Seasonal Variation of Carbon Dioxide Exchange in a Coniferous Forest in Korea

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Introduction

➢***Forest influences climate through exchanges of energy, water, carbon dioxide and other chemical species with the atmosphere.*** **Coniferous forest ecosystem is considered as a huge carbon sink.**

➢**In Korea, a coniferous forest is one of the most important plant functional types, covering about 42% of the total forest areas of Korea (Forest Statistics, 2005).**

➢***The influences of Monsoon climate on ecosystem carbon exchange are of great potential to the annual carbon balance (Yu et al., 2008; Hirata et al., 2008; Saigusa et al., 2008; Kato et al., 2008, Kwon et al., 2009).***

Goal of the study

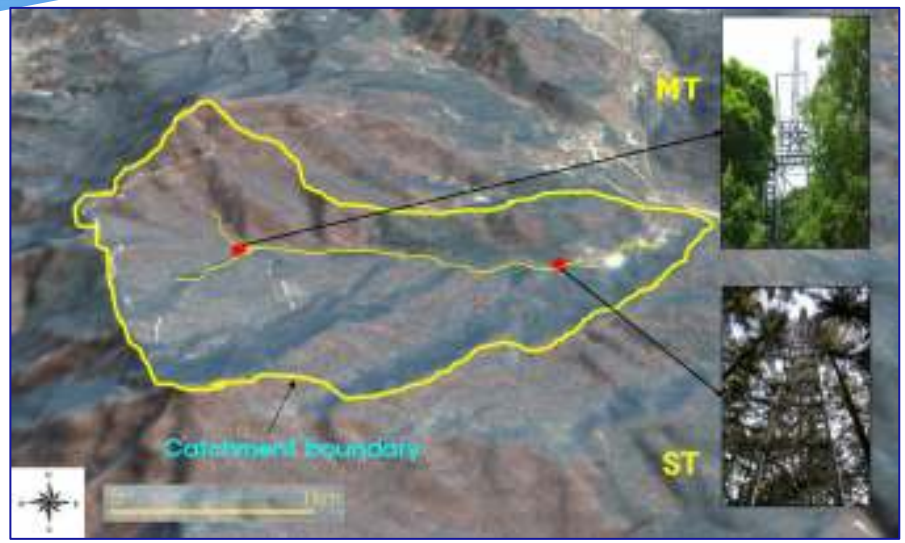
❖ **The Objectives of the present study were to**

(1) **introduce the Gwangneung Coniferous site (GCK)**

(2) **characterize seasonality of net ecosystem exchange (NEE), gross primary production (GPP) and ecosystem respiration (RE) and**

(3) **quantify the annual carbon balance at the GCK site in 2008.**

Study Area



General Site Information

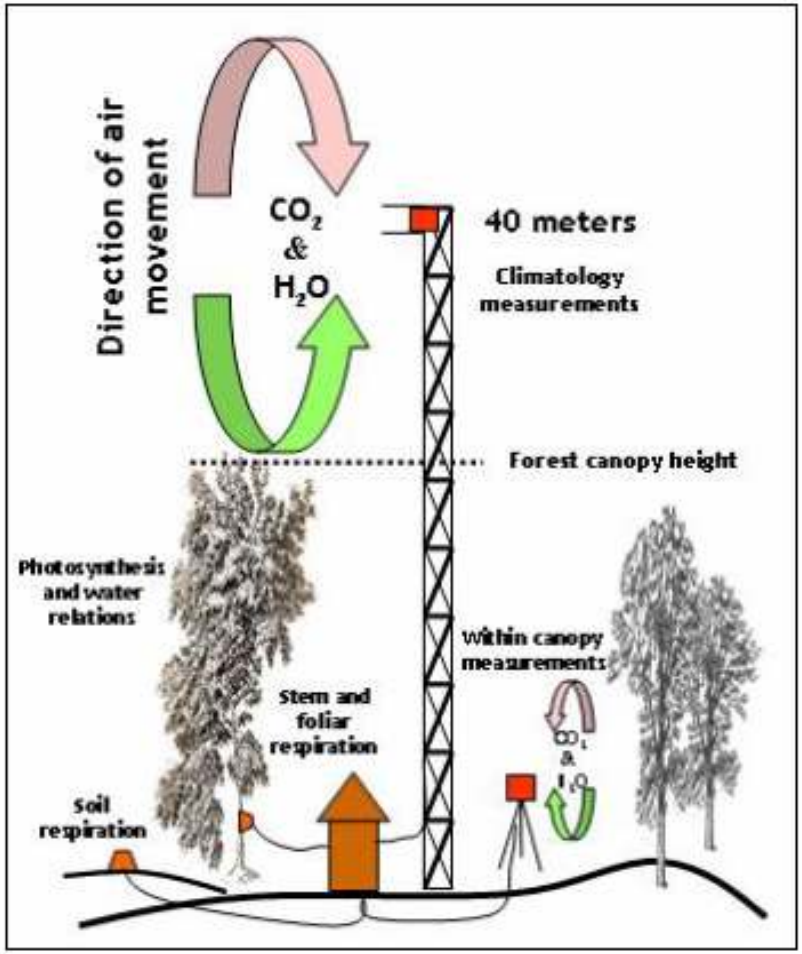
- **Site name : KoFlux Gwangneung Coniferous site**
- **Lat. and long. & Elevation : 37° 45′N, 127° 9′ E, 175 m.s.l**
- **Measurement : Nov 2006 - present**
- **Stand age: 93 yrs and planted**
- **Plant types : *Abies nephrolepis, A. Koreana and Pinus koraiensis***
- **Canopy height : 23m**
- **Tower height : 40 m**
- **Soil type: Sandy loam**
- **Plant Area Index (PAI) : 4 to 7.6**

