High-resolution crustal velocity imaging using ambient noise recordings at a high-density seismic array: An example of the Xinjiang basin

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Crustal velocity of the shallow crust (1~2 km) is a key to understand the sedimentary environment and shallow tectonic deformation. Recent advances in surface wave tomography based on ambient noise data which are recorded by high-density seismic arrays have improved our understanding of regional crustal structures. With increasing interest in detailed shallow crustal structures, the dense seismic array can be deployed environment-friendly and efficiently. Here, a dense seismic array was deployed in the Xinjiang basin that is located in southeast of China, and the recorded seismic data were processed by the ambient noise tomography method. The high-density seismic array contains 203 short-period seismometers with a short footprint (~400 m). Continuous ambient noise records were observed for 33 days. Through data preprocessing, cross correlation calculation and Rayleigh surface wave phase velocity dispersion curve extraction, more than 16000 Rayleigh surface wave phase velocity dispersion curves were obtained, and then the Direct-Inversion Method was used. The result shows a high resolution. The checker-board test results show that shear wave velocities can well be recovered in the study area at the depth of 0-1.4 km and reveal a lateral resolution of ~400 m. Model test results show that the seismic array can observe a thin slab with a thickness of 50 m at a depth of 0-300 m, and recover an anomalous body with a thickness of 150 m at a depth of 300-600 m. The thickness of the anomalous body may be 400 m at a depth of 0.6-1.4 km. Especially an S velocity profile shows the coherent characteristics with a deep reflection seismic profile across the study area. Therefore, the shallow crustal velocity structure, in this study, has high resolution and the ambient noise tomography with a high-density seismic array will play a significant role in detecting shallow crustal information.