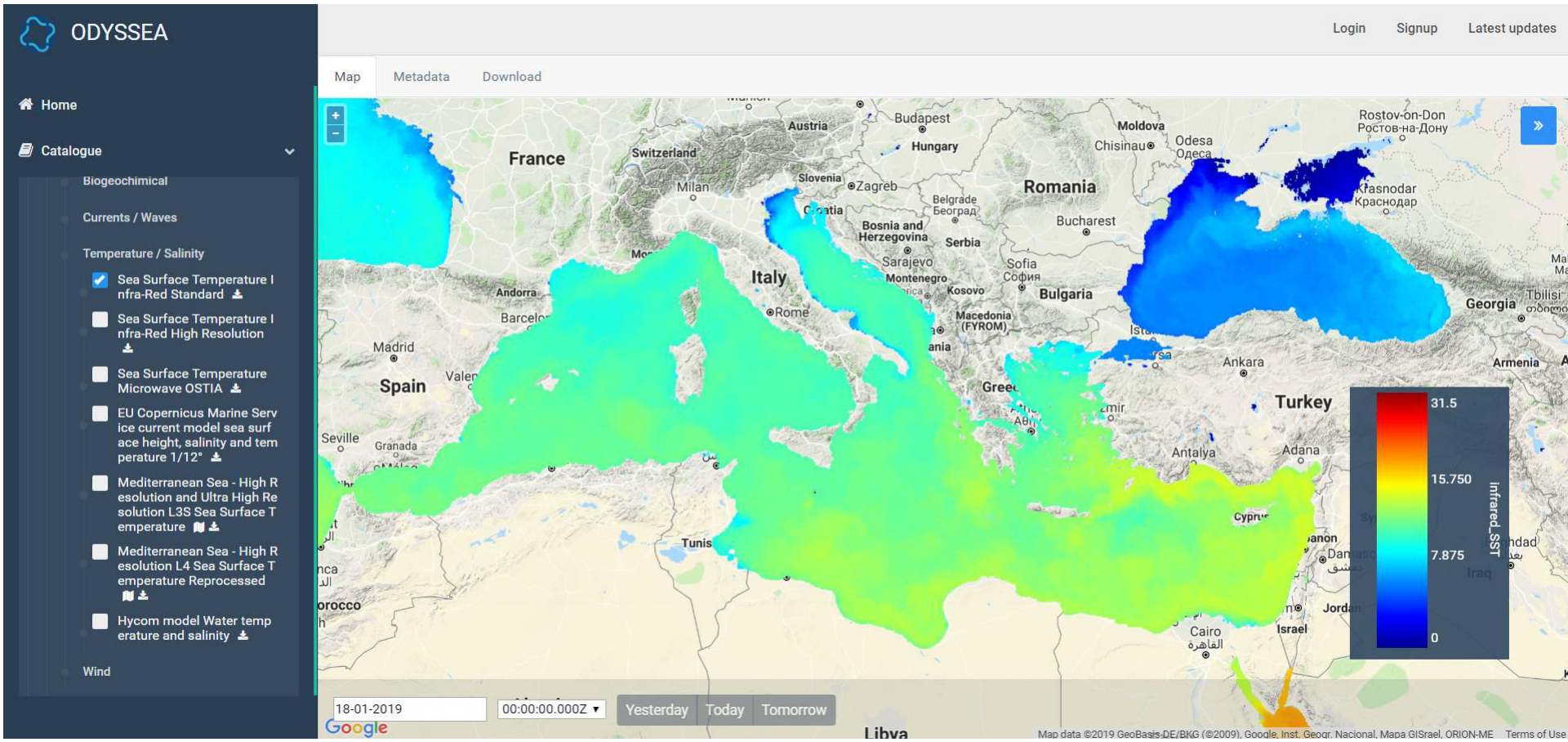
ODYSSEA

Ocean Bathymetry – Mediterranean Sea

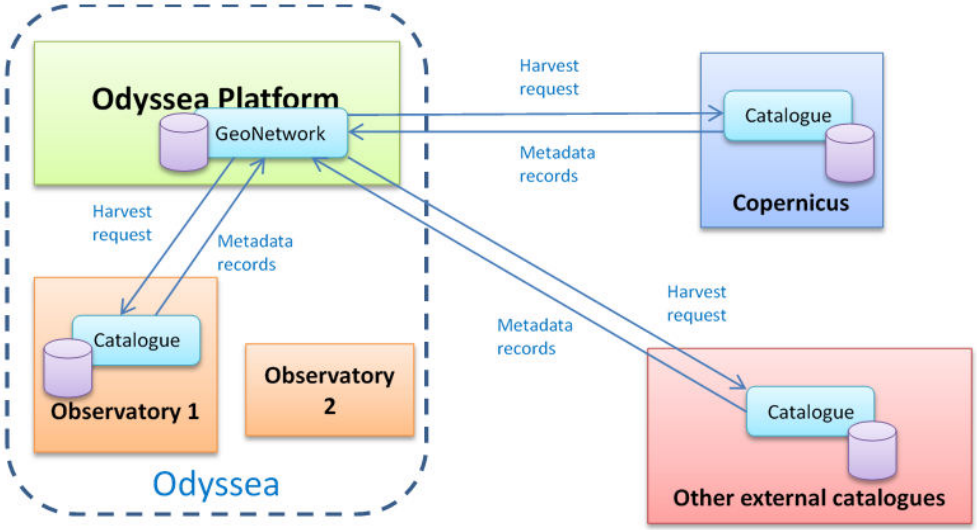


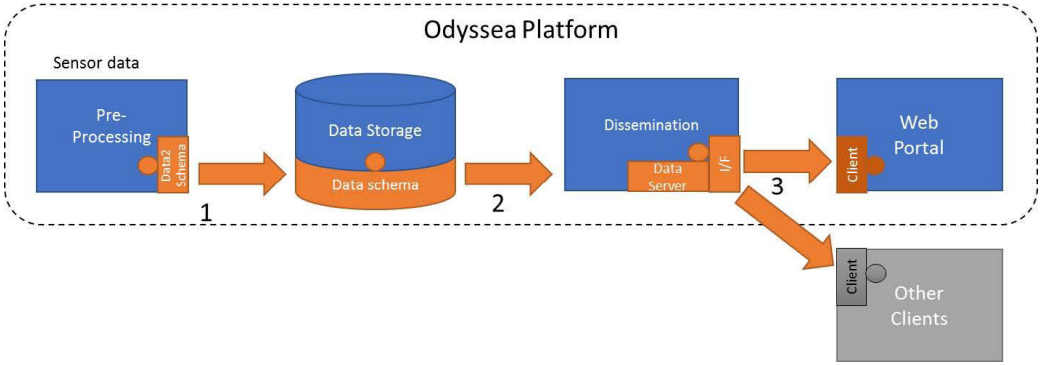
ODYSSEA Platform v0

Sea Surface Temperature – Mediterranean Sea



ODYSSEA Platform Components





9 ODYSSEA Observatories

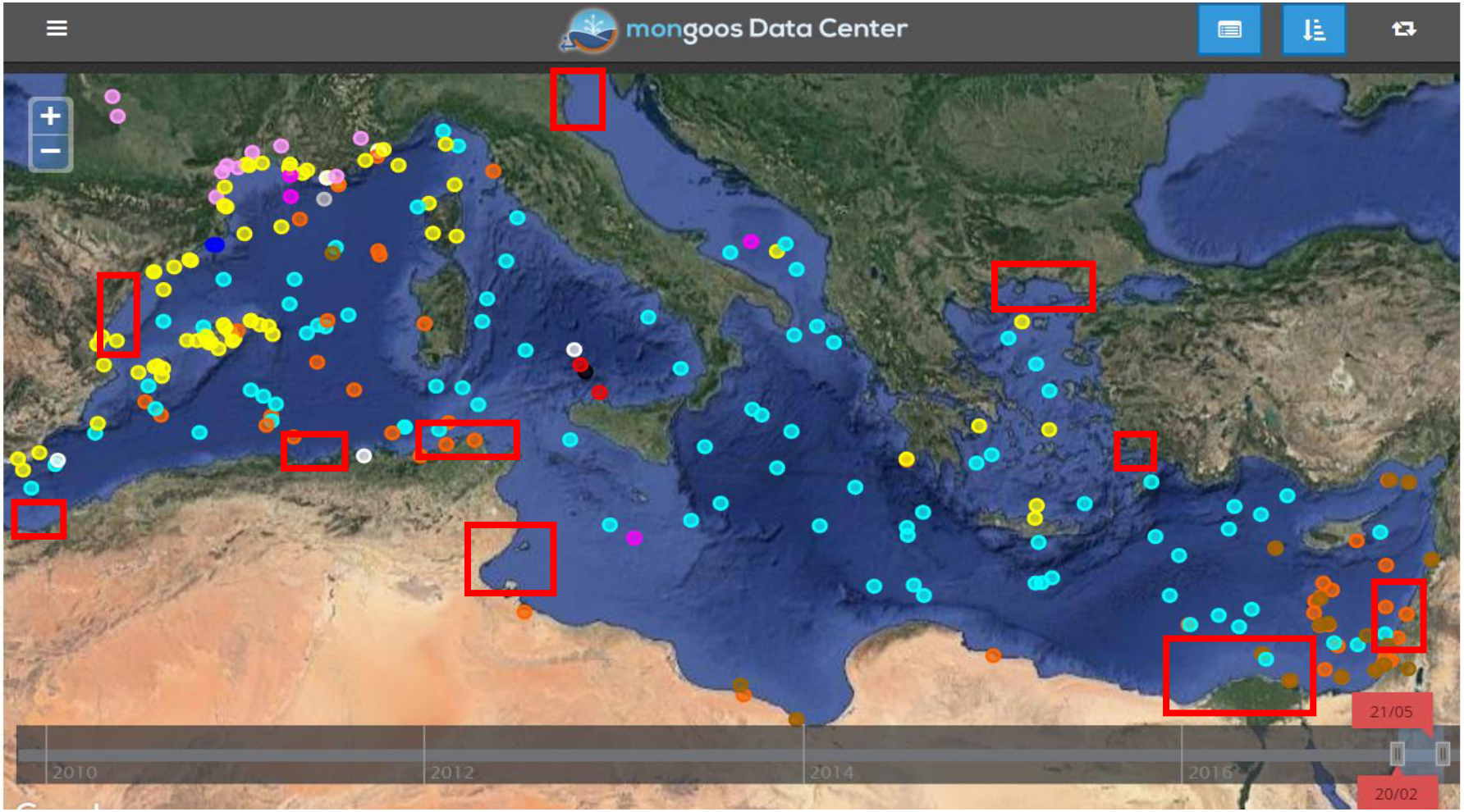
ODYSSEA

Establish ODYSSEA Observatories to fill-in data gaps & increase spatial and temporal resolution

A. North Aegean/Thracian Sea (Greece/Turkey),
B. Gulf of Gökova (Turkey),
C. Valencia's regional coastline (Spain),
D. Northern Adriatic Sea basin,
E. Arzew Bay/Stora Gulf (Algeria)
F. Gulf of Gabes (Tunisia),
G. MPA National Park Al-Hoceima (Morocco),
H. Israel's coastline and
I. Nile River of Freshwater Influence (Egypt).

The Observatories

ODYSSEA



