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Description	This report identifies the key outputs of the project, with a particular emphasis on the demonstration work packages, with the aim of developing a set of strategies for their exploitation (commercial, scientific and otherwise) and sustainability.
Work Package number	8
Work Package title	Communication: Engagement, Dissemination, Exploitation, and Legacy
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Comments	

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Table of Contents

1 Introduction to EuroSea

Although the Ocean is a fundamental part of the global system providing a wealth of resources, there are fundamental gaps in ocean observing and forecasting systems, limiting our capacity in Europe to sustainably manage the ocean and its resources. Ocean observing is “big science” and cannot be solved by individual nations; it is necessary to ensure high-level integration for coordinated observations of the ocean that can be sustained in the long term. For Europe, EuroSea will point the way for the current and future cooperation between science and industry, politics and the public with the common goal of a sustainable blue economy and the responsible handling of the sensitive marine ecosystems. The project will make a significant contribution to not only generating, processing and linking information about our oceans, but also to make long-term and extensive use of this and the resulting knowledge in a wide variety of areas. As a link between sectors and disciplines, EuroSea faces a very big challenge.

2 EuroSea Exploitation Strategy Background and Context

This document outlines the strategy to exploit the results generated in the EuroSea project. It updates and expands on the initial dissemination and exploitation plan that was developed at the proposal phase, where several expected results were identified and were categorised into commercially and non-commercially exploitable results. This document is intended to be a high-level strategy for the exploitation or use of the EuroSea results. As not all of the EuroSea results have been achieved at this time, the strategy will remain a “living document” and will be updated at regular intervals throughout the remainder of EuroSea as the project progresses and further results are delivered.

According to the European Commission definition, results refer to any tangible or intangible output of the action, such as device, data, knowledge and information whatever their form or nature, whether they can be protected. Exploitation refers to the utilisation of results in further research activities other than those covered by the action concerned, or in developing, creating and marketing a product or process, or in creating and providing a service, or in standardisation activities. As this definition outlines it is important to note that exploitation does not just refer to commercial use of the results but also refers to results that can be used for further research and in public policymaking. Exploitation, along with the dissemination of project results are the key activities required to maximise the use of EuroSea results developed throughout the project.

3 Measures to ensure that results meet real needs of end users

A number of measures are in place to ensure that the products and services being developed in EuroSea meet the needs of potential users. Key to this is the involvement of end users in the process of co-developing the demonstration products and services. The co-development process aims to determine the needs and requirements of end users while also demonstrating the benefits of ocean observations for end users. In addition, the co-development of the demo products/services with the end users will help to ensure that market and specific customer needs are fulfilled.

4 List of Main Results and Description

The main exploitable results from the project that have been identified are listed in the tables below. The tables include a description of the result, the intentions for exploitation and users and the status of the result.

4.1 Work Package 1: Governance and coordination of ocean observing and forecasting system

Result	Description	Exploitation and use of the result	Status
Report on initiatives, strategies, roadmaps and policies that contribute to foresight in ocean observation	This report identifies existing initiatives in foresight in ocean observation, emerging strategies and roadmaps.	Use in further research and to inform policy and decision makers.	Deliverable report submitted
Map of BioEco observing networks capability	The result provides a map of the locations and properties of sustained biological observing networks through Europe including coordinating groups and data aggregators.	Use in further research and to inform policy and decision makers.	Deliverable report submitted
Report on European BioEco networks	This task will strengthen and extend the BioEco networks throughout the European Seas, including data flow and establishing use of best practices and/or undertaking an Essential Ocean Variable (EOV)/network focused workshop on European Seas.	Use of best practices among the European BioEco networks.	Deliverable due M27 (D1.4)
Marine Plastics EOV and common sampling protocol	This result aims to establish global coordination of sustained observations of marine plastic contaminants as a “Human Pressure” EOV. This result will establish a common sampling protocol, support implementation among European observing network partners, and establish the capacity to map out marine plastic contaminant monitoring.	The protocol will be used by the European ocean observing networks to sample marine plastic contaminants in the ocean.	Deliverable due M27 (D1.5)
Maps and metrics on observing systems and metadata for main in-situ platforms and networks	This result will support OceanOPS to deliver observing system metadata, visualisation and indicators across European seas. The data flow to European data infrastructures, such as EMODnet, will be monitored and optimised and the metadata vocabulary will be harmonized and connected to SeaDataNet services.	The result will be used to improve access to data for further research purposes.	Deliverable due M30, D1.6
Report and recommendations for the European Commission on wider legal frameworks relating to ocean observing systems	This report will review the existing legal frameworks in relation to ocean obervations (UNCLOS, UNFCCC, CBD) to assess how these legal frameworks can be used practically for the European ocean observing system.	Best practice document for the use of legal frameworks to support sustained ocean observing and fit for purpose ocean information products.	Deliverable due M40, D1.7
Final report on the European Ocean Observing System (EOOS) implementation plan	This report will provide recommendations on how to progress with implementation of EOOS and its function.	This report will be used by the ocean observing community for the implementation of EOOS.	Deliverable due M48, D1.8

4.2 Work Package 2: Ocean Observing System Design

Result	Description	Exploitation and use of the result	Status
Design of the Observing System Simulation Experiments (OSSEs) with multi-platform in-situ data and impact on fine-scale structures	Improvements to the design of multi-platform experiments aimed to validate the Surface Water and Ocean Topography (SWOT) satellite observations with the goal to optimize the utility of these observing platforms.	This result will be used for further research purposes.	Deliverable report submitted (D2.1)
Analysis of the physical and biogeochemical (BGC) design experiments: impact of physical and biogeochemical observation network evolutions on Copernicus Marine Service global analysis	This result will deliver objective guidelines to improve existing elements and/or implement new components of the Atlantic and Mediterranean Sea Observing system. The general approach will be based on Observing System Design Experiments that rely on physical and biogeochemical models, or statistical techniques that realistically represent the space-time variability of the EOVs to be observed, both methods will be optimally merging in situ and satellite observations.	This result will be used to inform the physical and BGC aspects of the ocean observing system design.	Deliverable due M24, D2.2
Analysis of the Observing System Simulation Experiments (OSSE) with multi-platform in-situ data and impact on fine-scale structures.	OSSEs will be conducted to optimize sampling from different configurations of the in-situ observing system, including velocities from surface drifter, glider, Argo floats displacement at the surface, shipborne ADCP and current meters.	This result will be used for further research purposes.	Deliverable due M30, D2.3
Development and dissemination of targeted indicators and their uncertainties for demonstrators (WP5,6,7) and forecasts (WP4).	This result will verify the EOVs required to inform the major societal drivers of sustained ocean observing. The Atlantic and Mediterranean indicators for climate (WP7), ocean health (WP6), and coastal resilience and operational services (WP5) will be linked into strategic recommendations on sustained monitoring strategies of the EOVs.	The indicators will be used within the demonstration work packages (5,6,7).	Deliverable due M36, D2.4

4.3 Work Package 3: Network Integration and Improvement

Result	Description	Exploitation and use of the result	Status
Data Management Plan	This plan provides the framework for the management of data generated in EuroSea from acquisition through to curation and dissemination.	The plan will enable the use of the data generated with EuroSea for a range of purposes.	Deliverable report submitted, D3.1
Observing networks initial assessment	This result provides an assessment of the current coordination of the EuroSea observational and thematic networks.	The report will help to inform decisions on the coordination (and the potential need for this) of the EuroSea observing networks.	Deliverable report submitted, D3.2
Tide gauge data flow strategy	This result outlines improvements to the existing tide gauge data flow strategy to follow FAIR (Findable, Accessible, Interoperable and Reusable) principles.	Use of the strategy to enable access to tide gauge data for a wide range of applications – research, sea level related hazards, tidal predictions, port operations, etc	Deliverable report submitted, D3.3
HF-Radar Governance	This report describes the governance of the European HF radar network including: the landscape of the ocean observation networks and infrastructures, the role and links between operators of observational systems and stakeholders, the role and activities of the EuroGOOS HF radar Task Team in building a sound community strategy, roadmap of the community with current achievements and future work lines.	Use of the report and its recommendations to inform decisions on the current and future governance structure of the HF radar network.	Deliverable report submitted, D3.4
Autonomous Surface Vehicle (ASV) network structure and roadmap	EuroSea will establish an ASV network for better coordination, technological innovation and best practices. This will involve defining the ASV network and roadmap to cover current and future user's needs, including access to infrastructures, community roadmap monitoring, promoting knowledge exchange, enhancement and partnership worldwide with the establishment of an ASV User Group.	This will improve the availability of ASV technologies at operational, data management and policy level, and will enhance the use of ASV data improving ocean observing products, their implementation and dissemination through existing EU data infrastructures.	Deliverable due M18, D3.5
Implementation of pH sensor on Eulerian observations in the Mediterranean Sea	This result will support WPs 6 and 7 by the deployment of pH sensors on Eulerian observatories.	This result will provide pH observations in the Mediterranean Sea.	Deliverable due M24, D3.6
Report on data harmonisation recommendations for WP3 networks	This result will provide recommendations to ensure that new data gathered through EuroSea or consolidated datasets will be ingested into the Copernicus Marine Service and EMODnet portfolios.	The harmonisation of EuroSea data will lead to improvements in the development of CMEMS and EMODnet data products and services.	Deliverable due M30, D3.7

