Biogeosciences

Discussions

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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.

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We deeply appreciate the very careful and constructive suggestions from Reviewer #1 and Reviewer #2, which help to improve our manuscript. Below we outline our response and the way in which we have addressed each of their comments:

Response to Referee #1's comments RC2:

Comments: Thank you for the responses to my comments. I would like to elaborate a little bit on the data sharing issue. While I am happy to read that you will be sharing your data on a webpage (http://globalmapping.org/). This webpage seems to be in Chinese and I would hope that the dataset will be put online on

a webpage that is easily accessed and understood in English. More than that, perhaps in addition to the personal webpage, or as replacement, I highly recommend the publication of the dataset in a dedicated repository. The journal is dedicated to this avenue of data sharing and it seems natural to follow the guidelines on http://www.biogeosciences.net/about/data_policy.html

Response: Thank you for this helpful suggestion. We will provide English version of our webpage. And this dataset will also be put online on the webpage of our department, Resources and Environmental Science Data Center, Chinese Academy of Sciences.

Response to Referee #2's comments RC3:

General comments

Comments 0: 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 nonmapped 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.

Response: According to this suggestion, Figure 4 and 5 will be revised to present in entire pages in landscape mode. The EBFs will be labeled in Figure 4, 5, and 9. Table 3 and 4 will be deleted since similar results are also presented in Figure 8 and relevant text.

Comments 1: 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 some-

times 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 âËŸA ËĞT that is perfectly adequate âËŸAËĞT it is about conveying meaning accurately and unambiguously.

Response: We really appreciate your careful review and helpful suggestions. The manuscript will be revised throughout the paper, and redundant text will be removed to make the language more concise and precise according to the reviewers' suggestions. Figure 6, Table 3 and 4 and relevant text will be removed. We really appreciate your efforts in improving the manuscript.

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.

Comments 2: 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?

Response: MISR does not have sufficient frequency to provide monthly complete retrievals. Here, it is assumed that the forest background changes only from month to

month but remain stable in the same month of different years. And the global monthly LAIu maps were produced by averaging the available valid retrievals from 2000 to 2010 for each month. The description of this assumptions was provided in Line 10-11 in page 3.

Comments 3: page 1 Isn't this an odd finding? What about lower latitude multi-layer forest? How is "mainly" defined, most biomass, largest extent?

Response: The largest extent of forest understory is presented in boreal forest zones since evergreen broadleaf forests are excluded. The sentence was revised.

Comments 4: page 1 This sentence does not seem to make sense: was the first "deciduous needleleaf forests" supposed to read "deciduous broadleaf forests"?

Response: Yes, it was corrected.

Comments 5: 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.

Response: The precise location of the dataset was added.

Comments 6: 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.

Response: The numbers were corrected and the order of overstory and understory in the last sentence in Abstract was changed to be consistent with the previous one. For comparison with the dataset in eastern Siberia, the absolute and relative error are smaller for overstory LAI than that for understory LAI. Although the R^2 and RMSE are slightly better for understory LAI for direct validation, available field measurements are quite rare, especially of understory LAI. Thus, it is hard to say that the retrieved understory LAI is of better accuracy.

Comments 7: 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?

Response: As the reviewer pointed out, Jiao et al. (2014) retrieved the background reflectivity using all available MISR observation for each day, which could not be mentioned as daily product. This sentence was revised.

Comments 8: 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.

Response: As the reviewer pointed out, MISR observations during one day could only cover parts of the globe, so MISR Land product could not be referred as a daily product. Additionally, cloud, cloud shadows, aerosol, sun glitter over water, topographically complex terrain and topographically shadowed regions result in large amount of missing data and invalid retrievals in MISR Land product. For these situation, the procedure was not carried out in retrieval of forest background reflectivity (Jiao et al., 2014). Relevant statement was revised to be precise.

Comments 9: page 3 do you mean: all available MISR observations for each DOY were averaged. . ..?

Response: Yes, it was corrected.

Comments 10: page 3 Did Jiao et al. (2014) screen for disturbance, e.g., fires?

Response: No, disturbance was not screened in Jiao et al. (2014). The disturbance may result in change in understory conditions among years, which may introduce uncertainties in our results. Relevant discussion was added in the last paragraph of Discussion section.

Comments 11: page 3 good statement of the assumption (though whether it is a good assumption is debatable).

Response: The background condition has to be assumed to be stable for each month in different years due to lack of adequate MISR observation. This assumption may introduce uncertainties when the background changes among years, such as fire and other disturbance. Discussion about these (in the last paragraph in Page 27) was revised according to your suggestions.

Comments 12: page 3 Actually, more frequently than this if we do not restrict to clear-to-surface observations and consider both Terra and Aqua instruments,

Response: Yes, this sentence was revise to be more precise according to this suggestion.

Comments 13: 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.

Response: Thank you for your agreement.

Comments 14: 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.

Response: This sentence was removed.

Comments 15: page 4 There are no daily products from MISR – please explain.

Response: As the reviewer pointed out, we mean the valid MISR observations for each

day, which could not be mentioned as a daily product. This sentence was revised.

Comments 16: page 4 indeed – but are the authors going to mention or explain the "fill" values mentioned earlier, on page 3?

