Biogeosciences
Discussions

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**Interactive
comment**

Interactive comment on "Separating of Overstory and Understory Leaf Area Indices for Global Needleleaf and Deciduous Broadleaf Forests by Fusion of MODIS and MISR Data" *by* Yang Liu et al.

Anonymous Referee #2

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General Comments

This manuscript examines methods to obtain maps of overstory and understory leaf area index (LAI) for needleleaf and deciduous broadleaf forest at global scales, at 1 km scale, using reflectance data from moderate resolution orbiting NASA remote sensing instruments (MISR and MODIS). It addresses some important issues in ecology and remote sensing of forest canopies and builds on very promising earlier work by Chen, Pisek, and others. The figures are well drawn and most do not need modification; exceptions include the global maps that ought to be presented larger and with non-mapped areas indicated. There are many tables in the Results section; some repeat a small number of values given in the text and are therefore superfluous.

While the goals are worthy and the methods both appropriate and promising, the structure of and writing in this lengthy manuscript make it very frustrating to read. There is too much repetition and the description of methods is sometimes quite unclear, with the use of undefined acronyms and ambiguous passages (highlighted in the Specific Comments section). The authors should try to reduce the volume by at least 25% by avoiding repetition and removing redundant text (and perhaps tables). Above all, the language needs to be far more precise; for example: the origin of one of the main methods (GLOBCARBON) is not even clear to readers in this original submission. There are instances of sloppiness, vagueness, and misleading statements throughout but I think these might become apparent to the authors from a fresh reading. This observation is not about the standard of the English âĂŤ that is perfectly adequate âĂŤ it is about conveying meaning accurately and unambiguously.

In my opinion it would be a shame not to publish this important work because of an insufficiently high standard of writing, so I recommend a major rewrite. Please see the attached PDF with embedded comments.

Specific Comments

Please see the attached annotated PDF for context. Where the embedded comments differ from those below, the latter shall take precedence.

page 1 ...but does MISR have sufficient frequency to allow monthly compositing to clear views? If not, some assumptions must have been made about the stability of understory reflectance – what were they?

page 1 Isn't this an odd finding? What about lower latitude multi-layer forest? How is "mainly" defined, most biomass, largest extent?

page 1 This sentence does not seem to make sense: was the first "deciduous needle-leaf forests" supposed to read "deciduous broadleaf forests"?

page 1 This is a bit vague: could the authors give it a name and/or indicate a more

precise location? There is no need to be vague, even in the abstract.

page 1 It is very interesting that understory LAI was retrieved with better accuracy and precision than overstory LAI. If supported by the results, this is a potentially important finding for remote sensing of forest canopies. On the other hand, in view of the inverse result presented in the next sentence, I wonder whether the metrics have been misattributed here, mixing up overstory and understory. Please check this.

page 3 How did Jiao et al. (2014) generate this using MISR data? Even before considering clouds, MISR has a 9-day repeat cycle: a "daily" product is not available. Is this an average for each DOY, accumulated over many years?

page 3 I do not think that these "fill values" are in the MISR Land product. This flags many anomalous conditions: failed aerosol/surface retrievals, topographic obscuration of cameras, low albedo thresholds – but does not plug the gaps. It seems more likely that these fill values were generated by Jiao et al. (2014) – please check and correct this statement, if necessary.

Also, MISR does not provide a daily land surface product; its revisit period is 9 days at the equator, so with a ∼400 km swath it cannot provide daily observations. Do the authors really mean "daily"? This requires further explanation.

The language needs to be precise, or we give readers an incorrect impression.

page 3 do you mean: all available MISR observations for each DOY were averaged. . .. ?

page 3 Did Jiao et al. (2014) screen for disturbance, e.g., fires?

page 3 good statement of the assumption (though whether it is a good assumption is debatable).

page 3 Actually, more frequently than this if we do not restrict to clear-to-surface observations and consider both Terra and Aqua instruments,

page 3 Good decision: because there is very limited light penetration to the bottom of these canopies, solar wavelength remote sensing provides little information on any understory vegetation in some circumstances.

page 3 MISR-derived. Also: which one? I assume Jiao et al (2014) but it could be Pisek and Chen (2009) – it ought to be explicit. Since the first part is vague, this sentence might well be removed without hurting the manuscript.

