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Mantle deformation beneath the central Alps from SKS anisotropy

Laura Petrescu, Silvia Pondrelli, Simone Salimbeni, and AlpArray Working Group
Istituto Nazionale di Geofisica e Vulcanologia (laura.petrescu90@gmail.com)

The Alpine chain in western and central Europe is a complex orogen developed as a result of the African-Adriatic plate convergence towads the European continent and the closure of several Tethys oceanic branches. The styles of deformation and the geology of the eastern and western Alps significantly differ and several tomography studies imaged subducting slabs beneath the orogen that may change polarity. The mantle deformation associated with subduction is complex and toroidal and poloidal asthenospheric flow are expected. To investigate the lithospheric deformation and mantle flow patterns in the Alpine region, we carry out SKS anisotropy analysis at 80 broadband permanent and temporary seismic stations, including the AlpArray network in northern Italy, Switzerland, Austria and south Germany, providing a significant contribution to the SKS anisotropy dataset in the central Alpine region. We use teleseismic earthquakes with Mw>5.8 and epicentral distances between 80° and 130°, recorded between 2015 and 2018. We estimate the direction of the fast axis and the time delay of the SKS waves, suggestive of the direction and magnitude of azimuthal anisotropy of the upper mantle, and analyse their variation with backazimuth to investigate the complexity of the anisotropy field with depth. We test for correlations with mantle heterogeneities and the location of subducting Alpine slabs imaged with seismic tomography and compare our results with previous studies of Pn and Rayleigh wave anisotropy of the uppermost mantle to discriminate between frozen lithospheric fabrics and asthenospheric flow. Our measurements span the continental transition from the Adriatic to the European plates, providing insights into the nature of mantle deformation in collisional orogens and placing fundamental constraints on the geodynamics of subducting slabs.