4th Dec

Zhou, K., Zhang, Q., Xiong, L. and Gentine, P., 2022. Estimating evapotranspiration using remotely sensed solar-induced fluorescence measurements. Agricultural and Forest Meteorology, 314: 108800.

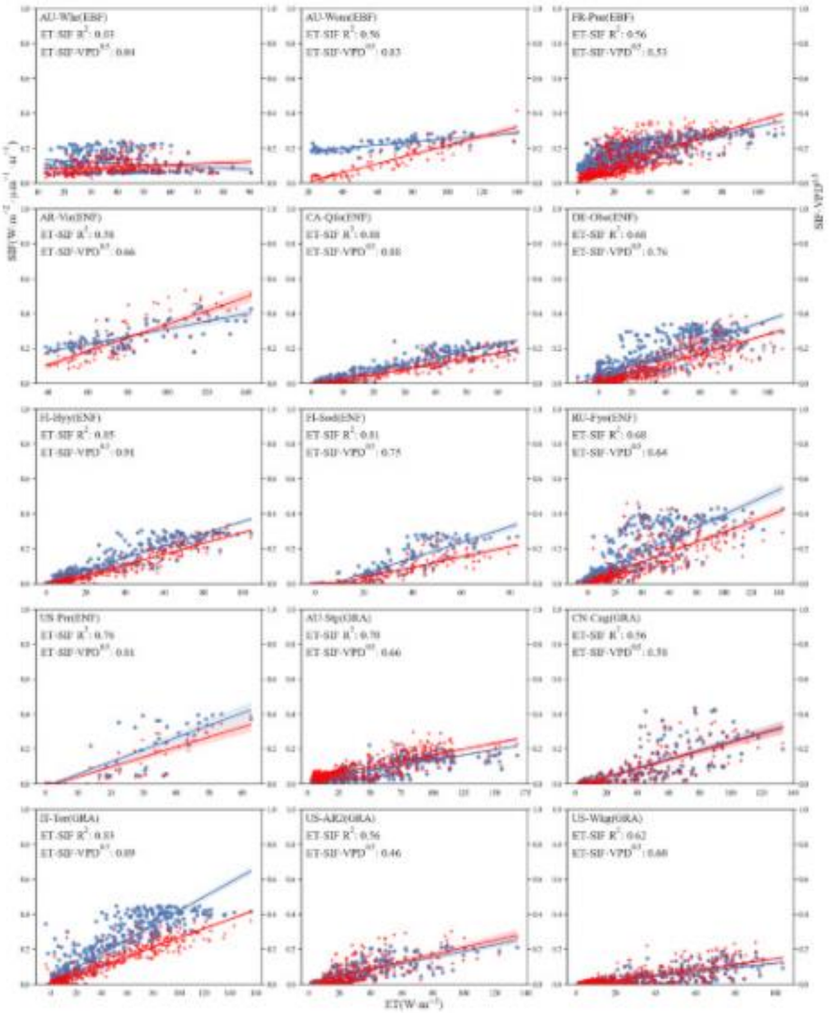

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Fig. 2. Regression of ET with normalized SIF and normalized SIF scaled by $VPD^{0.5}$. Blue dots

This paper is quite similar to Nan Shan's papers which are the relationship between ET and SIF. But, I am quite skeptical about the detailed mechanism in ET-SIF. In this paper, they also assumed that SIF is similar to GPP and then developed the equation based on the GPP-ET relationship. In my view, there are still missing parts in the SIF-GPP relationship and it is hard to connect SIF to ET directly. At canopy-level, it seems that there are linear relationships in SIF-ET, but SIF is poxy of APAR and leaking signal from incoming solar irradiance, thus, there might be a low connection in their mechanism. But, I agree that more studies are needed to investigate the ET-SIF relationship.

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3rd Dec

Tran, P. H. (2021). Estimation of Pesticide Residues on Leafy Vegetables Using a Developed Handheld Spectrometer.

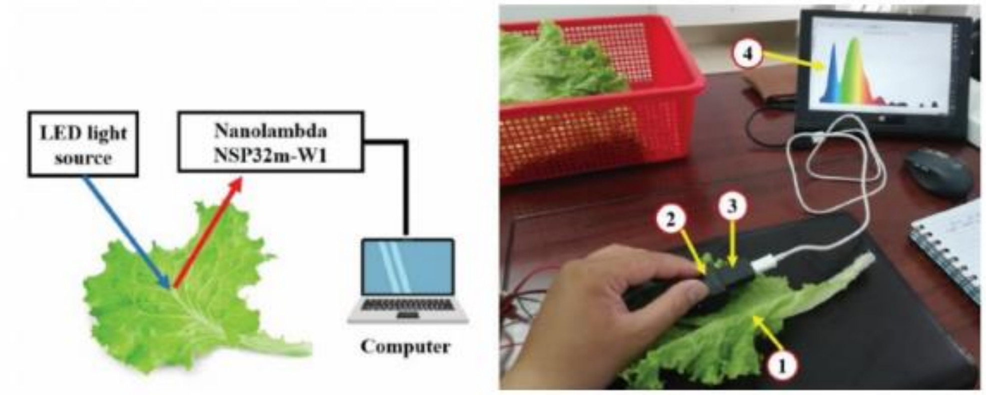


Figure 2. Schematic diagram of the spectral data acquisition system (1) lettuce leaf sample; (2) spectrometer holder; (3) spectrometer; (4) computer.

I think the overall contents in this paper are not that new, but I want to keep this paper in POW because they used quite an interesting spectrometer made in Korea. I did not know such a company and machine. I guess near future, I will co-work with them to catch my goal.

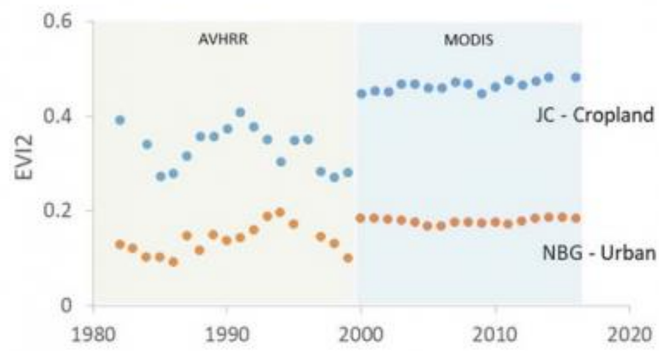
"In this study, a Nanolambda application development kit (Model: NSP32m-W1 ADK, Nanolambda, Daejeon, South Korea), a full spectrum 1W LED, a rechargeable Li-ion battery was integrated to develop a portable spectrometer. "

——————————————————

2nd Dec

Donnelly, A., Yu, R., & Liu, L. (2021). Comparing in situ spring phenology and satellite-derived start of season at rural and urban sites in Ireland. *International Journal of Remote Sensing*, *42*(20), 7821-7841.

Figure 2. Comparison of AVHRR- (green shading, 1982–2000) and MODIS- (blue shading, 2000–2016) derived two-band Enhanced Vegetation Index (EVI2) values for Start of Spring at two long-term International Phenological Garden sites with varying land cover type in Ireland. Johnstown Castle, (blue symbols, JC – Cropland) and National Botanic Gardens (orange symbols, NBG – urban)



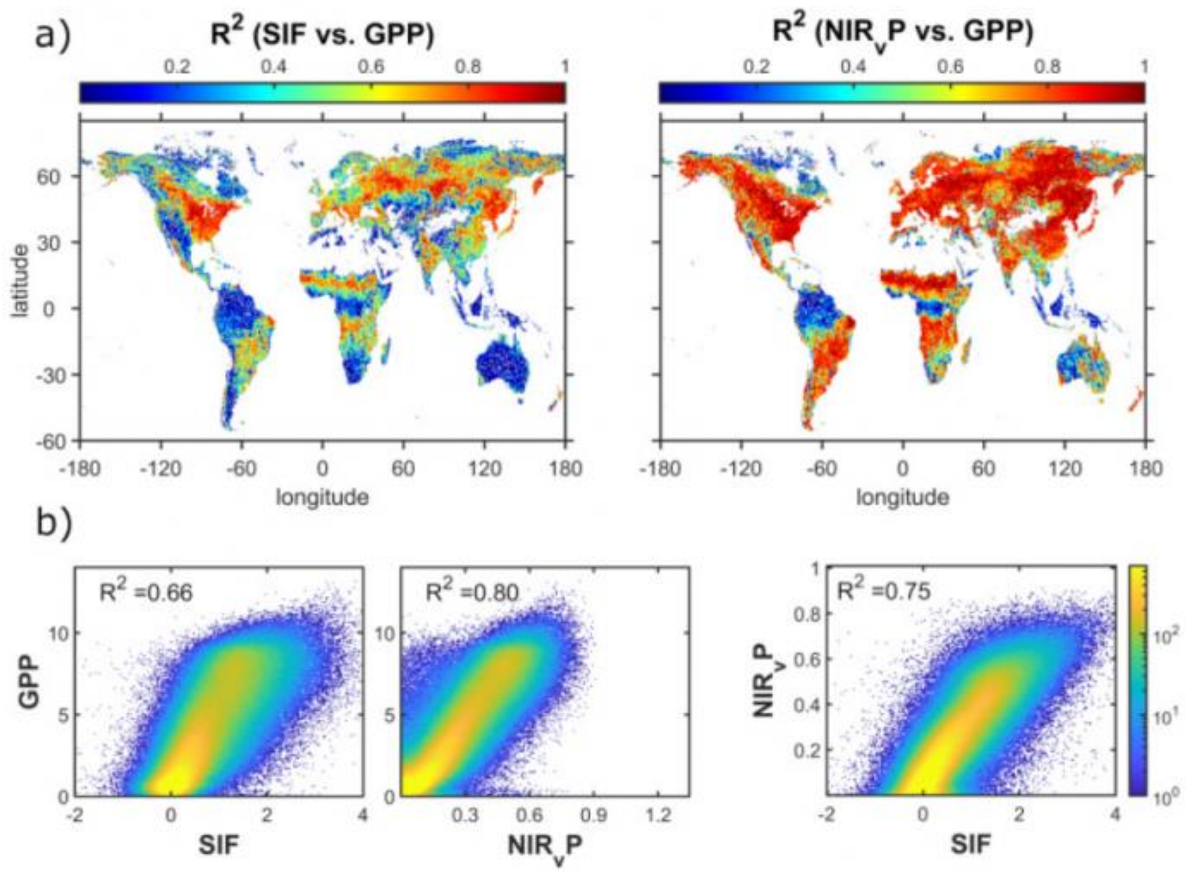
This paper was published this year and they compared in-situ spring phenology and satellite-based SOS at rural and urban sites. They found that both measurements showed consistent results as SOS was earlier in urban sites compared to rural regions. But the magnitude was quite different. I should think more about which statistical analysis is important in such a study (e.g. R2 or bias). I think this paper might be cited for my phenology paper.

————————————————————

1st Dec

Dechant, B., Ryu, Y., Badgley, G., Köhler, P., Rascher, U., Migliavacca, M., ... & Berry, J. A. (2022). NIRVP: A robust structural proxy for sun-induced chlorophyll fluorescence and photosynthesis across scales. *Remote Sensing of Environment*, *268*, 112763.

Our group's paper!



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4th Nov

Vitasse, Y. (2013). Ontogenic changes rather than difference in temperature cause understory trees to leaf out earlier. *New Phytologist*, *198*(1), 149-155.

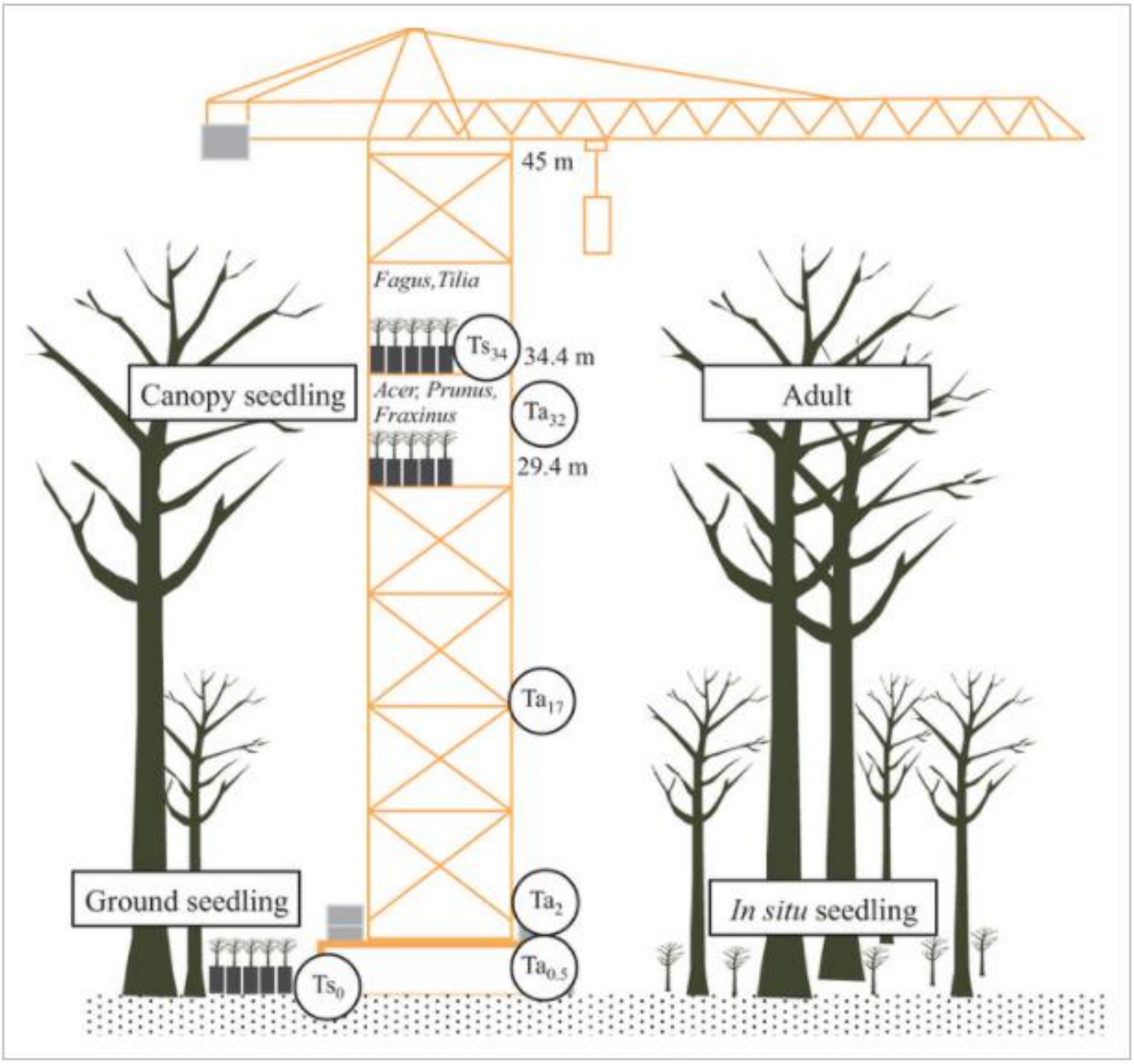


Figure 1 Open in figure viewer | PowerPoint

The experimental design used to compare seedling and adult tree phenology. Ta_{32}, Ta_{17}, Ta_{2} and $Ta_{0.5}$ correspond to the air temperature recorded at 32, 17, 2 and 0.5 m height during the experiment. Ts_{34} and

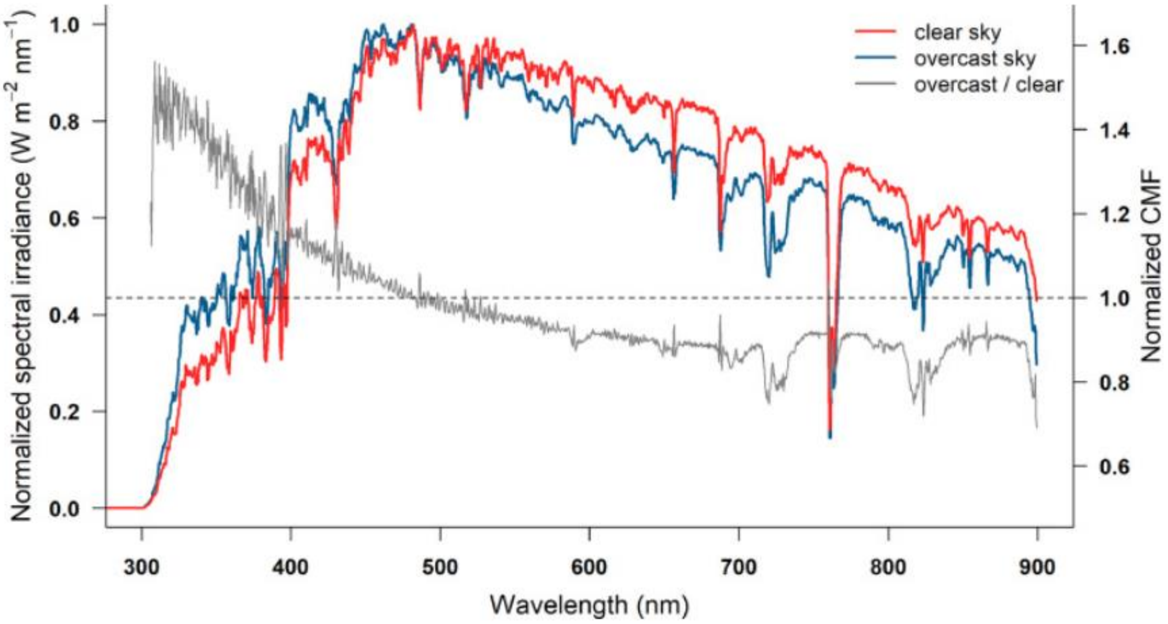
I like their experiment design! Here are findings!

- This study demonstrates that later leaf emergence of canopy trees compared with understory trees results from ontogenic changes and not from the vertical thermal profile that exists within forests. This study warns against the assumption that phenological data obtained in warming and photoperiod experiments on juvenile trees can be used for the prediction of forest response to climate warming.

———————————————————

3rd Nov

Durand, M., Murchie, E. H., Lindfors, A. V., Urban, O., Aphalo, P. J., & Robson, T. M. (2021). Diffuse solar radiation and canopy photosynthesis in a changing environment. *Agricultural and Forest Meteorology*, *311*, 108684.



This paper will be useful to understand the spectral shape in diffuse sky conditions.

———————————————————

2nd Nov

Augspurger, C. K., & Bartlett, E. A. (2003). Differences in leaf phenology between juvenile and adult trees in a temperate deciduous forest. *Tree Physiology*, *23*(8), 517-525.

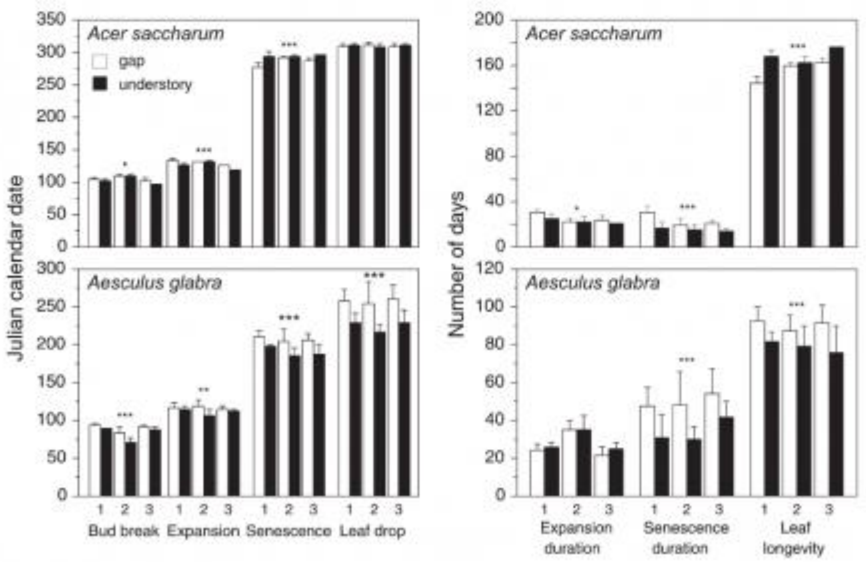


Figure 3. Comparisons between subcanopy individuals of *Acer saccharum* and *Aesculus glabra* in the understory versus gap microhabitats for four phenological events and three phases in each of 3 years. Means + 1 SD are shown. Stars indicate significant differences between microhabitats. Symbols: * = $P < 0.05$; ** = $P < 0.001$; and *** = $P < 0.0001$.

