NAUTILOS

Summer School – Course Content

17th – 19th April 2024

The Nautilos Summer School offers a three-day program for early career scientists, marine specialists and experts interested in marine litter science. During the summer school the latest developments concerning marine litter including international treaties, measuring technologies, sensors and possibilities for citizen science will be covered. The course will include hands-on training on several newly developed sensor and measuring systems developed within the Nautilos project and synergetic initiatives. The summer school will be hosted at the Hellenic Centre for Marine Research (HCMR) at Gournes (Heraklion, Crete), including possibilities to test equipment at sea. The course will include lectures, discussions, practical demonstrations and measurements, and interpretation of marine data.

The course consists of 3 blocks starting with a description of marine litter legislation including detailed information on the UN Global Treaty on Plastic Pollution and the need for monitoring activities, as well as an in-depth presentation of sensors. The second day is devoted to citizen science. The 3rd block highlights synergies, data management and hands-on experience on board a scientific vessel.

NAUTILOS

Agenda

Day	Time	Title	Duration (min)
Wednesday, 17 April 2024	10:00	Introduction	15
		Observing the ocean: needs, gaps and technological challenges	60
		Marine Litter Legislation	60
		Active Acoustic Profiling Sensor	90
		Monitoring methods for plastic pollution in the marine environment technology/techniques	60
		Fluorometric Oxygen Sensor	60
		Underwater Broadband Sound Recorder	60
	18:15	*End of the day*	
		Free evening	
Thursday, 18 April 2024	09:00	NIVA Sensors (NIR scanner/camera, Carbonate system, Above Water Radiometry)	60
		Citizen Science App	45
		Tracking our own trash: following the dispersal of floating litter from the Arno river using open source technology and a citizen science based approach	60
		Citizen Science in practice - the power of collective intelligence. This interactive workshop will delve into the fascinating realm of citizen science, where ordinary individuals play a crucial role in scientific research and data collection	60
		Adopt a dune project	60
		Citizen Science in Practice/Beach Cleanup - NIR Scanner + Camera - CS App	180
	18:15	*End of the day*	
		Social Dinner	
Friday, 19 April 2024	09:00	Data Crackathon	60
		TechOCEANS	30
		CLAIM	60
		Deep-ocean low-level radioactivity sensor	30
		Best Practices for ocean sensors/platforms	30
		Hands on Experience/Vessel demo	180
	17:15	*End of the day*	
		Free evening	

Day 1

Observing the ocean: needs, gaps and technological challenges (Stefania Sparnocchia (CNR-ISMAR), 60 min, Theory)

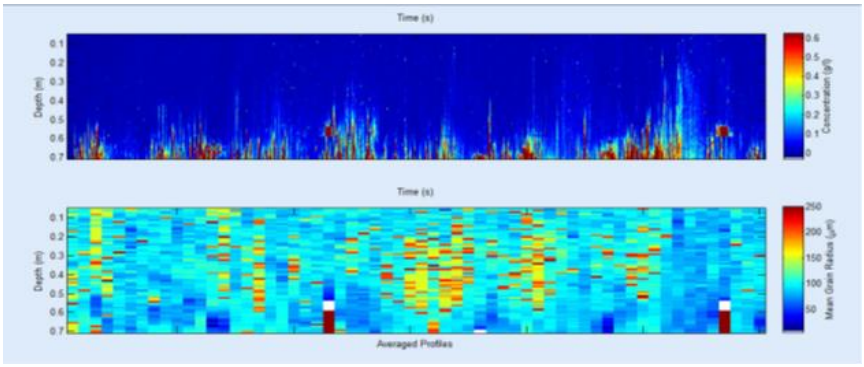
Sustainable, multidisciplinary, efficient, and fit-for-purpose marine observation is indispensable to develop the knowledge needed to support ocean and blue growth research, as well as political and societal needs. However, collecting measurements in the vast ocean is not easy and comes with costs and challenges. Despite decades of progress in ocean monitoring and the continuous development of advanced marine observing technologies, there are still significant gaps when it comes to getting data with the spatial and temporal resolution necessary to follow and understand complex processes and changes in rapid evolution. This is especially true in complex crosscutting domains like biogeochemistry, biology, and ecosystems.
The present session will review the political and societal drivers of ocean observation, highlighting how these are addressed by the scientific community in a common framework that involves the acquisition of information relating to essential ocean variables employing a collaborative approach and networked marine observing infrastructure coordinated at global and European levels. Finally, the contribution and potential of NAUTILOS will be discussed in the context of the emerging trends currently characterizing technological development in the specific field of ocean observing.

