Development of an open-source platform for pedometrics

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The high dimensionality of large soil profile databases makes soil data analysis a complex task. It is also complicated by difficulties associated with processing horizon data that vary widely in depth and thickness. Moreover, visualising and communicating these data is typically a challenging and laborious task.

Here we present the development of an flexible open-source framework that address the difficulties associated with processing soils information. aqp (*Algorithms for Quantitative Pedology*) is a R package that supports quantitative analysis of massive soil databases through numerical extensions to traditional methods of visualizing, aggregating, and classifying soils information.

Visualising soil profile data

aqp provides tools that address the challenge of visually analyse and communicate soil profile data .

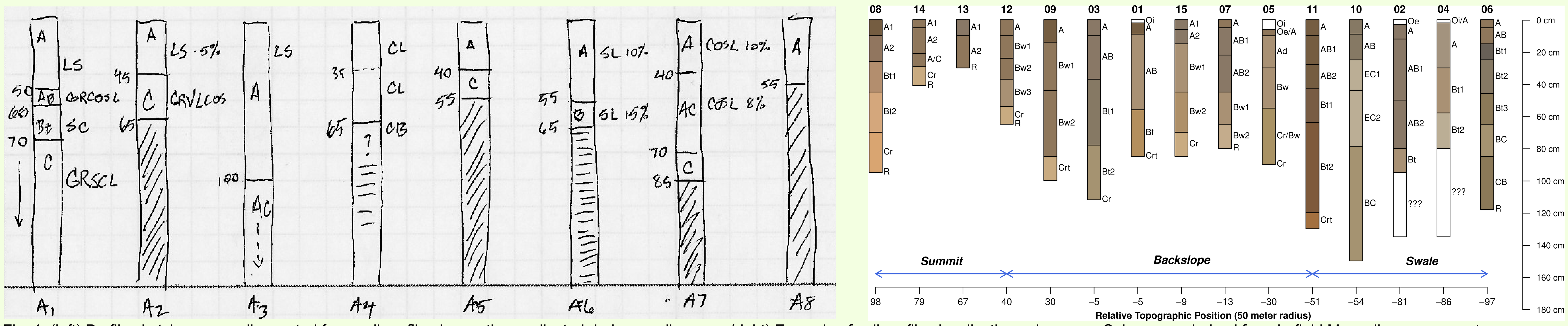

Fig. 1: (left) Profile sketches manually created from soil profile observations collected during a soil survey. (right) Example of soil profile visualisation using aqp. Colours are derived from in-field Munsell measurements.

Harmonisation of soil data

Different methods are available to harmonise data in a soil profile collection. Harmonisation can not only be done on attributes values, but also to resample data to a common set of depth intervals.

