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Seismic imagery of landslides: how complex media can be a pitfall.

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Imaging landslides using seismic methods constitutes a common approach since these methods have been widely tested in the ten past years. In particular, Spectral Analysis of Surface Waves, have demonstrated a good capacity for characterizing subsurface layered structures since this technique provide information on the shear-wave velocity, closely related to the soil stiffness. However, field observations have shown that lateral velocity heterogeneities can also occur in the uppermost parts of landslides due to varying deposit conditions, structural deformations or moisture variations. Current seismic methods do not enable such small-scale heterogeneities to be taken into account in inversion processes. Here, we aim to highlight the effects of such heterogeneities on the dispersion of seismic signals through simple synthetic examples. For this, we numerically computed synthetic seismograms in the 2D elastic approximation, using a Finite Difference Time Domain simulation code to try and understand how the characteristics of the heterogeneities impact the seismic wave propagation. The study shows that Rayleigh wave phase velocities are systematically lower when propagating in heterogeneous media compared to an equivalent constant-velocity one. This raises significant consequences when inverting shear-wave velocity values from Rayleigh wave dispersions since this bias is generally not taken into account. Such a bias could have an impact when interpreting the results in terms of landslides mechanical properties (shear modulus). We also show this behavior can be observed when dealing with volume waves, and so, can affect first-break tomographies. We propose in this case a simple way to estimate this effect in order to adapt the interpretations accordingly.