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Crustal structure of the Aegean area obtained by traveltime tomography

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The Hellenic arc and Aegean sea area are of locus of high seismicity and intense tectonic activity. Previous studies using either traveltimes of body waves or dispersion curves of surface waves show strong lateral heterogeneity of velocity structure of the crust and upper mantle under the Aegean area. Especially crustal thicknesses vary from about 20 km to 45 km. The complexity of crustal structure often requires the use of a number of one-dimensional layered models, in the calculation of synthetic seismograms for different ray traversing paths, to determine moment tensor of small-to-moderate earthquakes in this area.

Using travel times from the EHB catalog data between 1980 and 1997 from International Seismological Center (Engdahl et al. 1998), Euro-Mediterranean Bulletin data between 1998 and 2008 from the Euro-Mediterranean Seismological Center (Godey et al. 2006), and additional local earthquakes recorded by the temporary stations deployed in the EGELADOS project, we derive a new three-dimensional velocity model of the crust in the Aegean area using the traveltime tomographic inversion code FMTOMO developed by Rawlinson et al. (2006). The events falling into the research area defined by 34°-40°N and 20°-29°E are firstly relocated using HypoDD (Waldhauser & Ellsworth 2000) before tomographic inversion is performed. Since the number of earthquakes is much greater than the number of stations, the source and receiver roles are interchanged to accelerate the forward calculation of traveltimes which is done by tracking the wavefront propagation with the fast marching method. The initial one-dimensional model was obtained by simultaneously inverting the data both for hypocenter locations and velocity using VELEST (Kissling et al. 1994).

Checkboard resolution tests for the P waves show that anomalies of size of half a degree could be correctly recovered down to depth of 50 km. One notable feature from the preliminary inversion results for the P velocity is that the low velocity belt follows the Hellenides mountain range trend as far down as 40 km depth. The resulting velocity model from traveltime tomography could serve as a three-dimensional reference model for moment tensor inversion in case a better fitting of seismograms could be obtained than using 1-D models, and it could also provide an initial model for waveform tomographic inversion in the future.