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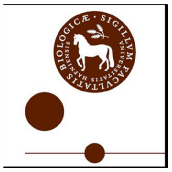

MSc Thesis topic:

Assessing Soil Carbon Stocks in the Mae Sa Noi Sub-watershed

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Abstract

Soil organic carbon (C) stocks form a very important component of a larger set of ecosystem services, provided by South East Asia's watersheds. Quantifying these carbon stocks under changing land use is one objective of sub-project C4.2 in the SFB 564 Uplands Program. Data on aboveground carbon stocks is relatively easy to obtain and is available for many ecosystems. Few datasets exist however, for soil C, particularly for (re)forested parts of the Mae Sa Noi sub-watershed. Furthermore, few reliable methods exist for upscaling C estimates from isolated case studies to regional scales, especially validated methods which do not require large amounts of data. If reliable C prediction algorithms can be constructed, based on validated and easily obtainable remote sensing data such as topography; substantial time and costs spent on sampling could be avoided.

196 topsoil and subsoil auger samples to a depth of 75cm were collected from a 2 km^2 forest at Mae Sa Mai using a grid sample layout and analysed for organic C, total nitrogen, pH and texture. C values were entered into a GIS and 75% of the dataset were used to construct five spatially explicit C models: ordinary Kriging (OK), coKriging (CoKr), spline with tension (SWT), inverse distance weighting (IDW), general linear mixed model (GLMM); and one global model: least squares regression (LS). The models were validated independently with the remaining 25% of the data. Regressions of C against hydrotopographic features (elevation, slope, wetness index, among others) were examined in order to draw conclusions about the major determinants of C distribution in the forest. Effects of soil and vegetation classes on C variation were also examined. Finally, C stocks were quantified, considering horizon thickness and bulk density, for both the forest and the Mae Sa Noi sub-watershed, by combining new and existing datasets.

Upon validation the models predicted topsoil carbon values in the following order of accuracy, from best to worst: CoKr > IDW > SWT > OK > LS > GLMM and for the subsoil:

IDW > SWT > OK > CoKr > GLMM > LS. Cokr (utilizing elevation as an auxiliary) could predict topsoil C concentrations with a mean prediction error of 233 g/kg (23.3%) and IDW for the subsoil, at 284 g/kg (28.4%). Differences between model scores however, were very small.

It was found that a combination of hydrotopographic, soil and vegetation data could explain 22.6% of topsoil C variation for a grid pattern, but 58.7% for a transect line on which models were improved with the addition of bulk density, texture and pH data. Elevation was the strongest topographic predictor of soil C explaining 25% of the C variation.

Significant effects of soil could not be discerned probably due to small within group sample sizes, however a statistically significant vegetation effect was detected, with a 0.5% reduction in mean C concentration being detected under banana when compared to evergreen forest.

The 2.49ha forest (to 75cm depth) is estimated to have a mean carbon density of 154.9 +/- 3.0 Mg C ha^{-1} and approximately 38,470 Mg of soil organic carbon.

Keywords: soil carbon stocks, topographic, spatial distribution, validation