GROUND MOTION CHARACTERISTICS IN LOCAL CITY IN KANTO AREA, JAPAN ESTIMATED BY MODERATE EARTHQUAKES -FOR SEISMIC DISASTER PREVENTION AT CHOSHI CITY-

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ABSTRACT :

For seismic disaster prevention, it is important to know how differences of ground motion in and around the target area. In this paper, ground motion characteristics at Choshi, that is a local city located in east part of Kanto plain, Japan, were investigated using moderate and small earthquake records. At the site covered over soft soil, it always observes seismograms with big amplitude. And instrumental seismic intensity is larger than the other sites. Going to west part of Choshi, the depth to bedrock increases. And instrumental seismic intensity becomes also larger gradually. But it is difficult to conclude that the different of seismic intensity between west and east part of Choshi is effects of deep understructure condition or not.

KEYWORDS: Ground motion, Amplitude, Seismic intensity, Site amplification

1. INTRODUCTION

For seismic disaster prevention, it is important to investigate characteristics of ground motion in and around the target area. For example, it is easy to expect that the urban area will be damaged, if grate earthquake will occur near this area. Therefore, seismographs were deployed in urban area with high population, and they have been investigated by many diverse approaches using moderate and small earthquake records and microtremors. But in the local city with small population, except special area that is occurred historical earthquakes, they were hardly done. In this such as situation, ministry of home affairs deployed seismic intensity meters to measure instrumental seismic intensity at all cities, towns and villages of Japan in 1996. So resolution of seismic intensity distribution, that is one of important information for seismic disaster prevention, became higher. But it is not enough to understand characteristics of ground motion at the local city, town and village that controls large area, and at area where geological condition changes change drastically. So it is impossible to explain that seismic intensity observed at central area is the average of whole area.

In this study, we will investigate characteristics of ground motion at Choshi city, Japan, where geological condition changes drastically, as a target area, using moderate and small earthquake records.

2. TOPOGRAPHY AND GEOLOGICAL CONDITION AT CHOSHI

Choshi is located at the east part of Kanto Plain in Central Japan. Figure 1 shows a topographic map of Choshi. The topography at this area can be classified into three types, low land along Tone river, hill area and mountain site. From geological point of view, it's condition changes drastically. The tip of Choshi peninsula consists of hard rock in Pre-Tertiary. The west part of Choshi is located at hill site covered over Kanto loam on Plio-Pleistocene layer. On the other hand, the surface geology on low land consists of Quaternary alluvium deposit (Unosawa *et al.* 1983, Takahashi *et al.* 2003). The depth to bedrock at west and east part of Choshi area were estimated about 300-500m and 0-100m by H/V spectral ratio on microtremors, respectively (Kurita *et al.* 2006).

3. OBSERVATION AND SEISMOGRAMS

At Choshi, there are at least three observation sites operated by Japan Metrological Agency (JMA) and National Research Institute for Earth Science and Disaster Prevention (NIED). But they installed at the central Choshi area. It is difficult to know the ground motion characteristics using only these data. Thus eight accelerographs were deployed at Choshi. ATG and CIS, at south-east part of Choshi peninsula, are located on bedrock and on reclaimed land, respectively. MEJ and KSG are located at central part of Choshi area. And KKN, NJR, CNH and MSK are located at west part of Choshi. The location of observation sites are shown in Fig.1.

The sampling rate to record signal is 100 samples/sec in this observation. Recording is started by a trigger system. Figure 2 shows NS-component seismograms observed at each site occurred on Aug. 14, 2007, off-east Chiba Pref. The waveform observed at ATG displays very simple, however it includes waves with high frequency comportment. Also waveforms at another site are simple. But from amplitude point of view, there is a very big difference between them. The maximum amplitude observed at each site is about 1.5 - 5 times as big as observed at ATG.

To know a distribution characteristic of maximum amplitude at Choshi area, average of maximum amplitude ratio referred to ATG was calculated (Fig. 3). It indicates that there is about 5-6 times difference, at its maximum. In horizontal comportment, the amplitude at MEJ and NJR is the biggest in this area. And going to west part of Choshi except MEJ and CIS, maximum amplitude is bigger. On the other hand, maximum amplitude in vertical component is not so change compared to horizontal one except MEJ.

