Climate manipulation (warming and wetting) experiment in Cambridge Bay, Canada

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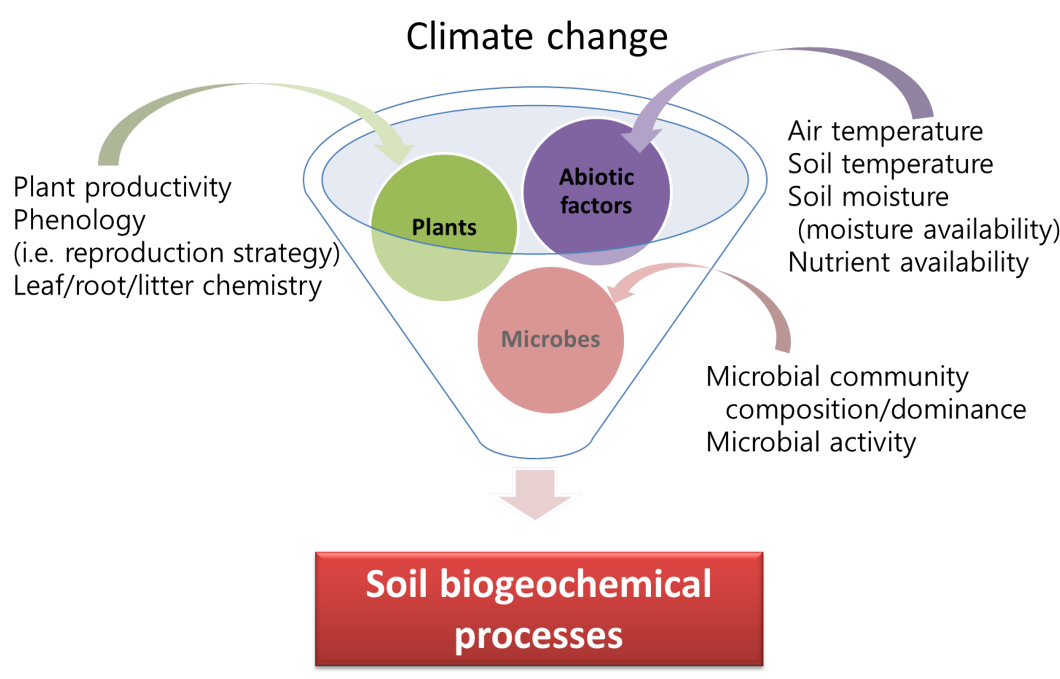
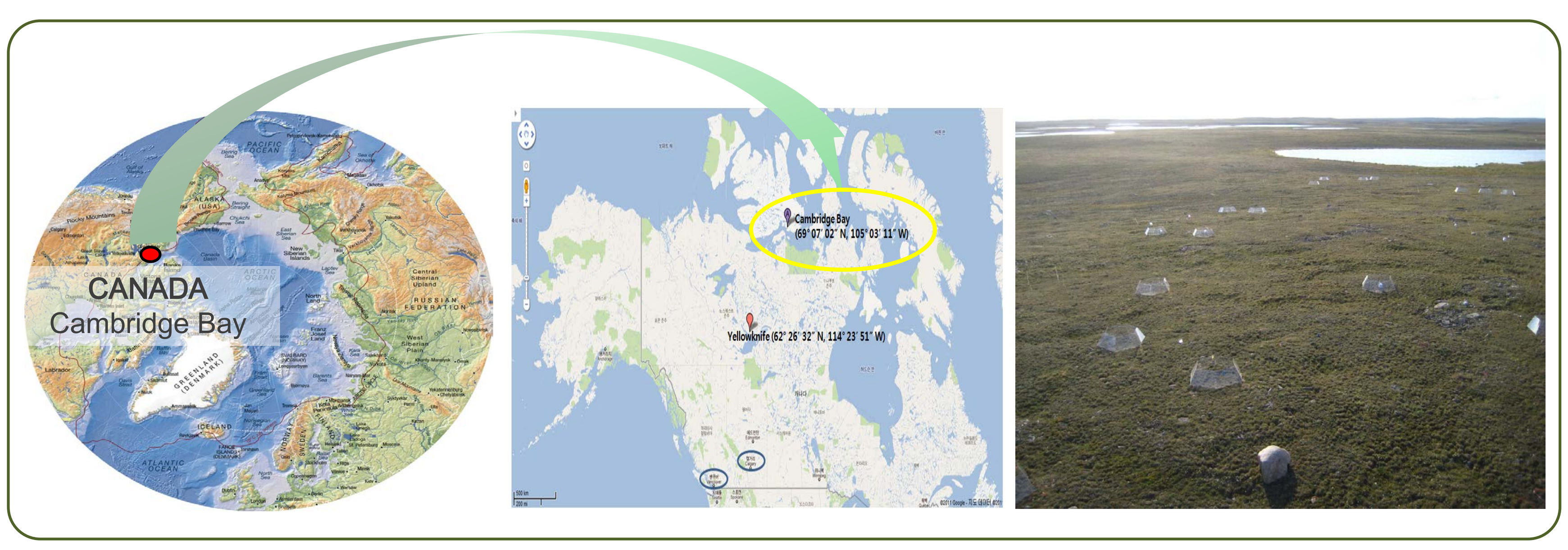
Introduction