Marine Litter Legislation (George Triantaphyllidis (HCMR), 60 min, Theory)

The Marine Strategy Framework Directive (MSFD) is central to the EU's efforts in protecting its marine environment. To achieve a good environmental status, the Directive aims to safeguard marine resources essential for economic activities. Practical documents like the recent Guidance on Monitoring Marine Litter in European Seas (Galgani et al., 2023) [1] support the MSFD's implementation effectively.
Data from initiatives like the European Marine Observation and Data Network (EMODnet) aid in assessing progress towards MSFD, EU Plastics Strategy, and Zero Pollution Action Plan goals. EMODnet enhances data accessibility, crucial for combating litter pollution.
EU legislation, such as measures against single-use plastics and regulations on waste collection from ships, contributes significantly to reducing marine pollution. The 2023 monitoring guidance aligns with global efforts, supporting UN negotiations on plastic pollution.
Key legislative measures addressing plastic pollution include the Plastic Bags Directive, Single-Use Plastics Directive, Circular Economy Action Plan, Plastics Strategy, Directive on Port Reception Facilities for Waste from Ships, Water Framework Directive, and Bans on Microplastics.
The Urban Wastewater Treatment Directive, in force for over 30 years, has improved water quality but needs updating to address remaining pollution.

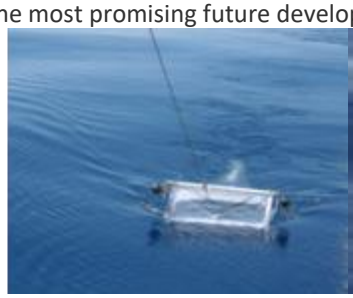
Active Acoustic Profiling Sensor (Andy Smerdon (Aquatec), 90 min, Theory and Demonstration)

The new evolution of Aquatec's AQUAscat acoustic sediment profiler instrument has been developed for the NAUTILOS project and will be adapted for integration into a seabed lander and a deep-water mooring. The high frequency active acoustic profiling sensor, based on Aquatec's next generation AQUAscat technology, transmits beams of ultrasound at various frequencies and detects the scattered signal from suspended material. The instrument has applications in identifying and potentially quantifying zooplankton biomass abundance and distribution, ice crystals, oil droplets, and organic and inorganic sediment. It also has the capability to measure particle dynamics such as settling velocity and turbulence.
During the course we will describe the principle of operation of the instruments and illustrate the capability of the technique using real-world datasets.



Monitoring methods for plastic pollution in the marine environment technology/techniques (Giuseppe Suaria (ISMAR-CNR)/Dr. Jana Fahning(SubCTech), 60 min, Theory)

Plastic pollution is now considered a global environmental and societal concern. Numerous protocols have been developed to monitor plastic debris, but these are rarely comparable. This is hindering the gathering of knowledge regarding pollution sources, development of monitoring programmes and risk assessments and implementation of mitigation measures. To develop long-term solutions, it is essential to develop harmonised, reliable and reproducible monitoring technologies. While several innovative methods are being developed, due to the intrinsic complexity and heterogeneity of these emerging pollutants, automatic monitoring of plastic pollution remains a difficult task. This session will review the state-of-the-art of macro and microplastic monitoring systems in the marine environment, with particular emphasis on the description of the main challenges encountered and on the most promising future developments in this exciting field of research.

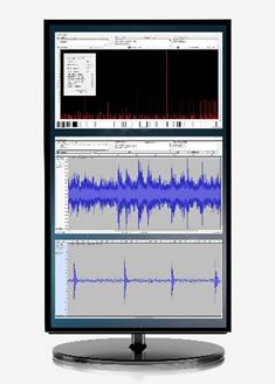


Fluorometric Oxygen Sensor (Marco Mazza (HES-SO), 60 min, Theory)

Fluorescence intensity analyses are subject to many drawbacks due to the variability of the fluorescence emission process with several factors such as: ambient light interference, variability of the fluorophore concentration and efficacy, drift in optical path length, etc. Measure of the fluorescence lifetime presents more robustness to these factors, since it is related to a physical constant of the fluorophore, unfortunately requires quite a high precision in terms of time resolution which is in the order of tens or hundreds of picoseconds. New commercial Time-to-Digital Converters (TDC) allows nowadays to deal with such orders of magnitude and at HES-SO, we successfully developed a low-cost, compact, oxygen sensor based on such principle for new-born calorimetry monitoring. Optical dissolved oxygen sensors,based on fluorescence quenching, are more attractive than conventional amperometric devices, because of their considerably faster response time, do not consume oxygen and are not easily poisoned.

Underwater Broadband Sound Recorder (Ivan Alonso (Aquatec), 60 Min, Theory)

A new Passive Broadband Sound and Click Recorder has been developed for the NAUTILOS project. This device is a completely new technological development of a Passive Acoustic Envelope Recorder designated to observe echo-locating marine mammals. It is combined with a 150kHz bandwidth sound recorder that captures the full wave form of frequency-modulated whale clicks, broadband dolphin clicks and narrow-band high frequency porpoise-like clicks, as well as dolphin communication whistle sounds, which will allow for better species classification.
In parallel, the broadband recorder is intended to address the needs of underwater soundscape observations, including the study of sea ice dynamics, detection of seismic events, and monitoring of acoustic impact of different human activities across a wide range of water environments.
The project includes the design and development of a custom-made hydrophone with a flat frequency response over the full recording bandwidth.
Building both instruments on one configurable electronics platform provides a common architecture with simplified firmware and hardware. The design covers all aspects in terms of deployment, data uploading and post-processing with a user-friendly software.
The new system is tested with dolphins and porpoises in controlled conditions at Kolmarden Dolphinarium, Sweden, and the Fjord&Belt Centre, Denmark, respectively, as well as in the field in Swedish and Danish waters, mainly targeting harbour porpoises.
The course will include analysis of datasets from both natural soundscapes and harbour porpoise populations.

