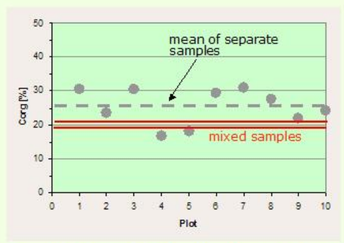
CarboInvent

Inventories of Forest Soil Carbon Stocks

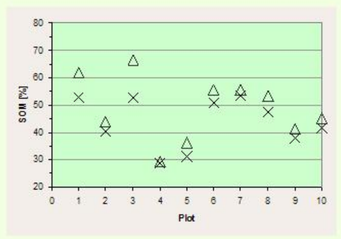
II. Methodology - Sampling

PLOT LEVEL METHODOLOGY

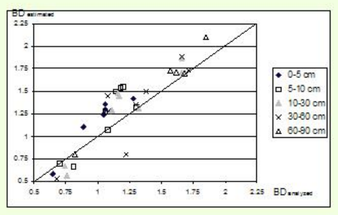
Site/forest stand



Spatial variability in 10m transect
Corg [wet oxidation]



Variability of C analysis
△= Loss on Ignition (LoI)
X = Wet Oxidation (x 1.724)



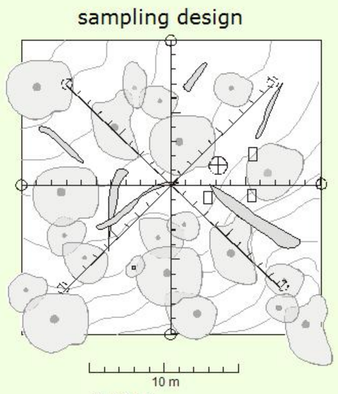
BD measured and estimated (Baritz 2002)
(data provided by Zoth and Block 1993)

spatial variability

microspatial variability/ number of sub-plots

separate subsamples vs. mixed samples

sampling design



data comparability

data/inventory sources

continuity of method

mineral soil **forest floor**

C concentration [C_{conc}]

bulk density

estimated *measured*

stone content

estimated *measured*

amount of fine SOM

Mass of fine earth [M_{fe}]

Uncertainty

C stock [t/ha]

Soil C stock estimate

1. **SAMPLING**

2. **LABORATORY ANALYSIS**

3. **CALCULATIONS**

Bulk density estimated
Example: pedo-transfer function (AK Standortskartierung 1994)

$BD_{est} = (2{,}65 - 0.015 * \%\ humus) * (1\text{-}TPV/100)$

BDest = bulk density estimated [g cm-3]
TPV = total pore volume

Mfe = BD x area x depth (homogenous sample)

Bulk density measured
(stones in the cylinder must be subtracted)

Mfe for high stone content (according to Block 1999)

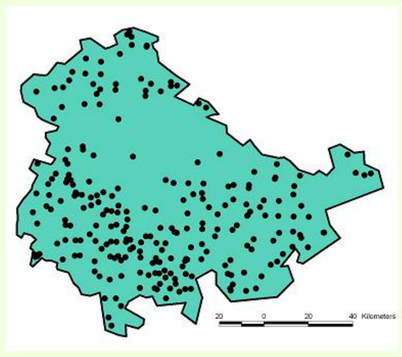
$$Mfe(layer) = \frac{V_{layer} * (1 - P_{stones}) * (M_{tot(sample)} - M_{stones(sample)})}{V_{tot(sample)} - V_{stones(sample)}}$$

V = volume of the layer
P = field-estimated proportion of stones
$M_{tot(sample)}$ = total mass of cylinder sample [g]
$M_{stones(sample)}$ = mass of stones in the cylinder sample [g]
$V_{tot(sample)}$ = total volume of the cylinder [cm^{-3}]
$V_{stones(sample)}$ = volume of stones in the cylinder sample [cm^{-3}]

REGIONAL/COUNTRY-LEVEL REPRESENTATIVITY

Example: Test area Thuringia

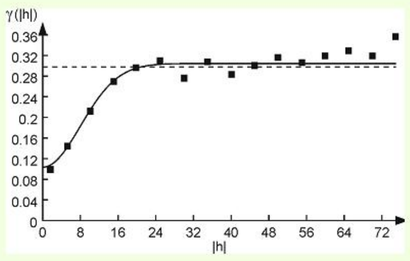
Zirlewagen D. (2003). Developing a sampling concept for the test area Thuringia with regard to the particular (existing) data base situation. CarboInvent, Internal Report.



