Determination of the Source Level of Underwater Noise Radiated From Marine Platforms: Effect of Surface and Bottom Reflections on Distance Normalization

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ABSTRACT

The concept of source level is often used to characterise the acoustic radiation strength of the platform, and for convenience, is usually referred to a conceptual 1 m distance from the acoustic centre of the platform. Distance normalization is the process where the propagation effects from the platform to the receiver are removed to determine an equivalent monopole source level which yields the same measurements in the acoustic far-field ("back-propagate" from far-field to 1 m). National and International Standards, e.g., NATO STANAG 1136-1995, ANSI-ASA S12.64-2009, ISO 17208-1:2016, have been developed for determination of radiated noise levels. In these standards, spherical spreading of acoustic energy is assumed in the distance normalization, which is equivalent to assuming that sound propagates from the source to the measurement hydrophone by only one direct, lossless, straight path, in particular the effects of surface and bottom reflections are ignored. The latest draft standard ISO 17208-2:2017 considers the effect of surface reflections on the estimation of source levels using coherent reflection coefficients due to sea surface roughness, which does not account for the incoherent energy scattered from the rough surface and also ignored the effect of the near surface bubbles. In this paper, we consider the effect of surface reflections using reflection coefficients fitted to published experimental data, which includes the incoherently scattered energy and the effects of bubbles. We also consider the effect of reflections from seafloor sediments. Based on acoustic modelling suitable for short-range propagation, we propose formulas for distance normalization that accounts for the effects of surface and bottom reflections in both deep and shallow water environments.