Watershed Health to In-Field and Edge-of-Field Water Management

Convening Event

January 23 – January 24, 2020 | Morgantown, WV

Erickson Alumni Center, West Virginia University

Impacts of water table management and field management on greenhouse gas emissions

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Chesapeake Bay Program

Science. Restoration. Partnership.

McGill | MIT | Civil and Environmental Engineering

Agronomic practices

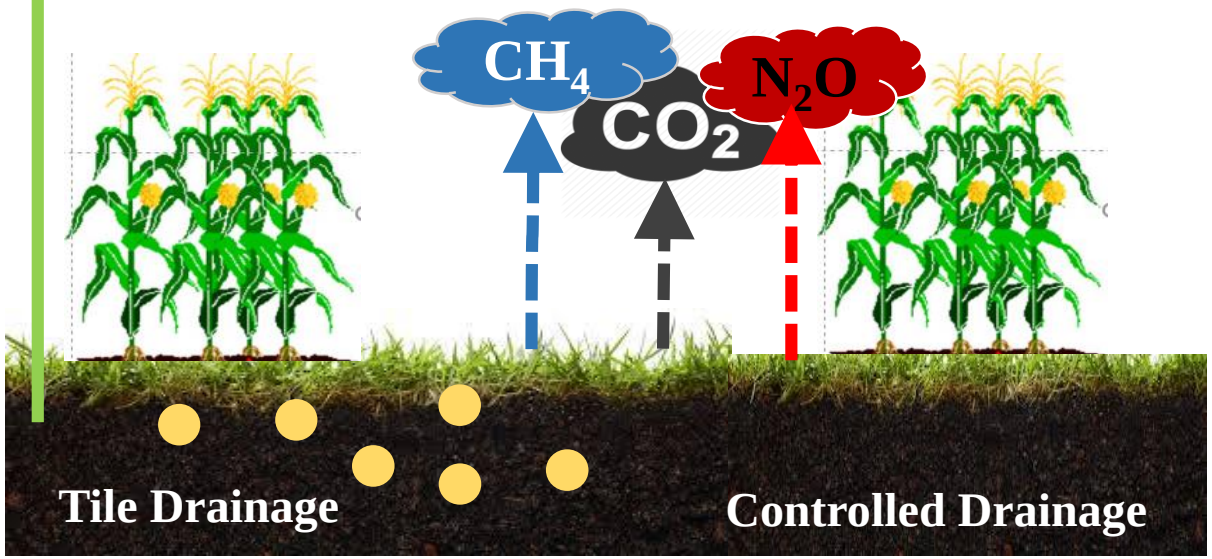
Meteorological data

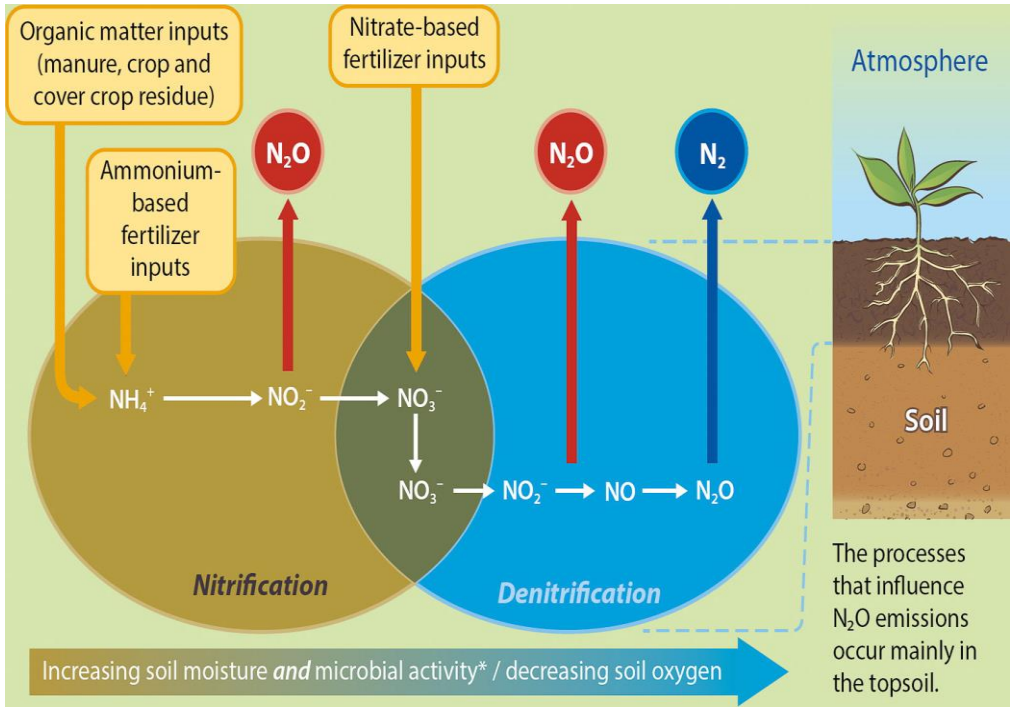
Soil properties

Analysis

Understand the effects of water management systems

GHG fluxes





