Converted-wave elastic reverse time migration imaging of the Cascadia Subduction Zone

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We use a newly developed 3D elastic reverse time migration (RTM) imaging algorithm based on the Helmholtz decomposition to test approaches for imaging the shallow (< 25 km) descending Juan de Fuca slab in the Pacific Northwest. Seismic imaging conditions are constructed by breaking down the seismic wavefield into its constituent P and S components via the Helmholtz decomposition and backpropagating the decomposed wavefields. This allows us to focus on particular converted-wave scattering geometries, e.g., incident S to scattered P, which may be expected to have dominant signals in any given data set. The method is designed to yield the location and strength of discontinuities, which may be characterized by the ratio of converted-wave to direct-wave transmission coefficients. It is intended to be applied to dense seismic array observations where array analysis is expected to isolate useful scattered wave energy before implementation in RTM. We first demonstrate that our technique can successfully recover the structure of a subducting slab by: 1) generating synthetic seismic data in a subduction zone-like structure from hypothetic intraslab events recorded by a dense receiver array and 2) backpropagating the decomposed P and S wavefields to obtain elastic RTM images. We also present seismic data collected during a dense array deployment in fall 2021 near Forks, Washington, which lies in the locked region of the Cascadia Subduction Zone, and discuss plans to use this data along with our imaging method to produce high-resolution images of the subducting slab.