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On the consistency and repeatability of ambient vibration measurements for site characterization

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The correlation of damage distributions of large earthquakes, e.g. the 1985 Michoacan earthquake, with local subsurface geology highlights the strong influence of local geological conditions on the seismic site response. Site characterization has therefore become a major issue for assessing the potential of future damage (scenario evaluation) and for the interpretation of strong motion records. The use of ambient vibration recordings as a low cost tool for the determination of the shallow subsurface shear wave velocity structure has gained increasing attention for the purpose of site effect assessment. However, the number of studies which aim to investigate the repeatability of ambient vibration measurements is rather limited, although it is known that the sources of ambient vibrations vary, e.g. with time of day or season, and that shallow subsurface conditions may differ seasonally (i.e. hydrological conditions).

Within the European research initiative NERIES (subproject JRA4), ambient vibration array measurements are scheduled at 20 selected European accelerometer sites. It thus presents the broadest and most focused study on the use of ambient vibration measurements for the study of site effects at European strong motion stations so far. Measurements at half of these sites, located in Greece and Turkey, were already performed in September and October 2007. By bringing together this new high-quality data set and data available from previous measurements, we are able to compare the resulting data products, i.e. H/V spectral ratios, Rayleigh phase velocity wave dispersion curves and spatial autocorrelation functions, for 4 sites in Greece and an additional site in Grenoble, France, where data from numerous previous independent measurements were available. These locations represent a mixture of shallow as well

as deep (bedrock depth larger than 100 m) and urban as well as non-urban sites with site classes between B and D.

Stable results are obtained for all sites independent of the time the recordings were made, the length of the recordings, the team that conducted the measurements and analysed the results, the equipment and array layout used in the field and the method used to derive the dispersion curve (frequency-wavenumber analysis, spatial autocorrelation method or crosscorrelation between individual station pairs), though the usable frequency range differs for each method. These results demonstrate the repeatability and consistency of ambient vibration measurements in a variety of conditions. Thereby, they serve as a prerequisite for further interpretation and inversion of the ambient vibration data in terms of subsurface structure and warrant their comparison to the results of contemporarily conducted active seismic experiments and available reference information.