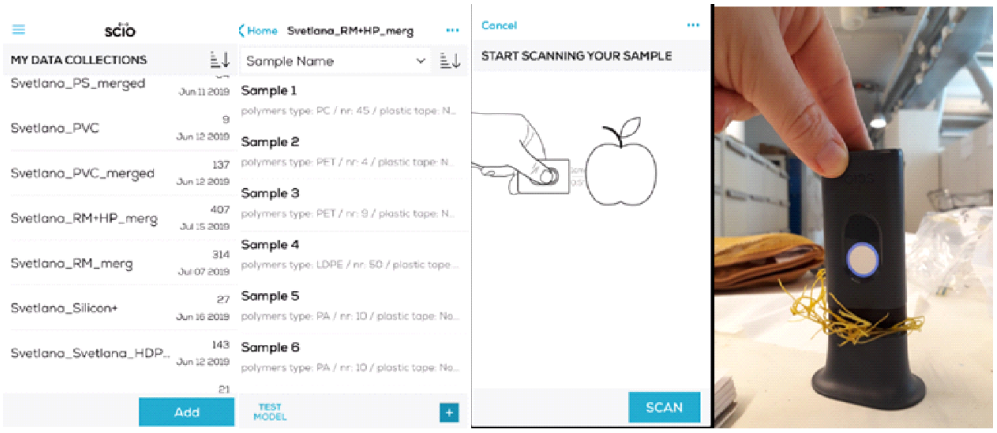


----------End of First Day----------

Day 2

Near Infrared Scanner (NIR) (Sabine Marty, Andrew Luke King (NIVA, 15 min, Theory)

The Nautilos project has developed a smartphone near infrared (NIR) scanner for citizen science applications to use as a tool for more detailed source identification of marine litter. The NIR Scanner can be connected by Bluetooth to a smartphone where we have used the SCiO software to build up a database of more than 400 consumer plastic items. This way the polymer type of plastic fragments can be identified specifically where other identification is not possible. The scanner is especially suited for reporting of macro and meso-litter (2.5 cm – 5 mm) which are often mistaken for food by marine species.



During the course we will demonstrate the smartphone NIR scanner and use it for identification of marine litter that will be collected during the course around Crete.

MicroNIR Camera Dr. (Sabine Marty, Andrew Luke King (NIVA, 15 min, Theory)

A simple method to detect polymer type was developed using a portable NIR spectrometer (MicroNIR) for identification of marine plastic litter down to the microplastic size range (1 mm). The MicroNIR is directly connected to the USB port of any laptop or tablet that has software with a developed identification method installed. The created database of polymer spectra comprised the nine most commonly produced and most frequently reported polymer types in the marine environment. The method for identification of marine plastic litter with MicroNIR is a fast, easy and efficient low-cost method that can be used in the field, and it does not need qualified personnel to operate it. In this way, plastic identification with MicroNIR is very well suited to support 'Citizen Science' projects. The development of a handheld easy to use NIR camera for the identification of polymers in the meso- and micro range (> 1 mm) could also play a major role in gathering more reliable data for identification of pollution source and subsequent mitigation of plastic and litter pollution to the environment. During the course we will demonstrate the MicroNIR camera and use it for identification of marine litter and microplastics (> 1 mm) that will be collected during the course around Crete.

Above Water Radiometry (Sabine Marty, Andrew Luke King (NIVA, 15 min, Theory)

Above water radiometry enables remote measurement of the water components, such as phytoplankton, dissolved organic matter or inorganic particles concentrations, from the light coming from the ocean, providing crucial insights on primary production and water quality. The lecture will include theoretical introduction to ocean color, radiometry, remote sensing, calibration, and use of instruments including multispectral and hyperspectral cameras used within Nautilos, as well as specific theory for deployments of radiometric instruments from drones such as flight planification with regulations aspect, maintenance and day-to day running of the drone operations, and data processing using PIX4d. The students will have the opportunity to familiarize themselves with the cameras and drones and software during a hands- on session and test their skills on piloting drones.

