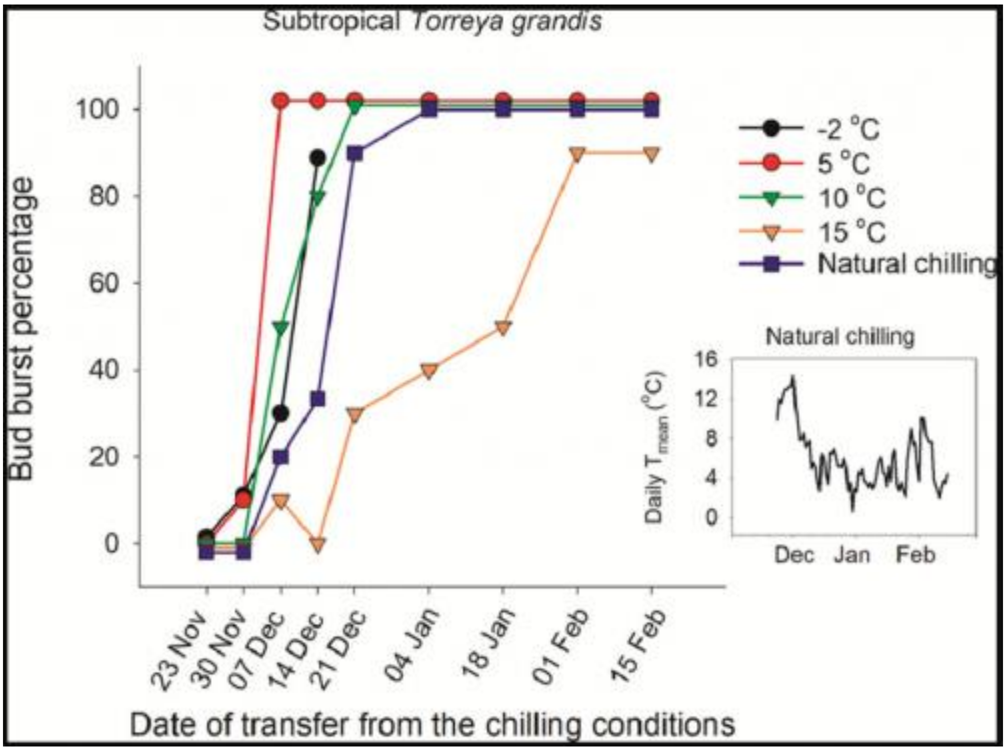
4th Dec

Zhang, R., Lin, J., Wang, F., Shen, S., Wang, X., Rao, Y., ... & Hänninen, H. The chilling requirement of subtropical trees is fulfilled by high temperatures: A generalized hypothesis for tree endodormancy release and a method for testing it. *Agricultural and Forest Meteorology*, *298*, 108296.



It has been suggested recently that similarly to temperate and boreal trees, subtropical tree species also show endodormancy and a chilling requirement of endodormancy release. However, there are no previous experimental results on the chilling temperature range that is effective for endodormancy release in subtropical trees. Their results show endodormancy and a chilling requirement in the tree species studied and reveal several differences among the four species in the manifestation and depth of endodormancy. Most importantly, their findings indicate that contrary to the prevailing mainline conception that chilling temperatures are generally restricted to those below +10 °C, higher temperatures of up to +15 °C are also effective for endodormancy release in the subtropical tree species examined. I think this paper is useful to explain the chilling effect in GDK phenology result (for the definition of a chilling effect and the relationships)

3rd Dec

Soudani, K., Delpierre, N., Berveiller, D., Hmimina, G., Pontailler, J. Y., Seureau, L., ... & Dufrêne, É. (2020). A survey of proximal methods for

monitoring leaf phenology in temperate deciduous forests. ***Biogeosciences Discussions*****, 1-29.**

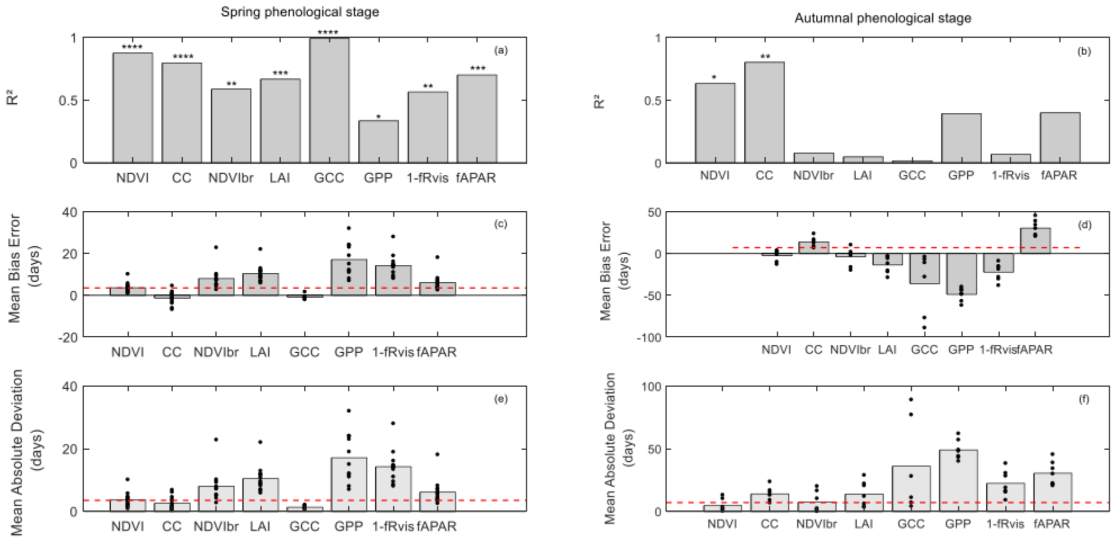


Figure 4: Coefficient of determination (R^2) (a and b), mean bias error (MBE) (c and d) and mean absolute deviation (MAD) (e and f) in days between observed and estimated phenological dates using MOS and MOF markers during spring (a, c and e) and autumnal (b, d and f) phenological stages. The significance levels of R^2 are given by stars: * P <0.05, ** $P < 0.01$, *** $P < 0.001$ and **** $P < 0.0001$. The height of grey boxes marks the average of the statistics across study years (individual years are represented by the black dots). Red horizontal lines represent temporal-resolution related uncertainties associated with field phenological observations of 3.5 days during the spring and of 7 days during the autumn.

The authors used seasonal time-series of ground-based NDVI (Normalized Difference Vegetation Index), RGB camera GCC (Greenness Chromatic Coordinate), broad-band NDVI, LAI (Leaf Area Index), fAPAR (fraction of Absorbed Photosynthetic Active Radiation), CC (Canopy Closure), fRvis (fraction of Reflected Radiation) and GPP (Gross Primary Productivity) to predict six phenological markers detecting the start, middle and end of budburst and of leaf senescence in a temperate deciduous forest. They compared them to observations of budburst and 15 leaf senescence achieved by field phenologists over a 13-year period. GCC, NDVI and CC captured the interannual variability of spring phenology very well ($R^2 > 0.80$) and provided the best estimates of the observed budburst dates, with a mean absolute deviation (MAD) less than 4 days. For the NDVI-based method, on average, the mean observed date coincides with the date when NDVI reaches 25% of its amplitude of annual variation. I think this paper is useful to explain the limitation in transmittance data to estimate the senescence period.

2nd Dec

Yin, G., Verger, A., Filella, I., Descals, A., & Peñuelas, J. (2020). Divergent Estimates of Forest Photosynthetic Phenology Using Structural and Physiological Vegetation Indices. ***Geophysical Research Letters*****,** ***47*****(18), e2020GL089167.**

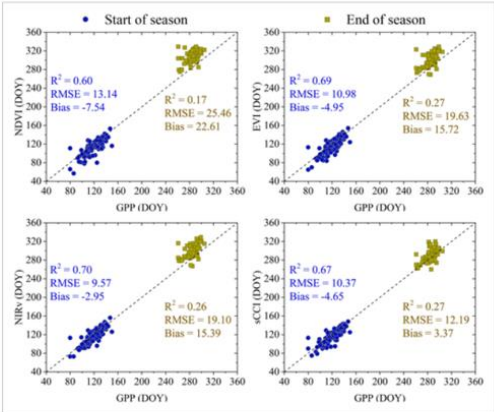


Figure 1 Open in figure viewer | PowerPoint

Scatterplots of the dates of the start of the photosynthetically active season (SOS, blue circles) and the end of the photosynthetically active season (EOS, yellow squares) estimated using the vegetation indices and in situ gross primary production (GPP) for DBFs. SOS and EOS were extracted from dynamic-threshold method (Equation 7). Statistics are also shown in the figures with blue and yellow texts for SOS and EOS, respectively. DOY: day of year.

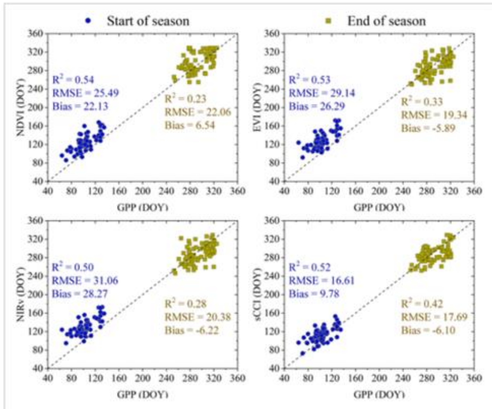


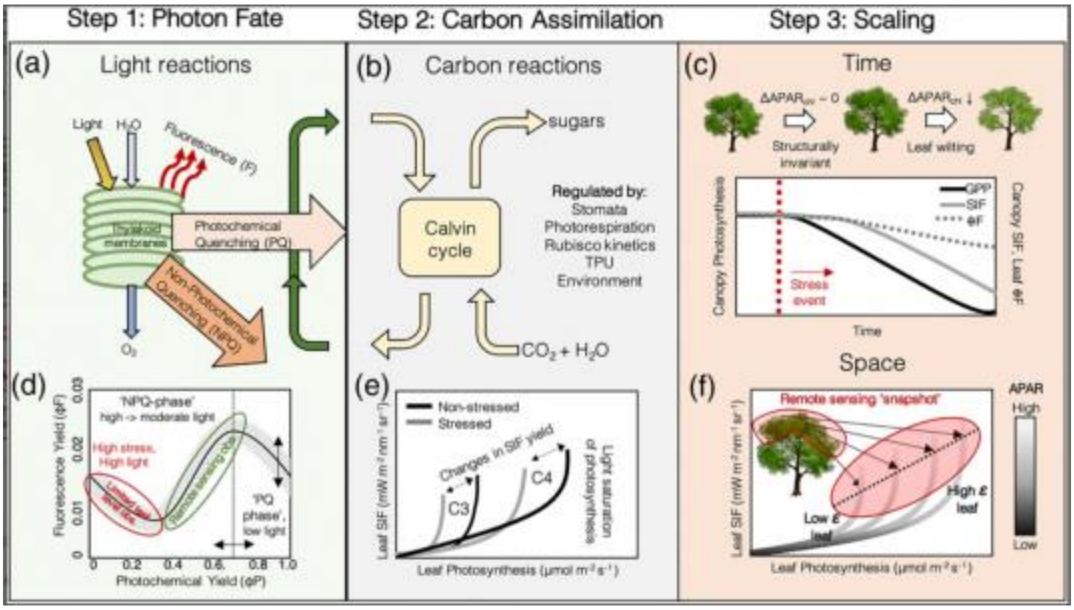
Figure 2 Open in figure viewer | PowerPoint

Scatterplots of the dates of the start of the photosynthetically active season (SOS, blue circles) and the end of the photosynthetically active season (EOS, yellow squares) estimated using the vegetation indices and in situ gross primary production (GPP) for evergreen needleleaf forests. SOS and EOS were extracted from dynamic-threshold method (Equation 7). Statistics are also shown in the figures with blue and yellow texts for SOS and EOS, respectively. DOY: day of year.

The author said that relative performances of structural and physiological VIs remain unclear. They found that **structural VIs** (normalized difference VI, enhanced VI, and near-infrared reflectance of vegetation) were suitable for estimating the start of the photosynthetically active season in deciduous broadleaf forests using gross primary production measured by FLUXNET as a benchmark, and a **physiological VI** (chlorophyll/carotenoid index) was better at identifying the end of the photosynthetically active season for deciduous broadleaf forests and both the start and end of season for evergreen needleleaf forests. The divergent performances were rooted in the combined control of structural and physiological regulations of carbon uptake by plants. Most existing studies of photosynthetic phenology have been based on structural VIs, so we suggest revisiting the dynamics of photosynthetic phenology using physiological VIs, which has significant implications on global plant phenology and carbon uptake studies. If the authors added SIF, I think it would be a really nice paper.

1st Dec

Magney, T. S., Barnes, M. L., & Yang, X. On the covariation of chlorophyll fluorescence and photosynthesis across scales. *Geophysical Research Letters*, e2020GL091098.



Really nice paper! This paper well organized the non-linear SIF-GPP relationship. To summarize these findings, we outline three steps necessary to translate a fluoresced photon at the photosystem scale to an estimate of GPP at the ecosystem scale: Step (1) understanding the fate of absorbed photons; Step (2) translating fluoresced photons to carbon assimilation; and Step (3) the scale dependence of the SIF-GPP relationship. I am sure our TNF data is correct!

4th Nov

Wohlfahrt, G., & Gu, L. (2015). The many meanings of gross photosynthesis and their implication for photosynthesis research from leaf to globe. *Plant, cell & environment*, *38*(12), 2500.

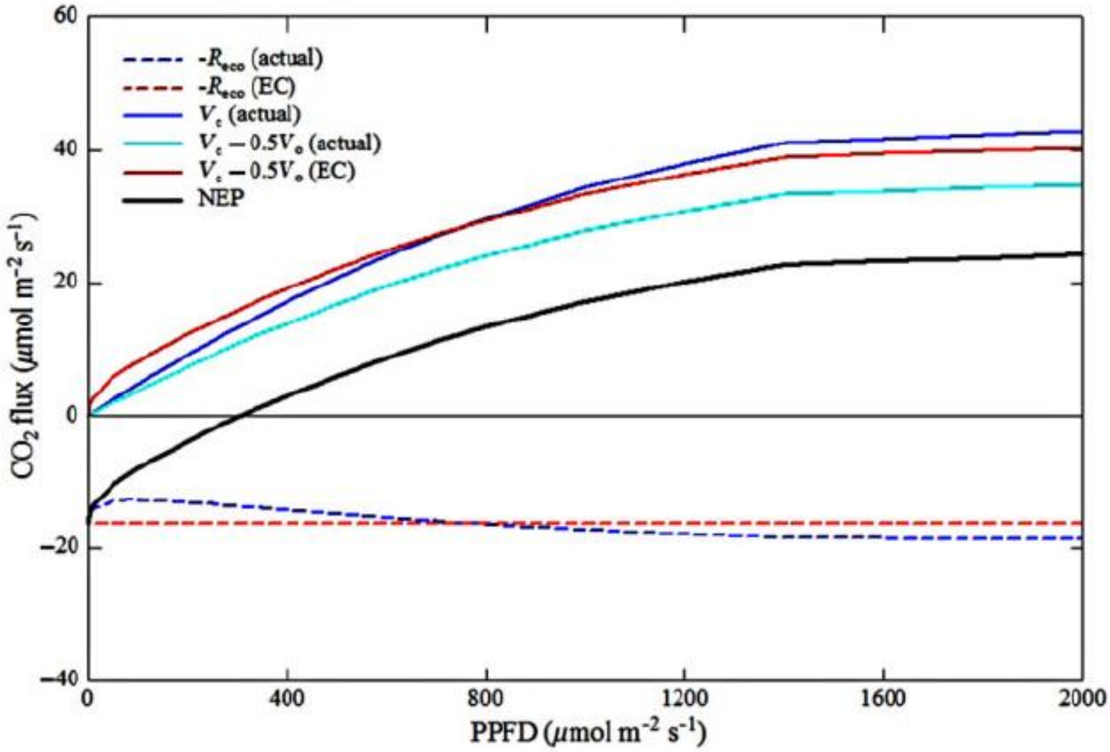


Figure 2. Simulation of ecosystem respiration (R_{eco}), 'apparent' ($V_c - 0.5V_o$) and 'true' (V_c) photosynthesis using the canopy photosynthesis model by De Pury & Farquhar (1997), modified to include the apparent reduction (maximum of 50% at high light) of leaf mitochondrial respiration in the light according to Wohlfahrt *et al.* (2005) and a constant (equal to 40% of leaf dark respiration) source of non-leaf respiration. This figure compares the actual ecosystem respiration, 'apparent' and 'true' photosynthesis with ecosystem respiration and the 'apparent' photosynthesis estimated through the flux partitioning approach. The leaf area index ($2\ m^2\ m^{-2}$), temperature (25 °C), intercellular CO_2 and O_2 partial pressures (25 Pa and 21 kPa), the fraction of diffuse radiation (0.1) and the sun's angle (65°) were kept constant in all simulations.

I did not know that the partitioning GPP into Vc (true photosynthesis) and Photorespiration (Vo). I think this paper is quite interesting but I think there are still limitations to estimate Vc and Vo from GPP because there was still a difference between Vc-0.5Vo from model-based and EC-based. Personally, I like the below sentences as follow: c Chlorophyll fluorescence intensity induced by sunlight is proportional to the electron transport rate from the photosystem II to photosystem I, which, in turn, is proportional to Vc – 0.5Vo, it should be a measure of apparent photosynthesis. However, the relationship between chlorophyll fluorescence and apparent photosynthesis will be affected by

temperature, radiation, water stress and other environmental variables and may not be linear.

3rd Nov

Chen, A., Mao, J., Ricciuto, D., Xiao, J., Frankenberg, C., Li, X., ... & Knapp, A. K. (2020). Moisture availability mediates the relationship between terrestrial gross primary production and solar-induced chlorophyll fluorescence: Insights from global-scale variations. *Global Change Biology*.

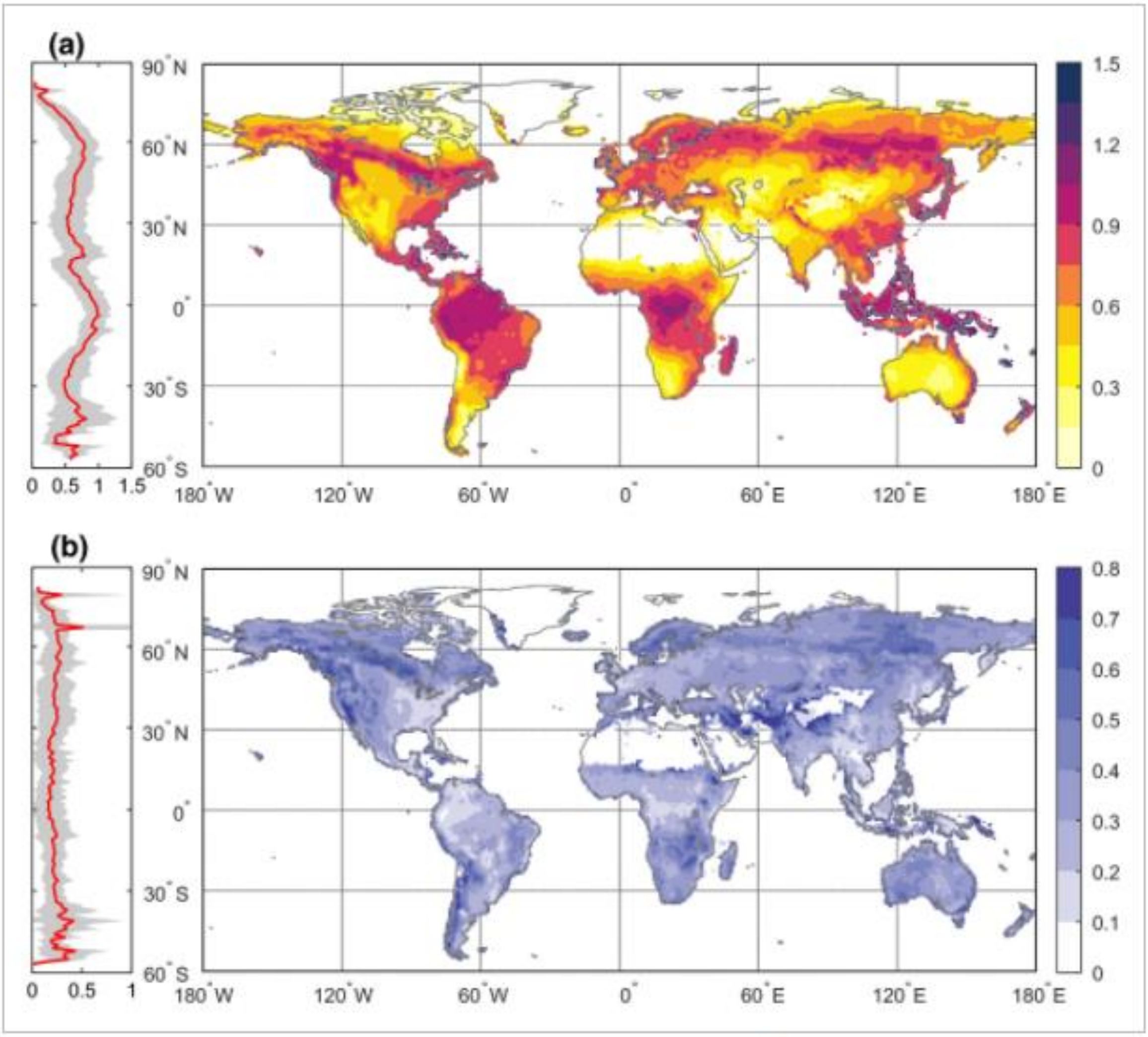


FIGURE 1 Open in figure viewer | PowerPoint

Growing season GPP/SIF ratio averaged from the ensemble of multiple gridded SIF and GPP products and its standard deviation of the ensemble over the global land. (a) Spatial distribution of averaged growing season GPP/SIF ratio derived from multiple gridded SIF and GPP products. Note that both GPP and SIF are normalized before calculating GPP/SIF ratios. Left panel shows the change of averaged GPP/SIF values along the latitudinal gradient. (b) Spatial distribution of the standard deviation of the ensemble of growing season GPP/SIF ratio. Similarly, the left panel in (b) is the change of averaged GPP/SIF variations along the latitudinal gradient. GPP, gross primary production; SIF, solar-induced chlorophyll fluorescence

I think this paper looks interesting for me because they showed that there was clear different slope in SIF-GPP relationship in the global scale. I think IF they check the phiF and NIRv or fesc, it would be more interesting. IF I get their data, we can test it. They showed that the growing season GPP/SIF ratio varied substantially across global land surfaces, with the highest ratios consistently found in boreal regions. Spatial variation in GPP/SIF was strongly modulated by climate variables. The most striking pattern was a consistent decrease in GPP/SIF from cold-and-wet climates to hot-and-dry climates. We propose that the reduction in GPP/SIF with decreasing moisture availability may be related to stomatal responses to aridity. Furthermore, we show that GPP/SIF can be empirically modeled from climate variables using a machine learning (random forest) framework, which can improve the modeling of ecosystem production and quantify its uncertainty in global terrestrial biosphere models. However, I am not sure which factor really affect the GPP/SIF relationship. I guess fesc is more critical factor to determine SIF/GPP relationship rather than phiF.

