Comparison of H/V spectral ratios of microtremors and earthquake motions at K-NET sites in Ehime Prefecture, Japan

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1. Introduction

The site of study is Ehime Prefecture; Japan, and continuously hit by small and large scale earthquakes (Figure 1). Data used in this study are the earthquake motions recorded in the K-NET stations and microtremor measurements. The main goals of this study are to find out the H/V spectral ratio of K-NET sites of Ehime and also to find out the relationships between the H/V spectral ratio of microtremors and those of P-wave, S-wave and coda waves of earthquakes.

2. Methodology

The relationships between H/V spectral ratio of earthquake motions and those of microtremors were investigated using observed data from earthquake observation stations of K-NET in Ehime. In this study, we selected two earthquakes Tottori-ken Seibu (Mj=7.3 and depth 11 km), October 6,2000 and Oita-ken Seibu (Mj=6.2 and depth 146 km), June 12,2006 earthquakes. Time histories of the earthquake motions are shown in Figure 2.Earthquake motion records were divided into parts of P-wave, S-wave and coda wave for analysis.

Microtremor measurements were carried out on the basement for the stations of K-NET. Microtremor measurements were performed using portable microtremor GEODAS12-US equipment. Three or more numbers of sensors were used to verify and the measurement was carried out for 300s to 180000s. The sampling frequency was 100 Hz. GPS was used at the sites. The recorded microtremors data were divided into segments each of 20.48s.The segments judged influence by very near traffic were removed. The Figure 3 shows the time histories of cleared data.

The Fourier spectral ratios were calculated for selected time histories and averaged for two or more segments was done and these were smoothed using Parzen window of 0.5Hz bandwidth. The predominant frequencies at all sites were determined from the H/V spectral ratio of microtremors and earthquake motions. After obtained the predominant frequency, we compared the predominant frequency of microtremors and those of

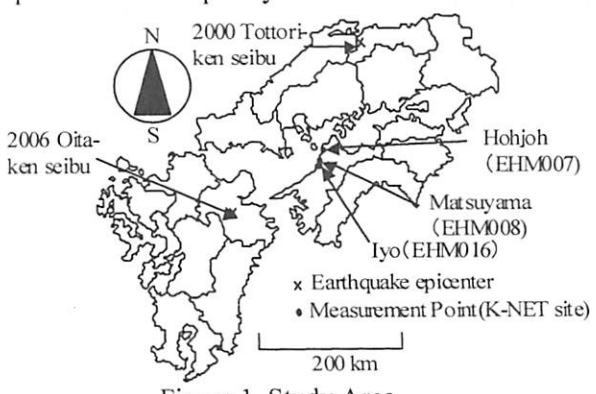

Figure 1. Study Area

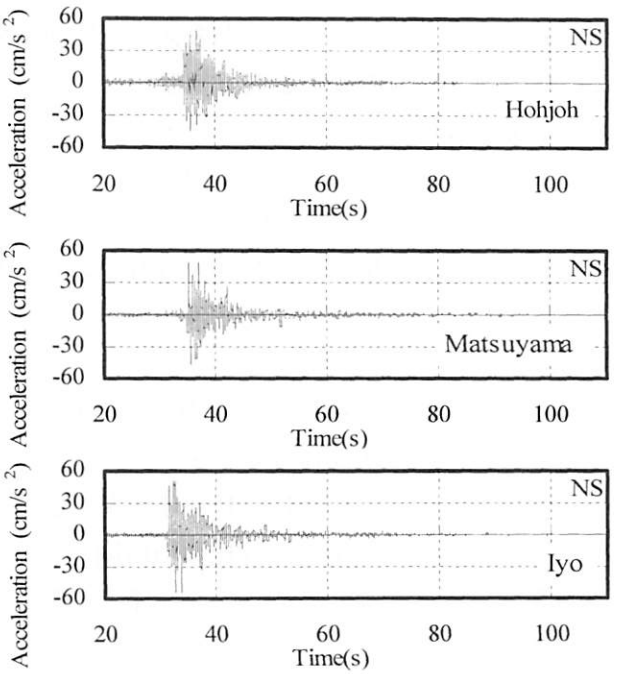

Figure 2. Acceleration time histories of 2006 Oita-ken Seibu earthquake at three sites

