Ground motion distribution of the 2011 off the Pacific coast of Tohoku earthquake estimated from strong motion records and ground condition

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1.Introduction

Ground motion intensity is an important factor in the analysis of earthquake damage to structures and the study of fragility functions. Most structures, however, are not near a strong motion station; it is necessary to estimate ground motion distributions when large number of structures are to be investigated.

Subjected to strong shaking, subsurface ground exhibits nonlinear response and accordingly, its ground motion amplification characteristics change. This nonlinear effect has not been taken into account in the estimation of ground motion distributions.

An improved procedure that can take account of the nonlinear effects was developed and employed for the estimation of the ground motion distributions of the 2011 off the Pacific coast of Tohoku earthquake.

2. Estimation of ground motion distributions

More than 2,000 strong motion records were collected from five organizations[1] and ground motion intensity measures such as peak ground acceleration (PGA) were calculated. Ground motion amplification factors of subsurface ground were derived referring to previous studies using the average S-wave velocity[2]. Spatial interpolation of ground motion intensity was then carried out based on the above-mentioned data to obtain ground motion distributions without taking account of the nonlinear effects.

Subsequently, average strain of subsurface ground was calculated from the ground motion intensity and the average S-wave velocity. The amplification factor taking account of the nonlinear effects was derived from the average strain and then used to re-estimate the ground motion intensity. Figure 1 shows the distribution of PGA estimated by the procedure.

3.Ongoing actions

Further research has been conducted to develop fragility functions based on the analysis of earthquake damage to structures considering the ground motion intensity.
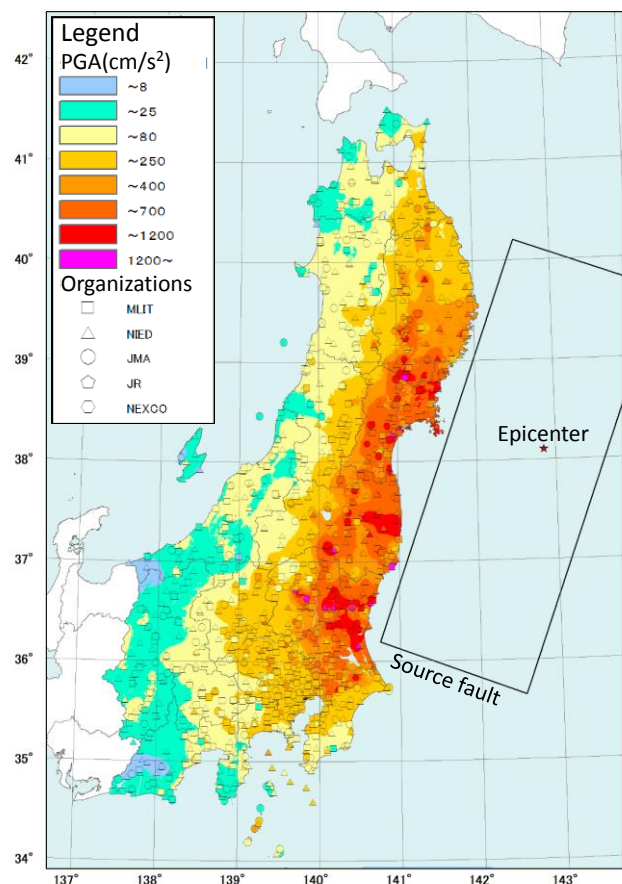

Figure 1 Estimated distribution of peak ground acceleration

The digital data of the ground motion distribution can be downloaded from our website[3].

[Sources]

1) Strong-motion records from the 2011 off the Pacific coast of Tohoku earthquake, Technical Note of NILIM, http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0726.htm

2) National Research Institute for Earth Science and Disaster Prevention: Japan Seismic Hazard Station, http://www.j-shis.bosai.go.jp/

3) Disaster Prevention Division, NILIM: http://www.nilim.go.jp/lab/rdg/index.htm