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Interactive comment on "POLENET/LAPNET teleseismic P-wave traveltime tomography model of the upper mantle beneath northern Fennoscandia" *by* H. Silvennoinen et al.

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The manuscript is on a teleseismic tomography study underneath Finland. For this region high-resolution models are missing and therefore such a study is an important contribution to better understand the evolution of the Baltic Shield. The method of teleseismic tomography using relative travel time residuals is well established. The input data are well determined and seem to provide reasonable and consistent travel time residuals (Figs. 4 and 7). The resolution of the tomography experiment is tested with appropriate methods, however their presentation must be improved. The tomography results are not well described, especially a rigorous consideration of the resolution is

missing. The interpretation of the results is partly unclear due to the unclear resolution of the anomalies and the misinterpretation of high- and low seismic velocities (only velocity contrasts are obtained). I recommend to completely rework section 5 (results and discussion) and write a new section 5 which clearly explains the model results and their significance and validity based on the input data and the resolution. Then a new section 6 with an interpretation should follow which is based only on the resolved results. See specific recommendations below and in the annotated manuscript. Many figures need a revision due to missing axis annotations etc.

P6, L12-16 Relative travel time residuals from two different datasets are combined. This means that the removed average is different for the two single datasets and hence their base value (which depends on the velocity structure underneath the complete station network). How can you be sure that the combined dataset is in accordance with a common base value ? Are the merged datasets really consistent ? See also Wawerzinek et al. (2011, Fig. 4 and section 3.1) on this problem. Wawerzinek et al., GJI, 2011, doi: 10.1111/j.1365-246X.2011.05071.x

P10, L23-28 The explanation of "fair" and "reasonably good" resolved model space regions is unclear. These terms should be assigned to a specific value range of the RDE in Fig. 8. E.g. RDE is between 0.7 and 0.8 for "fair" etc. Then a clear description and outline of the well resolved regions is possible. Remind also that the RDE values do not necessarily indicate the true resolution of the model parameters (see e.g. Evans & Achauer, 1993, Fig. 13.5). My impression is that RDE is not very favourable for your model, hence more synthetic tests as in Fig. 10 may be added (instead of RDE or in addition to RDE).

Section 4 Following section 4.2 (Crustal correction model) the final input data for the inversion could be discussed in more details. The input data seem to be well determined and one could describe what kind of anomalies can be expected due to the distribution of the residuals. Such a description of the input data would facilitate the validity of the tomography models.

Section 5 Results and Discussion: The input data for the inversion are relative residuals with a balanced amount of positive and negative residuals. This balance results in models with balanced negative and positive velocity perturbations irrespective of the background model (see Evans and Achauer, 1993 or Wawerzinek et al. 2011). Therefore only velocity contrasts are recovered in the models. This must be considered during the description of the results and the discussion. The description of the results is hard to follow, because the different geological/tectonic units cannot be clearly seen. I strongly recommend to give names to the resolved anomalies (e.g. numbers such as I, II, III etc.) which are indicated in the figures and then used and described in the text. Then there is a clear connection between the figures and the text.

Fig. 8: The RDE values do not necessarily indicate the true resolution of the model parameters (see e.g. Evans & Achauer, 1993, Fig. 13.5). The ray distribution may be a much better way to display the data coverage of the model parameters. Kissling (1988) presented a nice way to do this (ray density tensor). This would be much better. Another point: What does the yellow line mean ? How is it determined ? Vertical axis annotation is missing (if it is depth, the numbers should be positive).

Fig. 9: The results of the checker board test (right panels) should include the outline of the input anomaly. This facilitates the analysis of the smearing effects. Vertical axis annotation is missing (if it is depth, the numbers should be positive). The colour scale is unclear: $\pm$2% vp are the input anomalies. How much are these values over- or underestimated ?

Fig. 12: Indicate the well resolved regions.

See attached and annotated manuscript.

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Please also note the supplement to this comment:
http://www.solid-earth-discuss.net/7/C1103/2015/sed-7-C1103-2015-supplement.pdf

Interactive comment on Solid Earth Discuss., 7, 2527, 2015.