Nonlin. Processes Geophys. Discuss.,
doi:10.5194/npg-2016-39-RC1, 2016
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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Inverting Rayleigh surface wave velocities for eastern Tibet and western Yangtze craton crustal thickness based on deep learning neural networks" *by* X.-Q. Cheng et al.

Anonymous Referee #1

Received and published: 21 October 2016

Cheng, Lui & Li inverted surface-wave phase-velocity maps from ambient noise to obtain crustal thickness for eastern Tibet and western Yangtze Craton. They applied a three steps procedure: in a first step, they collected the phase velocity maps and extrapolated the phase velocities into group velocities. In a second step, they performed a joint inversion of phase and group velocities using neural network techniques in order to obtain crustal thickness of western China. Finally, a comparison between their results and other published models is performed.

Novelty
This paper presents new results that are in good agreement with existing models and published results.

Fluency and precision of the text
Check the English please. Some parts of the manuscript are difficult to understand. A few examples: Page 1, lines 27-28 "As we all know, the more we know the characteristic and composition of crust which is an important part of lithosphere, the further we investigate deep earth".

Page 1, lines 36 What does "adjants" stands for?

Page 1, lines 40-42 "in regions with good data coverage and uncomplicated structure but in regions with poor or no data coverage or complicated structure crustal thickness estimates are largely extrapolated"

Those statements (and several others in the manuscript) are not clear and would need some rephrasing. In addition, several typos and missing capitalization of letters in nouns should be checked carefully. Several sections of the text should be checked carefully. The consistency of the text is not always straightforward.

Bibliography
In this paper, a strong effort was made to provide relevant references to the methodology. However, several aspects would require a more extensive referencing.

In the last decade, and the deployment of hundreds of seismic stations in mainland China, several important publications arose, and several focusing on crustal structure have been omitted in this manuscript:

Legendre, C. P., Deschamps, F., Zhao, L., & Chen, Q. F. (2015). Rayleigh-wave dispersion reveals crust-mantle decoupling beneath eastern Tibet. Scientific reports, 5.
Sun, X., X. Song, S. Zheng, Y. Yang, and M. Ritzwoller (2010), Three dimensional shear wave velocity structure of the crust and upper mantle beneath China from ambient noise surface wave tomography, Earthquake Sci., 23, 449–463.
Xu, L., Rondenay, S. & Van Der Hilst, R. D. (2007), Structure of the Crust beneath the southeastern Tibetan Plateau from teleseismic Receiver Functions. Physics of the Earth and Planetary Interiors. 165, 176–193.
Yao, H., R.D. Van Der Hilst, and M. V. De Hoop (2006), Surface-wave array tomography in SE Tibet from ambient seismic noise and two-station analysis–I. Phase-velocity maps, Geophys. J. Int., 166(2), 732–744.
Zhang, Q., E. Sandvol, J. Ni, Y. Yang, and Y. J. Chen (2011), Rayleigh wave tomography of the northeastern margin of the Tibetan Plateau, Earth Planet. Sci. Lett., 304(1-2), 103–112.
Zheng, S., X. Sun, X. Song, Y. Yang, and M. H. Ritzwoller (2008), Surface wave tomography of China from ambient seismic noise correlation, Geochem. Geophys. Geosyst., 9, Q05020, doi:10.1029/2008GC001981.
Zhou, L., J. Xie, W. Shen, Y. Zheng, Y. Yang, H. Shi, and M. H. Ritzwoller (2012), The structure of the crust and uppermost mantle beneath South China from ambient noise and earthquake tomography, Geophys. J. Int., 189(3), 1565–1583.

Also, a recent review of inversion strategies provide many discussions that would be emphasized in the manuscript:
Lebedev, S., Adam, J. M. C., & Meier, T. (2013). Mapping the Moho with seismic surface waves: a review, resolution analysis, and recommended inversion strategies. Tectonophysics, 609, 377–394.
In addition, several references contain some typos, mostly missing capitalization of some names (as “rayleigh” instead of “Rayleigh”), and some errors in the citation occur

[(Ueli Meier et al. (2007), (Zhu J S et al., 2012) or (Liu, 2015)].

Another point is the lack of consistency in the referencing style, as well as the abbreviations used for some journals. For example, Montagner et al. (1988) has been published in Geophysical Journal International, and its short form is “Geophys. J. Int.”, not “Geophys. J.”.

The Mineos package (page 4, line 28) is not referenced (page 4, line 31) at its first occurrence. Please check the references carefully.

Comments on the figures
Table 1 provides many parameters but no unit is given.

Regarding the figures, I would suggest to merge Figures 1 and 2. Both describes the auto-encoder with one or two hidden layers, and could easily be merged.

Similarly, Figures 3 and 4 could be merged. They both show crustal thickness from this study and from another model, used later for comparison.

In the text, several places are mentioned but are not located on any map, as the Wenchuan or Lushan earthquakes, the Longmenshan region, ... In addition, in Figures 3 and 4, the caption doesn’t mention that the blue lines are the boundaries of sedimentary basins.

Technical comments
First, the authors wrote (page 4, line 37) that the phase and group velocities of surface-waves are not sensitive to similar depth layers. However, they extrapolates the phase velocities into group velocities, using the formula (4) , line 1-2, page 5. But the resulting periods for group and phase velocity dispersion curves are similar (10.0 - 30.0 mHz for group-velocity and 10.0 - 35.0 mHz for phase-velocity). This is not consistent with

the period range described page 5, line 26, with Rayleigh phase velocities and group velocities (10 - 37.5 mhz). (Note that it should also be mHz and not mhz).

Basically, the authors only have constraints on Rayleigh-wave phase velocity (from Xie et al. 2013), that are derived for approximated group velocities, and joint inverted for crustal thickness. Why not using the Love-wave models in order to add different constraints to their inversion?

The authors used the phase-velocity model (from Xie et al. 2013) for periods between 33 and 100 s (10 - 30.0 mhz). But Rayleigh-wave phase velocities at periods of 33 s are mostly sensitive to depths of 30-80 km. In some regions (Sichuan Basin), the authors found some Moho depths shallower than 30 km. Are those depths realistic?

Why don't the authors used periods of 8-40 s (25-125 mHz) as in Xie et al., (2013) to have additional constraints on the regions with shallow crust?

In the same way, Xie et al., (2013) used a grid of 0.5*0.5 °. Why do the authors down-sample those maps to 2*2 ° (page 2, line 16)?

Comments on the method

Another point that the author did not mention is how they invert the surface-waves velocities (phase and group) for Moho depth. They only mention (page 7, lines 21-25) that the dispersion curves are inverted for crustal thickness using 3 to 6 layers. Some additional information of the methodology seems needed. Did they used 1D, 2D or 3D sensitivity kernels? How did they defined the Moho discontinuity (velocity contrast, specific velocity, ...)?

The authors mention (page 7, line 35-36) "test error may be not the only criterion determining which neural network is best". So what are the other criteria that needed to be taken into account?

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