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quietMED2

DELIVERABLE 8.2

Data and information tool to support updating monitoring programmes

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3	Department of Fisheries and Marine Research	DFMR	Cyprus
4	Inštitut za vode Republike Slovenije/Institute for water of the Republic of Slovenia	IZVRS	Slovenia
5	Hellenic Centre for Marine Research	HCMR	Greece
6	Institute of Oceanography and Fisheries	IOF	Croatia
7	University of Malta -The Conservation Biology Research Group	UM	Malta
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9	General Secretariat for Natural Environment and Water	GSNEW	Greece
10	Specially Protected Areas Regional Activity Centre	SPA/RAC	Tunisia
11	International Council for the Exploration of the Sea	ICES	Denmark

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Abstract

This document is the Deliverable "D8.2. Data and information tool to support updating monitoring programmes" of the QUIETMED2 project funded by the DG Environment of the European Commission within the call "DG ENV/MSFD 2018 call". This call funds projects to support the implementation of the second cycle of the Marine Strategy Framework Directive (2008/56/EC) (hereinafter referred to as MSFD), in particular to implement the new GES Decision (Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU) and Programmes of Measures according Article 13 of the MSFD. The QUIETMED2 project aims to support Member States Competent Authorities in the Assessment of the extent to which GES on Descriptor 11-Underwater noise has been achieved in the Mediterranean Region by providing practical outcomes to implement the new GES Decision through: i) a joint proposal of a candidate for an impulsive noise indicator in the Mediterranean Region ii) a common methodology for Competent Authorities to establish thresholds values, together with associated lists of elements and integration rules, iii) a data and information tool to support the implementation of the monitoring programmes of impact of impulsive noise based on the current ACCOBAMS joint register which will be demonstrated on iv) an operational pilot of the tool and v) several activities to boost current regional cooperation efforts of Barcelona Convention developing new Mediterranean Region cooperation measures.

This document details both technically and functionally the updating of the Impulsive Noise Register in the Mediterranean Sea Region (INR-MED) tool to support updating monitoring programs.

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List of Abbreviations

CTN	Centro Tecnológico Naval y del Mar
ACCOBAMS	Permanent Secretariat of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
DFMR	Department of Fisheries and Marine Research
IZVRS	Inštitut za vode Republike Slovenije/Institute for water of the Republic of Slovenia
HCMR	Hellenic Centre for Marine Research
IOF	Institute of Oceanography and Fisheries
UM	University of Malta -The Conservation Biology Research Group
POLIMI-DICA	Politecnico di Milano-Department of Civil and Environmental Engineering
SSW	Special Secretariat for Water-Hellenic Ministry of Environment and Energy
SPA/RAC	Specially Protected Areas Regional Activity Centre
ICES	International Council for the Exploration of the Sea
MSFD	Marine Strategy Framework Directive
GES	Good Environmental Status
MS	Member States
INR-MED	Impulsive noise register in the Mediterranean Sea Region
PBD	Pulse-block day, defined as the number of days in a calendar year in which impulsive sound activity occurred within a particular area.
TG Noise	European Commission Technical Group on Noise
D11C1	Anthropogenic impulsive sound

1. Introduction

The QUIETMED2 Project is funded by DG Environment of the European Commission within the call "DG ENV/MSFD Second Cycle/2018". This call funds the next phase of MSFD implementation, in particular, to implement the new GES Decision (Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU) and Programmes of Measures according Article 13 of the MSFD.

The QUIETMED2 project aims to enhance cooperation among Member States (MS) in the Mediterranean Sea Region (MED) to implement the Second Cycle of the Marine Directive and in particular to assist them in the preparation of their MSFD reports through the following specific objectives:

- Develop and implement a candidate impact indicator in the Mediterranean Region for D11C1 Criteria.
- Make a joint proposal of a methodology to establish threshold values, list of elements and integration rules to implement the GES decision in reference to D11 in the Mediterranean Region.
- Build an efficient data and information tool to support the implementation of the D11C1 Criteria and the update of the monitoring programmes of Impulsive Noise according the new GES Decision.
- Perform an operational pilot of an impulsive noise impact monitoring programme implemented with the updated Joint register to demonstrate its feasibility.
- Promote Mediterranean Region Coordination by i) boosting current regional cooperation efforts of Barcelona Convention and others and ii) developing new cooperation measures.
- Enhance collaboration among a wide network of stakeholders through the dissemination of the project results, knowledge share and networking.

