SAFE WAVE

STREAMLIING THE ASSESSMENT OF ENVIRONMENTAL EFFECTS OF WAVE ENERGY

DELIVERABLE 4.1
Requirements for the Data Platform

Co-funded by the EMFF programme of the European Union

WP 4

Deliverable 4.1 Requirements for the Data platform

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1. SAFE WAVE project synopsis

The Atlantic seaboard offers a vast marine renewable energy (MRE) resource which is still far from being exploited. These resources include offshore wind, wave and tidal. This industrial activity holds considerable potential for enhancing the diversity of energy sources, reducing greenhouse gas emissions and stimulating and diversifying the economies of coastal communities. As stated by the European Commissioner of Energy, Kadri Simson, during the Energy Day in the framework of the climate conference (COP25) held in Madrid (2-13 December 2019), "the European experience shows that the benefits of clean energy go beyond reduced greenhouse gas emissions and an healthier environment. Clean energy transition boosts the economy and creates jobs. The European Green Deal is also a growth strategy". In the same framework of COP25 and during the Oceans Day, the European Commissioner for environment, oceans and fisheries, Virginijus Sinkevičius explained that "fighting climate change and protecting marine life biodiversity is a centrepiece of the EU's ocean policy. Due to climate change, our oceans are facing serious challenges, which require an urgent and comprehensive response. But oceans are also a part of the solution". Therefore, ocean energy is one of the pillars of the EU's Blue Growth strategy. Ocean energy could provide clean, predictable, indigenous and reliable energy and contribute to the EU's objective of reaching a share of renewables of at least 32% of the EU's gross final consumption by 2030. As it was underlined by Virginijus Sinkevičius, "Marine renewable energy has an incredible potential. The offshore wind sector is growing strongly enough to compete with traditional energy sources. The emerging technologies such as wave and tidal energy will take the same pathway".

The nascent status of the Marine Renewable Energy (MRE) sector and Wave Energy (WE) in particular, yields many unknowns about its potential environmental pressures and impacts, some of them still far from being completely understood. Wave Energy Converters' (WECs) operation in the marine environment is still perceived by regulators and stakeholders as a risky activity, particularly for some groups of species and habitats.

The complexity of MRE licensing processes is also indicated as one of the main barriers to the sector development. The lack of clarity of procedures (arising from the lack of specific laws for this type of projects), the varied number of authorities to be consulted

and the early stage of Marine Spatial Planning (MSP) implementation are examples of the issues identified to delay projects' permitting.

Finally, there is also a need to provide more information on the sector not only to regulators, developers and other stakeholders but also to the general public. Information should be provided focusing on the ocean energy sector technical aspects, effects on the marine environment, role on local and regional socio-economic aspects and effects in a global scale as a sector producing clean energy and thus having a role in contributing to decarbonise human activities. Only with an informed society would be possible to carry out fruitful public debates on MRE implementation at the local level.

These non-technological barriers that could hinder the future development of WE in EU, are being addressed by the WESE project funded by EMFF in 2018. The present project builds on the results of the WESE project and aims to move forward through the following specific objectives:

1. Development of an **Environmental Research Demonstration Strategy** based on the collection, processing, modelling, analysis and sharing of environmental data collected in WE sites from different European countries where WECs are currently operating (Mutriku power plant and BIMEP in Spain, Aguçadoura in Portugal and SEMREV in France); the SafeWAVE project aims to enhance the understanding of the negative, positive and negligible effects of WE projects. The SafeWAVE project will continue previous work, carried out under the WESE project, to increase the knowledge on priority research areas, enlarging the analysis to other types of sites, technologies and countries. This will increase information robustness to better inform decision-makers and managers on real environmental risks, broad the engagement with relevant stakeholders, related sectors and the public at large and reduce environmental uncertainties in consenting of WE deployments across Europe;

2. Development of a **Consenting and Planning Strategy** through providing guidance to ocean energy developers and to public authorities tasked with consenting and licensing of WE projects in France and Ireland; this strategy will build on country-specific licensing guidance and on the application of the MSP decision support tool developed for Spain and Portugal in the framework of the WESE project; the results

will complete guidance to ocean energy developers and public authorities for most of the EU countries in the Atlantic Arch.

