

# Effects of climate change treatments on soil microbial community composition

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# Objective

- Investigate the effects of elevated temperature, elevated CO<sub>2</sub> and altered precipitation on soil microbial community composition and biomass in a constructed oldfield community

# Why do soil microbial communities matter?

- Microbial biomass is an important carbon store
- Composition of microbial community affects amount and residence time of carbon stored in soil
- Activity of microbial communities controls nutrient availability



# Effects of increased temperature on microbial community composition

- Decreases total microbial biomass
- Increases bacterial stress index
- Increases arbuscular mycorrhizal fungi (AMF)

# Effects of elevated CO<sub>2</sub> on microbial community composition

- Decreases gram + bacteria
- Increases gram – bacteria
- Increases total fungi
- Increases AMF

# Effects of drought on microbial community composition

- Decreases total microbial biomass
- Decreases microbial diversity
- Decreases AMF

What about interactive effects?



# Oldfield Community Climate and Atmospheric Manipulation



- Oldfield ecosystem:
  - Ribgrass
  - Meadow fescue
  - Orchardgrass
  - Broomsedge
  - Goldenrod
  - Lespedeza
  - Red clover
- Treatments:
  - T=ambient or ambient + 3.5°C
  - [CO<sub>2</sub>]= ambient or ambient + 300 ppm
  - Precipitation=2 mm/wk or 25 mm/wk

# Oldfield Community Climate and Atmospheric Manipulation

## Treatment Assignments

Block 2	10	ECAT	A=ambient E=elevated C=CO <sub>2</sub> T=temperature NC=no chamber	Block 3
	9	ACET		
	8	NC		
	7	ACAT		
	6	ECET		
Block 1	5	NC	ECAT	15
	4	ECET	ACAT	14
	3	ACAT	ACET	13
	2	ECAT	ECET	12
	1	ACET	NC	11

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# Field Sampling

- 4 sample dates (data shown for 3 dates)
- 6 soil cores per chamber (3 wet, 3 dry)
- 5 cm diameter
- 15 cm depth
- Passed through an 8 mm sieve
- Roots picked
- Soil freeze-dried

# How can we measure microbial community composition?

- Phospholipid fatty acid analysis
  - Utilizes key membrane components—proxy for biomass
  - Distinguishes between broad microbial functional groups