Result	Description	Exploitation and use of the result	Status
EuroSea guidelines for a Strategic European Vision of Ocean Observing Integration	This report will gather input from relevant organisations in Europe on their approach to balance activities driven by network/platform/sensor/process with global/integrated/actions. A coordination body will be established to overlook the integration across observing networks that will channel and advance common strategies and response capacities.	The guidelines will be used to support the implementation of EOOS.	Deliverable due M36, D3.8
Report on European glider coordination (Best Practices, OceanGlider, metadata and data management)	This report will support EOOS to develop a glider network that is in phase with the results of recent international programs, the EuroGOOS glider Task Team, and the G7 recommendations for gliders.	This result will be used to improve glider coordination at the European level (providing a technical coordinator) though EuroGOOS and its ROOSes in particular, and to link them to the global activities in order to make them fully integrated in GOOS.	Deliverable due M36, D3.9
Progress report on Glider metadata management	This report will create Best Practices for glider operations (including EOV observations) and data management at the European and global level.	The Best Practices created will be used by glider operators and data managers.	Deliverable due M36, D3.10
Upgrade Best Practices for fixed observatories in term of data processing	This report will improve Best Practices for processing data gathered by fixed point observatories.	The Best Practices will be used by fixed observatory operator and data processors/managers	Deliverable due M36, D3.11
Metadata catalogue for fixed observatories including updated EMSO observatories information and OceanSites observatories through OceanOPS.	This result will enable access to harmonised metadata from EMSO-ERIC and the global Eulerian observatory network (OceanSITES) through OceanOPs.	This result will improve harmonisation between the EMSO-ERIC and the global Eulerian observatory network (OceanSITES) data in order to create a coherently coordinated European network of Eulerian observations.	Deliverable due M24, D3.12
EuroSea data handbook.	This handbook will ensure that new data gathered through EuroSea or consolidated datasets will be provided to the European and international marine and ocean data management infrastructures	This result will lead to improvements in the development of CMEMS and EMODnet data products and services.	Deliverable due M36, D3.13
Innovative tools to suport the HF radar community (outage reporting, reprocessing historical data, model assessment)	This report will describe the development of tools to support the advanced delayed mode quality control of HF radar REP and products and for inter-comparing model outputs and HF radar products with a process-oriented approach.	This result will be used by the HF radar community for research purposes.	Deliverable due M38, D3.14

Result	Description	Exploitation and use of the result	Status
New tide gauge metadata catalogue	This report will outline the development of a new tide gauge metadata catalogue.	The catalogue will be used to enable access to tide gauge data for a wide range of applications – research, sea level related hazards, tidal predictions, port operations, etc.	Deliverable due M42, D3.15
Euro-Argo updated strategy for DEEP and BGC development in Atlantic and Med Sea including implementation cost and Best Practices	This result will outline the strategy to coordinate the extension of the Euro-Argo programme to the deep ocean (below 2000m) and to collect biogeochemical variables. This will involve the development of Best Practices for DEEP and BGC Argo operations and data management via workshops and feedback from WP7.	The strategy will be used by Euro-Argo ERIC and other Argo operators to implement the extension of the deep and BGC Argo programmes.	Deliverable due M44, D3.16
Report on ocean data integration in EuroSea	This report will outline the integration of data in CMEMS and EMODnet achieved by harmonising work flow between the observing networks and the integrators through interoperable interfaces based on existing, international standards following up on the recommendations issued within the AtlantOS project.	This result will lead to improvements in the development of CMEMS and EMODnet data products and services.	Deliverable due M44, D3.17
Observing networks final assessment	This report will provide a final assessment of the coordination of the EuroSea observational and thematic networks.	Use of the report to inform decisions on the future coordination (and the potential need for this) of the EuroSea observing networks.	Deliverable due M44, D3.18
Standardised community protocols for long-term omics observing archived in the UNESCO/IODE Ocean Best Practices System and bearing on the GOOS Microbial EOV.	This result will outline the development of a set of standard operating procedures (SOPs) for long-term omic observation aligned to the GOOS EOVs (e.g. Microbial biomass and diversity) to augment well-established marine LTERs.	The result will be used for further research purposes.	Deliverable due M46, D3.19

4.4 Work Package 4: Data Integration, Assimilation and Forecasting

Result	Description	Exploitation and use of the result	Status
Design of experiments to be conducted and update of the data assimilation systems (global/IBI)	Data assimilation techniques will be refined/adapted to best use physical and biogeochemical observations considered in EuroSea (e.g. DEEP and BGC Argo). Assessments from the global system will include both physics and biogeochemistry (incl. carbon cycle). Assessment from the regional (IBI) system will be focused on physics.	This result will provide recommendations for the long-term evolution of the observing system.	Deliverable due M24, D4.1
Design of experiments and update of the data assimilation systems of the Med-Monitoring Forecasting Centre (MFC) and SOCIB systems	This result will assess the impact of the assimilation of glider and float physical observations from WP3 networks in the future versions of the CMEMS Med-MFC and SOCIB WMOP modelling and data assimilation systems.	This result will support understanding of the potential influence of the data assimilation approach and model resolution.	Deliverable due M24, D4.2
Probabilistic user-relevant climate indicators as specified by WP7 using ocean ensembles of seasonal forecasts	This task will use improved climate records of Ocean Heat Content (OHC) from the CMEMS GLO-RAN ensemble and CMEMS regional centres (MFCs), the SLA ECV distributed by the Copernicus Climate Change Service (C3S), and the new SST records from ESA-CCI, to validate seasonal forecast of ocean variables.	These new indicators will enable the assessment of the quality of ocean variables of the seasonal forecast contributing to C3S.	Deliverable due M24, D4.3
Manual of operational implementation of temperature and salinity quality control	This manual will test the implementation of the quality control routines for ship-based time-series EOV data developed by GEOMAR.	The manual will be used for further research purposes.	Deliverable due M30, D4.4
Manual of operational implementation of SOCAT quality control	This manual will outline how to operationalise SOCAT quality control efforts.	The manual will be used for further research purposes to help operationalise SOCAT quality control efforts	Deliverable due M36, D4.7
Impact of EuroSea observations and recommendations for the observing system evolution	This result will involve an assessment of the impact of observations from the WP3 networks and from WP5,6,7 demonstration activities for the global and North East Atlantic (IBI) Copernicus Marine modelling and data assimilation systems.	This result will provide recommendations for the long-term evolution of the observing system.	Deliverable due M42, D4.8
Intercomparison of skill scores of forecast and analyses for the two different assimilation and model systems in the Med Sea	This result will compare the skill scores of forecast and analyses for the CMEMS Med-MFC and SOCIB WMOP modelling and data assimilation systems.	This will support understanding of the potential influence of the data assimilation approach and model resolution.	Deliverable due M42, D4.9

Result	Description	Exploitation and use of the result	Status
Impact of BGC Argo assimilation on the analysis and forecast quality of Med-BIO and evaluation of physical glider assimilation on biogeochemistry	This result will evaluate the impacts of multivariate BGC-Argo float observations on the biogeochemical CMEMS products.	This result will provide suggestions for the evolution of the BGC-Argo observing system.	Deliverable due M42, D4.10
Definition and implementation of Extreme Forecast Indices and evaluation of effectiveness in WP5 and WP6	This result will develop an operational implementation of an ensemble forecasting system for the CMEMS Med-MFC, producing products for the two demos in WP5 and WP6. The ensemble forecast will be based on the methods already developed but not set operational and used by the demos developed in EuroSea.	The Extreme Forecast Indices will be used in further research.	Deliverable due M42, D4.11
Manual of operational implementation of GLODAP quality control.	This manual will outline how to operationalise GLODAP quality control efforts.	The manual will be used for further research purposes.	Deliverable due M48, D4.12

4.5 Work Package 5: Coastal Resilience and Operational Services Demonstrator

Result	Description	Exploitation and use of the result	Status
Prototype sea level planning and scenario visualisation tool.	Development of a prototype data-driven modelling and visualisation tool tested with selected stakeholders. The prototype will be used to create a roadmap for visualising data leading to better coastal resilience decisions in the management of future sea level rise.	Exploitation will include further development of the prototype and commercialisation. Users include port operators and local coastal communities; Marine Spatial Planners; Insurance industry.	Deliverable submitted, D5.1
Mediterranean sea-level reconstruction spanning 1950-2017.	This result will involve combining tide-gauge data with fields of coastally re-tracked satellite altimetry to yield reconstructed sea-level fields with the same spatial coverage as the altimetry data and spanning the same period as the tide-gauge record (1950-2017).	This data will be used to feed the prototype data-driven modelling and visualisation tool outlined above.	Deliverable due M24, D5.2
CMEMS downscaled circulation operational forecast system for the three demonstration sites, including documentation on architecture and validation of the system.	This result will involve the development of high-resolution operational forecast systems for circulation at the three demonstration sites.	This result will be used to provide higher resolution circulation operational forecasts.	Deliverable due M24, D5.3
CMEMS downscaled wave operational forecast system for the three sites, including documentation on architecture and validation of the system.	This result will involve the development of high-resolution operational forecast systems for wave at the three demonstration sites.	This result will be used to provide higher resolution wave operational forecasts.	Deliverable due M24, D5.4
Final version of the Oceanographic Services for Ports and Cities (OSPAC) software running operationally for the demonstration	The OSPAC software system will consist of an integrated set of tools and measuring instruments that will provide an operational service to the city and the adjacent port in order to minimise risks and improve environmental management.	Commercialisation - The OSPAC software will gradually progress to TRL 9 in the years after the end of the project by means of installing it at additional port authorities in Spain.	Deliverable due M24, D5.5
Documentation associated to the capacity building.	The capacity building for the African demonstration site will be based on supporting two visits of two local technicians to acquire appropriate skills for the installation and maintenance of the station and the operation of the software.	The capacity building activity will help to ensure the continued use of the system at the African demonstration site after the project ends.	Deliverable due M24, D5.6

