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Issues of sampling scale and transferability for digital soil mapping

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Mapping the current state of soil landscapes requires strategic sampling, which has implications for capturing variation and for cost. Addressing issues of sustainability requires soil mapping at the landscape scale. Such an endeavor, however, needs to consider relationships between sampling scale, representation of spatial variation, and accuracy of estimated error. Also, the importance of extending information from sampled points increases with larger map extents due to limitations in practical sampling density. Therefore, the purpose of this research is to examine the ability of different spatial models to predict a soil property for a range of scales and for areas beyond the sampling extent. The respective spatial modelling methods were tested on sample sets taken at two different scales and independently validated on samples taken at three different scales. Each spatial modelling method produced a similar, but unique, map of soil organic carbon content in the topsoil. Kriging approaches excelled at internal spatial prediction, particularly with more densely spaced sample points. Because kriging depends on spatial autocorrelation, kriging performance was naturally poor in areas of spatial extrapolation. In contrast, the spatial regression approach tested could continue to perform well in spatial extrapolation areas depending on the covariates used. In this case, the problem of induction allowed for the potential of problems in some areas, which was less predictable. Spatial regression approaches have the ability to map soil properties at the landscape scale at a high resolution, but are highly dependent on the inclusion of the full feature space in the calibration of the model and the availability of transferable covariates.