Dynamics of CO_2 exchange in croplands in Haean Catchment, South Korea

Peng Zhao, Johannes Lüers
peng.zhao@uni-bayreuth.de, johannes.lueers@uni-bayreuth.de

Motivation

- the economic development, the ecosystem function, and the climate system
- The CO_2 flux estimate for croplands: more uncertain
- CO_2 exchange under monsoonal conditions

Objectives

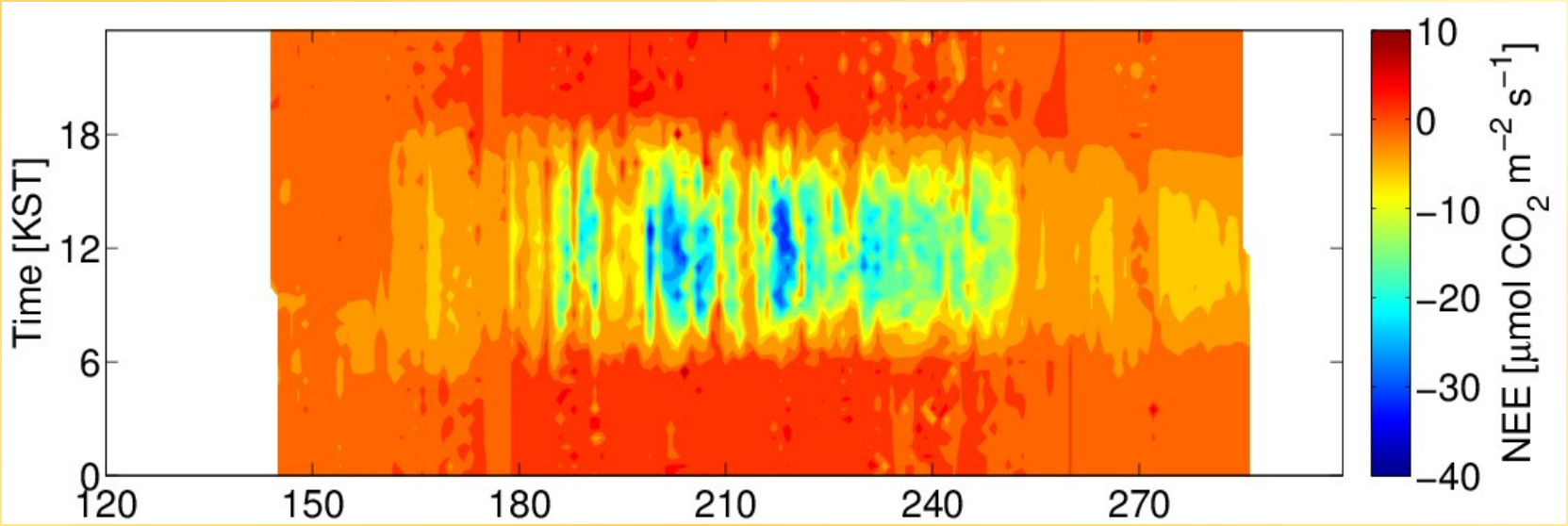
- To obtain reliable information about the net ecosystem exchange of CO_2 in typical (both flooded and dry) croplands in a monsoonal region.
- To better understand the dynamics of agro-ecosystem CO_2 exchange during the whole growing period.

This study was carried out as part of the International Research Training Group TERRECO (GRK 1565/1) funded by the Deutsche Forschungsgemeinschaft (DFG) at the University of Bayreuth, Germany and the Korean Research Foundation (KRF) at Kangwon National University, Chuncheon, S. Korea.