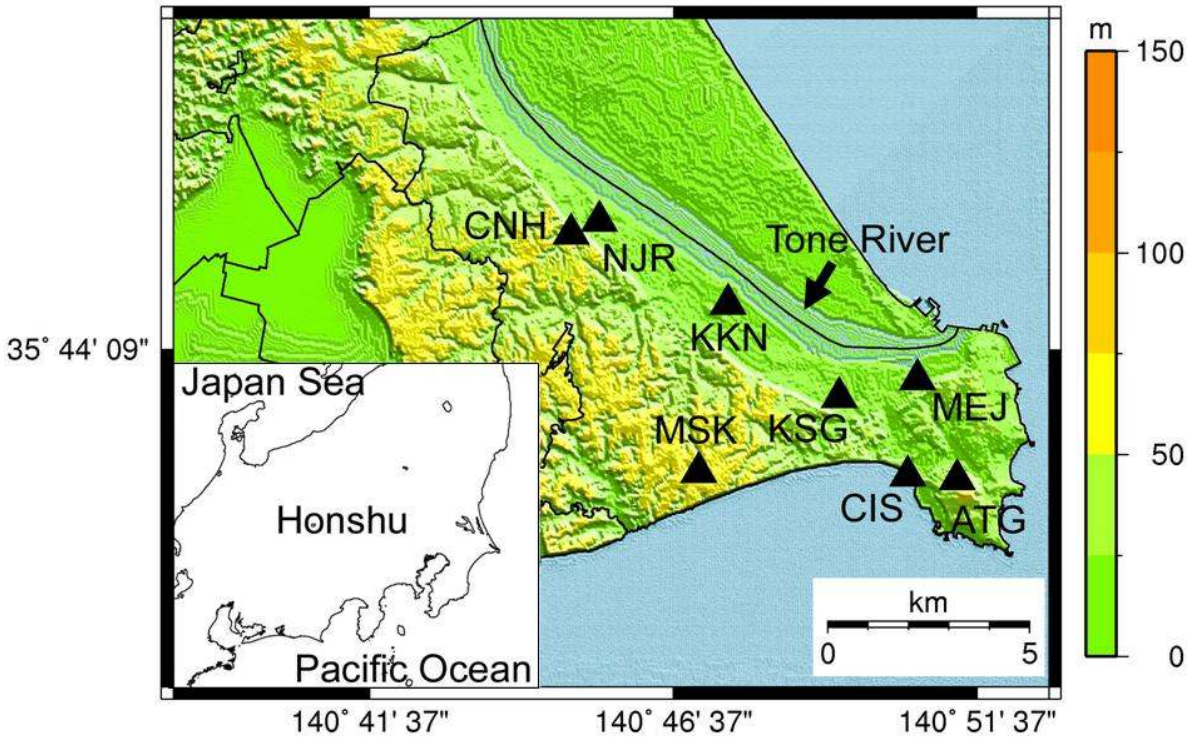

Figure 1 A distribution map of observation sites at Choshi

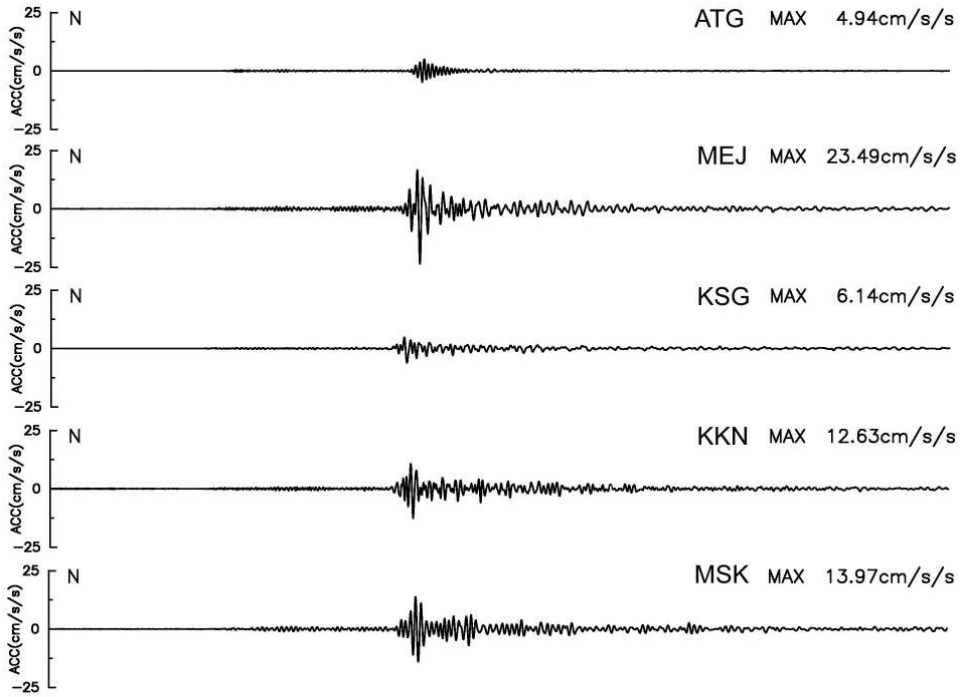

Figure 2 NS component waveforms observed at each site on Aug., 14 2007.

