

Chlorophyll fluorescence-gross primary productivity relationships during the spring awakening of an evergreen needleleaf forest

M. Schwarz ¹, K. Sakowska ^{1, 2}, K. Ziemblińska ³, P. Dukat ³, M. Urbaniak ³, J. Olejnik ³, A. Hammerle ¹, G. Wohlfahrt ¹

¹ University of Innsbruck, Department of Ecology, Innsbruck, Austria.

² National Research Council (CNR), Institute of BioEconomy (IBE), San Michele all'Adige, Italy.

³ Poznan University of Life Sciences (PULS), Department of Construction and Geoengineering, Meteorology Lab, Poznan, Poland

FIELD SITE AND SETUP

Pinus sylvestris forest located in Meżyk, Poland
(52°82'00 "N and 16°25'30" E) at 56 m a.s.l.

Eddy Covariance

LI-7200 Gas Analyzer (LI-COR, USA)

WindMaster Pro 3D Sonic Anemometer (GILL, UK)

SIF system

QEPro spectrometer (Ocean Optics, Inc., Ostfildern, Germany)

Spectral range: 650 - 800 nm

FWHM=0.3 nm

PAM system

Monitoring-PAM

(Walz GmbH, Germany)



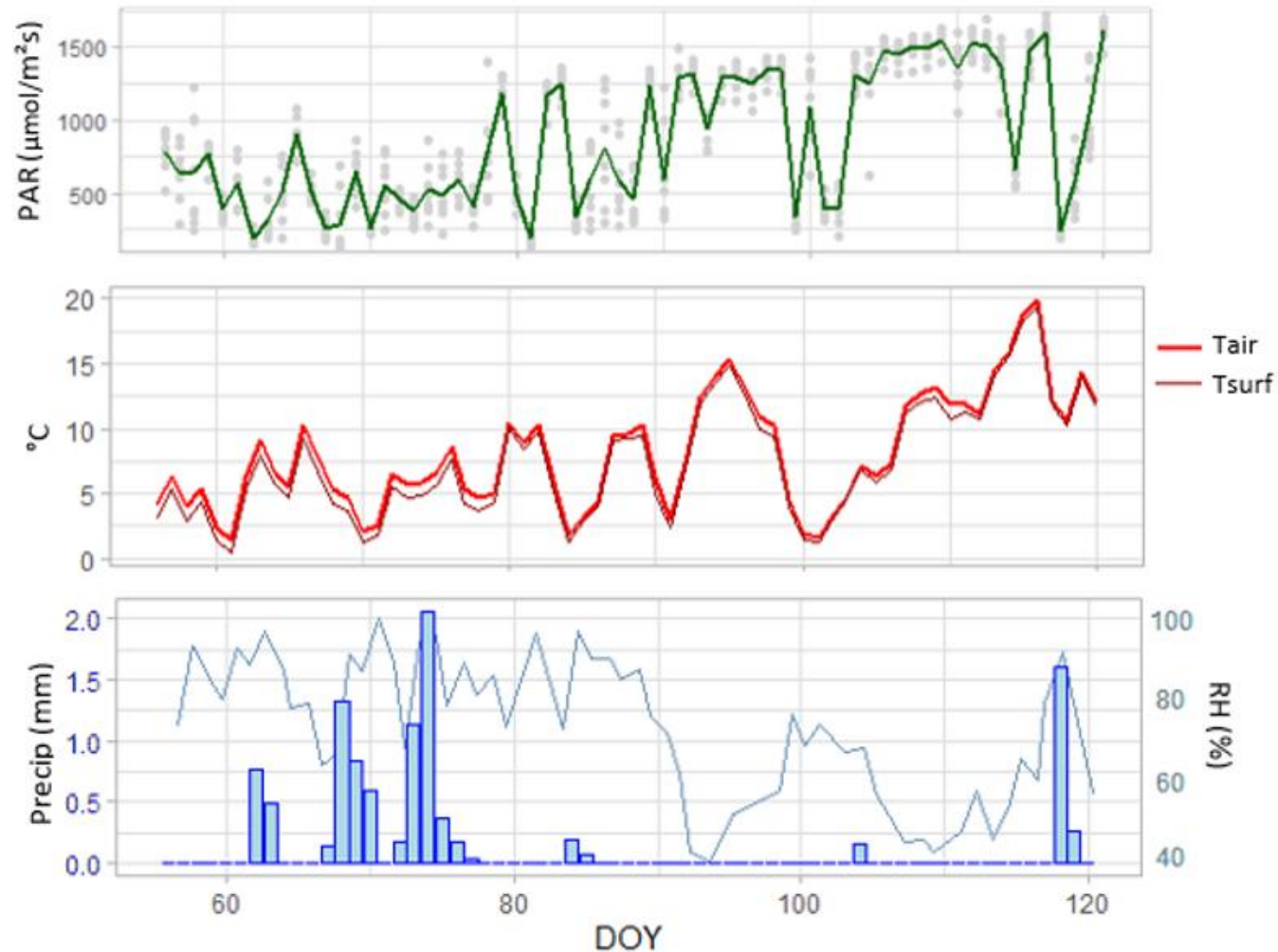


Fig. 1: Timeseries of incoming photosynthetically active radiation (PAR), air (T_{air}) and surface (T_{surf}) temperature, precipitation (Precip) and relative humidity (RH) throughout the measurement campaign.

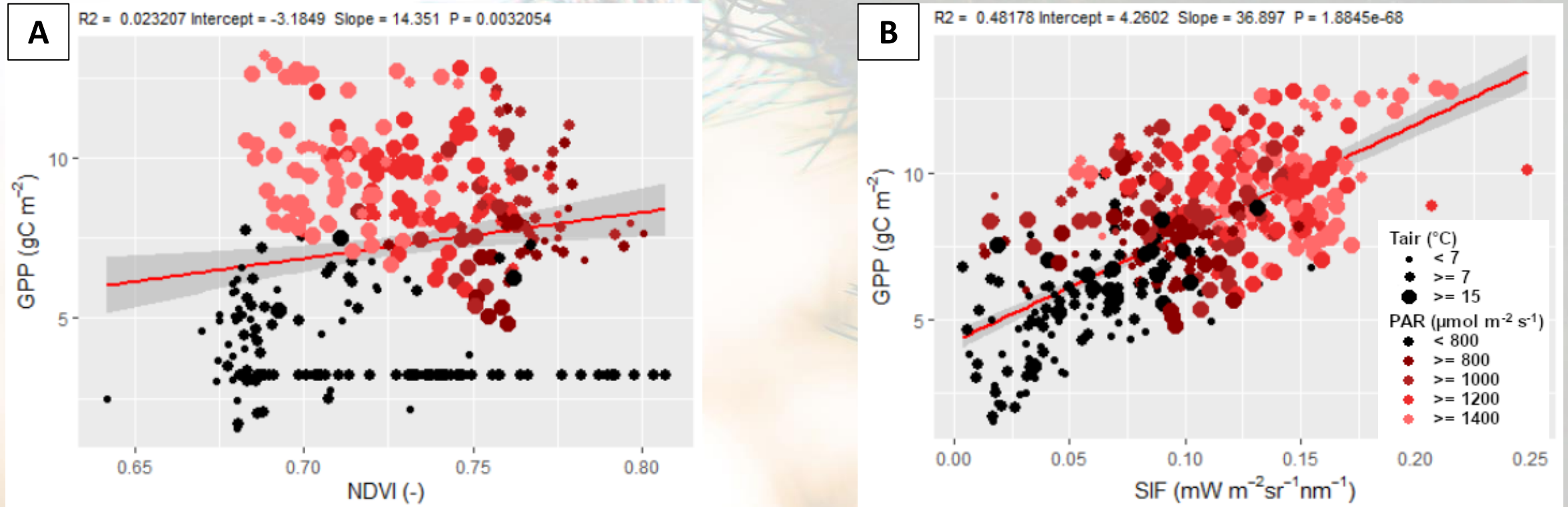


Fig. 2: Relationship between (A) normalized difference vegetation index (NDVI) or (B) SIF and GPP derived from CO₂ flux partitioning. Colors represent intensity of photosynthetically active radiation (PAR); symbol size represents average air temperature (T).