2nd Nov

Van der Tol, C., Berry, J. A., Campbell, P. K. E., & Rascher, U. (2014). Models of fluorescence and photosynthesis for interpreting measurements of solar-induced chlorophyll fluorescence. ***Journal of Geophysical Research: Biogeosciences*****,** ***119*****(12), 2312-2327.**

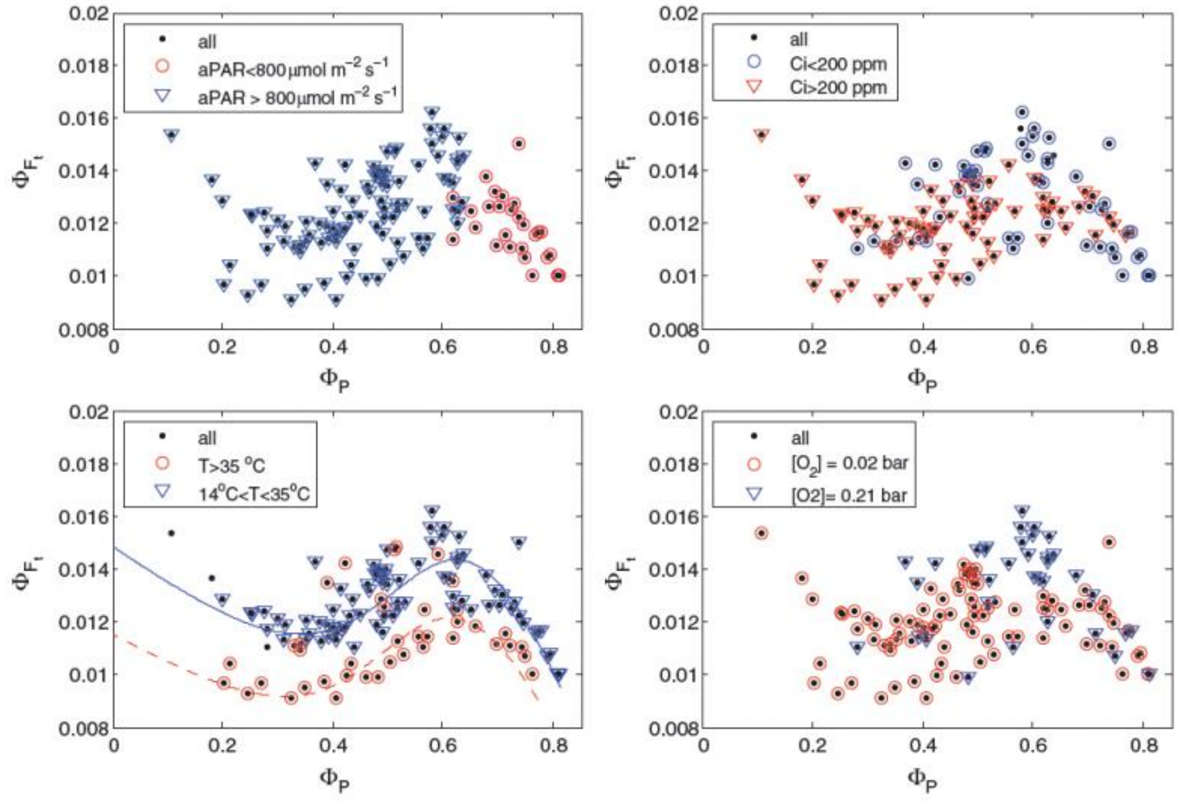


Figure 3. The data and model results of the cotton experiment presented as Φ_{F_t} versus Φ_P, with different symbols for driving variables. The lines are computed from the empirical $K_N(x)$ with temperature correction for 25°C (solid line) and 35°C (dashed line).

The authors checked the conventional photosynthesis model to simulate field and laboratory measurements of chlorophyll fluorescence at the leaf scale. The fluorescence paramaterization is based on a close nonlinear relationship between the relative light saturation of photosynthesis and nonradiative energy dissipation in plants of different species. This relationship diverged only among examined data sets under stressed (strongly light saturated) conditions, possibly caused by differences in xanthophyll pigment concentrations. The relationship was quantified after analyzing data sets of pulse amplitude modulated measurements of chlorophyll fluorescence and gas exchange of leaves of different species exposed to different levels of light, CO2, temperature, nitrogen fertilization treatments, and drought. I could check the many useful information in phiF and Y(PS(II)).

1st Nov

Raczka, B., Porcar-Castell, A., Magney, T., Lee, J. E., Köhler, P., Frankenberg, C., ... & Burns, S. P. (2019). Sustained nonphotochemical quenching shapes the seasonal pattern of solar-induced fluorescence at a high-elevation evergreen forest. *Journal of Geophysical Research: Biogeosciences*, *124*(7), 2005-2020.

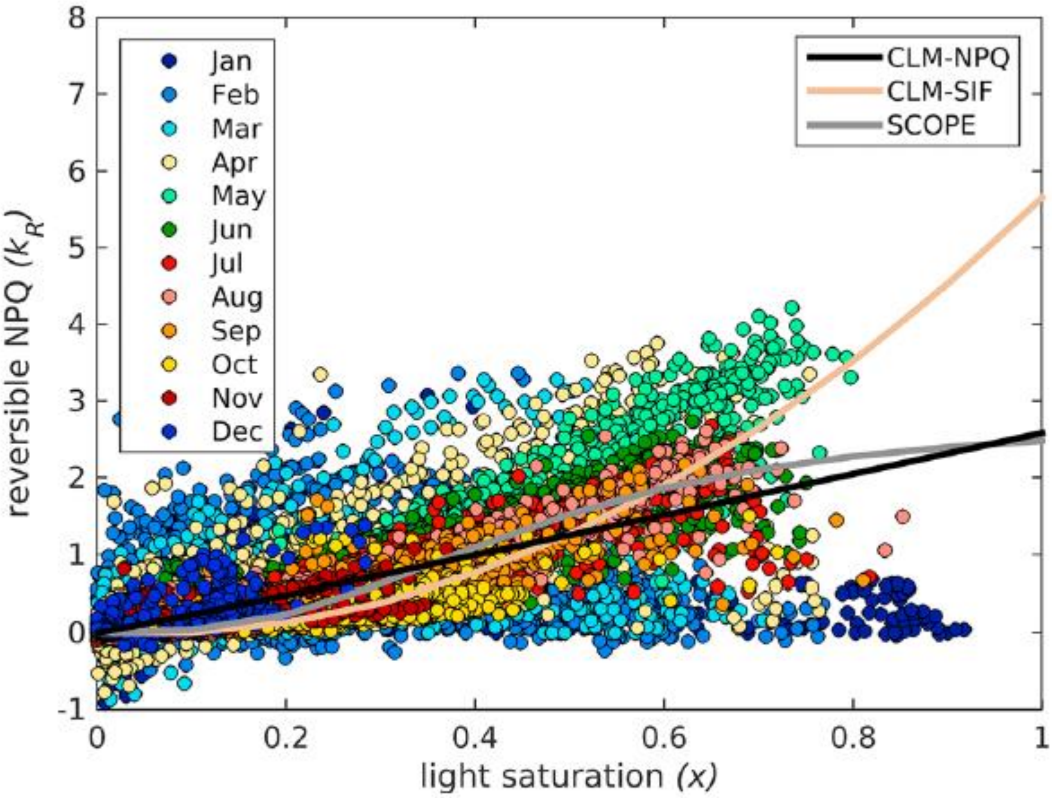


Figure 5. Reversible NPQ (k_R) as calculated from MONI-PAM fluorescence measurements (colored dots) at Hyytiälä (Porcar-Castell, 2011). A single fit for all the data (equation (22)) for the Hyytiälä data was used for the *CLM-NPQ* simulation. *CLM-SIF* and SCOPE simulations used the Flexas et al. (2002) fluorescence data for a two-parameter (equation (19)) and three-parameter fit, respectively, for k_R.

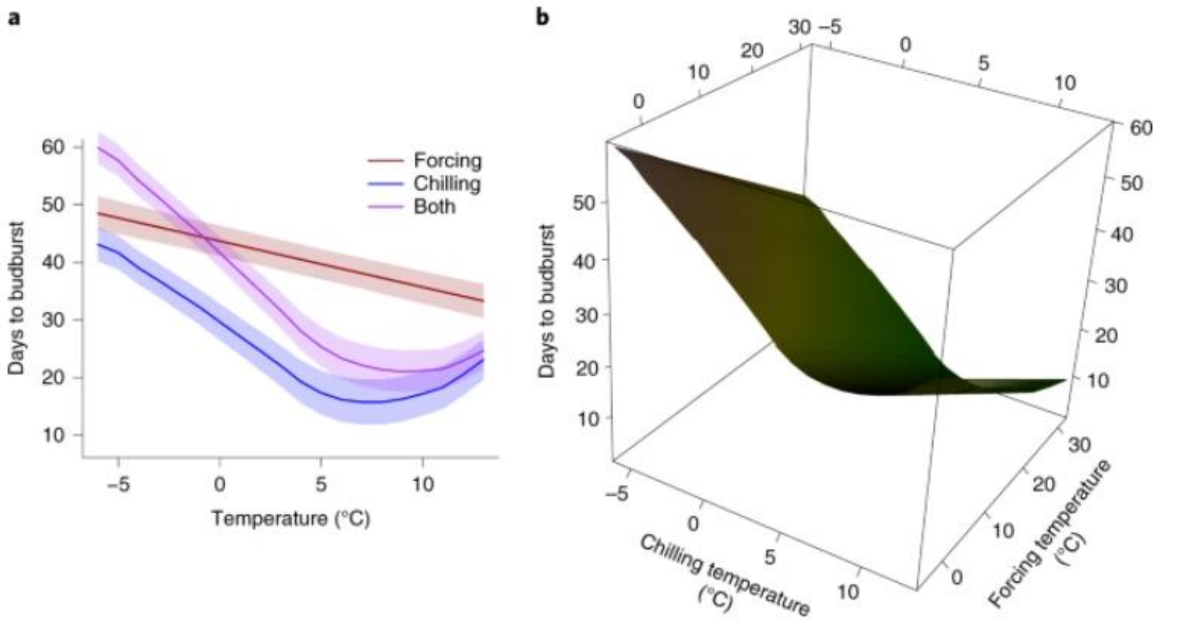
Although the empirical linkage between SIF and GPP is strong, the current mechanistic understanding of this linkage is incomplete and depends upon changes

in leaf biochemical processes in which absorbed sunlight leads to photochemistry, heat (via nonphotochemical
quenching [NPQ]), fluorescence, or tissue damage. In this paper, the authors improved fluorescence model within the Community Land Model, Version 4.5 (CLM 4.5), to simulate seasonal changes in SIF. The authors found that when the model accounted for sustained NPQ, this provided a larger seasonal change in fluorescence yield leading to simulated SIF that more closely resembled the observed seasonal pattern. They found that an acclimation model based on mean air temperature was a useful predictor for sustained NPQ. However, there is still a limitation in this paper because the authors used the fixed relationship for reversible NPQ within their model and they found that that is quite different compared to MONI-PAM data. I think our data could be useful for improving their data.

4rd Oct

Ettinger, A. K., Chamberlain, C. J., Morales-Castilla, I., Buonaiuto, D. M., Flynn, D. F. B., Savas, T., ... & Wolkovich, E. M. (2020). Winter temperatures predominate in spring phenological responses to warming. *Nature Climate Change*, 1-6.

Fig. 3: Estimates of budburst across a range of forcing temperatures and estimated chilling.

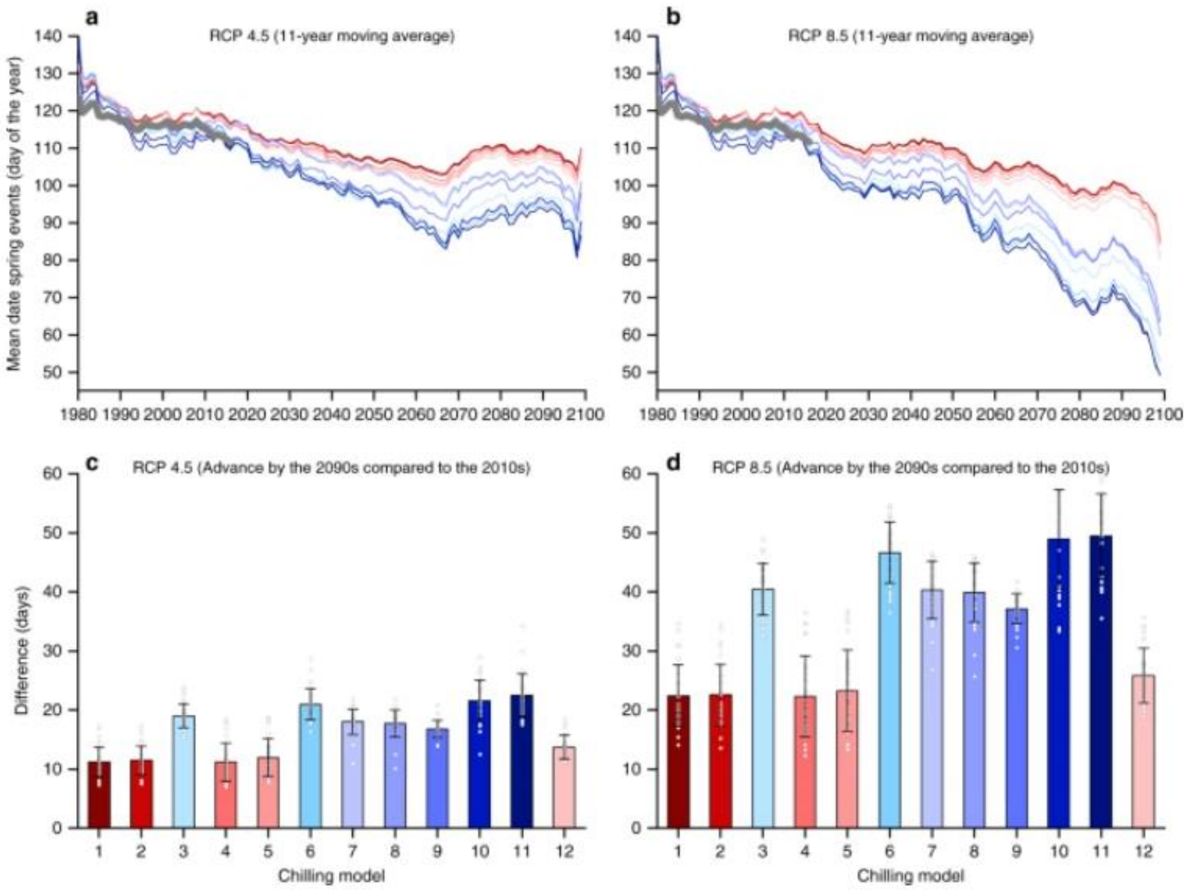


I think that there are some issues about the relationship heat and chilli requirements. It seems the similar factors between them but there could be a clear different rule. This paper also showed that winter temp is the dominant factor in spring phenology. They said that increasing research on the phenological impacts of climate change has led to debate over whether chilling and/or photoperiod cues have slowed phenological responses to warming in recent years. Here we use a global metaanalysis of all published experiments to test the relative effects of these cues. Almost all species show strong responses to all three cues, with chilling being the strongest and photoperiod the weakest. Forecasts from our findings for Central Europe suggest that spring phenology will continue to advance, as stalling effects of chilling generally appear above 4 °C warming in this region. I will check the winter temperature. BTW, how they defined the winter temp? I found that they also suffered from the data analysis because the data collection time is not all same.

3rd Oct

Wang, H., Wu, C., Ciais, P., Peñuelas, J., Dai, J., Fu, Y., & Ge, Q. (2020). Overestimation of the effect of climatic warming on spring phenology due to misrepresentation of chilling. *Nature Communications*, *11*(1), 1-9.

Fig. 4: Changes in spring phenology averaged for all species and stations for 2019-2099.

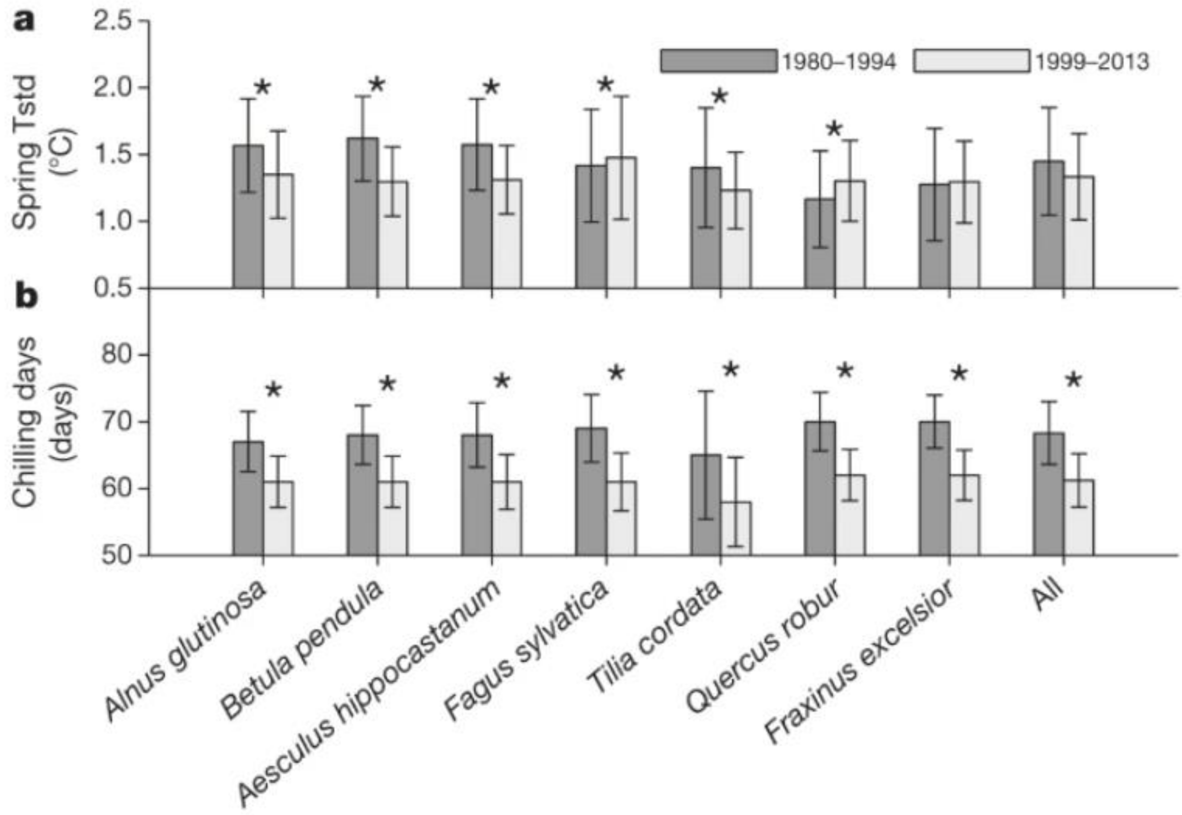


In this paper, they presented that chilling requirement (CA) vs heat requirement (HR) is different over the species and it could be affect the leaf unfolding. They said whether or not this negative CA-HR relationship is correctly interpreted in ecosystem models remains unknown. Using leaf unfolding and flowering data for 30 perennials in Europe, here we show that more than half (7 of 12) of current chilling models are invalid since they show a positive CA-HR relationship. The possible reason is that they overlook the effect of freezing temperature on dormancy release. Overestimation of the advance in spring phenology by the end of this century by these invalid chilling models could be as large as 7.6 and 20.0 days under RCPs 4.5 and 8.5, respectively.

2nd Oct

Fu, Y. H., Zhao, H., Piao, S., Peaucelle, M., Peng, S., Zhou, G., ... & Song, Y. (2015). Declining global warming effects on the phenology of spring leaf unfolding. *Nature*, *526*(7571), 104-107.

Figure 2: Changes of chilling and spring temperature variation between 1980–19 and 1999–2013.

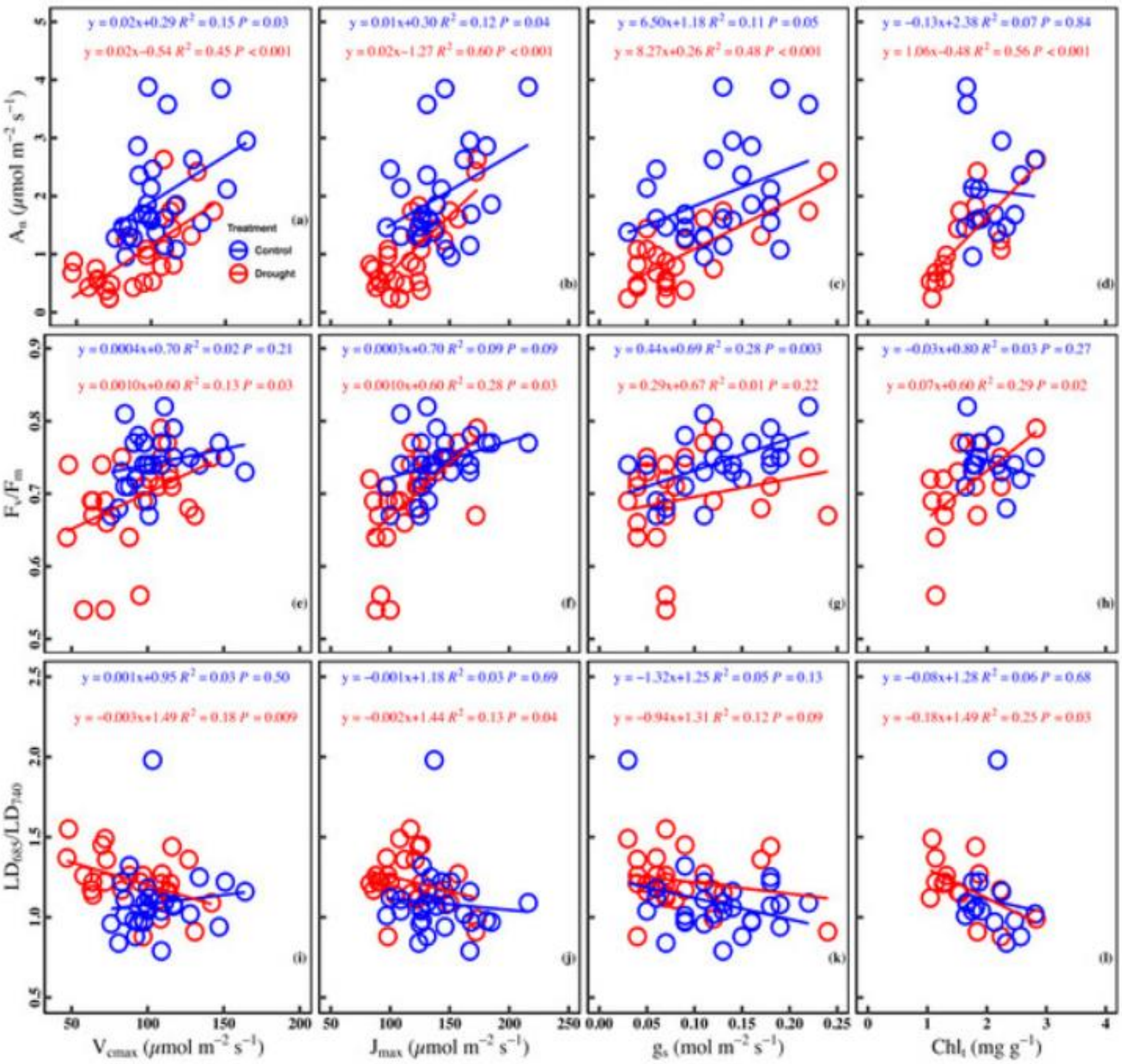


I think this paper is really interesting. Key point of this paper is that the chilling days could explain why there was the apparent response of leaf unfolding to climate warming has significantly decreased from 1980 to 2013. They used long-term *in situ* observations of leaf unfolding for seven dominant European tree species at 1,245 sites, here we show that the apparent response of leaf unfolding to climate warming (S_T, expressed in days advance of leaf unfolding per °C warming) has significantly decreased from 1980 to 2013 in all monitored tree species. Averaged across all species and sites, S_T decreased by 40% from 4.0 ± 1.8 days °C^{-1} during 1980–1994 to

2.3 ± 1.6 days $^{\circ}C^{-1}$ during 1999–2013. The declining S_T was also simulated by chilling-based phenology models, albeit with a weaker decline (24–30%) than observed *in situ*. It would be useful data to check the temperature response in our GDK site.

