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Quantifying the uncertainty of regional and national estimates of soil carbon stocks

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At regional and national scales, carbon (C) stocks are frequently estimated by means of regression models. Such statistical models link measurements of carbons stocks, recorded for a set of soil profiles or soil cores, to covariates that characterize soil formation conditions and land management. A prerequisite is that these covariates are available for any location within a region of interest G because they are used along with the fitted regression coefficients to predict the carbon stocks at the nodes of a fine-meshed grid that is laid over G. The mean C stock in G is then estimated by the arithmetic mean of the stock predictions for the grid nodes. Apart from the mean stock, the precision of the estimate is often also of interest, for example to judge whether the mean C stock has changed significantly between two inventories.

The standard error of the estimated mean stock in G can be computed from the regression results as well. Two issues are thereby important: (i) How large is the area of G relative to the support of the measurements? (ii) Are the residuals of the regression model spatially auto-correlated or is the assumption of statistical independence tenable? Both issues are correctly handled if one adopts a geostatistical block kriging approach for estimating the mean C stock within a region and its standard error.

In the presentation I shall summarize the main ideas of external drift block kriging. To compute the standard error of the mean stock, one has in principle to sum the elements a potentially very large covariance matrix of point prediction errors, but I shall show that the required term can be approximated very well by Monte Carlo techniques. I shall further illustrated with a few examples how the standard error of the mean stock estimate changes with the size of G and with the strenght of the auto-correlation of the regression residuals. As an application a robust variant of block kriging is used to quantify the mean carbon stock stored in the soils of Swiss forests (Nussbaum et al., 2012).

Nussbaum, M., Papritz, A., Baltensweiler, A., and Walthert, L. (2012). *Organic carbon stocks of swiss forest soils*. Final report, Institute of Terrestrial Ecosystems, ETH Zürich and Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), pp. 51, http://e-collection.library.ethz.ch/eserv/eth:6027/eth-6027-01.pdf