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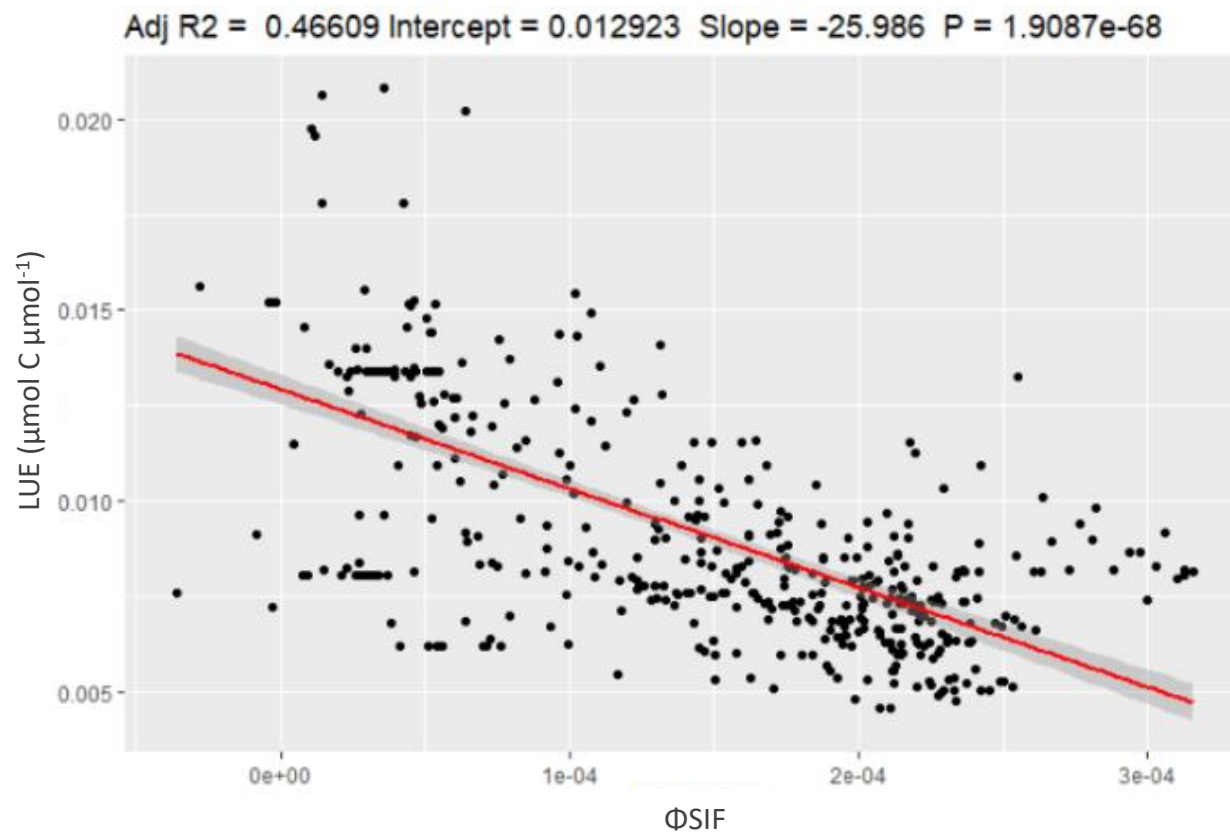


Fig. 3: Relationship between SIF yield (ΦSIF) and Light-use efficiency (LUE).