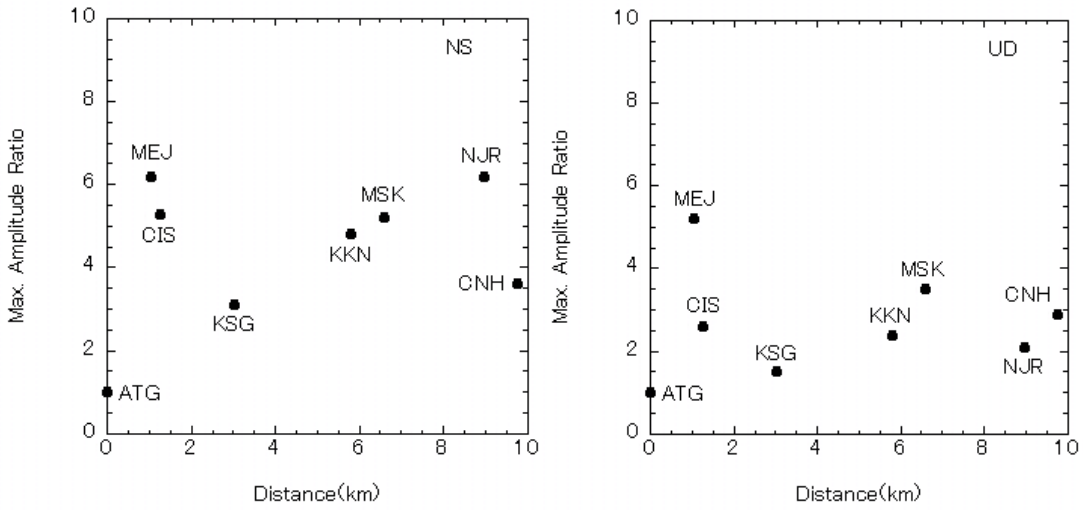

Figure 3 Average of maximum amplitude ratio referred to ATG at each site.
Left: NS-component Right: UD-component

4. INTENSITY DISTRIBUTION

Seismic intensity is one of important scale to understand ground motion characteristics. So distribution of instrumental seismic intensity was investigated. Figure 4 shows an intensity map occurred on south-east off Chiba Pref., Oct. 14, 2006. It indicates that instrumental seismic intensity at west part of Choshi area is bigger than east part, except MEJ and CIS. It is comparable a characteristic of maximum amplitude ratio on horizontal component.

It is well known from many experiences of earthquake that there is the difference of seismic intensity between east part of Choshi peninsula and central area. To know variations of instrumental seismic intensity at this area, intensity ratio into the reference site was calculated. Usually, the record on bedrock site is used as a reference. But it is not convenient to calculate the intensity ratio, because sometimes ATG as a reference site was recorded intensity scale 0. In this case, MEJ that observed always biggest instrumental seismic intensity in this network was choose as a reference site. Figure 5 shows the average of seismic intensity ratio at Choshi area. It can be classified into 3 types, almost 0, 0.5-0.75, and more than 0.75. Although the range of instrumental seismic intensity using this analysis is less than 3.0, it means that there is a twice difference at Choshi except ATG, and seismic ground motion is very small at ATG.

