MASW imaging from shallow seismic reflection data

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In the last two decades, MASW (Multi-Channel Acquisition of Surface Waves) has become a staple for shallow seismic characterization in form of shear-wave velocity models. However, in its classical form the MASW method is restricted to layered media with little lateral variation and relies on dedicated equipment and data acquisition parameters such as land streamers and low-frequency geophones with small receiver spacing. Nonetheless, P-wave near-surface reflection and high-density refraction data often show significant surface wave energy which largely remains unused since the acquisition geometry and therefore the data are considered unfit for conventional MASW imaging. Furthermore, significant topographic variation and small scale subsurface inhomogeneities challenge most classical dispersion imaging and inversion algorithms. We show how this non-optimum but still useful data can be turned into robust subsurface shear-wave velocity models which in turn supplement the P-wave models and their interpretation. Our suggested approach aims at minimizing manual interaction and effort for the processor. The workflow includes advanced sorting and stacking techniques, improved dispersion analysis for low-quality data, and a laterally constrained joint inversion of all dispersion curves into one final 2D or 3D model. This final result, obtained at almost no additional costs, can be a valuable by-product for any conventional P-wave field campaign. We also argue that the method provides an alternative to deriving shear-wave velocity models from S-body wave travel time picks, which usually can only be estimated with considerable uncertainty in shallow P-wave data. The practicability of the approach is demonstrated with several examples from different geologic environments and application scenarios.