3. Development of a **Public Education and Engagement Strategy** to work collaboratively with coastal communities in France, Ireland, Portugal and Spain, to co-develop and demonstrate a framework for education and public engagement (EPE) of MRE enhancing ocean literacy and improving the quality of public debates.

2. Executive summary

The present document describes the new requirements to include in the MARENDATA Data Platform, within the SafeWAVE project. MARENDATA is designed to present marine renewable energy industry with resource and impact assessment related information instantaneously in a format suitable for technical and non-technical audiences. It integrates datasets from the different sites, providing scientifically robust data on the potential environmental effects of marine energy devices to support consenting and licensing processes.

The SafeWAVE project aims to continue to improve the data organization and continue to collect more data that is relevant for the project. It is intended that this platform will gather several sets of information, thereby improving its ability to answer a wide and diversified set of questions related to wave energy harnessing.

3. MARENDATA Data Platform

3.1 History

The first data were collected during the SOWFIA project[1]. This project ended in October 2013 and back then the name was SOWFIA's Data Management Platform (Leitão et al., 2013 and Magagna et al., 2012). In 2018 it got funds from projects WESE (http://wese-project.eu/) and SeaWAVE (http://www.seawave-emff.eu/) After a poll proposed to all partners of both consortia, the name MARENDATA was chosen for the Data Platform.

The latest project that started using this platform is SafeWAVE (https://www.safewave-project.eu/).

Data from SOWFIA were integrated into the MARENDATA platform and complemented with new data collected in the WESE and SeaWAVE project. Environmental data are collected in sites where devices are operating in Spanish, Portuguese and Scottish coastal waters, representing different types of marine environment (onshore, nearshore and offshore) that can potentially be affected by wave energy projects.

3.2 Present context

The data collection around wave energy harnessing devices currently operating at sea will increase the knowledge on positive, negative, and negligible environmental impacts of the following priority research areas:

1. Risk to marine animals from sound generated by wave devices.
2. Changes in physical systems (energy removal).
3. Effects of Electromagnetic Fields (EMF).
4. Seafloor integrity effects.
5. Reef-effect: generally speaking, any submerged structure located in the sea may cause an attraction effect on fish communities, especially if it is floating.

[1] Further information on this project can be seen at https://ec.europa.eu/energy/intelligent/projects/en/projects/sowfia and https://www.plymouth.ac.uk/research/coast-engineering-research-group/sowfia-project

Data measured by project partners must be structured for dissemination purposes and to ensure transferability with existing data platforms.

Then, the Data Platform is where project generated primary raw data is organized along with validated metadata information (compliant with Spatial Information in the European Community INSPIRE Directive) and secondary data (post-processed data, if any). In addition, numerical results from wave hindcast models are also included in the platform.

The organization of data within the Data Platform has undergone some changes to ensure that the data is findable, accessible, interoperable, and reusable. To this end, some standard rules of the European Marine Observation and Data Network (EMODnet) but also a set of recommendations from the Columbus project, funded by the EU, have been followed.

3.3 Framework

The Vision and the Mission put forward for MARENDATA frames the long-term goals and helps establish partnerships with new financing projects and organizations.

Vision:

- The renewable energy industry requires complex environmental information to overcome the challenges of harnessing energy from the marine environment.
- This will be delivered through an established open platform aggregating multiple sources of raw and secondary data to ensure access to meaningful information for the user.

Mission:

- Establish an adequate IT platform that links with existing and new data repositories;
- Enable access to raw and secondary data;
- Disseminate data and knowledge previously reviewed by experts;
- Survive individual projects' financing constraints;
- Reach a significant audience in the industry.

4. Requirements

4.1 Introduction

The MARENDATA platform started with the SOWFIA project, which allowed gathering the first data (available on the Data Platform). The data measured by the project partners have been properly structured for dissemination purposes and to ensure transferability with existing data platforms. For the organization of the data, a set of standards was considered in the data structure, according to reference Data Platforms such as, European Marine Observation and Data Network (EMODnet), Pan-European infrastructure for ocean & marine data management (SeaDataNet) and Copernicus Marine Environment Monitoring Service (CMEMS).