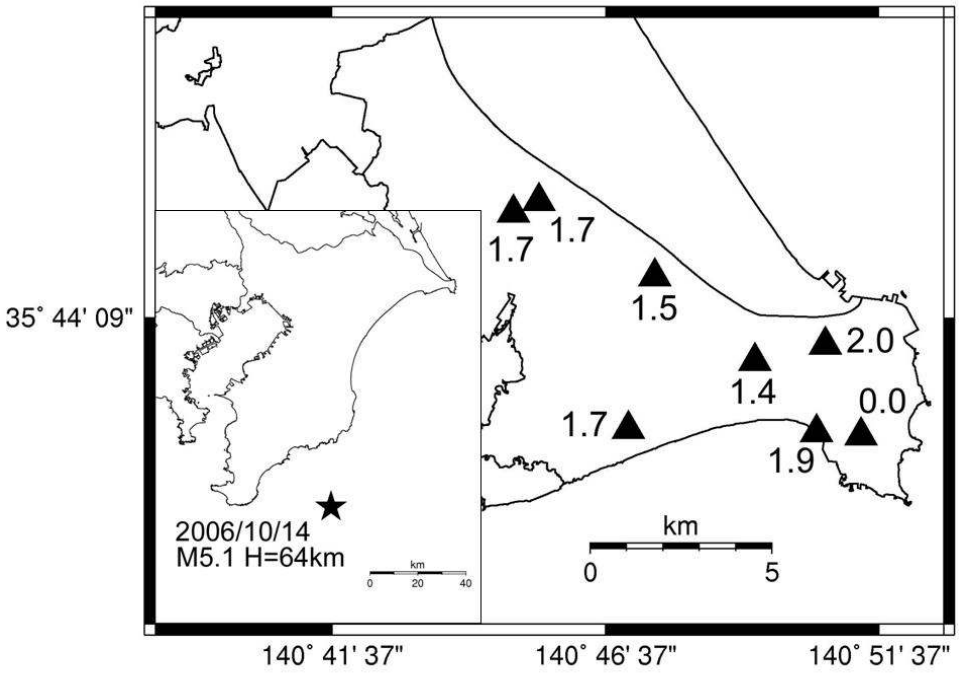

Figure 4 A distribution map of instrumental seismic intensity at Choshi on Oct. 14, 2006

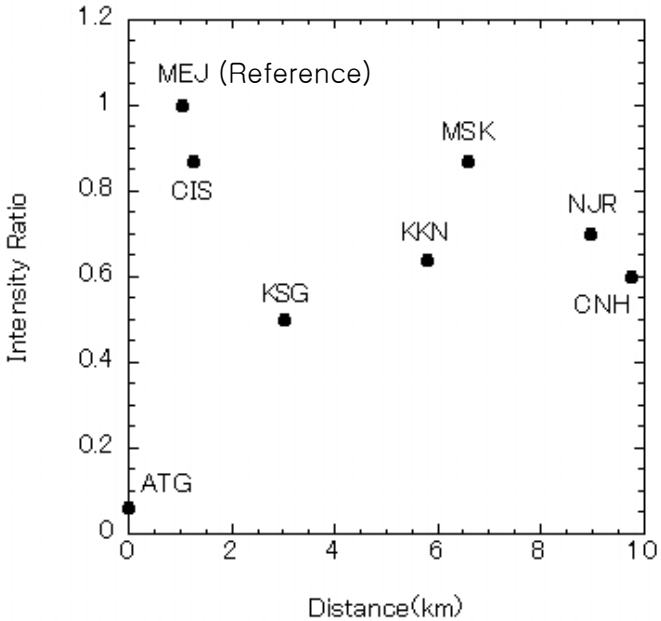

Figure 5 Average intensity difference at Choshi

5. SITE AMPLIFICATION

The area where underground condition changes drastically affects characteristics of ground motion by effects of site amplification. So site amplification at each site was estimated. We used an inversion method (Iwata and Irikura, 1987) for this analysis. The time window is 10 second including main part of S waves. And it was assumed that the site amplification factor at ATG was equal to 2 in frequency between 0.2 and 10 Hz band.

Figure 6 shows results of site amplification at all sites. The value of site amplification factor at all sites indicates more than 10 in frequency of more than 2Hz. Because of this reason, the difference of seismic intensity exists between ATG and the other sites. Especially, it is more than 20 at MEJ and CIS. It was a rice field at MEJ according to old map in the 1880's, and is reclaimed land at CIS, so that ground surface consists embankment. Therefore instrumental seismic intensity at MEJ and CIS is always higher than the other sites.

