Title: Marchenko-based target replacement in laterally varying media

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Abstract:
Seismic time-lapse studies are generally concerned with variations in a specific target zone, situated inside an otherwise static medium. In seismic monitoring the entire reflection response at the surface needs to be remodeled for every change in the target zone. Ideally, however, only the response of the target zone is remodeled, which is then inserted into the stationary response of the surrounding medium. Such an insertion is relatively straightforward when solely primary reflections are considered, but more complicated when internal multiples are introduced. The data-driven Marchenko method retrieves the responses to virtual sources inside the subsurface, and fully accounts for all orders of multiple scattering. Wapenaar and Staring (2018), therefore, use the method to predict the reflection response at the Earth's surface for different target-zone scenarios, from a single reflection response at the surface and a model of the changing target zone. This is achieved in two steps. First, the responses of the static over and underburden are resolved from the reflection response. Second, the newly modeled response from the target zone is inserted. While this methodology was originally only tested for laterally invariant media, we show how it can be extended for laterally inhomogeneous media. A 2D model is considered to compare the performance of the Marchenko-based replacement with a remodeled response of the entire medium. The results show that the method accurately captures the different arrivals in the reflection response, including the multiples, aside from minor differences in amplitude. We conclude that the method can be used to more efficiently model reflection responses of variable target zones, therefore, enabling more effective modeling for time-lapse monitoring.