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Organisation EurOcean

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DEC	Websites, patents, filing, etc.	
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NAUTILOS - New Approach to Underwater Technologies for Innovative, Low-cost Ocean observation is an H2020 project funded under the Future of Seas and Oceans Flagship Initiative, coordinated by the National Research Council of Italy (CNR, Consiglio Nazionale delle Ricerche). It brings together a group of 21 entities from 11 European countries with multidisciplinary expertise ranging from ocean instrumentation development and integration, ocean sensing and sampling instrumentation, data processing, modelling and control, operational oceanography and biology and ecosystems and biogeochemistry such, water and climate change science, technological marine applications and research infrastructures.

NAUTILOS will fill-in marine observation and modelling gaps for chemical, biological and deep ocean physics variables through the development of a new generation of cost-effective sensors and samplers, the integration of the aforementioned technologies within observing platforms and their deployment in large-scale demonstrations in European seas. The fundamental aim of the project will be to complement and expand current European observation tools and services, to obtain a collection of data at a much higher spatial resolution, temporal regularity and length than currently available at the European scale, and to further enable and democratise the monitoring of the marine environment to both traditional and non-traditional data users.

NAUTILOS is one of two projects included in the EU´s efforts to support of the European Strategy for Plastics in a Circular Economy by supporting the demonstration of new and innovative technologies to measure the Essential Ocean Variables (EOV).

More information on the project can be found at: https://www.NAUTILOS-h2020.eu/.

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4. EXECUTIVE SUMMARY

This report frames the strategic policy agenda for the NAUTILOS project and defines communication priorities towards policy makers that include National bodies, EC, Parliaments, MS officials, UN bodies, HELCOM and OSPAR commissions. It takes into account EU and International policies such as the SDGs and the Ocean Investment Platform from the World Ocean Council (WOC), and key initiatives promoted by the Intergovernmental Oceanographic Commission (IOC) such as The UN International Decade of Ocean Science for Sustainable Development which aims to raise public awareness of the urgent need to promote new technologies and the use of existing science to increase our understanding of the cumulative impacts that affect our ocean.
Using the Message box methodology the project consortium has identified the following messages to convey to policy makers:

- Message#1 Ocean Observations must continue
- Message#2 Information and Data not collected is information and data lost
- Message#3 Beyond climate change, sustained observation will support economic activities in the Ocean
- Message#4 Citizens must be empowered through Ocean Knowledge co-production

5. List of Acronyms and Abbreviations

Abbreviation	Definition
CMEMS	Copernicus Marine Environment Monitoring Service
D	Deliverable
DEFRA	Department for Environment, Food and Rural Affairs
DOOS	Deep Ocean Observing Strategy
EC	European Commission
EEA	European Environment Agency
EMODnet	European Marine Observation and Data Network
EOV	Essential Ocean Variable
ESPCE	European Strategy for Plastics in a Circular Economy
EU	European Union
EuroGOOS	European Global Ocean Observing System
FAIR	Findable, Accessible, Interoperable, and Reusable
G7	Group of Seven
GES	Good Environmental Status
GMOS	Global Mercury Observation System
GEOBON	Group on Earth Observations Biodiversity Observation Network.
GOOS	Global Ocean Observing System
HELCOM	Baltic Marine Environment Protection Commission
IOC	Intergovernmental Oceanographic Commission

MS	Member States
MSFD	Marine Strategy Framework Directive
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
R&D	Research and development
RRI	Responsible Research and Innovation
SDG	Sustainable Development Goals
TMT	Transfer of Marine technology
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WOC	World Ocean Council
WP	Work Package

6. INTRODUCTION

To improve ocean observing efforts, ocean science experts have identified several key variables known as the Essential Ocean Variables (EOVs). The measurement of these variables is essential to understand an oceanic system including the state of the ocean, its dynamics and properties, to quantify the forcing of the atmosphere-ocean boundary and to understand the role played in Earth's climate. These data are also fundamental for the forecasting, analysis and reanalysis of the ocean and the development, validation and improvement of the models of the ocean and Earth's-system. In addition to the GOOS EOVs (table 1), deep ocean specific EOVs recommended by the Deep-Ocean Observing Strategy and the Descriptors of GES-Good Environmental Status (according to the EU-MSFD) for in situ assessment have been identified as target variables to be sampled/detected by NAUTILOS' technologies.

