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Modelling 3D Seismic Wave Propagation in Marmara Region

Abstract

This study focuses on the modeling of 3D seismic wave propagation in the east of the Marmara Sea in particular for the city of Istanbul, which is identified as one of the megacities with the highest seismic risk in the world. For the first time, an attempt is made for creating a 3D seismic model and for testing the new model with real data. In the frame of constructing 3D velocity model, previous crustal studies of Marmara region and all other available field data, including surface and borehole measurements, are compiled to form a collection of 1D models. Each 1D model relates to a specific location point inside the study area. We have used interpolation methods, in particular Delaunay triangles approach, in order to fill in the no-data zones, which separate the 1D observation points.

Elastic wave propagation is simulated inside the newly created 3D model using finite difference approach. An open source code called Wave Propagation Program (WPP), which operates on parallel processing environment, is used for that purpose. We have tested the performance of the 3D model with real data using the earthquake of September 29, 2004 (Ml=4.1) occurred in Çınarcık Basin, which was recorded by 18 permanent broadband stations and 100 strong motion stations. A detailed analysis of the source properties of the event is done, both for the location and the fault plane solution. Real and synthetic waveforms are compared both in time and frequency domains. Matching of the waveform shapes are studied in detail. In each case improvement of 3D model over 1D counterpart is discussed. A more quantitative evaluation of 1D and 3D performances is carried out using waveform correlation. The final result shows that a considerable improvement is achieved with 3D model both in terms of amplitudes and P and S arrival times. The finite difference method is also applied to specified basin structures filled with soft sediments of low shear velocities. Sabiha Gökçen Airport area in Pendik, is studied in detail because its basement geometry and sedimentary cover are well-known. The analysis, performed both in the time and frequency domain, helps to understand the characteristics of the 3D wave propagation inside the basin and the site effects related to it.

PUBLICATIONS

Conferences

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