Flooding and fecal addition have little impact on the temperature response of soil respiration and methanogenesis in Arctic wetland and tundra soils

A. Joshua Leffler[1]

Jenna M. Ross[1]

Katharine C. Kelsey[2]

Matteo Petit Bon[3]

Karen H. Beard[4]

1. South Dakota State University, Department of Natural Resource Management; 2. University of Colorado-Denver, Department of Geography and Environmental Sciences; 3. North Carolina State University, Applied Ecology; 4. Utah State University, Department of Wildland Resources

SOUTH DAKOTA STATE UNIVERSITY

Department of Natural Resource Management

Acknowledgments

Nate Floyd
Nathaniel Abrahams
Brianna Barr
Cristina Chirvasa
Trevor Hoffman
Forrest Lampert
Tyler Williams
Greg Cooper
Gabi Bolwerk

PolarField Services

The Chu’pik Community of Chevak, Alaska

South Dakota State University

University of Colorado Denver

South Dakota State University
Department of Natural Resource Management

NSF-OPP 2113641 NSF-OPP 2302105
NSF-OPP 2113692 NSF-OPP 2302106
NSF-OPP 2113750 NSF-OPP 2302107

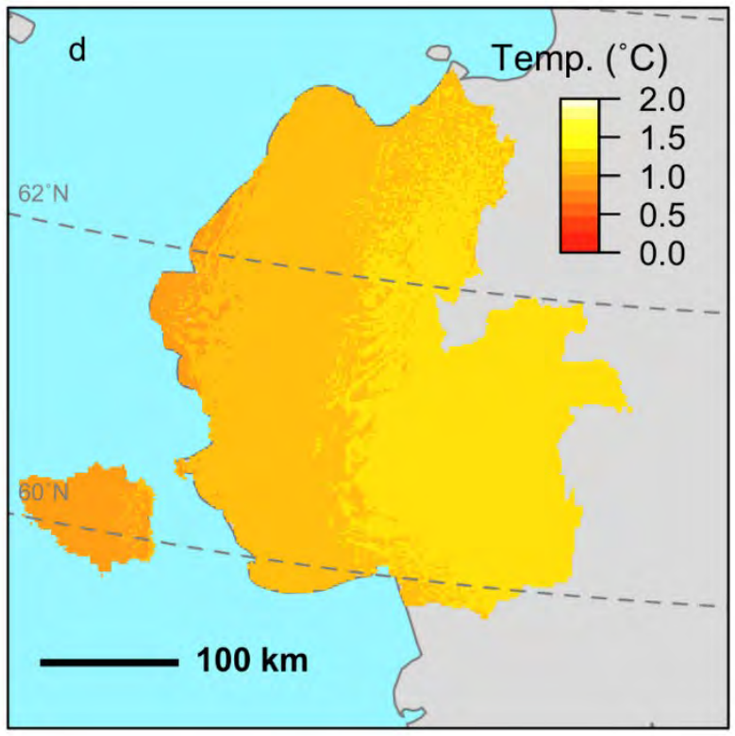
The Yukon-Kuskokwim Delta

A landscape of ponds, wetlands, and tundra

A Changing Delta

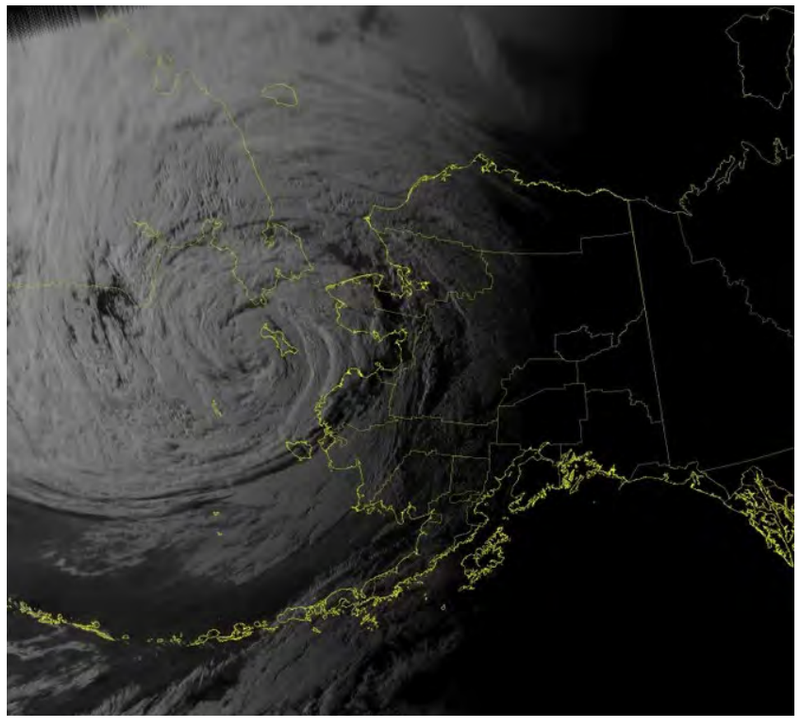
Temperature, floods, herbivores affect ecosystems

