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Surface wave tomography across the wider Alpine region

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The Alpine belt, a very complex and highly deformed structure, has been shaped as a consequence of the continent–continent collision between the European and Adriatic plates($\sim$35 Ma ago). Itsintense tectonic activity and the strong surface deformation have been attributed to the lithospheric and deep mantle processes. Numerous studies have attempted to characterize the kinematics of the Alpsto capture the dynamics of itslithosphere-asthenosphere system. Nevertheless, there are still many controversial issues such asthe switches in the subduction polarity of Adria beneath eastern Alps, the geometry of the subducted Eurasian slab, the presence a subducting Eurasian slab in the central Alps and not in the eastern Alps, the opening of the slab gaps beneath the Alps and Dinarides and the geometry of the Dindaridic slab. Surface waves, due to their high sensitivity to velocities variations with depth, are well suited to study properties of the lithosphere-asthenosphere system. In this project, the 3D shear-wave velocity structure of the lithosphere-asthenosphere system beneath the entire Mediterranean including the Alps and the adjacent regions are investigated using new tomographic images obtained from surface wave tomography. An automated algorithm for inter-station phase velocity measurements is applied to obtain both Rayleigh and Love fundamental mode phase velocities. We utilize a database consisting of more than 4000 seismic events recorded by more than 3000 broadband seismic stations within the area, provided by the European Integrated Data Archive (WebDc/EIDA) and IRIS. Path average dispersion curves are obtained by averaging the smooth parts of single-event dispersion curves. We calculate maps of Love and Rayleigh phase velocity at more than 100 different periods which, in turn, provide a local phase-velocity dispersion curve for each geographical grid node of the map. Each local dispersion curve is inverted individually for 1D shear wave velocity model using a newly implemented Particle Swarm Optimization (PSO) algorithm. The resulting 1D velocity models are then combined to construct the 3D shear-velocity model. Our preliminary 3D isotropic SV model reveals significant variations in shear wave velocity both vertically and laterally in the lithosphere and asthenosphere. It highlights the processes associated with the convergence between the Eurasian and Adriatic plates shows a high variability of the resulting lithospheric structure. The Alpine mantle shows nearly vertical subducting lithospheric slabs of the European and Adriatic plates. A relatively low velocities in the upper mantle below the southwestern Alps indes a slab tear of the subducted European slab. Beneath the Apennines, the model shows an attached Adriatic slab in the northern Apennines and a slab window in the central Apennines. There is also evidence for subduction of Adriatic lithosphere to the east beneath the Pannonian Basin and the Dinarides down to a depth of about 150 km. Based on our results, surface wave tomography can contribute significantly in imaging complex slab geometries and slab segmentation beneath the Alps.

Key words: phase velocity, seismic tomography, surface waves inversion, particle swarm optimization, Alps