FPCUP ACTION 2021-2-33: COPERNICUS FOR MARINE SPATIAL PLANNING AND EU DIRECTIVES

1st Reporting Process//SGA#20/WP21
Country report for Portugal

➢ Task 1. Review of the official implementation of EU Marine Directives

➢ Task 2. Data gaps analysis in the implementation of EU Marine Directives

➢ Task 3. Identification on how to use Copernicus Data in the implementation of EU Marine Directives

Technical Team:

Scientific contents:
Miguel Fernandes (MARE-ULisboa/ARNET)
Giulia Sent (MARE-ULisboa/ARNET)
Ana C. Brito (MARE-ULisboa/ARNET)

PT Project coordination and revision:
Carolina Sá (PT Space)

Consortium:
Instituto de Hidráulica Ambiental de la Universidad de Cantabria - **IH Cantabria** (ES, Coordinator); Portuguese Space Agency - **PT Space** (PT); Centre National D'Études Spatiales - **CNES** (FR); Cyprus University of Technology - **CUT** (CY) and University of Tartu - **Tartu Observatory** (EE)

Collaborating Entities:

Aquatic Research Network (ARNET), Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal
Marine and Environmental Sciences Centre (MARE), Faculdade de Ciências, Universidade de Lisboa, Campo Grande 1749-016 Lisboa, Portugal
Portuguese Space Agency (PT Space), Estrada das Laranjeiras 205, 1649-018 Lisboa, Portugal

How to cite this document:

Fernandes, M., Sent, G., Brito, A.C. (2024). FPCUP ACTION 2021-2-33: COPERNICUS FOR MARINE SPATIAL PLANNING AND EU DIRECTIVES, Country Report for Portugal, October 2024, 61pp.

This activity is support by the European Union Caroline Herschel Framework Partnership agreement on Copernicus User Uptake under the specific grant agreement nº20, WP21 Action nº 33, "Copernicus for Marine Spatial Planning and EU directives", Implementing the FPA 275/G/GRO/COPE/17/10042.

CONTENTS

CONTENTS

List of Figures

BACKGROUND

Maritime sectors face several challenges regarding management and sustainability. It is becoming evident that these challenges are even more noticeable during the implementation of specific policies and strategies, particularly those related to marine data and information availability in the context of certain European Directives.

The Copernicus program is dedicated to deliver global data in a reliable and sustainable way. Numerous nations encounter difficulties in ensuring sustainable growth in specific industries, and the Framework Partnership Agreement for Copernicus User Uptake (FPCUP) focuses on harnessing Copernicus data for different maritime sectors within the framework of some EU Directives implementation.

The FPCUP aims at a better integration of Copernicus data in the European regulatory framework by increasing the number of users and applications derived from Copernicus through different actions. This report relates to Action 2021-2-33: Copernicus for Marine Spatial Planning and EU Directives that pursues "to promote the use of Copernicus data in the implementation of the EU Maritime Spatial Planning Directive (Directive 2014/89/EU; MSPD) and EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD), while contributing to the standardisation of methodologies in the implementation process".

This goal will be achieved through 3 specific objectives:

1. To examine the implementation of EU Directives by Member States using as pilot sites Spain, Portugal, Estonia, Cyprus, and France, and to identify data gaps.
2. To analyse how Copernicus satellite data products can improve those data gaps.
3. To use Copernicus data services in the implementation of EU Marine Directives.

To address these objectives within Action 2021-2-33, the following duties should be carried out:

- **Task 1** (Review of the official implementation of EU Marine Directives) is dedicated to carry out a review of the application of the two EU Marine Directives in each country.
- **Task 2** (Data gaps in the implementation of EU Marine Directives) is dedicated to identify data gaps and needs within the maritime sectors that are actively engaged in the implementation of the EU Marine Directives mentioned earlier.
- In **Task 3** (Identification on how to use Copernicus Data in the implementation of EU Marine Directives) the requirements of the EU Marine Directives and the data gaps detected in Task 2 will be contrasted with the benefits and opportunities offered by Copernicus data services. As a final result, a jointly standardised set of protocols/recommendations leading to the implementation of improved methodologies for use in national reporting will be compiled.
- In **Task 4** (Copernicus data to generate high spatial information for the implementation process) Copernicus spatial data will be analysed and processed to generate spatial maps related to specific maritime activities and uses required by the national authorities and stakeholders.

Task 1. Review of the official implementation of EU Marine Directives

1. Introduction to Task 1

Europe recognizes the importance of the marine environment and the necessity of its protection and conservation given the accelerated pressure on natural resources. In recent years, the European Union has focused on finding mechanisms to improve the protection and management of Member States' marine resources. Through the development of **Directive 2000/60/EC**, **Directive 2008/56/EC**, and **Directive 2014/89/EU**, Europe established mandatory tools and processes to enhance the quality of water and the marine environment and to foster sustainable ocean use. This report focuses on the 2008/56/EC and 2014/89/EU directives and their implementation in Portugal.

The **Marine Strategy Framework Directive (MSFD - Directive 2008/56/EC)** aims to establish a framework to achieve or maintain a good environmental status of European marine waters. To achieve this, Member States must develop marine strategies and programs of measures to prevent degradation and preserve marine ecosystems while also preventing and reducing negative inputs in the marine environment. These strategies must follow an ecosystem approach, considering the collective pressure of human activities.

The **Maritime Spatial Planning Directive (MSPD - Directive 2014/89/EU)** aims to establish a framework for maritime spatial planning (MSP) in the EU. Recognizing the need for an integrated and sustainable approach to managing maritime activities, it requires Member States to develop maritime spatial plans to ensure sustainable use of marine resources.

Together, these directives aim to ensure the conservation of aquatic ecosystems, maintain water quality, and promote the sustainable use of marine resources. In **Task 1**, we will focus on the stage of implementation of these directives in Portugal. The next section begins with an exploration of the directive's background, elucidating their origins and overarching objectives within the Portuguese maritime context. Subsequently, attention turns to an in-depth analysis of the national legislation governing MSP, encompassing its defined objectives, application area, and the roles of relevant competent authorities. Furthermore, the report delineates the structured phases involved in the Portuguese implementation process, spanning from initial diagnosis through to the development, implementation, and periodic review of maritime spatial plans. This structured approach not only highlights Portugal's commitment to EU guidelines but also identifies key challenges and achievements encountered during the implementation of the MSP, providing a comprehensive foundation for further analysis and discussion in subsequent sections of this report.

2. Marine Strategy Framework Directive (Directive 2008/56/EC) in Portugal

2.1. Portuguese legislation

The **Marine Strategy Framework Directive** (**MSFD**; **Directive 2008/56/EC**) was first transposed into the Portuguese Law in 2010, through the Decree-Law nº108/2010. It defined the competent authorities and introduced a plan of action that begins with the development of

Marine Strategies, followed by the development of a programme of measures for these strategies. Later, it was reviewed through the following instruments:

i) **Decree-Law nº201/2012**, which clarified that the Directorate-General for Natural Resources, Safety and Maritime Services (DGRM) is the competent entity to coordinate the implementation of MSFD, except in the autonomous regions of Portugal (Azores and Madeira), where DGRM will articulate the implementation with regional entities with competences on topics related with the sea and the environment. In addition, this document also creates a new subdivision, the extended continental shelf.

ii) **Decree-Law nº136/2013**, which defined marine regional convention, within the context of the MSFD and specified the national obligations, in terms of reporting and implementation of action plans, when the marine environment located in a region or subregion that is shared with other Member State, is in critical condition.

iii) **Decree-Law nº143/2015** that describes the guidelines for the follow-up meetings, ensuring an adequate and better articulation between entities.

iv) **Decree-Law nº137/2017** updates Annex III of MSFD, *i.e.,* the list of pressures and impacts to be assessed.

These documents established the legal framework to implement the Directive 2008/56/EC, in order to guarantee the good environmental status of marine waters until 2020. In this context, marine waters are considered: i) waters, seabed and subsoil on the seaward side of the baseline from which the extent of territorial waters is measured; and ii) coastal waters, defined by **Directive 2000/60/EC**, first transposed to Portuguese Law in 2005 (Law n.58/2005), their seabed and their subsoil, regarding aspects of the environmental status of the marine environment not covered by this Directive or other legislation.

2.1.1. Objectives

The overall goal of the Marine Strategy Framework Directive was to ensure Good Environmental Status (GES) of all EU's marine waters by 2020. To reach this, the specific objectives were to:

i) Protect and preserve the marine environment, ensuring that they are resilient to human activities;
ii) Prevent degradation and restore ecosystems, preventing further degradation of marine environments and restoring the ones negatively affected;
iii) Ensure sustainable exploitation of marine resources, managing activities such as fishing, tourism, and shipping without compromising the health of marine environments;

MSFD was designed to ensure that the EU's marine waters are ecologically healthy and able to support sustainable economic activities through a coordinated strategy among Member States, as part of an overarching EU-wide effort.

2.1.2. Application area

For the context of the MSFD, marine waters are part of the region North-East Atlantic and two sub-regions (Figure 2-1): Bay of Biscay and Iberian Coast and Macaronesia. For these, four subdivisions were considered (Figure 2-2):

i) Continental Portugal (Bay of Biscay and Iberian Coast sub-region). This subdivision covers waters off the mainland Portuguese coast;
ii) Azores (Macaronesia sub-region). This subdivision covers marine waters surrounding the Azores Archipelago;
iii) Madeira (Macaronesia sub-region). This subdivision covers marine waters surrounding the Madeira Archipelago;
iv) Extended Continental Shelf. This subdivision covers marine waters beyond the Exclusive Economic Zone (EEZ), extending into the deep-sea environments.

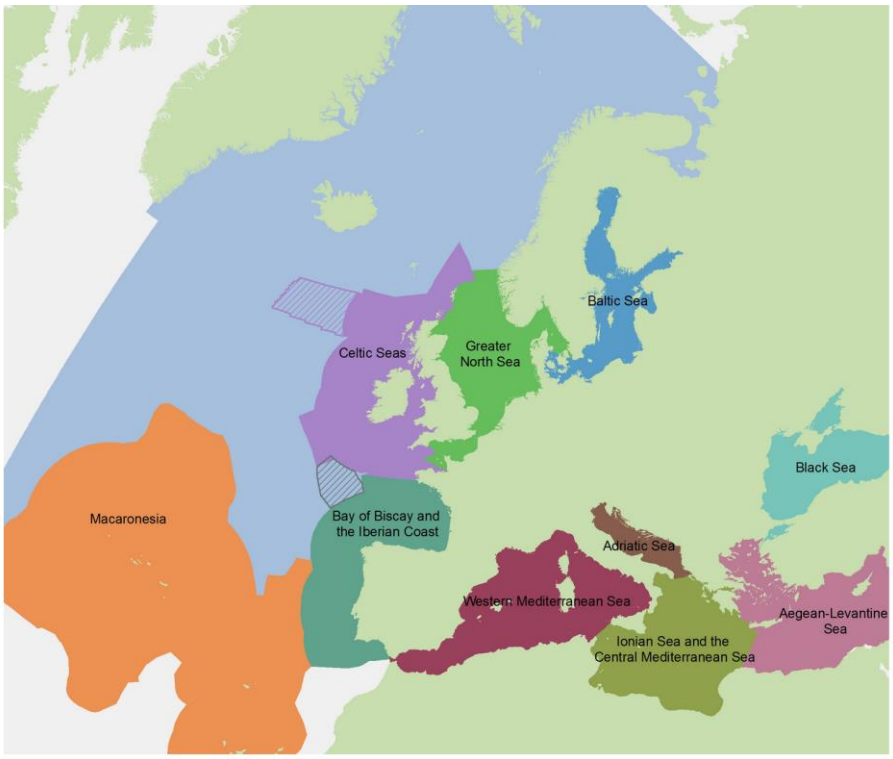


Figure 2-1. Marine regions and subregions of MSFD. From OAP (2024).

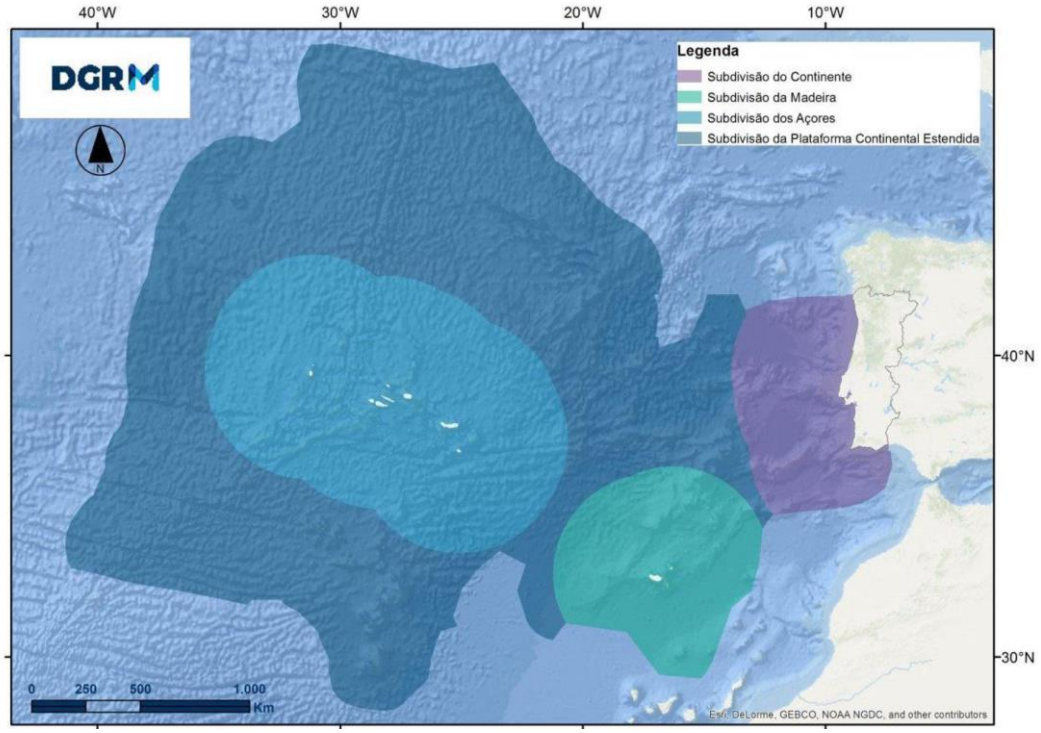


Figure 2-2. Subdivisions for the implementation of MSFD in Portugal. From MM, SRMCT, SRAAC (2020).

2.1.3. Competent Authorities

The government is responsible for promoting national marine management policies and enforcing the current legislation. This coordination can be performed in collaboration with the autonomous regions of Azores and Madeira. In Portugal, the competent Authorities for MSFD are the DGRM and the Regional Directorates for the Azores and Madeira archipelagos, namely: i) the Regional Directorate for Maritime Policies (DRPM) in Azores; and ii) the Regional Directorate for the Sea (DRM) in Madeira.

The DGRM is responsible for the coordination and development of the Marine Strategies, except for the Madeira and Azores subdivisions, *i.e.,* for two sub-divisions, the Continental Portugal (mainland Portuguese coast) and the Extended Continental Shelf. The Marine Strategies for these archipelagos are the responsibility of DRPM in Azores and DRM in Madeira. DGRM is also responsible for external communication with EU entities.

2.1.4. Phases of Marine Strategies

The Marine Strategies (MS) are developed and implemented in accordance with the plan of action that is composed of two parts: preparation and programme of measures.

The **preparation** step includes the following phases:

i) Initial assessment of the current environmental status of marine waters, the main impacts and pressures, as well as a socio-economic analysis of the implications of human activities on those environments. These should be done in accordance with Article 8 of the MSFD and completed by July 2012;

ii) Definition of Good Environmental Status (GES), according to the Article. This should also be achieved by July 2012;

iii) Establishment, by July 2012, of a series of environmental targets and associated indicators, to guide the process in achieving good environmental status. This is in accordance with Article 10;

iv) Establishment and implementation of a monitoring programme in order to assess and update the targets, previously defined. This is in accordance with Article 11 and should be implemented by July 2014.

The development of the **Programme of Measures** (PMe) designed to achieve or sustain good environmental status should be completed by 2015. This is in accordance with Article 13 of the MSFD. This programme of measures should enter into operation by 2016.

The development and implementation of Marine Strategies (MS) in Portugal is an iterative process composed of six-year cycles. The first cycle was implemented from 2012 to 2018. The second cycle should follow the same temporal approach. It was initiated in 2018 and should be finalised by 2024.

2.2. Portuguese application

2.2.1 First Cycle (2012-2018)

2.2.1.1 Initial Assessment, definition of GES and environmental targets

The report on the **Initial Assessment** of the MSFD contains a detailed characterization of each subdivision, in terms of their physico-chemical conditions, biodiversity, and trophic chains, as well as specific sections for description of pressures and impacts, according to Article 8 of the MSFD. It also has specific sections for the evaluation of GES (in accordance with Article 9) and the definition of environmental targets (in accordance with Article 10), as explained above.

The most important negative impacts that were identified in the First cycle for the Continental subdivision were the following: i) Contamination by hazardous substances, including priority substances and priority hazardous substances. (*e.g.,* metals, PCBs, PAHs) in the water, sediments, and biological material; and ii) Biological perturbation due to fishing activities. However, the lack of data is significant, mainly for underwater noise and marine litter. Regarding the Madeira and Azores subdivision, a list of several pressures and impacts were provided in the Initial Assessment report. For the Extended Continental Shelf subdivision, the most relevant activities that can affect the environment the most are fishing (due to bycatch) and shipping. Activities that can affect the integrity of seabed can also be of relevance in most offshore regions.

In terms of the evaluation of GES, environmental status was classified as 'GES achieved' and 'GES not achieved', for all subdivisions. Moreover, a 3-level of confidence in these evaluations was also provided; low, intermediate and high confidence. For the continental Portugal subdivision, GES was not achieved for some indicators of descriptor 1 (biodiversity; *e.g.,* sardine), descriptor 3 (commercial fish and shellfish), and descriptor 8 (contaminants), all with high levels of confidence. Descriptors 10 (marine litter) and 11 (underwater noise) were not evaluated due to lack of data. For the subdivision Madeira, descriptors 1 (biodiversity), descriptor 9 (contaminants in fish and seafood) did not achieve GES. Descriptors 4 (marine food webs), 10 (marine litter) and 11 (underwater noise) were not evaluated due to lack of data. For the subdivision Azores, descriptors 1 (biodiversity) did not achieve GES. Some indicators of Descriptor 3 (commercial fish and shellfish), 8 (contaminants) and 9 (contaminants in fish and seafood) were not evaluated due to lack of data. Descriptors 7 (hydrographical conditions), 10 (marine litter) and 11 (underwater noise) were also not evaluated due to lack of data. For the Extended Continental Shelf subdivision, descriptors 3 (commercial fish and shellfish), 4 (marine food web), 8 (contaminants) and 9 (contaminants in fish and seafood) were not evaluated due to lack of data. It is important to note that, given the remote nature of this subdivision, datasets for this subdivision were very limited, thus, all evaluations (when possible) were done with low level of confidence.