# What is a phospholipid?

Hydrophilic head

- phosphate

- variable carbon group

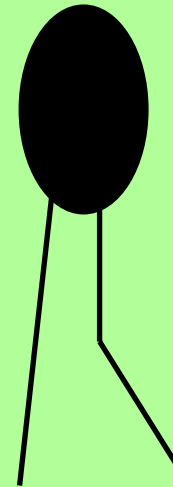
- glycerol

Hydrophobic tails

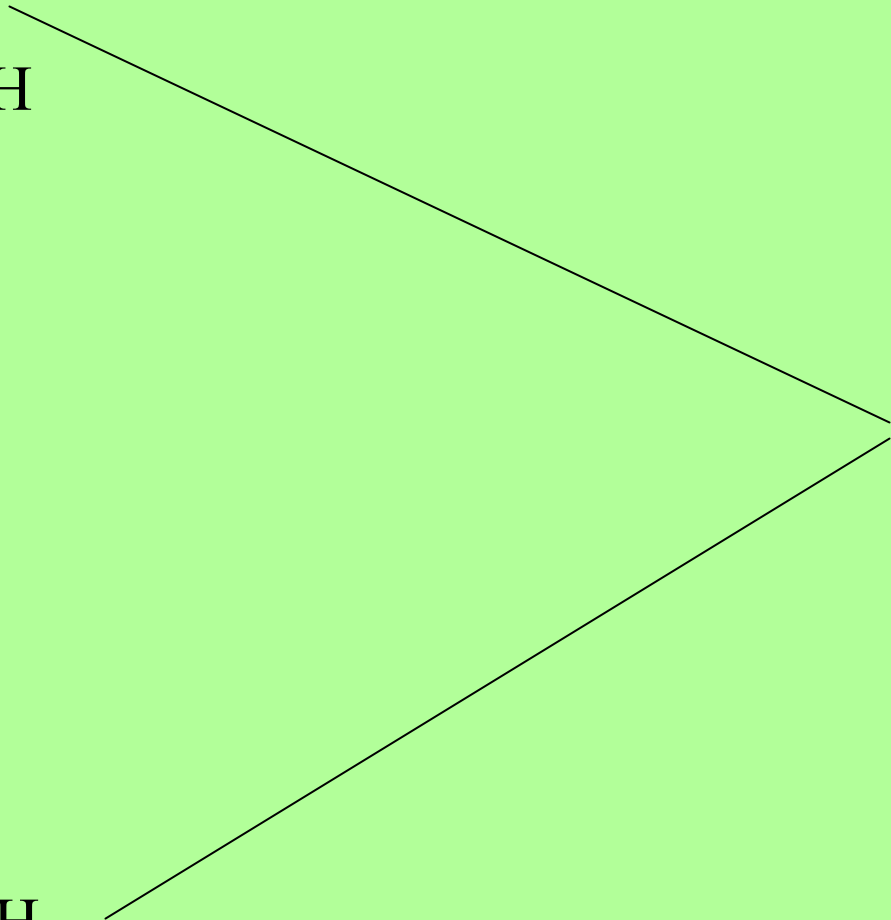
