Multi-Mode Rayleigh Wave Phase Velocity Inversion of Ambient Noise Tomography across Central Taiwan

Authors

Cheng-Nan Liu[1] (Cheng-Nan.Liu@utah.edu), Fan-Chi Lin[1], Hsin-Hua Huang[2,3], Yu Wang[3]

Affiliations

1. Department of Geology and Geophysics, University of Utah.
2. Institute of Earth Sciences, Academia Sinica, Taipei 11529, Taiwan.
3. Department of Geosciences, National Taiwan University, Taipei 10617, Taiwan.

Abstract

Taiwan located at the convergence margin of the Eurasian Plate and Philippine Sea Plate is one of the most active orogenic belts worldwide. The vigorous tectonic activities lead to several destructive events on the island. The most devastating inland event occurred on September 21, 1999, the Mw7.7 Chi-Chi earthquake shattered the central Taiwan, which nearly 2000 people were killed. To better understand local geologic structures and regional tectonics for post-seismic evaluation and future hazard mitigation assessment, we perform the ambient noise double beamforming tomography technique on an east-west linear dense seismic array, which cut through the major fault zone from Chi-Chi earthquake and was deployed across central Taiwan as part of the TAIGER project. We use three months of continuous seismic records to calculate vertical-vertical cross-correlations where both fundamental mode and higher mode Rayleigh waves can be clearly observed. We then use double beamforming to determine local phase velocities between 2 and 5 s periods at each beam center location. For each location, we jointly invert fundamental and higher mode phase velocities at each beam center for a 1D shear wave velocity model with a Bayesian-based inversion method. All piecewise continuous 1D models are then used to construct the final 2-D model from surface to ~6 km depth. Our 2-D model reveals structures that are overall consistent with known surface geological features at higher resolution. Near the surface, the model delineates the low-velocity Coastal Plain and the adjacent fast-velocity mountainous areas, with clearer basin geometry consistent with the results of previous geophysical exploration and geological studies. The model also provides new geometrical constraints on major active faults and depth to the basement, which are important to the understanding of orogeny dynamics and regional seismic hazards.