quiet seas

QUIETSEAS - Assisting (sub) regional cooperation for the practical implementation of the MSFD second cycle by providing methods and tools for D11 (underwater noise)

D6.2. Inventory of data

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4	Politecnico di Milano-Department of Civil and Environmental Engineering	POLIMI-DICA	Italy
5	Hellenic Centre for Marine Research	HCMR	Greece
6	Inštitut za vode Republike Slovenije/Institute for water of the Republic of Slovenia	IZVRS	Slovenia
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Abstract

This document is the Deliverable "D6.2 Inventory of data" of the QUIETSEAS project funded by the DG Environment of the European Commission within the call "DG ENV/MSFD 2020". 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 the MSFD), in particular to implement the EU Commission Decision 2017/848 of 17 May 2017 as well as Programmes of Measures according to Article 13 of the MSFD. QUIETSEAS aims to support the practical development of the second implementation cycle under the MSFD for D11 (underwater noise).

The object of this document is to describe the data collected and used to test the applicability of methodologies proposed under QUIETSEAS for GES assessment related to D11. Furthermore, this document presents a short review and discussion about data platforms and data suppliers, their role and current interest for such assessments as those required under the MSFD-D11. Hence, we identified a number of priorities for future developments of these tools with a view to increase their level of maturity and become more effective.

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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
UM	University of Malta -The Conservation Biology Research Group
POLIMI-DICA	Politecnico di Milano-Department of Civil and Environmental Engineering
SPA/RAC	Specially Protected Areas Regional Activity Centre
ICES	International Council for the Exploration of the Sea
Shom	Service hydrographique et océanographique de la marine
MHD	Maritime Hydrographic Directorate
MSFD	Marine Strategy Framework Directive
GES	Good Environmental Status
MS	Member States
MED	Mediterranean Sea
BS	Black Sea
CA	Competent Authority
NR	National representative
SO	Specific Objective
TB	Thematic Block

1. Introduction

The QUIETSEAS Project is funded by DG Environment of the European Commission within the call "DG ENV/MSFD 2020". The QUIETSEAS project aims to enhance cooperation among Member States (MS) in the Mediterranean Sea Region to implement the third Cycle of the Marine Directive and in particular to support Competent Authorities and strengthen cooperation and collaboration in the Mediterranean Sea and Black Sea regions.

This deliverable is the result of work done on Activity 6, testing applicability of the methodologies and tools of QUIETSEAS to promote the consolidation of indicators by performing an operational pilot on GES assessment for D11 (D11C1 and D11C2) and support the achievement of the following specific objectives of the project:

- Specific objective 1 (SO1): To identify relevant indicators for criterion D11C2 (Anthropogenic continuous low-frequency sound in water).
- Specific objective 2 (SO2): To promote the consolidation of relevant indicators for D11 and support the operationalisation of indicators on the state, pressure and impacts of underwater noise in close coordination with TG Noise.
- Specific objective 3 (SO3): To promote harmonisation of regional work on threshold values with TG Noise recommendations.

The project is developed by a consortium made up of 10 entities coordinated by CTN and it has a duration of 24 months starting on 1st February 2021.

2. Data Collected

As part of activity 6, data on noise, cetaceans, and environmental variables were collected:

- **With regards to noise**, continuous and impulsive noise were addressed. Concerning the former, the outputs of sound propagation models were used as input data to test GES assessment methodologies. Such inputs are statistical noise maps containing noise values over a period for each point of the area. They were provided by SHOM and SINAY which used two different methodologies to derive such noise maps readable in common GIS software. Sound propagation modelling also needs several input data to be implemented, including ship position and characteristics as well as environmental covariates. Input data for sound propagation modelling are also reviewed in this document. Finally, a Continuous Noise Data Call was developed and launched after a consultation process held during QUIETSEAS among project partners, competent authorities and further experts, including from the ACCOBAMS/ASCOBANS/CMS Joint Noise Working Group. Concerning the latter, a Data Call for impulsive noise was launched following the process installed during the QUIETMED2 project. The results of this Data Call are described in this document.

