Geophysical Research Abstracts
Vol. 17, EGU2015-9371, 2015
EGU General Assembly 2015

Application of Ambient Noise Array Tomography on Geotechnical Scales and Comparison with Independent Geophysical Information: A Test for the Thessaloniki Area (Northern Greece)

Marios Anthymidis (1), Costas Papazachos (1), Alexandros Savvaidis (2), Nikos Theodoulidis (2), and Ilias Fikos (1)

(1) School of Geology, Aristotle University of Thessaloniki (AUTH), Thessaloniki, Greece (manthymi@geo.auth.gr), (2) Earthquake Planning and Protection Organization (EPPO), Institute of Engineering Seismology and Earthquake Engineering (ITSAK), Thessaloniki, Greece

Ambient noise array tomography has been recently recognized as a promising tool for the study of the shallow 2D/3D geophysical structure. The method basis relies on the implementation of cross-correlation analysis on ambient noise data, which is able to provide the Green's Function of the medium between two spatially separated recording stations (Gouedard et al. 2008). The obtained cross-correlation trace contains information about the group and phase velocity of the surface waves that are dominant in the ambient noise wavefield. A typical application, similar to larger-scale studies, employs appropriate narrow-band Gaussian filters on the cross-correlation trace (Multiple Filter Analysis), allowing the construction of the group velocity dispersion curves for selected paths within the study area. An inversion procedure leads to tomographic images (group velocity maps for specific frequencies), which can be locally inverted to derive 1D shear wave (S-Wave) velocity profiles. The superposition of all the local 1D S-Wave velocity profiles can potentially lead to a pseudo-3D (or pseudo-2D) velocity model for the subsurface structure.

In order to study the capability of the ambient noise array tomography method to provide reliable geophysical ground models on geotechnical scales in urban environments, a relative small circular array (radius of 500m approximately) incorporating 34 recording stations was installed inside the city of Thessaloniki (Northern Greece). The study area corresponds to the boundary between the geological bedrock and Quaternary/Neogene sediments, with the gneiss bedrock showing a gradual thickness increase from its NE outcrop towards the SW, to the coastline of the city. Large-scale studies in the broader Thessaloniki area (e.g. Anastasiadis et al. 2001, Panou et al. 2005) have showed that the bedrock exhibits a more or less 2D structure in the study area, gradually dipping towards the coastline realizing depths possibly exceeding 200m. Furthermore, in order to provide additional constrains on the local subsurface structure, an Electric Resistivity Tomography (ERT) exploration profile, as well as single station ambient noise measurements analysed by the Horizontal to Vertical Spectral Ratio (HVSR) method were applied on a NE-SW profile for the validation of the ambient noise tomography results. In general, the ERT and HVSR profiles showed an excellent correlation, both verifying the gradual dipping of the bedrock from NE to SW.

The detailed variations of the group velocity distribution showed that the subsurface geophysical/geological structure appears to be complex and heterogeneous, with strong lateral variations and local velocity inversions in the upper layers (including anthropogenic layers of historical times). The general features of the obtained S-Wave velocity models appear to be in good correlation with the results of the ERT and the HVSR profiles, as well as with existing larger-scale geological/geotechnical models for the study area.