Ground Motion and Attenuation Characteristics in the March 24, 2001 Geiyo Earthquake

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1. Introduction

The March 24, 2001 Geiyo earthquake (Mjma=6.4, Mw=6.8), which characterized by a normal faulting system caused a unilateral rapture propagation from north to south direction. The major slip occurred at a depth of 50 km with the fault length of 25 km and width of 10 km. The epicentre of this earthquake is located at 34.125N 132.713E, southern part of Hiroshima Prefecture. According to the joint inversion results using the strong ground motion data and teleseismic data by Yagi and Kikuchi, 2001, two large asperities were identified with the maximum dislocation of 1.1 meters. In order to better understanding the characteristics of the ground motion distribution first, the ground motion parameters such as Peak Ground Acceleration (PGA) and Peak Ground Velocity (PGV) are calculated using the free field three-components acceleration records of the K-NET and KiK-NET networks. Then the attenuation relationships for those ground motion indices in the Geiyo 2001 earthquake are developed.

2. Ground Motion Parameters

The Geiyo 2001 earthquake caused slight to moderate damage to the lifeline facilities and residential houses at the Hiroshima, the Ehime, the Yamaguchi, and the Okayama Prefectures. At the several areas near the costal line of the Hiroshima Prefecture soil liquefaction on the ground surface and on the pavement of the roads took place. In this study using 306 free-field acceleration records of K-NET and 246 acceleration records of KiK-NET the ground motion parameters are obtained. The distribution of the PGV versus PGA is shown in Fig. 1. At the Hiroshima K-NET station HRS009, the maximum PGA and PGV reach to more than 800 cm/s/s and 30 cm/s values, respectively. Due to the deep focus of this event at the intermediate shortest distances the stronger ground motion observed than from the same magnitude event with a shallow deep focus one (Molas and Yamazaki, 1995). Figure 2 shows the epicenter location and the surface projections of the assumed fault plane for this earthquake.

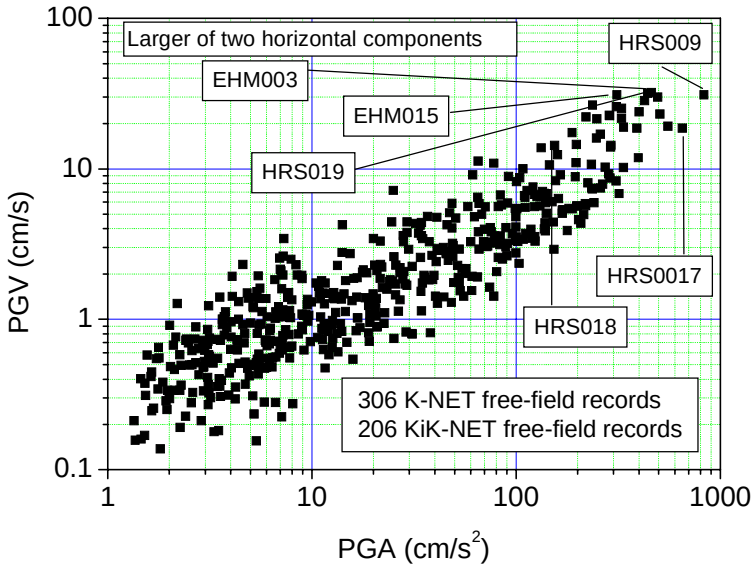

Fig.1 Distribution of the PGV and PGA in Geiyo 2001 earthquake.

For those K-NET stations (HRH013 and HRS018), which located at the near liquefied areas of the Hiroshima Mitsubishi Heavy Industrial and Takehara-shi, the acceleration and the velocity time histories, and the relative velocity response spectra are demonstrated in Fig. 2. The dominant periods between 0.2s – 0.4s and 1.0s-2.0s in the both horizontal components of the velocity response spectra are observed.

