IMPACT OF CLIMATE CHANGE ON CANOPY CO_2 AND H_2O EXCHANGE OF A TROPICAL RAINFOREST IN PENINSULAR MALAYSIA, PASOH

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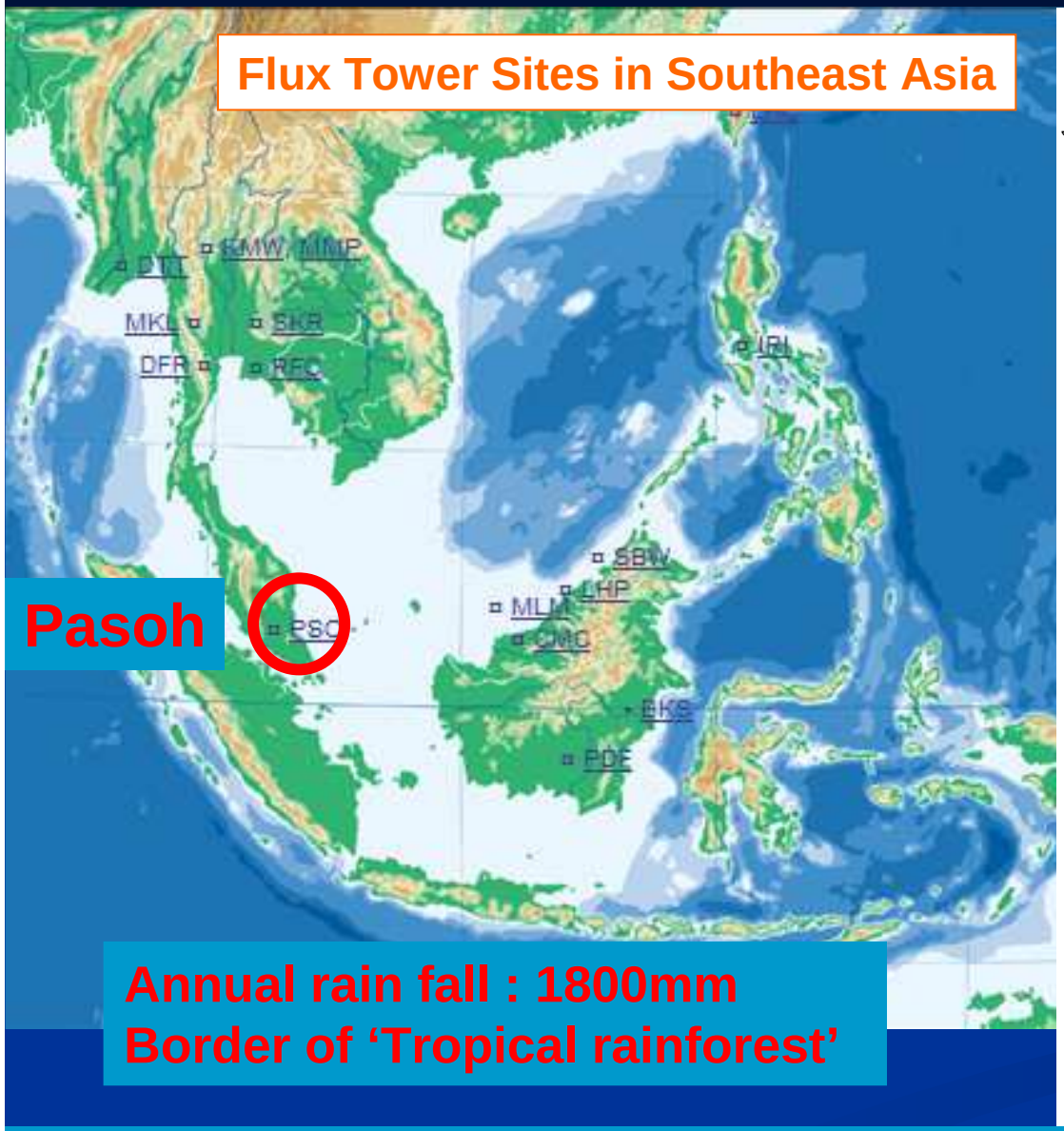
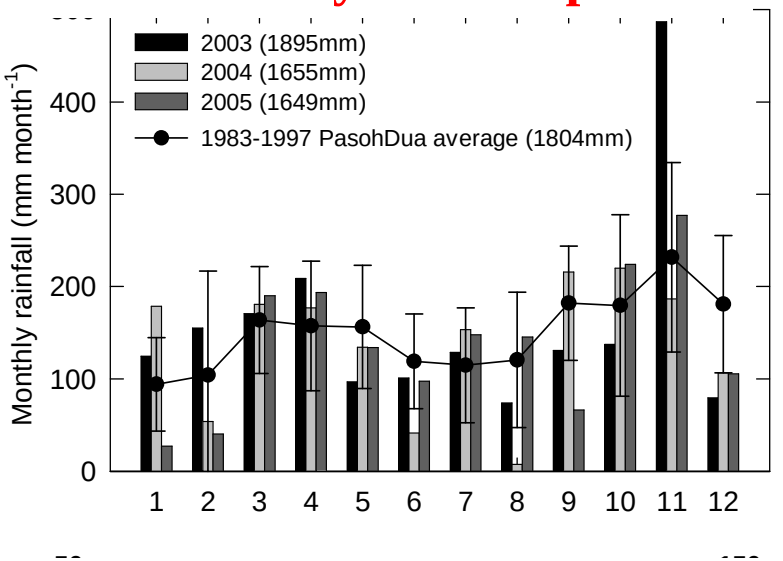
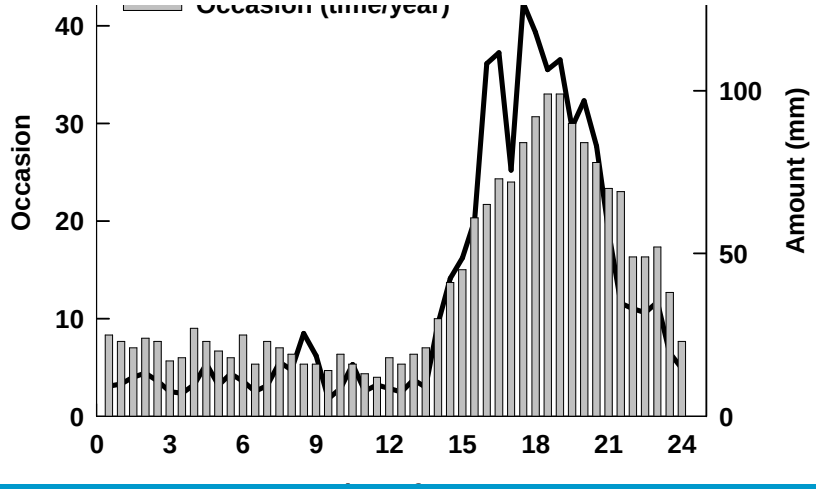
INTRODUCTION