The Observatories

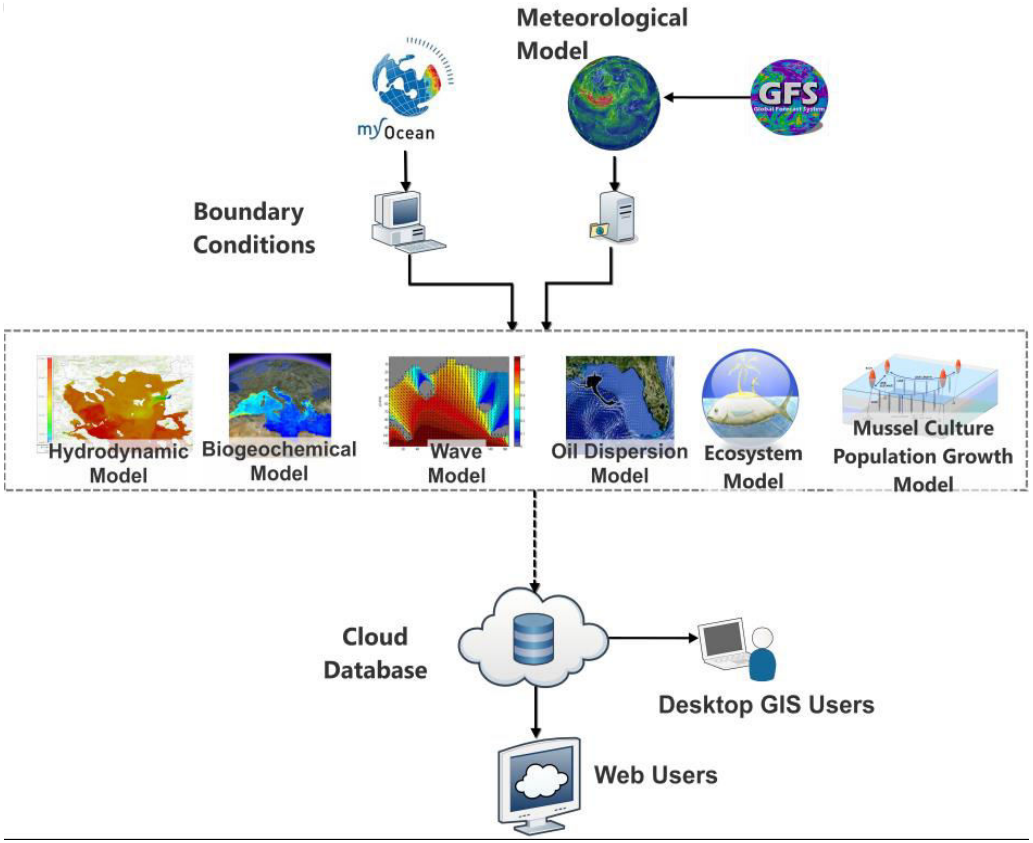
ODYSSEA

- ✓ Comprise a network of 9 observing and forecasting systems,
- ✓ Decentralized entities
- ✓ Cover coastal and shelf zone environments,
- ✓ Cover Ecologically-vulnerable systems (MPAs) / systems with increased human pressure,
- ✓ Combine monitoring and modeling activities,
- ✓ Produce new datasets, store, manipulate, make accessible through the ODYSSEA platform,

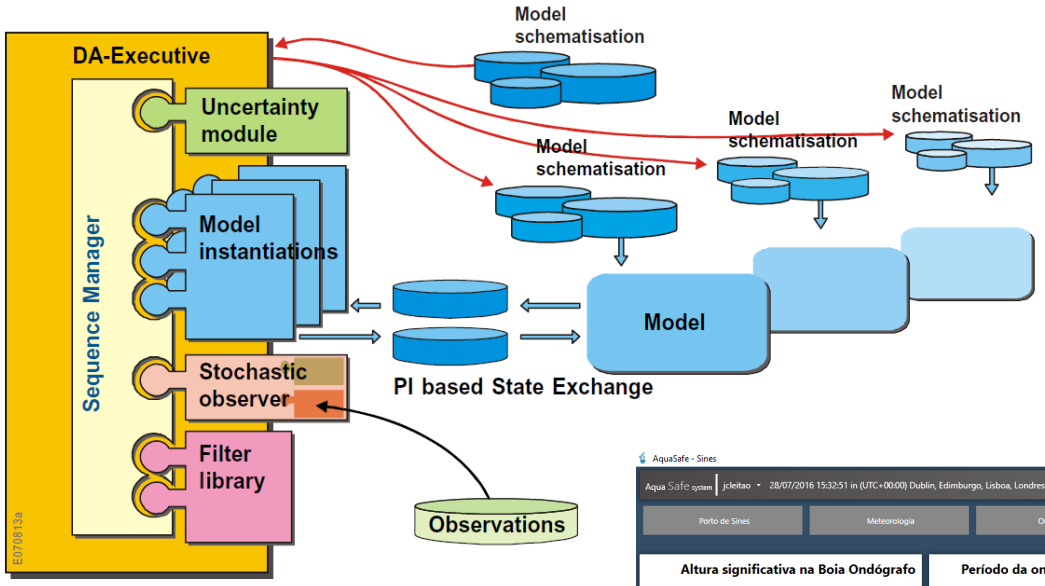
The Models

- ✓ 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,
- ✓ Report on parameters never previously reported,

Models: Meteorological (WRF), 3Dhydrodynamic (Delft3D), Wave (SWAN), Oil spill (MEDSLICK-II), Water quality (DELWAQ), Ecosystem models (Ecopath with Ecosim), Fish and Mussel/oyster culture population growth