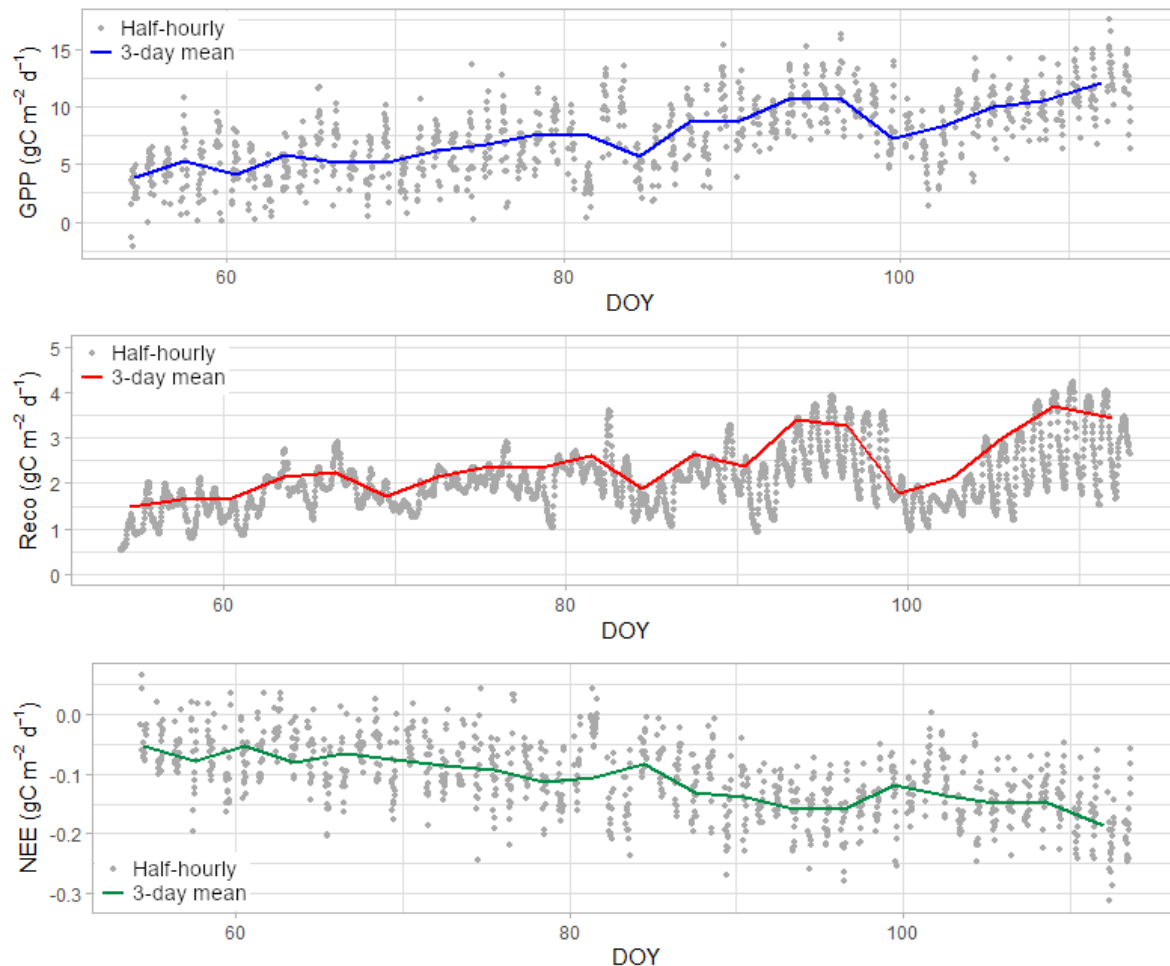
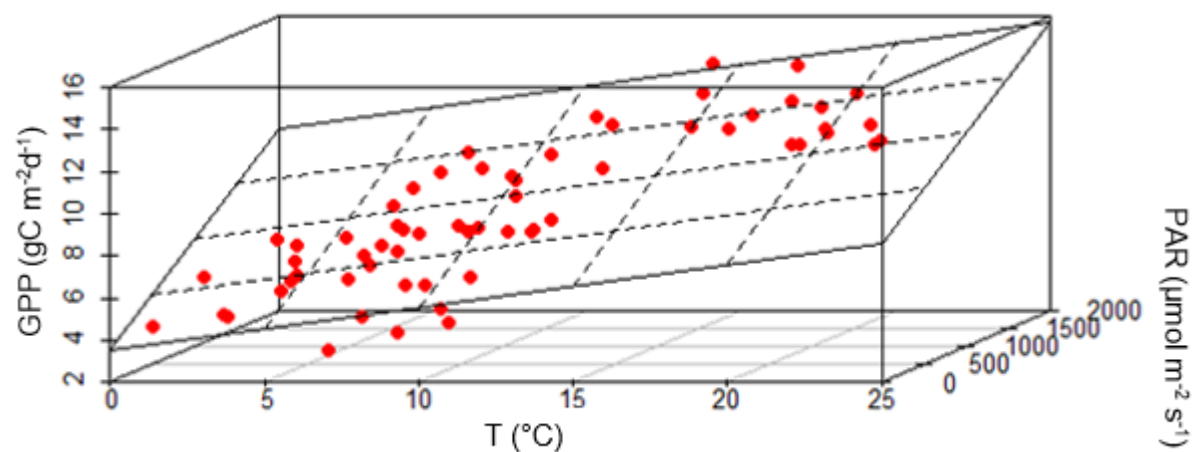


Fig. 4 (l): Seasonal variation of GPP, ecosystem respiration (Reco) and net ecosystem exchange (NEE) fluxes. Dots represent half-hourly data, lines represent 3-day means. GPP and NEE are presented by values filtered for daytime.