3. Attenuation Relationships of Ground Motion Parameters in the Geiyo 2001 Earthquake

Using the free filed strong ground motion records of K-NET and KiK-NET attenuation relations for the ground motion parameters are developed. The attenuation model consists of the attenuation of the body waves in an elastic continues medium. The model considers anelastic and geometric spreading terms, intercept coefficient, and record-to-record variance. The records with PGA less than 1 cm/s/s in one horizontal component are excluded. The final data set consists of 512 three-component acceleration records. The results of the attenuation relations for the PGA and PGV are shown in Fig. 3. The PGA and PGV values at the K-NET HRS009 Hiroshima station with 5.5m sandy soil deposit profile, exceed the one plus standard deviation of the mean attenuation curves, this is an example of the site amplification due to local soil condition. For this site the relative amplification factors was obtained by the previous study result of the attenuation relationship by Shabestari and Yamazaki, 2000.

Key words: The 2001 Geiyo earthquake, Earthquake ground motion parameters, Attenuation relation
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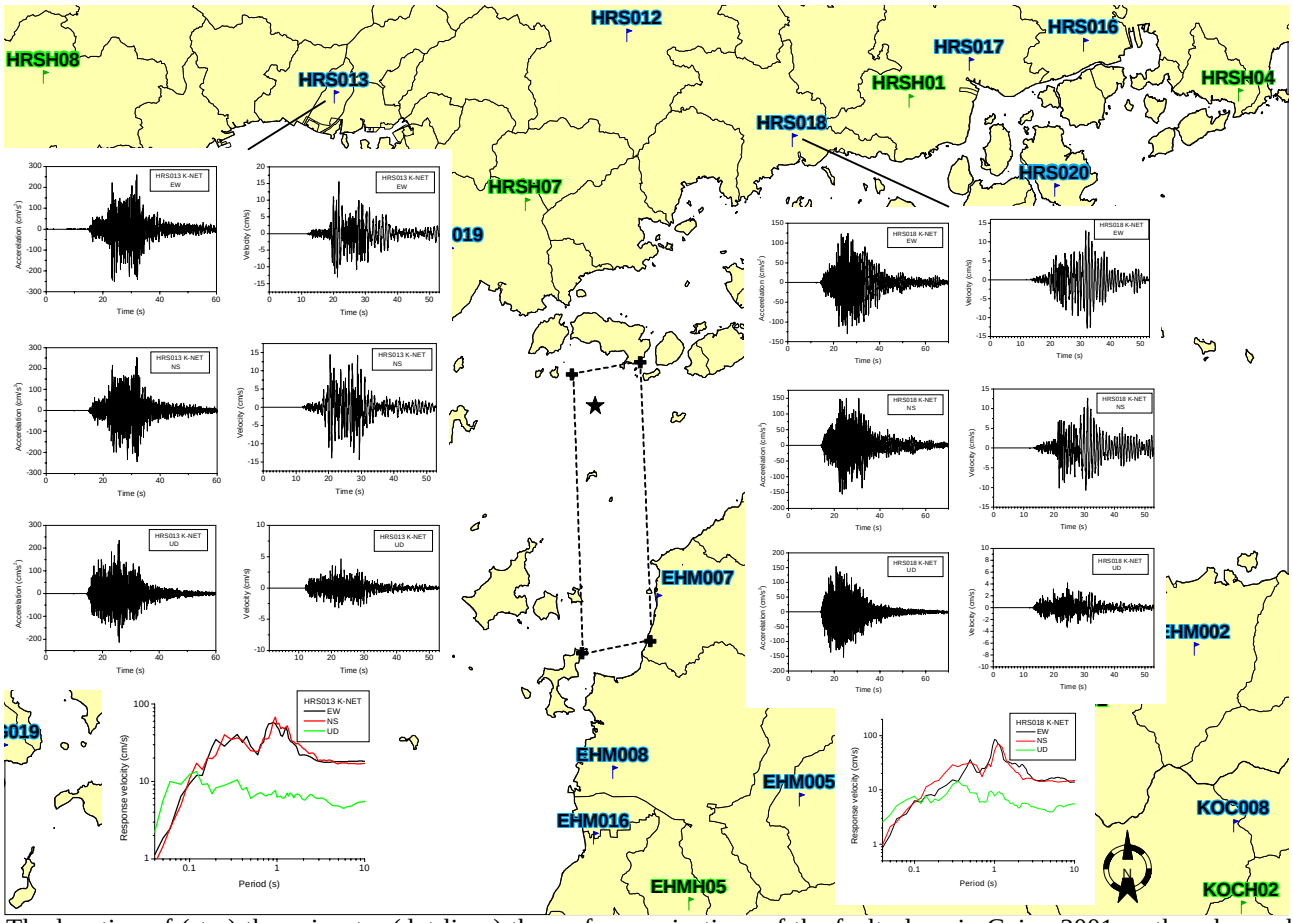