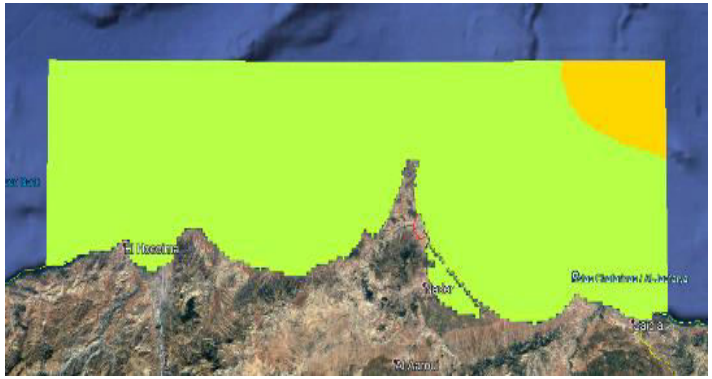


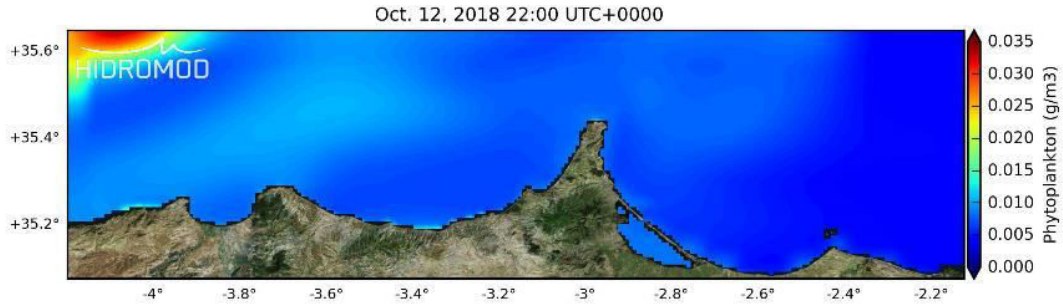
The Models

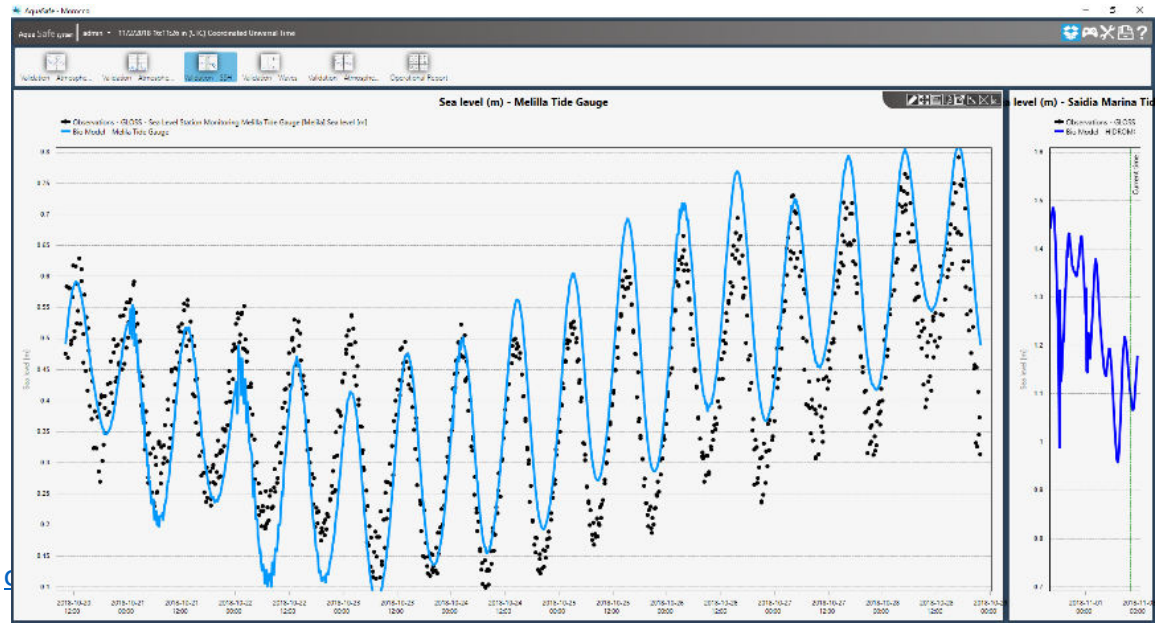

DA-Executive
Sequence Manager
Uncertainty module
Model instantiations
Stochastic observer
Filter library
Model schematisation
Model schematisation
Model schematisation
Model schematisation
Model
PI based State Exchange
Observations
E0708113a


AquaSafe - Sines
Porto de Sines
Meteorologia
Ondulação
Correntes
Maré
Altura significativa na Boia Ondógrafo
Período da ondulação na Boia Ondógrafo
Intensidade do Vento - Entrada da Baía de Sines
Nível de Maré - Marégrafo de Sines
Direção da Ondulação na Boia Ondógrafo
Altura significativa em 3 locais
Direção do vento - Entrada da Baía de Sines
Pressão Atmosférica

The Models in Al Hoceima Observatory







AQUASAFE Morocco. Validation workspace for sea level. Comparison between observations from Gloss (black dots) and numerical model results (blue line).

Novel ODYSSEA Systems

ODYSSEA

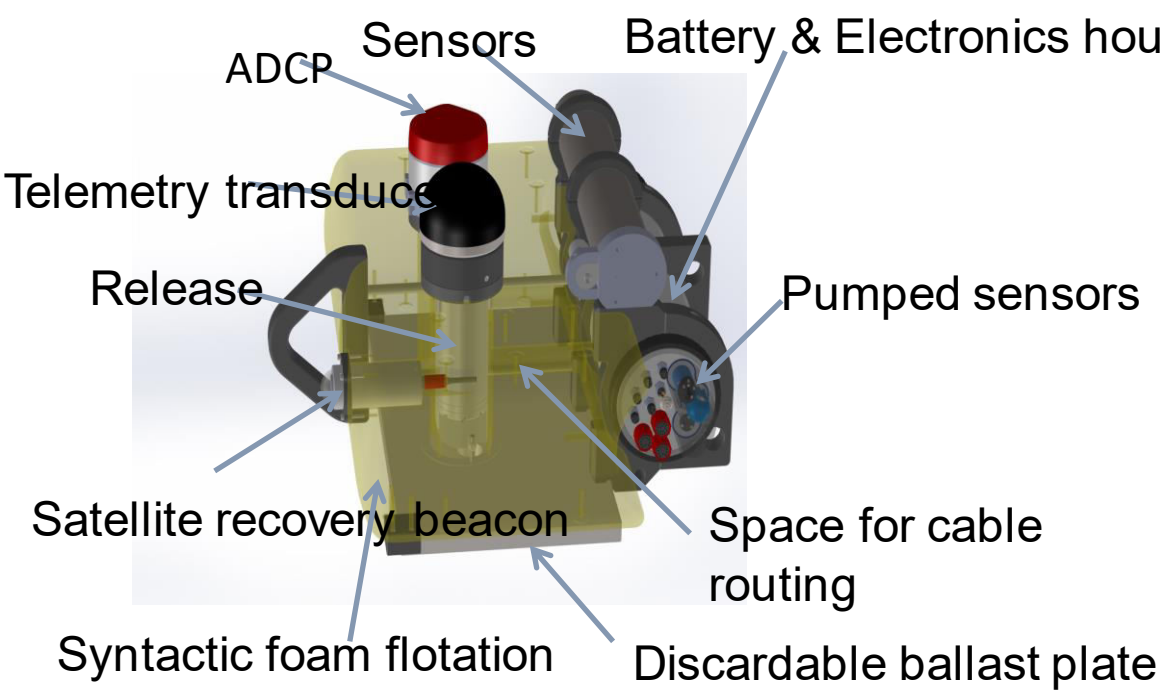
Expand existing operational monitoring systems capacity

ODYSSEA will develop a prototype monitoring module:

- Two data collection systems: static and mobile
- Deployed at each ODYSSEA Observatory
- Continuous real-time monitoring at each site
- Surface platforms include typical sensors as: temperature, salinity, DO, turbidity, fluorimeter.
- Bottom platforms additionally will include ADCP and novel sensors for emerging pollutants, such as micro-plastics, submarine cameras and hydrophones.
- To reduce costs and to ensure active participation of end-users on ODYSSEA platform, existing facilities (onshore and offshore) will be used to deploy static sensors.

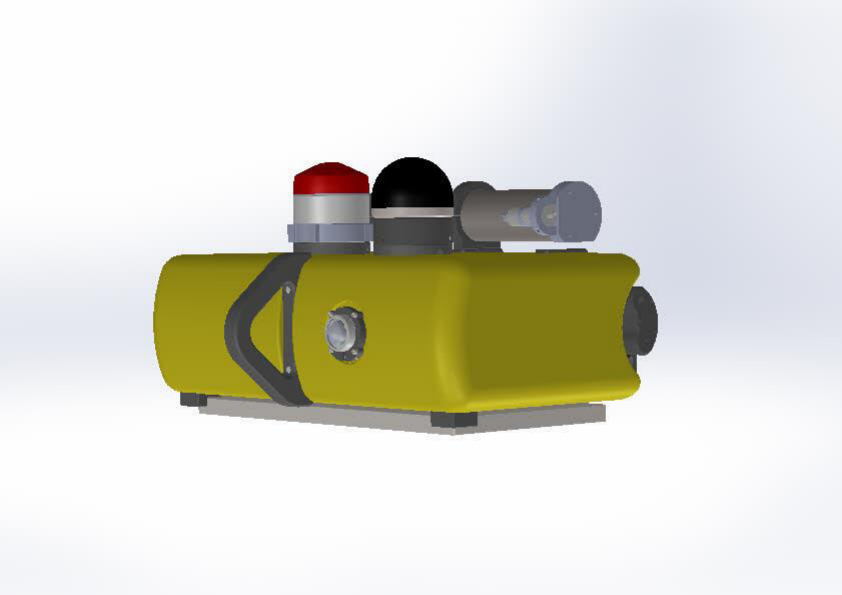
ODYSSEA Monitoring Systems

Static Monitoring Systems



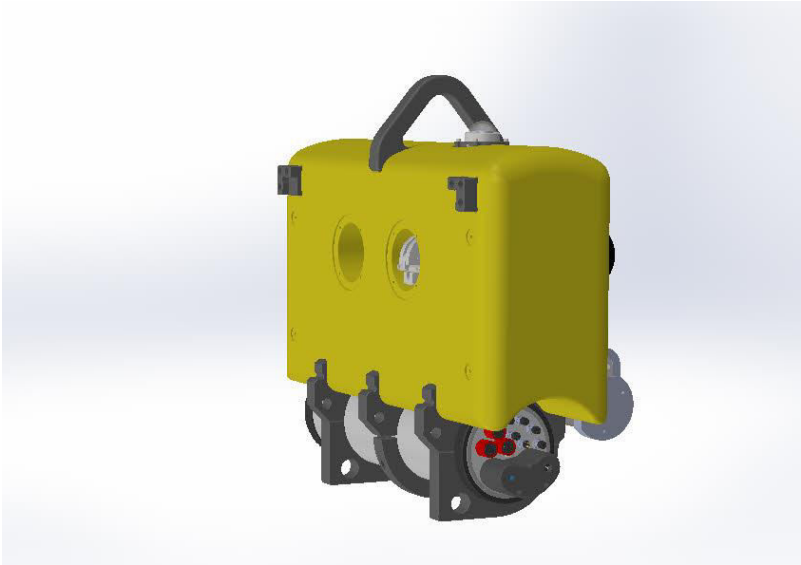
– Sensors
  - Temperature
  - Salinity, pH
  - Pressure
  - Dissolved Oxygen
  - Hydrophone to record marine mammals
  - Submarine camera to record fish
  - Currents
  - Microplastics sensor

