Mineral soil in forests accumulates carbon as trees grow

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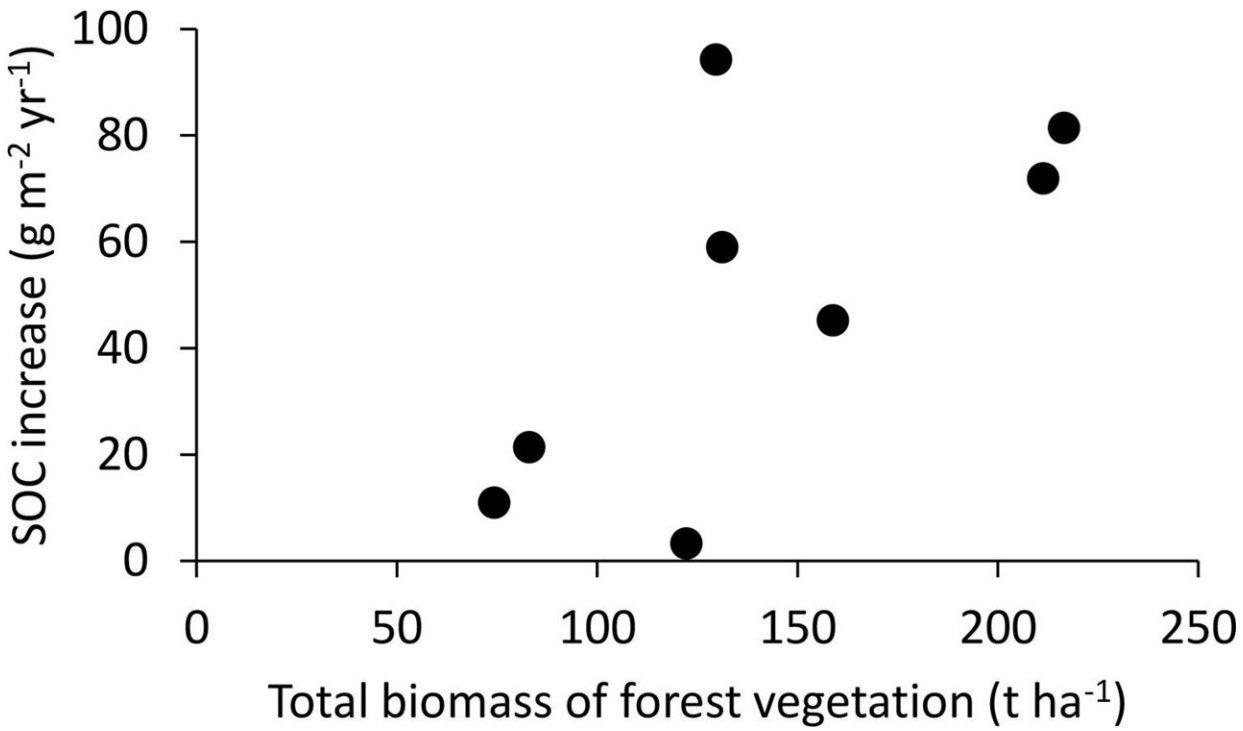

Graphical abstract. Credit: *Ecological Indicators* (2022). DOI: 10.1016/j.ecolind.2022.109551

A recent study by the Natural Resources Institute Finland (Luke) investigated the accumulation of soil carbon in forest sites monitored intensively in the long term. In mature spruce- and pine-dominated forests where the growing stock volume increased, the soil acted as a

carbon sink. In turn, natural damage and roundwood removals reduced soil carbon stocks.

The study focused on changes in carbon stocks in mineral soil forests. Research sites were monitored in 14 forests across Finland for more than 20 years. Carbon stocks in soil were determined in 1995, 2006 and 2016 as part of the UNECE's International Cooperative Program on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests). In addition, the study identified how changes in soil carbon stocks is linked with various soil factors and forest characteristics.

Carbon stocks were higher in spruce forests than in pine forests, and the high volume of plant litter correlated with the size of carbon stocks in forest soil. On average, carbon stocks in forest soil (organic layer and the first 40 cm of the mineral soil layer) increased annually by 36 grams per square meter. The more organic matter of vegetation origin a forest had and the higher fertility a site had, the higher was the growth rate of carbon stocks in forest soil layers.

"According to one of our new and interesting findings, the surface layer of mineral soil underneath the organic layer comprises significant carbon stocks and it also accumulates carbon as forests grow older," says senior scientist Antti-Jussi Lindroos.

Carbon stocks in forest soil decreased in two spruce-dominated sites in which natural damage and resulting harvesting operations reduced the growing stock.

"We need more measurements of the development of carbon stocks in soil after clear cutting to identify for how long carbon stocks in soil decrease after harvesting," says research professor Raisa Mäkipää.

The study proved the value of long-term monitoring and field trials.

What makes the study particularly important is that changes in carbon stocks were determined accurately in specific locations over more than 20 years. Principal scientist Päivi Merilä emphasizes that the time series collected using comparable methods have various uses in forest research, the documentation of environmental changes, and related model development.

The research was published in *Ecological Indicators*.

More information: Antti-Jussi Lindroos et al, Soil carbon stock changes over 21 years in intensively monitored boreal forest stands in Finland, *Ecological Indicators* (2022). DOI: 10.1016/j.ecolind.2022.109551

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