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Lithospheric structure of the Western Alps as seen by full-waveform inversion of CIFALPS teleseismic data

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Full-waveform inversion (FWI) is a powerful but constitutionally intensive technique that aims to recover 3D multiparameter images of the subsurface by minimising the waveform difference between the full recorded and modelled seismograms. This method has recently been adapted and successfully applied in lithospheric settings by tackling teleseismic waveform modelling with hybrid methods. For each event, a global scale simulation is performed once and for all to store the wavefield solutions on the edges of the lithospheric target. Then, for each modelling involved in the FWI process, these global scale solutions are injected within the lithospheric medium from the boundaries.

We present the results of the application of teleseismic FWI to the data acquired by the CIFALPS experiment that was conducted in the Western Alps to gain new insights its lithospheric structure and geodynamic evolution of the alpine range. Nine teleseismic events were inverted to infer 3D models of density, P-wave velocity and S-wave velocity of the crust and the upper-mantle down to 200 km depth. Our models show clear evidences of continental subduction during the alpine orogeny. They outline a dipping European Moho down to 75 km depth and finely delineate the geometry of the Ivrea body at the suture between European and Adriatic plates. Deeper, in the mantle a slow S-wave velocity anomaly might indicate the location of the European slab detachment.

Overall, FWI models give access to new seismic images that fill the resolution gap between smooth tomographic model and sharp receiver function images of the lithosphere and enable integrated interpretations of crustal and upper-mantle structures.