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# RESOLVABILITY OF REGIONAL DENSITY STRUCTURE

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Lateral density variations are the source of mass transport in the Earth at all scales, acting as drivers of convective motion. However, the density structure of the Earth remains largely unknown since classic seismic observables and gravity provide only weak constraints with strong trade-offs. Current density models are therefore often based on velocity scaling, making strong assumptions on the origin of structural heterogeneities, which may not necessarily be correct.

In order to assess if 3D density structure may be resolvable with emerging full-waveform inversion techniques, we proceed in two steps:

First, we quantify the impact of regional-scale crustal density structure on seismic waveforms. For this, we compare synthetic seismograms computed with and without realistic 3D density structure. For epicentral distances of around 1000 km, we detect time shifts reaching 2.5 s relative amplitude differences approaching 90 %. Our analyses indicate that reasonably sized density variations within the crust can leave a strong imprint on both travel times and amplitudes. While this can produce significant biases in velocity and Q estimates, the positive conclusion is that seismic waveform inversion for density may become feasible.

Second, we perform principal component analyses of sensitivity kernels for P velocity, S velocity, and density. This is intended to establish the extent to which these kernels are linearly independent, i.e. the extent to which the different parameters may be constrained independently. Since the density imprint we observe is not exclusively linked to travel times and amplitudes of specific phases, we consider waveform differences between complete seismograms, including the scattered wavefield.