# Development of a New Seismic Waveform Inversion Method with the Multi-Scale Source Model

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One of the most interesting questions in earthquake seismology is, 'What are the differences between large earthquakes and small ones?' Especially, we focus on the questions, 'How is the initial part of large earthquakes different from or similar to that of small ones?', and 'Whether a small earthquake grows up to a large one by chance?'

The initial part of seismograms holds clues to these questions. Ellsworth and Beroza (1995) pointed out that most seismograms have a small distinct initial phase whose duration scales as the cubic root of the total seismic moment, Mo. Although temporal properties of initial phase have been studied by many authors, we know little about spatiotemporal properties such as rupture velocity, directivity, and relative location between the sources of the initial phase and the main phase. Seismic waveform inversion is a quite useful method to investigate such spatiotemporal properties. However, ordinary waveform inversion methods cannot resolve the details of rupture initiation, because they use large subfaults or basis functions for representing whole seismic rupture process. To analyze small scale phenomena, we need small scale seismic source representations.

To examine micro- and macroscopic seismic source properties of large earthquakes at the same time, we developed a new seismic waveform inversion method with a multi-scale seismic source model proposed by Aochi and Ide (2004). Their model connects different scales by renormalization, which is also used by Ide and Aochi (SSJ Fall Meeting, 2004) who propose 'fractal patch model.'

Followings are the outlines of our new inversion method: At first, we prepare data kernel matrix on each scale in the same way as ordinary inversion methods. Next, using the renormalization technique, we integrate all these data kernel matrices on the different scales into one data kernel matrix for multi-scale seismic source model. Then, using this multi-scale data kernel, we invert seismic data to seismic source parameters.

In this study, we will show the concept and methodology of the new inversion method and the result of calculation tests by using some seismic source models.