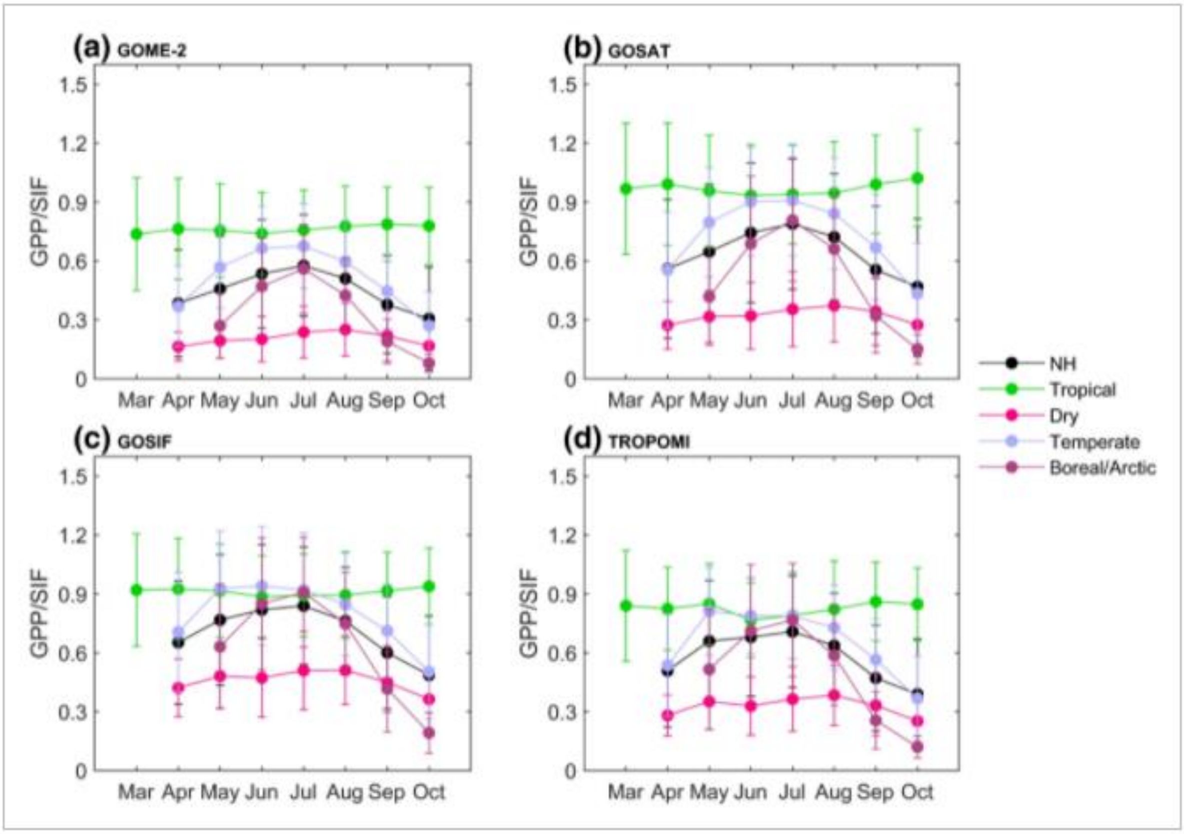
I really enjoyed this paper!

"Understory trees in deciduous forests have a third option for increasing carbon gain: phenological avoidance of canopy shade (Uemura 1994). If understory trees have earlier leaf expansion in spring or later leaf drop in autumn than canopy trees, they partially avoid the period of low light imposed by leaves of canopy trees. Phenological avoidance has been advanced as an important characteristic by which juvenile canopy trees maximize light acquisition, enabling them to persist in shaded forest understories during summer. "

————————————————————

1st Nov

Chen, A., Mao, J., Ricciuto, D., Lu, D., Xiao, J., Li, X., ... & Knapp, A. K. (2021). Seasonal changes in GPP/SIF ratios and their climatic determinants across the Northern Hemisphere. *Global Change Biology*, *27*(20), 5186-5197.



I think this paper is related to my previous work that SIF-GPP non-linear relationship. In this paper, they found that the SIF/GPP ratio could be different in a monthly time scale. However, I think it would be necessary to check structural and physiological terms seperately.

————————————————————

4th Oct

Zeng, Y., Hao, D., Badgley, G., Damm, A., Rascher, U., Ryu, Y., … & Chen, M. (2021). Estimating near-infrared reflectance of vegetation from hyperspectral data. *Remote Sensing of Environment*, *267*, 112723.

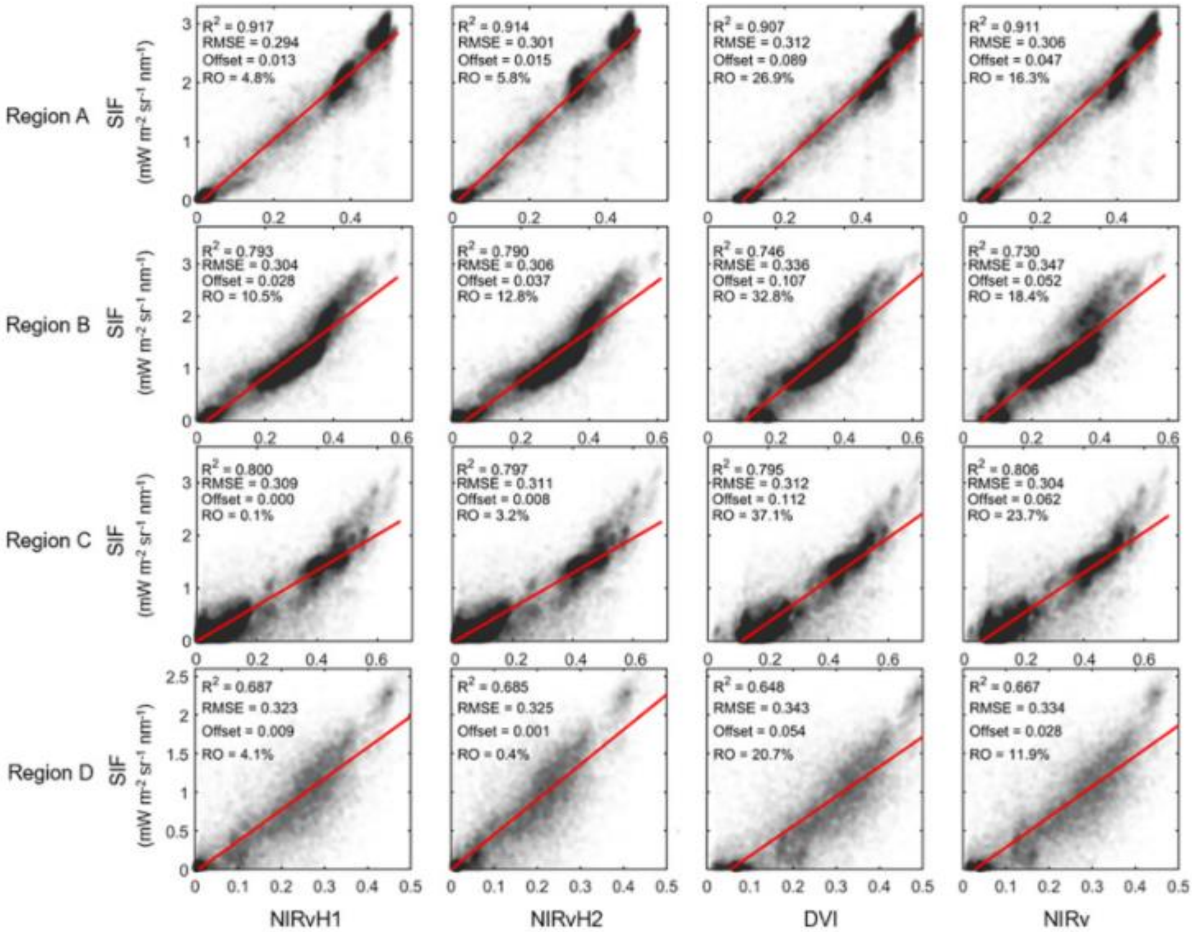


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Fig. 10. Scatter plots of SIF at 760 nm and different VIs for HyPlant imageries at four study regions on August 23rd, 2012, June 30th, 2015, July 19th, 2016 and August 23rd, 2012, respectively. Regions A ~ C were agricultural fields, while region D was over complex land surfaces composed of forest, water body and urban areas. The relative offset (RO) was estimated by the ratio of the offset to the mean value of the corresponding VI in the SIF-VI relationship.

They tried to extract NIR from hyperspectral data. They highlighted that 1) Previous VIs have not accounted for the shape of the soil spectrum at the red edge. 2) We propose the NIRvH approach for estimating the true NIR reflectance of vegetation. 3) NIRvH reduces the soil contamination using the SVD method and a logistic function. 4) Compared to DVI and NIRv, the proposed NIRvH has the best agreement with SIF. NIRvH is promising for the anisotropic correction of directional observed SIF.

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3rd Oct

De Cannière, S., Herbst, M., Vereecken, H., Defourny, P., & Jonard, F. (2021). Constraining water limitation of photosynthesis in a crop growth model with sun-induced chlorophyll fluorescence. *Remote Sensing of Environment*, *267*, 112722.

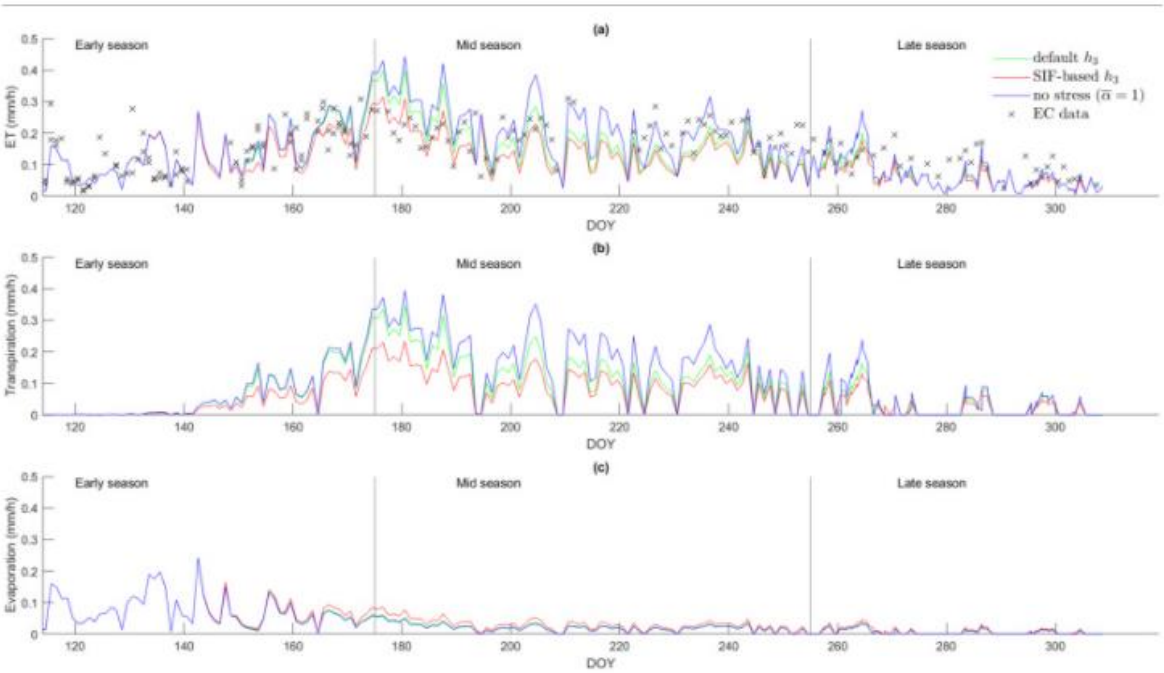

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Fig. 9. (a) AgroC-SCOPE modeled evapotranspiration using different parametrizations compared to EC-derived evapotranspiration; (b) modeled transpiration; (c) modeled evaporation.

This paper pointed that there might be physiological changes and it could affect emitted SIF. They highlighted that 1) The biochemical component of SIF emission is sensitive to drought stress. 2)Drought stress can be accounted for by decreasing the carboxylation capacity and by increasing the non-photochemical quenching. 3) A reduction in VCMax and an increase in NPQ translate into a decrease in SIF and photosynthetic activity. 4) Using SIF observations, a water stress function can be calibrated in a crop growth model. 5) A better parametrization of the water stress function improves estimates of water and carbon fluxes. However, I am not sure they fully considered canopy structure.

———————————————————

2nd Oct

Mokroš, M., Mikita, T., Singh, A., Tomaštík, J., Chudá, J., Wężyk, P., ... & Liang, X. (2021). Novel low-cost mobile mapping systems for forest inventories as terrestrial laser scanning alternatives. *International Journal of Applied Earth Observation and Geoinformation*, *104*, 102512.

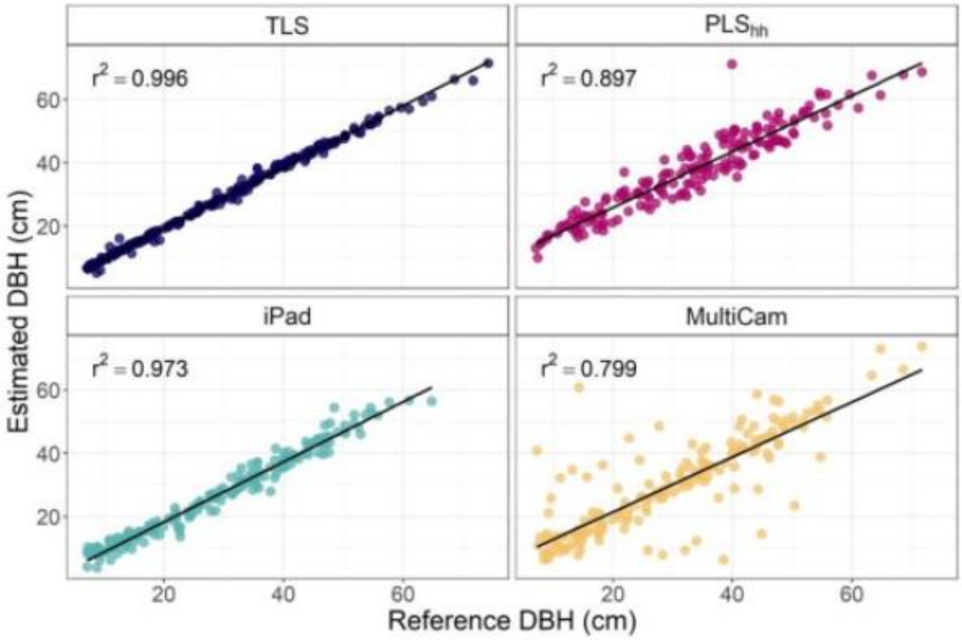

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Fig. 6. Conventional and point cloud based methods for DBH measurement, according to each device used, with its regression line and r squared.

I think this paper will be related to 4S-LIDAR later. They highlighted as 1) Highest accuracy using mobile scanning was achieved by iPad Pro equipped with LiDAR. 2) Multi-camera system successfully generated point clouds for all research plots. 3) Hand-held personal laser scanning accuracy highly depends on data acquisition path. 4) TLS was most reliable approach for point cloud generation.

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1st Oct

Howell, T. A., Meek, D. W., & Hatfield, J. L. (1983). Relationship of photosynthetically active radiation to shortwave radiation in the San Joaquin Valley. *Agricultural Meteorology*, *28*(2), 157-175.

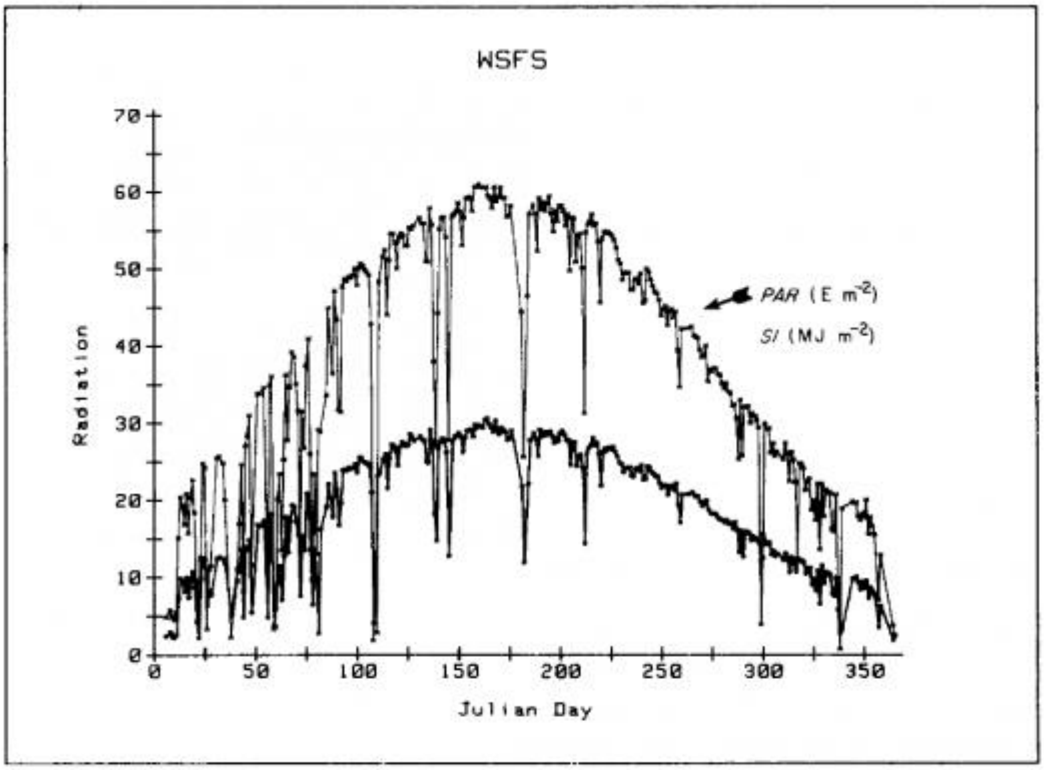

Fig. 1. Daily integrated totals of *PAR* and *SI* for West Side Field Station for 319 days between July 1, 1980 and June 30, 1981.

I think this paper is classical paper about the relationship between PAR and shortwave radiation. They measured moth and then tried to calculated the Coef.

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4th Sep

Camps-Valls, G., Campos-Taberner, M., Moreno-Martínez, Á., Walther, S., Duveiller, G., Cescatti, A., ... & Running, S. W. (2021). A unified vegetation index for quantifying the terrestrial biosphere. *Science Advances*, *7*(9), eabc7447.

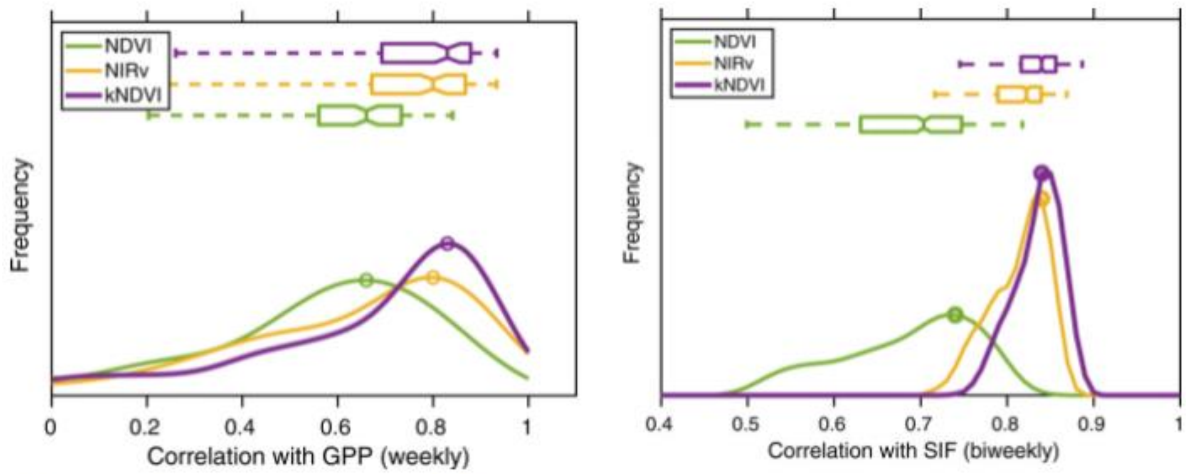

Fig. 1 Correlation between the indices and parameters.
Histogram of the correlation coefficient between the **VIs** and the parameters: for GPP (left) correlation computed over 169 FLUXNET sites, and for SIF (right) averaged over all 506 global images.

In this paper, the authors presented kNDVI which is tanh(NDVI^2). They found that the statistical approach maximally exploits the spectral information and addresses long-standing problems in satellite Earth Observation of the terrestrial biosphere. The nonlinear NDVI will allow more accurate measures of terrestrial carbon source/sink dynamics and potentials for stabilizing atmospheric CO_2 and mitigating global climate change. I will check kNDVI in near future.

————————————————————

3rd Sep

Pisek, J., Erb, A., Korhonen, L., Biermann, T., Carrara, A., Cremonese, E., … & Vincke, C. (2021). Retrieval and validation of forest background reflectivity from daily Moderate Resolution Imaging Spectroradiometer (MODIS) bidirectional reflectance distribution function (BRDF) data across European forests. *Biogeosciences*, *18*(2), 621-635.

