Title:	Analysis of Pdiff coda using the axi-symmetric finite difference method

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Abstract

The scattering of seismic waves from small spatial variations of material properties (e.g., density and seismic wave velocity) affects all seismic observables including amplitudes and travel-times and also gives rise to seismic coda waves. A large amount of the seismic energy observed at high frequencies is contained in these coda waves, and is especially evident for the seismic phases P and Pdiff. Analysis of seismic scattering has provided a means to quantify small-scale seismic properties that cannot be determined through travel-time analysis or ray theoretical approaches. Numerical wave propagation techniques, such as Finite Difference (FD) techniques, have been utilized in analyzing the full waveform effects of the scattered wave field, although application of these techniques has been focused on studies in regional distance ranges. We examine the seismic coda of the phases P and Pdiff for events occurring in the Tonga/Fiji and Kermadec Trench regions, recorded at the short period Yellowknife array (YKA) located in northwestern Canada. We model the envelope of the coda wave train using the axi-symmetric finite difference approach PSVaxi. Although, we do not model full 3D scatterer geometries, the 2.5D axi-symmetric approach allows us to reach dominant seismic periods on the order of 3-4 sec. The result of using 2.5D scatterer geometries is that our scattering strength is smaller than suggested by full 3D geometries, thus producing a conservative estimate to the scattering strength. We generate our models of random heterogeneity by application of the Karhunen-Loève Expansion (KLE). The KLE technique is ideal for this application as it works for both isotropic and anisotropic correlation structures on both Cartesian and non-Cartesian grids, and is also capable of producing models with non-stationary correlation structures without introducing first-order discontinuities. The Pdiff phase for the ray path geometry we study passes through the lower mantle in the central Pacific region, an area showing a high degree of lateral heterogeneity. For these ray paths, Pdiff shows strong coda development and also demonstrates strong lateral variability of coda duration. Using this numerical approach is the first attempt at actually synthesizing waveforms for seismic scattering at the global scale and comparing these waveforms with data. We present comparisons of the synthesized waveforms for our best fitting models with our YKA dataset.