Warming



1.2˚C 1950-79
vs. 1980-2009

Flooding



Sea-Level Rise
More frequent
Storm Surge

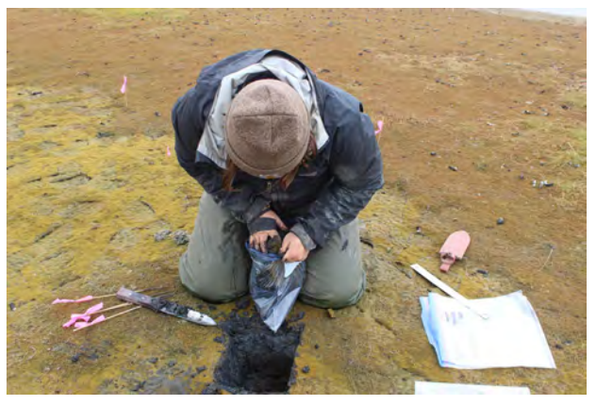
Herbivory

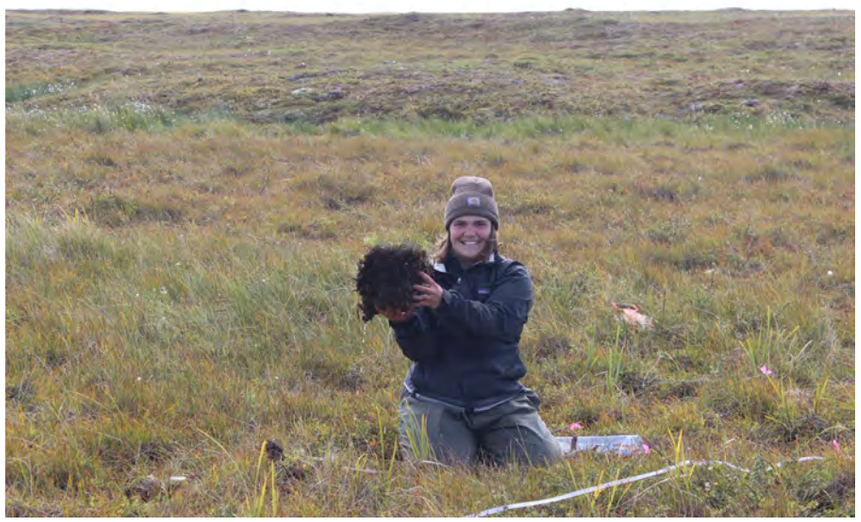
Population Changes

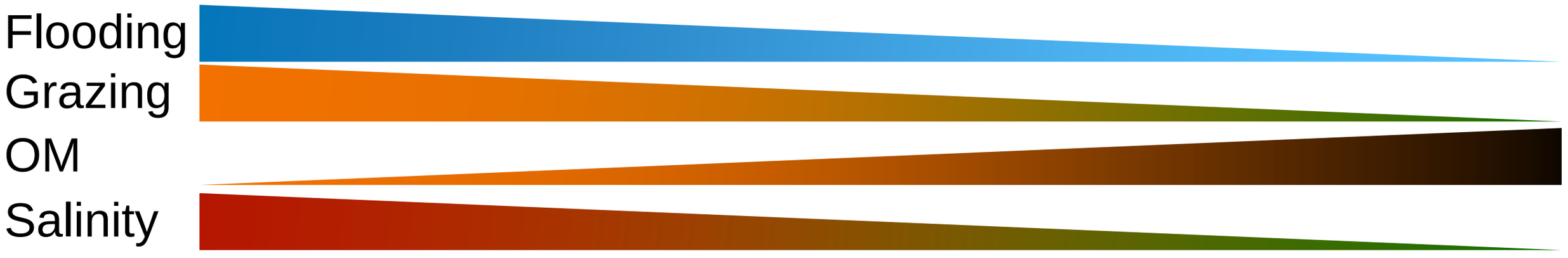
To what extent do flooding and herbivore feces affect temperature sensitivity of greenhouse gas emissions from soils?

