Factors Influencing Soil Organic Carbon Storage Estimation in Agricultural Soils: A Machine Learning Approach Using Remote Sensing Data Integration

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Abstract : The decline of soil organic carbon (SOC) in global agriculture is a critical issue requiring rapid and accurate estimation for informed policymaking. While it is recognized that SOC predictors vary significantly when derived from remote sensing data and environmental variables, identifying the specific parameters most suitable for accurately estimating SOC in diverse agricultural areas remains a challenge. This study utilizes remote sensing data to precisely estimate SOC and identify influential factors in diverse agricultural areas, such as paddy, corn, sugarcane, cassava, and perennial crops. Extreme gradient boosting (XGBoost), random forest (RF), and support vector regression (SVR) models are employed to analyze these factors' impact on SOC estimation. The results show key factors influencing SOC estimation include slope, vegetation indices (EVI), spectral reflectance indices (red index, red edge2), temperature, land use, and surface soil moisture, as indicated by their averaged importance scores across XGBoost, RF, and SVR models. Therefore, using different machine learning algorithms for SOC estimation reveals varying influential factors from remote sensing data and environmental variables. This approach emphasizes feature selection, as different machine learning algorithms identify various key factors from remote sensing data and environmental variables for accurate SOC estimation.