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A Comparison study on the infrastructure of national seismic networks considering earthquake early warning

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Distribution of national seismic networks is generally designed by seismologist's experience. They are typically not optimized for various applications in engineering seismology such as earthquake early warning systems (EEWS). On the other hand, optimum performance can be achieved by investigating current station distribution, active faults and population of regions with the focus on EEWS. In this study, I investigated Turkey's seismic station infrastructure and compared the station distribution with three region/country EEWS; California, Japan, and Switzerland. Region's area and population together with area and population per station statistics are calculated. I explored the distribution of interstation distances within Turkey. At each of the Kandilli Observatory and Earthquake Research Institute, (KOERI) and Disaster and Emergency Management Presidency (AFAD) stations, I assigned an average interstation distance value, which is computed from the average distance to the three closest stations. From these values, I created contour maps of interstation distances using a linear interpolation between stations. Comparing the median interstation distances of stations in Turkey network with that of the other networks, I found striking differences. The Japanese network has a near-normal distribution with a mean of 17.7 km whereas the others has a non-normal distribution. Turkey's network may also be considered as normally distributed with a large standard deviation but there are some stations between 5 -15 km interstation distances. Median of interstation distances are less than 18 km except Turkey. California and Switzerland networks are skewed at the small-distance end by very dense network configuration. I found that more than 50% of Turkey has an average of 70 km or more whereas highly populated areas, such as Istanbul, Kocaeli, have less than 30 km spacing. Qualitatively, regions that have both large populations as well as high likelihood of experiencing strong shaking include: the southern part of Trakya, the extended parts of North Anatolian Fault Zone (NAFZ), the southern part of Turkey around Hatay, and lastly Aegean region around Izmir. I evaluated if the interstation distances in these identified regions are at or below the 20 km. For the central NAFZ, between Kocaeli Erzincan, I found there are an inadequate number of stations. In this critical part of Turkey, the interstation distance varies from 30 to 50 km but mostly over 70 km. These values are well outside the desired interstation distance of 20 km or less. The current distribution of stations in the Turkey's network was not designed for EEWS purposes. The capabilities of an EEWS are primarily determined by station distribution. The distribution of station is currently not adequate for EEWS in Turkey. However, in our budget limited reality, I proposed three strategy to improve seismic station density in this study.