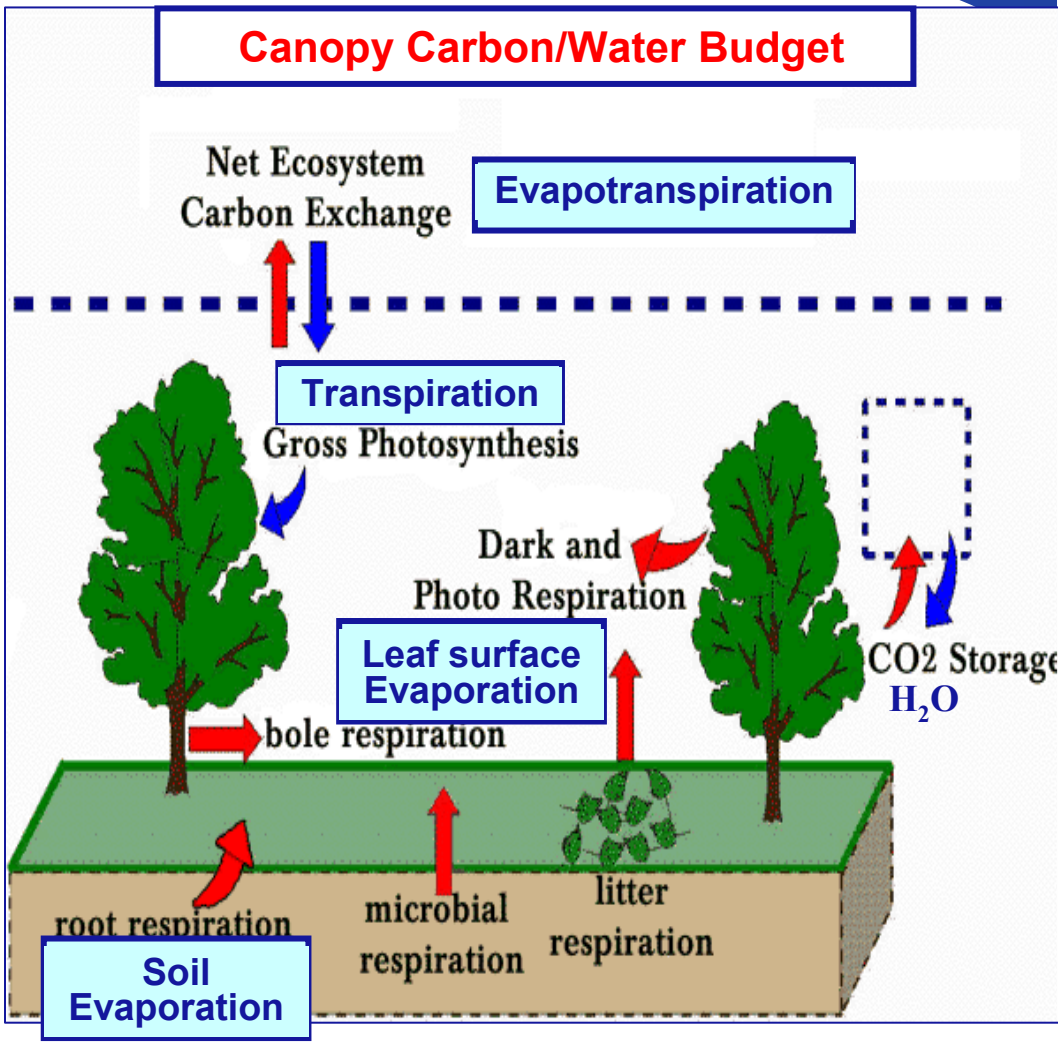
Measurements at GCK site

- **Flux measurement : open path Eddy covariance system**
- **Vertical profile of CO_2 and H_2O concentration**
- **Low level eddy covariance system**
- **Various meteorological observations - Four components of solar radiations, Soil moisture, soil temperature, soil heat flux, precipitation**
- **Ecological measurements - Leaf Area Index, Leaf wetness**
- **Stable isotope measurements**

Eddy Covariance System

GPP = - NEE + RE





Partitioning of Evapotranspiration

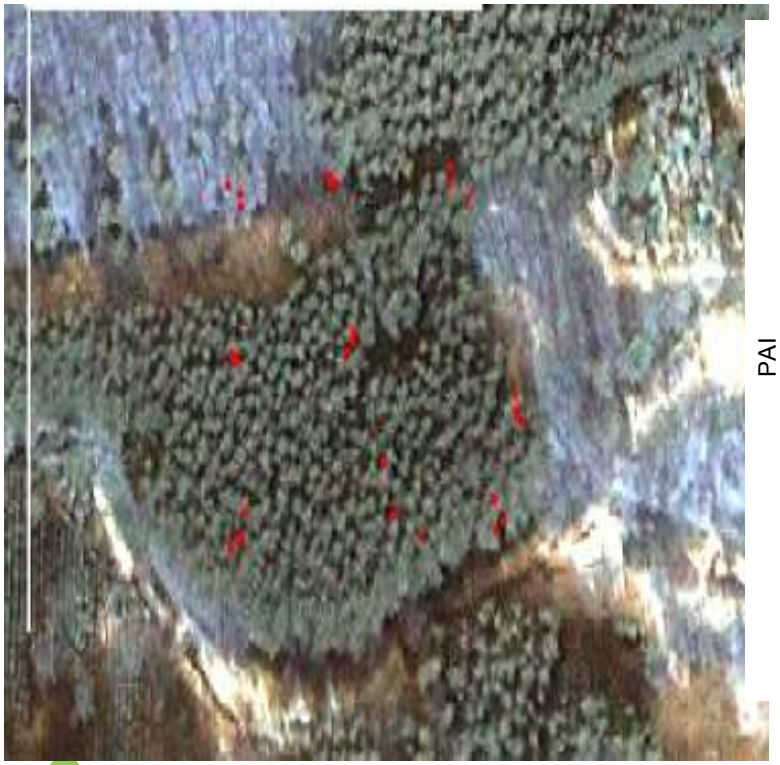
Evapotranspiration = Soil Evaporation + wet canopy evaporation + transpiration

