Title: Green’s function representations for seismic interferometry
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Seismic interferometry is the process of generating new seismic responses by cross-correlating seismic observations at different receiver locations. The first version of this principle was derived in 1968 by Claerbout, who showed that the reflection response of a horizontally layered medium can be synthesized from the autocorrelation of its transmission response. From Rayleigh's reciprocity theorem and the principle of time-reversal invariance it follows that the acoustic Green's function between two points in a lossless arbitrary three-dimensional inhomogeneous medium can be represented by an integral of cross-correlations of wave field observations at those two points. The integral is along sources on an arbitrarily shaped closed surface; no assumptions are made with respect to the diffusivity of the wave field. The Rayleigh-Betti reciprocity theorem leads to a similar representation of the elastodynamic Green's function. When a part of the closed surface is the Earth's free surface, the integral need only be evaluated over the remaining part of the closed surface. In practice not all sources are equally important: the main contributions to the reconstructed Green's function come from sources at stationary points on this surface. When the sources emit transient signals, a shaping filter can be applied to correct for the differences in source wavelets. When the sources are uncorrelated noise sources, the representation simplifies to a direct cross-correlation of wave field observations at two points, similar as in methods that retrieve Green's functions from diffuse wave fields in disordered media or in finite media with an irregular bounding surface.