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Spatial variation of ground motion in Istanbul: preliminary results based on data from the Istanbul earthquake rapid response system

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The spatial variation of earthquake ground motions can occur as a consequence of soource properties, wave propagation through different earth strata, soil media and topographic features and serves to quantify the amplitude and phase differences of ground motion over distance or area. The spatial variation of earthquake ground motion has an important effect on the response of linear lifelines such as bridges, pipelines, communication systems, and should preferably be accounted for in their design.

In this study spatial variation of strong-ground motion in Istanbul from two earthquakes recorded by the Istanbul Earthquake Rapid Response and Early Warning System (IERRS) is analyzed. The first event (ML 4.3) took place on 16.05.2004 off the Yalova coast in the Eastern Marmara Sea close to the entrance of the Izmit Bay. The second one (ML 4.0) occurred on 29.09.2004 to the south of the Prince islands close to Istanbul. Both events can be associated with the North Boundary (or Cinarcik) segment of the North Anatolian Fault in the Marmara Sea. The May 16, 2004 event had an oblique-normal focal mechanism that coincides with the strike orientation, dip and slip properties of the North Boundary fault. Although there is some contraversy about the focal mechanism of the September 29, 2004 event, it is very likely similar to the May 16, 2004 event.

In the first event 73 stations and during the second one 86 stations of the 100-station IERRS were triggered. The inter-station separation distances in the IERRS vary between 0.67km and 56 km. Our study focuses on the distance range upto 5km. The spa-

tial variance of strong-ground motion within the network is investigated by the analysis of the intra-event variation of peak horizontal accelerations (PHA) and pseudo spectral velocities (PSV), as well as by coherency and correlation analysis. The intra-event spatial variability of PHA's is examined by the PHA ratio of two stations as a function of separation distance over a frequency range of 0.2 to 25 Hz The analysis is repeated using ratios of PSV's of station-pairs calculated as the average of PSV's between 0.2 and 1.0 s periods for 5-percent critical damping, and plotted against station-separation distance. In both cases, the data are corrected for distance and local site effects. We also carried out coherency and correlation analysis, where coherency and correlation functions for smoothed horizontal components of recorded ground motion are computed.

The results are preliminary in the sense that so far two events were recorded by the larger number of stations in the IERRS This work forms the skeleton of an automated system to uniformly calculate the variance of recorded motions. It is expected that the results obtained will stabilize and become more reliable as the number of recorded events increase.