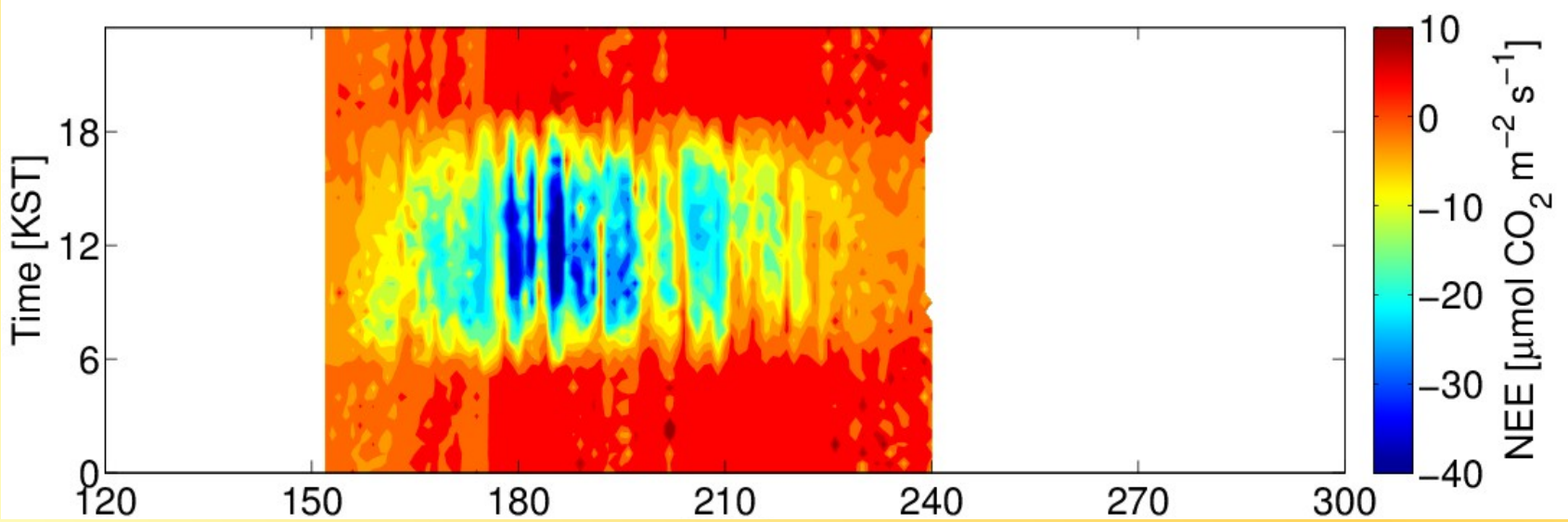
Weather stations
2010, 2011

Biomass measurement
2010

Eddy-covariance
2010, 2011



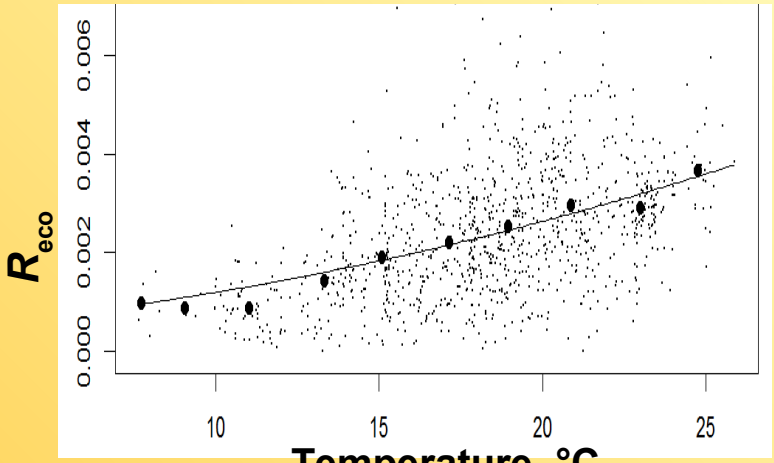
NEE in the rice field



NEE in the potato field

Respiration

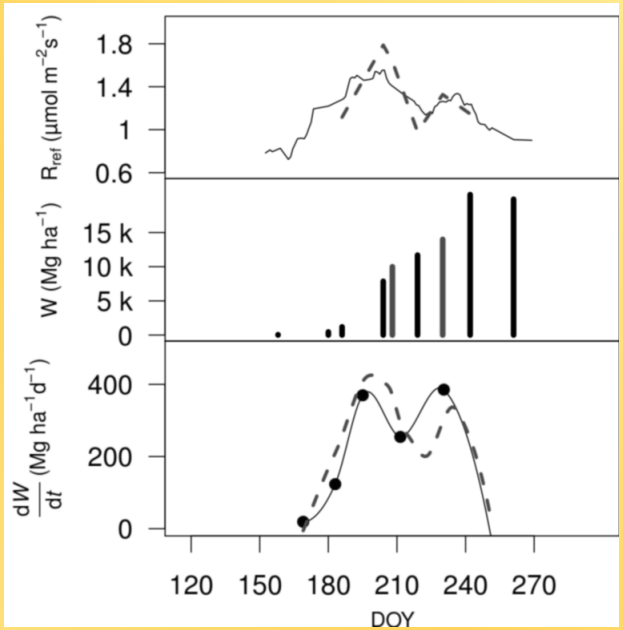
Temperature response



$$R_{eco} = R_{ref} e^{E_0 \left(\frac{1}{T_{ref} - T_0} - \frac{1}{T - T_0} \right)}$$