Result	Description	Exploitation and use of the result	Status
Low cost and maintenance free tide gauges	The product will be a high quality (scientific standard) tide gauge system, with low operating costs.	Commercialisation - Discussions by NOC with key sensor manufacturers will be used to assess the appetite for issuing license agreements or other means of commercialisation.	Deliverable due M34, D5.7
Mediterranean sea-level trend and acceleration estimates with reduced uncertainty and toolbox for automated recalculation	This result will be a system that provides continuous updates of more accurate sea level trends and variabilities in the Mediterranean Sea.	This system will feed the prototype sea level planning and visualisation tool.	Deliverable due M34, D5.8
Operational monitoring systems available at the three sites	This result will involve the deployment, implementation and configuration of the system instrumentation at the three demonstration sites.	The result will be used by the port and city authorities at the three demonstration site locations.	Deliverable due M36, D5.9

4.6 Work Package 6: Ocean Health Demonstrator

Result	Description	Exploitation and use of the result	Status
Report on the connections between "Extreme Marine Events" and Biological EOVs	This report will ingest, maintain, exploit, and develop ocean *in-situ* data and downscaled operational forecast numerical models to produce real-time and 3-day modelled forecasts of extreme marine events at aquaculture sites in the NE Atlantic (Irish waters) and W Mediterranean (Alborán Sea). In consultation with co-developers, the data products will be merged with existing marine biological datasets (WFD, MSFD, and MPA) and associated target organism vulnerabilities identified.	This report will be used for further research purposes.	Deliverable due M33, D6.1
Annual and quarterly assessments and description of the production system	This result will integrate efforts from the Baltic Operational Oceanographic System (BOOS) and the Baltic Marine Environment Protection Commission (HELCOM) monitoring networks, resulting in a more fit for purpose operational oceanography system and enhanced environmental assessments in the Baltic Sea.	The enhanced integration of the BOOS-HELCOM system will provide users with more timely and rapid environmental assessments. All products delivered by the system will be published on BOOS and HELCOM websites.	Deliverable due M36, D6.2
Method or Standard Operating Procedure on how to create "Extreme Marine Events" hazard maps & forecasts report	Using EuroSea capabilities to identify local and regional impacts of oxygen, heat and pH related “Extreme Marine Events”, this result will outline the method on how to develop bespoke mapping and forecasting products for industry, government and scientific customers.	This method/SOP developed will be documented and shared with co-developers and wider stakeholders.	Deliverable due M40, D6.3
Linking oceanographic products to fisheries advice	This result will enable the use of data products from the EuroSea value chain to support fishery management decisions leading to a better understanding of environmental pressures on exploited fish populations.	This result will help to inform the development and increase uptake of oceanographic products for fishery management.	Deliverable due M40, D6.4
Sustainability and Business Plan report	This result will outline a business plan for the system to measure extreme marine events at aquaculture sites including a detailed market analysis as a key component.	The business plan will set out a roadmap towards commercialisation of the system.	Deliverable due M48, D6.5

Result	Description	Exploitation and use of the result	Status
Assessment of the benefits of the BOOS-HELCOM integrated system and recommendations for transferring this to other sea areas.	This result will integrate efforts from BOOS and HELCOM monitoring networks, resulting in a more fit for purpose operational oceanography system and enhanced environmental assessments in the Baltic Sea.	The enhanced integration of the BOOS-HELCOM system will provide users with more timely and rapid environmental assessments. All products delivered by the system will be published on BOOS and HELCOM websites.	Deliverable due M48, D6.6
Real-time data to central server with display to stakeholders.	This result will ensure that the real time data collected by the buoys deployed at the aquaculture sites in Ireland and Spain is accessible by stakeholders.	This result will ensure that the data collected by the buoys deployed at the aquaculture sites in Ireland and Spain is accessible by stakeholders.	Deliverable due M48, D6.7
Solution for marine sensors to measure and forecast oxygen, heat and pH related Extreme Marine Events onsite for aquaculture	This system is an application for marine sensors to measure and forecast extreme marine events at aquaculture sites in the NE Atlantic (Ireland) and W Mediterranean (Spain) through a setup including optimal sensor, location and measurement cycles for ocean observing. Practical training will be provided to set-up, operate, maintain and interpret the data products produced.	Commercialisation - The system to measure and forecast parameters such as oxygen, heat related Extreme Marine Events onsite for aquaculture will be delivered by Xylem to new customers and a well defined fixed-price service will be established.	In development

4.7 Work Package 7: Ocean climate indicators demonstrator

Result	Description	Exploitation and use of the result	Status
Report on demo mission and dissemination pathways of obtained data based on different observational platforms.	This report will describe the demo mission and the data dissemination pathways to end-users developed in cooperation with WP4.	This report will be used for further research purposes.	Deliverable due M28, D7.1
The data validation tool will apply GLODAP data at depth along with ASV surface data to enhance BGC-Argo pH data quality.	This result will develop a methodology to increase carbon data quality of the emerging BGC-Argo network using Tropical Atlantic Observing System as a demonstration environment. The current BGC-Argo data validation procedure, based on GLODAP data, will be extended by systematic crossovers with at the surface during the pilot study, thereby reducing uncertainties in CO2 flux estimates and ocean acidification indicators.	The data validation tool will be used for further research purposes.	Deliverable due M32, D7.2
Identification of key drivers for the observed changes in carbon uptake at the convection sites.	This result will identify and estimate the temporal evolution of gas exchange processes (convection center) and carbon transport (boundary currents) and their link/contribution to the regional carbon variability.	This result will be used for further research purposes.	Deliverable due M36, D7.3
Verification and calibration of user-driven calibrated seasonal forecast ocean indicators using ECVs/OCVs.	User-driven calibrated ocean climate and forecasting indicators, with reliable uncertainty for the Atlantic Ocean and Mediterranean Sea, will be developed in consultation with stakeholders using records of Essential Ocean Variables from ocean observing systems. The aim is to demonstrate the end-to-end connection from climate and seasonal forecast products to a wide variety of stakeholders.	Use of the indicators in further research and to inform policy and decision makers.	Deliverable due M36, D7.4
Report on estimation of economic benefit of regional ocean carbon uptake based on the three approaches (cost-benefit, cost-effectiveness, market-based carbon prices in the EU-ETS).	This task will evaluate the economic value of the ocean carbon sink in deep convection regions via operational carbon assessments using a combined observing, integration, and dissemination approach.	The results of the EuroSea carbon audit will be communicated in user/producer meetings and at a policy briefing to discuss and identify new users/market opportunities.	Deliverable due M40, D7.5
Quantification of improvements in carbon flux data for the tropical Atlantic based on the multi-platform and neural network approach.	This result will use a combination of remote sensing, the multi-platform approach and neural network techniques to upscale carbon fluxes for the whole tropical domain.	This result will be used for further research purposes.	Deliverable due M40, D7.6

4.8 Work Package 8: Communication: Engagement, Dissemination, Exploitation, and Legacy

Result	Description	Exploitation and use of the result	Status
Lessons learnt on science-policy interfaces in European ocean observing	This report will outline the design of science-policy interfaces needed to sustainably engage with the project's stakeholders and demos' targeted users. This will involve organising workshops on the topic of science-policy interfaces.	The report will be used as a guidance document on science-policy interfaces.	Deliverable due M24, D8.3
Lessons learnt from the EuroSea public engagement activities on the importance of ocean observing for environmental policies and Blue Economy along the Ocean Literacy principles	This result will develop a public engagement resource portfolio on the importance of ocean observing for environmental policies and Blue Economy, along the Ocean Literacy principles.	This result will be used as a guidance document on how to engage with the public on the importance of ocean observing.	Deliverable due M32, D8.5
Report on economic value of ocean observations highlighting the potential economic impact of the demonstrations and analyses the value of the ocean observing system	This will involve conducting a case study of one of the demonstration products or services developed in EuroSea to estimate the economic value and impact of it for end users.	This report will be used to demonstrate the economic impact of one of the EuroSea demonstration products or services.	Deliverable due M36, D8.6
Lessons learnt on public-private interfaces in European ocean observing	This report will outline the design of public-private interfaces needed to sustainably engage with the project's stakeholders and demos' targeted users. This will involve organising workshops on the topic of public-private interfaces.	The report will be used as a guidance document on public-private interfaces.	Deliverable due M40, D8.7
Business plan that will highlight the value added of an integrated ocean observing system	This result will provide a business plan for the commercial key exploitable products and services co-developed in WP5,6,7, including a detailed market analysis as a key component.	The business plan will set out a roadmap towards commercialisation of the Key Exploitable Results.	Deliverable due M40, D8.8
Recommendations on the implementation of Responsible Research and Innovation (RRI) in ocean observing system design and innovation	This result will assist the development of demo activities on system design and governance using the RRI guidelines and stakeholder engagement mechanisms established through the previous EU initiatives, including the EU H2020 action Marina.	This result will be used to inform the design of the ocean observing system in relation to RRI.	Deliverable due M45, D8.9

