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Crustal corrections predicted by ray theory and finite frequency theory compared to measured time shifts from SEM seismograms using Crust2.0

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Mantle models from surface wave tomography rely on a good crustal correction. Using geometrical ray theory, relative phase shifts between source and receiver can be expressed as the sum of relative local phase velocity perturbations along the path. Ray theory is not valid if the length-scale of the perturbations is smaller than the wavelength or the width of the Fresnel zone. The path integral is then replaced by an integral over the finite frequency sensitivity kernel. We investigate how far classical ray theoretical and finite frequency approximations can predict crustal corrections to fundamental mode surface wave dispersion. For this purpose we calculated synthetic seismograms in (i) transversely isotropic PREM and, in (ii) three-dimensional crustal model Crust2.0 on top of PREM using the spectral element method. We measured the corresponding time shifts as a function of frequency. We then applied crustal corrections to the PREM seismograms using ray theory and finite frequency theory and exact local phase velocity perturbations calculated by solving the radial equations for spherically symmetric earth models in each cell of the model Crust2.0 on top of PREM. We will show how well calculated corrections correspond to the measured ones.