Moderate dry and wet periods

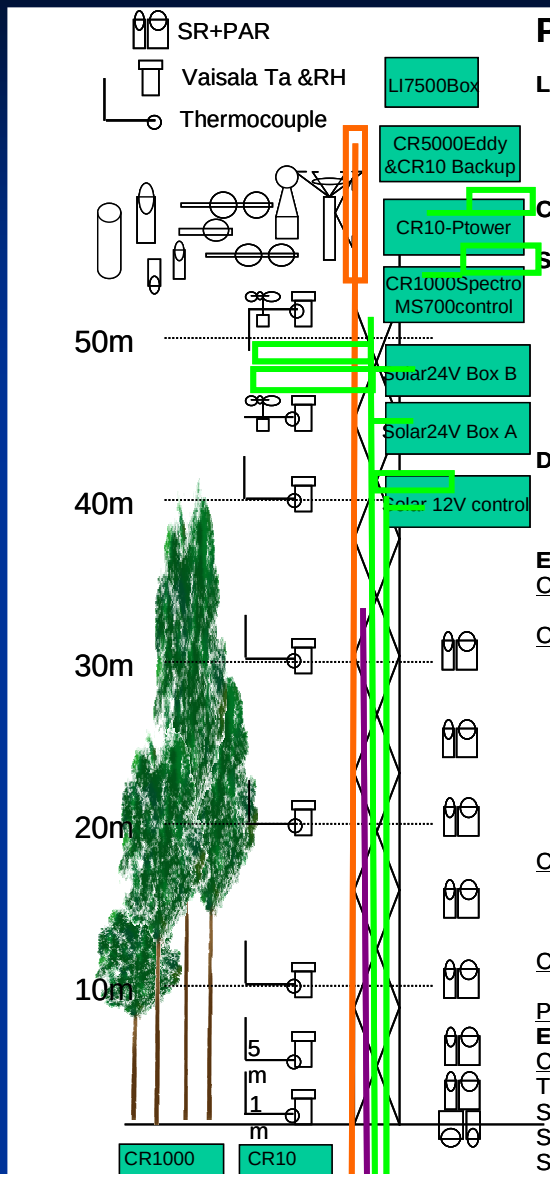


Most rainfall occur in the evening



Objective : Evaluation of the impact of climate change on evapotranspiration and canopy CO_2 exchange

METHOD



Pasoh Tower Equipments

Lightning conductor and network
a lightning rod at tower top
sheet line from tower top to the ground and their network under the ground to induce the electricity

Commercial electricity lines
100V line to the 30m corridor from the House.

Solar Panels and their systems
Main Solar 24V system (6 big panels, lines to and from the House, 2 control boxes at tower top)
Old 12V Solar system (2 panels, lines to and from House, one control box at tower top)
CR10-12V (a panel, line to CR10-Ptower、battery)
Spectrometer-12V（2 panels, line to CR1000-Specrto, 2 batteries)

Data Loggers and Boxes
4 data loggers and 7 boxes at the top of tower
2 data loggers at the House
Earth lines from data loggers to the ground

Equipments (line to the tower top loggers)

CR5000Eddy
SAT550, LI7500 Probe and Box

CR10-Ptower
Ta & RH Vaisala (53m, 45m, 40m, 30m, 20m)
Pair, Wind (53m, 45m) and wind direction(53m)
Rainfall gauge
SR (53m, upper & lower), LR (53m, upper & lower)
PAR (53m, upper & lower)
SR & PAR (30m, 25m, 20m, 15m)
Thermocouple (45-53, 53m, 40m, 30m, 20m, 10m, 5m, 1m)

CR10-Pbackup
SR(53m, upper & lower), LR(53m, upper & lower), PARdiffusive (53m), PAR (backup), Wind(53m)
CO_2-Vaisala (30m, 53m)

CR1000-Spectro
MS-700 Spectrometers (53m, upper & lower)