1st Oct

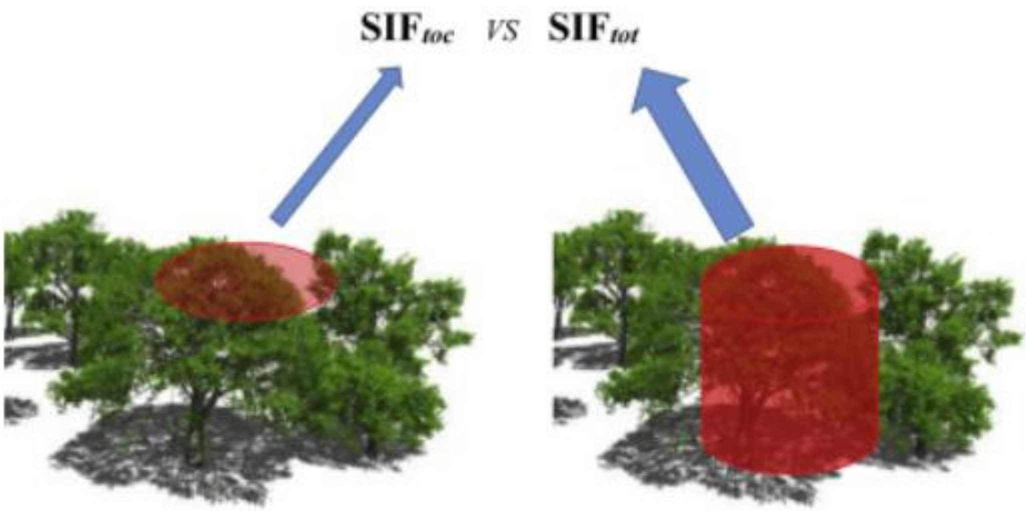
Zhuang, J., Wang, Y., Chi, Y., Zhou, L., Chen, J., Zhou, W., ... & Ding, J. (2020). Drought stress strengthens the link between chlorophyll fluorescence parameters and photosynthetic traits. *PeerJ*, *8*, e10046.

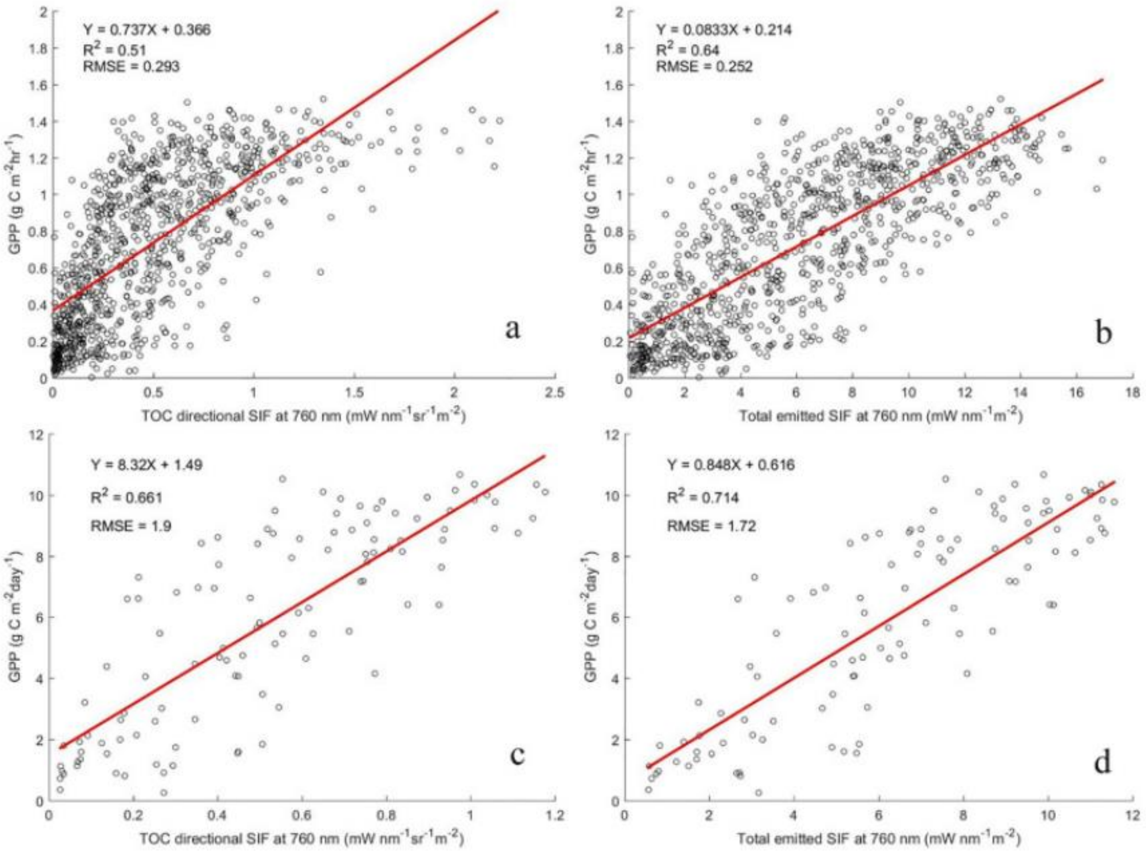


The authors also tested chlorophyll fluorescence parameters and photosynthetic traits under drought stress. They showed that Jmax and VCmax also changed. However, I am not sure their result is clear because IF we remove the one point in net CO_2 assimilation rate and Laser-induced chlorophyll fluorescence intensity ratio relationship, the pattern could be changed.

4th Sep

Lu, X., Liu, Z., Zhao, F., & Tang, J. (2020). Comparison of total emitted solar-induced chlorophyll fluorescence (SIF) and top-of-canopy (TOC) SIF in estimating photosynthesis. *Remote Sensing of Environment*, *251*, 112083.



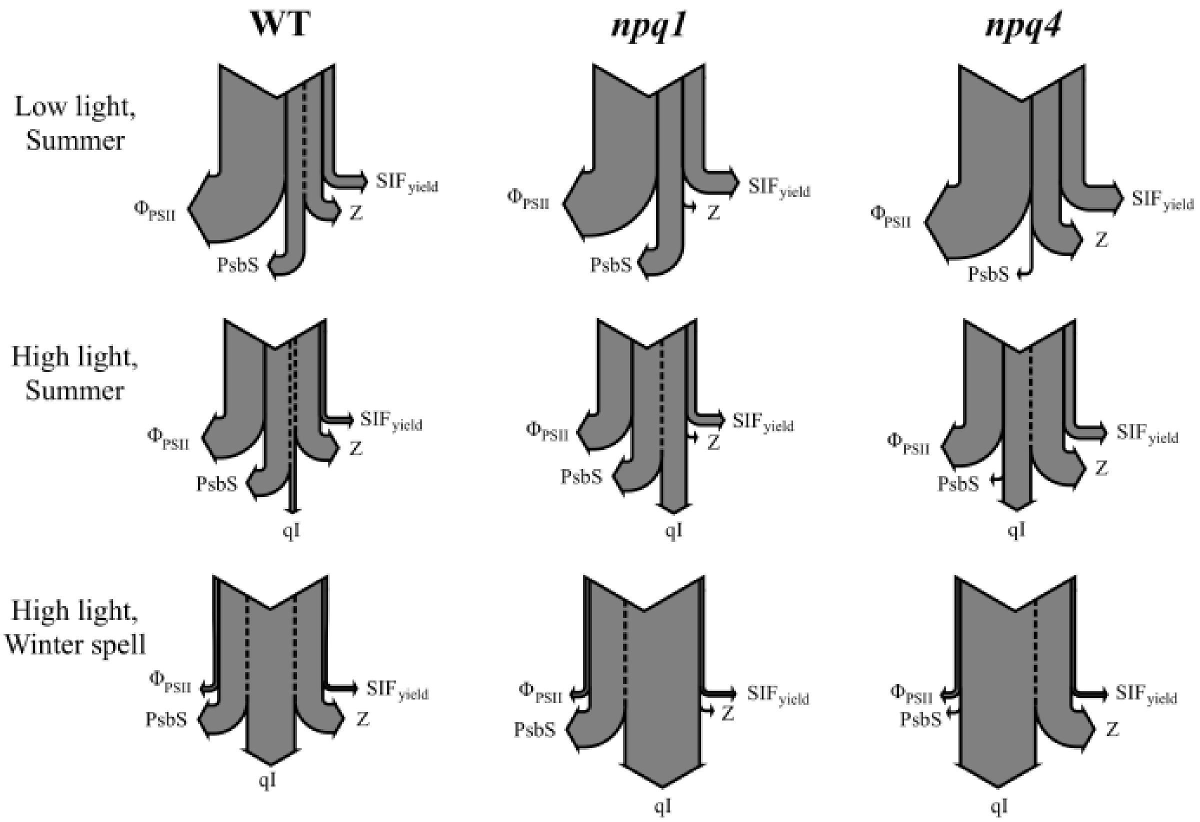


I think this one could be one of the reasons which is a non-linear relationship between SIF and GPP.

Total emitted SIF (SIF_{tot}) can be estimated from top-of-canopy SIF (SIF_{toc}). The sensor only received on average 22.9% of total emitted SIF. SIF_{tot} improves the diurnal estimate of canopy GPP. SIF_{tot} produced a stronger correlation with GPP for plants with complex structure. The SIF_{tot}-GPP relationship shows a stronger resilience to environmental stresses.

3rd Sep

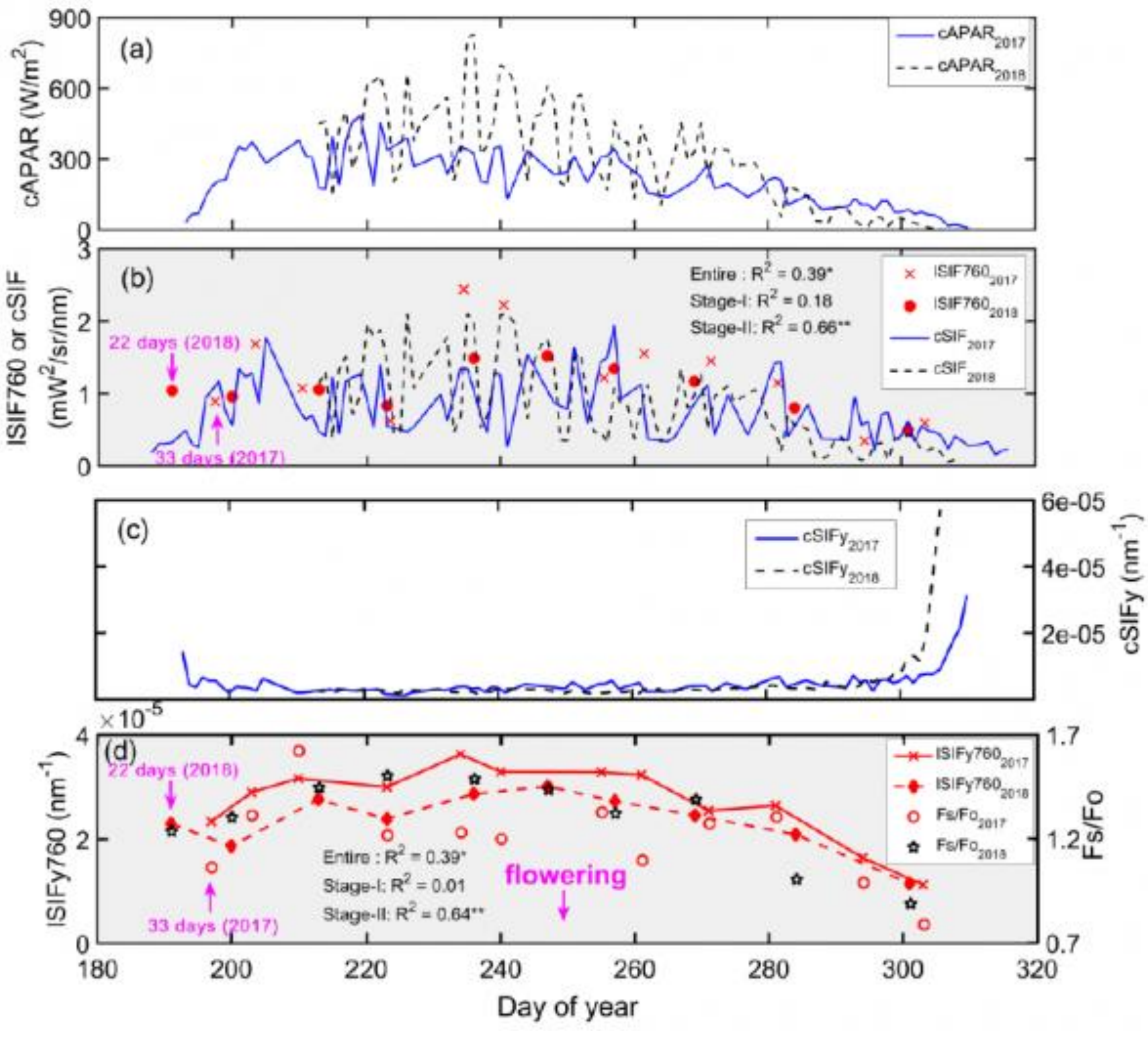
Acebron, K., Matsubara, S., Jedmowski, C., Emin, D., Muller, O., & Rascher, U. Diurnal dynamics of non-photochemical quenching in Arabidopsis npq mutants assessed by solar-induced fluorescence and reflectance measurements in the field. *New Phytologist*.



I think this paper is really interesting. Results showed that both *npq* mutants had higher levels of SIF compared to wild type. Changes in reflectance were related to changes in the violaxanthin-antheraxanthin-zeaxanthin cycle and not to PsbS-mediated conformational changes. When plants were exposed to cold temperatures, rapid onset of photoinhibition strongly quenched SIF in all lines. I think If they check the crop or fruits plant under different environmental condition, it might be useful to know the function of the SIF.

2nd Sep

Li, J., Zhang, Y., Gu, L., Li, Z., Li, J., Zhang, Q., ... & Song, L. (2020). Seasonal variations in the relationships between sun-induced chlorophyll fluorescence and photosynthetic capacity from leaf to canopy in a rice paddy. *Journal of Experimental Botany*.



This paper showed the leaf-level SIF yield changed in the rice paddy but the canopy-level SIF yield did not change. I think the canopy structure is really unique in rice paddy and it strongly affect the canopy-level SIF. However, I am not sure the exact mechanism between VCmax and SIF yield here.

1st Sep

Ball, J. T. (1988). *An analysis of stomatal conductance* (Doctoral dissertation, Stanford University).

of light, temperature, humidity, and CO_2 is accounted for in the relationship

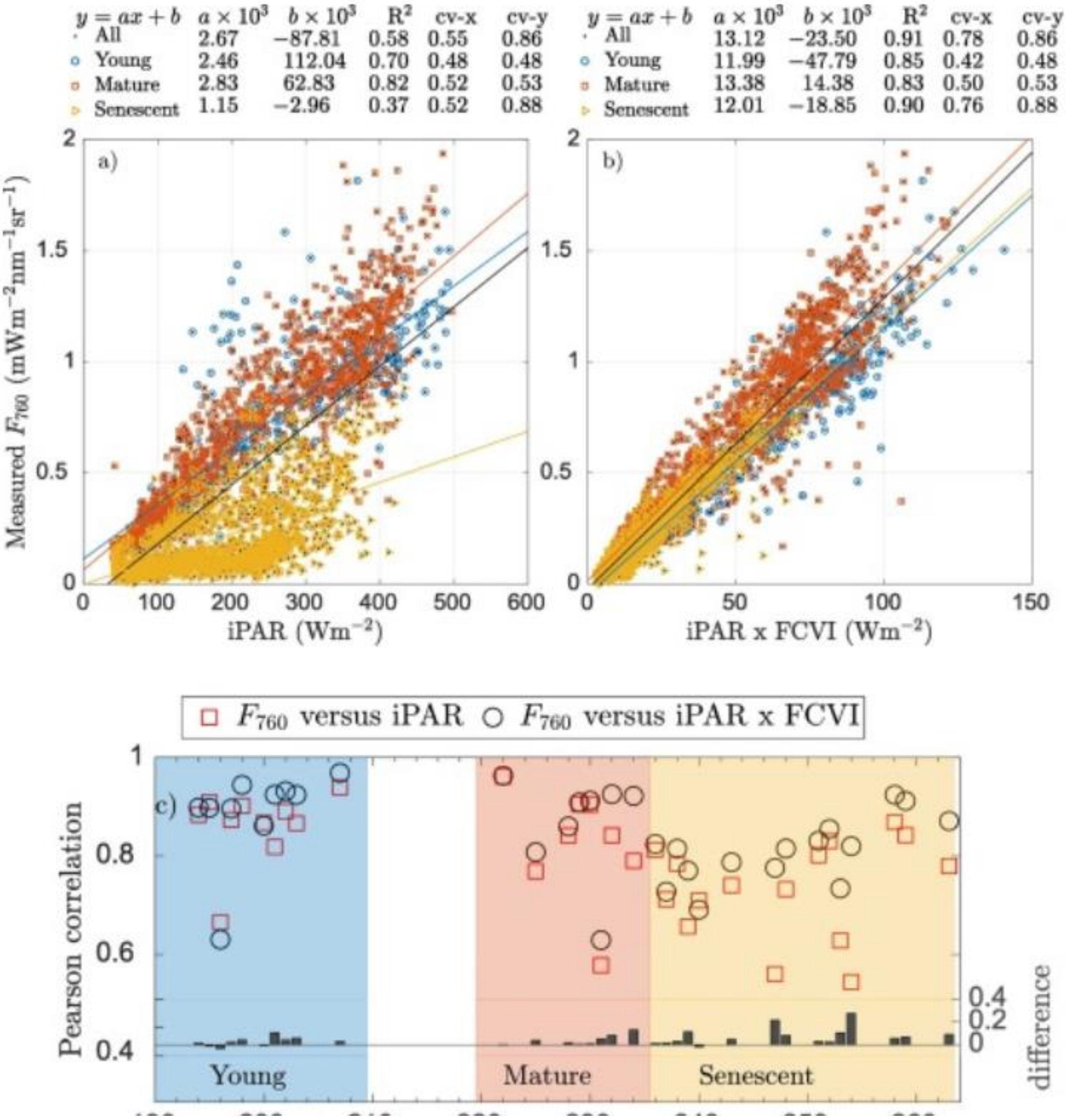
$$g_{sw} = m\frac{Ah_s}{c_s} + b \tag{2.3}$$

where m and b are constants. This model, represented by the dotted line in Fig. 2.6, is an unconstrained regression which, in the case of *Glycine max*, has an intercept not significantly different from the origin. The parameters in Fig. 2.6 have the following units: A is in μmol CO_2 $m^{-2}s^{-1}$, c_s is in μmol mol^{-1} air, h_s (the decimal relative humidity at the leaf surface) is mol H_2O mol^{-1} air, g_{sw} is in mol air $m^{-2}s^{-1}$. Thus, the ordinate intercept, b, has units of mol $m^{-2}s^{-1}$ and m is unitless. In the case of *G. max*, b is not significantly different from zero. The slope, m, represents a composite sensitivity of stomatal conductance to environmental factors. The

I think this paper is really key paper for Ball-berry equation. A lot of studies come from this paper. Ca is mole fraction Co2 in ambient air, A is Co2 assimilation rate, Hs is relative water vapor saturation of air at the leaf surface, Gsw is stomatal conductance to Co2

4th Aug

Yang, P., van der Tol, C., Campbell, P. K., & Middleton, E. M. (2020). Fluorescence Correction Vegetation Index (FCVI): A physically based reflectance index to separate physiological and non-physiological information in far-red sun-induced chlorophyll fluorescence. *Remote sensing of environment*, *240*, 111676.



I love this paper. Really well-made paper, I think. In this paper, the authors proposed an index (FCVI) for the effects of physical processes on far-red SIF. FCVI is the difference between near-infrared and broadband visible reflectance. Normalizing SIF by FCVI and PAR is an estimate of fluorescence emission efficiency. FCVI was tested with field measurement and a numerical experiment. I will check this FCVI and NIRv in TNF data.

3rd Aug

Mengistu, A. G., Mengistu Tsidu, G., Koren, G., Kooreman, M. L., Boersma, K. F., Tagesson, T., Ardö, J., Nouvellon, Y., and Peters, W.: Sun-induced Fluorescence and Near Infrared Reflectance of vegetation track the seasonal dynamics of gross primary production over Africa,

Biogeosciences Discuss., https://doi.org/10.5194/bg-2020-242, in review, 2020.