To achieve its objectives, the project is divided in 3 work packages around 3 priorities and 10 activities whose relationships are shown in Figure 1.

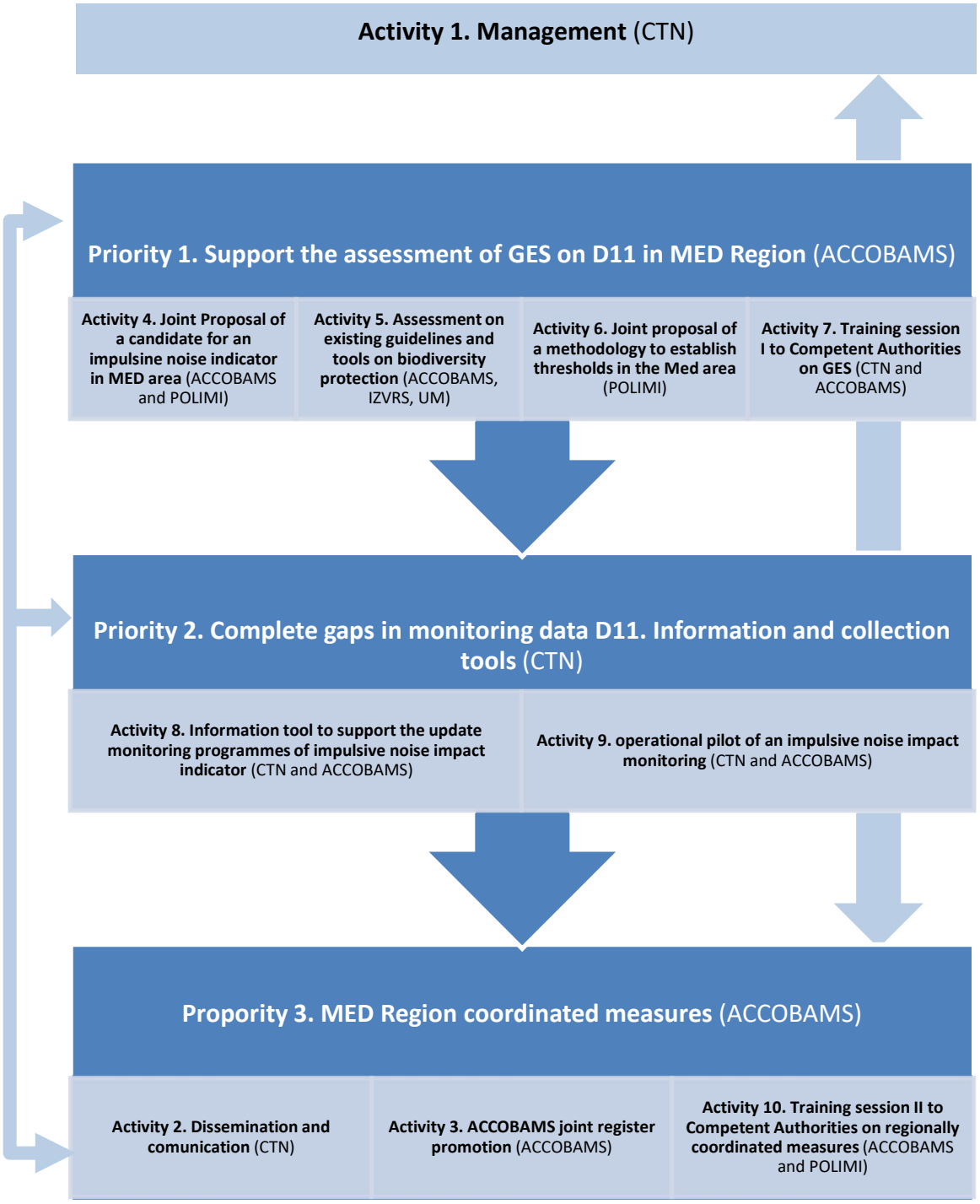

Figure 1. Work Plan Structure

The project is developed by a consortium made up of 11 entities coordinated by CTN and it has a duration of 24 months starting on February 2019.

This document explains in detail the technical and functionally characteristics of the updating of the Impulsive Noise Register in the Mediterranean Sea Region (INR-MED) tool to developed to support updating monitoring programs.

2. Definition and specification of requirements of the tool

2.1. General definition of the software project

The main aim of the developed software is to make a complete tool to support the impulsive noise events data collection, the update of monitoring programmes and, consequently, facilitating the assessment of impulsive noise (D11C1 criteria) in the Mediterranean Sea Region.