Experimental Design

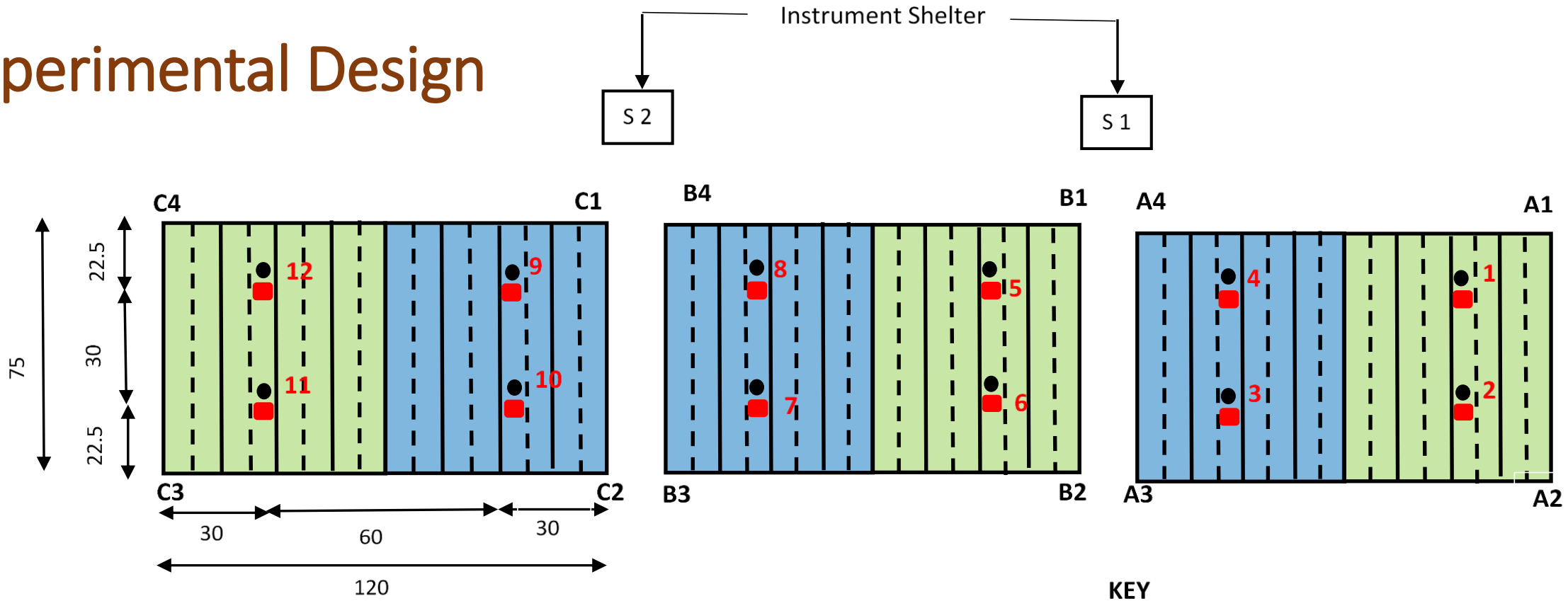


Figure: Layout of St Emmanuel experimental site

* Figure not to scale. Dimensions are in meters

Gas measurements

- closed non-steady state chambers
- treatments between snow melt and late summer
- 3 times a week : spring thaw, and nitrogen N-application
- once every two weeks: for the rest of the season, and for the rest of the growing season

Water table management and fertilizer application impacts on CO_2, N_2O and CH_4 fluxes in a corn agro-ecosystem

Cynthia M. Crézé[1,2] & Chandra A. Madramootoo[1]

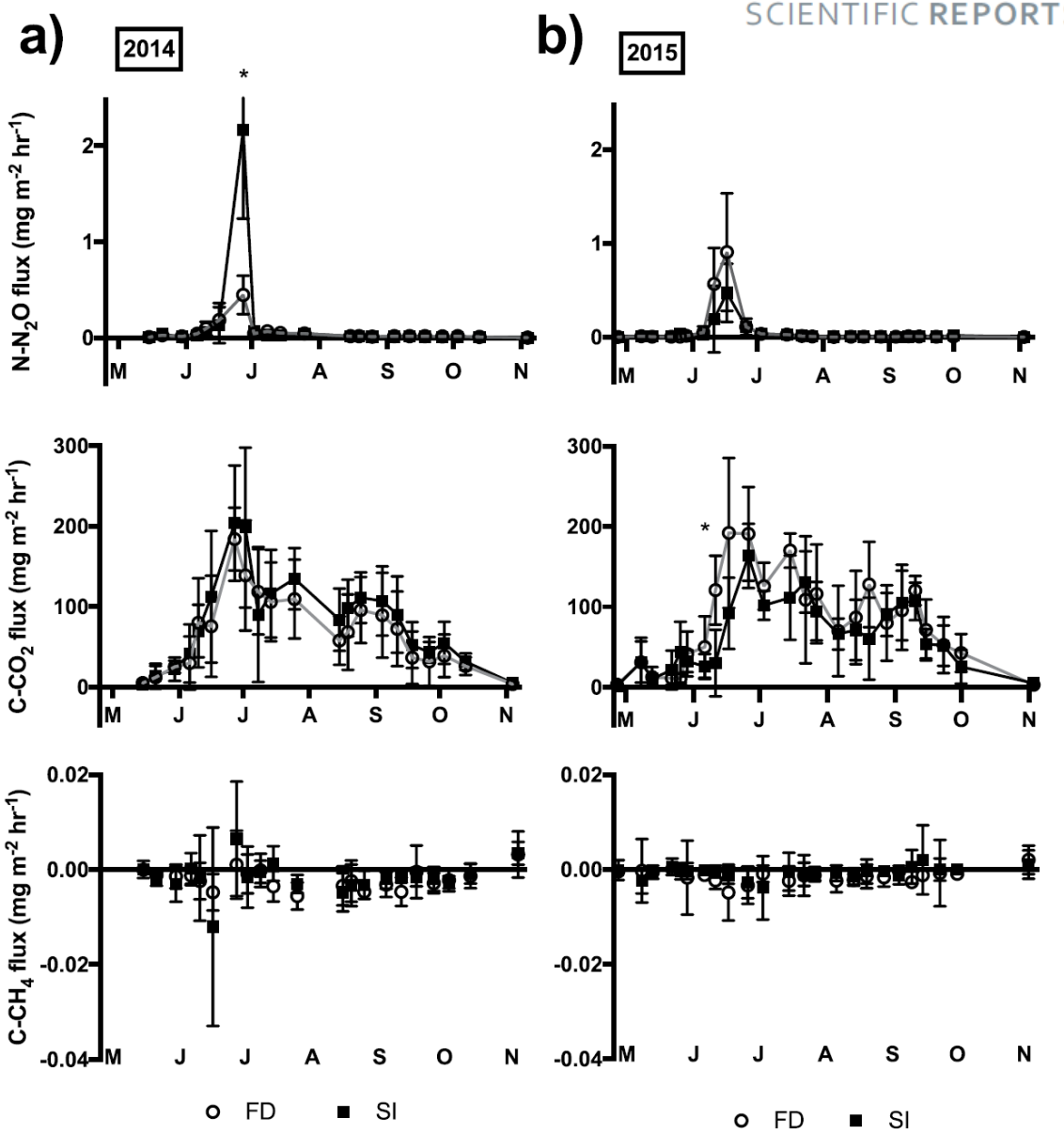
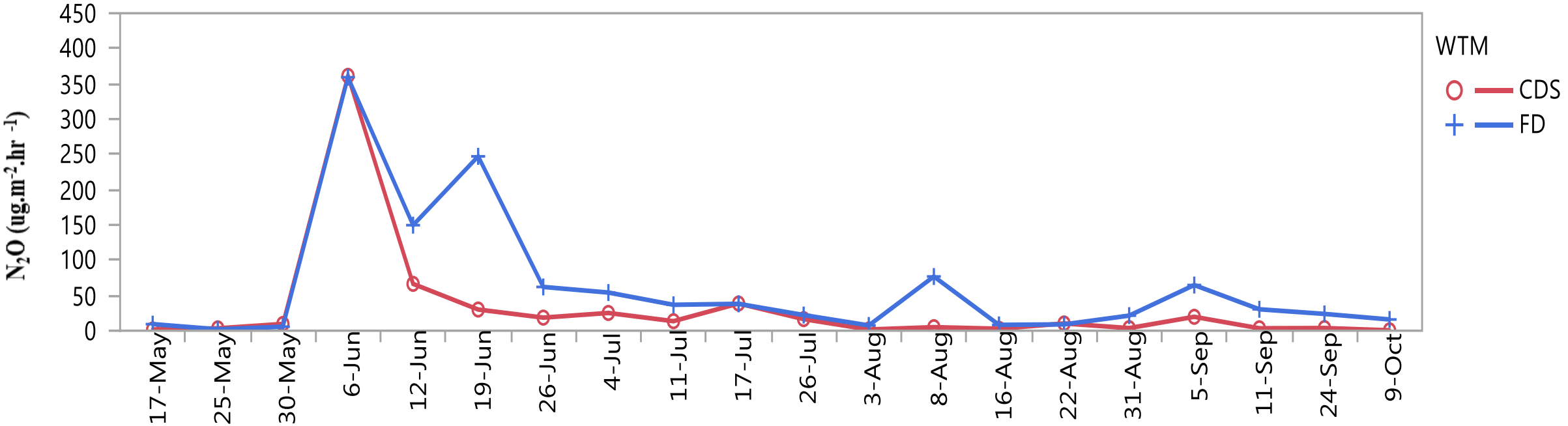


