

Regional and depth distribution of soil carbon amounts in Finland

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Introduction

Carbon stores in forest ecosystems can be allocated to the tree biomass and soil pools. Because of the difference in the nature of the carbon balance of upland and organic (peat) soils, it is sensible to separate these major soil types. The store of carbon in Finnish peatlands dominates (Kauppi et al. 1997):

Pool	Tg	%
Tree biomass	618	10
Upland forest soils (70 cm)	1040	16
Peat	4800	74

Because of the thickness of the peat deposits, much of the carbon in peat, however, is stable. The stock of carbon in upland forest soils is comprised of that in the surface organic (humus) layer and that in the mineral soil. The pool of carbon in upland forest soils can be expected to be less stable than that of peat because of the more rapid turnover of organic matter and impacts of forestry management and land-use change. The store of carbon in trees is subject to much more fluctuation; increasing as the stand grows, but then suddenly diminishing upon harvesting.

Aim of the presentation

In this presentation, we describe the pool of carbon in upland forest soils, its vertical distribution and regional variation.

Methods

Samples of the organic layer and underlying mineral soil down to 70 cm depth were taken from about 500 plots selected from a systematic network of national forest inventory plots (Tamminen & Starr 1990). The samples were air-dried, organic samples were ground into a powder and the mineral soil samples sieved to retain the under 2 mm fraction. Total carbon concentrations were analysed from all organic layer (mor, moder, peaty) samples and from a selection (259) of the mineral soil samples using a Leco CHN-analyser. The carbon concentration for the remaining mineral soil samples (1500) was predicted using a regression equation based on the 259 samples and organic matter content (determined as loss-on-ignition) and sampling depth as predictors ($R^2=0.98$).

Results

Carbon concentrations decrease rapidly with depth (Fig. 1). The organic layer has a carbon content of 15 to 58 % and that of the mineral soil layers, from 0 to 15 %. The correlation between carbon concentration and sampling depth was highest when the logarithm of both variables was used. Carbon concentrations in the organic layer showed a normal bell-shaped distribution, but concentrations in the mineral soil were very skewed, with many low values a few high values.

Depth profile of carbon concentration

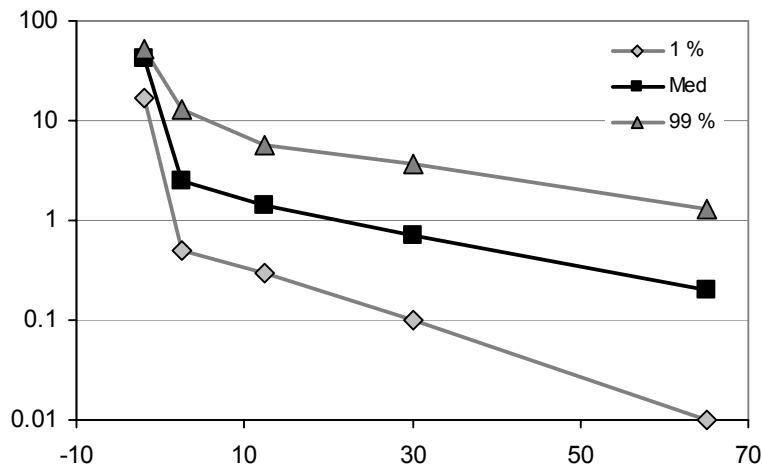


Figure 1. Carbon concentration as a function of sampling depth.

Average amounts of carbon (Mg/ha) in the organic layer and the 0-20 cm mineral soil layer were similar, but that in the 20-40 cm layer was half of that in the organic layer and 0-20 cm layer (Table 1).

Table 1. Amount of carbon by soil layer (Mg/ha)

Layer	Median	Min–Max
Organic layer	18	0–101
Mineral soil 0–20 cm	21	2–94
Mineral soil 20–40 cm	10	0–78

Organic layer carbon amounts were highest on moist sites having a peaty organic layer and on medium fertile sites. The lowest amounts were associated with the least fertile sites and in stands, where the organic layer is thin. The amount of carbon in the organic layer showed a weak geographic trend (Fig. 2a). Amounts increased slightly with latitude ($r = 0.10$), i.e. the ratio between organic matter production and decomposition seems to be higher in northern compared to southern Finland.

Carbon amounts in the surface mineral soil were the highest on the most fertile sites, sites with fine-textured soils dominated by deciduous trees or Norway spruce, and lowest on coarse-textured and stony soils dominated by Scots pine. There was a weak trend for mineral soil carbon amounts to increase towards the south (Fig. 2b).

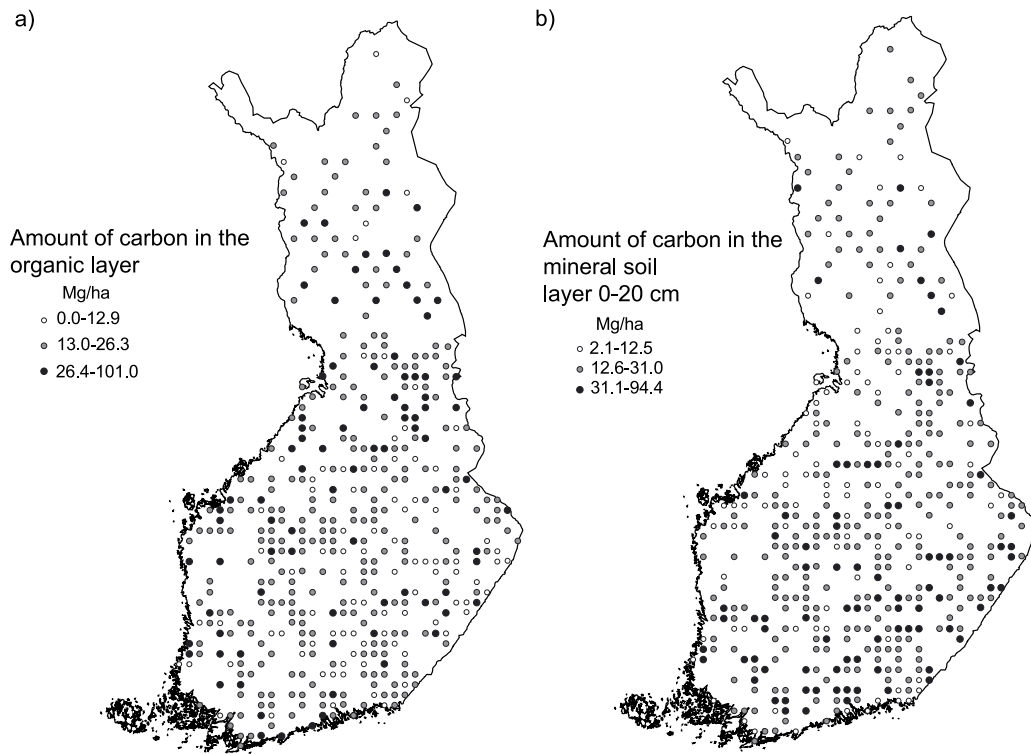


Figure 2. Amount of carbon (mg/ha) in the organic layer (a) and in the mineral soil layer 0-20 cm (b).

References

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