The development of this tool is closely linked with other activities within the project, where the theoretical framework for the design of new functionalities will be defined (Activity 6) and also the test and implementation of these new functionalities for D11C1 assessment will be assessed (Activity 9).

The tool facilitates access at different types of users:

- Competent Authorities and/or personnel responsible for the MSFD, in particular, related to the reporting of impulsive noise generating activities.
- Scientist specialized in bioacoustics and environmental analysis.
- General audience interested in underwater noise issues.
- System administrator and maintainers.

2.2. Update of INR-MED. From a noise register to an assessment tool for D11C1.

The Development of this tool has as its starting point the Impulsive Noise Register in the Mediterranean Sea Region (INR-MED) developed within the QUIETMED project[1]. The main aim of INR-MED was the recording of the occurrence of noise events with a potential for causing impact on sensitive species. The current INR-MED can be accessed and explored from the following provisional URL: http://80.73.144.60/CTN_Geoportal/home/.

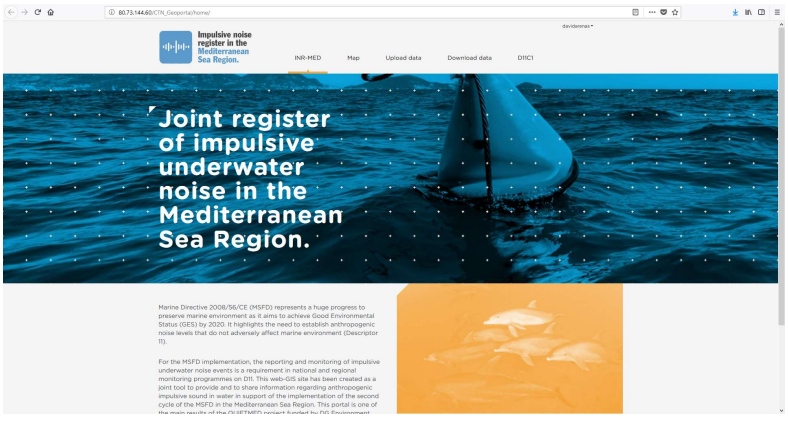

Image 1. INR-MED Home page

[1] Project funded by the DG Environment-European Commission. http://www.quietmed-project.eu/

This tool is able to record the impulsive noise generating activities for all the member states in the Mediterranean Sea, in addition to showing the results related to D11C1 according to the MSFD guidelines.

For further reference see QUIETMED deliverables: "Deliverable 4.1. International impulsive noise register for the Mediterranean basin[2]" and "Deliverable 4.2. User manual of the Impulsive Noise Register of the Mediterranean Sea Region (INR-MED)[3]"

In QUIETMED 2, the INR-MED has been updated and is renamed to D11C1-MSFD. The most significant additions are:

- Software architecture is optimized in term of modularity and powerful.
- Existing functionalities are optimized.
    - "Hotspot maps and D11C1 calculation" following TG-Noise guidelines.
- New functionality to assess the risk of impact on biodiversity caused by impulsive noise.
- It keeps track of impulsive noise generating activities as per INR-MED.

[2] http://www.quietmed-project.eu/wp-content/uploads/2019/01/QUIETMED_D4.1_Joint-register-for-impulsive-noise-in-the-MED_final.pdf
[3] http://www.quietmed-project.eu/wp-content/uploads/2019/01/QUIETMED_D4.2_INR-MED_User_manual_final.pdf

3. Using the new functionalities in the web application

The main addition to QUIETMED 2 application is the "Risk of impact on Biodiversity" section. It is accessible from the top menu. This new functionality will allow the implementation of the proposed methodology to establish thresholds in the Mediterranean Sea Region developed within the QUIETMED 2 project (see section 6.2.).

Image 2. Tool main menu

This tool enables the users to view on a map a graphic representation of the different steps included in the mentioned methodology.

