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Global finite-frequency S-wave delay-times: how much crust matters

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Body-wave seismic tomography is widely used to investigate the deep Earth's interior. This technique unravels the large scale features of the Earth such as plume and diving slabs all over the world. But to go any further in better imaging the deep Earth, improvements need to be brougth in inversion, modelling and most of all in data quality. To this aim, we are looking for data containing only mantle-related structure information. In order to assess this assumption, we investigate the influence of crust on time residual measurements made by cross-correlation in the 10-51s filtering period range. A quantitative analysis of crustal influence on time residuals motivates us to define a "two-parts" crustal correction. One part of this correction is directly based on ray theory, whereas a second part is related to crustal seismic phases. This second component, called finite-frequency crustal correction, is frequency-dependent unlike the ray-theory based correction. We show that if this finite-frequency crust-related correction is not taken into account in cross-correlation measurements, it may lead to a dispersive effect in S-wave delay times that could ultimately bias tomographic models. On average, this finite-frequency correction increases with the filtering period. Comparison between two crustal models, CRUST2.0 and CRUST1.0, shows the significant dispersive effect of crustal models and clear differences which exhibit complex patterns depending on geological contexts, with a significative role of the sediment thickness. Although ray crustal corrections remain important, finite-frequency crustal effects may lead to a bias in measurements and on average may reach 0.9-1.6s for CRUST2.0 and 0.5-1.6s for CRUST1.0, for period ranging from 10-51s, respectively.