Table 1 - GOOS Essential Ocean Variables

Physics	**Biochemistry**	**Biology and Ecosystems**
Sea state	Oxygen	Phytoplankton biomass and diversity
Ocean surface stress	Nutrients	Zooplankton biomass and diversity
Sea ice	Inorganic carbon	Fish abundance and distribution
Sea surface height	Transient tracers	Marine turtles, birds, mammals abundance and distribution
Sea surface temperature	Particulate matter	Hard coral cover and composition
Subsurface temperature	Nitrous oxide	Seagrass cover and composition
Surface currents	Stable carbon isotopes	Macroalgal canopy cover and composition
Subsurface currents	Dissolved organic carbon	Mangrove cover and composition
Sea surface salinity		Microbe biomass and diversity (*emerging)
Subsurface salinity		Invertebrate abundance and distribution (*emerging)
Ocean surface heat flux		
Cross-disciplinary (including human impact)		
	Ocean colour	Ocean sound
	Marine debris (*emerging)	

Such targeted variables have been identified and chosen according to the current maturity of relevant sensors/equipment in the Technology Readiness Levels scale. NAUTILOS will cover 14 Biology and Ecosystem and Biogeochemical EOVs (inorganic carbon, stable carbon isotopes, dissolved oxygen, inorganic macronutrients, suspended particulates, ocean colour, ocean sound, phytoplankton biomass and diversity, zooplankton biomass and diversity, marine turtles, birds, mammals, abundance and distribution, live coral, sea grass cover, microbe biomass and diversity (emerging) and invertebrate abundance and distribution (emerging), 2 DOOS specific EOVs (litter including microplastics, seafloor sponge habitat cover) and 9 MSFD Descriptors in Figure 1: D1, D3, D4, D5, D6, D7, D9, D10, D11 by the sensors and samplers as identified in Figure 2. The wide adoption of the technologies developed and demonstrated in the context of the project will increase participation in environmental observation, will help reduce the costs of the technologies proposed and used, thus multiplying the social, economic and environmental benefits.

Figure 1- Marine Strategy Framework Directive descriptors

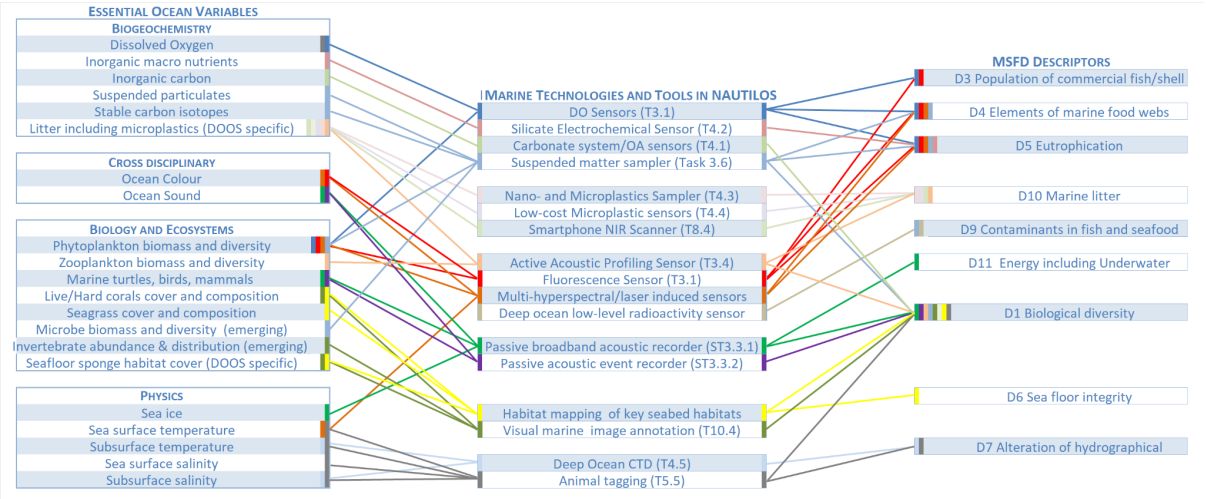

Figure 2 - Sensors and samplers to be developed by NAUTILOS

6.1. Contributions of NAUTILOS to Key Policy areas

NAUTILOS will develop, integrate, validate and scenario test and demonstrate 11 types of sensors and 2 types of samplers to observe the marine environment and intensify the integration of observations

made from various platforms. The project will provide significant improvements in observing those variables that have been challenging to observe so far – 14 biogeochemistry and biology and ecosystems Essential Ocean Variables (as defined by GOOS), two (2) deep ocean specific EOVs (as defined by DOOS) and 9 MSFD Descriptors. The developments are well and timely aligned to the needs of marine data as requested by various global and EU-initiatives, programmes and legislation. Indeed, from its very onset the project ensured to be in alignment to political and societal requirements and legislation through the deliverable 2.1.

