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Mapping physical properties of Swiss forest soils by robust external-drift kriging from legacy soil data

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Climate change scenario predict for Switzerland increasing summer temperature and decreasing precipitation. In coming decades forests will therefore likely experience more often drought. However, it is not clear to what extent these changes will occur and where in Switzerland they will be most pronounced. Soil-Vegetation-Atmosphere-Transfer (SVAT) models allow to explore likely changes in the water regime of forest under changing climate. Such process models require information of soil physical properties that largely control water storage in forest soils. Spatial information on physical properties of forest soils is currently lacking in Switzerland. Therefore one objective of the project "Soils and water regime of Swiss forests and forest sites under present and future climate BOWA-CH" (http://www.wsl.ch/fe/boden/projekte/bowa_ch/index_EN) was to predict basic physical properties of forest soils at high spatial resolution for the whole Swiss territory.

Based on legacy data of about 2000 forest soil profiles, we mapped particle size composition, volumetric content of rock fragments, soil organic carbon (SOC) content and soil density for fixed-depth soil layers (0–10, 10–30, 30–60, ..., 120–150 cm) by robust external drift kriging (Nussbaum et al., 2014). Comprehensive, digitally available information on climate, topography, vegetation and geology were used as covariates for statistical modelling. Preliminary sets of covariates were chosen by LASSO, and the selection was refined by cross-validating the model for the external drift. External validation with 20 % of the data revealed that clay and sand content, soil density and SOC could be predicted with acceptable precision. Predictions of rock fragment content and silt content were less precise, and the developed model failed to spatially predict soil depth. This is unfortunate because soil depth and rock fragment content largely control water storage in soils.

Nussbaum, M., Papritz, A., Baltensweiler, A. & Walthert, L. 2014. Estimating soil organic carbon stocks of Swiss forest soils by robust external-drift kriging. Geoscientific Model Development, 7, 1197-1210.