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Scattering of seismic waves in the German crust; a multiple isotropic scattering model

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Major characteristics of crustal high frequency seismograms consists of two superimposed parts. The first being described by wave theory in a deterministic earth model. Secondly coda waves carry energy outside the arrivals predicted by any deterministic models. The energy content of coda waves might be described by radiative transfer theory in an earth model that contains randomly distributed heterogeneities.

We use multiple isotropic scattering of shear waves in a heterogeneous half space to model coda wave envelopes of regional earthquakes in Germany. Our model is described by the total scattering coefficient and a parameter of intrinsic absorption, both being frequency dependent. Additionally we invert for radiated energy of the events and for site amplification factors of the seismic stations in the German Regional Seismic Network (GRSN with more than 20 station). The dataset consists of the GRSN recordings of 12 regional earthquakes (Ml > 4) that occurred during 1992 and 2004.

To account for effects that are not included in our model like source radiation pattern or *P* to *S*-wave conversions we invert the envelopes from two times the s-wave travel time onwards. With this restriction we observe a tradeoff between the total scattering coefficient and the radiated energy. This tradeoff is an evidence for the dominance of single scattering in the coda envelope, because radiated energy and scattering strength have the same influence on the coda in the single scattering model. To resolve the tradeoff we introduce a measure for the radiated energy by means of the direct *S*-wave. With this additional condition we obtain values for the total scattering coefficient of the order of 0.001 1/km which corresponds to a mean free path length of about 1000 km. We can not identify a significant frequency dependence of this value. The intrinsic quality factor *Q* ranges between 100 and 1500 and increases with frequency. We compare the site amplification factors to the geological conditions of the GRSN stations and discuss the relation between the seismic moment and the radiated energy estimated with our model.