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10 July 1894 Istanbul Earthquake: Comparing Damages and Ground Motion Simulations

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One of the major earthquakes that resulted in intense damages in Istanbul and its neighborhoods took place on 10 July 1894. The 1894 earthquake resulted in 474 losses of life and 482 injuries. Around 21,000 dwellings were damaged, which is a number that corresponds to 1/7 of the total dwellings of the city at that time. Without any doubt, the exact loss of life was higher. Because of the censorship, the exact loss numbers remained unknown. There is still no consensus about its magnitude, epicentral location, and rupture of length. Even though the hardness of studying with historical records due to their uncertainties and discrepancies, researchers should enlighten the source parameters of the historical earthquakes to minimize the effect of future disasters especially for the cities located close to the most active fault lines as Istanbul. The main target of this study is to enlighten possible source properties of the 1894 earthquake with the help of observed damage distribution and stochastic ground motion simulations. In this paper, stochastic based ground motion scenarios will be performed for the 10 July 1894 Istanbul earthquake, using a finite fault simulation approach with a dynamic corner frequency and the results will be compared with our intensity map obtained from observed damage distributions. To do this, in the first step, obtained damage information from various sources has been presented, evaluated, and interpreted. Secondly, we prepared an intensity map associated with the 1894 earthquake based on macro-seismic information, and damage analysis and classification. For generating ground motions with a stochastic finite fault simulation approach, the EXSIM 2012 software has been used. Using EXSIM, several scenarios are modeled with different source, path, and site parameters. Initial source properties have been obtained from findings of our previous study on the simulation of the 26 September 2019 Silivri (Istanbul) earthquake with Mw 5.8. With the comparison of spatial distributions of the ground motion intensity parameters to the obtained damage and intensity maps, we estimate the optimum location and source parameters of the 1894 Earthquake.