Y-K Delta Communities

Lowland to Upland







Photos: Jenna Ross

Experimental Design

Laboratory incubation

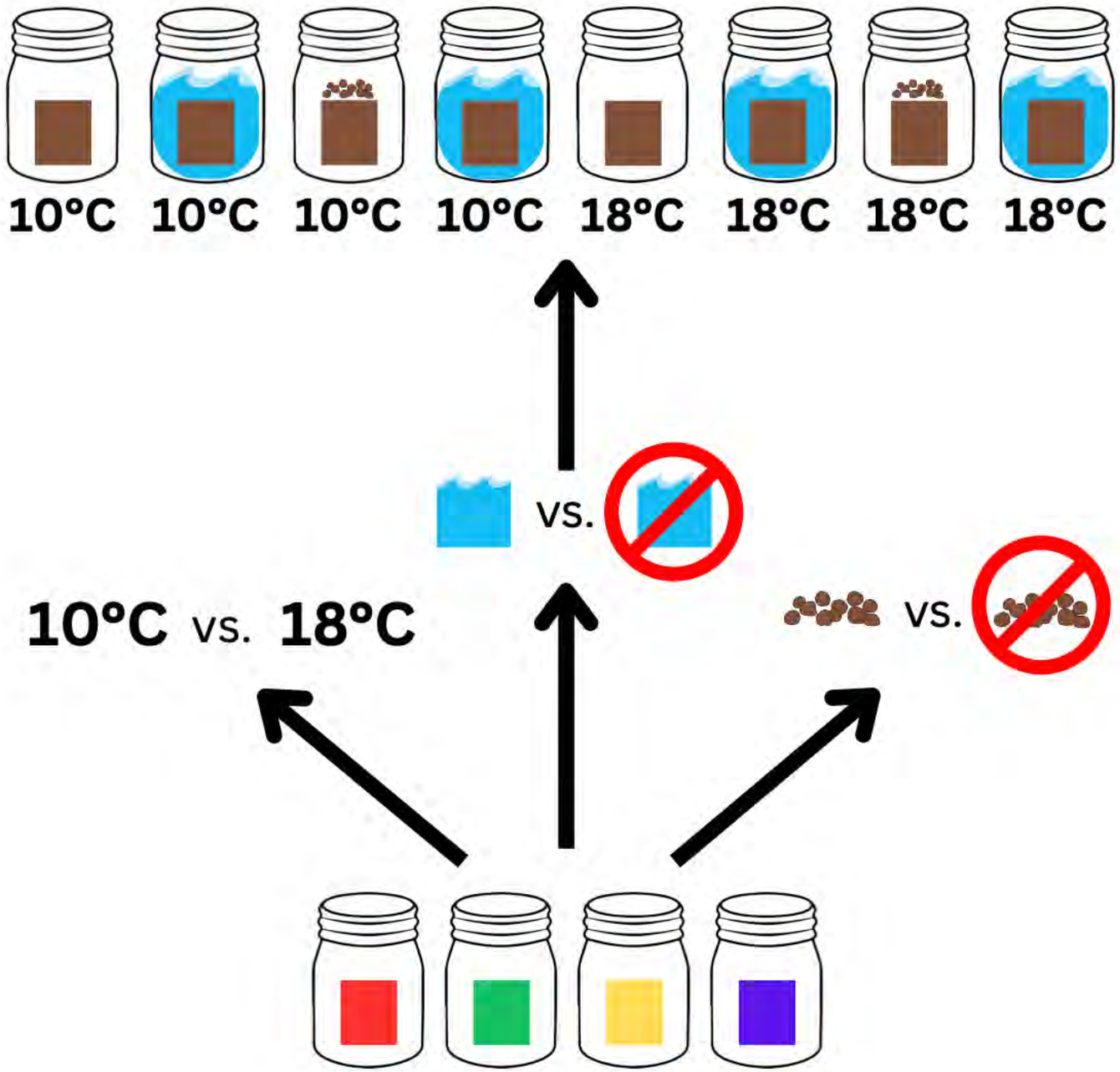
