Geophysical Research Abstracts
Vol. 21, EGU2019-3319, 2019
EGU General Assembly 2019

Turkey-Japan Joint Project on Modeling of Geological Structures for Strong Ground Motion Simulations due to Crustal Earthquakes in Eskisehir Basin, Turkey

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The promotion of earthquake research in Japan covers comprehensive basic policies for the promotion of seismic research through the observation, measurement and survey of earthquakes. HERP (Headquarter for Earthquake Research Promotion) proposed a framework of survey and observation plan of earthquakes in Japan. At the first stage of this framework, it consists of observation of crustal activities and surveying of underground structures. Next step is to improve the methods of predicting strong ground motion and increase accuracy, and thus the improvement of seismic hazard maps. In order to fully capture the seismic hazard of a region, we must understand the effects of the regional 2D/3D underground structure on wave propagation. Selection and modification of ground motion time series to represent a specific hazard at a site has a large impact on the results of nonlinear response history analyses using these input motions, indicating the need to establish rational procedures for ground motion selection, scaling and modification. Validated seismological methods may be used to generate ground motion time series that incorporate near-fault rupture directivity effects and basin effects, and appropriately represent the duration and long period energy content of these large design events. These effects cannot be fully predicted by simply adopting GMPEs that are developed for other regions. The main objective of this project is to determine time-histories for distant and near-field earthquakes through ground motion simulations.

This joint project proposes to investigate the validation of the modeling procedure of determination of geological models proposed by HERP for seismic hazard map in Japan, and output of this validation will be applied to the Eskisehir basin in Turkey. We can understand the performance of the procedure through the application to the Kumamoto area by the Japanese side (using HERP procedure), and will be compared with the results from Eskisehir by Turkish side. We also incorporate the methods used in the Japanese procedure into estimation of geological models in the Eskisehir basin. In this frame, we attempt to calculate broadband period ground motion time series from near-field and far-field earthquakes by using source modeling and ground motion techniques. The effects of ground motions having a broadband period range can be studied in two parts; first one is the rupture directivity effects and secondly basin edge effects. The prediction and simulation of such ground motions need source modeling, determination of 2D/3D basin geometry and S-wave velocity structure.

We performed both array- and single-station microtremor measurements at a number of locations so as to characterize the area to determine 1-D S-wave velocity structures down to the bedrock depth beneath the strong motion sites for the broadband simulation. Final geological models obtained will be verified by seismic interferometry method and microgravity measurements. As next step, we make ground-motion simulations to get time histories to analyze the effects of ground motions to buildings. In spite of increasing number of buildings having different heights and characteristics in urbanized areas in Turkey, a few studies exist on the interaction of such buildings with ground motions having broadband periods.