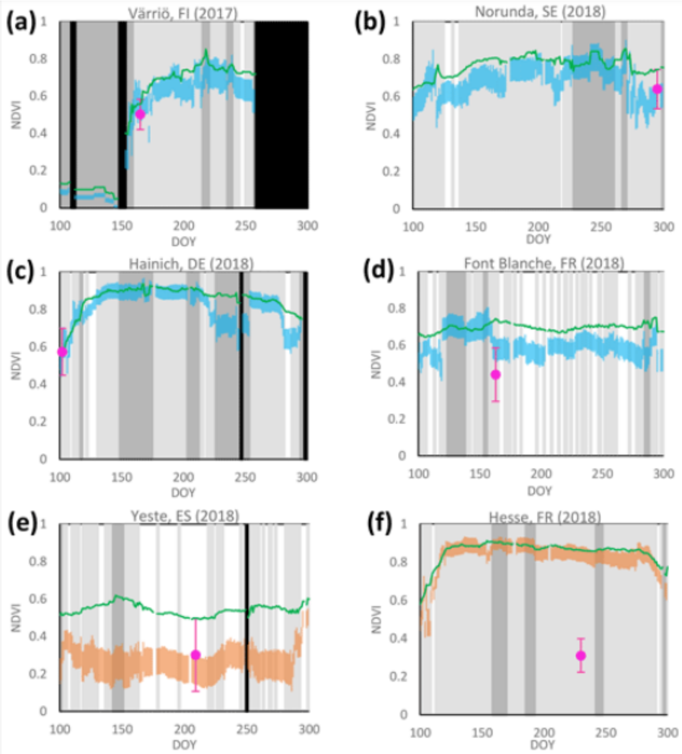

Figure 6 Seasonal courses of estimated understory NDVI (NDVIu) ranges (blue bars – site-representative retrievals; orange bars – possible non-site-representative retrievals), nadir total (understory and overstory) NDVI values from MODIS BRDF/albedo data (green lines), and in situ measurements (mean ±1 SD shown in purple) over selected study sites. Gray bars mark MODIS BRDF parameters with lower quality flags (light gray – QA = 1; dark gray – QA >1). Black bars indicate where no data are available.

Pisek's new paper about BRDF and understory. I think he is one of the frontier person in this field. They found that the performance of the method was found to be limited over forests with closed canopies (high foliage cover), where the signal from understory becomes too attenuated. The spatial heterogeneity of individual field sites and the limitations and documented quality of the MODIS BRDF product are shown to be important for the correct assessment and validation of the retrievals obtained with remote sensing. I think in our case where the overstory density is quite high in deciduous forest site, it might be hard to extract understory NDVI.

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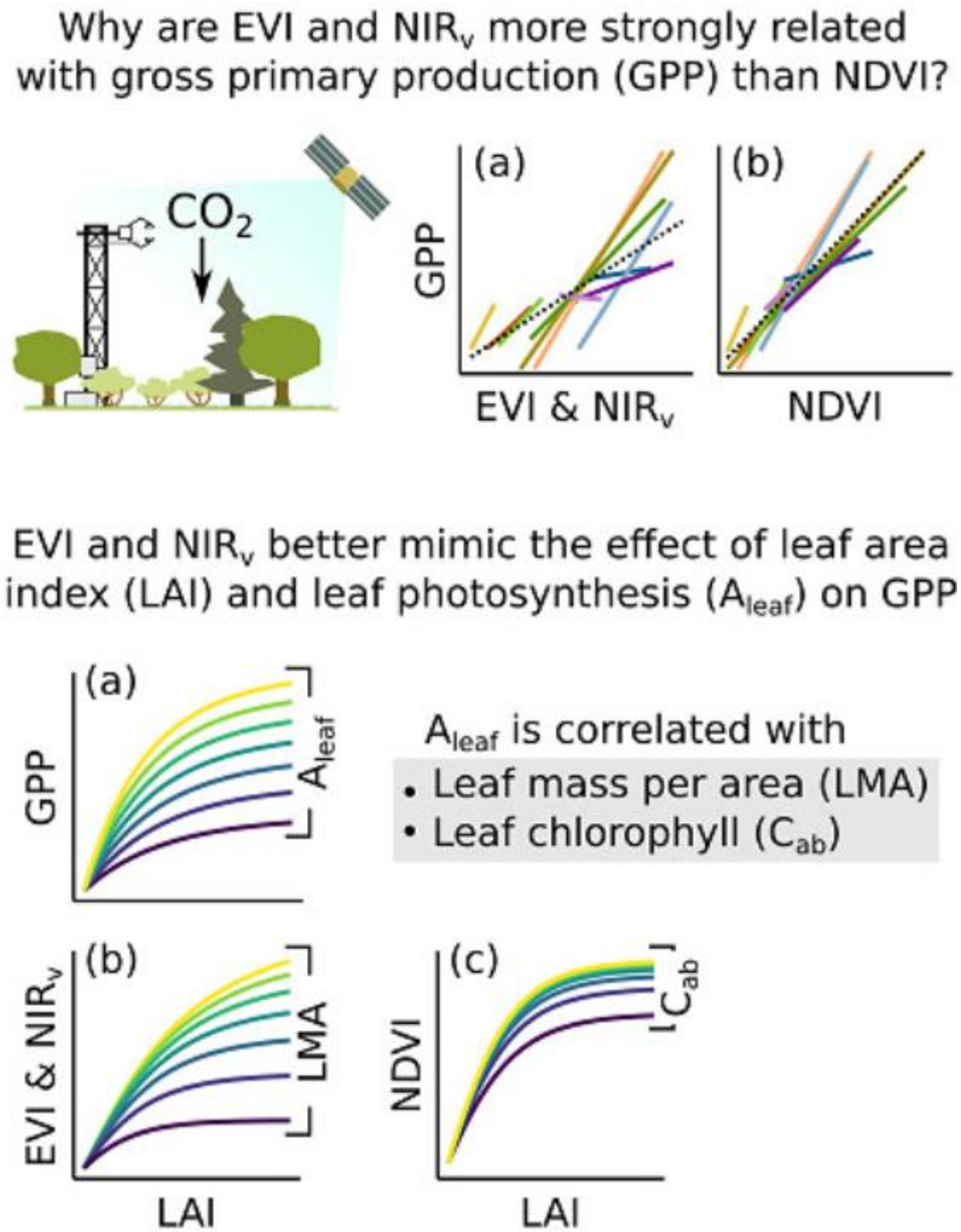
2nd Sep

Hinojo-Hinojo, C., & Goulden, M. L. (2020). Plant traits help explain the tight relationship between vegetation indices and gross primary production. *Remote Sensing*, *12*(9), 1405.



I think the authors in this paper well described the NIRv-GPP relationship. In this paper the authors checked the NIRv-GPP relationship in 10 flux sites and explored the relationships with plant traits. They found that NDVI lacked EVI and NIR_v's sensitivity to both LAI and A_{leaf}. These findings carry implications for understanding the limitations of current VIs for predicting GPP, and also for devising strategies to improve predictions of GPP. I think if they mentioned about the SIF-NIRv relationship also, it would be better.

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1st Sep

Frankenberg et al., (2021), Comment on "Recent global decline of Co2 fertilization effects on vegetation photosynthesis"

Science TECHNICAL COMMENTS

Cite as: C. Frankenberg *et al.*, *Science* 10.1126/science.abg2947 (2021).

Comment on "Recent global decline of CO_2 fertilization effects on vegetation photosynthesis"

Christian Frankenberg[1,2*], Yi Yin[1], Brendan Byrne[2], Liyin He[1], Pierre Gentine[3,4]

[1]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, USA. [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA. [3]Department of Earth and Environmental Engineering, Earth Institute, Columbia University, New York, NY, USA. [4]Data Science Institute, Columbia University, New York, NY, USA.

*Corresponding author. Email: cfranken@caltech.edu

Wang *et al.* (Research Articles, 11 December 2020, p. 1295), using photosynthesis proxies from long-term satellite records, report a significant decline in CO_2 fertilization effects. We find that small systematic biases in Advanced Very High Resolution Radiometer (AVHRR) data affect their analysis to the degree that the key finding is not robust. Caution is recommended when using AVHRR to detect changes in near-infrared reflectance of vegetation (NIRv) trends and vegetation indices.

I enjoyed this comments paper. They said there are some reasons that Songhan's paper is not robust as: (i) Inconsistencies in the time series of AVHRR data affect the magnitude of β declining trends, (ii) NIRv and solar-induced chlorophyll fluorescence (SIF) should perhaps not be used as the perfect proxy of gross primary production (GPP), (iii) there is inconsistency of the β results between the factorial simulation–based method and the regression-based method, and (iv) the fusion of the AVHRR and MODIS data may lead to some biases. I agree that Frankenberg's point and at the same time also agreed that Songhan's last sentence. "The lively discussion about our findings
proves that the paper has raised an important issue, and more studies on this difficult but crucial problem are called for".

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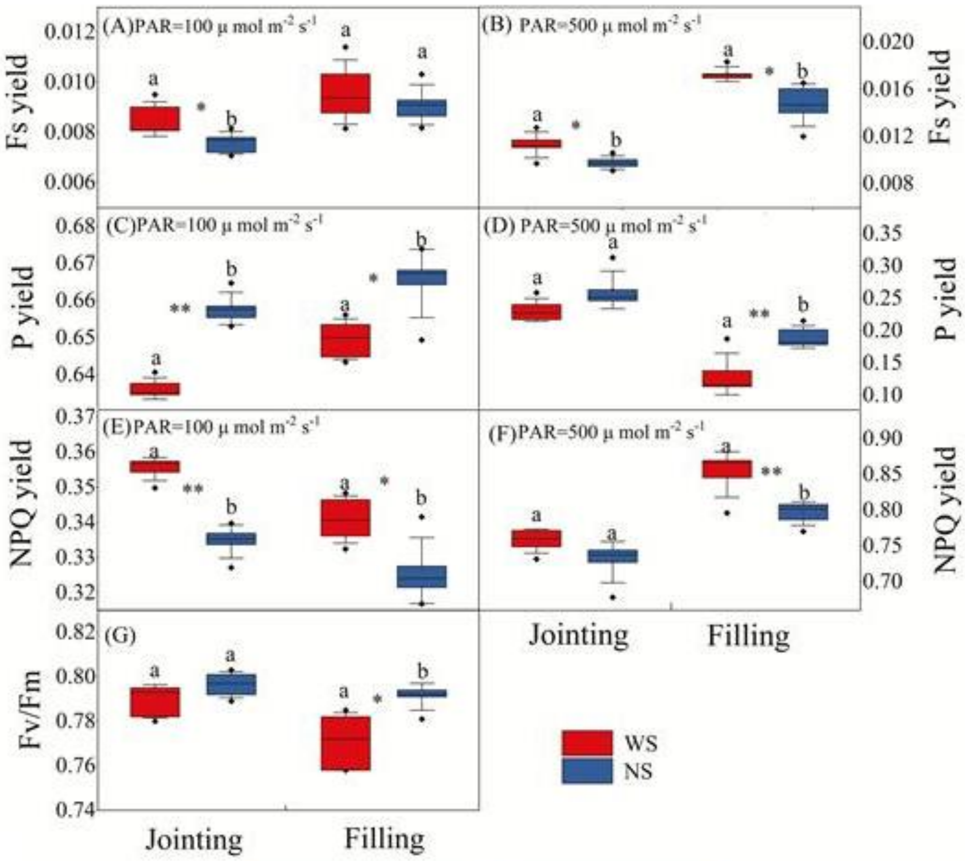
4th Aug

Chen, X., Mo, X., Hu, S., & Liu, S. (2019). Relationship between fluorescence yield and photochemical yield under water stress and intermediate light conditions. *Journal of experimental botany*, *70*(1), 301-313.

Fig. 6.



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Comparisons of F_v/F_m, F_s yield, P yield, and NPQ yield in leaves of summer maize between the water stress (WS) and non-water stress (NS) treatments at the jointing stage (45 days after sowing) and

I found that quite interesting result that Fs yield was increased under water stress conditions. WHY? The autrhos said that photochemistry was decreased, thus the NPQ and Fs was increased. I think this argument is quite interesting! "However, a negative relationship between fluorescence and photosynthetic light use efficiency or P yield has also been reported (Damm *et al.*, 2010; Liu and Cheng, 2010). Liu and Cheng (2010) stated that photosynthetic light use efficiency is negatively related to chlorophyll fluorescence due to their competition for light energy."

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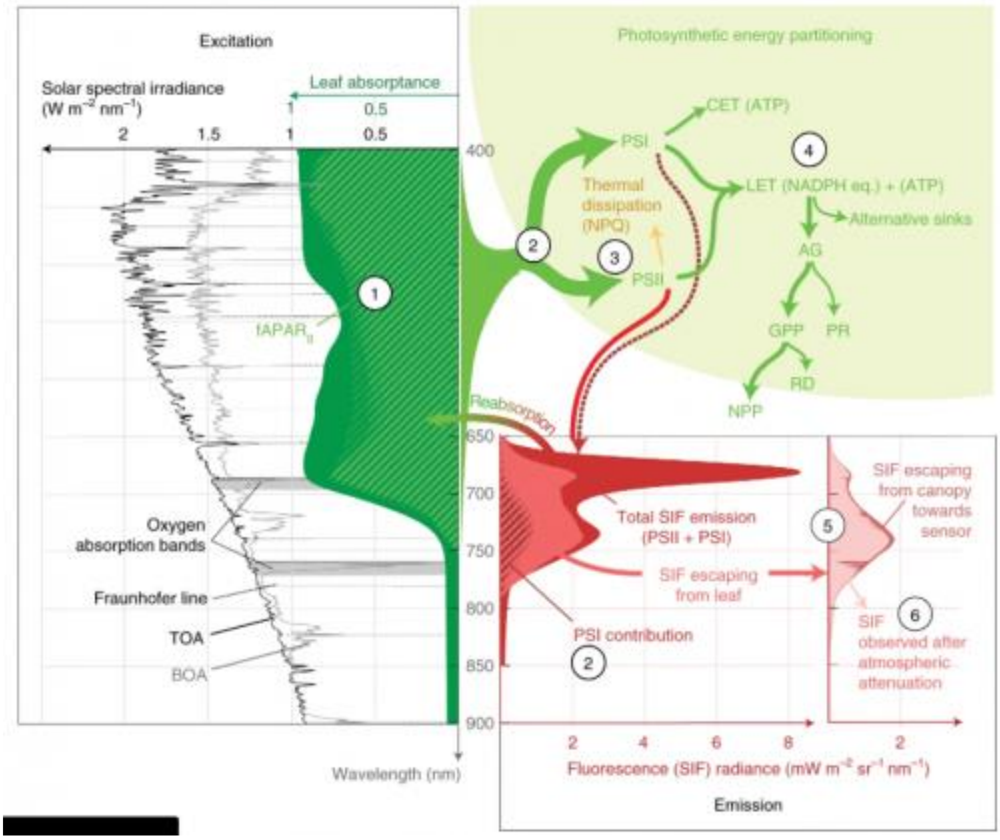
3rd Aug

Porcar-Castell, A., Malenovský, Z., Magney, T., Van Wittenberghe, S., Fernández-Marín, B., Maignan, F., ... & Logan, B. (2021). Chlorophyll a fluorescence illuminates a path connecting plant molecular biology to Earth-system science. *Nature Plants*, 1-12.

Fig. 1: From incoming radiation to observed SIF and photosynthesis: mechanistic challenges.

From: Chlorophyll a fluorescence illuminates a path connecting plant molecular biology to Earth-system science



I think this is really nice perspective paper. The interesting point was that they listed up the challenge of SIF field as 1) APARgreen, 2) Distribution of excitation energy between PSII and PSI and their ChlF emissions, 3) Energy partitioning in PSII, 4) Alternative energy sinks, 5) leaf and canopy ChlF scattering, reabsorption and measurement geometry, 6) Atmospheric absorption and scattering, 7) Integrating SIF controls across space and time.

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2nd Aug

Jonard, F., De Canniere, S., Brüggemann, N., Gentine, P., Gianotti, D. S., Lobet, G., … & Vereecken, H. (2020). Value of sun-induced chlorophyll fluorescence for quantifying hydrological states and fluxes: Current status and challenges. *Agricultural and Forest Meteorology*, *291*, 108088.

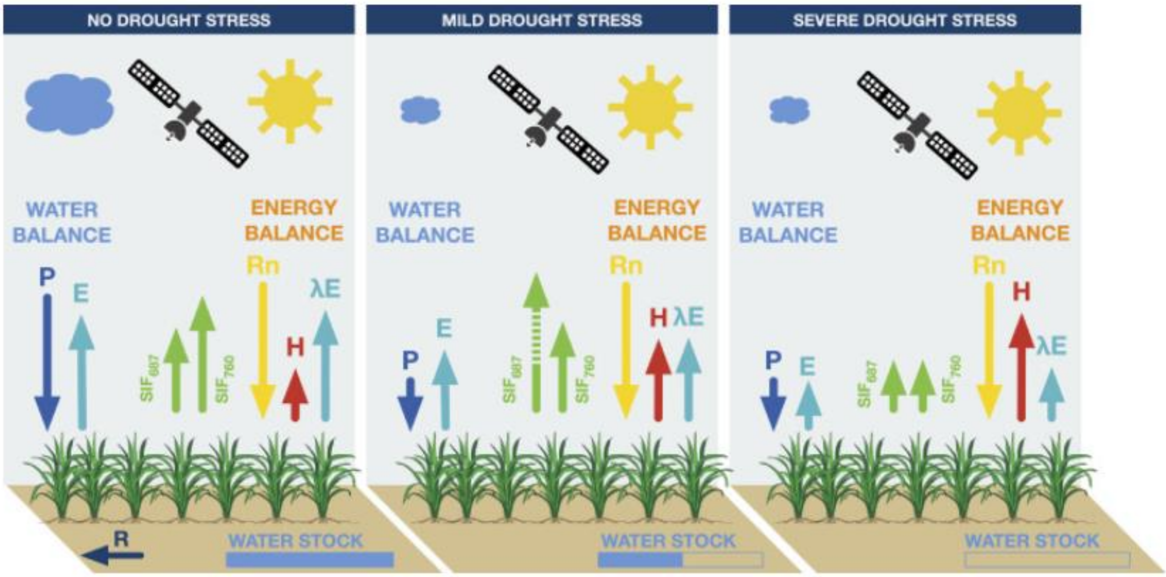

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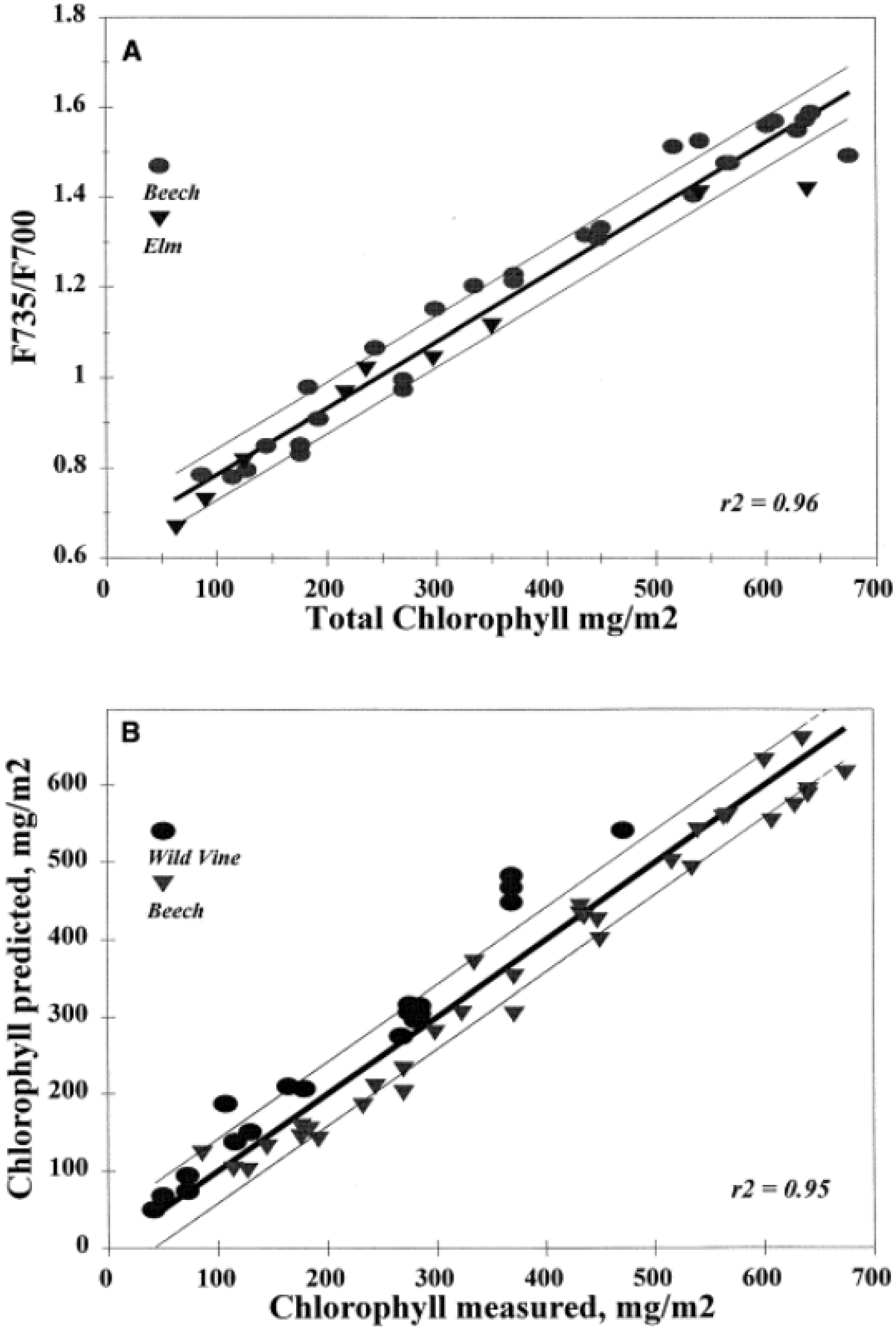
Fig. 6. Possible impact of soil water status on the water and energy balance and sun-induced chlorophyll fluorescence (SIF) at 687 nm and 760 nm (P: precipitation; E: evaporation; λE: latent heat flux; H: sensible heat flux; Rn: net radiation; R: runoff).

