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Shake Mapping in Turkey

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Turkey is a seismically active country located at the Eastern Mediterranean region, and has been the site of several destructive and extremely damaging earthquakes (Io≥10) since historical times (e.g.; 17 Izmir, 1458 Erzincan, 1509-1894 Istanbul, 1653-1668-1688 Izmir, 1855 Bursa and 1872 Antakya). Tragic examples of these earthquakes in the past century include the 1912 Ganos M7.4, 1939 Erzincan M7.8, 1942 Tokat M7.4, 1943 Samsun M7.6, 1944 Bolu M7.4, 1976 Van M7.5, 1999 August in Kocaeli M7.4, 1999 November in Duzce M7.2 and 2011 Van M7.2). All these earthquakes caused extensive destruction and thousands of casualties. In recent years, the Disaster and Emergency Management Authority (AFAD) which answers directly to the Turkish Prime Ministry, has supported several projects in the field of engineering and earth science studies aimed toward a better understanding of the occurrence of earthquakes on Turkish territory and their associated ground shaking. In this context, a project was specifically designed at the quick assessment of PGA and intensity in Turkey. The AFAD is indeed in great need of rapid and accurate information on where earthquake damage is located, so they can properly direct rescue teams and organize an emergency response. For these reasons, we decided to implement the software package ShakeMap, developed by the USGS Earthquake Hazards Program (Wald et al. 2006). It generates maps of the PGA parameters and the instrumentally derived intensities in few minutes after the earthquake occurrence.

ShakeMap is a routine which maps the epicentral area which is affected by ground motion during the earthquake, according to Peak Ground Acceleration (PGA), Spectral Acceleration (PSA), Peak Ground Velocity (PGV) and Instrumental Intensity. These kind of maps could be prepared by gathering data in a very short time during and immediately after a strong earthquake. Accuracy and precision increase when combining observed real data from accelerometric network stations with that of estimated values derived from attenuation relationship. Principal aim for generating ShakeMaps is sending relevant information (such as effected hazardous and predictive damage areas) to governmental establishments as soon as possible, and producing accurate knowledge for rapid response teams (Wald et al. 2006).

As a single authority of an earthquake prone country, Turkey, the AFAD has started to finance several projects in the field of seismology aimed toward a better understanding of earthquake occurrence in the country. In this context, project UDAP-G-14-15 was directed

specifically at the quick assessment of ground-motion shaking in Turkey. For these reasons, the ShakeMap routine has implemented to the AFAD computing servers and specifically designed to generate maps of the peak ground-motion (PGM) parameters and the instrumentally derived intensities. We started to have initial results on a scenario earthquake in Kocaeli (Figure 1).

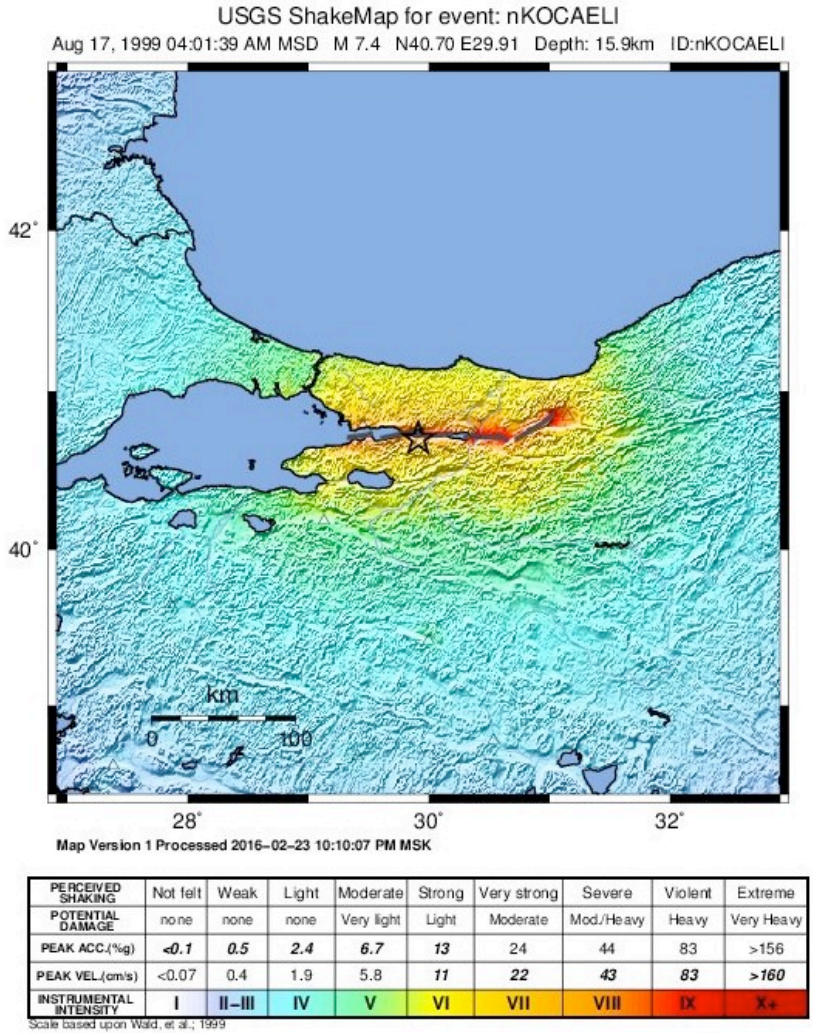

Figure 1. ShakeMaps for instrumental intensity of the 17 August 1999, M7.4 Kocaeli earthquake. Intensities rely on relationship for earthquakes in California.

One critical factor in successfully predicting PGM when generating ShakeMaps is the use of well-calibrated magnitude versus distance ground-motion predictive equations (GMPEs). Other important parameters are site corrections and Vs30 determinations. Our works to obtain best results are ongoing by including recent GMPEs and site classifications based on geology and velocities. For the purpose of rapid estimation of damage assessment for an area where the strong motions have occurred, we think that the results can be greatly valuable for fast response for effective emergency response to disaster area. This is, eventually, the final goal of the ShakeMap approach.

Acknowledgements
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References
Wald, D.J., Worden, B.C., Quitoriano, V. and Pankow, K.L., 2006. The ShakeMap, USGS Open File Report, 156p.