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Relationship between asperity and surface earthquake faults for behavioral segments in a long active fault zone

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Introduction

Taking into account the characteristics of a behavioral segment in a long active fault zone can be the key to establishing a construction methodology of a source model for strong ground motion simulation for a variety of multi-segment rupture scenarios. In this research, we compile the source fault parameters and the geological fault parameters (e.g., surface displacements) for each segment of the source faults of inland crustal earthquakes. Based on the relationships among these extracted parameters, we examine a method to estimate inner fault parameters for each behavioral segment from these geological fault parameters.

Data and method

We target 7 earthquakes: 1979 Imperial Valley, 1992 Landers, 1995 Hyogo-ken Nanbu, 1999 Duzce, 1999 Hector Mine, 1999 Kocaeli, and 2002 Denali. For each segment of the source fault of these earthquakes, we utilize the source fault model, which was obtained by applying the waveform inversion technique in previous researches (e.g., Hartzell and Heaton, 1983; Wald and Heaton, 1994; Sekiguchi *et al.*, 2000; Birgoren *et al.*, 2004; Ji *et al.*, 2002; Sekiguchi and Iwata, 2002; Asano *et al.*, 2005), and extract the asperity area by following the procedure in Somerville *et al.* (1999). Then, we compile the outer fault parameters (segment length and segment width) and inner fault parameters (average slip on asperity and area of asperity) for each segment. We also obtain the geological fault parameters, such as the maximum value of coseismic surface displacements, and the recurrence interval. Here, we use the value obtained by multiplying the maximum value of surface displacements by the segment length, as a parameter value related to an shape of the distribution of surface displacements. In this presentation, we examine the segments with a segment length of less than 60 km and an aspect ratio (segment length/segment width) of less than 2.5.

Examination on the average slip on asperity and the area of asperity

The correlation coefficients between the average slip on asperity and, the segment length, the maximum value of surface displacements, and the recurrence interval are 0.49, 0.61, and 0.94, respectively. Here, the recurrence intervals for the segments ruptured in the 1992 Landers earthquake, 1995 Hyogo-ken Nanbu earthquake and the 1999 Hector Mine earthquake are used. The average slip on asperity is found to have a high correlation with the recurrence interval. The average slip on asperity also has a relatively high correlation with the maximum value of surface displacements. If we exclude two segments where the upper edge of asperity area reaches the ground surface and the relatively larger maximum value of surface displacements is observed, the correlation coefficients are improved (0.91). Moreover, the area of asperity correlates with the value obtained by multiplying the maximum value of surface displacements by the segment length (correlation coefficient: 0.62).

From our results, it is found that the maximum value of surface displacements correlates with not only the average slip on asperity, but also the area of asperity if we utilize the segment length together. This means that the maximum value of surface displacements is one of the useful geological fault parameters to estimate the parameters on asperity. We will examine the relationship between the inner fault parameters and both seismological and geological conditions near the source faults.

Acknowledgements

In this research, we use the source fault models compiled in the Finite Source Rupture Model Database (http://equake-rc.info/srcmod/). We sincerely thank Dr. Kimiyuki Asano for providing the information on the source model of 2002 Denali earthquake.

Keywords: long active fault zone, behavioral segment, asperity, surface earthquake fault