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Evaluation of underwater acoustic propagation model (Ray theory) in a river using Fluvial Acoustic Tomography System

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Abstract

Underwater acoustics is widely used in many applications, such as oceanography, marine biology, hydrography, fishery, etc. Different models are introduced to simulate the underwater acoustic propagation in the oceans and the seas. In this study, the Ray Theory model is used to simulate the acoustic wave propagation in a shallow-freshwater river (Gono River) located in western part of Japan. The Fluvial Acoustic Tomography System (FATS) evaluated the accuracy of the model estimations. The vertical sound speed profiles were measured by a CTD in the five positions and they were used as the model inputs. The simulation results showed two main groups of acoustic waves that propagated in different paths. The reasons were because of the riverbed topography and the flow velocity. Whilst, in the sea and the ocean, the temperature/salinity gradient and the existence of internal waves are the reasons of the acoustic propagation in different paths. The lag time between the arrival time of two ray groups was 0.5 msec. The FATS transducers were deployed on both sides of the river, where, the transmission length was set to 294.629 m and the central acoustic frequency was set to 30 kHz. Finally, the FATS measurements confirmed the model results.

Keywords: Underwater acoustic wave propagation, Ray theory, Shallow-freshwater river, FATS.

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