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DELIVERABLE 8.1

Preparatory study for the development of the advanced functionalities in the GIS tool

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List of participants:

No	Participant organization name	Participant short name	Country
1	Centro Tecnológico Naval y del Mar	CTN	Spain
2	Permanent Secretariat of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	ACCOBAMS	Monaco
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
8	Politecnico di Milano-Department of Civil and Environmental Engineering	POLIMI-DICA	Italy
9	Special Secretariat for Water-Hellenic Ministry of Environment and Energy	SSW	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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Contribution	Company/Organization	Name and Surname
Main author	CTN	Pablo Ruiz and Marta Sánchez
Contributions	ACCOBAMS-SINAY	Alessio Maglio
Contributions	ICES	Neil Holdsworth and Carlos Pinto
Final editing	CTN	Marta Sánchez

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Abstract

This document is the Deliverable “D8.1. Preparatory study for the development of the advanced functionalities in the new INR-MED” 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 assesses the conditions for developing new functionalities of the Impulsive Noise Register in the Mediterranean Sea Region (INR-MED) developed under the QUIETMED project.

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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
JNWG	CMS/ACCOBAMS/ASCOBANS Joint Noise Working Group.
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 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.

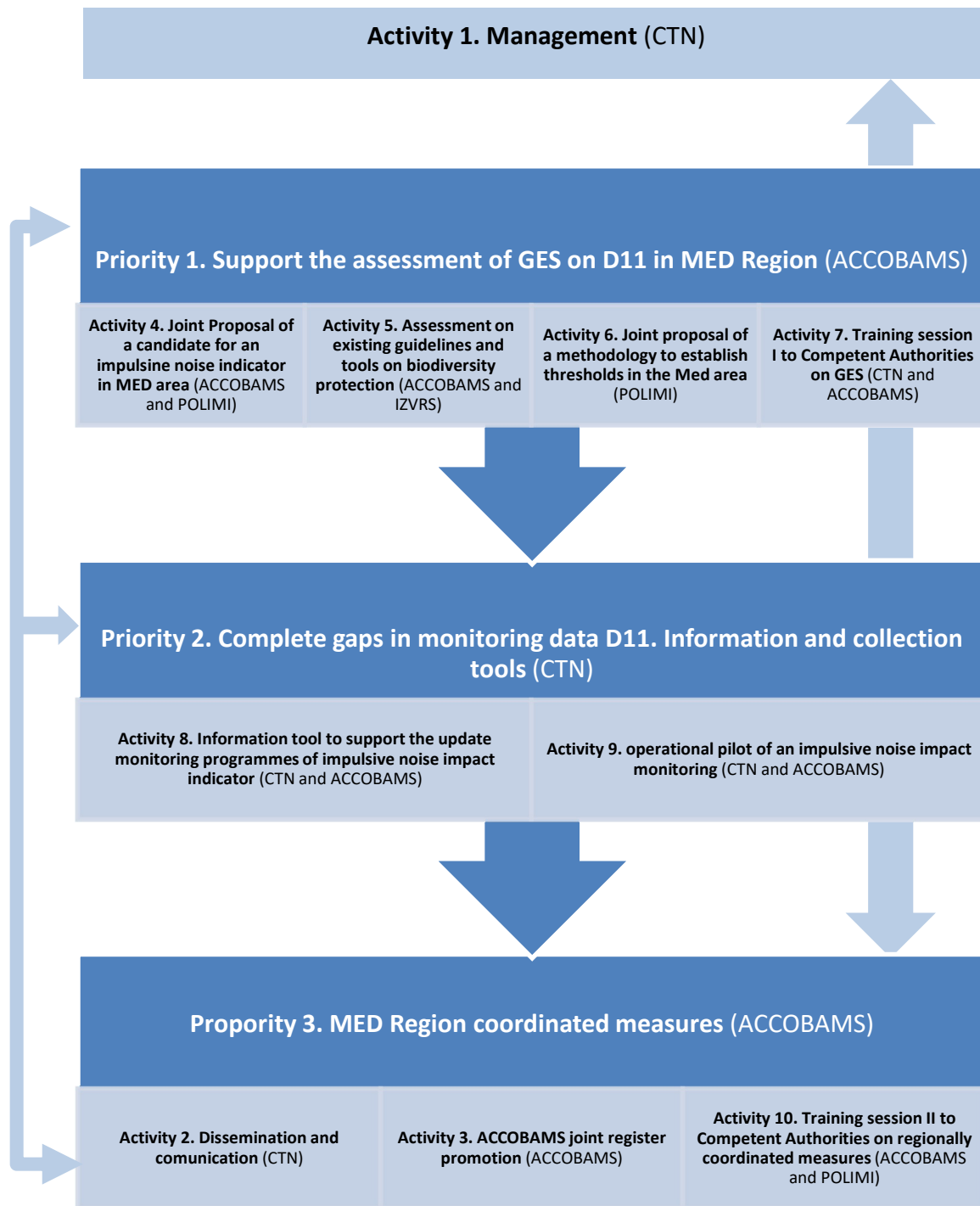


Figure 1. Work Plan Structure

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 reports the needs, potential limitations and the proposed solutions to implement advanced functionalities to support the noise data collection and analysis to enable the D11C1 assessment.

2. The INR-MED tool. Current status.

The Impulsive Noise Register in the Mediterranean Sea Region (INR-MED) is a GIS tool designed and developed under the QUIETMED project¹. The main aim of the register is 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_Ge/home/.

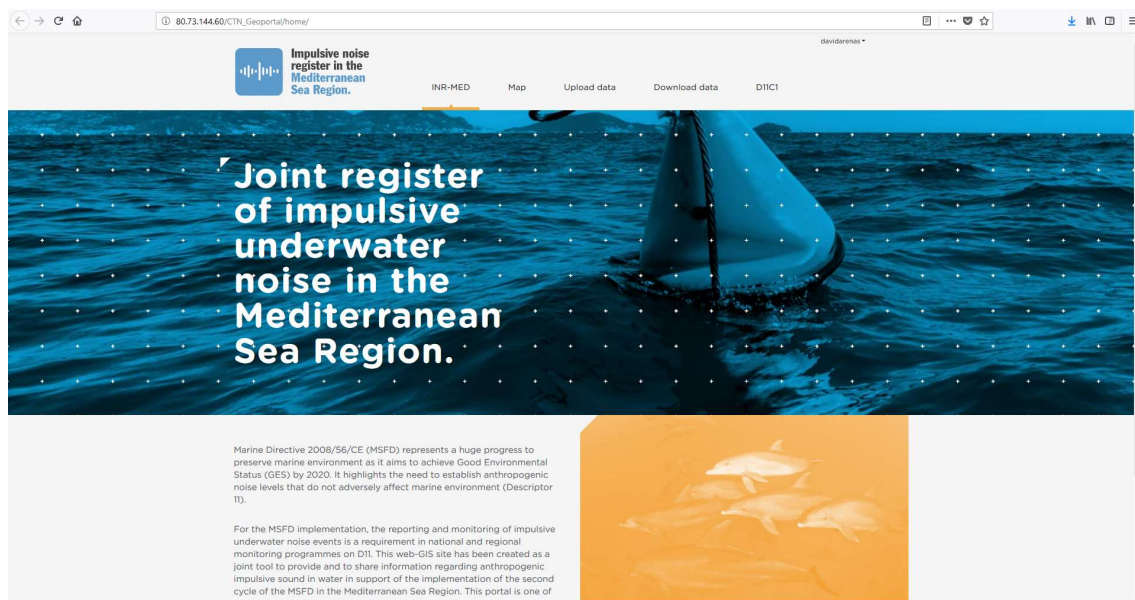


Image 1. INR-MED Home page

The current functionalities of this tool are briefly described below. For further reference see QUIETMED deliverables: “Deliverable 4.1. International impulsive noise register for the Mediterranean basin²” and “Deliverable 4.2. User manual of the Impulsive Noise Register of the Mediterranean Sea Region (INR-MED)³”

2.1. Functionalities of the INR-MED

The functionalities of the impulsive noise register are structured in three groups:

2.1.1. The functionalities belonging to the noise register interface group address the administration of the register, as well as the upload and download of data.

