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Spatial aggregation of soil predictions over pre-defined areas of interest for better use by local land managers.

Kévin Vaysse (1,2), Gerard B.M. Heuvelink (3), and Philippe Lagacherie (1)

(1) INRA, UMR LISAH, Montpellier, France (kevin.vaysse@supagro.inra.fr), (2) SIG L-R, Montpellier, France, (3) ISRIC – World Soil Information, Wageningen, Netherlands.

The GlobalSoilMap project aims to provide global soil property predictions and associated uncertainties at multiple depths at fine spatial resolution (100mx100m grid). This product is specifically tailored for agro-environmental modellers that produce results at global scales over large regions. However, local land managers are less interested in fine resolution maps because they need to make decisions for much larger areas of interest, such as provinces, districts, watersheds or farm territories. To serve their need, we propose a spatial aggregation approach that uses the GlobalSoilMap prediction maps as input and derives from these linear as well as non-linear spatial aggregates, such as the spatial mean, the spatial median or any other quantile, or the proportion of land within the area of interest that satisfies a pre-specified criterion (e.g. pH < 5; clay content > 400g/kg). The method must also be able to quantify the uncertainty in the spatial aggregate. For this reason, we employed a spatial stochastic simulation approach.

We tested the method in the Languedoc-Roussillon region (27,236 km2), by first applying regression kriging using legacy soil profile observations (Vaysse and Lagacherie, 2015). Next we predicted the proportion of land for all districts within the region (average size 18 km2) that is suitable with regard to a threshold applied to three different soil properties: pH, organic carbon and clay content at 5-15 cm interval of depth. This procedure comprises four different steps: i) empirical reproduction of the joint conditional probability distribution of the soil properties at all grid cells in the district by means of sequential Gaussian simulation applied to a regression kriging model (Goovaerts, 2001); ii) calculation of the indicator (0 or 1, depending on whether the thresholds are met) for each simulation and each grid cell; iii) calculation of the proportion of "suitable" land area by zonal statistics of the indicator variable over the district for each simulation; and iv) for each district, derivation of the empirical probability distribution and from it a prediction interval of the proportion of "suitable" land.

The performance of the method was evaluated for 30 districts using independent soil validation data derived from the French soil analyses database (BDAT).