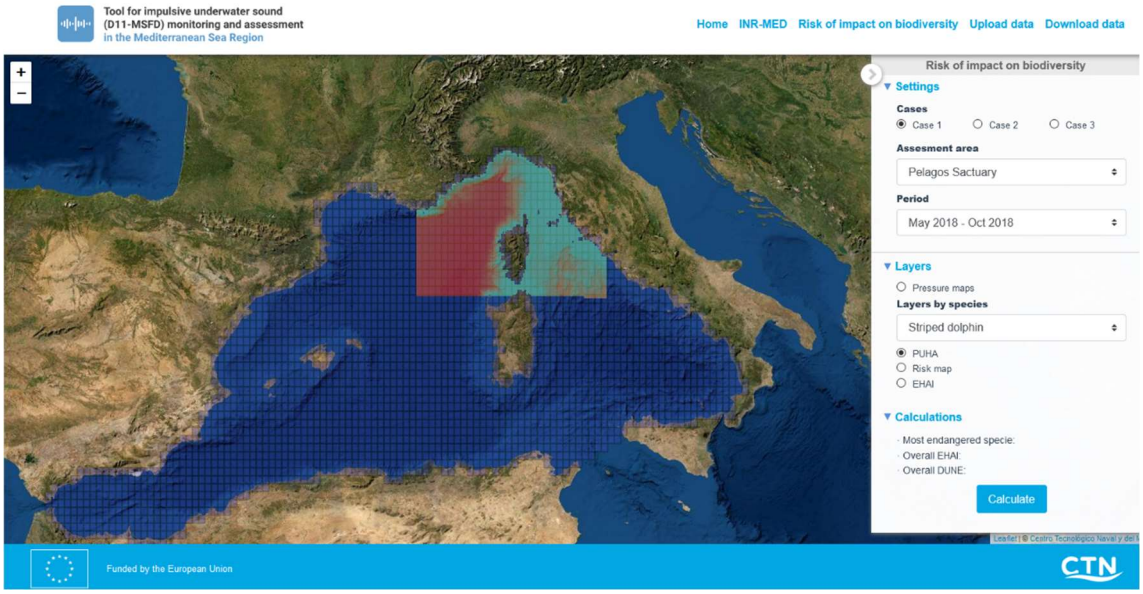

Image 3.New functionality: Risk of impact on biodiversity

Main points concerning the use of this new functionality can be summarised as follows:

- Selection of assessment area and assessment period. Once the user selects these options, representative species of cetacean are integrated in the methodology.
- Production of pressure maps. Using the information provided by the Impulsive Noise Registry (INR-MED), noise pressure maps are plotted by using appropriate acoustic propagation models.
- Representation of Potentially Usable Habitat Area (PUHA) for each one of the representative species as function of physiographic predictors within the assessment area.
- Produce risk maps using Exposed Habitat Area Index (EHAI), constructed by superimposing PUHA for each one of the representative species with the noise pressure map.

- Calculation of cumulative EHAI of the species exposed to fixed sound levels and the Duration of Noise Events (DUNE), that will be the basis to establish threshold values at spatial and temporal scale.

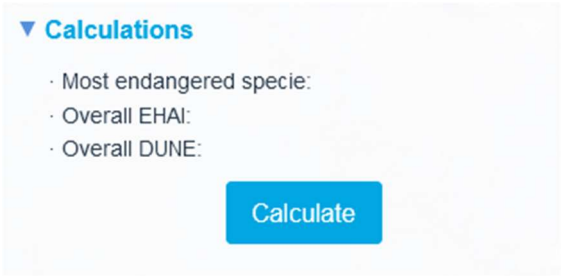

Image 4. Setting thresholds by using the new functionality

This new functionality will be tested in a later stage and consequently, further improvements could be implemented after the submission of this report. The final version of the tool will be described in detail in the Deliverable 9.2.Report on the evaluation of the use of data and information tool to support the update monitoring programmes (available in http://quietmed2.eu/outputs/).

4. Software Architecture

4.1. Hierarchical description

An **API-REST** type architecture has been adopted to carry out the communication between a *client* and a *server*, implicitly the *front-end* of the application is a client and the *back-end* of the application is a server. In this modality the front-end makes HTTP requests of type *get*, *post*, *put* and *delete* to the *back-end* and latter returns the appropriate response to the front-end whenever it is requested.

By having each part of the system composed in separate repositories some development advantages are achieved; these include programming language and technology independence between a client and a server, reliability, scalability and flexibility for handling various data payloads, improvements in user experience, and better computer resource usage at each part.

The *back-end* has been developed on the Django framework, which is also programmed with Python 3. In addition, the Django Rest Framework library is used to display the necessary API-REST endpoints.

For its part, the *front-end* has been based on the JavaScript library Vue.js, which caters for creating a modular component *Single Page Application (SPA)* with the very latest design advantages and qualities. In addition, the *Vuex* module is used to manage the state of the application whilst a user is interacting with a web page on D11C1-MSFD.

