

DIGITAL SOIL MAPPING OF AN ARGENTINIAN PAMPA REGION USING STRUCTURAL EQUATION MODELLING

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The most productive soils of the Argentinian Pampas are Phaeozems formed over loess-like sediments. Soil maps of this region were developed through conventional soil mapping, but the poor updateability of these maps, the lack of uncertainty information and the demand of high spatial resolution incite the application of Digital Soil Mapping (DSM) as an alternative approach. However, current DSM methods are highly empirical and have difficulty to predict many soil properties simultaneously, while preserving relationships between properties and including pedological knowledge. Therefore, we investigated the use of structural equation modelling (SEM), which has not yet been applied in DSM. SEM integrates empirical information with mechanistic knowledge by deriving model equations from known causal relationships, while estimating the model parameters using the available data. It distinguishes between endogenous and exogenous variables, where, in our application, the first are soil properties and the latter are external soil forming factors (e.g. climate, relief, organisms). We applied SEM to a 22,900 km² region in the Argentinian Pampas. First, we identified the main soil forming processes and main soil properties involved. Next, we incorporated these processes and properties in a conceptual model and converted this to a SEM graphical model. Finally, we derived the SEM equations and implemented these in R code. The model was calibrated using a dataset of 350 soil profiles and environmental covariates. After calibration spatial predictions were made of over 12 soil properties, among others base saturation, thickness and organic matter content of the A horizon, and presence of natric and E horizons. We compared maps obtained with SEM and regression-kriging DSM using a validation dataset of 100 soil profiles collected through stratified simple random sampling. This allowed to quantify the accuracy of both prediction methods and test whether accuracy differences were statistically significant.