S047-002 Room: 304 Time: May 26 9:15-9:30

Study on the spatial correlation of elastic-wave field in random heterogeneous media based on the finite difference simulation (1)

Hisashi Nakahara[1]

[1] Geophysics, Science, Tohoku University

So far, I studied the correlation characteristics of seismograms for closely located events by using observed records of aftershocks of the 1995 Kobe earthquake and obtained the following results: (1) Cross-correlation coefficients of seismograms for closely located events decrease with increasing frequency and increasing event separation. (2) Correlation distance of waveforms, which is defined as the distance where cross-correlation coefficients first become lower than 0.6 as the event separation increases, shows clear regional difference. Now, I have a speculation that these characteristics are affected by the heterogeneous structure around the earthquake source. So there is a possibility that we can estimate the heterogeneous structure around the earthquake source from correlation characteristics of seismograms for closely located events. Bearing this in my mind, I started to make numerical simulations of elastic wave propagation in 2D-elastic media. Our present purpose is to clarify the relation between correlation characteristics of elastic-wave field and parameters of the medium.

In the simulation, I followed a staggered-grid finite difference scheme with the fourth-order spatial accuracy and the second-order temporal accuracy for 2D-elastic media (Levander, 1988). One boundary is a free surface and the other three are A1-absorbing boundaries of Clayton and Engquist (1977). The length and width of the media are 70km and 30km, respectively. Grid spacing of 40m and time step of 2.5 ms were adopted so as to satisfy the stability condition. An isotropic source was assumed, whose source time function is Gaussian with the duration time of 0.2s. Random media with exponential-type power spectrum were assumed, whose media are expressed by two parameters of correlation length and mean fractional fluctuation of seismic-wave velocity.

The correlation length of 100m, 400m, and 2000m, and the mean fractional fluctuation of 5%, 10%, and 20% were tested. Six depths of the source were tried: 6km, 7km, 8km, 10km, 12km, and 14km. Ten stations were set on the free surface with the epicentral distance from 5km to 50km. At each station, cross-correlation coefficients of seismograms in two frequency bands of 2-4Hz and 4-8Hz were calculated for pairs of two sources with different depths. Time windows of 2s including P-wave onsets were adopted for calculation of cross-correlation coefficients.

Simulation results show that cross-correlation coefficients decay with increasing event separation. The mean fractional fluctuation of seismic-wave velocity seems to have more effect on cross-correlation values than the characteristic length within the range of parameters examined. For mean fractional fluctuation of 5%, the cross-correlation value is generally higher than 0.8, which is far higher than observed. From the 2D-simulation in this study, the mean fractional fluctuation of more than 10% is needed to decrease the cross-correlation coefficient as similarly as observed.

Acknowledgments: This study was started when I stayed in Institute of Geology and Geophysics, Leipzig University, Germany. I am very grateful to Prof. M. Korn for his support and hospitality.