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Seasonal and diurnal dynamics of CO_2 balance in two hemi-boreal forests in Estonia

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Two eddy towers, one in the mixed Norway spruce – Silver birch forest in Liispõllu (58°16′N 27°16′E tower height 20 m) and another one in Scots pine forest in Soontaga (58°01′N 26°04′E; 36 m) both located in southern Estonia - were equipped with CO_2/H_2O analyzer for mixing ratio of CO_2 (Licor 7200 Li-Cor Inc, Lincoln, NE, USA) and 3-D ultrasonic anemometer for wind measurements (Gill Windmaster Pro; Solent, Lymington, UK) and used for measurement of carbon dioxide balance and net ecosystem exchange (NEE). In Liispõllu, the studies were conducted in Auguat and September 2011 above the forest canopies and at 1.5 m above the soil surface.. In Soontaga, measurements lasted from April to October 2012. The data acquisition system consists of the LI-7550 Analyzer Interface Unit, 3G wireless router and analog-to-digital converter that were used to record turbulence and scalar signals. Signals from the sensor and anemometer were recorded 20 times sec-1. The eddy fluxes were averaged over 30 minute time intervals. The flux calculations and corrections of were done using EddyPro program. In addition, soil respiration was measured with automatic chambers in Liispõllu and with closed chambers in Soontaga twice a month from April to October 2011 and 2012. In both study areas around the towers, soil physical and chemical parameters in 3 depths, biomass of trees and understory species, C sequestration in biomass and litter decay has been measured. In Soontaga pine forest the average monthly CO_2 flux varied from -59.2 to -388.8 mg m-2 h-1 showing a regular seasonal temperature-related variation.
CO_2 flux from lowered in spring and summer as plants consume the gas through photosynthesis and days are longer, and rise during the autumn and winter as plants go dormant, die and decay and when also the daytime is shorter. The average monthly flux over the analyzed period was -246.5 mg m-2 h-1. In consequence, the CO_2 sequestration from the atmosphere was highest in June.
In Liispõllu, the CO_2 flux for the two-months study period was was estimated -250 mg m-2 h-1. While above the forest canopy the uptake of CO_2 by the plants during daytime was registered, the understory showed a constant release of carbon dioxide.