- **With regards to cetacean data**: we used outputs of habitat models as input data for the operational pilot on GES assessment for D11C2 (on two areas). Such inputs are habitat maps containing a suitability score (i.e. a number between 0, non-suitable, and 1, highly suitable) for cetacean species for each point of the map. Habitat maps were produced for striped dolphin (*Stenella coeruleoalba*), bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), Cuvier's beaked whale (*Ziphius cavirostris*), long finned pilot whale (*Globicephala melas*), sperm whale (*Physeter macrocephalus*) and Fin whale (*Balaenoptera physalus*) for the Mediterranean Sea, and the Black Sea subspecies of common dolphin (*Delphinus delphis ponticus*), bottlenose dolphin (*Tursiops truncatus ponticus*) and harbour porpoise (*Phocoena phocoena relicta*) for the Black Sea. They were provided by POLIMI that carried out the modelling exercise using appropriate methods to derive such habitat maps readable in common GIS software. Habitat models need several input data to be implemented, including sighting data from field surveys on cetacean populations and environmental covariates. Input data for habitat modelling are also reviewed in this document.

The collected data were used to perform the tests of assessment methodologies on two areas of interest: the Mediterranean Sea and the Black Sea Region. More precisely, in accordance with Activity 4 and Activity 8, the pilot study was carried out in the following two assessment areas:

- The North Western Mediterranean Sea, Slope and Canyon System Important Marine Mammal Area – IMMA

- The two Natura 2000 areas (ROSCI0269 (Vama Veche) and ROSCI0273 (Capul Tuzla Marine Area)) along the coasts of Romania in the western part of the Black Sea.

3. Input data for the operational pilot for D11C2

3.1. Input data for underwater sound propagation modelling done with tools developed by SINAY

To set up the acoustic model which is based on the RAMgeo model (Collins, 1993), SINAY collected input data on ships (the continuous noise sources) and environmental covariates influencing noise propagation.

3.1.1. AIS data

The AIS feed (Automated Information System) is a protocol for the automated exchange of messages between vessels by VHF radio signals trasmitted through land- and satellite-based AIS stations. This system makes it possible to know the identifier, status, position in near real time, as well as the size, speed, load and route of vessels located in the area. AIS data can be used to enable realistic shipping noise mapping, as they provide parameters required as input for an acoustic modelling system. For the present work, AIS messages sent by both VHF and satellite were used to guarantee best quality data.

We obtained AIS data by the antenna network and satellites images provided by the SPIRE, a company specialised in maritime AIS and vessel tracking data, which were structured to be directly exploited by underwater noise modeling algorithms.

3.1.2. The Source level Model

Several physical phenomena can generate noise in the displacement of a ship, e.g., the effect of cavitation, vibration tree line, vibration rotary machine transmitted by the hull and bow wave etc. Further factors affect the noise generated by a navigating ship and especially the speed, the length, the load and the depth of the the propeller.

The Source Level (SL) is the noise level emitted by a noise source, in our case a ship, which is generally referred to the level that could be measured at 1 m from the source.

A SL model is described by several arrays of levels in dB re 1 µtPa m where each level of each array is associated to a frequency band. Each array of levels corresponds to one of the possible combination of factors affecting the emission level of a ship. Vessel speed and size were used as factors influencing the SL in this modelling exercise.

To perform effective propagation modelling, general source level models available in litterature can be used, each presenting strenghts and weaknesses depending on sea state, available vessel information, water depth, and more. Therefore, the choice of the best source model was made empirically comparing the calibration data gathered during the QUIETMED project (2017-2018) to the estimate produced by the propagation model implemented by SINAY.

We found that the SL model which delivers the best estimates is the **Randi 3 model** in the low frequency (Breeding et al., 1996).