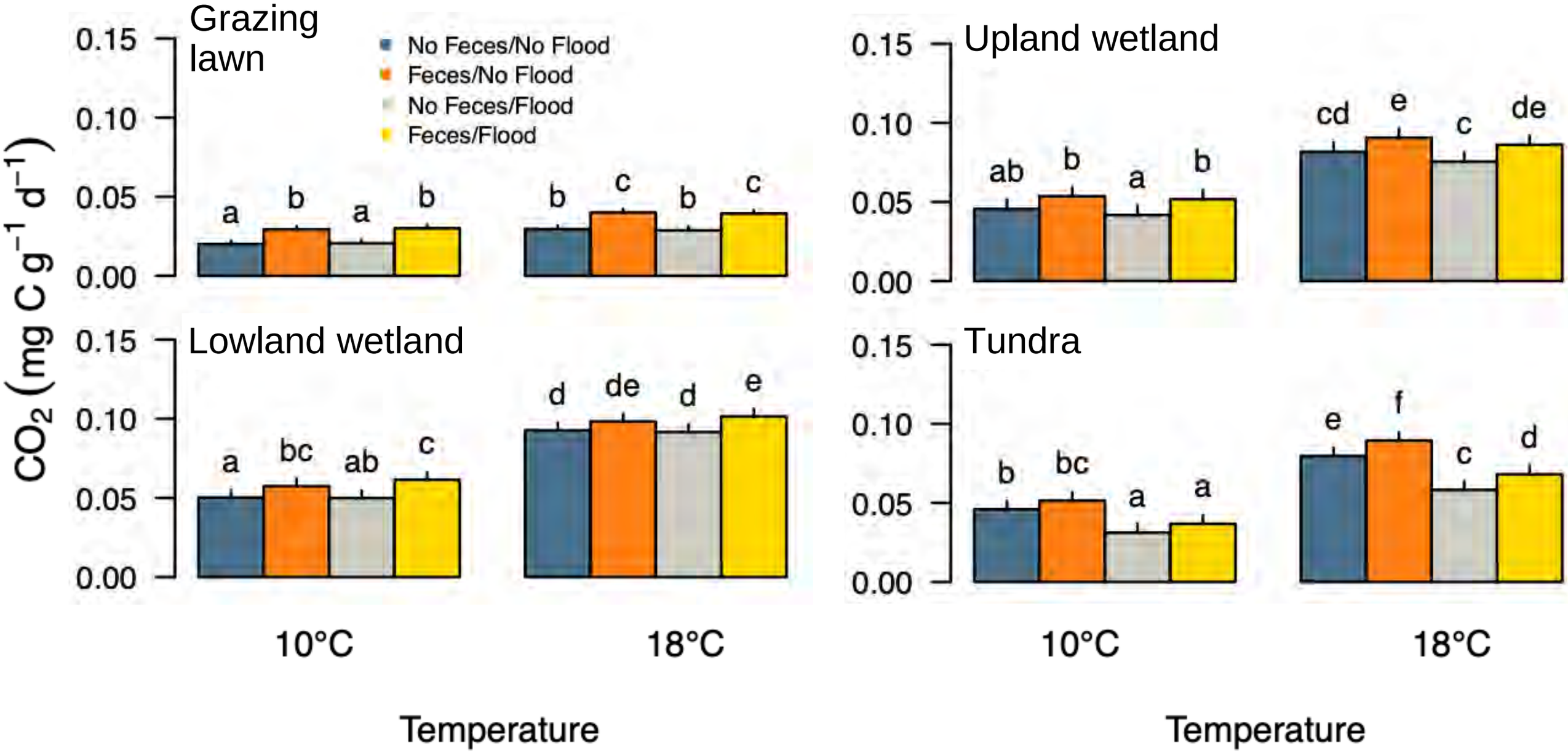


Photo: Jenna Ross

CO_2 emissions

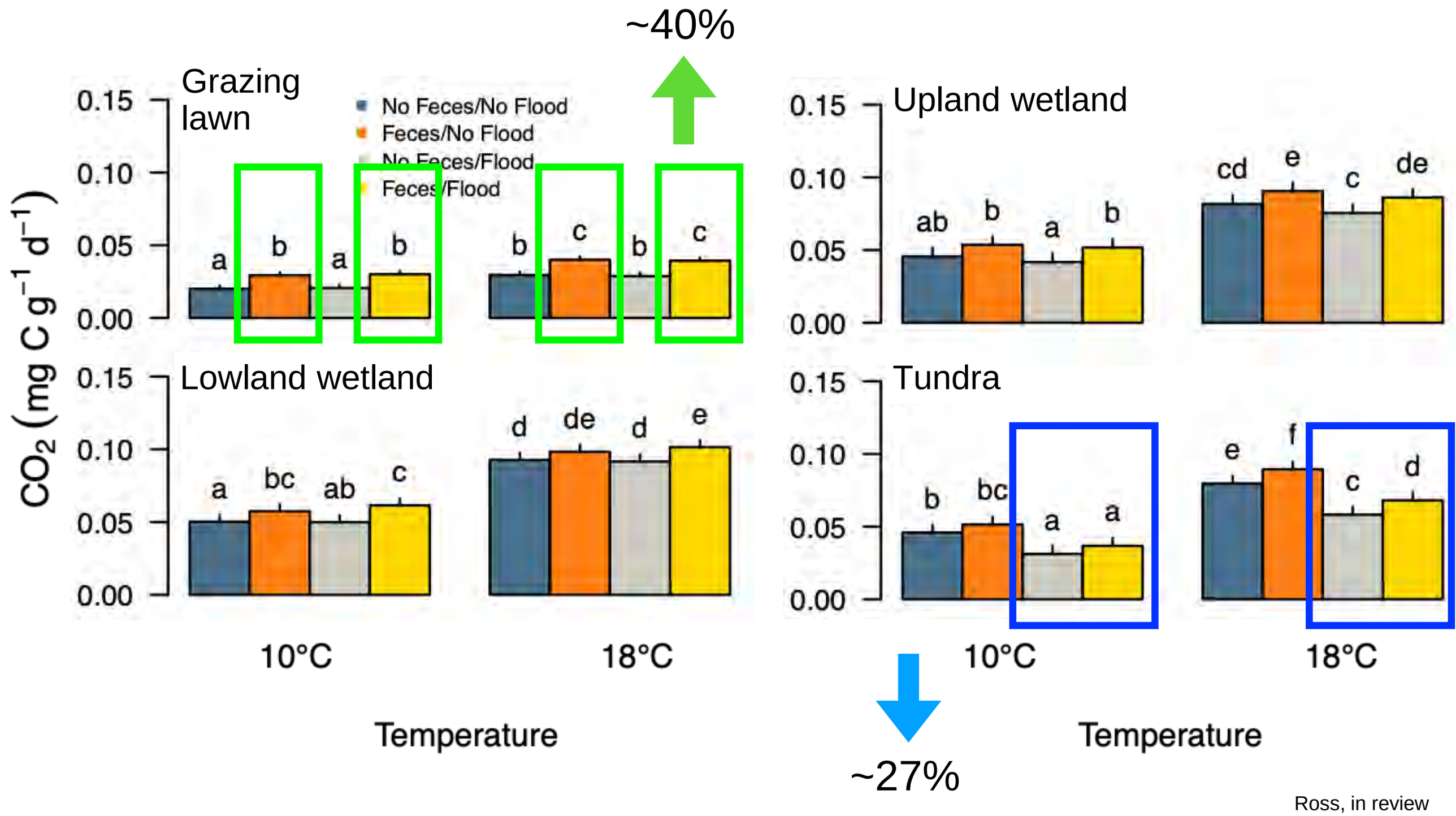
Flooding reduces but feces increases respiration



