United States Department of Agriculture

Comparison of Spline Depth Interval and Point-Depth Approaches for Predicting Soil Properties

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Introduction

- Soil property maps are critical for assessing natural resource concerns and solutions to support effective land management decisions
- Two fundamental prediction approaches exist: depth interval estimates from spline functions, and point-depth estimates
- Point-depth estimates use original horizon data without alteration to predict properties at a specific depth and have emerged as an alternative to the spline-based depth interval approach in DSM studies
- Methods have not been compared for model performance and prediction accuracy

Methods

- Organic carbon, pH, sand, silt, and clay content for six depths in the Upper Colorado River Watershed at 30m resolution were predicted using both methods
- Cross-validation with quantile random forests was used to generate accuracy measures for all properties and all depths
- Spline models were compared to point-depth models estimated at the center of each depth interval
- Paired t-tests were applied to compare R^2 and RMSE between prediction methods

Results

- Most models had similar R^2 and RMSE with only a few statistically detectable differences
- R^2 decreased with depth for all properties for both methods
- Sample size was artificially increased in most spline models due to extrapolation of horizons that partially cover a depth interval

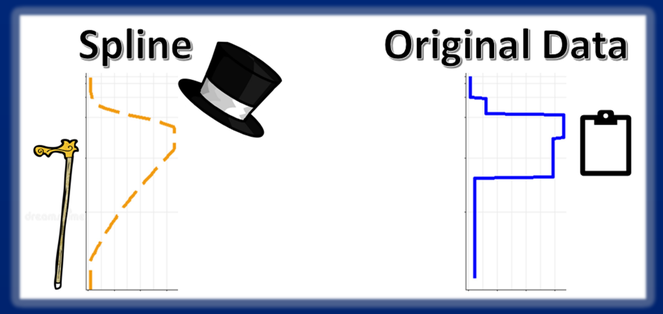
Discussion

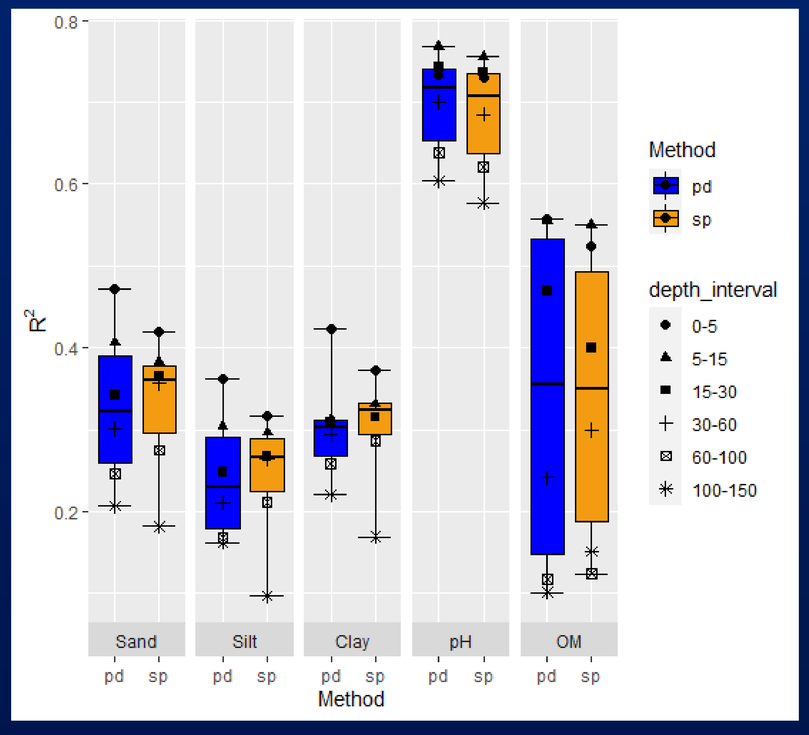
- Choice of prediction method has little affect on model performance and results
- Spline functions estimate property values in training data that may not exist in reality

Conclusion

The point-depth approach makes less assumptions in the treatment of training data and may be a good alternative for predicting continuous soil properties over the spline approach.

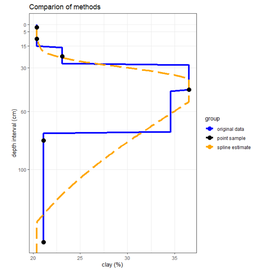
Splines are over-rated





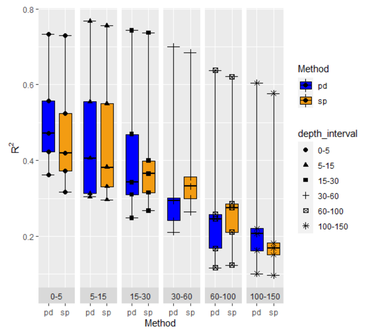
Variance explained was similar between the spline (sp) and point-depth (pd) methods for all properties except minor differences in pH (p=0.009).

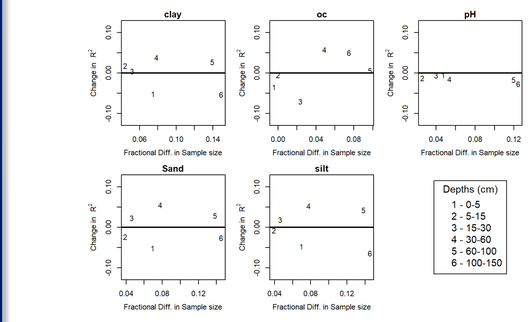
Figures and Maps



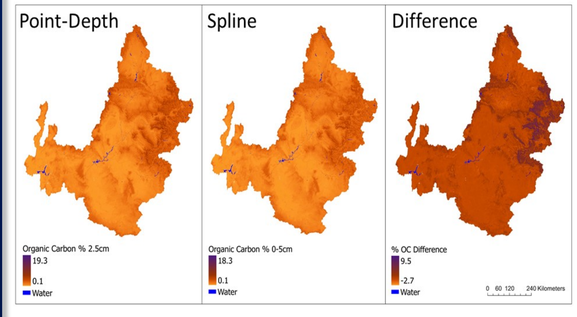
Representation of how each method handles training data shows how the spline method fits a function that inevitably changes original measured property values. This may be particularly true for properties that vary inconsistently with depth. The point-depth approach will always represent a measured property value.

In general, R^2 decreases with depth. Significant differences only exist between spline (sp) and point-depth (pd) methods for 0-5cm (p=0.013) and 30-60cm (p=0.049).





Sample size seems to have little impact on variance explained, except for organic carbon (oc). Spline models for organic carbon at deeper depths had larger sample sizes corresponding to higher variance explained than point-depth models relative to the models at shallow depths where sample sizes were more comparable and point-depth models explained more variance. Data points above the y = 0 line indicate that spline models had higher variance explained, whereas values below the line indicate point-depth models fared better.



Spatial predictions of surface organic carbon for point-depth and spline. The difference map shows how predicted values deviate between the two methods.