Fig. 5 (r): Multiple regression of GPP with PAR and air temperature (Tair) for daily means (midday data; 11:00 – 13:00).

GPP x PAR: $R^2 = 0.55$ GPP x Tair: $R^2 = 0.44$



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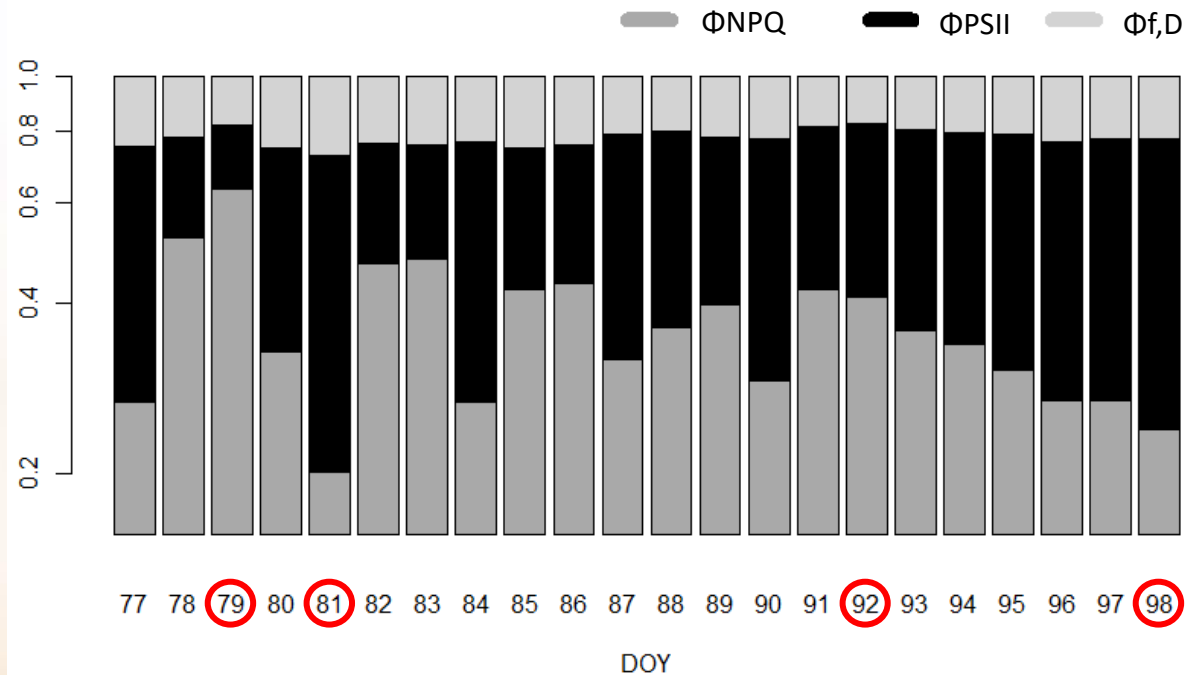


Fig. 6: Yields of non-photochemical quenching (Φ_{NPQ}), photochemistry (Φ_{PSII}) and the combined quantum yield of fluorescence and constitutive thermal energy dissipation ($\Phi_{f,D}$) for midday hours (11:00 – 13:00).

DOY	77	79	80	81	82	90	92	93	98
Φ_{NPQ}	0.267	0.521	0.328	0.201	0.470	0.291	0.408	0.338	0.239
Φ_{PSII}	0.485	0.259	0.421	0.523	0.294	0.487	0.418	0.461	0.539
Φ_{NO}	0.247	0.220	0.251	0.276	0.237	0.222	0.174	0.201	0.222
T	6.7	10.0	12.5	10.4	20.8	9.9	13.5	20.7	23.7
PAR	202	686	274	93	730	357.5	897	873	812

Tab. 1: PAM-retrieved parameters of process yields for selected days.

