Seasonal underwater Sound Pressure Level variability at OBSEA

Albert Garcia-Benadí[1], Javier Cadena Muñoz[1], Enoc Martínez Padró[1], Joaquín del Rio Fernández[1]

[1] *Universitat Politècnica de Catalunya (UPC). SARTI research group, Vilanova i la Geltrú, Spain (albert.garcia-benadi@upc.edu)*

Introduction

The underwater soundscape is a dynamic and intricate environment influenced by various natural and anthropogenic factors. This paper delves into the seasonal variation of sound levels, measured in Sound Pressure Level (SPL), recorded at the OBSEA[1] underwater observatory. The dataset spans from 2015 to 2023, providing a comprehensive temporal overview. Understanding the seasonal patterns in underwater sound can offer valuable insights into the ecological and environmental dynamics of the marine ecosystem, as well as aid in the identification of potential sources of anthropogenic noise.

Data Acquisition

The sound level data analysed in this study was obtained through the deployment of a NAXYS hydrophone deployed at the OBSEA underwater observatory. The hydrophone recorded acoustic signals at a sampling rate of 96 kHz, ensuring a detailed and accurate representation of the underwater sound environment. To facilitate meaningful analysis, the acquired raw data was processed in 1-minute intervals, and the sound pressure levels (SPL) were computed and expressed in dB_{rms}, providing a standardized measure of the root mean square level. Notably, the data acquisition strategy involved a 10-minute sampling scheme, wherein 1 minute of acoustic information was extracted from each 10-minute recording period. This approach balances data granularity with resource efficiency, capturing the essential features of the underwater background noise while optimizing the use of observational resources over the extensive temporal span from 2015 to 2023. The full time-series data is depicted in Figure 1.

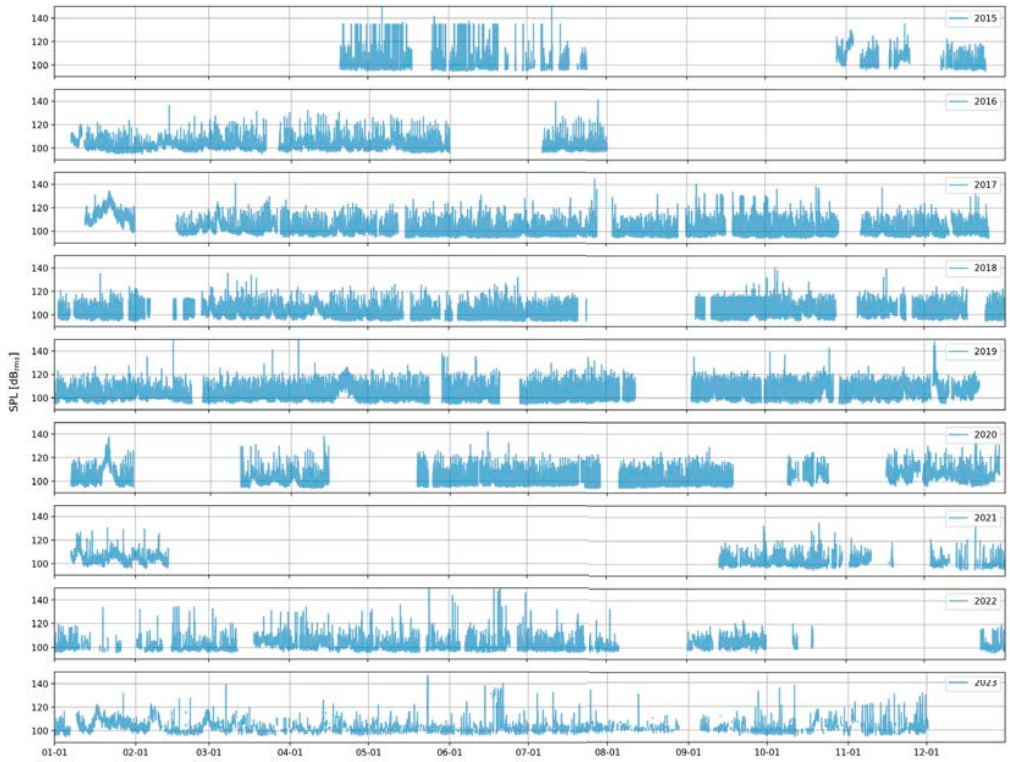

Figure 1 SPL obtained every year. Each sample is the mean in 1 minute and the interval between measures is 10 minutes. The blank intervals are offline time due to maintenance operations