Result	Description	Exploitation and use of the result	Status
Recommendations on engaging with the next generation	Recommendations on influencing the next generation of professionals in the ocean observing value chain will be made based on targeted engagement activities and taking into account the recommendations of the European Marine Board Future Science Brief 2 on marine graduate training.	The recommendations will be used as guidance to engage with the next generation of professionals in the ocean observing value chain.	Deliverable due M49, D8.11
EuroSea legacy report	This report will help distil and sustain the project's legacy, deliver advice on RRI guiding principles, best practice in knowledge and technology transfer.	The report will be used to ensure the project's outcomes and legacy inform relevant political agendas.	Deliverable due M49, D8.12

5 Key Exploitable Results for Commercialisation

External expertise was provided to EuroSea through the EU funded Horizon Results Booster (HRB) services in relation to Module C – assisting projects to improve their existing exploitation strategy. The aim of this service is to strengthen the capacity of projects in using their research results and enhancing the capacity of partners to improve their exploitation strategy. These services were provided by LC Innoconsult International and the focus was on the commercial exploitation of results.

After an initial meeting between the EuroSea coordination team, exploitation partners and the service provider, it was decided to focus on three Key Exploitable Results (KERs) from the demonstration work packages for the HRB services. These are:

- Oceanographic Services for Ports And Cities (OSPAC software) – real time alert to provide forecast of sea conditions (WP5)
- Solution for marine sensors to measure and forecast oxygen, heat and pH related Extreme Marine Events onsite for aquaculture – monitoring system for extreme marine events at aquaculture sites (WP6)
- Low maintenance tide gauges (WP5)

The KER on user-driven calibrated seasonal forecast ocean indicators - indicators for reliable decision making (WP7) was also considered. However, after a meeting on this it was decided that the commercialisation potential of this KER was low and it was not ready for exploitation. Following on from this meeting, it was then decided to choose the low maintenance tide gauges as the third KER to be examined under the HRB services.

For each of these KERs additional information was provided and the template tables provided by LC Innoconsult were completed. These tables contained the following information:

- Characterisation of the KERs – this covered the problem facing the customer, alternative solution, unique selling point (USP), description of the KER, market analysis including the target market, early adopters, competitors, go to market – use model, timing, background IPR and foreground IPR.
- Risk assessment and priority mapping – this involved identifying the risks including partnership risk factors, technological risk factors, market risk factors, IP/legal risk factors, financial/management risk factors, environmental/regulation/safety risk factors. This also involved outlining mitigation actions to avoid the risks identified.
- Exploitation roadmap – this covered actions and roles of the relevant partners, milestones, financials and costs, revenues, other sources of funding, impact in 3 years time for company and customer.
- Use options – this section outlined how the KER will be exploited further and the use option to be chosen. This included direct use options such as commercialisation (deployment of a novel product/service offered to the target markets), contract research (new contracts signed by the research group with external clients), a new research project (application for publically funded research programmes), implementation of a new university course. Indirect use options included assignment of the IPR, licensing of the IPR, development of a new legislation/standard and/or a spin-off company.

The next step involved the organisation of exploitation strategy seminar workshops for each of the three KERs. The workshops for the OSPAC software and the solution to measure extreme marine events for aquaculture were held on February 18th and 19th 2021 respectively. The workshop for the tide gauges was held on 11th June 2021. The seminar workshops covered the following information:

- Introduction to exploitation (definition of exploitation, KERs, exploitation vs dissemination, exploitation plan/strategy)
- Introduction to each KER and a further development and refining of the characterisation table and the risk map and sketching of the exploitation roadmap.

During the webinars feedback was provided by the experts to the relevant partners and several areas of importance were discussed. For each of the KERs additional information was requested by the experts. The output from the webinars was a report on the KERs identified and which was used to inform this exploitation strategy.

In addition to the three KERs outlined above, the tables were also completed for the prototype sea level planning and scenario visualisation tool (WP5), as this is a further key EuroSea result that has significant potential for commercialisation. The output from the exploitation strategy seminar and the tables that were completed are elaborated on in the following sections.

5.1 Oceanographic Services for Ports and Cities (OSPAC) software on port and city real-time alert to provide forecast of sea conditions (KER leading beneficiary: EPPE, Nologin)

5.1.1 OSPAC Software Characterisation table

KER name: Oceanographic Services for Ports and Cities (OSPAC) software on port and city real-time alert to provide forecast of sea conditions	
Problem	Port authorities, city authorities and coastal communities share common coastal areas and face a number of similar potential environmental risks and management problems. These problems are in relation to: ● water quality and sea pollution – coastal water quality depends on the activities of neighbouring cities, ports and beaches, as well as in coastal circulation; ● navigation safety in cities and ports – an increase in commercial and recreational ship activity in ports and coastal areas can lead to safety issues; ● beach safety - e.g. rip current forecasts and sea state monitoring and forecasting; ● storm surges and hazards, flooding and erosion which can cause extensive damage, destroy infrastructure and property and can result in loss of life. Port and city authorities currently do not work together to address these challenges. The integrated OSPAC software product will provide cities and ports with decision-making tools to solve similar problems they face and in the process foster better relationships between port and city authorities.
Alternative solution	Forecast models of sea conditions currently exist but they do not meet the specific environmental management requirements of port and city authorities. They also do not provide real-time alerts that enable improved management, planning and decision-making around the environmental issues outlined above.
Unique Selling Point USP - Unique Value Proposition UVP	Oceanographic Services for Ports and Cities (OSPAC) software will provide improved real–time alerts for water quality, navigation safety, safety on beaches, improved efficiency of port operation, etc. The specific customer and end user needs are currently being defined through the co-development process in WP5. Most forecast models do not currently provide real-time alerts, which are needed to address the environmental management challenges outlined above for the specific requirements of port and city management and planning. OSPAC software will provide an integration layer that will help to support decision making at ports and cities and help to improve relationships and close the gap in decision-making between city and port authorities.
Description	The OSPAC software system will consist of an integrated set of tools and measuring instruments that will provide an operational service to the city and the adjacent port in order to minimise risks and improve environmental management. There are two main layers to the system. The first layer includes forecast models of local sea conditions. The second layer is the software that is being developed to provide real-time alerts based on the models. The system will provide an integration layer that will work with existing forecast models for wave, sea level, sea surface temperature and circulation conditions. The software will use the models to deliver real-time alerts by SMS and email to provide forecasts of sea conditions, rip currents, flushing times, floating debris and flood and erosion risk. The use of local models, depending on their availability, will enable the system to be rolled out to other ports.

KER name: Oceanographic Services for Ports and Cities (OSPAC) software on port and city real-time alert to provide forecast of sea conditions	
"Market" – *Target market*	Target market is port authorities, city halls and local government, companies working at the ports, marine litter control, oil spill response. The current target market is the ports where the software will be demonstrated.
"Market" – *Early Adopters*	OSPAC will be tested by port authorities at the pilot sites in Barcelona, Taranto and Alexandria. It is intended that use of the software will be extended to other ports in Spain and these are likely to be the early adapters.
"Market" - Competitors	Deltares is an independent institute for applied research in the field of water and subsurface. They provide a range of software products in relation to flood risk and sea level rise. Their expertise covers the full scope of flood risk management from risk calculations to practical support for making policy decisions. Their strengths are that they are well established and trusted organisation in relation to the software products and services they provide. Danish Metrological Institute is the official meteorological institution in Denmark and they are funded by the Department of Energy, Utilities and Climate. They provide a range of forecasting and early warning services that help to better inform planning and decision-making in economic and environment sectors. Their strengths are that they are an experienced and trusted source of oceanographic data and forecasting.
Go to Market – Use model	As mentioned above, OSPAC will be tested by port authorities at the pilot sites in Barcelona, Taranto and Alexandria. These port authorities are currently involved as co-developers of the software and the system will be demonstrated at these ports with their full cooperation. The system will be provided to the ports through engagement from Puertos del Estado, which is a partner in the development of the software and is the government agency responsible for the co-ordination of the Spanish port system. It is intended that use of the software will be extended to other ports in Spain. The software will depend on the availability of forecast models for respective ports.
Go to Market - Timing	It is intended that the product will reach TRL 7 by the end of the project. It is intended that it will reach TRL 9 in the three years after EuroSea has ended.
Go to Market – IPR Background	Background IP is the downscaled operational forecast models for wave, sea level, sea surface temperature and circulation based on boundary conditions provided by the CMEMS system. Ownership of the different models corresponds to the model developers: LIM-UPC, CMCC and PdE
Go to Market – IPR Foreground	Foreground IP is the software product that will be developed using existing forecast models and real-time data. Ownership of this software corresponds to the software developer, Nologin.