The format of data to be disclosed (classified according to format, size, and other characteristics) has been defined, as well as the standards to be used and the metadata to be produced for each dataset (following the INSPIRE data specification template in its relevant parts, i.e., dataset-level, services metadata, and data quality). It was further defined where each type of data will be stored and how each dataset will be uploaded and by whom.

Once these topics were defined, all the data collected can be inserted into the Data Platform, organized by test sites. In addition, numerical results from wave hindcast models are also included in the platform as well as secondary data which follows the technical specifications for wave energy resource assessment provided by the International Electrotechnical Commission.

4.2 Structuring User Needs and User Requirements

MARENDATA Platform was implemented in a dedicated server (dedicated cloud server to store frequently used data or data that may not fit in existing Data Portals), based on Hidromod's AQUASAFE software, allowing access to all the information collected in all the projects involved. The server is hosted in the cloud and is accessible via Web services.

Recently, with SEA WAVE and WESE projects, requirements evolved, this time mostly due to technological evolution, but also due to the existence of the other European platforms (mentioned above) and to project partner's input.

In this sense, it is now necessary to reassess whether the structure, methods of organization and the allowed file formats can satisfy the needs of all users of the platform.

Table 1 summarizes the description of user needs. It contains a set of user needs identified by the platform's initial users.

Table 1. User needs

ID	User needs
01	Have a platform where it is possible to access all information collected in a project through a single access
02	Associate metadata to each data set
03	Georeference the imported data and associate the data to previously defined test sites
04	Allow importing data in different formats
05	Allow quick and easy access to data
06	View data in a quick and easy way
07	Easily identify the data of the defined test sites
08	Associate secondary data to raw data
09	Make all files developed during the project available, even after the end of the project
10	Seamless integration of environmental data and wave/wind reanalysis

The user needs were then translated into user requirements, further detailing how the system answers those needs. An agile approach is being followed in the project. Therefore, the User Requirements may be updated in latter stages. With the evolution of requirements in recent projects, the users' requirements have also evolved and, therefore, it can be necessary to readapt the initial user needs and consequent definition of requirements.

In Table 2 there are already some recent user needs which are translated into user requirements of Table 3.

Table 2. Description of new user needs

ID	User needs
11	Allow adding data on new test sites
12	Increase options for data formats as well as options for quickly viewing data on the platform.
13	Link to other EU data platforms

Table 3. Users requirements.

ID	User requirements	Description	Justification/Comment	User need ID
01	Data Platform	Create and maintain a platform where it is possible to enter data in an organized way	A platform that allows easy access to data and gather all the information collected	01-13
02	Metadata	The definition of metadata is done through Geonetwork	This service allows the definition of metadata following the INSPIRE data specification template in its relevant parts, i.e., dataset-level, services metadata, and data quality	03
03	Use cases	Create different use cases to help the platform exploration	Allow users to better understand how they can use the data for their own problems	05; 07
04	Add new test sites	Facilitate the creation of new test sites on the platform	Allow the user to add new places where data is collected	01; 07
05	Add data with more format options	Allow adding files in recent formats	The constant increase in technology and data has made it possible to develop new data formats that better adapt to the needs of users.	01; 04
06	Allow quick and easy access to data	The creation of videos on the YouTube channel will be a form of dissemination but also a demonstration of the platform's features	The videos created show the procedure of different features available on the platform	05; 07
07	Link to EMODNET	Allow storing of metadata without raw date and guide the user of data gathered in SafeWave (or other types of relevant data) to the EMODNET site where raw data is stored	This is intended to give flexibility to the users of the platform by linking it ro other relevant data repositories	13
08	Access data via command line	Allow users to create a key for downloading data, with a certain valid time, enabling advanced users to construct command lines within their favorite tools (e.g., cURL, Powershell, Postman, C#, Go, HTTP, Java, Javascript, NodeJs, PHP, Python or Shell).	Easily integrate MARENDATAS with other platforms and operational systems	05; 13
09		Make available model reanalysis until the previous month (currently ERA5 data sources), allowing the comparison of reanalysis wave and wind data with data collected in the field	Frame data campaigns with metocean data for the site, when simultaneous measurements of wave and wind does not exist	10