page 4 There are no daily products from MISR – please explain.

page 4 indeed – but are the authors going to mention or explain the "fill" values mentioned earlier, on page 3?

page 4 why would you use this and not bilinear interpolation? These reflectance data are not represented as integers.

page 4 This is ambiguous: does this mean that the method was effective, or that the description approximates the operation?

page 4 This construction is odd: what are "related references"? Do the authors mean "collated from a variety of third-party surveys"?

page 7 Citation required – and maybe an explanation: to which organization or research group does this product belong? Or is this the name given to the method developed in this manuscript? The reader does not know.

page 7 – but on page 2 we read: "...and GLOBMAP LAI from a combination of Terra/MODIS and NOAA/AVHRR data (Liu et al., 2012a).". Readers do not know whether this GLOBMAP LAI was derived by Liu et al., 2012a, or here. Unfortunately, the manuscript seems to be rife with this kind of sloppiness.

page 7 Doesn't VI also have an angular dependence? Or perhaps f_BRDF takes care of that here?

page 8 Perhaps it would be good to include citations for each of the inputs here, within

each box (where appropriate).

page 8 Is "the" correct, or do the authors mean "a". It is important to use the correct article (definite or indefinite), otherwise readers might be misled. If this is a specific mixture, the reader needs more explanation than provided by the Deng et al. (2006) citation.

page 8 So the changing angles were used with a BRDF model to simulate daily reflectivity? This has to be made clear.

page 9 How was this "combining" done? What was (were) the compositing criterion (criteria)? The average of all values? Otherwise, how to choose the "best" LAIu value?

Also, do the authors mean "spatially coherent", or "spatially complete"? It is not clear what "coherent" would mean in this context. Presumably, the reason for using LAIu from multiple years was to obtain as complete a global map as possible.

Were all the holes filled? If so, how? If not, how were gaps flagged?

page 9 The nature of this noise ought to be clarified so that reader can determine if this is a reasonable thing to do.

page 10 Which one? 5, 6, or 7? The "the" implies only one MODIS SWIR band.

page 10 This is vague: name them please (BDF, DNF, ENF?) .

page 10 What is the theoretical basis for RSR and the justification for using it for forests, as opposed to SR? Since no citation was provided, this is not clear.

page 10 ok – but you cannot write "the shortwave IR band" in line 2.

page 10 This passage is confusing: it starts by describing the GLOBCARBON LAI algorithm (again?); then describes a method for calculating understory LAI that may relate to GLOBCARBON or to a new method. Please make this clear: try to write so that the meaning is unambiguous.

page 11 This is very confusing: does it refer to the GLOBCARBON LAI, or to the average?

page 11 This passage requires some sort of introduction, rather than pointing the reader at a figure with unknown relevance. In earlier studies of this kind, it was mentioned that temporal profiles of total and understory reflectivity differ, providing a means of verifying the retrieval of the latter. Is that the intention here, with LAIu?

page 12 How is this relevant to the discussion?

page 12 Perhaps include a sentence explaining the significance of these observations to the goal of obtaining accurate global monthly LAIu?

page 12 This is a bit vague, maybe say something about the nature of this procedure, for example, what criteria were used?

page 13 which? u or o? or both?

page 13 how? is this really worth stating?

page 13 This is a very nice figure but it is far too small: maybe present this figure using an entire page in landscape mode. Also, indicate the unmapped areas on the maps using (e.g.) gray, another unused color, or shading.

page 13 Indicate the unmapped areas on the maps using (e.g.) gray, another unused color, or shading.

page 13 Previously, 50 - 70° N was described as "boreal".

page 15 See the comment on Figure 4; in particular, indicate the unmapped areas on the maps using (e.g.) gray, another unused color, or shading.

page 16 See the comment on Figure 4; in particular, indicate the unmapped areas on the maps using (e.g.) gray, another unused color, or shading.

page 16 These do not look right. For example, why do we see large mean overstory

LAI values for longitudes corresponding to the Atlantic ocean and Greenland? Please check the calculation of the values used in these profile plots.

page 16 using which flags? i.e., what was the source of the flags?