4.2. Module diagram

A diagram is presented below where the relationships of each module in the application are conceptually shown.

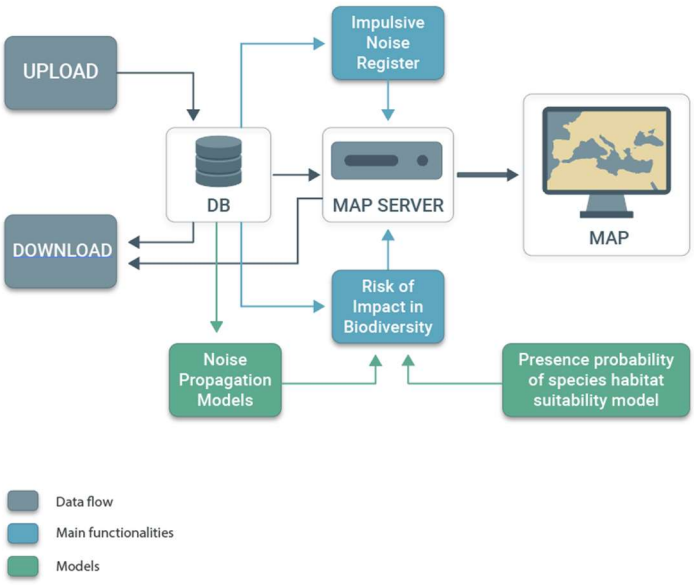

Figure 2. Module diagram in the tool.

The process on the “Map Server” outputs a “Map” where the latter shows the results are layered over a geographical map. The “Impulsive Noise Register” and the “Risk of Impact in Biodiversity” modules performs the necessary verifications and calculations based on the data stored in the database and help the ”Map Server” to render the information generated over layers on the “Map”.

4.3. Individual description of the modules

Each module is described in more detail below:

1. **Map:**

   - *General description:* This module represents the map on which the “Impulsive Noise Register” and the “Risk of Impact in Biodiversity” results are presented.

   - *Responsibility:* It is responsible for bringing together all the interaction that the user has on a map, as well as representing the requested information. As the most relevant functionality, D11C1-MSFD provides:

     1. Interaction with the Impulsive Noise Register and represent the results.
     2. Interaction with the Risk of Impact on Biodiversity and represent the results.

2. **Map Server:**

   - *General description:* This module represents the server that hosts the map information layers required in the tool.

   - *Responsibility:* Map Server provides map information through the Internet, usually as images or vector graphics. The standard specification for such a server followed in this project is the OGC Web Map Service. As the most relevant functionality, Map Server provides:

     1. Geolocated points with information (values) of any given parameter.
     2. Geolocated polygons, that can be drawn on the map to mark areas or regions.
     3. Geolocated lines, useful to show trajectories on the map.
     4. Geotiff images that can be positioned on the map.
     5. Graphic information styles, such as colours, transparency or legends, that make easier for the user to analyze the information displayed on the map.

3. **Impulsive Noise Register:**

   - *General description:* This module maintains the main functionality of INR-MED.

   - *Responsibility:* It is in charge of offering the information related to the impulsive noise register based on meeting the requirements by the Commission Decision 2017/848 and by the guidance from **TG-Noise on D11 implementation.** As the most relevant functionality, Map Server provides:

     1. D11C1 Days: "pulse-block days" (PBD) proposed by TG-Noise, which considers the number of days one or more impulsive noise events (pulses) occur in a block
     2. D11C1 Area: spatial quantities in terms of area percentage, calculated as the ratio of the number of grid cells with pulse-block days (PBDs) to the total number of grid cells of a marine region or subregion.

4. **Risk of Impact on Biodiversity:**

   - *General description:* This module provides information on how the habitat for selected species may be affected by anthropogenic impulsive sound.

   - *Responsibility:* This module takes all relevant data from the DB and the models modules, process it, and display graphic indicators on the map that help to estimate the risk for species and habitats. Detailed steps are the following:

     1. Monitoring of impulsive noise sources.
     2. Definition of area covered, period or duration.
     3. Definition of selected species, to better identify sound characteristics that are relevant.
     4. Production of pressure maps.
     5. Production of exposure risk maps.
     6. Determine potential for negative effects.

5. **Noise Propagation Models:**

   - *General description:* This module calculates how sound sources are propagated in water.