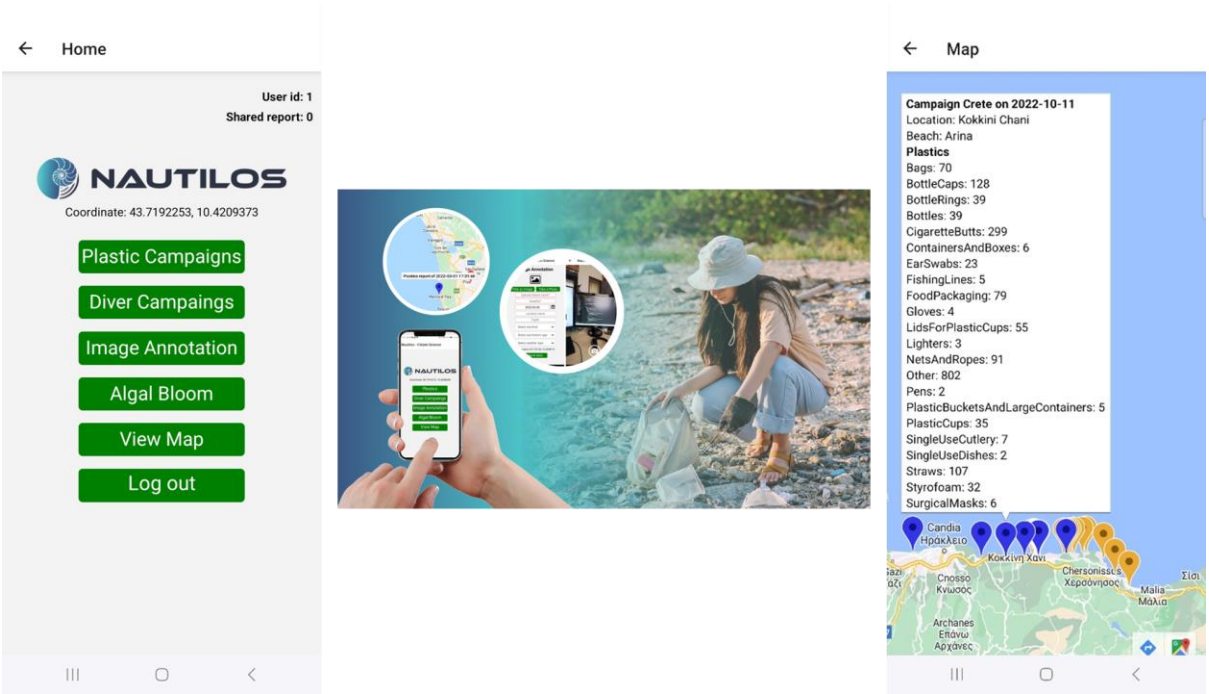
Carbonate Systems (Sabine Marty, Andrew Luke King (NIVA, 15 min, Theory)

Carbonate system/ocean acidification variables are included in the essential ocean variable of inorganic carbon and are important for various oceanic biological and geochemical processes, including photosynthesis, calcification, and the atmospheric uptake (or outgassing) of carbon dioxide (including anthropogenic carbon dioxide). In NAUTILOS, we have carried out further development of commercial off-the-shelf sensors (COTS) for measuring seawater pH (concentration of hydrogen ion) and pCO2 (partial pressure of carbon dioxide) with the aim of reducing cost, providing a modular approach for integration with multiple ocean observing platforms, increasing user-friendliness, and widening the use of these sensors within the research and applied/citizen science communities (for example, avoiding the need for manufacturer calibration), while still measuring pH and pCO2 with accuracy and precision that is environmentally relevant and meaningful. This module of the summer

school will introduce the topic of the ocean carbonate system, ocean acidification, and how the NAUTILOS-developed sensors will be demonstrated and used in the future.

Citizen Science App (Marco Tampucci (CNR /ISMAR), Gabriele Pieri (CNR/ISMAR), 45 min, Theory)

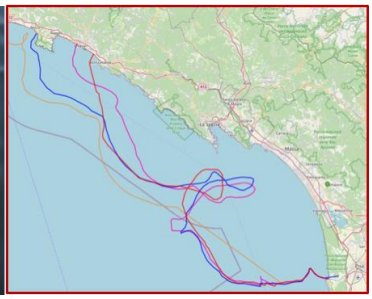
The Citizen Science dedicated App is one of the tools that has been designed, implemented, and integrated into the NAUTILOS data infrastructure. It has been designed and developed to support the various CS activities performed in the ambits of NAUTILOS project and it allows the uploading of data gathered during various Citizen Science campaigns. Data acquisition, management, and visualization work as a common entry-point to operate as a bridge towards NAUTILOS data infrastructure, with which they are fully integrated.
The application is designed to provide two main usages: storing and visualisation.
The storing covers four types of possible campaigns: (i) Plastic Campaigns, (ii) Diver campaigns, (iii) Image Annotation and (iv) Algal bloom; on the other hand, the visualisation (View Map) allows to view previous sent data. Each section can be accessed directly from the main page by simply pressing the dedicated button.
The application is also devoted to the promotion of data sharing, indeed, the application follows European Marine Observation and Data Network (EMODnet) guidelines in order to produce data integrable inside EMODnet data aggregator. These guidelines specify which fields are mandatory and, if applicable, the list of accepted values. Such feature is currently available only for Plastic Campaigns that are regularly submitted to EMODnet.



