AN AUTOMATIC SYSTEM FOR NEAR REAL-TIME DETERMINATION OF EARTHQUAKE FOCAL MECHANISM AND GROUND MOTION IN TAIWAN

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Abstract

We are developing a system for the rapid and automatic determination of focal mechanisms and estimation of strong ground motion distributions from earthquakes in Taiwan. The system is composed of two parts: inversion of broadband waveforms for the centroid focal mechanism solution as soon as an earthquake happens, and calculation of ground motions at distributed locations. For focal mechanism determination, we use the Cut-And-Paste (CAP) method of Zhu and Helmberger (1996), an efficient and reliable approach to obtaining earthquake source properties including fault-plane solutions, focal depth and seismic moment by fitting broadband waveforms of body and surface waves. For real-time calculation of accurate and realistic ground motions, we adopt the Strain Green Tensor (SGT) database approach of Zhao et al. (2006). The pre-calculated SGT database eliminates the need for running numerical simulations for actual earthquakes, which makes it possible to consider complex 3D subsurface structure, surface topography, and even site amplification effect in ground motion prediction. In practice, we first compute the Green's functions using the finite-difference method and establish the SGT database. Whenever an earthquake occurs, the automatic system is triggered by the early warning alert from the Central Weather Bureau (CWB). Records at stations from the Broadband Array in Taiwan for Seismology (BATS) are used by the CAP method to determine the focal mechanism, focal depth and the moment magnitude based on the epicentral location (latitude and longitude) from the CWB alert. Then for any given location where ground motion is desired, the appropriate SGTs are retrieved from the database and convolved with the source parameters. Without the need for numerical simulations after earthquakes, this system ensures the rapid evaluations of realistic ground motions even at a large number of locations, enabling near real-time generation of shake movies and maps which are helpful for quick assessment of earthquake damage, public information dissemination and disaster relief operations.