- Climate models predict considerable changes in temperature and precipitation in the Northern Hemisphere. This change occurring in the Arctic might influence microbial activity and soil organic carbon (SOC) dynamics
- The purpose of this study is to investigate the effects of warming and precipitation increases on soil biogeochemical processes in the Canadian High Arctic



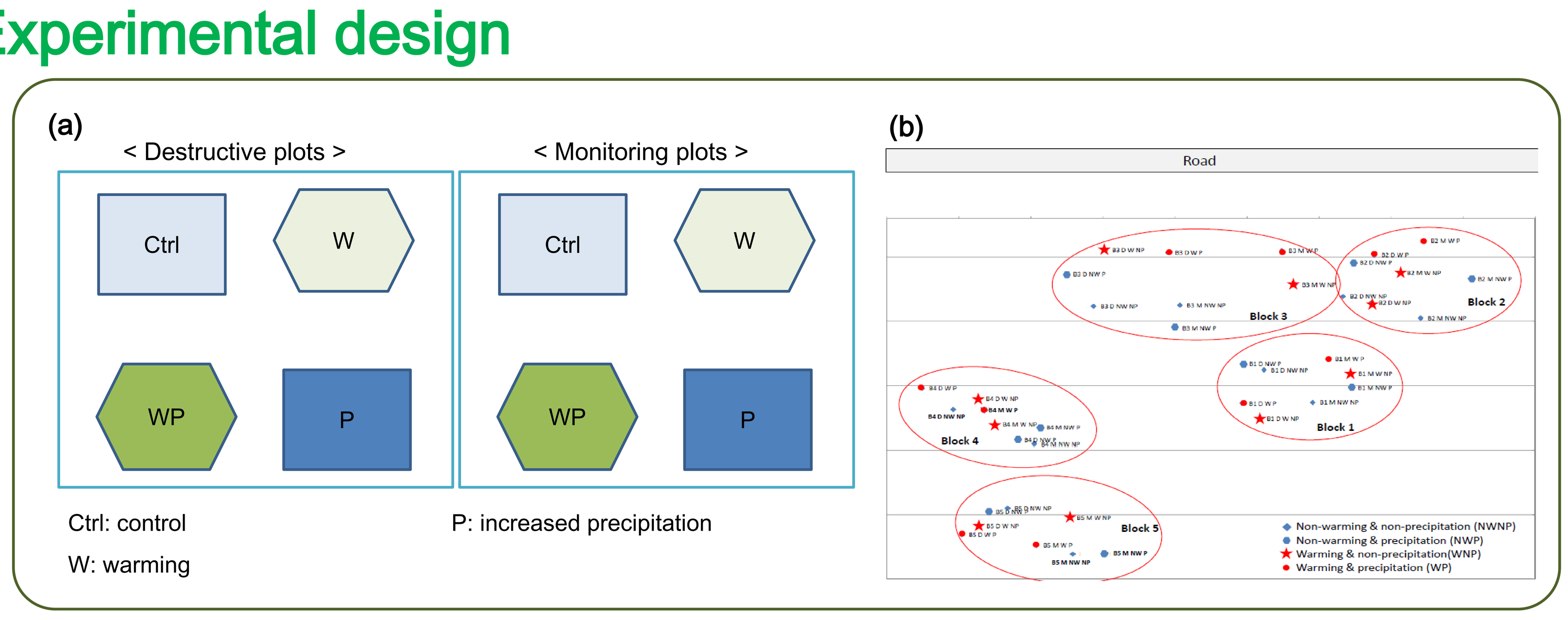
Study site

- Cambridge Bay, Nunavut, Canada (69° 8′ 44.42″ N, 105° 3′ 28.20″ W)
- Mean annual temperature: -10℃; Annual precipitation: 140 mm
- Vegetation: Mainly *Dryas integrifolia* and *Carex* spp.
- Soil type: Orthic Eutric Turbic Cryosol (Sand 75.5%, Silt 9.8%, Clay 4.7%; Sandy loam)



