The crust and upper mantle structure of the Japanese islands from ambient noise and seismic surface waves

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A new 3-D crust and upper mantle structure beneath the Japanese islands is reconstructed from dispersion data originally derived from ambient noise and seismic surface waves. We combined two earlier S-wave speed models in Japan: the 3-D crust model by Nishida et al. (2008, JGR) and the 3-D upper mantle model by Yoshizawa et al. (2010, PEPI). The crust model by Nishida was constructed from the short-period phase speeds extracted from ambient noise analysis using the Hi-net tiltmeters. The upper mantle model by Yoshizawa was derived from the long-period phase speeds measured from inter-station analysis of seismic surface waves using broadband seismometers of F-net, GSN (Global Seismograph Network), and temporary stations in far-east Russia.
Using these two models, we first computed the local phase speeds of the fundamental-mode Rayleigh waves at every 0.1-degree grid across Japan. From the crust model, we calculated phase speeds in a short period range from 10 to 40 s, while, from the upper mantle model, we computed those in a long period range from 26 to 130 s. In the overlapped period range (26 –40 s), we calculated a weighted average of these two sets of dispersion curves, resulting in a single broadband dispersion curve from 10 –130 s at each grid point. Then, we performed linearized inversions for local 1-D isotropic S-wave speed models using the combined dispersion curves. Repeating this process for all grids across Japan forms the new 3-D S-wave model covering both the crust and upper mantle down to about 250 km depth. The new 3-D model shows improvement in both the crust and mantle owing to the better constraint on the S-wave structure around the Moho depth, which could not have been very well constrained in the two original models by Nishida et al. (2008) and Yoshizawa et al. (2010). The new model also suggests that the inversion incorporating the short period dispersion curves with good sensitivities to the crust affects the upper mantle structure down to the depth of about 100 km

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