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Background CH_4 and N_2O fluxes in low-input short rotation coppice

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Extensively managed short rotation coppice systems are characterized by low fluxes of CH_4 and N_2O. However due to the large global warming potential of these trace gases (GWP_{100}: CH_4: 34, N_2O: 298), such background fluxes can still significantly contribute to offsetting the CO_2 uptake of short rotation coppice systems. Recent technological advances in fast-response CH_4 and N_2O analysers have improved our capability to capture these background fluxes, but their quantification still remains a challenge. As an example, we present here CH_4 and N_2O fluxes from a short-rotation bioenergy plantation in Belgium. Poplars have been planted in a double-row system on a loamy sand in 2010 and coppiced in the beginning of 2012 and 2014 (two-year rotation system). In 2013 (June – November) and 2014 (April – August), the plantation's CH_4 and N_2O fluxes were measured in parallel with an eddy covariance tower (EC) and an automated chamber system (AC). The EC had a detection limit of 13.68 and 0.76 μmol m^{-2} h^{-1} for CH_4 and N_2O, respectively. The median detection limit of the AC was 0.38 and 0.08 μmol m^{-2} h^{-1} for CH_4 and N_2O, respectively. The EC picked up a few high CH_4 emission events with daily averages $>$100 μmol m^{-2} h^{-1}, but a large proportion of the measured fluxes were within the EC's detection limit. The same was true for the EC-derived N_2O fluxes where the daily average flux was often close to the detection limit. Sporadically, some negative (uptake) fluxes of N_2O were observed. On the basis of the EC data, no clear link was found between CH_4 and N_2O fluxes and environmental variables. The problem with fluxes within the EC detection limit is that a significant amount of the values can show the opposite sign, thus "mirroring" the true flux. Subsequently, environmental controls of background trace gas fluxes might be disguised in the analysis. As a next step, it will be tested if potential environmental drivers of background CH_4 and N_2O fluxes at the plantation can be uncovered by analysing the measurements of the AC. The majority of the fluxes captured by the AC ranged between -2 and 2 μmol m^{-2} h^{-1} for CH_4, and -0.2 and 0.2 μmol m^{-2} h^{-1} for N_2O, respectively. Understanding the environmental drivers of background CH_4 and N_2O fluxes is the basis for designing reasonable gap-filling strategies, and thus for a more accurate quantification of the contribution of these gases to the overall greenhouse gas balance of low-input short rotation coppice systems. Additionally, it is also an important contribution to the current debate whether soils can be significant N_2O sinks.

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