plotKML — a platform for scientific visualization of 2D and 3D soil data in Google Earth™

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Package design and main functionality

There is a great interest in using virtual globes (e.g. Google Earth) to visualize soil data products for several reasons: (1) Google Earth is the most widely-used geographical data browser with >1 billion downloads (since October 2011), (2) KML is a leading **OGC XML** Encoding Standard for Observations and Measurements, (3) Google Earth provides a large collection of contextual spatial data layers (Ikonos and GeoEye high resolution imagery, administrative vector data, SRTM DEM, web-contributed content).

plotKML, an R package contributed by the authors via R-forge, provides a number of elementary and wrapper functions for the visualization of soil data products in Google Earth. It offers R users a toolset for visually exploring spatio-temporal data: sampling locations, mapping units (polygons), soil property maps (gridded maps), vertical profiles, ground photographs and similar. It helps soil surveyors validate soil survey data and derived predictions.
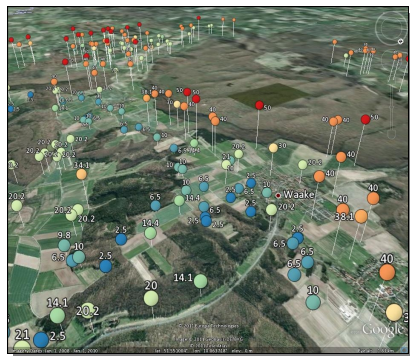

Fig. 1: Observed sand content (in percent) displayed using both altitude and color aesthetics. Ebergötzen case study.

Supported classes / data formats

The packages is designed to work with spatial packages: **sp**, **spacetime**, **raster**, **aqp** and similar. It basically writes R objects (data structures in R) into styled KML documents. It allows visualization of geographical layers similar to cartographic plots available in a variety of proprietary software.

The wrapper functions allow direct visualization of the results of analysis together with all inputs and model parameters. The figure on the left shows the results of visualizing the **SpatialPredictions**-class, contributed by the authors.
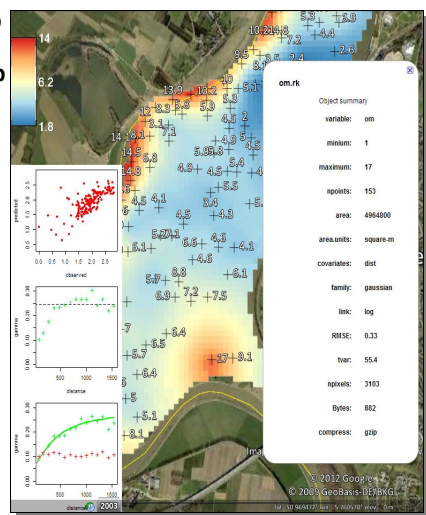

Fig. 2: Visualizing results of geostatistical mapping in Google Earth: sampling locations and observed values (organic carbon in top-soil), predicted values and model parameters.

Visualizing soil profile data

In the **aqp** package, one can construct **SoilProfile**-class objects that can then be visualized via plotKML as 3D objects. In this case we use altitude to represent different depths, so that a soil profile appears to stand above land surface. For practical purposes, profile depths also need to be exaggerated to allow visual comparison and interpretation (see figures below).
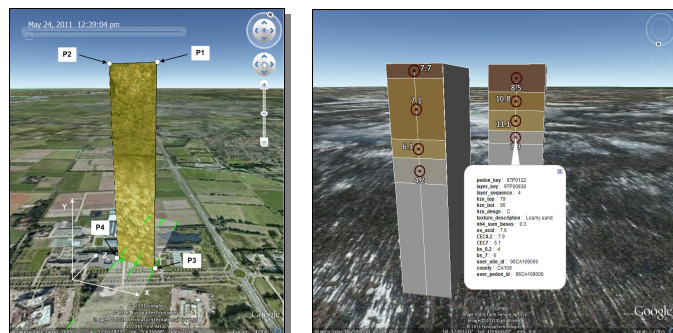

Fig. 3: Visualizing soil monoliths in Google Earth.

Conclusions and next steps

KML could serve as an universal soil-data products delivery platform as both description of the data, view on the data and links to the actual data can be embedded in a single KML/KMZ document.

We can foresee that the whole spatial analysis projects in the near future could be delivered as a single KMZ file (instead of MS Powerpoints for example), which would then contain all input and output data, description of the processing steps, metadata, video manuals, slides and similar. The users would only need to install Google Earth or KML compatible browser and then browse all attached geographical and textual/statistical data without a need for a training. The same way Iphone users find their way to using this device without reading any manual or following a training course.
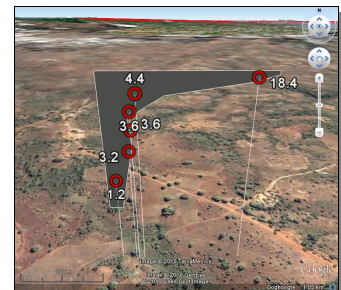

Fig. 4: Mass-preserving spline fitted to organic carbon data (in permilles) and visualized in Google Earth.

References:

- Algorithms for Quantitative Pedology (http://CRAN.r-project.org/package=aqp)
- Google Earth Outreach project (http://earth.google.com/outreach/tutorials.html)
- plotKML project URL (http://plotkml.r-forge.r-project.org/)

ISRIC World Soil Information