The requirements' update for the Platform is due to the existence of new sets of data, new use cases and improved dissemination:

- New observed data sets are being collected during the project and other data sources may also be considered.
- Different platform use case studies will be made available to allow users to better understand how they can use the data for their own problems.
- The creation of videos on the YouTube channel (Figure 1) will be a form of dissemination but also a demonstration of the platform's features (https://www.youtube.com/channel/UCAthG4deoFoCfyfnj54P73g).

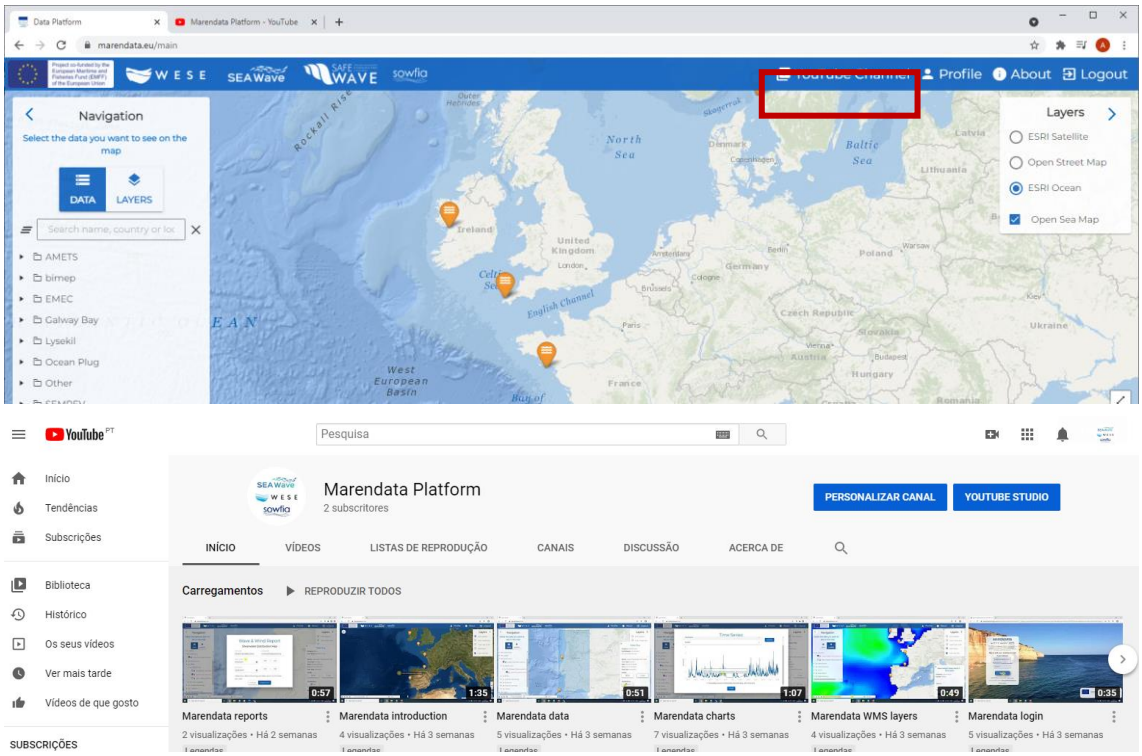
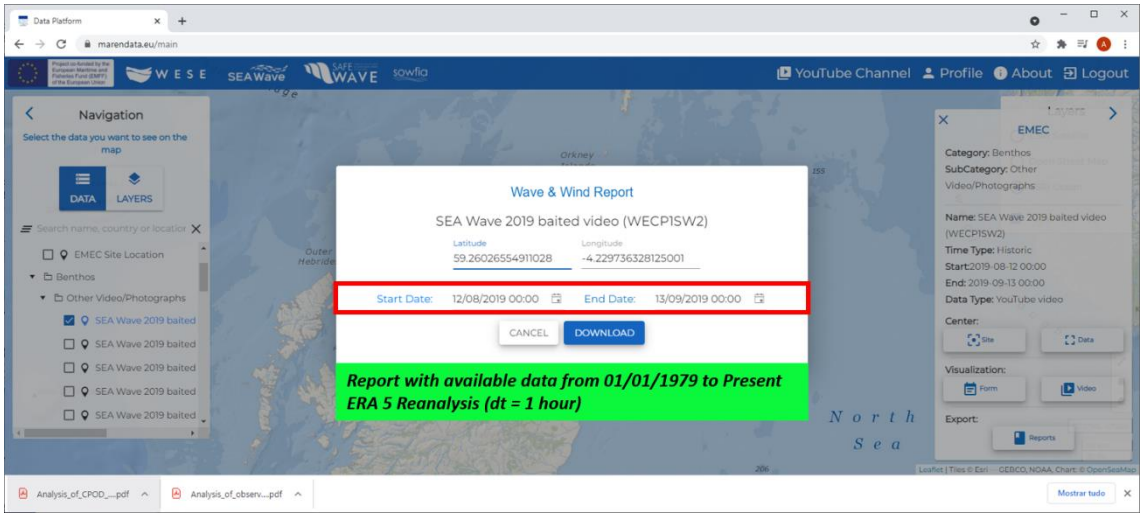


