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Applying the Data Nullspace Projection Method to a Geoacoustic Bayesian Inversion in a Randomly Fluctuating Shallow-Water Ocean

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Bayesian inversion techniques which are commonly used in geoacoustic inversion can suffer the effects of uncertain water-column fluctuations. To reduce these effects, one could also invert for the fluctuating water-column parameters; however, there are issues with this approach. One obvious problem is that the dimensions of parameter space will increase, so that Bayesian inversion may not be efficient. Another issue arises from the temporal and spatial randomness and variability of the water-column parameters; this requires extra effort in handling the randomness and variability in the inversion procedure. In this paper, we propose another approach to the problem. The data nullspace projection method, which has been applied to perturbative inversion, is extended to Bayesian inversion using acoustic modal wavenumbers and group velocities. The idea of this method is to project acoustic data onto a subspace that is insensitive to uncertain water-column fluctuations, and use the projected data to invert for bottom properties. The advantage of this approach is that we do not need to invert for water-column parameters, so that the inversion requires less operations than the previous approach. A numerical simulation demonstrates the feasibility of the projection approach. It is then applied to real data collected in the SW06 experiment.