Location of Cambridge Bay and a view of the experimental site

Experimental design

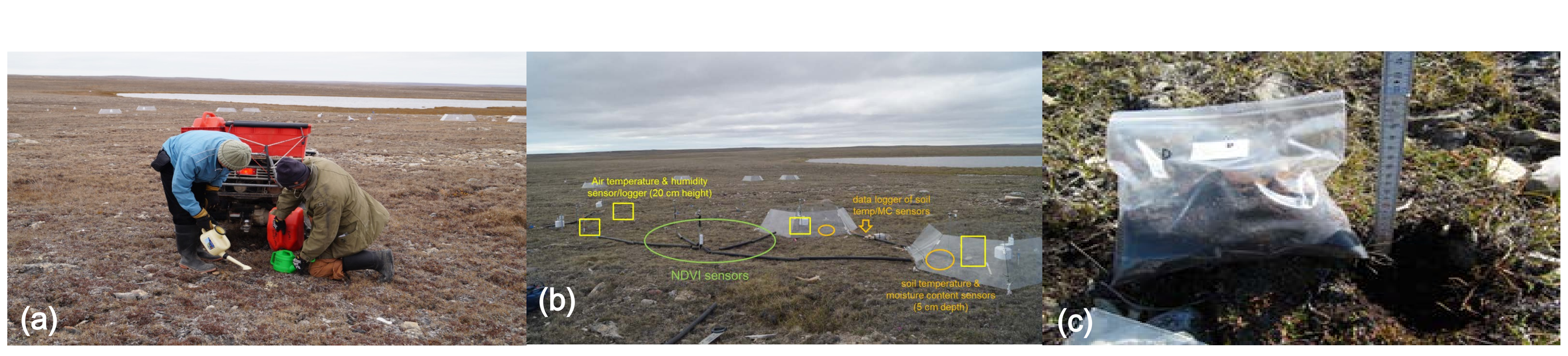


(a) A composition of one block containing monitoring and destructive sampling plots with four treatments and (b) arrangements of five blocks with four treatments

- Completely randomized block design: Two replicate plots (monitoring and destructive), each plot is composed of five blocks with four treatments
- Warming effect: Open top chamber (OTC) with hexagon design
- Precipitation effect: Addition of 2 L distilled water per plot every week
- Operation period: Early July ~ Early October since 2012 (during growing periods)

Field Activities

- Monitoring plots: air temperature & relative humidity and soil temperature & moisture content (5 cm depth), NDVI sensor; CO_2 fluxes in summer
- Destructive plots: soil sampling of organic and mineral layers to measure water extractable C, inorganic N, and extracelluar enzyme activities



Pictures of (a) watering, (b) air temperature & relative humidity and soil temperature & moisture content sensors, and (c) soil sampling