Figure 1. Link to the YouTube channel of MARENDATA Platform.

Currently, MARENDATA is focused on providing raw data and expert treatment of each individual data set. An example of such developments is the availability of wave and wind reanalysis until the previous month (currently from ERA5 data sources), allowing the comparison of reanalysis data with data collected in the SafeWave project (Figure 2).



21	Title:	ERA5 hourly data on single levels from 1979 to present				
22	Abstract:	ERA5 is the fifth generation ECMWF reanalysis for the global climate and weather for the past 4 to 7 decades. Currently data is available from 1950, split into Climate Data Store entries for 1950-197				
23	Identifiers:	https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels				
24						
25	Responsible parties:	Owner ECMWF				
26						
27	Language:	eng				
28	Point of contact:	European Centre for Medium-Range Weather Forecasts (ECMWF)				
29						
30						
31		**Waves&Wind Extracted Data**				
32						
33	Demanded					
34	Longitude:	-17.05078125				
35	Latitude:	40.04443758				
36	Start:	01/01/2017				
37	End:	31/12/2017				
38						
39		ERA5 hourly data on single levels from 1979 to present				
40	Start:	01/01/2017				
41	End:	31/12/2017				
42						
43		Significant height Era5 (1979-actual)	Mean wave direction Era5 (1979-actual)	Peak wave period Era5 (1979-actual)	Wind intensity Era5 (1979-actual)	Wind direction Era5 (1979-actual)
44	01/01/2017	2.608182025	260.9673579	15.93388542	9.342612195	123.563994
45	01/01/2017 01:00	2.690583004	261.6979895	15.88790882	9.323352071	125.6163871
46	01/01/2017 02:00	2.764231548	262.2857909	15.8192464	8.950401815	125.0827542
47	01/01/2017 03:00	2.826779442	263.2581353	15.73183037	8.85593982	124.9368895
48	01/01/2017 04:00	2.888900388	263.1098116	15.62687064	8.773467155	122.8931232
49	01/01/2017 05:00	2.952302178	262.0056239	15.39729012	8.892629096	123.9559529
50	01/01/2017 06:00	3.008445851	261.0332795	15.15500555	8.626814612	120.0612755
51	01/01/2017 07:00	3.10194748	259.2094471	15.03219964	9.231387154	118.9333944
52	01/01/2017 08:00	3.179865505	254.649866	14.8827757	9.969490607	119.5117622

Figure 2. Data source ERA5 available in MARENDATA

Automatic and user dependent procedures are two categories of data handling which will be developed. An example of automatic procedures is the computation of indexes to support project permitting. An example of user dependent procedure is the selection and download of a subset of data.