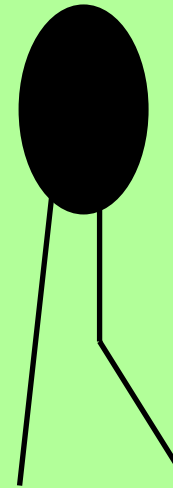
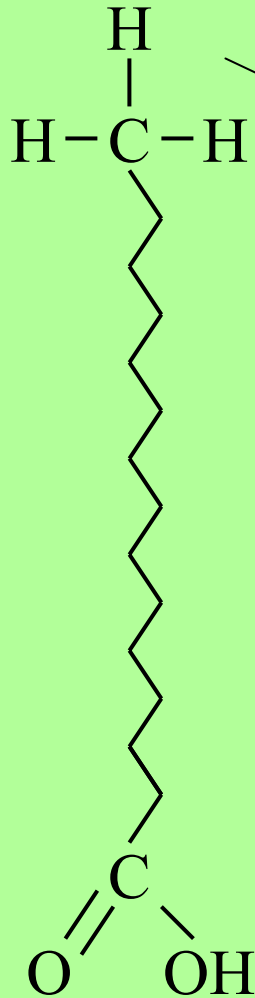
- fatty acid chains

- mostly C and H

- non-polar



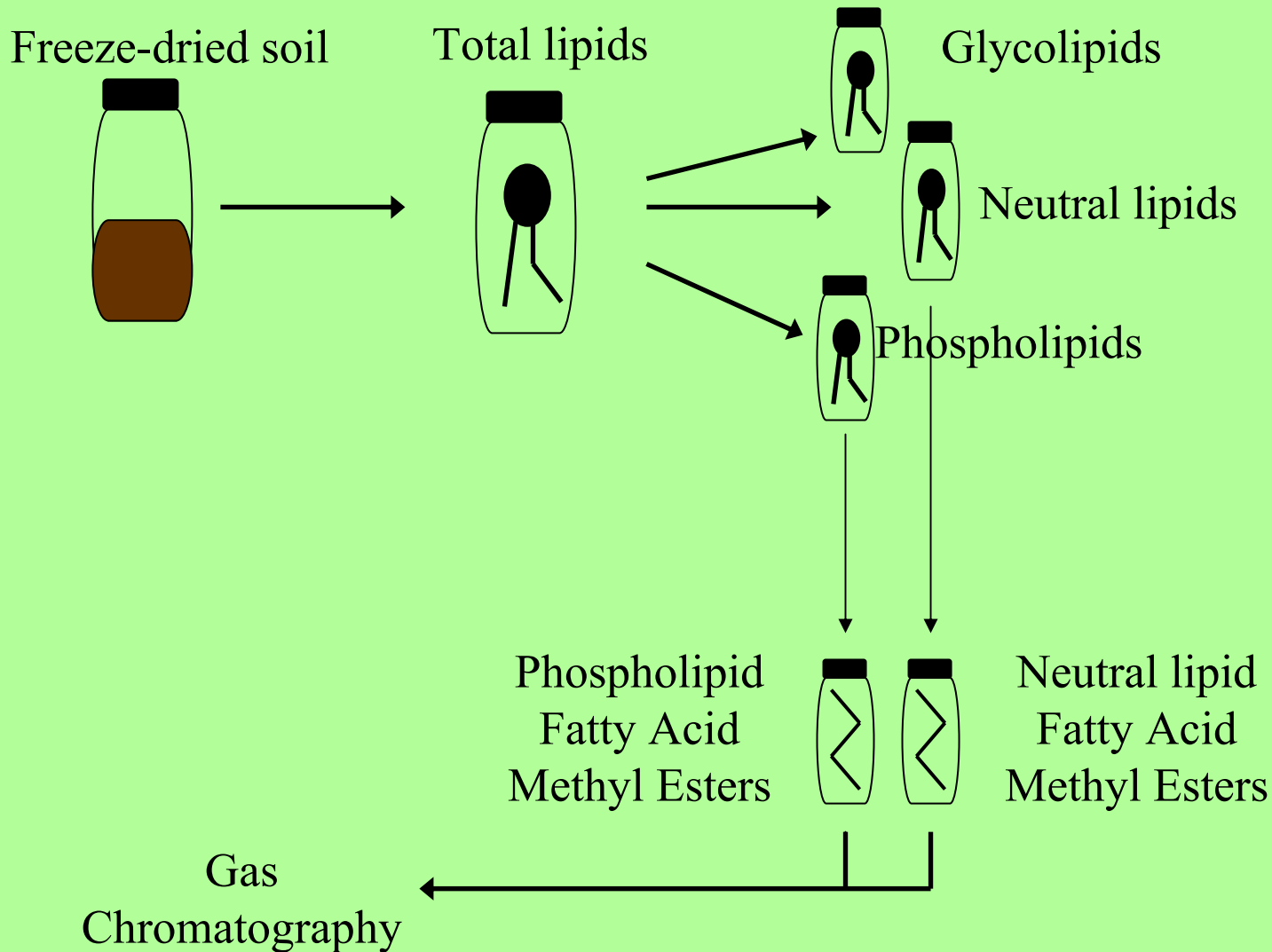
# What is a fatty acid?



