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Spatial disaggregation of complex soil map units at regional scale based on soil-landscape relationships

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Accurate soil information over large extent is essential to manage agronomical and environmental issues. Where it exists, information on soil is often sparse or available at coarser resolution than required. Typically, the spatial distribution of soil at regional scale is represented as a set of polygons defining soil map units (SMU), each one describing several soil types not spatially delineated, and a semantic database describing these objects. Delineation of soil types within SMU, ie spatial disaggregation of SMU allows improved soil information's accuracy using legacy data. The aim of this study was to predict soil types by spatial disaggregation of SMU through a decision tree approach, considering expert knowledge on soil-landscape relationships embedded in soil databases.

The DSMART (Disaggregation and Harmonization of Soil Map Units Through resampled Classification Trees) algorithm developed by Odgers et al. (2014) was used. It requires soil information, environmental covariates, and calibration samples, to build then extrapolate decision trees. To assign a soil type to a particular spatial position, a weighed random allocation approach is applied: each soil type in the SMU is weighted according to its assumed proportion of occurrence in the SMU. Thus soil-landscape relationships are not considered in the current version of DSMART. Expert rules on soil distribution considering the relief, parent material and wetlands location were proposed to drive the procedure of allocation of soil type to sampled positions, in order to integrate the soil-landscape relationships. Semantic information about spatial organization of soil types within SMU and exhaustive landscape descriptors were used.

In the eastern part of Brittany (NW France), 171 soil types were described; their relative area in the SMU were estimated, geomorphological and geological contexts were recorded. The model predicted 144 soil types. An external validation was performed by comparing predicted with effectively observed soil types derived from available soil maps at scale of 1:25.000 or 1:50.000. Overall accuracies were 63.1% and 36.2%, respectively considering or not the adjacent pixels. The introduction of expert rules based on soil-landscape relationships to allocate soil types to calibration samples enhanced dramatically the results in comparison with a simple weighted random allocation procedure. It also enabled the production of a comprehensive soil map, retrieving expected spatial organization of soils.

Estimation of soil properties for various depths is planned using disaggregated soil types, according to the GlobalSoilmap.net specifications.

Odgers, N.P., Sun, W., McBratney, A.B., Minasny, B., Clifford, D., 2014. Disaggregating and harmonising soil map units through resampled classification trees. Geoderma 214, 91-100.