The noise model implemented by Sinay is based on a temporal approach, meaning that several noise snapshots, i.e. the noise levels estimated in an area at an instant *t*, are derived from AIS snapshots, i.e. the list of ships and associated parameters that are found in that area at that instant *t*). Each ship in each AIS snapshot is used as a noise source. Therefore, a Source Level is assigned to each ship based on the information (speed, ship type, length) contained in the AIS snapshot. The depth of the source is set to 7 m based on McKenna et al. (2011). The propagation of sound radiated from each ship is then simulated and the contributions from all ship in each mesh of the study area are summed up to derive the noise snapshot. 180 noise snapshots were produced (1 snapshot every 8h during 2 months, July and August 2020), to compute summary statistics: mean, median and percentiles.

3.1.3. Environmental variables

For the estimation of the propagation of sound waves, environmental drivers are to be quantified through several coefficients:

- ✓ Water column data: sound speed profile (calculated from temperature and salinity, in 3D);
- ✓ Geo-acoustic model of the bottom:
  - o number of layers (sediment layers, sub-bottom, etc.) and thickness (in meters)
  - o velocity profile (m/s)
  - o density (g/cm^3)
  - o attenuation of compressional waves and shear waves (dB/λ)

The selection of the coefficients depends on the availability and on the resolution of environmental data, and therefore on the assumptions made whenever necessary to overcome data gaps.

Bathymetry

The acoustic wave propagation in the ocean can be defined into two main phases: free propagation and interactions with frontiers and obstacles. When an acoustic wave encounters the bottom, a part of the wave is transmitted into the sediment, while the other part is reflected. That's why the energy losses in the shallow waters are much greater than in the deep sea.

The shape of the bottom is also important. Many phenomena occur during the contact of the acoustic wave with the seabed as the diffusion of waves, transmission and reflection. For this reason, the angle of incidence of the wave that arrives at the interface (water / seabed) affect the amount of energy transmitted and reflected. Therefore, the resolution of the bathymetry data is a crucial parameter in the choice of the database. In our case over a large area a resolution of **130 m** between two successive points is considered adequate.

Bathymetry was obtained from the EMODnet Digital Terrain Model with a resolution of **0.01°**.

Sound speed profile

Due to the limitation of the propagation medium by the surface and the sea floor, the acoustic wave undergo successive reflections on the interfaces. Moreover, variations in the speed of the medium can cause deformations of the sound wave paths. The speed of sound depends both on temperature, salinity and depth, and varies in the same direction as these three magnitudes. The temperature and the salinity of the area are two key parameters for calculating the velocity profile of sound in water which changes with depth.

We collected the data from from **Copernicus Marine Environment Monitoring Service (CMEMS)**. Means for July and August 2018 were calculated from the daily means obtained from the service.

Sediment type and sediment thickness database

The shape and nature of the sediments have a major impact on the level of ambient noise and especially in the shallow bottom where reflections are multiple. The sedimentation process leads naturally to vertical stratification in most cases. The geometry of the studied environment varies slowly in the horizontal plan but quickly in the vertical plan. The influence of the seabed is much more complex than that of the surface; many phenomena are present simultaneously: diffusion by the relief of the water-bottom interface; penetration of the sediment incident wave, sediment damping, sediment refractions and reflections, and attenuation of the P (longitudinal) and S (shear) waves.

Given the unavailability of samples on the study area or calibration measures with active emissions that allows us to identify the geoacoustic parameters accurately, our choices are based on the database provided the **Shom** (The French National Hydrographic and Oceanographic Service). These maps allow us to identify the type of sediment to define approximately the values of the density and the coefficient of attenuation in this medium.

3.2. Input data for underwater sound propagation modelling done with tools developed by SHOM

3.2.1. AIS data

The Shom purchased and used AIS data from the company ExactEarth for the purpose of the QUIETSEAS project. Likewise SPIRE's data (see Section 2.3.1), these data contains information on vessels purpose (Vessel type, activity, flag, load, size), position (location, time) and routing (speed, heading). The set is a compilation of terrestrial and satellite AIS data that cover the Mediterranean Sea and the Black Sea for the two years 2019 and 2020. The dataset size is approximately 1.8 Giga Octet (Go) per month for the Black Sea region and 10 Go per month for the Mediterranean Sea region.

