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Fluxes of methane and nitrous oxide in an unmanaged old growth beech forest during winter

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The aim of this work was to investigate the dynamics of methane and nitrous oxide fluxes in the Hainich National Park (Thuringia, Germany) during winter time. For that, 15 frames for the application of the static (closed) chamber technique have been installed at the forest floor, soil temperature and soil moisture have also been measured. From November 2005 to September 2006, we determined sink and source strengths of the fluxes and studied the factors controlling the fluxes.

Data evaluation aimed to test the hypothesis that soil moisture, soil temperature and soil compaction are closely related to the gas fluxes. While CH_4 fluxes were closely related to all three factors, N_2O fluxes appeared (a) not o be affected by soil moisture, neither spatially nor temporally, (b) to be weakly related to soil compaction, and (c) not to be affected by soil temperature.

Frozen soil clearly affects gas fluxes. The average CH_4 flux for unfrozen soil was +23.0$\pm$6.6 μg CH_4 m^{-2} h^{-1}, whereas at frozen soil it was only +11.7$\pm$8.7 μg CH_4 m^2 h^1. Moreover, CH_4fluxes decreased gradually with the duration of frost, most likely due to the decreasing activity and number of methanotrophic bacteria. N_2O fluxes varied between -5.6 and +8.1 μg N_2O m^2 h^{-1} for unfrozen soil, whereas it increased to +41.3$\pm$18.1 μg N_2O m^{-2} h^{-1} on average for frozen soil. This increase is enormous and emphasizes the importance of flux measurements during winter.

The results of the gas fluxes measurements indicate that the National Park Hainich constitutes a sink of methane. Based on our measurements during the 11 months measurement period, we estimate an annual flux of -2.6 kg CH_4 ha^{-1}. Further-

more, the Hainich turns out to be only a weak source of nitrous oxide: +0.8 kg N_2O ha^{-1} a^{-1} have been interpolated from measurements during winter (4 months), +0.7 kg N_2O ha^{1} a^{-1} are estimated when taking into account the full eleven months of measurements.