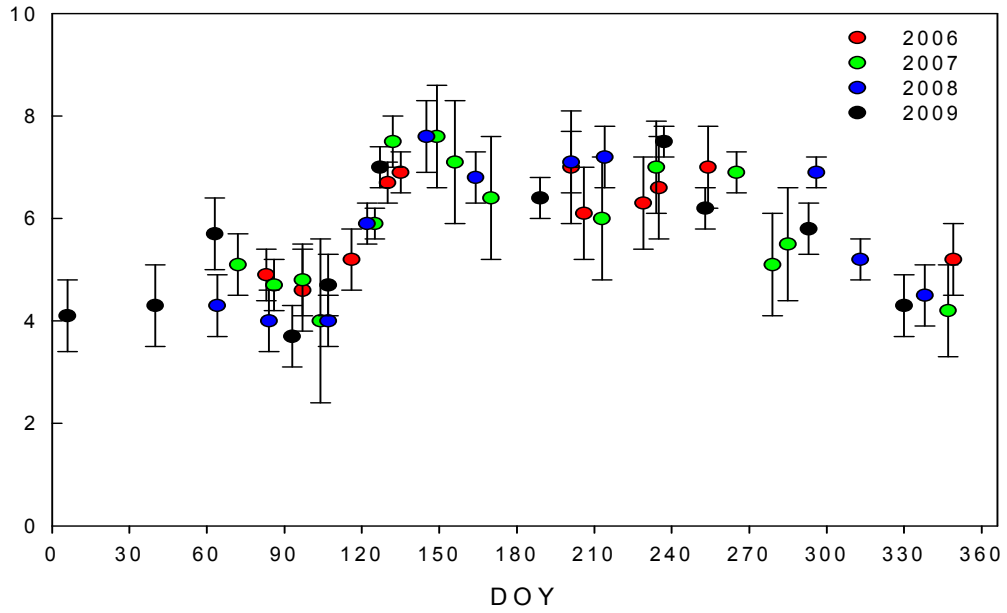
Soil evaporation

Leaf wetness

Transpiration

Phenology Measurement: Plant area index





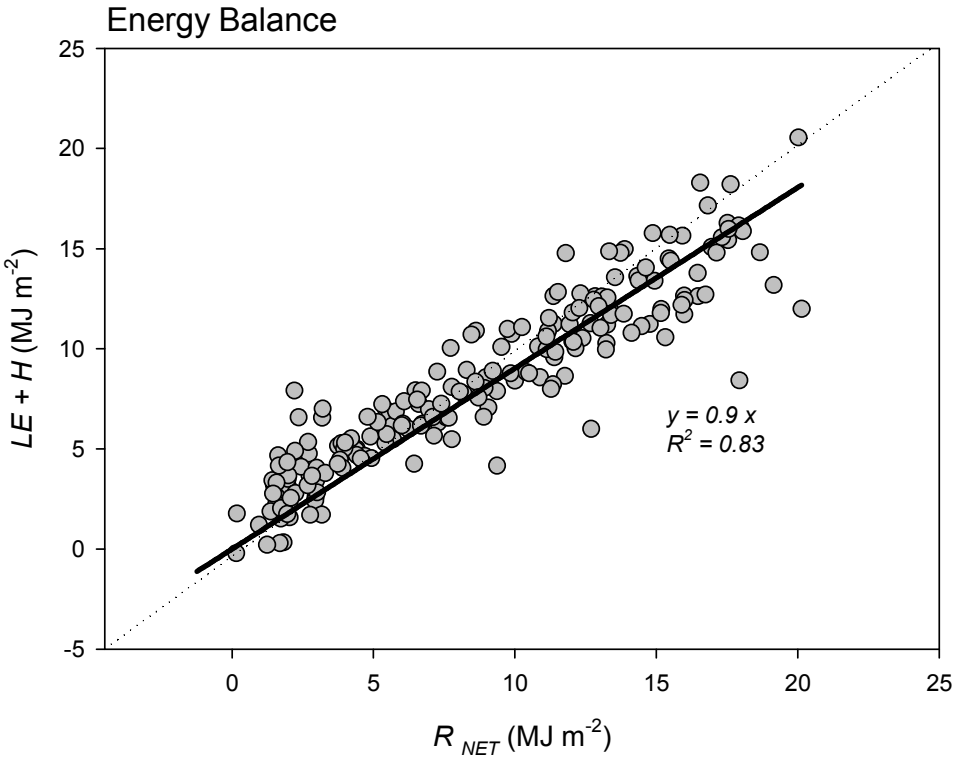
Daily energy balance closure

$$Rn = LE + H + S + G$$

Where, Rn - G - S = A (available energy)