Regarding the **environmental targets**, these are specified in each Marine Strategy developed for each subdivision. For each subdivision, the following environmental targets were defined:

i) State Target: target for the status of a specific component of the marine environment, considering its physical, chemical and biological condition;
ii) Pressure Target: target for the level of pressure in the marine environment, which implies that the acceptable levels of a certain pressure are established;
iii) Operational Target: directly associated with the management actions required or implemented.

It is also important to note that for the continental subdivision, pre-existent environmental targets, in particular the ones derived from other legal instruments and international partnerships/agreements (*e.g.,* Habitats Directive), were also included in the list. A short summary of the targets defined for all subdivisions was also included in the report on the Monitoring Programme and Programme of Measures (DGRM, 2014).

2.2.1.2. Monitoring Programme (PMo) and Programme of Measures (PMe)

The contribution of the Programme of Measures (PMe) to the good environmental status (GES) strongly depends on the progress of the PMo to be developed and their capability to assess deviations from GES. On the other hand, some of the measures proposed in the PMe are related to the acquisition of new scientific knowledge, which have a direct relationship with the PMo. Thus, due to their organic association, Portugal decided to prepare both programmes simultaneously, anticipating the delivery of the PMe to 2014.

The **Monitoring Programme** (PMo) envisages the follow-up of the environmental status of marine waters, using the environmental targets as a comparative reference. In Portugal, due to data scarcity, it was decided to consider and analyse existent datasets obtained from different sources, *i.e.,* collected during on-going long-term monitoring programs, as well as during specific scientific projects (thesis, technical reports, etc.) to prepare the development of the PMos. A significant effort was made to promote coherence between all assessment methods used in the different Portuguese subdivisions, ensuring comparability of results. In the end, a list of guidelines and recommendations that were considered for the development of PMos in Portugal was produced and is provided in the same report (MAM, RMCT, SRA, 2014).

The **PMo** develops across four different axes:

- **Axis I**: contaminants present in species intended for human consumption;
- **Axis II**: descriptors that did not reach the good environmental status;
- **Axis III**: descriptors for which there are enough evidences that a deviation from the good environmental status will happen in the next 5 years;
- **Axis IV**: human activities that are prone to negatively affect marine protected areas and other sensitive and valuable marine environments.

A total of 11 thematic monitoring programmes were established in the continental Portugal subdivision, 13 in the Azores subdivision, 9 in the Madeira subdivision and 1 in the Extended Continental Shelf subdivision (MAM, RMCT, SRA, 2014). Some of these thematic monitoring programmes are shared across subdivisions (*e.g.,* Fish and Ships programme that aim to monitor the fishing and shipping activities in the marine waters).

The **Programme of Measures** (PMe) integrates a series of measures that were determined according to the initial assessment of Portuguese marine waters and the existence of measures within the context of other legislation or international agreements. Hence, the processing chain is constituted by the following steps: 1) identify an environmental target; 2) verify if the adequate measure already exists; 3) Analyse if the measure if sufficient to reach the environmental target; 4) define additional measures to ensure that the specific target is reached; and 5) evaluate the impact, including a cost-benefit analysis, for new measures. Additional measures, not directly related to the environmental targets but considered important to ensure good environmental status, were also included in the PMe. These, named complementary measures, include measures associated with knowledge gaps, measures in the area of education and dissemination, as well as measures derived from other instruments such as the ones used for MSP (described below). Moreover, specific protection measures, to ensure the establishment of marine protected areas, are also considered in the PMe.

A total of 14 MSFD measures were established in the continental Portugal subdivision, with 3 complementary measures and a large set of measures derived from other instruments (see details in DGRM, 2014). For the Azores subdivision, 14 MSFD and 2 complementary measures were established. Regarding the Madeira subdivision, 15 MSFD and 9 complementary measures were defined. For the Extended Continental Shelf subdivision, 3 MSFD measures were established. Similarly to what was described for the PMos, some measures are also shared across subdivisions (*e.g.,* DQEMsat, focused on the

implementation of the use of satellite images to acquire knowledge on the marine environment).

2.2.2 Second Cycle (2018-2024)

2.2.2.1 Initial Assessment, definition of GES and environmental targets

For the second cycle of the MSFD, it was necessary to update the initial assessment reports produced during the first cycle. The structure of the report is different from the first cycle. In this case, it is composed of four parts (MAM, RMCT, SRA, 2020):

- **Part A:** Provide the context and overview of the whole report and is a common section for all subdivisions;
- **Part B**: provides a detailed analysis of the main activities, pressures and impacts (Article 8 of the MSFD);
- **Part C**: provides a socio-economic analysis for the use of Portuguese marine waters (Article 8 of the MSFD);
- **Part D**: re-evaluation of the Good Environmental Status (Articles 8 and 9), as well as the definition of the environmental targets (Article 10).

The report on **Part B** of the Initial Assessment is focused on the description of activities, pressures and impacts, according to up-to-date Tables 2a and 2b of Annex III of the MSFD. Three reports are available, one for each subdivision, except for the Extended Continental Shelf, which is included in the report for the Continental Portugal subdivision.

Reports focused on the socio-economic analysis (**Part C**) of the subdivisions Continental Portugal, Azores and Madeira were provided during the second cycle. They all provide estimates for the degradation costs of Portuguese marine waters. However, they highlight the need to improve the methodology and to include additional information in the future, which should include the application of an approach based on Ecosystem-services. Nevertheless, most of the indicators used for these analyses are now provided by the Instituto Nacional de Estatística (INE; Statistics Portugal) in a more operational way.

In terms of the evaluation of GES (**Part D** of Initial Assessment), environmental status was classified as 'GES achieved' and 'GES not achieved', for all subdivisions. As in the previous cycle, a 3-level of confidence in these evaluations was also provided: low, intermediate and high confidence. In the second cycle of MSFD, the targets (when provided) are presented for each descriptor, in the same subsection as the results for the evaluation of GES.

For the continental Portugal subdivision, GES was not achieved for some indicators of descriptor 1 (biodiversity; *e.g.,* sardine), descriptor 3 (commercial fish and shellfish), and descriptor 8 (contaminants), some with high level of confidence. Although there were significant improvements, descriptors 10 (marine litter) and 11 (underwater noise) were not evaluated due to lack of data. For the subdivision Madeira, indicators of descriptors 3 (commercial fish and shellfish), 8 (contaminants) and 9 (contaminants in fish and seafood) did not achieve GES. No sufficient data were available to evaluate the new assessment criteria considered for Descriptor 1 (biodiversity). Descriptors 4 (marine food webs), part of descriptor 6 (seafloor integrity), 10 (marine litter) and 11 (underwater noise) were also not evaluated due

to lack of data. For the subdivision Azores, except for descriptor 7 (hydrographical conditions) that achieved GES, all descriptors had indicators that were not evaluated due to lack of data. This was particularly relevant for descriptors 1, 2, 3, 6, 8, 9, 10 and 11. For the Extended Continental Shelf subdivision, descriptors 1 (biodiversity), 3 (commercial fish and shellfish) and part of 6 (seafloor integrity) were not evaluated due to lack of data. It is important to note that, given the remote nature of this subdivision, datasets for this subdivision were very limited, thus, all evaluations (when possible) were done with low levels of confidence.

2.2.2.2. Monitoring Programme (PMo)

The **Monitoring Programme** (PMo) envisages the follow-up of the environmental status of marine waters, using the environmental targets as a comparative reference. The document produced in the second cycle is an update of the report previously submitted (first cycle) in 2014. It follows the same spirit as before, but resulted from a revision of the main strategic axes considering, for example, the updated requirements on data availability, legal updates, financial constraints, and main results from international discussion groups (MM, SRMP, SRMar, 2022).

In the second cycle, the **PMo** develops across four different strategic axes:

- **Axis I**: assess the elements that did not reach the good environmental status, evaluating if measures proposed were adequate;
- **Axis II**: assess the effectiveness of measures proposed, in order to evaluate if they were successful in promoting or maintaining the GES;
- **Axis III**: evaluate the descriptors for which there was the risk of not achieving GES;
- **Axis IV**: increase the confidence levels of assessments.

A total of 47 specific monitoring programmes were established in the continental Portugal subdivision, 46 in the Azores subdivision, 35 in the Madeira subdivision and 1 in the Extended Continental Shelf subdivision (MM, SRMP, SRMar, 2022). Some of these thematic monitoring programmes are shared across subdivisions (*e.g.,* Eutrophication monitoring in the Portuguese marine waters).

2.2.2.3 Programme of Measures (PMe)

In the second cycle of the MSFD, the **Programme of Measures** (PMe) was updated in order to maintain or achieve GES and achieve the proposed environmental targets (MM, SRMP, SRMar, 2023). It was also reviewed considering new documentation that became available (*e.g.,* Guidance reports), as well as the results of the evaluation of the first cycle of the MSFD. Hence, the definition of measures takes in consideration the main impacts identified in the initial re-assessment (second cycle) as well as the following criteria: 1) Ensure that MSFD environmental targets are achieved; 2) verify if the adequate measure already exists and if they are sufficient to reach the environmental targets; 3) include additional measures of special protection associated with MPA; and 4) include complementary measures, associated with knowledge gaps, as well as measures in the area of education and

dissemination, with the aim of defining new specific measures for monitoring programmes to be included in the PMe.

A total of 14 MSFD measures were established as described: i) 8 MSFD measures that provide information for all descriptors of the MSFD; ii) 8 measures focused only on D1 (biodiversity); iii) 1 measure focused on D2 (non-indigenous species); iv) 1 measure focused on D3 (commercially exploited fish and shellfish); v) 1 measure focused on D6 (seafloor integrity); vi) 1 measure focused on D7 (Hydrographic conditions); vii) 4 measure focused on D10 (marine litter); viii) 1 measure for both descriptors D1 and D6; ix) 1 measure for D5 (eutrophication) and D8 (contaminants); x) 1 measure for D8 and D9 (contaminants in fish and other seafood); xi) 1 measure for all descriptors except D2, D3 and D9; and xii) 8 measures for all descriptors. Similarly to what was described for the PMos, some measures are also shared across subdivisions (*e.g.,* management plans for marine resources, in particular fish stocks).

3. Maritime Spatial Planning Directive (Directive 2014/89/EU) in Portugal

3.1. Background

MSP has emerged as a crucial tool in managing and balancing competing uses of marine and coastal waters to achieve sustainable development goals. In the context of Portugal, MSP follows the guidelines of the **Directive 2014/89/EU**, which mandates EU member states to adopt a systematic approach to planning activities at sea. This directive aims to promote the sustainable use of marine resources and protect marine ecosystems.

Portugal, with a rich maritime heritage and extensive coastline, faces the dual challenge of harnessing its maritime potential while safeguarding marine biodiversity and ecosystems. The implementation of MSP in Portugal involves a structured process that begins with an initial diagnosis of current maritime activities and environmental conditions. This is followed by setting clear objectives for sustainable development and conservation, delineating maritime spatial plans that allocate space for various maritime uses and activities, and implementing these plans while ensuring continuous monitoring and adaptive management.

3.2. Portuguese Legislation

In Portugal, the **National Ocean Strategy (2021-2030)** is the public policy instrument that defines a strategic framework for the sustainable development of ocean-related economic activities. This strategy refers to MSP as an important instrument for developing a sustainable blue economy, alongside environmental and social developments. The first version of the strategy (2006-2016) highlighted the need for MSP in Portugal, and in 2008 the country defined the first steps of Portuguese MSP with the development of the "*Plano de Ordenamento do Espaço Marítimo* (POEM)" for mainland adjacent waters. However, through **Order No. 14449/2012**, POEM was not considered a planning instrument but only a reference study with the characterization of existing maritime activities in Portuguese waters.

The foundation for MSP was then established with the approval of **Law No. 17/2014** in April 2014, which defined the basis for MSP in the entire Portuguese maritime space, including the continental shelf beyond 200 nautical miles. To align with the European MSP Directive,

Portugal transposed its requirements into national law through **Decree-Law No. 38/2015**. This Decree-Law defined the responsible authorities and introduced the two types of national MSP instruments: the **Situation Plan** and **Allocation Plans**. The Situation Plan identifies the protection and preservation of areas within maritime space, as well as the spatial and temporal distribution of current and potential uses and activities. As for Allocation Plans, they provide information on the private use of certain areas or volumes of the maritime space that are not covered in the Situation Plan. Decree-Law No. 38/2015 also defines the juridic guidelines for the emission of **private use permits (TUPEMs)** for activities that could require the reservation of an area or volume of the ocean space for the use of the marine environment and its resources.

Additionally, in 2015, **Order No. 11494/2015** initiated the development of the Situation Plan, known as **"*Plano de Situação do Ordenamento do Espaço Marítimo* (PSOEM)"**, and designated the competent authorities responsible for its preparation and support. Following this premise and the national implementation of the MSFD and MSPD, the PSOEM was developed according to four subdivisions: the Mainland, Azores, Madeira, and the Extended Continental Shelf. In 2019, through **Resolution No. 203-A/2019**, Portugal adopted the PSOEM for the Mainland, the Madeira, and the Extended Continental Shelf subdivisions. The plan for the Azorean subdivision was approved in July 2024 by the Regional Government of Azores, through **Resolution No. 77-A/2024** to be presented to the Republic Government. All information regarding these strategic instruments is provided in the **PSOEM website** and corresponding **geoportal**.

3.2.1. Objective

The national MSP objective is to promote the sustainable economic exploration of its marine resources, focusing on supporting compatibility between different uses of the ocean space. These activities must be aligned with the principles of preservation, protection and recuperation of marine and coastal ecosystems, striving to maintain the good environmental state of Portuguese marine habitats. Attention must also be given to the prevention and mitigation of anthropogenic and environmental risks. Furthermore, Portuguese MSP aims to minimise future potential conflicts between different marine-related activities and strives to compile available information on the national maritime space.

3.2.2. Application Area

Maritime national space extends from the baselines until the outer limit of the continental shelf beyond 200 nautical miles and it can be organised into the following maritime zones:

- Territorial sea, from the baselines to the distance of 12 nautical miles;
- Exclusive economic zone, from the outer limit of the territorial sea to the distance of 200 nautical miles (includes the contiguous zone);
- Continental shelf, from the outer limit of the territorial sea and including the area beyond 200 nautical miles.

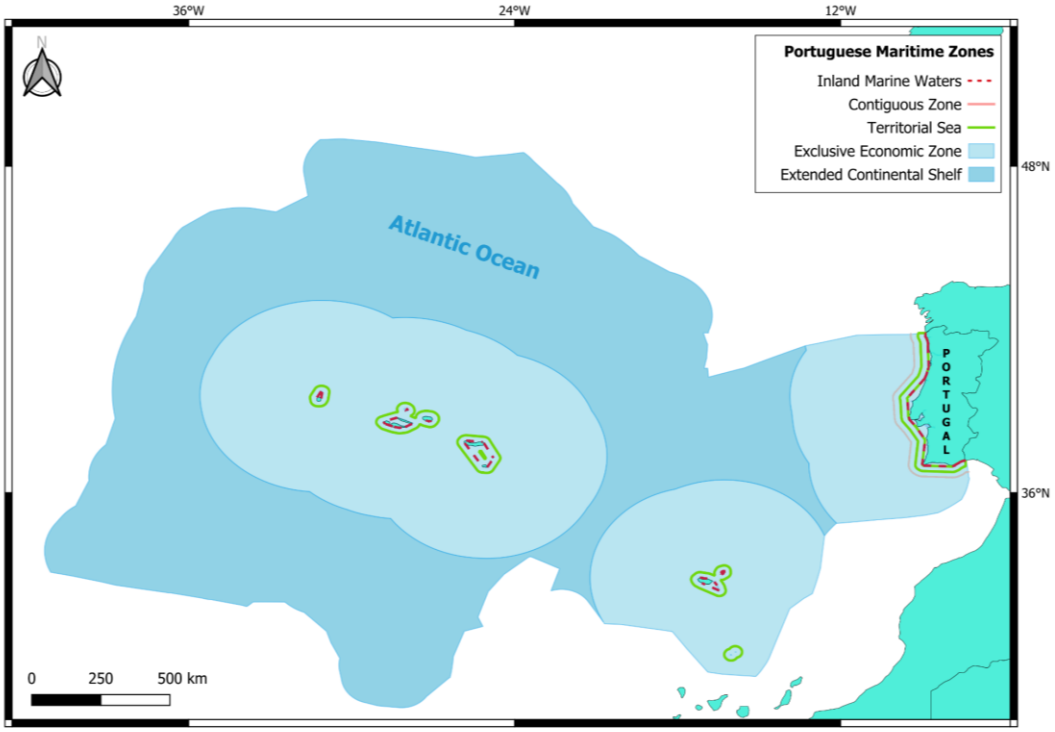


Figure 3-1. Portuguese maritime zones. Adapted from PSOEM Geoportal.

In accordance with the United Nations Convention on the Law of the Sea (UNCLOS), Portugal has sovereignty over the territorial sea and its associated airspace, following the same rights as the national land territory (including its inland marine waters). For the exclusive economic zone, the country has sovereign rights for exploring and conserving "the natural resources, whether living or non-living, of the waters suprajacent to the seabed and of the seabed and its subsoil", including the activities for the economic exploitation and exploration of the zone. Although the contiguous zone is part of the exclusive economic zone (*i.e.,* from the outer limit of the territorial sea to the distance of 24 nautical miles), its sovereignty rights are similar with the ones over the territorial sea and land territory. In the continental shelf, Portugal exercises rights of exploring the mineral and other non-living resources of the seabed and subsoil, together with living organisms that are in constant physical contact with the seafloor. In 2009, Portugal submitted a proposal for the extension of the continental shelf beyond 200 nautical miles. The evaluation of the current proposal started in august 2017, and it is still under deliberation (for more information, please see UN site).

3.2.3. Competent Authorities

The government is responsible for promoting national marine management policies and enforcing the current legislation. This coordination can be performed in collaboration with the autonomous regions of Azores and Madeira. Portugal's Competent Authorities for MSP are the Directorate-General for Maritime Policy (DGPM), the DGRM, the DRM, and the DRPM.

