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Greenhouse gas balance of a Scots pine forest using biometric, eddy covariance and chamber measurements.

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In recent years, the status of forests as sources or sinks of carbon has received much attention. Nonetheless, evidence-based long-term estimates of the magnitude of the carbon sequestration in forests are still scarce. In this study we present two independent estimates of net carbon sequestration in a temperate Scots pine dominated forest ecosystem over a 9 year period (2002-2010) and in addition, to determine the full greenhouse gas balance, the first results of automated chamber measurements of N2O and CH4. First, the net ecosystem carbon balance (NECB) was estimated from net ecosystem CO_2 exchange as measured by the eddy covariance technique (NECBEC). To this end, the eddy covariance estimates were combined with non-CO_2 carbon fluxes such as DOC leaching and VOC emissions. The second approach to determine the carbon sequestration was based on the changes in the ecosystem carbon stocks over time (NECBSC). For this NECBSC estimate, two assessments of the ecosystem carbon stocks (2002 and 2010) were compared. Results showed that the eddy covariance approach estimated a net uptake of 2.4 $\pm$ 1.25 tC ha-1 yr-1, while the stock based approach suggested a carbon sink of 1.8 $\pm$ 1.20 tC ha-1 yr-1. No significant change was observed in the mineral soil carbon, while the carbon stock of the litter layer slightly decreased. Phytomass was thus the main carbon sink (2.1 tC ha-1 yr-1) in the pine forest, predominantly in the stems (1.3 tC ha-1 yr-1). The fact that stem wood is the main carbon sink within the ecosystem implies that the future harvesting has the potential to fully offset the CO_2 uptake by this Scots pine forest. Estimates of the impact of N2O and CH4 emissions from the soil on the total greenhouse gas budget will be presented.