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3D Interactions in Under Water Acoustic Simulations

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Abstract : Due to stringent emission regulation targets, large-scale transition to renewable energy sources is a global challenge, and wind power plays a significant role in the solution vector. This scenario has led to the construction of offshore wind farms, and several wind farms are planned in the shallow waters where the marine habitat exists. It raises concerns over impacts of underwater noise on marine species, for example bridge constructions in the ocean straits. Dangerous to aquatic life, the environmental organisations say, the bridge would be devastating, since ocean straits are important place of transit for marine mammals. One of the highest concentrations of biodiversity in the world is concentrated these areas. The investigation of ship noise and piling noise that may happen during bridge construction and in operation is therefore vital. Once the source levels are known the receiver levels can be modelled. With this objective this work investigates the key requirement of the software that can model transmission loss in high frequencies that may occur during construction or operation phases. Most propagation models are 2D solutions, calculating the propagation loss along a transect, which does not include horizontal refraction, reflection or diffraction. In many cases, such models provide sufficient accuracy and can provide three-dimensional maps by combining, through interpolation, several two-dimensional (distance and depth) transects. However, in some instances the use of 2D models may not be sufficient to accurately model the sound propagation. A possible example includes a scenario where an island or land mass is situated between the source and receiver. The 2D model will result in a shadow behind the land mass where the modelled transects intersect the land mass. Diffraction will occur causing bending of the sound around the land mass. In such cases, it may be necessary to use a 3D model, which accounts for horizontal diffraction to accurately represent the sound field. Other scenarios where 2D models may not provide sufficient accuracy may be environments characterised by a strong up-sloping or down sloping seabed, such as propagation around continental shelves. In line with these objectives by means of a case study, this work addresses the importance of 3D interactions in underwater acoustics. The methodology used in this study can also be used for other 3D underwater sound propagation studies. This work assumes special significance given the increasing interest in using underwater acoustic modeling for environmental impacts assessments. Future work also includes inter-model comparison in shallow water environments considering more physical processes known to influence sound propagation, such as scattering from the sea surface. Passive acoustic monitoring of the underwater soundscape with distributed hydrophone arrays is also suggested to investigate the 3D propagation effects as discussed in this article.

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