

## ***Interactive comment on “Assessing shadow effects on Photochemical Reflectance Index (PRI) for the water stress detection in winter wheat” by Xin Yang et al.***

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1. “The conclusion is that shadow fraction does not significantly affect the prediction capabilities of PRI of relative water content. I find that hard to believe. If PRI is different for a range of shadow fractions and water content in an entire plant is generally similar then there must be a difference? Let’s think about a pixel with either 10% shadow or 90% (we don’t know what it is), the PRI is different (right?) but the relative content in the plant is not (or is that a wrong assumption?).” We understand the review’s concern. This study aims to evaluate the effect of the shadow fraction on the remote estimation of crop water status using PRI, because shadow is mixed with sunlit leaves in a pixel of

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airborne or spaceborne remote sensing images. However, when we collect the ground ‘truth’, the best way to evaluate water status of crops is to measure the relative water content (RWC) and/or water potential and/or canopy temperature of the sampled plants and then average the values of sampled plants. This value represents the real water status of crops no matter how much fraction of the shadow exists in a pixel. Vegetation indices derived from remotely sensed images are expected to be correlated with the ground measurements, so that we can evaluate the water status in pixels without ground measurements. However, shadow exists in every vegetation pixel and the fraction may vary with pixels and also with image resolution as well as viewing geometry. Thus, our analysis was trying to figure out whether the varying shadow fractions may influence PRI and its ability to estimate RWC. If the shadow effect was influential, and then the mixture analysis is needed before applying PRI to evaluate water status. But if the shadow effect was minimal (as the conclusion of our analysis), and we can ignore the varying shadow fractions among pixels. We changed the shadow fraction from 10% to 90% in order to demonstrate the relationship between shadow fractions and PRI, but in reality, the range of shadow fraction may not be so large. We thought the assumption of this study is correct, in agreement with the sampling strategy in the studies of remote detection of plant water stress, but we welcome comments, suggestions, and arguments.

2. “It would be interesting to mention whether this conclusion holds up for other crop types. How generally applicable is the outcome of this research?” Thanks for the suggestion. We wouldn’t reach the same conclusion for the other crops, because from our reasonable guess it is probably related with canopy structural features, such as leaf orientation and green leaf coverage. Therefore, it is hard to reach a conclusion or propose a hypothesis for the crops with different leaf orientation or green leaf coverage. But it is definitely a good suggestion for our next experiment.

3. “I don’t understand why the authors focus just PRI. The title only mentions PRI, but the research also includes different forms of NDVI and WI. However, on page3, line 7,

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only different formulations of PRI are mentioned. It seems like a waste of data, when the feature extraction is so limited. There are many other VI's in literature than can be explored. . ." Thanks for the valuable comments. The audience may have the same concern with you. As mentioned in the introduction section, several methods can be used to remotely assess water status of crops, and relating PRI with physiological water stress indicators of crops is one of them. Unlike the other vegetation indices (VIs), PRI is sensitive to physiological properties of plants, particularly highly sensitive to the changes in photosynthetic rate. Therefore, several studies have been done to evaluate water stress of plants specially using PRI. But in this study, we also included the other VIs that are sensitive to changes in the plant canopy structure, pigment content, and water content for comparisons, in order to show the advantage of PRI in estimating RWC. In this case, we didn't analyze the shadow effect on the other indices. However, we understand the comparisons with the other selected vegetation indices may cause confusions, and we will make revisions accordingly if a major revision is suggested by the editor.

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