Biogeosciences Discuss., 12, C10124–C10127, 2016
www.biogeosciences-discuss.net/12/C10124/2016/

Biogeosciences Discussions
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Interactive comment on "Technical note: A new approach for comparing soil depth profiles using bootstrapped Loess regression (BLR)" *by* A. M. Keith et al.

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Received and published: 7 March 2016

We thank the referee for their review of the manuscript and hope that we can allay concerns as to the suggested novelty, predictive ability and utility of the approach described in the manuscript.

A "new" approach:

We used the word "new" in the title because we had not came across the use of this bootstrapped Loess approach to compare and test soil depth profiles. It was not intended to suggest anything otherwise and we fully acknowledge that there are other approaches to non-linear modelling of soil depth profiles. Therefore, in order to remove any ambiguity, we would amend the title of the manuscript to 'A bootstrapped Loess regression approach for comparing soil depth profiles'. We would also intend to add to discussion using examples from other relevant publications on the equal-area splines approach: Bishop et al. 1999. Modelling soil attribute depth functions with equal-area quadratic smoothing splines. Geoderma 91, 27-45; Odgers et al. 2012. Equal-area spline functions applied to a legacy soil database to create weighed-means maps of soil organic carbon at a continental scale. Geoderma 189-190, 153-163; Adhikari et al. 2014. Mapping soil pH and bulk density at multiple soil depths in Denmark. GlobalSoilMap – Arrouays et al. (Eds); Adhikari et al. 2014. Digital Mapping of soil organic carbon contents and stocks in Denmark. PLoS One 9, e105519.

The support of the measurement:

The referee commented that the manuscript fails to consider support for the measurements. We acknowledge that we don't have higher resolution depth data to compare the Loess model against (as per Bishop et al. 1999). However, we believe that our data derived from continuous 10 cm increments to 100 cm depth is appropriate and useful, particularly with the bootstrapping approach. To address this issue we intend to present an additional figure with a horizontal barplot including the mean and SD of the real data and the bootstrapped mean for the depth increments in each soil C concentration profile. It would also be possible to include an RMSE and R-squared value for an observed subset or observed means versus bootstrapped means, though we recognise this would not be an out-of-sample assessment. The rationale behind this additional plot, and inclusion of error metrics such as RMSE, is to highlight how the modelling approach presented is suitable and optimal for the type of data.

Depth functions with equal-area smoothing splines:

The referee has indicated that there is already much discussion on the rationale for using equal-area smoothing spline functions, that the Loess function does not guarantee

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an equal-area criteria, and that the paper has “completely missed the point”.

We fully acknowledge that the equal-area spline method can improve depth functions based on bulk horizon data and would intend to add to the discussion around such other methods and cite relevant publications (as listed above). We are advocating the non-parametric approach presented because it uses bootstrapping to draw inference (something which the other papers don’t address) and, as the Loess is fitted by use of a moving window, is not affected by pockets of data. A similar advantage of both approaches, compared to polynomial and decay functions, is that modelled profiles are fitted locally. We agree that the Loess approach doesn’t guarantee an equal-area criteria. However, neither does it appear that fitting equal-area quadratic splines guarantee an equal-area criteria for all horizons in published examples (See Figure 4 and 5 in Bishop et al. 1999, Figure 5 in Malone et al. 2009, Figure 4 in Odgers et al. 2012). Indeed, Odgers et al. 2012 discuss the limitations of the equal-area spline method and how they can be inadequate when depth profiles change abruptly. The new figure that we would intend to present would allow readers to see the bootstrapped loess depth profile in relation to the increment data and link well with the further discussion on the equal-area splines approach and equal-area criteria.

This approach taken in our study was used primarily to compare depth profiles between different land uses in a transition. Rather than having “completely missed the point” we feel that our use of bootstrapping with a flexible non-parametric regression presents a valuable example of how this can be done. We acknowledge that in some circumstances the equal area spline functions is a viable alternative to Loess regression for producing a fitted profile. This could, however, easily be incorporated into the non-parametric estimation and bootstrapping framework that we present here. Any revision would include a discussion of this. Overall, we believe that our non-parametric approach can be extremely useful and, by providing our data and code for others to use, the opportunity for further comparison exists.

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