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Implications of fault behaviour in the Marmara Sea on ground motion simulations and seismic hazard assessment

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Estimating a reliable earthquake ground motion and assessing the seismic hazard in Istanbul is one of the crucial aspects of the ongoing risk mitigation efforts. In this regard it is important to note that the earthquake hazard in Istanbul is mainly controlled by the North Anatolian Fault Zone (NAFZ) in the Marmara Sea, and contributions from other segments of the NAFZ in the region are assumed to be insignificant for the near future as both the eastern and the western parts of the Marmara Sea have experienced recent earthquakes (i.e. 1912 Ganos earthquake in the west and 1999 Izmit and Düzce earthquakes in the east). In this sense, previous probabilistic seismic hazard assessments conducted for the region are not sufficient to account for the expected earthquake threat in this mega-city with more than 12 million inhabitants. Deterministic ground motion simulations based on complex multi-asperity fault rupture scenarios, give a more realistic estimate of the ground motions from a future large earthquake in the Marmara Sea. The recent ground motion simulations conducted using hybrid methodologies gave important insights about the variability of the ground motion in the metropolitan area of Istanbul and its surroundings. However, the uncertainties in the input parameters for ground motion simulations now force us to look more carefully into our understanding of the fault behaviour in the Marmara Sea. In this sense, several input scenario models with various critical fault parameters are applied in ground motion simulations. The resulting ground motion distribution reveals the effect of fault behaviour as expressed by these critical parameters. The most influential parameters affecting the results are the location and size of the asperities,

rupture initiation point, rupture velocity, rise time and stress-drop. Other important aspects of the fault behaviour are the geometry of the fault segmentation and linkage between the segments in individual earthquake ruptures. Assessing these critical parameters requires a detailed understanding of the fault behaviour in the Marmara Sea where direct observations apart from the bathymetric and geophysical data are not available. Detailed paleoseismological studies of the fault ruptures during the 1912 Ganos earthquake in the west and the 1999 Izmit and Düzce earthquakes in the east therefore provide important clues on the fault behaviour in the Marmara Sea.