Ross, in review

CO_2 emissions

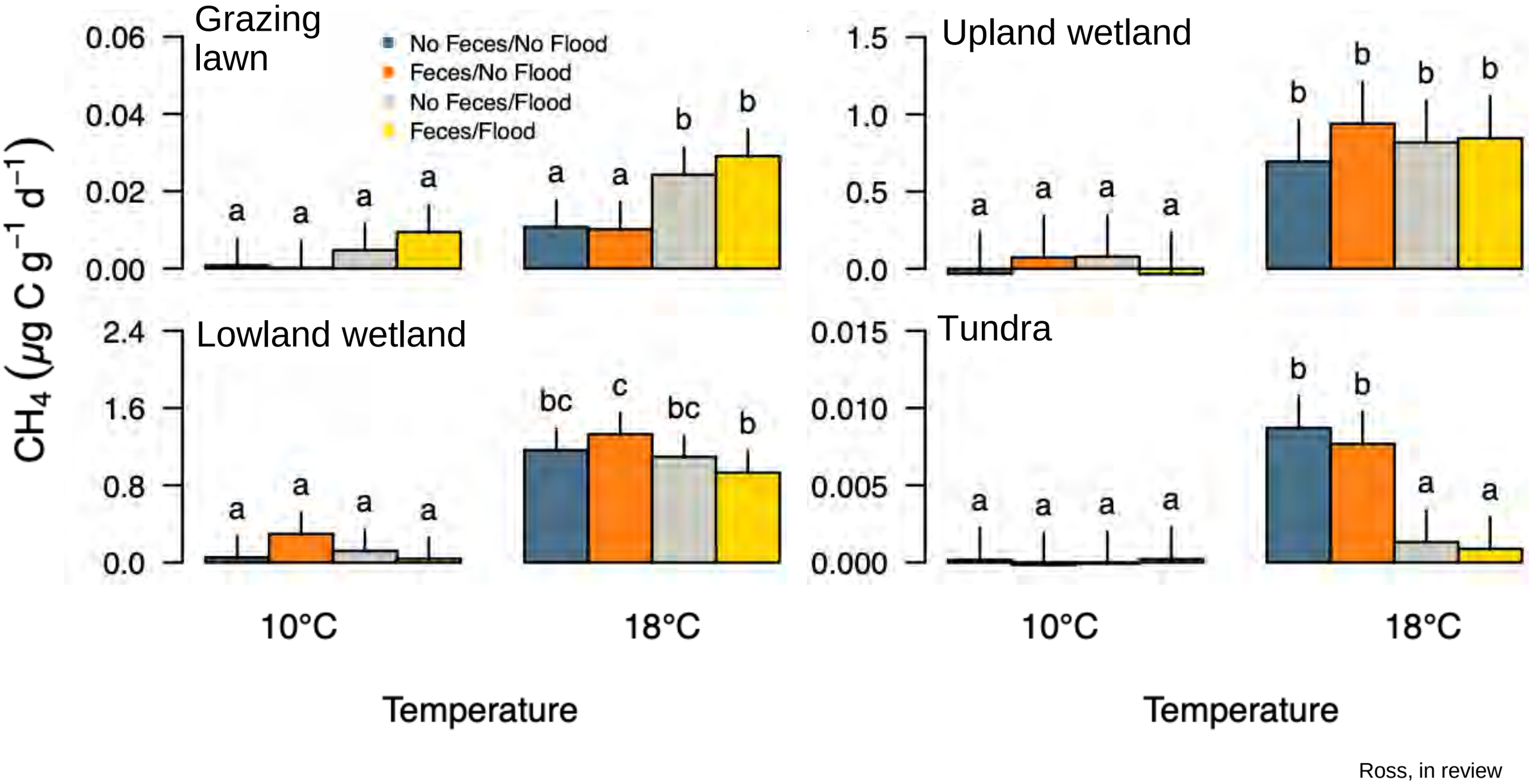
Flooding reduces but feces increases respiration



