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Generation mechanism of short period seismic waves using numerical simulation,part 3.

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Introduction:

It is important to clarify radiation mechanism of high frequency seismic waves for strong ground motion simulation and for study of physical mechanism of earthquake. Two mechanisms, i.e., stochastic rupture process and stopping phase, had been proposed. When the former mechanism is dominant, high frequency waves must be radiated from inside the asperity. On the other hand, in the case of the latter mechanism, it must be generated from edge of the asperity. In waveform analyses of four inland earthquakes, Japan, Miyake et al (2003) found that the size and position of high frequency rich strong motion generation area coincide with those of asperities. Considering the resolution of the analyses, however, it is not possible to distinguish which mechanism is dominant. The generation area might be along the edge of the asperity or might be inside the asperity. Here we discuss the mechanism by using computer simulation, especially, which mechanism is efficient. Since seismic wave has usually high frequency components, effective mechanism is more plausible than ineffective one.

1D model

For simplicity, we consider two line source models: (1) uniform slip and random rupture velocity distribution, and (2) random slip distribution and uniform rupture velocity distribution. We found that model (1) generate high frequency seismic waves more effectively than model (2).

Asperity model

Since stopping phase depends on the shape of the asperity and rupture process, we consider the following five models:

1) Rectangular asperity with uniform slip

2) Rectangular asperity with tapered slip,

3) Circular asperity with uniform slip

4) Circular asperity with tapered slip,

5) Circular asperity with slip distribution of static crack.

We obtained analytical solutions for above models. For example, far field velocity wave from (4) circular asperity with tapered slip does not have singularity and peak velocity is proportional to W^-1/2, where W is width of taper normalized by radius. In circular asperity, taper dramatically decreases peak velocity. In rectangular asperity, on the other hand, slight decrease is found.

Fault model

We calculated near field seismic waves from the rectangular fault, which has an asperity. When we assume random rupture velocity only on the asperity, high frequency waves are more effectively radiated than stopping phase mechanism. Our random distribution of rupture velocity has a standard deviation of 0.002 sec in rupture time, which is very small. So random rupture can generate more effectively high frequency wave than the stopping phase mechanism.