Acknowledgements

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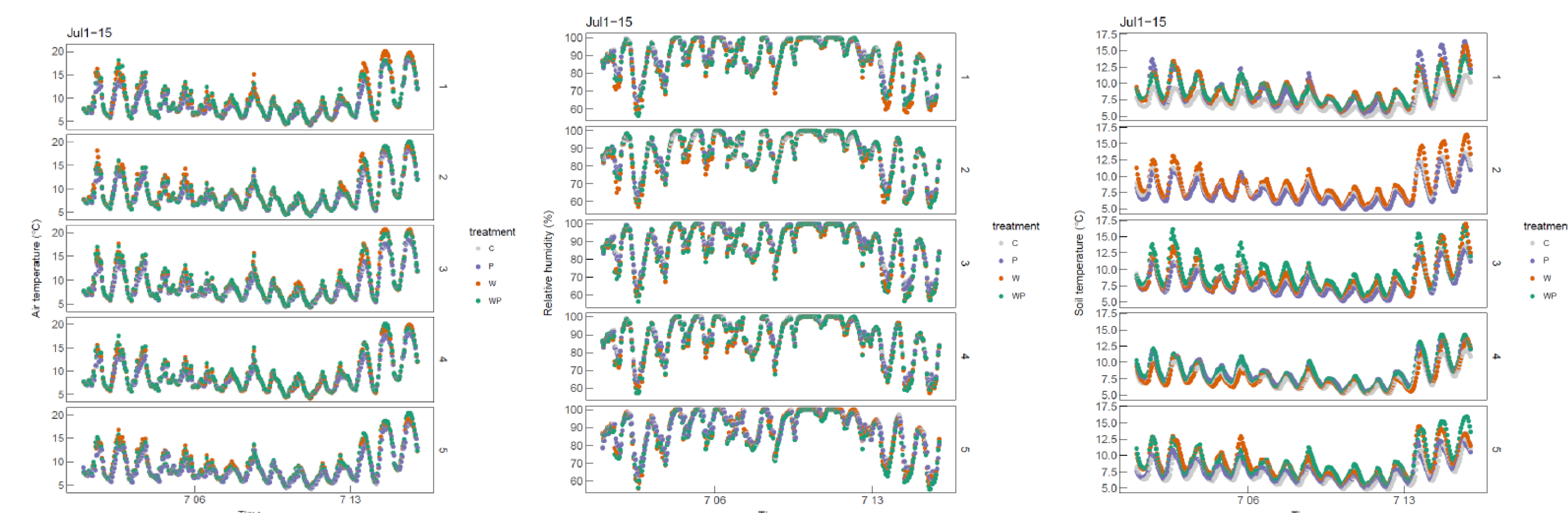
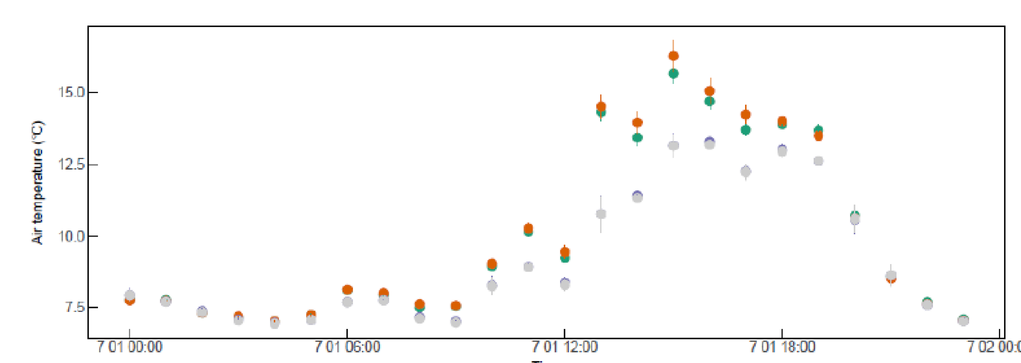
Results

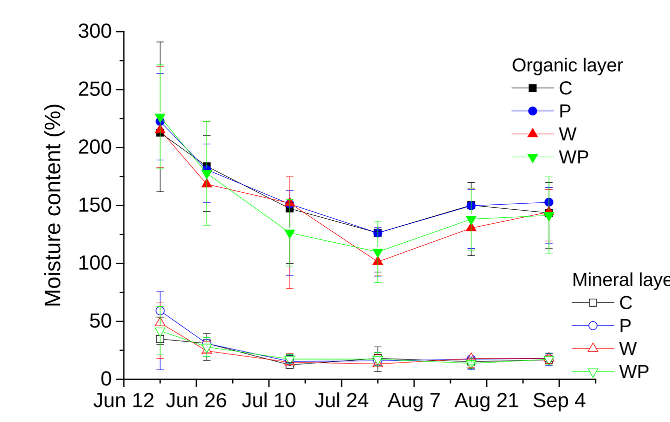
❖ Environmental parameters



(a) Mean air temperature (July 1-15) (b) Relative humidity (July 1-15) (c) Mean soil temperature (July 1-15)