The DGPM is responsible for the monitorization of the MSPD, while DGRM is responsible for the coordination, preparation and development of the PSOEM in all maritime zones

between the baseline and the continental shelf beyond 200 nautical miles, except for the Madeira and Azores subdivisions. The PSOEM around these archipelagos are the responsibility of the DRM for Madeira, and DRPM for Azores. For these subdivisions, the plan encompasses all maritime zones between the baseline and the continental shelf up to 200 nautical miles.

3.3. The Implementation of the MSP in Portugal

3.3.1. Initial diagnosis

The Portuguese MSP seeks to promote a sustainable management of existing maritime activities, while trying to identify future possible uses of the ocean space. Following the existent legislation and the preliminary work of the POEM, the PSOEM must include:

- The spatial and temporal representation of the existing and potential values, uses and activities of Portuguese maritime space;
- The identification of the natural and cultural values with strategic relevance for environmental sustainability;
- The association to the geospatial elements related to the execution norms of restrictive zones of public utility and security (*e.g.,* national defence, civil protection, coastal management), the protection of natural and cultural resources, and the good practices observed in utilising the national maritime space.

3.3.2. Objectives

Portuguese MSP aims to organise and utilise the national maritime space, contributing to the sustainable development of the country. This instrument is responsible for the national management of the ocean space and strives to:

- Execute the objectives defined in Law No. 17/2014 and in the National Ocean Strategy;
- Contribute to the valorisation of marine resources to the national economy, promoting the sustainable exploration of the ecosystem services while safeguarding natural and cultural marine heritage;
- Contribute to the national cohesion, highlighting Portugal's archipelagos' dimensionality and interterritorial sea;
- Contribute to the spatial planning of the Atlantic Basin;
- Contribute to the recognition of Portugal geopolitical and geostrategic importance in the Atlantic Basin as the biggest coastal state in the EU;
- Contribute to the management of maritime activities and ensure juridic security and transparency of the TUPEMs conceded;

- Ensure the maintenance of the good environmental state of marine waters by preventing human-associated risks such as conflicts between uses and activities, and mitigating environmental hazards effects;
- Ensure the utilisation of the available information regarding the national maritime space;
- Contribute to ocean knowledge by reinforcing the national scientific and technology capacity.

3.3.3. Maritime Spatial Plan

The PSOEM distinguishes the activities that occur in national waters, considering current uses covered by the TUPEMs and uses with potential to be developed in identified areas and volumes of the plan. It compiles written and graphic information regarding the identification, and temporal and spatial distributions of the following existing and potential activities:

- Aquaculture and fisheries associated with infrastructures;
- Carbon geologic storage;
- Disposal of dredging spoils;
- Equipment and infrastructures;
- Fossil resources;
- Marine biotechnology;
- Marine natural heritage;
- Marine renewable energy;
- Metallic mineral marine resources;
- Multi-use platforms;
- Non-metallic mineral marine resources;
- Recreation, sports, and tourism;
- Scientific investigation;
- Ship sinking and artificial reefs;
- Subaquatic cultural heritage;
- Submarine cables, ducts, and outfalls.

It also identifies existing restrictive zones (*e.g.,* for maintaining marine security) and defines fisheries, navigation, the recreational use of the sea, and scientific investigation as common uses. Common uses refer to activities that do not need to reserve any maritime space to occur in the national space. However, if in any situation, a reservation of the ocean space is needed, these activities will need a TUPEM to occur.

Furthermore, PSOEM identifies the relevant territorial programs with expression on convergent areas. With that, it provides important information regarding possible coordination and articulation, especially regarding coastal erosion. Nature conservation and cultural heritage sites are also referred to in Portuguese MSP, including existing Marine Protected Areas, Natura 2000 sites, Vulnerable Marine Ecosystems, and National Ecological Reserve and archaeological important sites.

Currently, the adopted PSOEM is compiled into the following six volumes:

VOLUME I - Framework, structure and dynamics

VOLUME II - Methodology for the spatialization of uses and activities

VOLUME III - Specialization of the activities by subdivision

VOLUME IV - Characterization report by subdivision

VOLUME V - Environmental report

VOLUME VI - Non-technical environmental report

3.3.4. Implementing Maritime Spatial Plan and Monitoring

In accordance with Portuguese legislation, the entities responsible for Portuguese MSP development held several meetings with interested parties for the characterization of national waters. These meetings together with the work developed by different established working groups, were accompanied by the Consultative Commission for each subdivision, ending with the approval of the PSOEM for the Mainland and Extended Continental Shelf, and Madeira subdivisions.

After approval by the Consultative Commission, PSOEM followed the first cycle of public discussion in 2018. Additionally, an Environmental Report was developed by responsible authorities to assess the impact of implementing the PSOEM. After the conclusion of these processes, together with the collaboration with Spanish entities, as transboundary consultation, the PSOEM underwent alterations. In 2019, the PSOEM was finally adopted for the aforementioned subdivisions. Considering the Azores subdivision, the elaboration of the PSOEM was performed after the spatialization of the activities for the other subdivisions and is currently in the final stages of implementation.

The PSOEM is the principal instrument for the spatial management of the maritime national space, and it is recognized as the operational instrument responsible for Portuguese marine development. This instrument is inherently adaptable and can be updated as new activities

are foreseen to occur in the national ocean space. This process can be achieved through the development of Allocation Plans. The Allocation Plans consider uses and activities not covered in the PSOEM. After approval, the activities referred to in these plans are automatically updated in the PSOEM and in the corresponding geoportal.

Furthermore, the implemented PSOEM is subject to monitoring and evaluation, considering the objectives and indicators established for the Nacional Ocean Strategy. DGPM is the entity responsible for elaborating periodic evaluation reports that compile information on the monitoring of activities occurring in the national space, considering the socio-economic effects achieved and the potential observed environmental impacts. The government submits a report on the state of the National MSP every three years, indicating the execution state of the MSP instruments and the necessity to revise the plan.

3.3.5. Maritime spatial plan review

Considering the EU directive, maritime spatial plans may be revised at least every 10 years. In the Portuguese legislation, MSP review phase can occur 5 years after the date PSOEM entered into force. Exceptions to these can occur due to alterations in environmental conditions or to guarantee community agreement compliance.

4. Conclusions for Task 1

Portugal has made significant advances in implementing EU Marine Directives. However, the continuous monitoring and revision processes mandated by these directives need a constant influx of new data. These data are fundamental for the effective implementation of EU directives. In Portugal, the main challenges related to data usage for the marine environment are as follows:

- **Data Unavailability and Inaccessibility:** Relevant information on the marine environment is often unavailable. When available, issues related to data restriction and proprietary usage can arise, limiting access.

- **Heterogeneous Data Sources:** Obtaining relevant data for monitoring is extremely challenging due to the diverse nature of data sources. MSP and MSF strategies must integrate data from socioeconomic studies as well as ecological assessments, each with different types of information. This challenge is intensified by the changing formats and methodologies used in different studies.

- **Incomplete and Unsuitable Spatial and Temporal Resolution:** The data obtained may have specific spatial and temporal distributions but often lacks complete or suitable resolution for the tasks at hand. Available data may not be sufficient for studies requiring finer spatial scales or extensive temporal data to assess potentially adverse changes in the marine environment.

In conclusion, while Portugal has advanced in implementing EU Marine Directives, addressing the challenges of data availability, format heterogeneity, and resolution is essential

for ongoing and future success. This is particularly relevant in remote and less accessible areas.

Task 2. Data gaps analysis in the implementation of EU Marine Directives

5. Introduction to Task 2

Data gaps have been analysed through consultations with practitioners, stakeholders and relevant administrations within the context of the MSFD and the MSPD.

This technical report presents the results of a survey conducted among Portuguese stakeholders to fulfil Task 2. Additionally, it provides initial insights for Task 3 by examining how the identified data gaps among Portuguese stakeholders could potentially be addressed using Copernicus data. Preliminary results for Task 4, which explore the services of higher interest required by the different maritime sectors, are also included. The **objectives of the survey** are:

- To identify the current needs and gaps of Portuguese stakeholders to better understand their use of Copernicus data, across various maritime sectors in implementing both EU Marine Directives (Task 2 and Task 3).
- To identify the Copernicus services of highest interest to the maritime sectors involved in the implementation process (Task 4).

6. Methodology

The survey was developed with contributions from different action partners, resulting in a final English version containing 34 questions (Annex I). Coordination with other actions, as part of Working Group Oceans, specifically Action 2021-2-42 (Copernicus uptake for the maritime sector) and Action 2021-2-47 (Coastal coordination of user needs and methodologies), ensured efficiency and minimised stakeholder fatigue by including relevant questions for all three actions. The survey was then translated into the languages of the participating countries for dissemination.

Survey questions were organised in the following sections:

- GENERAL INFORMATION (Q.1)
- MARITIME SECTORS & MSP DIRECTIVE (Q2-Q13)
- MARITIME SECTOR & MSP GAPS (Q14-Q18)
- MSFD DIRECTIVE (Q19-Q23)
- MSFD GAPS (Q24-Q27)
- COPERNICUS (Q28- Q34)

Each partner independently identified stakeholders and disseminated the survey using contacts from previous projects, email campaigns, social media, and personalised invitations

to maximise participation and gather diverse perspectives. The objective was to gather diverse perspectives, maximise participation and enrich the outcome of the project.

In the Portuguese case study, the survey was disseminated to 104 stakeholders nationwide. Stakeholders were identified through the contact list of the Portuguese Space Agency and the Atlantic International Research Centre (AIR Centre), and were contacted by email (general mailing list and individual email reminders). The list of contacts has been derived from previous projects related to the maritime sector. From the identified contacts, responses from 13 stakeholders were obtained.

7. Results for survey conducted in Portugal

7.1. General overview of stakeholder's profile for the maritime sector in Portugal

The survey in Portugal received a total number of 13 responses. A list with the stakeholder's participant in the survey is presented in Annex II: Stakeholders for Portuguese survey.

The profile of the stakeholders that responded to the survey is shown in Figure 7-1. Regarding their **entity type**, they are mostly from public administration (8), followed by research institutes (3). Regarding their **area of activity** (coastal, marine, inland), since respondents could select more than one area, only two selected one area of interest. In Portugal, most of the entity's activities are located in both coastal and marine areas, with nine responses each, followed by inland areas with three responses.

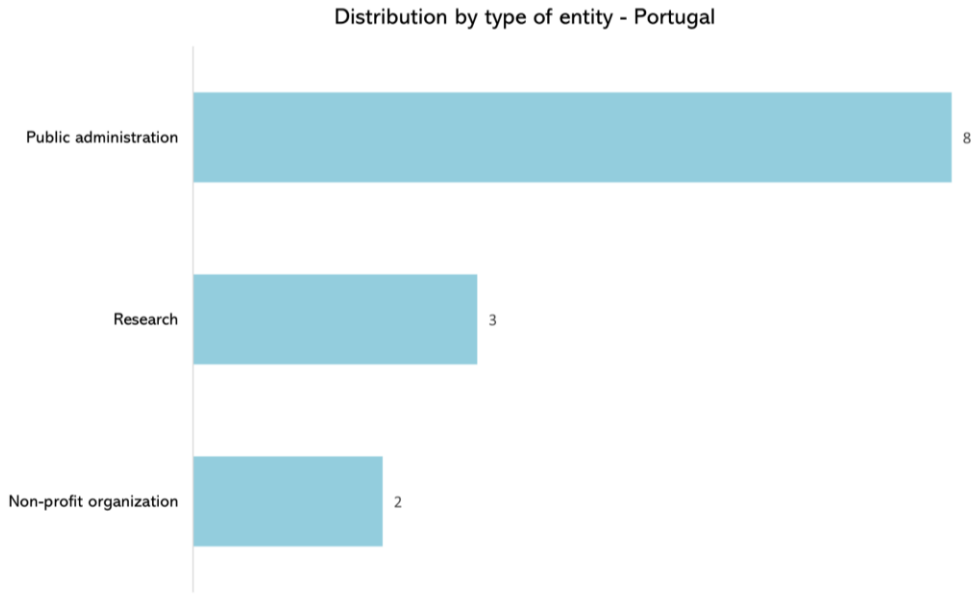


Figure 7-1. Stakeholder profiles by type of entity for Portugal.

Stakeholder's affiliations with various sectors were assessed using multiple-choice questions, so that respondents could select more than one sector of their interests or involvement. Results are shown in Figure 7-2. Regarding maritime sectors, the analysis indicates that "species conservation and protected areas" sector received the highest number of responses (8), followed by "ports and harbours" sector (7).

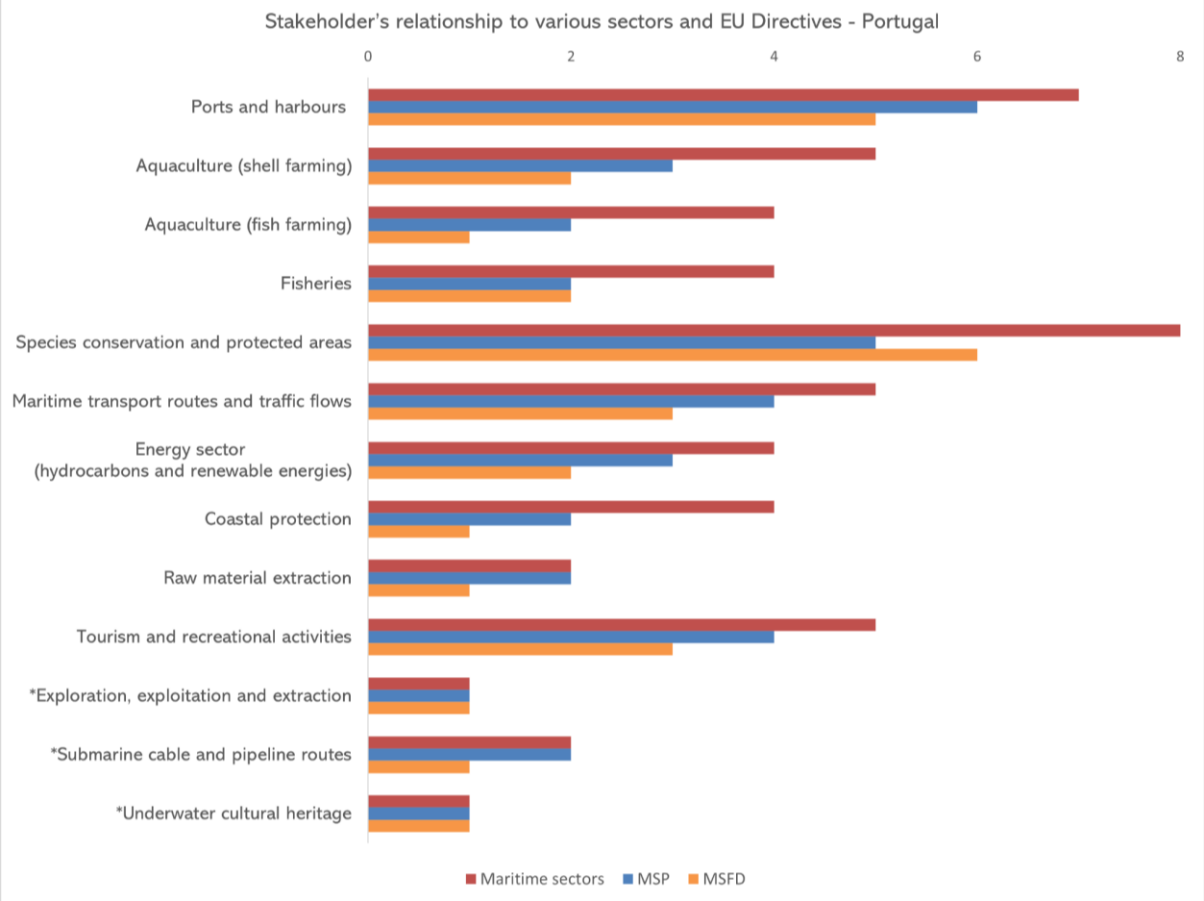


Figure 7-2. Stakeholder's relationships to various sectors and EU Directives implementation. (*) - information regarding the activities of the respondents who choose the category “others”.

Regarding the stakeholder’s profile involved in implementation of the EU Marine Directives in Portugal, the analysis revealed that 8 participants had direct participation on the implementation of one of the directives, 6 on MSP and 7 on the MSFD. Considering the answers provided, 4 entities include respondents who have worked or participated in the implementation of both directives (the DGRM, DRPM, the DRM, and the AIR Centre). The profile of the respondents that have participated in the implementation of these Directives is mainly from public administration, with significant impact on the implementation of these strategies in Portugal.

7.2. Stakeholder’s areas of interest for the maritime sector in Portugal

Stakeholder's areas of interest were evaluated with multiple-choice questions, so that respondents could rate different areas by order of interest (Figure 7-3). The results indicate that the areas of higher interest for the maritime sector in Portugal are the identification of pressures and environmental monitoring, and ship detection. Interestingly, a shared lower interest emerged for the services related with the effects of climate change across most maritime sectors. Figure 7-4 shows a detailed analysis of the services of interest for each of the maritime sectors listed in Figure 7-2.

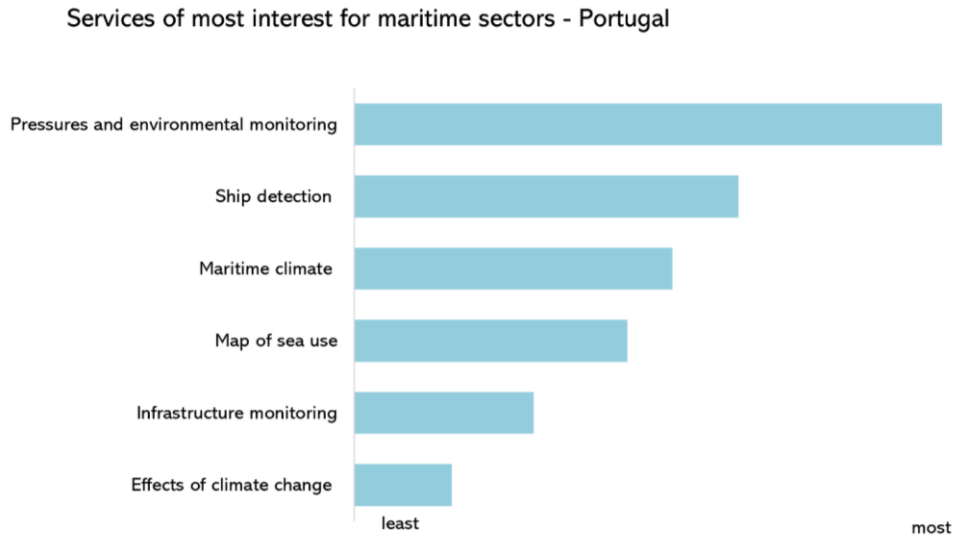


Figure 7-3. Stakeholder areas of interest for the Portuguese maritime sectors. (least = minimum interest, most = higher interest).