Figure 2. Mean GHG fluxes (mg m^{-2} hr^{-1}) and standard deviation under free drainage (FD) and subsurface-irrigation (SI) treatments in 2014 (**a**) and 2015 (**b**). An SD bar was clipped at the axis limit for N_2O in 2014. Asterisks indicate statistically significant differences between water treatments ($P < 0.05$).

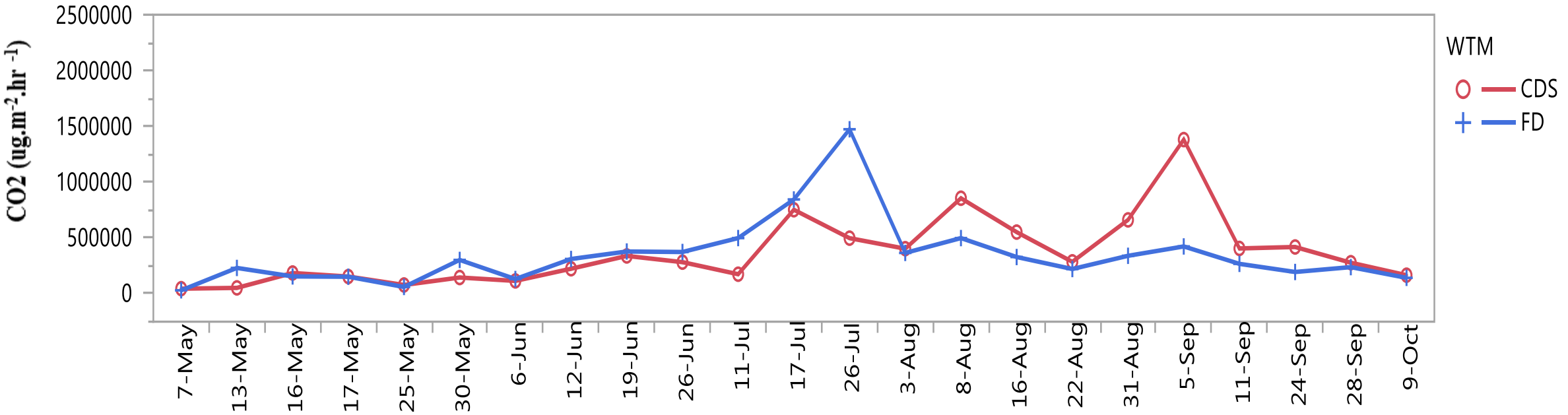
			Average mean daily flux		
			N_2O (S.D.)	CO_2 (S.D.)	CH_4 (S.D.)
			mg $N\text{-}N_2O.m^{-2}.hr^{-1}$	mg $C\text{-}CO_2.m^{-2}.hr^{-1}$	mg $C\text{-}CH_4.m^{-2}.hr^{-1}$
2014	Water treatment	FD	0.055 (0.039)	66.9 (8.9)	−0.002 (0.001)
		SI	0.131*** (0.069)	80.2**(8.9)	−0.001 (0.001)
2015	Water treatment	FD	0.074** (0.053)	80.5***(6.0)	−0.001 (0.000)
		SI	0.042 (0.039)	63.6 (6.0)	−0.001** (0.000)
	Fertilizer treatment	Bulk	0.079**(0.049)	72.4 (6.0)	−0.001 (0.000)
		Split	0.037 (0.037)	71.8 (6.0)	−0.001 (0.000)

Table 1. Mean daily N_2O, CO_2 and CH_4 fluxes by treatment for 2014 and 2015. Significance levels are indicated for the treatments that had significantly higher fluxes. **p<0.05–0.01; ***p<0.01.

