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A new 3D Vs model for the Northern Mygdonia basin-Euroseistest area (Northern Greece) from high-frequency ambient noise tomography

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A new 3D Vs model is presented for the northern part of the Euroseistest area, in Mygdonia basin (N.Greece). The basin is a Neogene graben structure with significant seismic activity along distinct normal fault patterns, composed mainly of fluvioterrestrial and lacustrin sediments, with a maximum thickness of approximately 500m that overlay the gneiss-schist basement. The central Mygdonia area hosts Euroseistest, a European Test site for Engineering Seismology, Earthquake Engineering, Soil dynamics and Structural Engineering, which has been established in the area since 1993. The availability of published information regarding mainly the 2D structural characteristics of the basin provided the opportunity to test the efficiency of ambient noise techniques at local scales, as well as calibrate their application.

In the present work, we focused on the northern part of the Euroseistest area, which includes almost all the observed Mygdonia basin formations, ranging from the bedrock outcrop in the North and reaching the Holocene deposits in the central part of the basin. For this reason, we used ambient noise cross-correlation tomography following a two-step approach, similar to larger scale applications. For the data collection, we used a pool of 27 instruments, consisting of 19 fixed position stations and 8 mobile units in order to improve the ray coverage of the study area. Initially, we extracted Rayleigh wave traveltimes from vertical component cross-correlation traces of the collected noise seismic recordings. The obtained Rayleigh wave traveltimes showed significant spatial, distance and frequency variability, as they are clearly affected by the dominantly 2D structure of the study area.

The final traveltime dataset was tomographically inverted, using a modified inversion approach that involved approximate Fresnel volumes and inter-frequency smoothing constraints. The resulting group velocity maps were used to reconstruct the local dispersion curves throughout the model, and were subsequently inverted using a node-based Monte Carlo 1D approach. Different model configurations were tested for the dispersion curve inversion in order to explore the derived model robustness. The final 3D model is in general agreement with previous results (Euroseistest 2D profile, borehole information, etc.) but also reveals new structural information for the study area, showing that the local geophysical/geological structure exhibits several 3D features (e.g. complicated fault geometry). Despite the complicated data patterns and processing, the results suggest that the application of full velocity modelling approaches using ambient noise tomography techniques at local scales (scales of a few hundred meters) is a practically feasible target.