

Can NIR spectroscopy predict potential mineralizable nitrogen?



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KEY FINDINGS

- PMN prediction using NIR was low at plot- and landscape scale.
- 10-fold CV produced higher model accuracy than Leave-One-Out CV.
- NIR reliably predicted stable soil properties (clay content) but not dynamic soil properties (PMN and Cmin).

1. Introduction

- Potential mineralizable nitrogen (PMN) is the soil's capacity to convert organic forms of nitrogen (N) to plant available forms.
- Lab PMN assays are time consuming and not readily available to growers.
- Near-infrared (NIR) spectroscopy is proposed as a rapid, low-cost alternative for estimating soil properties.

2. Objective

- Can hand-held NIR spectrometer predict PMN across different spatial scales?

3. Materials and Methods

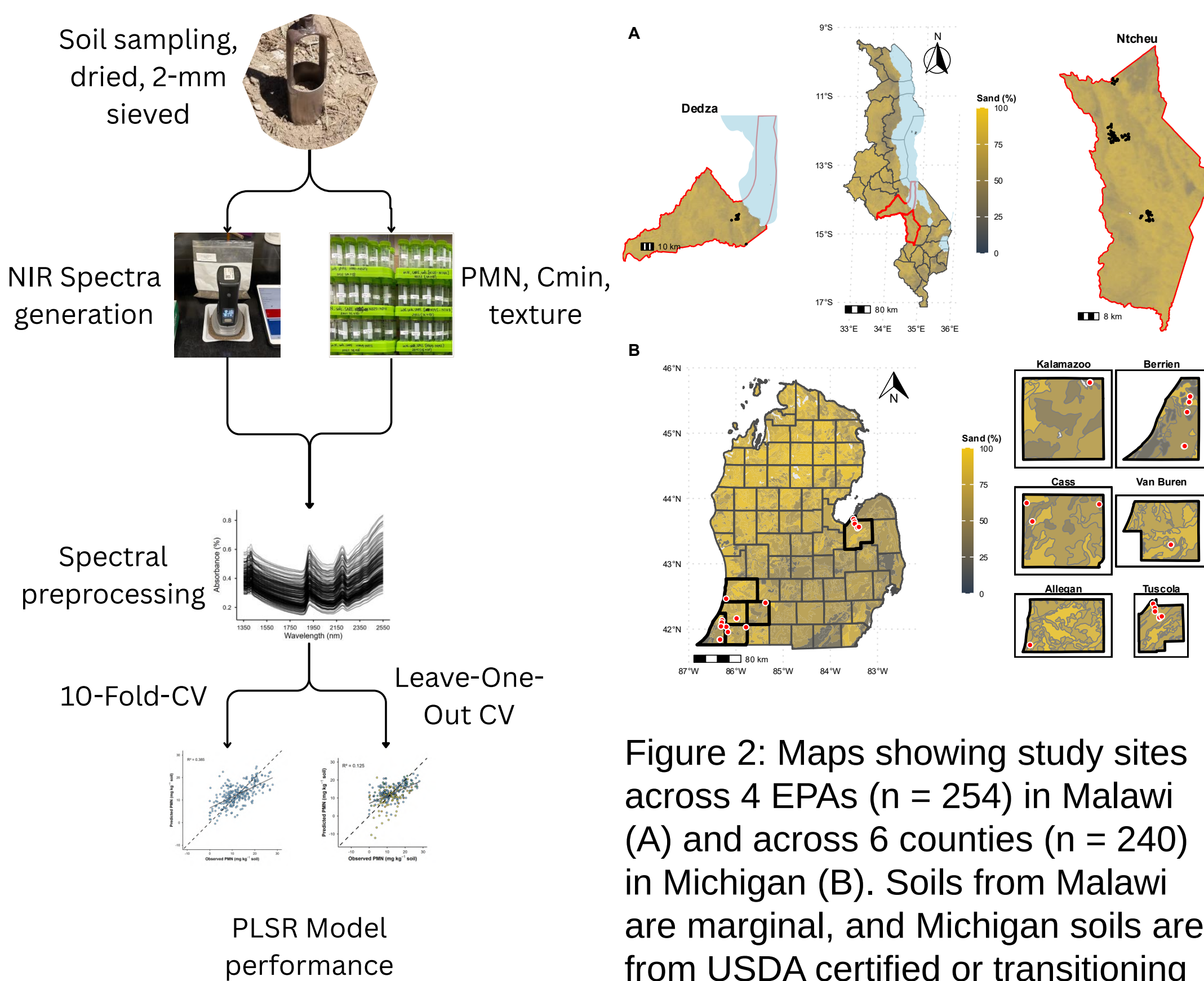


Figure1: Analysis workflow

4. Results

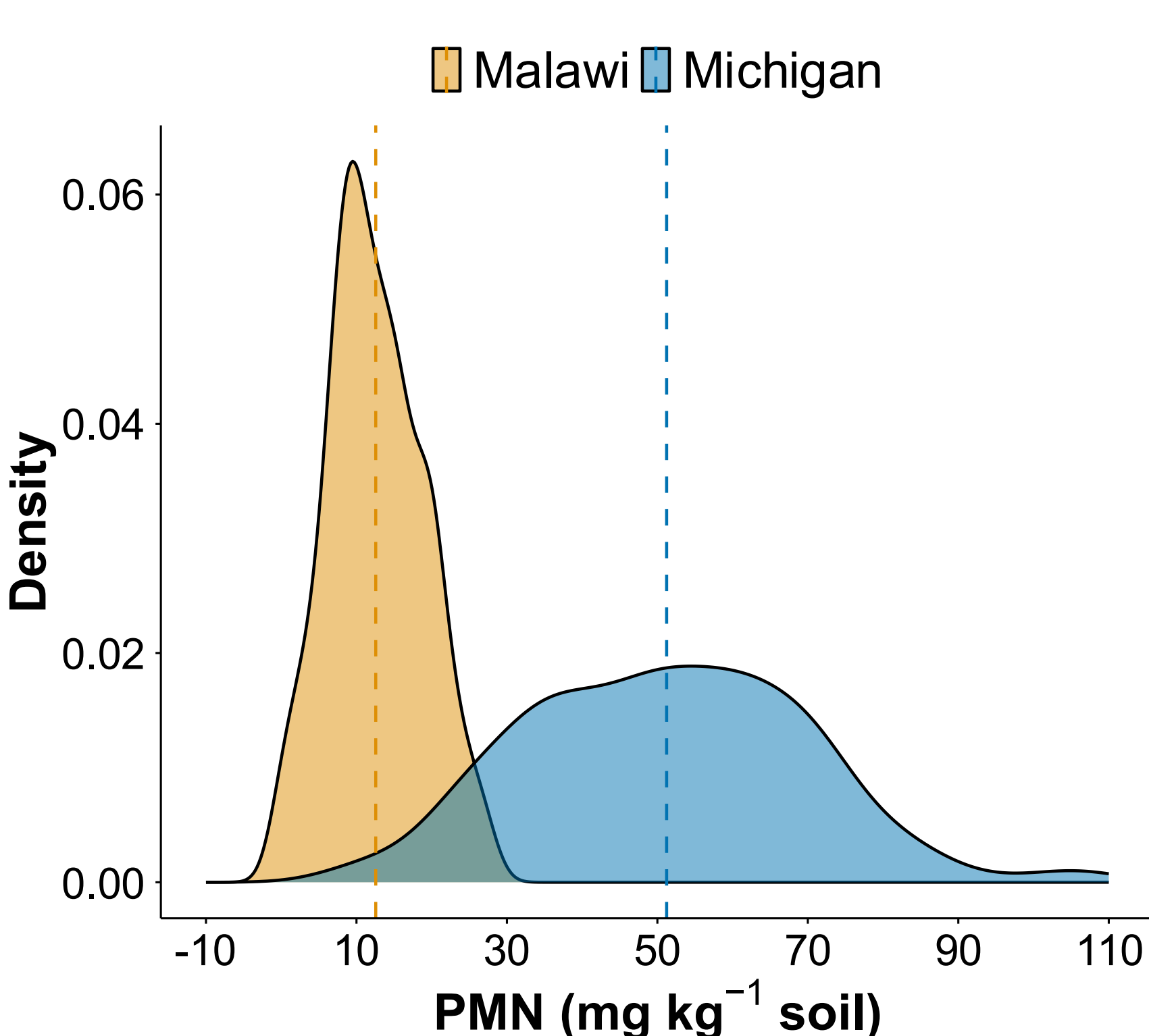


Figure 3: Distribution of PMN across Malawi (landscape-scale) and Michigan (plot-scale). Michigan soils had greater PMN values and variability than Malawi soils. Vertical dashed lines show mean PMN values