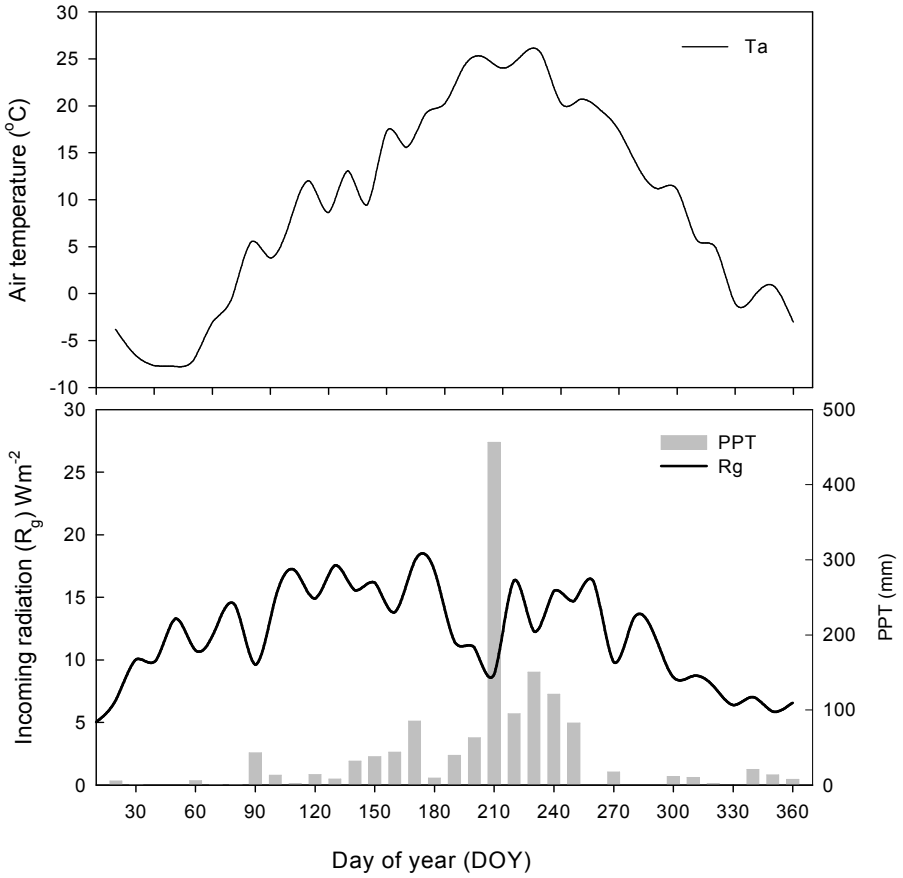
LE and H are latent and sensible heat fluxes

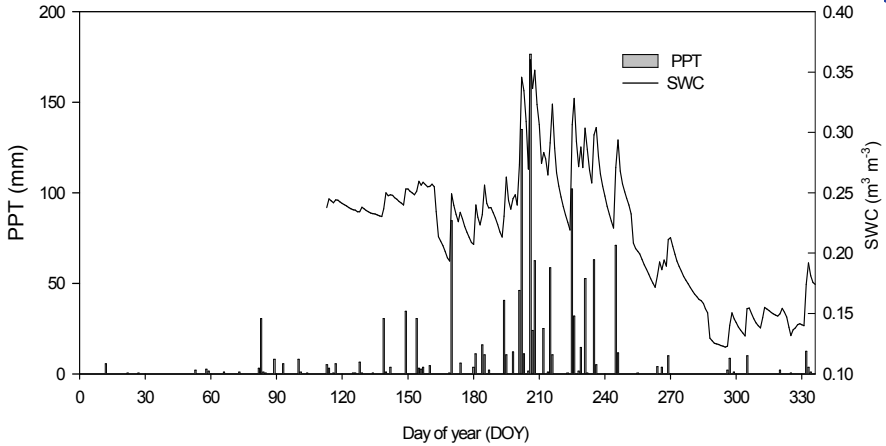
S= heat storage by trunk, leaves, biomass