MSL Descend / Ascend



Horizontal descend with ballast locked

- Ballast plate sits on sediment
- Drop velocity approx. 1.5m/s



Vertical after release of ballast plate

- Low drag, quick ascend
- Ascend velocity up to 1.2m/s

MSL Communication

Lander communication

- Hydro acoustic modem or HAM.BASE for wireless communication with lander
- Bi-directional
- For downloading measured data and device status
- Can be used for re-configuring the lander
  - For more or less measurements
  - For power saving
  - Changing the CSV output format
- Manually operated from boat or ship
  - Laptop and training required
  - Data output in CSV format

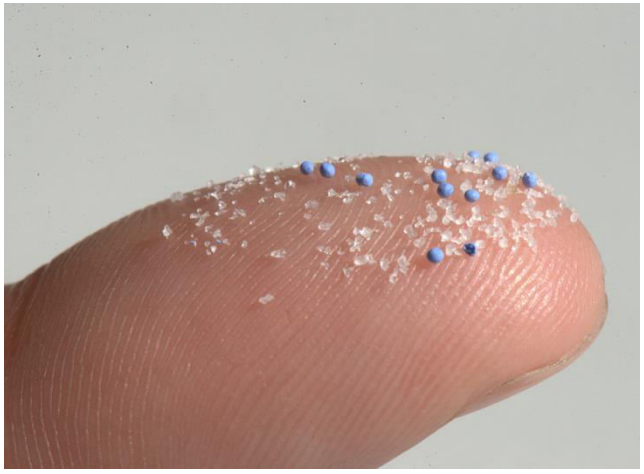
Mobile Monitoring Systems for Al-Hoceima Observatory

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

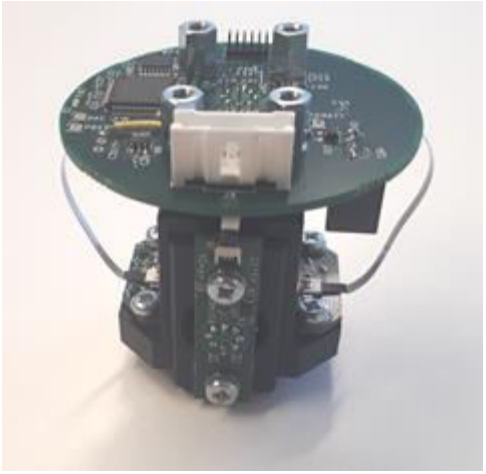
The Microplastic Sensor – ODYSSEA Global Novelty