5.1.2 Exploitation Roadmap

Exploitation Roadmap – OSPAC software	
Actions	The OSPAC software will gradually progress to TRL 9 in the years after the end of the project by means of installing it at additional Port authorities in Spain. Its use will be extended to the whole Spanish Port system by means of a new project, where the ports and adjacent cities will fund the installation of selected components of OSPAC.
Roles	Nologin and Puertos del Estado will continue to collaborate to advance the software. Puertos del Estado will be responsible for the operation of the OPSAC software at the Spanish ports.
Milestones	Suggested indicative milestones include: ● OSPAC software progressing to TRL 8 where the product has been fully tested and demonstrated (first year post project) ● OSPAC software progressing to TRL 9 where the product is fully operational (second year post project) ● Extension of OSPAC software to additional ports of the Spanish port system (third year post project)
Financials **Costs**	Cost estimation to implement planned activities (1 year, 3 years). Provide information on the costs/investments needed to bridge the end of the project to the next steps planned and increase TRL or go to market (you may invest in a patent, in the realisation of a prototype, etc.). The cost estimation will depend on the availability of existing forecasting models. Cost estimation for further development of the software is under discussion and more accurate costs to be provided towards the end of the project.
Revenues	Grant funding to extend the use of OSPAC to more Spanish ports. Ports will fund the installation of selected components of OSPAC.
Other sources of coverage	Further funding opportunities and grant funding will be explored.
Impact in 3-year time	The rollout of the OSPAC software to the Spanish port system will provide real –time alerts leading to improved efficiency of operations at ports and cities, cost reductions and improved navigation safety.

5.1.3 Risks Assessment and Priority Map

KER Risk Assessment Map - OSPAC software							
	Description of Risks	**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
	Partnership Risk Factors						
1	Partners must agree on the exploitation intentions for the software beyond the project	*7*	*2*	**14**	Frequent meetings to discuss things	*8*	**Control**
2	Similar product of patent exists	*7*	*4*	**28**	A market analysis and patent search will be conducted	*8*	**Control**
3	Involvement of ports in the demonstration of the software	*8*	*3*	**24**	The ports are actively interested and involved in the development of the software	*8*	**Control**
	Technological Risk Factors						
4	There may be some technological issues with the software reaching TRL7 by the end of the project	*8*	*2*	**24**	This is not foreseen to be a major issue - regular meetings are taking place to ensure this does not happen	*9*	**Control**
	Market Risk Factors						
5	The KERs do not meet the market needs	*8*	*3*	**24**	The KERs are being co-developed with end users and in consultation with stakeholders to ensure that they meet their needs	*8*	**Control**
6	There may be some companies developing competing software products	*8*	*5*	**40**	Market analysis will be conducted, including an analysis of competitors	*8*	**Control**
7	Pricing may be too high for potential customers to buy in	*7*	*5*	**35**	Business plan for the software will be developed. This will include customer and market analysis to determine an appropriate market price for the software.	*7*	**Control**
	IPR/Legal Risk Factors						

KER Risk Assessment Map - OSPAC software							
	Description of Risks	**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
8	Issues around ownerhsip of IP	*6*	*6*	**36**	External IP expertise will be sought to advise EuroSea partners	*7*	**Control**
9	Issues around disclosure of IP	*7*	*5*	**35**	External IP expertise will be sought to advise EuroSea partners	*7*	**Control**
	Financial/Management Risk Factors						
10	Funding is not secured to advance the software to higher TRLs	*8*	*6*	**48**	Business plan will involve identifying funding sources for the further development of the software and input from potential buyers. Business plan will look at the next phase of development for OSPAC where the software will be introduced to ports in Spain and determine costs of this and assess funding sources.	*8*	**Control**
	Environmental/Regulation/Safety risks:						
11	N/A			**0**			**N/A**

5.1.4 Use options

KER's Exploitation route (how the KER will be further exploited) Oceanographic Services for Ports and Cities (OSPAC) software on port and city real-time alert to provide forecast of sea conditions			
Selected route		**Implementing actor**	**Yes**
DIRECT USE	Commercialisation: *deployment of a novel product/service (offered to the target markets)*	One partner	Nologin
		A group of partners	Nologin and the OSPAC partenrs providing addiitonal background models
	Contract research (*new contracts signed by the research group with external clients*)	A partner	
		A group of partners	
	A new research project (*application to public funded research programmes*)	A partner	
		A group of partners	X
	Implementation of a new university – course (*Note that a training course is a service*)	A partner	
		A group of partners	
		A new partnership	
INDIRECT USE	Assignment of the IPR	A partner	
		A group of partners	
	Licensing of the IPR	A partner	
		A group of partners	
	Development of a new legislation/standard	A partner	
		A group of partners	
	Spin- off	A partner	
		A group of partners	
		By assignment	
		By licensing	
	Other (*please describe*)		

Nologin and other partners would like to commercialize the software together. Furthermore, they need more funding, and they are currently identifying funding sources. The most straightforward would be a new research project to reach TRL9.

5.2 Solution for marine sensors to measure and forecast oxygen, heat and pH related Extreme Marine Events onsite for aquaculture – monitoring system for extreme marine events at aquaculture sites (KER leading beneficiary: Xylem-Aanderaa)

5.2.1 Characterisation Table

KER name: Solution for marine sensors to measure and forecast oxygen, heat and pH related Extreme Marine Events onsite for aquaculture	
Problem	Oxygen, heat and pH related extreme marine events can result in significant impacts to stock and equipment for the aquaculture industry. These include health impacts on fish, loss of fish and loss of infrastructure which could result in significant economic losses for aquaculture companies. Real time data is required as part of a solution to manage this problem along with forecast models that can provide a real time warning to aquaculture companies. Timely forecasts of extreme marine events and predictions of the probability of marine heat waves, deoxygenation events, or extreme wave events occurring can help the aquaculture industry make sound management decisions. The protection of juvenile fish, early harvest of adult fish, and the timely protection or removal of equipment and installations – are all supported by forecasts of the ocean temperature, pH, turbidity, and water current speed and direction. Such forecasts can potentially help save thousands of euros for aquaculture companies.
Alternative solution	Existing buoys and sensor systems can provide real time ocean observation data but do not provide the predictive capabilities required to make sound management decisions outlined above. There are services offering forecasting and prediction of coastal and ocean data prediction from meteorological institutes such as Barentswatch (waves, weather), DMI 5 day Ocean Forecast (met, waves, temp, currents, salinity), Irish Met office (temp, waves, met), Spanish met office (sea temp, wind waves and swell), but the resolution is low and essential parameters are missing. An integrated solution of both observed local data and forecasted data is not available.
Unique Selling Point USP - Unique Value Proposition UVP	The innovative solution is an increased operational ability connecting in-situ sensors (for oxygen, temperature, turbidity, currents, waves, salinity, pH, ORP and algae) via telemetry to land where data is processed in a user-friendly interface to give an environmental alert. The service, with the added value data alert products, increases the marketing potential of the commercial sensors. The service includes practical training to set-up, operate, maintain and interpret the data products. The system is being developed in collaboration with end users from the aquaculture industry (Mowi and CTAQUA) to determine requirements, maintenance capabilities and equipment available. The use of real time data to inform models to provide forecasting and predictions of extreme marine events will be a key USP. Developing high accuracy predictive models that work for end users and are easy to understand is key to the USP. Training for end users to be able to use the system is also part of the USP. At the core of the Xylem buoy systems, are the Xylem sensors producing an integrated set of data. Meta data on sensor status, data quality, measurement specifics and raw data is transmitted along with the reading from the sensor. This data is delivered through to the user in a specially designed user interface. In contrast to other buoys where integrators utilize different vendor's products, the Xylem buoys are backed with in-depth knowledge of the solutions installed, and ability to ensure the correct utilization of the data. The sensors utilized have a long track record for both scientific purposes and operational use by the aquaculture industry.
Description	This system is an application for marine sensors to measure and forecast extreme marine events at aquaculture sites in the NE Atlantic (Ireland) and W Mediterranean (Spain) through a setup including optimal sensor, location and measurement cycles for ocean observing. The

KER name: Solution for marine sensors to measure and forecast oxygen, heat and pH related Extreme Marine Events onsite for aquaculture	
	solution allows for real time management and will help to optimise aquaculture operations. Practical training will be provided to set-up, operate, maintain and interpret the data products produced.
"Market" – *Target market*	The current target customers are the aquaculture companies listed above (Mowi and AVRAMAR). Once the system reaches then the target market will be expanded to include other aquaculture companies. These companies will be identified through existing connections with Mowi and AVRAMAR, which is a technology centre with strong links to Spanish aquaculture companies.
"Market" – *Early Adopters*	The system is being developed in collaboration with end users from the aquaculture industry (Mowi and AVRAMAR) to help determine adequate sites for testing.
"Market" - Competitors	Specialising in Buoys: Axys, Datawell, EIVA, local integrators. Specialising in Sensors: Turner, Chelsea, AMT, Rbr, Nortek, RDI, SeaView
Go to Market – Use model	Xylem-Aanderaa will further develop the system and it will be rolled out at further aquaculture sites operated by Mowi and AVRAMAR. The system will be delivered by Xylem to new customers and a well-defined fixed-price service will be established.
Go to Market - Timing	The system is expected to reach TRL7 by the end of the project. It is currently intended that the system will be ready for market within one year of the project end.
Go to Market – IPR Background	The background IP include the sensors provided by Xylem-Aanderaa, telemetry solutions, buoys, moorings and platforms.
Go to Market – IPR Foreground	The foreground IP will include the combination of sensors providing real time data to improve forecasting models to give an environmental alert.