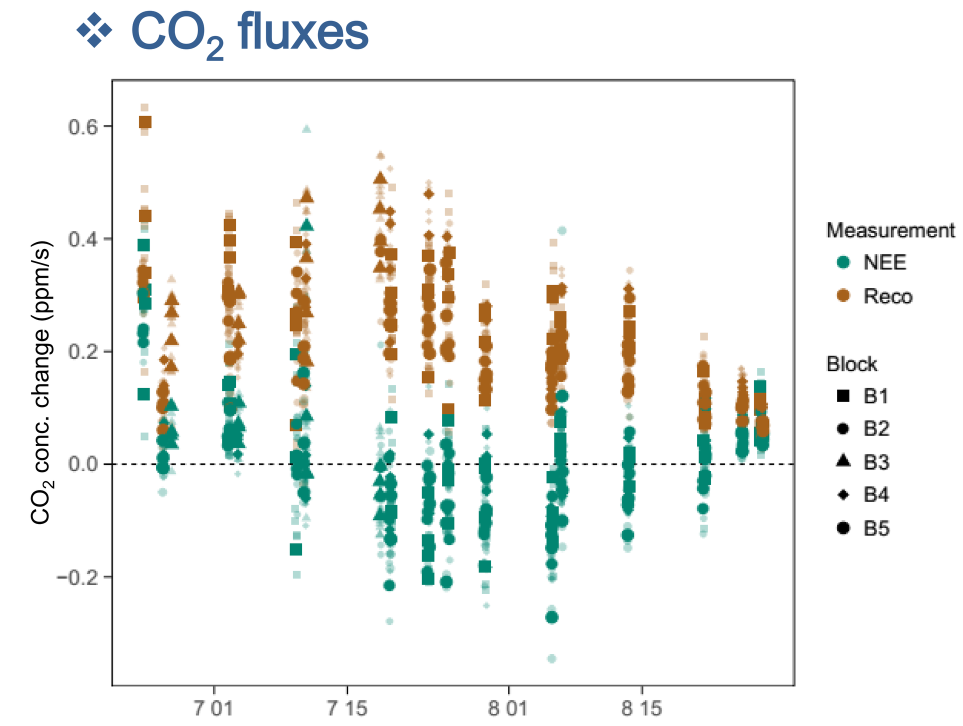
(d) Daily air temperature



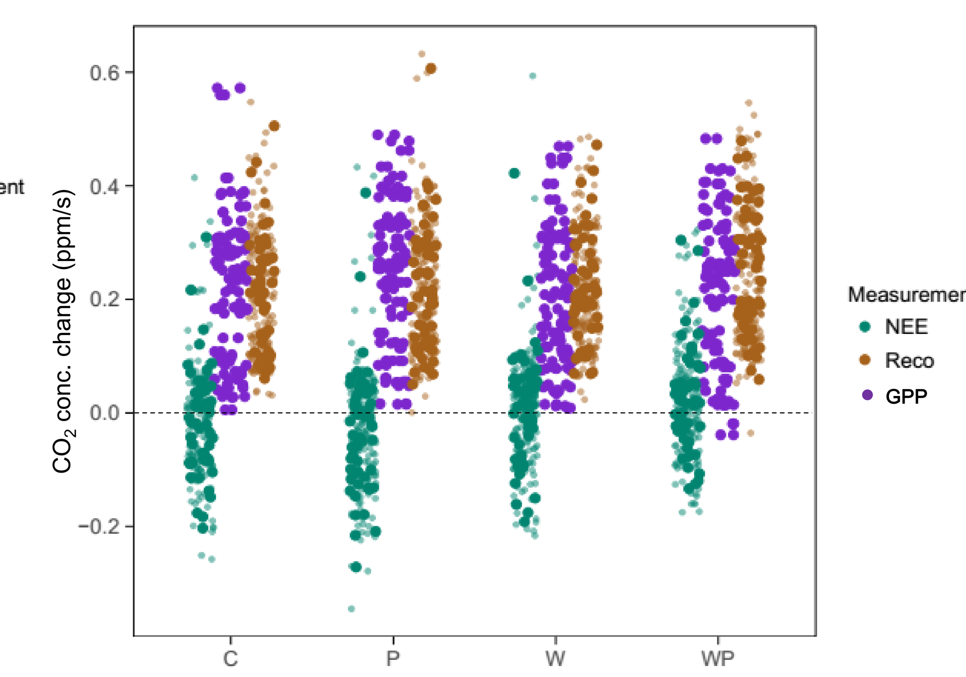
(e) Gravimetric soil moisture content

- Warming increased both atmospheric and soil temperature and decreased relative humidity
- Warming effect via OTC was pronounced between 10 AM and 7 PM
- Soil moisture content was not different among treatment during a growing season