Phenology auto cameras

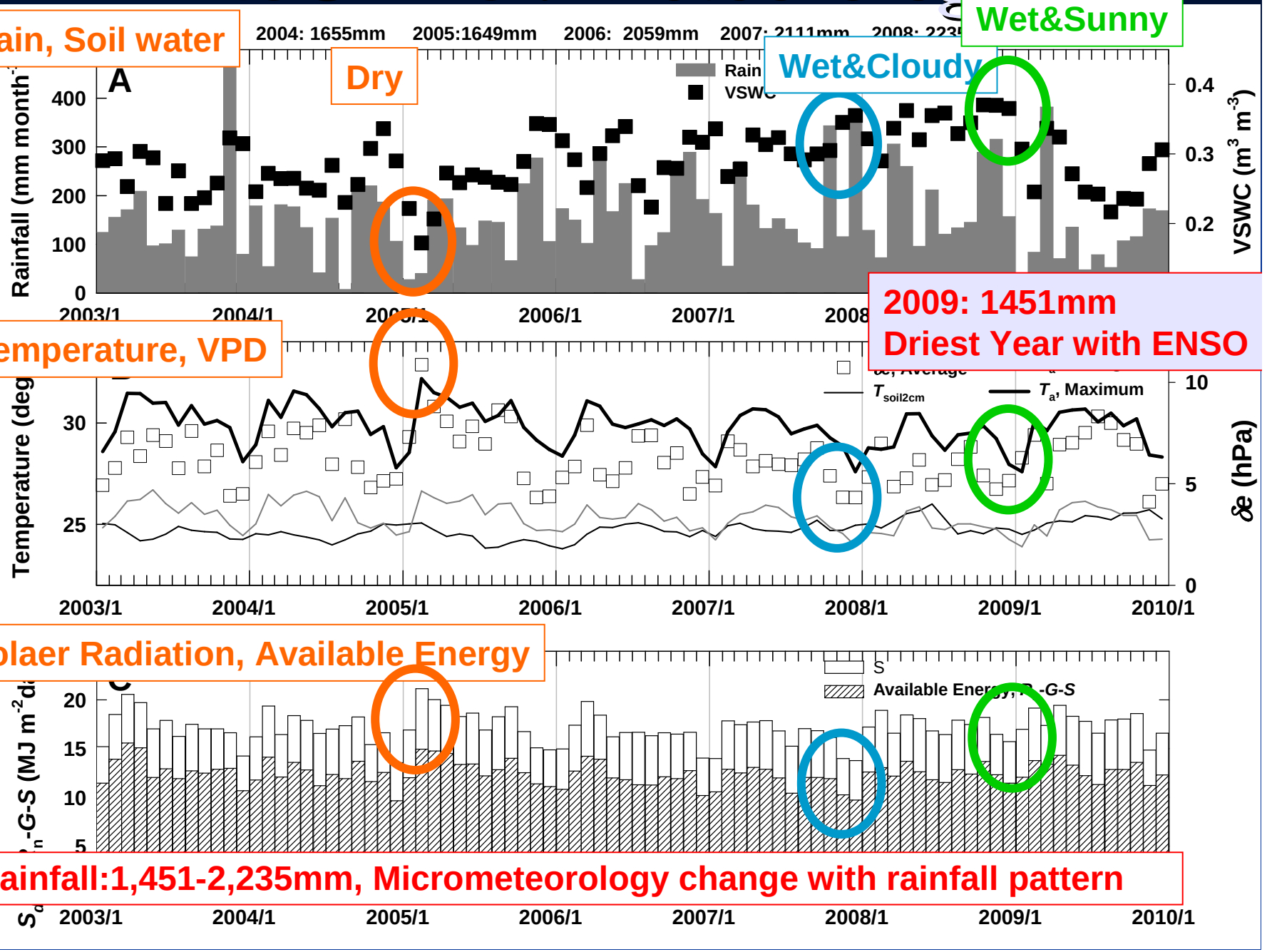
Equipments (line to the House loggers)

CR10-Phouse
Ta & RH Vaisala (10m, 5m, 1m)
SR & PAR (10m, 5m),
SR (1m, upper & lower), PAR (1m, upper & lower)
Soiltemp (A2cm, 10cm, B2cm, C2cm)

Tower Flux Observation
2002.9- now

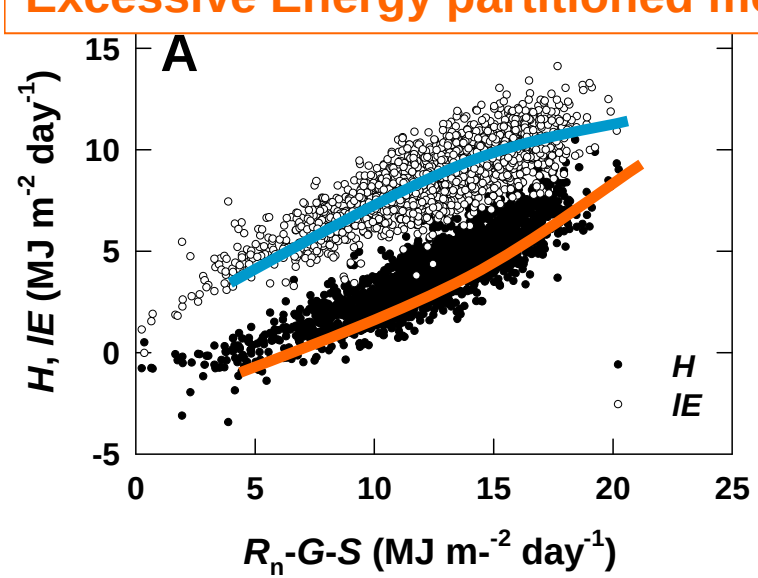
Seasonal/interannual variations in evapotranspiration and CO_2 exchange at Pasoh, with the change in environmental conditions?