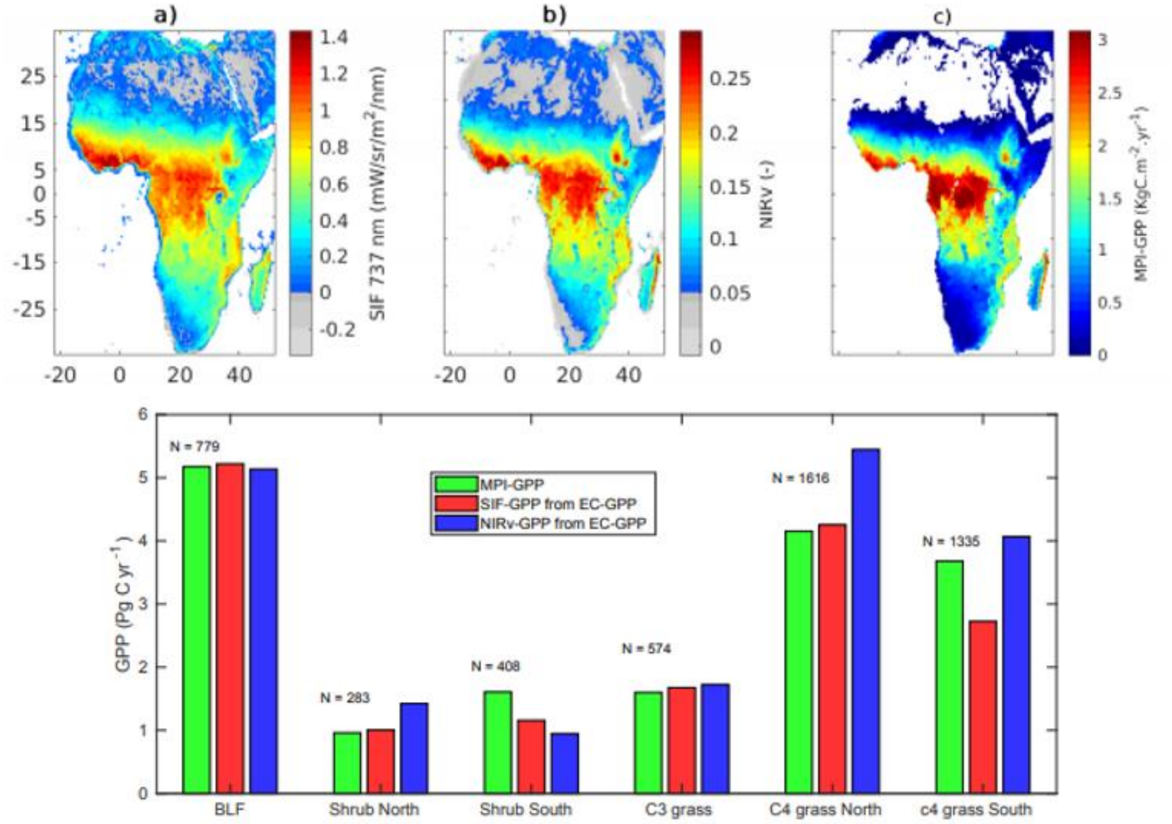
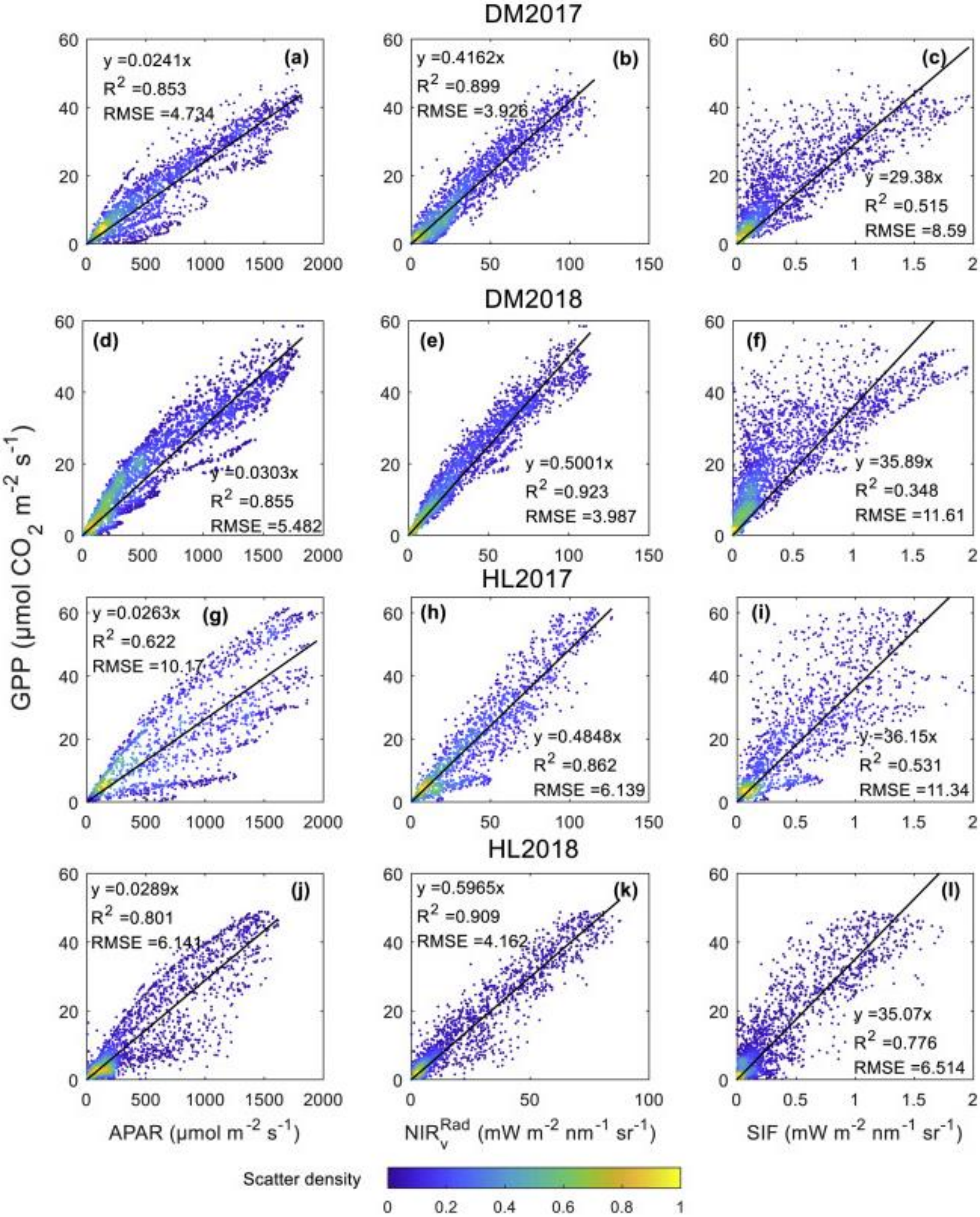


Figure 6. Comparison of aggregated MPI-BGC GPP, SIF-GPP and NIRv-GPP for major biomes in Africa. N is the number of grid box of size $0.5° \times 0.5°$ used in the aggregation.

I think this paper also related to the relationship between SIF, NIRv and GPP. Similar to SIF signals in the neighboring Amazon, peak productivity occurs in the wet season coinciding with peak soil moisture, and is followed by an initial decline during the early dry season, that reverses when light availability peaks. This suggests similar leaf dynamics are at play. Spatially, SIF and NIRv show a strong linear relation ($R > 0.9$, $N = 250$ + pixels) with multi-year MPI-BGC GPP even within single biomes. Both MPI-BGC GPP and EVI show saturation relative to peak NIRv and SIF signals during high productivity months, which suggests that GPP in the most productive regions of Africa might be larger than suggested. However, I think they missed the radiance term in NIRv-GPP relationship.

2nd Aug

Liangyun Liu, Xinjie Liu, Jidai Chen, Shanshan Du, Yan Ma, Xiaojin Qian, Siyuan Chen, Dailiang Peng, Estimating Maize GPP using Near-infrared Radiance of Vegetation, Science of Remote Sensing, Science of Remote Sensing, 2020



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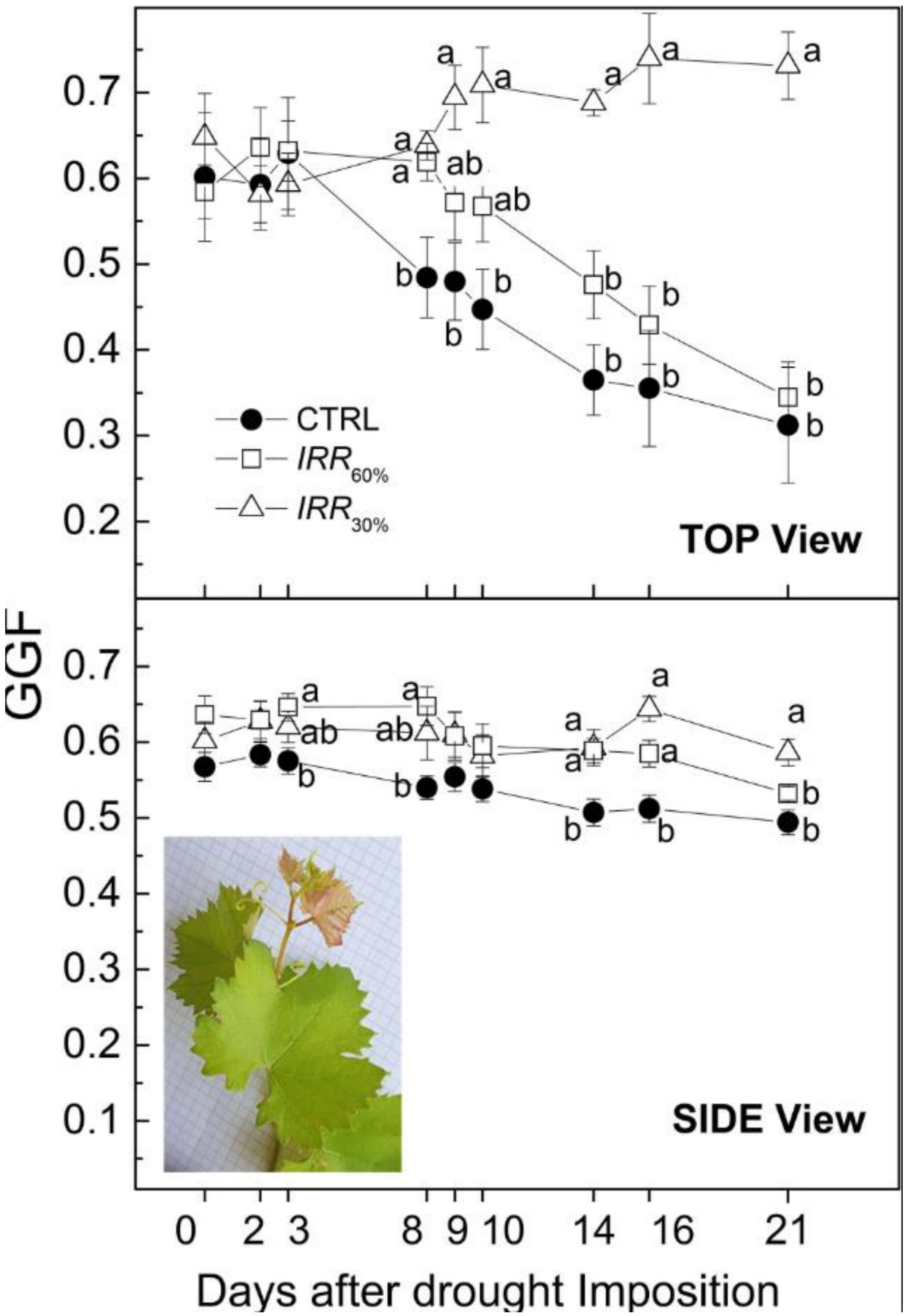
I think this paper also related to Ben's recent work which is comparing NIRv and LUE in crops. They found that 1) NIR reflectance of vegetation well tracks the diurnal and seasonal LUE of maize. 2) NIR radiance of vegetation well tracks the diurnal and seasonal GPP of maize. 3) NIR radiance of vegetation outperforms SIF, APAR and LUE-model for GPP estimation. I think NIRv x PAR is obviously working well in GPP tracking in crops.

1st Aug

Briglia, N., Williams, K., Wu, D., Li, Y., Tao, S., Corke, F., … & Doonan, J. H. (2020). Image-Based Assessment of Drought Response in Grapevines. *Frontiers in Plant Science*, *11*.

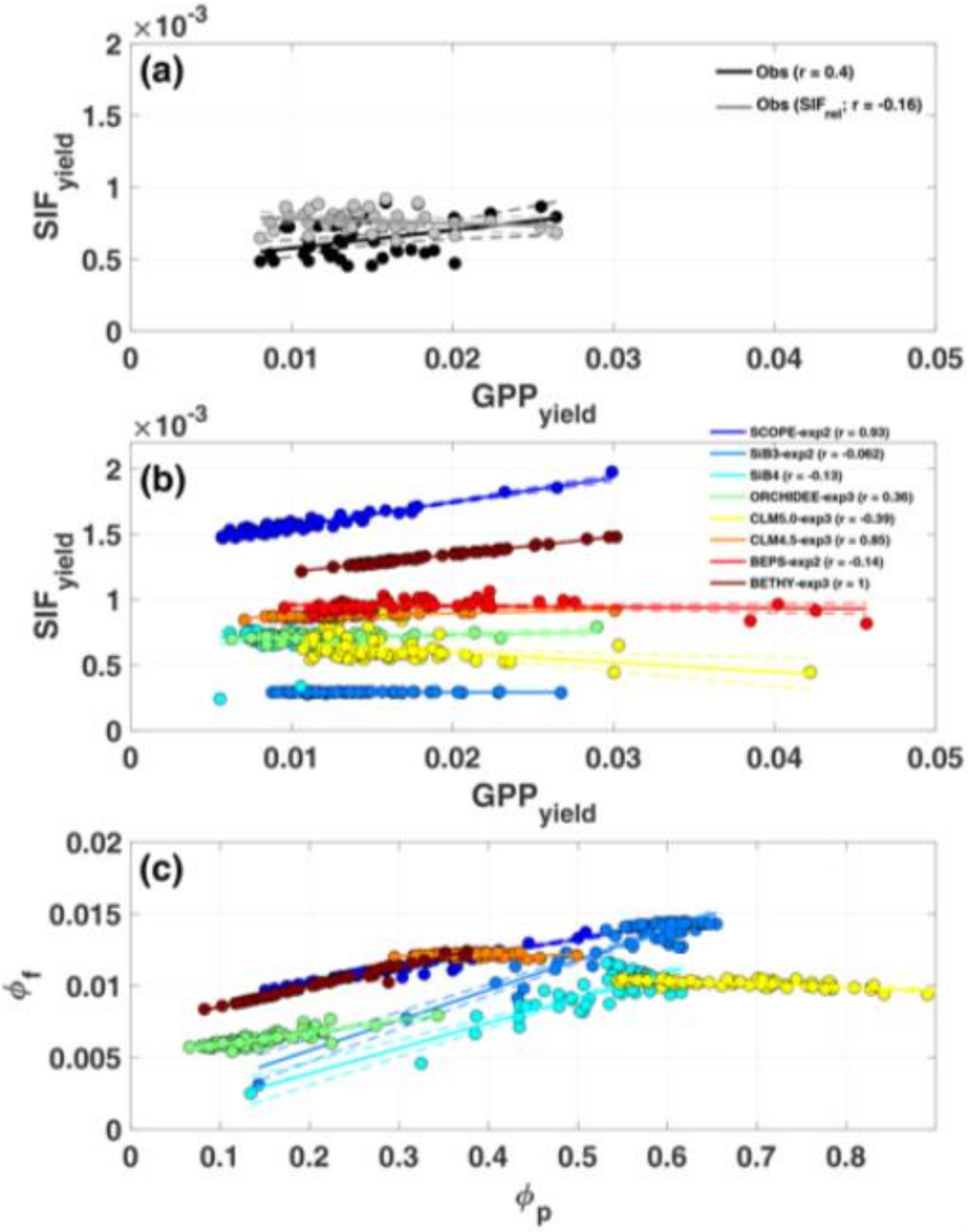


GGF
0.7
0.6
0.5
0.4
0.3
0.2
0.1
CTRL
IRR60%
IRR30%
TOP View
SIDE View
0
2
3
8
9
10
14
16
21
Days after drought Imposition

I think this paper is really related to our rooftop drought experiment. They measure the leaf angle and physiological term. I think this paper must be cited if we publish the drought experiment paper.

4th July

Parazoo, N. C., Magney, T., Norton, A., Raczka, B., Bacour, C., Maignan, F., ... & MacBean, N. (2020). Wide discrepancies in the magnitude and direction of modeled solar-induced chlorophyll fluorescence in response to light conditions. *Biogeosciences*, *17*(13), 3733-3755.



I think this paper is really interesting and well demonstrate the research gap in SIF field. They found that these models (SIF-GPP) are generally well constrained in simulating photosynthetic yield but show strongly divergent patterns in the simulation of absorbed photosynthetic active radiation (PAR), absolute GPP and fluorescence, quantum yields, and light response at the leaf and canopy scales. This study highlights the need for mechanistic modeling of nonphotochemical quenching in stressed and unstressed environments and improved the representation of light absorption (APAR), distribution of light across sunlit and shaded leaves, and radiative transfer from the leaf to the canopy scale.

3rd July

Zhou, H., Wu, D., & Lin, Y. (2020). The relationship between solar-induced fluorescence and gross primary productivity under different growth conditions: global analysis using satellite and biogeochemical model data. *International Journal of Remote Sensing*, *41*(19), 7660-7679.

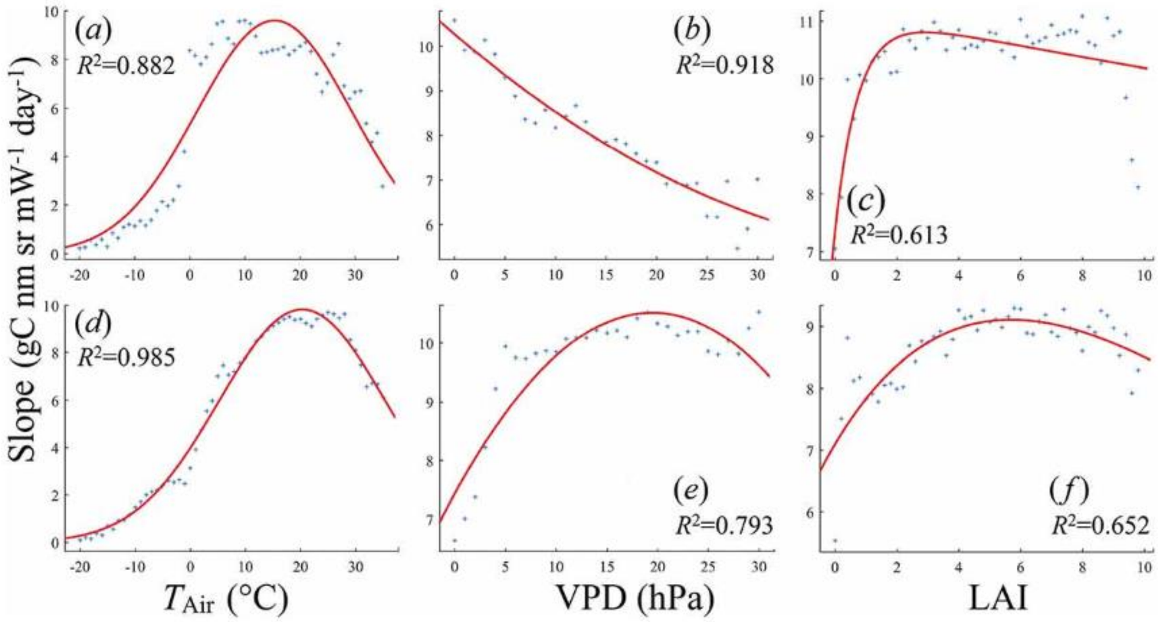


Figure 8. Relationship between SIF and GPP for forest (*a, b, c*) and non-forest (*d, e, f*) plants under different T_{Air}, VPD and LAI conditions.

I think this paper could be related to non-linear GPP-SIF relationship. They presented SIF-GPP slope could be changed at different Tair, VPD, LAI.

2nd July

Gitelson, A. (2020). Towards a generic approach to remote non-invasive estimation of foliar carotenoid-to-chlorophyll ratio. *Journal of Plant Physiology*, 153227.

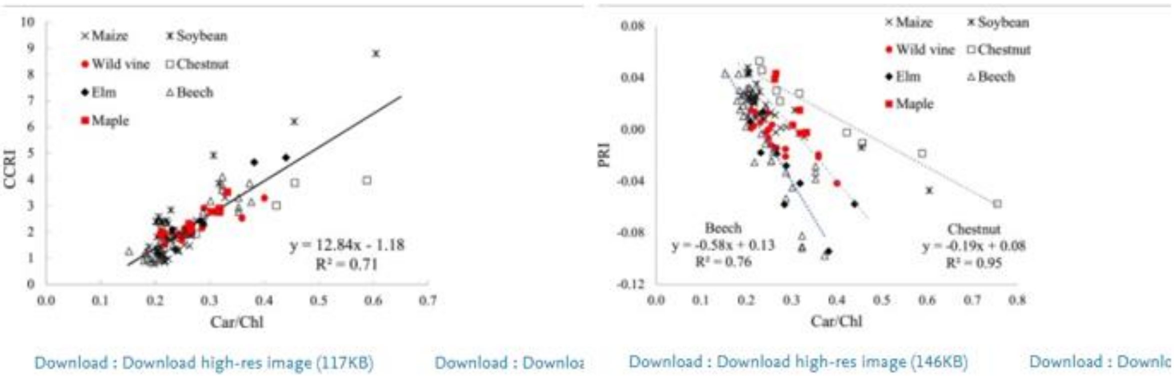


Fig. 3. Relationships between CCRI and Car/Chl for seven species. Fig. 4. Relationships between Car/Chl and PRI for seven species.

I think this paper is quite interesting because PRI showed a different slope over the species compared to CCRI. CCRI is a ratio of the carotenoid index CARI = $[(\rho_{720}/\rho_{521}) - 1]$ and the red edge chlorophyll index $CI_{red\text{-}edge} = (\rho_{780-800}/\rho_{700}) - 1$. They presented that The findings of a close relationship between leaf absorption coefficients, retrieved from reflectance, and Car/Chl present the first step towards accurate generic quantification of pigment composition and hence the progression of developmental stages, impact of stresses, and potential photosynthetic activity. In addition, they checked the CCI and CCI also showed similar pattern with PRI to estimate Car/Chl.

1st July

Helm, L. T., Shi, H., Lerdau, M. T., & Yang, X. (2020). Solar-induced chlorophyll fluorescence and short-term photosynthetic response to drought. *Ecological Applications*.

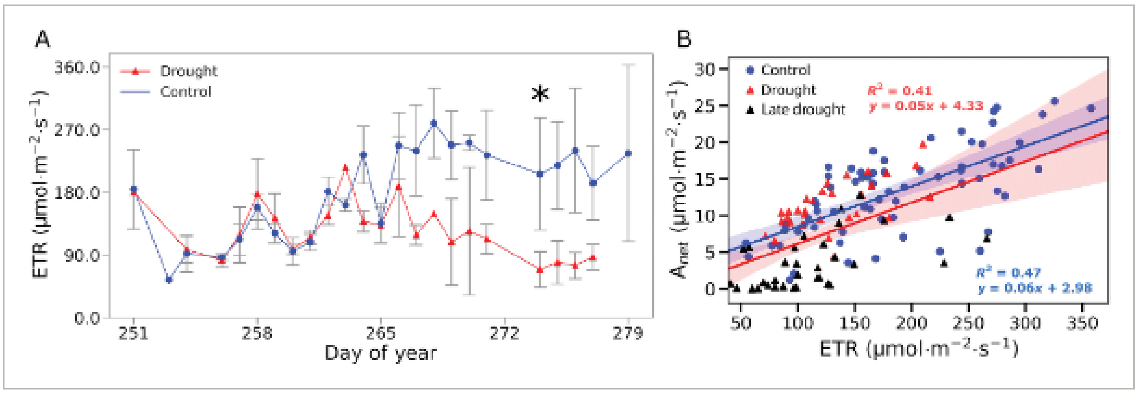


Fig. 4

Open in figure viewer | PowerPoint

(A) Average electron transport rate (ETR) for each treatment during the drought. The drought plants show decreases in electron transport rate during the drought. Error bars represent standard deviations. (B) Net photosynthesis and electron transport rate were found to have a strong relationship. The relationship is the same for both the control plants and the drought plants before the drought. The black triangles represent points not included in the regression analysis, they indicate values for the last 15 d of the drought when A_{net} and stomatal conductance were both close to zero. Shaded areas represent 95% confidence intervals. Asterisks indicate statistically significant differences ($P \leq 0.05$) between drought and control treatments during first and/or last 10 d of experiment (*t* test, $\alpha = 0.05$; for the beginning of experiment, $n_{drought} = 19$, $n_{control} = 20$; for the end of the experiment, $n_{drought} = 18$, $n_{control} = 23$).

