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ConMap - a new spatial data mining framework for terrain based digital soil mapping

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In this talk, we present a new digital terrain analysis framework for digital soil mapping based on spatial data mining, referred to as the contextual elevation mapping (ConMap). Aiming at integrating different scales, which can be important at landscape scale level due to interrelations of topo- and climofunctions, it comprises local surface function approximations in terms of standard local terrain attributes as well as the incorporation of geomorphic arrangements within larger neighborhoods. In contrast to common digital terrain analysis of deriving multiple terrain attributes, ConMap is based on elevation differences from the center pixel to each pixel in a local neighborhood. These differences are then used as predictors in machine learning approaches such as Random Forests. Thus, it is not necessary to choose a specific set of terrain attributes. Additionally, possibly unknown surface functions can be taken into account, as well as larger geomorphic settings. We applied and validated the framework by predicting topsoil silt content for an area of 1150 km2 in Rhineland-Palatinate and Hesse, Germany, based on 342 samples, a 20 m resolution DEM, and neighborhood sizes up to 12 km. Cross-validation R2 values increase from 0.15 for standard digital terrain analysis to 0.61 using ConMap. This effect is due to a spatial trend in the data. As ConMap is able to map this trend and as it is based on the pedological concept of integrating scales it can be seen as a new entry to spatial prediction approaches such as Kriging or Geographically Weighted Regression. We conclude that ConMap shows a great potential for future digital soil mapping studies.