In-situ Real-time Underwater Noise Dataflow: from OBSEA to EMODnet

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OBSEA Underwater Noise Monitoring System

Human activities such as shipping, construction, sonar and seismic exploration have been raising the underwater ambient sound level to unprecedented levels in the past decades. In order to reduce its harmful impact on the ecosystem, the European Commission's (EC) Marine Strategy Framework Directive (MSFD) included the long-term monitoring of underwater noise as a relevant indicator to achieve a good environmental status.

OBSEA is a cabled observatory, located off the coast of Vilanova i la Geltrú (Barcelona, Spain) at a depth of 20 meters [1]. It is equipped with a wide variety of oceanographic instruments, including CTD, ADCP, an underwater camera and a hydrophone. Since 2017 acoustic data is processed in-situ to provide real-time underwater measurements and can constitute the baseline for D11C2 (best practices guidelines on continuous underwater noise monitoring) according to the MSFD directive and the recommendations of the EC Task Group Noise [2]. These measurements include Sound Pressure Levels (SPL) calculated at different band frequencies: 63, 125, 2000 Hz third-octave bands and full bandwidth.

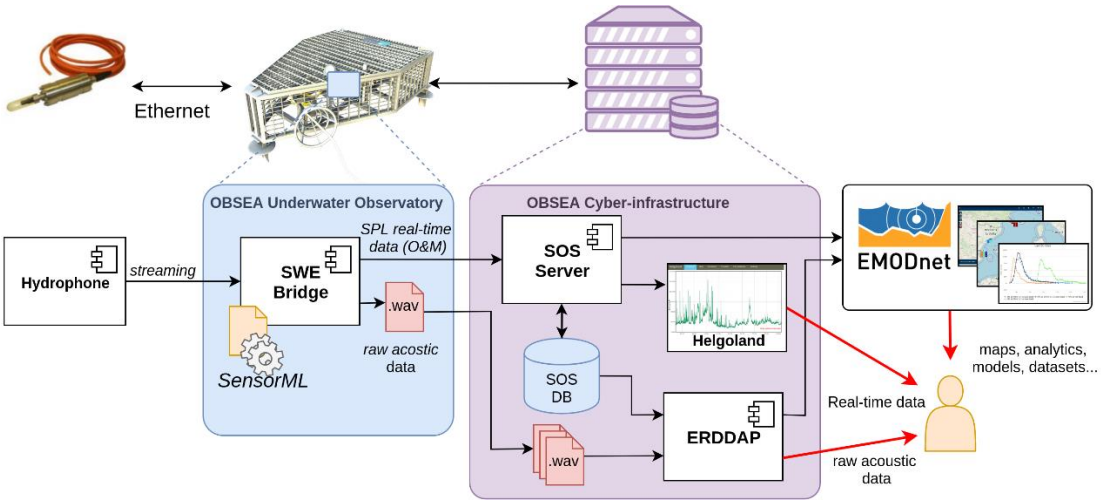

Figure 1: OBSEA's real-time underwater noise monitoring system dataflow

The underwater noise acquisition system, depicted in figure 1, provides an end-to-end real-time in-situ processing, following the FAIR principles (Findable, Accessible, Interoperable and Reusable). The SWE Bridge is a standards-based universal driver configurable through SensorML capable of interfacing almost any oceanographic instrument, including hydrophones [3]. It includes embedded real-time SPL algorithm for real-time noise measurements. The processed data is encoded in a Observations and Measurements (O&M) output, compatible with Sensor Observation Services (SOS). Alongside real-time processed data, raw audio files are also generated using the WAV format, allowing further analysis and validation.

Data and Metadata Management

The SensorML file contains a full description of the hydrophone metadata, including data streams, algorithm configuration, description, identification, contacts as well as technical information. To provide unambiguous meaning for each term, SeaDataNet and IOOS controlled vocabularies are used. The metadata contained within the SensorML file is propagated to the SOS service (52north implementation) and stored alongside the processed data, where it is archived and accessible through its standard API.

The WAV format, used for raw audio data, does not provide any standardized way to embed acoustic metadata. Thus, the ID3 container has been adopted. This metadata container, widely used in commercial audio formats such as mp3, embeds standardized metadata tags to a file. This tagging system has been leveraged to include all the hydrophone metadata as user-defined tags, including hydrophone sensitivity, deployment location, timestamp, sensor name, manufacturer serial number, contact information among others.

In order to make the WAV data available in a coherent and standardized manner, an ERDDAP service has been set up. ERDDAP provides a standardized way to retrieve data and metadata, including access to raw files. Using the ERDDAP and SOS interfaces the data is connected with EMODNet Physics data portal, where data is integrated into an underwater noise product. The same data is then used to calibrate underwater noise models and sound maps.

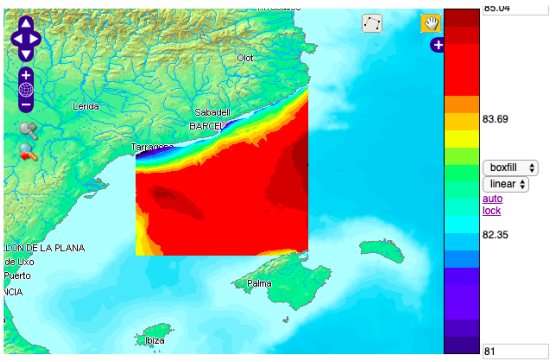

Figure 2: Example of a soundmap from EMODnet Physics in the OBSEA area

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