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Clear-cutting is causing large emissions of greenhouse gases – are there other harvest options that can avoid these emissions?

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Carbon sequestration in forests can potentially be enhanced through optimized forest management strategies and thus, mitigate climate change. However, carbon dioxide is not the only greenhouse gas (GHG) that is being exchanged between a forest ecosystem and the atmosphere; also methane and nitrous oxide are involved through different processes. A full assessment of the benefits of any management practice aiming at increasing the capacity of forests to mitigate climate change has to include all greenhouse gases.

The effects of clear-cutting on GHG fluxes were studied at Norunda forest in central Sweden. Two different plots were established on a new clear-cut. Both plots were clear-cut (early 2009) and subsequently site prepared. On each of the plots, a 3 m high tower was erected and equipped for flux-gradient measurements of CO_2, H_2O, CH4 (May 2010 –) and N2O (June 2011 –). The clear-cut became waterlogged after harvest in 2009. One of the plots was significantly wetter than the other. All plots were on average sources of CO_2, with daily average fluxes ranging between -2.5 and +5.8 μmol m¬-2s-1. The ingrowth of new vegetation was faster on the wetter plot, resulting in lower average CO_2 emissions. Preliminary results indicate a switch from a weak CH4 sink to a significant CH4 source at both plots with higher emission from the wetter plot. Daily average CH4 fluxes ranged between -7.0 – +208.7 μmol m¬-2h-1. There were significant N2O emissions on all plots during the main growing season of 2011, with large emissions following heavy rain events. N2O fluxes ranged between -36.2 and +403.7 μg m¬-2h-1 but without clear differences between wetter and drier plots as in the case with CO_2 and CH4.

Although clear-cutting is the most common harvest method in Sweden today, other methods such as selective cutting are being increasingly discussed. We therefore studied the effects of thinning on soil and ecosystem carbon fluxes in the mature part of Norunda forest, located just beside the clear-cut experiment. The CO_2 fluxes from the forest were measured by eddy covariance method while soil CO_2 and CH4 effluxes were measured by automatic chambers. The thinning was made in November/December 2008. Immediately after the thinning, we found significantly higher soil effluxes, probably due to increased decomposition of dead roots but the soil was still a sink of CH4. The stand level flux measurements showed no effect on total ecosystem respiration, probably because of reduced autotrophic respiration from canopy layer. Initially the GPP was slightly reduced as compared to the non-thinned sector but already after 6-7 months, no effect of the thinning on GPP could be detected.

The results indicate that selective harvest such as thinning has the potential to avoid the emissions that occur after a heavy disturbance such as that caused by clear-cutting. Thus, more efforts should be made to study the long-term effects on the total GHG exchange by selective harvest methods as compared to clear-cut methods.