Ross, in review

CH_4 emissions

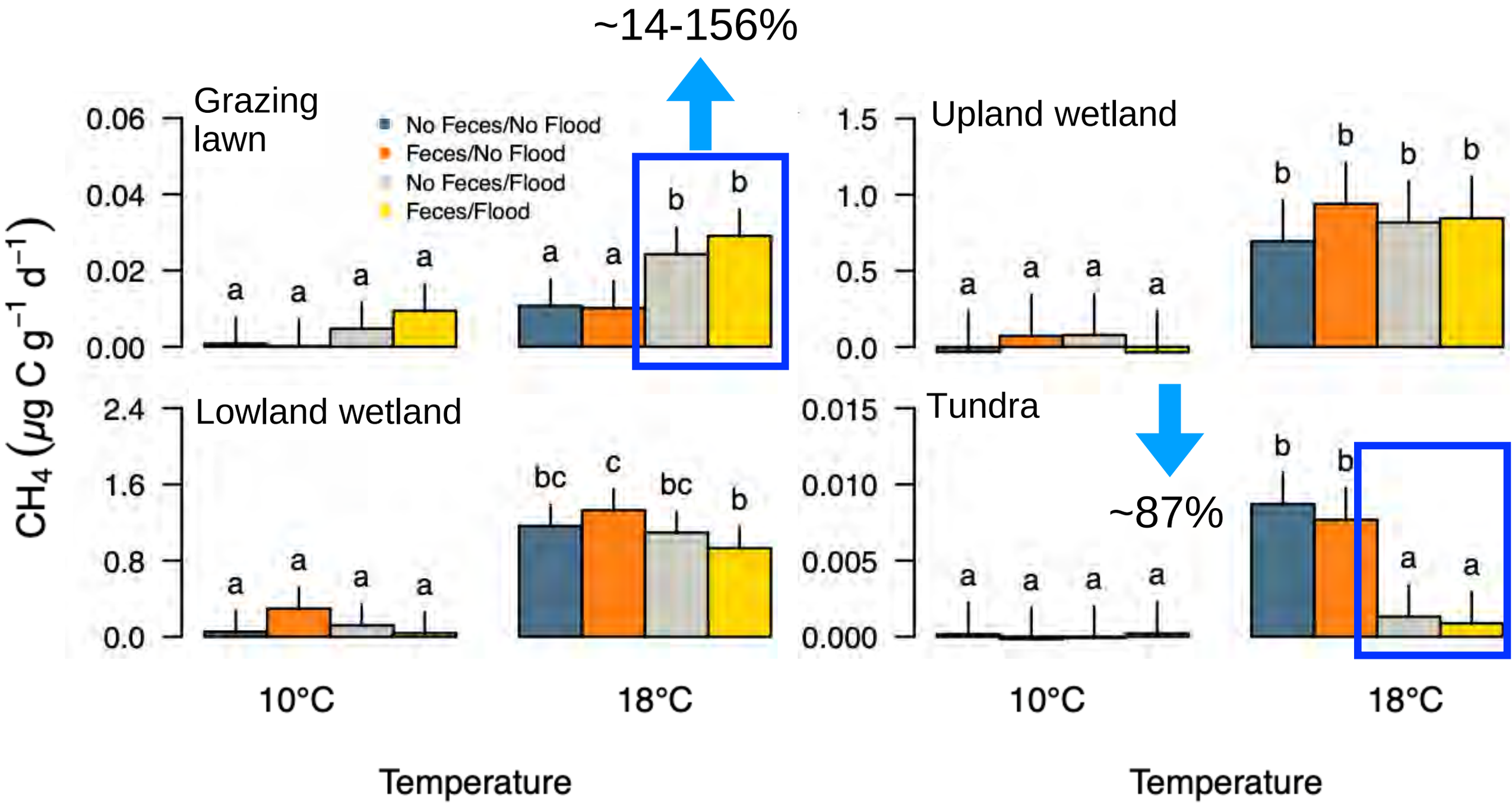
Effect of flooding depends on soil



Ross, in review

CH_4 emissions

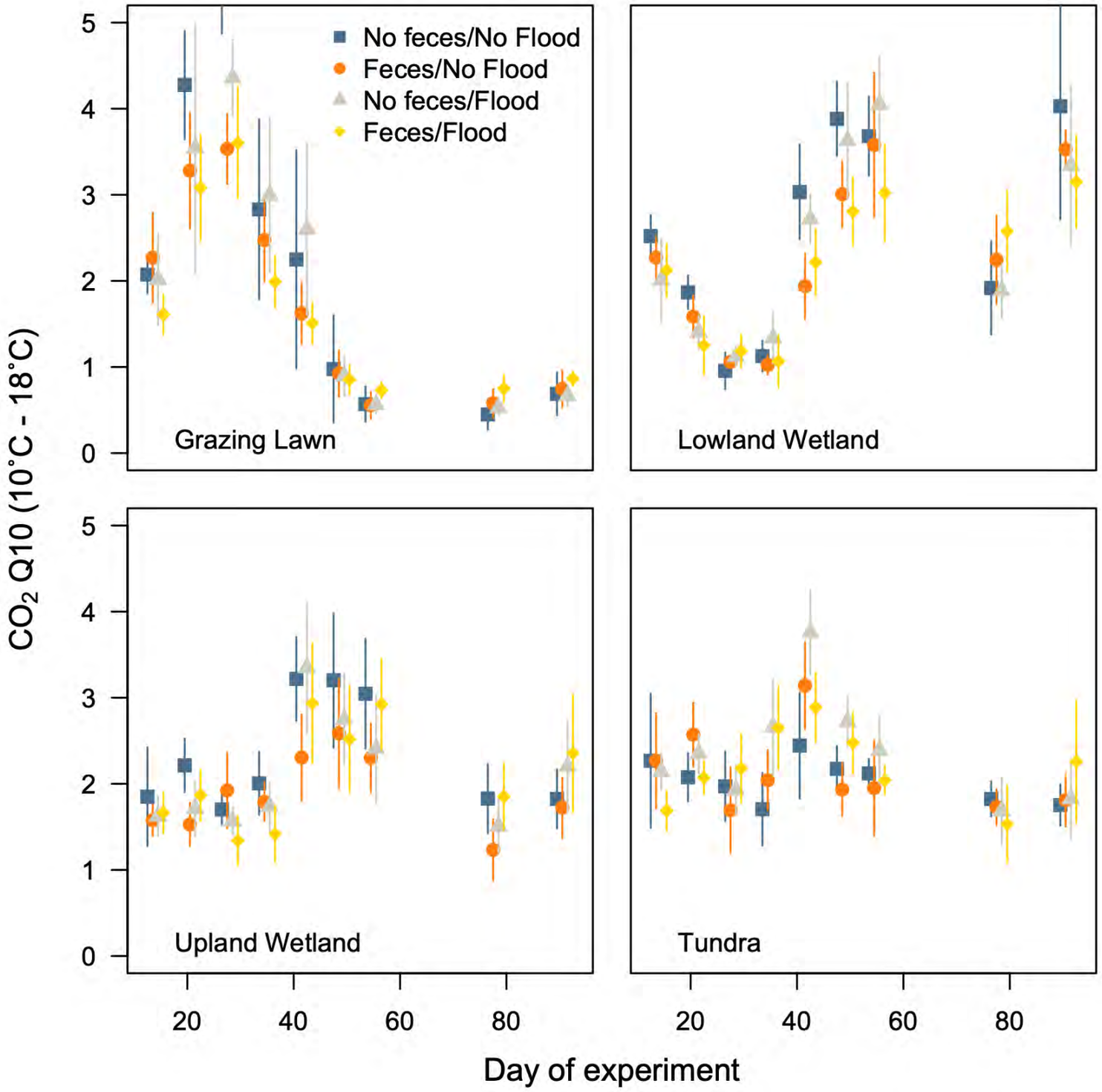
Effect of flooding depends on soil



Ross, in review

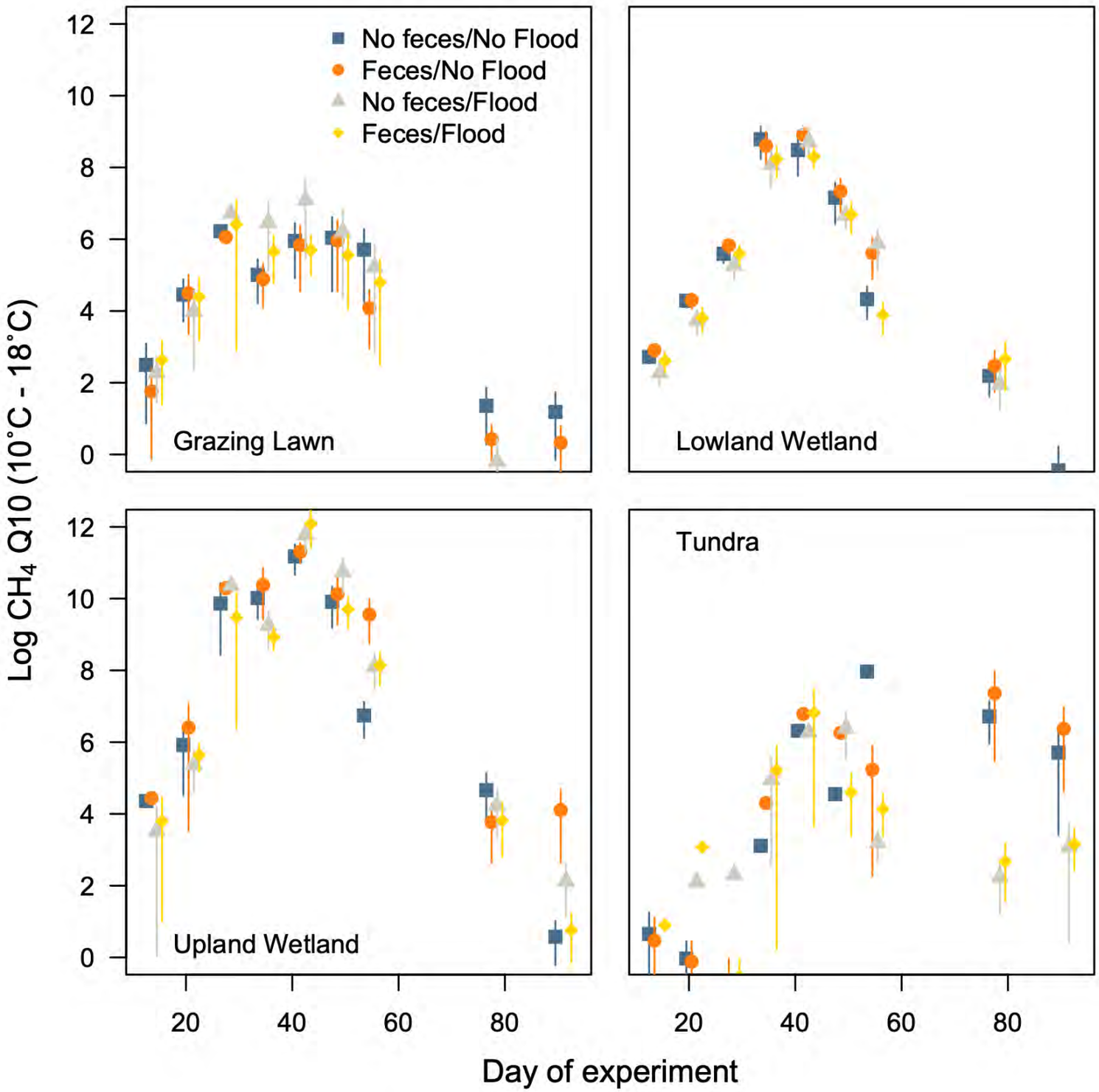
CO_2 sensitivity to temperature

Soil type and time matter more than forcings



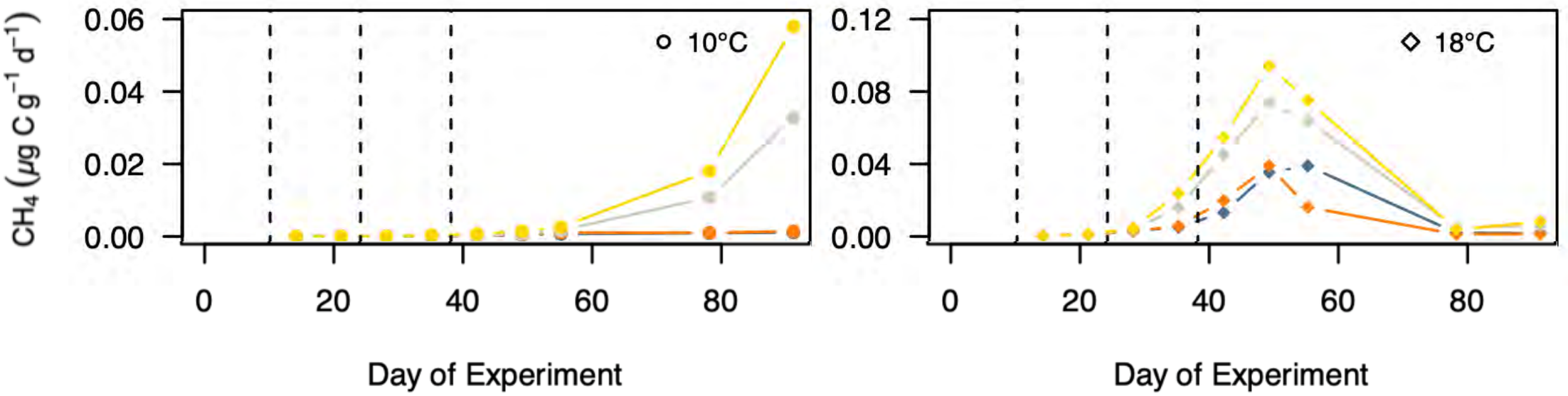
CH_4 sensitivity to temperature

Soil type and time matter more than forcings