5.2.2 Exploitation Roadmap

Exploitation Roadmap	
Actions	The system to measure and forecast parameters such as oxygen, heat related Extreme Marine Events onsite for aquaculture will be delivered at two demonstration sites in Ireland and Spain within the duration of the project. The system will then be rolled out at further aquaculture sites. The system will be delivered by Xylem to new customers and a well defined fixed-price service will be established.
Roles	Xylem will continue to work with end users in the aquaculture sector and build on market experience to include in-situ sensors with new capabilities, depending on customer needs.
Milestones	Milestone 1: the system will be installed and operational at the two sites identified in Ireland and Spain (end of the project). Milestone 2: the system will be further developed to include extra sensors to measure additional variables (one year after the project end). Milestone 3: installation of the system at other sites (two years after project end)
Financials Costs	The cost and extent of the provision of the system and additional services will depend on customer specified needs. Costs will be estimated once the demonstration systems have been set up.
Revenues	Projected revenues and eventual profits once the KER will be used (1 and 3 years after use). The system consisting of buoy and prediction software will have an initial cost of estimated €100,000. In addition, there will be about €5,000 of repeatable revenue on a yearly basis for services and data delivery. The profit is about €50,000 per system, not taking into account development cost. Repeatable revenue is high margin if we do not take into account development cost, estimate about €3,500 per year.
Other sources of coverage	Grant funding and other R&D funding sources will be explored. Xylem-Aanderaa plan to expand the prediction part to cover needs in other markets such as ports and harbour. In addition, Xylem-Aanderaa continuously invest in product development that can be added to the system for future capability expansion.
Impact in 3-year time	The services will help to optimise aquaculture operations for new customers and could potentially reduce financial losses from stock damage caused by Extreme Marine Events. For Xylem-Aanderaa, the additional products and services developed as part of the Eurosea project will make us more competitive as a supplier of ocean and coastal observations systems. Our vision is that in addition to being able to deliver real time data, we are also able to do short term local predictions beyond what our competitors do. That could be a real win in many of our markets.

5.2.3 Risks Assessment and Priority Map

KER Risk Assessment Map - System to monitor extreme marine events at aquaculture sites							
	Description of Risks	**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
	Partnership Risk Factors						
1	Collaboration between partner institutes, system developer and end user is required	*8*	*2*	**16**	Regular meetings, continuous negotiation.	*8*	**Control**
2	If key experts leave partner companies, it will be difficult to replace them	*8*	*2*	**16**	Knowledge and information about the system will be shared internally to insure that this information will be known within partner companies	*7*	**Control**
	Technological Risk Factors						
3	The monitoring system and the predictive models fail to reach TRL7	*8*	*3*	**24**	There will be regular meetings with key partners and co-developers to ensure the system reaches the required TRL	*8*	**Control**
4	Potential issues with some sensors (e.g: Ph) not working as expected	*8*	*2*	**16**	To ensure sensors remain operational regular maintenance will be carried out and necessary action taken (e.g. anti-fouling measures, UV lights). Staff at the aquaculture sites will be trained in how to carry out routine maintenance of the buoy system.	*7*	
5	The requirement for long term maintenance of the buoy system at the aquaculture sites.	*7*	*6*	**42**	Staff at the aquaculture sites will be trained in how to carry out routine maintenance of the buoy system.	*7*	
	Market Risk Factors						
6	The system does not meet the customer needs	*8*	*2*	**16**	The system is being co-developed with end users to ensure that they meet their needs	*7*	**Control**

KER Risk Assessment Map - System to monitor extreme marine events at aquaculture sites							
	Description of Risks	**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
7	Similar products and competitors exist	*6*	*5*	**30**	The system is being co-developed with end users to ensure that they meet their needs	*7*	**Control**
8	The system is too difficult for aquaculture companies to operate	*7*	*4*	**28**	Training will be provided by the aquaculture companies on how to use the system	*7*	**Control**
	IPR/Legal Risk Factors						
9	Potential issues around ownership of IP developed in the project	*6*	*6*	**36**	External expertise will be provided to deal with IP management and related question from partners	*8*	**Control**
10	Issues around disclosure of IP	*6*	*6*	**36**	External expertise will be provided to deal with IP management and related question from partners	*8*	**Control**
	Financial/Management Risk Factors						
11	Additional funding is required to ensure system and services developed advance to higher TRLs	*7*	*4*	**28**	Funding sources will be identified for further development of the system beyond the project end.	*7*	**Control**
12	High maintenance cost for the buoy	*7*	*4*	**28**	The maintenance schedule for the buoy will be aligned with the regular maintenance activities of the aquaculture company	*7*	
	Environmental/Regulation/Safety risks:						
13	Potential safety issues around deployment of sensors, vessels use, etc	*8*	*4*	**32**	Ensure appropriate health and safety procedures are followed	*8*	**Control**

KER Risk Assessment Map - System to monitor extreme marine events at aquaculture sites							
Description of Risks		**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
14	Potential impact of the environment on sensors	*8*	*3*	**24**	Sensors are designed to withstand stresses from fish (bites, etc) and to be operational in the marine environment	*7*	**Control**
15	Potential impact of the sensors on the environment	*8*	*3*	**24**	Sensors are designed to not harm fish and the wider environment	*7*	**Control**

5.2.4 Use options

KER's Exploitation route (how the KER will be further exploited) Solution for marine sensors to measure and forecast oxygen, heat and pH related Extreme Marine Events onsite for aquaculture			
Selected route		**Implementing actor**	**Yes**
DIRECT USE	Commercialisation: *deployment of a novel product/service (offered to the target markets)*	One partner	Xylem-Aanderaa
		A group of partners	
	Contract research (*new contracts signed by the research group with external clients*)	A partner	
		A group of partners	
	A new research project (*application to public funded research programmes*)	A partner	
		A group of partners	
	Implementation of a new university – course (*Note that a training course is a service*)	A partner	
		A group of partners	
		A new partnership	
INDIRECT USE	Assignment of the IPR	A partner	
		A group of partners	
	Licensing of the IPR	A partner	
		A group of partners	
	Development of a new legislation/standard	A partner	
		A group of partners	
	Spin- off	A partner	
		A group of partners	
		By assignment	
		By licensing	
	Other (*please describe*)		

5.3 Low maintenance tide gauges (KER leading beneficiary: National Oceanography Centre)

5.3.1 Characterisation Table

KER name – Low maintenance tide gauge	
Problem	Globally, there is strong evidence of Climate Change–induced increases in sea level, tidal range and extreme events, elevating the risk to coastal populations. Developing economies are often most vulnerable to these hazards and require long-term sea level observations to understand and mitigate these threats. However, traditional monitoring solutions (tide gauges) are costly to install and maintain and in the absence of sustained funding, have tended to fall rapidly into disrepair.
Alternative solution	Tide gauges for monitoring Climate Change-related variability must comply with the internationally recognised standard of the Global Sea Level Observing System (GLOSS). These comprise a sea level monitoring component and a Vertical Land Motion (VLM) component. Some sea level instruments that are mounted underwater (e.g. pressure sensors) need regular maintenance, whilst others (such as pneumatic bubbler gauges or acoustic sensors) require complex calibrations. Annual labour-intensive levelling exercises are required to connect the data to the VLM instruments. In addition, tide gauge instrumentation has traditionally employed utility services for telecommunications systems and power.
Unique Selling Point USP - Unique Value Proposition UVP	The new tide gauge will harness Global Navigation Satellite System Interferometric Reflectometry (GNSS-IR), which allows the simultaneous measurement of sea level and VLM, eliminating the need for regular manual levelling exercises. The tide gauge will use above water radar technology for sensor longevity and ease of maintenance. Data will be delivered in near real time using inexpensive geostationary satellite and GSM telemetry solutions. Instruments will be solar powered. Customisation will be available to allow for monitoring of additional parameters (e.g. significant wave height, lightning strikes) as dictated by stakeholders.
Description	The product will be a high quality (scientific standard) tide gauge system, with low operating costs. The systems will comprise a core suite of low-maintenance sea level, air pressure and VLM sensors, which will be mounted on purpose-built marine grade steelwork, for added resilience. The system will harness low-cost or free telecommunications and power solutions and will allow customisation for monitoring additional environmental parameters to suit customer needs, including significant wave height and lightning detection.
"Market" – *Target market*	Since this is a scientific quality system suitable for monitoring Climate Change-related trends, the target market is likely to include scientific and research institutions and national and local agencies responsible for environmental forecasting, management and disaster response and mitigation, particularly in developing economies. Port authorities are less likely to be interested in the core VLM functionality, but should not be excluded from consideration. Geographically, the focus is likely to be on the Caribbean, South American, South West Indian Ocean and European markets. North America and the Pacific Ocean areas are dominated by US and Australian providers.
"Market" – *Early Adopters*	Early adopters are likely to include the countries where the prototype tide gauges will be demonstrated (Spain, Italy and Egypt), but the overseas developing economies of the Caribbean and South West Indian Ocean may also adopt this solution.
"Market" - Competitors	UK competitors include Gardline Marine and OceanWise Ltd, but these firms primarily cater to ports and harbour authorities who monitor for local navigation purposes. They do not have NOC expertise at installing systems to GLOSS standards and for scientific applications.
Go to Market – Use model	The prototype will be demonstrated during the project with the intention to reach a Technology Readiness Level 7. The use model will be determined before the end of the project, but may include the issuing of license agreements to sensor manufacturers to use the steelworks designs, instrument configurations and data processing algorithms.