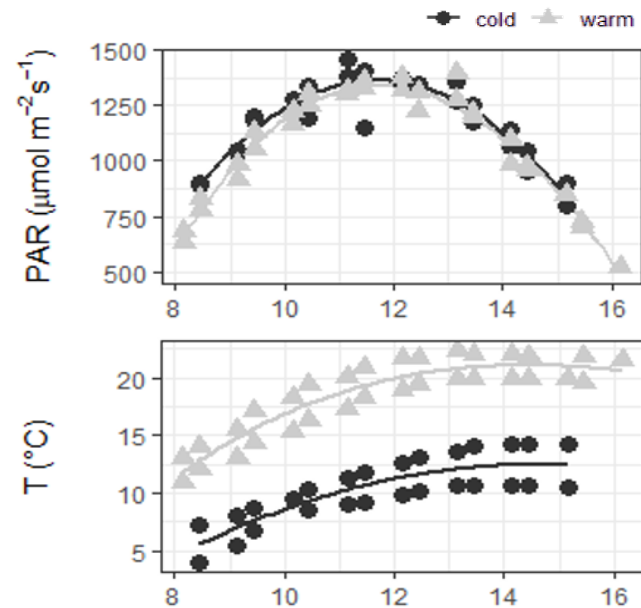
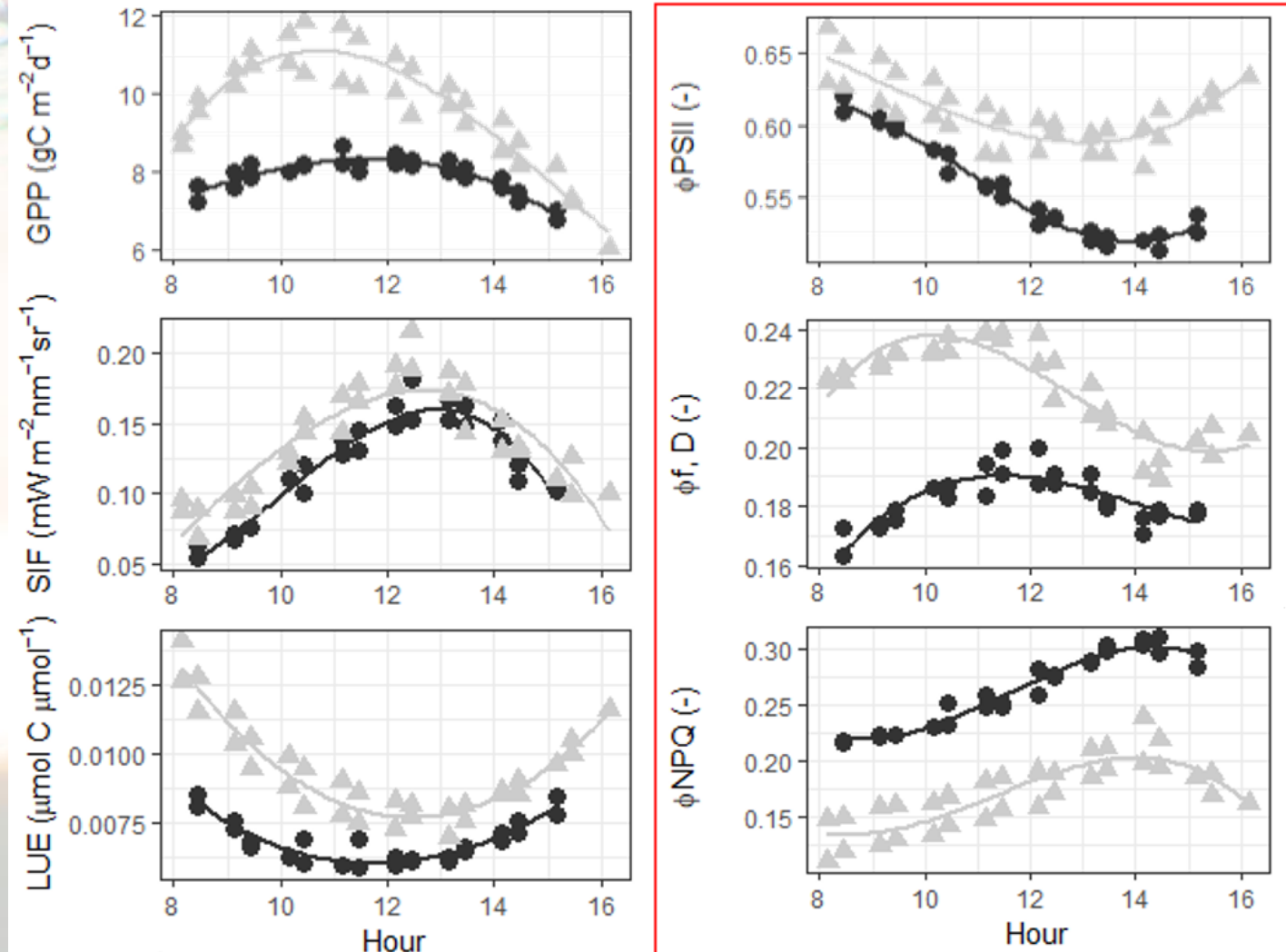