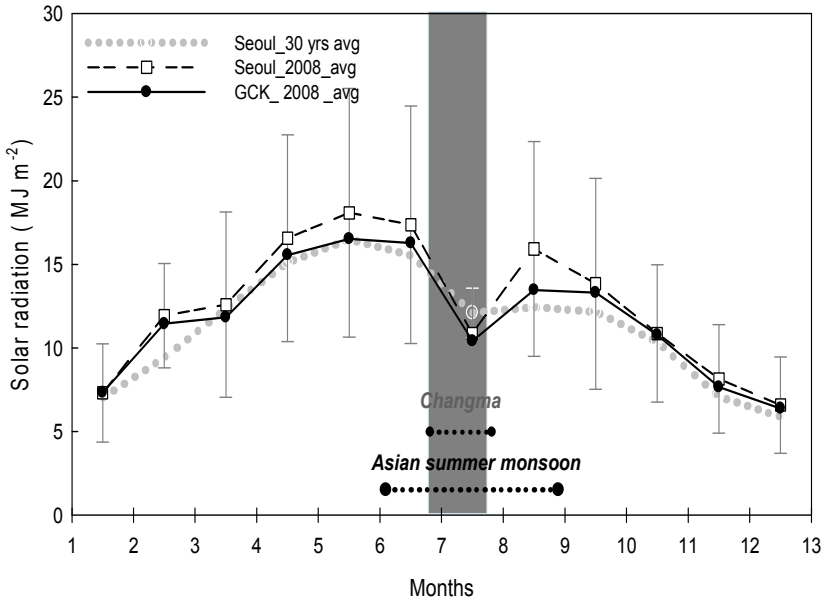


Results- meteorological variables

Avg. annual Temp 11.3 ^{0} C
Annual sum PPT 1395 mm

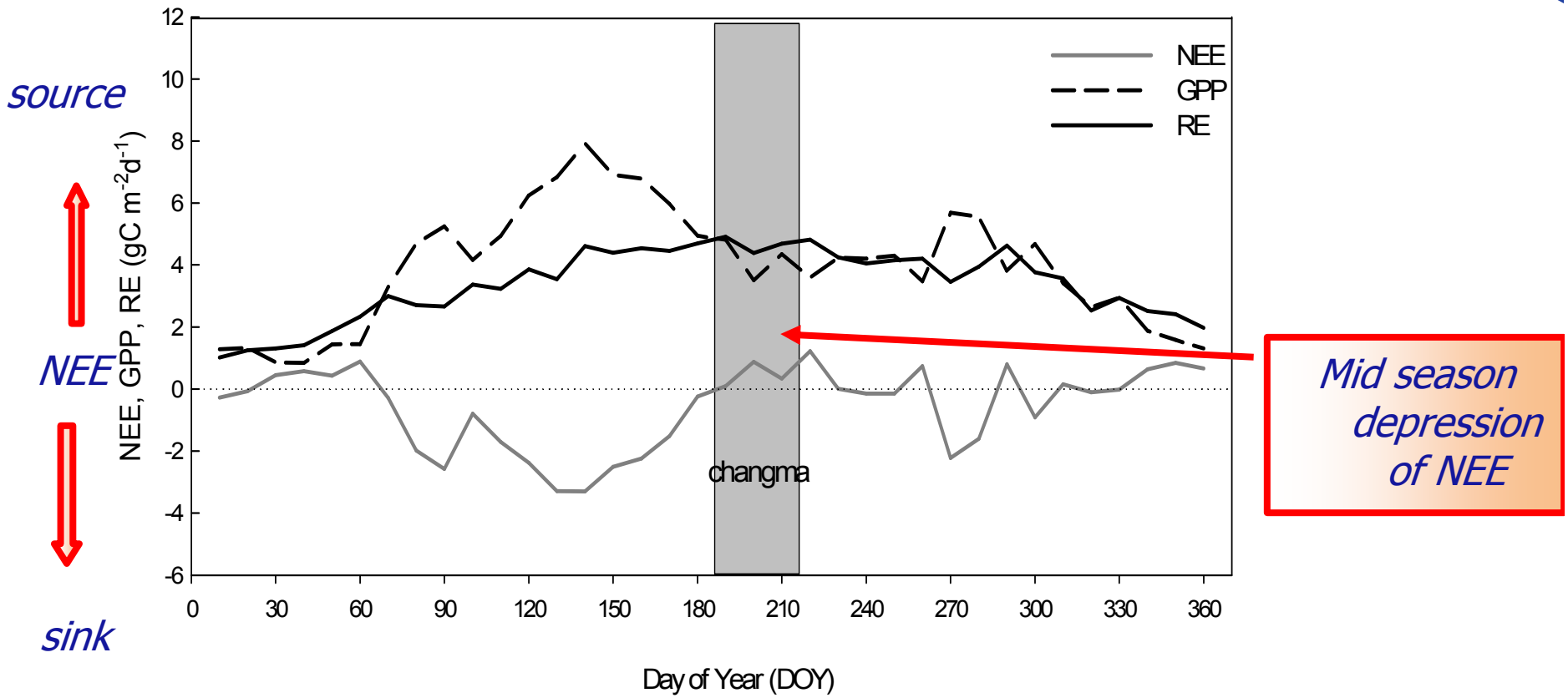




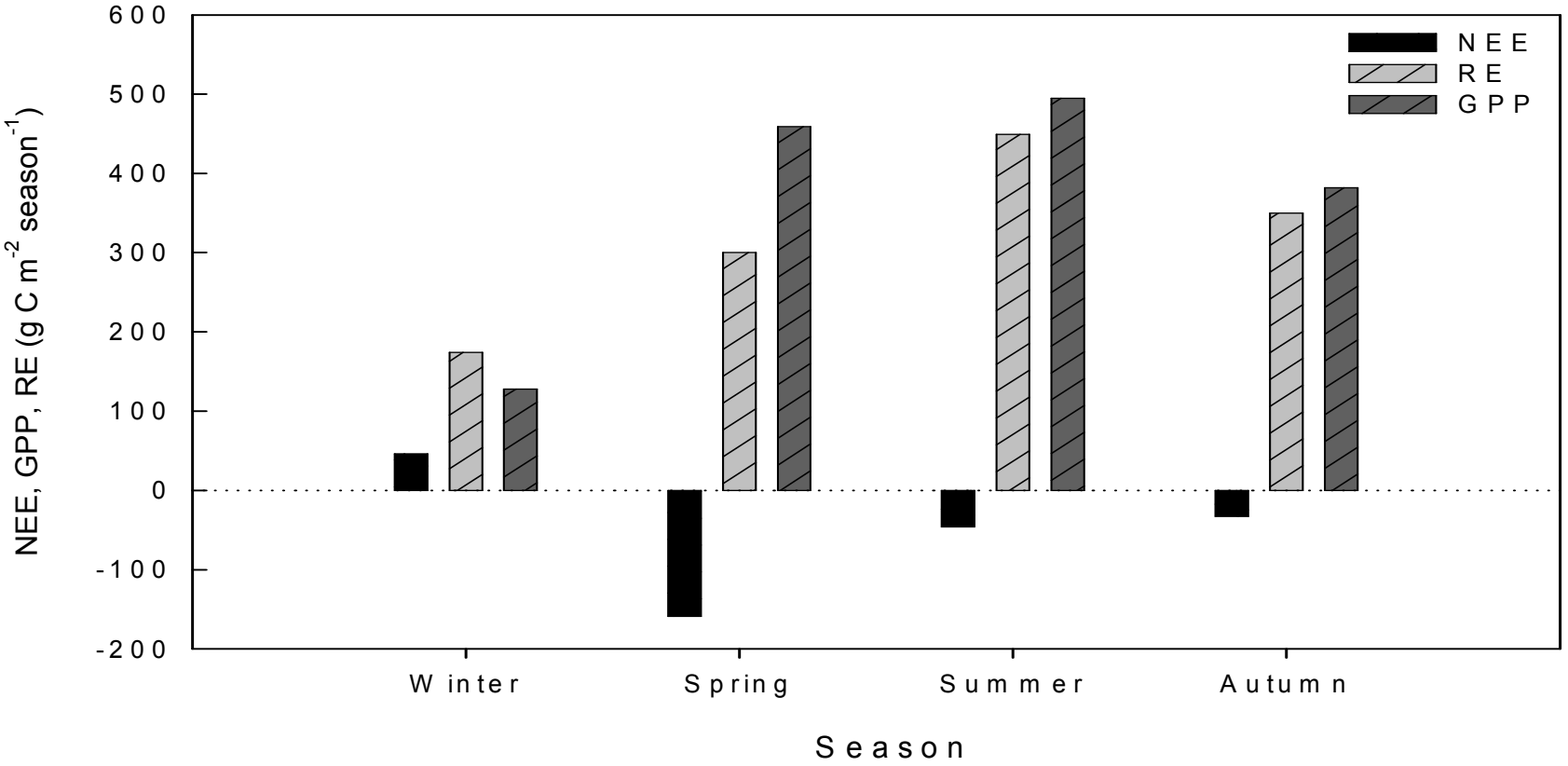


Results - seasonal variations of NEE, GPP and RE

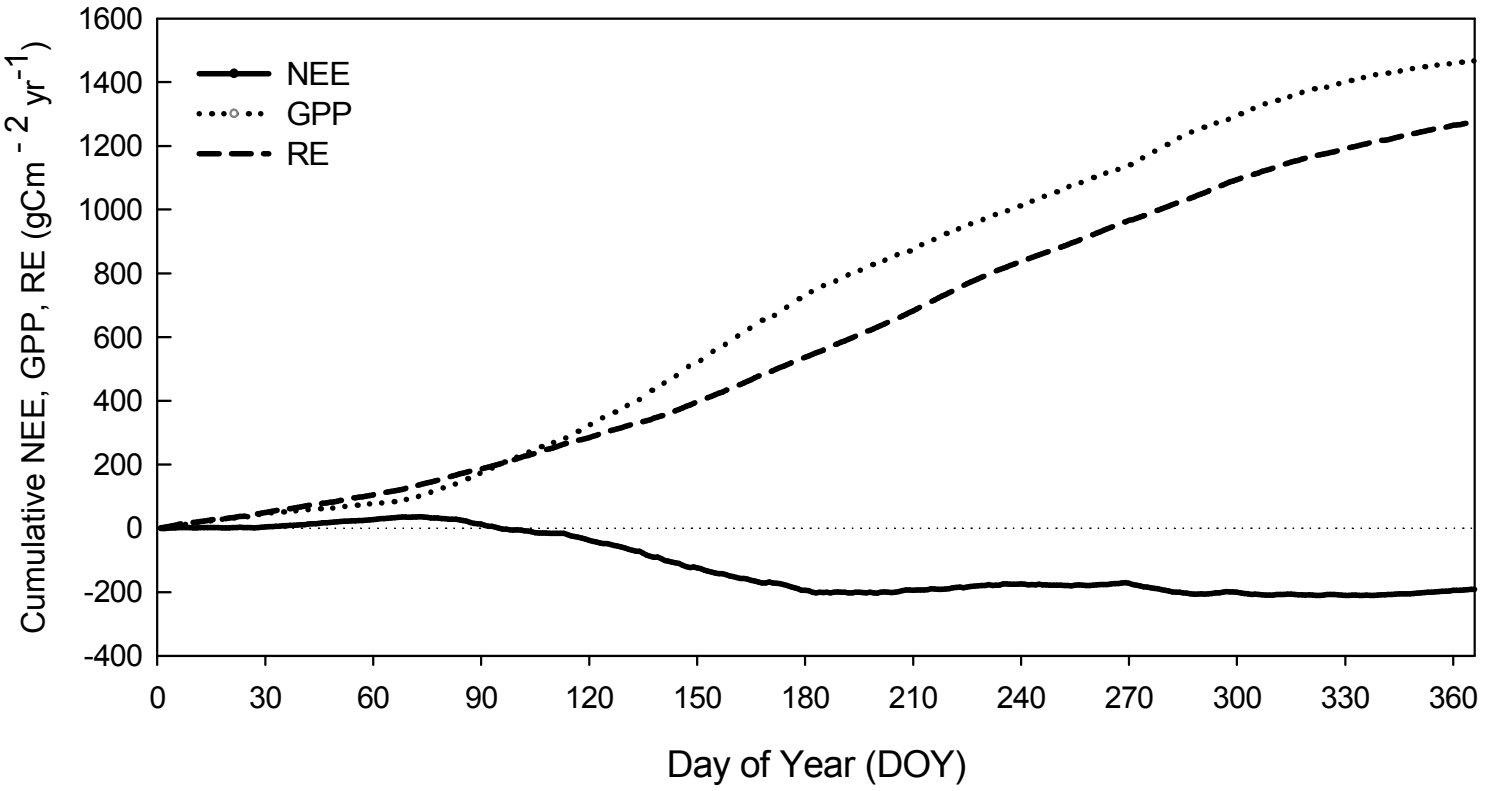
GPP = - NEE + RE



Results - seasonal variations of NEE, GPP and RE