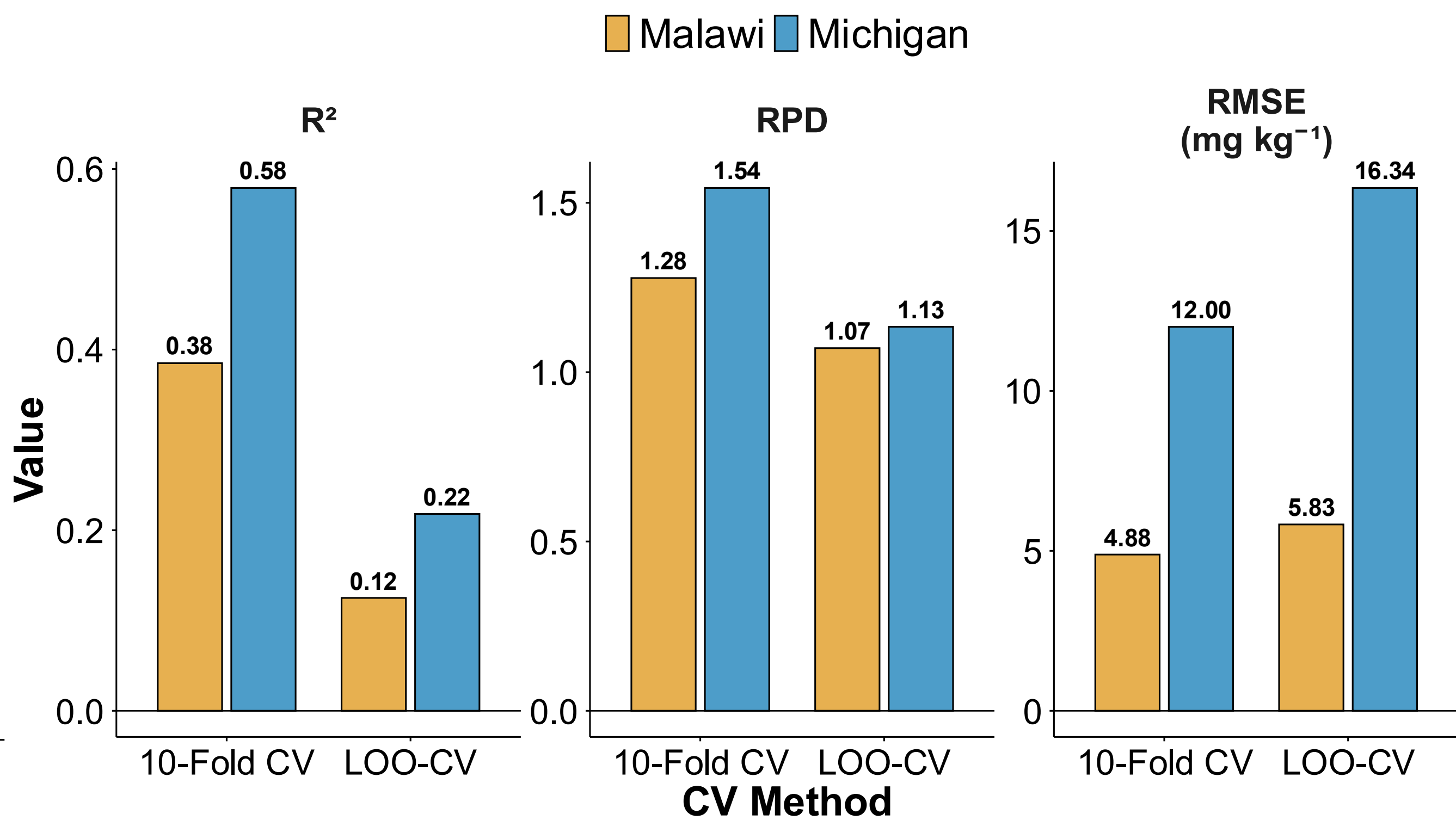


Figure 4: Partial Least Square Regression (PLSR) model performance for Malawi (landscape-scale) and Michigan (plot-scale) based on 10-fold and leave-one-out (LOO) cross validation method. 10-fold CV consistently produced greater R² compared to LOO-CV

