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Site Effect Analysis in the Izmit Basin of Turkey: Preliminary Results from the Wave Propagation Simulation using the Spectral Element Method

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Sedimentary basins affect the propagation characteristics of the seismic waves and cause significant ground motion amplification during an earthquake. While the impedance contrast between the sedimentary layer and bedrock predominantly controls the resonance frequencies and their amplitudes (seismic amplification), surface waves generated within the basin, make the waveforms more complex and longer in duration. When a dense network of weak and/or strong motion sensors is available, site effect or more specifically sedimentary basin amplification can be directly estimated experimentally provided that significant earthquakes occur during the period of study. Alternatively, site effect can be investigated through simulation of ground motion.

The objective of this study is to investigate the 2-D site effect in the Izmit Basin located in the eastern Marmara region of Turkey, using the currently available bedrock topography and shear-wave velocity data. The Izmit Basin was formed in Plio-Quaternary period and is known to be a pull-apart basin controlled by the northern branch of the North Anatolian Fault Zone (Şengör et al. 2005). A thorough analysis of seismic hazard is important since the city of Izmit and its metropolitan area is located in this region. Using a spectral element code, SPECFEM2D (Komatitsch et al. 1998), this work presents some of the preliminary results of the 2-D seismic wave propagation simulations for the Izmit basin. The spectral-element method allows accurate and efficient simulation of seismic wave propagation due to its advantages over the other numerical modeling techniques by means of representation of the wavefield and the computational mesh.

The preliminary results of this study suggest that seismic wave propagation simulations give some insight into the site amplification phenomena in the Izmit basin. Comparison of seismograms recorded on the top of sedimentary layer with those recorded on the bedrock show more complex waveforms with higher amplitudes on seismograms recorded at the free surface. Furthermore, modeling reveals that observed seismograms include surface waves whose excitation is clearly related to the basin geometry.