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Communicating soil property variability in heterogeneous soil mapping units

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Soil properties and classes can change over very short distances. For the purpose of scale, clarity and field sampling density, soil maps in England and Wales commonly use mapping units which are groupings of taxonomic soil series, commonly found in association with each other in the landscape. These mixed units (Soil Associations), typically contain between 3 and 7 soil series with physical or chemical properties, which can vary across the mapping unit, or may be relatively homogeneous. The degree of variation is not constant between soil properties, for instance, pH may be relatively constant, but volumetric shrinkage potential may be highly variable.

Over the past ten years, the number of users of GIS soil property maps has dramatically increased, yet the vast majority of these users do not have a soil or geoscience background. They are instead practitioners in specific industries. As a result, new techniques have been developed to communicate the variation in maps of soil properties to a non-expert audience. GIS data structures allow more flexibility in the reporting of uncertainty or variation in soil mapping units than paper-based maps. Some properties are categorical, others continuous. In England and Wales, the national and regional memberships of soil associations are available, with areal percentages of the comprising soil series being estimated for each association by a combination of expert judgment and field observations. Membership at a local scale can vary considerably from the national average.

When summarizing across a whole map unit, for continuous variables, rarely is it appropriate to provide a mean value, or even a weighted average based on membership percentage of the association. Such approaches can make a nonsense of wide-ranging data. For instance a soil association comprising soil series with highly different percentages of sand, silt and clay may result in a 'loamy' mean soil texture which is not reflective of any of the comprising soils. For categorical data, the choice of the property of the spatially dominant soil series may provide the 'most likely' answer, but this may not be the most helpful answer for the end user. Additionally, when aggregating to select the dominant property or class, rather than the dominant taxonomic soil series, it is not uncommon for the 'dominant' class to change.

One example of our new approach is to communicate the attributes of the soil associations on the basis of the worst-case scenario at various confidence levels, based on the percentage of the soil series of the association. As an example, when soil maps are used to help underwriters understand the vulnerability of an area to soil related subsidence, the maximum subsidence rating can be chosen from soils which comprise, for example, more than 5% or more than 30% of the soil association in question. Developing an understanding of end-user requirements allows optimization of soil datasets to suit their needs, and encourages engagement between soil scientists and industry.