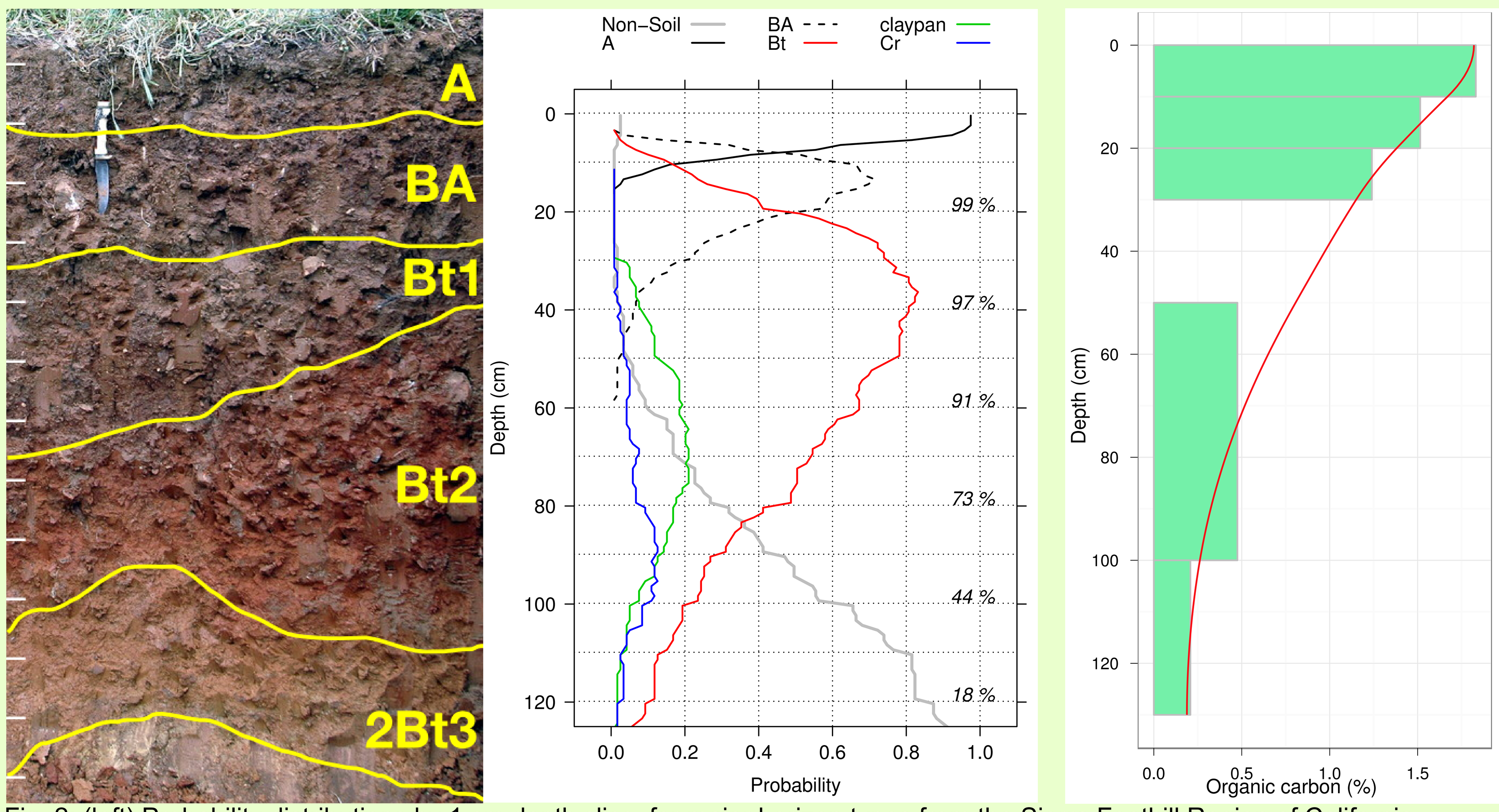

Fig. 2: (left) Probability distributions by 1 cm depth slice, for major horizon types from the Sierra Foothill Region of California. (right) Disagregation of continuous attributes using a mass-preserving spline.

