Digital (soil) mapping as a suitable approach to generate spatial forest site and biodiversity data at different scales

Forest site data are important for the estimation of tree species suitability, silvicultural adaptation measures and possible changes to soil biodiversity under climate change. Forest sites are characterized by various factors. especially soil and humus forms and its physical and chemical characteristics, which are determinants for tree species suitability and tree growth. In forest site science, it was previously assumed that these factors are subject to annual fluctuations, but in principle remain unchanged at least within a forest rotation period of 100 – 150 years. With climate change, this assumption is no longer correct: Seasonal anomalies are accumulating, deviations from long-term means, and an increase in climate extremes, such as drought are observed and require a re-thinking of classical concepts of forest site classification, mapping and in assessing soil biodiversity.

While pedo- and hydropedological information at the plot or site-scale is often available from standardized inventory or survey programs, data with complete spatial coverage are often inexistent. Terrestrial mapping of such characteristics isn't a suitable approach in most cases due to limited financial and human resources and due to rapidly changing environmental conditions. Therefore digital mapping approaches are getting increasingly popular, also due to the advancing development of such methods in general, but also to the increasing availability of source data and the progressive development of computing power.

State of the art in digital soil mapping is the use of various artificial intelligence methods in the form of machine learning algorithms and deep learning approaches with neural networks.

Digital mapping techniques allow the use of numerous geological, topomorphometric, climatic, hydrological and other auxiliary variables related to soil formation and soil biodiversity. Such predictive datasets are becoming increasingly important with the development of remote sensing techniques, in particular, datasets on soil moisture or wetness but also on current vegetation cover and vegetation-related indices. In addition, digital elevation models are becoming increasingly detailed. Based on DEMs a wide range of topographical and hydrological indices can be derived and provided for predicting pedological issues.

Furthermore, digital mapping techniques enable prediction of current and future soil-related issues. As global warming progresses, essential spatial datasets may be developed for the adaption of forest management to climate stress or for optimizing carbon offseting. In addition, topic-specific models can be applied to well-surveyed areas and the results subsequently applied to a target area.

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