Forest soil carbon stock estimates in a nationwide inventory: evaluating performance of the ROMULv and Yasso07 models in Finland

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Dynamic soil models are needed for estimating impact of weather and climate change on soil carbon stocks and fluxes. Here, we evaluate performance of Yasso07 and ROMULv models against forest soil carbon stock measurements.

More specifically, we ask if litter quantity, litter quality and weather data are sufficient drivers for soil carbon stock estimation. We also test whether inclusion of soil water holding capacity improves reliability of modelled soil carbon stock estimates. Litter input of trees was estimated from stem volume maps provided by the National Forest Inventory, while understorey vegetation was estimated using new biomass models. The litter production rates of trees were based on earlier research, while for understorey biomass they were estimated from measured data. We applied Yasso07 and ROMULv models across Finland and ran those models into steady state; thereafter, measured soil carbon stocks were compared with model estimates.

We found that the role of understorey litter input was underestimated when the Yasso07 model was parameterised, especially in northern Finland. We also found that the inclusion of soil water holding capacity in the ROMULv model improved predictions, especially in southern Finland. Our simulations and measurements show that models using only litter quality, litter quantity and weather data underestimate soil carbon stock in southern Finland, and this underestimation is due to omission of the impact of droughts to the decomposition of organic layers. Our results also imply that the ecosystem modelling community and greenhouse gas inventories should improve understorey litter estimation in the northern latitudes.