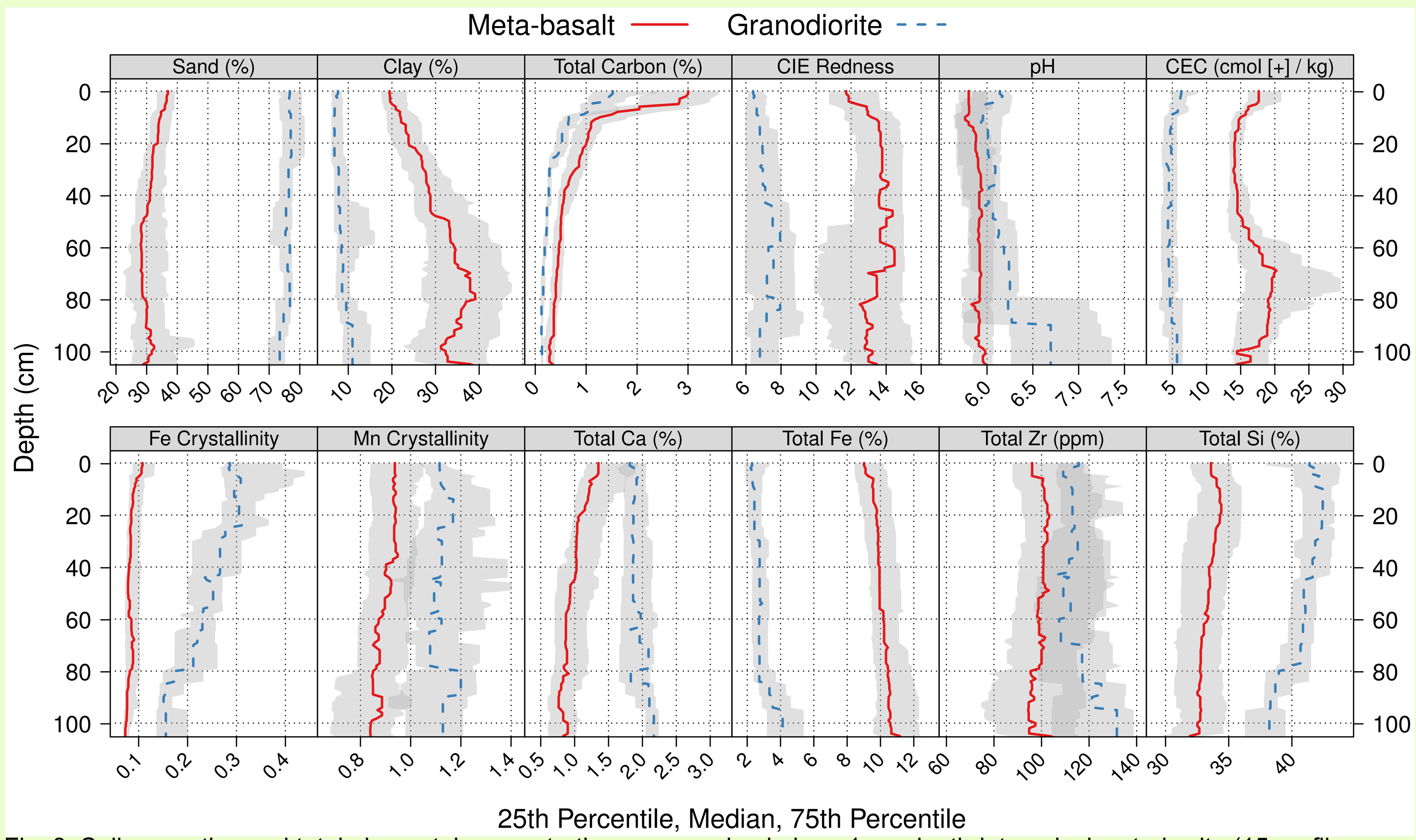

Fig. 3: Soil properties and total elemental concentrations summarised along 1 cm depth-intervals, by study site (15 profiles on granodiorite, 50 profiles on meta-basalt). Median values are plotted as lines, bounded by 25th percentile and 75th percentile.

It is possible to summarise attributes values over a soil profile collection, in order to get statistics and most probable depth functions.

Analysing and modelling soil profile data

Numerical classification of soil profile data is accomplished through pair-wise evaluation of dissimilarites along regular depth slices.

