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Automated inter-station phase velocity measurements across the eastern Mediterranean and Middle East

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The eastern Mediterranean, Middle East and northern Africa are tectonically complex regions from the closure of the Tethys Sea and the convergence of the relatively stable African plate with the Eurasian. The structure of the lithosphere is highly variable and several tectonic features are present, including young oceanic ithosphere in the Red Sea, to what is considered the oldest oceanic lithosphere on Earth in the Mediterranean Sea north of Libya, and from highly deformed continental lithosphere at the east-Mediterranean margins to more stable continental lithosphere of Phanerozoic origin and to cratonic lithosphere beneath the Arabian Peninsula. Furthermore, it has been suggested that movements of the Arabian and Anatolian plates are driven at least in parts by asthenospheric flow. Despite the numerous studies have attempted to characterize the earth‘s structure and the flow in the asthenospherein that area, details of the lithospheric structure are, however, poorly known. Surface waves are ideally suited for studies of the lithosphere and the sub-lithospheric mantle. The purpose of this research is to better define the 3D lithospheric shear-wave velocity structure, its deformation and the flow of the underlying asthenosphere within this region by surface wave tomography. Using regional to teleseismic Rayleigh and Love waves that traverse the area we can obtain information about its seismic structure by examining phase velocities as a function of frequency. A newly developed algorithm for automated inter-station phase velocity measurements (Soomro et al. 2016) is applied here to obtain both Rayleigh and Love fundamental mode phase velocities. We utilize a database consisting of more than 3800 regional and teleseismic earthquakes recorded by more than 1850 broadband seismic stations within the area, provided by the European Integrated Data Archive (WebDc/EIDA) and IRIS. Moreover, for the first time, data from the Egyptian National Seismological Network (ENSN), recorded by up to 25 broad band seismic stations, is also included in the analysis. For each station pair, approximately located on the same great circle path, the recorded waveforms are cross correlated and the dispersion curves of fundamental modes are calculated from the phase of the weighted cross correlation functions. Path average dispersion curves are obtained by averaging the smooth parts of single-event dispersion curves. Parameters tests and final results of automatically measured phase velocities are presented here. For selected inter-station paths, inversions for the 1D path-average S-wave velocity structure are shown. Finally, preliminary results of tomographic inversions to calculate azimuthally anisotropic phase velocity maps at different periods are also presented. Our broadband surface wave measurements, utilizing the dense sampling of the area with newly available data, can offer important new insights into the lithospheric structure and the interaction with the asthenosphere in the considered region.

KEY WORDS: fundamental modes; phase velocities; tomographic inversions; anisotropy.

REFERENCE: Soomro, R.A., C. Weidle, L. Cristiano, S. Lebedev, T. Meier. Phase velocities of Rayleigh and Love waves in central and northern Europe from automated, broadband, inter-station measurements, Geophys. J. Int., 204, 517–534, 2016.