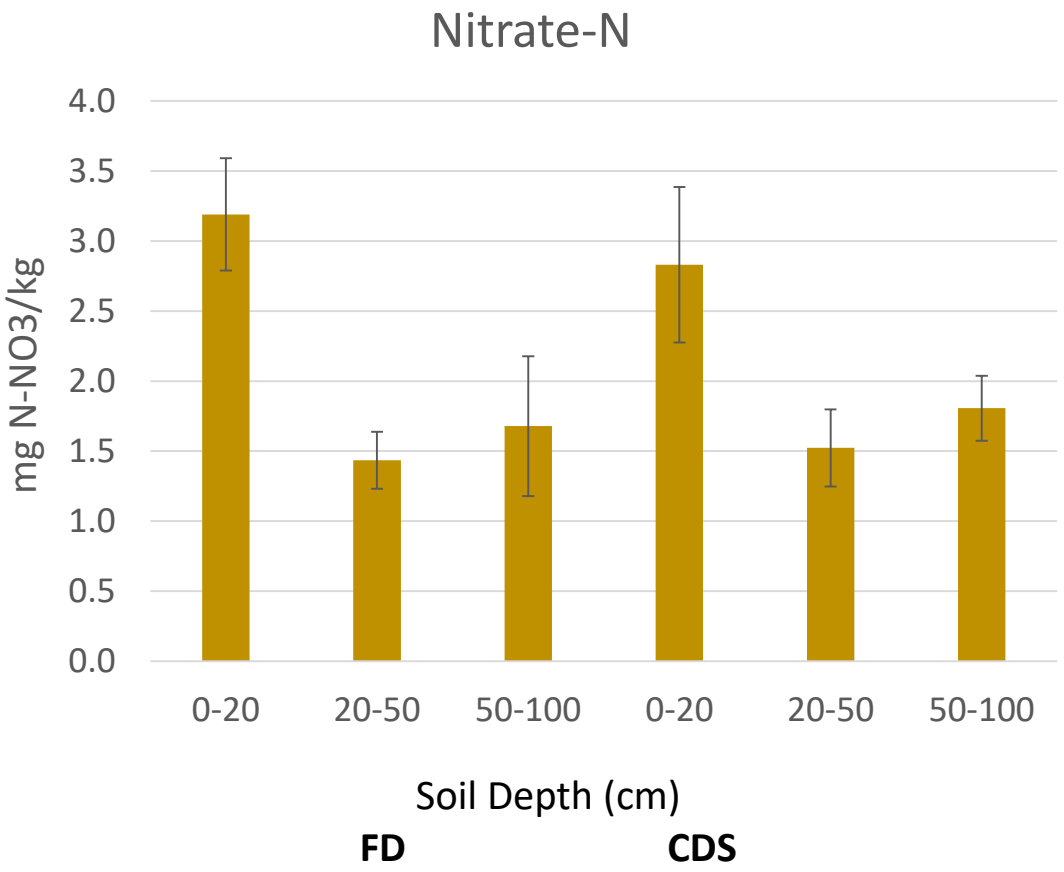
N_2O Flux 2018

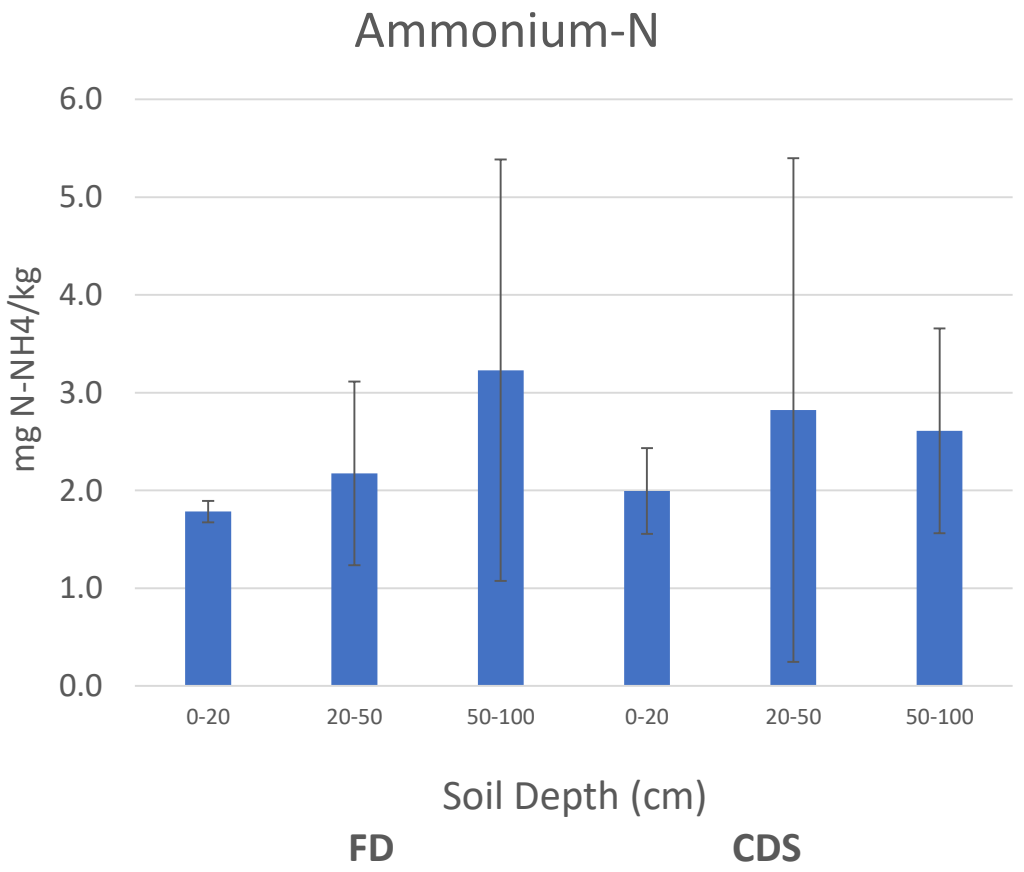


CO_2 flux 2018

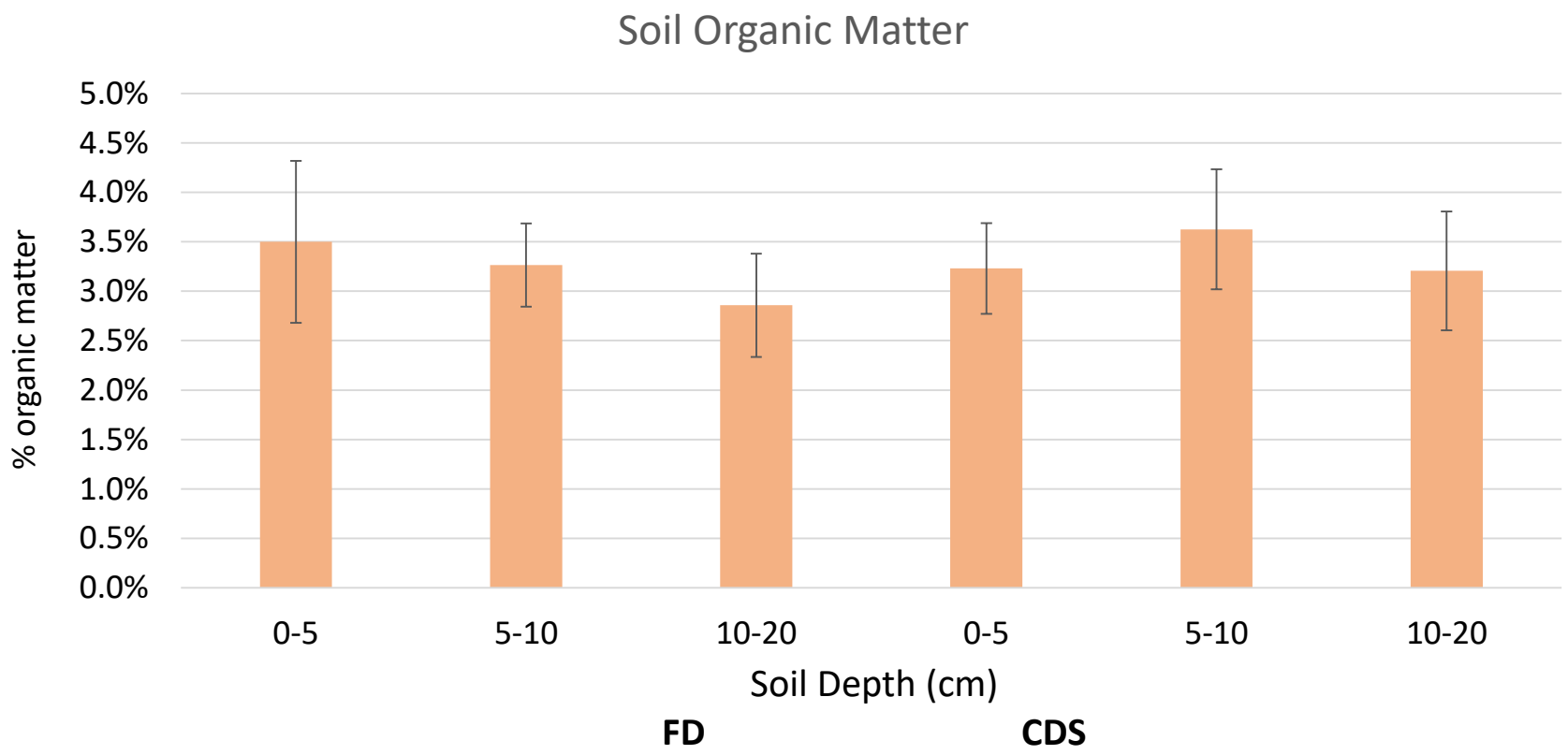


