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Characterization of heterogeneous landfill: seismic waveform inversion and wavefield retrieval to integrated quantitative inversion of high-resolution seismic-electrical datasets

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A landfill body is typically highly heterogeneous. The scale of these heterogeneities - which are relevant for the purpose of assessment of preferential flow paths, the degradation processes, and the spatio-temporally varying aging and settlements - is quite often small considering the limiting resolution and confidence of the prevalent near-surface geophysical methods. High-density areas act as obstruction to fluid flow and are important for understanding the degradation processes. These areas manifest as scatterers in the recorded seismic wavefield. Strong presence of scattered energy is typical of seismic datasets acquired on landfills. Our research has been concentrated on resolving and monitoring density and porosity variations, as well as distribution of water saturation, phreatic surface, matric suction and stress. Dedicated schemes of early-arrival waveform tomography, full-waveform inversion and interferometric seismic wavefield retrieval complemented by electrical resistivity tomography show promise in high-resolution delineation and monitoring of these properties in a heterogeneous landfill. We will discuss the results of a novel inversion scheme which allows quantitative estimation of spatio-temporally heterogeneous matric suction, stress and porosity.