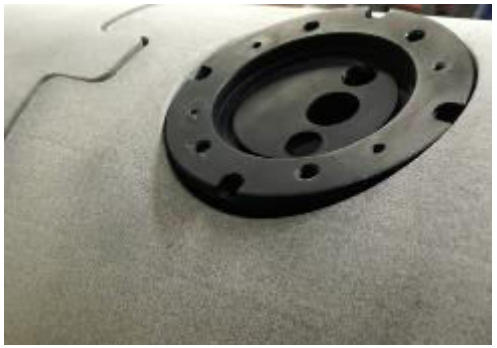


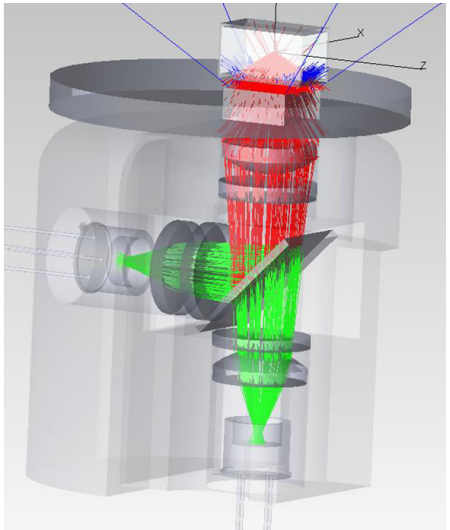
tform

The Microplastic Sensor – ODYSSEA Global Novelty

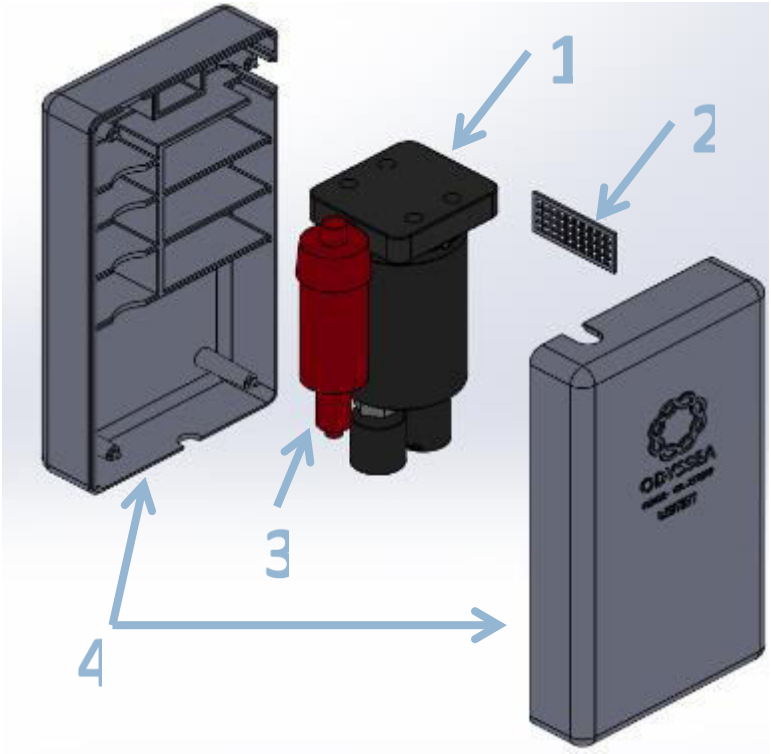
ODYSSEA

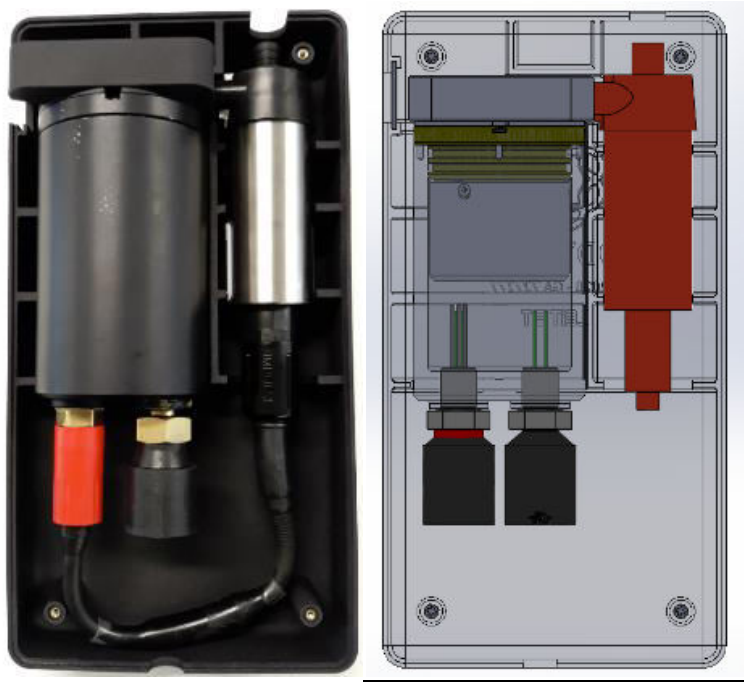






The Microplastic Sensor – ODYSSEA Global Novelty

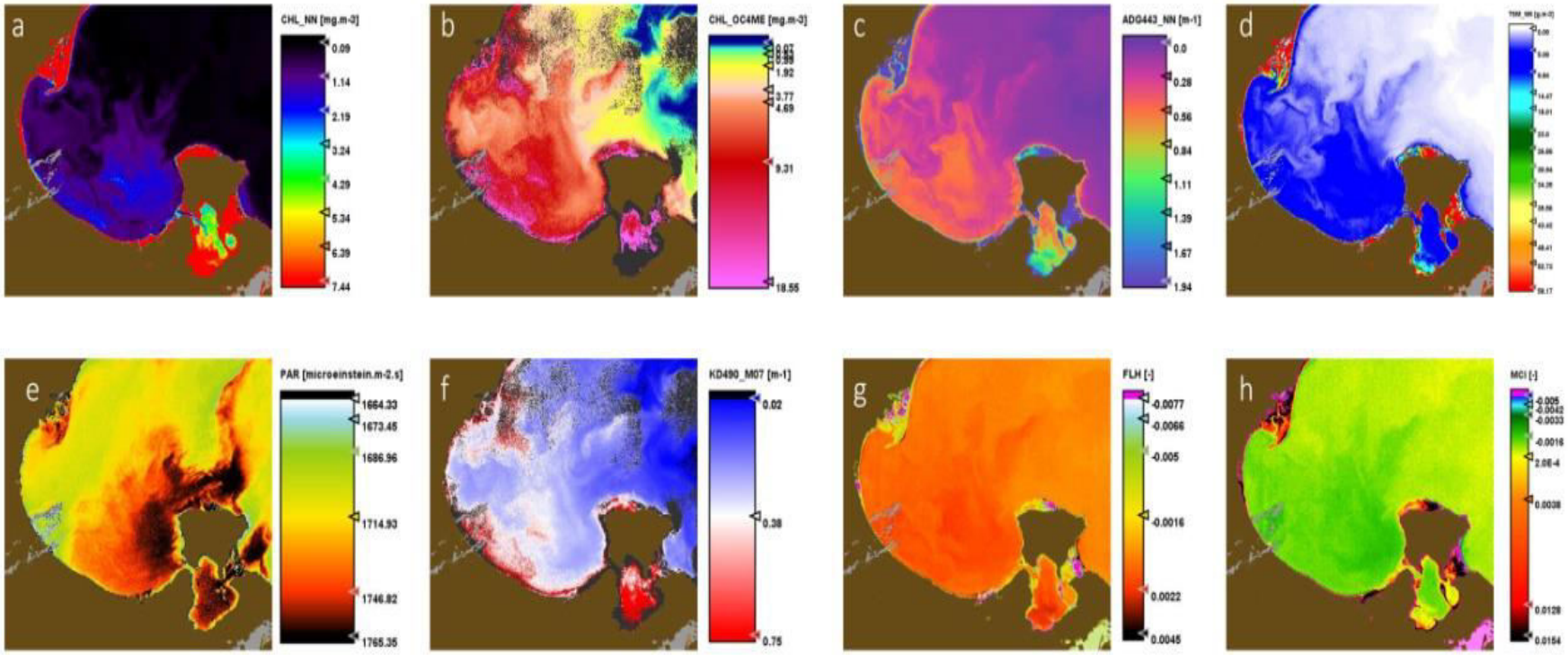




Lander/Sea Surface MPS assembly. (1) MPS / (2) housing net / (3) water pump / (4) external housing

Remote Sensing

ODYSSEA

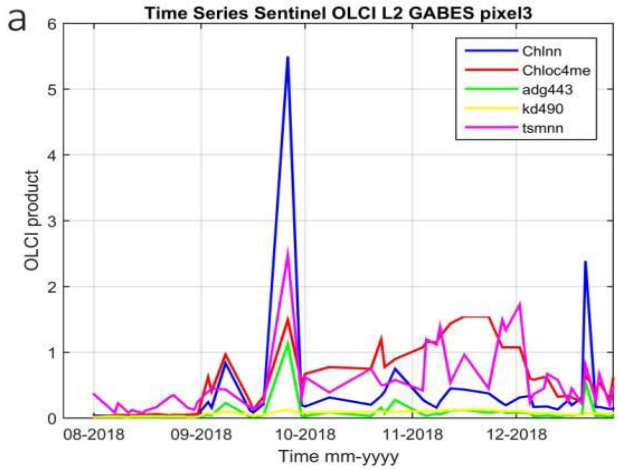


Sentinel-3 Level2 spatial distributions of a) chlorophyll-a conc (mg m^{-3}) Oc4me algorithm, b) chlorophyll-a conc (mg m^{-3}) chlnn neural network algorithm, c) absorption of CDOM at 443 nm (m^{-1}), d) TSM concentration (gm^{-3}), e) PAR in the spectral range 400-700 nm (µEinstein m^{-2} s^{-1}),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

Remote Sensing

ODYSSEA

a



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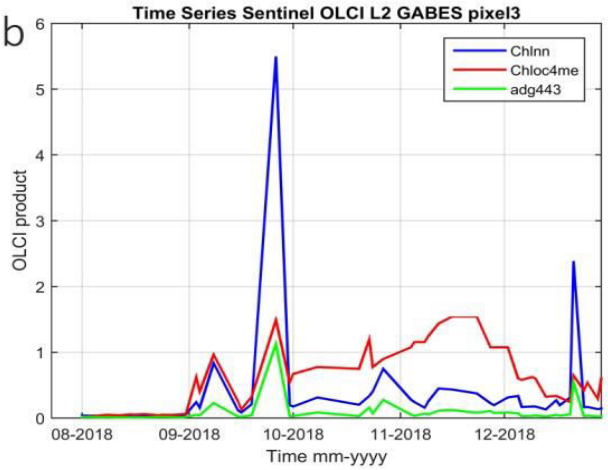

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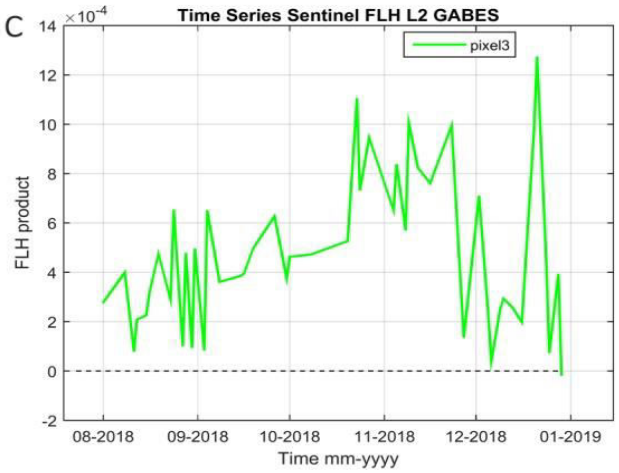

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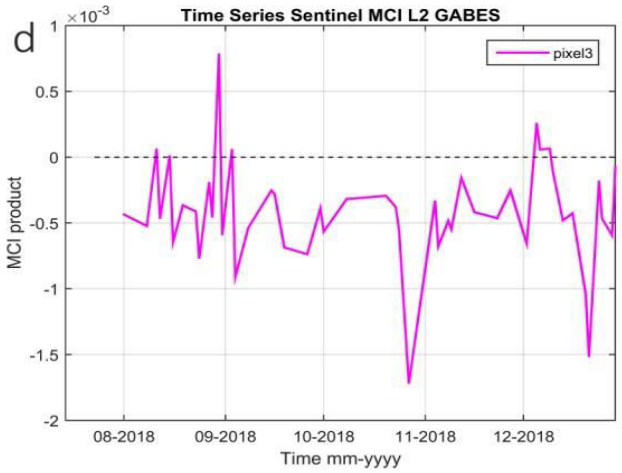
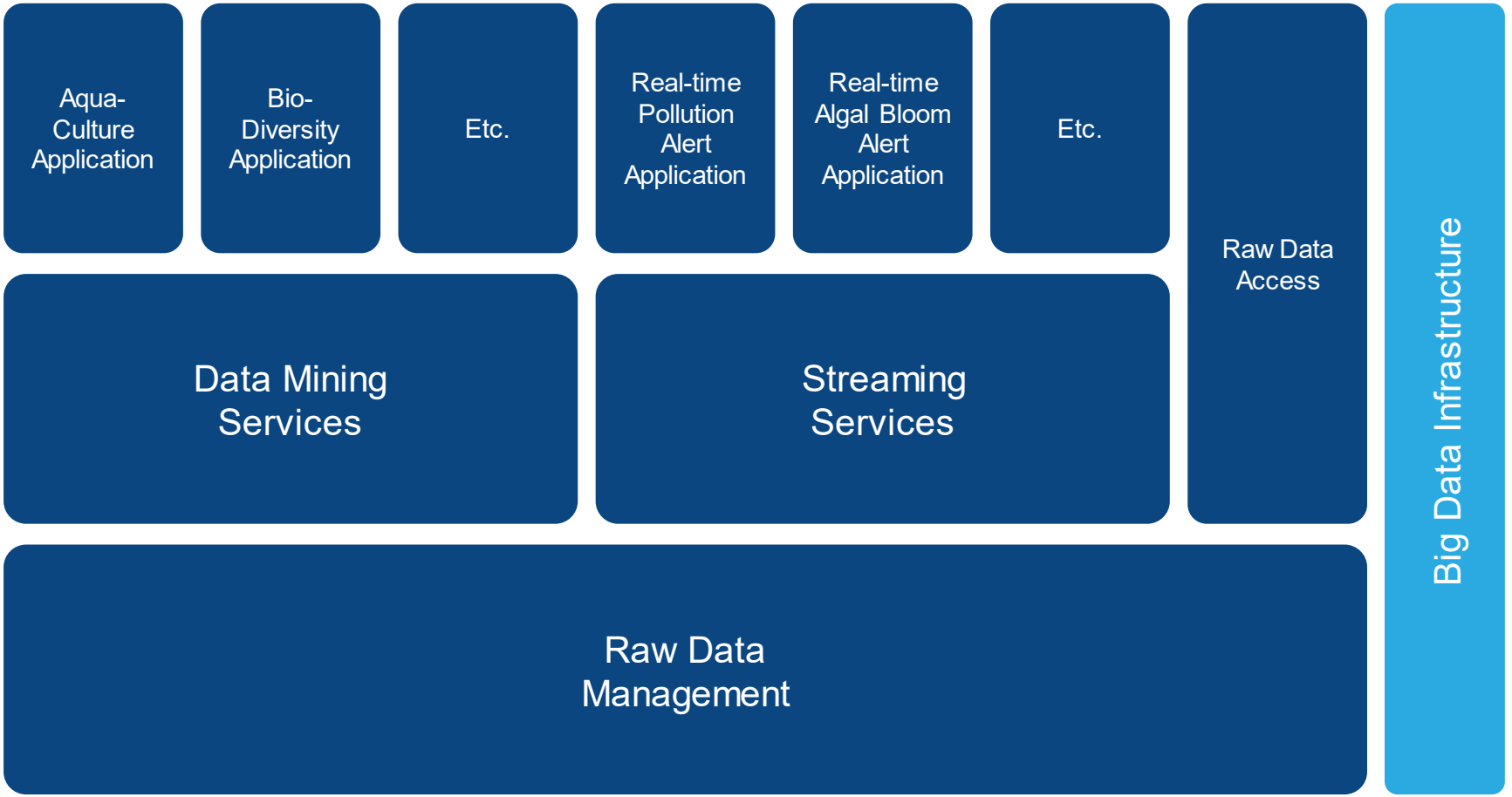