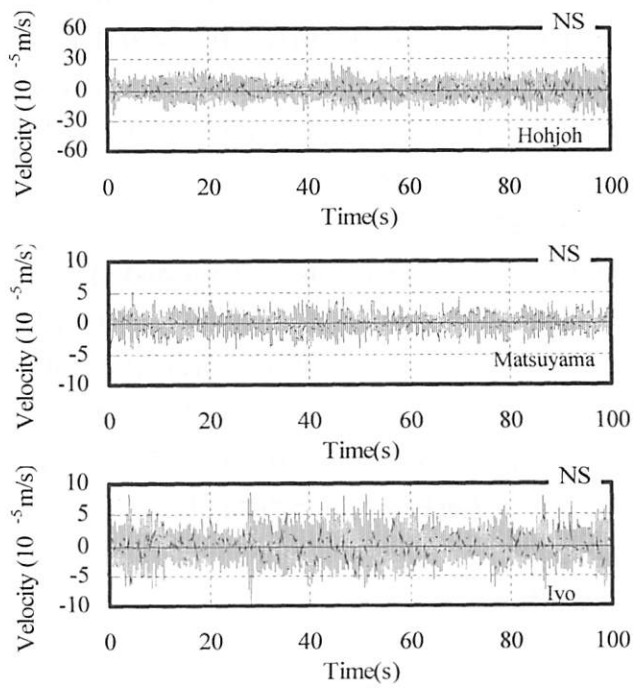

Figure 3. Velocity time histories of microtremor at three sites

earthquakes. For the case of earthquake motions, we analyzed separately parts of P-wave, S-wave and remaining part as a coda wave for all three sites.

3. Results and Discussions

We have carried out the comparison of H/V spectral ratio of microtremors and earthquakes motions. In this study, two aspects of the H/V spectral ratio are examined and results are discussed as follows:

a) Comparison between microtremors and earthquake motions.

Figure 4 compares the average H/V spectral ratio of NS and EW component of microtremors and earthquakes at three sites. All the three sites are on medium soil. The H/V spectral ratio of both earthquakes shows consistency when all earthquake-recorded data are used in the analysis. The amplitude of H/V of microtremor is nearly equal to those of both earthquakes when the frequency range is less than 2Hz and beyond 2Hz, which is less than earthquakes. In case of Hohjoh site, the maximum amplitude of H/V spectral ratio of microtrenor is higher than others. The predominant frequency of microtremor is slightly larger than earthquake motions at all sites. Consequently, the troughs have been appeared at the lager frequency of microtremor and disappearing in the earthquakes.

b) Comparison between microtremors and the parts of P-wave, S-wave and coda wave of earthquakes.

Figure 5 compares the average H/V spectral ratio of NS and EW component of microtremors and P-wave, S-wave and coda wave of earthquake motions at K-NET stations. In this case, H/V spectral ratio of microtremor and coda wave shows similarity. The amplitude of S-wave is higher than others. S-wave shows only similarity in the low frequency range but different in higher frequency range. And also, the H/V spectral ratio of EW components of earthquakes shows the clear peak when we have used only S-wave part of earthquake at which the peaks of microtremor are magnified.

4. Conclusions

In this study, the comparison of the H/V spectral ratio of microtremors and those of earthquake motions are studied. The H/V spectral ratios of two different earthquakes at three sites are roughly identical. The shape of H/V spectral ratio of microtremors is similar to the coda wave of earthquakes at three sites. In case of Matsuyama, the predominant frequency of H/V spectral ratio of microtremors and those of coda wave of earthquake motions are very close.

5. Acknowledgement

We would like to express our thanks to K-NET; from this organization we have obtained the earthquake motions data.