Fig. 2 The location of (star) the epicenter (dot lines) the surface projections of the fault plane in Geiyo 2001 earthquake, and (flag bar) the location of K-NET and KiK-NET stations. The acceleration, the velocity time histories, and the relative velocity response spectra for the K-NET, HRH013 and HRS018 stations are given.

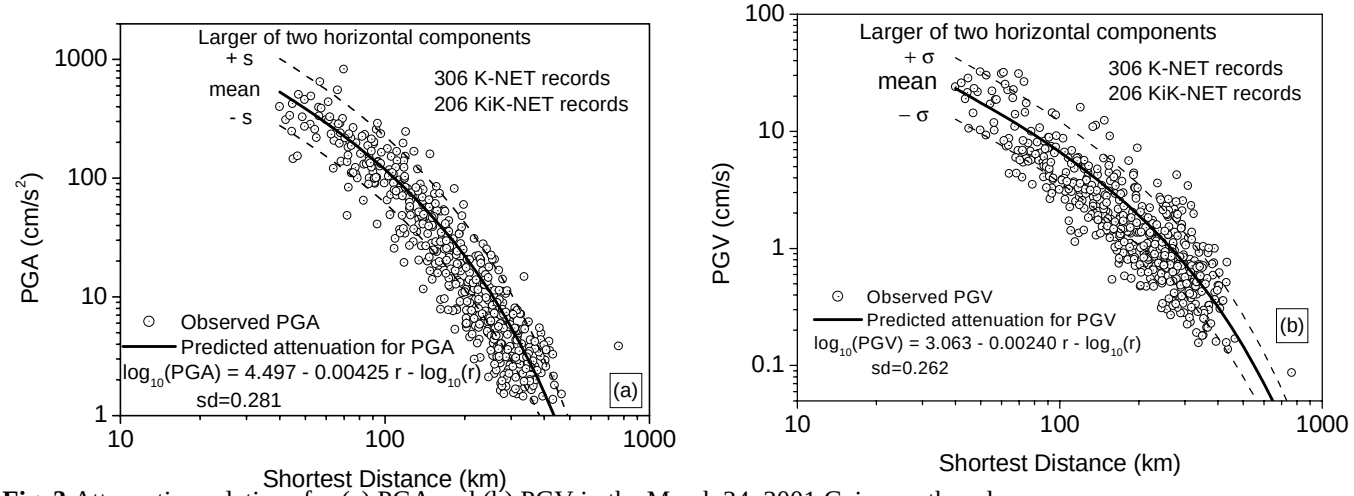

Fig. 3 Attenuation relations for (a) PGA and (b) PGV in the March 24, 2001 Geiyo earthquake.

4. Conclusions

In this study the ground motion parameters for the Geiyo 2001 event were calculated and the frequency contents of two stations near the liquefied areas were demonstrated. From the horizontal velocity response spectra, the dominant periods at the short period (0.2s-0.4s) and at the intermediate period (1.0s-2.0s) ranges were found. The damage caused by this earthquake especially to the low-rise buildings and lifeline facilities might be explained by those dominant periods. The attenuation relationships for the PGA and the PGV were developed. In order to better understanding the characteristics of this earthquake, a furthermore, study is necessary with the consideration of the local site and deep-focus effects into the distribution of the ground motion parameters.

References

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