3.2.2. The Source level Model

In order to find the source level radiated from a position, vessels are sorted into 7 different categories, depending on their activity and their speed range and length. This categorization permits to gather ships sharing a same range of source levels. Categories 1 to 5 concern all types of commercial vessels, with increasing ranges of SL, category 6 gathers fishing vessels and category 7 gathers passenger vessels.

For each ship category, a traffic density map is computed. For a single ship, the SL is computed at 5 m depth following the RANDI 3.1 model (Breeding et al., 1996). This source model relies on the vessel information of length and speed, extracted from the AIS database.

For each emitting mesh and each category of vessels considered, a Monte-Carlo scheme is performed to estimate the expectancy and standard deviation of SL of the category, from a subset of randomly sampled vessels. The expected SL of each category is then multiplied by the category's density to account for the complete SL of the category within the given mesh. Finally, SL from all categories are summed up to obtain the mean source level at the centre of the mesh.

3.2.3. Environmental variables

The bathymetry data used in this work is provided by GEBCO and has a resolution of 5 arc-minutes (https://www.gebco.net/data_and_products/gridded_bathymetry_data/).

The seabed nature used in this work has a resolution of 15 arc-minutes and is provided by the French Navy and Defence Services. Finally, the sound celerity dataset is composed of monthly SSP (Sound Speed Profile) provided by the French Navy and Defence Services.

3.3. Input data for Habitat Modelling

Habitat models are empirical models which are widely used in ecology to estimate the probability of presence of cetaceans in each point of the study area (for example in each cell of a spatial grid with a given cell size). Such models were used for this works and were set up based on presence/absence data and on environmental covariates which influence animal distribution.

3.3.1. Cetacean presence Data

For the Mediterranean Sea, we used sighting data from the ASI aerial survey initiative (Panigada et al., 2021), which are available upon request to the ACCOBAMS Secretariat and in accordance with terms of use *(https://accobams.org/asi-data-access-request/)*.

The survey was conducted in summer 2018 (June, July and August), during which Visual line-transect aerial sampling surveys had 77% coverage of the sub-areas of the Mediterranean Sea.

For the Black Sea, we used aerial survey data from the EU-funded CeNoBS project (Marian Paiu et al., 2021) which are available again upon request to the ACCOBAMS Secretariat. This survey was done in Summer 2019 (June and July) in the waters offshore Romania, Bulgaria, Turkey and Ukraine.

Presence data from such surveys were obtained in the form of Excel spreadsheets containing the following information for each sighting made by the observers onboard:

- Position in latitude and longitude (GPS data)
- Date and Time (GPS data)
- Species name (identified by the observers onboard).
- Group size, i.e., the number of animals in each sighting (identified by the observers onboard).
- Age classes, i.e., the number of adults, juveniles, calves and newborns (identified by the observers onboard).

As a common practice in habitat modelling, absent data are pseudo absence data obtain by the survey.

Further data were obtained from the surveys:

- Effort, defined in terms of km of surveyed track-lines.
- Environmental conditions, as these may affect the detectability of the species, such as the sea state, cloud coverage, turbidity, etc.

Of the total effort, only favorable effort was considered, i.e. effort made in favorable sea conditions (wind conditions below 3 on the Beaufort scale). Favorable effort was used to calculate the encounter rate for each species considered as the number of sightings per km detected in favorable conditions.

3.3.2. Environmental variables

The following variables were collected:

