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Using landscape characteristics to define an adjusted distance metric for improving kriging interpolations

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Interpolation of point measurements using geostatistical techniques such as kriging can be used to estimate values at non-sampled locations in space. Traditional geostatistics are based on the spatial autocorrelation concept that nearby things are more related than distant things. In this study additional information was used to modify the traditional, Euclidean, concept of distance into an adjusted distance metric that incorporates similarity in terms of quantifiable landscape characteristics such as topography or land use. This new approach was tested by interpolating maps of soil moisture content, pH and carbon to nitrogen (C:N) ratio measured in both the mineral and organic soil layers at a field site in central Sweden. Semivariograms were created using both traditional distance metrics and the proposed adjusted distance metrics to carryout ordinary kriging (OK) interpolations between sampling points. In addition, kriging with external drift (KED) was used to interpolate the measures of soil properties to evaluate the ability of the adjusted distance metric to incorporate secondary data into interpolations. The new adjusted distance metric typically lowered the nugget associated with the semivariogram thereby better representing small scale variability in the measured data compared to semivariograms based on a traditional distance metric. The pattern of the resulting kriging interpolations using KED and OK based on the adjusted distance metric were similar in that they represented secondary data and, thus, enhanced small-scale variability compared to traditional distance OK. This created interpolations that agreed better with what is expected for the real-world spatial variation of the measured properties. Based on comparisons of cross-validation error, OK interpolations made using the adjusted distance metric better fit observed data than either OK interpolations made using traditional distance or KED.