Relating Soil Structure to Water Retention Using Multistripe Laser Triangulation Scanning

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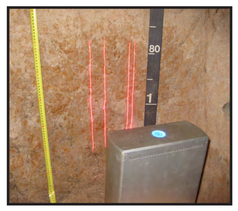
Introduction

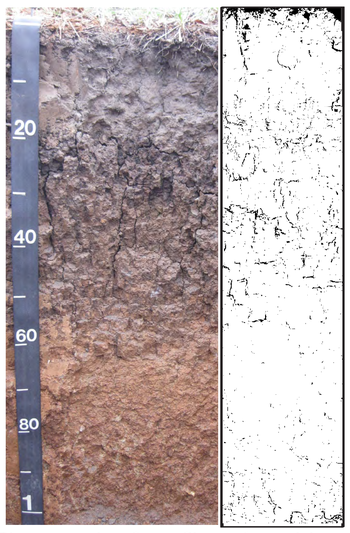
Multistripe laser triangulation (MLT) is a recent development in three-dimensional (3-D) scanning technology that has been used to quantify soil structure (Eck, et al., 2013). The benefit of MLT over other types of 3-D scanners is field portability and affordability.



Objective

The goal of this work was to examine if a relationship exists between quantitative representation (measured by MLT) of soil structure and parameters of a dual porosity model of water retention.

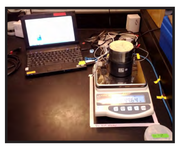
Materials and Methods

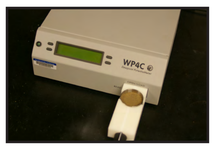


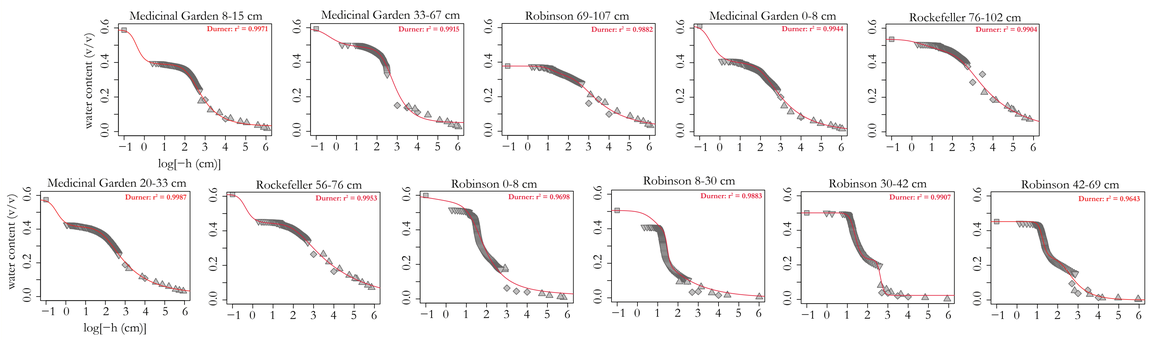
Photograph of profile and resulting MLT data used for analysis. The scan was taken adjacent to the photograph.

Soil profiles were prepared for scanning following Hirmas (2013). This method removes tool marks by flash freezing with 1,1-difluorethane and peeling away the frozen surface layer of soil.

Soil cores used in determining water retention by the Wind-Schindler method were sampled *in situ* from three soils in triplicate by horizon in order to preserve soil structure.

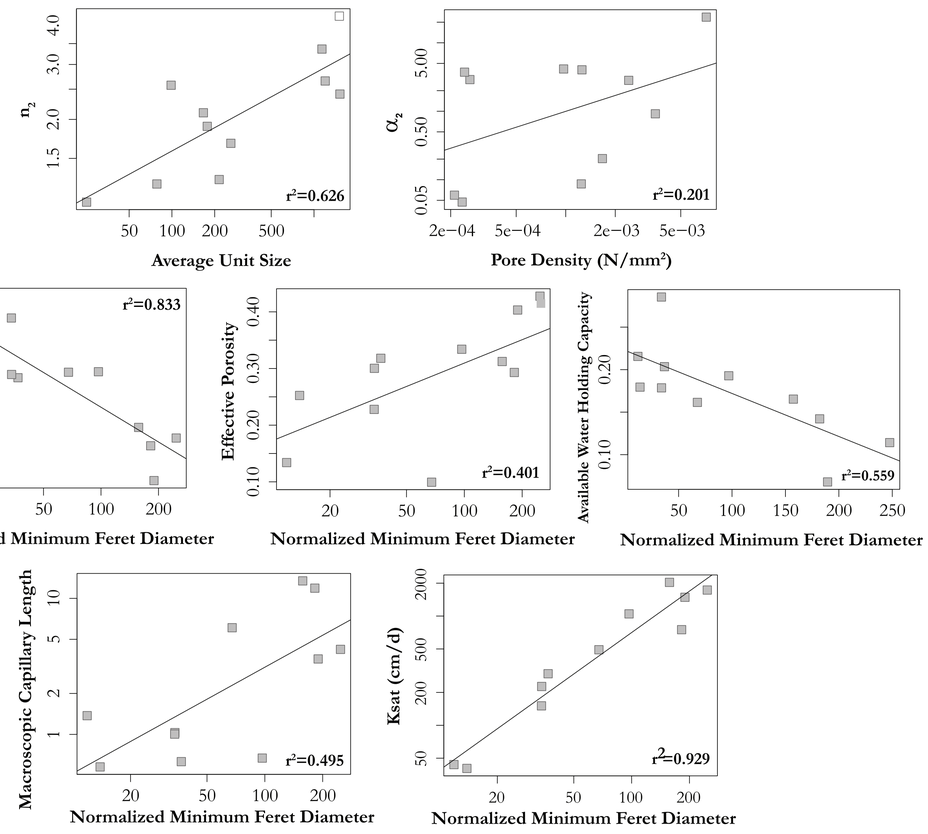






Water retention curves were created using a combination of the Wind-Schindler method, pressure plates and water vapor techniques. The Durner model (1994) was used to describe the bimodal distribution of pores in these soils.

Results



Discussion and Summary

Initial results indicate that many of the derived MLT metrics correlate with water retention parameters. Normalized minimum feret diameter (the minimum pore caliper diameter divided by coeficient of linear extensibility) was the metric that most correlated with hydraulic properties. MLT shows promise in obtaining information about soil structure from excavated pit walls in order to parameterize water retention models.

Future work is needed to varify these relationships over a wider range of soils.

References

Hirmas, D.R. 2013. A simple method for removing artifacts from moist fine-textured soil faces. SSSAJ 77:591-593.

Eck, D.V., D.R. Hirmas, and D. Giménez. 2013. Quantifying soil structure from field excavation walls using multistripe laser triangulation scanning. SSSAJ 77:1319-1328.

Durner, W. 1994. Hydraulic conductivity estimation for soils with heterogeneous pore structure. Water Resources Research 30.2:211-223..

Acknowledgements

This work would not be possible without the support of the University of Kansas Field Station and The University of Kansas General Research Fund.