

Three-Dimensional Simulations of Seismic-Wave Propagation in the Taipei Basin with Realistic Topography Based upon the Spectral-Element Method

Shiann-Jong Lee¹, How-Wei Chen², Qinya Liu³, Dimitri Komatitsch^{4,5}, Bor-Shouh Huang¹ and Jeroen Tromp⁶

¹Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan, ROC

²Institute of Geophysics, National Central University, Jung-Li, Taiwan, ROC

³Seismological Laboratory, California Institute of Technology, Pasadena, California, USA

⁴Institut universitaire de France, 103 boulevard Saint-Michel, 75005 Paris, France

⁵Department of Modeling and Imaging in Geosciences, CNRS UMR 5212 and INRIA Magique3D, University of Pau, France

⁶Department of Geosciences, Princeton University, Princeton, USA

We use the spectral-element method to simulate strong ground motion throughout the Taipei metropolitan area. Mesh generation for the Taipei basin poses two main challenges: 1) the basin is surrounded by steep mountains, and 2) the city is located on top of a shallow, low wave-speed sedimentary basin. To accommodate the steep and rapidly varying topography, we introduce a thin high-resolution mesh layer near the surface. The mesh for the shallow sedimentary basin is adjusted to honor its complex geometry and sharp lateral wave-speed contrasts. Variations in Moho thickness beneath Northern Taiwan are also incorporated in the mesh. Spectral-element simulations show that ground motion in the Taipei metropolitan region is strongly affected by the geometry of the basin and the surrounding mountains. The amplification of ground motion is mainly controlled by basin depth and shallow shear-wave speeds, although surface topography also serves to amplify and prolong seismic shaking.

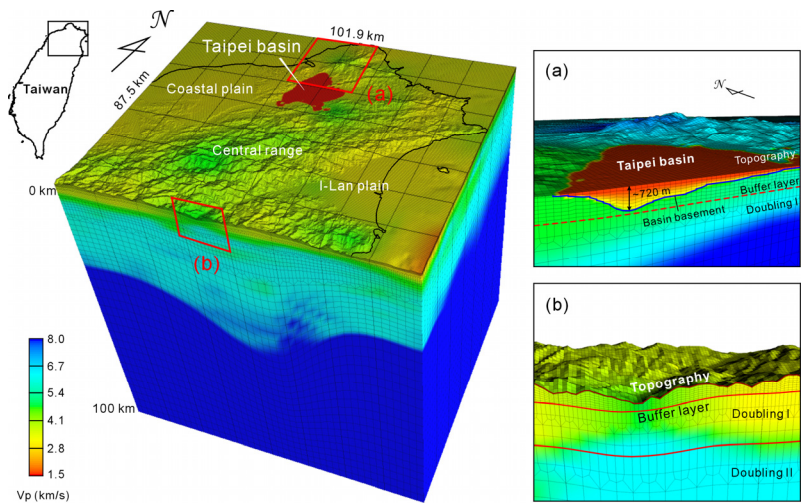


Fig.1 Spectral-element mesh for northern Taiwan. (a) Mesh implementation for the Taipei basin. (b) Mesh that incorporates realistic topography.

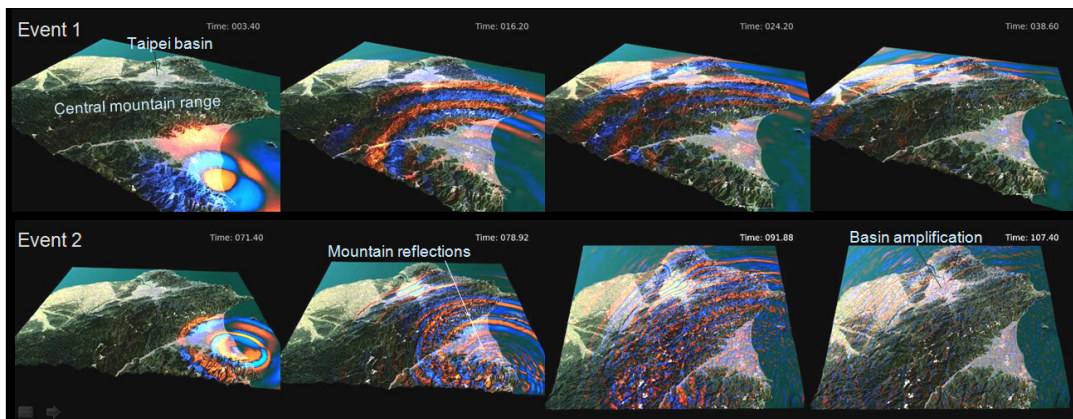


Fig.2 3-D SEM simulation and visualization of March 6, 2005 Iilan earthquake doublet. The amplification due to soft materials in the Taipei basin as well as the reflected and refracted waves generated by scattering from the mountains are clearly observed in these visual images.

Reference

Lee, S. J., H. W. Chen, Q. Liu, D. Komatitsch, B. S. Huang and J. Tromp, 2008. Three-dimensional simulations of seismic wave propagation in the Taipei basin with realistic topography based upon the spectral-element method, *Bull. Seism. Soc. Am.*, 98, 253-264, doi: 10.1785/0120070033.