For the stakeholders involved in **"Ports and harbours"** the most interesting services are related to "pollution and environmental monitoring", followed by "ship detection". "Infrastructure monitoring" received the lowest level of interest.

For the stakeholders involved in **"Aquaculture (shell farming)"** the most interesting services are related to "pollution and environmental monitoring", followed by "oceanographic data". "Ship detection" received the lowest level of interest.

For the stakeholders involved in **"Aquaculture (fish farming)"** the most interesting services are related to "ship detection", followed by "oceanographic data". "Water quality data" received the lowest level of interest.

For the stakeholders involved in **"Fisheries"** the most interesting services are related to "fishing area characterization", followed by "ship detection". "Effects of climate change" received the lowest level of interest.

For the stakeholders involved in **"Species conservation and protected areas"** the most interesting services are related to "pollution and environmental monitoring", followed by "habitat distribution area and trends". "Effects of climate change" received the lowest level of interest.

For the stakeholders involved in **"Maritime transport routes and traffic flows"** the most interesting services are related to "ship detection", followed by "pollution and environmental monitoring". "Sea ice covered area" received the lowest level of interest.

For the stakeholders involved in the **"Energy sector"** the most interesting services are related to "selection of suitable renewable energy locations", followed by "energy production surveying". "Effects of climate change" received the lowest level of interest.

For the stakeholders involved in **"Coastal protection"** the most interesting services are related to "bathymetry and sedimentation", followed by "monitoring and prevention of coastal erosion". "Characterisation of emerged coastal areas" received the lowest level of interest.

For the stakeholders involved in **“Raw material extraction”** the most interesting services are related to “maritime climate”, followed by “map of sea use”. “Effects of climate change” received the lowest level of interest.

For the stakeholders involved in **“Tourism and recreational activities”** the most interesting services are related to “identification of pressures”, followed by “water quality”. “Landscape quality” received the lowest level of interest.

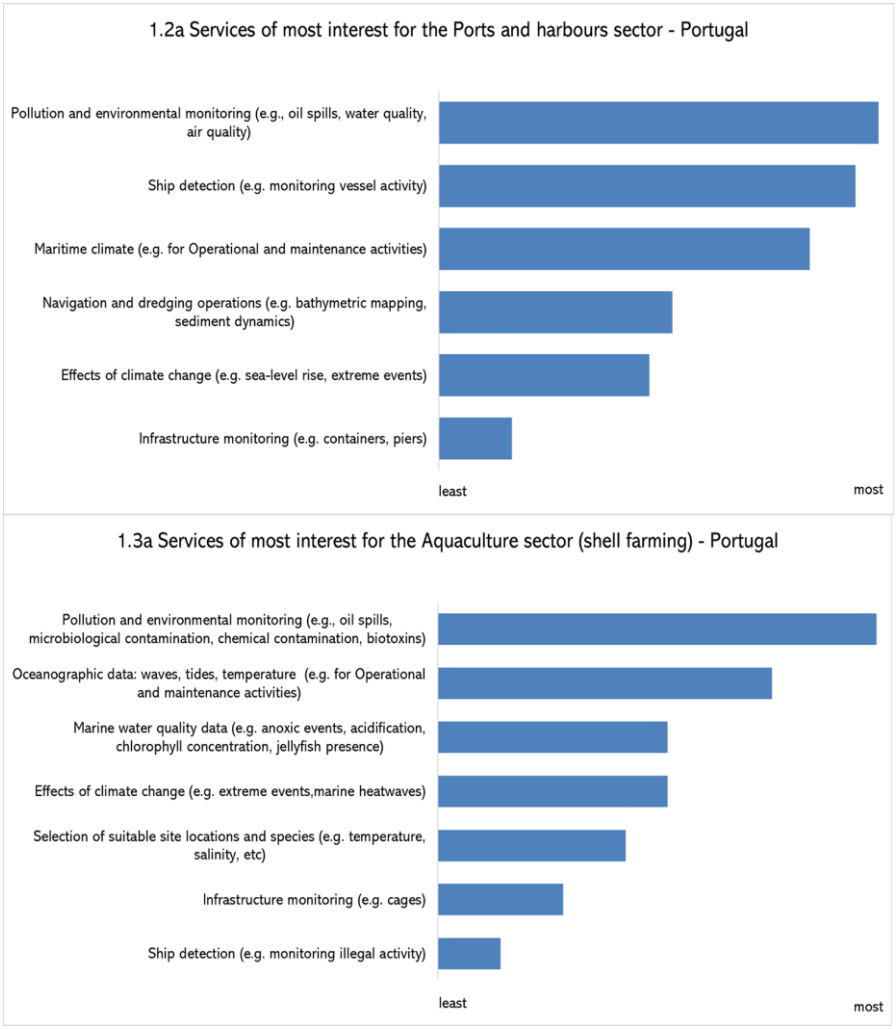


Figure 7-4. Detail of stakeholder's areas of interest for the maritime sector in Portugal. (least = minimum interest, most = higher interest).

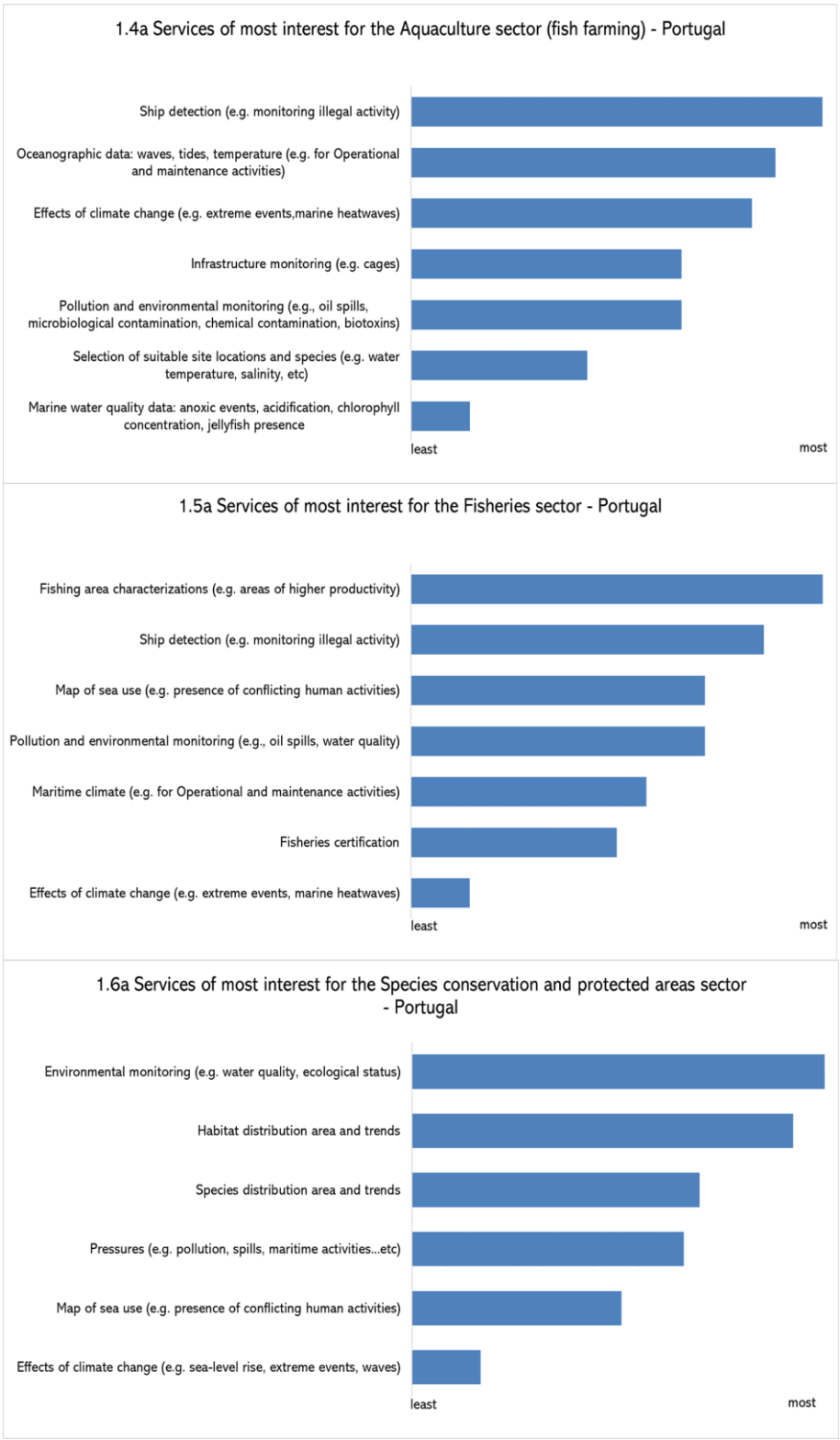
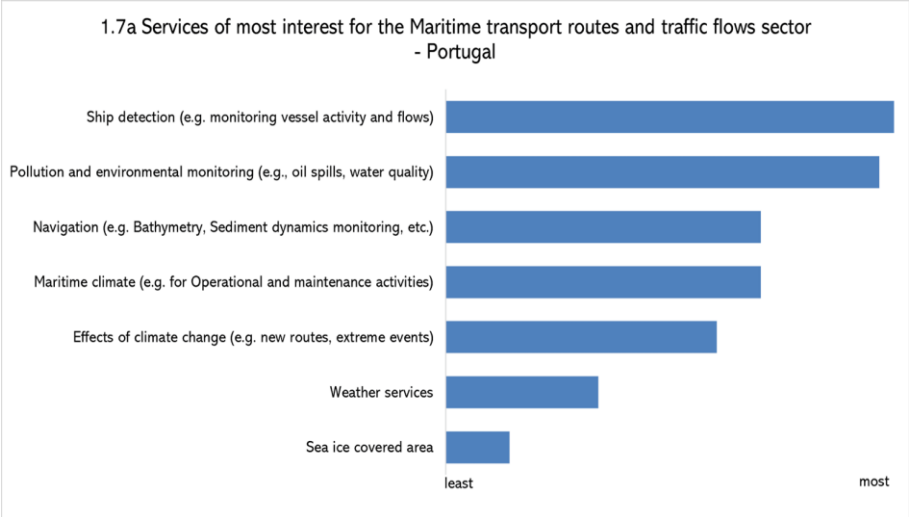
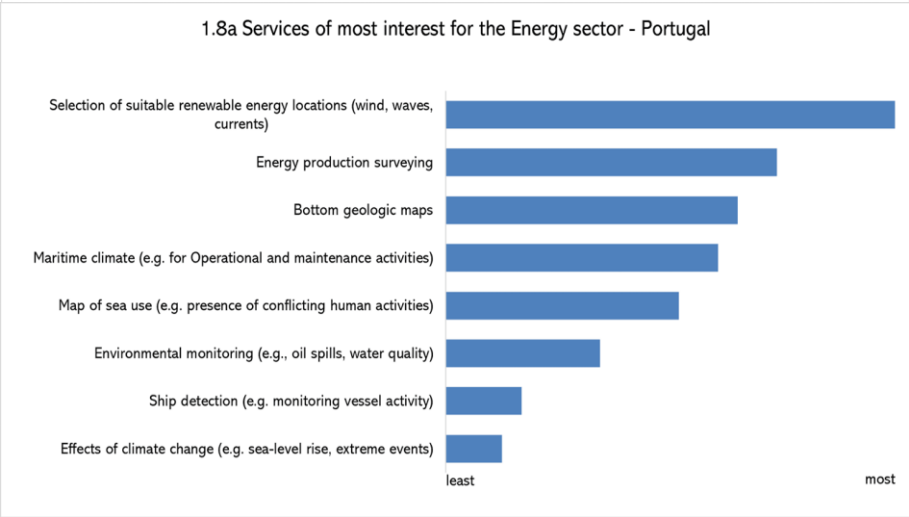


Figure 7-4. (Continuation) Detail of stakeholder's areas of interest for the maritime sector in Portugal. (least = minimum interest, most = higher interest).





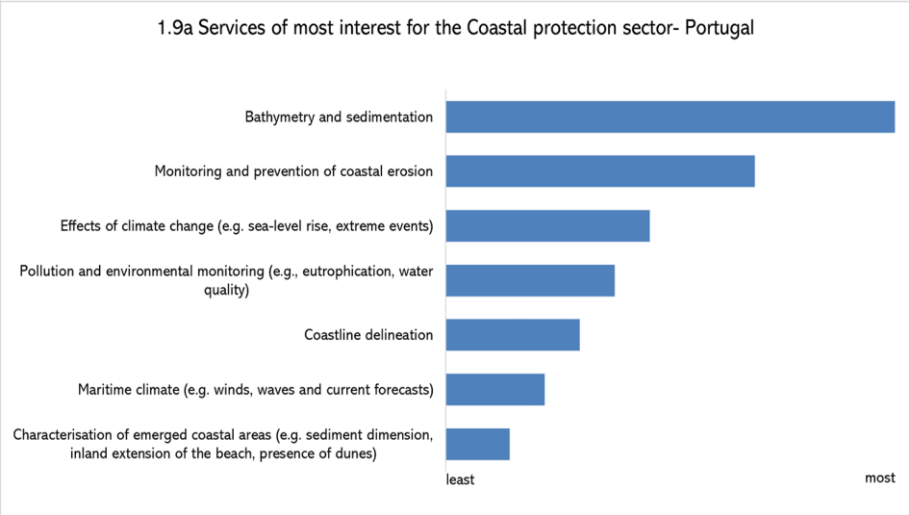


Figure 7-4. (Continuation) Detail of stakeholder's areas of interest for the maritime sector in Portugal. (least = minimum interest, most = higher interest).

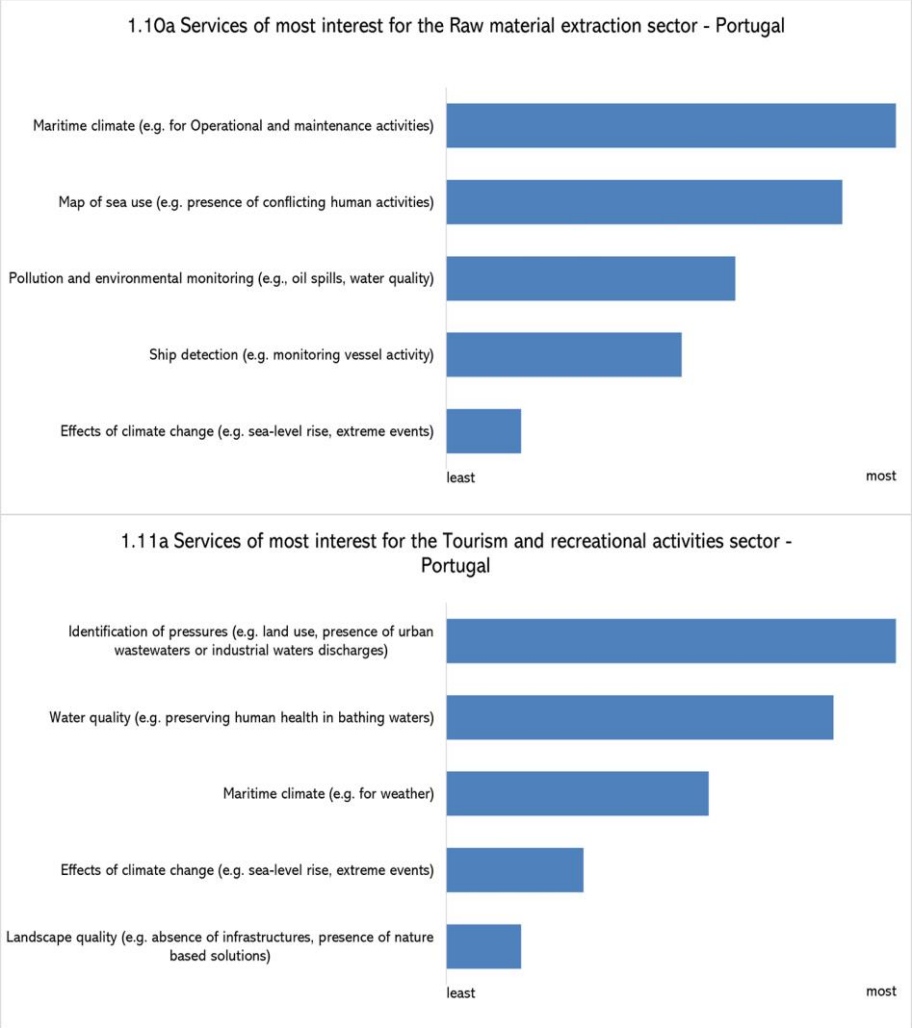


Figure 7-4. (Continuation) Detail of stakeholder's areas of interest for the maritime sector in Portugal. (least = minimum interest, most = higher interest).

7.3. Data gaps and needs in the implementation process of EU Marine Directives in Portugal

The survey helps to highlight the current needs and gaps among Portuguese stakeholders regarding the use of available data and the requirements identified. This assessment is performed with stakeholders from different maritime sectors and considers the participants in the implementation of both EU Marine Directives (*i.e.,* MSFD and MSP).

7.3.1. Stakeholders involved in EU Marine Directives implementation

7.3.1.1. Problems encountered when working with the data available

Regarding general data usage, most of Portuguese stakeholders involved in MSP Directive implementation (6), identified “inaccessible data or unavailability of data” (23%) and “heterogeneous sources” (18%) as the most common challenges encountered when working

with data. In contrast, the “complexity of the data”, “data format” and “data reliability” do not present so many problems to the participants (around 5% each). For the stakeholders involved in the MSFD implementation (7), when asked about the most common problems encountered when working with data, mentioned the challenges associated with “inaccessible data or unavailability of data” (21%) and “incomplete temporal distribution” (18%). In contrast, the least referred were problems associated with “data format”, “heterogeneous data collection methodologies” and “lack of tools to manipulate and visualise the data” (around 4% each). For more information, please see Figure 7-5.

