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Interactive comment on "Predicting landscape-scale CO_2 flux at a pasture and rice paddy with long-term hyperspectral canopy reflectance measurements" *by* J. H. Matthes et al.

Anonymous Referee #3

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This is a very interesting and original paper using the full spectrum reflectance (400-900nm) to predict landscape-scale (or maybe it would be better "ecosystem-scale"?) CO2 fluxes at a pasture and at a rice field.

PLSR using reflectance values is without doubt providing high potential, as it is exploiting all the spectrum in the VIS-NIR, and this is clearly demonstrated in the paper. In particular, relevant information on the predictive power of spectral observations at increasing flux integration intervals are provided.

However, the paper is not providing any type of comparison between the PLSR presented method and the "traditional" Spectral Vegetation Index (SVI) approach in esti-

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mating carbon fluxes. A simple graph/table comparing the performance of PLSR with a few standard indices which showed a good performance according to many authors such as e.g. Gitelson, Rossini, etc. (such as NDVI, NDVIgreen, NDVIred edge e.g. based on MODIS, Sentinel2 bands) would be of great interest to the reader. I understand that this is not the main focus of the study, but this additional information would, in my view, significantly strengthen the paper. In similar studies estimating biophysical parameters, in fact, the PLS models performed equally -or slightly better- compared to the best indices based on e.g. exponential curve fitting.

To this regard, it would be good to add a discussion on the advantages and disadvantages (expected -in the introduction- and observed -in the analyzed datasets discussion-) of using full spectrum PLSR vs. SVIs more traditional approaches. Despite being very promising, the PLRS method may not be able to "read" some important information contained in the spectrum. Optical sampling is based on reflectance information, but it is mostly focused on relative values rather than reflectance values themselves. Hence, it should be mentioned that to retrieve relevant information, the reflectance values in the SVI approach are generally weighted against a reference band, as in the case, for istance- of CIred-edge, PRI or WBI. This is one of the reasons why the "best" bands for PLSR may not correspond to the "best" bands for SVIs. Also, normalisation in the SVI approach is used and it is also important e.g. to limit the effects of slightly different illumination conditions during the different observation days shen spectral measurements are carried out: reflectance temporal trends can be a bit noisy, but normalised SVIs trends are generally much less affected by noise.

Specific comments

Methods/Site Characteristics section 2.1, page 5085: adding some photos of the investigated sites/instrumentation would help the reader understanding the site and the measurements characteristics such as spatial heterogeneity, measurements set ups, etc.

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Section 2.2: a discussion regarding the bi-hemispherical reflectance measurements advantages and limitations and the possible impact in the authors' observations could be added (see e.g. Meroni et al, 2011 - REVIEW OF SCIENTIFIC INSTRUMENTS).

At page 5092, the authors mention that intra-site variability during an individual sampling event is particularly high in the NIR. The authors should explain more in detail why this is happening.

Page 5093: "The NIR reflectance at the pasture had a stable mean during the year". This comment is quite general. It would be better to analyze and discuss the NIR trends and explain the variations more in detail. Maybe adding a trend of a simple greenness SVI -such as NDVI- would help to identify and clarify the complexity of the VIS-NIR wavelenghts response to canopy phenology.

Page 5094: It is interesting to see that for shorter timescales is the highest VIP score at around 700nm, while for longer timescales NIR is providing more relevant information. According to such results, spectral regions related to structure (and not to chlorophyll absorption) provide relevant information to monitor GPP. This finding was also presented in a BG discussion paper by Balzarolo et al. (http://www.biogeosciences-discuss.net/11/10323/2014/bgd-11-10323-2014.pdf) and I think should be discussed by the authors.

Page 5096: to investigate temporal trends, measurements should be carried out at fixed points. This should be highlighted and discussed in more detail in the paper.

Page 5099, line 5: is the Pasture (as it is not irrigated) water limited and sometimes affected by water stress? This maybe would explain part of the variability which is not explained by the model.

Page 5101, line 26: "... could be used in conjunction with a spectrometer capable of makind wider spectral reflectance measurements at eddy covariance sites to evaluate areas of the NIR spectrum at longer wavelengths". As in the previous lines you were

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mentioning the importance of investigating the "infrared area" correlated with structural components and fiber, lignin, cellulose. Did you mean SWIR instead of NIR? Within the EUROSPEC Cost Action, a spectrometer measuring in the SWIR was developed (Sensors 2015, 15(1), 1088-1105; doi:10.3390/s150101088)

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