Big data in Action

ODYSSEA



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Seagrass detection in the mediterranean: A supervised learning approach

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ABSTRACT

We deal with the problem of detecting seagrass presence/absence and distinguishing seagrass families in the Mediterranean via supervised learning methods. By merging datasets about seagrass presence and other external environmental variables, we develop suitable training data, enhanced by seagrass absence data algorithmically produced based on certain hypotheses. Experiments comparing several popular classification algorithms yield up to 93.4% accuracy in detecting seagrass presence. In a feature strength analysis, the most important variables determining presence–absence are found to be Chlorophyll-α levels and Distance-to-Coast. For determining family, variables cannot be easily singled out; several different variables seem to be of importance, with Chlorophyll-α surpassing all others. In both problems, tree-based classification algorithms perform better than others, with Random Forest being the most effective. Hidden preferences reveal that *Cymodocea* and *Posidonia* favor the low, limited-range chlorophyll-α levels ($< 0.5\ mg/m^3$), *Halophila* tolerates higher salinities (> 39), while *Ruppia* prefers euryhaline conditions (37.5–39).

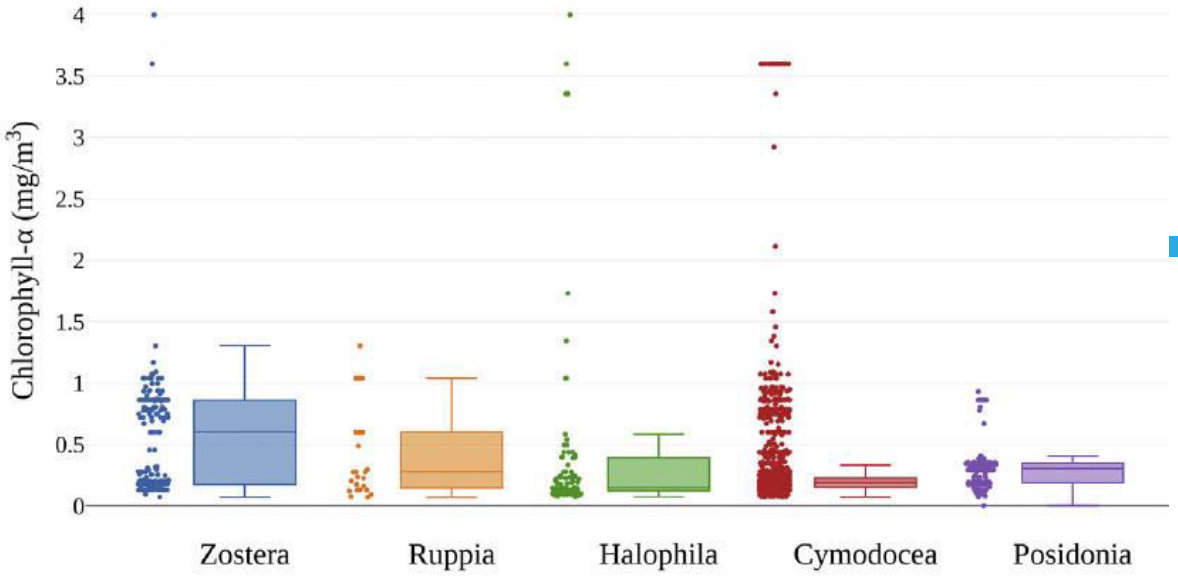


Fig. 9. Distribution of Chlorophyll-α-December values per seagrass family.

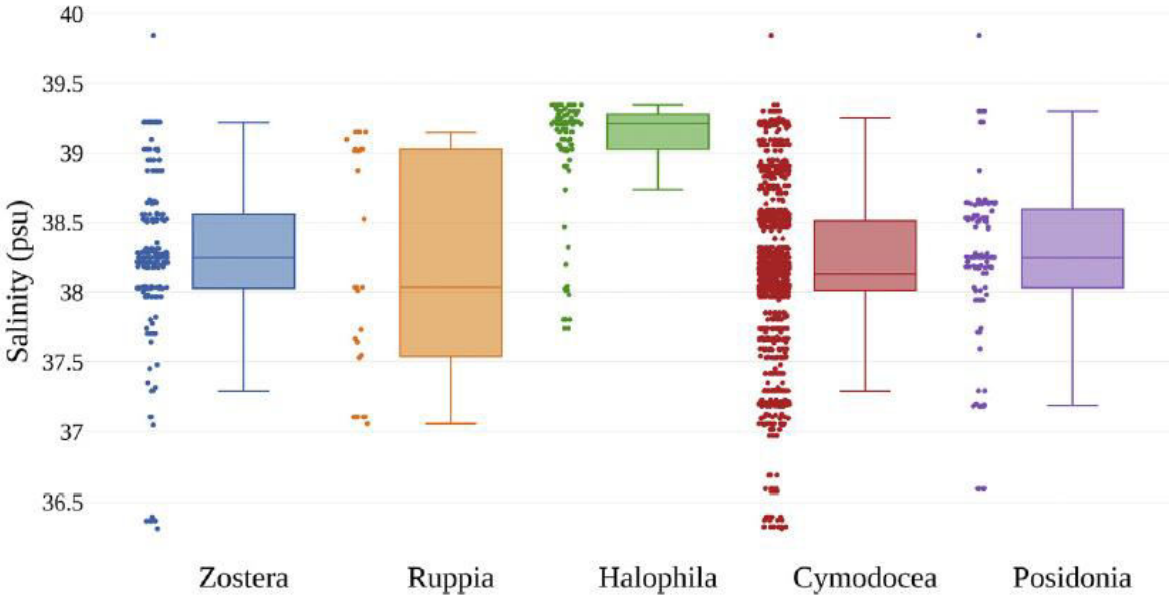


Fig. 10. Distribution of Salinity-December values per seagrass family.

Generating services

ODYSSEA

WP6

Platform Development, Operation and Maintenance

WP7

Big Data Management and Tools Development

WP8

ODYSSEA End-user Services

Services for end-users

ODYSSEA will:

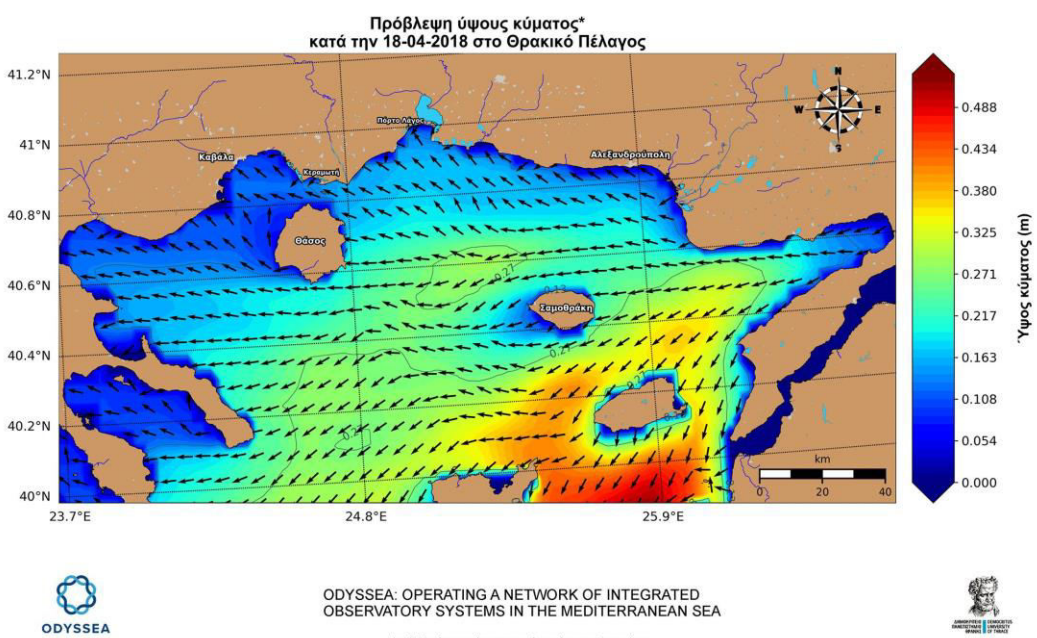
- **Eventually be transformed into a business**
- Develop a **community of data users** who enjoy the benefits of facilitated access to marine data
- Classify end-users into: **primary users, advanced users and higher-level clients**
- Directly involve end-users in **the design and data collection** of Observatories monitoring module through the use existing facilities (onshore and offshore), like oil & gas terminals and rigs, mariculture installations and ports,
- Ensure **increased number/types of end-users** requiring real-time data from the sea
- **Reduce costs for end-users** data assembling from different sources
- Inform end-users on **emergencies and risks**

