[JJ] Evening Poster | H (Human Geosciences) | H-DS Disaster geosciences

[H-DS10]Tsunami and Tsunami Forecast

convener:Naotaka YAMAMOTO CHIKASADA(National Research Institute for Earth Science and Disaster Resilience), Kentaro Imai(Japan Agency for Marine-Earth Science and Technology), Hiroaki Tsushima(気象庁気象研究所)

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This session discusses issues related to improving real-time and long-term prediction accuracy of tsunami from earthquakes, landslides, and volcanoes, which include such as a better understanding of tsunami dynamics, new real-time tsunami observing systems deployed in the open ocean and coastal waters, methodologies of more rapid and accurate prediction during tsunami emergencies, more extensive and accurate inundation maps, and long-term tsunami potential forecast.

[HDS10-P01]Study on Magnitude Estimation Method of Slow Earthquakes (2)

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The tsunami earthquakes (the slow earthquakes) are phenomena that generate abnormally large tsunamis, and they usually occur in subduction zones and have characteristics that the rupture durations and periods of seismic waves are longer than those of normal earthquakes. For example, the 1993 Nicaragua earthquake (M_s 7.2, M_w 7.6, GlobalCMT) and the Meiji Sanriku earthquake (M_s 7.2, M_w 8.0) were tsunami earthquakes and caused tsunami disasters. Magnitude determination is a key to issue an effective tsunami warning. But, we think that the magnitude determined within three minutes for tsunami warning by the Japan Meteorological Agency would be underestimated for those tsunami earthquakes. On the other hand, it still takes time to estimate the moment magnitude M_w (Kanamori, 1979) for the first issue of tsunami warning.

According to Kikuchi and Ishida (1993), the P-wave initial part of the seismic motion obtained with a broadband seismograph (STS-2) is proportional to source time function. Seismic moment M_0 can be calculated by integrating velocity twice. Tsuboi *et al*. (1995) proposed a broadband P-wave moment magnitude M_{wp} using the P-wave portion of the broadband seismic waveform (STS-1). However, with respect to the tsunami earthquake, "When we integrate only the first-arrival P-wave displacement, the M_{wp} gives the value less than 7.0." and "So we may have to conclude that the present problem does not work for the tsunami earthquakes." (Tsuboi *et al*., 1995)

We consider that a broadband seismometer that can observe up to long period is useful for the magnitude estimation of the tsunami earthquakes. We analyze the records of the velocity type strong motion sensor and broadband seismograms for magnitude 7 or more earthquakes which occurred in and around Japan to develop a technique to determine moment magnitude based on seismic records including long-period S-wave portion. We investigate integrated displacement like M_{wp} to develop a magnitude determination method for tsunami earthquakes. In this study, we use seismic record obtained at local distances. Whereas the meaning of integrated displacement is not so clear at local distances due to mixture of various phases, we expect that integral of displacement can emphasize long period components of seismic waves.

We used the record of the Full Range Seismograph Network of Japan (F-net) of the National Research Institute for Earth Science and Disaster Resilience (NIED). We selected 20 earthquakes of magnitude 7.0 or more and that occurred from April 2004 to September 2017 in the Japan Meteorological Agency catalog. Instrumental response correction is applied with the deconvolution filter. The displacement and Integrated displacement records are obtained from velocity records with numerical integration and high-pass filter. Second- (for displacement) and Third- (for integrated displacement) order high-pass Bessel filters are used in this study. Cutoff periods of high-cut filters are set at 200 seconds. We exclude the case when the recording is abnormal. We investigate the relationship between M_w of the Global Centroid-Moment-Tensor catalog (Dziewonski *et al.*, 1981) and the maximum amplitude of displacement integral for epicentral distance up to 600 km. Here, we examine the moment magnitude determined from the peak amplitude including long-period S-waves used of integrated displacement which is absolute value.

The relationship between the epicentral distance (logarithm) and the maximum amplitude (logarithm) of the integrated displacement of absolute value is as shown in Fig. 1. The peak of integrated displacement (m・ s) A and magnitude M_{wt} is assumed to be expressed as follows:
$M_{wt} = a \log_{10} A + b \log_{10} R + c$.
Here, a, b, and c are constants, and R (km) is the epicentral distance. A is measured over a seismic record on a vertical component obtained at a local station. When the constants a, b, c are obtained by linear regression, $a = 1$, $b = 0.68$, $c = 6.93$, and the standard deviation of M_{wt} falls within 0.3.

In Figure 1 the relationship between the epicentral distance (logarithm) and the maximum amplitude (logarithm) of the integrated displacement which is the absolute value. The maximum amplitude of the integrated displacement is arranged corresponding to the magnitude of the earthquake. The solid line is the theoretical value when M_{wt} is 6.5, 7.0, 7.5, 8.0, 8.5 and 9.0.