Fig. 7: Diurnal trends for GPP and SIF, and variation in the quantum yields of total non-photochemical quenching (ΦNPQ), photochemistry (ΦPSII) basal thermal energy dissipation ($\Phi\text{f,D}$). Data consists of 30-minute averages throughout the day for a selection of (black) cold spell days and (grey) warm days with similar incoming PAR.



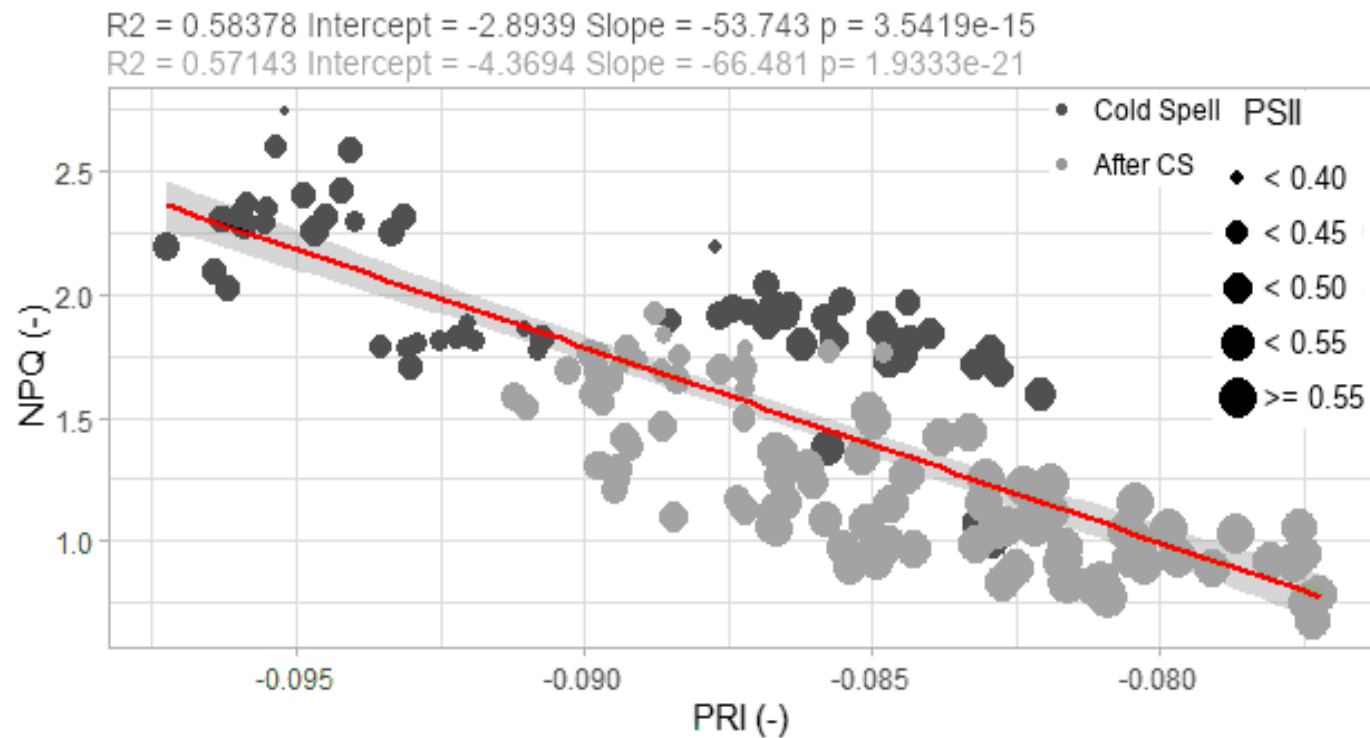


Fig. 8: Relationship between NPQ and photochemical reflectance index (PRI) for coldspell (dark) and warm (light) days. Symbol size indicates different thresholds of Φ_{PSII} .