

Prediction of Strong Ground Motions for the Off Miyagi Earthquakes by Using Stochastic Green's Function Method

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1.Introduction

Headquarters for Earthquake Research Promotion, Ministry of Education, Japan (2000) published the report for long-term evaluation of the earthquakes, in which large earthquakes off the coast of Miyagi prefecture of magnitude 7.5 or 8.0 will occur within 20 years in a probability of 80%. For example peak ground accelerations over 200 gal were recorded in several stations during the 1978 Off Miyagi earthquake (Mj7.4) so that, from the engineering point of view, the evaluation of strong motions for the off-Miyagi event must be taken into account in the seismic design.

We estimate the strong ground motions for the Off-Miyagi earthquakes of moment magnitude 7.6 and 8.2 at the specific evaluation point. Ground motions are calculated at the rock outcrop surface ($V_s=500\text{m/s}$). The stochastic Green's function method (Irikura and Kamae, 1999) is employed for the estimation and the site response under the evaluation point is determined from the strong motion records observed there empirically. Synthesized ground motions are compared with the PGA distribution during the 1978 off-Miyagi earthquake.

2.Source Models

Construction of source models for the stochastic Green's function method needs two steps. First the kinematic source model, especially slip distribution must be determined. Secondly the stress drop distribution model is established based on the pre-estimated kinematic model. In this study we prepared two kinematic models and two stress distribution models for each scenario earthquakes of Mw 7.6 and 8.2. The kinematic models for the Mw 7.6 event were determined from the inversion result of the 1978 Off-Miyagi earthquake (Kikuchi and Yamanaka, 2001) and the stochastic model by Somerville et al. (1999), whereas only the stochastic model is used for those of the Mw 8.2 event because of no inversion results. For the stress distribution models, we adopted the multi-crack model proposed by Irikura and Kamae (1999) and the model based on the short-period source spectra by Dan et al. (2001).

3.Estimation of Site Response

The site response at the evaluation point is estimated by taking the spectral ratios of the S-waves at $V_s=500\text{m/s}$ observed at the evaluation point to those at $V_s=3.26\text{km/s}$ of the KiK-net (MYGH01).

4.Results and Discussion

The peak ground accelerations of the synthesized ground motions range from 100 to 280gal for the Mw 7.6 event and from 300 to 390gal for the Mw 8.2 event. On the other hand the attenuation curve proposed by Shi and Midorikawa (1999) shows the good agreement with the PGA distribution during the 1978 Off-Miyagi earthquake. Their attenuation curve predicts the PGA at the rock outcrop of the evaluation point as 180gal. This result is relatively well matched with our results of Mw 7.6 event.