6. References

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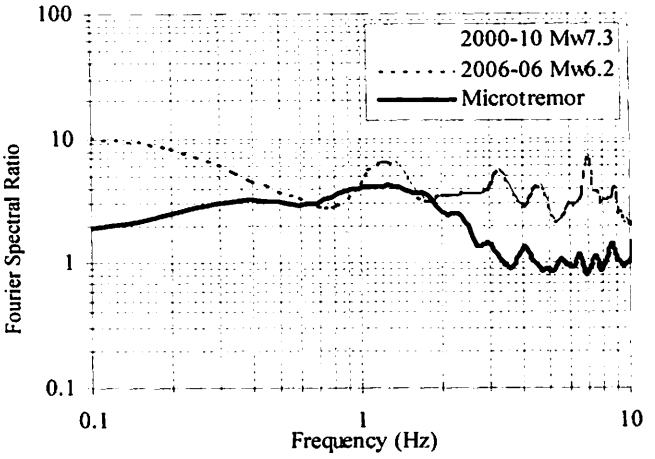

Figure 4. Comparison H/V spectral ratio between earthquake motions and microtremor at Iyo site

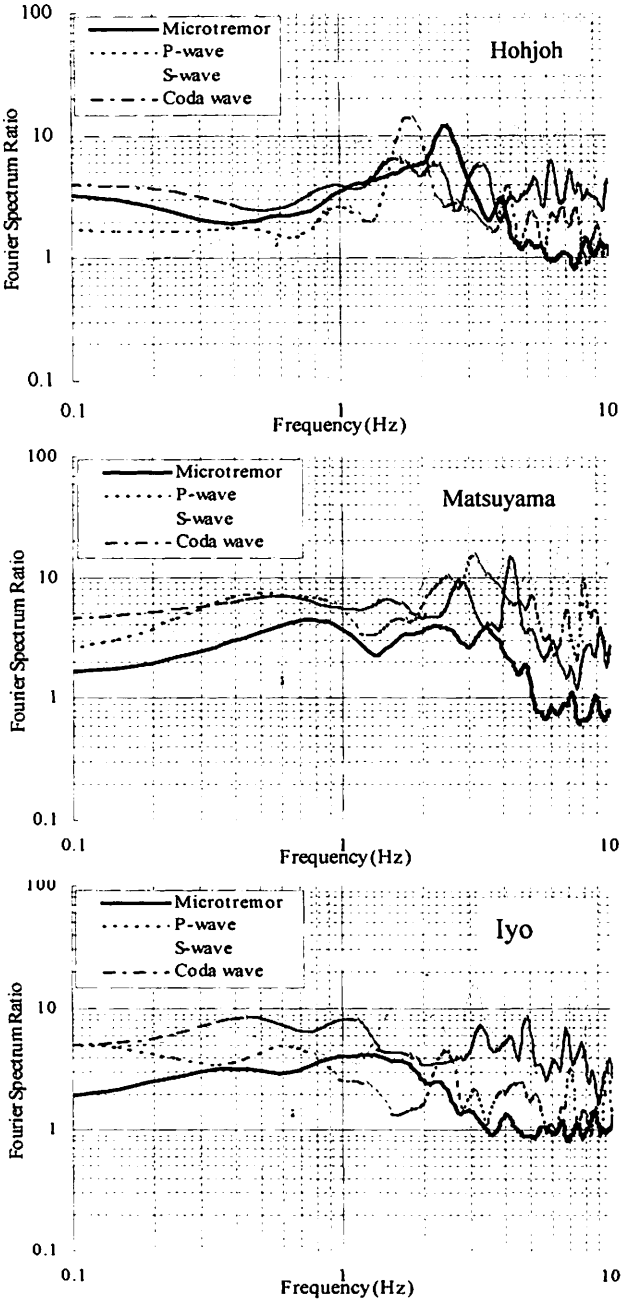

Figure 5. Comparison H/V between Tottori-Ken Seibu earthquake motion and microtremor at three sites