

Comparison of high frequency peak time and time differences from space-time distribution of high frequency energy radiation

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Recently, we showed that time differences between P arrivals and times when squared amplitudes of high bandpass (2-4 Hz) filtered teleseismic P-waves became the largest, which we call the high frequency peak times, congregated around centroid time shifts for large shallow earthquakes (Hara, 2008, EPS, 60, 781-784). This implies that the high frequency energy radiation is weak in vicinity of rupture starting regions.

In order to investigate whether large amplitudes of high bandpass filtered teleseismic P-waves reflect high frequency energy radiation at seismic sources, we compared the high frequency peak times to time differences computed as follows. Using space-time distribution of high frequency energy radiation obtained from seismogram envelope inversion, we calculated theoretical arrival times of P waves from the initial rupture point and the subfault where the maximum energy was radiated. Then, we calculated their time differences and compared them to the high frequency peak times.

We chose the December 28, 1994 far east off Sanriku earthquake and the September 20, 1999 Chi Chi earthquake. We used space-time distributions of high frequency energy radiation by Nakahara et al. (1994, JGR, 103, 855-867) and Nakahara et al. (in preparation), respectively. High frequency peak times were calculated using teleseismic P waves recorded at GSN stations.

For both events, no peak time was obtained in earlier parts of P waveforms, which is consistent with Hara (2008). For the 1994 off Sanriku earthquake, we found a general agreement between the high frequency peak times and the time differences from the high frequency energy radiation model, although the former shows a significant scatter. On the contrary, for the 1999 Chi Chi earthquake, the high frequency peak times show a larger scatter, which may reflect other factors such as scattering within the earth's crust.