



Modelling and mapping soil pH in Andalusia (Spain) using phenological products as predictor features

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Soil pH is one of the most important soil parameters, due to its importance for soil management and food security. Spatial distribution of pH could be altered by the different environmental conditions, such as geology, climate or soil-vegetation interactions. pH has an ecological function in controlling spatial distribution of plant species, conditioning absence or presence of different species due to soil pH ability or modifying mineral solubility. Hence, pH and remotely sensed land surface phenology (LSP) could be associated. The objective of this work was two-folded: i) mapping the soil pH of Andalusian soils and ii) the evaluation of new features derived from remote sensing which are related to seasonal cycles of vegetation applied to digital soil mapping

We developed a pH model using 3215 pH measurements at different locations together with three types of predictor features: terrain (elevation, slope, hydrological attributes...), climatic (annual and monthly precipitation and maximum and minimum temperatures) and phenological features extracted from remotely sensed vegetation indices time series (date of the start of spring, date of the end of senescence, growing season length, end of the growing season, length of the growing season, maximum peak, and large seasonal integral as a proxy of productivity). The LSP features were obtained from time series of NDVI that were computed from the MODIS weekly surface reflectance product (MOD09Q1 v6) at a spatial resolution of 250 for the entire study period. The performance of multiple linear regression (MLR) and Random Forest was evaluated within the framework of a high dimensional feature space.

The results showed that RF outperformed MLR (R^2 : 0.66 and 0.58; RMSE: 0.76 and 0.83). pH and feature pairwise correlations were higher for the phenological features: median of large integral (-0.55); median of maximum peak (-0.51); valley depth (0.48); median of date of start of spring (-0.47), median of value on the date of start of spring (-0.46). The most important features in RF prediction were almost the same: the median of large integral, valley depth, maximum temperatures in September and median of maximum peak, showing that LSP features were relevant in pH spatial modelling, with a better performance of RF model.