

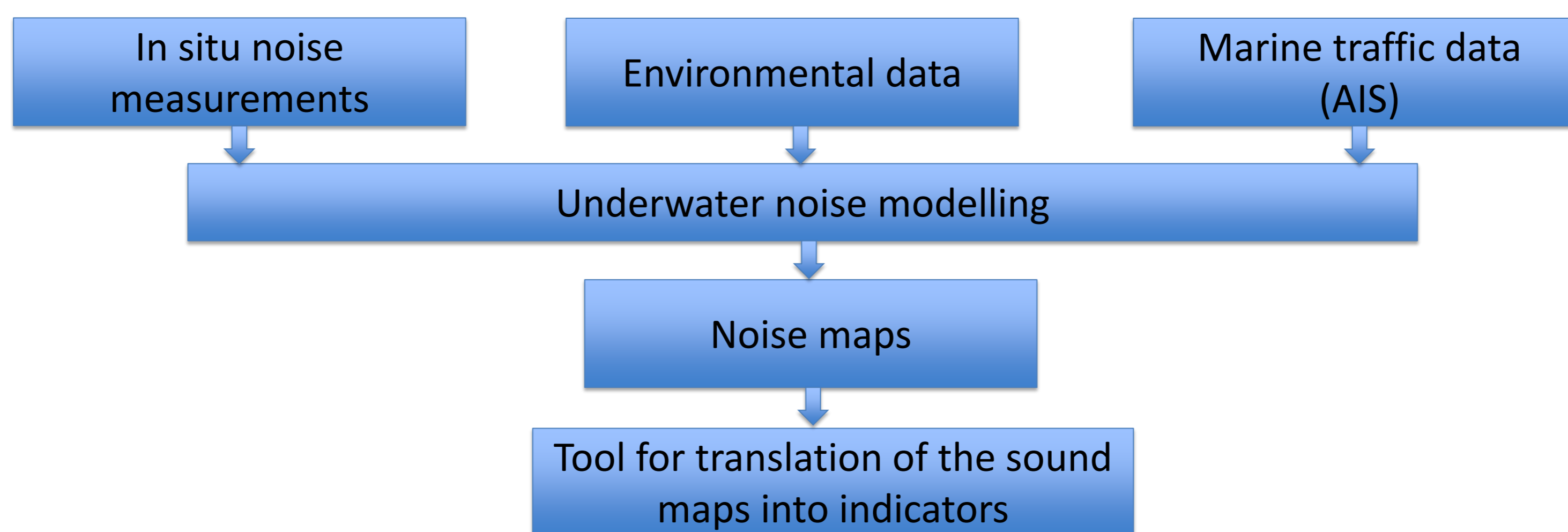
Introduction

The Bulgarian Black Sea coast is an area with intense human activity, but also there is a complex ecosystem. Several anthropogenic sources generate loud sound levels in this area. The two most wide spread are maritime transport and hydrocarbon exploration and exploitation in the Bulgarian offshore sector. Underwater sound may have negative impact on animals in the Bulgarian waters that are sensitive to sound, such as marine mammals and certain fish species.

The knowledge of ambient noise levels is very important for the characterization of the environmental status with regard to the European Marine Strategy Framework Directive (MSFD). The directive is aiming at a more effective protection of the marine environment including the protection of marine life exposed to noise (descriptor 11), and the improvement of the health of the marine environment as a whole.