KER name – Low maintenance tide gauge	
Go to Market - Timing	The time to market will be determined when the tide gauge has been tested and demonstrated at the ports listed above and has reached an appropriate TRL number, but the earliest likely time to market will be 2 years from initial installation (~October 2023).
Go to Market – IPR Background	The NOC is the partner responsible for designing and installing the tide gauge. NOC's experience in the design, deployment, maintenance and use of sea level monitoring systems has been acquired over ~50 years. This is not specifically referenced in the Consortium Agreement.
Go to Market – IPR Foreground	Under discussion with an external IP expert.

5.3.2 Exploitation Roadmap

Exploitation Roadmap – low maintenance tide gauges	
Actions	Data from each of the 3 prototype gauges will be evaluated by NOC in the context of other local tide gauge data to ensure it achieves the necessary quality level. Discussions between NOC and Puertos del Estado will take place with key stakeholders to understand what additional monitoring needs might be useful to accommodate in the final design. Feasibility of these additions will be explored by NOC. Discussions by NOC with key sensor manufacturers will be used to assess the appetite for issuing license agreements or other means of commercialisation.
Roles	NOC will lead quality assessment and technology enhancement. PdE will assist with stakeholder discussions.
Milestones	Suggested indicative milestones include: ● Tide gauge progressing to TRL 8 (first year post project) ● Tide gauges progressing to TRL 9 where the product is fully operational (second year post project) ● Extending the use of tide gauges to other ports internationally (third year post project)
Financials **Costs**	Detailed calculations of the cost to further develop the tide gauges will be provided nearer to the project end. Progress to TRL8 (first year post project): Data validation ~Eur 20K labour Stakeholder discussions ~Eur5K labour Technology enhancement testing~Eur 20K capital ~Eur 25k labour Progress to TRL9 (second year post project): Commercialisation discussion and agreements ~Eur20k
Revenues	Projected revenues from the tide gauges will be estimated closer to the end of the project. Grant funding from sources such as the European Innovation Council will also be pursued.
Other sources of coverage	Innovate UK funding calls, national and international coastal hazard monitoring calls (by Research councils, Environment Agency and DEFRA) and NOC internal funding from its commercial subsidiary will all be considered.
Impact in 3-year time	The use of new low-cost tide gauges in the three trial locations will provide information to improve safety of port operations and navigation locally and may potentially provide early warning and mitigation of natural disasters such as storm surges and tsunamis. Similar benefits will be achieved if this technology is adopted elsewhere within the three years post-project. Quantification of potential financial benefits is not possible and would depend upon the characteristics of installation locations and the natural disasters.

5.3.3 Risks Assessment and Priority Map

KER Risk Assessment Map: Low maintenance tide Gauges							
	Description of Risks	**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
	Partnership Risk Factors						
1	Partners should agree on the exploitation intentions for the tide gauges	*2*	*2*	**4**	Regular meetings between relevant partners to ensure that there is agreement on the exploitation intentions for the tide gauges.	*9*	**Control**
2	Potential risks around the involvement of stakeholders to test and demonstrate the tide gauges	*3*	*2*	**6**	Regular meetings to ensure the involvement of key stakeholders in the development of the tide gauges	*8*	**Control**
	Technological Risk Factors						
3	Delays in the development of the tide gauges to reach the targeted TRL	*7*	*2*	**14**	Determine relevant milestones to track progress on the development of the tide gauges	*9*	**Control**
	Market Risk Factors						
4	The tide gauge does not meet the market needs and requirements of customers	*7*	*3*	**21**	The tide gauges are being developed with input from key users to ensure the tide gauges meet their needs	*8*	**Control**
5	Existing tide gauge suppliers may be developing something similar	*5*	*4*	**20**	Market analysis of similar tide gauges being developed	*6*	**Control**
6	Customers are interested in the tide gauges but are not willing to pay for them	*9*	*5*	**45**	Pricing will be discussed with stakeholders at preliminary stages of the exploitation plan.	*9*	**Control**
	IPR/Legal Risk Factors						
7	Potential issues around ownership of IP	*3*	*3*	**9**	External IP expertise will be sought to advise EuroSea partners	*9*	**Control**

KER Risk Assessment Map: Low maintenance tide Gauges							
	Description of Risks	**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
8	Potential issues around the disclosure of IP	*3*	*3*	**9**	External IP expertise will be sought to advise EuroSea partners	*9*	**Control**
	Financial/Management Risk Factors						
9	Lack of resources to further develop the tide gauges beyond the end of EuroSea	*7*	*6*	**42**	Determine the funding required for further development and identify and review appropriate funding sources for this	*9*	**Control**
	Environmental/Regulation/Safety risks:						
	N/A						**N/A**

5.3.4 Use options

KER's Exploitation route (how the KER will be further exploited) Low maintenance tide gauge			
Selected route		**Implementing actor**	**Yes**
DIRECT USE	Commercialisation: *deployment of a novel product/service (offered to the target markets)*	One partner	NOC
		A group of partners	
	Contract research (*new contracts signed by the research group with external clients*)	A partner	
		A group of partners	
	A new research project (*application to public funded research programmes*)	A partner	
		A group of partners	
	Implementation of a new university – course (*Note that a training course is a service*)	A partner	
		A group of partners	
		A new partnership	
INDIRECT USE	Assignment of the IPR	A partner	
		A group of partners	
	Licensing of the IPR	A partner	
		A group of partners	
	Development of a new legislation/standard	A partner	
		A group of partners	
	Spin- off	A partner	
		A group of partners	
		By assignment	
		By licensing	
	Other (*please describe*)		

NOC will commercialise the result with the help of Puertos del Estado. After the project completion, they are also looking for potential grants for further funding.

5.4 Prototype sea level planning and scenario visualisation tool (KER leading beneficiary: ARUP, University of Cambridge)

5.4.1 Characterisation Table

Prototype sea level planning and scenario visualisation tool	
Problem	Flood Risk Management (FRM) in the coastal zone requires consideration of a range of hazards from the sea and their impacts inland, typically focusing on urbanised areas of population in need of protection. There is currently great uncertainty over how climate change induced sea level rise (SLR) can impact decision making for flood risk management in the coastal zone. The core problem in making informed decisions with SLR is that the large variation in potential future scenarios is currently not considered due to the complexity of the processes and calculations required to translate each physical scenario into societal impacts and this is not taken into account for economic decisions. The challenge therefore is to provide a full picture of the scientific predictions and associated uncertainty within the economic decision making framework.
Alternative solution	The current approach to assessment of risk of coastal inundation typically considers a range of extreme events, each with return periods and establishes an annualised risk. This annualised risk is projected into the future taking account of changing risk with sea level rise (SLR), and an optimum level of protection is established by comparing reduced risk from interventions with the costs of those interventions. However, this risk-based process is relatively complex, involving several analytical steps. This complexity means that the processing, time and cost of analysis are prohibitively large. Organisations who have the responsibility for managing coastal flood risk have limited time and budgets, which means that efficiencies have to be found in the risk assessment process. This generally has a direct impact on the number of Sea Level Rise possibilities that are considered. This does not provide a robust understanding of the extent to which investment decisions are sensitive to the choice of Sea Level Rise scenario. The initial decision to select the main Sea Level Rise projection therefore carries a risk that it will lead to a sub-optimal conclusion. With the high degree of uncertainty present in current sea level rise projections, a more robust approach is required to bring more of the SLR science through to decision makers.
Unique Selling Point USP - Unique Value Proposition UVP	This prototype provides a full picture of the scientific predictions and associated uncertainty within the economic decision making framework. The prototype visualises the economic damage resulting from a large set of SLR flood risk scenarios, accounting for the flood mechanisms at the coastal boundary. The prototype aims to develop a new streamlined approach to modelling the interactions between sea level hazards, economic activity and risk, bringing more science through the risk assessment process, resulting in better informed decision making and investment planning.
Description	In order to develop the prototype, Hull, on the east coast of the UK, was selected as a case study location. The basic premise of the prototype is to visualise the economic damage resulting from a large set of SLR flood risk scenarios. This requires a correspondingly large set of simulations to generate the flood risk data and, potentially, a prohibitive amount of computational expense to estimate the associated economic losses. With the aim of providing a full representation of the scientific uncertainty in the predicted damage, the aim was to reduce the detail in the engineering calculations, which translate the environmental conditions into building level flood impacts, and also the economic calculations that turn flood impacts into damage estimates. This was the alternative to reducing the number of SLR scenarios to be visualised. The modelling process can be summarised in 3 steps: 1) Specifying nearshore hydrodynamic conditions (still water level, storm surge profile, wave conditions). 2) Calculating the pathway of water onto the land through overflow and wave overtopping of high ground or defences.