   - *Responsibility:* Calculates sound pressure in the selected areas.

     1. Determine the specific sound characteristics (pressure, frequency, duration, origin position…).

2. Determine water characteristics of the given sea area (depth, salinity, density…)
3. Calculate the size of the ensonified area (cells).
4. Produce pressure maps based on impulsive noise registry data and the selected sound characteristics.
5. The INR-MED will be the basic tool for producing the pressure maps.

6. **Presence Probability of Species-Habitat Suitability Model:**

- *General description:* This module defines the estimated habitat area potentially used by representative species.
- *Responsibility:*

1. Determine presence / absence of species using robust physiographic predictors.
2. Estimate presence probability of six species of cetaceans in the Mediterranean Sea.
3. Habitat model gridded using GIS software.
4. Potentially Usable Habitat Area (PUHA) evaluated in every grid's cell.

7. **DB:**

- *General description*: Geospatial Data Base that allows storing data with spatial information.
- *Responsibility:* The sole purpose of the Data Base module is to store and provide all data needed for the rest of modules to work. A PostGIS DB is implemented to ensure this data can be positioned in a map. It is a geospatial extension of PostgreSQL DB that can store not only regular data, but also points, lines, polygons and raster files with spatial information, regardless of the geographic reference system used.

8. **Upload:**

- *General description:* This module allows data on underwater noise generating activities to be uploaded to the DB.
- *Responsibility:*

1. Upload module uses a reporting system based in an Excel template to ensure compatibility with OSPAR and HELCOM (ICES´s underwater noise registry).

2. XML files are generated using the Excel template, which are ready to be uploaded.
3. Files are uploaded from the tool.

9. **Download:**

- *General description:* This module allows users to download data to a local system.
- *Responsibility:* Different types of data available to download:
    1. Raw data stored in data base, such as Mediterranean regions and noise activities.
    2. Processed data stored in the map server.

5. Technical aspects:

This section details the technologies that have been used in the implementation of this project. In this sense an explanation of the following is provided: the back-end technologies, the front-end technologies, the external dependencies used and, lastly, tools that are necessary for putting the application into production.

5.1. Back-end Technologies

For the development of the server part, or back-end technology, the open source Django framework is used together with Python 3.x. This framework allows to develop Python code in an elegant and effective way based on an MVC model (Model-View-Controller). This framework is currently in constant maintenance and expansion by its developers, which ensures the continuity and security of the framework with regular updates. In support of Django, several libraries have been used that allow extra functionality.

As an important backend element, the ArcGis Server, is chosen as a Map Server. It stands out for its quality, functionality and robustness. The counterpart is the need for a license to operate with it in development (not for the end user).

Regarding the database engine, PostgreSQL has been used. It is open source and currently the most popular in the world for developments that involve storing geo-referenced information. PostgreSQL is a post relational database system and can encode a variety of data formats other than tables thus allowing for greater flexibility to meet data requirements and a reasonable performance with a high level of portability, security and robustness assured. These data tables are related in defined ways, making it possible to combine different data into multiple tables and connect them.

On the other hand, Nginx has been chosen as a lightweight and high-performance web server. It is free and open source software, licensed under the Simplified BSD License. In addition, it is cross-platform, so it runs on Unix-like systems (e,g. GNU / Linux, BSD, Solaris, Mac OS X) and Microsoft Windows.

5.2. Front-end Technologies

As the main technology for programming the rendering of the web application, the Vue.js framework has been selected. This is also open source, and is based on JavaScript. One of the most important features of Vue.js is its component programming. This fact makes it possible to develop the project in a modular way and that, in turn, is easy to adopt and scale. To support Vue.js, Vuex has been adopted; it is

a complete library that allows managing the state of the application whilst a user is interacting with it.

In relation to the actual style technology, the designs have been based on the Bootstrap framework. It is one of the most popular and widely used frameworks, since it allows a developer to prototype ideas and build a complete application with variables and Sass combinations, responsive grid system, extensive pre-compiled components and highly configurable plugins integrated in jQuery.

5.3. External libraries:

The project is nourished by external libraries to be able to carry out the functionalities required by the application and provide a good user experience.

1. *Maatwebsite Laravel Excel:* Is a library to export and import Excel documents, which optimizes its creation and editing from our application environment.
2. *Chart.js*. It is a JavaScript library that uses HTML5 canvas and allows for graphical artefact creation in web environments.
3. *Node Package Manager:* Is a package manager that allows the developers to manage node modules, compile vue and sass components.
4. *Sass:* The sass preprocessor is an improved version of CSS that facilitates the development of modular CSS code.