Tracking our own trash: following the dispersal of floating litter from the Arno river using open source technology and a citizen science based approach (Silvia Merlino (ISMAR-CNR), 60, min, Theory and Group Discussion)

The Marine LItter Trackers (MLT) project has, from the very beginning, had a special connotation, namely that of being a scientific research project supported by citizen science. This does not mean that its only goal is to collect as much (verified and controlled) data as possible, but also to actively involve citizens in order to bring them closer to the issues addressed. In this specific case, the issue is one of those most in the media limelight as it addresses a major current problem, that of marine litter (ML) dispersal. The idea of having citizens participate in our scientific investigations of marine litter dispersal and beach accumulation of ML (especially plastic ML)

stems from the conviction that such an approach will produce greater interest in this problem from those directly involved.
This applies, all the more so, to the younger generation, hence the idea of implementing a PCTO within a high school, where the awareness aspect is also associated with education, both scientific and environmental. The school involved is, in this case, IIS Capellini - Sauro in La Spezia, which participates with four classes of about 20/25 pupils each. The classes belong to different addresses, namely the "electronic/computer" and "chemical" addresses. The PCTO programming took place from January 2022 to May 2022, and was divided into consisted of several steps:
- a general lecture, divided into two parts: the first on the problem of marine litter, and the survey methodologies according to the issues of interest: monitoring at sea and on the beach, methodologies in use, use of technological tools (drones, satellites); the second on the methodologies currently used in the field of physical oceanography for the study of marine currents, and thus the role of drifters and that of Lagrangian modeling.
- one particular lecture dedicated to explaining the specific purpose of the ML-DAR project and the operational characteristics: what is the novelty of our approach; how MLT drifters were designed and what technologies they use; what we have already achieved and what we expect to achieve with the construction and implementation of the final experiment, thanks to the contribution of MLTs and models.
- four specific laboratories, dedicated to each of the fields of study (chemistry and electronics/computer science) of the school involved.
During the labs, students from the electronics address acquired skills on the management of the MADUINO SIM 808 board and devoted themselves to the wiring of the entire system where the charging circuit, battery and solar panel were also present. The students from the computer science address acquired skills on programming the MADUINO SIM 808 BOARD, managed and processed the software and proceeded to the programming of the same board.
Students from the chemistry address dealt with the selection of marine litters subject to the integration of the electronic device. In particular, they studied how to insert the device into wooden bottles and tablets, the bonding of the different parts of their watertight sealing for the duration of the experiment. They tested different materials and conducted tank experiments to evaluate hydrodynamic stability and effectiveness of the sealing.
At the end of these differentiated paths, students conducted a joint integration and final testing activity.
- students and teachers from the different addresses collaborated with the researchers involved in the assembly phase of the different parts in order to produce a number of MLTs (about fifteen in total).
- Finally, thanks to the collaboration of the CNeS - Nautical and Diving Center of the La Spezia State Police, students participated in the launch of the SMART DRIFTERS, which was carried out in May 2022 from the mouth of the Arno River, as with previous launch-tests.
The students were then able to follow the progress of the experiment in the following days, by means of the specific web app developed by us, and accessible at http://infomap.altervista.org, where, with appropriate accounts and passwords for access, it is possible to view in real time the routes followed by the different MLTs, as well as change the time interval between one data transmission and the next, monitor the state of charge of the devices' batteries (supported by photovoltaic panels) and other functions.

The project served to test this new type of devices, which are easy to build and inexpensive, as replacements for the much more expensive oceanographic drifters, in the specific case of studying the dispersion of marine litter at sea. The citizen science experience demonstrated how it is possible to carry out dispersion experiments with the help of citizens (in this case, even high school students), collect useful data (the experience was followed by two relevant scientific publications), and at the same time involve and motivate people, bringing them actively closer to an issue such as marine pollution. The further involvement of the police and citizens who helped us in placing the MLTs in the sea and retrieving them once they were beached, is an additional factor in actively co-involving citizenship.

Citizen Science in practice - the power of collective intelligence. This interactive workshop will delve into the fascinating realm of citizen science, where ordinary individuals play a crucial role in scientific research and data collection (Valeria Pizziol (ETT), 60, min, Theory)

In this summer school session, we invite you to explore the world of citizen science and discover the power of collective intelligence. This interactive hands-on workshop will delve into the fascinating realm of citizen science, where ordinary individuals play a crucial role in scientific research and data collection. Through hands-on demonstrations and interactive discussions, you will learn about the various applications of low-cost sensors in citizen science projects, from tracking water quality and air pollution to monitoring biodiversity and climate patterns. We will discuss the significance of harnessing community-driven efforts to tackle global challenges and foster a sense of environmental stewardship.

