Characteristics of long period seismic waves and shallow structure

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1. Introduction

Long period seismic waves, as well as short period waves, have had effects on our society. A recent example is the big fire of oil tank caused by the 2003 Tokachi-oki earthquake. The countermeasure of long period waves is an important task. The Central Disaster Management Council made investigations of the characteristics of long period seismic waves.

2. Characteristics from observed records

The target features of long period seismic waves are the spectrum, predominant period, and duration. The main causes of excitation are the seismic source and shallow structure around propagation path and the observation site. The purpose of our study is to make clear the excitation mechanisms of long period waves. We made use of the K-NET recordings.

We analyzed for Kanto area the 2000 Kodu-jima earthquake of M5.3. The amplitudes are larger along the Tokyo Bay coastal region and along the Tone River, where the sediment is thicker than the surrounding mountain area. The predominant periods are correlated with the characteristic periods of ground. We also studied for Hokkaido area the 2003 Tokachi-oki earthquake of M8.0, and found the similar features of amplitudes and predominant periods. These results show that the long period waves are mainly surface waves.

3. Long period waves in Kanto area

In order to study the relationship between the characteristics of long period waves and shallow structure, we modeled the 3-D velocity structure with four layers of Vs=3,000, 2,400, 1,400, and 700m/s, using the exploration data. The 3-D model is tuned up by the dispersion curves from micro-tremor measurements or by finite difference simulations.

The calculated predominant period is, as is the observed, correlated with the characteristic period of ground shallower than the 2,400m/s layer. The calculated amplitudes are in good accordance with the observed. The simulations of wave forms are carried out by the methods of finite difference and statistical Green function for the M7.3 plate boundary earthquake, the M7.5 active fault earthquake, and the M6.9 earthquake. In areas of thick sediment where the characteristic period of ground is longer, amplitude is larger and the duration longer, and the velocity response is larger with increasing period. In areas of thin sediment, the long period waves are not evident.

4. Long period waves in Hokkaido

We referred to the results by Aoi et al.(2004) to study the characteristics of the long period waves in Hokkaido area. The 3-D velocity structure model is tuned up by simulation of the 2003 Tokachi-oki earthquake. The calculated amplitudes are larger in plain areas, which is in good accordance with the observed. The predominant period is correlated with the characteristic period of ground shallower than Vs=2,100m/s layer, the result being similar to that in Kanto area.

5. Characteristics of long period waves

The main conclusions are as follows:

(1) The long period waves are mainly the surface waves. The amplitude is larger for the larger magnitude and the shallower hypocenter. In areas of thick sediment, the amplitude is further large and the duration longer.

(2) The predominant period, being dependent on the earthquake mechanism and propagation paths, is correlated with the characteristic period of ground shallower than Vs2,000m/s layer.

(3) In areas of thick sediment, and for the shallow large earthquakes, the velocity response is larger with increasing period.

Acknowledgements:

We used the K-NET recordings.

Refferences:

1) Aoi, S., et al.:3-D finite difference simulation for the 2003 Tokachi-oki earthquake, Proc. of International workshop on strong ground motion prediction and earthquake tectonics in urban areas, 2004.