Probability maps as a way to communicate uncertainty in soil texture classes at landscape scale

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Soil texture is critical for a range of functions and degradation threats including soil carbon cycling, hydrology and erosion. The texture of a soil at a point in the landscape is often expressed as a class in a soil texture triangle. The boundaries between these classes are based on the proportions of sand, silt and clay-sized particles. Soils are typically attributed to a single class, without considering the uncertainty associated with class membership.

We demonstrate an approach for communicating uncertainty in spatial prediction of soil texture classes using a database of 2600 measurements of particle size distribution across part of England. A subset of these measurements included repeated analyses of separate aliquots from the same sample from which we could compute uncertainties associated with analytical and subsampling variance to include in our uncertainty analysis. After appropriate transformation for compositional variables, the spatial variation of the soil particle size classes was modelled geostatistically using robust variogram estimators to produce a validated linear model of coregionalization. This was then used to predict the composition of topsoil at the nodes of a fine grid. The predictions were backtransformed to the original scales of measurement by a Monte Carlo integration over the prediction distribution on the transformed scale. This approach allowed the probability to be computed for each class in the soil texture classification, at each node on the grid. The probability of each class, and derived information such as the class of maximum probability could therefore be mapped. We validated the predictions at a set of randomly sampled locations. We consider this technique has the potential to improve the communication of uncertainty associated with the application of soil texture classifications in soil science.