- Bathymetric data (e.g. Depth/Slope). Bathymetry, available as open data, were collected from the **GEBCO portal** (.*tif* format) which provides elevation data, in meters, on a 15 arc-second interval grid. Such data were collected for the Mediterranean and Black Sea areas with reference to the year 2021.
- Salinity/Density. The density/salinity, available as open data, were collected for the period 2017-2020 from the Giovanni NASA portal (.*tif* format) in the two variables *sea salt column mass density* and *sea salt surface mass concentration*:
    - *Sea salt column mass density:* monthly temporal resolution, spatial resolution 0.5 x 0.625 ° and units of kg m-2.
    - *Sea salt surface mass concentration*: monthly temporal resolution, spatial resolution 0.5 x 0.625 ° and units of kg m-3.
- Sea Surface Temperature (SST). SST, available as open data, were collected from the Giovanni NASA portal (.tif format) measured between 1 millimetre and 20 metres below the surface with diurnal reference. The data have monthly temporal resolution, spatial resolution of 4 km and units of degrees centigrade (C°). Data were collected for the Mediterranean and Black Sea areas of interest covering the 2017- 2020 timespan.
- Chlorophyll-a concentration, available as open data, were collected from the Giovanni NASA portal (.*tif* format) with monthly temporal resolution, spatial resolution of 4 km and units of mg m-3. Data were collected for the Mediterranean and Black Sea areas of interest covering the 2017- 2020 timespan.

4. Summary of data used for testing the assessment methods in QUIETSEAS

The summary of data and related sources used in this activity is provided in the table 1 and 2.

- Noise modelling

SINAY		SHOM	
Inputs	**Source**	**Inputs**	**Source**
AIS	Spire	AIS	ExactEarth
Source level model	Randi	Source level model	Randi3
Bathymetry	EMODnet Digital Terrain Model	Bathymetry	GEBCO
Temperature	CMEMS	Temperature	Shom - French Navy and Defence Services
Salinity	CMEMS	Salinity	Shom - French Navy and Defence Services
Sediment type and thickness	Shom - French Navy and Defence Services	Sediment type and thickness	Shom - French Navy and Defence Services
Output format		**Output format**	
Raster maps readable in GIS software		Raster maps readable in GIS software	

Table 1. Summary of noise modelling data sources

- Habitat modelling

POLIMI	
Inputs	**Source**
Presence data	ACCOBAMS Survey Initiative (MED), CeNoBS (Black Sea)
Bathymetry	GEBCO portal
Temperature	GIOVANNI NASA portal
Salinity	GIOVANNI NASA portal
Chlorophyll-a	GIOVANNI NASA portal
Output format	
Raster maps readable in GIS software	

Table 2. Summary of habitat modelling data sources

5. A short discussion about environmental input data sources

The topic of data availability and quality is widespread in every scientific domain and is of crucial importance also for underwater noise assessments.

As shown in this document, techniques employed for modelling (both noise and habitat) require a substantial expertise to process raw data and prepare outputs that can be used for assessment. It was shown in this document that raw environmental data can be obtained from open data platforms and from organisations (e.g., private companies) providing data under certain conditions which generally include a fee and a licence of use.

It is foreseeable that in the future the role of open data portals in the internet will be of increasing importance to enable and/or increase the quality and/or increase the frequency of assessments. Also, some crucial data sources will likely continue to be “closed” to a certain degree. Some of them will be only available under licence and/or payment of associated fees (such as AIS). Other data will be restricted to authorised users. The latter concern platforms containing data shared by a community of users which collaborate to, or is concerned with, a common purpose, but that not necessarily concern a wider audience.

Therefore, with a view to identify priorities for future developments of such tools, a short discussion is presented here about existing tools/portals/repositories containing open and/or closed data and about providers of data under licence and payment of fees.

5.1. State-of-the-art on web-based data portals on noise, biodiversity, and environmental covariates

As a first step, we address here the different kinds of roles involved in the lifecycle of marine data, and describe the different processes employed to deal with data from such different perspectives. Four main roles can be identified: data producers, and three levels of data aggregators, as defined in table 3.

Role	Description	Examples	Type of data	Main objective
Producers	People who carried out fieldwork, deployed sensors, etc.	Research groups from universities, laboratories, NGOs, private companies	Raw data	**Produce new knowledge and new data**
Aggregators I	Thematic ocean data aggregator/integrators	OBIS (biology) CMEMS, GIOVANNI NASA (oceanography) SeaDataNet (chemistry) GEBCO (Bathymetry)	Mainly raw data	**Promote research and data sharing among scientists**
Aggregators II	Holistic ocean data aggregators (biology, chemistry, oceanography, human activities, etc.)	EModNet ICES	Raw and processed data	**Promote research; and tool for supporting env. policy**

Aggregators III	Bodies centralising information to support to environmental policy	ICES OSPAR (ODIMS) ACCOBAMS (NETCCOBAMS)	Mainly processed data	**Tool for supporting env. policy**

Table 3. State-of-the-art of open data platform

Considering the potential value for use into an assessment such as for D11C2, data found in Aggregator platforms I and II fit better for scientists because a high degree of expertise is required to exploit such data.