Analysis

This variability of the sound pressure level allows us to analyse the different between seasons from the contribution of anthropogenic activities as [2], [3] . To introduce analyse type, the Figure 2 let us detail the SPL for all years, from 2015 to 2023, by season.
Another analyse could be to join the data from different meteorological events follows a similar methodology [4] including several storms in Spain, for instance the Storm Gloria or analysis, not included in this abstract.

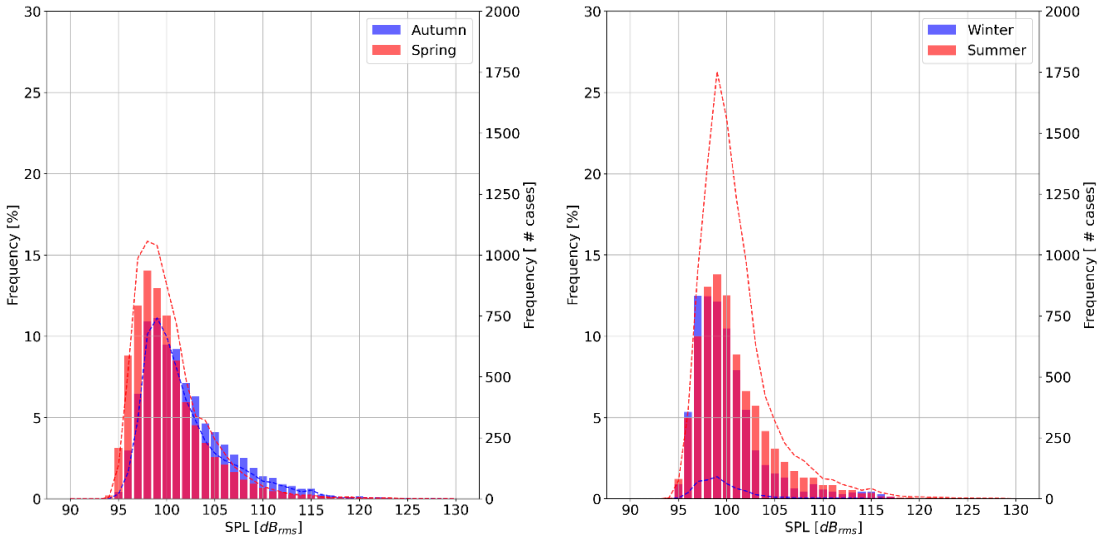

Figure 2 Histogram comparison of SPL levels during seasons for all years. Spring and autumn (left) and histogram comparison of SPL levels during summer and winter (right). The bars are the relative frequency expressed in % and the dash line corresponding to the frequency expressed in number of cases. Note that the overlap values haven't pure colour.

The dataset spanning from 2015 to 2023 was categorized into distinct seasons, allowing for a focused comparison between spring and autumn, as well as winter and summer (Figure 2). The analysis also incorporated data from meteorological events, notably the Gloria storm, to assess the impact of extreme weather phenomena on underwater background noise.

Preliminary observations indicated a noteworthy trend, with slightly elevated SPL levels during summer compared to winter, probably due to the increase of recreational shipping in summer months such the summer bars trend more high in high values of SPL. Note the values for low SPL values, around 98 dB_{rms} are dominant to summer due to only the fishing ships stay in the zone and where the acceleration sudden have lowest probability. On the other hand, in this case the number of cases of winter is lower than summer, so it's the season when the maintenance surveys had been employed, see Figure 2.

The differences in spring and autumn are subtler, having slightly higher values of SPL in autumn. This difference is probably induced by the harder meteorological conditions in autumn, since similar anthropogenic impact are expected in spring and in autumn.

Keywords – *SPL, OBSEA, variability, seasons, hydrophone.*

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