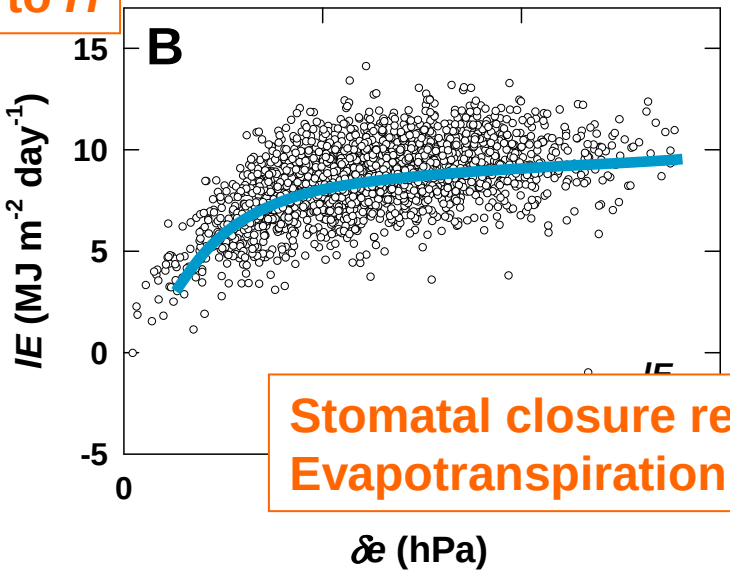
RESULTS : Meteorology



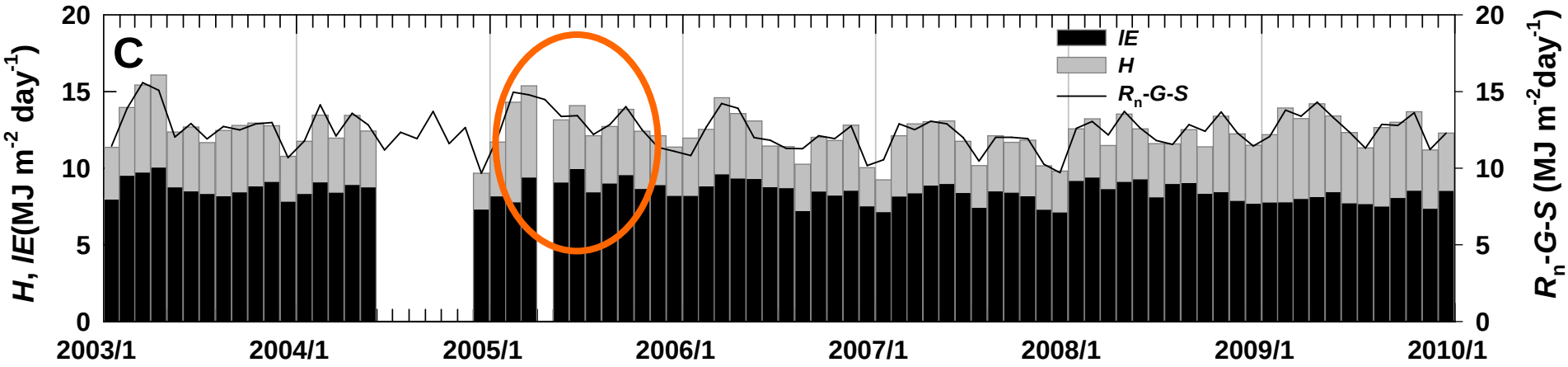
RESULTS : Evapotranspiration

Excessive Energy partitioned more to *H*

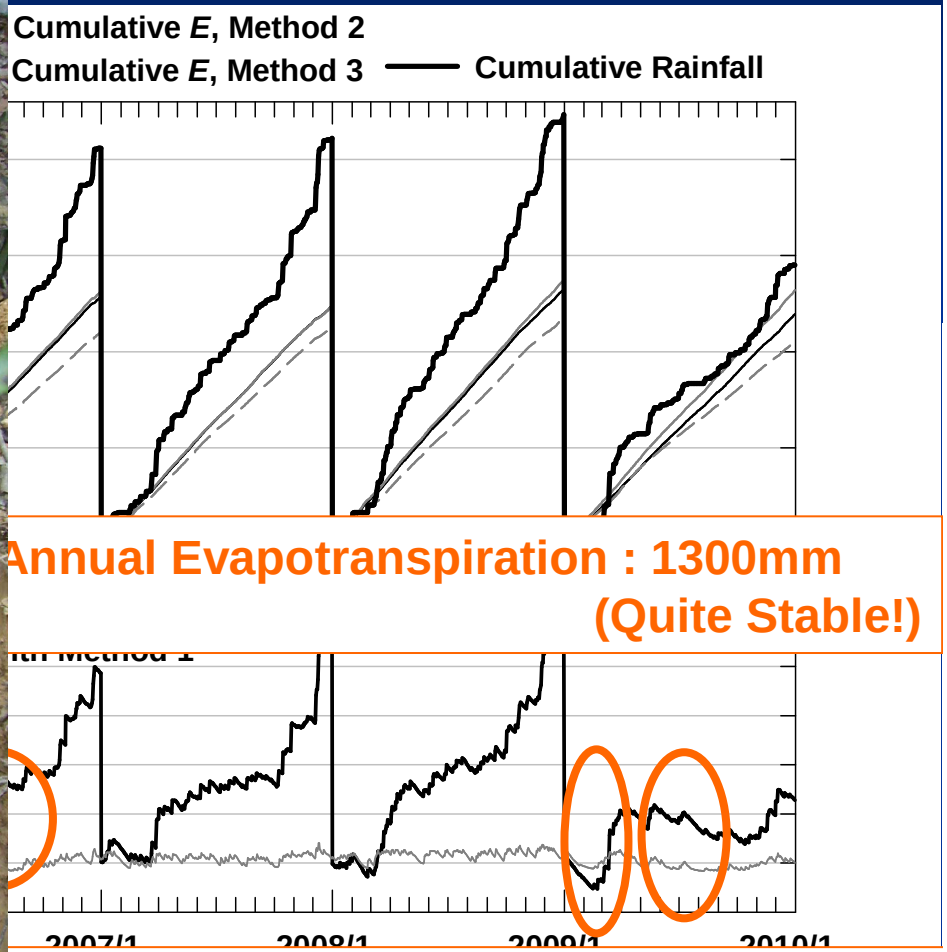




