PROCEDURE OF EVALUATING FAULT PARAMETERS OF SUBDUCTION PLATE-BOUNDARY EARTHQUAKES WITH SURFACE BREAKINGS FOR PREDICTING STRONG MOTIONS

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After the 2011 Tohoku, Japan, earthquake, the Nuclear Regulation Authority (2013) suggested three source areas of tsunamis which could be caused by mega earthquakes around Japan in the “Examination guideline for design-basis tsunami and design policy”. The area along the Nankai trough extended to the Southwest Islands trench was estimated as the largest-scale seismic source with M_W of 9.6 and the length of approximately 2,000 km. However, the physical characteristics of such mega subduction plate-boundary earthquakes have not been examined yet.

Meanwhile, the prediction of strong ground motions caused by subduction plate-boundary earthquakes is carried out according to the recipe published by Headquarters for Earthquake Research Promotion (2005), which is based on the circular crack equation of Eshelby (1957). However, this recipe is applicable only to small earthquakes of about M_W 8 or smaller (Shimazaki, 2012; Tajima *et al.*, 2013). Larger earthquakes which rupture to the surface (trench or trough) have clearly different boundary conditions from those of the circular crack, because the stress at the top is released on the surface. On the other hand, for large subduction plate-boundary earthquakes, instead of the circular crack equation, Dorjpalam *et al.* (2015) obtained an approximate equation of the dynamic stress drop from dynamic fault rupturing simulations.

In this paper, first, we classified the subduction plate-boundary earthquakes into small and large earthquakes, and we estimated the averaged dynamic stress drop and the dynamic stress drop on the asperities to be 1.0 MPa and 19.9 MPa, respectively, for large earthquakes by applying the equation of the dynamic stress drop by Dorjpalam *et al.* (2015). Using these values, we established the scaling laws for subduction plate-boundary earthquakes.

Next, we proposed a procedure of evaluating fault parameters of subduction plate-boundary earthquakes with surface breakings for predicting strong motions (Fig. 1). Here, we introduced large-slip areas and very-large-slip areas proposed by Sugino *et al.* (2014) for modeling tsunami sources.

Finally, we applied the proposed procedure to the Tohoku earthquake, and reproduced the observed strong ground motions to validate the procedure. The results showed that the synthetics waveforms and response spectra agreed with the observed ones.

In this paper, we assumed identical dynamic stress drops on all the asperities of the fault model. However, Oana *et al.* (2015) suggested that the heterogeneous of dynamic stress drops on different asperities affects the strong ground motions from inland earthquakes caused by very long faults. Therefore, we will intend to compile the stress drop data on the asperities of subduction plate-boundary earthquakes.

Keywords: Strong motion prediction, Subduction plate-boundary earthquake, Surface fault breaking, Fault medel, Averaged dynamic stress drop

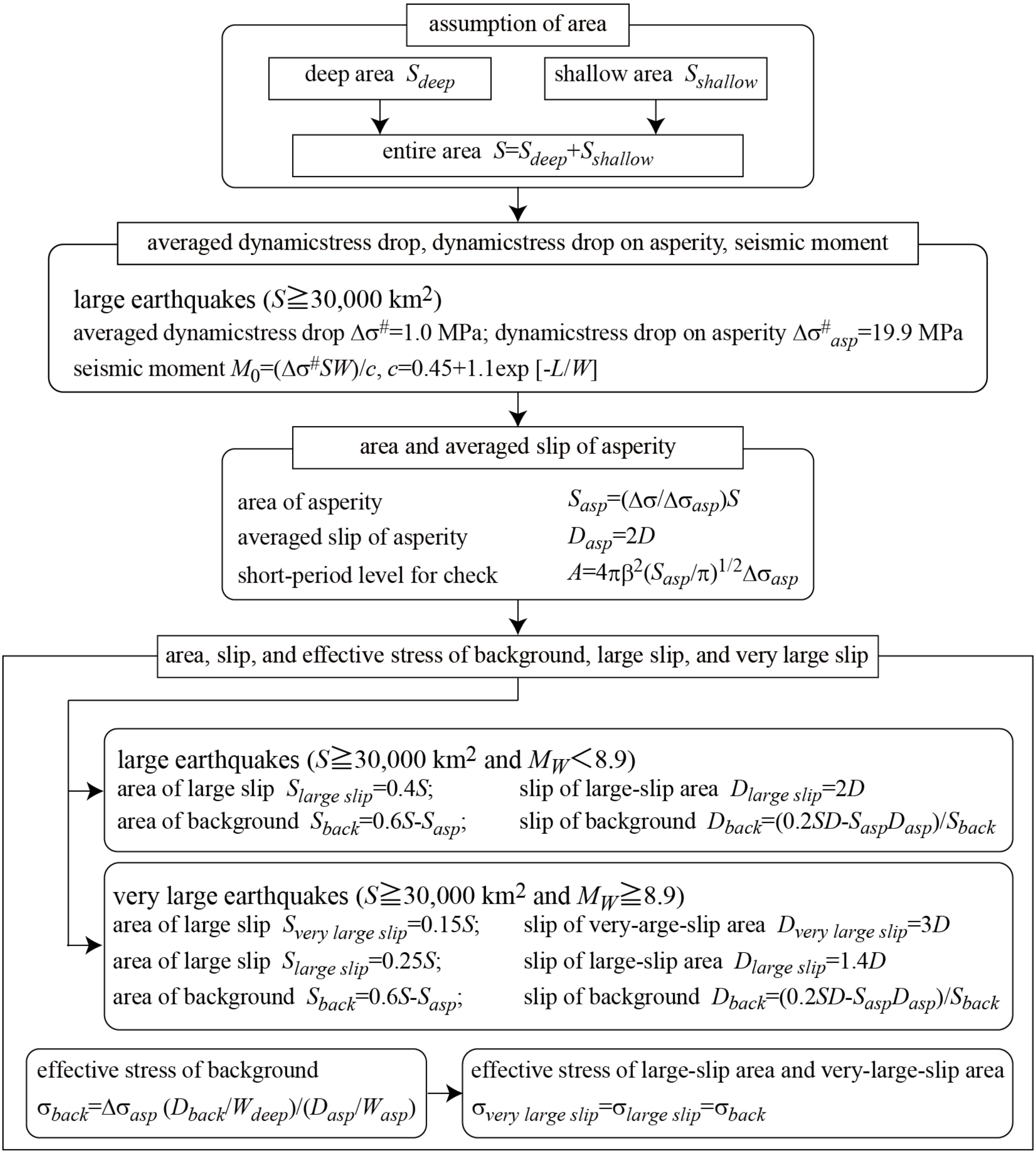

Fig. 1 Procedure of evaluating fault parameters for predicting strong ground motions from subduction plate-boundary earthquakes with surface breakings