# Trans-dimensional imaging of random velocity inhomogeneity at southern Ryukyu arc

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Precise imaging of randomly inhomogeneous structure is essential to describe wave scattering processes of high frequency seismic waves. Recent studies have constructed a fundamental basis of 2D or 3D imaging of power spectral density of random velocity inhomogeneity (e.g., Takahashi et al. 2013). Yet, it is difficult to know how small-scale spatial variations of random inhomogeneities can be extracted from observed seismic wave data. Here we used the reversible Jump Markov chain Monte Carlo (rjMCMC) (Green 1995) to achieve an adequate spatial-resolution imaging of random inhomogeneity. The rjMCMC is a framework of trans-dimensional parameter-sampling under a target distribution. Under the Bayesian framework, we can use this method to solve inverse problems of which number of unknown parameters is variable. In this study, a study area is partitioned into discrete Voronoi cells. A parameter sampling under a posterior probability is conducted with changing number and spatial layout of Voronoi cells, and unknown parameters in cells. Ensemble average of MCMC samples around the maximal posterior would be an optimal result with an adequate spatial resolution. Regularization term for this inversion is defined as a difference between the maximal and minimal values of power spectral density at a large wavenumber. This regularization is a relatively weak constraint, but gives stable reconstructions of original structures in synthetic tests.

We applied this method for S-waves data (4-8Hz, 8-16Hz and 16-32Hz) recorded at southern Ryukyu arc, Japan. Seismic stations consist of 30 ocean bottom seismographs and 6 onshore stations that were temporary deployed for 3 months. Inversion result shows two significant anomalies. One is a strong inhomogeneity in the mantle wedge beneath islands at 30-40km depth. This anomaly, however, shows no clear correlation with other geophysical observations. Another one is imaged beneath a submarine volcano off the southern Ryukyu arc. This inhomogeneity has a gentle spectral gradient at large wavenumber. Similar inhomogeneity was commonly observed in other volcanic rock areas, and then this anomaly may be related magma inclusions. Stable extraction of these anomalies is mainly because of the rjMCMC and weak regularization term. We may say that the rjMCMC is an important basis for precise imaging of underground structures.

 