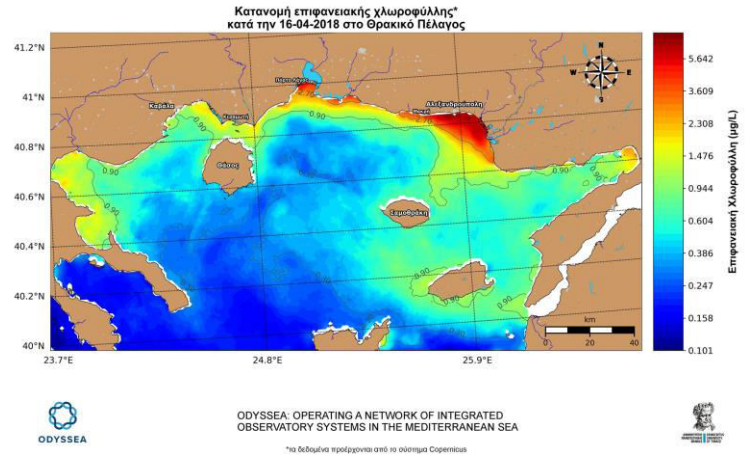
Potential Users/Clients

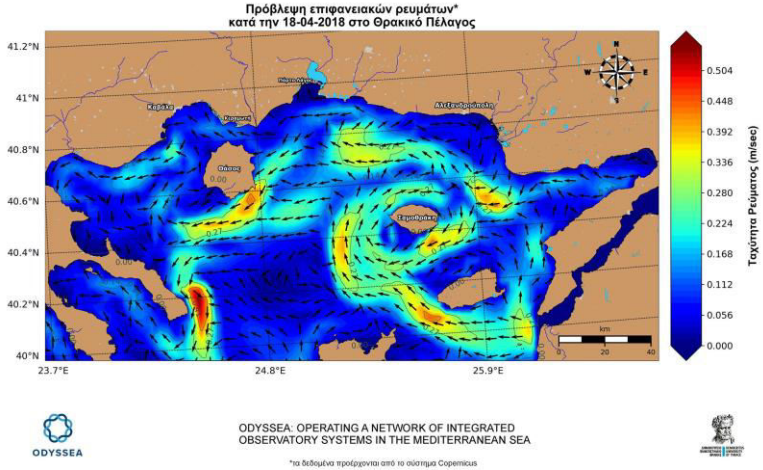
ODYSSEA

Table 1: Potential end-user groups per ODYSSEA Observatory, as identified in Deliverable 2.1	
ODYSSEA observatory name	**Potential end-users**
North Aegean/Thracian Sea Observatory (Greece)	Fish and mussel farms; Port authorities; oil and gas industry; Cruise companies; touristic industry (hotels, yachts).
Gulf of Gökova Observatory (Turkey)	Cruise companies; ferries to Greece; fishing and sponge diving; recreational fishing, tourism (hotels, yachts).
Valencia's regional coastline Observatory (Spain)	Cargo and Cruise companies, ferries, fishery communities, tourism (hotels, yachts), local authorities.
Northern Adriatic Sea (NAS) basin Observatory (Italy)	Industry, wetlands management bodies, fishermen, fish and mussel farmers.
Gulf of Arzew/Stora Bay Observatory (Algeria)	Petrochemical industry, LNG terminal, Chlorine industry, cargo and ferry companies, fisheries, aquaculture.
Gulf of Gabes Observatory (Tunisia)	Dredging activities, fisheries, oil and gas platforms, port authorities, aquaculture, mussel farms.
National Park of Al-Hoceima (PNAH) Observatory (Morocco)	Port authority, fish farms, mussel farms, marine protected area management body.
Israel Coastal Observatory (Israel)	Port authorities, oil and coal terminals, offshore gas extraction, desalination and power plants, sand mining, marine farms, tourism.
Nile River Region of Freshwater Influence Observatory (Egypt)	Port authorities, oil and coal terminals, desalination and power plants, sand mining, marine farms, tourism.

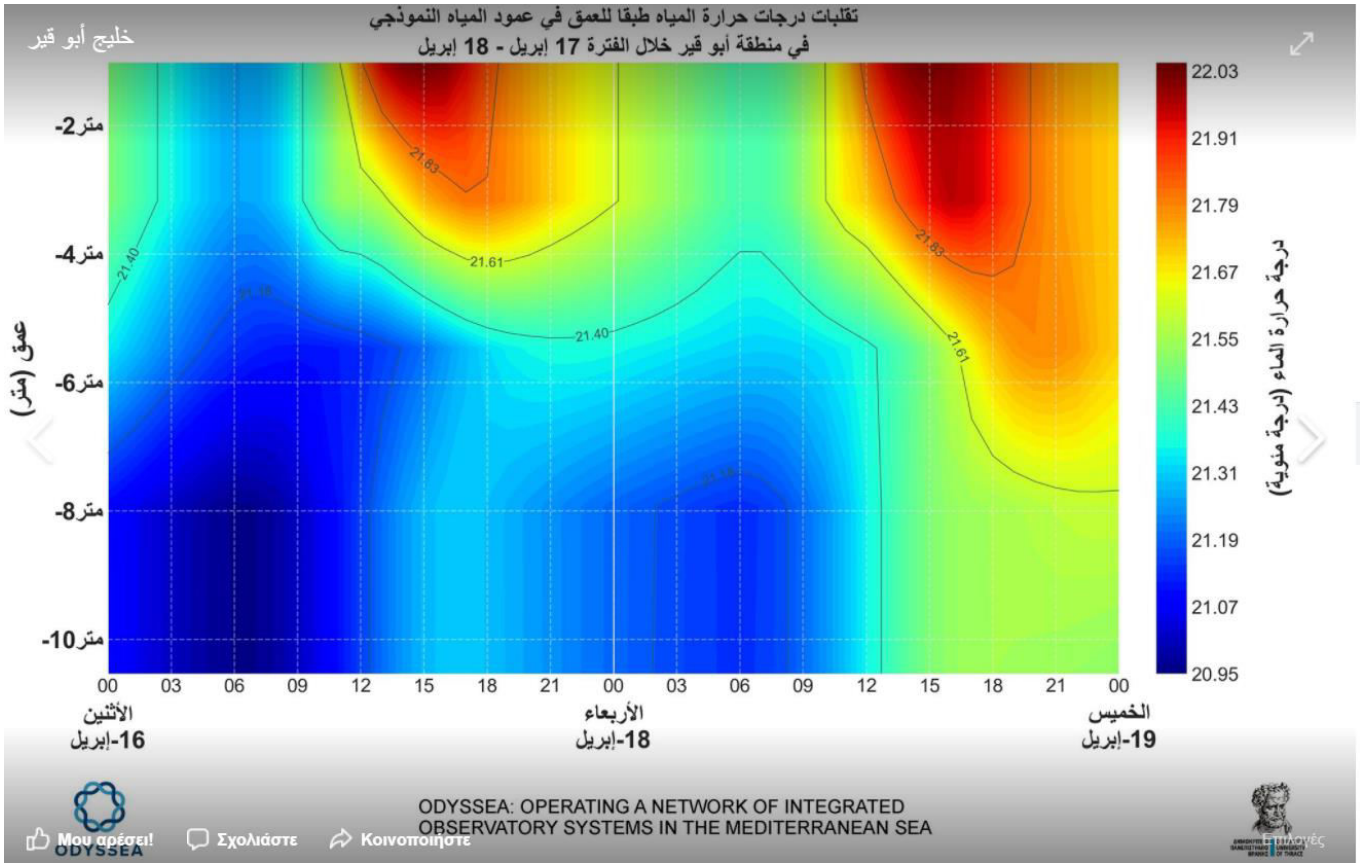
ODYSSEA - Greece







ODYSSEA - Egypt



Capacity Building

Improve professional skills and competences - focus on Northern Africa capacity building

ODYSSEA will:

