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Co-effect of increased humidity and meteorological conditions on greenhouse gas fluxes in a young hybrid aspen forest

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Due to the climate change, higher precipitation and an increase in air humidity is expected in northern Europe in the near future (IPCC 2007). There are some studies about irrigation, elevated CO_2 and O_3 etc., but still we have too little knowledge about the humidity effect on the deciduous forest ecosystem.
In 2006 a free-air humidity manipulation (FAHM) facility was established in Estonia and in 2008 we started to artificially increase the air humidity in young hybrid aspen (Populus tremula L. x P. tremuloides Michx.) forest trials on an Endogleyic Planosol of former arable land. Air humidity was raised on average about 7% compared to ambient condition (Tullus et al., 2012). We measured the carbon dioxide, methane and nitrous oxide fluxes from the FAHM system using closed static chamber and gas-chromatograph techniques from July 2009 to November 2012 during snow free periods. Flux measurements were done once a month in three humidification (h) plots and in three control (c) plots. We monitored soil temperature, soil water potential (SWP), precipitation and relative humidity.
The vegetation period was rainy in 2009, droughty in 2010 and 2011 (according to SWP the drought was severe in 2011) and cold in 2012. Soil respiration was the lowest in 2011 both in c and h plots; however it was significantly higher in h. Most of the time the soil was a sink for methane, but less CH4 was oxidized in the soil of h plots. Emission of N2O did not have good correlation with air humidity, although one could observe a clear tendency of bigger N2O fluxes when soil was continuously water-saturated. Expectedly, soil respiration had strong positive correlations with soil temperature and CH4 emission demonstrated strong positive correlation with SWP. Hence, interaction of humidification and precipitation affected greenhouse gas fluxes.

IPCC, Climate Change 2007: The Physical Science Basis. Cambridge University Press, Cambridge. 2007.
Tullus A, Kupper P, Sellin A, Parts L, Sõber J, Tullus T, Lõhmus K, Sõber A and Tullus H. Climate change at northern latitudes: rising atmospheric humidity decreases transpiration, N-uptake and growth rate of hybrid aspen. PLoS ONE, 7(8): e42648. doi:10.1371/journal.pone.004248, 2012.