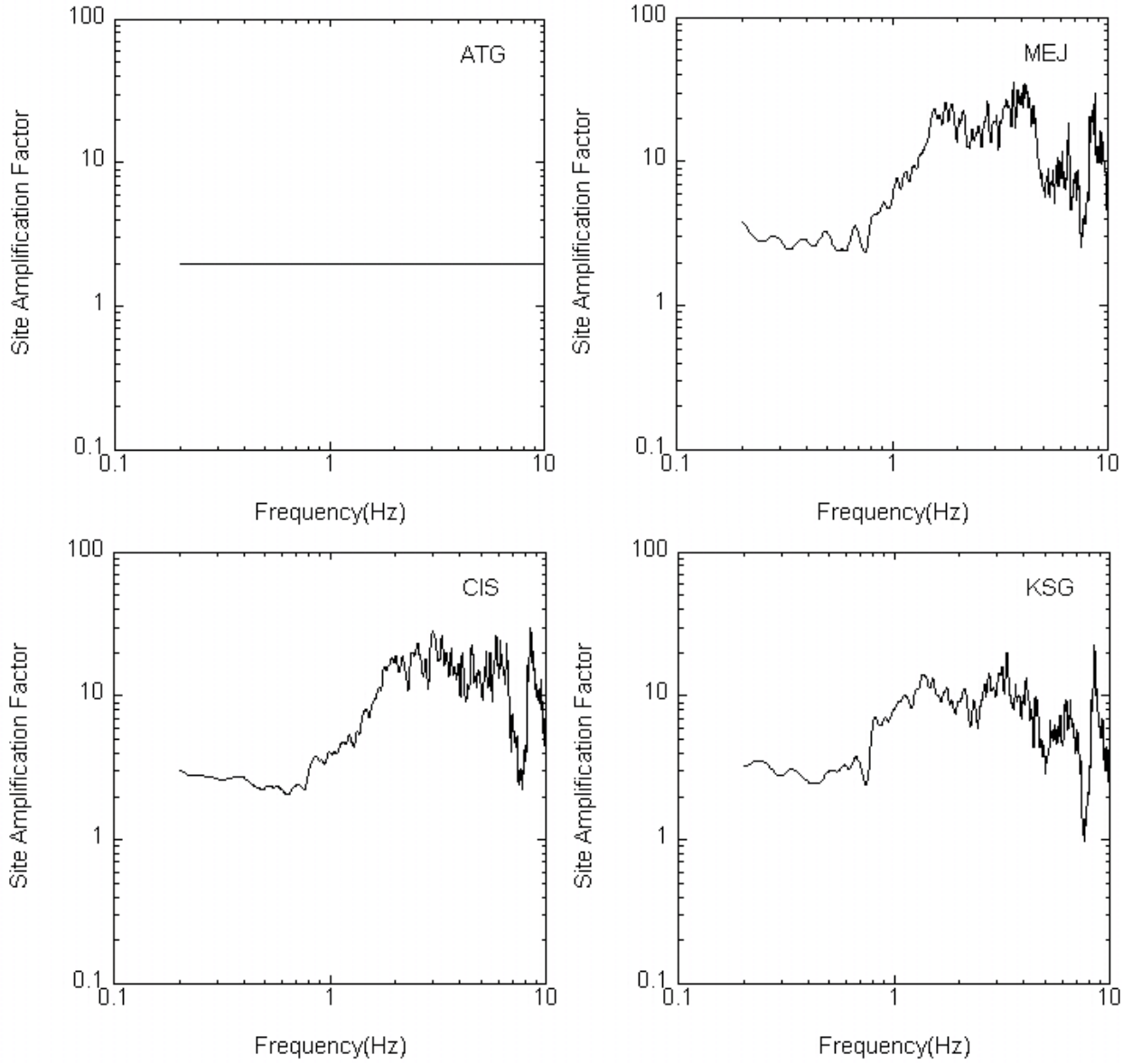

Figure 6 Site amplification at each site.

