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Digital soil mapping of organic carbon and it's spatial distribution uncertainty in field scale

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Soil organic carbon (SOC) is a key property that affects soil quality and the assessment of soil resources. However, the spatial distribution of SOC is very heterogeneous and existing soil maps have considerable uncertainty. Traditional polygon-based soil maps are less useful for fine-resolution soil maps modeling and monitoring because they do not adequately characterize and quantify the spatial variation of continuous soil properties. And recently, digital soil mapping of organic carbon is the main source of information to be used in natural resource assessment and soil management. In this study, we collected 100 soil samples on a 50 m grid to conduct soil maps of topsoil (0-20 cm) organic carbon in a 500×500m field and evaluate the uncertainty by spatial stochastic simulation. The map of soil organic carbon generated by inverse distance weighting interpolation indicated that the average topsoil SOC is 11.59±0.61g/kg with averaged standard deviation error is 0.61. In order to evaluate the uncertainties, numbers were defined as 50, 100, 200, 500, 1000, 5000, 10000 with interval of 2×2 m to conduct conditional simulation. The standard deviation error gradually declined from 0.74 to 0.51 g/kg. Then, the uncertainty of SOC was expressed as the range of the 95% confidence intervals of the standard deviation error. Maps of uncertainty showed fine spatial heterogeneity even the numbers of simulations reached 10000. Compared with inverse distance weighting interpolation method, conditional simulation approach can improve the fine-resolution SOC maps. For some points, the simulated values deviated from the averaged values while closed to the observed values. On the whole, the maps of uncertainty showed larger waves in the field-edge and different SOC contour border. Consideration of the sample distribution and sampling strategy, the uncertainty map provides a guide for decision-making in additional sampling.

Key words: Soil organic carbon (SOC); uncertainty assessment; conditional simulation; digital soil mapping

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