Assessment, Description, and Delineation of Soil Spatial Variability at Hillslope to Landscape Scales ($10m^2$ to $100m^2$)

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Bioiophysical processes operating through time differentiate the soil-landscape continuum into repeating patterns of variability that can be observed at multiple spatial scales. These patterns of variability for spatial resolutions in the range of 10 m^2 to 100 m^2 may be largely determined by hillslope and other geomorphic processes resulting in the redistribution of soil components. Mapping scales appropriate for this level of variability roughly corresponds to map scales of 1:10,000 to 1:100,000. Soil maps of these scales are typically used to make land-use decisions for individual and local governmental planning purposes documenting variability from within fields to within minor watersheds. These maps usually contain sufficient detail for making specific land-use decisions, yet are still cost-effective to produce. As such, considerable resources have and will continue to be dedicated to mapping soil variability at these scales. Feasible sampling densities for these spatial scales are generally too dispersed to map variability from one soil observation to another. Hence, relationships with observable landscape features (topography, vegetation, etc.) are used to infer the variability of soil properties. Both qualitative and quantitative approaches have been used to formulate these soil-landscape models. Traditional methods of describing and mapping soil variability within this range rely on conceptual soil-landscape models formulated by field soil scientists. These conceptual models are based on accumulated experience of soil-landscape observations. While these models are the mainstay of many soil survey activities, the specific decision criteria used to map soil variability is seldom documented and often is difficult for field scientists to articulate. Legends are based on multivariate soil taxa which define the composition of spatial mapping units and are used as the basis for making soil interpretations. More recent research has focused on quantifying empirical soil-landscape relationships based on observational data coupled with an understanding of local pedogenic and geomorphic processes. Many efforts at quantitative soil-landscape modeling have focused on mapping specific soil properties, rather than soil taxa. The use of multivariate statistical procedures permits assessments of class uncertainty, while other spatial modeling techniques have been used to map gradients of change for continuous soil variables. The success of quantitative modeling efforts relies heavily on the quality of ancillary spatial data, such as digital maps of topographic, land-cover, or climatic attributes.