A new functionality that has already been implemented on the platform allows access to data via command line (Figure 3). The MARENDATA Platform allows each user to create a key with a certain valid time that will be used in different operational tools, independent of the operating system. Any advanced user can use this key to download data with its favorite tool like cURL, Powershell, Postman, C#, Go, HTTP, Java, Javascript, NodeJs, PHP, Python or Shell.

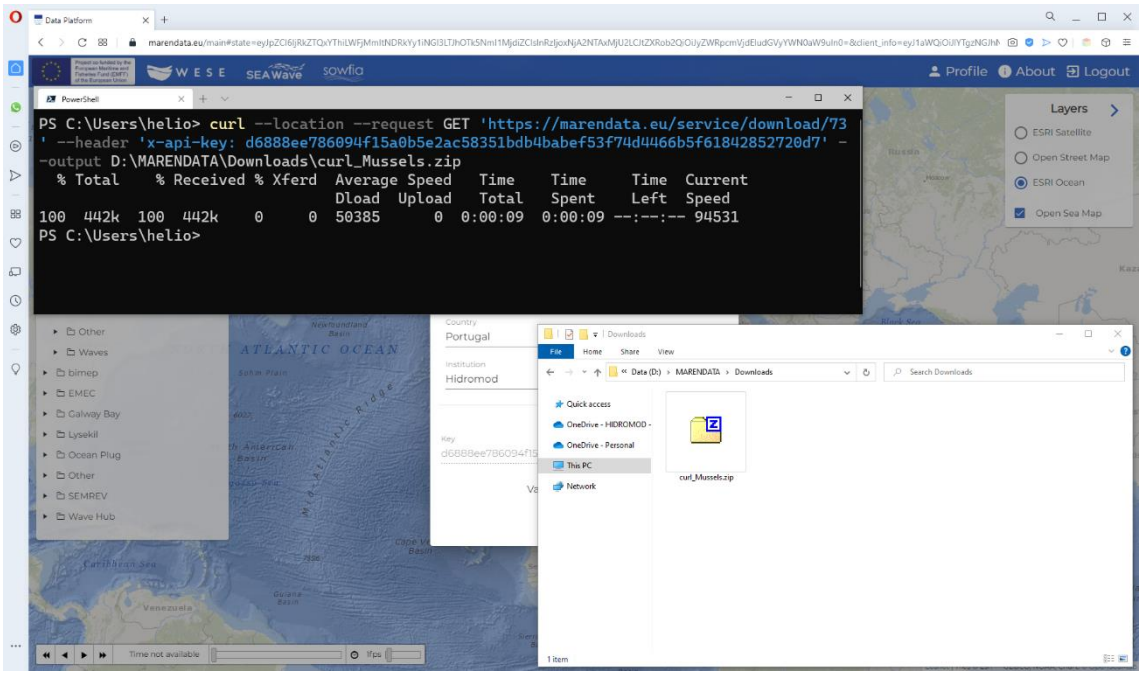


Figure 3. Data access via command line.

The following development lines are still being pursued:

- Enable the automatic treatment of different data sets mixing raw data from different sources (this work is in progress using a Thredds structure).
- Develop an additional interactive tool for treatment, visualization and sharing data.
- Make available real time data and operational models forecast for specific sites.
- Expansion of the geographical coverage outside Europe.
- Development of plugins with external data handling tools like QGIS, Python, Excel or others.

4.3 Project information storage

The MARENDATA Platform has information uploaded to platform stored and organized, as well as the deliverables for all the projects supported by the platform, even after project completion. The information from all data sources of the project is

available in the "DATA" and all documentation organized by clicking the link design, the top bar.

Figure 4 and Figure 5 show the information organized for the example of the SOWFIA project that ended in 2013.

