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A statistical approach for validating eSOTER and digital soil maps in front of traditional soil maps

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During the European research project eSOTER, three different Digital Soil Maps (DSM) were developed for the pilot area Chemnitz 1:250,000 (FP7 eSOTER project, grant agreement nr. 211578). The core task of the project was to revise the SOTER method for the interpretation of soil and terrain data. It was one of the working hypothesis that eSOTER does not only provide terrain data with typical soil profiles, but that the new products actually perform like a conceptual soil map. The three eSOTER maps for the pilot area considerably differed in spatial representation and content of soil classes. In this study we compare the three eSOTER maps against existing reconnaissance soil maps keeping in mind that traditional soil maps have many subjective issues and intended bias regarding the overestimation and emphasize of certain features. Hence, a true validation of the proper representation of modeled soil maps is hardly possible; rather a statistical comparison between modeled and empirical approaches is possible. If eSOTER data represent conceptual soil maps, then different eSOTER, DSM and conventional maps from various sources and different regions could be harmonized towards consistent new data sets for large areas including the whole European continent.

One of the eSOTER maps has been developed closely to the traditional SOTER method: terrain classification data (derived from SRTM DEM) were combined with lithology data (re-interpreted geological map); the corresponding terrain units were then extended with soil information: a very dense regional soil profile data set was used to define soil mapping units based on a statistical grouping of terrain units. The second map is a pure DSM map using continuous terrain parameters instead of terrain classification; radiospectrometric data were used to supplement parent material information from geology maps. The classification method Random Forest was used. The third approach predicts soil diagnostic properties based on covariates similar to DSM practices; in addition, multi-temporal MODIS data were used; the resulting soil map is the product of these diagnostic layers producing a map of soil reference groups (classified according to WRB). Because the third approach was applied to a larger test area in central Europe, and compared to the first two approaches, has worked with coarser input data, comparability is only partly fulfilled.

To evaluate the usability of the three eSOTER maps, and to make a comparison among them, traditional soil maps 1:200,000 and 1:50,000 were used as reference data sets.

Three statistical methods were applied: (i) in a moving window the distribution of the soil classes of each DSM product was compared to that of the soil maps by calculating the corrected coefficient of contingency, (ii) the value of predictive power for each of the eSOTER maps was determined, and (iii) the degree of consistency was derived. The latter is based on a weighting of the match of occurring class combinations via expert knowledge and recalculating the proportions of map appearance with these weights. To re-check the validation results a field study by local soil experts was conducted.

The results show clearly that the first eSOTER approach based on the terrain classification / reinterpreted parent material information has the greatest similarity with traditional soil maps. The spatial differentiation offered by such an approach is well suitable to serve as a conceptual soil map. Therefore, eSOTER can be a tool for soil mappers to generate conceptual soil maps in a faster and more consistent way. This conclusion is at least valid for overview scales such as 1.250,000.