Approximate vector sensitivity kernels of coda-wave decorrelation: 2D single scattering

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Coda-wave interferometry has been used to detect medium changes in association with large earthquakes or volcanic eruptions. It is important to determine the region of these medium changes correctly for understanding physical mechanisms to cause them. For that purpose, sensitivity kernels of coda waves play a crucial role. Regarding travel time changes of coda waves, the sensitivity kernels have been approximately extended to vector waves under single scattering regime by Nakahara and Emoto (2016). Regarding decorrelation of coda waves, the sensitivity kernels have been formulated so far for scalar waves only (e.g. Planes et al, 2014; Margerin et al., 2016). Hence, we try to derive analytical expressions for vector waves in two-dimensional cases. The key point in our simple extension to vector waves is the projection of seismic phonon energy into horizontal and vertical components by using the square of the direction cosine of the polarization direction. This idea is the same as one used in Nakahara and Emoto (2016) for travel-time sensitivity kernels. Thanks to this simple idea, we can derive approximate but analytical expressions of the sensitivity kernels by using the two-dimensional single isotropic scattering model for scalar waves, though we can treat either P waves or S waves at a time. Our results show that the sensitivity kernels are different for different components. They have non-zero values only on the single-scattering shells. There exist points where the kernels have zero amplitudes, and these points are different for the two components. These are theoretically shown by this study for the first time. These sensitivity kernels are helpful for us to know how to use different components simultaneously in coda-wave interferometry.

Keywords: Sensitivity kernel, coda waves, vector waves