- a) INR-MED Homepage. The home page explains the aim of the Marine Directive 2008/56/CE (MSFD)

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

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

- b) Map. The collected data are processed and then are displayed in a map as points, lines, or polygons. The application also calculates and shows the corresponding pulse-block days.
- c) Upload. The reporting system based in an Excel template was established in order to ensure compatibility with the register used in OSPAR and HELCOM (ICES's underwater noise registry).
- d) Download. Information contained in noise register is available for download.
- e) Admin interface to allow its management by administrators.

2.1.2. The Web map GIS group address the functionalities associated to the map application tool.

- a) Layer Switcher. Tool to select layers to be displayed in the map.
- b) Legend. Dynamic legend designed to adapt to changes set in the map visualization.
- c) Table of attributes. Tool to see the associated information to the geographic data, to select database records (e.g. noise events) or apply filters to data
- d) Pop-ups. It allows to see the selected record in the map directly.
- e) Graphics and charts. Graphic tool enables the analysis of information in a visual way.
- f) Geocoder. Search bar configured to search and reach data in the map by typing the information related to searched data (codes, dates, etc.)
- g) Get coordinates. Tool to take a coordinate from the map view with user click interaction. The available geographic coordinate system are WGS 1984 and ETRS 1989.
- h) D11C1 filter. The D11C1 filter allows the user to select a spatial scale (Region, Subregion or GFCM grid), a temporal scale (year or month) and a calculation type (days or area percentage) to show D11C1 values.

2.1.3. 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.

3. New functionalities of the INR-MED. Needs, limitations and proposed solutions.

The main improvement planned for this tool is related to include new functionalities to support the implementation of the D11C1 criteria- Anthropogenic impulsive sound in water - and the update of the monitoring programmes of impulsive noise according to the new GES Decision. In particular, it is expected that this tool will be designed to support the data collection and analysis information for the D11C1 assessment. Also, possibilities for including information related to thresholds, i.e, methodologies, thresholds values etc. will be analyzed.

The needs, limitations and proposed solutions to implement these new functionalities are explained below.

3.1. Support the data collection and analysis information to assess the D11C1.

The QUIETMED2 project will develop a common framework to assess the D11C1 Criteria in the Mediterranean Region. This framework will be developed in the Activity 4 (and specified in the related Deliverable 4.1) of the project and it will support the definition of a methodology to establish thresholds, which will be specified in the Activity 6 (and Deliverable 6.2) of this project. (For additional information with regards to these activities see the project outputs available in: <https://quietmed2.eu/outputs/>)

The inclusion of new functionalities in the INR-MED to support the assessment and the implementation of the methodology mentioned above requires to analyze them in order to identify needs and to detect technical limitations in the implementation into the tool. The following analysis refers to the technical aspects to consider in that assessment process according to a processes.

3.1.1. Framework to assess the D11C1

In this section will be analysed the technical aspects for the implementation of each step included in the stepwise framework proposed for assessing impulsive sound into the tool. For this assessment will be taken into consideration the progress from TG Noise and Regional Sea Conventions, OSPAR, HELCOM and Barcelona Convention at the date this document is produced.

1. Select indicators species or habitats

TG Noise identifies two different approaches to assess impulsive sounds: a) species-oriented approach, based on species or hearing group/population; b) habitat approach, based on predefined habitat negatively affected. Technical consideration regarding these approaches are indicated in the table below:

Information needed ----- Technical considerations	Available information source ----- Proposed solution
Species or habitat approach	
Depending on the selection, density population, species probability of occurrence and/or potential habitat information will be needed. ----- It could be feasible to include both approaches.	- Open data platforms, data of transboundary monitoring programmes, ACCOBAMS Survey Initiative, MSFD monitoring programmes, Habitat Directive. -Species probability of occurrence and potential habitat must be calculated ad hoc. ----- To build a specific layer with the initial information related to species/habitat as base layer.

Table 1. Selection of approach. Technical considerations

2. Define assessment area.

The following technical considerations are about choosing the relevant evaluation area depending on the chosen approach, either specie or habitat. It could be feasible to use predefined areas or to leave the definition of this area open to the user on the map itself.