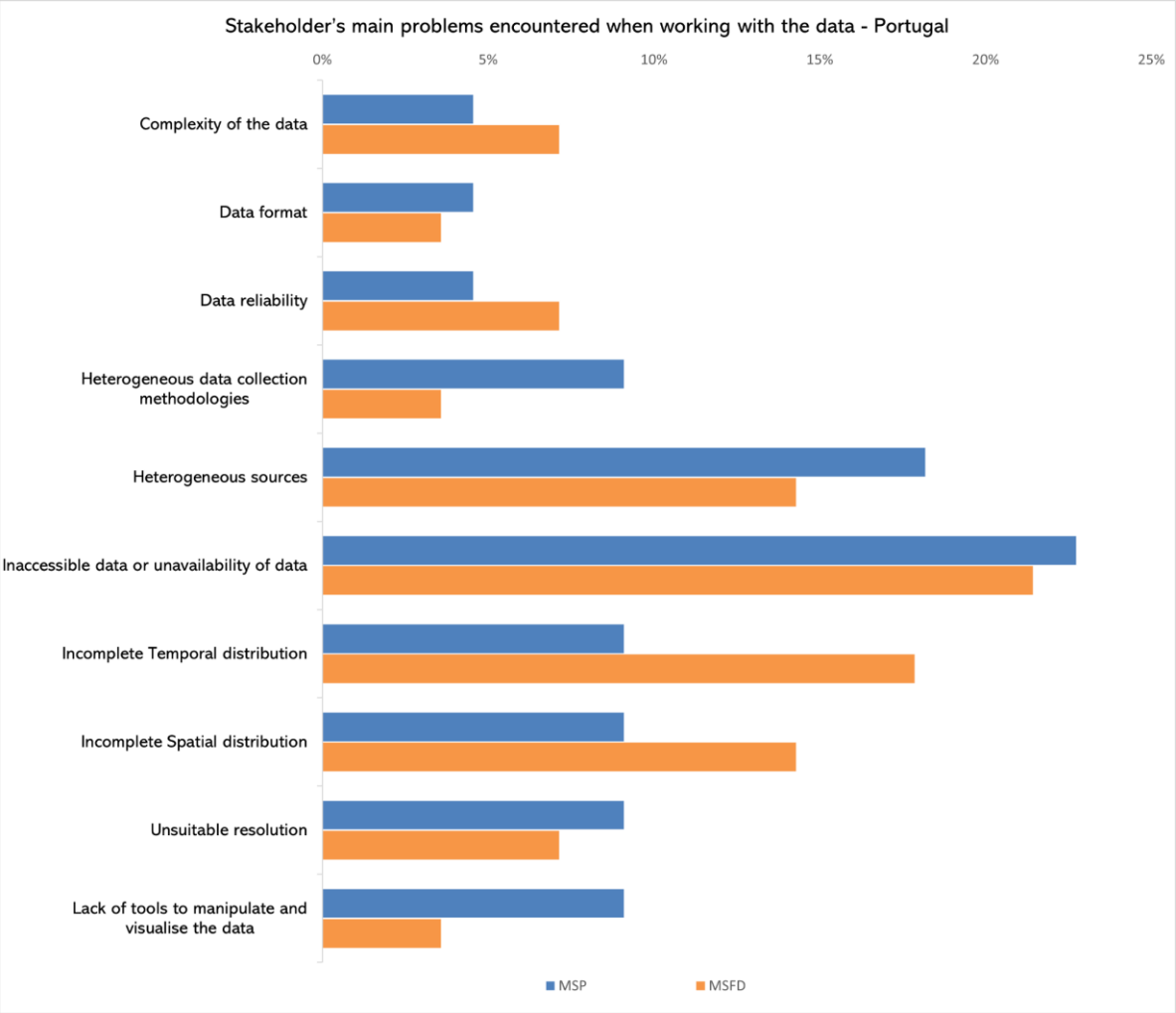


Figure 7-5. Stakeholder’s main problems encountered when working with the data available in the implementation process of EU Marine Directives in Portugal

7.3.1.2. Needs regarding temporal extent and spatial resolution of the data

Portuguese stakeholders involved in MSP Directive implementation (6), when asked about their needs regarding temporal extent of the data currently available (Figure 7-6A), expressed a clear need for “long-term historical data series (years)” (38%) but also for “real time or near real time (hours)” data (31%). Regarding their needs concerning spatial resolution of data

(Figure 7-6B), they expressed the identical need for “medium (5-30m)”, “low (≥250m-1Km)” and “high (1-5m)” spatial resolutions (23% each).

Considering the stakeholders involved in MSFD implementation (7), when asked about their needs regarding temporal extent of the data (Figure 7-6A), expressed a clear need for “long-term historical data series (years)” (50%) and for “long-term projections (month)” (25%). Their spatial resolution needs (Figure 7-6B) included “low (≥250m-1Km)” and “reduced (>1km)” spatial resolutions.

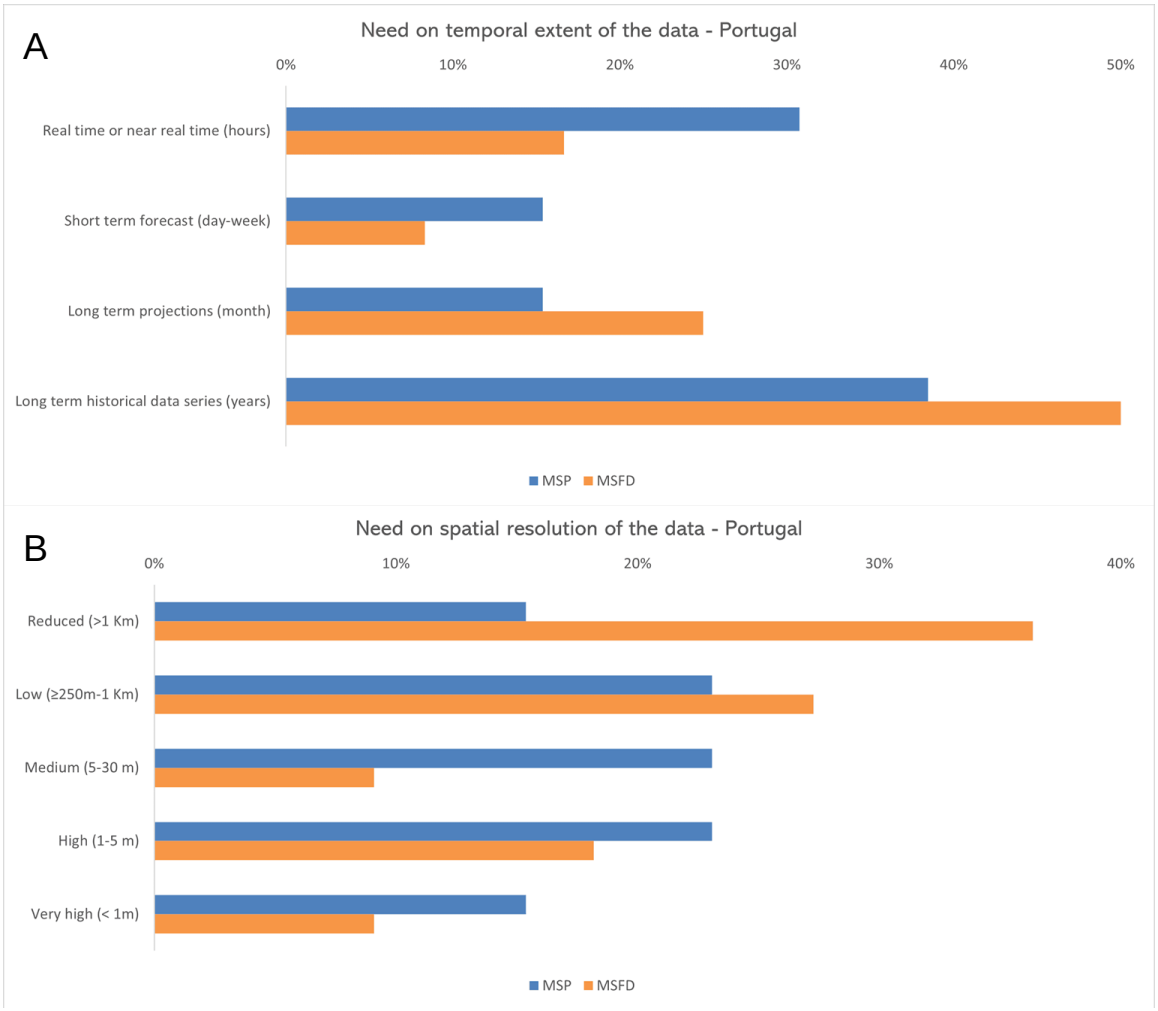


Figure 7-6. Stakeholder’s needs on temporal extent (A) and spatial resolution (B) of data in the implementation of EU Marine Directives in Portugal.

7.3.1.3. Knowledge gaps encountered when working with the descriptors within the Marine Strategy Framework Directive

Portuguese stakeholders involved in Marine Strategy Framework Directive implementation (7), when asked about the most common problems encountered when working with the EU Directive descriptors (Figure 7-7), mentioned that, the greatest challenges encountered were those associated with “pressures and impacts", followed by “spatial and temporal distribution”,

"abundance" and "spatial cover/extent". No challenges related to "genetics" and "concentration" were reported.

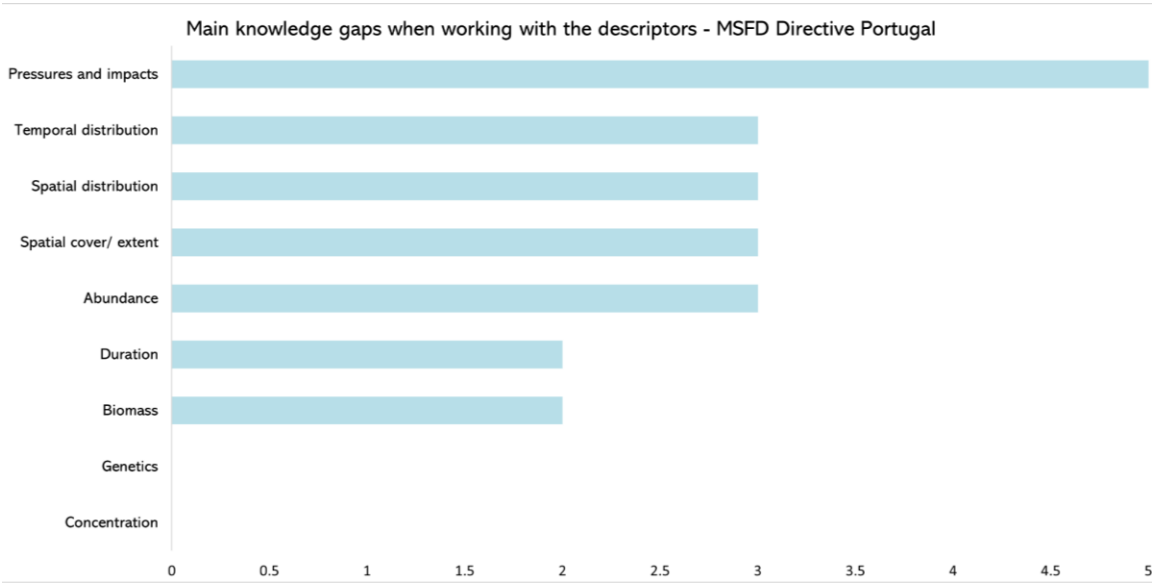


Figure 7-7. Stakeholder's main knowledge gaps regarding MSFD descriptors in Portugal

7.3.2. Maritime sectors affected by EU Marine Directives implementation

7.3.2.1. Problems encountered when working with the data available

Regarding maritime sectors general data usage in Portugal (Figure 7-8), most stakeholders, when asked about the most common problems encountered when working with data, mentioned the challenges associated with "inaccessible data or unavailability of data" (24%), followed by "incomplete temporal distribution" and "heterogenous source" (around 14% each). Least problematic seemed to be the challenges associated with "complexity of the data" (3%) and "data reliability" (4%). Figure 7-8 shows a detailed analysis of the stakeholder's main problems encountered when working with the data available for each of the maritime sectors listed in Figure 7-2.

For the **"Ports and harbours"** sector, stakeholders stated that the most common challenges encountered when working with data are related with "inaccessible data or unavailability of data" (24%), "heterogeneous sources" (16%) and "incomplete spatial and temporal distribution" (12%).

For the **"Aquaculture"** sector, **shell farming** stakeholders stated that the most common challenges encountered when working with data are related with "inaccessible data or unavailability of data" (25%), incomplete spatial (13%) and temporal distribution (19%), and heterogeneous data collection methodologies and sources (13% each). **Fish farming** stakeholders stated that the most common challenges encountered when working with data are related with "inaccessible data or unavailability of data" (23%) and incomplete spatial (15%) and temporal distribution (23%). All other data issues seem less important for the users (from 0-8%).

For the **"Fisheries"** sector, stakeholders stated that the most common challenges encountered when working with data are related with "inaccessible data or unavailability of data" (33%) and incomplete spatial (17%) and temporal distribution (25%). Data issues related with heterogeneous data collection methodologies and sources, and "unsuitable resolution" seemed less important for participants (8%).

For the **"Species conservation and protected areas"** sector, stakeholders stated that the most common challenge encountered when working with data is related with "inaccessible data or unavailability of data" (27%). Other challenges are related with "heterogeneous sources", "unsuitable resolution", and incomplete spatial and temporal distribution (12% each).

For the **"Maritime transport routes and traffic flows"** sector, stakeholders stated that the most common challenges encountered when working with data are related with "inaccessible data or unavailability of data" (21%), "heterogeneous sources" (16%) and "unsuitable resolution" (16%).

For the **"Energy sector"**, stakeholders stated that the main challenge encountered when working with data is related to "inaccessible data or unavailability of data" (31%), followed by "heterogeneous sources" (15%). All other data issues seem less important for the users (from 0-8%).

For the **"Coastal protection"** sector, stakeholders stated that the main challenge encountered when working with data is related to "inaccessible data or unavailability of data" (20%). The "complexity of the data" seems less important for users, while the other issues follow similar concerns (from 7 to 13%).

For the **"Raw material extraction"** sector, stakeholders stated that the most common challenges encountered when working with data are related with "heterogeneous sources" and "lack of tools to manipulate and visualise the data" (20% each). All other data issues seem less important for the users (from 0-10%).

For the **"Tourism and recreational activities"**, stakeholders stated that the main challenge encountered when working with data is related to "inaccessible data or unavailability of data" (19%), followed by "heterogeneous sources" and incomplete spatial and temporal distribution (14% each).

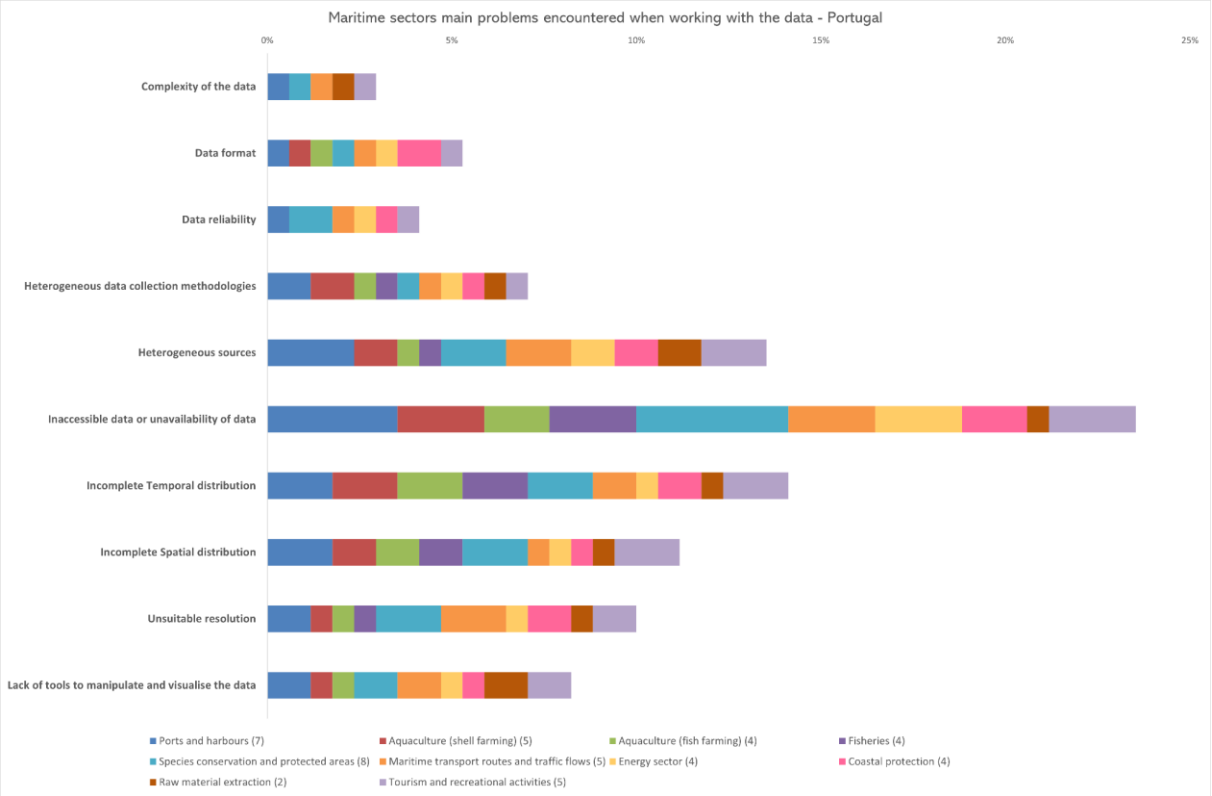


Figure 7-8. Maritime sectors' main problems encountered when working with available data in Portugal

7.3.2.2. Needs regarding temporal extent and spatial resolution of the data

In terms of the temporal extent, considering the maritime sectors in Portugal (Figure 7-9A), 34% of stakeholders expressed a need for "long-term historical data series (years)". Interestingly, 25% of participants also recognize a need for "real time or near real time (hours)". When we analyse sectors separately, "Fisheries" stated "real time or near real time (hours)" as a high priority for the resolution needed for the development of their activities. For the "Aquaculture", "Species conservation and protected areas", "Energy", "Coastal protection" and "Tourism and recreational activities" sectors "long-term historical data series (years)" is a bigger priority. "Ports and harbours", "Maritime transport routes and traffic flows" and "Raw material extraction" sectors recognize the importance of these two different data resolutions.

