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SAVANI2: towards a waveform-based image of shear-velocity variations underneath Europe embedded in a global model

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In a recent study (Auer et al. 2013, in revision) we have devised a novel tomography approach to image radially anisotropic shear-velocity variations in the Earth's mantle. By applying our tomography toolbox to a comprehensive compilation of surface-wave phase delays from fundamental modes up to the 6th overtone and cross-correlation traveltimes of major body-wave phases, we derived the multi-resolution tomography model SAVANI, which is one of the first whole-mantle models of radial S-wave anisotropy.

Here we illustrate the first steps towards the second iteration of our model ("SAVANI2"), in which we define Europe and the surrounding regions as the target area for a higher-resolution regional revision of our initial model. To this end, we augment our global database with additional teleseismic and regional broadband measurements recorded within the last five years. We download raw waveforms from the Orfeus and IRIS data centers in a fully automated way with a python based toolbox and extract multiple-frequency traveltime delays in the period range between 5 and 25 s employing the method of Sigloch et al. (2006). Furthermore, we replace the crustal model CRUST2.0 with its successor CRUST1. Importantly, waveform observations will be interpreted using Fréchet sensitivity kernels computed with AxiSEM (Nissen-Meyer et al., 2007), which is an efficient visco-elastic spectral element solver for axisymmetric background models.

The main idea behind SAVANI2 is to keep semi-approximate (ray) theory where appropriate (global long-wavelength structure, surface wave dispersion), but to revert to a full-waveform interpretation where necessary (regional scale, non-geometrical wave phenomena). Our hybrid approach to waveform inversion has multi-scale capabilities and is essentially equivalent to the first iteration step of a Gauss-Newton type inverse problem, thus allowing full access to the model resolution matrix. The set of algorithms we are developing represent a straightforward manner to stepwise improve upon a global background model by updating the tomographic system whenever new data becomes available.