They found clear responses of net photosynthesis and stomatal conductance to water stress, however, SIF showed a smaller response to drought. Net photosynthesis (A_{net}) and conductance dropped 94% and 95% on average over the drought, while SIF values only decreased slightly (21%). Electron transport rate dropped 64% when compared to the control over the last week of drought, but the electron transport chain did not completely shut down as A_{net} approached zero. Additionally, SIF yield (SIF_y) was positively correlated with steady-state fluorescence (F_s) and negatively correlated with non-photochemical quenching (NPQ; $R^2 = 0.77$). Both F_s and SIF_y, after normalization by the minimum fluorescence from a dark-adapted sample (F_o), showed a more pronounced drought response, although the results suggest the response is complicated by several factors. Leaf-level experiments can elucidate mechanisms behind large-scale remote sensing observations of ecosystem functioning. The value of SIF as an accurate estimator of photosynthesis may decrease during mild stress events of short duration, especially when the response is primarily stomatal and not fully coupled with the light reactions of photosynthesis. I am curious about the variation of canopy structure in this experiment.

4th June

Marrs, J. K., Reblin, J. S., Logan, B. A., Allen, D. W., Reinmann, A. B., Bombard, D. M., et al.. (2020). Solar-induced fluorescence does not track photosynthetic carbon assimilation following induced stomatal closure. *Geophysical Research Letters*, 47, e2020GL087956.

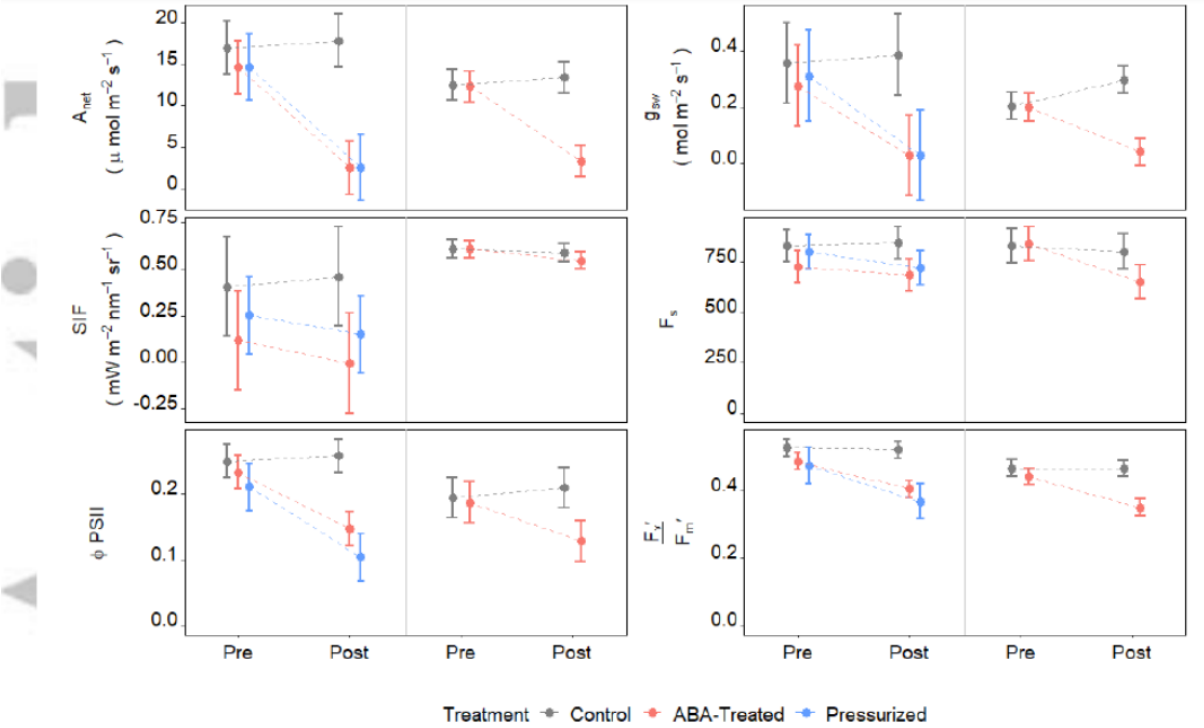


Figure 2. Trends in SIF, gas exchange, and PAM fluorescence parameters. Error bars represent 95 % confidence intervals determined from LME models. Points are means from pre-treament ("Pre") and post-treatment ("Post") days. Parameters include net carbon assimilation (A_{net}), stomatal conductance to water (g_{sw}), SIF, steady-state PAM fluorescence (F_s), light-use efficiency of Photosystem II (ΦPSII), and Photosystem II quantum yield under illumination (F_v'/F_m').

They highlighted that 1) Leaf-level chlorophyll fluorescence does not exhibit a significant relationship with photosynthesis after inducing stomatal closure. 2) Remote fluorescence data provide insight into the light reactions of photosynthesis but do not directly track carbon assimilation. 3) The link between fluorescence and primary productivity may result from shared drivers, such as chlorophyll content or energy partitioning. My question is that canopy-level SIF will show the same result? because In the case of the canopy-level SIF, the structure term is also included. I think the canopy structure also will be changed.

3rd June

Wang, X., Chen, J. M., & Ju, W. (2020). Photochemical reflectance index (PRI) can be used to improve the relationship between gross primary productivity (GPP) and sun-induced chlorophyll fluorescence (SIF). *Remote Sensing of Environment*, *246*, 111888.

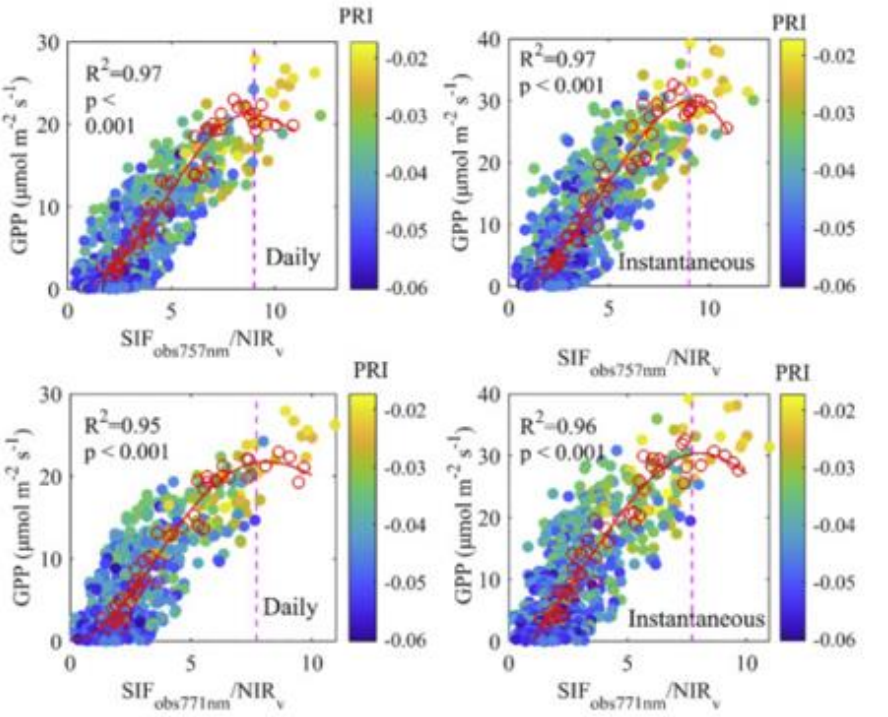


Fig. 11. The relationship between GPP and SIF_{obs}/NIR_v is mediated by PRI (inversely related to NPQ) at both daily and instantaneous scales. The dots from blue to yellow colors represent increasing PRI, while the red circles show the average GPP at different PRI values in increments of 0.001. The red line is the polynomial curve fitted to the red circles, showing that GPP peaked at PRI of about −0.021 to −0.019. (a) and (c) show SIF_{obs}/NIR_v and GPP at the daily scale, while (b) and (d) show SIF_{obs}/NIR_v and GPP at the instantaneous scale. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Time	Variable	Equation	R^2	*RMSE* (μmol m^{-2} s
Daily	$SIF_{obs757nm}/NIR_v$	$GPP = 1.8913 \times SIF_{obs757nm}/NIR_v + 179.597 \times PRI + 8.0278$	0.73	3.04
	$SIF_{obs771nm}/NIR_v$	$GPP = 2.0498 \times SIF_{obs757nm}/NIR_v + 206.331 \times PRI + 10.254$	0.72	3.12
Instantaneous	$SIF_{obs757nm}/NIR_v$	$GPP = 2.6894 \times SIF_{obs757nm}/NIR_v + 276.299 \times PRI + 12.682$	0.71	4.01
	$SIF_{obs771nm}/NIR_v$	$GPP = 2.6829 \times SIF_{obs771nm}/NIR_v + 329.379 \times PRI + 16.283$	0.70	4.09

Note: Sample of number: 371.

In this paper, the authors highlight that 1) GPP from 61 tower flux sites is well correlated with coincident SIF from OCO-2. 2) This correlation is significantly improved when SIF is corrected with NIR_v. 3) The correlation is further improved using PRI as an indicator of NPQ. 4) The slope of SIF against GPP varies much less among cover types when PRI is used.

I am not sure this paper is correct or not. 1) In the case of SIF/NIRv - GPP relationship, SIF/NIRv did not include the PAR term. But, GPP include PAR. I think it is quite hard to understand this comparison. 2) they said that the combination of PRI and SIF/NIRv showed higher correlation to GPP. BUT, IF I check the equation they showed that the PRI has a higher impact. I am not sure that SIF could be necessary to estimate GPP in this equation.

2nd June

Merrick, T., Jorge, M. L. S., Silva, T. S., Pau, S., Rausch, J., Broadbent, E. N., & Bennartz, R. (2020). Characterization of chlorophyll fluorescence, absorbed photosynthetically active radiation, and reflectance-based vegetation index spectroradiometer measurements. *International Journal of Remote Sensing*, *41*(17), 1-28.

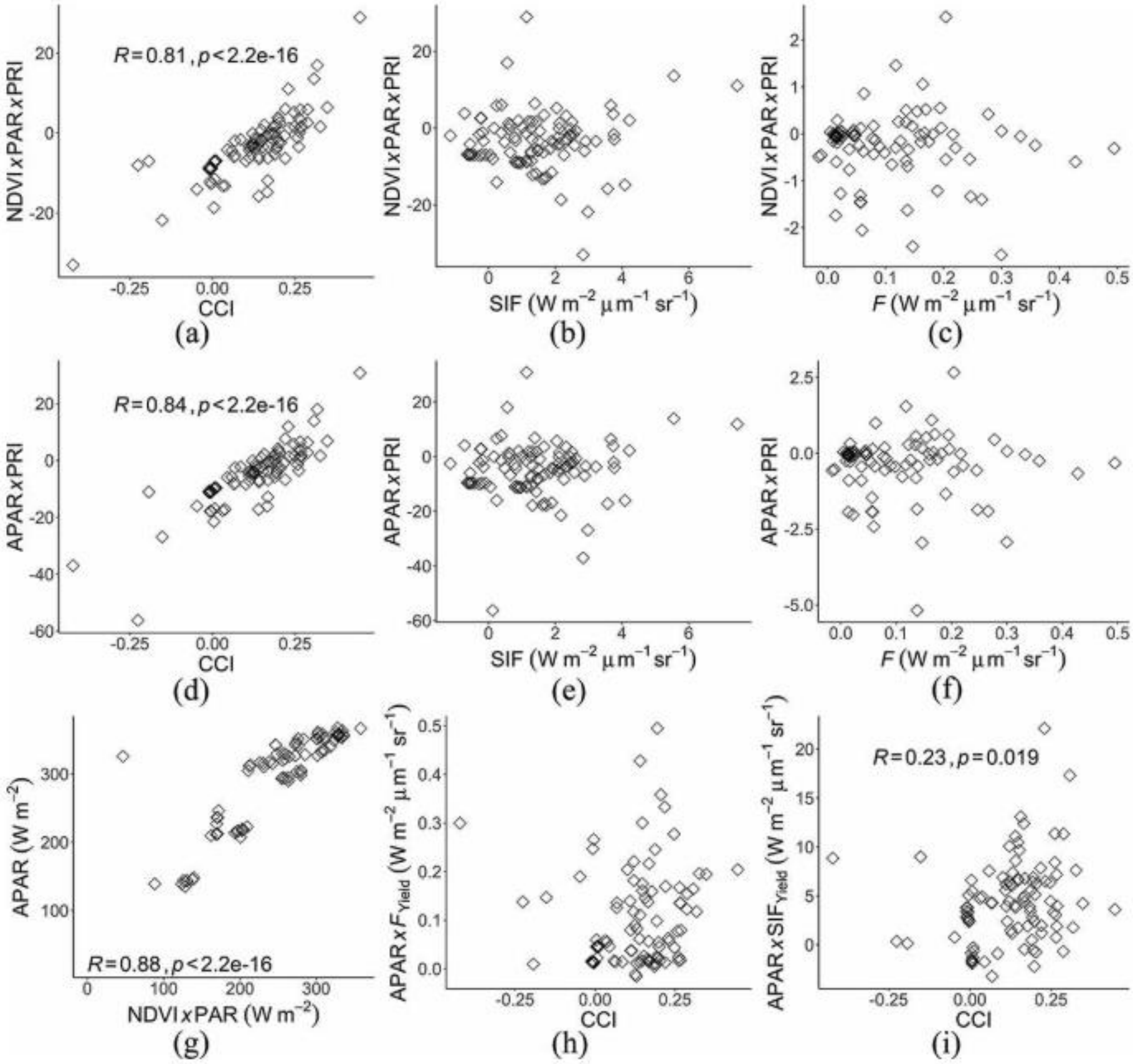


Figure 12. Comparisons of RI, CF, and APAR measurements according to the RI model CCI = NDVI×PAR×PRI. (*a*) NDVI×PAR×PRI vs CCI (*b*) NDVI×PAR×PRI vs SIF (*c*) NDVI×PAR×PRI vs *F* (*d*) APAR×PRI vs CCI (*e*) APAR×PRI vs SIF (*f*) APAR×PRI vs *F* (*g*) APAR vs NDVI×PAR (*h*) APAR× F_{Yield} vs CCI (*i*) APAR×SIF_{Yield} vs CCI.

In this paper introduction, They showed that following Springer, Wang, and Gamon (2017), Equation (5) can be written in terms of the RIs typically used as model parameters as follows: CCI=(NDVI)×(PAR)×(PRI). But I am not sure this equation is correct because the CCI is chlorophyll index which is just pigment index which does not include the sky condition. They said that there is potential to relate both CCI and SIF to GPP. Studies show SIF is related to GPP because it is sensitive to APAR and LUE and this relationship depends on the vegetation observed (e.g. Wagle et al. 2016; Cui, Sun, and Qiao 2017; Verma et al. 2017; Li et al. 2018). CCI has been shown to track seasonal photosynthetic activity in deciduous and evergreen species along with SIF due to its sensitivity to APAR, LUE, and photosynthetic downregulation (Springer, Wang, and Gamon 2017; Porcar-Castell et al. 2014; Atherton, Nichol, and Porcar-Castell 2016). Together NDVI and PRI have been utilized to estimate FPAR and LUE, respectively (Garbulsky et al. 2011; Gamon et al. 2001). But I am not sure this is true or not.

1st June

Chen, J., Liu, X., Du, S., Ma, Y., & Liu, L. (2020). Integrating SIF and Clearness Index to Improve Maize GPP Estimation Using Continuous Tower-Based Observations. *Sensors*, *20*(9), 2493.

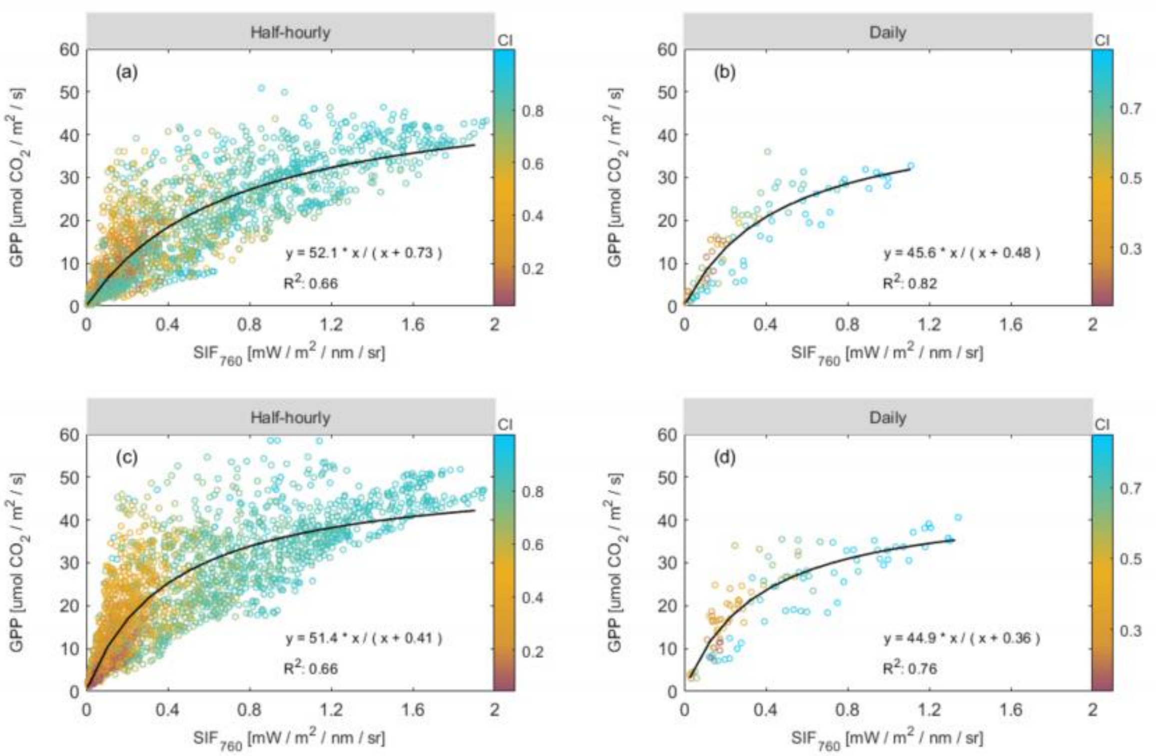


Figure 6. Relationships between canopy GPP and SIF based on half-hourly (**a**,**c**) and daily (**b**,**d**) mean data observed over the whole growing season in the DM maize field in 2017 (**a**,**b**) and 2018 (**c**,**d**). The color scale represents the value of the clearness index (CI). Hyperbolic regression lines are shown in black and the coefficient of determination (R^2) for each best-fitting line is given.

This paper also showed that non-linear relationship between SIF and GPP. 1) they showed that the SIF_{760} tracked GPP well at both diurnal and seasonal scales and that SIF_{760} was more linearly correlated to PAR than GPP was. Therefore, the SIF_{760}–GPP relationship was clearly a hyperbolic relationship. For instantaneous observations made within a period of half an hour, the R^2 value was 0.66 in 2017 and 2018. Based on daily mean observations, the R^2 value was 0.82 and 0.76 in 2017 and 2018, respectively. 2) the SIF_{760}–GPP relationship varied with the environmental conditions, with the Clearness Index (CI) being the dominant factor. At both diurnal and seasonal scales, the ratio of GPP to SIF_{760} decreased noticeably as the CI increased. I think they should explain why and they should separate the fesc and SIF yield.

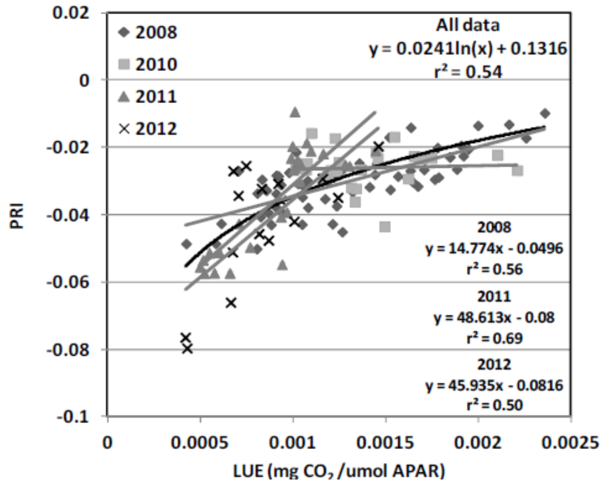
4th May

Cheng, Y. B., Middleton, E. M., Zhang, Q., Huemmrich, K. F., Campbell, P. K., Cook, B. D., ... & Daughtry, C. S. (2013). Integrating solar induced fluorescence and the photochemical reflectance index for estimating gross primary production in a cornfield. *Remote Sensing*, *5*(12), 6857-6879.

Table 3. Summary of statistics (r^2 and RMSE) of LUE models examined in this study. Note: the highest performing model in each group is shown in bold type.

Output Variable	Predictor Variable	r^2	RMSE (mg CO_2/µmol PAR)
LUE	**PRI**	**0.45 (0.54 Logarithm Fit)**	**0.000324 (0.000322 Logarithm Fit)**
	SIF (red)	0.12	0.000409
	SIF (far-red)	0.01	0.000435
	SIF (red) yield	0.29	0.000368
	SIF (far-red) yield	0.06	0.000424
	PRI, SIF (red)	0.55	0.000297
	PRI, SIF (far-red)	0.48	0.000317
	PRI, SIF (red) yield	**0.61**	**0.000275**
	PRI, SIF (far-red) yield	0.53	0.000301

Figure 4. Relationship between canopy PRI and flux tower-based LUE for 2008 (◆), 2010 (■), 2011 (▲), 2012(✕) in the USDA BARC cornfield.



I think this paper already showed that the combination of PRI and SIF could improve the relationship with GPP. In this paper, by combining the PRI and SIF in a linear regression model, stronger performances for GPP estimation were obtained. The strongest relationship (r2 = 0.80, RMSE = 0.186 mg CO2/m2/s) was achieved when using the PRI and SIF retrievals at 688 nm. Cross-validation approaches were utilized to demonstrate the robustness and consistency of the performance.

3rd May

Wang, X., Chen, J. M., & Ju, W. (2020). Photochemical reflectance index (PRI) can be used to improve the relationship between gross primary

productivity (GPP) and sun-induced chlorophyll fluorescence (SIF). *Remote Sensing of Environment*, *246*, 111888.

This paper highlighted that the product of NIR reflectance (R_{NIR}) and the normalized difference vegetation index (NDVI), (i.e. NIR_v) can be used to correct the influences of canopy structure and SIF observation angle on GPP estimation using SIF. The relationship between GPP and observed SIF corrected by NIR_v (i.e., SIF_{obs}/NIR_v) outperformed that between GPP and SIF_{obs}, with R^2 improved from 0.53 to 0.67 and RMSE reduced from 4.28 to 3.89 μmol m^{-2} s^{-1} for the case of SIF at 757 nm against daily GPP. The reason for this improvement is that NIR_v quantifies the escaping probability of SIF from the canopy. The conversion of SIF observed at one angle (SIF_{obs}) to the total SIF emission (SIF_{obs}/NIR_v) from the canopy improved the estimation of GPP.

The relationship between GPP and SIF_{obs}/NIR_v is further improved using PRI to quantify the additional excitation energy dissipation pathway in parallel with SIF, and the R^2 is further increased to 0.73 and RMSE is further reduced to 3.04 μmol m^{-2} s^{-1}. These results suggest that PRI from optical remote sensing data, such as MODIS data, can be used in conjunction with SIF measurements to improve regional and global GPP estimation.

The variability in the slope of GPP against SIF among plant functional types (PFTs) is greatly reduced from 33% to 19% when PRI is used. Our results suggest that the differences are mostly caused by different strengths of NPQ as quantified using PRI in different PFTs. With the consideration of NPQ as an additional energy pathway, we have narrowed the range of the sensitivity of GPP to SIF, allowing us to approach its inherent sensitivity that would greatly help the use of satellite observed SIF for global GPP estimation.