Functional Group	Signature PLFAs					
Actinomycetes	10Me16:0	10Me18:0				
Bacteria	14:0	a15:0	16:1 $\omega$ 9c	i17:0	a17:0	cy19:0
Gram+ve	cy17:0	18:1 $\omega$ 7c				
Gram-ve	i15:0	i16:0				
Fungi	18:2 $\omega$ 6	18:1 $\omega$ 9c				
AMF	16:1 $\omega$ 5c	20:1 $\omega$ 9				
Protozoa	20:4 $\omega$ 6					

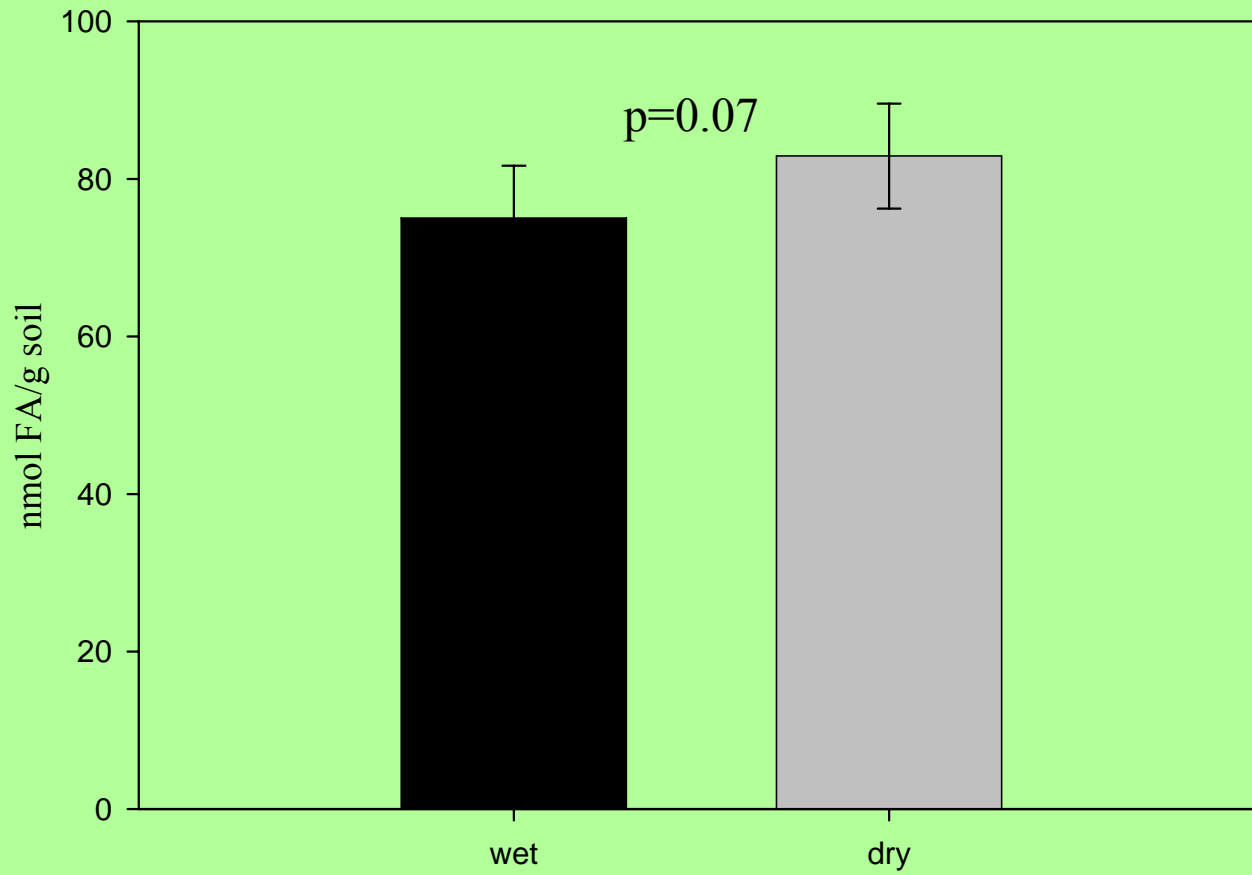
Functional Group	Signature PLFAs					
Bacteria	14:0	a15:0	16:1 $\omega$ 9c	i17:0	a17:0	cy19:0
Fungi	18:2 $\omega$ 6	18:1 $\omega$ 9c				
AMF	16:1 $\omega$ 5c	20:1 $\omega$ 9				