Stomatal closure regulates Evapotranspiration at high VPD



RESULTS : Evapotranspiration

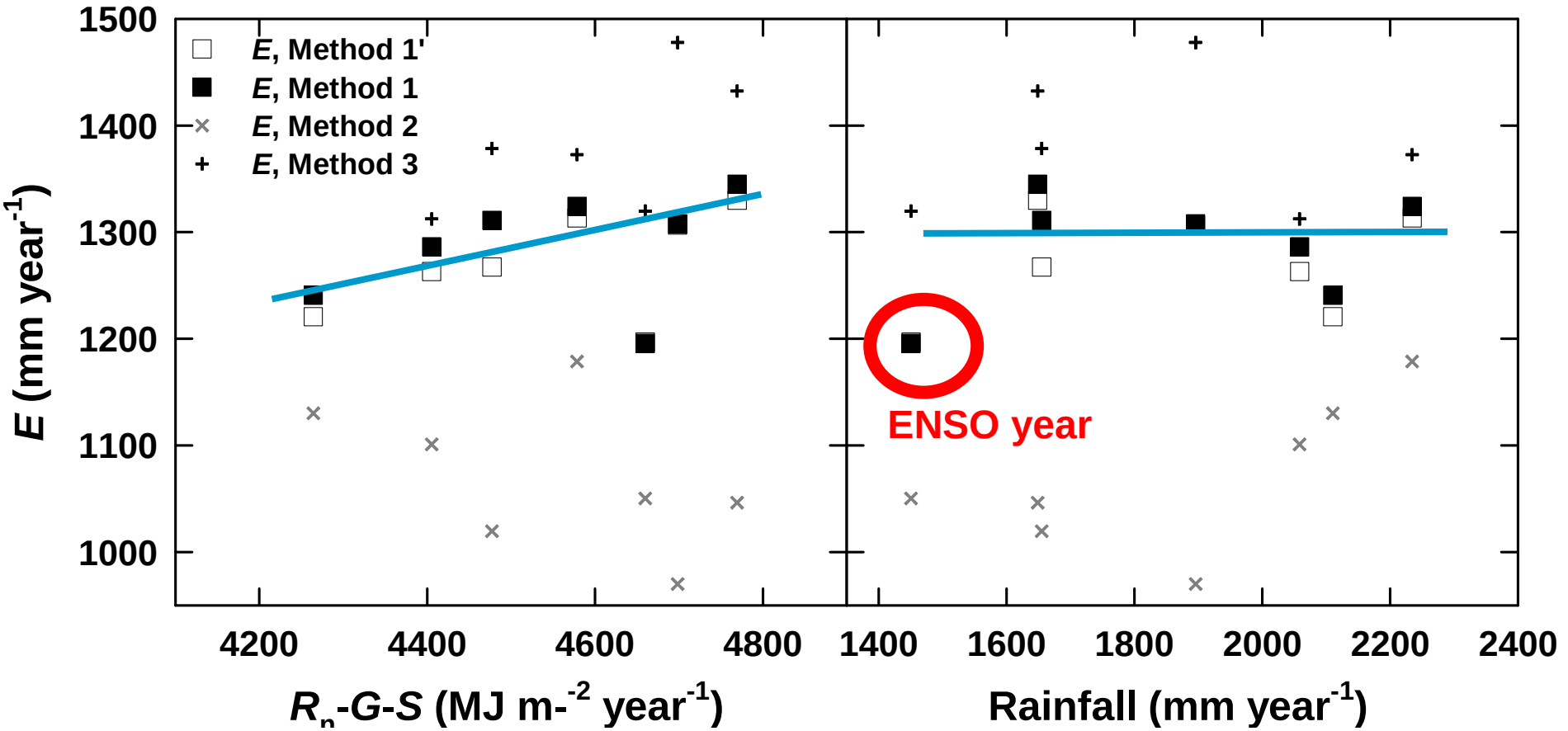


Annual Evapotranspiration : 1300mm
(Quite Stable!)

