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Mapping spatio-temporal relationships between soil properties and remote sensing-derived information for Scotland.

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Analysis and forecast of the spatial distribution and dynamics of soil are important elements of sustainable land management. Recent studies have noted that the most successful and promising approach to estimating soil properties continuously over time and space should include a combination of remote sensing and modelling. The aim of this paper was to investigate the spatial relationships between soil properties measured or observed at various soil profiles across Scotland and indices derived from remote sensing. Methodology was implemented to exploit fully the high number of covariates in order to identify the band, index or product that best correlates with the soil property of interest. Soil properties were measured or observed across the whole of Scotland following a regular grid at more than 1000 profiles National Soil Inventory of Scotland (NSIS1). Remote sensing data were derived from Terra Moderate Resolution Imaging Spectroradiometer (MODIS) data. The indices considered were i) Enhanced vegetation Index, ii) Leaf Area Index, iii) Land Surface Temperature and iv) derived drought indices, such as the Normalised Difference Water Index. The models fitted show a fairly good agreement with existing data sets, presenting a consistent spatial pattern across Scotland, mainly following the morphological landscape, such as slope and river valleys and the soil type classification. The remote sensing data proved useful for predicting various soil properties such as AWC and organic matter content. The methodology provides estimates of the spatial uncertainty of the modelled values that could be used in further modelling and in the assessment of consequences of climate-change and trade-offs in land use changes. MODIS data are potentially very helpful for soil mapping in areas where soil data are not available. However a spatial calibration is often needed. This approach can contribute to improving our understanding and modelling of soil processes and function over large, and relatively sparsely sampled, areas of the world. The National Soil Inventory of Scotland provides valuable data to validate remote sensing-based soil mapping. The methodology used on this study was implemented using open source software, in particular GRASS and R.