

Interactive comment on “Towards spatial assessment of carbon sequestration in peatlands: spectroscopy based estimation of fractional cover of three plant functional types” by G. Schaepman-Strub et al.

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GENERAL COMMENTS: In their manuscript, Schaepman-Strub et al. present results from the evaluation of two mixture decomposition techniques widely applied within the optical remote sensing community, linear spectral mixture analysis (SMA) and one of its extensions called multiple endmember spectral mixture analysis (MESMA), respectively, regarding their suitability to derive information on two important biophysical parameters (fractional cover and biomass) of three major plant functional types (PFT) in some types of peatlands (i.e., Sphagnum mosses, graminoids, and shrubs). Con-

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sidering the importance of peatlands within the global carbon (C) cycle, as demonstrated and outlined by various studies, a better understanding of their ecological functioning and potential responses to climate change is needed. The present study by Schaepman-Strub et al. contributes to this needed research by suggesting a non-destructive methodology based on MESMA in combination with field spectroscopy to distinguish between Sphagnum mosses, graminoids, and shrubs in terms of fractional cover and biomass on the basis of the different spectral characteristics of Sphagnum mosses and vascular plants (graminoids and shrubs). The measurements taken for the development (spectral characteristics of the three PFT: field spectrometer) and evaluation (fractional cover: point intercept; biomass: harvesting) of the suggested methodology are sound and straightforward to repeat (not considering the costs and logistics involved). The manuscript is easy to read in terms of length and depth. However, I would suggest re-organizing some parts of the Methods section to make it more accessible to readers outside the remote sensing community who might not be familiar with SMA and its variants such as MESMA (see my specific comments below). The references are generally appropriate, but should be extended (see specific comments below). All tables and figures are presented with purpose and clarity, and well explained in the text. The manuscript is written in an appropriate scholarly style, but some sections would benefit from more information and explanation (see specific comments below). There are some minor stylistic and linguistic problems here and there (e.g., consistency: the acronym for "plant functional type" is introduced as "PFT" [page 1296, line 4] but in places "plant functional types" is used [e.g., page 1300, line 10]; the same for "carbon" vs. "C" that should be addressed, together with at least some of my specific comments below, prior to the final publication of this manuscript in Biogeosciences. I am not going to address these in my specific comments below, but I suggest that the authors carefully edit and revise the manuscript.

SPECIFIC COMMENTS: [1] page 1294/ starting line 1: The introduction doesn't say anything about the biomass component of this manuscript.

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[2] page 1295/ starting line 6: "Particularly the cover and productivity of the bryophyte component, dominated by the genus Sphagnum ..." The moss endmember in this study is of the genus Sphagnum, but not all peatlands are dominated by Sphagnum mosses. I would suggest being a bit more specific and include a few words on which types of peatland are dominated by Sphagnum mosses vs. brown mosses (especially with regard to the field site of this study with heath vs. bog [page 1297, line 17]).

[3] page 1295/ line 25: Please provide references for these statements.

[4] page 1296/ starting line 4: At several places throughout the manuscript "mosses" is used as an alternative for "Sphagnum". This paragraph highlights the different spectral characteristics of red Sphagnum species vs. vascular plants, which differ as outlined in the manuscript. Also, the dependence of the moss spectral characteristics on moss moisture content is addressed. However, since the general term "mosses" is used, I think the authors should include a few words on the spectral characteristics of brown mosses and their abundance in certain types of peatlands. Also, what about the spectral characteristics (and sometimes to some degree spectral similarities) of green Sphagnum species vs. brown mosses vs. vascular plants and their implications for applying remote sensing techniques to different types of peatlands?

[5] page 1296/ line 6: Please define "monocots" and "diocots".

[6] page 1296/ line 20: Define LAI before its first usage.

[7] page 1297/ line 6: Please define "ericoid".

[8] page 1298/ line 13: "For the chosen experimental plots this means that the continuous Sphagnum layer if no ericoid or graminoid leaves are covering it." Are there any potential implications (uncertainty?) of this assumption/ "indirect" measurement (i.e. the observation in the field that the Sphagnum cover is more or less continuous for all plots) on the transferability of the results of this study to other sites with considerably less than 95% Sphagnum moss ground cover (e.g., lack of Sphagnum moss ground

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cover under shrubs)?

[9] page 1298/ line 17: "On 5 June, 2006..."

[10] page 1299/ starting line 10: Did the authors look at how the reflectance spectra measured in the field differ from "pure" reflectance spectra measured in the lab (integrated sphere) in terms of the influence of background material (in this case I guess mostly Sphagnum mosses, litter, woody components, bare soil, dead material, etc.)?

[11] page 1299/ starting line 21: I suggest reorganizing section 2.5 on MESMA to make it more accessible to readers not familiar with mixture decomposition techniques commonly used in optical remote sensing (since Biogeosciences is not a remote sensing journal per se). Such a reorganization could start with a general description of linear SMA (in contrast to non-linear mixture decomposition) supported by references for its applications, followed by further developments/ variants of SMA such as MESMA (again supported by references for its numerous applications). The way it stands right now it reads as if MESMA and SMA are nothing but two similar mixture decomposition techniques. Furthermore, was the mixture decomposition with MESMA performed using VIPERTOOLS (plug-in for ENVI from the University of California at Santa Barbara) or coded from scratch? Especially the critical step of selecting representative endmembers deserves discussion (and references).

[12] page 1300/ starting line 23: "The main reason being that the endmember ... thus all endmembers get a fraction assigned." What about the fact the fixed set of endmembers additionally has constant spectral characteristics, i.e. one reflectance spectra per endmember?

[13] page 1301/ line 2: Remove the "and" between "assigns" and "abundances".

[14] page 1301/ line 4: Why not use them all and let MESMA select the most representative one as part of the mixture decomposition? What criteria were used to determine the representativeness of individual reflectance spectra?

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[15] page 1301/ line 25: At this point it would be appropriate to include a few words on the role of shade in mixture decomposition and the effect of shade measured on different backgrounds (references?).

[16] page 1301/ line 9: I think the rationale behind this step requires more explanation.

[17] page 1304/ line 2: On page X, line Y it says 95% ...

[18] page 1304/ starting line 4: This needs some clarification. Also, what does "their" refer to? First-hit data or is it a mistake and "its" signal refers to vascular plant cover?

[19] page 1304/ line 6: Significant at what level?

[20] page 1304/ line 5: What characteristics of graminoids/ measurements have the potential to result in this less tight relationship?

[21] page 1304/ line 26: "This indicates that results based explained by provided endmembers)." This sentence is awkwardly constructed. Please consider rewriting it.

[22] page 1305/ starting line 12: The sequence of analysis steps should be outlined more clearly in an earlier section, i.e. the results from the fractional cover determination are used in a final step to derive information on biomass.

[23] page 1307/ line 2: Awkward wording: I wouldn't refer to endmember fractions as "suitable solutions"...

[24] page 1307/ line 5: Awkward wording: "operationally operated".

[25] page 1307/ line 22: I don't really understand this part what's the benefit of mapping open Sphagnum moss ground cover whereas no information on Sphagnum moss ground cover under vascular plants can be derived? How does the index look like? Are any activities in this regard planned for the future?

[26] page 1308/ line 6: "... results for more temperate peatlands would suffer...." In what way? Implications?

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[27] page 1308/ line 13: What is meant here exactly? Shadow cast by graminoids and shrubs on different materials, e.g. graminoids shadow cast on graminoids vs. graminoids shadow cast on the Sphagnum moss ground cover.

[28] page 1308/ line 23: I don't really see this as a conclusion of the present study.

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