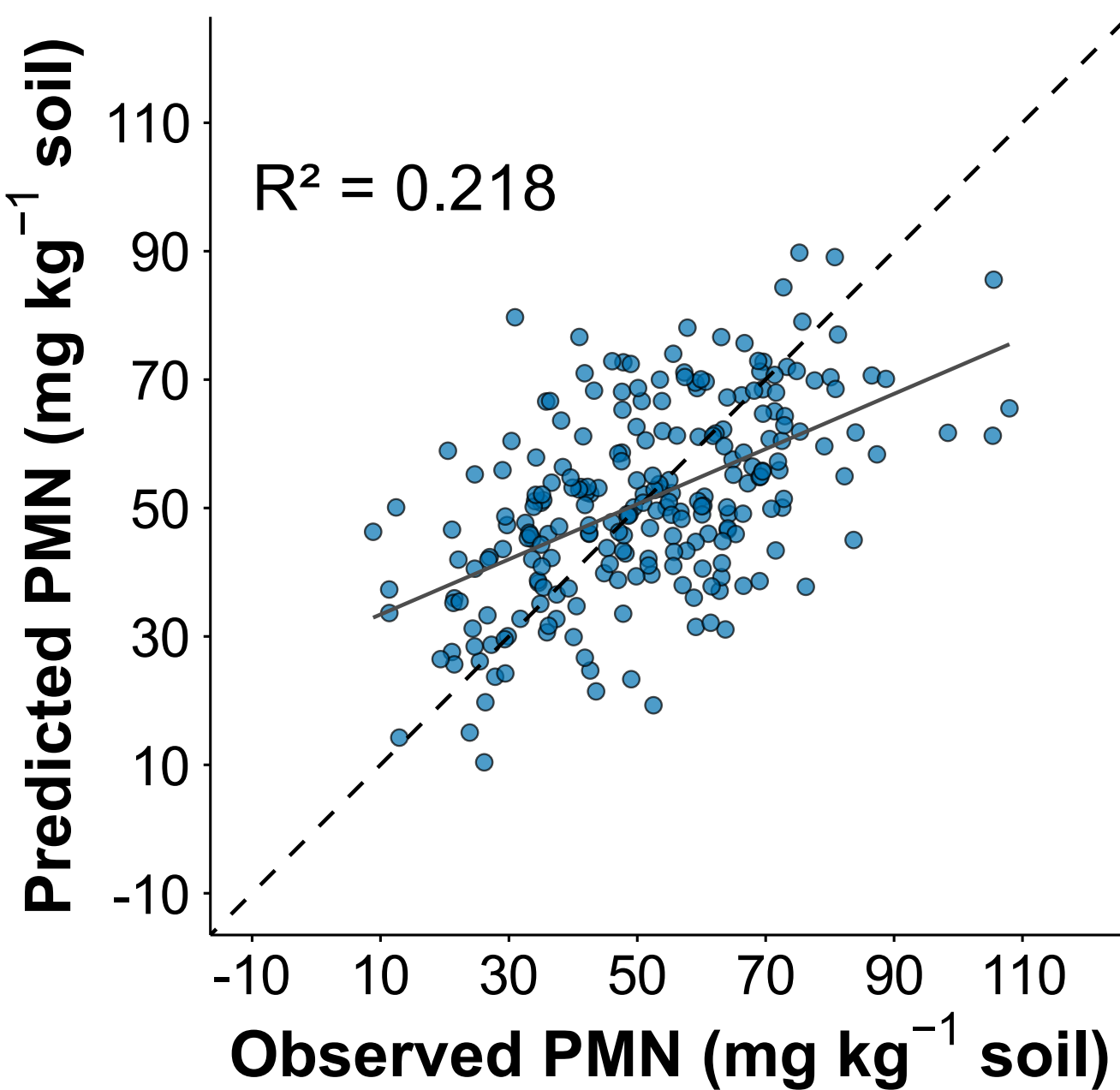


Figure 5: Predicted vs observed PMN for Michigan based on leave-one-out CV

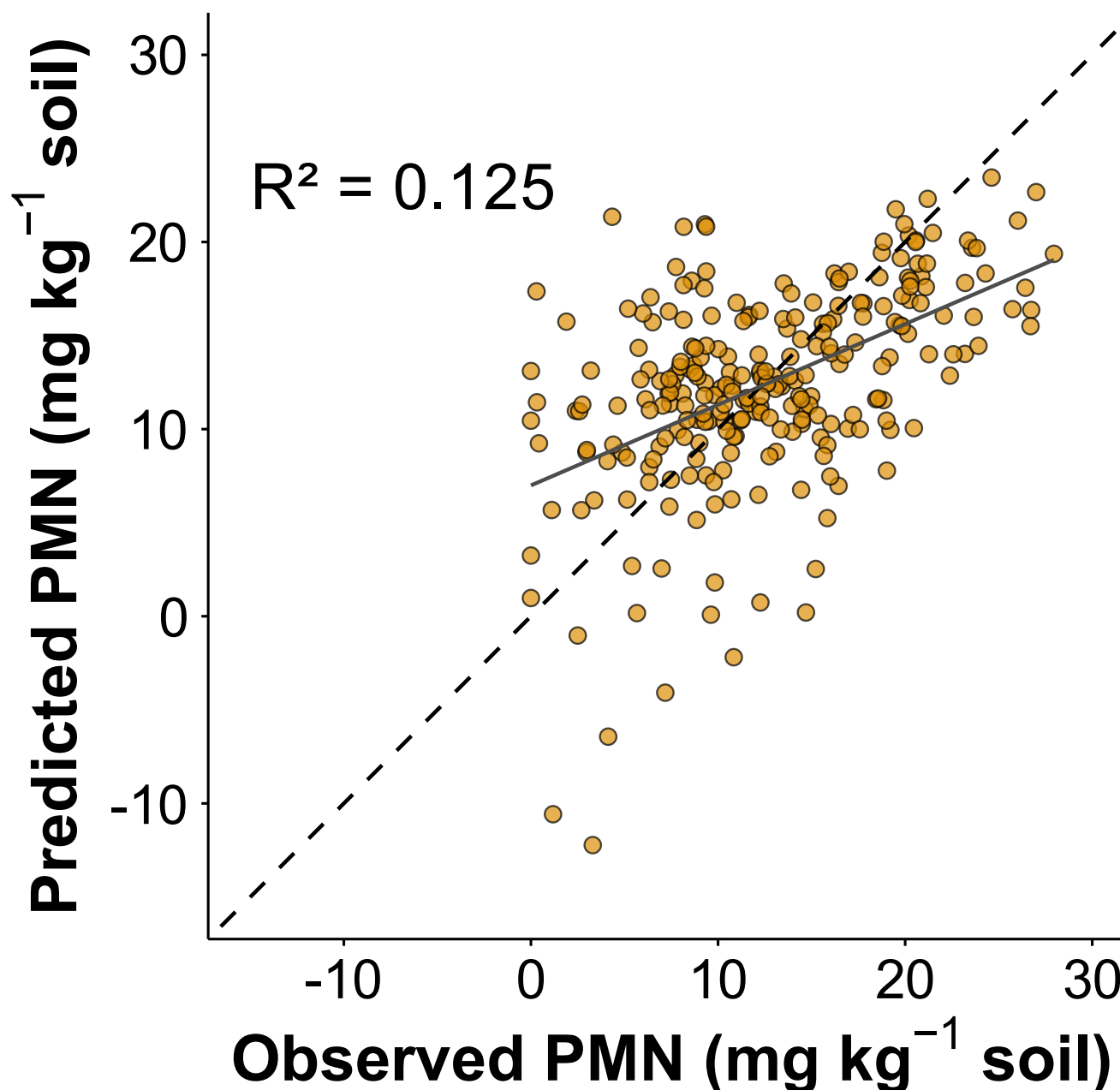


Figure 6: Predicted vs observed PMN for Malawi based on leave-one-out CV

