SS time shift due to the crustal reverberation at the bounce point -effect on topography of the transition zone discontinuities-

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[1]Introduction

It is important to map topography on the transition zone discontinuities because their undulations are associated with thermal, chemical and dynamic processes in the Earth's interior. The undulations of the 410- and 660-km discontinuities have been often obtained using differential travel times between SS and its precursors (underside reflections from these discontinuities) (e.g. Flanagan and Shearer [1998]). The crustal effect at the SS bounce point on the measured differential travel time has not been accounted for in the previous studies. Recently we have pointed out that PP waveforms shift negatively in time apparently because of interference of PP with its crustal reverberation (e.g. Obayashi et al. [2002]). If SS waveforms shift as well as PP waveforms, therefore, the estimated topography on the discontinuities could be biased.

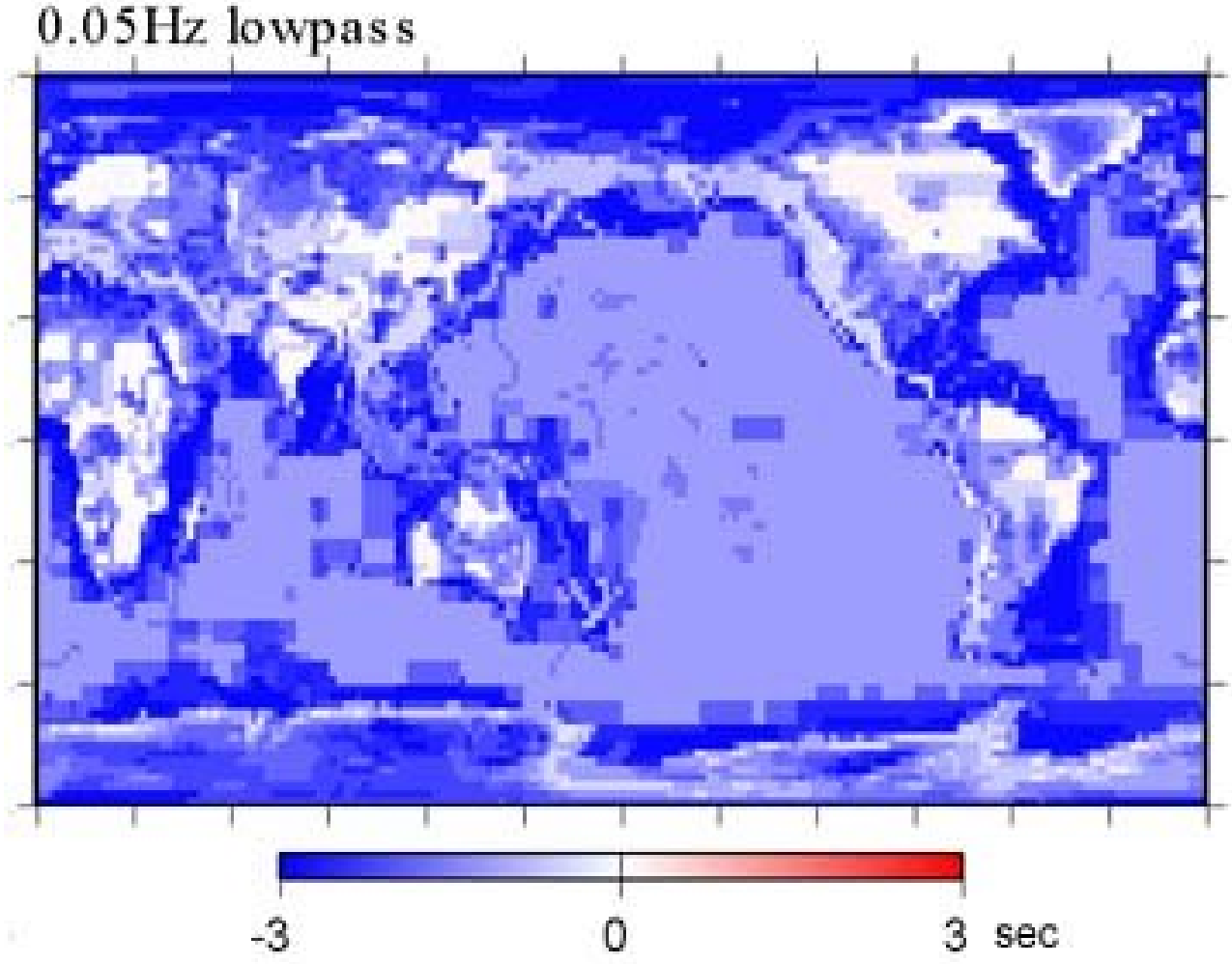
In this study, we assess by synthetic experiments to what extent SS waveforms can shift due to the interference with the crustal reverberation.

[2]Method

We compute a synthetic seismogram of the transverse component by the DSM (Takeuchi et al. [1996]). We then construct two synthetic SS waveforms from the S wave pert of the synthetic seismogram. The first is obtained by performing the Hilbert transform and by applying t* operator to account for the different attenuations along the S and SS ray paths. The second is obtained by further convolving this synthetic SS waveform with the crustal response at the SS bounce point. Hereafter we refer to the former as SS(0) and the latter as SS(+). Then the time difference between SS(0) and SS(+) is measured by a cross-correlation method. We verified that SS(+) waveform reconstructs well the SS part of the synthetic seismogram and the measured time difference between them is zero when the crustal response is calculated with the crustal structure used in computing the synthetic seismogram. Accordingly the time difference between SS(0) and SS(+) indicates how much SS waveform is shifted apparently by the crustal reverberation.

[3]Result

Using a 0.05Hz lowpass filtered synthetic SH waveform of a 500km depth strike slip event at 80 degree epicentral distance, we constructed SS(0) and SS(+) waveforms. The SS(+) waveform was constructed with every structure of 2 degrees x 2 degrees grid crustal model CRUST2.0 (Bassin et al. [2000]). The figure shows the measured time differences plotted on the grids of the corresponding crustal structures. The apparent time shift of SS is negative at all the grids. The shifts are large near coast lines and their values are up to about 3 sec. This result indicates that the transition zone discontinuities are probably deeper by 5km at the maximum than those in the existing models obtained with no crustal effects taken into account. The existing models show the deeper 660 km discontinuities than average along the circum-Pacific subduction zones, which are often near coast lines. The present study suggests that the 660 depths of the circum-Pacific region could be underestimated.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