NAUTILOS is also contributing to the needs of the Common Fisheries Policy (EU REGULATION 1380/2013) and the Marine Strategy Framework Directive (Directive 2008/56/EC).

NAUTILOS also directly addresses the UN Decade for Ocean Science for Sustainable development two (2) overarching objectives (1, 3) and most of its challenges: 1, 2, 5, 7, 8 and 9. By making its scientific data open and accessible, as required by FAIR principles, the project will leave a legacy in unison with UN Decade's objectives (Figure 3).

Figure 3 - Scheme of the steps required to achieve the goals for this decade

Alongside these main policies, other mechanisms have been put in motion, among those of the United Nations Sustainable Development Goals (UN SDGs)[1] published in 2015. The UN SDGs comprised a set of 17 global objectives towards creating a better future for all by 2030 (Figure 4). While some of these goals were beyond the scope of NAUTILOS, the project could directly contribute to meeting Goals 13,

[1] https://sdgs.un.org/goals

14, 15, through research and its associated activities, and could further contribute to Goals 4, 5, 8, 9 and 10, through its engagement activities and capacity building activities.

Additionally, the project addresses multiple targets under SDG 14: the target 14.1 which aims to "prevent and significantly reduce marine pollution of all kinds, including marine debris and nutrient pollution" is integral to the project, 14.2 on ecosystem-based approaches, 14.3 on ocean acidification, 14. An on research capacity and TMT, 14.C on policy for the conservation and sustainable use of the oceans and their resources. Access to relevant high-quality data is critical to informing sustainable management and use of the ocean.

Figure 4 - The Sustainable Development Goals, adopted on 25 September 2015 as a part of the UN Agenda 2030.

An ethics task considers the ethical side of NAUTILOS activities, the demand for scrutiny of research and development by society and alignment to RRI principles.

Two unique capacity building and training initiatives will be organised, adopting all RRI principles, including in the organisation and selection process, specifically targeting the ESPCE, thus contributing to the implementation of the G7 Action Plan on Marine Litter.

6.2. Related documents

D2.1. A review and prospectus of the mandate for marine environmental monitoring systems: technology challenges and opportunities

This report compiles the outcomes of the work performed in Task 2.1 (Political and societal drivers and requirements), informing on the potential of evolving trends in technological progress in advancing contemporary marine environmental monitoring practices and examining the role any resulting changes in established operating paradigms could play in shaping the socio-political framework defining ocean observing needs at the global and European levels.

D10.1. Outreach, Communication and Dissemination Strategy (PU)

Report outlining the communication and dissemination strategy and actions that will be implemented throughout the project's lifetime in order to achieve the project's widest promotion, greatest visibility

and awareness to the external audiences with a particular emphasis on citizen science campaigns. The Communication and Dissemination Plan will provide the framework and structure of all project information, communication and activities; will define the communication goals, the objectives and timelines; will allocate responsibilities on a partner level and define a set of key performance indicators (KPIs) for the quantification and measurement of the communication and dissemination activities' success.

D10.8. Outreach, Communication and Dissemination Strategy (PU)

An updated version of deliverable 10.8 is to be issued in September 2022, along with this deliverable.

7. THE STRATEGY

7.1. The Message Box

The first face to face meeting had a special session to make use of the message box tool to prepare relevant messages extracted from the project to transfer to policy makers.

The Message Box was created by COMPASS[2], an organization dedicated to helping scientists effectively share their knowledge by providing practical support for scientists to engage without compromising the accuracy of their science.

The Message Box is a simple but powerful tool to help shifting through all the information in the project to focus on key messages for the identified audiences.

7.2. Stakeholders

The Global Earth Observation System of Systems (EuroGOOS, GEOBON, GMOS), CMEMS, EMODnet will act as an overarching umbrella of all activities to take place within NAUTILOS. During the exercise the partners have identified the following groups as the main policy makers to address through their messages including the European Commission, Parliaments, Members States officials, UN bodies, HELCOM and OSPAR commissions, EEA, supporting agencies of member state legislators, state agencies, governmental bodies, national funding agencies (i.e. DEFRA, BEIS in the UK) – a two-way interaction with policy makers will be sought, key engagement being with the European Environment Agency, and with Member State legislators and their support agencies. Many observation and monitoring programs inform policies designed to enable protection of the global ocean. The observation and monitoring technologies developed within the project can significantly contribute to policy aimed at promoting the good environmental status, conservation and protection of marine ecosystems. Key policy makers can benefit from a close collaboration with the project, they will be informed about the project's results, and will be actively engaged in providing feedback on whether project outcomes address current limitations, match the needs of those making decisions on policies affecting marine environment and answer future needs.