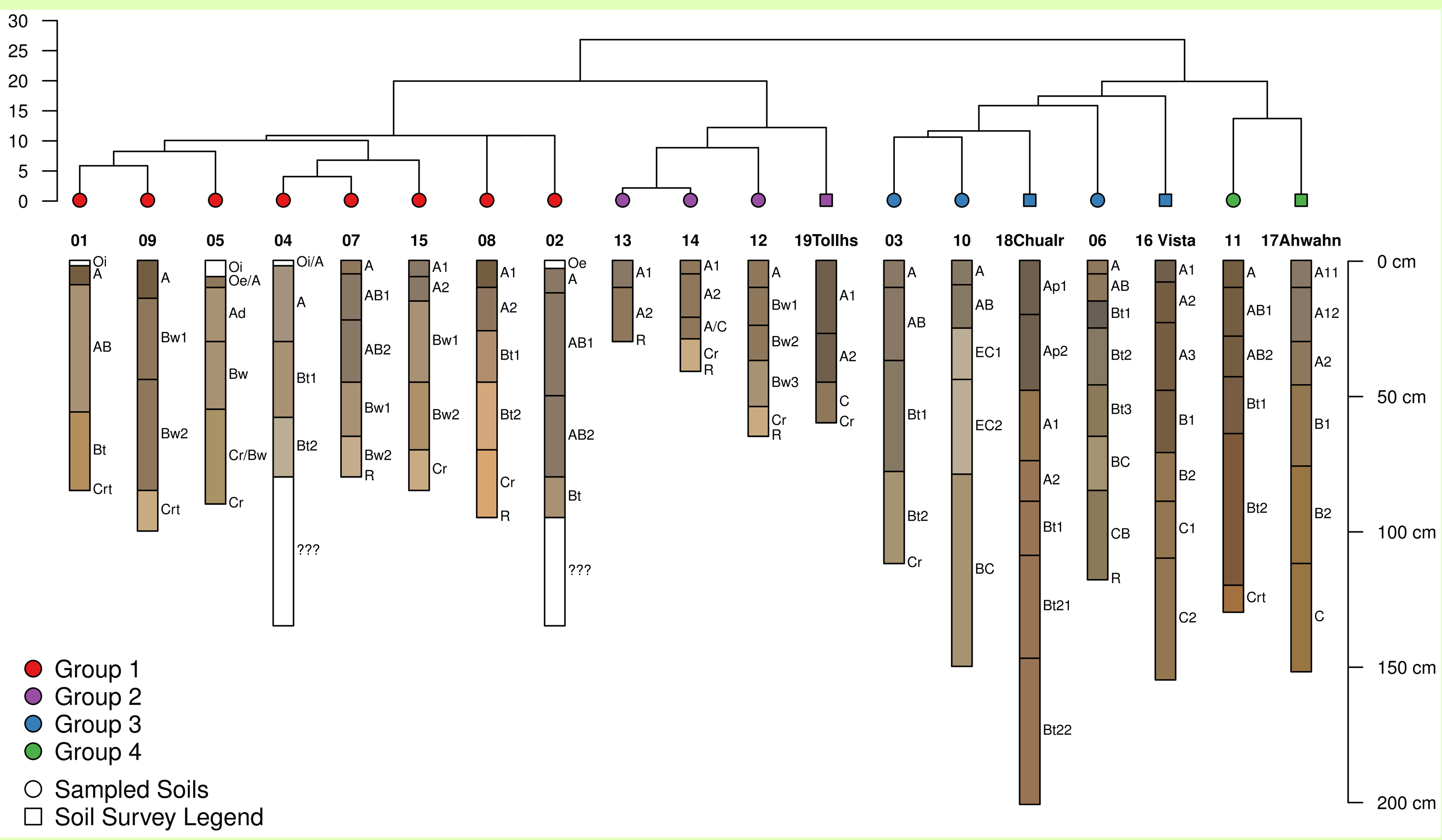

Fig. 4: Sampled soils from a granodiorite landscape along with 4 soil series mapped extensively in this region, arranged according to pairwise dissimilarities (based on soil texture, pH, CEC, carbon concentration, and Munsell chroma). Groupings are based on divisive hierarchical clustering.

R is a very powerful environment for data analysis and modelling, and offers numerous options for regression, classification, and visualisation. Repetitive tasks can also be scripted and sent to a high-performance computing grid.

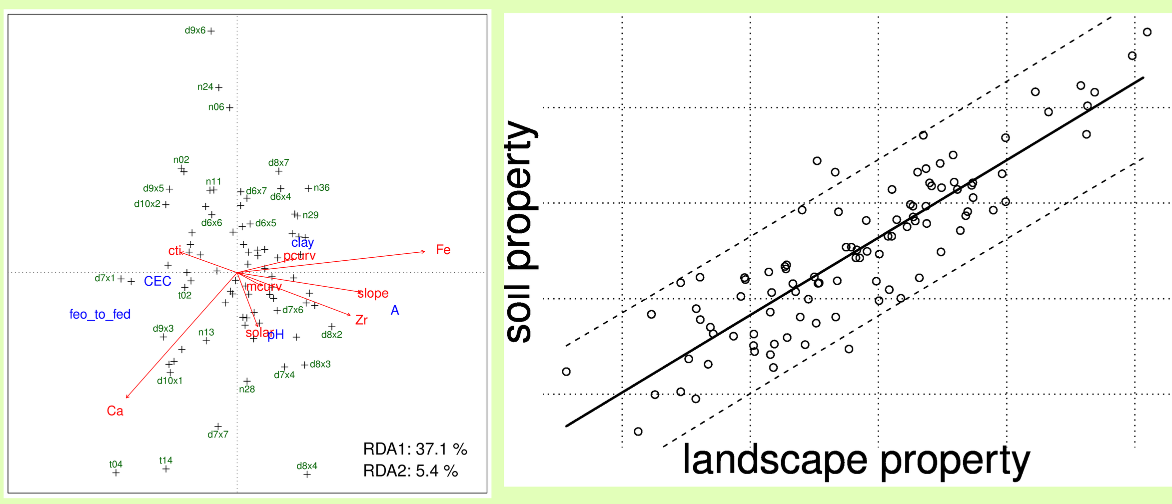

Fig. 5: (right) result of a RDA. (left) . Predicting soil properties from covariates.

Seamless binding to R's spatial analyis packages allow for rapid spatial analysis (including mapping) of attributes along depth slices, or at specified depth intervals.

