

Automated monitoring of low-frequency tremors (2)

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Activities of low-frequency tremors, which occur in a non-volcanic region of southwest Japan along the subduction zone of the Philippine Sea plate, often show slow migrations and quasi-periodicities with intervals of 2-6 months. Such characteristics are thought to be results from dynamics of fluids liberated from the subducting slab. Therefore a long-term monitoring of tremor activities may lead us to elucidate dynamics of fluids in the subduction zone, which has some relationship to the occurrence of the great earthquakes.

To monitor activities of low-frequency tremors, we have been developing programs for automatic detection and hypocenter determination using real-time seismic records from the seismic telemetry system with a communication satellite. In the last meeting of SSJ we have reported an automatic detection method using a two-step statistical test. In this study we report an automatic hypocenter determination method using time lags of the maximum cross-correlation between two station records as differential traveltimes data.

We used vertical-component records from eight seismic stations in the east Shikoku region as in the previous study. We prepare time series data by applying the bandpass filter with a frequency band of 1-10 Hz to the original seismic records, resampling them from 100 Hz to 20 Hz, calculating their envelope waveforms, and finally applying moving-average procedure with a length of 3 seconds. For hypocenter determination we can utilize time lags giving the maximum cross-correlation between two station records, which are obtained in our detection method. In this study we used the time lags giving the maximum cross-correlations larger than 0.5. Unknown parameters, longitude, latitude and depth, were determined by minimizing the absolute residual sum using the simplex method. We eliminated the results giving the averaged absolute residuals larger than 2 seconds even if the method converged. Also we culled the data with the absolute residual larger than 2 seconds to perform the inversion again.

For tremors with large amplitude we obtained the results that were able to explain all of the data well at the first inversion, while in some cases the simplex method did not converge for tremors with small amplitude. In this preliminary experiment we obtained the results consistent to those of our previous study, in which we determined the hypocenters by using traveltimes of local maxima in envelope waveforms as data. It is thus shown that the hypocenter determination method tested in this study is available in real operation.