Nitrate and Ammonium Nitrogen

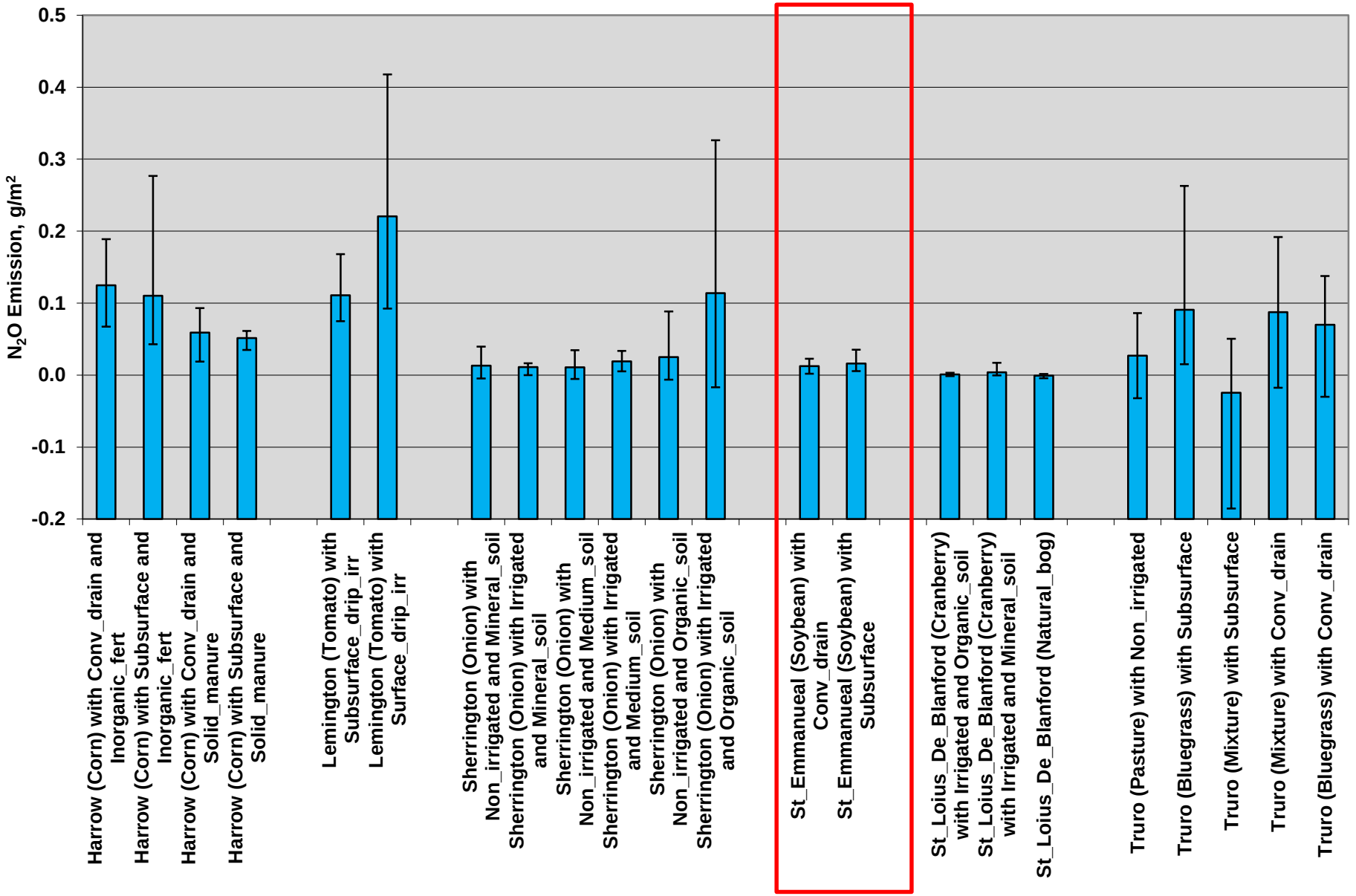




Soil Organic Matter



Nitrous Oxide Emission