# PLFA Extraction Procedure



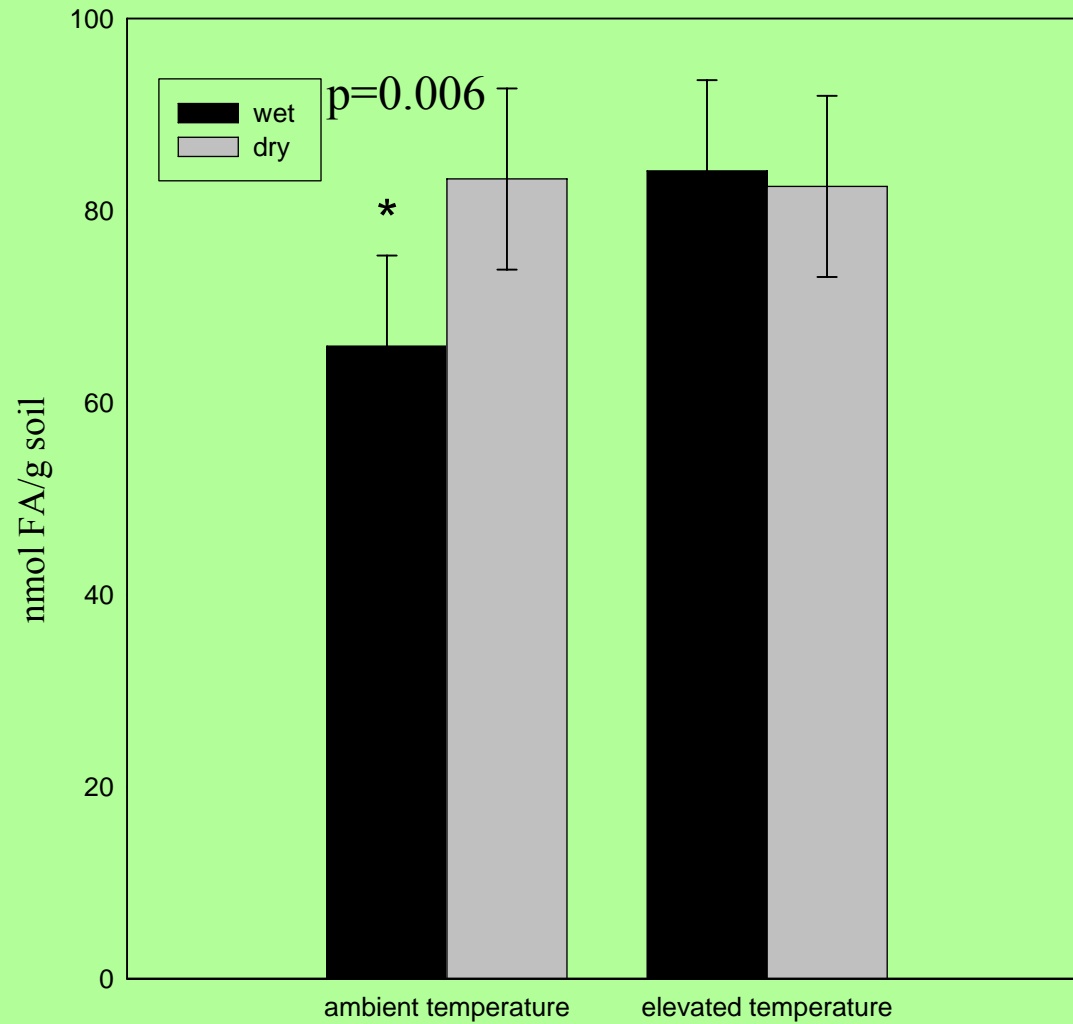
# Total PLFA

H<sub>2</sub>O



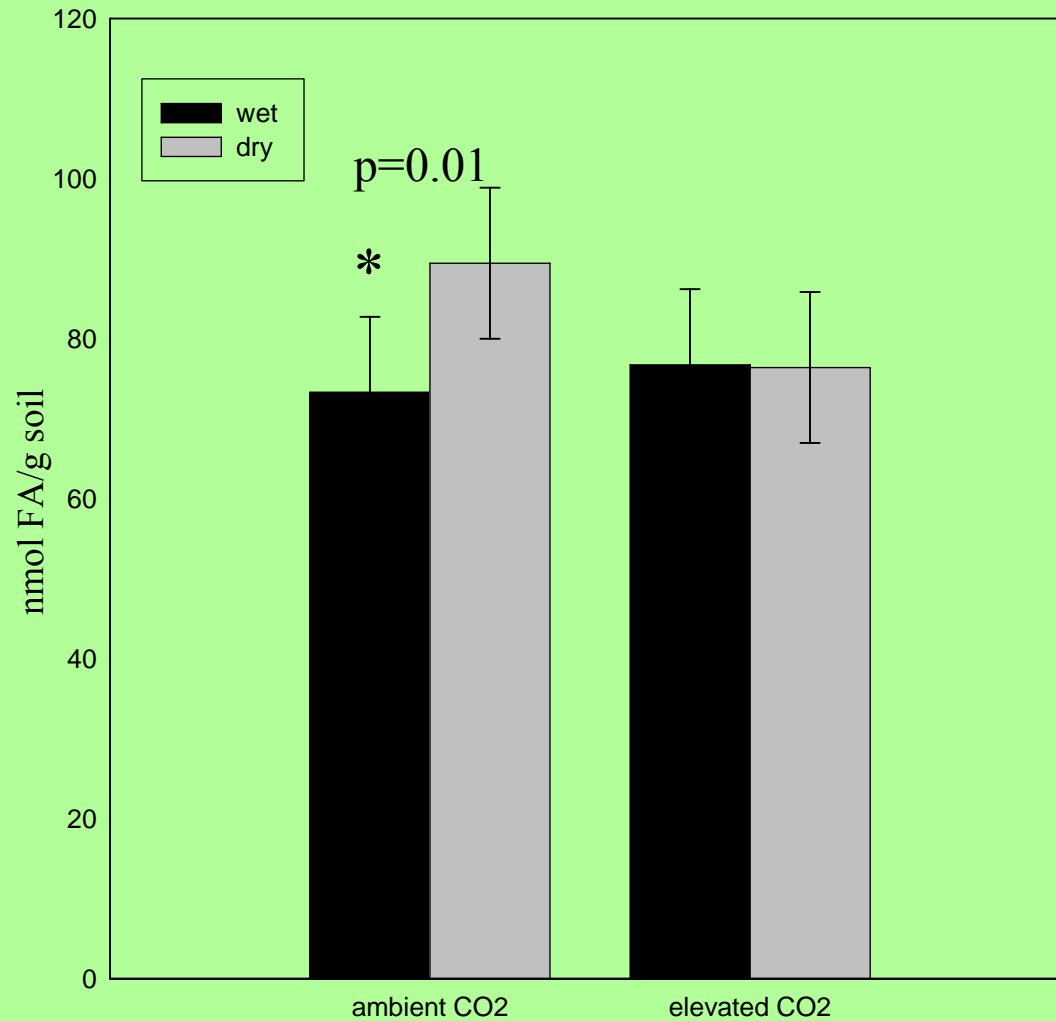
# Total PLFA

Temperature \* H<sub>2</sub>O



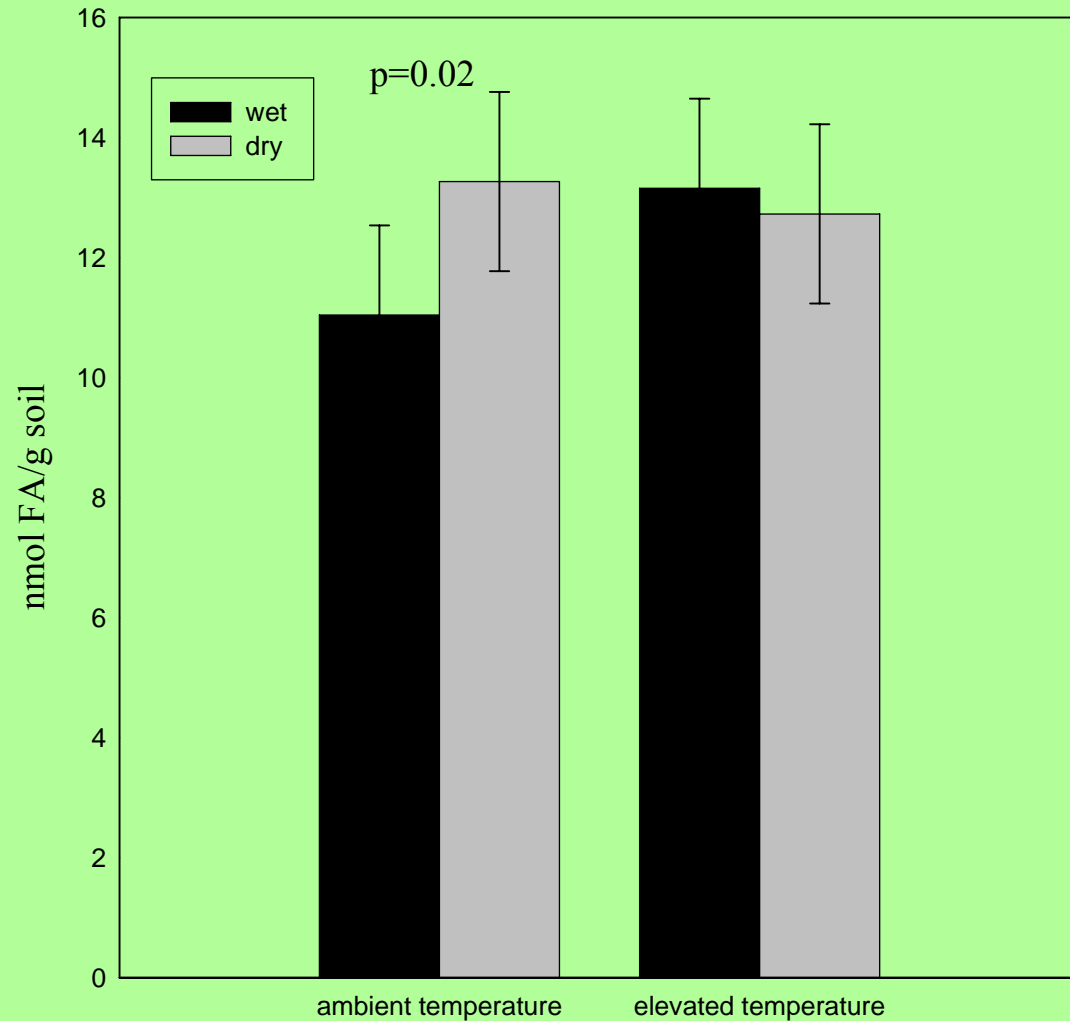
# Total PLFA

CO<sub>2</sub> \* H<sub>2</sub>O



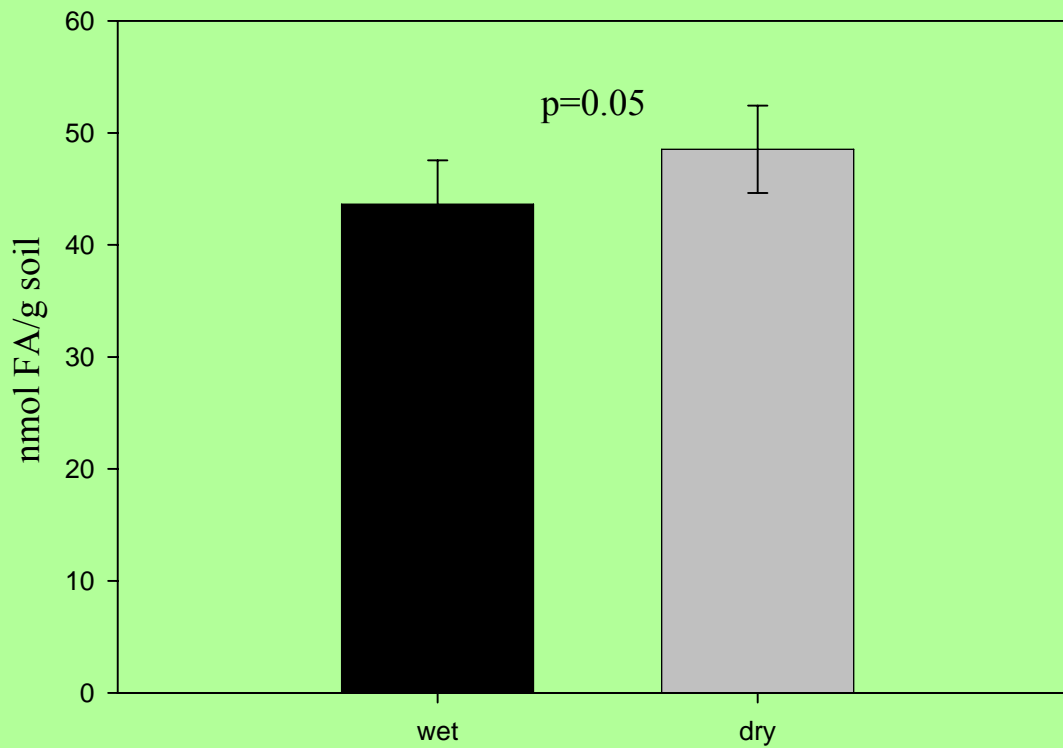
# Total Fungal PLFA

Temperature \* H<sub>2</sub>O