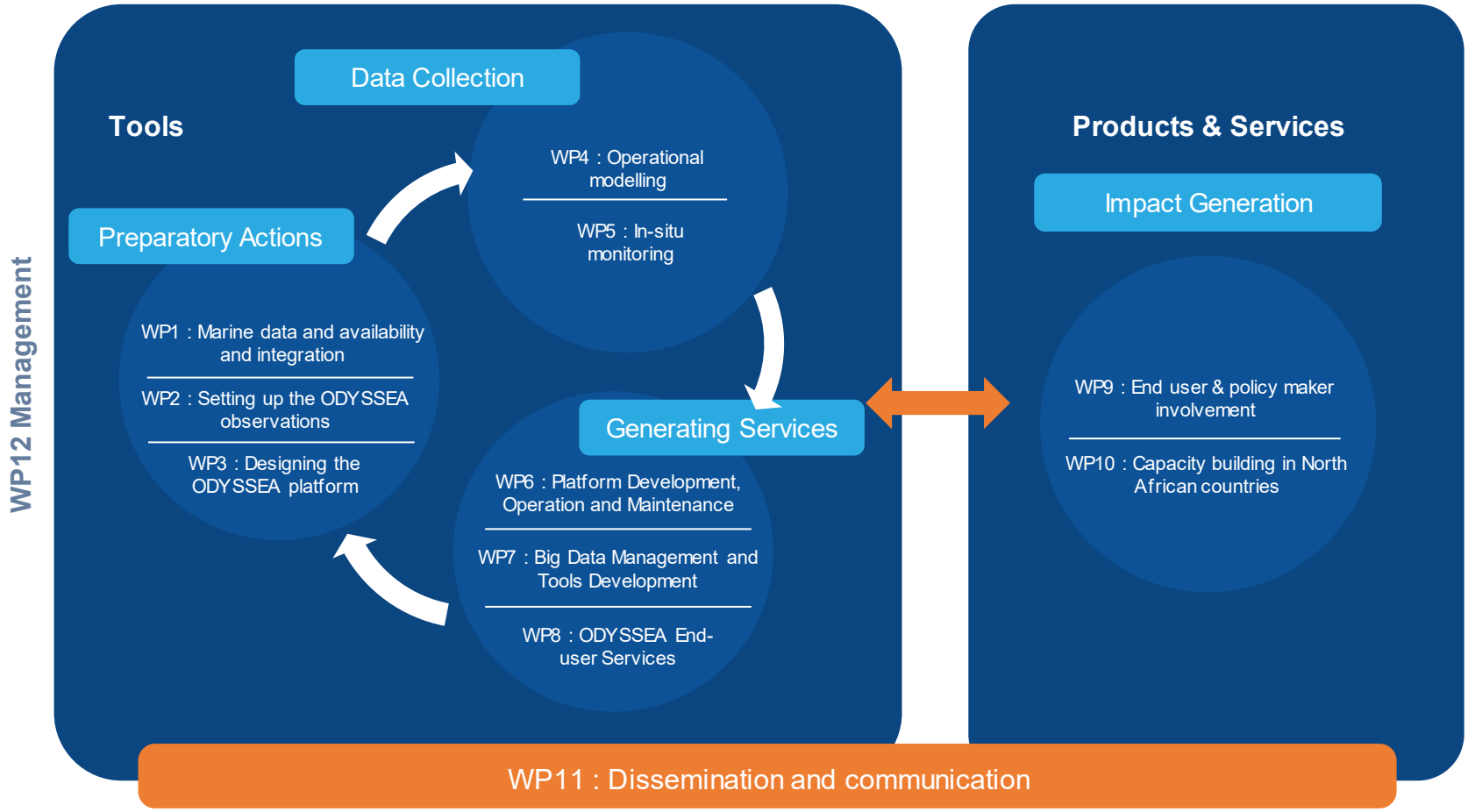
- Improve professional skills on environmental modeling,
- Link environmental technologies to marine policies and legislation
- Support tertiary education, transfer of technologies and knowledge for new and qualified **"jobs of the sea"**

1st ODYSSEA Summer School – 3-13/9/2018

ODYSSEA

Operational Oceanography for Science, Business and Society

The ODYSSEA Work Plan



Contribution to Europe 2020 Strategy

ODYSSEA

- Reducing operational costs and delays for those who use marine data
  - helping private industry compete in the global economy and meet the challenge of sustainability;
  - improving the quality of public decision-making at all levels;
  - strengthening marine scientific research
- Increasing competition & innovation amongst (re-)users of marine data by providing wider access to quality-checked, rapidly-available & coherent marine data
- Reducing uncertainty in knowledge of the Med Sea and so providing a sounder basis for managing future changes

Contribution to BLUEMED

ODYSSEA

- Provide a Med Sea Integrated Observing system as a component for GEOSS
- Contribute to increasing the temporal and geographic coverage of observational data in the Mediterranean Sea and identify observational gaps
- Provide qualified data to improve the predictive capacity of model products and improve the cost effectiveness of data collection
- Improve the knowledge base that is needed in order to cope with global challenges to make better-informed decisions within key sectors
- Improve the implementation of European maritime and environmental policies and international agreements
- Improve the professional skills and competences of those working and being trained to work within the blue economy

ODYSSEA for gSDG indices

ODYSSEA

- 14.1.1 Prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
- 14.2.1 Sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts
- 14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stations
- 14.4.1 Proportion of fish stocks within biologically sustainable levels
- 14.5.1 Coverage of protected areas in relation to marine areas
- 14.a Increase scientific knowledge, develop research capacity and transfer marine technology in developing countries

Work Done

ODYSSEA

- Preparatory phase almost completed
- Phase A established the foundation of project
- Phase A described process, identified problems, explored solutions
- Existing data sources review, Platform design, Models configuration, explore interfaces to operationally couple models, sensors design

Work Done

ODYSSEA

- All deliverables in all WPs were submitted on time – no delays experienced so far
- Strong collaboration among WP-leaders and partners in all WPs
- Commitment from task leaders and partners

Work Done

ODYSSEA

- Ethics Processes & Guidelines (D1.1)
- Inventory for Data sources (platforms, data sources, models, satellite data, etc) in Med - Identified data gaps – Compiled a Data Gaps Inventory (D13.1)
- Post-processing procedures to data analysis (D13.2)
- Legal documents for data multi-use and collaboration agreements between Observatory managers and end-users (D13.3)

Work Done

ODYSSEA

- Produced a guide on how to set-up, operate and maintain a marine Observatory (D2.1)
- Users at each Observatory were identified – 128 user cases for marine data needs were compiled (D2.2)
- Modeling – Models and Interfaces for operational forecasting were reviewed (D2.3)
- Monitoring – Sensors technical specifications were defined (D2.4)

Work Done

ODYSSEA

- ODYSSEA platform architecture was designed (D3.1) – set a deadline for v0 (July18)
- Data management plan – type, format, access, processing, storage, QA/QC, transfer (D3.2)
- Initial algorithms on sample data (D7.2)
- Stakeholders workshop
- Training workshop on FEWS and Aquasafe
- Summer School in Kavala, Sept 2018
- Training of Observatory Managers

Work Done

ODYSSEA

- Models – Comparative test (Aquasafe vs Delft FEWS)
- Sensors development – integration MPS on glider and MSL
- ODYSSEA v0 is in operation – bugs identified and solved – moving towards V1
- Business cases were identified – Business board – entrepreneurial model
- Communication flow – posts, tweets, articles, publications
- Active fb community

Challenges ahead

ODYSSEA

- Next 18 months - the most challenging period for ODYSSEA
- All individual systems should be prepared, assembled and ready to operate
- Models should be ready for operational use
- Sensors should be deployed and start receiving data
- Platform should be upgraded to receive inputs from models and sensors
- Observatory managers should be active
- Training of technical staff

Next steps for Observatories

ODYSSEA

- Period 2 is the Observatories Period
- Observatory managers have a crucial role to play
- Finalize the deployment of sensors
  - define end-user,
  - obtain licenses,
  - solve logistics,
  - follow training,
  - help Develogic and Alseamar to deploy
- Operate the models

Next steps for Observatories

ODYSSEA

- Connect with end-users
  - Find potential users
  - Understand their needs in marine data
  - Present the platform
  - Receive comments
  - Provide feedback
  - Act as ‘sales representative’

Next steps for Platform

ODYSSEA

- Period 2 is the Platform v1-2 Period
- Resolve all bugs from v0
- Increase data sources, platforms
- Enrich with diverse data (physical, biological, geological, biodiversity, fisheries, etc.)

Next steps for Platform

ODYSSEA

- Receive data from models and sensors
- Integrate algorithms for services and products
- Develop one dashboard per sector
- Test platform transferability to DIAS - Dockers
- Make the system ‘salable’

Next steps for Models

ODYSSEA

- Integrate all models in the 'ODYSSEA modeling chain'
- Delayed on SWAN and DELWAQ
- Calibrate models with sensors and satellites
- Resolve issues on data storage
- Assimilate data from sensors
- Transfer data to platform
- Focus on points of interest for users

Next steps for Sensors

ODYSSEA

- Test the Micro-Plastics Sensor in Action
- Train Observatory technical managers
- Deploy systems at Observatories
- Receive data from field, QA/QC on data, transfer data to platform and models

Next steps for Algorithms

ODYSSEA

- Specify services and products to end-users
- Develop user-specific algorithms
- Integrate data from models and sensors
- Industrialize algorithms
- Integrate algorithms to platform
- Test algorithms performance
- Provide alarms and alerts

Next steps on User Engagement

ODYSSEA

- Showcase the platform
- Understand users needs for marine data
- Promote services and products
- Publicize users collaboration
- Receive feedback
- Seek for potential investors on Blue Economy
- Organize training sessions for young scientists

ODYSSEA Management

- Management Board – convenes weekly
- Innovation board – convenes monthly
- Dissemination board – convenes monthly
- Regular monthly WP meetings – Task leaders and partners all present

ODYSSEA Consortium

- **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)

Creating products and knowledge
for the Mediterranean

ODYSSEA

THANK-YOU

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