I think this paper was well-reviewed about sun-induced chlorophyll fluorescence for quantifying hydrological states and fluxes: Current status and challenges. In this paper, the author said, "Remote sensing of SIF may improve early detection of drought stress." "Remote sensing of SIF holds potential to improve transpiration monitoring." and "Integrating fluorescence in hydrological models may improve model estimations and predictions." In addition, I found that some interesting point that the response of phiF in leaf-level and canopy-level could be different as PAM-studies report an initial increase in ϕ_F caused by the decrease in photosynthesis, under mild stress conditions (Chen et al., 2018; van der Tol et al., 2014). However, in canopy-scale studies, stress results in a decrease in SIF_{760} (e.g., Wieneke et al., 2018; Wohlfahrt et al., 2018).   I think it is quite an interesting result for me. I guess the canopy-level SIF could be influenced by leaf-angle (canopy structural changes) and in leaf-level increased phiF is related to decreased phis2 yield.

——————————————————————

1st Aug

Gitelson, A. A., Buschmann, C., & Lichtenthaler, H. K. (1999). The chlorophyll fluorescence ratio F735/F700 as an accurate measure of the chlorophyll content in plants. *Remote Sensing of Environment*, *69*(3), 296-302.



Nowadays, I am curious about the ratio of red and far-red SIF. They found that the ratio of ChlF could be a useful tool to estimate chlorophyll content. The ratio between chlorophyll fluorescence at 735 nm and in the range 700–710 nm, F_{735}/F_{700} was found to be linearly proportional to the chlorophyll content (with determination coefficient, r^2, more than 0.95), and, thus, this ratio can be used as a precise indicator of chlorophyll content in plant leaves. This new chlorophyll fluorescence ratio indicates chlorophyll levels with high precision- the error in chlorophyll prediction over a wide range of chlorophyll content (from 41 to 675 mg m^{-2}) was less than 40 mg m^{-2}.

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4th July

Magney, T. S., Frankenberg, C., Köhler, P., North, G., Davis, T. S., Dold, C., … & Porcar-Castell, A. (2019). Disentangling changes in the spectral shape of chlorophyll fluorescence: Implications for remote sensing of photosynthesis. *Journal of Geophysical Research: Biogeosciences*, *124*(6), 1491-1507.

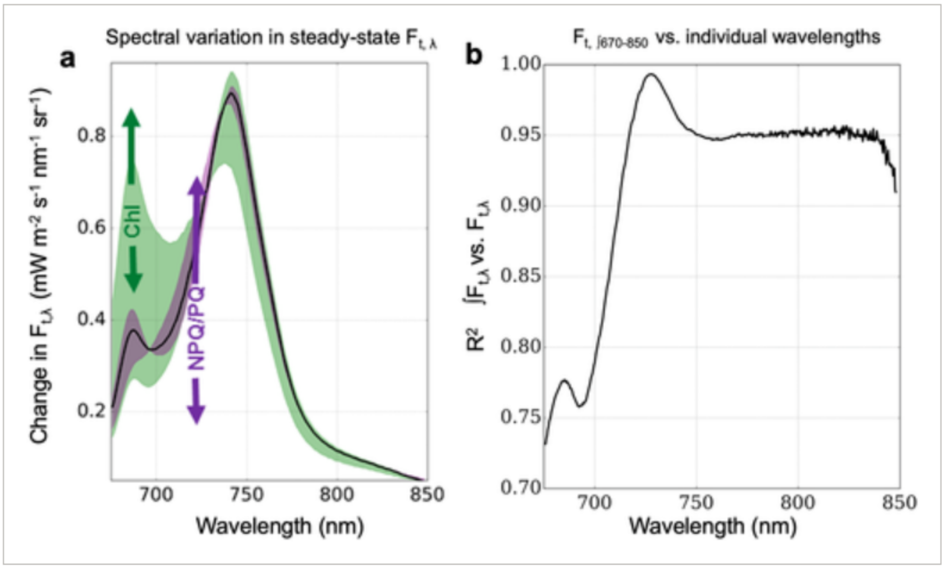

Figure 2 Open in figure viewer | PowerPoint

Summary of expected changes in the ChlF emission spectrum from across species at steady state (from Experiment 1). (a) The expected spectral changes in radiance units associated with PC2 and PC3, the first, which we attribute to changes in chlorophyll concentration (green), and the latter which we attribute to changes in NPQ (purple). The solid line refers to the mean spectral shape across all samples. (b) Coefficient of

I think this paper will be my one of key paper about leaf-level ChlF. They found that the spectral shape of ChlF was changed with leaf-level condition such as Chl and NPQ/PQ. (Chlorophyll concentration and nonphotochemical quenching control 9% and 3% of the remaining spectral variance, respectively.) They found that the spectral shape of fluorescence is remarkably stable where most current satellite retrievals occur ("far-red," >740nm), and dynamic downregulation of photosynthesis reduces fluorescence magnitude similarly across the 670- to 850-nm range. That means far-red SIF could be stable.

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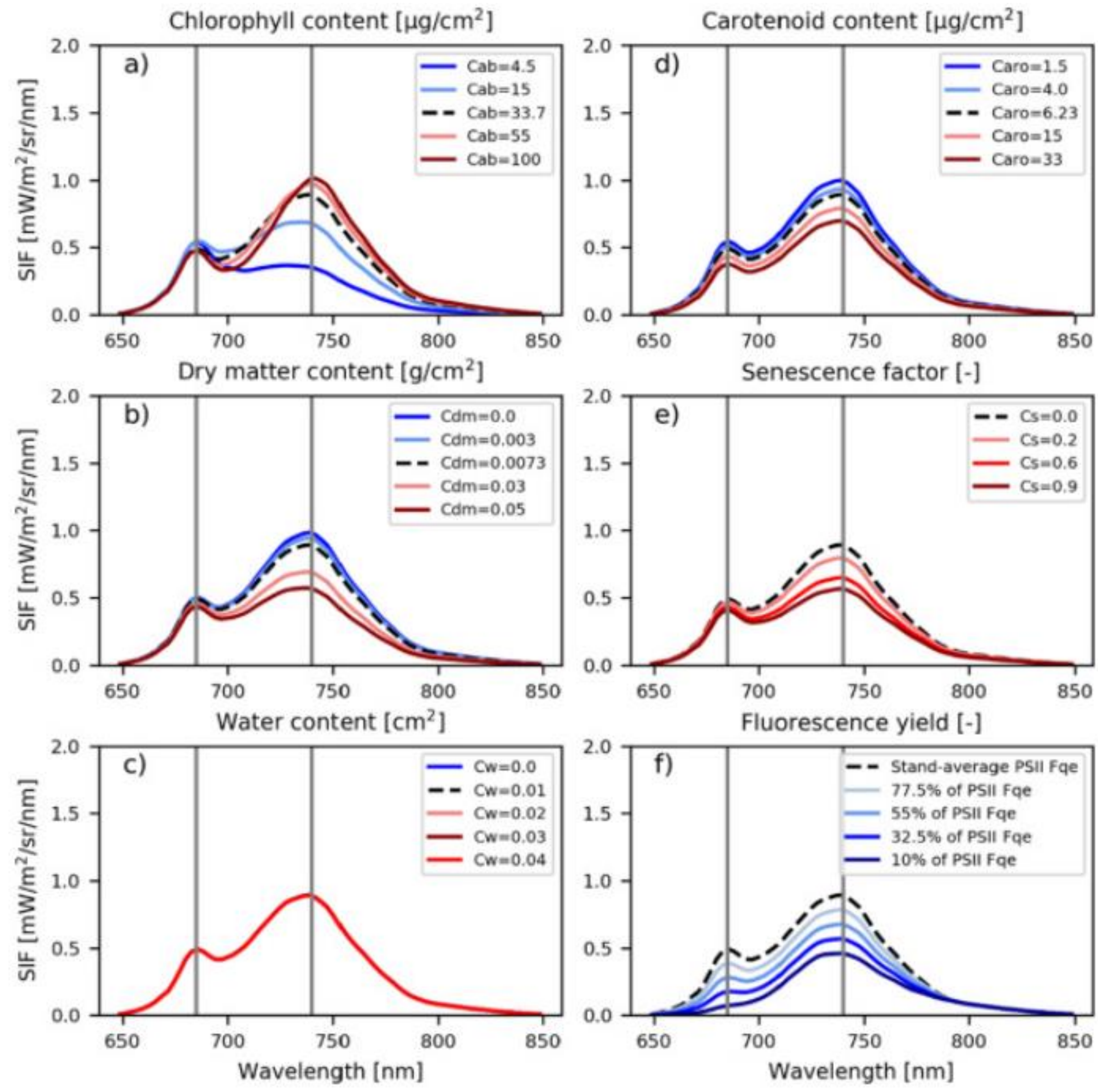
3rd July

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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I think this paper is quite interesting to see the farred and red SIF ratio. DART simulated red TOC fluorescence was found to be less affected by biochemical factors such as chlorophyll and dry matter contents or the senescent factor than far-red fluorescence. Quite interesting! Red SIF is more stable? In contrast, canopy structural factors such as overstory leaf area index (LAI), leaf angle distribution and fractional cover had a substantial and comparable impact across all SIF wavelengths, with the exception of understory LAI that affected predominantly far-red fluorescence.

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2nd July

Tol, C. V. D., Verhoef, W., Timmermans, J., Verhoef, A., & Su, Z. (2009). An integrated model of soil-canopy spectral radiances, photosynthesis, fluorescence, temperature and energy balance. *Biogeosciences*, *6*(12), 3109-3129.

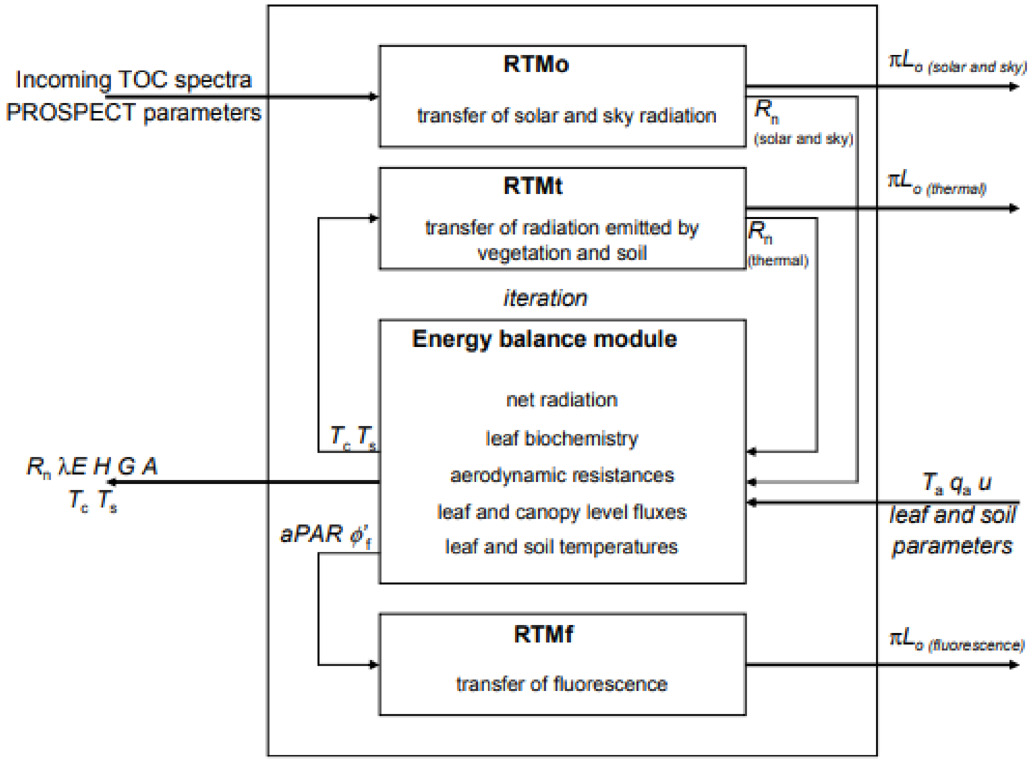

Fig. 1. Schematic overview of the SCOPE model structure.

I think it is time to study the SCOPE.   I am thinking that the relationship between leaf-level fluorescence and canopy-level SIF will be different according to SIF retrieval methods.

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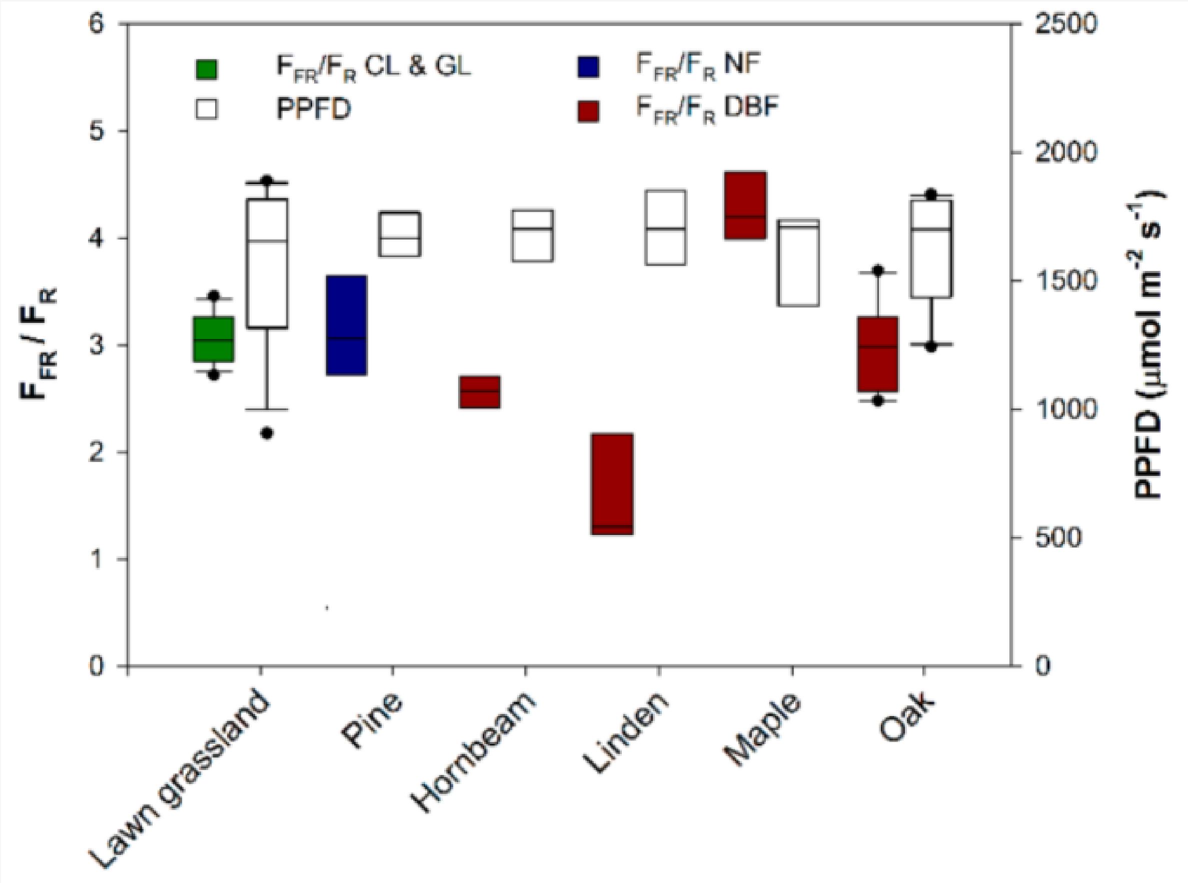
1st July

Rossini, M., Meroni, M., Celesti, M., Cogliati, S., Julitta, T., Panigada, C., ... & Colombo, R. (2016). Analysis of red and far-red sun-induced chlorophyll fluorescence and their ratio in different canopies based on observed and modeled data. *Remote Sensing*, *8*(5), 412.

Figure 3. Plot of the median, 10th, 25th, 75th and 90th percentiles as vertical boxes of the ratio between F_{FR} and F_R estimated at canopy level (full bars). Empty bars refer to the incident photosynthetic photon flux density (PPFD) expressed in $\mu mol \cdot m^{-2} \cdot s^{-1}$. The statistics refer to 20 samples for each species. CL: cropland, GL: grassland, NF: Needleleaf Forest, DBF: Deciduous Broadleaf Forest.



Nowadays, I could see there were a lot of papers about far red and red chlorophyll fluorescence ratio. I think I could not find some paper about the relationship between SIF retrieval method and chlorophyll fluorescence shape. I think this paper will be useful to write an introduction or discussion.

———————————————————

4th June

Middleton, E. M., Julitta, T., Campbell, P. E., Huemmrich, K. F., Schickling, A., Rossini, M., … & Alonso, L. (2015, July). Novel leaf-level measurements of chlorophyll fluorescence for photosynthetic efficiency. In *2015 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)* (pp. 3878-3881). IEEE.

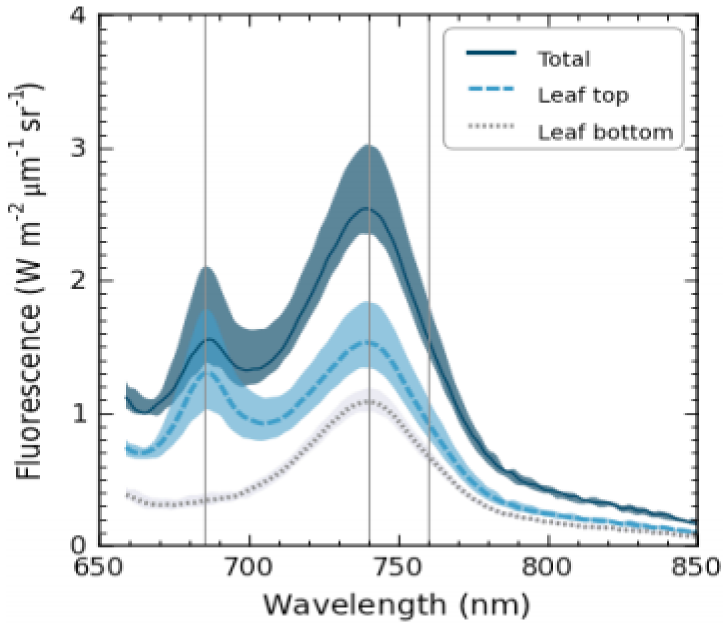


Fig. 1. Chlorophyll fluorescence emitted from corn leaves was measured using the FluoWat leaf clip and an ASD spectrometer July 30, 2014 in Beltsville, MD, USA. The values are the average of 4 leaves from an irrigated plot without supplemental nitrogen fertilization. The blue dashed line is the fluorescence emitted from the solar illuminated leaf top, the gray dashed line is the fluorescence emitted from the leaf bottom (transmitted away from the illumination), and the solid blue line is the total fluorescence emitted from the whole leaf (Top + Bottom). The vertical lines represent the two Red and Far-Red peak wavelengths 685 nm 740 nm, and at the position of the Far-Red SIF retrieval wavelength, centered at 760 mn.

I think I should measure transmitted F also. Quite interesting values. I noticed that the bottom F shape is quite weird. It would be interesting IF I checked the transmitted F.

———————————————————

3rd June

Van Wittenberghe, S., Alonso, L., Verrelst, J., Hermans, I., Delegido, J., Veroustraete, F., ... & Samson, R. (2013). Upward and downward solar-induced chlorophyll fluorescence yield indices of four tree species as indicators of traffic pollution in Valencia. *Environmental Pollution*, *173*, 29-37.

