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PO Box 117
221 00 Lund
+46 46-222 00 00

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WATERLOGGING AFTER CLEAR-CUTTING TURNS BOREAL FOREST SOILS INTO SOURCES OF METHANE

Patrik Vestin (1), Anders Lindroth (1), Meelis Mölder (1), Margareta Hellström (1), Elin Sundqvist (1), Leif Klemedtsson (2)
(1) Department of Earth and Ecosystem Sciences, Lund University, Sweden
(2) Department of Plant and Environmental Sciences, Gothenburg University, Sweden
Patrik.Vestin@nateko.lu.se

Clear-cutting and subsequent site preparation is common forest management practice in Sweden. According to the Swedish National Forest Inventory [1], final fellings were carried out on 170.000 ha during 2009. The net effects of final fellings on greenhouse gas fluxes are not well understood.
Increased substrate availability for decomposers following harvest may result in higher carbon dioxide (CO_2) emissions from soils and in increased nitrogen mineralization (e.g. [2]). This may be further enhanced by increased soil temperatures after site preparation. In addition, removal of trees causes reduced evapotranspiration and subsequently, a raised ground water table. Boreal forest soils are normally sinks of atmospheric methane (CH_4) (e.g. [3]; [4]), with soil water content, nitrogen availability [5] and soil temperature (see review [6] and references therein) as main factors controlling CH_4 exchange between the biosphere and the atmosphere.
The net effects of clear-cutting on CH_4, CO_2 and H_2O fluxes were studied at Norunda forest in central Sweden. Micrometeorological measurements (i.e. flux-gradient and eddy covariance) allowed for quantification of CO_2, CH_4 and H_2O fluxes at two plots at a new clear-cut during the growing season of 2010. Soil chamber measurements (CO_2, CH_4 and H_2O) were carried out in the adjacent forest stand during the main growing season and at the clear-cut during October-November 2010.
The clear-cut became waterlogged after harvest and preliminary results indicate a switch from a weak CH_4 sink to a significant CH_4 source at both plots. Daily average fluxes during the period 20 May through 30 November were in the order of -6.3 – 142.5 µmol $m^{-2}hr^{-1}$ (fig.1) with mean values of 39.0 µmol $m^{-2}hr^{-1}$ (plot 1) and 16.3 µmol $m^{-2}hr^{-1}$ (plot 2). The preliminary results also indicate increased soil temperatures at disturbed microsites and enhanced CO_2 emissions. Data will be further analyzed and presented at the conference.

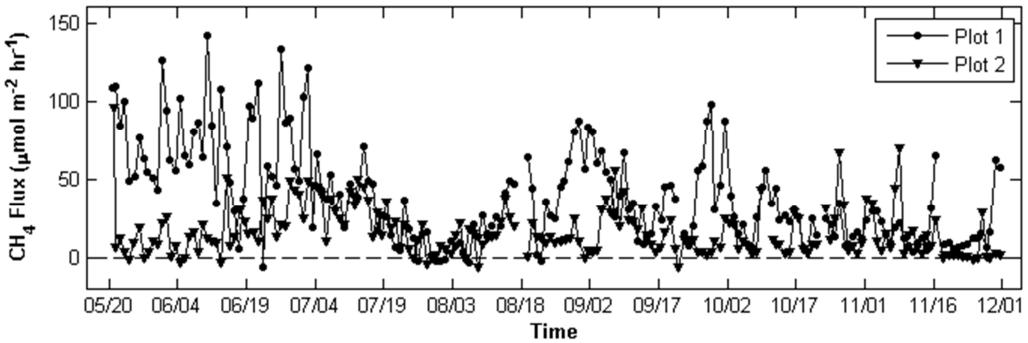


Fig 1. Daily average CH_4 fluxes at plot 1 (circles) and plot 2 (triangles) measured with the flux-gradient technique at the Norunda clear-cut during the period 20 May through 30 Novemver 2010. Both plots are, on average, significant CH_4 sources. The decreasing trend from mid-June through late July coincides with a period with low amounts of precipitation and decreasing soil water content.

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