Adopt a dune project (Silvia Merlino (ISMAR-CNR), 60 min, Theory)

Sand dunes are often part of the coastal landscape. They are fascinating formations but also fragile natural habitats that suffer from human impact. They often play an important role in coastal erosion management and record some precursor signs of it. That is why efforts are being made around the world to protect them. Human activities can severely damage dune ecosystems, and in some cases stabilization through vegetation or man-made structures is essential, actions that are also decisive in preventing coastal erosion. Dune restoration projects often include removal of invasive species and replanting of native plants to help stabilize sandbars and promote biodiversity. Many countries have designated dune and sandy areas as protected sites to preserve their unique ecosystems and prevent further damage from human intervention.
The "Adopt a Dune" project aims to bring students (in this case, high school students) closer to the study of coastal areas in their areas, with a focus on dunes and everything that revolves around that ecosystem. Using the tool of citizen science, we involve students in real monitoring activities and useful data collection, following for a period of two years the evolution of a small coastal area removed from tourist exploitation and included within the MonteMarcello Magra Park since a few years.
Thus is followed and monitored the slow re-naturalization of the area, the growth of the dunes (present in the area before the massive atropization of the territory), the repopulation by native plants (some introduced by us re), and the soil stratifications are stripped by means of core drills. Marine litter pollution is also monitored, through periodic sampling and grading of the anthropogenic material accumulated there.
Periodic monitoring is implemented in two ways: by hand directly in the field and with the help of a drone that acquires images of the areal. Students were previously given a brief course of how a drone can be used for scientific purposes and how to plan transects, image acquisition, and especially what to do in the post processing phase. In the final months of the project, students will analyze the collected images to extract information about

the distribution of vegetation over time, the dynamics of marine litter accumulation, and the morphological and stratigraphic characteristics of the dune. All of this will be compared with data collected in the standard mode, i.e., in the field by hand, to assess the validity of using aerial drones in these types of studies.
Throughout this didactic/research path, both researchers and teachers will work alongside the students and participate in data collection. In fact, at the end of the course, the data acquired from the "expert" and "citizen/student" categories will be compared and contrasted, and a validation of the citizen science data acquired will be done to assess how effective this strategy is. The citizen science data that are found to be suitable will be utlized for research purposes.
In this lesson we will describe the purpose of the project and the different techniques used to collect data through the citizen science approach, as well as the strategies used to best engage the people (in this case, high school students) involved in the project.

Hands-on experience Citizen Science in Practice/Beach Cleanup
Eva Chatzinikolaou and Niki Keklikoglou (beach cleaning - HCMR)
Sabine Marty (NIR scanner/camera - NIVA)
Gabriele Pieri & Marco Tampucci (CS App - CNR)
180 Min, Practical

----------End of Second Day----------

Day 3

Data Crackathon (Marco Alba (ETT), 60 min, IT Session on tools in data management)

This course provides a hands-on demonstration of M2M (Machine-to-Machine) systems for managing and visualizing oceanographic data. Here you will gain practical insights into the usage of ERDDAP, ncWms, and GeoServer through a series of exercises focused on data integration and mapping representation. The course will also allow you to enhance your skills in data visualization and analysis for improved decision-making. Please bring your own laptops for the practical sessions and join us for the DATA CRACKATHON and unlock the power of M2M systems for effective management and representation of oceanographic data. Expand your skill set and gain valuable insights into the world of data-driven oceanography.

TechOceanS (Martha Valiadi (TechOCEANS), 30 min, Theory)

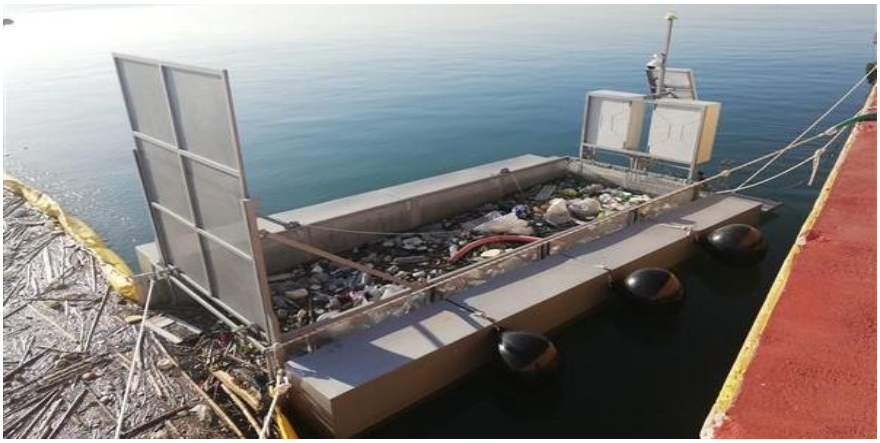
The TechOceanS project is developing new remote ocean sensing technology supporting wider ocean measurement and a drive to net zero. This talk will provide a brief overview of the technologies and early results from testing. Five new sensor classes are being developed for biogeochemistry, biology and ecosystems addressing 10 of 19 EOVs, 31 of 73 subvariables, 6 of 9 MSFD targets together with microplastics, eDNA and a range of biotoxins and contaminants. These innovations concentrate on key capability gaps in ocean observing from non-ship systems with a focus on low-cost per measurement through minimized instrument and deployment costs. I will present the work undertaken towards a nucleic acid analyzer for fast eDNA quantification for a range of targets, including harmful algae, invasive fish and groups of primary producers. Additionally, a new particle sampler has been developed, serving both as an eDNA and microplastic sampler.

