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Quantifying ocean acoustic sensitivity to environmental uncertainty/variability

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It is well known that acoustic data used in sonar applications are strongly influenced by physical parameters of the ocean environment. Environmental sensitivity studies are often based on a qualitative comparison of acoustic fields computed for a reference environmental model and for a perturbed model in which one or more parameters have been changed. The acoustic-field perturbation generally includes a component representing a spatial shift of the field (i.e., local field structure remains coherent, but shifts in range and/or depth) and a component representing a change to the shifted field. Hence, the field change at a fixed point can indicate high sensitivity in cases where the field structure changes little but is simply offset, which can conflict with an intuitive understanding of sensitivity. This paper quantifies sensitivity rigorously in terms of a statistical measure of the relative uncertainty of acoustic fields or transmission loss due to realistic uncertainty/variability in environmental parameters. Further, accounting for field shifts can provide a more meaningful sensitivity measure for many applications. The sensitivity of acoustic fields to the state of knowledge of the sound-speed profile, bathymetry, and seabed geoacoustic parameters is examined for both range-independent and range-dependent cases. [Funded by DRDC-Atlantic Rapid Environmental Assessment Project.]