ME-1 Integrated observations and modeling of greenhouse gas budgets at the ecosystem level in The Netherlands

Drainage induced variability of N_2O emission from grassland on peat soil

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Introduction

Approximately 42% of the Dutch agricultural land is drained using tile drains. Drain distances vary between 10 and 20 m. Of all Dutch soil types peat soils are responsible for the highest emission of nitrous oxide per unit of surface for agricultural land. The emission of nitrous oxide is characterized by its high spatial variability, to which the presence of tile drains may contribute. The objective of this study was to quantify the spatial variability due to drainage of peat soil on grassland.

Figure 1. Flux measurements using closed chambers.

Materials & Methods

Nitrous oxide emissions were measured at least monthly using the closed vented chamber method and a photoacoustic infrared gas analyzer. Measurements were performed on two fields with a different mean groundwater level ('wet' vs 'dry') and each field was drained with tile drains with an inner drain distance of 0 (control), 4, 8 and 12 m. Also, measurements were performed between the drains at two distances from the ditch (Figure 2).

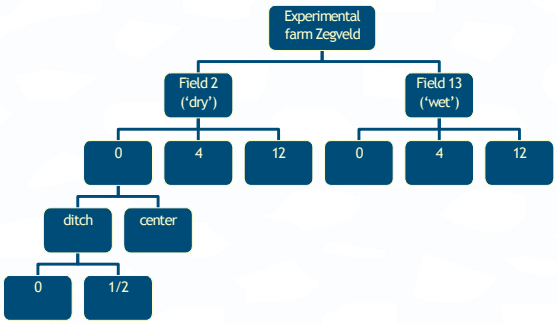

Figure 2. The experimental setup.

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Results & Discussion

Average annual emissions of nitrous oxide totaled 7659 ± 3861 g N-N_2O ha^{-1} for the dry field and 2612 ± 1845 g N-N_2O ha^{-1} for the wet field. The drain distance had little impact on annual N_2O-N emissions, but the distance from the drains explained a considerable part of the in-field spatial variability (Table 1). Also, the effect of groundwater fluctuations on N_2O emission was more pronounced for the dry field than for the wet field (Figure 3).

Table 1. Annual N_2O emissions for different treatments (g N_2O-N $ha^{-1}yr^{-1}$). Different symbols in the superscripts refer to significant differences between treatments within fields ($p<0.01$).

Field		Inner drain distance		Position		Distance to drain	
wet	2612	0	2638^{a}	ditch	2618^{a}	0	2667^{a,b}
		4	3219^{a}	center	2607^{a}	¼	3400^{a}
		8	2249^{a}			½	1770^{b}
		12	2344^{a}				
dry	7659	0	5262^{a}	ditch	7754^{b}	0	7810^{a}
		4	8482^{b}	center	7563^{b}	¼	6959^{a}
		8	7713^{a,b}			½	8207^{a}
		12	9176^{b}				

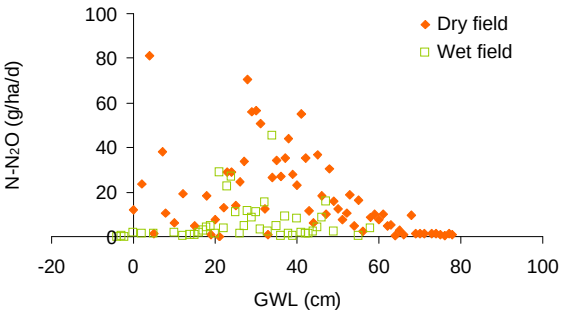

Figure 3. Relations between groundwater level and N_2O fluxes in the 'dry' and 'wet' fields.

Conclusions

Annual N_2O emissions were higher on the 'dry' field than on the 'wet' field. Shallow groundwater levels resulted in less variable N_2O fluxes. The distance to the drains partly explained the in-field variability, but the impact of inner drain distance on the in-field variability was limited.