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Implementation of Multi-Mode Spatial Autocorrelation (MMSPAC) Methods along the North Anatolian Fault Zone (Turkey)

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The North Anatolian Fault Zone (NAFZ), the major tectonic structure in Turkey, is formed as a result of the relative motions between surrounding tectonic plates. The NAFZ is an active right lateral strike- slip fault located in Northern Anatolia. This fault, with an approximate total length of 1200 kilometers, starts at the Karliova triple junction in the East and extends west to the Aegean Sea. Combination of the tectonic and geological behavior of the region have led to destructive earthquakes with M $\geq$6.5 along NAFZ including the 1992 Erzincan (Mw=6.6), 1999 Kocaeli (7.4) and 1999 Düzce (7.2) events. These events occurred on soft soils located in mostly pull-apart basin and led to significant structural damages and human losses. Thus, it is essential to study the soil behavior in detail within urban areas along the NAFZ.

In this study, results of microtremor analyses performed at selected sites in Bolu, Düzce and Erzincan are presented. The Multi-Mode Spatial Autocorrelation (MMSPAC) method as outlined in Asten (2006) is employed to obtain S-wave velocity profiles at these sites. The uncertainties involved and non-uniqueness of the results are presented in the form of variabilities from independent analysts.

In the second part of the study, fundamental frequencies of soils and corresponding amplitudes obtained from empirical Horizontal-to-Vertical Spectral Ratio curves from microtremors, weak motions and strong motions recorded at the selected sites are compared with results from one-dimensional theoretical transfer functions. Theoretical transfer functions are computed using S-wave velocity profiles derived from array observations of the microtremor wavefield. Our results are consistent with studies from other regions in that the fundamental frequencies from microtremors, weak motions and theoretical transfer functions are mostly in agreement with each other although some discrepancies are observed. Even though important information about the fundamental resonance frequency can be derived from Horizontal-to-Vertical Spectral Ratios, observed amplitudes do not yield consistent results with the theoretical amplification factors. Thus, the use of Horizontal-to-Vertical Spectral Ratio amplitudes is not recommended for estimation of amplification factors. Based on our observations, complementary use of alternative methods for site response is recommended.