Biomass response

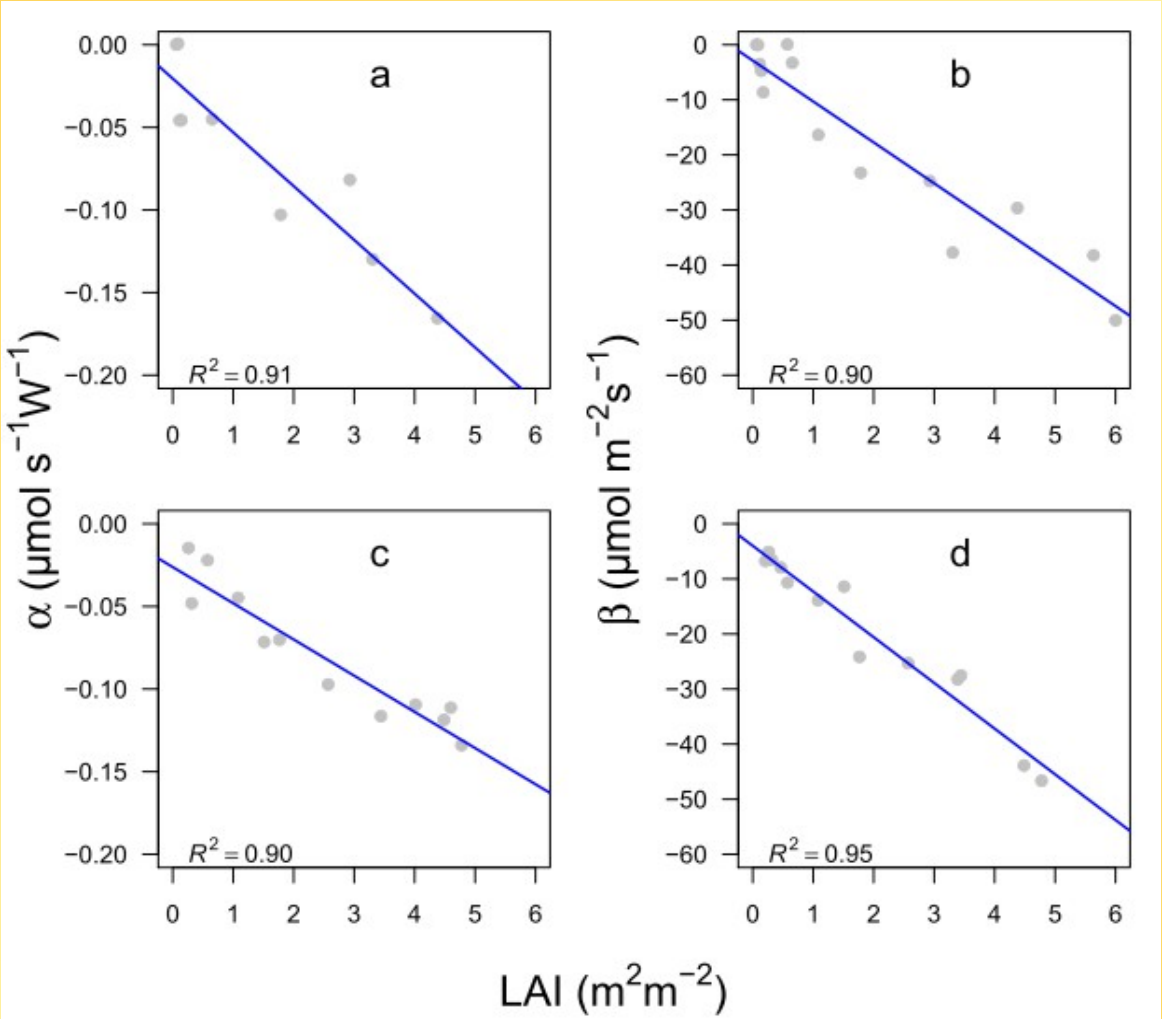
$$R_{plant} = a \frac{dW}{dt} + bW$$



Rice

GPP: light

$$\mathrm{GPP} = \frac{\alpha R_g \beta}{\alpha R_g + \beta}$$

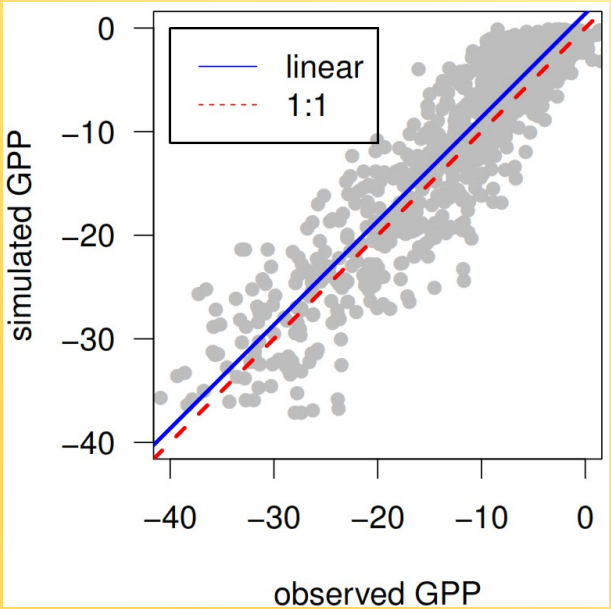


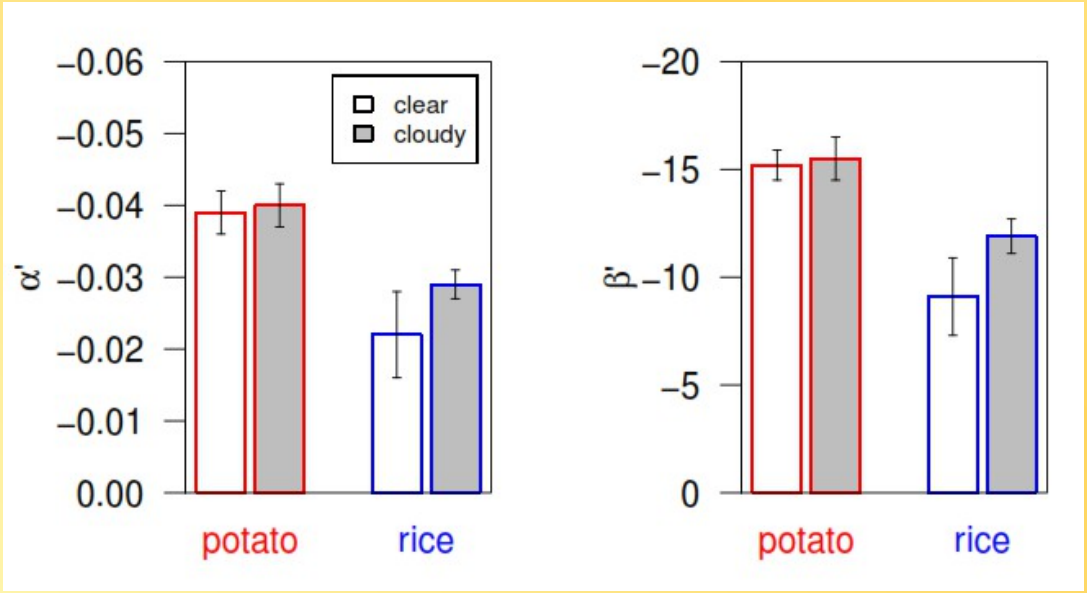
Rice

Potato