r supply from deeper layer under drought

periods

RESULTS : Evapotranspiration

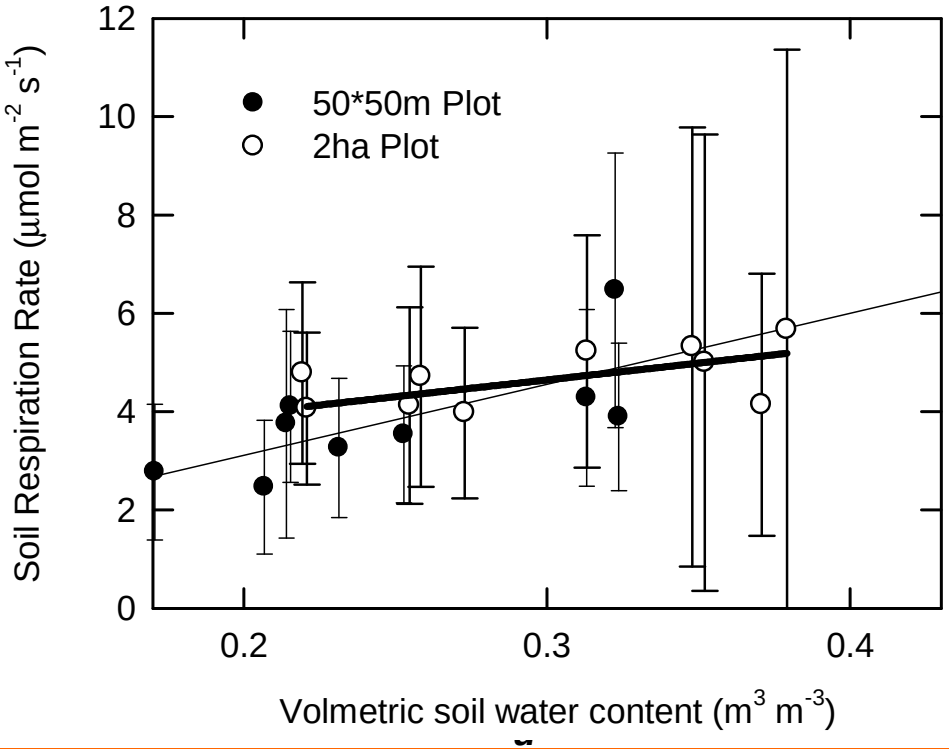


Annual Evapotranspiration : approximately 1300 mm

dependence with available energy, no dependence with rainfall

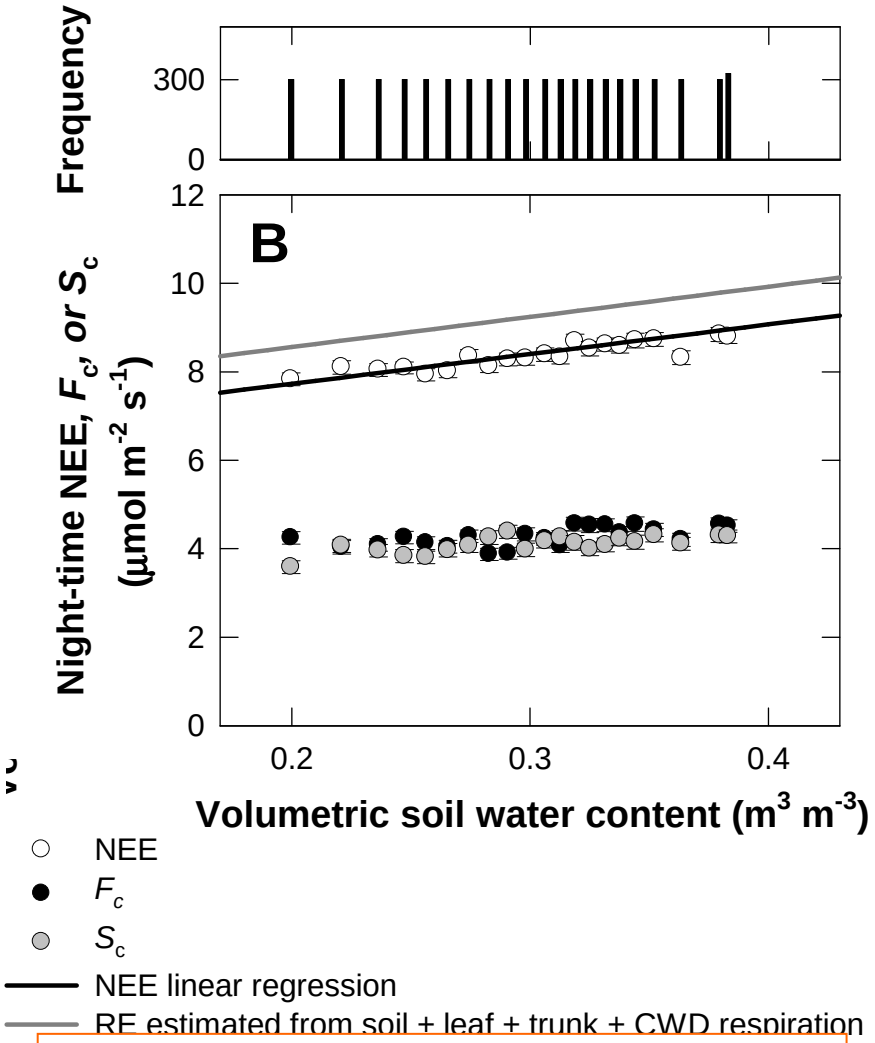
RESULTS : Nighttime Respiration

Chamber Soil Respiration



Coinsided with the soil respiration related with soil water content (base on 8-year chamber observations)

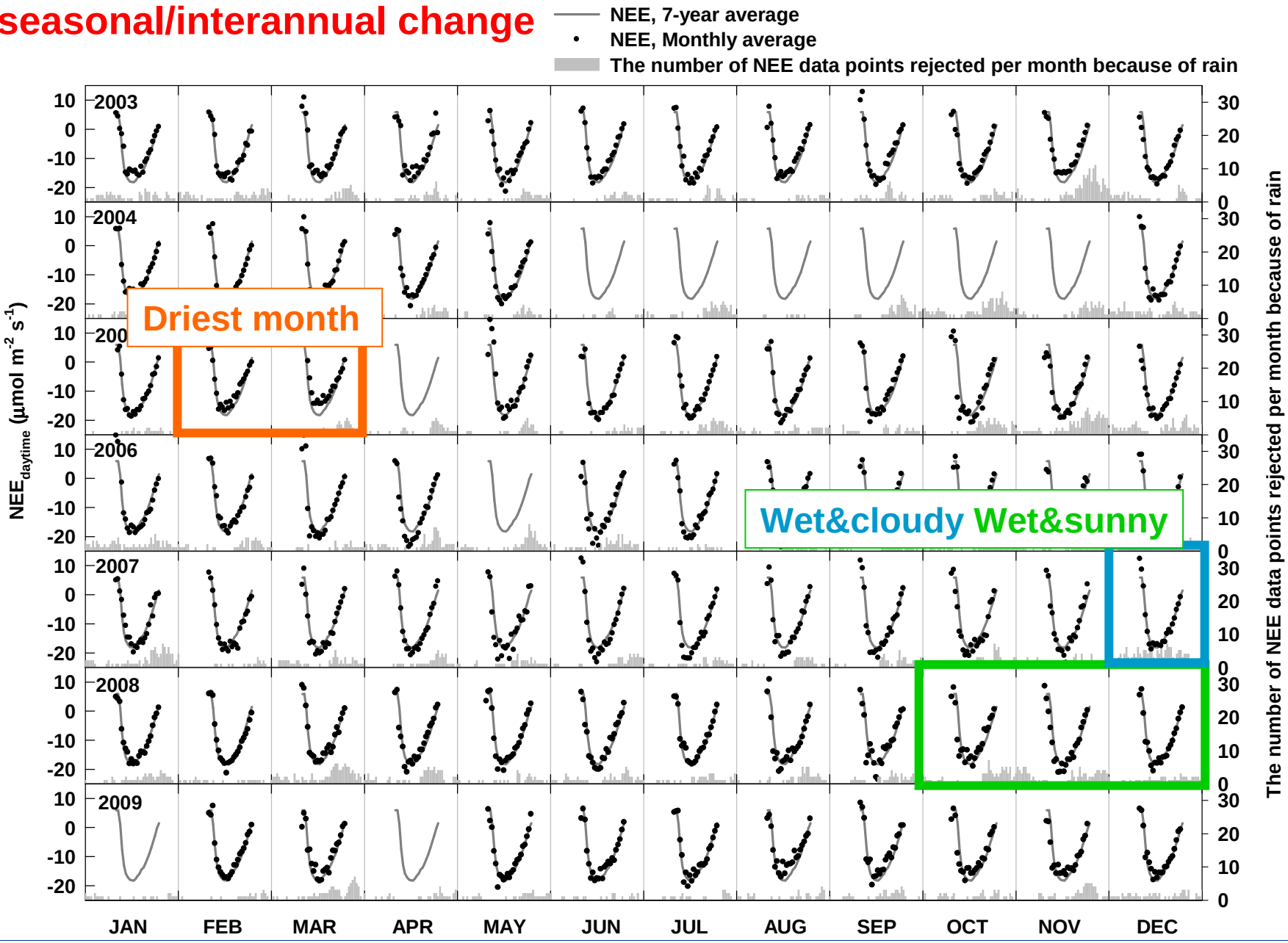
Nighttime NEE (=RE) versus Soil water content



