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Long Period Seismic Waves Developped at Local Distances and Their Importance for EEWs

Esra Kalkan Ertan and Ali Pınar
Bogazici University, Kandilli Observatory and Earthquake Research Institute, İstanbul, Turkey (esra.kalkan@boun.edu.tr)

Long period ground motions is an highly importance topic nowadays because of the number of the large-scale structures increases day by day in metropolitan areas. Their effect on the large-scale structure (high rise buildings, suspension bridges, off-shore oil drilling platforms etc.) are more perceivable than small structures. Studies show that long period ground motions especially occurs in distant sedimentary basins with the help of the path effects. (Koketsu and Miyake, 2008) Period of the waves is ranging from several to ten seconds and that causes dramatic resonance and severe damage to the structures which are located in deep sedimentary basins (Furumura et al., 2013).

There are so many examples of how destructive these waves can be. A devastating example is Mexico City, which is located 400 km away from the 1985 Michoacan Earthquake (Mw=8.0) epicenter, where 300 buldings collapsed and 800 buildings were demolished beyond repair. (Celebi et al, 1987). Another example is 2003 Tokachi-oki Earthquake associated with severe damage on large oil tanks, and fires lasting two days at the city of Tomakomani 250 km away from the source (Koketsu et al, 2005).

Lots of studies revealed that the sedimentary basins amplifiy the long period seismic waves. In the case of Marmara Region, three important basins namely Çınarcık, Central and Tekirdağ Basins exist in Marmara Sea. The primary objective of the proposed study is to investigate if any relations exist between basins structures and generation of long period seismic waves which can be effective in Istanbul Metropolitan Area and develop reliable early warning applications or systems for structures which are under such risk.

Three types of algorithms are in use for EEW applications used for this study, Virtual Seismologist, PRESTo and ELARMS2. The early warning signal is communicated to the appropriate server shut-down systems of the recipient facilities, that automatically decide proper action based on the alarm levels. The stations are located at basin-edges, outside and inside the basins. So we have a chance to compare the seismograms whether or not the earthquake generates long period ground motions and to send signals to early warning systems.

Until now, we have a good example for long period seismic waves which was caused by North Aegean Earthquake on 24 May 2014 (Mw=6.9). It was located approximately 30 km north-west of Gökçeada Island and widely felt in İstanbul Metropolitan area. The earthquake epicenter was 300 km away from Istanbul, but the shaking duration of tall buildings was high up to 10 minutes. The travel time of the long period waves from the epicenter to the metropolitan area of Istanbul is about 85 seconds providing more than 50 seconds warning time. Although, the amplitude of the strong motion waveforms were small, the long period and the long duration of the velocity waveforms acquired at more than 100 strong motion stations within the city, explains to some degree the causatives of the long shaking duration of tall buildings.