Distribution of plots with mineral soil samples
N = 250 (Wirth et al. 2003)

Wirth, C. et al. (2003). Dynamik der Kohlenstoffvorraete der Waelder Thueringens. Abschlussbericht BMBF 01LK9901. Max Planck Institut fuer Geochemie, Jena, 2003.

1. Quantitative description of spatial structure using variograms

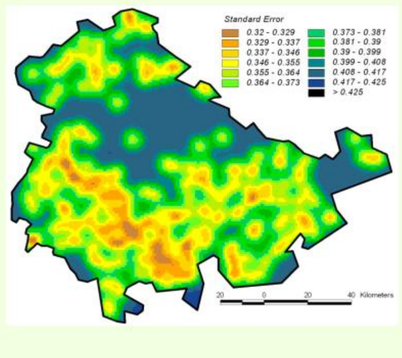


mineral soil 0-60 cm

2. Modelling spatial uncertainty

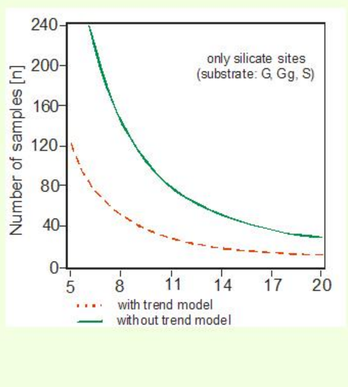
Kriging after applying a trend-surface-model (linear regression model with elevation as independent variable)

Semi-variance as measure of the error mean square of space-dependent C stock estimates.



3. Calculating necessary sampling intensities

Number of samples needed to obtain C-stock estimates within various accuracy ranges (**percentage of mean**); at 10% confidence level.



4. Detection of representativity lacks

			MINERAL SOIL SAMPLING					
			current soil inventory status			minimum number of soil samples for leveling out negative representativity lacks		
Tree species / substrata		forest area [%]	soil data [n]	soil data [%]	diff [%] soil data – forest area	new samples [n]	new share [%]	diff [%] soil data – forest area
KI	C/CT/T	1,9	13	5,3	3,3		4,4	2,5
	G/Gg	1,4	5	2,0	0,7		1,7	0,3
	L	0,8	3	1,2	0,4		1,0	0,2
	LL	0,3	3	1,2	0,9		1,0	0,7
	S	8,8	30	12,1	3,3		10,1	1,3
LB	C/CT/T	16,2	15	6,1	-10,1	29,8	15,2	-1,0
	G/Gg	5,9	15	6,1	0,2		5,1	-0,8
	L	3,7	2	0,8	-2,9	8,5	3,6	-0,1
	LL	4,4	19	7,7	3,3		6,4	2,0
	S	3,7	7	2,8	-0,8	2,5	3,2	-0,5
NB	C/CT/T	4,5	8	3,2	-1,3	3,9	4,0	-0,5
	G/Gg	34,4	90	36,4	2,0		30,4	-4,0
	L	2,2	10	4,0	1,9		3,4	1,2
	LL	1,2	4	1,6	0,4		1,4	0,2
	S	10,8	23	9,3	-1,5	4,5	9,3	-1,5
					Sum:	49,2		

C / CT = carbonate sites
G = granite and gneiss with less skeleton
Gg = granite and gneiss with more skeleton
L / LL = loamy sites
S = sand(stone)
LB = deciduous forests
NB = coniferous forests (without pine)
KI = pine forests

Proportion of soil inventory plots according to dominant tree species and soil substrate relative to forest area; highlighted is the minimum number of required additional soil samples to level out representativity lacks.

5. Identification of additional sampling plots

Fazit

Optimize forest soil carbon inventories as to detect changes given the uncertainties of the sampling and regional assessment methods. Forest floor and mineral soil carbon have to be considered separately. Further multivariate approaches need to be tested.

CarboInvent work package "Soil Carbon Inventories" will apply and compare existing, and develop and test new methodologies to assess the distribution of regional and national soil carbon stocks. The evaluations will be accompanied by a careful assessment of plot level and upscaling-related uncertainties, so that the value of forest soil inventories to assess changes in soil carbon stocks can be judged.

For several regional and national examples, bottom-up approaches using data from discrete sampling sites from various grid densities will be conducted. The methods will allow to connect soil and forest (biomass) inventories. Default values will be calculated to allow generalized top-down calculations in order to cross-check the bias and validity of national estimates. The evaluations will concentrate on 6 test countries (SE, FI, DE, AT, ES, IE) and 4 test areas (FI, DE, AT, ES). The calculations will allow to derive baseline soil carbon stocks for the reporting of soil carbon sinks.

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