2nd May

Cheng, R., Magney, T. S., Dutta, D., Bowling, D. R., Logan, B. A., Burns, S. P., Blanken, P. D., Grossmann, K., Lopez, S., Richardson, A. D., Stutz, J., and Frankenberg, C.: Decomposing reflectance spectra to track gross primary production in a subalpine evergreen forest, Biogeosciences Discuss., https://doi.org/10.5194/bg-2020-41, in review, 2020.

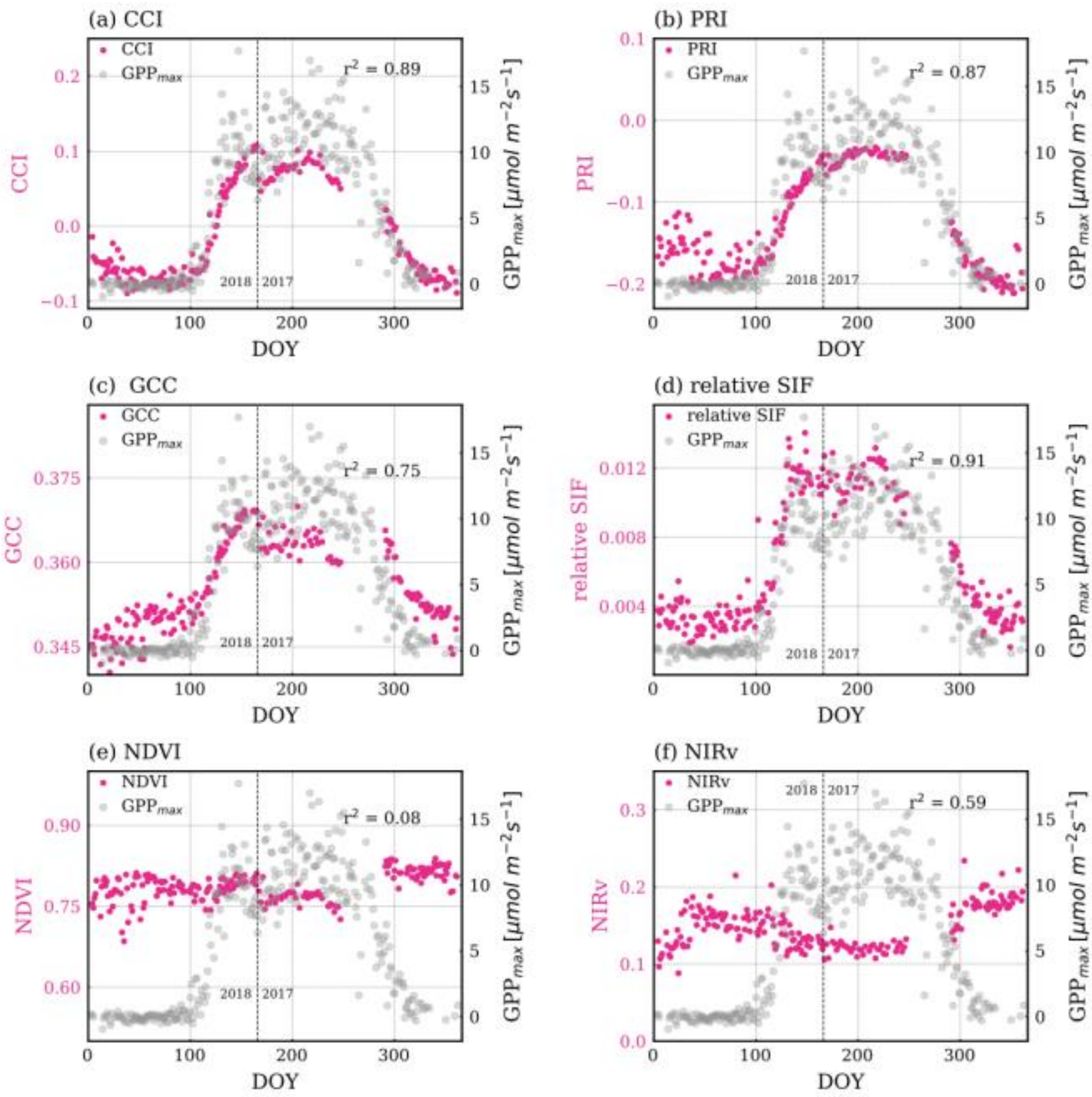


Figure 5. Magenta points are time series of VIs: (a) CCI, (b) PRI, (c) GCC, (d) relative SIF (e) NDVI (f) NIRv.The grey points in the background show GPP_{max}. The Pearson-r^2 values of regressing VIs and GPP_{max} are noted in each plot. The p values of all correlations in this figure are less than 0.005. The vertical dashed line divides the observations from DOY for year 2017 and 2018.

From this paper, I could learn many things, especially the introduction. The interesting point is that they found that SIF could track the GPP very well. In addition, the CCI also showed good performance to estimate GPP in ENF. But, I am wondering that the CCI is related to pigment changes thus it could not track GPP well in different sky condition.

1st May

Wang, R., Gamon, J. A., Emmerton, C. A., Springer, K. R., Yu, R., & Hmimina, G. (2020). Detecting intra-and inter-annual variability in

gross primary productivity of a North American grassland using MODIS MAIAC data. ***Agricultural and Forest Meteorology*, *281*, 107859.**

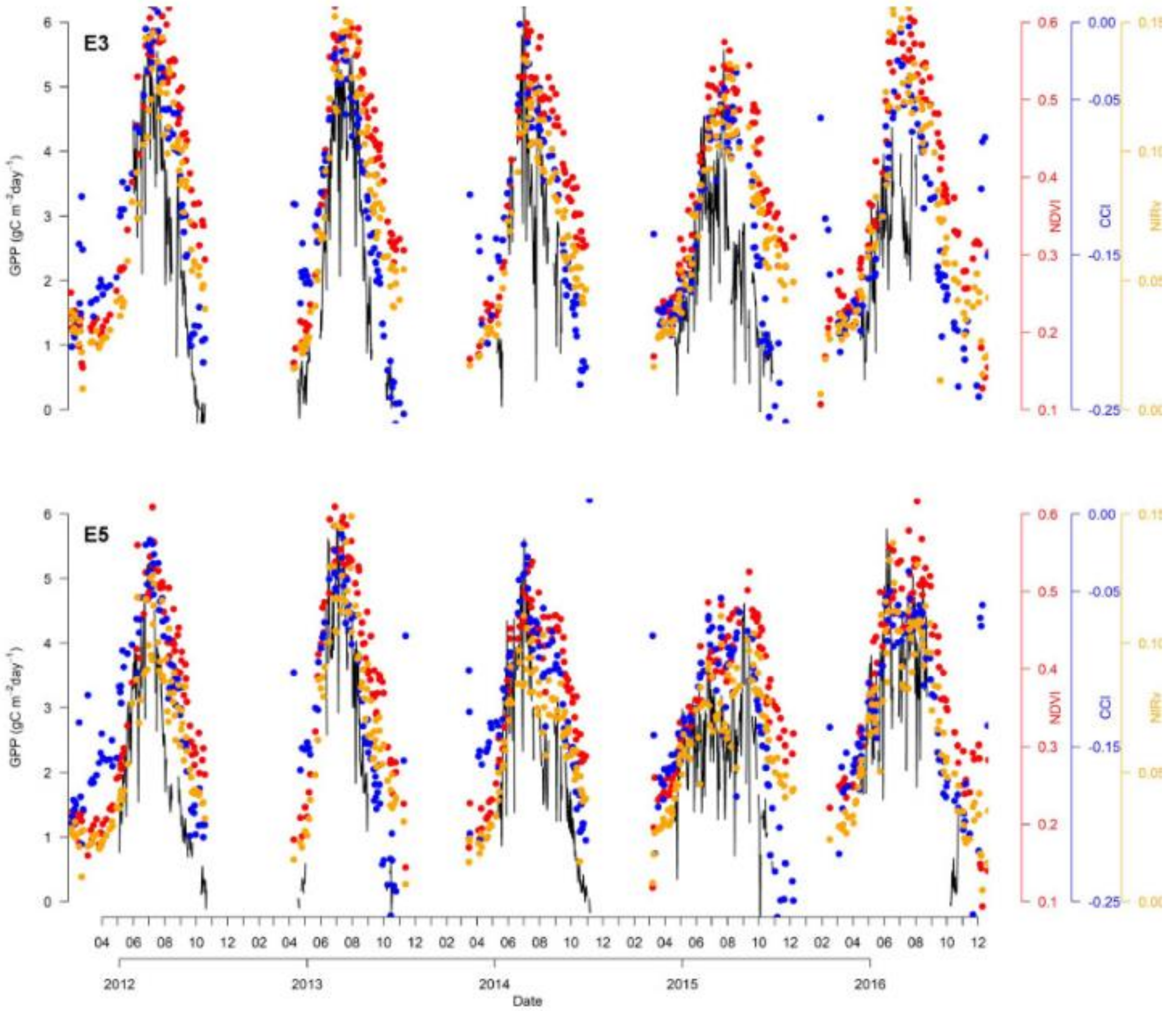


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Fig. 3. Seasonal patterns of daily GPP (black lines), MAIAC daily NDVI (red), CCI (blue), and NIRv (orange) at sites E3 and E5. Gaps in flux measurements were also shown. The numbers above years on the X-axis are months within each year. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

I think this paper also related to Gamon's PNAS and Middleton's 2016 paper. They showed that the CCI also could track well in grassland. I hope we could share the data also.

4th April

Middleton, E. M., Huemmrich, K. F., Landis, D. R., Black, T. A., Barr, A. G., & McCaughey, J. H. (2016). Photosynthetic efficiency of northern forest ecosystems using a MODIS-derived Photochemical Reflectance Index (PRI). ***Remote Sensing of Environment*, *187*, 345-366.**

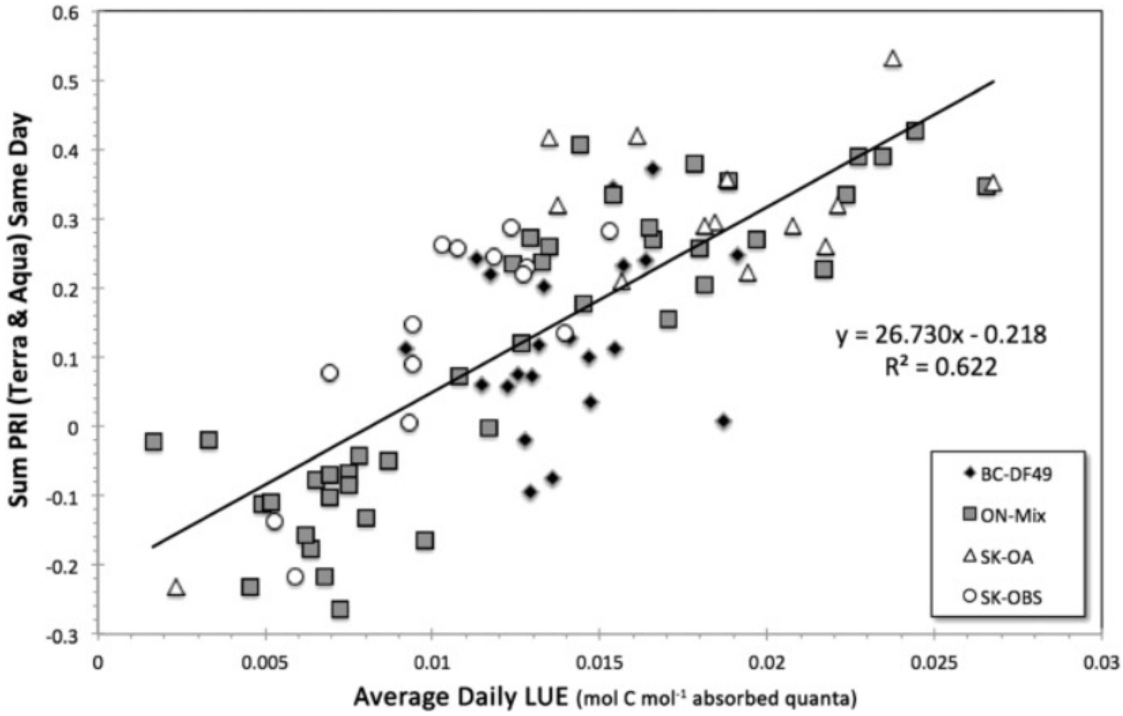

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Fig. 9. The daily sum for PRI(1,11) computed from Terra + Aqua across the four study sites (n = 92). The daily average LUE was computed as the average of the two flux tower LUE values determined at the overpass times: $r^2 = 0.622$; RMSE = 0.013; F-ratio, LUE = 147.91; $p < 0.000$). y = 26.73 * LUE - 0.2176. Influences from Site or View group combinations were not significant factors, but identifying the sites reduced the overall unexplained variation by 6% ($r^2 = 0.679$; F-ratio, LUE = 46.53).

I think this paper is really interesting and quite new method to estimate PRI using MODIS data. I guess this paper is really related to Gamon's PNAS paper but in this paper the author used multiple bands to check the relationship between MODIS-based PRI and ground-based GPP. I hope they will provide global PRI data.

3rd April

Chang, C. Y., Guanter, L., Frankenberg, C., Köhler, P., Gu, L., Magney, T. S., et al (2020). Systematic assessment of retrieval methods for canopy far-red solar-induced chlorophyll fluorescence (SIF) using high-frequency automated field spectroscopy. ***Journal of Geophysical***

Research: Biogeosciences, 125, e2019JG005533. https://doi.org/10.1029/2019JG005533

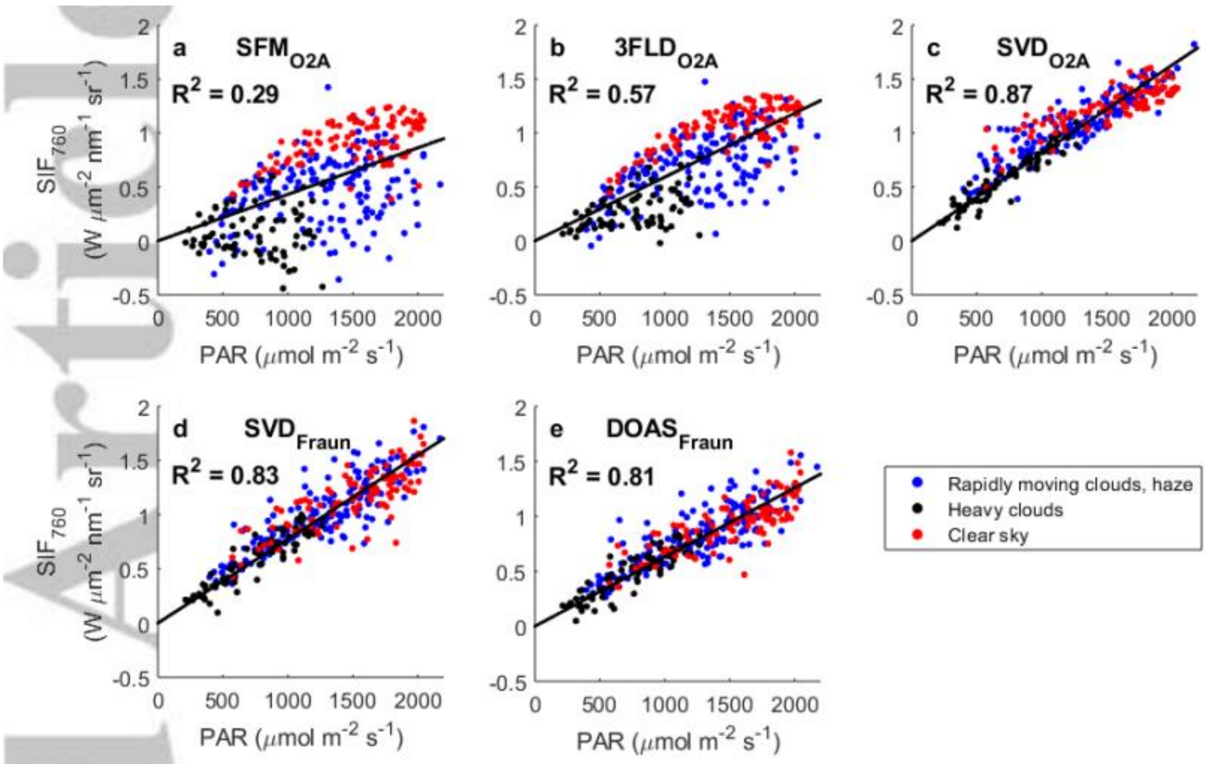


Figure 1. The relationship between PAR and SIF$_{760}$ under different sky conditions recorded from a bi-hemispherical system using fitting windows commonly used in published literature. SIF is retrieved using (a) SFM$_{O2A}$ with fitting window 759-767.76 nm; (b) 3FLD$_{O2A}$; (c) SVD$_{O2A}$ with fitting window 759-767.76 nm, trained using all *E* spectra measured during each day; (d) SVD$_{Fraun}$, trained using all *E* spectra measured during each day; (e) DOAS$_{Fraun}$. Measurements, recorded during peak growing season (DOY 200-230), are

I think this paper is really nice about SIF retrieval method. The highlights are :
1) Fraunhofer-based DOAS and SVD retrievals show a strong SIF-PAR relationship and consistent diurnal patterns across different sky conditions.
2) In contrast, O2A-based SFM and 3FLD result in divergent SIF-PAR dependence under different sky conditions, including under clear skies, and can only achieve consistent diurnal shapes with Fraunhofer-based methods under clear skies with stable illumination.
3) The robustness of O2A-based retrievals under cloudy conditions can be improved by using a narrow, e.g. 759.5-761.5 nm fitting window to avoid atmospheric-induced artifacts and, for SVD, training with a temporally constrained set of spectra.
3) In contrast to O2A-based retrievals, Fraunhofer-based retrievals are insensitive to atmospheric impacts, but are more sensitive to changes in hF due to the closer proximity of Fraunhofer region to the red-edge which is affected by chlorophyll reabsorption.
4) Fraunhofer-based retrievals generate more retrieval noise than O2A-based retrievals, but this noise can be minimized by measurement aggregation and, for SVD, training with a temporally constrained set of spectra.
5) These findings are applicable for both bi-hemispherical and hemispherical-conical

systems, although hemispherical-conical systems are less affected by atmospheric scattering.

2nd April

Baldocchi, D. D., Ryu, Y., Dechant, B., Eichelmann, E., Hemes, K., Ma, S., et al (2020). Outgoing Near Infrared Radiation from Vegetation Scales with Canopy Photosynthesis Across a Spectrum of Function, Structure, Physiological Capacity and Weather. *Journal of Geophysical Research: Biogeosciences*, 125, e2019JG005534. [**https://doi.org/10.1029/2019JG005534**](https://doi.org/10.1029/2019JG005534)

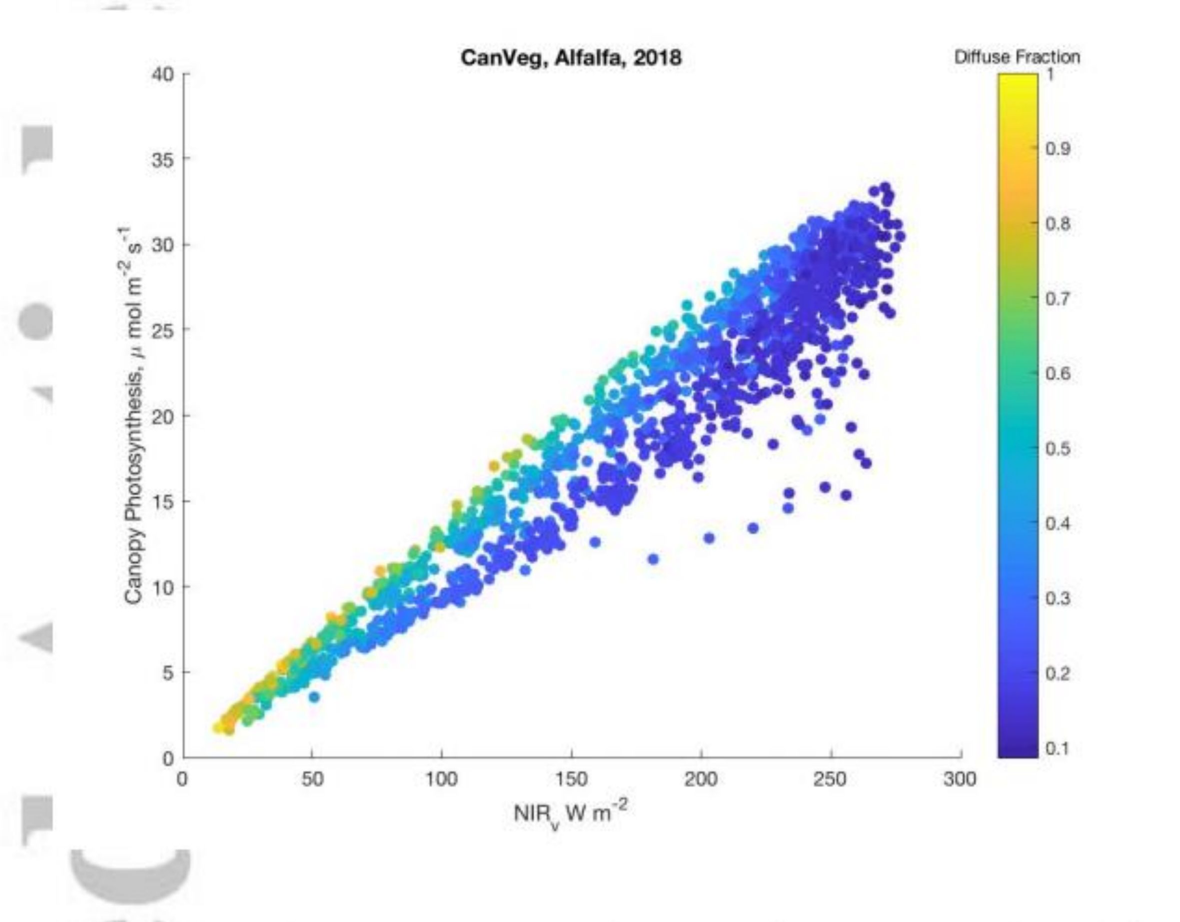


Figure 15 Computations of canopy photosynthesis and near infrared radiation reflected by vegetation, as a function of diffuse light fraction. Computations were confined to periods with low vapor pressure deficits. Computations were based on half-hour meteorological data from between day 195 and 258 in 2018 when smoke from fires in northern California veiled the ecosystems.

In this paper, they showed the relationship between GPP and NIRv in multiple-vegetation types and location. The NIRv track well GPP in many sites even in cloudy and time series. I think the highlight is that NIRv does not saturate at high leaf area indices, it is insensitive to the presence of dead legacy vegetation, thus we could measure it using low-cost sensors.

1st April

Maguire, A. J., Eitel, J. U., Griffin, K. L., Magney, T. S., Long, R. A., Vierling, L. A., ... & Bruner, S. G. (2020). On the Functional Relationship Between Fluorescence and Photochemical Yields in Complex Evergreen Needleleaf Canopies. *Geophysical Research Letters*, e2020GL087858.