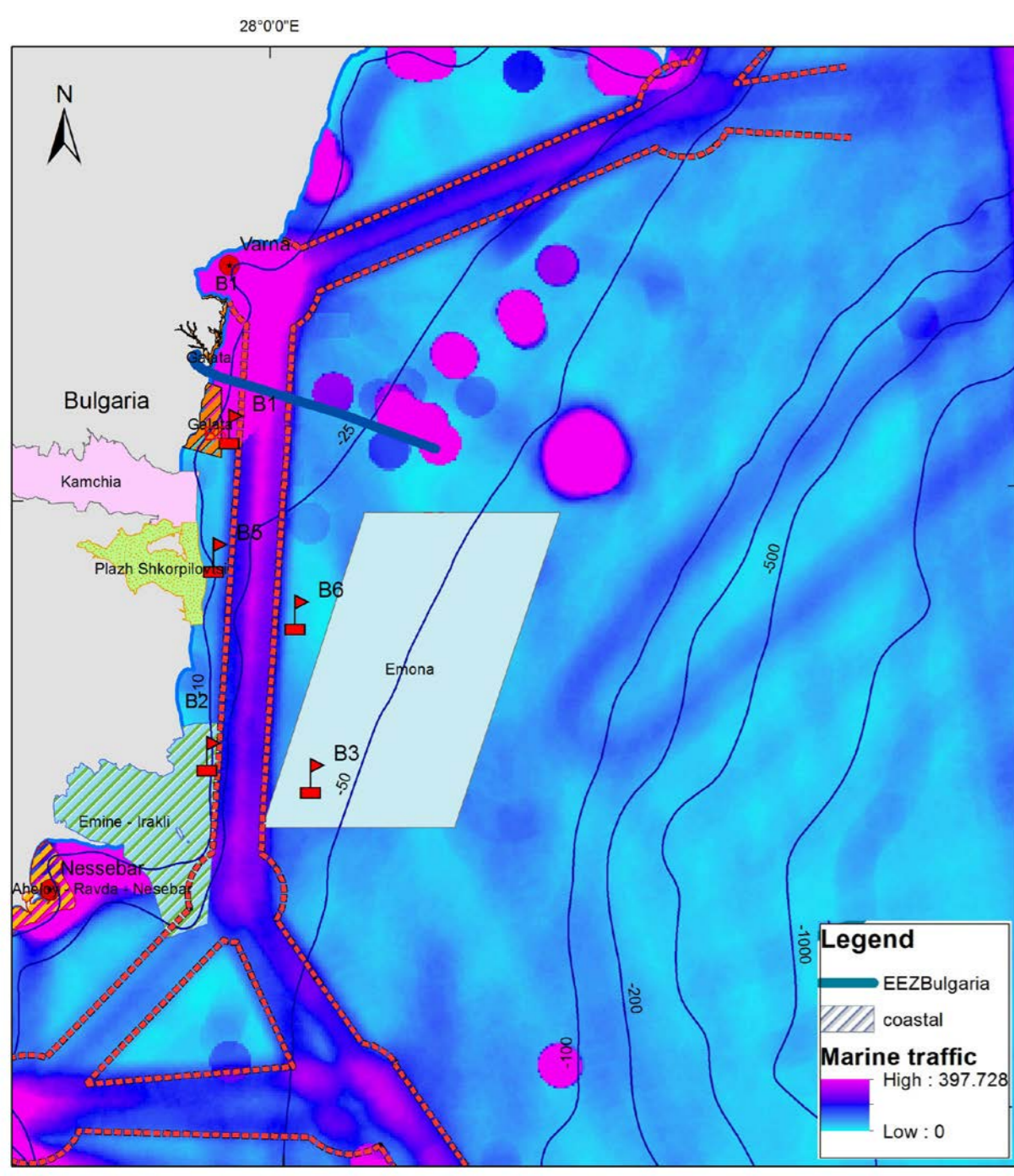
Methodology

To estimate noise impact the ocean technologies department of Bulgarian Institute of Oceanology developed a system to monitor sound generated by human activities following the TSG Noise guidance. The aim was to provide an integrated solution to assess, monitor and mitigate the noise impact of ship traffic, or other marine activities. The system consists of monitoring and simulation components. The simulation tool is in development. Appropriate modelling approaches, modelling scenarios, and acoustic model input values are being selected and applied for the most important sources of sound and for underwater sound propagation in the Bulgarian waters. The tool computes sound maps produced by noise sources, as input for assessment of the environmental status. For optimum results, the simulation tool will be validated using acoustic measurements provided by the monitoring tool.



Field measurements

The monitoring component comprises an array of passive sound recorders (Wildlife Acoustics SM3M), equipped with hydrophones, self-contained power supplies, data acquisition and storage electronics. Several consecutive deployments of recorders were made at the four sites during 2017-2018. The units were moored in the water column ~3 m above the seafloor. Monitoring stations are shown on the map and results are summarized in table below.



Metric	Time period (mm/yyyy)	1/3 octave band SPL (dB re 1 μPa)	
		63 Hz	125 Hz
Median	10-12/2017	71.4	80.4
	08-10/2018	83.2	79.1
Mode	10-12/2017	72.1	76.9
	08-10/2018	71.2	75.7
90 th percentile	10-12/2017	97.4	97.1
	08-10/2018	92.8	97.7
Root mean square (RMS) level	10-12/2017	99.7	107.9
	08-10/2018	103.8	111.9

Future work includes developing a tool for translation of the sound maps into indicators relevant to both the noise anthropogenic pressure and biological effect of underwater noise impact on marine life. The value of indicators will be present in a map format.