Information needed ----- Technical considerations	Available information source ----- Proposed solution
Simple approach	
To define assessment areas previously ----- NA	Updated compilation of layers with MSFD marine regions and subregions available in the website of the European Environment Agency (EEA) ----- MSFD marine regions and subregions are already included in the tool as base layers. To check if updated versions have been produced.
Dynamic approach	
Allow a user to draw new evaluation areas on the map. ----- The information is based in a layer of vector type (points, lines and polygons).	To be defined by the user directly in the map. ----- Create different layers for each assessment area defined by the user. These layers will be stored for further assessments.

Table 2. Assessment area definition. Technical considerations

3. Define spatial and temporal resolution.

Spatial and temporal resolution will be based on data availability and ecological relevance.

Information needed ----- Technical considerations	Available information source ----- Proposed solution
Temporal scale	
To define temporal scale in D4.1. and 6.2. ----- It could be useful to follow the same temporal scale used for the D11C1 criterion calculation in the INR-MED (month, quarter and year).	Information of D4.1 and D6.2. ----- To calculate indicator following the temporal scale chosen by the user.
Spatial scale	
To define spatial scale in D4.1 and 6.2. ----- It is strictly recommended to follow the same spatial scale used by the D11C1 criterion in INR-MED (30' x 30') so that noise data can be related to species/habitat data.	Information of D4.1 and D6.2. ----- To calculate indicator following the spatial scale. It is important to highlight that the comparison regarding noise unit measurements with other tools (i.e. ICES Noise Register) are not dependent of the spatial resolution.

Table 3. Spatial and temporal resolution. Technical considerations.

4. Biodiversity information.

It is related to specify estimated animal density of indicator species, presence probability species or habitat area regarding cetacean species. Considerations related to the selection of species will be specified in the Deliverable 5.1. Set of cetacean species representative at national, subregional and regional level in the Mediterranean Region (available in <http://quietmed2.eu/outputs/>)

Information needed ----- Technical considerations	Available information source ----- Proposed solution
Species density	
Population density (or distribution if population data are not available). ----- It could be necessary to define a methodology for population density calculation.	Open data platforms, data of transboundary monitoring programmes, ACCOBAMS Survey Initiative, monitoring programmes. ----- Automatic density calculation from row data could be implemented provided that these row data are included into the tool using a standardised template (similar to the current D11C1 calculation).

	In case of use of processed data (density already calculated) maybe it would useful to include a system to verify the calculation methodology used. In any case, the supporting information in Merchant et al 2018 could be useful to define the calculation method. Both possibilities could be implemented into the register. If the automatic processing of abundance models is considered useful, it would be beyond the scope of this project. In a continuous project it could be addressed.
To include a weight factor considering sensitivity. ----- NA	Weight factor to be defined in Act 4, if applicable. ----- To use a weight factor value associated to each specie.
Species probability (presence probability of species- habitat suitability)	
Long-term data series to calculate presence/absence habitat models. ----- It is essential to know the computational cost of these models.	Open data platforms, data of transboundary monitoring programmes, ACCOBAMS Survey Initiative, MSFD monitoring programmes, Habitat Directive. ----- To implement the presence probability of species models. The models would be executed as long as the data of species probability on the platform changes. Important: they would not be recalculated every time a user uses the tool, only when the data are updated.
Habitat layer	
Depth range of physical features: coastal, slope, deep sea ----- It is needed to define categories depending on the depth	EMODnet Bathymetry. Ranges of physical features defined in science literature. ----- Drawing a layer using categories defined.
To include a weight factor considering seasonality, the presence of sensitive species, ecological importance... ----- NA	Weight factor to be defined in Act 4. if applicable. ----- To use a weight factor value associated to each habitat category.

Table 4. Biodiversity information. Technical considerations

5. Produce pressure maps

Other key information for the anthropogenic impulsive sounds criterion assessment are the pressure maps. These pressure maps are based on the information included in the impulsive noise register.

In this regard, it is essential to highlight the current lack of noise data in the INR-MED register which only contains data provided by France from 2016-2017.

