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Title: Performance of global and local models in predicting soil carbon at different scales in a subtropical watershed

Abstract:

Due to the impracticability of exhaustive long-term measurements that capture spatial variability, predictive statistical and geostatistical methods have been applied for development of baseline estimates and accounting for changes in soil carbon stocks over time and space. Attaining accurate predictive capability, while minimizing model complexity is often a challenge for pedologists in choosing appropriate prediction approaches. However, scaling behavior of statistical and geostatistical models that are used to predict soil properties is still poorly understood. This study was conducted to assess the prediction performance of PLSR and GWR at two different depth(z) scale of 0-30cm and 0-100cm, and at two spatial resolution(α) scales of 30x30 m and 100x100m.Using log- normal transformed TSC data of soil cores (sampled at 141 locations within the Santa Fe River Watershed, FL) and environmental covariates prepared in ArcGIS, we assessed the impact of data-scale on the predictive performance of the models (in R). Generally, prediction outputs of GWR (a local interpolation technique) produced higher R^2 than PLSR (a global interpolation technique), scoring maximum R^2 of 0.27 (compared to 0.22 in PLSR). Computed RPD values increased diminutively for both depths by 0.79%~1.20% across α-scale in PLSR, while it decreased for 0-30cm and was unchanged at 0-100cm in GWR. A similar trend was observed in RMSE values. This study is critical for optimizing predictive capability and minimizing complexity in pedological studies, and shows that at changing scales, a modeling technique that captures local variability provides more reliable results than a technique that captures global variability of TSC.

Abbreviations:

GWR: Geographically weighted regression; TSC: Total Soil Carbon; PLSR: partial least square regression; R^2: coefficient of determination; RMSE: Root Mean Square Error; RPD: Residual Prediction Deviation.