

Interactive comment on “Deriving seasonal dynamics in ecosystem properties of semi-arid savannas using in situ based hyperspectral reflectance” by T. Tagesson et al.

Anonymous Referee #2

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The manuscript describes an interesting study using multi-angular hyperspectral data collected from a tower at a semi-arid savanna. Overall the study seems to have been undertaken in a scientifically appropriate manner and makes a valuable contribution to scientific progress. The scientific quality is high. And the presentation of the manuscript is of excellent quality.

While the data analysis is sound I have the following questions, comments and suggestions which should be addressed to improve the manuscript:

The analysis of effects of varying sun / sensor geometry has been done over 15 days (of which 3 have been removed) during the peak of the growing season. This misses

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the highest zenith angles and times of different vegetation conditions. I suggest to repeat the analysis for other time periods as well to gain a full picture of sun / sensor geometry effects. Furthermore, why have only NDSIs been investigated and not the reflectances themselves? This information would help to understand the behaviour of the NDSIs and would support the claim in the discussion that NDSIs reduce angular effects.

Why has the analysis of the relationship between reflectance / NDSI and ecosystem variables been restricted to a linear relationship? E.g. other studies found a non-linear relationship between reflectance and biomass due to saturation effects. Also why have only daily median reflectances / NDSIs been used when GPP, LUE and FAPAR were daily integrals? Averages would be more appropriate in these cases. And why have the off-nadir views not been analysed?

Some minor more specific comments:

page 3318, line 22: “Environmental conditions” usually mean variables like temperature, humidity, rainfall, etc. Do you mean reflectance in different wavelength regions have different sensitivity to “environmental conditions”? Or do you really mean “vegetation condition”?

page 3320, section 2.1: It would be good to provide some information on the height of the grasses, trees and shrubs and the tree and shrub cover to get a better idea about the vegetation structure at the site.

page 3320, line 6: “(3%, of the land cover)”. remove comma.

page 3320, line 12: “rainfall (mm) was measured at 2m height”. Is the height relevant? Rainfall always has to be measured with the rain gauge not obstructed by any obstacles. What would be more interesting here is to know at what interval rainfall has been collected, i.e. daily, hourly, etc.

page 3320, equation 1: Please define “albedo_soil”. Has it been measured?

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page 3321, line 19: Please define “VPD” on first use.

page 3322, section 2.4: The authors refer to Huber et al. (2014) for more detail on the spectrometer setup. However, the manuscript should provide some of the more fundamental information: 1. Were foreoptics used? 2. What are spectral resolution and spectral sampling of the spectrometers? 3. Have the seven different viewing angles been measured simultaneously? Or has a rotating or moving head been used? Was always the same target in the field of view? Or did the target change because of the rotating head? 4. How have solar irradiance measurements been made? Transmissive or reflective diffusor? 5. If multiplexing setup how long does it take to go through a whole measurement sequence? 6. Has solar irradiance been measured for each view angle measurement separately?

page 3322, line 22: Why have daily median reflectances been used? Why not an average over a certain time interval?

page 3323, line 6: “median” over what? The 15 days?

page 3323, lines 19-22: I suggest to move the last sentence to the start of the paragraph, i.e. before line 13 as the NDSI has to be calculated before the ANIF can be calculated.

page 3325, line 5 + 22: Change “in the end” to “at the end”.

page 3329, line 15: Change “accurate and extra” to “additional”.

page 3329, line 25: Change “the majority” to “most”.

page 3330, line 12: “Peak” suggests it is lower again at very high biomass. Rephrase.

page 3330, lines 11-14: This is not the reason for the saturation of the NDVI. The NDVI saturates at high biomass because the NIR reflectance is much larger than the red reflectance. NDVI therefore reduces to R_{NIR} / R_{NIR} which equals 1.

page 3330, lines 14-17: Again this is wrong. The saturation is not necessarily reduced

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with narrower bands. Narrow bands might even cause saturation earlier. Saturation can be reduced by selection of bands that show a smaller difference therefore avoiding the NDVI equation becoming 1 (see above).

page 3331, line 17-18: “As fluorescence is competing with photochemical conversion ...” suggests high fluorescence equals low photochemical conversion. The reality is more complex. And it looks like often the opposite is true. So either remove this sentence or formulate differently.

page 3331, line 19-20: “... should have very spectral high resolution (0.05-0.1nm)”. This is not true. Fluorescence has been measured successfully with a spectral resolution of about 10nm. Whether very high spectral resolution is necessary depends on the method applied.

page 3332, lines 1-7: The whole discussion only focuses on what is happening at the leaf level, i.e. reduced pigment contents. What about changes in vegetation cover?

page 3342, Figure 2. Why are there gaps in the reflectance time series? Black vertical lines at the start and end of the rain seasons should be in all diagrams.

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