5.4. Production Environment

5.4.1. Docker

In relation to the deployment of the application, both in development and in production, it has been decided to use Docker. Docker is a set of open source tools with which you can easily create what are known as "virtual containers". These allow you to have all the necessary technology to deploy an application regardless of the operating system over which it is run. The main features of these containers are portability, lightness, and self-sufficiency. Its main advantage is that it provides for testing applications and systems in a safe environment equal to that of production, thus reducing test times and adaptations to hardware changes from the environment test to production.

6. Description of processes and services offered by the system

6.1. Hotspot maps and D11C1 calculation

Hotspots maps in the INR-MED report the number of pulse-block days (PBD) per unit areas, per month or per year. The calculations made have been based on meeting the requirements by the Commission Decision 2017/848 and by the guidance from TG-Noise on D11 implementation.

a) D11C1 Days

The calculation method D11C1 for QUIETMED is based in the metric called "pulse-block days" (PBD) proposed by TG-Noise, which considers the number of days one or more impulsive noise events (pulses) occur in a block. Here the concept of "block" applies to grid cells of the spatial grid selected for the INR-MED, as well as to each subregion and to the whole region. For several impulsive noise events, in case they occur in the same day, only one day will be counted in the computation process.

b) D11C1 Area

The solution adopted for the INR-MED is to calculate spatial quantities in terms of area percentage, and not in terms of extent in km². The percentage is calculated as the ratio of the number of grid cells with pulse-block days (PBDs) to the total number of grid cells of a marine region or subregion. Therefore, when a block of the GFCM grid has an impulsive noise event contained in it (no matter how many PBDs), that block participates in the calculation of this percentage for the period of reference (month, or year). In short, the area percentage is the result of the sum of all blocks that contains impulsive noise events divided by the total blocks for the Mediterranean region or the Mediterranean subregion of concern.

The Deliverable 4.1. Joint register for impulsive noise in the Mediterranean Sea Region produced under the QUIETMED project provides detailed specifications on how the calculations are made.

6.2. Risk of Impact on Biodiversity

As commented before, this new functionality is built upon the results of the development of the "Activity 6. Joint proposal of a methodology to establish thresholds in the Mediterranean Sea Region". The development of this methodology is based on a risk-based approach (i.e. on the basis of pressure distribution, it estimates the risk of impact for selected species) and follows the Habitat approach: "determination of GES thresholds based on the amount (in time and space) that a pre-defined area (habitat) is negatively affected by anthropogenic noise. Furthermore, it adopts the stepwise framework approach proposed by TG Noise:

- Step 0. Implementation of joint monitoring of impulsive of sound sources.

- Step 1. Definition of scope of assessment: specific purpose, area covered, period or duration.
- Step 2. Definition of indicator/representative species or habitat to define sound characteristics likely to affect populations of marine animals.
- Step 3. Define sound characteristics to be used in the assessment.
- Step 4. Production of pressure maps based on impulsive noise registry data and the sound characteristics chosen.
- Step 5. Define the estimated habitat area potentially used by indicator (representative) species.
- Step 6. Produce exposure risk maps combining sound pressure and species habitat area.
- Step 7. Compute proportion of habitat area exposed using an exposure index.
- Step 8. Determine potential for negative effects at population level (habitat displacement/avoidance/loss).

The system will offer all the necessary services to implement all the steps included in this methodology by new functionalities that include to execute habitat and underwater acoustic modelling detailed on the following sections.

Specifications about the definition of the referred methodology are provided in the associated deliverable D6.2. Joint proposal of a methodology to establish threshold values, together with associated lists of elements and integration rules in the Mediterranean Region

6.3. Habitat Modelling

Habitat modelling will be applied to define the estimated habitat area potentially used by indicator (representative) species (Step 5) in the proposed methodology.

Presence/absence habitat models using robust physiographic predictors (e.g. depth and slope) as covariates, developed based on long-term data series and validated in areas other than calibration (see Azzellino et al., 2012 and 2011 for reference methodology), will be used to estimate the presence probability of six species of cetaceans regularly occurring in the MED.

This habitat model will be gridded by means of a GIS software and implemented as a functionality into the tool. Based on such species presence probability (e.g. habitat suitability) a Potentially Usable Habitat Area (PUHA) will be evaluated in every cell unit of the grid to estimate habitat area potentially affected by noise.

