

## ***Interactive comment on “Measuring and crust-correcting finite-frequency travel time residuals – application to southwestern Scandinavia” by M. L. Kolstrup and V. Maupin***

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We would like to thank Masayuki Obayashi for his comments. We reply to the comments below.

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Comments by M. Obayashi (Referee) obayashi@jamstec.go.jp

In this paper, the authors show a method to measure P or S -wave differential times between different stations. To avoid the cycle skip problem for the higher frequency bands, they refer the previously obtained low-frequency travel time residuals. I think

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this works in usual cases that the dispersions of body waves are much smaller than the residuals. They applied the method on the seismic data recorded by temporal and permanent stations in the region of Fennoscandian Shield. They also make the correction for the crust that depends on the frequency.

1 - I suppose that their resultant data were used in the tomography for the upper mantle in the region (Kolstrup et al., Geophys. J. Int., 2015). Although the method was briefly introduced in the GJI paper, the details of the method and the correction are shown in this paper. I have some questions/comments.

2 - The depth phases such as pP, sP, sS can also cause errors in the travel time measurement because of similar effects by the crustal reverberations. I wonder if observed residuals shown in Fig. 9 and Fig. 10 contain such errors due to the depth phases because they do not show the depths of events.

3 - It is fine that the authors describe about the color of each trace in Fig. 3. I do not know why the colors of the traces for the same station are different between in (a) and (b).

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Replies:

1 - Unfortunately, we realized the importance of the frequency-dependence too late to incorporate frequency-dependent corrections in the tomography. We did two tomographies, one with corrections calculated with ray-theory and one without corrections. With reference to work that was not fully completed at that time, we argued that our tomography was valid in the areas without sediments, and that the true model in the south western part lies somewhere between the ray-theoretically corrected model and the model with no correction. The difference between these two models was not such that it had any major impact on our conclusions.

2 - Our data, especially at long periods, do not contain only the first arrivals, but also

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depth phases and crustal multiples at the source. We agree that crustal reverberations at the source can cause errors in absolute travel time measurements. In the case of regional body wave tomography, however, we work with relative travel times in a network of stations located close to each other compared to the source-station distance. The effect of the reverberations at the source will therefore be very similar at all stations, and will not cause errors in the relative times.

3 - The colors just help distinguish the different records better. The colors of some stations change because some stations are rejected between fig (a) and (b) and the color scheme is not attached to each station but its rank in the list. We have added some information about the color in the caption.

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Interactive comment on Solid Earth Discuss., 7, 1909, 2015.