INTRODUCTION TO ODYSSEA PROJECT, ITS PLATFORM AND MODELS

CONTRIBUTION TO BWM CONVENTION IMPLEMENTATION

Webinar on the implementation of the International Convention for the Control and Management of Ships' Ballast Water and Sediments in the Mediterranean region

Prof. Georgios SYLAIOS
Democritus University of Thrace
gsylaios@env.duth.gr

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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
Horizon 2020

Horizon 2020 is the biggest EU Research and Innovation program ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract.

Achievements: scientific breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.
The EU Blue Growth Strategy

- Long term strategy to support sustainable growth in the **MARINE** and **MARITIME** sectors as a whole.

- Leads to achieving the Europe 2020 Strategy for Smart, Inclusive and Sustainable Growth.

- Recognizes that seas and oceans have great potential for innovation and growth.

- Considers the blue economy as a driver for Europe's welfare and prosperity.

- **KEY ISSUES: Jobs and Sustainability**
Marine Open Data

EMODnet
European Marine Observation and Data Network

NOAA
US Department of Commerce

NASA

JAXA

ECMWF

Copernicus
Europe's eyes on Earth

USGS
Science for a changing world

OneGeology

AquaMaps

BODC
British Oceanographic Data Centre

EuroArgo

JRC
European Commission

EuroCOCO

EMSO
European Research Infrastructure Consortium

Geobathymetric Chart of the Oceans

GECO

SeaDataNet

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Data to Information

Water Temperature is 28°C

If Water Temperature is higher than 26°C for more than 5 days then ‘HEAT STRESS’

High probability of fish mortality
Data to Information

Data → Knowledge Models → Information → Informed Decisions

Current time

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Sustainability

Business strategy to provide end-user services and ensure long-term sustainability

Global and regional data and models results providers

Local data and models results providers

Crowd Sourcing

Real time operational services

Studies

Crowd Sourcing

Real time operational services

Studies

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ODYSSEA 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.
• Novel, easy to use
• Integrate, aggregate, expose data from existing systems

• Development and integration of novel sensors
• Emerging pollutants as microplastics

• Develop of well-defined products and services to end-users
• Modern algorithms on Big Data analysis (AI, ML) will be used

• Coupling and linking a set of operational numerical models
• Use of existing tools and interfaces

ODYSSEA Pillars
What is ODYSSEA?

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’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 Platform v0.8

Static and Mobile Sensors – Mediterranean Sea
ODYSSEA Platform v0.8

Tidal Sea Level Variability – Mediterranean Sea
ODYSSEA Platform v0.8
Surface Water Temperature – Mediterranean Sea
ODYSSEA Platform v0.8

Surface Currents – Mediterranean Sea
ODYSSEA Platform v0.8

Significant Wave Height – Mediterranean Sea
ODYSSEA Platform v0.8

Wind Field – Mediterranean Sea
ODYSSEA Platform v0.8

High Resolution Water Quality Models – Morocco and Israel

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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
ODYSSEA focuses on biological data integration

- Connect to existing platforms with open, reliable biological data at Mediterranean scale
- Develop new biological datasets at ODYSSEA Observatories
- Integrate biological dimension on the Monitoring module of ODYSSEA Observatories
- Develop/use existing marine biological models (e.g., Ecopath and Ecomap)
- Include the human impact (e.g., fisheries)
- Provide stock assessment recommendations per stock and per area
- Foster the ecosystem assessments, forecasts, scenarios and a deeper understanding of vulnerability, risks and interventions at local and regional levels
Seagrass detection in the Mediterranean: A supervised learning approach

Dimitrios Effrosynidis\textsuperscript{a,}* , Avi Arampatzis\textsuperscript{a} , Georgios Sylaios\textsuperscript{b}

\textsuperscript{a} Database & Information Retrieval research unit, Department of Electrical & Computer Engineering, Democritus University of Thrace, Xanthi 67100, Greece
\textsuperscript{b} Lab of Ecological Engineering & Technology, Department of Environmental Engineering, Democritus University of Thrace, Xanthi 67100, Greece

\begin{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-\(a\) levels and Distance-to-Coast. For determining family, variables cannot be easily singled out; several different variables seem to be of importance, with Chlorophyll-\(a\) 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 \textit{Cymodocea} and \textit{Posidonia} favor the low, limited-range chlorophyll-\(a\) levels (< 0.5 mg/m\(^3\)), \textit{Halophila} tolerates higher salinities (> 39), while \textit{Ruppia} prefers euryhaline conditions (37.5–39).
\end{abstract}
Fig. 9. Distribution of Chlorophyll-α-December values per seagrass family.

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

Engraulis Encrasicoles Distribution

- Temperature
- Salinity
- Dissolved Oxygen
- Zonal Current
- Meridional Current
- Euphotic Depth
- Chlorophyll
- Secchi Disk Depth
- Bathymetry
- Rivers Distance from Start
- Rivers Distance from End
- Wave Height
Apply AI and ML tools for Species Distribution Models
ODYSSEA is a high-resolution marine information system for the Mediterranean Sea which combines abiotic and biological datasets.

It can aid the BWM Convention Implementation by cooperating with Port Authorities and Shipping Companies to provide a service in line with the requirements of the Ballast Water Convention. More specifically:

1. Developing customized operational high resolution water quality and ballast water dispersion models for specific ports;
2. Develop tools for AIS early detection and control;
3. Employ AI and ML tools to distinguish “natural” Alien Invasive Species from “Ballast-related” AIS
4. Utilize existing datasets to produce risk assessment tools following the HELCOM/OSPAR algorithm – assess the risk associated with the discharge of ballast water by a ship at a specific port.
The process - What will players do to comply

- Analyse the data **to be collected by the ports**
- Transfer data to ODYSSEA platform **to be analysed by ODYSSEA experts**
- Cluster ports according to their physicochemical and ecological characteristics **to be developed by ODYSSEA experts**
- Run models, tools and risk assessments to produce reports on ship vessels **to be carried out by ODYSSEA Algorithms**
- Based on risk assessment produce or prohibit exemption certificate **to be carried out by Maritime Administrations**
Creating products and knowledge for the Mediterranean

Thank-you

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