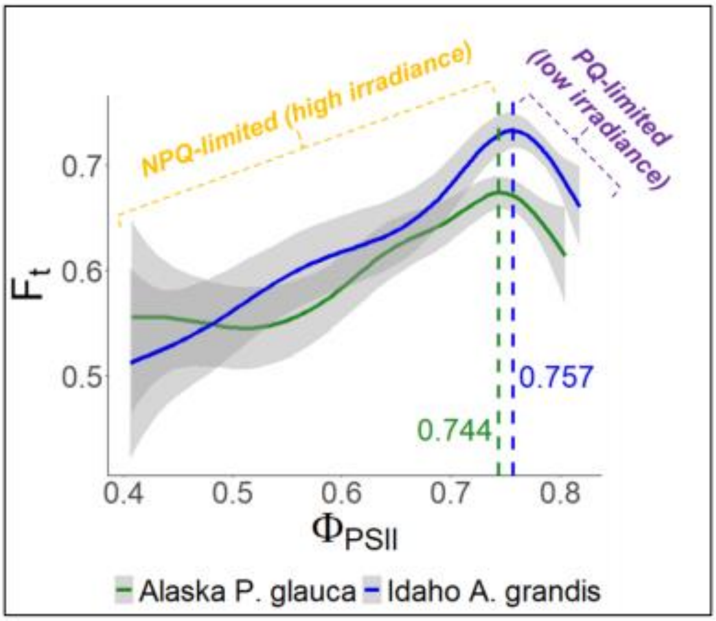
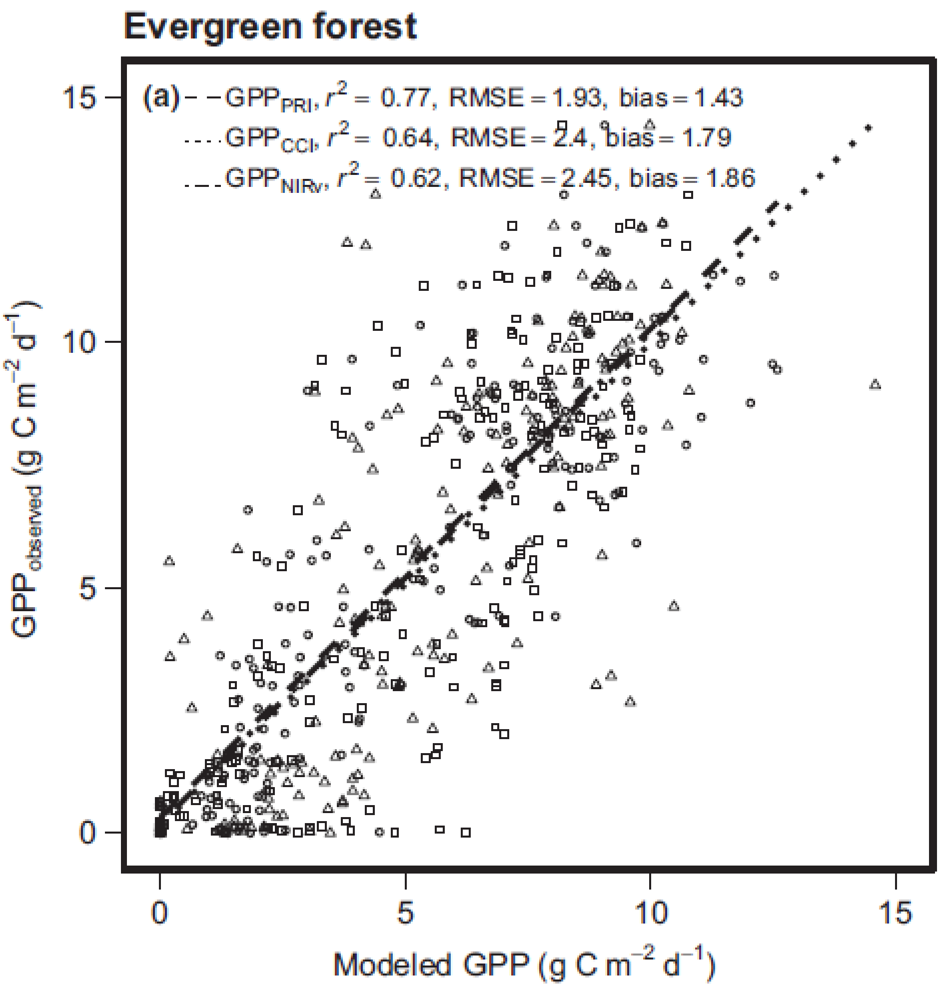


Figure 1. Generalized additive models (GAMs) fit to steady-state fluorescence yield (F_t) and photosystem II yield (Φ_{PSII}) for observations from Alaska *P. glauca* needles (green, *n* = 523) and Idaho *A. grandis* needles (blue, *n* = 417). 95% confidence intervals are show in gray. Breakpoints (dashed lines) were identified as the value of Φ_{PSII} at which the first derivative (i.e., slope) equaled zero and the slope switched from positive to negative. Observations of F_t were normalized to $F_{t,max}$ following Magney et al. (2017).

In this paper, they measured needleaf Fs using PAM system. They showed the Ft and Phis2 yield showed non-linear. But, I think this one is not that strongly interesting because we could see their relationship in Albert's previous paper.   But I think the number of samples is enough in this paper so I should cite it in the future.

4th March

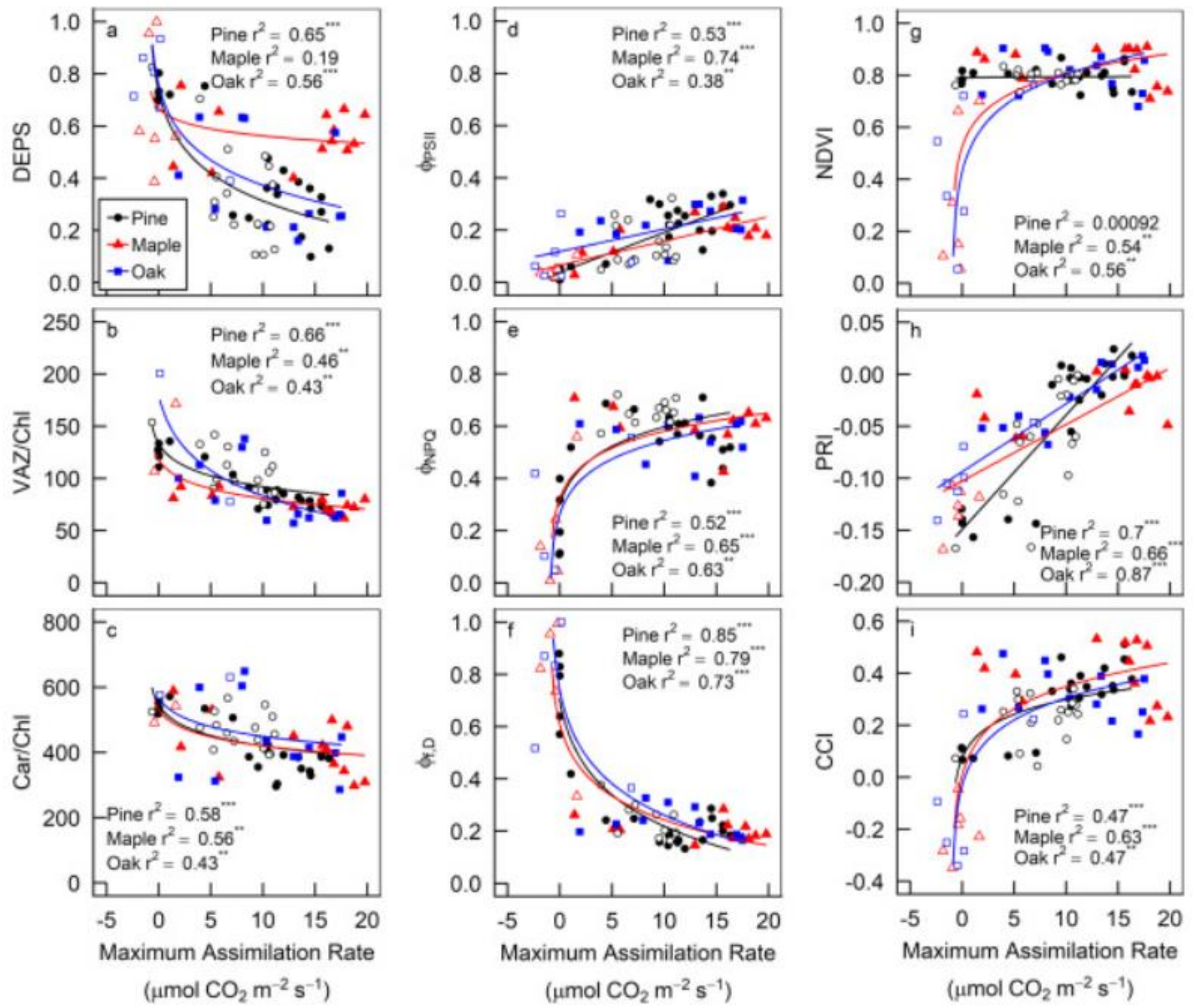
Wong, C. Y., D'Odorico, P., Arain, M. A., & Ensminger, I. (2020). Tracking the phenology of photosynthesis using carotenoid sensitive and near-infrared reflectance vegetation indices in a temperate evergreen and mixed deciduous forest. *New Phytologist*.



I think this paper is quite similar to his previous paper (2019 RSE), but they added NIRv and This paper was focus on the canopy-level measurement. They showed that PRI and CCI captured the large seasonal carotenoid/chlorophyll ratio changes and good relationships were observed between PRI–ε and CCI–photosynthesis and NIRV–photosynthesis. PRI-, CCI- and NIRV-based models effectively tracked observed seasonal GPP. They propose that carotenoid-based and near-infrared reflectance vegetation indices may provide useful proxies of photosynthetic activity and can improve remote sensing-based models of GPP in evergreen and deciduous forests. But I think they should check the slope changes over the seasons.

3rd March

Wong, C. Y., D'Odorico, P., Bhathena, Y., Arain, M. A., & Ensminger, I. (2019). Carotenoid based vegetation indices for accurate monitoring of the phenology of photosynthesis at the leaf-scale in deciduous and evergreen trees. *Remote Sensing of Environment*, *233*, 111407.



One of my favourite author published the paper. In this paper, they said "For pine, NDVI overestimated photosynthetic activity for most of the year and was hence not able to represent photosynthetic phenology, due to the fact that needle chlorophyll content shows only little variation over the course of the year. By contrast, using the photochemical reflectance index (PRI) and the chlorophyll/carotenoid index (CCI), which both detect variations in carotenoids, we were able to observe an improved representation of the seasonal variation of CO_2 assimilation and photosynthetic phenology for the two deciduous and the conifer species." In our data, SIF showed linear relationship with PRI and it might be PRI also could be non-linear relationship with GPP. But I have to check the data is come from leaf- or canopy level. In this paper, they measured leaf-level data.

2nd March

Benjamin Dechant, Youngryel Ryu, Grayson Badgley, Yelu Zeng, Joseph A. Berry, Yongguang Zhang, Yves Goulas, Zhaohui Li, Qian Zhang, Minseok Kang, Ji Li, Ismaël Moya, Canopy structure explains the relationship between photosynthesis and sun-induced chlorophyll

fluorescence in crops, Remote Sensing of Environment, Volume 241, 2020, 111733, ISSN 0034-4257, https://doi.org/10.1016/j.rse.2020.111733.

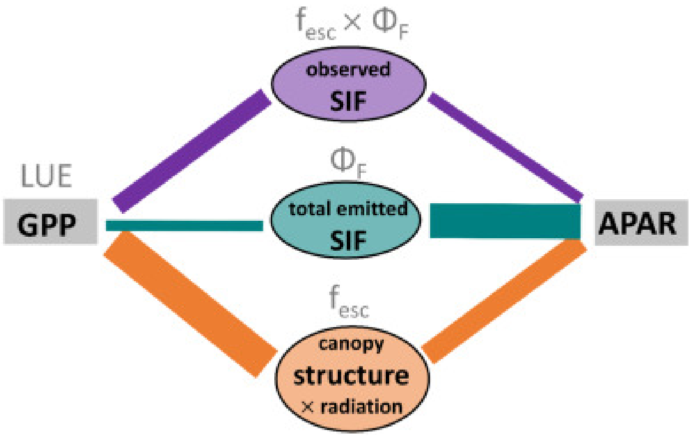


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Fig. 6. Schematic overview of the observed relationships between SIF-related terms and either absorbed photosynthetically active radiation (APAR) or gross primary productivity (GPP). The relationships of canopy-level observed SIF (SIF_{obs}) and its two components, total emitted SIF ($APAR \times \Phi_F = SIF_{obs}/f_{esc}$) and the canopy structure × radiation factor ($APAR \times f_{esc} = SIF_{obs}/\Phi_F$), are shown. In addition to these terms that all contain APAR as main driver, also the corresponding ratio terms that are normalized for APAR are indicated in grey color on top of the flux variables. LUE_P is the photosynthetic light use efficiency, LUE_F the apparent light use efficiency of SIF_{obs} ($LUE_F = SIF_{obs}/APAR$), f_{esc} is the escape fraction and Φ_F is the physiological SIF yield. The line widths between flux terms represent strength of linear correlations (not to scale) based on the results of half-hourly time series at the seasonal time scale and include aspects of seasonal slope stability. This figure links back to the conceptual definitions and illustration of Fig. 1.

This is KEY PAPER for my TNF manuscript!

1st March

Yudina, L., Sukhova, E., Gromova, E., Nerush, V., Vodeneev, V., & Sukhov, V. (2020). A light-induced decrease in the photochemical reflectance index (PRI) can be used to estimate the energy-dependent component of non-photochemical quenching under heat stress and soil drought in pea, wheat, and pumpkin. *Photosynthesis Research*, 1-13.

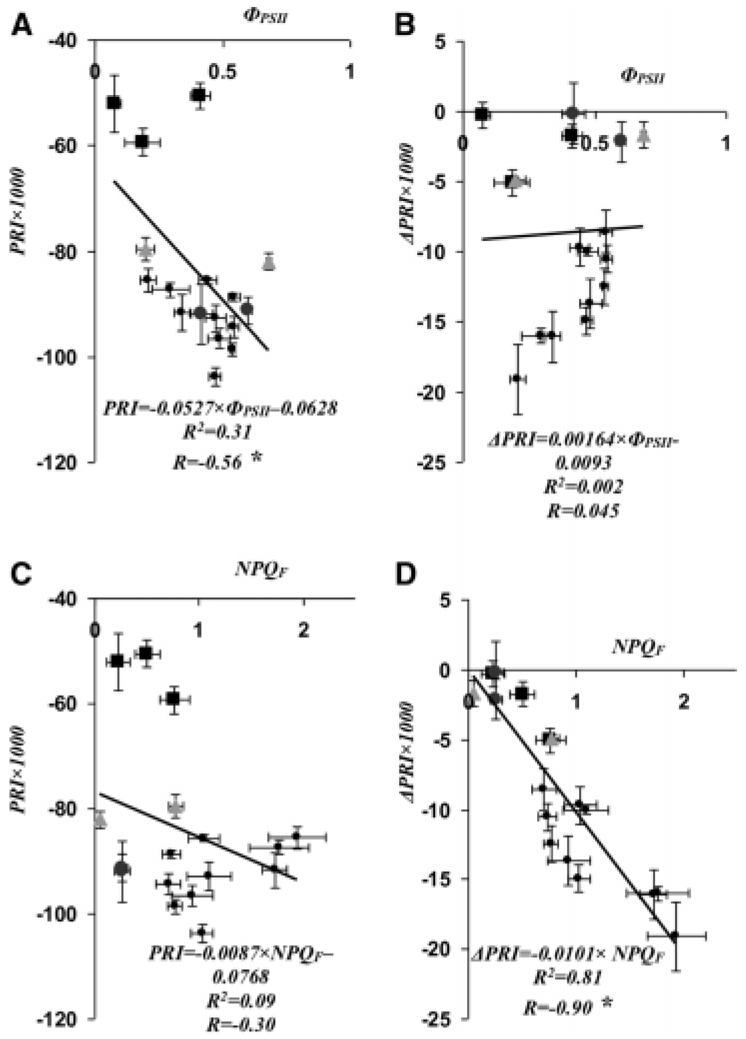

Fig. 8 Scatter plots between the average PRI and Φ_{PSII} (**a**), ΔPRI and Φ_{PSII} (**b**), PRI and NPQ_F (**c**), and ΔPRI and NPQ_F (**d**) in the investigated plants in the control, after heating, and during soil drought. The mean values and standard errors were taken from Fig. 2 (gray triangle, pea; the experiment with heating), Fig. 3 (filled square, wheat; the experiment with heating), Fig. 4 (filled circle, pumpkin; the experiment with heating), and Fig. 6 (filled small circle, pea; the experiment with soil drought). R^2 and R are the determination and correlation coefficients, respectively. *; the correlation coefficient was significant

I think this paper is quite interesting. They compared between PRI and quenching yield. "The decreased ΦPSII and increased ΔPRI were observed in wheat after heating, but significant changes in NPQF were absent; the significant decrease in ΦPSII was observed in pumpkin seedlings, while there were no significant changes in the other parameters. ΔPRI and NPQF after heating were significantly correlated. However, a significant correlation of the absolute values of PRI with photosynthetic parameters was absent. The soil drought increased NPQF and the magnitude of ΔPRI and decreased ΦPSII in peas. ΔPRI was strongly correlated with photosynthetic parameters, but this correlation was absent for the absolute value of PRI. Thus, ΔPRI is strongly connected with the magnitude of NPQF and can be used as an estimator of this parameter."

4th February

Bandopadhyay, S., Rastogi, A., & Juszczak, R. (2020). Review of Top-of-Canopy Sun-Induced Fluorescence (SIF) Studies from Ground, UAV, Airborne to Spaceborne Observations. *Sensors*, *20*(4), 1144.

Table 2. *Cont.*

Instrument/Measuring Systems	Responsible Agency	Description of the Instrument/Measuring System	Field-of-View (FOV)	SIF Bands/Spectral Range (nm)	FWHM (nm)	References
		Measuring Systems				
S-FLUO box	Jülich Research Center and JB Hyperspectral. Germany	This prototype was assembled with two HR4000s (HRNR and HRFR; Ocean Optics Inc., Dunedin, FL, USA) and designed for the high temporal frequency acquisition of continuous radiometric values. A commercial optical multiplexer (MPM-2000, Ocean Optics Inc., Dunedin, FL, USA) is provided to switch between the upwelling and downwelling channels.	25°	680–755	0.2	[24]
FLUORESCENCE BOX (FloX)	JB Hyperspectral Devices, Düsseldorf, Germany	A commercial system using a QE Pro spectrometer by Ocean Optics Inc., Dunedin, FL, USA for fluorescence measurement. The spectrometer is further boxed inside a thermally regulated field encloser that further improves the SNR. An in-built shutter is provided to switch between the upwelling and downwelling channels.	25°	648–808	0.31	[96]
PICCOLO-DOPPIO	University of Edinburgh, Scotland	The prototype system use the QE Pro spectrometer by Ocean Optics Inc., Dunedin, FL, USA. In the system, a double-bifurcated fiber optic is used to transfer light from the foreoptics to the spectrometers. The system uses another spectrometer, FLAME-T-VIS-NIR of Ocean Optics Inc., Dunedin, FL, USA (Spectral range 400–1000 nm) for the purpose of calculating vegetation indices.	25°	650–800	0.31	[99]
Multiplexer Radiometer Irradiometer (MRI)	Remote Sensing of Environmental Dynamics Lab., DISAT, University of Milan-Bicocca, Milan, Italy	MRI is a prototype consisting of two HR4000 (Ocean Optics Inc., Dunedin, FL, USA) spectrometers, namely $SPEC_{full}$ (400–1000 nm) and $SPEC_{fluo}$ (700–800 nm) with different resolutions. An optical multiplexer (MPM2000, Ocean Optics Inc., Dunedin, FL, USA) was used to switch between the spectrometers.	25°	760	0.1	[88]
FUSION	Goddard's Space Flight Center, NASA, Greenbelt, MA. USA	FUSION prototype assembled with two spectrometers (1) Ocean Optics USB 4000 Spectrometers (345–1040 nm) and (2) Ocean Optics HR 4000 Spectrometers (650–840 nm) with upward and downward viewing properties. FUSION also contains a CFmicro SF15 infrared sensor (8 to 14 μm).	25°	650–760	< 0.13	[24]
		* *user specified.*				
TriFLEX	IPSL Dynamic Meteorology Laboratory (LMD), CNRS, France.	A prototype sensor with three spectrometers, where two identical spectrometers (HR2000+, Ocean Optics Inc., Dudenin, FL, USA) were used simultaneously to get irradiance and sample radiance spectra in the chlorophyll emission bands (630–815 nm). A third spectrometer (Ocean Optics Inc., Dudenin, FL, USA) measures vegetation radiance over a large spectral range. The fluorescence was estimated by FLD or another retrieval algorithm.	25° (approx.)	630–815	0.5	[24,87]
FluoSpec	Brown University, Providence, Rhode Island, USA	FluoSpec is a prototype instrument with an HR2000+ spectrometer (Ocean Optics Inc., Dunedin, FL, USA). The spectrometer was designed to be connected with a fiber optic shutter (FOS-2×2-TTL, Ocean Optics, Inc. USA) with two ports, each of which was connected to a fiber optic.	25°	680–775	0.13	[93]
FluoSpec 2	University of Virginia, Charlottesville, USA	FluoSpec with a modification of spectrometer where HR2000+ is replaced with a QE Pro Spectrometer (Ocean Optics, Inc., Dunedin, FL, USA). The advantage is a better SNR due to temperature control. The spectrometer can be optimized at different wavelengths as per the need. The QE Pro has an internal shutter that closes when dark current measurements are needed.	25°	730–780 650–730	0.14 0.4	[90]

I think this paper well organized all system to monitoring SIF.

3rd February

Liu, W., Atherton, J., Mõttus, M., Gastellu-Etchegorry, J. P., Malenovský, Z., Raumonen, P., ... & Porcar-Castell, A. (2019). Simulating solar-induced chlorophyll fluorescence in a boreal forest stand reconstructed from terrestrial laser scanning measurements. *Remote Sensing of Environment*, *232*, 111274.

