

Constructing an open library containing a curated and continuously growing digital catalogue of individual sound signatures from the marine underwater soundscape in shallow seas

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Abstract – Creation and validation of an open-access digital repository for distinctive underwater sound signatures in shallow seas, emphasizing anthropic noise sources.

Keywords - Artificial Intelligence, Open Access Data, Underwater Sound Signature

I. INTRODUCTION

The European contract (CINEA/CD(2022)5010/PP/SI2.899121) titled "Catalogue of Underwater Sound Signatures from Shallow Seas" represents a project dedicated to the creation and validation of an open-access digital repository, housing a meticulously curated and continuously expanding collection of distinctive sound signatures from the underwater soundscapes of shallow seas, with a focus on anthropic noise sources. The outcome of the project will be integrated in the structure of and become publicly accessible through the European Marine Observation and Data Network (EMODnet). This endeavor aligns closely with the principles set forth in the EU's Open Science Policy, the INSPIRE Directive, and the FAIR (Findable, Accessible, Interoperable, and Reusable) data guidelines [1]. A deeper comprehension of the diverse sound signatures emanating from underwater sources is crucial for effectively linking observed sounds to their origins and identifying abiotic sound pressures within a region. The primary objective is therefore to develop a tool that can facilitate the design of action plans and contribute to their execution under the EU Marine Strategy Framework Directive, with a particular focus on Descriptor 11 (D11 Energy and Noise). The partners of the project are: CTN - Centro Tecnológico Naval y del Mar (Coordinator), ETT (Technical Coordinator), ICES - International Council for the Exploration of the Sea, SHOM - Service Hydrographique et Océanographique de la Marine, SMHI - Swedish Meteorological and Hydrological Institute, SAES - Sociedad Anónima de Electrónica Submarina, OnAIR and Witteveen + Bos.

II. DATA FRAMEWORK

Underwater soundscape refers to the acoustic environment of the underwater world, including the sounds produced by both natural and human-made sources. This includes the sounds of marine animals, as well as the sounds of waves, wind, and boats. The underwater soundscape plays a critical role in the behaviour, communication, and navigation of marine life, and its alteration or degradation due to human activities, such as shipping and oil and gas exploration, can have negative impacts on marine species and their ecosystems. Making underwater data available is instrumental in developing a clearer picture of noise pollution's effects. In this scenario, EMODnet Physics stands as a pivotal initiative within the European Marine Observation and Data Network (EMODnet), focusing on collecting, harmonizing, and disseminating high-quality marine physics data. The primary objectives of EMODnet Physics include enhancing data accessibility, promoting interoperability, and supporting various stakeholders, including researchers, policymakers, industries, and the public by facilitating a deeper understanding of the marine environment, enabling informed decision-making processes and the development of sustainable marine policies. The available parameters cover temperature, salinity and currents profiles, sea level trends, wave height and period, wind speed and direction, water turbidity (light attenuation), underwater noise, river flow, and sea-ice coverage. In situ data recorded by fixed platforms (moorings, tide gauges, HF radars, etc.), moving

platforms (ARGO, Lagrangian buoys, ferryboxes, etc.) and repeated observations (CTDs, etc.) are available. Data products are collections of in-situ data, reanalysis and trends of parameters, space and time aggregated in situ data and model outputs. In this framework EMODnet Physics is already offering two products:

- Impulsive Noise Registry: impulsive noises are generally regulated through national marine licensing therefore an Impulsive Noise Registry was developed to hold the information and produce a regional assessment based on pulse block days (PBDs). PBDs record the number of days and their distribution within a calendar year that anthropogenic impulsive activity (meeting the criteria) occurred, within a defined spatial unit (grid cell). PBDs are extracted from the following datasets:
 - the type of activity (seismic survey; pile driving; explosion; sonar; acoustic deterrent device);
 - location of each activity (as a single point or polygon area);
 - the days on which the activity occurred;
 - source properties – source level or proxy (essential minimum).
- Continuous Noise monitoring stations map: it shows the stations that are equipped with underwater hydrophones and where Member States and Sea Regional Conventions are collecting sound recordings as reference datasets for their assessment. This map is providing information about the station owner, the monitoring program, the specifications of the measurement settings (hydrophone, frequency, sampling strategy, etc.).

III. THE SOUND SIGNATURES PROJECT

A digital catalogue of underwater soundscape is a collection of recordings of underwater sounds stored in a digital format. It typically includes sounds produced by both natural sources, such as marine animals, and human-made sources, such as ships and submarines. Specifically to the project presented in the abstract, the expected outcomes will be:

- an open access library/data repository of individual underwater sounds, together with whatever information is known about their emitting source, which will be integrated in the structure of the European Marine Observation and Data Network (EMODnet);
- the definition of criteria to build, populate and evaluate the prototype database;

- the creation of links with related open data streams that can strengthen the interpretation of underwater sound reference signals;
- the definition of open-source artificial intelligence algorithm packages for automated signal classification;
- the organization of an event at which the open-source database will be presented and discussed with the relevant stakeholders.

IV. CONCLUSIONS AND CALL TO ACTION

To summarize, the open access library will be continuously growing, making it an ever-expanding resource for researchers, conservationists, and other interested parties, providing easy access to data. It will be implemented to be used for various purposes, such as monitoring and studying the underwater environment, researching the impacts of human activities on the underwater soundscape, and supporting conservation and management efforts for marine life. The open reference library will also serve as a tool to help define programmes of measures under the Marine Strategy Framework Directive.

To progress with the initiative, the project team is actively seeking information on further potential data sources for shallow seas in the European waters. This abstract plays therefore also as a call to action in the search for data which could enrich our repository in the context of the ongoing project.

REFERENCES

- [1] Mark D. Wilkinson, Michel Dumontier, IJsbrand Jan Aalbersberg, I. et al., “The FAIR Guiding Principles for scientific data management and stewardship”, *Sci Data*, vol. 3, pp. 1-9, 2016.