The calculation of PUHA will be essential to develop the subsequent steps of the methodology such as: Step 6. produce exposure risk maps combining sound pressure and species habitat area, Step 7.Compute proportion of habitat area exposed using an exposure index and, in consequence Step 8.Determine potential for negative effects at population level (habitat displacement/avoidance/loss).

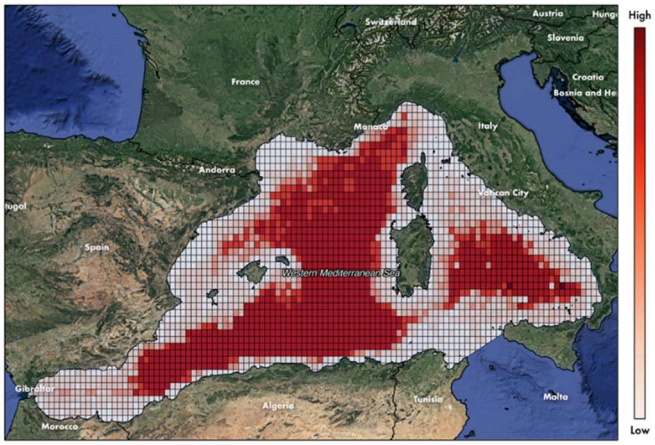

Image 5. Example of Fin whale PUHA in the Western Mediterranean Sea subregion under the MSFD.

6.4. **Underwater Acoustic Modelling.**

Underwater acoustic propagation models will be implemented to calculate the size of the ensonified area (cells) in order to produce pressure maps based on impulsive noise registry data and the chosen sound characteristics (Step 4).

Pressure map indicates the degradation level by anthropogenic noise that should be expected in a certain area. The INR-MED will be the basic tool for producing the pressure maps, constructed based on the position of sources and the number of days per semester (or per year) in which impulsive sound activity occurred within a unit INR-MED cell.

The technical specifications regarding the acoustic modelling is being developed at the moment of drafting this deliverable. Further developments will be reflected in the Deliverable 9.2. Report on the evaluation of the use of the data and information tool to support the update monitoring programmes, available in the project website[4].

6.5. **Upload Data.**

To upload the data on underwater noise generating activities, the same procedure is followed as in INR-MED. An excel file is used to preserve the existing data format used in ICES' underwater noise registry. This way, the same file can be used to feed data, both in this tool and in applications used by ICES in OSPAR and HELCOM maritime conventions.

Thus, the process to follow to upload data to the tool has the following steps:

1. Check the latest versions of the Excel spreadsheet and XML Schema.

[4] http://quietmed2.eu/outputs/

2. Copy the data to upload into the excel file with the aid of vocabularies worksheet, in the different tabs:
    1. File_information: This worksheet should always be filled in.
    2. Noise_register_data: This worksheet should always be filled in
3. Use the button in excel to export input data template to XML.
4. Go to the tool where you can upload your XML data file.

7. References

Azzellino A., C. Lanfredi, A. D'Amico, G. Pavan, M. Podestà, J. Haun, 2011. Risk mapping for sensitive species to underwater anthropogenic sound emissions: Model development and validation in two Mediterranean areas. Mar. Pollut. Bull., 63: 56- 70.

Azzellino, A., Panigada, S., Lanfredi, C., Zanardelli, M., Airoldi, S. and Notarbartolo di Sciara, G. 2012. Predictive models for managing marine Areas: habitat use and temporal variability of marine mammal distribution within the Pelagos Sanctuary (Northwestern Mediterranean Sea). Ocean and Coastal Management 67:63-74.

Azzellino A., Fossi M.C., Gaspari S., Lanfredi C., Lauriano G., Marsili L., Panigada S., and Podestà M. 2014. An index based on the biodiversity of cetacean species to assess the Environmental Status of marine ecosystems. Marine Environmental Research (2014), pp. 94-111. DOI information: 10.1016/j.marenvres.2014.06.003

TG Noise-Technical report advice. Towards thresholds for underwater noise. Common methodology for assessment of impulsive noise. December 2019 (on development).

QUIETMED project, Deliverable D4.1 International impulsive noise register for the Mediterranean basin (2018).

QUIETMED project, Deliverable 4.2. User manual of the Impulsive Noise Register of the Mediterranean Sea Region (INR-MED) (2018).