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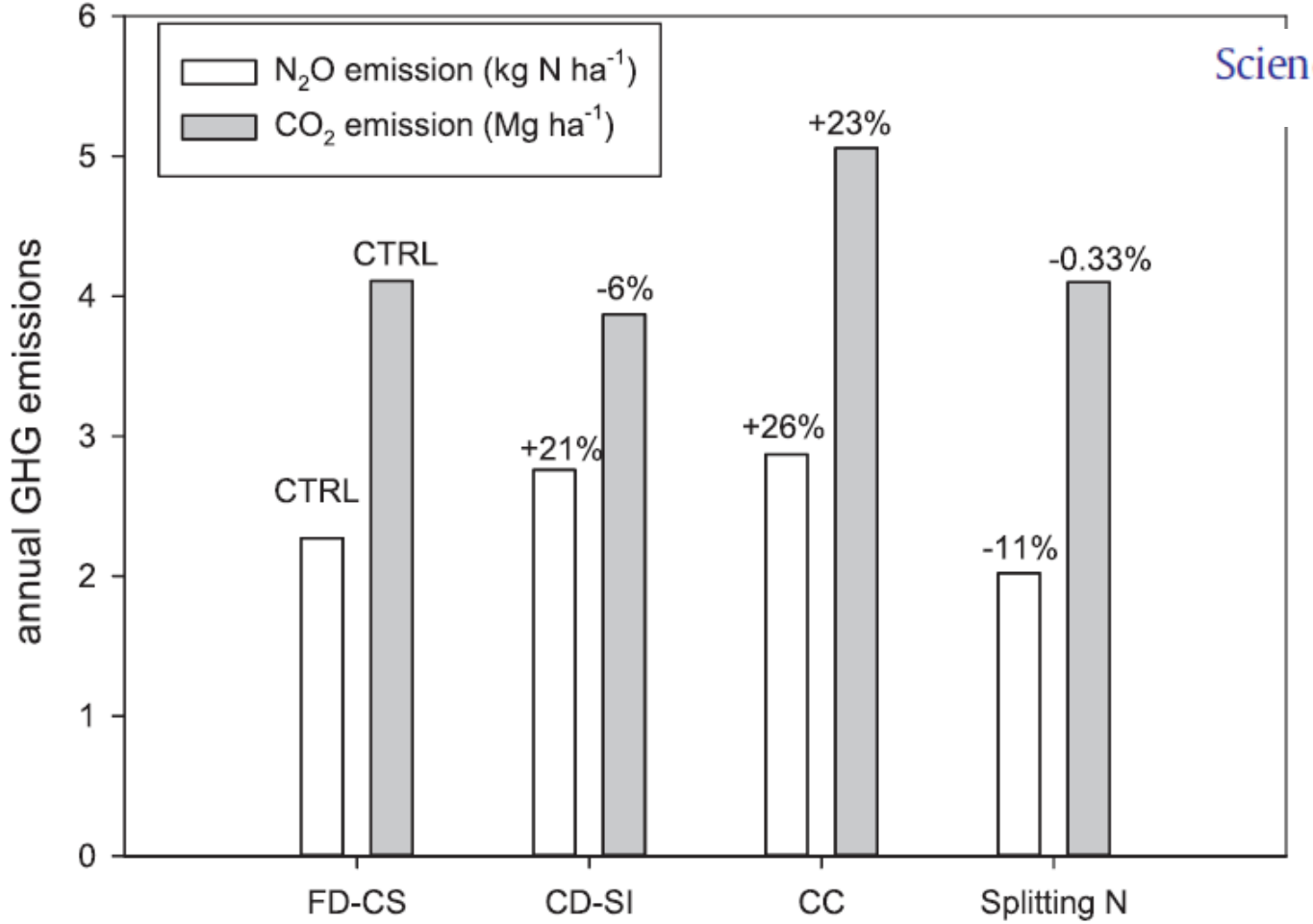
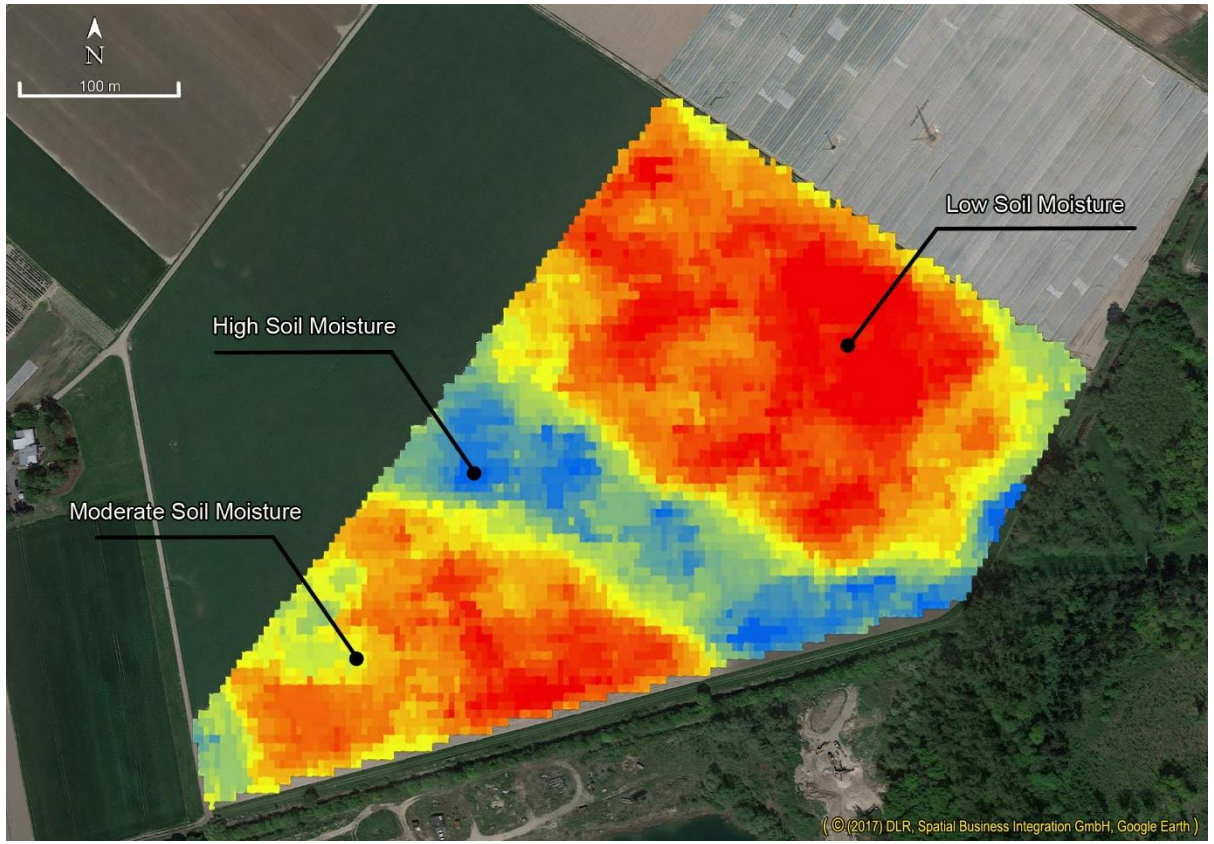
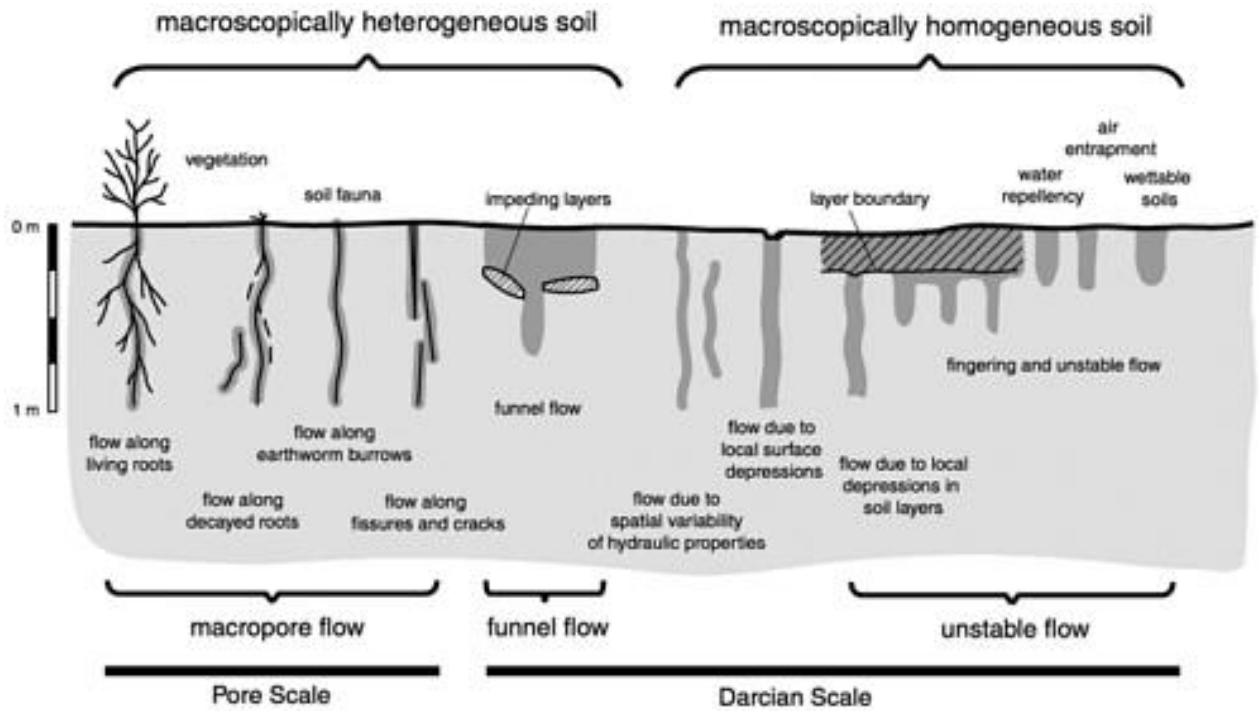


