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Assessment of tomographic mantle models using SEM seismograms

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The availability of large data sets allows the construction of potentially high resolution tomografic models, but the exact level of damping, and thus the final resolution, is still largely determined by subjective means. Furthermore, the data only use a fraction of the information contained in a seismogram (i.e. travel times, phase velocities). The aim of this study is to investigate the agreement between real seismograms and those predicted by mantle models obtained from classical surface wave tomography with varying levels of damping by looking at phase and amplitude differences. We examined body waves as well as surface waves since the models were constructed from fundamental modes as well as overtones. We computed the synthetic seismograms using a spectral element method with the 3-D mantle models and the appropriate crustal model on top. To check the phase agreement, we measured the time shifts between the real and synthetic surface waves and body wave phases such as P, S, and SS using a cross-correlation technique. We also compared the amplitudes of real and synthetic seismograms in order to understand how well the models explain not only the phases but the whole waveforms. Although the tomographic models appear quite different, the resulting seismograms are quite similar however the synthetics from smooth models match the real data slightly better than the synthetics from rough models. We also noticed a bias in measured time-shift histograms, particularly at short period surface waves and S-SS phases, which might be due to imperfect crustal corrections in mantle tomography.