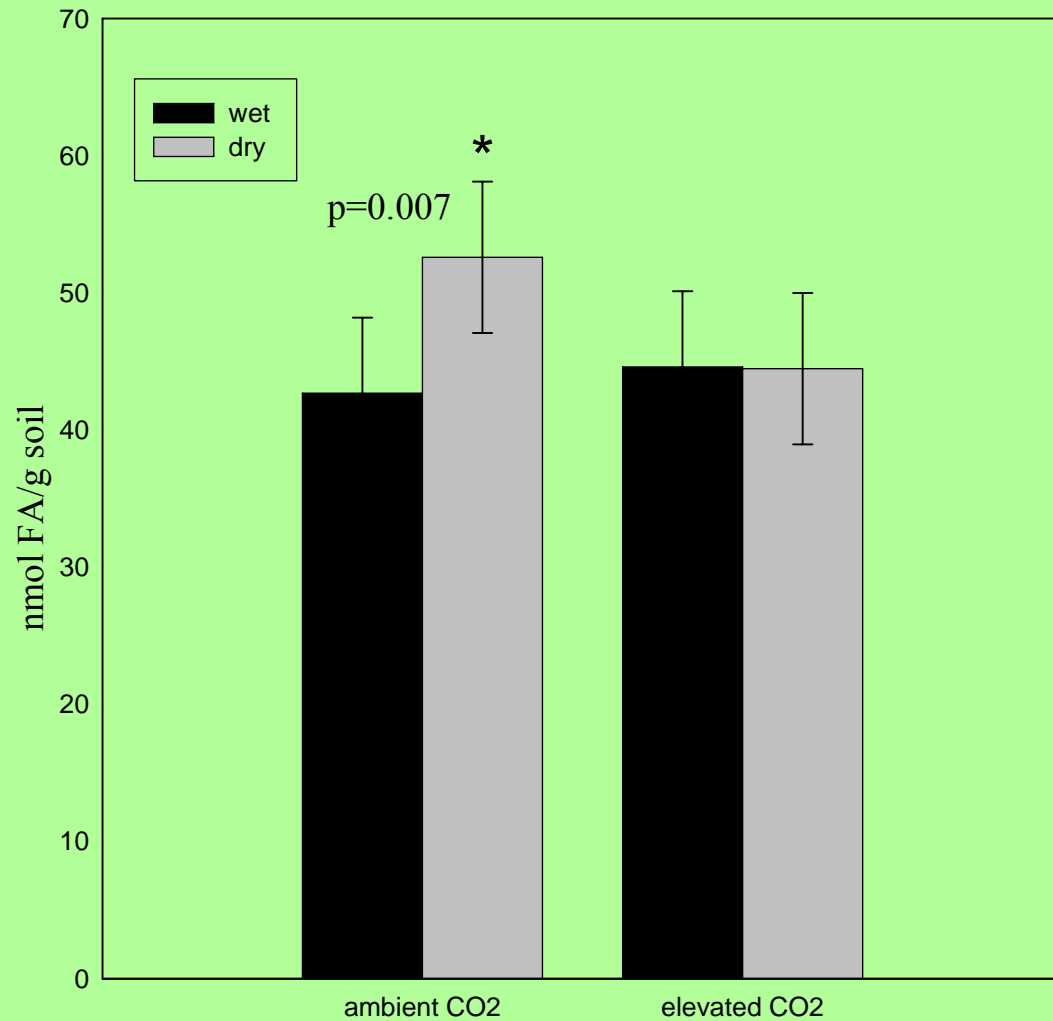
# Total Bacterial PLFA

H<sub>2</sub>O



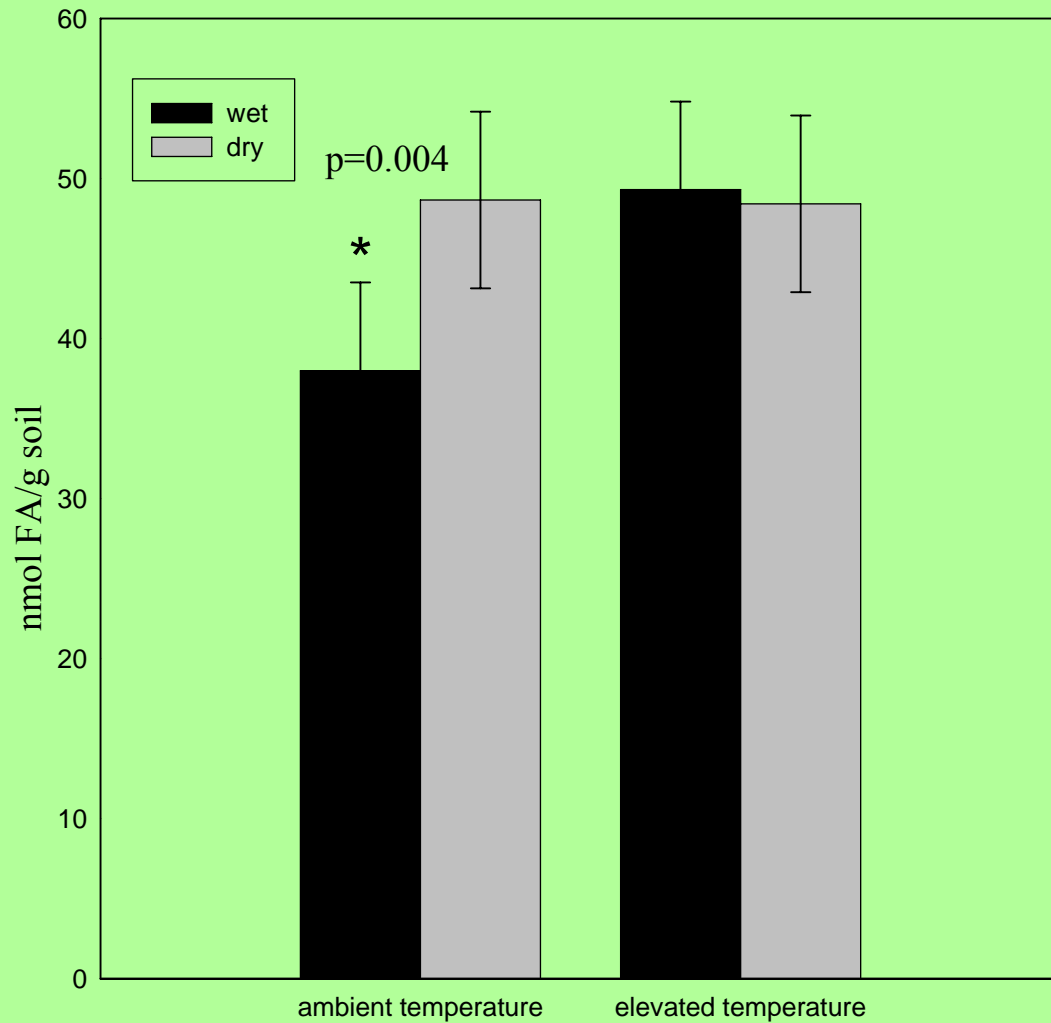
# Total Bacterial PLFA

CO<sub>2</sub> \* H<sub>2</sub>O



# Total Bacterial PLFA

Temperature \* H<sub>2</sub>O



# H<sub>2</sub>O Treatment

- Lower total PLFA in wet plots
- Lower fungal PLFA in wet plots
- Significantly lower bacterial PLFA in wet plots

# H<sub>2</sub>O \* Temperature Treatment

- Total PLFA significantly lower in wet plots under ambient temperature
- Total bacterial PLFA significantly lower in wet plots under ambient temperature

# H<sub>2</sub>O \* CO<sub>2</sub> Treatment

- Significantly lower total PLFA in wet plots under ambient CO<sub>2</sub>
- Significantly lower bacterial PLFA in wet plots under ambient CO<sub>2</sub>

# Future work

- Finish analyzing PLFA data
- Discuss community composition data with groups with community genome data

# Acknowledgements

- GCEP
- Mike Miller, Aimee Classen, Chris Schadt
- The Terrestrial Ecology Group at Argonne National Laboratory