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Mapping Soil Organic Carbon Using Local Terrain Attributes: A Comparison of Different Polynomial Models

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ABSTRACT:

Derived directly from digital elevation model (DEM), local terrain attributes have been widely applied in digital soil mapping (DSM). This study aimed to evaluate the mapping accuracy of soil organic carbon (SOC) concentration by combining prediction methods with local terrain attributes calculated using different polynomial models. The prediction accuracy was used as a benchmark for those who may be more concerned with how accurately the variability of soil properties is modeled in practice, rather than how morphometric variables and their geomorphologic interpretations are understood and calculated. In this study, two neighborhood shapes (square and circular) and six representative algorithms (Evans-Young, Horn, Zevenbergen-Thorne, Shary, Shi and Florinsky algorithms) were applied. In general, 35 combinations of first- and second-order derivatives were produced as candidate predictors for soil mapping using two mapping methods, respectively (i.e. kriging with an external drift and geographically weighted regression). The results showed that appropriate local terrain attribute algorithms can better capture the spatial variation of SOC concentration in a region where soil properties are strongly influenced by the topography. When different combinations of first- and second-order derivatives were used, there was a best combination that leads to a more accurate estimate. For different prediction methods, the relative improvement in the two zones varied between 0.30% and 9.68%. The SOC maps resulting from the higher-order algorithms (Zevenbergen-Thorne and Florinsky) yielded less interpolation errors. Therefore, it is concluded that the performance of predictive methods which incorporate auxiliary variables could be improved by the attempts of different terrain analysis algorithms.

Key Words: cross-validation, digital soil mapping, geographically weighted regression, kriging with an external drift, map accuracy

INTRODUCTION

With respect to many chemical and physical processes, soil organic carbon (SOC) plays a major role in terrestrial ecosystems and often varies spatially due to the fast changing environmental conditions. A precise map of SOC concentration is often desirable for soil quality evaluation and soil management. With the rapid development of digital soil mapping in recent decades, various soil

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