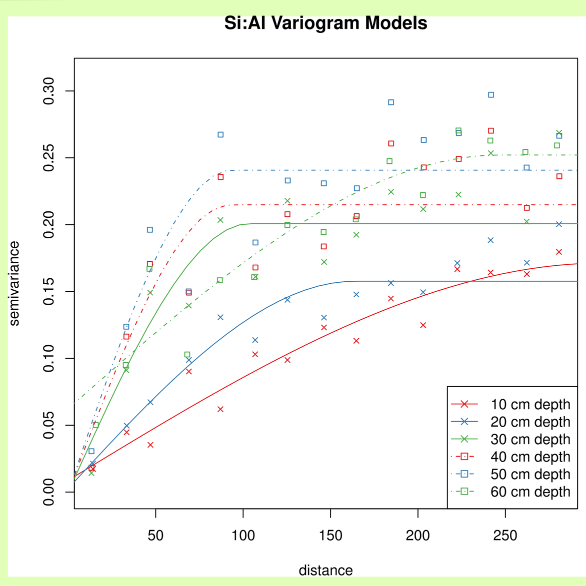

Fig. 6: variograms of Si to Al ratio at various depths.

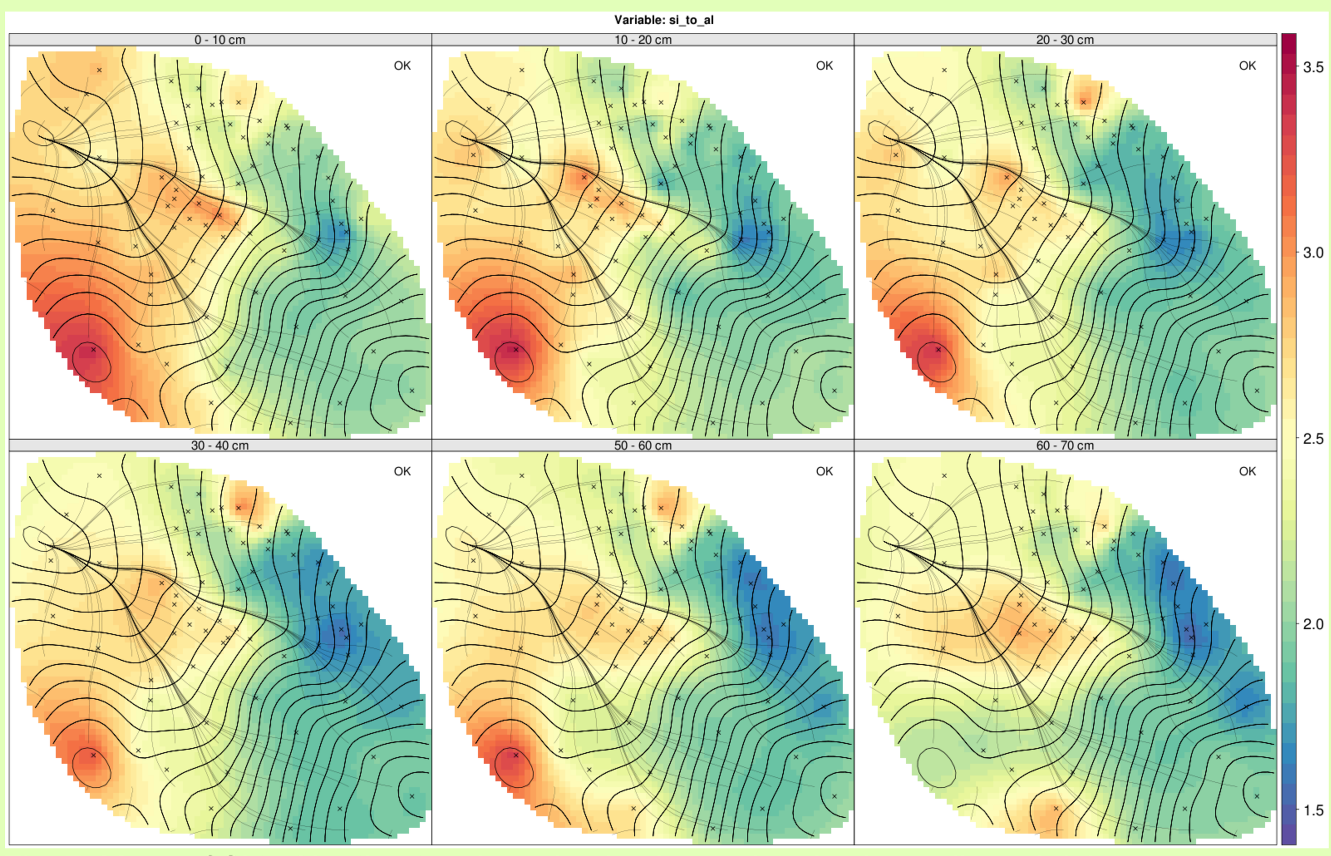

Fig. 7: Maps of Si to Al ratio at various depths. interpolated using ordinary kriging.