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Site selection for environmental survey: cLHS and smart.cLHS

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One important objective of the data collected in natural resource surveys is to understand and model the spatial distribution of a certain environmental target variable. Often, data collection is cumbersome and cost-intensive, so that the application of a reasonable statistical sampling design which will reduce the necessary number of samples is of uttermost importance. In the case of soils, the spatial landscape structure which is nowadays captured by multiple sensors from remote and proximal platforms indicates patterns of site characteristics that guide the site-specific interaction of soil processes that lead to the spatial pattern of pedodiversity in a certain landscape. Stratified random sampling designs that base sampling site selection on this auxiliary information are known to improve the predictive performance while only a small dataset is available. A sampling algorithm that strives to optimise site selection for environmental surveys by sampling the n-dimensional auxiliary space and which has advanced to be a standard method in digital soil mapping applications is conditioned Latin hypercube sampling (cLHS) by Minasny and McBratney (2006). However, in its present form, the inclusion of an increasing amount of ancillary information and the selection of an increasing number of sampling points leads to a worse representation of landscape structures, a reduction of the random element in the algorithm, and possibly too simple models to explain spatial pedodiversity. A new algorithm, smart.cLHS, is presented, which provides a solution to these drawbacks.