Enhancing digital soil mapping in southeastern Brazil: incorporating stream density and soil reflectance from multiple depths

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There is need to integrate methods to enhance soil maps across large areas. This study proposes a novel and simple method to incorporate laboratory soil spectral data in the production of digital soil maps. We integrated laboratory, field and remote sensing data to derive maps of soil suborder (second highest hierarchical level) with and without additional textural information based on the Brazilian Soil Classification System. We described and classified 289 soil profiles in an area of ~13,000 ha with great soil, geologic, and topographic variation in the state of São Paulo, southeastern Brazil. Classification models using multinomial logistic regression were derived to classify soils based on diverse GIS layers (geology, topography, geomorphology, emissivity, vegetation index, and land cover) and laboratory soil visible/near-infrared reflectance at three depths (0-20, 40-60, and 80-100 cm). The maps derived by the models were compared with two maps at different scales (1:100,000 and 1:20,000) produced using conventional soil survey methods. Soil suborders with and without texture were correctly classified for 44 and 52% of the soil profiles, respectively. The derived soil suborder maps agreed with the 1:100,000 and 1:20,000 conventional maps in 20 and 23% (with texture), and 41 and 46% (without textural information) of the area, respectively. Stream density was included in all classification models and closely related to the spatial distribution of soil classes, showing great potential as a new variable for digital soil mapping. Laboratory soil reflectance also improved the classification models. In complex environments, inclusion of comprehensive terrain (i.e. stream density) and easy to measure (i.e. soil reflectance) variables can greatly advance digital soil mapping, especially in large areas with scarce soil and ancillary data.