CLAIM (George Triantafyllou (CLAIM), 60 min, Theory)

The Horizon 2020 Innovation Action “Cleaning Litter by developing and Applying Innovative Methods in European seas” (CLAIM) was a 4.5 year project that brought together 21 partners from 13 European Union countries, Tunisia and Lebanon and received funding from the EU under Grant Agreement No 774586. CLAIM focused on the development of five innovative cleaning technologies, modelling tools and approaches fostering ecosystem services, targeting the prevention and in situ management of marine plastic litter[1] at their point of introduction to the marine environment (river estuaries and wastewater treatment plants (WWTPs)), towards the mitigation and efficient ecosystem management of marine litter pollution in the Mediterranean and Baltic Seas. These enabling innovative technologies include:

1. An **innovative floating boom (floating barrier- CLEAN TRASH system[2])** that retains, collects and monitors floating litter (that include macroplastics), specifically devised to operate in river mouths and waterways, reached a TRL 9.

The CLEAN TRASH system:



2. The collected marine litter from the CLEAN TRASH system can be treated in an **innovative small-scale thermal treatment device (pyrolyser)**.
The Pyroliser:

3. A low-cost, automated and self-cleaning **filtering system for microplastics for WWTPs, the Waste & Water EcoPlex Microplastic Remover®**, that has been designed and fabricated at a TRL8.
The Waste & Water EcoPlex Microplastic Remover®:

4. The retained microplastics in the EcoPlex device are fed into a **photocatalytic nanocoating device (Photocatalytic Reactor)** composed by a photocatalytic oxide, grown on a suitable substrate, designed and constructed by KTH and DEVENTUS in Sweden.

The photocatalytic nanocoating device:

5. A **seawater sampling device and passive flow-through filtering system** for measurements of plastic particles on board ships of opportunity (Ferrybox) was developed that significantly reduce monitoring costs for microlitter, as compared to existing methodologies.
The CLAIM's seawater sampling device and passive flow-through filtering system:

CLAIM facilitate better governance of the issue of marine litter by providing tools, such as **new models** and concentration maps to give insights into the distribution of macro- and microplastics and scenarios to determine the efficiency of CLAIM's technologies.

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[1] Plastics are the largest and most discussed components of marine litter. There are two major types of plastic items, **macroplastics** (items of plastics larger than 5mm in size) and **microplastics** (items smaller than 5mm in size).
[2] **C**LAIM's **L**itter **E**ntrapping **A**utonomous **N**etwork **T**actical **R**ecovery **A**ccumulation **S**ystem **H**ellas
[3] With 1 kWh power we may iron (1,000 watts) for 60 minutes or cook in an oven (2,000 watts) for 30 minutes, or use a laptop (20-50 watts) all day, or keep a broadband router (7-10 watts) on for five days or watch a 42" LED TV (80 watts) for 12 and a half hours.

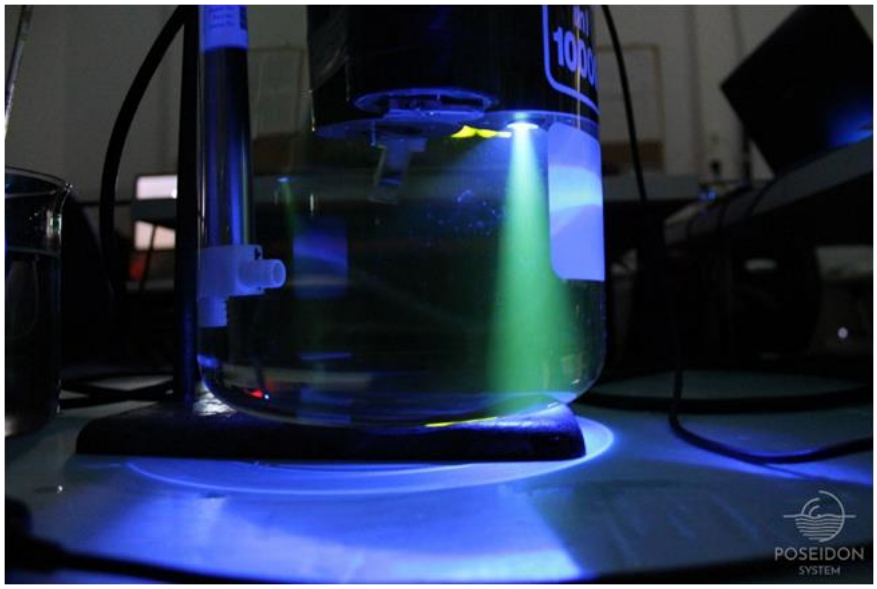
Deep-ocean low-level radioactivity sensor (Christos Tsambaris (HCMR), 30 min, Theory)

In the frame of NAUTILOS project, HCMR has developed an in-situ low-level marine radioactivity sensor for exploring the deep ocean and observe gas/fluids emissions and any other potential radioactive material (including the buried ones). Preliminary studies for the enclosure material are performed studying four types of

material (titanium, stainless steel, carbon fiber, Acetal). The scintillation crystal and the data logger are also selected according to required specifications.
The housing/enclosure for the deep ocean sensor is constructed and the scintillation crystal and all electronic units (voltage divider and other units) are assembled and installed. The sensor enclosure is constructed from stainless steel for safe operation, to be tolerant at high pressures (~300 atm) and deep ocean applications, to install the system in mobile platform (e.g. rosette of a research vessel) or in a lander stationary unit. Some tests in high pressures are also performed with and without the electronics modules. Calibrations are also performed in the air environment as well as in special tank filled with water where standard sources are diluted. The deep-ocean low-level radioactivity sensor operates in an autonomous mode offering to the end-use time series of data selecting the appropriate time lag for each experiment. The end-user communicates via wifi protocol and can save the data internally. The data are extracted after the experiment even if the power is cut off. The sensing system needs further validation and demonstration exercises before the market uptake process and its penetration to the worldwide ocean market for sensors. The real-time methods can be easily upgraded as a custom made request.