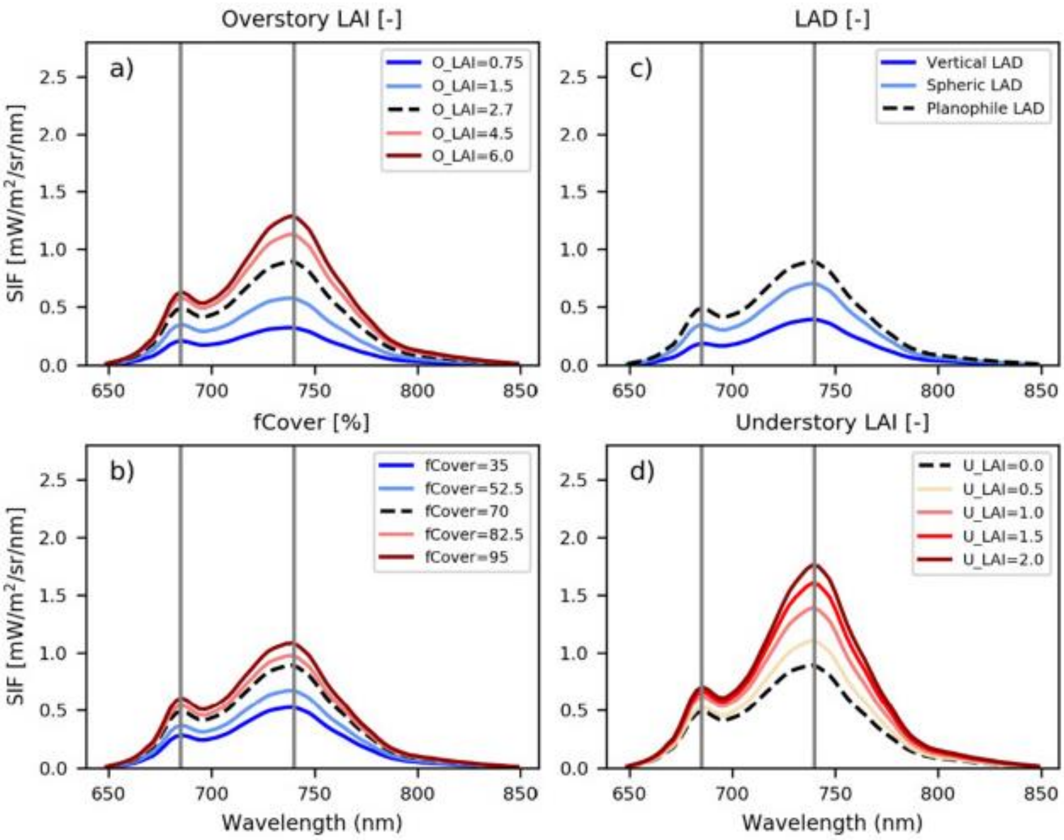

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Fig. 9. Sensitivity of simulated forest scene TOC SIF spectra to changes in canopy and understory structural variables: a) overstory LAI, b) fCover, c) LAD, and d) understory LAI. Lines corresponding to increased variable values are in red, and lines for reduced variables are in blue. O_LAI refers to overstory LAI, U_LAI refers to understory LAI. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

This paper highlighted that 1) 3D boreal forest scene generated from TLS data for simulation of TOC SIF, 2) The potential of the scheme was demonstrated with a local sensitivity analysis. 3) Understory SIF can substantially contribute to TOC SIF in open-canopy forests. 4) TOC red SIF was largely independent of foliar Cab content compared to far-red SIF. It was quite interesting that understory SIF can contribute to TOC SIF by using model simulation.

2nd February

Rowland, S. D., Zumstein, K., Nakayama, H., Cheng, Z., Flores, A. M., Chitwood, D. H., ... & Sinha, N. R. (2019). Leaf shape is a predictor of fruit quality and cultivar performance in tomato. *New Phytologist*.

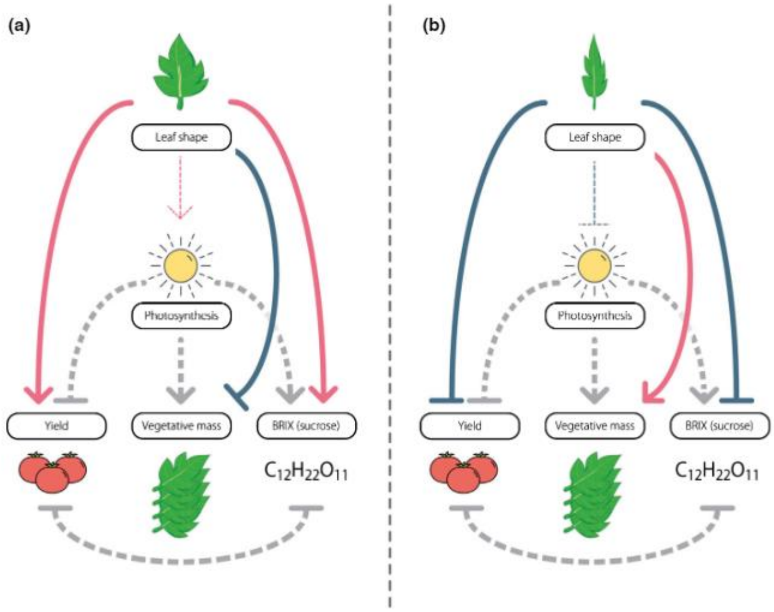


Fig. 7 Composite model for leaf shape effects on fruit quality. The model was derived from the partial least-squares path modeling (PLS-PM) analysis. (a) Effects of round leaves on fruit quality and photosynthesis. (b) Effects of narrow leaves on fruit quality and photosynthesis. Red lines indicate a positive interaction while blue lines indicate a negative interaction. Gray dashed lines indicate that the relationship does not change between the two leaf shapes. Colored dashed lines indicate a significant but weak relationship between the two connected traits.

I am familiar with this topic, but it seems quite interesting to me. I always thought that photosynthesis is the most important factor to make high-quality fruit and yield. But this paper showed that " Photosynthesis contributed strongly to vegetative biomass and sugar content of fruits but had a negative impact on yield. Conversely, leaf shape, specifically rounder leaves, had a strong positive impact on both fruit sugar content and yield. Cultivars such as Stupice and Glacier, with very round leaves, had the highest performance in both fruit sugar and yield. "

1st February

Keenan, T. F., Richardson, A. D., & Hufkens, K. (2020). On quantifying the apparent temperature sensitivity of plant phenology. *New Phytologist*, *225*(2), 1033-1040.

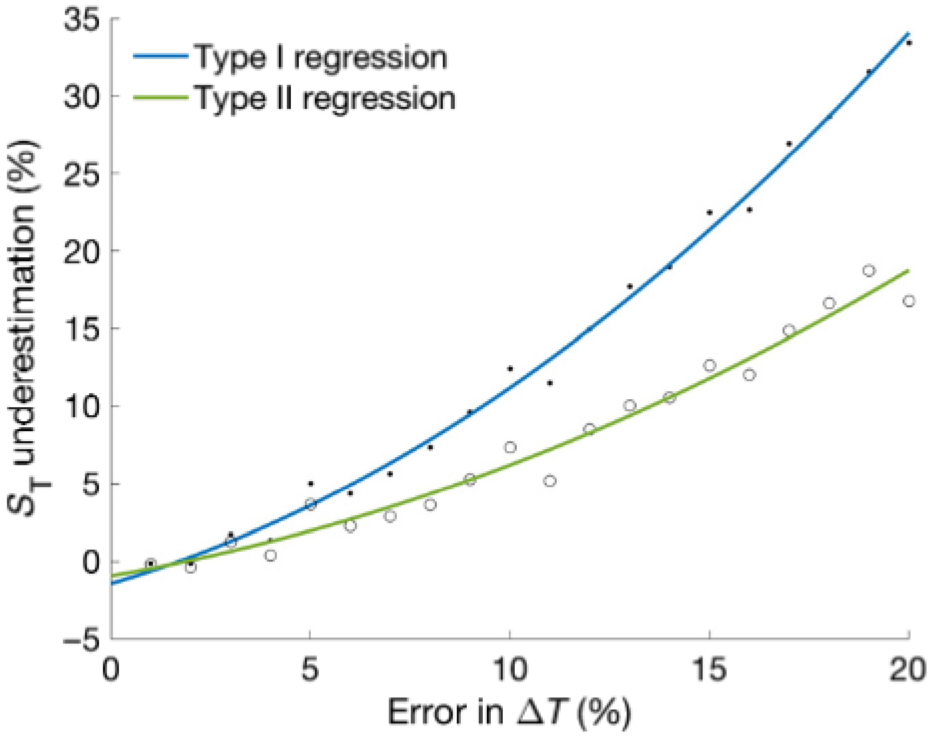
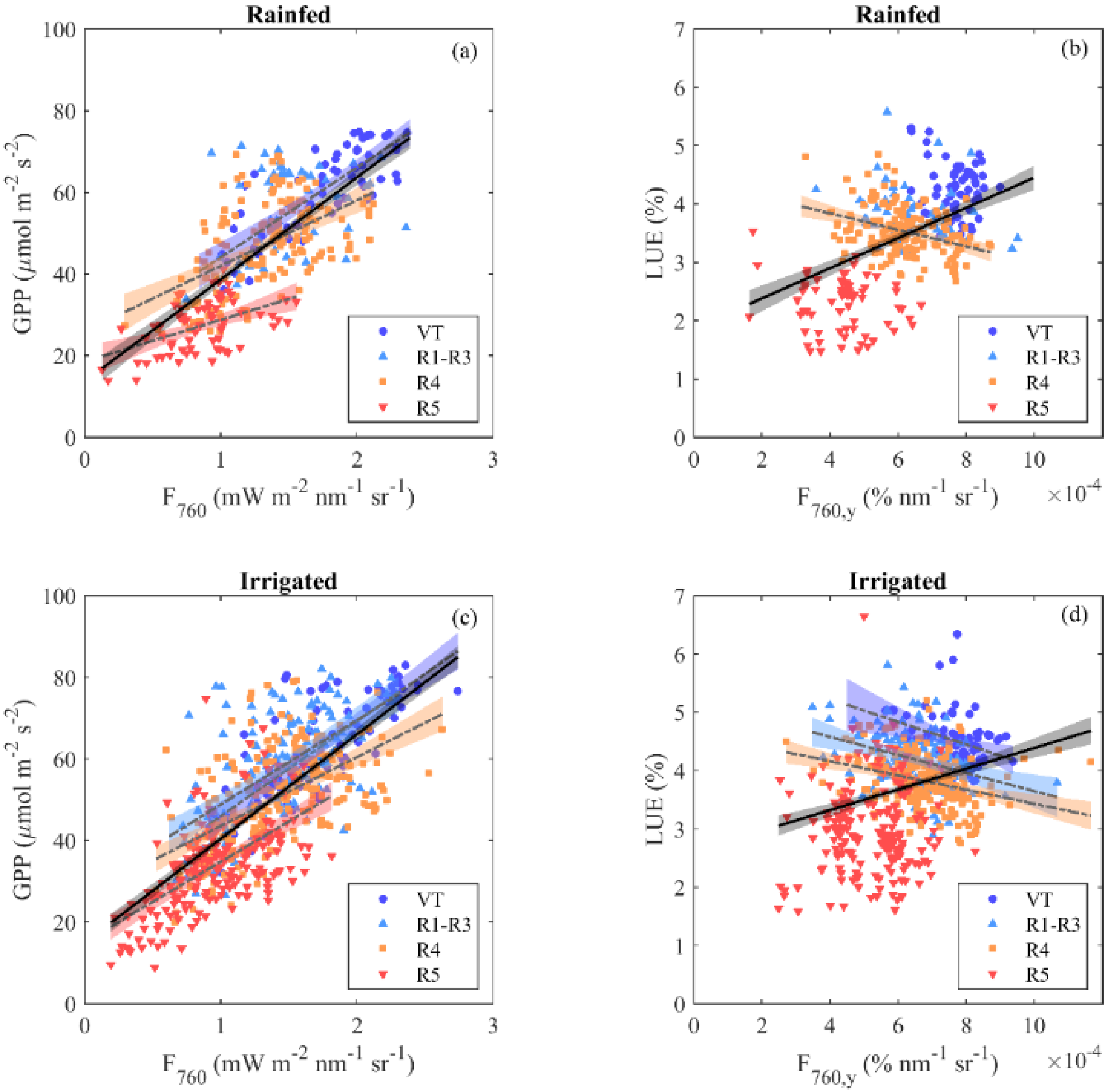


Fig. 3 The implicit underestimation of the apparent temperature sensitivity due to unaccounted for uncertainty in integrated temperature. This synthetic example shows the effect of increasing error in integrated temperature (T) on the derived apparent temperature sensitivity (S_T, days °C^{-1}), using both linear regression (Type-I) and reduced major axis (Type-II) regression. Both the phenology dates and the temperature metric used are obtained from the hypothetical relationship of $\Delta P = 5 \times \Delta T$ (representing a temperature sensitivity of 5 d per °C), with random error drawn from a normal distribution with zero mean and standard deviation of 0–20%.

I think this paper is quite interesting because they showed the limitation of previous studies method. They showed how the resulting artefacts can lead to spurious differences in apparent temperature sensitivity and artificial spatial gradients. Such issues are rarely considered in analyses of the temperature sensitivity of phenology. Given the issues identified, The authors advocate for process-oriented modelling approaches, informed by observations and with fully characterised uncertainties, as a more robust alternative to the simple days-per-degree temperature sensitivity metric. In addition, I like the discussion section such as "Although it is a widely accepted fact that phenology responds to temperature, there is no broad consensus on how exactly that dependence manifests. For example, the timing of warming matters (Clark et al., 2014; Friedl et al., 2014), as do other moderating factors such as winter chilling, dormancy requirements, photoperiod, humidity and leaf longevity." It should be useful to write a phenology manuscript.

4th January

Miao, G., Guan, K., Suyker, A. E., Yang, X., Arkebauer, T. J., Walter-Shea, E. A., ... & Frankenberg, C. Varying contributions of drivers to the relationship between canopy photosynthesis and far-red sun-induced fluorescence for two maize sites at different temporal scales. *Journal of Geophysical Research: Biogeosciences*.



This paper showed that SIF-GPP relationship in variance drivers. In this paper, the LUEp and apparent SIFy also showed not strong relationships. However, I thought that this paper did not show fesc, so it is quite shamed.

3rd January

Turner, A. J., Köhler, P., Magney, T. S., Frankenberg, C., Fung, I., & Cohen, R. C. (2019). A double peak in the seasonality of California's

photosynthesis as observed from space. *Biogeosciences Discussions*, 1-27.

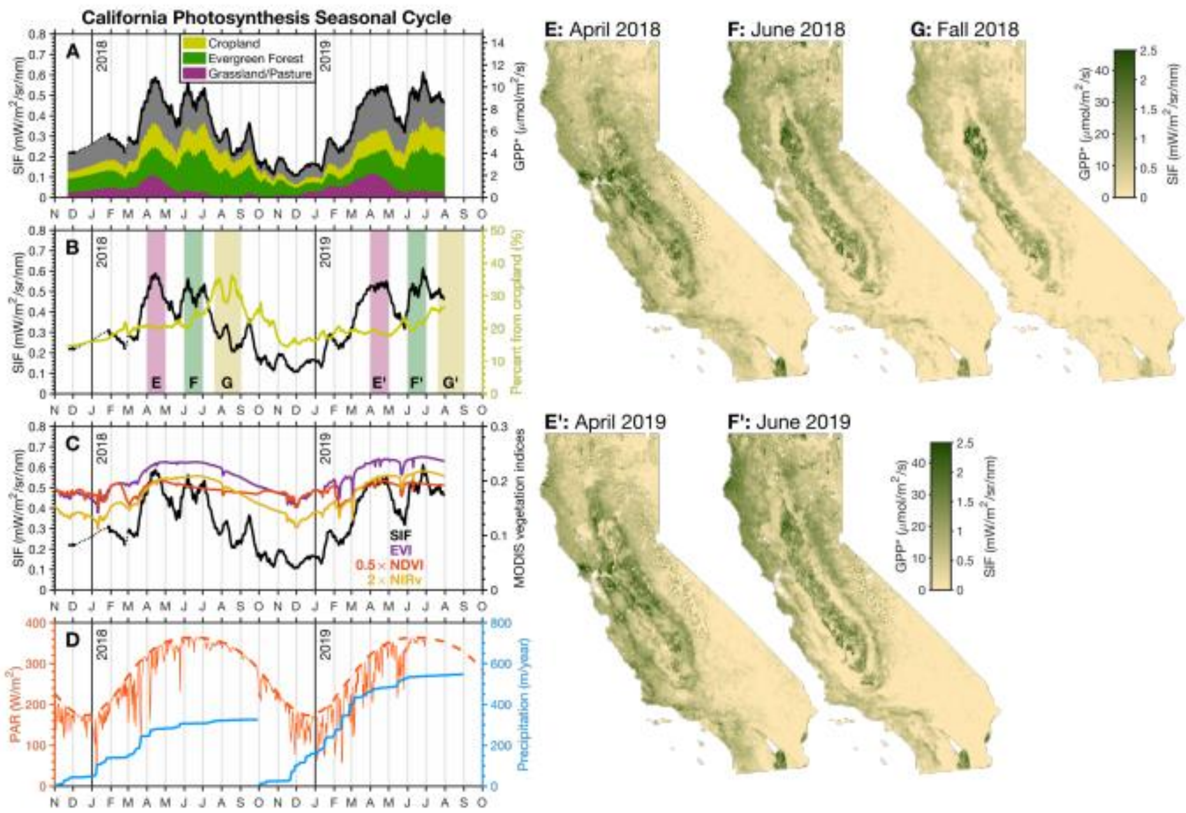
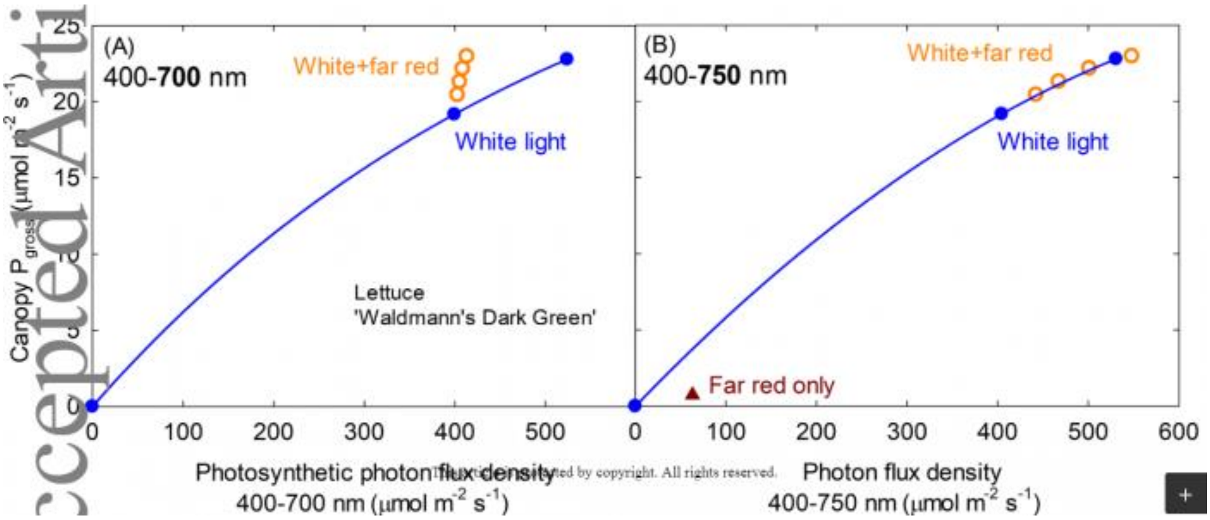


Figure 6. Seasonal cycle of photosynthesis in California. Panel A shows the statewide mean SIF (black line) at 13:30 PST from November 2017 through September 2019 broken down by the contributions coming from cropland (yellow), evergreen forests (green), grasslands or pastures (purple), and other (gray). Rice is included in cropland here. Land types are taken from the 2018 CropScape database shown in Figure 1. Right axis shows the estimated GPP* based on comparison with AmeriFlux sites in California. **Panel B** shows the percentage of SIF coming from cropland (yellow). Vertical bars indicate the time periods with corresponding spatial plots in Panels E–G'. **Panel C** shows the vegetation indices (NDVI, EVI, and NIR_v) from MODIS over the same time period. **Panel D** shows clear sky PAR over California at 13:00 PST (dashed red line), surface PAR estimated from the ERA-Interim Reanalysis (thin red line), and cumulative precipitation over the water year from the GPM satellite (blue). **Panels E–G'** show the spatial patterns of SIF for the time periods indicated in Panel B.

The authors presented daily values based on a 14-day window. TROPOMI SIF data show a strong correspondence with daily GPP estimates at AmeriFlux sites across multiple ecosystems in California. They found a linear relationship between SIF and GPP that is largely invariant across ecosystems with an intercept that is not significantly different from zero. Measurements of SIF from TROPOMI agree with MODIS vegetation indices (NDVI, EVI and NIRv) at annual timescales but indicate different temporal dynamics at monthly and daily timescales. TROPOMI SIF data show a double peak in the seasonality of photosynthesis, a feature that is not present in the MODIS vegetation indices. The different seasonality in the vegetation indices may be due to a clear-sky bias in the vegetation indices, whereas SIF has a low sensitivity to clouds and can detect the downregulation of photosynthesis even when plants appear green. I think this paper will be useful to explain our SIF-GPP relationship in cloudy days.

2nd January

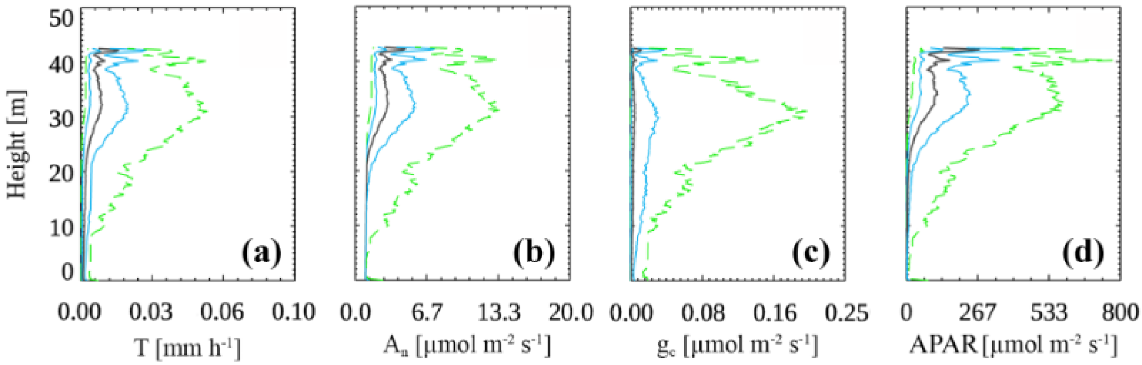
Zhen, S., & Bugbee, B. (2020). Far-red photons have equivalent efficiency to traditional photosynthetic photons: implications for re-defining photosynthetically active radiation. *Plant, Cell & Environment*.



This paper showed that we should consider the PAR should be included far-red region. I also had a question about why the range of PAR showed 400 - 700 nm? In this paper, especially the introduction they made a nice story and information. The authors siad that " Far-red alone minimally increased photosynthesis. This indicates that far-red photons are equally efficient at driving canopy photosynthesis when acting synergistically with traditionally defined photosynthetic photons." and This paper suggests that far-red photons (700 to 750 nm) should be included in PAR.

1st January

Damm, A., Paul-Limoges, E., Kükenbrink, D., Bachofen, C. and Morsdorf, F. (2020), Remote sensing of forest gas exchange: Considerations derived from a tomographic perspective. Glob Change Biol. Accepted Author Manuscript. doi:[10.1111/gcb.15007](10.1111/gcb.15007)



gcb_15007_f5.tif

Fig. 5: Vertical profiles of forest gas exchange. A: Transpiration (T). B: Net CO2 assimilation (A_n). C: Canopy conductance (g_c). D: Absorbed photosynthetic active radiation (APAR) for the simulated forest canopy on 21st June 12:27 l.t. Profiles represent the average of the entire 60 m x 60 m canopy. The grey line indicates the median, the blue lines 25th and 75th percentile and the green dashed lines the 5th and 95th percentile.

I think this paper is really interesting. 1) I did not know that the first author also working on the except SIF part, 2) And this paper tried to monitor multi-layer gas exchange using satellite image which is hard to separate under and over story. In this paper, they showed that substantial 3D heterogeneity of forest gas exchange with top of canopy A_n and T being reduced by up to 98% at the bottom of the canopy.
They showed that a simplified use of RS causes uncertainties in estimated vertical gas exchange of up to 300% and that the spatial variation of gas exchange in the footprint of flux towers can exceed diurnal dynamics.