MAPPING THE DISTRIBUTION OF GREENHOUSE GAS FLUXES IN A MISSOURI CORN AND SOYBEAN FIELD

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INTRODUCTION

The spatial distribution of greenhouse gases fluxes (GHG) across fields represents the combined effects and interactions of various soil controlling factors. Because of the difficulty in measuring GHG fluxes at several locations in a field, mapping their distribution can help examine their spatial patterns and then assess the relationships of these patterns to controlling factors. We used Geographic Information Systems to map the spatial distribution of GHG fluxes in an ongoing study monitoring gas fluxes from soil in a field planted to corn and soybean. The interpolation method of Kriging in ARCGIS 10-Geostatistical Analyst Extension was used to predict the gases fluxes at un-sampled locations in the field. The resulting surface maps allowed us to monitor the fluctuations of gases across the field, identify field locations with consistently high/low fluxes and assess their particular conditions.

OBJECTIVES

- Monitor the variation in gas flux distribution and intensity over a four month period
- Study the relationship between between gas flux and tillage management

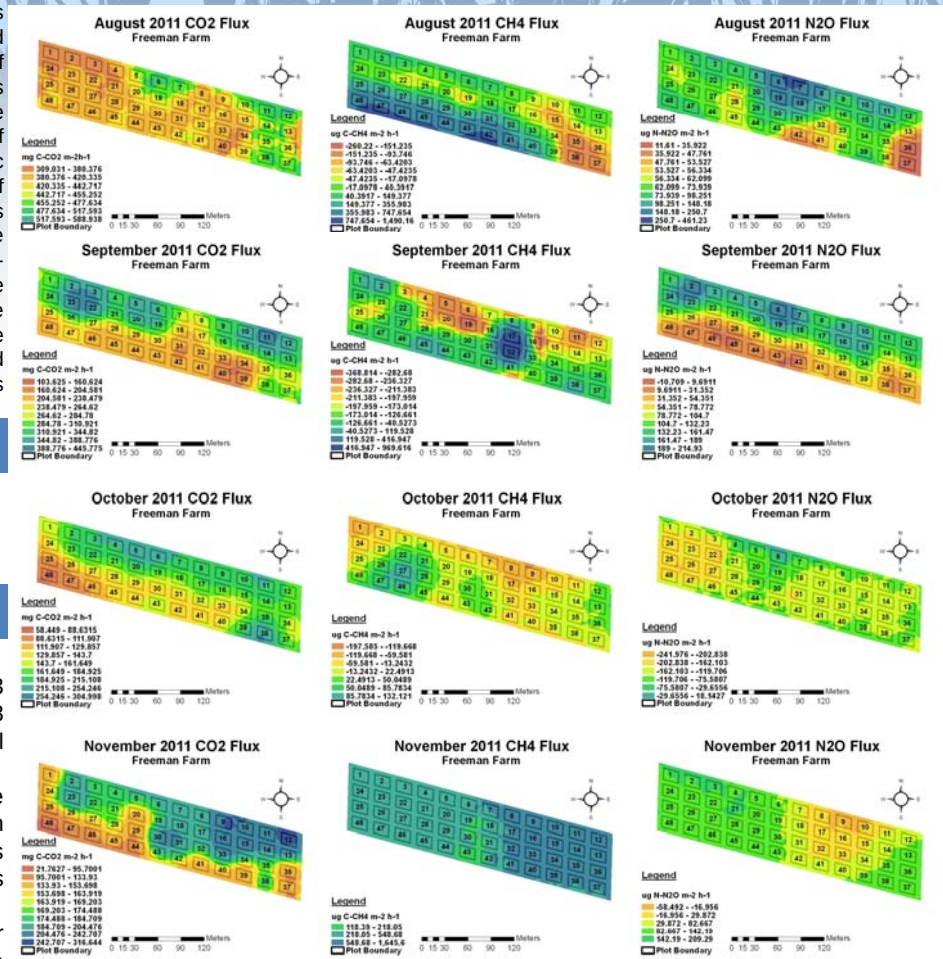
METHODS

Site/soils: Freeman Farm, Jefferson City, MO
Soil type varies as a result of flooding events (1993 & 1995). The experimental site is divided into 48 research plots with 24 plots receiving conventional tillage and 24 with no-till.

Laboratory analysis: Gas samples (60 ml) were collected from static and vented chambers placed in the center of each research plot. Gas concentrations were analyzed with a Shimadzu gas chromatograph (GC) within 24 hours of collection.

Geostatistical analysis: Calculated flux values for each gas from the eight sampling dates were recorded as representative values for each research plot. These flux values were entered into a Microsoft Excel worksheet and assigned to their respective plots. The resulting Excel worksheet was added to an ARCGIS project where it was joined to shapefile points representing the location of soil air flux sampling chambers. This layer of information was placed on top of a shapefile of the experimental field boundary. Geostatistical analyst extension was selected and the Kriging interpolation method was chosen to map monthly estimated flux values across the entire experimental field.

RESULTS



Tillage treatment	Aug 2011			Sept 2011			Oct 2012			Nov 2012		
	CO2	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
NT	635.52	141.67	-14.42	498.57	-193.04	161.63	309.01	9.63	-158.85	296.36	1669.9	79.25
CT	605.93	221.32	19.43	390.56	-170.96	113.39	285.39	2.37	-86.44	227.72	276.5	105.51
ANOVA												
Rep	ns	****	ns	ns	ns	*	ns	*	ns	*	ns	*
Tillage	ns	ns	ns	*	ns	*	ns	ns	*	**	*	ns

ns= non significant, *, **, *** and**** = significantly different at p< 0.05, 0.01, 0.001 and 0.0001, respectively

Figure 13. Mean monthly gas flux from no-till (NT) and conventional tillage (CT) treatments and ANOVA results

SUMMARY

The flux distribution maps created using ARCGIS 10.0- Geostatistical Analyst Extension are shown in Figures 1-12. August CO_2 flux distribution was greater near the northern and eastern edges of the experimental field. This trend was consistent throughout the months of September, October, and November. The intensity of CO_2 flux along the northern edge of the experimental field may be explained by the proximity of Highway 94 to the field. August CH_4 fluxes were greater along the southern edge of the experimental field, particularly from plots 42 to 48. This area typically exhibited saturated to inundated soil conditions which provide ideal anaerobic conditions for the production of CH_4. The September CH_4 fluxes were distributed differently as the greatest fluxes were confined to a small area near plots 17 and 32. Fluxes in the month of October were decreased and less defined across the experimental field. In November, fluxes displayed a more even distribution with the greatest fluxes located in the eastern half of the experimental field. August N_2O fluxes were greatest near the north-central region and lowest at the south-eastern region of the experimental field. N_2O fluxes in September were different as the greatest fluxes were located along the northern edge of the experimental field. October flux distribution changed across the field as fluxes were lowest through the middle of the field and greater along the perimeter. The final month displayed N_2O fluxes of the greatest intensity in the western half and southeastern corner of the field.

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