Annual budget of NEE, GPP and Re



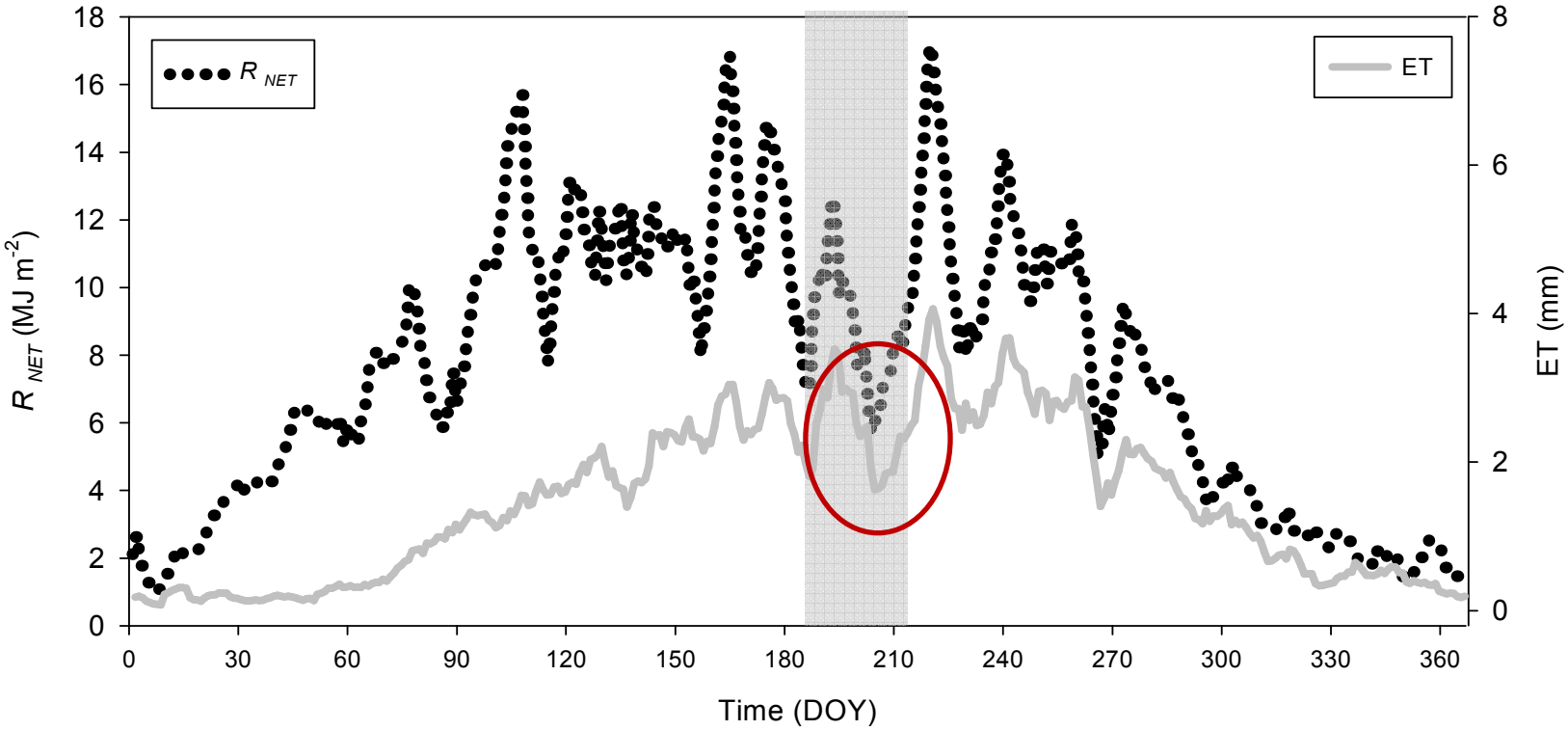
1464

1273

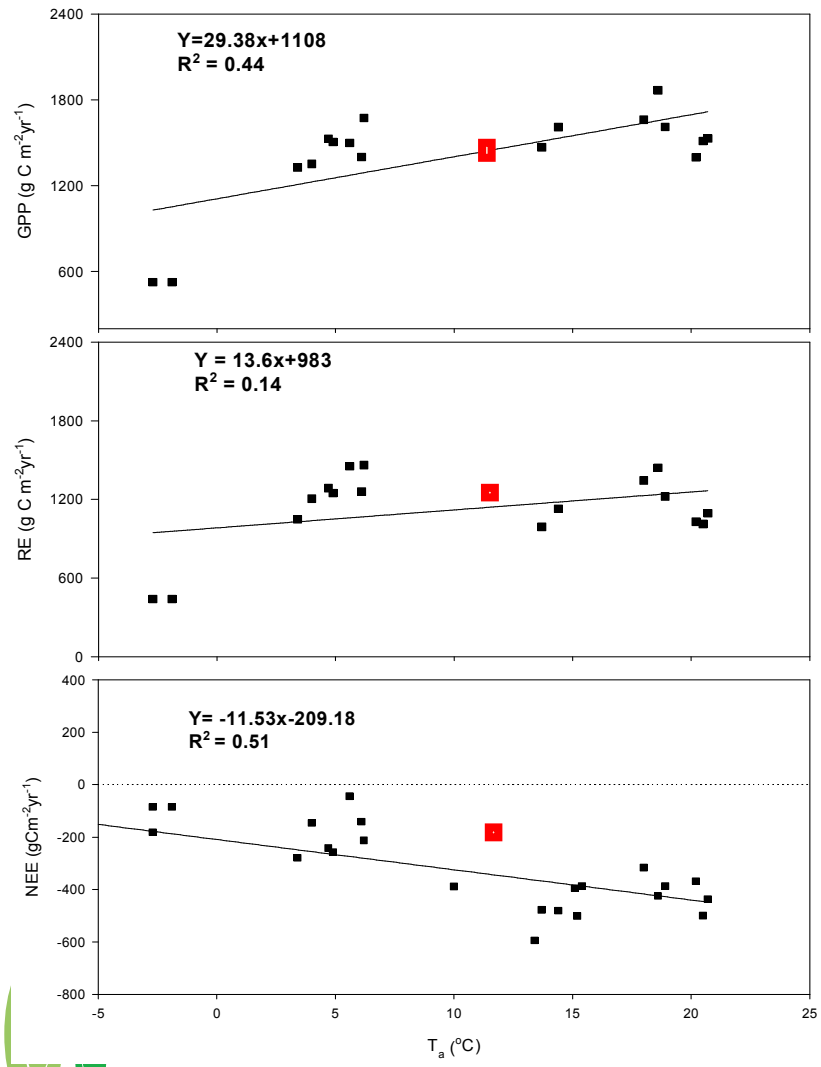
-192

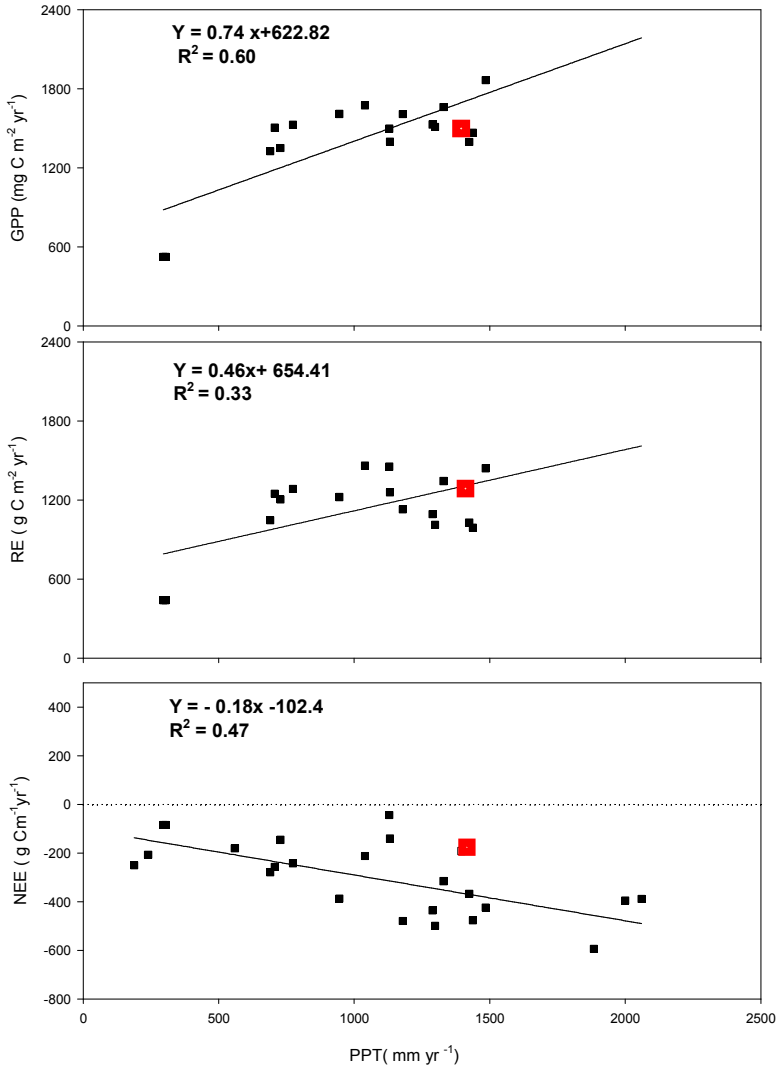
g C m^{-2} yr^{-1}

Result – Mid season depression of Evapotranspiration



Relation between Environmental Variables and Carbon budget





Conclusion

- The seasonality of the individual components (i.e., GPP , NEE and RE) showed clear variation with strong carbon uptake in spring.
- The seasonal variation of GPP and NEE showed clear mid-season depression but RE did not.
- Mid-season depression of GPP and NEE was attributed mainly by decreased in radiation. Thus ecosystem became carbon source in the middle of growing season.
- The annual budget of GPP, NEE and RE were 1464, - 192 and 1273 g C m^{-2} yr^{-1}, respectively, and coniferous forest acted as a moderate carbon sink.

Future study

- We will further examine interannual variability of carbon exchange under Asian monsoon climate and driving mechanism of interannual variability of carbon exchange.

Thank You !