Regarding the spatial resolution of data (Figure 7-9B), 51% of stakeholders expressed a clear higher need for "medium (5-30m)" and "low (≥250m-1Km)" resolutions. Around 20% also expressed the need for "reduced (>1 Km)" spatial resolutions and 18% expressed the need for "high (<1m)" spatial resolutions. A clear less need seemed to be to "very high (<1m)" spatial resolutions (11%). When we analyse sectors separately, "Ports and harbours", "Aquaculture", "Fisheries" and "Coastal protection" seem to prioritise low and medium resolutions, while "Maritime transport routes and traffic flows" and the "Energy" sectors seem to prioritise medium and high resolutions. "Species conservation and protected areas" and "Tourism and recreational activities" sectors, although they recognize the importance of intermediate resolutions, also prioritise reduced spatial resolutions.

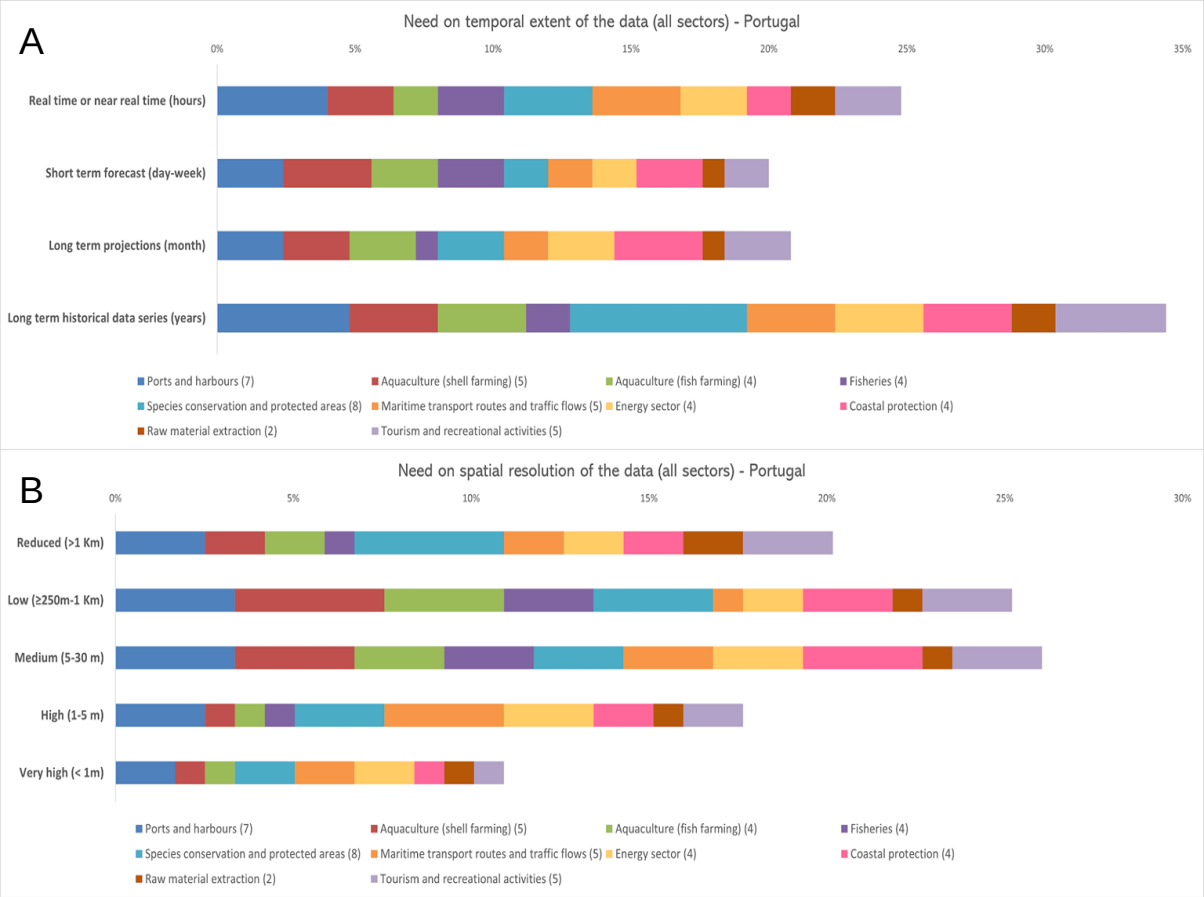


Figure 7-9. Maritime sectors' needs on temporal extent (A) and spatial resolution (B) of data in Portugal

7.4. Copernicus usage and needs in the implementation process of EU Marine Directives in Portugal

The following section aimed to understand the general awareness and data usage related to Copernicus products among the maritime sectors and the stakeholders engaged in the implementation of the two EU Marine Directives in Portugal. Stakeholders were asked what type of Copernicus user they considered themselves to be. For Portuguese stakeholders the majority stated to be "End users". Only 2 affirmed to be service providers: one entity is from research and the other a non-profit organisation. These entities develop activities related with all maritime sectors considered in Figure 7-2, except for the "Raw material extraction" sector.

7.4.1. Stakeholder's awareness with the Copernicus program

Regarding stakeholder's awareness of the Copernicus program, all inquired Portuguese stakeholders were aware of the Copernicus program, irrespective of the maritime sectors where their activities are developed or their involvement in MSP and MSFD implementation process. Still, our reduced number of respondents (13), do not permit us to assess clear trends for the sector regarding Copernicus' program awareness. A previous survey conducted by the Portuguese Space agency (FPCUP A2018-1-24, SGA6), in 2021-22, with 579 participants,

revealed a general lack of awareness of the program in Portugal, with >50% of inquiries not ever having heard about the program (~12%) or not being certain of what the program was about despite having heard of it (~43%).

7.4.2. Copernicus data usage and needs

Since stakeholders were aware of the program it was further questioned their usage of Copernicus data (Figure 7-10). Results indicate that 54% of the stakeholders of existing maritime sectors use this type of data. Also, only for stakeholders related with “Maritime transport routes and traffic flows”, there is a majority that do not use Copernicus data (60%). For all the other sectors the majority or half of the stakeholders do use this type of data.

When analysing the stakeholders responsible for EU Marine Directives implementation, half of the ones responsible for MSP Directive implementation use Copernicus data and 43% of the ones responsible for MSFD implementation use this data.

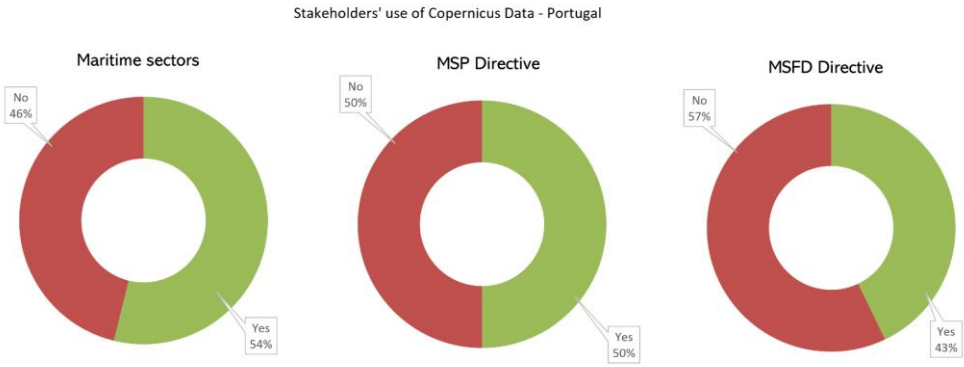


Figure 7-10. Stakeholder’s Copernicus data usage across maritime sectors and EU marine Directives in Portugal

For the stakeholders that declared using Copernicus data, the periodicity of usage and type of data used were further inquired (Figure 7-11). The majority of stakeholders (57%) reported using Copernicus data on a weekly basis, and 14% use it only on an annual basis (*i.e.* once per year). Considering the Copernicus data usage, most stakeholders (71%) rely on satellite-derived products, rather than in-situ or model-derived products (Figure 7-11).

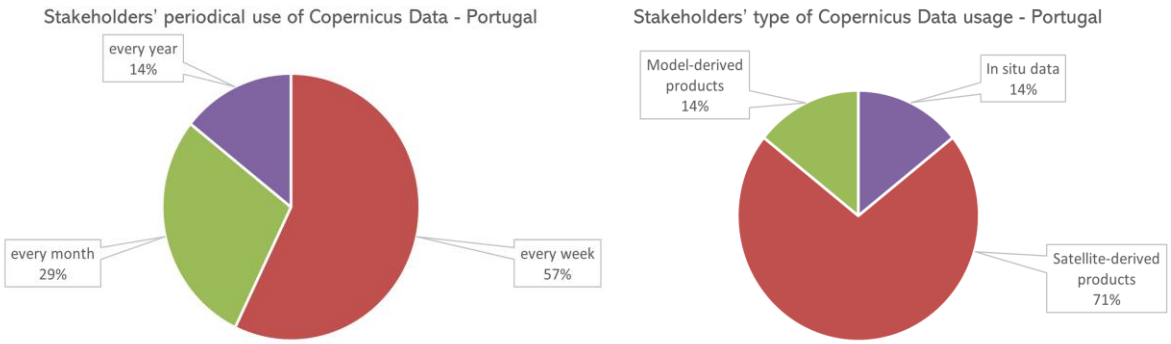


Figure 7-11. Stakeholder’s that declared using Copernicus data in Portugal: periodicity of usage and type of data used.

For the stakeholders that declared using Copernicus data, one open-ended question (Q.30ii) was asked to get further information about stakeholder's purpose for using Copernicus data. In summary, Portuguese stakeholders stated to use Copernicus data for the study of ocean processes and dynamics, including physical processes adjacent to phytoplankton dynamics, the mapping of habitats and species and the use of climate-related risks inventories (*e.g.,* marine heat waves). They also use these data to develop numerical models and to address coastal risk, monitoring anthropogenic activities in the area. Detailed summary to question Q30 is reported in the Annex III.

Regarding the stakeholders that declared not using Copernicus (Figure 7-12), 67% of them stated that the main reason for it was the lack of knowledge or skills to use the data, while 17% declared institutions do not promote the use of Copernicus data or that they do not have enough human resources and time to do it.

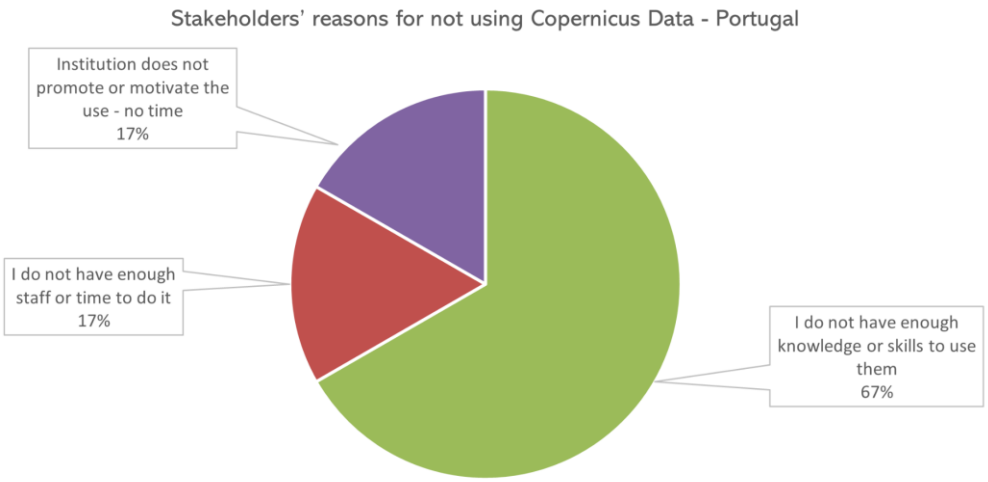


Figure 7-12. Stakeholder's that declared not using Copernicus data in Portugal.

7.4.3. Data analysis and visualisation tools

Regarding data transformation needs for the implementation process of the two Directives, stakeholders were asked about most-used data tools for Copernicus data analysis and visualisation (Figure 7-13). Considering the stakeholders responsible for implementing MSFD and MSP Directive, "mapping software" is the most used tool for visualising and analysing Copernicus data in a spatial context, followed by "image processing software" for MSP participants and "visualisation software" for MSFD participants.

Regarding the maritime sectors, the most used tool continues to be "mapping software", but "programming languages" emerges as the second most used tool. When looking at the maritime sectors separately, the majority of them follow this trend with "mapping software" as the most used tool. Most sectors consider "image processing software" as the second most important tool. Interestingly, although "Aquaculture" and "Fisheries" sectors recognize the importance of using "mapping software", a big importance is also given to "programming languages" tools.

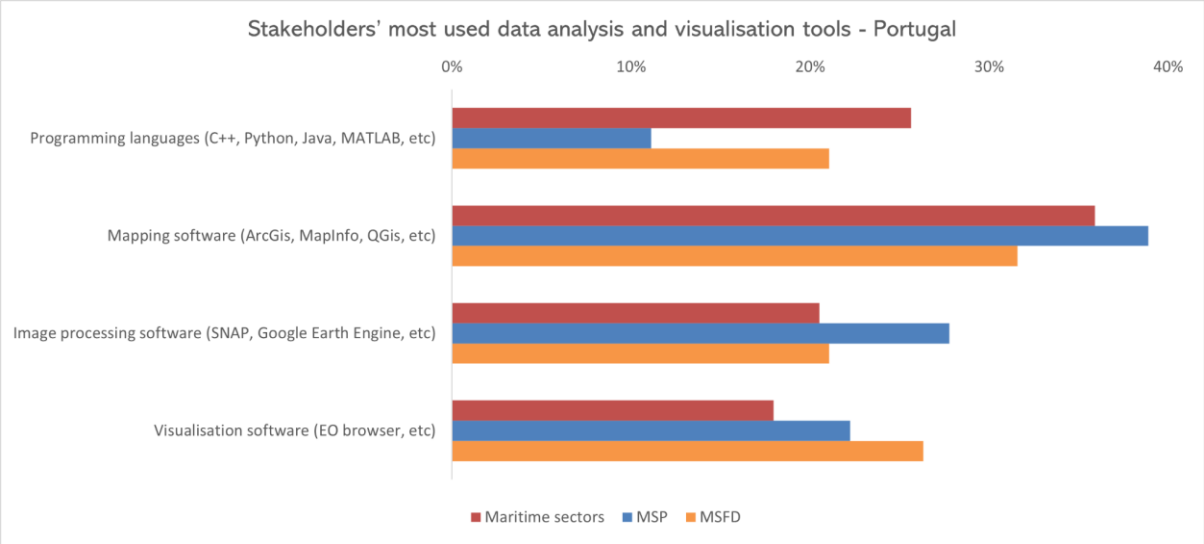


Figure 7-13. Stakeholder's most used data analysis and visualisation tools across all maritime sectors in Portugal

7.4.5. Open ended questions

Three open-ended questions were asked at the end of the survey to get further information on: how users think that Copernicus data can be improved (Q30.vi), stakeholder's needs besides Copernicus data (Q32) and other relevant space solutions for the maritime domain (Q33). For Q30. vi, stakeholders highlighted that Copernicus data may improve considering developments on better accessibility of the available data and on creating new products, especially related with long term data. Other needs besides Copernicus data (Q32) are related with accessible national monitoring data on natural ecosystems (*e.g.,* through cloud servers). Regarding other relevant space solutions for the maritime domain (Q33), Portuguese stakeholders highlight the use of in-situ data (*e.g.,* sea surface temperature, chlorophyll concentration and salinity) and numerical models from Copernicus or US agencies. Finally, they highlighted the role of data offered by EMODnet, SeaDataNet or ICES.

Detailed summary of these responses are provided in Annex III.

8. Conclusions for Task 2

The survey conducted among Portuguese stakeholders has provided significant insights into the current state and needs of data usage in the implementation of EU Marine Directives. The majority of respondents were from public administration and the research sector, with significant involvement in both the MSFD and MSP Directive implementation. Most stakeholders were engaged in activities spanning coastal and marine areas, with "species conservation" and "ports and harbours" being the most prominent sectors. Conversely, the "raw material extraction" sector was the least represented. Key areas of interest identified among stakeholders included pressures and environmental monitoring, ship detection, and maritime climate. Notably, there was a lower interest in services related to the effects of climate change.

Regarding the main problems encountered when working with the available data, the primary challenges faced by stakeholders were the inaccessibility or unavailability of data and the heterogeneous nature of data sources. Additionally, there is a significant need for long-term historical data series and real-time data across various maritime sectors. Stakeholders involved in MSP implementation specifically highlighted the need for medium (5-30m), low (≥250m-1Km), and high (1-5m) spatial resolutions, while those involved in MSFD implementation required long-term historical data series and low (≥250m-1Km) spatial resolutions.

While awareness of the Copernicus program was high among stakeholders, actual usage reported is relatively low, varying from 43-54%, with a slight majority of those using Copernicus data, doing it on a weekly basis. Stakeholders expressed a need for improved accessibility and more user-friendly data products. Mapping software and image processing software were the most commonly used tools for data analysis and visualisation, highlighting the importance of spatial data tools in maritime sector applications.

For stakeholders who used Copernicus data, it was primarily for studying ocean processes and dynamics, mapping habitats and species, addressing coastal risk, and monitoring anthropogenic activities. However, those who did not use Copernicus data cited a lack of knowledge or skills, institutional support, and insufficient human resources and time as the main reasons. Stakeholders recommended enhancing data accessibility, developing new long-term data products, and integrating more in-situ data sources and numerical models to support their activities more effectively. These findings underscore the necessity for better data accessibility, enhanced user skills, and the integration of advanced data products and tools to support the effective implementation of EU Marine Directives in Portugal.

In summary, addressing the identified data gaps and enhancing the usability of Copernicus data will be crucial for improving the efficiency and effectiveness of maritime sector activities. These improvements will support the sustainable management and conservation of marine resources, contributing to the successful implementation of EU Marine Directives.

Task 3. Identification on how to use Copernicus data in the implementation of EU Marine Directives

9. Introduction for Task 3

The Copernicus program, established by the European Union, offers a continuous and comprehensive supply of marine data. This data comes from a variety of sources, primarily Earth observation satellites, and is used to monitor and analyse various marine parameters and phenomena. Copernicus includes several services that will contribute to a better implementation of the EU Marine Directives.

The primary objective of Task 3 is to identify how the Copernicus programme can support the needs and requirements of EU Marine Directives at the national level, providing a set of recommendations and suggestions that will facilitate the development of enhanced methodologies for national reporting. To achieve this, the requirements outlined in the directives and the data gaps identified in Task 2 have been compared with the capabilities provided by Copernicus data services.

