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Underwater noise from shipping is a potential stressor for marine animals and has been listed as a pollutant under Descriptor 11 of the Marine Strategy Framework Directive. Noise modelling is an essential tool to assess noise levels for regulatory procedures such as environmental impact assessments and ship noise monitoring. Complex models (e.g. ray-tracing and PE models), which are based on an advanced physical representation of sound propagation, are essential for shipping noise modelling in dynamic shelf seas (Shapiro et al., 2014). However, these acoustic propagation models are computationally expensive for modelling noise fields originating from many ships over a large geographic area.

Horizontal spatial discretization with a uniform grid is often used to group shipping sources. The selection of the grid size is somewhat arbitrary. Criteria to choose a proper grid size with which both the greatest computational efficiency and the greatest accuracy are achieved have not been developed yet. This work aims to produce efficient and accurate noise level predictions by presenting an adaptive grid where cell size varies with distance from the receiver. The relation between grid size and distance from the receiver has been established to generate the adaptive grid. The computational efficiency and accuracy of the resulting adaptive grid was tested by comparing it to uniform 1 km (accurate grid) and 5 km (computationally efficient) grids through a case study in the Celtic Sea.

Out results show that the adaptive grid over an area of 160×160 km reduced the number of model executions required to estimate the noise level from a large number of ships distributed over the area from 25600 which are necessary for a 1 km grid to 5356 in December. A similar reduction for calculation performed for the months of August was from 13132 to 5056 executions. The use of the adaptive grid represents a significant increase in efficiency by 2 to 5 fold. The 5 km grid reduces the number of model executions further to 1024. However, over the first 25 km, the coarse 5 km grid produces the errors of up to 13.8 dB when compared to the highly accurate but inefficient 1 km grid. The newly developed adaptive grid generates much smaller errors of less than 0.5 dB while demonstrating high computational efficiency. This can help safeguard sensitive marine ecosystems from noise pollution by improving the underwater noise predictions that inform management activities.

Reference

Shapiro, G., Chen, F., Thain, R., 2014. The Effect of Ocean Fronts on Acoustic Wave Propagation in a Shallow Sea, Journal of Marine System, 139: 217 – 226. http://dx.doi.org/10.1016/j.jmarsys.2014.06.007.

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