Review for “Unravelling the physical and physiological basis for the solar-induced chlorophyll fluorescence and photosynthesis relationship” by Yang et al.

General comments:

This manuscript used field measured leaf and canopy fluorescence and photosynthesis and investigated the physical and physiological basis of SIF-GPP relationship at a corn field. They found that APAR dominated the positive SIF-GPP relationship. They further used the continuous active fluorescence measurements from the MoniPAM system to analyze the relationship between fluorescence yield and photochemical yield at leaf scale and found a moderate correlation between the efficiencies of fluorescence emission and photochemistry for sunlit leaves but a weak correlation for shaded leaves.

The manuscript has some strength. The major strengths are: (1) The author combined leaf-scale active fluorescence measurements to fully investigate the physiological basis of the SIF-GPP relationship which is lacking in many studies. (2) The authors are on top of the most recent literatures in this topic. The references used are up to date, and the authors had a very thorough summary of the past literatures. The manuscript is also well-written.

However there are several unclear points which should be addressed:

(1) The reliability of relative efficiency of the sustained heat dissipation ($\Phi D*$) calculation. In L210, the author claims that “Because Fm was measured during the night in the absence of both reversible heat dissipation and photochemistry, a change in Fm must be caused by a change in the sustained heat dissipation”. But during night, there are still ΦN and ΦF from Fig. 5. I am concerned about the reliability of $\Phi D*$ calculation since to my knowledge, this calculation hasn’t been used in previous studies. The author should provide more literature to back up this method.

(2) The data availability across the whole growing season is not provided. In L154, the author mentioned that they excluded 29 days rainy and cloudy data, but the whole period of available canopy data is not provided. The author could provide a time series of the SIF, GPP, APAR data in the supplementary. Also, the availability of the active PAM measurements is also not explicitly provided.

(3) The author reported the overall correlation between $\Phi Pcanopy$ and $\Phi Fcanopy$. It would be good that they provide the scatter plot and compare this with the leaf scale relationship.

(4) L423 They found no clear relationships between $\Phi Pcanopy$ vs. ΦP or $\Phi Fcanopy$vs. $\Phi F*$. This result needs more explanation, such as this poor correlation is for sunlit leaves or for shaded leaves or both and what causes this poor correlation. Of course, they are from different levels (leaf vs canopy) and canopy structure plays a role here. Although fesc calculation still has large uncertainty, there are several methods proposed to quantify this term (e.g., NIRv/fPAR). The author should try to correct fesc effect and get canopy total $\Phi Fcanopy$ and compare with leaf $\Phi F*$.

(5) L440. They found progressive increase of sustained heat dissipation ($\Phi D*$) during senescence. In contrast with no seasonal variation of ΦN. Why there is no seasonal variation of ΦN? What factor determined the seasonal variation of ΦN.

(6) L455. The author mentioned that reversible heat dissipation is responsible for the positive relationship between ΦF and ΦP at diurnal scale, but there is no diurnal relationship between ΦF and

ΦP in the current manuscript. The author only provided the seasonal and seasonal+diurnal relationships.

(7) L520. The author claimed that a stronger relationship between SIF and GPP for dense canopies is expected since ΦF sunlit and ΦP sunlit are moderately correlated. I am not convinced that dense canopy means the fraction of sunlit leaves is larger. Also, the poor correlation between SIF and GPP at senescent stage is probably due to the less data points and more uncertainty of the SIF retrieval.

(8) L528. The author claimed that under cloudy conditions, SIF-GPP relationship becomes worse. But this is opposite to the previous study from Yang et al. (2018) in a rice paddy. They found similar relationship under sunny and cloudy conditions. Why will diffuse condition lead to a worse SIF-GPP relationship?

(9) Overall, I feel that the link between MoniPAM active fluorescence and canopy SIF is weak and the author analyzed these two datasets separately. Although they used to SCOPE but only to model the leaf scale relationship. It would be good if the author can use the leaf measurements to run SCOPE and get canopy SIF and GPP and compare with observations.

Finally, I want to provide encouragements for this work. The general goal that this work aims to achieve is worth praising. I enjoyed the reading of this manuscript and it clearly shows the authors have been putting lots of efforts into the literature review. I can see that this work could have a good impact and contribution to this field if all the above concerns can be properly addressed. Thus I fully encourage moderate revision of this work. Meanwhile, please understand that a rigorous scrutiny is necessary here as this topic that you are addressing is very important and your conclusion can have a large impact for the general public's understanding about SIF and photosynthesis.