10. Gap filling based on Copernicus data

In light of the gaps and limitations identified by Portuguese stakeholders regarding the implementation of EU Marine Directives, several key benefits and solutions emerge from the use of Copernicus data services:

- **Data availability and accessibility:** The Copernicus program, including its Sentinel satellites network, offers extensive Earth observation capabilities, covering a wide range of domains such as land, ocean, atmosphere, and climate variables. Each satellite is equipped with specialised sensors designed for precise data collection, enabling detailed and consistent global monitoring. Copernicus prioritises making this data freely accessible, offering both raw and pre-processed products tailored to specific applications, enhancing usability and providing clear temporal insights for marine data users.

  At national level, several platforms already provide access to ready-to-use Copernicus Marine data for the Portuguese territory, offering an efficient solution for a simplified visualisation, compilation and integration of relevant data for end-users. Examples of platforms are: i) the Portuguese Coastal Monitoring Network (**CoastNet**, **http://geoportal.coastnet.pt/**), which provides easy data visualisation capacity and free access to in-situ data from oceanographic buoys and a compilation of Copernicus satellite products such as Chlorophyll concentration, sea level, sea surface temperature and salinity, and wind data; ii) the local Coastal Monitoring Service for Portugal (**CONNECT**), which delivers data of the Portuguese coastal waters through a service that integrates model-based forecasts and observations to provide physical and biogeochemical data to the Copernicus Marine Environment Monitoring Service (CMEMS). CONNECT main features include high-resolution circulation and water quality modelling for daily forecasts, downscaling CMEMS regional data, real-time

physical and biogeochemical data from in-situ observation networks, and remote sensing data from CMEMS. The products are made available through a dedicated WebGIS portal, providing web services and open access to the data (**CONNECT's portal**).

- **Data homogeneity:** Copernicus ensures high-quality, standardised datasets through rigorous quality control processes. It uses standardised procedures for data collection, calibration, and validation across multiple satellites and sensors. By integrating data from multiple sources, including Sentinel satellites, other Earth observation missions, and ground-based measures, Copernicus creates cohesive, uniform datasets. Additionally, the program's use of advanced data fusion techniques results in seamless, integrated datasets with consistent temporal distributions, following international standards for data encoding and formatting.

- **Temporal and spatial coverage:** Copernicus offers a wide range of temporal resolutions, from daily observations to long-term records spanning several decades. This flexibility allows users to select data that best suits their specific needs, whether for real-time monitoring or historical trend analysis. Data assimilation techniques are also employed to combine observational data with models, bridging temporal gaps and providing forecasts. Furthermore, Copernicus maintains extensive archives of Earth observation data dating back to the 1980s. This program's approach ensures continuous and up-to-date marine information, ensuring a stable and consistent temporal distribution of environmental data, critical for ongoing marine monitoring and research. Regarding the spatial and temporal resolution, the Copernicus products offer an unprecedented opportunity for high-resolution data, with Sentinel-3 and Sentinel-2 satellites providing information at high spatio-temporal resolution (daily at 300m for Sentinel-3 and 5-days at 10m for Sentinel-2 (mainly for coastal areas).

11. Service opportunities for Portuguese maritime sectors

This section explores the opportunities provided by Copernicus data services for the key sectors of the Portuguese maritime industry. This mainly includes the development of new products that can be made available in the future as an operational service:

- **Ship detection and Maritime Surveillance:** Ship detection is vital for maritime management of ocean traffic, enforce maritime law, and protect marine environments from overexploitation and illegal activities. Copernicus Maritime Surveillance Service (CMS), also part of the Copernicus Earth observation program, uses synthetic aperture radar (SAR) and optical satellite imagery to provide real-time data on vessel positions and movements, even in remote areas. By integrating satellite imagery with Automatic Identification Systems (AIS) data, Copernicus enables accurate tracking of vessel activities, aiding in the prevention of illegal fishing, smuggling, and pollution events that threaten marine ecosystems. CMS is one of the Security services of the Copernicus Programme, and as such does not have an open data policy. Information from users is provided to the CMS team through request forms which are sent via email. Once the request has been received, the request forms are then accessible only to the CMS

team and are not shared with third parties. Discrete data elements from the request forms are shared with satellite service providers only to the extent that is necessary to provide the requested service (*e.g.,* definition of the area of interest and period of acquisition). The satellite data and value-added products are transferred from the satellite ground receiving station to EMSA, and subsequently to the end-user, via encrypted connections. End-users interested in ship detection products, are advised to make a request for CMS service for the region of interest.

- **Marine Heat Waves monitoring:** Marine Heat Waves (MHWs) are prolonged periods of abnormally high sea surface temperature compared to the seasonal average for a specific region. These extreme events, which have seen an increase in frequency and intensity due to continuous global warming, can drastically affect marine ecosystems and disrupt economic activities, impacting the normal living of coastal populations. For Portugal's maritime industry, MHWs are a key concern due to the country's reliance on the sea for fisheries, aquaculture, and coastal tourism. CMEMS provides daily to monthly data on sea surface temperature, including analysis of trends, and ocean forecasts at global and regional scales. For the Portuguese region, Sea surface Temperature data can be visualised and downloaded from the **Copernicus Marine Data Store**, where multiple products are available, or from the national **CoastNet geoportal**. Regarding the specific Copernicus MHW monitoring service, for now it is only available for the Mediterranean sea, with data updated daily using the Sea Surface Temperature provided by Copernicus Service. For the Portuguese maritime industry, it would be useful to have a dedicated product for MHW events and alerts, made available through the national services.

- **Aquaculture site suitability and management:** Aquaculture, defined as the farming of aquatic organisms, is part of Marine Food, one of the twelve Blue Economy markets targeted by the Copernicus Marine Service. In Portugal, aquaculture plays a growing role in the maritime economy and the use of Copernicus Services can support decision-making for site selection and management by ensuring sustainable production, environmental stewardship and economic viability of aquaculture farms. Copernicus data useful for aquaculture management include indicators for water quality, Harmful Algae Blooms (HABs) events and sea surface temperature from multi-sensors platforms. By the analysis of spatio-temporal trends of these key indicators, end-users can make informed decisions on site selection for developing aquaculture activities. They can also monitor the impact of aquaculture units on the environmental conditions. At the moment, there is no specific Copernicus service for aquaculture monitoring and management. Nonetheless, products such as Sea Surface Temperature, Chlorophyll-a, net primary production, and turbidity from the Copernicus Marine Service can be used for this purpose. This has been illustrated by successful applications at international level (Pereiro et al., 2023, Valentini et al., 2016). For the Portuguese coast, stakeholders are advised to use products from the high resolution sensors onboard Sentinel-2 and Sentinel-3 satellites when focusing on areas adjacent to the coast. Additionally, the **CONNECT portal** provides detailed physical and biogeochemical information on estuarine regions. Tailored analyses can also be

developed by academic or technical groups with competences in satellite data processing. These include (*e.g.,* i) the identification of the most productive areas, in terms of phytoplankton; ii) delimitation of temperature ranges).

- **Definition of reference conditions and operational monitoring programs:** Monitoring ocean conditions is essential for evaluating marine ecosystems and their response to human impacts like pollution and climate change. Reference conditions, which are used as baseline for environmental status, can be defined from long-term Copernicus datasets, which include Sea Surface Temperature, salinity and Chlorophyll-a, all important indicators in the context of the MSFD. These indicators provide critical insights into the functioning of marine ecosystems, helping scientists and water managers detect harmful algal blooms, track pollution sources, and assess the sustainability of habitats. Given the unprecedented capabilities of Copernicus products to provide high spatio-temporal data, they have the potential to be used to assess the reference (or "pristine") conditions of a specific region and to detect anomalies from the reference. For the Portuguese territory, Sea Surface Temperature and Chlorophyll concentration are particularly relevant considering the high productivity of the Portuguese coastal waters. The long-term Copernicus data can be analysed to characterise the different seasons and regions. End users can then use this information to detect deviations from the reference, which may indicate a degradation of ecosystem health. Nonetheless, the long-term products available have a coarse spatial resolution, posing challenges for the monitoring of areas adjacent to the coast or transitional systems (*i.e.,* estuaries). The higher resolution of Sentinel-2 and Sentinel-3 satellites make these sensors more suitable for monitoring coastal areas. Although these sensors can be useful for operational monitoring of ecosystems health within the context of the MSFD and MSPD, the temporal coverage of the products is limited to the last 7 years and therefore cannot be used for the analysis of reference conditions.

12. Preliminary results for Task 4

The need to obtain data on indicators of human activities, ecosystem processes and climate events is highlighted from the analysis of results obtained in this consultation. For most cases, the information requested by stakeholders, which requires additional processing of datasets, is not yet available from main providers, such as Copernicus. Thus, in this context, the development of new satellite-based products is a clear added-value. Hence, as an example, the spatial distribution of the total number of marine heat waves (MHWs) and marine cold spells (MCSs) is provided in Figure 12-1. These results were obtained after processing 40-years of sea surface temperature data available at Copernicus. The routine created identified the number of extreme events in the Iberian coast, but can calculate additional metrics, such as the trend in the occurrence of extreme events. This will be further explored in Task 4.

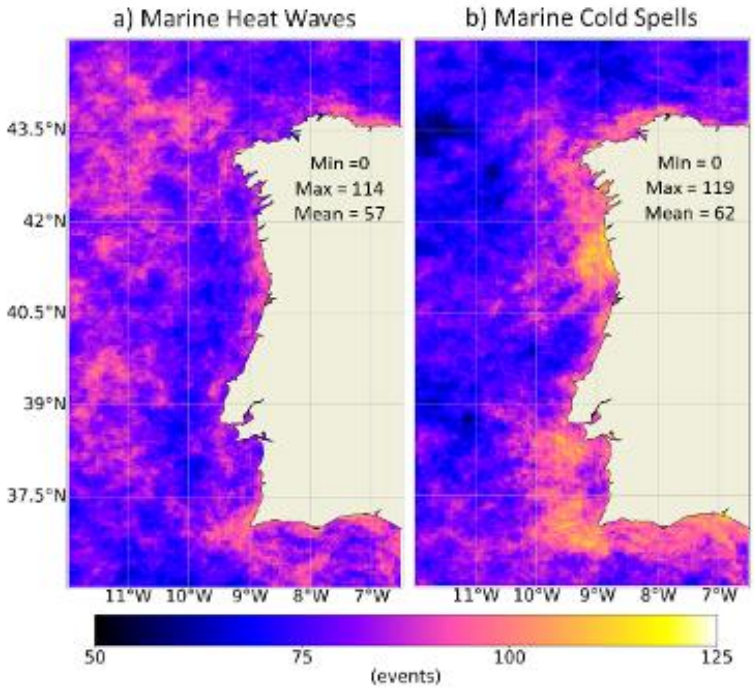


Figure 12-1. Total number of Marine Heat Waves (MHWs) and Marine Cold Spells (MCSs) that occurred between 1982 and 2022 along the Western Iberian Coast. From Biguino et al. (in review).

13. Conclusions for Task 3

The integration of Copernicus data into the implementation of EU Marine Directives offers significant advantages, particularly in addressing critical gaps identified by stakeholders. With its comprehensive marine monitoring capabilities, Copernicus supports various applications, including oceanographic data collection and ship detection, which are essential for the sustainable management of marine environments. By providing freely accessible, high-quality, and standardised datasets on key water quality indicators, Copernicus facilitates the assessment of marine health, supports biodiversity conservation, and contributes to climate change mitigation efforts. Additionally, its advanced ship detection capabilities enhance maritime security, ensuring compliance with international laws and protecting marine ecosystems.

The CMEMS and CMS demonstrate the Copernicus program's capacity to deliver targeted, timely, and actionable data across various sectors, including fisheries, renewable energy, tourism, and maritime safety. Nonetheless, the development of new products tailoring the specific needs of each European country is needed in order to effectively exploit Copernicus data and to deliver useful information across various sectors. For example, the MHWs monitoring service is only operationally available for the mediterranean region. Also, temporal trends are only available for a few main variables (i.e., Sea surface temperature and Chlorophyll-a), while other parameters such as water quality indicators, would also benefit from dedicated monitoring services at national level.

By leveraging advanced satellite technology and integrating it with in-situ measurements and models, Copernicus empowers researchers, policymakers, and environmental managers

to make informed decisions that foster a healthier and more sustainable marine environment. This transformative data resource plays a crucial role in addressing the complex challenges posed by climate change and human activity, ensuring that EU member states have the tools to meet the goals outlined in the EU Marine Directives.

References

Assembleia da República (2014). Law n.o 17/2014. Available at: https://dre.pt/dre/detalhe/lei/17-2014-25343987?_ts=1656979200034. Accessed on the 7th October, 2024.

Biguino, B., Haigh, I.D., Dias, J.M. Brito, A.C. (in review). Are marine heat waves overcoming cold spell events along the Western Iberian Coast? Weather and Climate Extremes.

DGPM (2021). National Ocean Strategy 2021-2030. Available at: https://www.dgpm.mm.gov.pt/enm-21-30. Accessed on the 7th October, 2024.

DGRM (2024). GeoPortal | Plano de Situação do Ordenamento do Espaço Marítimo Nacional. Ordenamento do Espaço Marítimo Nacional | Plano de Situação. Available at: https://www.psoem.pt/geoportal_psoem/. Accessed on the 7th October, 2024.

DGRM (2024). PSOEM Web Page | Ordenamento do Espaço Marítimo Nacional. Ordenamento do Espaço Marítimo Nacional | Plano de Situação. Available at: https://www.psoem.pt/. Accessed on the 7th October, 2024.

EMEPC (2017). Executive Summary | Continental Shelf Submission of Portugal, Pursuant to Article 76, paragraph 8 of the United Nations Convention on the Law of the Sea. Available at: https://www.un.org/depts/los/clcs_new/submissions_files/prt44_09/prt2017executivesummary.pdf. Accessed on the 9th October, 2024.

European Union (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Available at: http://data.europa.eu/eli/dir/2000/60/oj. Accessed on the 7th October, 2024.

European Union (2008). Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Available at: http://data.europa.eu/eli/dir/2008/56/oj/eng. Accessed on the 7th October, 2024.

European Union (2014). Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning. Available at: http://data.europa.eu/eli/dir/2014/89/oj/eng. Accessed on the 7th October, 2024.

Ministério da Agricultura e do Mar - Gabinete da Ministra (2015). Order n.o 11494/2015. Available at: https://dre.pt/dre/detalhe/despacho/11494-2015-70684019. Accessed on the 7th October, 2024.

Ministério da Agricultura e do Mar (2015). Decree-Law n.o 38/2015. Available at: https://dre.pt/home/-/dre/66727183/details/maximized?p_auth=OpSPQzt9. Accessed on the 7th October, 2024.

Ministérios das Finanças, dos Negócios Estrangeiros, da Defesa Nacional, da Administração Interna, da Economia e do Emprego, da Agricultura, do Mar, do Ambiente e do Ordenamento do Território, da Saúde e da Educação e Ciência - Gabinetes dos Ministros de Estado e das Finanças, de Estado e dos Negócios Estrangeiros, da Defesa Nacional, da Administração Interna, da Economia e do Emprego, da Ministra da Agricultura, do Mar, do Ambiente e do Ordenamento do Território e dos Ministros da Saúde e da Educação e Ciência (2012). Order n.o 14449/2012. Available at:

https://data.diariodarepublica.pt/dr/detalhe/despacho/14449-2012-1476004.Accessed on the 7th October, 2024.

MM, SRMCT, SRAAC (2014). Estratégias Marinhas para as Águas Marinhas Portuguesas. Diretiva-Quadro Estratégia Marinha. Programa de Monitorização e Programa de Medidas. Ministério da Agricultura e do Mar, Secretaria Regional do Mar, Ciência e Tecnologia, Secretaria Regional do Ambiente e dos Recursos Naturais. Novembro de 2014.

MM, SRMCT, SRAAC (2020). Estratégia Marinha: relatório do 2º ciclo. Ministério do Mar Secretaria Regional do Mar, Ciência e Tecnologia, Açores, e Secretaria Regional de Ambiente, Recursos Naturais e Alterações Climáticas, Madeira. Março de 2020.

MM, SRMP, SRMar (2022). Estratégia Marinha: Atualização do Programa de Monitorização - 2º ciclo. Ministério do Mar; Secretaria Regional do Mar e das Pescas, Açores; e Secretaria Regional de Mar e Pescas, Madeira. Janeiro de 2022.

MM, SRMP, SRMar (2023). Estratégias Marinhas para as Águas Marinhas Portuguesas. Diretiva-Quadro Estratégia Marinha. Programa de Medidas – 2.º Ciclo. Ministério da Economia e do Mar, Secretaria Regional do Mar e das Pescas dos Açores, Secretaria Regional de Mar e Pescas da Madeira. Dezembro de 2022.

OAP (2024). OSPAR Assessment Portal. https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/introduction/policy-context/. Accessed on the 4th October 2024.

Pereiro, D., Belyaev, O., Dunbar, M. B., Conway, A., Dabrowski, T., Graves, I., Navarro, G., Nolan, G., Pearlman, J., Simpson, P., & Cusack, C. (2023). An observational and warning system for the aquaculture sector. *Frontiers in Marine Science*, *10*. https://doi.org/10.3389/fmars.2023.1288610

Presidência do Conselho de Ministros (2019). Resolution n.o 203-A/2019. Available at: https://dre.pt/dre/detalhe/resolucao-conselho-ministros/203-a-2019-127659203. Accessed on the 7th October, 2024.

Presidência do Governo Regional dos Açores (2024). Resolution n.o 77-A/2024. Available at: https://jo.azores.gov.pt/pdf/atos/77-A-I-Resolu%C3%A7%C3%A3o_do_Conselho_do_Governo-2024-07-05.pdf. Accessed on the 9th October, 2024.

United Nations (1982). United Nations Convention on the Law of the Sea (UNCLOS). Available at: https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf. Accessed on the 7th October, 2024.

United Nations (2024). Submissions, through the Secretary-General of the United Nations, to the Commission on the Limits of the Continental Shelf, pursuant to article 76, paragraph 8, of the United Nations Convention on the Law of the Sea of 10 December 1982. Oceans & Law of the sea | Division for Ocean affairs and the law of the sea. Available at: https://www.un.org/Depts/los/clcs_new/commission_submissions.htm. Accessed on the 9th October, 2024.

Valentini, E., Filipponi, F., Xuan, A. N., Passarelli, F. M., & Taramelli, A. (2016). Earth observation for maritime spatial planning: Measuring, observing and modeling marine environment to assess potential aquaculture sites. *Sustainability (Switzerland)*, *8*(6). https://doi.org/10.3390/su8060519

Annexes

Annex I: Survey questions

Survey on the use of Copernicus data for the Maritime sector

The maritime sector faces several challenges regarding management and sustainability. It is becoming evident that the challenges linked to marine data and information availability will become even more important during the implementation of certain policies and strategies. Users from different maritime sectors can use Copernicus data to extract information to determine the environmental status of coastal waters, to support sustainable development or growth in certain maritime areas and activities.