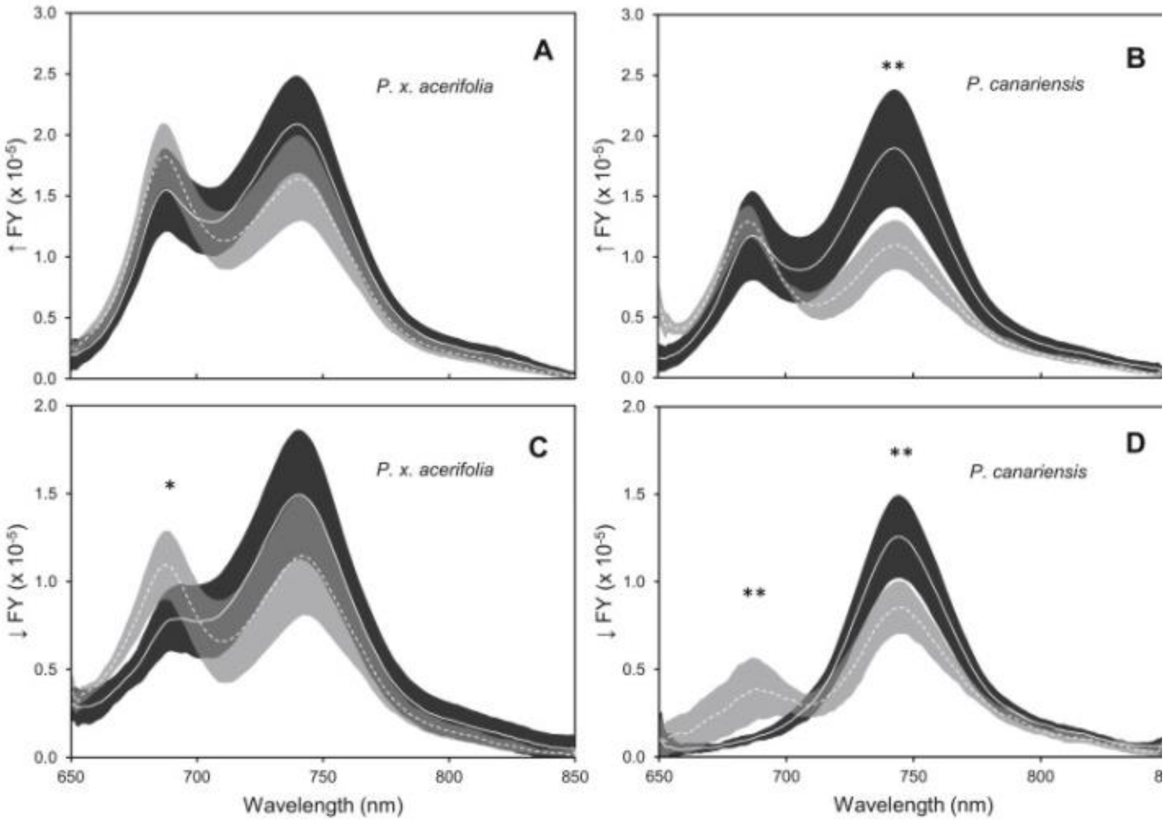


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Fig. 7. Upward and downward fluorescence yield (↑FY, ↓FY) of *P. x acerifolia* (panels A and C) and *P. canariensis* (panels B and D) for Low (——) and High (- - - -) traffic emission exposure; bands indicate standard deviation; significantly different peaks (at 687 or 741 nm) between traffic exposure classes are indicated by $*p < 0.05$ and $**p < 0.01$.

I think this paper really well organized and I guess first paper about Fluowat. I am quite surprised that the spectral shape of F was different according to species.

———————————————————

2nd June

Aasen, H., Van Wittenberghe, S., Sabater Medina, N., Damm, A., Goulas, Y., Wieneke, S., ... & Mac Arthur, A. (2019). Sun-induced chlorophyll fluorescence II: review of passive measurement setups, protocols, and their application at the leaf to canopy level. *Remote Sensing*, *11*(8), 927.

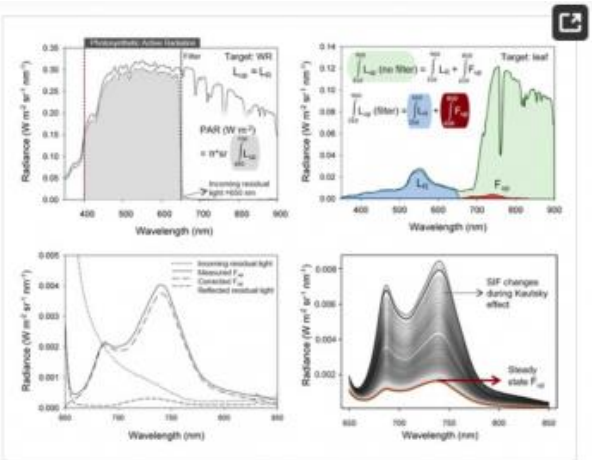

Figure 3. FluoWat leaf clip measurements for incoming radiance with and without filter and the corresponding received PAR calculation (up, left), upward radiance flux (L_{up}) typically measured perpendicularly to the illuminated adaxial leaf surface (up, right) (modified from [63]), correction for light contaminating the F signal (here: reflected residual light transmitted by the filter) by subtracting the light contamination from the measured upward emitted fluorescence (F_{up}) (down, left), and illustration of the dynamic F signal during sudden incoming radiance changes shown for a dark-adapted leaf (down, right).

Back to Top

I think this paper is well described in SIF and fluorescence. I like the below sentence for Fluowat as the F signal, however, needs further processing. If the used band-pass filter does not cut off the light sharply at 650 nm (to be verified with a WR target measurement), some residual light may pass through the filter and add to the F_{up} signal as reflected residual light, calculated as the residual light passing the filter times the calculated leaf reflectance. After removal of this reflected residual light, the F_{up} is added to the F_{dw} signal, giving the total F leaving the leaf's surface.

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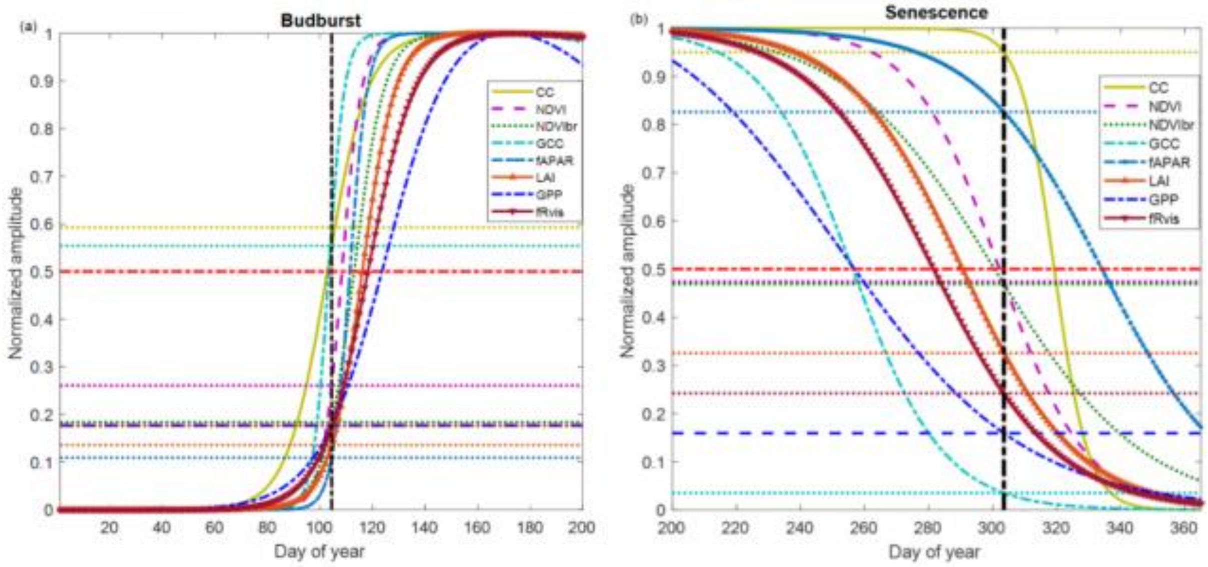
1st June

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.



I think this paper also could be useful when I write the GDK phenology manuscript. They found that 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) of less than 4 d. I could see there is a large variation between each variable. They said that using an asymmetric double sigmoid function (ADS)-based phenology extraction method led to results showing that this potential is different depending on the method and the season. I think for GPP, the new method should be presented. In this paper, I could see that the GPP also showed a weird seasonal pattern compared to other variables.

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4th May

Shang, R., Liu, R., Xu, M., Liu, Y., Zuo, L., & Ge, Q. (2017). The relationship between threshold-based and inflexion-based approaches for extraction of land surface phenology. *Remote Sensing of Environment*, *199*, 167-170.

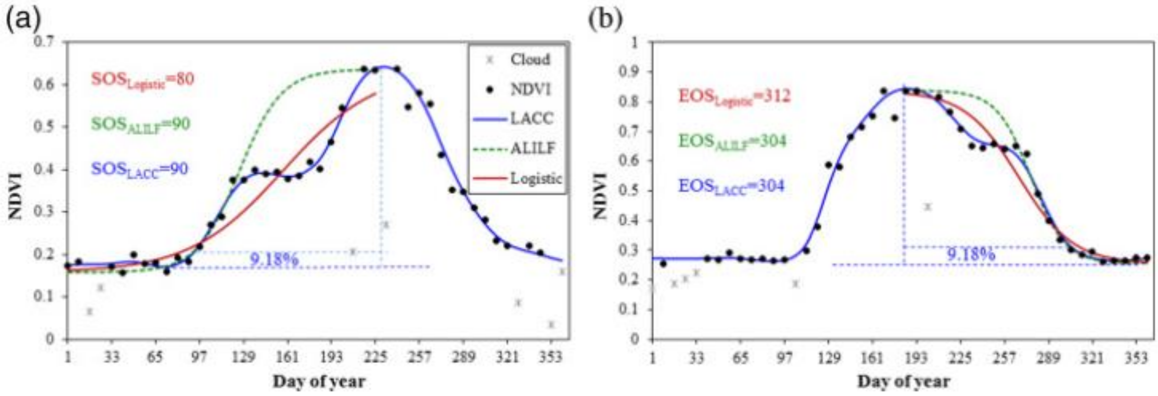

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Fig. 4. Two examples for application of the threshold-based approach with threshold of 9.18% to extract the SOS and EOS. (a) mixture of grassland and forest in 2004 (36.75°N, 110.29°E); (b) vegetation under the summer water stress in 2003 (41.22°N, 118.20°E).

I think this paper will be really useful when I write the introduction. They investigated the relationship of the inflexion-based and threshold-based approach. They found that the threshold at the transitional point for SOS is 9.18%. In their introduction, I could see some references as below.

(LSP) at regional and global scales. Two approaches are broadly used to determine the timing of the start-of-season (SOS) and end-of-season (EOS) from satellite data. The first determines SOS and EOS as a predefined percentage of the vegetation growth amplitude (Jonsson and Eklundh, 2004) (hereafter referred as the threshold-based approach), and the second identifies SOS and EOS by using the transitional characteristics of the vegetation growth curve (Zhang et al., 2003) (hereafter referred the inflexion-based approach).

The SOS for the two approaches was previously found to differ by up to ± 60 days (White et al., 2009). For example, the SOS from the threshold-based approach (50% of vegetation growth amplitude) occurs considerably later (> 3 weeks) than that with the inflexion-based method in the eastern part of the United States (de Beurs and Henebry, 2010). The SOS acquired using the inflexion-based approach represents the vegetation growth transition from one approximately linear stage to another (Zhang et al., 2003). However, some vegetation growth trajectories cannot be fitted well with a logistic function (Cao et al., 2015), which prevents an inflexion point from being determined correctly. The threshold-based approach can extract SOS from a variety of vegetation growth trajectories. However, the threshold was arbitrarily set to extract SOS in terms of vegetation growth amplitude: 10% (Wu et al., 2014), 20% (Jonsson and Eklundh, 2004), 30% (Verger et al., 2016) or 50% (White et al., 1997).

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3rd May

Bórnez, K., Descals, A., Verger, A., & Peñuelas, J. (2020). Land surface phenology from VEGETATION and PROBA-V data. Assessment over deciduous forests. *International Journal of Applied Earth Observation and Geoinformation*, *84*, 101974.

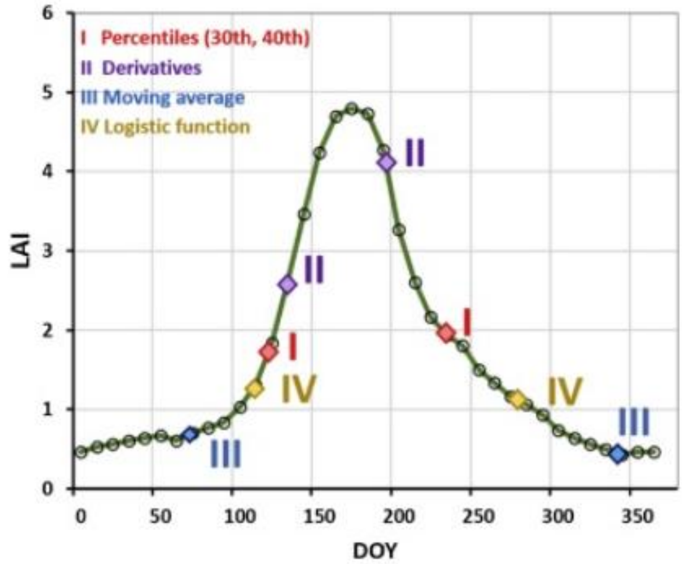

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Fig. 3. Schematic representation of SoS (on the left of the peak) and EoS (on the right of the peak) retrieved with the four methods for the PEP725 site 4959 (50°42′20.49″N, 13°46′59.55″E) for 2011. The black circles correspond to the original LAI data at a 10-d frequency, and the green line corresponds to the data interpolated at daily steps, which is used for phenological estimation.

The autrhos used LAI to extract phenology. They found that the threshold method, using the 30th percentile, performed the best for SoS. The threshold method, using the 40th percentile, performed the best for EoS.

————————————————————

2nd May

White, K., Pontius, J., & Schaberg, P. (2014). Remote sensing of spring phenology in northeastern forests: A comparison of methods, field metrics and sources of uncertainty. *Remote Sensing of Environment*, *148*, 97-107.

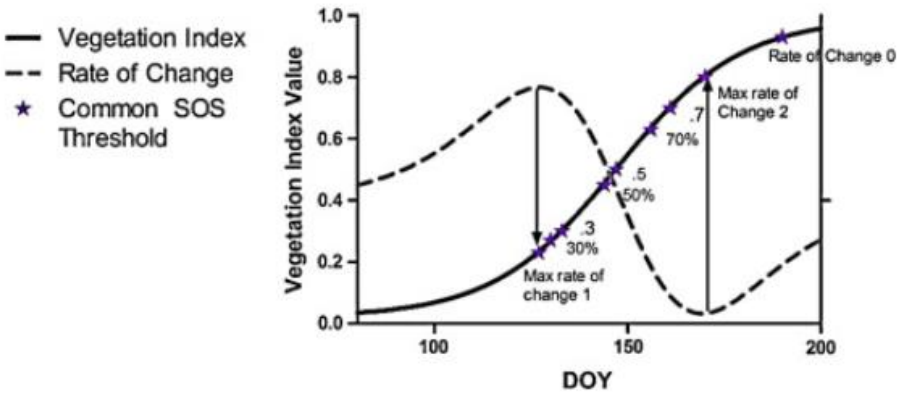

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Fig. 2. The nine common start of spring (SOS) thresholds derived from interpolated vegetation index curves that were compared to field phenology rankings for accuracy assessment.

In this paper, the authors tested five vegetation indices, five mathematical fits to model a continuous temporal response, and a suite of threshold estimates for "start of spring/season" (SOS) assessments were compared to field measurements of bud burst stage and hemispherical photo derived canopy structural metrics (transparency, leaf area index, greenness). The results indicated that a four-parameter logistic model based on at least five spring coverages of the Enhanced Vegetation Index (EVI) and a SOS threshold of 0.3 was most closely related to field metrics and most accurate in predicting the date of full leaf out. "*Remote sensing methods provide this scale of analysis but need to represent meaningful phenology events as seen in the field, with appropriate guidance for interpretation of the accuracy of results.*"

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1st May

Pontailler, J. Y., Hymus, G. J., & Drake, B. G. (2003). Estimation of leaf area index using ground-based remote sensed NDVI measurements: validation and comparison with two indirect techniques. *Canadian Journal of Remote Sensing*, *29*(3), 381-387.

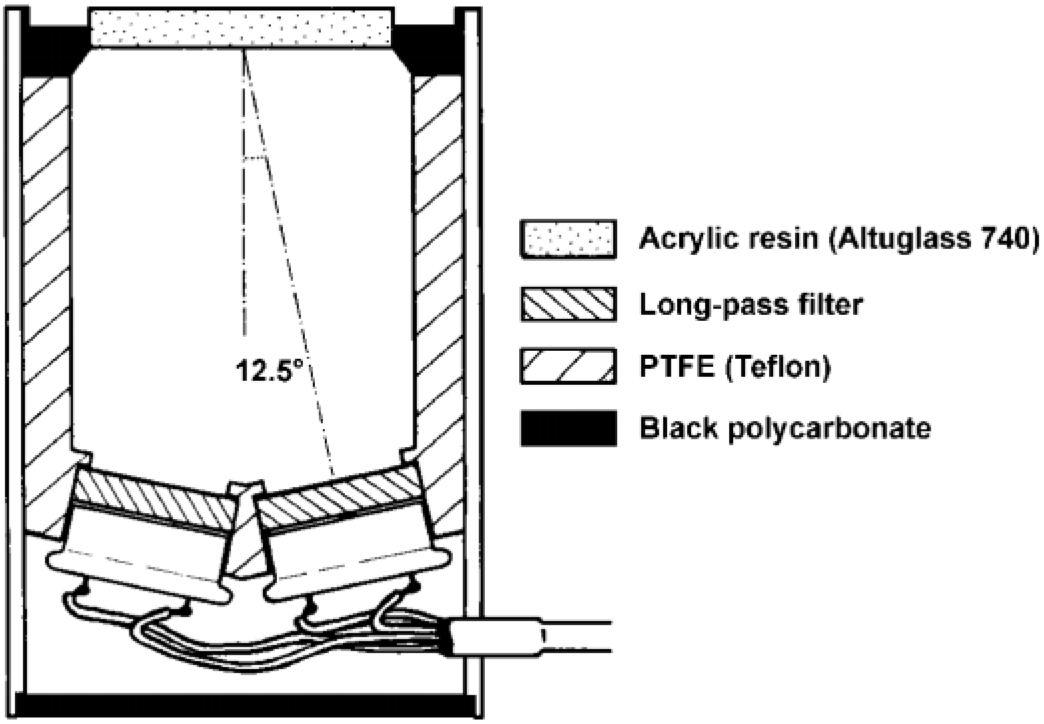

Figure 1. Longitudinal section of the NDVI hand-held sensor (length 55 mm, diameter 42 mm).

I think the LED system is not that novel now... Very interesting that there is long history of photodiode system to measure NDVI. Vegetation reflectance was measured in situ with a laboratory-made sensor in the red (640–665 nm) and near-infrared (750–950 nm) bands to calculate the normalized difference vegetation index (NDVI) and derive the leaf area index (LAI). LAI estimates from this technique were compared with two other nondestructive techniques, intercepted photosynthetically active radiation (PAR) and hemispherical photographs, in four contrasting 4 m2 plots in February 2000 and two 4 m2 plots in June 2000. We used Beer's law to derive LAI from PAR interception and gap fraction distribution to derive LAI from photographs.

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4th April

Pontailler, J. Y., & Genty, B. (1996). A simple red: far-red sensor using gallium arsenide phosphide detectors. *Functional Ecology*, 535-540.

I did not know this paper! They used photodiode to measure NDVI!!!

Summary

1. A low-cost portable instrument was designed to measure the red:far-red ratio (660:730 nm) and photosynthetically active radiation (PAR, 400–700 nm). The sensor head comprises three gallium arsenide phosphide photodiodes associated with tinted-glass filters.
2. Such detection takes advantage of the spectral response curves of these diodes, which provide a narrow bandpass response when combined with an appropriate filter. No interference filtering and no amplification is required. The output is displayed on a battery-powered unit enclosing two digital voltmeters for both PAR and red:far-red ratio readings.
3. The unit is easy to produce and requires no knowledge of electronics. The instrument was tested under field conditions against a spectroradiometer.
4. This approach may provide a basis to assess other spectral vegetation indices such as NDVI.

