Adjoint tomography beneath the Kanto region using broadband seismograms

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The three-dimensional seismic structure in the Kanto region of Japan has been revealed in many past studies, whereas no model with the ability to reproduce observed waveforms is available to aid in the tectonic interpretation of the heterogeneity of the region. We have inferred the three-dimensional seismic wave-speed structure using adjoint tomography (e.g. Miyoshi at al. 2015 SSJ; Miyoshi 2016 JpGU). I report here revised results using the modified procedure from the manner of Miyoshi (2016).
The revisions were following three. (1) I re-determined centroid time. I basically used the parameters of MT solutions provided by the NIED F-net as initial source parameters. Although the synthetics are similar with the observation, the synthetic was faster than the observation on almost seismograms due to significant rupture duration. I estimated the centroid time using the differential time between observation and synthetic estimated by phase correlation for a packet of P-waves. (2) I considered attenuation effect in the forward modeling. I assumed attenuation structure depending on S-wave structure (Olsen et al. 2003). (3) I broaden the period band toward shorter periods. I used four period bands between 5 and 30 sec in the iteration. I started the inversion from the waveforms in the period band of 20 - 30 sec, and finally 5 - 30 sec in order to avoid cycle skipping.
One iteration involved forward modeling, estimation of misfit, calculation of misfit kernel using adjoint method, and model update using Hessian kernels. I obtained the preferred model after 16 iteration. Initial model was the tomographic model based on ray theory (Matsubara and Obara 2011). The main results are as follows: (i) the synthetic waveforms improved 20 % based on the amplitude misfit between observation and synthetics in the period of 5 - 30 sec. The new model reproduced the waveforms of both inversion data and extra data well. (ii) As for average wave-speeds in each depth, the average S-wave speed is not changed basically, while the P-wave speed model was slightly slower than that of the initial model. (iii) I detected the extreme low wave-speed areas at a depth of 5 km and 40 km. These low wave-speed areas are consistent with geological and tectonic features pointed out by the previous researches (e.g. Suzuki 1996; Kamiya and Kobayashi 2000).
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