Fig. 11. Differences of annual GHG emissions under different management practices (FD-CS, free drainage with corn-soybean rotation and one-time N fertilization, set as CTRL, control treatment; CD-SI, controlled drainage with sub-irrigation; CC, continuous corn planting).

Variability in GHG fluxes

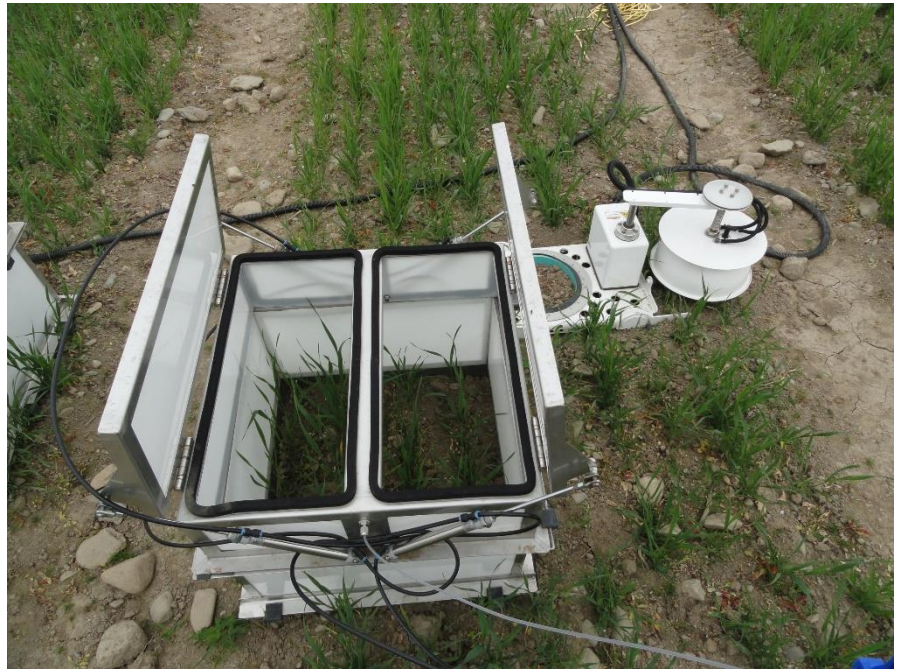
- Soil properties
- Hot spots and hots moments