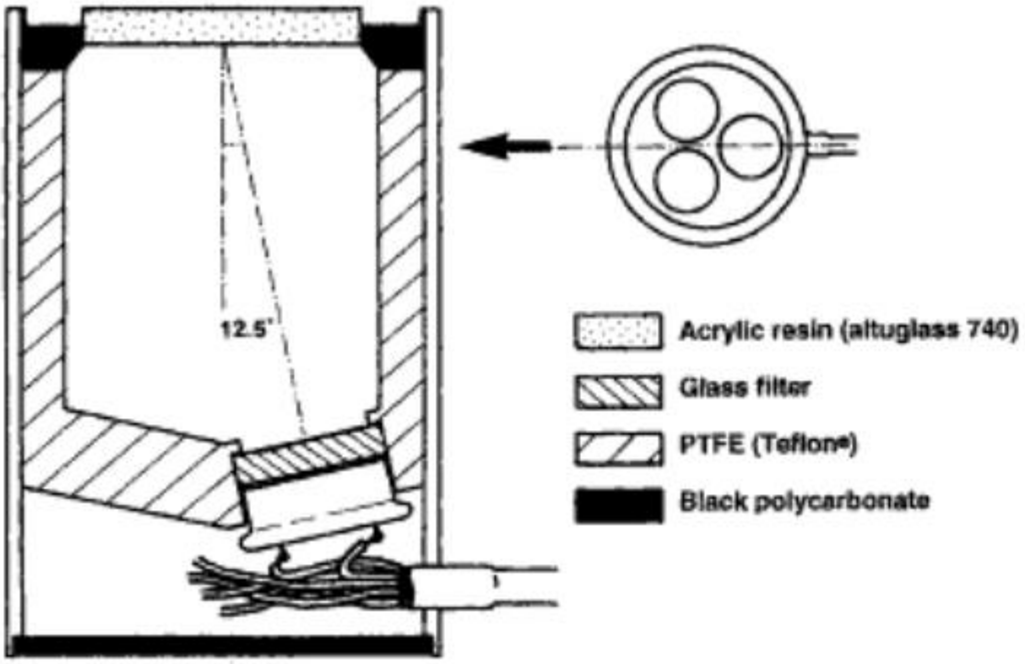

Fig. 2. Cross-section of the sensor. The top view on the right shows that only one diode appears on the cross-section.

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3rd April

Soudani, K., Hmimina, G., Delpierre, N., Pontailler, J. Y., Aubinet, M., Bonal, D., … & Dufrêne, E. (2012). Ground-based Network of NDVI measurements for tracking temporal dynamics of canopy structure and

vegetation phenology in different biomes. *Remote sensing of environment*, *123*, 234-245.

2.2. NDVI sensor description and *in situ* NDVI measurements

NDVI sensors installed on the towers of different sites are laboratory-made according to Pontailler and Genty (1996) and Pontailler et al. (2003) design. The body of the sensor is made of Teflon® installed into a stainless steel cylinder having a diameter of 3.8 cm and a height of 9 cm. The upper part of the sensor body has a 5 mm thick acrylic diffuser (Altuglass® 740, Altulor, France). The body of the sensor is equipped with two photodiodes having spectral sensitivity in red and near infrared bands, respectively centred on 640 nm and 720 nm. The red channel uses a large gallium arsenide phosphide photodiode (G1117 GaAsP, Hamamatsu Photonics, Hamakita, Japan) and a long-pass glass filter (RG 645, Schott Glaswerke, Mainz, Germany) allowing a sharp cut-off below 640 nm. The near infrared channel uses a silicon photodiode (S1226 44BK, Hamamatsu Photonics) and a long pass glass filter (RG 780, Schott Glaswerke) allowing a sharp cut-off below 770 nm. The two detectors were facing the diffuser. Their pins were directly welded onto a screened cable that linked the sensor to the central unit. Current was converted to voltage with shunt resistors. To provide a high sensitivity, the value of the resistors was selected as high as possible without affecting signal linearity (10 and 2 kΩ). As a result, no amplification was necessary.

I did not know this paper. They presented the photodiode + filter system to monitor NDVI. The authors provide an accurate description of the seasonal dynamics of vegetation cover in these different ecosystems (2) we identify the most relevant remotely sensed markers from NDVI time-series for determining the dates of the main phenological events that characterize these ecosystems and (3) we discuss the relationships between temporal canopy dynamics and climate factors. In addition to its importance for phenological studies, this ground-based Network of NDVI measurement.

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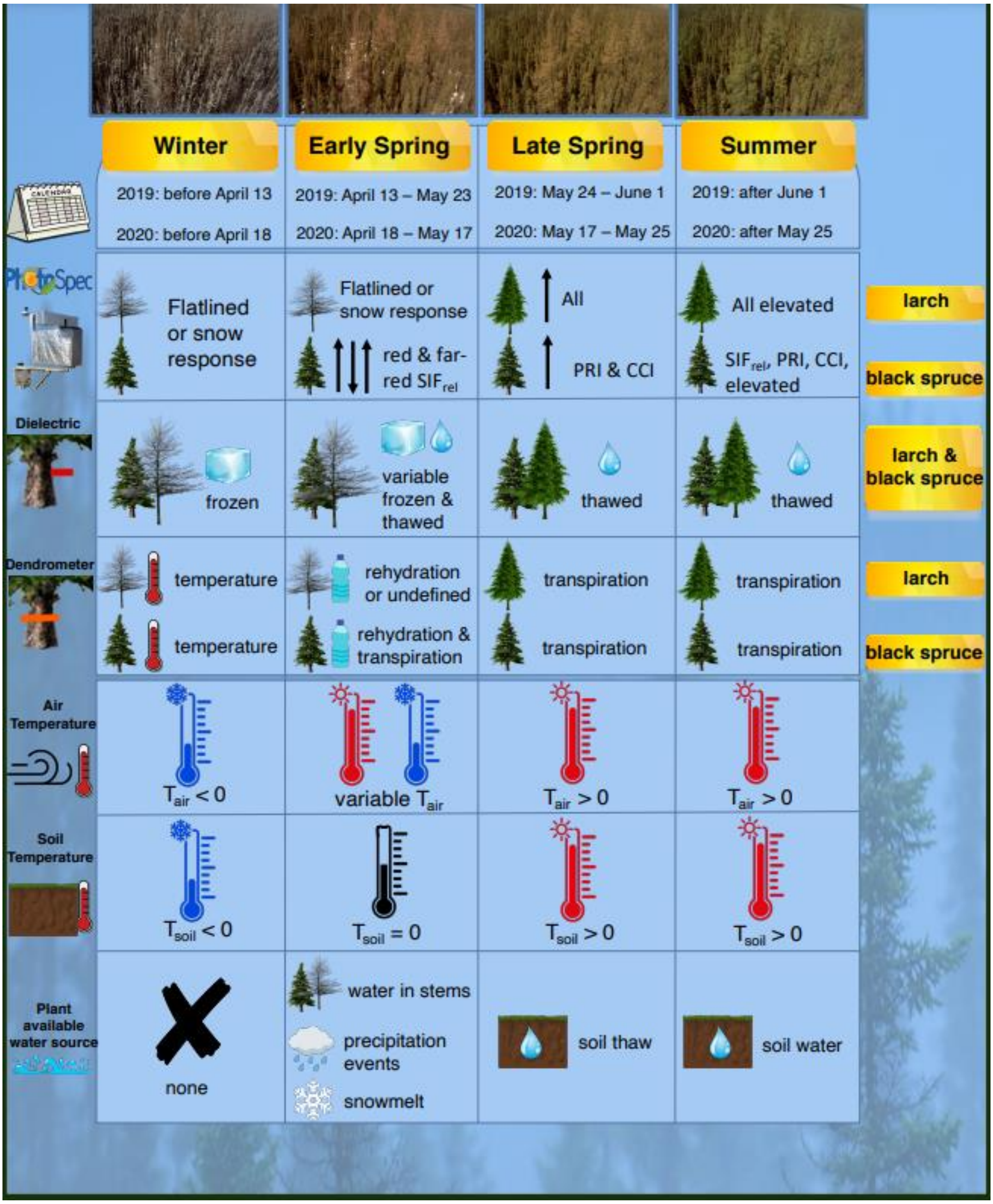
2nd April

Pierrat, Z., Nehemy, M. F., Roy, A., Magney, T., Parazoo, N. C., Laroque, C., ... & Stutz, J. Tower-based remote sensing reveals mechanisms behind a two-phased spring transition in a mixed-species boreal forest. *Journal of Geophysical Research: Biogeosciences*, e2020JG006191.



The authors collected tower-based remotely sensed data (reflectance-based vegetation indices and Solar-Induced Chlorophyll Fluorescence (SIF)), stem radius measurements, gross primary productivity, and environmental conditions in a boreal mixed forest stand. The first phase is the reactivation of photosynthesis and transpiration in evergreens, marked by an increase in relative SIF, and is triggered by thawed stems, warm air temperatures and increased available soil moisture. The second phase is a reduction in bulk photoprotective pigments in evergreens, marked by an increase in the Chlorophyll-Carotenoid Index. Deciduous leaf-out occurs during this phase, marked by an increase in all remotely sensed metrics. The second phase is controlled by soil thaw. Therefore, they said remote sensing metrics can be used to detect specific physiological changes in boreal tree species during the spring transition.

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1st April

Wu, W., Epstein, H. E., Guo, H., Li, X., & Gong, C. (2021). A pigment ratio index based on remotely sensed reflectance provides the potential for universal gross primary production estimation. *Environmental Research Letters*.

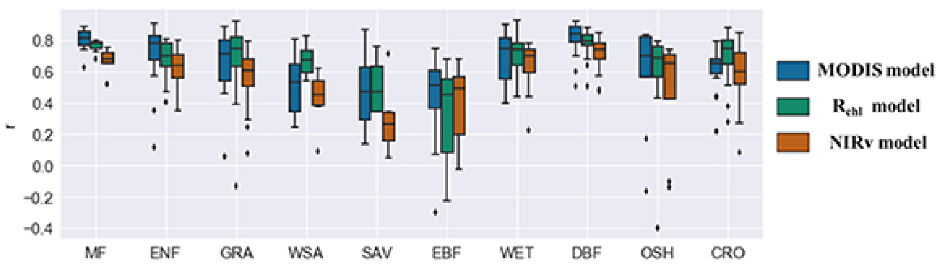

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Figure 2. Comparison of GPP derived with the MODIS model, R_{chl} model (equation (7)), and NIRv model (equation (11)) against flux tower GPP. Labels on the *x*-axis refer to IGBP PFTs (CRO—croplands; DBF—deciduous broadleaf forests; EBF—evergreen broadleaf forests; ENF—evergreen needleleaf forests; GRA—grasslands; MF—mixed forests; OSH—open shrublands; SAV—savannas; WET—permanent wetlands; WSA—woody savannas). Whiskers denote the 5th and 95th percentile of site-level Pearson correlation *r*, with markers indicating outlying sites. $p < 0.05$ except for site BR-Sa3 (EBF) and CN-Sw2 (GRA) of R_{chl} model; AR-Vir (ENF), AU-GWW (SAV), CN-SW2 (GRA), and ES-Ln2 (OSH) of MODIS model; AU-Rob (EBF) of NIRv model.

Download figure:

Standard image High-resolution image

I think this paper is really similar to my previous AGU poster. I made the NICE which is NIRv x CCI x PAR. They also used a similar model equation and they showed that the high R2 in the global scale. But, I am still thinking that NICE might be not enough for other PFT. Validated with over one hundred thousand field measurements, the model exhibited comparable accuracy to biome- and climate-based GPP models (r = 0.74 for both types of models), demonstrating satisfactory performance.

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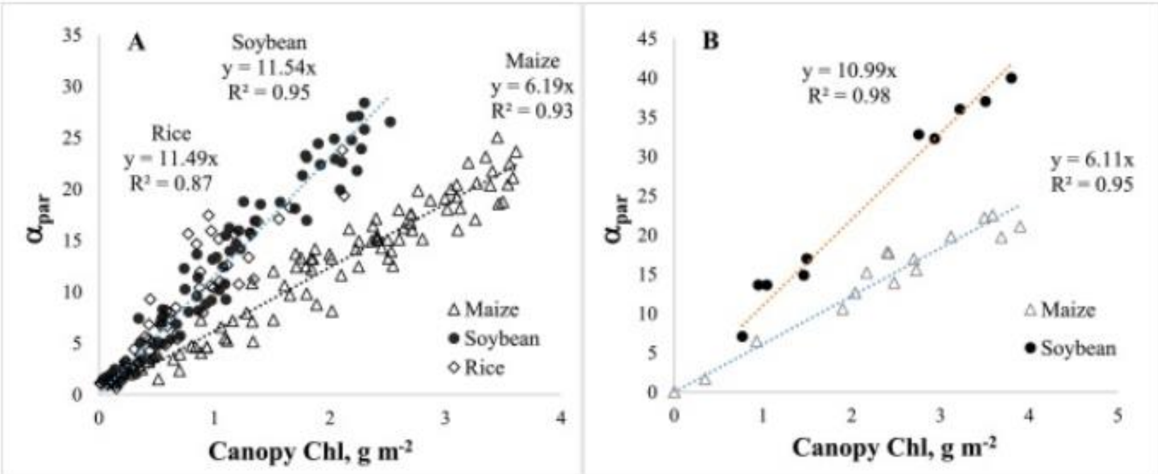
4th March

Gitelson et al., (2021). Evaluating plant photosynthetic traits via absorption coefficient in the photosynthetically active radiation region. ***Remote Sensing of Environment***



I think the first author is really crazy on estimating chlorophyll contents using spectral data. He made new index as Alpha_par. Absorption coefficient in the PAR region α_{par}, is retrieved from reflectance at close range and from Landsat imagery. α_{par} is closely related to fAPAR$_{green}$, and to leaf and canopy chlorophyll content. The high sensitivity of α_{par} to plant traits makes it suitable for monitoring photosynthesis rates across different species. Findings enable the use of global Landsat products to estimate photosynthetic status of terrestrial ecosystems.

I will try to incorporate Alpha_par with NICE later.

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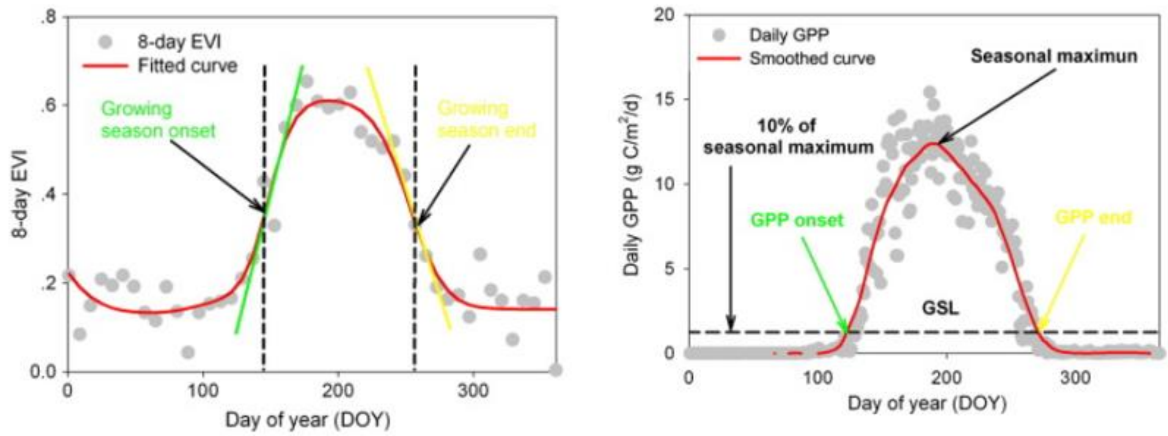
3rd March

Wu, C., Gonsamo, A., Gough, C. M., Chen, J. M., & Xu, S. (2014). Modeling growing season phenology in North American forests using seasonal mean vegetation indices from MODIS. ***Remote Sensing of Environment*, *147*, 79-88.**



If I could not find the optimal phenological phase detection method, I will cite this paper and then use different method for NDVI and GPP. In this paper, the interesting point is that widely used NDVI and EVI exhibited limited potential in tracking growing season phenology of ENF ecosystems, while indices sensitive to water (i.e., LSWI) or less influenced by soil (i.e., OSAVI) may have unrevealed powers in indicating phenological transitions. I think this paper could be used for showing the limitation of NDVI in ENF also.

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2nd March

Xie, Y., & Wilson, A. M. (2020). Change point estimation of deciduous forest land surface phenology. *Remote Sensing of Environment*, *240*, 111698.

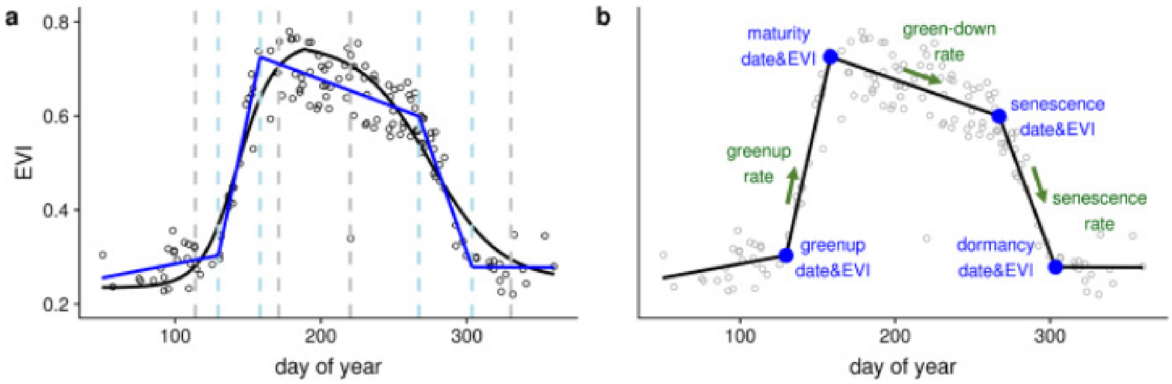

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Fig. 1. Demonstrations of LSP estimated from twice daily EVI time series data of an example MODIS pixel at Harvard Forest in MA, USA. a. Two methods (solid black: piecewise logistic fitting, and solid blue: change point estimation) were used. Vertical dashed lines indicate estimated four phenological transitions (greenup, maturity, senescence, and dormancy dates) for each method (grey: piecewise logistic fitting, and light blue: change point estimation). b. Multiple LSP metrics estimated using change point estimation method including four phenological transition dates, the EVI value on each transition date, and green-up, green-down, and senescence rates. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

I will try this method for phenological phase detection with GDK data set!!
There is a large (and unquantified) uncertainty in estimated phenological dates due to the relatively coarse temporal resolution of typical data and methodological limitations. The authors developed a new LSP estimation method using linear change point models to determine four phenological transitions using twice-daily Moderate Resolution Imaging Spectroradiometer (MODIS) Enhanced Vegetation Index (EVI) from 2000 to 2015. They evaluated the approach using long-term phenological ground observations and compare performance of four LSP estimations generated from two data sources (i.e. 8-day and twice daily EVI time series) and two methods (i.e. double logistic and change point estimation). We found that the phenology generated from change point estimation with twice daily EVI time series had the highest accuracy (i.e. lower Root Mean Square Error (RMSE), mean bias, and Mean Absolute Error (MAE)) for both spring and fall phenology evaluated by Harvard Forest phenology observations and a large citizen science database of phenological observations from the National Phenology Network. For example, change point estimation reduced the estimation error for fall senescence date from over 40 days in the standard MODIS phenology product (version 005) to 11.5–24 days of RMSE, −2.6 to −5.8 days of mean bias, and 7.9–20.1 days of MAE. The change point methodology also enables calculation of additional metrics to describe the biophysical process of vegetation, including rates of greenup, green-down, and senescence, EVI values at each phenological transition, and the estimation uncertainties for each transition date.

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1st March

De Frenne, P., Lenoir, J., Luoto, M., Scheffers, B. R., Zellweger, F., Aalto, J., ... & Hylander, K. (2021). Forest microclimates and climate change: Importance, drivers and future research agenda. *Global Change Biology*.

