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Geospatial modeling approaches for mapping topsoil organic carbon stock in northern part of Mongolia

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Soil organic carbon (SOC) is one of the most important indicators of soil quality and agricultural productivity. This paper presents the application of Regression Kriging (RK), Geographically Weighted Regression (GWR) and Geographically Weighted Regression Kriging (GWRK) for prediction of topsoil organic carbon stock in Tarialan. A total of 25 topsoil (0-30 cm) samples were collected from Tarialan soum of Khuvsgul aimag in Mongolia. In this study, seven independent variables were used including normalized difference vegetation index (NDVI), soil adjusted vegetation index (SAVI), normalized difference moisture index (NDMI), land surface temperature (LST) and terrain factors (DEM, Slope, Aspect). We used root mean square error (RMSE), mean error (ME) and determination coefficient (R^2) to evaluate the performance of these methods. Validation results showed that performance of the GWRK, GWR, and RK approaches were good with not only low values of root-mean-square error (1.38 kg m^{-2}, 1.48 kg m^{-2}, 0.69 kg m^{-2}), mean error (0.28 kg m^{-2}, -0.22 kg m^{-2}, 0.17 kg m^{-2}) but also high values of R^2 (0.76, 0.72, 0.94). The estimated SOC stock values ranged from 0.28-16.26 kg m^{-2}, 0.72–15.24 kg m^{-2}, 0.16–15.83 kg m^{-2} using GWRK, GWR, RK approaches in the study area. The highest average SOC stock value was in the wetland (6.47 kg m^{-2}, 6.08 kg m^{-2}, 6.44 kg m^{-2}) and the lowest was in cropland (1.63 kg m^{-2}, 1.48 kg m^{-2}, 1.80 kg m^{-2}) using these approaches. According to the validation, GWRK, GWR, and RK approaches produced satisfactory results for estimating and mapping SOC stock. However, Regression Kriging was the best model, followed by GWRK and GWR to predict topsoil organic carbon stock in Tarialan.