Under this context, the Framework Partnership Agreement on Copernicus User Uptake (FPCUP) aims at a better integration of Copernicus data in the European regulatory framework by increasing the number of users and applications derived from Copernicus through 3 different actions:

- Action A2021-2-33 pursues "to promote the use of Copernicus data in the implementation of the EU Maritime Spatial Planning Directive (Directive 2014/89/EU; MSP) and EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD)";
- Action A2021-2-42 pursues "to promote the use of Copernicus data across the maritime sector, focusing on Ports and Harbours, Aquaculture and Fisheries";
- Action A2021-2-47 pursues "to define the roadmap to guide the future evolution of Copernicus products to fulfil the needs of users in coastal areas".

The aim of this survey is to identify the current needs and gaps of the stakeholders to better understand the current usage of Copernicus data across different sectors:

- implementation of the two Directives (Action 33);
- maritime sector, focusing on Ports and Harbours, Aquaculture and Fisheries (Action 42);
- national coastal users (Action 47).

By participating in this survey, you will have the opportunity to join future Copernicus training events that will be organised in the scope of the FPCUP project.

For this survey, please consider the following definitions and policies:

"**Copernicus** program" is the Earth Observation program of the European Union.

"Copernicus satellite data" are the data from Sentinel satellite missions (Sentinel 1, 2, 3, 5P and 6), as well as data from satellite missions of other space agencies and commercial providers, called Contributing Missions.

"Copernicus service products" are the products provided by the 6 Copernicus Services (Land, Marine, Atmosphere, Climate Change, Emergency, Security), that use satellite and in-situ data as inputs.

"**EU Marine Strategy Framework Directive** (Directive 2008/56/EC)". This Directive establishes a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status in the marine environment.

"**Commission Decision (EU) 2017/848**" laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment.

"**EU Maritime Spatial Planning Directive** (Directive 2014/89/EU)". This Directive establishes a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources.

"**Water Framework Directive** (Directive 2000/60/EC)". This Directive requires EU Member States to achieve good status in all bodies of surface water and groundwater by 2027.

"**Habitats Directive** (Directive 92/43/EEC)". This Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species.

Survey **(in bold below was for internal reading)**

1. General information

a. Entity
b. Department
c. Contact name:
d. Email:
e. Job position:
f. City:
g. Country:
h. Type of Entity
    i. Academia
    ii. Research
    iii. Public administration
    iv. Another public entity
    v. Private sector
    vi. Non-Governmental Organization (NGO)
    vii. Other (please specify)
i. What is your area of activity? **(Multiple choices allowed)**
    i. Inland
    ii. Coastal
    iii. Marine
j. In terms of Copernicus Data, do you consider yourself a:
    i. End-user
    ii. Service provider

Maritime sectors & MSP Directive

2. Which of these maritime sectors are you related with? **(Multiple choices allowed)**

a. Ports and harbours
b. Aquaculture (shell farming)
c. Aquaculture (fish farming)
d. Fisheries
e. Species conservation and protected areas
f. Maritime transport routes and traffic flows
g. Energy sector (hydrocarbons and renewable energies)
h. Coastal protection
i. Raw material extraction
j. Tourism and recreational activities
k. Other

3. **(If chosen "Ports and harbours" in Q2)** For the "Ports and harbours" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest) **(bold means it is a common option between maritime sectors)**

a. Maritime climate (e.g., for operational and maintenance activities)
b. Ship detection (e.g., monitoring vessel activity)
c. Pollution and environmental monitoring (e.g., oil spills, water quality, air quality)
d. Effects of climate change (e.g., sea-level rise, extreme events)
e. Infrastructure monitoring (e.g., containers, piers)
f. Navigation and dredging operations (e.g., bathymetric mapping, sediment dynamics)
g. Others (specify)

4. **(If chosen "Aquaculture (shell farming)" in Q2)** For the" Aquaculture" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Oceanographic data: waves, tides (e.g., for operational and maintenance activities)
b. Ship detection (e.g., monitoring illegal activity)
c. Pollution and environmental monitoring (e.g., oil spills, microbiological contamination, chemical contamination, biotoxins)
d. Effects of climate change (e.g., extreme events, marine heatwaves)
e. Marine water quality data (e.g., anoxic events, acidification, chlorophyll concentration, jellyfish presence)
f. Infrastructure monitoring (e.g., cages)
g. Selection of suitable site locations and species (e.g., temperature, salinity, etc)
h. Others (specify)

5. **(If chosen "Aquaculture (fish farming)" in Q2)** For the" Aquaculture" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Oceanographic data: waves, tides (e.g., for operational and maintenance activities)
b. Marine water quality data: anoxic events, acidification, chlorophyll concentration, jellyfish presence
c. Ship detection (e.g., monitoring illegal activity)
d. Pollution and environmental monitoring (e.g., oil spills, microbiological contamination, chemical contamination, biotoxins)
e. Effects of climate change (e.g., extreme events, marine heatwaves)
f. Infrastructure monitoring (e.g., cages)
g. Selection of suitable site locations and species (e.g., water temperature, salinity, etc)
h. Others (specify)

6. **(If chosen "Fisheries" in Q2)** For the "Fisheries" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Maritime climate (e.g., for operational and maintenance activities)
b. Ship detection (e.g., monitoring illegal activity)
c. Pollution and environmental monitoring (e.g., oil spills, water quality)
d. Effects of climate change (e.g., extreme events, marine heatwaves)
e. Fishing area characterizations (e.g., areas of higher productivity)
f. Fisheries certification
g. Map of sea use (e.g., presence of conflicting human activities)
h. Others (specify)

7. **(If chosen "Species conservation and protected areas" in Q2)** For the "Species conservation and protected areas" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Pressures (e.g., pollution, spills, maritime activities...etc.)
b. Environmental monitoring (e.g., water quality, ecological status)
c. Effects of climate change (e.g., sea-level rise, extreme events)
d. Habitat distribution area and trends
e. Species distribution area and trends
f. Map of sea use (e.g., presence of conflicting human activities)
g. Others (specify)

8. **(If chosen "Maritime transport routes and traffic flows" in Q2)** For the "Maritime transport routes and traffic flows" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Maritime climate (e.g., for operational and maintenance activities)
b. Ship detection (e.g., monitoring vessel activity and flows)
c. Pollution and environmental monitoring (e.g., oil spills, water quality)
d. Effects of climate change (e.g., new routes, extreme events)
e. Weather services

f. Navigation (e.g., Bathymetry, Sediment dynamics monitoring, etc.)
g. Others (specify)

9. **(If chosen "Energy sector" in Q2)** For the "Energy sector" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Maritime climate (e.g., for operational and maintenance activities)
b. Ship detection (e.g., monitoring vessel activity)
c. Environmental monitoring (e.g., oil spills, water quality)
d. Effects of climate change (e.g., sea-level rise, extreme events)
e. Selection of suitable renewable energy locations (wind, waves, currents)
f. Bottom geologic maps
g. Energy production surveying
h. Map of sea use (e.g., presence of conflicting human activities)
i. Others (specify)

10. **(If chosen "Coastal protection" in Q2)** For the "Coastal protection" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Maritime climate (e.g., winds, waves and current forecasts)
b. Pollution and environmental monitoring (e.g., eutrophication, water quality)
c. Effects of climate change (e.g., sea-level rise, extreme events)
d. Monitoring and prevention of coastal erosion
e. Bathymetry and sedimentation
f. Coastline detection
g. Characterisation of emerged coastal areas (e.g., sediment dimension, inland extension of the beach, presence of dunes)
h. Others (specify)

11. **(If chosen "Raw material extraction" in Q2)** For the "Raw material extraction" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Maritime climate (e.g., for Operational and maintenance activities)
b. Ship detection (e.g., monitoring vessel activity)
c. Pollution and environmental monitoring (e.g., oil spills, water quality)
d. Effects of climate change (e.g., sea-level rise, extreme events)
e. Map of sea use (e.g., presence of conflicting human activities)
f. Others (specify)

12. **(If chosen "Tourism and recreational activities" in Q2)** For the "Tourism and recreational activities" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)

a. Maritime climate (e.g., for weather)
b. Effects of climate change (e.g., sea-level rise, extreme events)

c. Water quality (e.g., preserving human health in bathing waters)
d. Identification of pressures (e.g., land use, presence of urban wastewaters or industrial
waters discharges)
e. Landscape quality (e.g., absence of infrastructures, presence of nature-based solutions)
f. Others (specify)

13. **(If chosen "Other" in Q2)** For "Other" sectors, select one of the lists below and describe which services are of higher interest to you.

a. Military
b. Exploration, exploitation, and extraction
c. Scientific research
d. Underwater cultural heritage
e. Submarine cable and pipeline routes

Maritime sectors & MSP Gaps

Concerning the sectors mentioned above, we will analyse the challenges you have encountered when searching/working for data related with them.

14. Within the framework of your current activities, what problems do you encounter when working with the data available to you? **(Multiple choices allowed)**

a. Complexity of the data
b. Data format
c. Data reliability
d. Heterogeneous data collection methodologies
e. Heterogeneous sources
f. Inaccessible data or unavailability of data
g. Incomplete Temporal distribution
h. Incomplete Spatial distribution
i. Unsuitable resolution
j. Lack of tools to manipulate the data.
k. Other, please specify.

15. Within the framework of your current activities, what temporal extent of the data would you need? **(Multiple choices allowed)**

a. Real time or near real time (h)
b. Short term forecast (day-week)
c. Long term projections (month)
d. Long term historical data series (years)

16. Within the framework of your current activities, what spatial resolution of the data would you need? **(Multiple choices allowed)**

a. Reduced (>1Km)
b. Low (>= 250 m-1Km)
c. Medium (5-30 m)
d. High (1-5 m)
e. Very high (< 1 m)

17. Have you participated in the implementation of these Directives in your Country? **(Multiple choices allowed)**

a. EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD)
b. EU Maritime Spatial Planning Directive (Directive 2014/89/EU; MSP)

18. **(If yes in Q17.b)**

a. In what period? **(Multiple choices allowed)**

i. 2012-2018

ii. 2018-2024

b. In what phase of MSP? **(Multiple choices allowed)**

i. Establishment of management objectives
ii. Diagnosis of the current situation
iii. Land-sea interactions
iv. Maritime spatial plans

MSFD

19. In what period? **(Multiple choices allowed)**

a. 2012-2018
b. 2018-2024

20. In what phase of MSFD? **(Multiple choices allowed)**

a. initial assessment
b. determination of good environmental status
c. establishment of environmental targets and associated indicators
d. monitoring programme
e. programme of measures

21. What Marine Region do you belong to?

a. Baltic Sea
b. North-east Atlantic Ocean
c. Mediterranean Sea
d. Black Sea

22. What subdivisions (if exist) of the Marine region do you belong to? (Each country please specify yours)

a. North-Atlantic
b. Sud-Atlantic
c. …
d. …
e. …

23. Following the classification in COMMISSION DECISION (EU) 2017/848, which of the following descriptors and Criteria elements are you related with? **(Multiple choices allowed)**

1. Biodiversity
    - Species groups (specify which):
        - birds,
        - mammals,
        - reptiles,
        - fish
        - cephalopods
    - Pelagic habitats (specify which)
    - Benthic habitats (specify which)
    - Ecosystems, including food webs (specify which)
2. non-indigenous species
3. Commercial fish species
4. Food webs
    - Ecosystems, including food webs (specify which)
5. Eutrophication
6. Sea floor
    - Benthic habitats (specify which)
7. Hydrographical conditions
8. Contaminants and effects
9. Contaminants in seafood
10. Marine litter
11. Introduction of energy (including underwater noise)

MSFD Gaps

Concerning the descriptors/criteria mentioned above, we will analyse the challenges you have encountered when searching/working for data related with them.

24. What are the main knowledge gaps descriptors you encountered when working with the descriptor/criteria specified above? **(Multiple choices allowed)**

a. Abundance
b. Biomass
c. Concentration
d. Duration

e. Genetics
f. Pressures and impacts
g. Spatial cover/ extent
h. Spatial distribution
i. Temporal distribution
j. Other, please specify.

25. Within the framework of your current activities, what problems do you encounter when working with the data available to you? **(Multiple choices allowed)**

a. Complexity of the data
b. Data format
c. Data reliability
d. Heterogeneous data collection methodologies
e. Heterogeneous sources
f. Inaccessible data or unavailability of data
g. Incomplete Temporal distribution
h. Incomplete Spatial distribution
i. Unsuitable resolution
j. Lack of tools to manipulate the data.
k. Other, please specify.

26. Within the framework of your current activities, what temporal extent of the data would you need? **(Multiple choices allowed)**

a. Real time or near real time (h)
b. Short term forecast (day-week)
c. Long term projections (month)
d. Long term historical data series (years)

27. Within the framework of your current activities, what spatial resolution of the data would you need? **(Multiple choices allowed)**

a. Reduced (>1 Km)
b. Low (>= 250 m - 1 Km)
c. Medium (5-30 m)
d. High (1-5 m)
e. Very high (< 1 m)

Copernicus

28. Have you ever heard before about the Copernicus program?

a. Yes
b. No

29. **(If yes in Q28)** Are you familiar with the different definitions of “Copernicus Satellite Data” and “Copernicus Service Products”.

a. Yes
b. No

30. **(If yes in Q28 go to a; If no in Q28 go to b)** Do you use data from Copernicus?

a. If Yes

i. How often?

1. every week
2. every month
3. every year

ii. For what purpose (*i.e.,* use case)? (Please specify)

iii. What kind of Copernicus data do you use?

1. In-situ data
2. Satellite-derived products
3. Modelled-derived products.

iv. Do you consider yourself as a basic, intermediate, or advanced Copernicus data user?

1. Basic
2. Intermediate
3. Advance

v. What is your level of satisfaction with Copernicus? (Set from 1(low) to 5 (very high))

1. 1
2. 2
3. 3
4. 4
5. 5

vi. How can Copernicus data be improved (e.g., new products, different spatial/temporal resolutions, improved access)? (Please specify)

b. If No, why?

i. I do not have enough knowledge or skills to use them.
ii. I do not have enough staff or time to do it.
iii. Not relevant for me
iv. Other

31. Within the framework of your current activities, which data analysis tools do you use most: **(multiple choices allowed)**

a. Programming languages (C++, Python, Java, MATLAB, etc)
b. Mapping software (ArcGIS, MapInfo, Qis, etc)
c. Image processing software (SNAP, Google Earth Engine, etc)
d. Visualisation software (EO browser, etc)
e. I do not use any.

32. Besides Copernicus data, what kind of data or services would you need? (Please specify)

33. From your entity's perspective, which space solutions (e.g., products, providers) are relevant to the maritime domain, that you are familiar with/have you heard of? (Please specify)

34. Would you be interested to attend a workshop presenting the different tools and services offered by Copernicus?

a. Yes
b. No

Annex II: Stakeholders for Portuguese survey

- Agência Portuguesa do Ambiente, APA (2 replies)
- Atlantic International Research Centre, AIR
- CoLAB +ATLANTIC (3 replies)
- Direção-Geral de Política do Mar, DGPM
- Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos, DGRM (4 replies)
- Instituto Português do Mar e da Atmosfera, IPMA
- Secretaria Regional do Mar e das Pescas, SRMP

Annex III: Open-ended questions summary replies

Purposes for using Copernicus data (Q.30ii)

- Management and territory monitoring including coastal monitoring.
- Physical processes adjacent to phytoplankton dynamics.
- Determine location of highest fish concentration.
- Ship detection on Synthetic Aperture Radar (SAR) imagery.
- Numerical modelling.
- Marine Heat Waves inventory.
- Ocean monitoring.

Suggestions for Copernicus improvement (Q.30vi)

- New products and better accessibility.
- Improvement and regional validation of numeric model solutions and satellite products.
- Historical data availability instantly and a free platform for large data analysis and visualisation.
- Stability of products and longer predictions/forecasts.
- Download format more suitable to the needs - e.g. download of a variable from an assembly of products.
- Better accessibility.

Data needs besides Copernicus data (Q.32)

- Thematic and official cartography.
- Distributed computing (cloud). Quick access to data without having to download it to the local computer.
- Data from national monitoring campaigns, easily accessible.
- Data on marine traffic, more data on biological sampling and ecosystems health.

Space solutions relevant to the maritime domain (Q.33)

- Chlorophyll concentration, salinity, temperature and sediments data.
- Coastline evolution, coastline uses/activities, offshore activities.

- Satellite optical radiometry data, altimetry, numerical models from Copernicus e US agencies.
- All spaceborne SAR image providers, Automatic Identification System (AIS) data providers, and companies who deliver NRT maritime monitoring services such as Thales Edisoft Portugal.
- EMODnet, SeaDataNet, ICES.
- Global numerical models and downscaling to Iberia and Mediterranean domains.
- Copernicus.
- Oil spills data.

Detailed summary

The survey revealed several key areas for improving the Copernicus platform. In Portugal, Copernicus data is highly valued for its applications in management and monitoring tasks, particularly for coastal and oceanic studies. It supports the assessment of oceanographic processes such as phytoplankton and fish dynamics, marine heat waves, as well as maritime security through ship tracking. Still, respondents emphasised the need for new satellite products, improved accessibility and better regional validation of numeric model solutions. There was a significant demand for instant access to historical data and the development of a user-friendly platform for large-scale data analysis and visualisation. Moreover, respondents sought more flexible data download formats tailored to specific needs, as well as greater product stability with extended predictions and forecasts. Beyond Copernicus data, respondents identified additional data needs. They called for additional cartographic resources, including thematic and official maps, and data from national monitoring campaigns. Enhanced data accessibility and infrastructure were also emphasised, particularly the need for distributed computing to facilitate data access and support advancements in data related to marine traffic, biological sampling, and ecosystem health.

In terms of space solutions relevant to the maritime domain, respondents stressed the importance of diverse spaceborne and related data solutions. They pointed to the need for comprehensive use of spaceborne Synthetic Aperture Radar (SAR) image providers, Automatic Identification System (AIS) data, numerical models from Copernicus and US agencies, and real-time maritime monitoring services such as those offered by Thales Edisoft Portugal. Integrating supplementary resources like EMODnet, SeaDataNet, and ICES was recommended to provide a more complete maritime data landscape. Additionally, there is a need for space solutions that provide information on in-situ biological data, crucial for ecosystem monitoring.