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Three-dimensional shear-wave velocity structure beneath the Tyrrhenian basin using seismic ambient noise

Daniel Manu-Marfo (1,2), Abdelkrim Aoudia (2), Surya Pachhai (3,4), and Radia Kherchouche (5)

(1) University of Trieste, Earth science and fluid mechanics, Italy (dmanu-ma@ictp.it), (2) The Abdus Salam International Center for Theoretical Physics, Earth System Physics, Trieste, Italy, (3) Bullard Laboratories, Department of Earth Sciences, University of Cambridge, Cambridge, UK, (4) Now at Institute of Geophysics and Planetary Physics, Scripps Institution of Oceanography, University of California, San Diego, California, USA, (5) Université des Sciences et de la Technologie Houari Boumediene, Algiers, Algeria

The Tyrrhenian basin is a back-arc extensional basin located in the Central Mediterranean region. In spite of its complex geodynamic evolution and fascinating geological features, the shallow seismic structure beneath this basin remains poorly studied due to the distribution of seismic stations on land. In contrast, the dense station distribution around the basin allows for the retrieval of a high-resolution 3-D shear-wave velocity structure using ambient noise technique. Here, we consider 4-years of continuous noise data recorded at 73 seismic stations to extract the Rayleigh wave group and phase velocity dispersions. We then compute the group and phase velocity tomography maps at periods ranging from 5 to 50 s using station pair dispersions. A self-parameterized Bayesian inversion is applied to estimate the lateral variation of velocity and its uncertainty as a function of depth (up to 100 km) from the group and phase velocity dispersions extracted at regular grids. The inversion results correlate well with known geological and tectonic features in the Tyrrhenian region. The velocity model shows different crustal and upper mantle velocities for the northern and the southern Tyrrhenian basin, with a clear crustal velocity contrast occurring approximately along the 41° Parallel Line. At shallow depths, we identify very high S-velocities beneath the Vavilov-Magnaghi sub-basin which we relate to a basement composed of exhumed mantle rocks. A prominent low S-velocity zone is extending from 50 to 80 km depth beneath the Tyrrhenian basin. Our model further shows a well pronounced low S-velocity zone between 30 and 80 km depth directly below the Vavilov-Magnaghi sub-basin. In this study we provide a well-constrained new map of the Moho discontinuity and we also identify new structural features at the transition between the Tyrrhenian basin and its surroundings namely the Apennines, the Calabrian Arc and the Sardinia block. We discuss our results also in the light of the recent findings reported in the literature in terms of shallow structures, magmatism and geodynamics.