RE related with soil water content

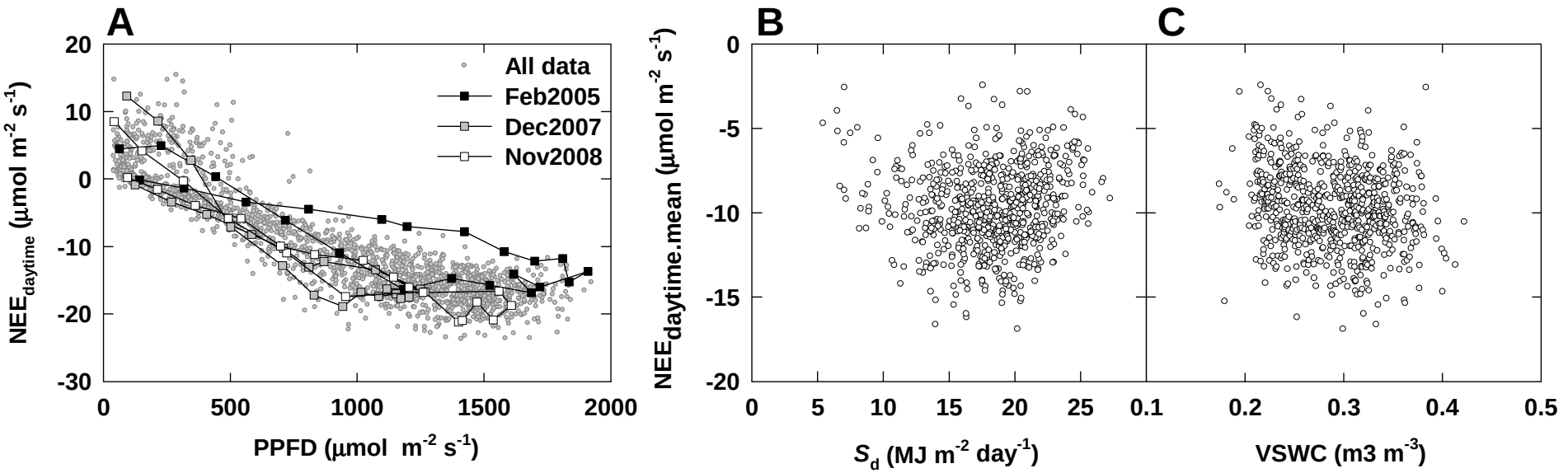
Daytime canopy CO_2 exchange

No seasonal/interannual change



Daytime canopy CO_2 exchange

Radiation did not govern daytime NEE.



Daytime NEE had an circadian rhythms independent of PPFD, and with clear decline in the afternoon.

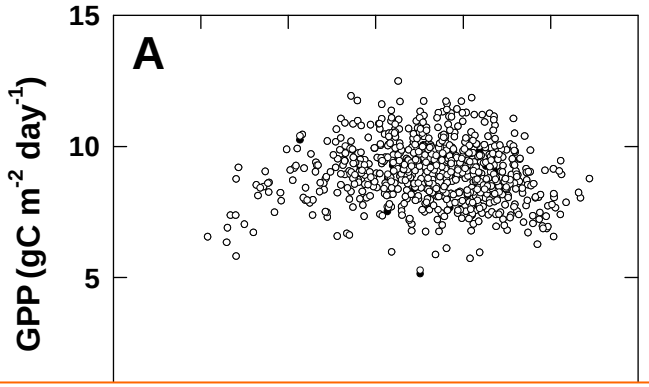
No dependence of daytime-mean NEE on daily solar radiation

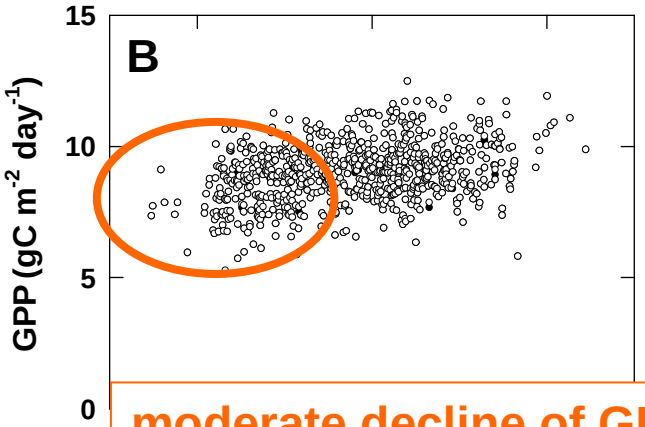
No dependence of daytime-mean NEE on soil water content

These results consist with those of leaf-scale gas exchange measurements at the study site

(Takanashi et al, 2006; Kosugi et al, 2009)

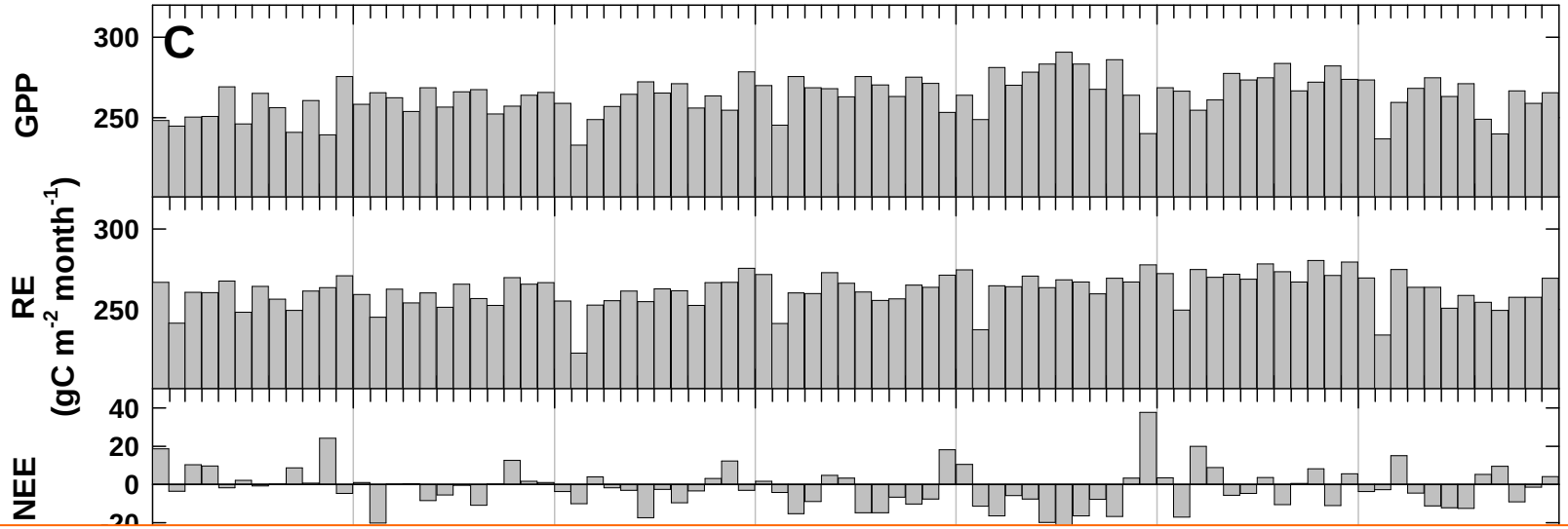
Daily/Monthly GPP·NEE·RE





No dependence of daily GPP on daily solar radiation

moderate decline of GPP at the dry period



Seasonal variation of GPP·RE were influenced by VSWC. At the dry period, canopy tended to absorb CO_2, caused by decrease of RE larger than that of GPP.