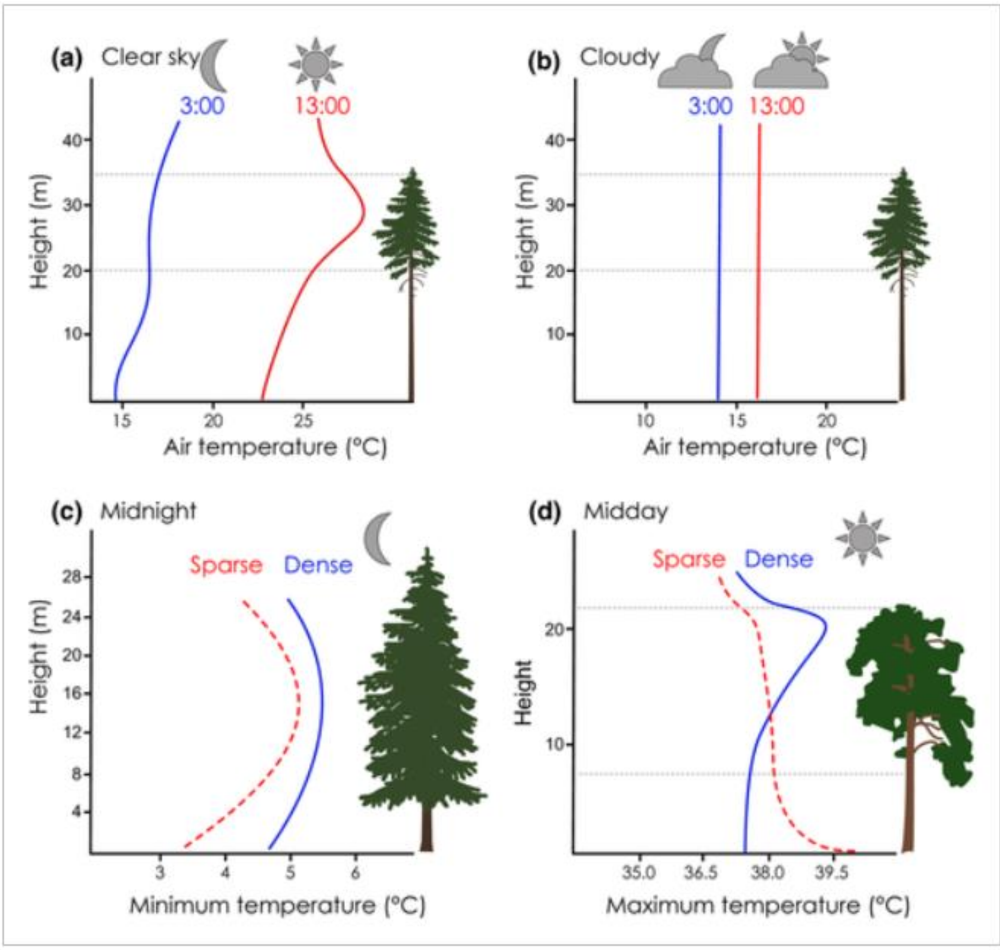

FIGURE 4 Open in figure viewer | PowerPoint

Typical vertical air temperature profiles inside forests of various canopy structure, for clear sky (a) or cloudy (b) conditions, and during the night-time (c) and daytime (d). These examples are based on, for example, Raupach (1989), Ogée et al. (2003), Brower et al. (2011) and Schilperoort et al. (2020)

The authors reviewed how spatial and temporal variation in forest microclimates result from an interplay of forest features, local water balance, topography and landscape composition. In addition, they explained how macroclimate warming (of the free atmosphere) can affect microclimates, and vice versa, via interactions with land-use changes across different biomes.
The research gap: Despite the potentially broad impact of microclimates on the response of forest ecosystems to global change, our understanding of how microclimates within and below tree canopies modulate biotic responses to global change at the species, community and ecosystem level is still limited.

Finding: I think the vertical profile of the temperature result was quite interesting and it could be used for reference in GDK phenology paper topic.

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4th Feb

van Moorsel, S. J. (2021). Born with a silver spoon: dandelion parents' life experiences affect the lives and afterlives of their offspring. *New Phytologist*, *229*(6), 3044-3047.

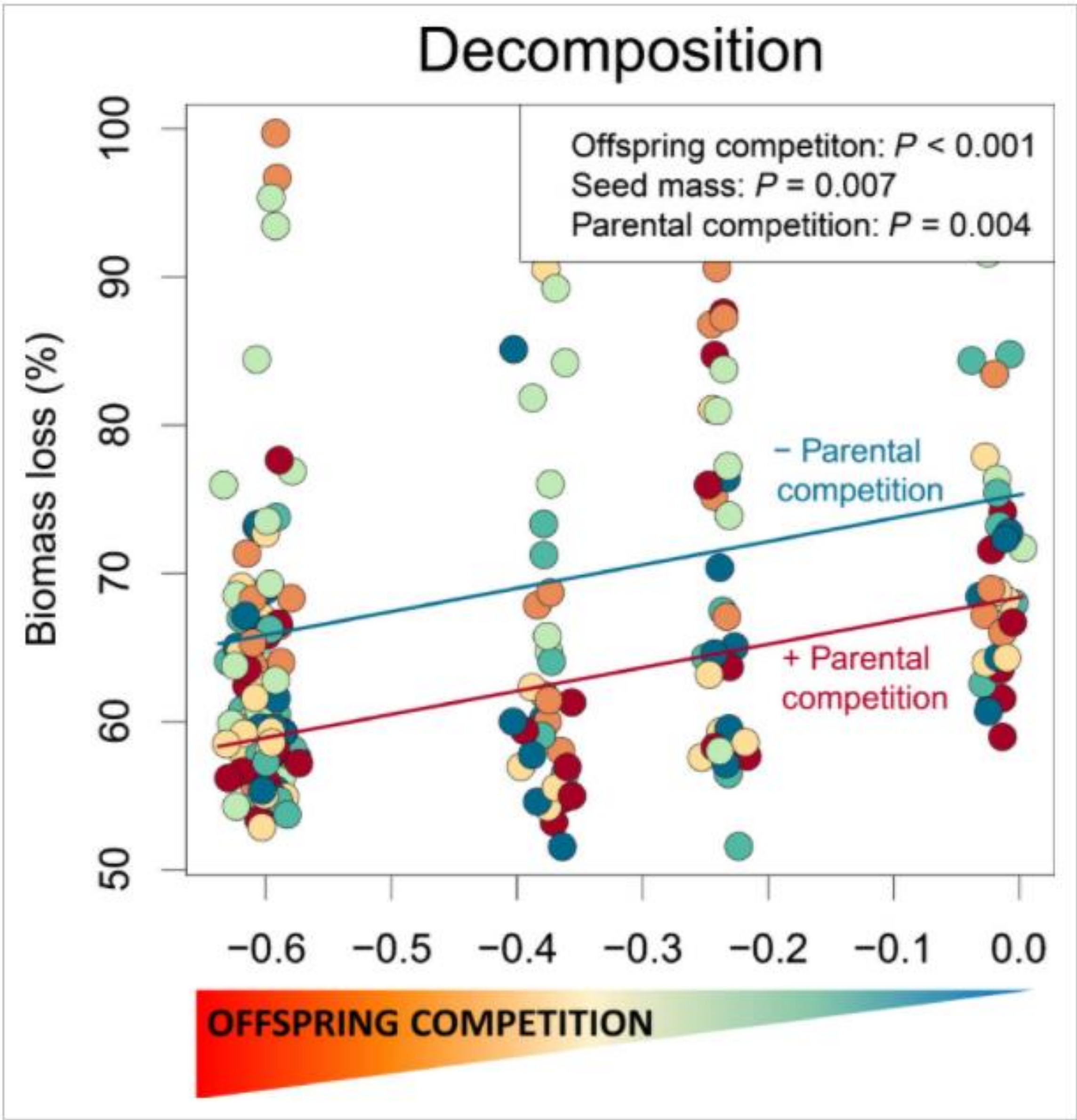

Fig. 4 Open in figure viewer | PowerPoint

Effect of offspring and parental competition on the leaf decomposability of the offspring (decomposition experiment). The different colours of the points, from blue to red tones, represent the gradient of

I think this title is really interesting. "Silver spoon". Nowadays, In Korea, especially young people, they usually talk about sliver (or soil) spoon or gold spoon. The actual original paper is that Puy, J., de Bello, F., Dvořáková, H., Medina, N. G., Latzel, V., & Carmona, C. P. (2020). Competition-induced transgenerational plasticity influences competitive interactions and leaf decomposition of offspring. *New Phytologist*. In the original paper, the authors found that by promoting differences in DNA methylation, offspring of plants under stronger competition developed faster and presented more resource-conservative phenotypes. Further, these adjustments associated with less degradable leaves, which have the potential to reduce nutrient turnover and might, in turn, favour plants with more conservative traits. Greater parental competition enhanced the competitive abilities of the offspring, by triggering adaptive phenotypic plasticity, and decreased offspring leaf decomposability. Our results suggest that competition-induced transgenerational effects could promote rapid adaptations and species coexistence and feedback on biodiversity assembly and nutrient cycling.

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3rd Feb

Peng, J., Wu, C., Wang, X., & Lu, L. Spring phenology outweighed climate change in determining autumn phenology on the Tibetan Plateau. ***International Journal of Climatology*****.**

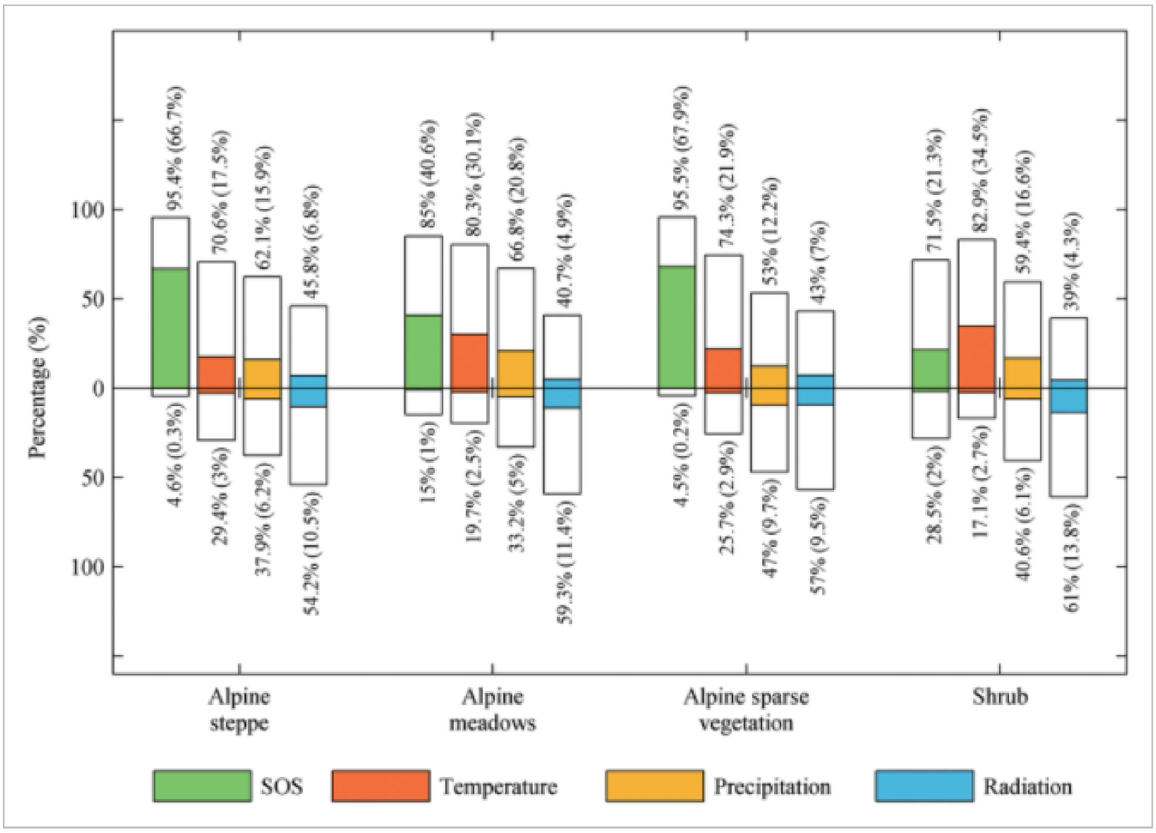

FIGURE 8

Open in figure viewer | PowerPoint

Percentages of the partial correlation between EOS and four influential factors at different vegetation types. Upward and downward bars indicate percentages of positive and negative correlations, respectively. Colored regions indicate significant correlations at $p < .05$. For each bar, the values in the brackets indicate the percentages of significant partial correlations for each vegetation [Colour figure can be viewed at

I think that the key figure (and result) in this paper is really similar to my previous AGU poster. I could not have confidence in my previous result but they found that SOS and EOS are coupled in the same year! Really interesting. They found that EOS showed an insignificantly delayed trend at an average rate of 0.14 days·decade^{-1} on the Tibetan Plateau. This variation was found for all vegetation types except for alpine sparse vegetation. We further showed that spring SOS had the largest contribution to the interannual variations in EOS, where 46.5% of the vegetated areas showed significantly positive correlations between SOS and EOS ($p < .05$). Temperature (26.5%) and precipitation (18.8%) also had significant positive impacts on EOS, while the contribution of radiation was negative (11.3%). These correlations were regulated by local hydrothermal conditions, especially for precipitation gradients.

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2nd Feb

Fu, Y. H., Piao, S., Op de Beeck, M., Cong, N., Zhao, H., Zhang, Y., ... & Janssens, I. A. (2014). Recent spring phenology shifts in western C entral E urope based on multiscale observations. *Global ecology and biogeography*, *23*(11), 1255-1263.

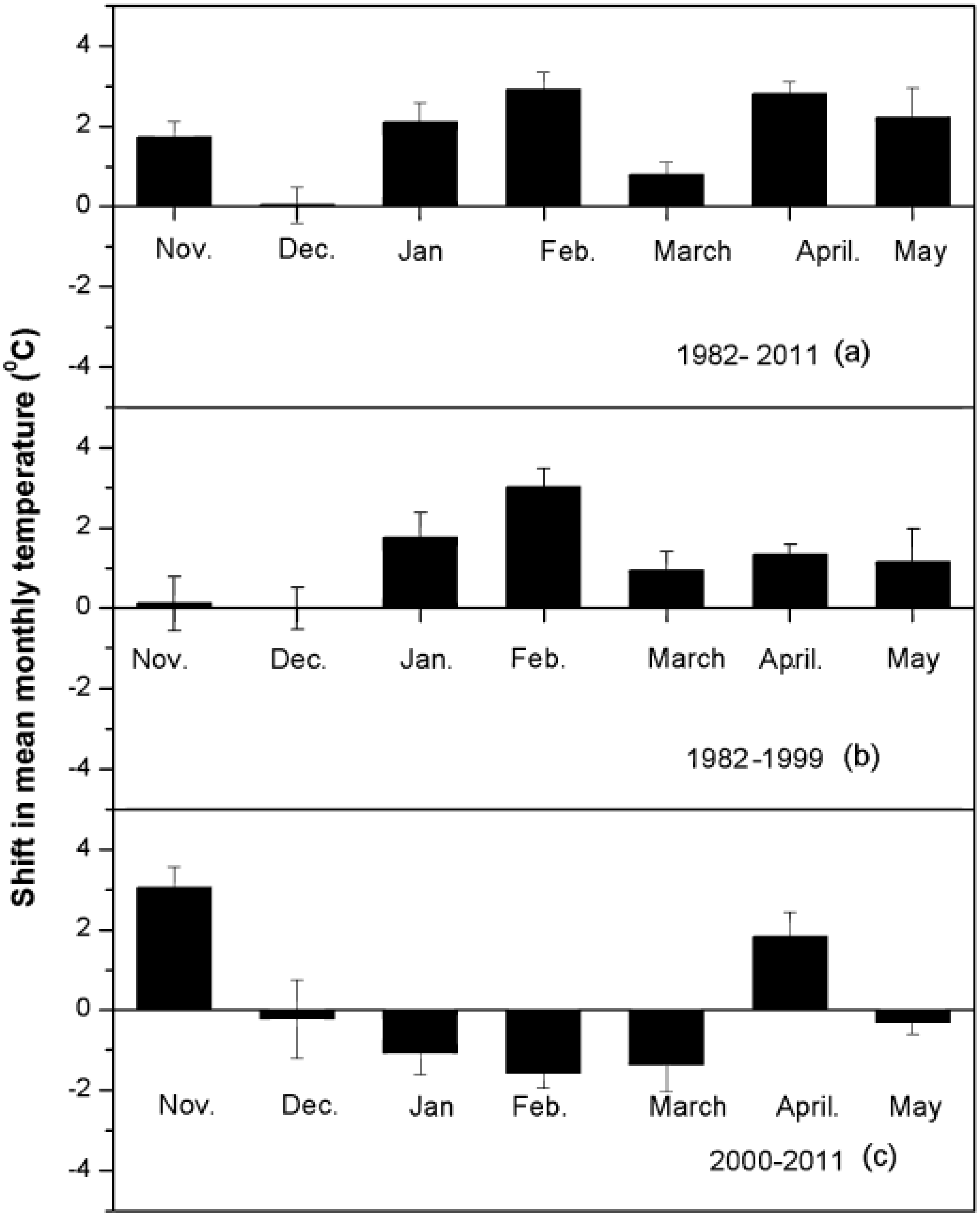

Figure 4 Changes in average monthly temperatures in western Central Europe, with standard error, for three time periods: 1982–2011; 1982–1999; and 2000–2011.

This paper topic is quite interesting. Actually, I thought that AVHRR had a problem in long-term phenology estimation because of sensor degradation (view angle, etc). In this paper, the authors said that temperature was changed over time (e.g. 1982-1999 vs 2000-2011) and it could affect AVHRR-based SOS, thus it showed "v-shape". They said " The recent trend reversal in the advancement of spring phenology in western Central Europe is likely to be related to the response of early spring species to the cooling trend in late winter. In contrast, late spring species continued to exhibit advanced leaf unfolding, which is consistent with the warming trend during spring months. Because remote sensing does not distinguish between species, the signal of growing-season onset may only reflect the phenological dynamics of these earliest species in the pixel, even though most species still exhibit advancing trends."

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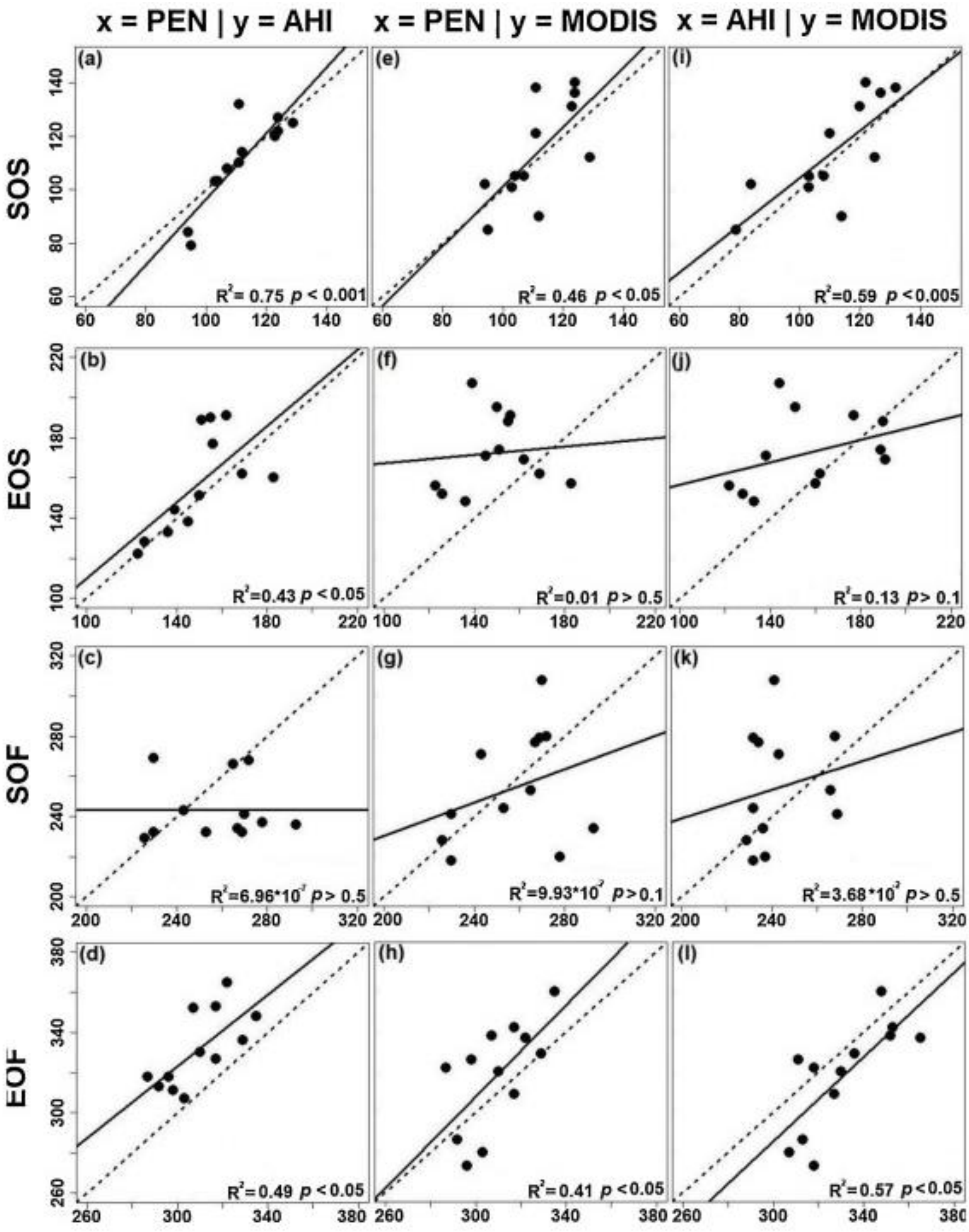
1st Feb

Yan, D., Zhang, X., Nagai, S., Yu, Y., Akitsu, T., Nasahara, K. N., ... & Maeda, T. (2019). Evaluating land surface phenology from the Advanced Himawari Imager using observations from MODIS and the Phenological Eyes Network. *International Journal of Applied Earth Observation and Geoinformation*, *79*, 71-83.



