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Validation of Stagnant Slab Image in a Tomography Model Using Broadband Waveform Synthetics in the Northwestern Pacific Region

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We report results of our recent waveform modeling using a finite difference (FD) code for the mantle transition zone structure with stagnant slabs in the Kurile subduction zone. Triplicated waveforms recorded at station HIA for deep focus events (deeper than 300 km) that have ample information for the structure near the 660 km discontinuity depth were selected for modeling. These waveforms were modeled by layered models M3.11 or M2.0 previously. Here, M3.11 is characterized by a high velocity anomaly (HVA) in the deeper part of the transition zone (525 to 660 km) relative to a standard model iasp91, and depression of the discontinuity depth to 690 km. M2.0 has a similar HVA without a depression of the 690 km discontinuity. The synthetics calculated with the structure constructed from the tomography model of Fukao et al. (2001) show no triplication like the observed waveforms of event A5 (at 454 km depth). Then, we applied the perturbations of the tomography model to the 2D structure constructed from iasp91 (model iasp91+tomo). The synthetics calculated with this model shows a triplication but the time interval between the first and later arrivals is not in agreement with the observed waveform. Next, the 660 km discontinuity was lowered to 690 km (model iasp91+690+tomo). The time interval between the two peaks was synthesized well. The comparison among the synthetics indicates that the stagnant slab images captured in the tomography model are stable in spite of the limited resolution. Another example of triplicated waveform from event A6 (568 km) is modeled well with the structure of iasp91 (i.e., the discontinuity depth of 660 km) superposed by the tomography perturbations. The structural change from model M3.11 to M2.0 occurs between the narrow region sampled by events A5 and A6. However, the anomalously broadened waveform of event A2 (606 km) that propagated in the vicinity this region could not be modeled by these models. Tajima and Nakagawa [2006] suggest that SV to P conversion caused the P waveform broadening within the anomalous narrow zone near the 660 km discontinuity because the corresponding SH waveform appears to be normal. We added a thin low velocity anomaly (LVA) layer near the source in the M3.11 structure, and estimate the effects to cause the broadening of the waveform. In the narrow zone of 10 km an LVA of -10 % is set for both P and S wave velocities. We also tested the effects of the geometry of the LVA layer having a downward trend in the subducting slab. The broadening of the P wave was somewhat produced with the LVA layer. The broadening of P waves may be associated with a very localized anomalous zone, possibly related with fluids or melt in the transition zone.