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the Design of the IMS Hydroacoustic Station HA04 Based on High-Fidelity 3-D Modelling of Hydroacoustic Signal Propagation

Continents, islands, plateaus and sea-mounts/guyots with shallow bathymetry, can block the propagation paths of hydroacoustic signals. However, diffraction around smaller structures, such as islands and sea-mounts/guyots, can illuminate parts of the shadow region, exposing portions of the oceans which are not covered by purely 2-dimensional (range/depth) acoustic models. In recent years, parabolic equation (PE) based models have advanced to a level where 3-D underwater acoustic propagation computations in the 1 – 100 Hz band relevant to Treaty Monitoring are possible at global scales. Examples are shown where diffraction into the shadow region of islands is consistent with measured seismic events that could not be associated based on the ray approximation or 2-D PE modelling. The model is furthermore applied in a study aimed at guiding the choice of hydrophone locations for the establishment of hydroacoustic station HA04 in the Crozet Islands (France), in the South-Western Indian Ocean. Three-dimensional horizontal effects related to bathymetric features and lateral stratification of the ocean and optimization of the hydrophone depth exploiting upslope enhancement, are addressed in the study. Quantitative estimates of the improvement in global coverage prediction based on fully 3-D modelling in comparison with the traditional 2-D slice modelling approach are also discussed.

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