Biological Fingerprint for Landscape Ecosystem Respiration with Agricultural Management of the Haean Catchment, Korea

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Introduction

The landscape of the Haean Catchment is characterized by a mosaic of fetches for agricultural fields at different scales. In the catchment, agricultural management determines landscape carbon dynamics. Studies on cross-scale connections of landscape carbon dynamics in agricultural landscapes, where human activity is the main agent of ecosystem dynamics, are rare. The objectives of this study are to develop a picture of the biological fingerprint of carbon dynamics using multi-scale observations (i.e., chambers, eddy covariance, models, and remote sensing) and to connect the individual observations of carbon dynamics carried out at different scales. Complementary to the work of Bora Lee on GPP, the focus here is on generalizing ecosystem respiration (R_{eco}), initially using chamber and eddy covariance (EC) measurements at rice paddy and potato sites. Based on Lloyd and Taylor equation (Eq. 1), R_{eco} was estimated by using the observed R_{eco} over different temporal intervals, and was compared against each method.

Materials & Methods

The measurements of chamber and eddy covariance (EC) were conducted periodically at rice paddy and potato sites in 2010 and 2011 (see Fig. 1 & Table 1). (For further information, see the posters by Lindner et al. and Zhao & Lüers)

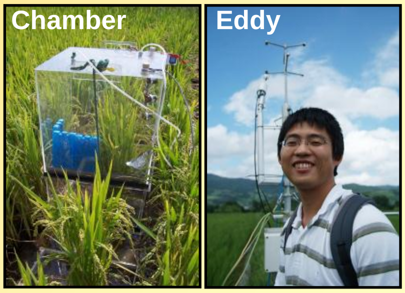


Fig. 1. The methods of chamber (left) and eddy covariance (right).

Table. 1. Measurement days of the chamber and the eddy covariance methods in 2010 (unit: Days of Year (DOY)).

Crop Type	Days of Chamber Measurement	Days of EC Measurement
Rice	181, 182, 208, 232, 261	177-186, 203-223, 242-274
Potato	152, 157, 174, 186, 210	152-175, 187-203, 225-240

R_{eco} was estimated as a temperature-dependent function following Lloyd and Taylor (1994) (Eq. 1).

$$R_{eco} = R_{eco\_ref}\, e^{E_0(1/T_{ref} - T_0) - (1/T_{air} - T_0))} \qquad (1)$$

For the estimated R_{eco}, dark respiration measurements by the chamber were used in Eq. (1). The EC data were divided into daytime and nighttime categories to estimate R_{eco}. Eq. (1) was used for the nighttime data, whereas Eq. (2) was used for the daytime data.

$$NEE = \frac{a \times PAR \times NEE_{max}}{a \times PAR + NEE_{max}} - R_{eco\_NEE} \qquad (2)$$

Results

Variation of the observed and the estimated R_{eco} (Chamber)

- Higher R_{eco} at the potato site than at the rice paddy site.
- Contradicting predictability of R_{eco} with different temporal interval at the two crops.

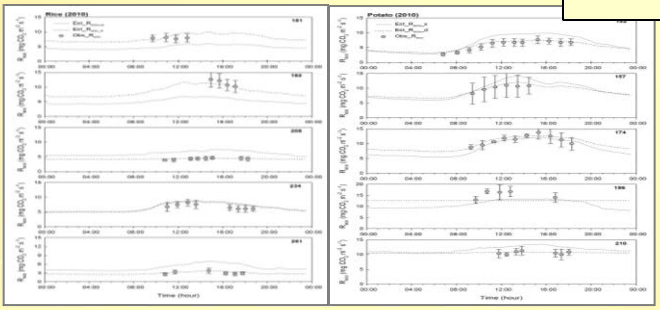


Fig. 2. Comparison of the observed R_{eco} with the estimated R_{eco} at different time intervals

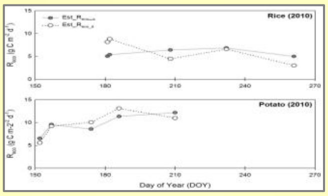
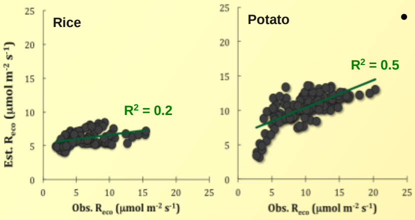


Fig. 3. Comparison of the estimated daily R_{eco} at different time intervals.

Variation of the observed and the estimated R_{eco} (EC)

EC – Daytime data



- The estimated R_{eco} had a better agreement with the observed R_{eco} at the potato site when the daytime data of EC were used.

EC – Nighttime data

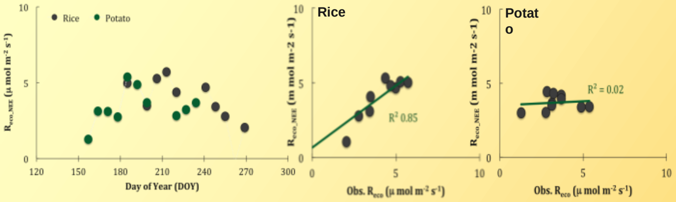


Fig. 4. Comparison of the observed R_{eco} with the estimated R_{eco}.

- The estimated R_{eco} had a better agreement with the observed R_{eco} at the rice paddy site when the nighttime data of EC were used.

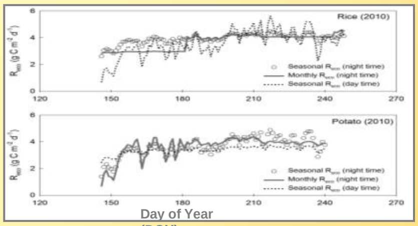


Fig. 5. Seasonal variation of the estimated daily R_{eco} with different time intervals.

Conclusion & Future Work

Progress is being made to understand observations of different types and to generalize respiration for fields across the catchment. Information from other sites will aide estimation of respiration for main crops in Haean. Spatially explicit climate data will allow us to obtain a high time resolution picture of the landscape respiration. Together with GPP (poster of Lee et al.), a biological fingerprint of landscape carbon dynamics will be obtained for the Haean Catchment.