❖ CO_2 fluxes



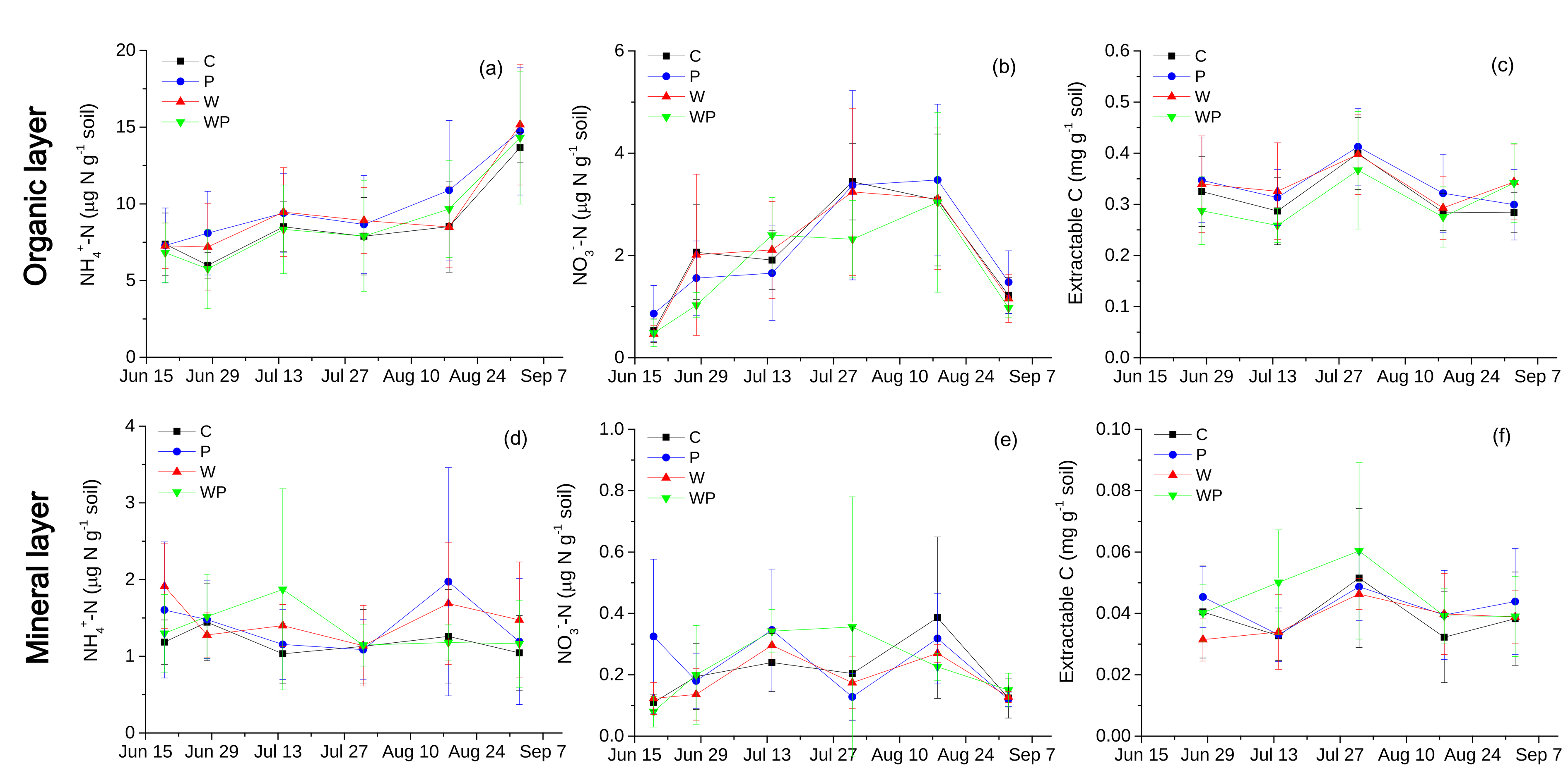
(a) Seasonal change of net ecosystem exchange (NEE) and ecosystem respiration (Reco)



(b) Range of net ecosystem exchange (NEE), ecosystem respiration (Reco), gross primary productivity (GPP) among treatments

- NEE was negative (CO_2 uptake > production) during mid July to mid August
- CO_2 fluxes during a growing season did not show significant differences among treatments

❖ Inorganic N and water extractable C



- Inorganic N and water extractable C contents were not significantly different among treatments
- Ammonium ion was much higher than nitrate ion content in both organic and mineral layers
- While nitrate ion and extractable C contents were highest at the end of July, ammonium ion content was the highest at the end of growing season
- Additionally, we measured the extracelluar enzyme activities associated with C and N dynamics at the same time, however, no apparent relationship was found with CO_2 fluxes, inorganic N content, and water extractable C