[2] https://www.compasscicomm.org/leadership-development/the-message-box/

7.3. The Messages

Conversation at the political level and at the science-policy interface has started to turn towards the actions needed to deal with the ocean and climate rather than the knowledge needed to understand it. This is a very positive step in the right direction, but one action cannot replace the other. It is not uncommon to hear statements claiming we have enough scientific knowledge, and now it is time to act.

Science, and earth observation, are dynamic. Excellent data sets allow for the extraction of knowledge of the geographical and temporal scope of trends and patterns in the environment, but excellent datasets are not the norm. Also, once data is collected, it is already representing a specific time in history. This means we will never have all the data we need, and this is particularly the case for the ocean observations. Ocean and climate are changing rapidly and unpredictably, and we can only begin to understand the extent and impact of these changes with permanent or very long-term monitoring data. Now is not the time to slow down ocean observation efforts

The key messages for policy makers from the NAUTILOS project are as follows:

Message#1 Ocean Observations must continue

Ocean observation is critical to understanding the earth system, particularly in the face of climate change. Although the time for climate action is here, Ocean observation, science and research must continue in parallel to better guide and evaluate the actions taken.

Call for Action: Ongoing and better support for integrated ocean observation through funding for and policy allowing for permanent or semi-permanent ocean observing programmes and infrastructure. Calling for the need of integration between EU initiatives (e.g. EMSO-Eric) and public funded Projects.

Message#2 Information and Data not collected is information and data lost

NAUTILOS has identified critical data gaps *in situ* observations and deep ocean. Closing knowledge gaps requires more extensive and more strategic investment in the ocean observation network. Taking advantage of new, innovative, cost-efficient technologies will be quite essential in achieving these goals.

Call for Action: Greater efforts and support for closing the knowledge gaps in ocean observing, developing new and strategic observational sites, leveraging new and innovative technologies, such as autonomous data collection systems.

Message#3 Beyond climate change, sustained observation will support economic activities in the Ocean.

Ocean Observation is crucial for a better understanding of the environment and supports the development of complete ecological models, thus supporting the development of predictive actions for the sustainable management of fishery resources.

Call for Action: Create informed international policies and protocols to protect and sustainably exploit newly accessible areas of the Ocean, ensuring maximum return with a minimum impact.

Message#4 Citizens must be empowered through Ocean Knowledge co-production

By actively supporting citizen science initiatives, policymakers are able to open up and democratise marine observation science, thus, co-creating a new type of self-driven, sustainable and cost-efficient observatory concept.

Call for action: Policy makers to support citizen scientist initiatives that foster ocean observation and empower citizens with knowledge to take better decisions

8. POLICY STAKEHOLDER ENGAGEMENT

Some activities have been planned to represent NAUTILOS interests to decision makers. These campaigns are NAUTILOS' main vehicle for representing its interests to decision makers including National bodies, EC, Parliaments, MS officials, UN bodies, HELCOM and OSPAR commissions. Within the framework of its participation in hearings, groups of experts, or meetings concerning MSFD, ocean and climate and research.

These activities include:

- At least three NAUTILOS presentations elaborated for European and international institutions, these objectives were already achieved with presentations given at EuroGOOS, EMODNET and European Maritime Day, NAUTILOS will continuously monitor other events where it can be presented along the project
- Three Policy Briefs: A policy brief presents a concise summary of information that can help readers understand, and likely make decisions about, government policies. Policy briefs may give objective summaries of relevant research, suggest possible policy options, or go even further and argue for particular courses of action. A policy brief was already issue in collaboration with ten innovative EU projects committed[3] to build ocean observation systems that provide input for evidence-based management of the ocean and the Blue Economy. These projects have joined forces in the strong cluster 'Nourishing Blue Economy and Sharing Ocean Knowledge'. Under the leadership of the EuroSea project, the group published a joint policy brief listing recommendations for sustainable ocean observation and management.
- One Roundtable: The Round Table is planned as a workshop conducted jointly with TechOcean, EurOcean, NAUTILOS Policy Officer and other participants recommended by the External Advisory Board from relevant EU policy bodies.

[3] EuroSea 862626; AtlantECO 862923; Blue-Cloud 862409; EU-Atlas 678760; Eurofleets+ 824077; iAtlantic 818123; JericoS3 871153; Mission Atlantic 862428; Nautilos 101000825; ODYSSEA 727277.