Geophysical Research Abstracts
Vol. 20, EGU2018-6521, 2018
EGU General Assembly 2018

Breakdown of equipartition in diffuse fields caused by energy leakage

Ludovic Margerin
IRAP-CNRS, Université Paul Sabatier Toulouse 3 (ludovic.margerin@irap.omp.eu)

Equipartition is a central concept in the analysis of random wavefields which stipulates that in an infinite scattering medium all modes and propagation directions become equally probable at long lapse time in the coda. The objective of this work is to examine quantitatively how this conclusion is affected in an open waveguide geometry, with a particular emphasis on seismological applications. To carry our this task, the problem is recast as a spectral analysis of the radiative transfer equation. Using a discrete ordinate approach, the smallest eigenvalue and associated eigenfunction of the transfer equation, which control the asymptotic intensity distribution in the waveguide, are determined numerically with the aid of a shooting algorithm. The inverse of this eigenvalue may be interpreted as the leakage time of the diffuse waves out of the waveguide. The associated eigenfunction provides the depth and angular distribution of the specific intensity. The effect of boundary conditions and scattering anisotropy is investigated in a series of numerical experiments. Two propagation regimes are identified, depending on the ratio H^* between the thickness of the waveguide and the transport mean path in the layer. The thick layer regime $H^* > 1$ has been thoroughly studied in the literature in the framework of diffusion theory and is briefly considered. In the thin layer regime $H^* < 1$, we find that both boundary conditions and scattering anisotropy leave a strong imprint on the leakage effect. A parametric study reveals that in the presence of a flat free surface, the leakage time is essentially controlled by the mean free time of the waves in the layer in the limit $H^* \to 0$. By contrast, when the free surface is rough, the travel time of ballistic waves propagating through the crust becomes the limiting factor. For fixed H^*, the efficacy of leakage increases with scattering anisotropy. For sufficiently thin layers $H^* \approx 1/5$, the energy flux is predominantly directed parallel to the surface and equipartition breaks down. Qualitatively, the anisotropy of the intensity field is found to increase with the inverse non-dimensional leakage time, with the scattering mean free time as time scale. Because it enhances leakage, a rough free surface may result in stronger anisotropy of the intensity field than a flat surface, for the same bulk scattering properties. Our work identifies leakage as a potential explanation for the large deviation from isotropy observed in the coda of body waves.