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Interactive comment on "A new model of the upper mantle structure beneath the western rim of the East European Craton" *by* M. Dec et al.

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Dear Reviewer,

Thank you for your valuable suggestions and comments that helped us to improve our manuscript. The quality of all the figures was improved since the original submission. Below we list detailed answers to your comments.

Specific points: The 1-D model is derived for all azimuthally distributed events. But as according to Fig. 1 and epicentral distances, the places to which the model refers are not always close. Also, one or two azimuthal regions to which the velocity refers are not located directly in EEC. Are there any differences in the velocity distribution for different azimuths? Or for different tectonic units?

Reply: For all chosen regions in this analysis we try to estimate 1D average model which will characterize the main seismic discontinuities. It came out during the modelling that a single 1D model (MP1-SUW model) explains well the observed traveltimes for the analysed 4 groups of events. Differences resulting from the different azimuth range of earthquakes are close to the assumed picking uncertainty.

As the authors say, the velocity model of the crust and upper mantle down to 100 km depth is constrained from previous published results. But how is the velocity of LVZ below this depth constrained?

Reply: The asthenosphere presented in this work has been adopted from the modelling performed by Thybo and Perchuc (1997) for long-range profiles from the US.

In structural modelling from such type of data, there is a trade of between velocities and depth of discontinuities. How can the change in velocity influence the depth of discontinuities? Such analysis superimposed on data (waveforms) would be instructive.

Reply: We are aware of this velocity-depth uncertainty. Based on our analysis of the refracted and reflected arrivals, we can conclude that a ± 0.025 km/s change in velocity will produce a similar RMS misfit as shifting the discontinuity by ± 10 km.

The quality of Figs. 4, 5, and 6 is poor and needs substantial improvement. Especially the seismic sections where the traces are hardly visible and do not document the fit of the data with calculated traveltimes. Also, it would be good to put there the interpreted arrivals to see the fit. In some parts the phases does not seem to be well constrained (only one or two waveforms show the phase arrivals – see e.g. 5b) and 5c) for phase P220 but similarly it seems to be for phase P440 at Fig. 4).

Reply: We improved all figures accordingly. We use one model for all the seismic section. Although P220 presented in Fig. 5b-c is not represented by many seismograms it was well documented in previous group - GTR (Fig. 4). Similar situation is for P440 – it is better documented in Fig. 5. Using the same model we calculated all the theoretical

SED
6, C359–C363, 2014

phases.

In error analysis, I cannot see the benefit in calculation of the S/N improvement after filtering. On the other hand it would be nice to discuss more the filtering, different band-pass filters and the accuracy of picking related to the filter applied. On page 564-565 the authors talk about tested range of band pass filter frequencies for displaying data and finally conclude that the best results were obtained for 0.5–2.0 Hz bandwidth. But how did they reach such conclusion? Would there be a change when different filters (e.g. 0.5-5 Hz or 0.5-8Hz) were applied? Discuss also how different filters would change the picking accuracy.

Reply: The band-pass filter with 0.5–2.0 Hz is commonly used in analyzing data recorded in the far-regional mode. In this paper we show how much it improves our data. Calculations of the signal-to-noise ratio (SNR) for filters you suggested are summarized in the Table #1. The choice of filter is not significantly affecting accuracy of picking. Although the signal shape is different, the picking error stays within the same limits ($\pm$0.1 s)

In Fig. 3 for both a) and b) subpanel mark the names of phases. Is the phase marked by green the P410P or later interpreted P440P phase? And from which sub-region?

Reply: The green phase shown in Fig. 3 is P440P, which was interpreted during further analysis. To make it more clear for readers, we changed caption of Fig. 3. into P"410"P and P"300"P for phases P440P and P335P respectively. Fig. 3 shows earthquakes from different azimuths. All events used in this Figure are shown in Tab. 1.

In Figs. caption 4-7 (and also Fig. 3) explain how the waveforms are displayed (band-pass filtered with 0.5-2 Hz or differently?).

Reply: We use data with band-pass filter 0.5-2 Hz applied. It was mentioned on page 564 line 27. Although at the end of this paragraph we added a sentence to make it more clear. "All presented seismic sections are displayed with this filter."

SED
6, C359–C363, 2014

The figures need to be organized according to how they are first referred to in the text. Fig. 7 is discussed before Figs. 5 and 6 are referred to.

Reply: All figures are introduced in order. First time description relates to modelling (page 566 line 5). After that we describe seismic sections one by one.

Mark the names of sub-regions in Fig. 1. Also, be consistent in using either the abbreviations or full names of different sub-regions used in the study.

Reply: The abbreviations were applied to Fig. 1. according to your comments. We applied also changes in main text to use abbreviations in the text. The full names of sub-regions are used only at the beginning of paragraphs to make it more convenient for the reader.

In Fig. 8 the authors say "...all analysed seismograms recorded at SUW station." The figure displays about 80 traces. But at page 564 the authors say there were 249 analyzed events in total. Which traces were selected for Fig. 8 and why?

Reply: Displaying all 249 seismograms in one figure would make it illegible. We didn't plot events with similar offsets and relatively noisy ones.

Table 1. "List of seismic events shown in Fig. 1. Numbers from column 1 correspond to numbers of seismic records in Fig. 1. ... " But I cannot see any numbers in Fig. 1. Table 1 is not mentioned in the text.

Reply: In description of Table 1 there should be Fig. 3. instead of Fig. 1. and we applied this change. "Table 1. List of seismic events shown in Fig. 3. Numbers from column 1 correspond to numbers of seismic records in Fig. 3."

Interactive comment on Solid Earth Discuss., 6, 559, 2014.

Region	Number of events	Signal to noise ratio				
		Raw data	After filtering (0.5 – 2.0 Hz)	After filtering (0.1 – 1.0 Hz)	After filtering (0.5 – 5.0 Hz)	After filtering (0.5 – 8.0 Hz)
JMR	34	4.70	8.17	5.88	5.24	4.66
CR 020	34	2.57	7.50	4.44	3.44	3.32
CR 2050	23	3.52	6.66	2.58	5.71	5.23
CR 50+	12	5.54	12.66	11.44	7.37	6.99
GTR 020	53	6.59	4.85	3.35	3.23	3.18
GTR 2050	36	3.61	5.26	3.74	4.04	3.99
GTR 50+	14	13.84	18.02	10.37	16.75	16.42
WMSR	43	6.30	11.54	6.17	6.27	6.00
Average		5.38	8.16	5.10	5.36	5.12

Tab. #1. Mean signal-to-noise ratio for the analysed groups of events.

Fig. 1. Table #1

SED
6, C359–C363, 2014