3D crustal structure of the Ligurian Basin revealed by surface wave tomography using ocean bottom seismometer data

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The Liguro-Provençal basin was formed as a back-arc basin of the retreating Calabrian–Apennines subduction zone during the Oligocene and Miocene. The resulting rotation of the Corsica–Sardinia block is associated with rifting, shaping the Ligurian Basin. It is still debated whether oceanic or atypical oceanic crust was formed or if the crust is continental and experienced extreme thinning during the opening of the basin. We perform ambient noise tomography, also taking into account teleseismic events, using an amphibious network of seismic stations, including 22 broadband ocean bottom seismometers (OBSs), to investigate the lithospheric structure of the Ligurian Basin. The instruments were installed in the Ligurian Basin for 8 months between June 2017 and February 2018 as part of the AlpArray seismic network. Because of additional noise sources in the ocean, OBS data are rarely used for ambient noise studies. However, we carefully pre-processed the data, including corrections for instrument tilt and seafloor compliance and excluding higher modes of the ambient-noise Rayleigh waves. We calculate daily cross-correlation functions for the AlpArray OBS array and surrounding land stations. We also correlate short time windows that include teleseismic earthquakes, allowing us to derive surface wave group velocities for longer periods than using ambient noise only. We obtain group velocity maps by inverting Green's functions derived from the cross-correlation of ambient noise and teleseismic events. We then used the resulting 3D group velocity information to calculate 1D depth inversions for S-wave velocities.

The group velocity and shear-wave velocity results compare well to existing large-scale studies that partly include the study area. We observe a high-velocity area beneath the Argentera Massif in onshore France, roughly 10 km below sea level. We interpret this as the root of the Argentera Massif. Our results add spatial resolution to known seismic velocities in the Ligurian Basin, thereby augmenting existing seismic profiles. The velocity model indicates that the southwestern and north-eastern Ligurian Basin are structurally separate (Figure 1, panel a). In agreement with existing seismic studies, our shear-wave velocity maps indicate a deepening of the Moho from 12 km at the south-western basin centre to 20–25 km at the Ligurian coast in the north-east and over 30 km at the Provençal coast. The lack of high crustal vp/vs ratios beneath the southwestern part of the Ligurian Basin precludes mantle serpentinisation there. The poster summarises the findings published in Solid Earth (Wolf et al. (2021).

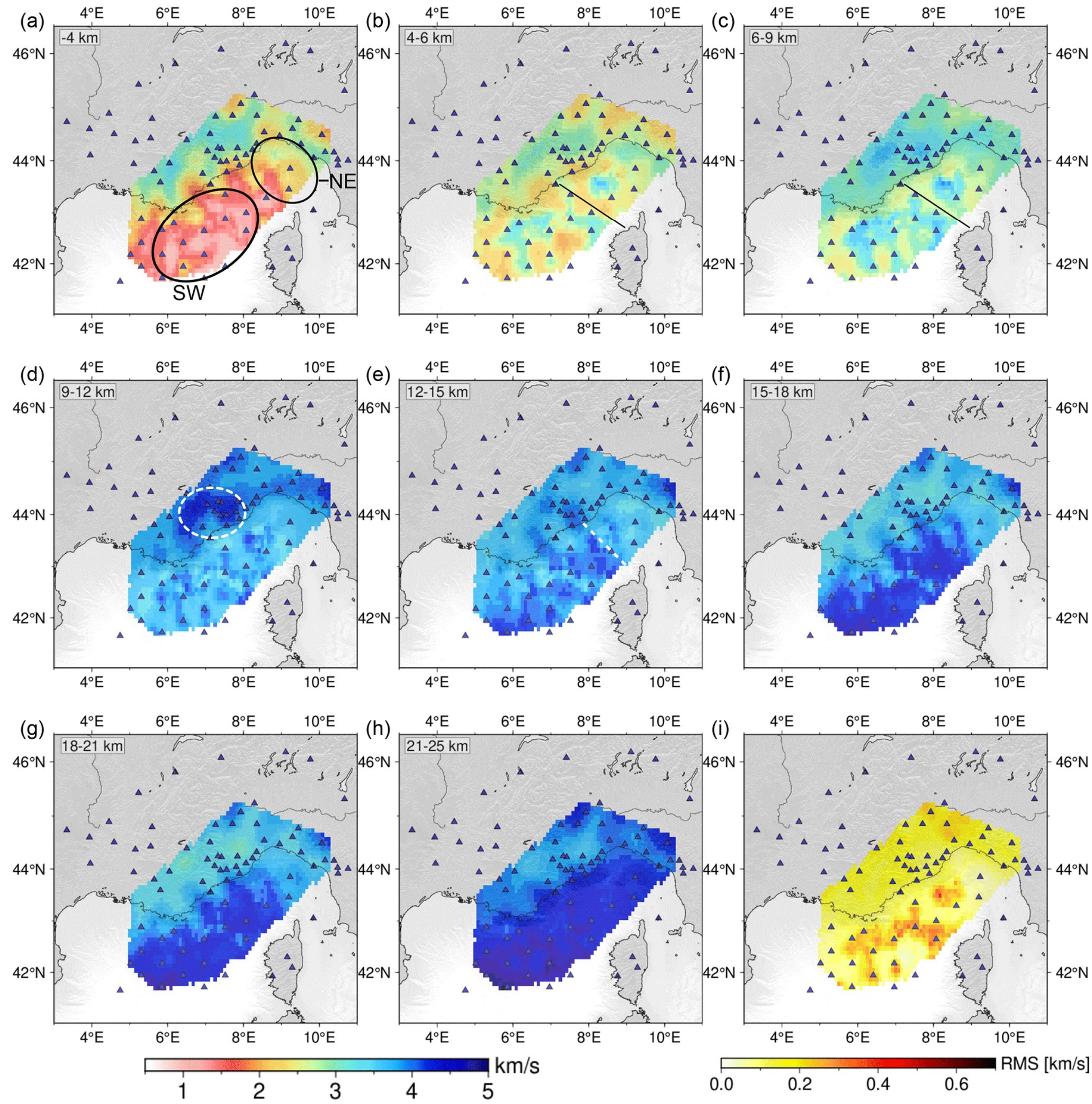

Figure 1: 2D shear velocity maps derived from the 1D inversion. Layer depth is stated in the upper left corner. Depths (in km) are relative to the sea surface. The annotations in (a) mark the southwestern and central (SW) and the north-eastern (NE) Ligurian Basin. The dashed circle in (d) marks a high-velocity area north of Nice, and the dashed white line in (e) represents the proposed prolongation of the Alpine front. Panel (i) shows the root mean square (RMS) value for the 1D shear-wave-inversion in map view (i.e., one RMS value per grid point). Blue triangles indicate stations.

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