This paper evaluated AHI SOS, EOS, (also full) compared to in-situ image-based SOS, EOS and MODIS-SOS, EOS. They found that First, the difference in the spatial variations of SOS and EOF timing between naturally vegetated areas, and urban areas and croplands indicates the anthropogenic footprints on LSP. Second, the RMSD of either AHI PTDs or MODIS PTDs against PEN PTDs were higher in the fall (i.e., SOF and EOF) than those in spring (i.e., SOS and EOS). Third, the later EOS and earlier SOF derived from satellite EVI2 relative to those derived from PEN GCC might be caused by the difference in the sensitivity of GCC and EVI2 to the increases in leaf area index (LAI) over high-LAI canopies. I think these results might be used for phenology paper.

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4th Jan

Wang, Z., Liu, S., Wang, Y., Valbuena, R., Wu, Y., Kutia, M., ... & Shi, Y. (2021). Tighten the Bolts and Nuts on GPP Estimations from Sites to the Globe: An Assessment of Remote Sensing Based LUE Models and Supporting Data Fields. *Remote Sensing*, *13*(2), 168.

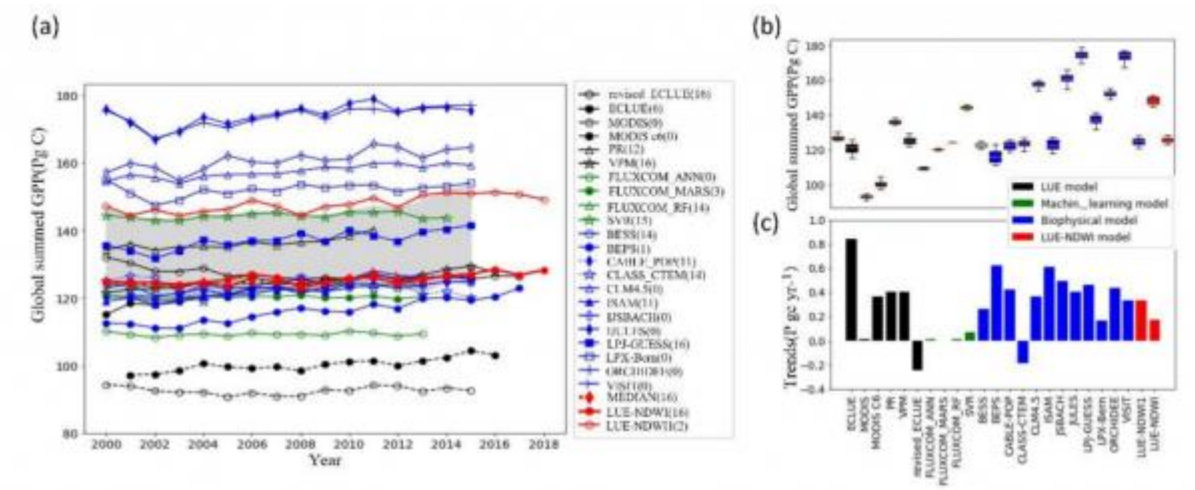

Figure 5. (**a**) Comparison of annual global GPP estimates from various models. The number after each model's name in parentheses is the model's number of years in the interquartile range (IQR) of all global GPP products, indicated by the shaded region. LUE-NDWI (data corrected) and LUE-NDWI1(i.e., LUE-NDWI with spatial data uncorrected) are GPP estimated by LUE-NDWI with corrected and uncorrected input data, respectively. (**b**) Boxplot of annual GPP values during the study period for each model. (**c**) Trends of annual GPP (Pg C yr^{-1}) by model. Symbols of LUE models are in black, machine learning models in green, and biophysical models in blue.

I think this paper showed well the difference between GPP estimation models. In this study, using observations from global eddy covariance (EC) flux towers, we appraised the performance of 24 widely used GPP models and the quality of major spatial data layers that drive the models.
1) Results show that global GPP products generated by the 24 models varied greatly in means (from 92.7 to 178.9 Pg C yr^{-1}) and trends (from −0.25 to 0.84 Pg C yr^{-1}).
2) Model structure differences (i.e., light use efficiency models, machine learning models, and process-based biophysical models) are an important aspect contributing to the large uncertainty. In addition, various biases in currently available spatial datasets have found (e.g., only 57% of the observed variation in photosynthetically active radiation at the flux tower locations was explained by the spatial dataset), which not only affect GPP simulation but more importantly hinder the simulation and understanding of the earth system.

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3rd Jan

He, L., Wood, J. D., Sun, Y., Magney, T., Dutta, D., Köhler, P., ... & Frankenberg, C. (2020). Tracking seasonal and interannual variability in photosynthetic downregulation in response to water stress at a temperate deciduous forest. *Journal of Geophysical Research: Biogeosciences*.

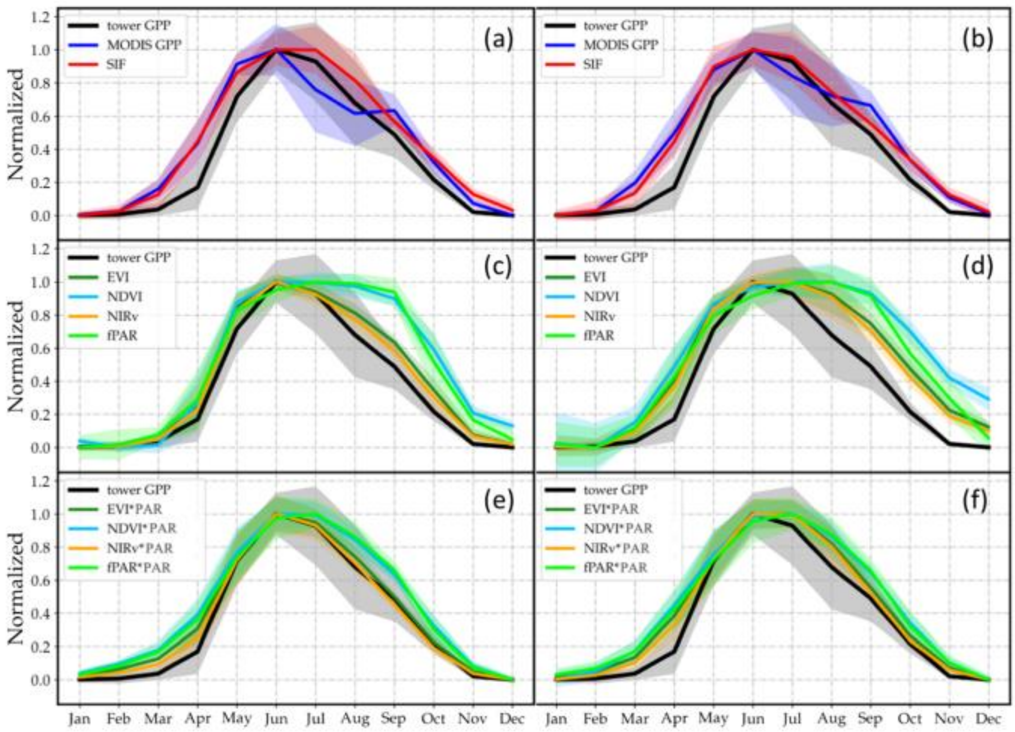

Figure 5. Seasonal cycles of monthly mean flux tower GPP, MODIS GPP, GOME-2 SIF, MODIS EVI, NDVI, NIRv and fPAR, EVI*PAR, NDVI*PAR, NIRv*PAR, and fPAR*PAR with the shadow regions representing ±1 standard deviation from 2007 to 2016. In (a), (c), and (e), MODIS products are aggregated at 0.02°, and native GOME-2 SIF footprints of the central longitude and latitude within 0.75° from the flux tower are used. In (b), (d), and (f), MODIS products and GOME-2 SIF are gridded at 0.25°. All variables are linearly normalized based on min-max scaling to fall in [0, 1]. RMSE and R^2 between flux tower GPP and SIF, NDVI, EVI, NIRv, fPAR, MODIS GPP, NDVI*PAR, EVI*PAR, NIRv*PAR, and fPAR *PAR are reported in Table S3.

I think this study might be related to weird NIRv, SIF and GPP relationships in CRK 2017. In this paper, we examined a well-characterized eddy covariance site in a drought-prone temperate deciduous broadleaf forest combining tower measurements and satellite observations.
1) increase in spring temperature usually leads to enhanced spring gross primary production (GPP), but a ***"GPP reduction in late growing season due to water limitation***."
2) In SCOPE, a simple stress factor scaling of Vcmax as a linear function of observed predawn leaf water potential (ψpd) shows a good agreement between modeled and measured interannual variations in both GPP and solar-induced chlorophyll fluorescence (SIF) from the GOME-2.
3) The modeled and satellite-observed changes in SIFyield are ~30% smaller than corresponding changes in light use efficiency (LUE) under severe stress, for which a common linear SIF to GPP scaling would underestimate the stress reduction in GPP.
4) Overall, GOME-2 SIF tracks interannual tower GPP variations better than satellite-based VIs representing canopy “greenness.” However, it is still challenging

to attribute observed SIF variations unequivocally to greenness or physiological changes due to large GOME-2 footprint.

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2nd Jan

Ma, X., Huete, A., & Tran, N. N. (2019). Interaction of seasonal sun-angle and savanna phenology observed and modelled using MODIS. *Remote Sensing*, *11*(12), 1398.

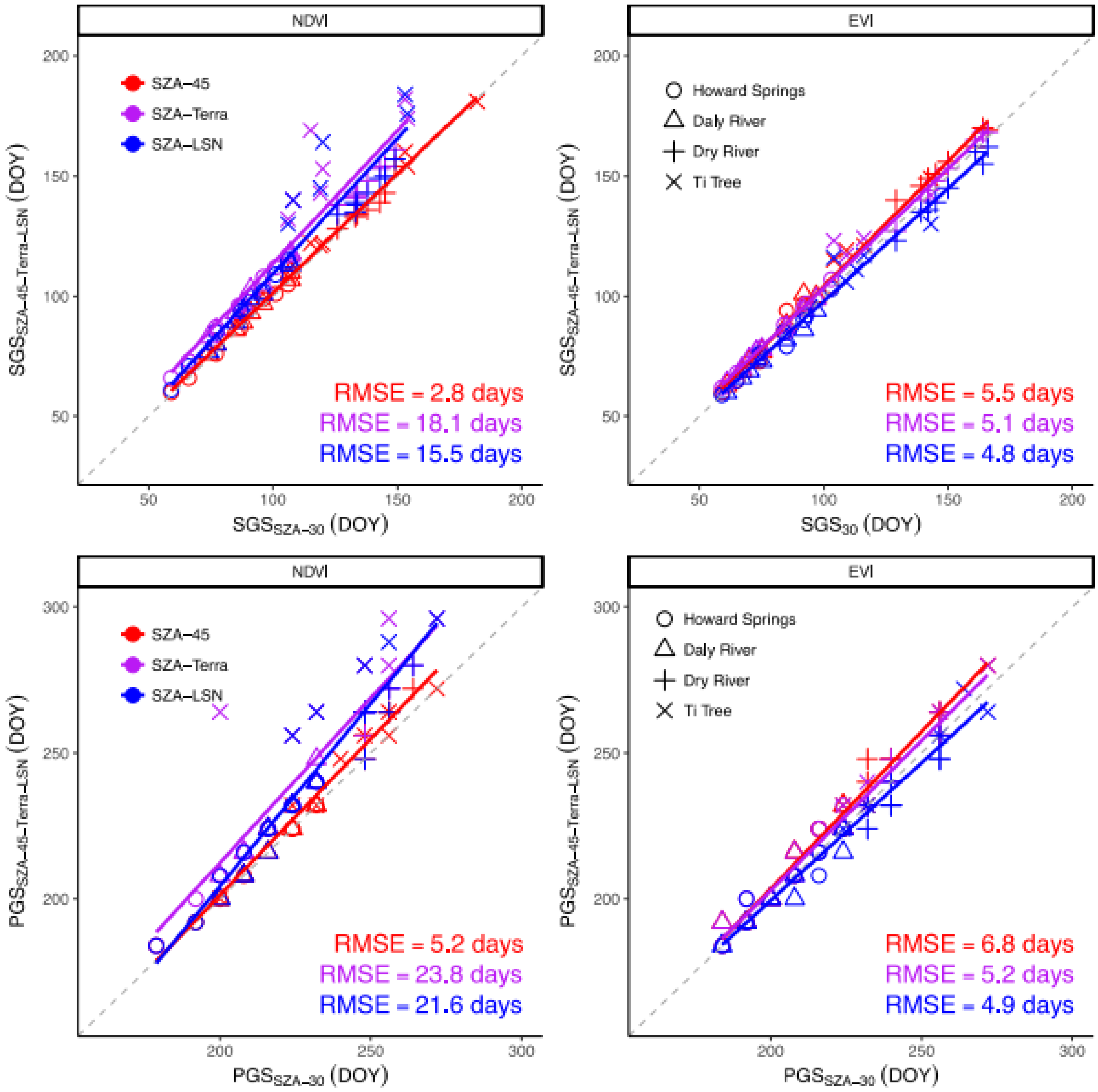

Figure 10. Cross-site relationship between the phenological metrics extracted from NDVI and EVI with different SZA configurations across four NATT sites. SGS—start of greening season; and PGS—peak of greening season. Phenological metrics extracted from the NDVI and EVI with three different SZA configurations (all at nadir view), with SZA varying according to the Terra overpass time (SZA-Terra) and the local solar noon (SZA-LSN), or fixed at 30° (SZA-30) or 45° (SZA-45).

This paper topic is interesting. In this study, the sensitivity of two widely used VIs (NDVI and EVI) to SZA was investigated at four northern Australian savanna sites, over a latitudinal distance of 9.8° (~1100 km). Time series of surface reflectances, as acquired with different SZA configurations, were simulated using BRDF parameters provided by MODIS. The sun-angle dependency of the four phenological transition dates were assessed. Results showed that while NDVI was very sensitive to SZA, such sensitivity was nearly absent for EVI. A negative correlation was also observed between NDVI sensitivity to SZA and vegetation cover, with sensitivity declining to the same level as EVI when vegetation cover was high. Different sun-angle configurations resulted in considerable variations in the shape and magnitude of the

phenological profiles.
1) The sensitivity of VIs to SZA was generally greater during the dry season (with only active trees present) than in the wet season (with both active trees and grasses), *thus, **"the sun-angle effect on VIs was phenophase-dependent"***.
*2) **The sun-angle effect on NDVI time series resulted in considerable differences in the phenological metrics across different sun-angle configurations***. Across four sites, the sun-angle effect caused 15.5 days, 21.6 days, and 20.5 days differences in the start, peak, and the end of the growing season derived from NDVI time series, with seasonally varying SZA at local solar noon, as compared to those metrics derived from NDVI time series with fixed SZA. In comparison, those differences in the start, peak, and end of the growing season for EVI were significantly smaller, with only 4.8 days, 4.9 days, and 3 days, respectively.

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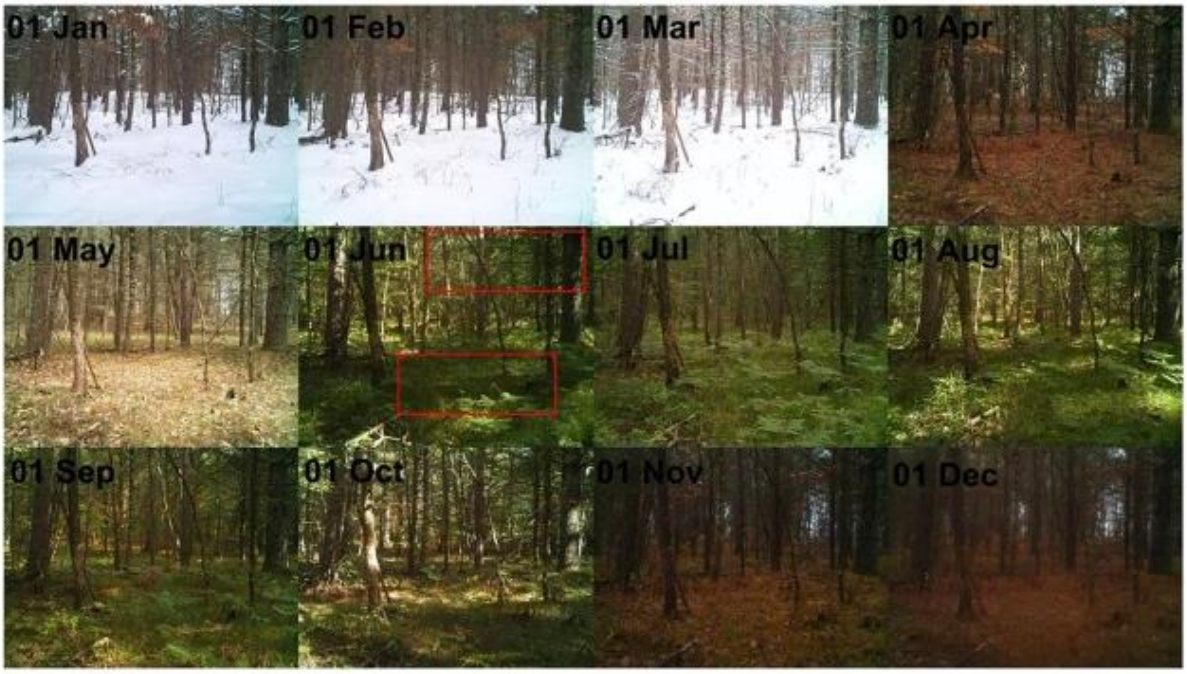
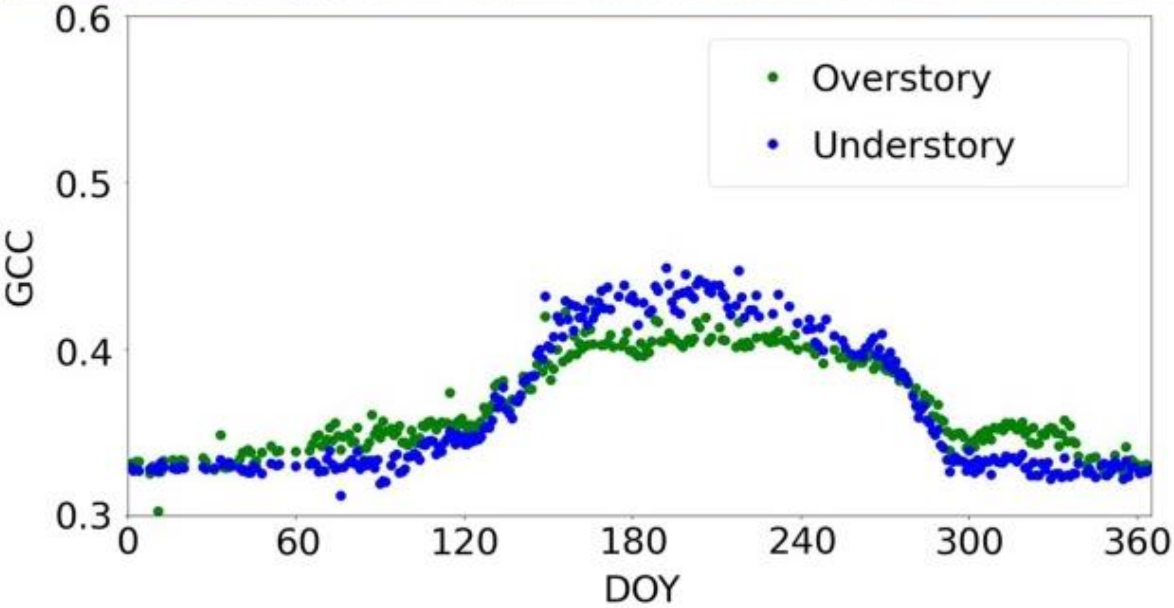
1st Jan

Liu, N., Garcia, M., Singh, A., Clare, J. D., Stenglein, J. L., Zuckerberg, B., ... & Townsend, P. A. Trail camera networks provide insights into satellite-derived phenology for ecological studies. *International Journal of Applied Earth Observation and Geoinformation*, *97*, 102291.





I like this paper. It is really interesting topic and related to GDK phenology paper. The authors explored the potential to monitor phenology using the Snapshot Wisconsin (SW) trail camera network, a citizen science program. Using three curve-fitting methods for characterizing phenological transition dates, they assessed the phenological offset between understory vegetation and the overstory canopy in the trailcam observations and compared variations in derived phenology over the different spatial scales represented by trailcams, Harmonized Landsat and Sentinel-2, and MODIS. Their results showed that the apparent phenological offset between understory and overstory vegetation differed among forest types: in broadleaf deciduous forests, understory vegetation had an earlier start-of-spring (SOS) and later end-of-autumn (EOA) than the overstory canopy; in mixed forests, the understory showed an earlier SOS than the overstory, but no significant difference in EOA; in evergreen conifer forests, neither SOS nor EOA differed significantly between the understory and overstory. They found moderate correlations ($0.25 \leq r \leq 0.57$) between trailcam- and satellite-derived phenological dates. Moreover, those derived dates varied significantly among the applied curve-fitting methods: total growing season length (from SOS to EOA) could be 19 days longer for a threshold-based method than for a logistic curve-fitting method (our reference model), but 17 days shorter than the logistic method when using a piecewise-continuous method based on fitted sine curves. I think I can find more information about under- and overstory phenology via this paper.

Paper of the week! 2021!