Shallow soil effects for contrasting PGAs at nearby strong-motion stations dring the Mj 5.2, 2017, Southern Akita Prefecture earthquake

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On September 8, 2017, an earthquake of Mj 5.2 occurred with epicenter in Southern Akita Prefecture at 22:23 local time. The focal depth provided by Japan Meteorological Agency (JMA) is 9 km. The maximum recorded instrumental intensity provided by JMA is 5-upper. We analyzed the strong-motion records of the earthquake recorded by K-NET and KiK-net, and found that the recorded peak ground accelerations (PGAs) differ by a factor of about 2 to 4 at some pairs of adjacent stations in spite of their close locations compared with the epicentral distances. In this paper, we show a comparison of PGAs and PGVs at two pairs of stations namely AKT011 and AKTH01 (first pair), and AKT021 and AKTH13 (second pair). The maximum PGAs of the three components (rounded to the clossest integer) are 105 cm/s/s and 47 cm/s/s at the AKT011 and AKTH01 (first pair), respectivly. Similarly, the maximum PGAs are 113 cm/s/s and 28 cm/s/s at the AKTH13 and AKT021 (second pair), respectively. The inter-station distance is about 240 m between the first pair of stations and about 1.5 km between the second pair of stations. The epicentral distance of AKTH01 (a station of first pair) is about 37.6 km, and that of AKTH13 (a station of second pair) is about 53.5 km. Considering the magnitude of the earthquake, large epicentral distances, and smaller inter-station distances between the stations of each pair, the source and path effects at each pair of stations may be considered to be identical.

The shallow velocity structure model at the recording sites provided by National Research Institute for Earth Science and Disaster Resilience (NIED) shows that the S-wave velocities of the top five meters of the soil columns are significantly different between the two stations of each pair. In contrast, the deeper subsurface velocity model provided also by NIED shows that the deeper velocity models at each pair of stations are identical. We calculated the theoretical 1D site amplifications using the shallow velocity models at the stations, and found that the amplifications are much larger at frequencies between about 5 Hz and 10 Hz at the sites having larger PGAs. We compared the PGAs from bandpass filtered waveforms, and found that the PGAs were controlled by the frequency components at 5 Hz to 10 Hz, which corespond to the frequencies of maximum site amplifications at the sites having larger PGAs. The values of ratios of PGVs at the corresponding stations are nearly half of the values obatained for the PGAs, thus suggesting that the components of relatively longer period ground motions are similar. We also analyzed the PGAs and PGVs from several well recorded events, and found that the results are similar. Thus, we conclude that the shallow soil amplification effects greatly contributed to the variation of PGAs at the sites mentioned above.

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