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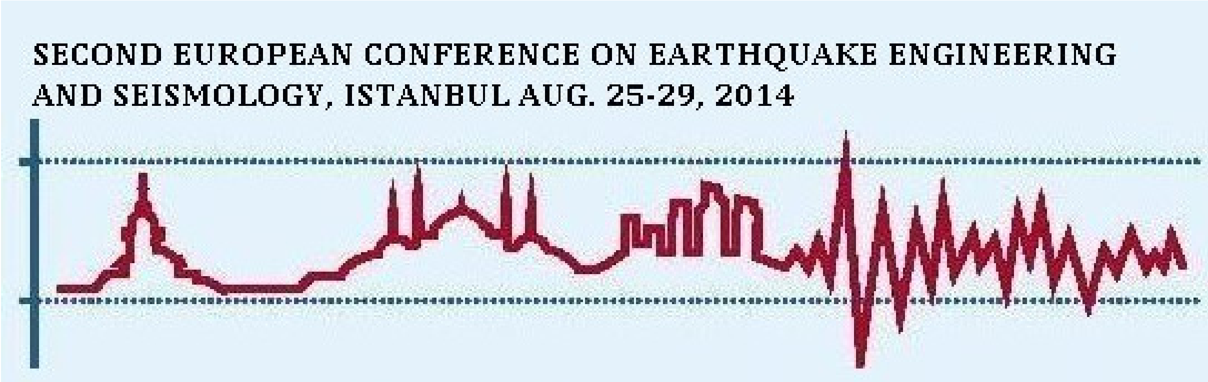

DYNAMIC RUPTURE AND GROUND MOTION SIMULATIONS IN THE SEA OF MARMARA

Hideo AOCHI[1] and Thomas ULRICH[2]

The Sea of Marmara, Turkey, is one of the regions of the highest seismic potential in the world, and therefore the risk prevention is one of the major concerns of the country, in particular for the biggest town of the area, Istanbul. The disaster from the nearby 1999 Izmit, Duzce earthquakes is unforgettable, and the seismologists have been studying these earthquakes for better understanding the cause and consequence and for better applying the obtained knowledge on expected earthquakes in the Sea of Marmara. Previously we carried out the simulations of dynamic rupture process and near-field ground motion for the 1999 Izmit earthquake (Aochi and Madariaga, 2003; Aochi et al., 2011). The dynamic rupture simulations showed that a small difference in fault geometry may leads to different rupture scenarios in the fault system (Aochi and Madariaga, 2003). The ground motion simulations indicated the possibility of a significant variation in strong ground motion parameters according to different scenarios (Aochi et al., 2011). We consider the same simulation procedure to discuss the possible earthquakes in the Sea of Marmara.

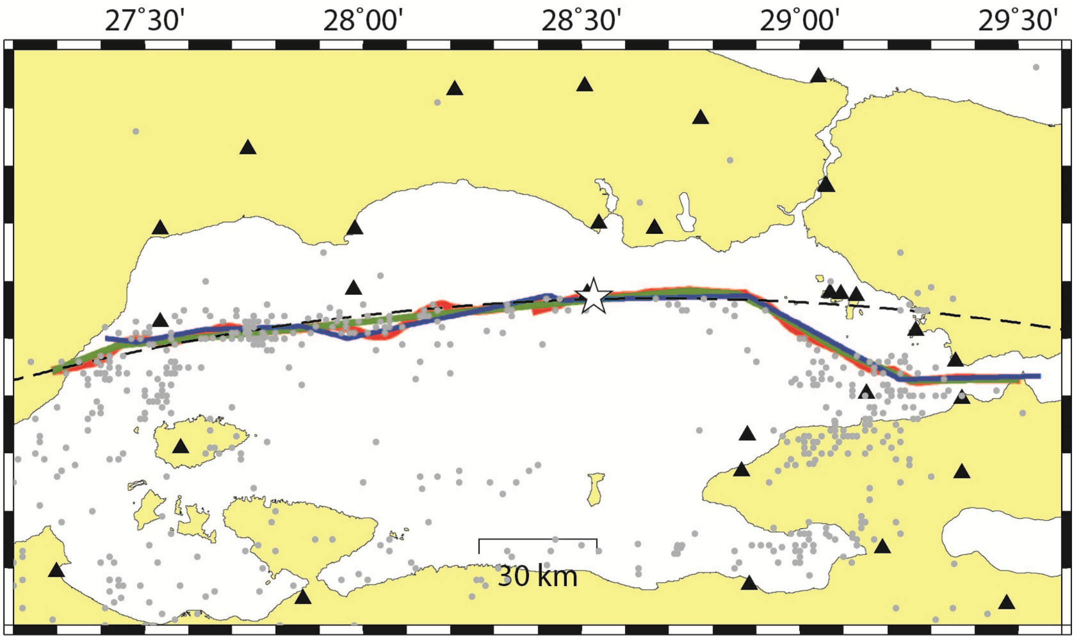

Figure 1. Model area for the Sea of Marmara simulations. Three different geometry models are tested for dynamic rupture propagations. The Marmara/Eurasia pole of rotation is specified by a black dashed circle (Le Pichon et al., 2003). The grey dots show the seismicity catalogue (KOERI, M > 3, 2000/01/01 – 2013/10/14). The hypocentre we choose for the simulation is situated with a star. The triangles are the short-period and broadband stations of the KOERI network.

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First, we carry out the dynamic rupture simulation in the complex fault systems inferred from the geological and geophysical studies. We adopt a 3D boundary integral equation method (BIEM) (Aochi et al., 2000). It is inferred that the fault traces have a few jogs and present an important change in strike in the south of Istanbul (east of the Sea of Marmara). We suppose the stress field according to the tectonic model of Le Pichon et al. (2002) and the same frictional parameters as in the previous simulation of the 1999 Izmit earthquake (Aochi and Madariaga, 2003). Since there is uncertainty on the model parameters (hypocentre, stress level), we also introduce a logic tree to determine the parameter set and discuss the probability of each scenario, as demonstrated in Aochi et al. (2006). The simulations show some possibility that the rupture may entirely progress in the Sea of Marmara.

Second, we aim to improve the ground motion simulations around the Sea of Marmara. We use the 3D finite difference method, code Ondes3D©2008 Aochi et al.. Thanks to the European project MARSITE (New Directions in Seismic Hazard Assessment through Focused Earth Observation in the Marmara Supersite), we were able to obtain the latest information on the available structure models (Bayrakci et al., 2013) and well-relocated earthquake catalogues (Korkusuz, 2012; Karabulut, pers. comm). Through preliminary tests of relatively small earthquakes (Mw4-5), we find that the 3D model improves significantly the waveforms around the Sea of Marmara, although it remains some residuals. This encourages continuing the refinement of the 3D configuration of the model to assure reliable ground motion simulations.

Using both simulations, we will generate more realistic ground motions according to a physically-consistent earthquake scenario. Several disaster scenarios may be considered to take into account the uncertainty in the model parameters. It is important to take into consideration the possible variation in earthquake scenarios, and therefore in the ground motions to better assess the seismic hazard in the area.

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