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Detection of near-surface lateral heterogeneities from surface wave analysis and recalculation of local dispersion curves

J. Demand, F. Marillier
Institute of Geophysics, University of Lausanne, Switzerland (Jehanne.Demand@unil.ch)

In the last decade, active surface-wave methods were widely used and they proved to be efficient at providing shear-wave velocities of the subsurface. However, this method suffers limitations due to the acquisition set-up that imposes constraints on the data interpretation.

In fact, shear-wave velocity profiles from multi-channel analysis of surface waves (MASW) along 2D profiles are provided by inverting dispersion curves assuming a 1D model. This implies that in a laterally heterogeneous medium the obtained dispersion curves depend on the length of the array used. Thus we are facing mutually exclusive constraints. On the one hand, to get a satisfactory depth of investigation and good mode separation it is necessary to use a long array, while to get a local dispersion curve a short array is needed.

Here, we investigate the possibility of obtaining reliable local dispersion curves in a laterally heterogeneous medium. On a test site, we carried out measurements along a 190 m long profile with a geophone spacing of 2 m and 4 m shot spacing. In total, 55 shots were recorded along the profile. For each shot, dispersion curves were calculated with different array lengths. For the same shot the calculated dispersion curves show a wide variability depending on array length.

Analysis of seismic data in time domain as well as in spectral domain was carried out in order to detect lateral changes. The study of spectral amplitude as well as phase variation in the spatial domain helped detect lateral changes. Then, a local receiver-array

length was defined taking into account the location of the observed lateral changes. For each local array we then simulated a time vs. offset record by combining different shot records. The new synthesized seismograms were used to recalculate dispersion curves that are less dependent on the array length and can be inverted independently in order to calculate a series of local shear-wave velocity-depth profiles.