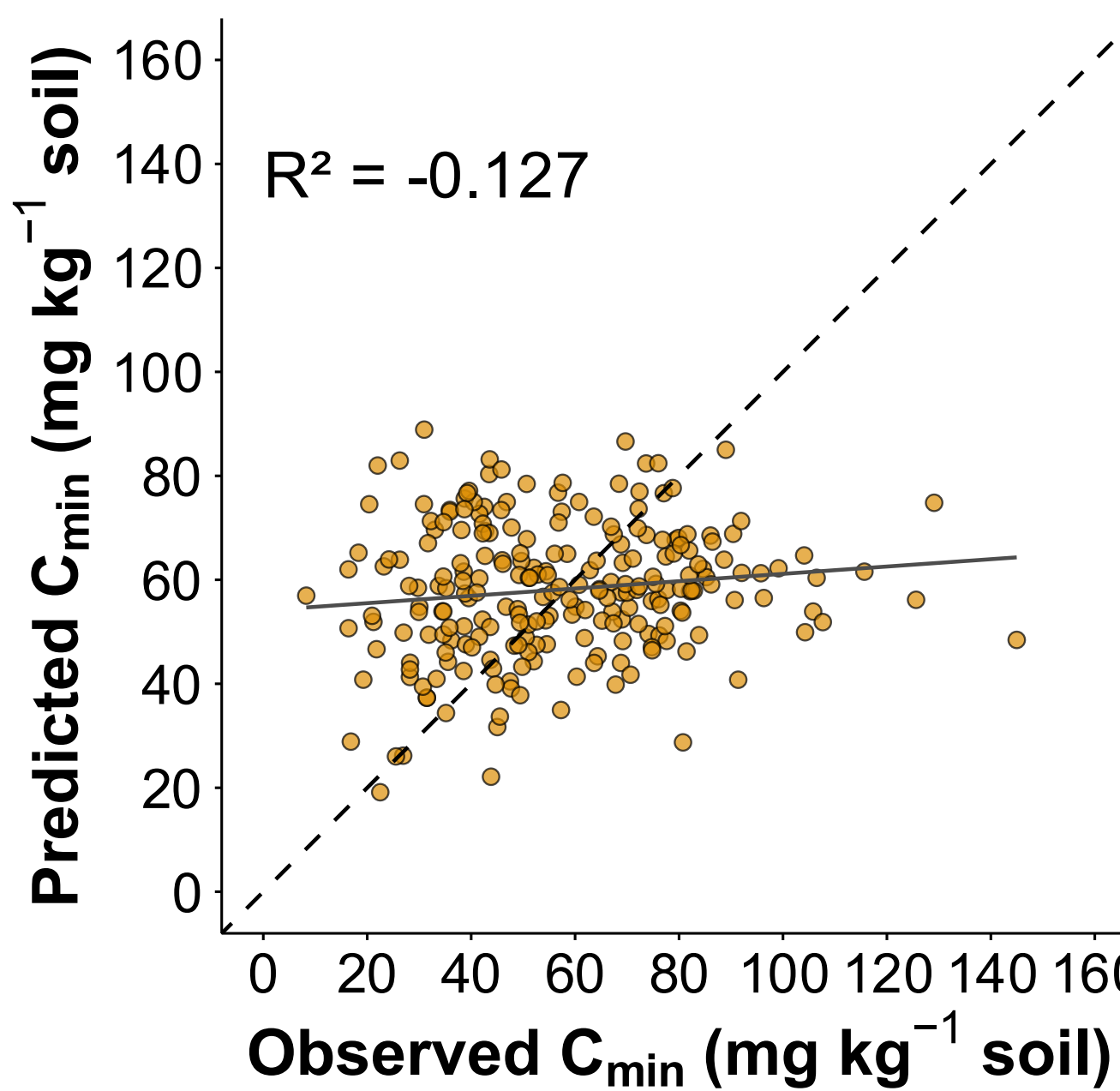


Figure 7: Predicted vs observed Cmin for Malawi based on leave-one-out CV

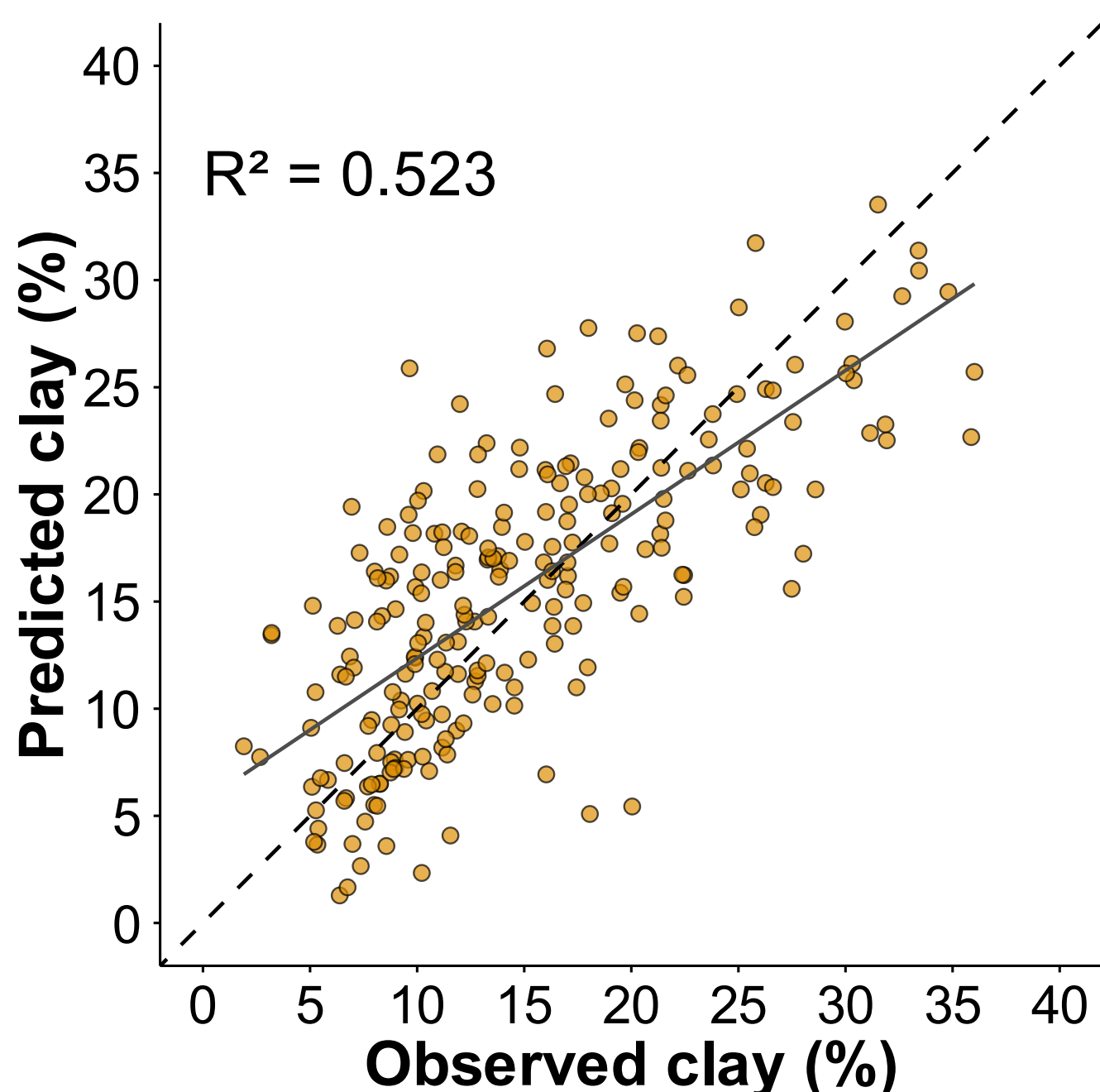


Figure 8: Predicted vs observed clay content for Malawi based on leave-one-out CV. Stable properties like clay is more reliable than PMN and C mineralization

5. Conclusions

- PMN is dynamic, biology-based, context dependent, and could not be reliably estimated using NIR spectroscopy.
- 10-fold cross validation inflates model performance suggesting within farm generations may work but are not generalizable across new farms.
- Reliable PMN prediction requires large and diverse training datasets.

6. Acknowledgements

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