page 17 6 and 8 but not 10, as far as I can see.

page 17 So does this mean that this is not real behavior but merely an artefact of the LAI algorithm? The peaks at 6 and 8 do not appear realistic but rather the result of some kind of quantization.

page 17 Isn't this more a function of tree spacing rather than clumping?

page 17 This is a description of methods (possibly re-stated).

page 19 Without knowing which one was subtracted, this does not mean anything.

page 20 Indicate the unmapped areas on the maps using (e.g.) gray, another unused color, or shading.

page 22 Was an independent validation of this data set performed? If not, make it clear that this is not intended as a validation data set,

page 22 or just eastern Siberia? see line 3.

page 22 A new forest understory LAI...

page 22 Why? Why not include ENF?

page 24 These are encouraging results – you probably should state N as well.

page 26 BRDF, not scattering; I do not think that shadowing can be described as a "scattering effect".

page 26 why? isn't a higher proportion of the understory illuminated in summer?

page 27 There is a big difference between invalid BRF retrievals (e.g., owing to failed aerosol retrievals) and "missing data" (owing to clouds, topographic obscuration).

Also, please check the use of "daily" in any mention of MISR or MISR-derived products – I do not think it can be correct.

page 28 retrievals of what? surface reflectance?

page 28 in the northern hemisphere.

page 28 This does not make much sense: we would expect forest understory LAI to reach a maximum in the summer and we would expect greater seasonality at higher latitudes (where needleleef forests dominate). So what is novel here?

page 28 This just repeats material from the results.

page 28 This seems very repetitive: try to state things once, in the most appropriate section.

page 29 Absolutely correct. No mention of the potential for field lidar to provide overstory and understory LAI at scales commensurate with the remote sensing data (though 1 km would still be quite tough, even with $\sim$50 m penetration)?

Technical Corrections

Please see the attached annotated PDF for context.

page 1 (...and also remote sensing of forest canopies by inversion of canopy reflectance models).

page 2 A global wall-to-wall....

[indefinite article missing]

page 2 Please give the full product name as well as the code.

page 2 ...using a combination of... [rather than "combining"]?

page 2 LAI was also estimated...

[definite article not required]

page 2 ; this means. . ..

page 2 a global...

page 3 Pisek and Chen, 2009),

page 3 near-infrared

[capitalization is not necessary]

page 3 , making the assumption that understory conditions remain stable over the period.

page 3 "accounted for" more appropriate than "corrected"?

page 3 Methods

["Data" is usually a subset of "Methods"]

page 3 Please give the name as well as the code. Also, move this sentence down, to where this product is described.

page 4 Please define all acronyms on first use.

page 4 on

page 4 of Jiao et al. (2014).

[must be specific]

page 4 This

or:

This MISR-based...

or:

The Jiao et al. (2014)...

C9

[otherwise the language impies that this forest background reflectivity data set is a MISR product]

page 4 What does this mean: on a geographic grid, perhaps?

page 4 resampled (or reprojected) to a geographic grid

– not "pre-processed to the geographic coordinate"

page 4 strictly speaking, a geographic grid holds data that are not "projected", so "geographic reference system" might be more appropriate.

page 4 Define acronym on first use:

MODIS Bidirectional Reflectance Distribution Function (BRDF)

page 7 "Methods" should be the overarching heading for section 2.

This section might be better headed with "Calculation of LAI".

page 7 Citations required.

page 10 repetition typo?

page 11 reference Eq. (4) and (5) here please.

page 11 show?

page 12 Figure

page 12 maps, for each month from January 2010.

page 12 the

page 12 the

page 13 for 2010.

page 13 (Figure 5).

page 14 Figure 5 needs to go above this text, not below it; Figure 6 is two pages away.

page 19 typo. : GLOBCRABON should read GLOBCARBON.

page 20 typo.

page 21 based on data from 2008 to 2010.

page 23 The axes on plot (a) should be rescaled to match the range of values (about 0 - 1).

page 23 or just eastern Siberia?

page 26 species names in italics please.

page 26 The quality. . .

page 27 A combination...

page 27 check "daily"

== end ===

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/bg-2016-448/bg-2016-448-RC3-supplement.pdf

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-448, 2016.