The availability of noise data will strongly condition the assessment.

To determine the size of the area potentially affected by sound emissions, activity 4 considers the following methods:

- a) Fixed buffer based on observed effect ranges from the scientific literature.
- b) Adjusted buffer based on acoustic modelling. Adjusted buffer with assumed thresholds for response, which results in using an adjusted buffer around the noise source based on source properties and propagation medium.

Information needed ----- Technical considerations	Available information source ----- Proposed solution
Fixed buffer	
Noise sources data. The fixed buffer per each specie/habitat. ----- NA	The current available information in the INR-MED: data from France 2016-2017 In case of more data are available, it could be feasible to produce pressure maps for different locations. Fixed buffer to be defined in Activity 4. ----- To implement an algorithm capable of evaluate the grid cells affected by noise taking into account the fixed buffer per each specie/habitat. Note that there will be information of affected area per each specie/habitat.
Adjusted buffer. Option 1: Acoustic modelling	
Noise sources data. Inputs required for model executing. It is also necessary to define the exposure-based threshold (in dB) in that the risk ceases to exist or the natural ambient noise is reached. ----- It is necessary to implement complex acoustic modelling. Also, it is necessary a lot of data for running	-Noise data: available information in the INR-MED (data from France 2016-2017) -Inputs for modelling: EMODnet. Exposure-based thresholds to be defined in activity 4 and 6. ----- Due to the complexity of the models, this approach could be not technically feasible. However, it is proposed to make a computer test of an execution of the models outside the platform to evaluate it.

the models (bathymetry, ground type, etc)	If so, the models would be executed as long as the noise data on the platform changes. Important: they would not be recalculated every time a user uses the tool. Thus, the affected cells will be those around the source where they have a noise level that exceeds the exposure-based threshold.
Adjusted buffer. Option 2: Acoustic modelling simplification. Transmission losses.	
Noise sources data. It is also necessary the exposure-based threshold (in dB) in that the risk ceases to exist. ----- NA	-Noise data: available information in the INR-MED (data from France 2016-2017) Exposure-based thresholds to be defined in activity 4 and 6. ----- If option 1 is not technically possible, it is proposed to use the transmission loss (TL) calculation to obtain an adjusted buffer. This approach was proposed in QUIETMED and it is based on reducing the computational calculation of the models with the commitment to obtain less precision in the results. In the same way as in option 1, the TL calculation would be executed as long as the noise data on the platform changes. Important: They would not be recalculated every time a user uses the tool. Thus, the affected cells will be those around the source where they have a noise level that exceeds the exposure-based threshold.

Table 5. Pressure maps. Technical considerations.

6. Compute exposure/risk map by combining 4 and 5

This section tries to make a quantitative assessment of the risk derived from habitats / species.

Information needed ----- Technical considerations	Available information source ----- Proposed solution
Information of estimated animal density of indicator species, presence probability of a species or habitat area (step 4) and information of pressure maps (step 5). ----- NA	Info derived from the implementation of phase 4 and phase 5 in the INR-MED tool. ----- The methodology proposed in activity 6 will be implemented. In any case, regardless of the methodology to be followed, it is a question of representing the results (at spatial and temporal scale) in a manner similar to how noise criterion D11C1 is represented. Including quantitative assessment of confidence in the risk values derived.

Table 6. Exposure/risk maps. Technical considerations

7. Compute exposure index(s)

Information needed ----- Technical considerations	Available information source ----- Proposed solution
Metric for the index. Quantitative definition ----- NA	To be defined in Activity 6. ----- To include automatic calculation. In this case, and at the expense of the exact definition of the calculation of the index and the thresholds, one of the results may be informative tables, beyond the information shown on the map. Calculation would be executed as long as the noise data on the platform changes. Important: they would not be recalculated every time a user uses the tool.

Table 7. Exposure index calculation. Technical considerations

8. Assess confidence in indicator values

Information needed ----- Technical considerations	Available information source ----- Proposed solution
Uncertainty factors associates to the methodology implementation. ----- NA	To be defined in Activity 6. ----- To include index of uncertainty as a complementary data for the assessment.

Table 8. Confidence assessment. Technical considerations

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