Seismic Surface Wave Tomography on dense 3D active data

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Surface Wave Tomography (SWT) is a well-established technique in global seismology: signals from strong earthquakes or seismic ambient noise are used to retrieve 3D shear-wave velocity models, both at regional and global scale. This study aims at applying the same methodology to controlled source data, with specific focus on 3D acquisition geometries for seismic exploration. For a specific frequency, travel times between all source-receiver couples are derived from phase differences. However, higher modes and heterogeneous spatial sampling make phase extraction challenging.

The processing workflow includes different steps as (1) filtering in f-k domain to isolate the fundamental mode from higher order modes, (2) phase unwrapping in two spatial dimensions, (3) zero-offset phase estimation and (4) travel times computation. Surface wave tomography is then applied to retrieve a 2D phase velocity map. This procedure is repeated for different frequencies. Finally, individual dispersion curves obtained by the superposition of phase velocity maps at different frequencies are depth inverted to retrieve a 3D shear wave velocity model.