CH_4 sensitivity to temperature

Population growth is critical



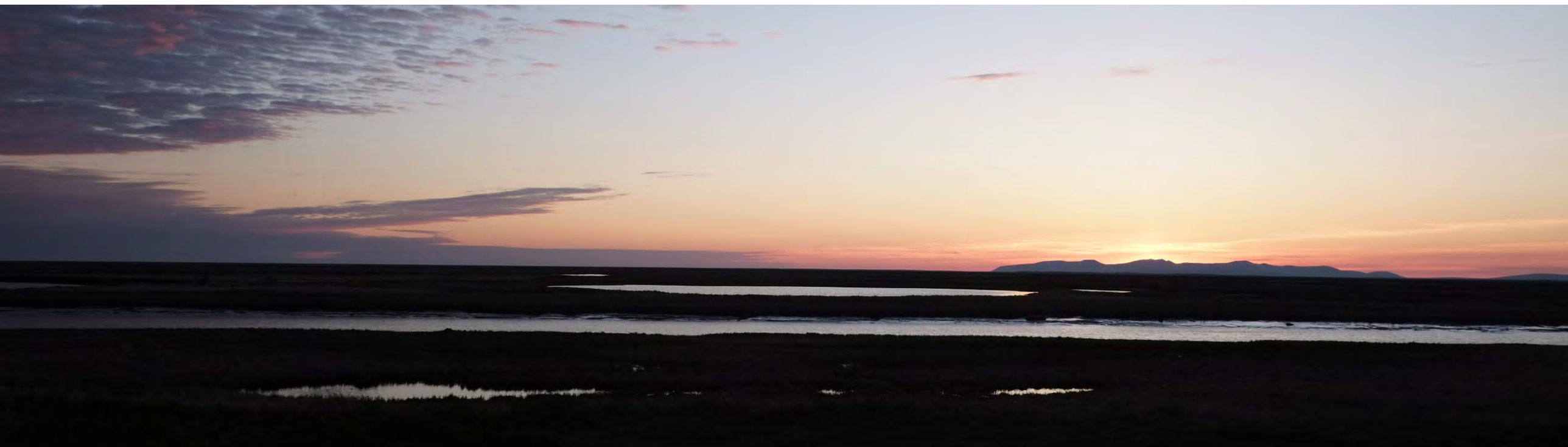
Conclusions

Temperature sensitivity is highly variable

- Floods and fecal addition have varying influences on GHG emissions from different soils

- Soil differences and time are bigger influences on temperature sensitivity of GHG emissions than climate forcings

- Sensitivity depends on population growth and C availability - indirect effects



Questions?

