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Multi-scale analysis of the spatial variability of soil organic carbon

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Information on soil properties and state is required for food security, global environmental management and climate change mitigation. Therefore, important efforts are put in the collection of soil data of many types and at very different spatial scales. Besides, soil organic carbon dynamics models at regional or global level and integrated soil policies require to predict soil properties on extensive areas, while keeping a resolution of a few meters. However, predict soil properties at fine resolution on large area is challenging, since soil properties are generally the result of a large number of soil processes, which may act at very different spatial scale. Indeed, both the strength and the nature of the link between soil properties and environmental factors depend on the scale at which we look to. Therefore, the characterization of the link between a soil property and a given controlling factor may be complicated by some variability in the soil property resulting from additionnal processes acting at other spatial scales. We propose a method of geostatistical analysis to decompose the spatial information on a soil property into multiple scale components. The variogram of soil properties is modeled by a function which is the sum of multiple sub-model with different ranges. Each sub-model can be used separately to predict the soil property at a particular scale. The analysis was performed in Belgian Loess Belt with the legacy dataset Aardewerk. The method allowed to highlight relationships between soil properties at particular spatial scales, which were hardly observable without spatial decomposition. In particular, the link between texture and organic carbon, or between topsoil and subsoil organic carbon, appeared more clearly at the coarsest scale. Besides allowing a better understanding of the controls on soil variables, the method provides a way to improve prediction of soil variables when different covariates are available at different scales.