Instead, data found in Aggregator platforms III are processed data (such as maps) which are potentially exploitable by people that are not necessarily scientists but can still correctly interpret those data.

The platforms reviewed in Table 3 are designed to meet the objectives of specific users and all present strengths and weaknesses when it comes to complex environmental assessment such as those required under the MSFD.

5.2. Main strengths, weaknesses, and gaps

As for today, assessments such as for the MSFD are done thanks to a heavy intervention of scientists and researchers who cross data they produce themselves with data coming from other producers or from Aggregators (I and II level) where they can usually find covariates as additional inputs for modelling exercises.

The **weaknesses** of doing this way are that there are long delays to get to results, which are associated to high costs. Moreover, the transparency may be seen as a matter of discussion because in the end it's hard to know what a researcher exactly did to produce the results included in the assessment. The output of an assessment is not a scientific paper indeed, but a technical report which is not peer-reviewed and where the methodological part is generally lighter than in scientific papers.

The main **strength** of aggregator platforms such as NETCCOBAMS and OSPAR ODIMS (III level) is that they centralise data potentially containing the most added-value for assessment. The contain data such as abundance and distribution maps of marine fauna and noise maps, that are produced and contributed by scientists after dedicated scientific projects or programmes. Once the results from such dedicated scientific efforts are validated, they become available into those platforms and can be re-used for other objectives, and especially to support the implementation of environmental policy.

However, these platforms (Aggregators III) may also suffer **weaknesses** such as the scientific validation processes of data contained therein as well as the degree of re-usability for different purposes than those for which they were produced. Nevertheless, issues related to scientific validation can be addressed by developing the required quality procedures to validate and publishing data into the platform. With regards to re-usability for further purposes, it is foreseeable that a certain intervention of scientists and technical staff will always be required in the future even in the case of highly performant platforms.

In the end, such **aggregator platforms remain promising tools** that deserve the necessary developments to bring and/or maintaining them at an adequate level of maturity.

With regards to **gaps,** we know that, as for today, continuous noise is not sufficiently addressed in any aggregator platform: there is no thematic open data portal (Aggregator I) containing raw noise measurements and there is just 1 instrument connected to the EmodNet- Physics portal (Aggregator II). Also, noise maps are included in the NETCCOBAMS platform (Aggregator III) and in the ICES data portal (classed as both Aggregator II and III) but much work is still needed to both improve transparency and harmonize methodologies across EU.

5.3. Priorities for future developments of web portals

Considering the above discussion on strengths, weaknesses and gaps, the priority items that are identified as contributing to the assessment of underwater noise are the following:

- That platforms continue to develop at all levels, and especially at the level of Bodies centralising information to support to environmental policy (Aggregator III).
- That quality-check and validation processes continue to be implemented and improved
- That transparency of methods be better addressed, also improving the re-usability and correct interpretation of input data.

5.4. About data provided under license and payment of fees

With regards to data relevant for D11C2 analyses, this section mainly concerns AIS data which are necessary as input for sound propagation modelling. AIS messages are transmitted in two ways: they can be shared thanks to receivers deployed in a network of land stations positioned in strategic locations (lighthouses, ports, other coastal infrastructures, cliffs…), or they can be transmitted through satellite communication:

- Data retrieved from land stations can be obtained for free in some cases. That's the case of **AIS-Hub**, a platform for sharing of AIS data between AIS-station operators. To get access to the entire network's data, a newcomer needs to buy and deploy an AIS receiver and stream the data into the global network. Weaknesses of this network are that no satellite data are available from AIS-Hub and the coverage of available stations, yet continuously increasing, may be quite low in many areas.
- With **Marine Traffic** there is a similar situation, with a network of AIS receivers owned by private or public bodies transmitting and sharing their data among AIS-station operators. However, since the coverage of the Marine Traffic network is much larger and complete for many areas, in practice there is little chance for newcomers to get the permission to contribute data into the network and hence accessing to the network for free. Marine Traffic is a company whose service models is based indeed on the selling of row AIS data as well as AIS-based services. In this regard, Marine Traffic not only provides data from the AIS-station network but is also a reseller of Satellite AIS (Sat-AIS) produced by companies operating their own AIS-equipped satellite constellation.
- **Sat-AIS** is generally considered the most reliable source of AIS data as there is no issue related to the distance of ships from the coast (where receivers are located and that may be out of coverage if ships are too far away and in bad weather conditions). Two

companies share the global market of AIS data: **Spire Global**, which recently acquired a third company (ExactEarth), and **ORBCOMM**. These two companies supply Sat-AIS data to any other reseller companies, including **Marine Traffic**, **FleetMon**, **up**[42], etc. Sat-AIS are sold with different models including the purchasing of data on selected periods and areas, and monthly subscriptions to get access to a continuous stream of local to global data.

6. Gathering of impulsive noise event data following the 2nd Impulsive Noise Data Call

As part of QUIETSEAS, a 2nd Impulsive noise Data Call was launched in July 2021 until December 2021, to gather data covering the period 2016 to 2021. This initiative followed the 1st Data Call for impulsive noise events launched in 2020 under QUIETMED2 and whose temporal scope covered 2017-2019.

The 2nd Data Call had a wider temporal scope but also a longer recipient list, including many stakeholders that were not competent authorities. This choice was taken to increase the quantity and improve the quality of data, both judged insufficient after the 1st Data Call had closed in December 2020.

The 2nd Data Call produced the following results:

- 9 answers were received from stakeholders in 9 countries
- New data were received on noise events occurring in 4 countries
- 1 Country affirmed that all data had already been provided under the 1st Impulsive Noise Data Call, closed in December 2020.
- 4 stakeholders answered that they could not provide any data
- No information was received regarding the remaining 15 countries which are Contracting Parties of ACCOBAMS.
- Usable data regarding the following activities:
    - 3 seismic surveys carried out in Bulgaria provided by Competent Authorities
    - 2 seismic surveys in Montenegro data provided by Competent Authorities
    - Information on seismic survey activities provided by a stakeholder in Turkey. Airgun use was recorded during cetacean observation campaigns thanks to the deployment of hydrophones.
    - 3 inshore construction activities occurred in Romania, provided by a stakeholder.
    - 1 explosive use and 1 drilling activity for oil and gas in Bulgaria, provided by competent authorities
- 1 reported noise event was considered unclear and not to be used for assessment purposes until clarification.

These data, added with those already present in the ACCOBAMS International Noise Register, should serve as the basis for the tentative GES assessment planned under QUIETSEAS Activity 6. However, to have a better basis for the assessment it will be necessary to pool these data with further noise event data collected by ACCOBAMS and described in the updated overview of the Noise Hotspots report which covers the period 2016-2021. The report is available since December 2022.

7. Issue of a first Continuous Noise Data Call

The 1st Continuous Noise Data Call was issued in September 2022, toward the last part of the project duration. The issue of this Call is considered an important milestone in the Mediterranean and Black Sea and is therefore an important result of QUIETSEAS. In fact, at the beginning of the project a great number of elements were not known or not ready:

- The objectives and juridical context
- The choice of data to be requested to recipients, which was dependent on the assessment methodology, still pending at the beginning of QUIETSEAS
- The use of such data
- The repository for data storage
- The need and the effort required to develop a web-tool that calculate the indicators allowing for the assessment, still unknown at the beginning of the project, but expected before the end of it.

After a consultation process held during QUIETSEAS among project stakeholders, and thanks to the delivery of the work done by TG-Noise at the end of 2022, all the unknowns listed above could be solved and the Data Call finalised and issued. At the time of writing this document, two months has passed since the launch of the Call and still no data could be gathered.

