Reducing Variation of Gas Flux Measurements at the Field Scale

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INTRODUCTION

Numerous studies investigated management effects on greenhouse gas (GHG) fluxes (Liu and Greaver 2009). High variation, especially of N_2O fluxes, has been observed. Variation is often up to 300% within homogeneously managed sites under on-farm conditions (Matthieu et al. 2006). Such high variability hampers our ability for precise upscaling from plot measurements to local or regional scales. The objectives of this study are to:

(i) quantify the number of closed chambers necessary to achieve a certain variation;
(ii) outline a sampling scheme to reduce the number of necessary measurements and
(iii) relate flux variability to variation in soil properties.

MATERIALS & METHODS

Site:

- Waterman Farm, Columbus, OH
- Conservational-till corn monoculture with manure application (2 heifers ha^{-1})
- Gentle slope of 1-5 degree

Gas sampling

- 40 closed chamber were distributed on two “transects” (Figure 1) by stratified random design
- All chambers were sampled for gas flux (CO_2, CH_4, N_2O) analysis four times in over two weeks

Soil sampling

- At three sampling dates: topsoil samples directly underneath 20 chambers were taken and the latter moved
- Last sampling date: soil samples taken at all 40 locations
- Soil profiles down to 1m depth were recorded

Lab methods

- Undisturbed soil cores will be used for measuring water retention characteristics and bulk density
- Aggregate size distribution and texture will be determined
- Nitrate content, pH and organic matter content will be quantified

Data analysis (Webster and Oliver 1990)

- Theoretical sample number calculation for a certain variation
- Temporal (repeated measures) and spatial (semi-variograms) autocorrelation will be determined
- Connatural areas will be outlined by principal component analysis

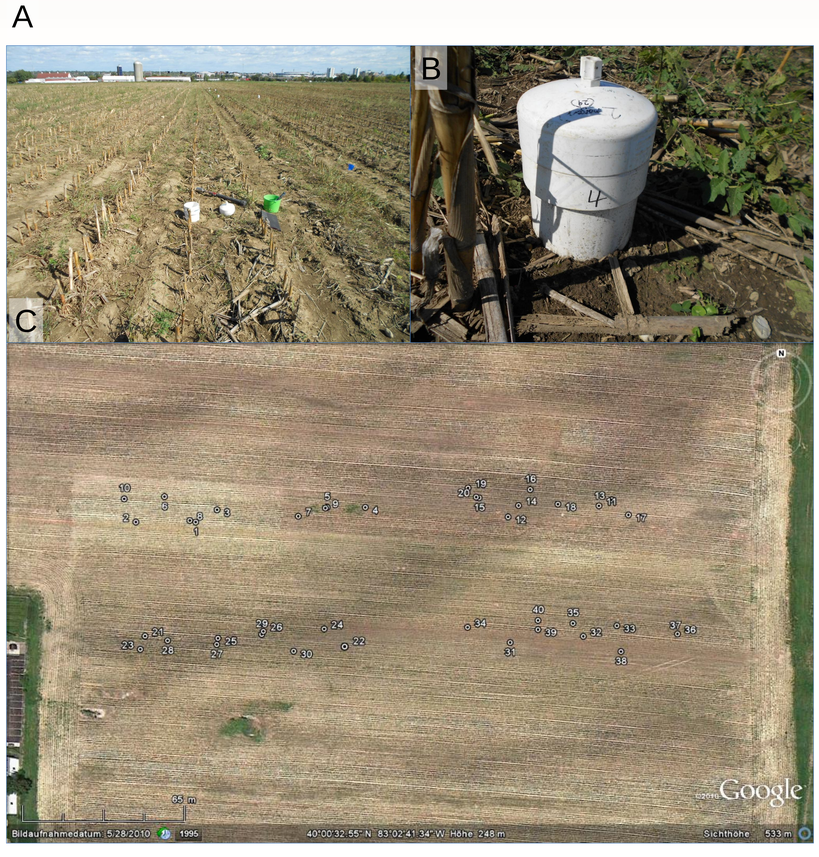

Figure 1: Photo of the study site at Waterman Farm, OH (A), closed chamber in the field (B) and aerial overview with the 40 chamber locations (C).

RESULTS & DISCUSSION

First results showed the highest variation in pore size distribution and pH values (Table 1).

Both properties are known to affect microbial activity, i.e. gaseous fluxes (Davidson et al. 2000).

Table 1: Mean values and coefficient of variation (CV) of some soil properties as first results (n = 40).

Property	Mean	CV (%)
Bulk density (g cm^{-3})	1.5	6
Total pore volume (%)	48	8
Pores > 50 µm (% of tpv)	20	32
Pores 50-10 µm (% of tpv)	7	27
pH (H_2O)*	6.3	39

*Calculated as H+ ions; tpv: total pore volume

OUTLOOK & CONCLUSION

The work will be finished latest end of February 2012. The results from this work will serve as:

- Guide for finding sampling locations for gas flux measure-ments under on-farm conditions.
- Estimate of experimental error when using limited number of sampling points.
- Help in sensitivity analysis for local or regional upscaling approaches.

A comparison of the INNOVA 1412 with a gas chromatograph is planned

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