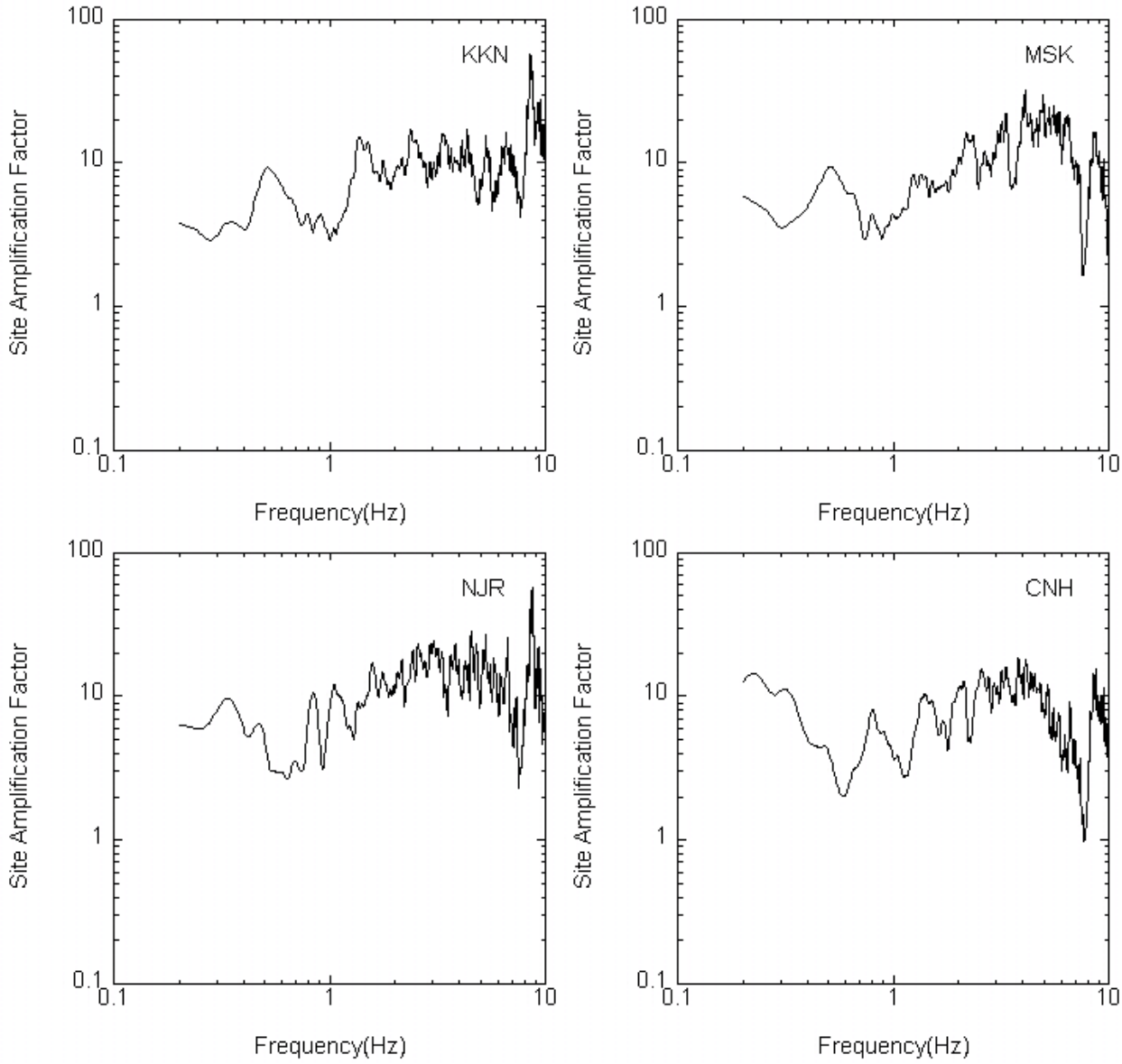

Figure 6 Ditto

In frequency of lower than 1Hz, site amplification factor is almost equal to 2-4 at east part of Choshi area. On the other hand, KKN, MSK and NJR that is located at west part area, it is also equal to 2-4 in the frequency between 0.5 and 1Hz band. But it has a peak around 0.3-0.5 Hz. From microtoremors point of view, it is compatible to find a peak by H/V spectral ratio (Kurita *et al,* 2006), and is generated by effects of deep underground condition. And the distribution trend of instrumental seismic intensity at Choshi is compatible the distribution of depth to bedrock. The rate of site amplification factor 0.5-10Hz band to 0.5-1Hz, related to calculate instrumental seismic intensity band, is not so big. So it is difficult to conclude that the seismic intensity difference between west and east part of Choshi is effects of deep understructure condition or not.

6. SUMMARY

For seismic disaster prevention at Choshi, that is located in east part of Kanto plain, characteristics of ground motion were investigated using moderate and small earthquake records.

At MEJ and CIS that are covered over soft soil, it is always observes seismograms with big amplitude and instrumental seismic intensity is larger than the other sites. And at ATG, that is located on the bedrock site and at east part of Choshi, amplitude of ground motion and seismic intensity are smallest at Choshi. In generally, going to west part of Choshi except MEJ and CIS, it indicates that instrumental seismic intensity becomes larger gradually. It seems that this trend is compatible to the depth to bedrock at this area. But it is difficult to conclude that the seismic intensity difference between west and east part of Choshi is effects of deep understructure condition or not.

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