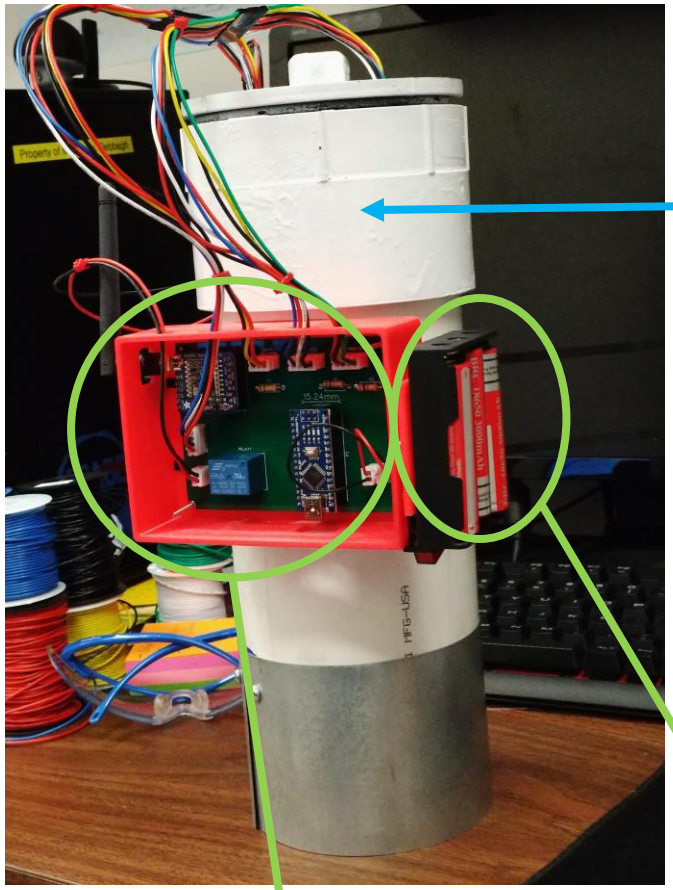
What are the drivers?

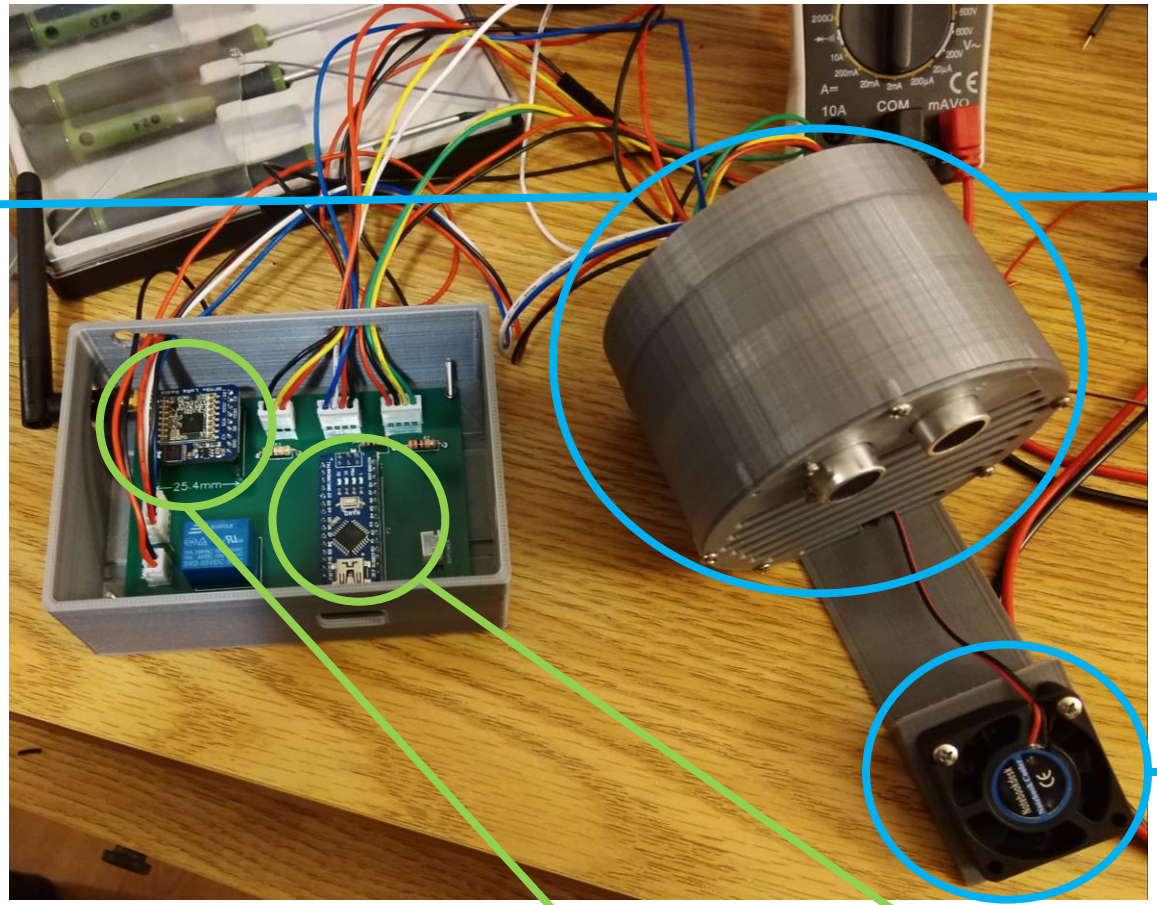
1. Water filled pore space
2. Timing and rate and method of fertilizer application
3. Timing of rainfall
4. Soil temperature
5. Soil microbial activity – soil respiration
6. WTM has lesser of an effect



DEVELOPMENT OF A NDIR CO2 WIRELESS SENSOR NETWORK

Sensor Nodes





Sensor Housing

- **NDIR CO2**
- **Pressure**
- **Temperature**
- **Humidity**
- **Ultrasonic Height**

Fan

Electronic Control Housing

11.1 V 3000mah Power Supply (rechargeable)

LoRa transceiver Module 900 MHz RF

Arduino Nano Microcontroller


Thank You