Annual GPP･NEE･RE

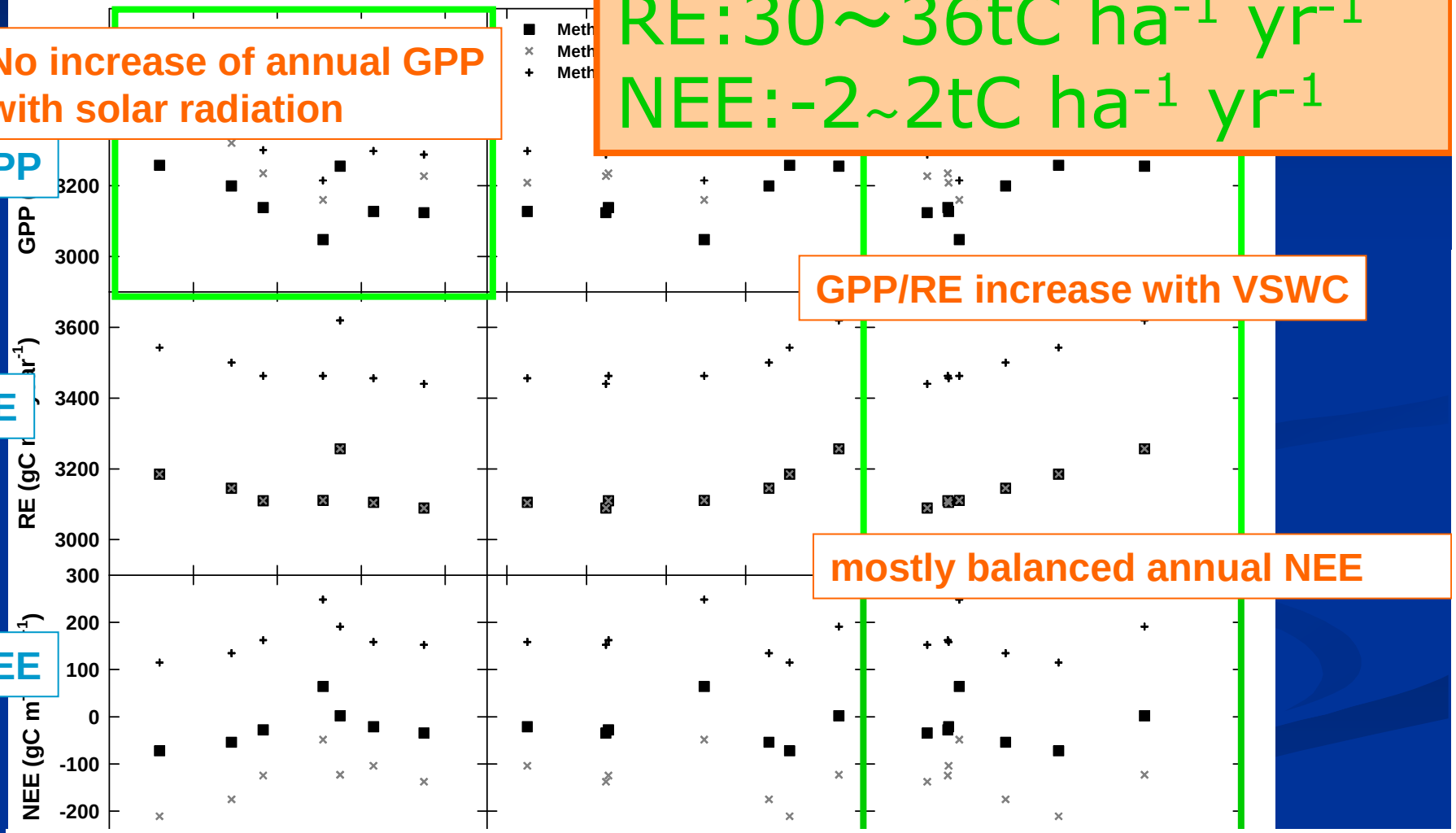
GPP:30～36tC ha^{-1} yr^{-1}
RE:30～36tC ha^{-1} yr^{-1}
NEE:-2~2tC ha^{-1} yr^{-1}

No increase of annual GPP with solar radiation

GPP

RE

NEE



GPP/RE increase with VSWC

mostly balanced annual NEE

Annual budget influenced lot by the method of gap filling and correction.
Cross check with ecological and ecophysiological data is needed.

Observation Campaign of Ecosystem Respiration

2010.2

Summary

- Micrometeorology：had moderate seasonal and interannual variations influenced by rainfall pattern.
- Evapotranspiration： moderately increased with available energy. Annual balance was stable with approximately 1300mm. A little decline at the ENSO dry year.
- Ecosystem Respiration：increased with VSWC.
- Daitime photosynthesis：did not increase with PPFD. Monthly average was stable during 7 years.
- GPP·NEE·RE： GPP did not increase with PPFD, but increased with VSWC. Moderate seasonal and interannual variation of GPP·RE·NEE were caused by VSWC.

- ✓ Evapotranspiration and CO_2 exchange at Pasoh Forest were very stable during these several years.
- ✓ Stable≠ Static
- ✓ In terms of stomatal regulation, photosynthetic ability, and ecosystem respiration, forest acted sensitive to climate change. These reactions compensated each other to produce very stable output as a canopy of Pasoh forest.

Prediction for future climate change

- **Decrease of Solar radiation**:

  [ET] ↓ decrease、[NEE] → no change

- **Increase of rainfall**:

  [ET] → no change [GPP] ↑ increase

  [RE] ↑ increase

  [NEE] → ↑ no change or increase(=CO_2 emit)

- **Decrease of rainfall**:

  [ET] → ↓ no change or decrease

  [GPP] ↓ decrease [RE] ↓ decrease

  [NEE] → ↓ no change or decrease(=CO_2 absorb)