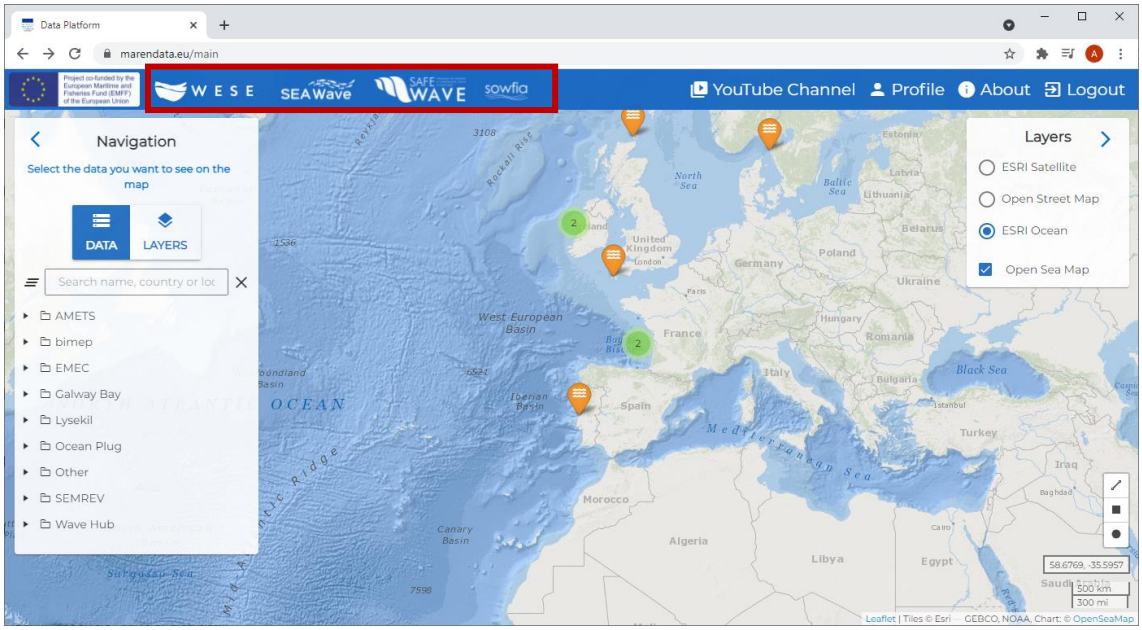


Figure 4. Data collected in the SOWFIA project available on the platform

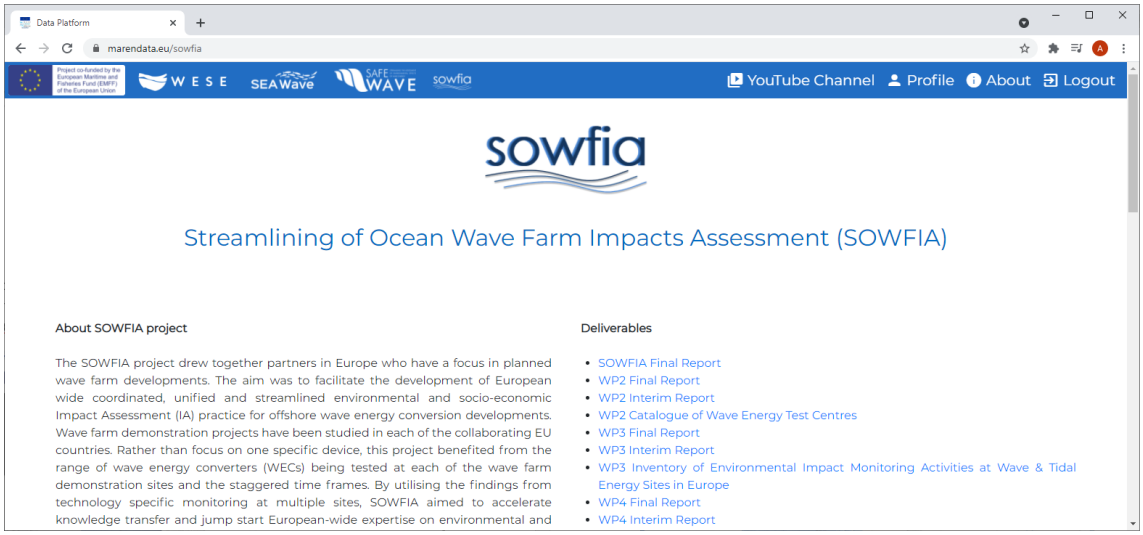


Figure 5. SOWFIA project description and deliverables storage. All the

5. References

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