Figure 1

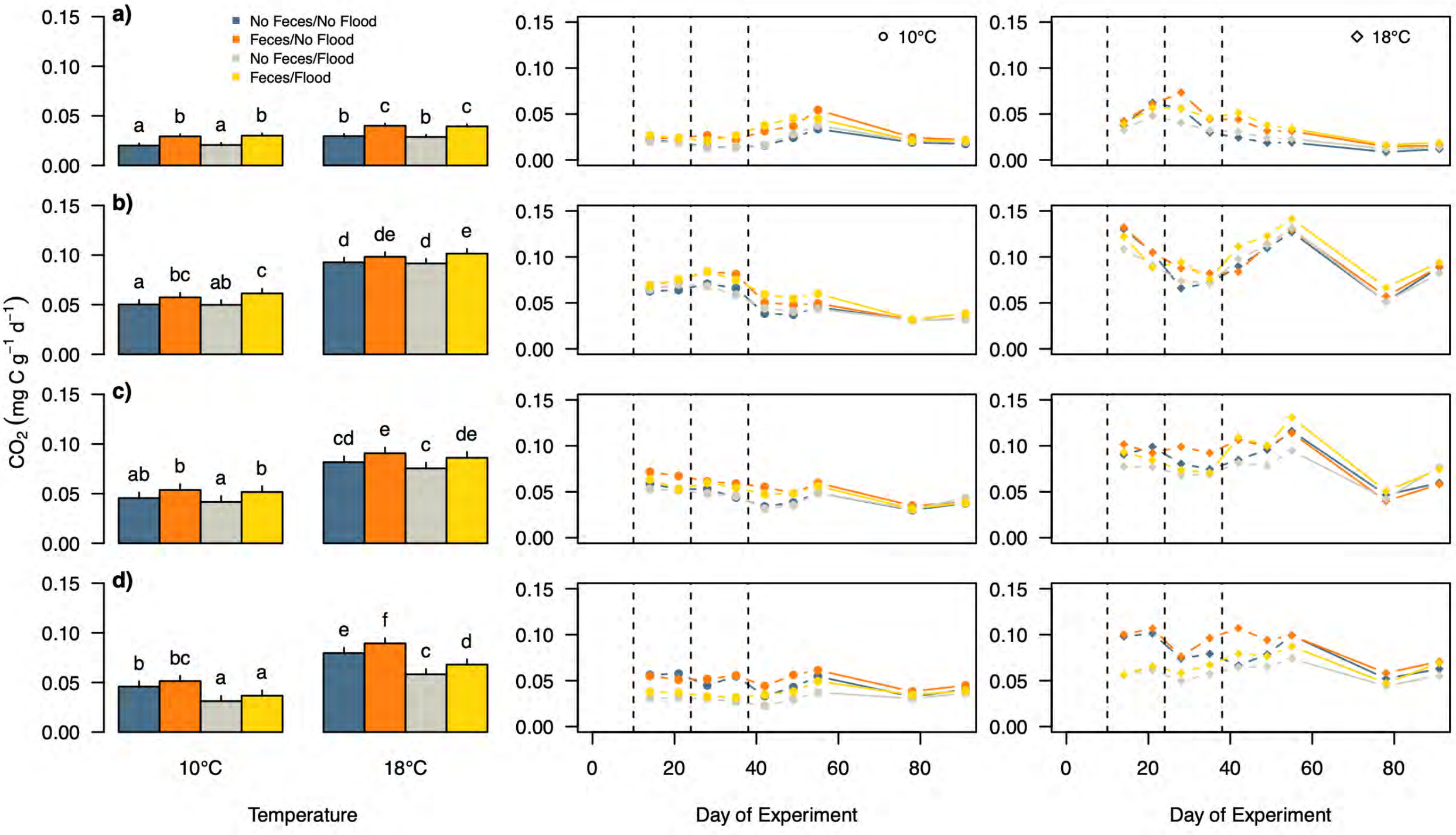
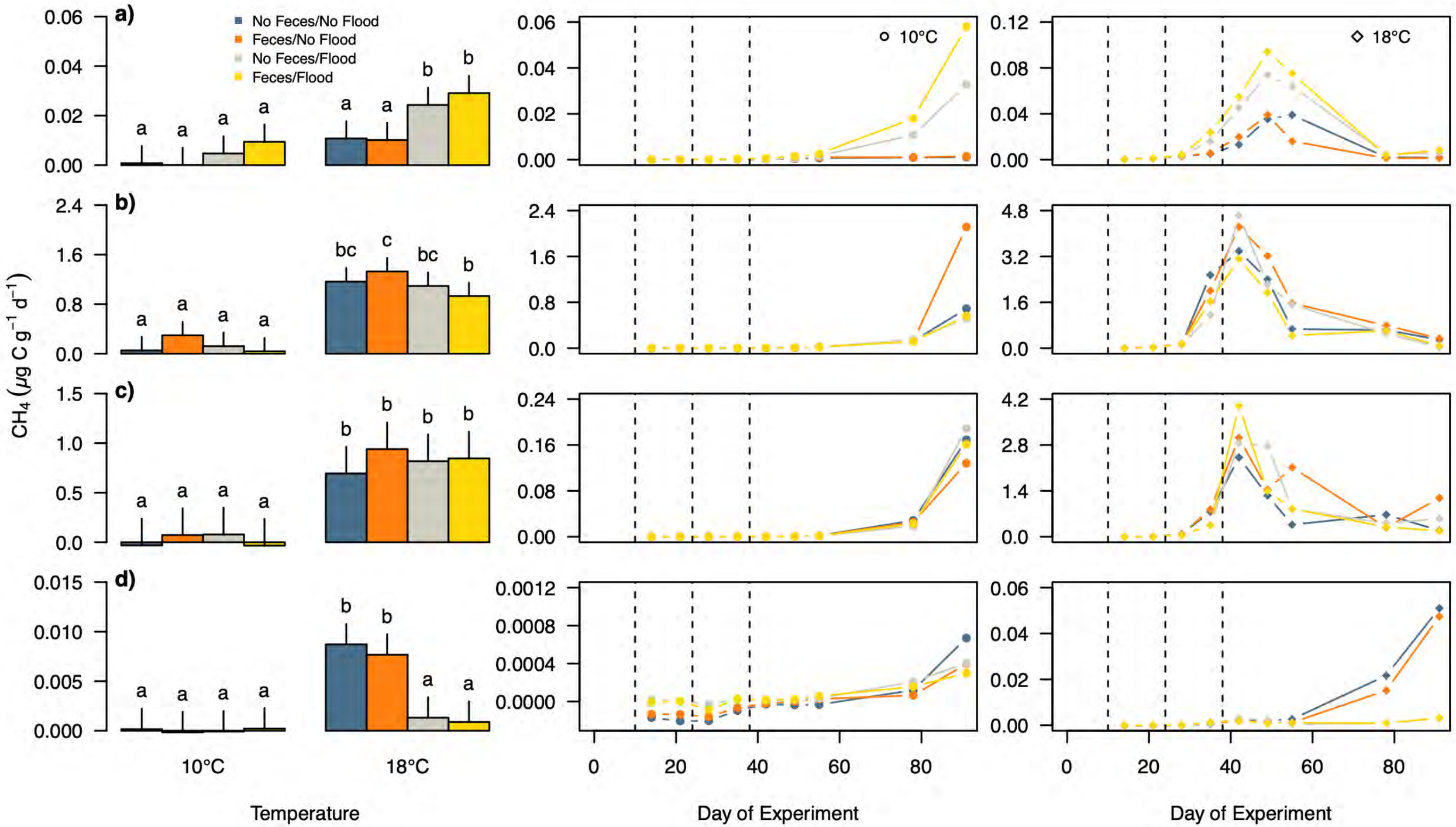

a)
b)
c)
d)
No Feces/No Flood
Feces/No Flood
No Feces/Flood
Feces/Flood
a b a b
b c b c
a bc ab c
d de d e
ab b a b
cd e c de
b bc a a
e f c d
0.15
0.10
0.05
0.00
CO_2 (mg C g^{-1} d^{-1})
10°C
18°C
Temperature
10°C
18°C
0 20 40 60 80
Day of Experiment
Day of Experiment

Figure 2


a)
b)
c)
d)
No Feces/No Flood
Feces/No Flood
No Feces/Flood
Feces/Flood
10°C
18°C
CH_4 ($\mu g\ C\ g^{-1}\ d^{-1}$)
Temperature
Day of Experiment
Day of Experiment

Experimental Design

Temperature, floods, feces, and greenhouse gasses

10 °C and 18 °C incubator

- 16 weeks

Flooding and draining

- Weeks 2, 4, 6
- 3.5 ppt salinity

Feces addition and “trampling”

- Weeks 2, 4, 6

Greenhouse gas emissions

- CO_2 and CH_4 over 24 hours