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Shallow Crustal Structure in Northern Taiwan from the TAIGER Active-Source Experiment

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To study the structures beneath the Taiwan Island and off-shore region, the TAiwan Integrated GEodynamics Research (TAIGER) project conducted a series of geophysical explorations, one of which involves 10 land explosions in 2008 along two east-west transects in northern and southern Taiwan. These valuable high-quality ground-truth observations greatly enhanced our capability to investigate the crustal velocity structure beneath Taiwan. In this study, we manually obtained the first-arrival times in the records collected from the 5 explosions in the northern transect to 551 stations densely-deployed in northern Taiwan. With a trial-and-error procedure, we fit the first-arrival times based on ray tracing and obtained 2D models along a number of shot-station profiles, which showed remarkable consistency with the well-established tectonic divisions in Taiwan. Based on the collection of 2D models, we then conducted an inversion for the 3D structure using the partition modelling approach of Bodin et al. (2009). The study area is partitioned into a number of randomly generated horizontal polygons defined by Voronoi tessellation cells. The velocity in each cell was determined by the 2D models already obtained from forward modelling. A stable inversion result was achieved through the ensemble average of a multitude of partition modeling realizations, without the need for explicit regularization in the inversion process. In comparison with existing tomography models for northern Taiwan, our 3D model obtained from the ground-truth first-arrival times provides a much better prediction of waveforms and phase arrival times.