Best Practices for Ocean sensors/platforms (Manolis Ntoumas (HCMR), 30 min, Theory)

Sensors, instruments, and scientific platforms play a pivotal role to environmental monitoring and beyond. These devices are designed to detect and measure various properties, enabling the collection of crucial data for analysis and decision-making. Best practices in handling sensors involve proper installation, calibration, and regular inspection to maintain accuracy and reliability. Additionally, sensor maintenance is essential to ensure prolonged functionality, requiring periodic cleaning, calibration, and troubleshooting to address any issues promptly.

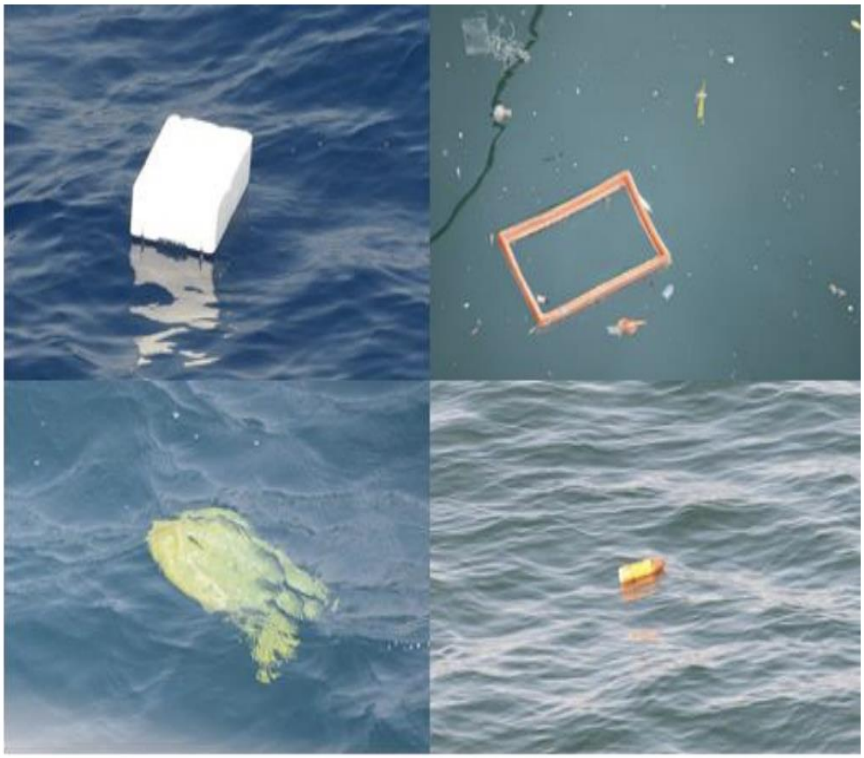


Hands on Experience – Research Vessel Phylia Demo

Christos Tsabaris (HCMR) for low level radiation sensor;
Giuseppe Suaria (CNR) for visual transects from the ship for monitoring floating macro litter during navigation using the JRC monitoring App;
Manolis Ntoumas (HCMR) for CTD, IR temperature sensor and CO2;
Ivan Alonso (AQUATEC) passive acoustic sensor
180 Min, Practical

Visual transects from the ship for monitoring floating macro litter during navigation using the JRC monitoring App. (Giuseppe Suaria (CNR), during RV Demo)

Marine litter stands as a significant facet of marine pollution, presenting a direct peril to marine life and instigating worldwide concern due to its environmental and economic repercussions. Floating Marine Macro Litter (FMML) constitutes the portion of marine debris consisting of objects larger than 2.5 cm that float on the water's surface, serving as a crucial direct gauge of the impact of marine litter on marine ecosystems. The surveillance of FMML offers insights into the primary sources and pathways of litter within marine habitats, facilitating the evaluation of waste prevention initiatives. Both the Marine Strategy Framework Directive (MSFD), along with regional frameworks and the UN, underscore the importance of monitoring and evaluating FMML. Within this module, students will acquire the skills to conduct FMML monitoring using a standardized fixed-width transect method, the predominant monitoring protocol endorsed by the MSFD Technical Group on Marine Litter of the European Commission.



@Vighi, M., Ruiz Orejon Sanchez Pastor, L. and Hanke, G., Monitoring of Floating Marine Macro Litter, EUR 31073 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-52436-6, doi:10.2760/78914, JRC129261.