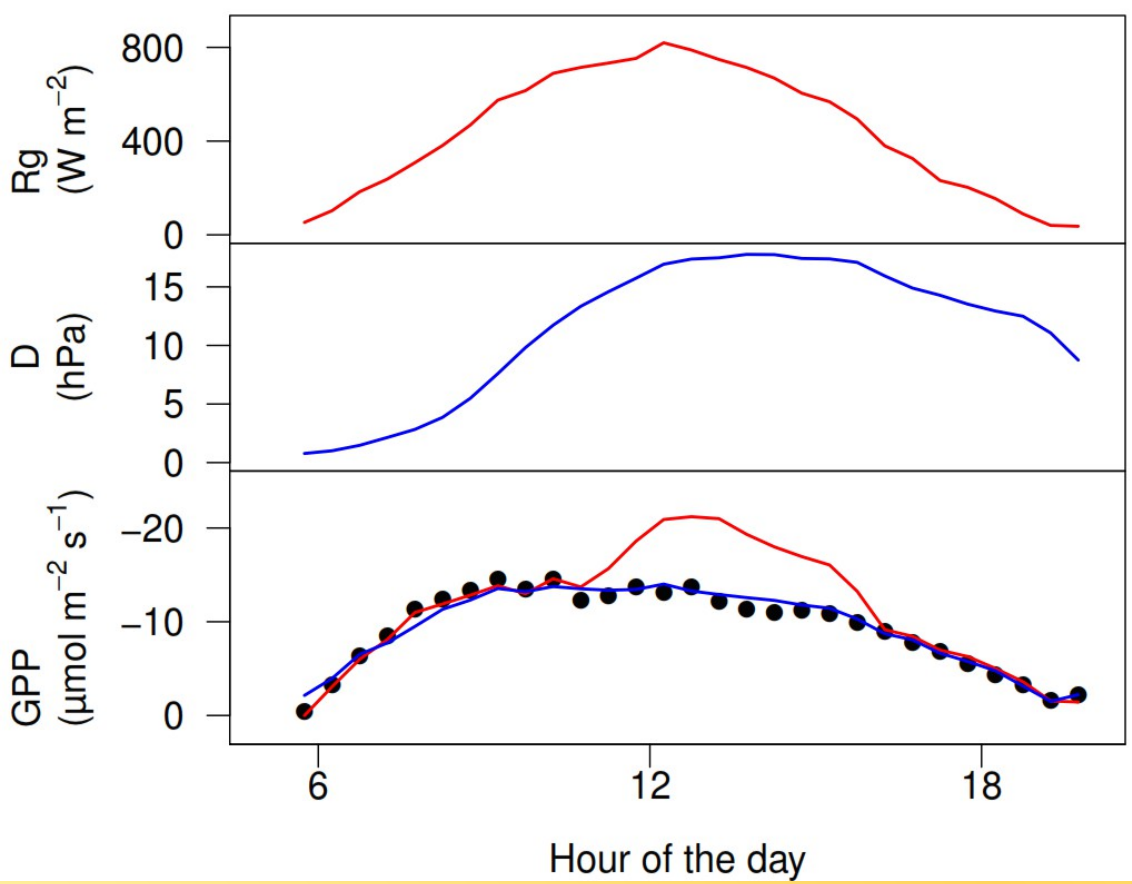
GPP: light and leaf

$$\frac{\mathrm{GPP}}{\mathrm{LAI}} = \frac{\alpha' R_g \beta'}{\alpha' R_g + \beta}$$

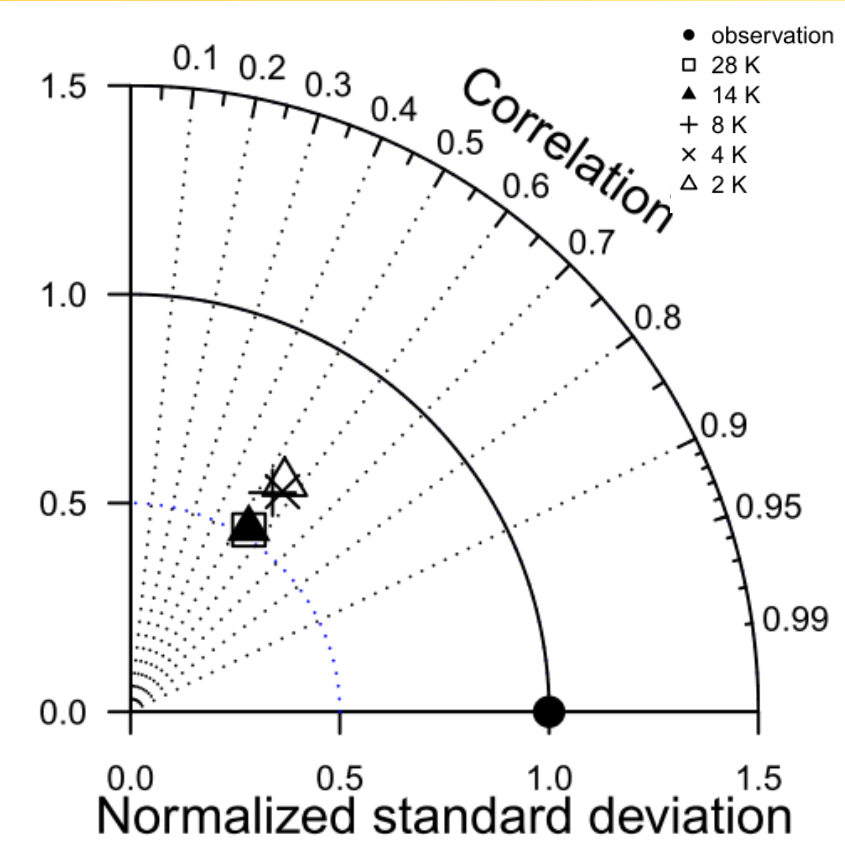




GPP: vapour pressure deficit



GPP: temperature



Conclusions

- The primary determinant of seasonal change in GPP is the change in LAI for both crops.

- The diurnal change in GPP is driven by the solar radiation. The photosynthetic efficiency of rice with diffuse radiation is larger than with direct radiation. The photosynthetic efficiency of potatoes showed no difference between sunny and cloudy days.

- The seasonal pattern in ecosystem respiration in the rice field is determined by both the temperature and the above-ground biomass.

- VPD plays a significant role in the dry cropland before summer monsoon and a minor role during summer monsoonal conditions.