Prototype sea level planning and scenario visualisation tool	
	3) Determining how the flood water spreads on land. Alongside the development of the modelling approach, a visualisation prototype was designed and built to receive, process and visualise the modelling outputs. The modelling method results in a very complex set of data focussed on a wide range of "scenarios". This visualisation prototype is a web-based interface to the data, allowing the user to easily select a scenario and, importantly, rapidly change the scenario and compare to other scenarios. In this way the user can immerse themselves in the data and get a feel for how decisions on the originating uncertainty levels alter the overall flooding in the region, its distribution and the resulting economic impact.
"Market" – *Target market*	The UK Environment Agency was involved as a key stakeholder during the development of the visualisation prototype and they represent a key target market. Other potential users include port operators and local coastal authorities; Marine Spatial Planners; insurance industry.
"Market" – *Early Adopters*	Early adopters are likely to be the UK Environment Agency and potentially Natural Resources Wales (NRW). Others may include those with an interest in the case study location including Hull City Council and Yorkshire Water.
"Market" - Competitors	Several international environmental and engineering consultancies operate in this space, including Jacobs, AECOM, Atkins and Binnies. There are also insurers and re-insurers with sophisticated catastrophe models. To date, all of their models/offerings generally concentrate on a more complex streamlined risk model; we have not yet see approaches that aim to bring through all of the science and make the results available in a live context.
Go to Market – Use model	The prototype will be further developed and sold in the market as a new product, or as an advanced aid to consultancy advice.
Go to Market - Timing	The prototype is currently at TRL 7 and it is intended that it will reach TRL 9 within the next three years.
Go to Market – IPR Background	The property data, sea level data, extreme levels, wave data, coastal defence data, topographic data and depth damage data (the MCM) are all background IPR, sitting with the data owners. Any modelling software used by the University of Cambridge will be background IPR.
Go to Market – IPR Foreground	The IPR for the prototype visualisation tool and associated code sit with ARUP. There may be some IPR in the University of Cambridge modelling method, which would site with them; this is to be discussed with IP experts.

5.4.2 Exploitation Roadmap

Exploitation Roadmap – Prototype sea level planning and scenario visualisation tool	
Actions	The visualisation prototype tool will gradually progress to TRL 9 over the next three years by developing it for use at other sites in the UK or worldwide. The tool will be expanded for use in other geographical areas.
Roles	ARUP will be responsible for the further development of the prototype at other locations with input from co-developers.
Milestones	Suggested indicative milestones include: • The prototype will progress to TRL 8 where it has been fully tested and demonstrated at another test location (first year post project) • The tool will progress to TRL 9 where the product is fully operational (second year post project) • Expansion of the prototype to additional sites in the UK (third year post project)
Financials **Costs**	The cost estimation will depend on the availability of data and computational requirements for the modelling of the flood and economic impacts. Cost estimation for further development of the prototype is under discussion and more accurate costs will be provided towards the end of the project.
Revenues	Grant funding to extend the use of the visualisation prototype tool to other coastal locations in the UK and/or worldwide.
Other sources of coverage	Further funding opportunities and grant funding will be explored.
Impact in 3-year time	The rollout of the visualisation prototype tool to other locations in the UK will help to assess the economic impact of sea level rise and provide a useful tool for better decision making in planning and regional development.

5.4.3 Risks Assessment and Priority Map

KER Risk Assessment Map: Prototype sea level planning and scenario visualisation tool							
Description of Risks		**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
	Partnership Risk Factors						
1	Partners must agree on the exploitation intentions for the prototype beyond the project	*7*	*2*	**14**	Frequent meetings to discuss the intentions	***8***	**Control**
2	Similar product or patent exists	*7*	*4*	**28**	A market analysis and patent search will be conducted	*8*	**Control**
	Technological Risk Factors						
3	There may be some technological issues with the prototype reaching TRL7 by the end of the project	*8*	*2*	**24**	This is not foreseen to be a major issue - regular meetings are taking place to ensure this does not happen.	*9*	**Control**
4	The tool requires a large set of simulations to generate flood risk data and high computational capability to estimate the economic losses	*8*	*4*	**32**	The detail in the engineering calculations was reduced.	*8*	**Control**
5	Replicating the UCAM modelling is prohibitively expensive or technically too challenging for commercial exploitation	*7*	*3*	**21**	Involve the right digital people alongside the technical modellers.	*8*	**Control**
	Market Risk Factors						
6	The KERs do not meet the market needs	*8*	*3*	**24**	The KERs are being co-developed with end users and in consultation with stakeholders to ensure that they meet their needs	*8*	**Control**
7	There may be some companies developing competing products	*8*	*5*	**40**	Market analysis will be conducted, including an analysis of competitors	*8*	**Control**

KER Risk Assessment Map: Prototype sea level planning and scenario visualisation tool							
	Description of Risks	**Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. (1 low- 10 high)**	**Probability of risk happening (1 low - 10 high)**	**Risk Grade**	**Potential intervention**	**Estimated Feasibility/Success of Intervention (1 low- 10 high)**	**Conclusion**
8	Pricing may be too high for potential customers to buy in	*7*	*5*	**35**	Business plan for the prototype will be developed. This will include customer and market analysis to determine an appropriate market price for the tool.	*7*	**Control**
9	Potential clients do not see the value in examining more of the science, instead seeing more value in current narrow detailed approaches	*7*	*5*	**35**	Clear communication of the benefits	*7*	**Control**
	IPR/Legal Risk Factors						
10	Potential issues around ownership of IP	*6*	*6*	**36**	External IP expertise will be sought to advise EuroSea partners	*7*	**Control**
11	Potential issues around the disclosure of IP	*7*	*5*	**35**	External IP expertise will be sought to advise EuroSea partners	*7*	**Control**
	Financial/Management Risk Factors						
12	Funding is not secured to advance the prototype to higher TRLs	*8*	*6*	**48**	Business plan will involve identifying funding sources for the further development of the tool and input from potential buyers. Business plan will look at the next phase of development for the tool where it will be used at other geographical locations.	*8*	**Control**

5.4.4 Use options

KER's Exploitation route (how the KER will be further exploited) Prototype sea level planning and scenario visualisation tool			
Selected route		**Implementing actor**	**Yes**
DIRECT USE	Commercialisation: *deployment of a novel product/service (offered to the target markets)*	One partner	ARUP
		A group of partners	
	Contract research (*new contracts signed by the research group with external clients*)	A partner	
		A group of partners	
	A new research project (*application to public funded research programmes*)	A partner	
		A group of partners	
	Implementation of a new university – course (*Note that a training course is a service*)	A partner	
		A group of partners	
		A new partnership	
INDIRECT USE	Assignment of the IPR	A partner	ARUP
		A group of partners	
	Licensing of the IPR	A partner	
		A group of partners	
	Development of a new legislation/standard	A partner	
		A group of partners	
	Spin- off	A partner	
		A group of partners	
		By assignment	
		By licensing	
	Other (*please describe*)		

6 Conclusion and Next Steps

As noted previously, as a number of the results have not yet been realised, it is intended for the EuroSea Exploitation Strategy to be a living document that will be updated as the results are realised. Results that have not yet been achieved outlined in Section 4 will be updated in a further draft of the plan.

There were several recommendations made by the Horizon Results Booster service providers on the commercially exploitable results outlined in Section 5 and these will be addressed as part of the business plan development for the KERs (D8.8). One key recommendation was for the ownership of the IP generated and responsibility for exploitation of the result to be decided as soon as possible. External expertise is being sought with input from the relevant partners who are exploiting the results to provide tailored guidance and advice on how to manage the IP generated within the project. This will provide advice on ownership of foreground Intellectual Property developed in the project requirement for each of the KERs and tighten up the IP agreements in place.

Another issue is the market risk factors that were identified for the KERs. These risks will be mitigated by completing a market analysis and this will be carried out as part of the business plan development for each of the KERs outlined in section 5 above. This will help to determine the early adapters and customers and will involve a detailed customer segmentation. The business plan will also set out Key Performance Indicators and milestones for the further development of the products. Funding for the further development of the KERs to higher TRLs and towards commercialisation is another potential risk. Identifying funding sources is another high-priority action and this will be carried out as part of the business planning work.