8. Conclusions

The whole inventory of data addressed in this document can be summarized in the following table:

Continuous Noise		
Input data for shipping noise models	**Source**	**Availability**
AIS	Owners of satellite networks used in QUIETSEAS: - Spire Global (today it includes ExactEarth, recently acquired by Spire) Further owners of satellite networks: - ORBCOMM Resellers of Spire and ORBCOMM - Marine Traffic - Fleetmon - Up[42]	Upon payment of subscription or fees
Source level model	Randi (Breeding et al., 1996)	Publicly available
Bathymetry	EMODnet Digital Terrain Model GEBCO	Publicly available
Temperature	CMEMS SHOM	Publicly available
Salinity	CMEMS SHOM	Publicly available
Sediment type and thickness	SHOM	Publicly available
Shipping noise data	**Source**	**Availability**
Noise maps	1st Continuous Noise Data Call	No data gathered so far
Noise levels from in-situ measurements	1st Continuous Noise Data Call	No data gathered so far
Impulsive Noise		
Impulsive noise data	**Source**	**Availability**
Noise Events (as defined in Dekeling et al 2014)	2nd Impulsive Noise Data Call	quietseas.ctnaval.com also available from NETCCOBAMS
Habitat Modelling		
Input data for habitat models	**Source**	**Avilability**
Presence data	ACCOBAMS Survey Initiative (MED), CeNoBS (Black Sea)	Upon request to the ACCOBAMS Secretariat
Bathymetry	GEBCO portal	Publicly available
Temperature	GIOVANNI NASA portal	Publicly available
Salinity	GIOVANNI NASA portal	Publicly available
Chlorophyll-a	GIOVANNI NASA portal	Publicly available

Table 4. Summary of data inventory

From this inventory, we have drawn some take-home messages with a view to improve the understanding, from the perspective of Competent Authorities, of the efforts required to carry out an assessment of underwater noise at the ecosystem scale:

- As shown in this document, techniques employed for modelling (both for noise and habitat) require substantial expertise to process raw data and prepare outputs that can be used for assessment. This prevents, at the time being, to set up entirely automated tools delivering standardised and meaningful assessments. The methodologies employed in QUIETSEAS (e.g., described in Deliverables 6.1 and 8.2) but also those recommended in the recent TG-Noise guidance to set up threshold levels for continuous and impulsive noise (adopted in November 2022), require indeed validation of each step from qualified personnel.
- However, most complex intermediate steps of the assessment methods can be optimized and even standardised by addressing them separately, thanks to the use of appropriate hardware and software by qualified personnel:
    - Data preparation and storage
    - Noise modelling and validation
    - Habitat modelling and validation
    - Calculation of habitat size affected by noise
- The identification of qualified personnel by Competent Authorities, as well as the necessary hardware and software is the first step enabling the achievement of the implementation of monitoring and assessment programs on noise
- If qualified personnel and the necessary hardware and software are not readily available, it is useful to identify the needs in terms of training and/or capacity building as well as external sourcing for most complex tasks (modelling).
- The collection of impulsive noise data should not require rare or highly specialistic skills. However, the data collected through the Data Calls for impulsive noise are still insufficient to allow a thorough and standardised assessment of D11 at the regional and subregional level.
- Responses to the second Data Call on impulsive noise were received from 4 countries only (2 EU Member-States and 2 non-EU countries). Additionally, 1 response come from a stakeholder and not from a Competent Authority, meaning that such data could not be used for standard D11C1 assessment.
- Despite the tools and processes installed since 2017, the ACCOBAMS International Noise Register still contains sparse data from a few countries only and the reasons expressed for not providing data appear, at the time being and at least for EU MS, hardly defensible.
- With regards to the Continuous Noise Data Call, as this is a very recent initiative we do not expect to gather quickly all required data with the expected quality. Lessons learnt from the "impulsive noise experience" should be capitalized to streamline the processes and ease the data gathering process.