Response to Comments by Albert Porcar-Castell

Specific comments: 1) Page 2951, Lines 1-2. Note that there are also Spectrometer based systems that have been successfully deployed in the field for several years, at least: " Rossini et al. (2012) Remote sensing-based estimation of GPP in a subalpine grassland. Biogeosciences 9, 2565-2584" and " Drolet et al. (2014) A temperature-controlled spectrometer system for continuous and unattended measurements of canopy spectral radiance and reflectance. IJRS 35:1769-1785".

Response: Thanks for pointing this out. We have modified the manuscript and added these references.

2) Page 2961, Lines 3-5. And Page 2962, Lines 8-9. It could be argued that these statements are biased towards getting a better correlation with Chl:Car compared to EPS because the changes in EPS took place before their intensive sampling started. In Fig. 3A one can see that PRI has increased from -0.2 to about -0.14 during a three week period outside from their analysis during which EPS has recovered and Chl/Car remains rather constant. Would the relationship between PRI and EPS be still nonsignificant if that period would have been included in the analysis? I too believe Chl/Car is the main control behind leaf level PRI dynamics at the seasonal scale, but can we conclude from this data that the dramatic re-organization undergone by the photosystems during spring recovery (which unlocks the xanthophyll-cycle and gradually shifts the system from sustained to reversible) produces no optical signal effecting the PRI? Perhaps the sentence in page 2962 could be re-written using less conclusive terms?

Response: The reviewer makes a reasonable observation here, but the timing of the recovery (EPS vs. Chl:Car) is really the key. This issue has also been independently addressed using other sensors and a longer time-series dataset in Wong and Gamon (2015a,b). The results presented here are consistent with Wong & Gamon (2015a,b), and also show that EPS increases precede both the pigment pool size changes and PRI changes. So we conclude that it is the chl:car pigment pools (not EPS) that drives spring PRI changes. Our focus here was really to show that the SRS sensors can also detect these seasonal transitions, and we refer to Wong & Gamon (2015a,b) for a more detailed argument of the timing of these transitions.

3) page 2965, Lines 18-19. How would seasonal changes in sun elevation interfere with this calibration scheme that considers only cloudiness? Would a combination of both calibration methods help bypassing these limitations? e.g. calibrating over a few days at start of experiment to obtain sufficient data so that one could build a function that considers both clould cover and sun elevation?

Response: Seasonal changes in solar elevation would presumably affect the cross calibration independently of the sky conditions (as discussed in the paper). In our short-term tests combining sky conditions with elevation effects over the course of a

day, it was difficult to get a good correction, most likely because of the complex and rapidly changing light fields at extremely low solar elevation angles. Clearly, more work is needed to evaluate the individual and combined effects of solar angle and sky conditions on the cross calibration, and this is a key recommendation of this paper.

Response to Reviewer 2

Comment 1) The presented study aimed to evidence the relationship between foliar pigments and spectral indices (PRI and NDVI) while testing brand remote sensors for experimental studies. The study is clear, well conducted, scientifically sound and potentially of interest for the public of BG. The main value of the ms is the simultaneous analysis of pigments and spectral indices in one deciduous species and one conifer species and the thorough description of the onset of the growing season. I do not find any new information in this study but known elements already described together in the same place.

Response: While we agree that some similar findings have been presented elsewhere, we note several novel and important aspects to our study. To our knowledge, this is the first published work demonstrating that low-cost SRS sensors can be used to monitor separate pigment effects over contrasting time scales. A key finding was the importance of proper sensors cross-calibration (e.g. correction for sky conditions). Given the frequency and extent of cloud cover for much of the world, this is a significant and useful finding. The direct contrast of PRI and NDVI behavior in deciduous and evergreen species is another novel aspect. To our knowledge these findings have not been presented in this way before.

Comment 2) My main concern is that the study is in some point disappointing. The text starts trying to convince the reader on the importance of vegetation indices as indicators of photosynthetic activity and light use efficiency. However nor direct measurements neither analysis on Carbon exchange were presented. I expected that Carbon net exchange or other direct photosynthetic measurements, LUE or any other direct measurement on what the authors refers as “photosynthetic activity” would be presented. So, we have now clearer ideas on the relationships between PRI and pigments, but we are in the same point on the relationship between PRI and photosynthetic activity.

Response: In this study, a main point was to evaluate novel sensor responses to pigment changes having implications for photosynthetic activity. The link between xanthophyll cycle, chl:carot pigments and photosynthetic activity (or LUE) has been discussed in other papers, several of which are cited in this study. Thus the link to photosynthesis was presented more as essential background material rather than the main focus. Note that it is these pigment changes themselves (not photosynthetic activity or LUE per se) that drive PRI responses, and a novel finding was that these low-cost SRS sensors can effectively monitor seasonal and diurnal pigment shifts. In companion papers (Wong and Gamon 2015a,b), clear links with

photosynthesis are made in considerable detail, and we cite these papers in our manuscript. A novel finding of these studies is that chl:carot pool sizes (not the xanthophyll cycle per se) is the primary driver of PRI over seasonal time scales, and we conclude that much more attention should be paid to the role of these pigment pools in seasonal photosynthetic activity, particularly for evergreens.