Crustal seismic anisotropy of Tohoku region, Japan constrained by ambient noises

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We present 3D crustal models of Vs and Vs azimuthal anisotropy of Tohoku region, Japan. We construct the models by using short to intermediate periods Rayleigh waves derived from noise interferometry and a wavelet-based multi-scale inversion technique.

We employ the Welch’s method to derive the empirical Green’s functions (EGF) of Rayleigh waves from one year of continuous records of 123 short-period stations of the dense high-sensitivity seismograph network (Hi-net), operated by National Research Institute for Earth Science and Disaster Prevention (NIED). We compute EGFs for about 3500 station pairs with interstation distance less than 300 km. For each qualified EGF, we measure Rayleigh wave dispersion in the period range from 3 to 16 seconds.

There are few interesting features in the resulting models: 1) The lateral variations of the crustal Vs and Vs azimuthal anisotropy are closely related to three major factors, surface geology, Quaternary volcano activity and the plate motion. 2) In the shallow crust (< ~ 10km), the prominent high velocity anomalies are observed in the eastern part of the volcano belt, and they can be attributed to the old sedimentary (Palaeozoic to Mesozoic) and plutonic rocks locating in the northeastern and the southeastern Tohoku, respectively. In the middle crust, the volcano belt is clearly identified by low velocity anomalies. 3) Patterns of the Vs azimuthal anisotropy demonstrate a strong depth-dependent variation. The anisotropy in the shallow crust is characterised by the typical orogeny parallel anisotropy (OPA), with fast polarization directions (FPD) parallel to the strikes of the mountain ranges, while the pattern of the lower crust anisotropy correlates fairly with the absolute plate motion. None of the above correlations is observed in the middle crust (~ 9 - 20 km), where the distribution of FPD presents rather chaotic pattern and the corresponding anisotropy is weak.

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