Response: The expression about "fill" value have been explained in response to comment 8. This sentence was revised.

Comments 17: page 4 why would you use this and not bilinear interpolation? These reflectance data are not represented as integers.

Response: The land cover type product MCD12Q1 could not use the bilinear interpolation. For land surface reflectance product MOD09A1, it is more efficient for the nearest neighbour interpolation than bilinear interpolation for processing of such global multi-year observations.

Comments 18: page 4 This is ambiguous: does this mean that the method was effective, or that the description approximates the operation?

Response: We mean that the method was effective. This sentence was revised.

Comments 19: page 4 This construction is odd: what are "related references"? Do the authors mean "collated from a variety of third-party surveys"?

Response: We read many published papers about LAI. Some of them provided field measurements of forest overstory and understory LAI. We collected these measurements to validate our results. The sentence was revised to be more precise.

Comments 20: 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.

Response: This LAI algorithm is part of the GLOBCARBON project of European Space Agency (ESA). The description was revised and citation was added.

Comments 21: 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.

Response: GLOBMAP is the name of series remote sensing products generated by our group, such as the global long-term LAI dataset (Liu et al., 2012). The forest overstory and understory LAI generated in this manuscript is another GLOBMAP product. And we are also processing other products, including global land cover types, phenology and water surface. This sentence and that in page 2 were revised to be more clear.

Comments 22: page 7 Doesn't VI also have an angular dependence? Or perhaps f_BRDF takes care of that here?

Response: Yes, function f_BRDF quantifies the BRDF effects of VI. Relevant description was revised to be more clear.

Comments 23: page 8 Perhaps it would be good to include citations for each of the inputs here, within each box (where appropriate).

Response: Citations of the inputs were added in Figure 1.

Comments 24: 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.

Response: We mean "a". It was corrected.

Comments 25: page 8 So the changing angles were used with a BRDF model to simulate daily reflectivity? This has to be made clear.

Response: No, these MISR observation angles were used to estimate the forest background reflectivity from all available valid MISR observation for each day (Jiao et al.,

2014). The word "daily" is inappropriate. This sentence was revised.

Comments 26: 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?

Response: This comment is very useful. The monthly LAIu map were produced by averaging valid retrievals for each month during 2000-2010. "Spatially coherent" was changed to "spatially complete". Almost all the holes filled. The LAIu were not retrieved over only 0.07% of global needleleaf and deciduous broadleaf forests areas due to missing of MISR background reflectivity during 2000-2010. Besides, some of derived LAIu exceed the valid range of LAI. These invalid retrievals are mainly occurred in summer, which are probably due to large uncertainties in background reflectivity for dense canopy. These missing values and invalid retrievals were labeled in understory LAI maps. Relevant description was revised. Thank you.

Comments 27: page 9 The nature of this noise ought to be clarified so that reader can determine if this is a reasonable thing to do.

Response: Although 11-year data were used to generate spatially complete monthly MISR forest background reflectivities, there are still missing values. Besides, uncertainties exist in the MISR forest background reflectivity dataset. For example, the reflectivities tend to be unrealistic for dense canopy, which may affect the retrieval of forest overstory LAI (Jiao et al., 2014). So, the monthly forest background SR was scaled to a 10-km resolution to fill the missing values and reduce these uncertainties. Relevant description was revised to be more precise.

Comments 28: page 10 Which one? 5, 6, or 7? The "the" implies only one MODIS SWIR band.

Response: MODIS band 5 was used. This sentence was revised.

Comments 29: page 10 This is vague: name them please (BDF, DNF, ENF?) .

Response: The forest types, including DBFs, ENFs and DNFs, were specified.

Comments 30: 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.

Response: Since RSR is less sensitive to variable background of forest stands compare to SR (Brown et al., 2000), it is more suitable for LAI retrieval for forests. This sentence was revised and citation was added.

Comments 31: page 10 ok – but you cannot write "the shortwave IR band" in line 2.

Response: The specific SWIR band used here was added.

Comments 32: 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.

Response: This passage was revised to be more clear.

Comments 33: page 11 This is very confusing: does it refer to the GLOBCARBON LAI, or to the average?

Response: This refers to the GLOBCARBON LAI algorithm for grass, which is also developed for crop and other non-forest vegetation except shrub (Deng et al., 2006). The descriptions here and in section 2.2 were revised to be more precise.

Comments 34: 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?

Response: The introduction of this passage was added. Figure 3 shows the seasonal cycles of the differences of derived understory LAI based on GLOBCARBON algorithm between shrub and grass. This indicates the seasonal distribution of uncertainties in derived LAIu. This section was rewritten to be more concise, and relevant statement was added.

Comments 35: page 12 How is this relevant to the discussion?

Response: This section was rewritten, and this sentence was removed.

Comments 36: page 12 Perhaps include a sentence explaining the significance of these observations to the goal of obtaining accurate global monthly LAIu?

Response: The meaning of these observations to derived LAIu was added in the end of section 3.1.

Comments 37: page 12 This is a bit vague, maybe say something about the nature of this procedure, for example, what criteria were used?

Response: Since a brief introduction of this cloud procedure and description of snow/ice labeling have been presented in the end of section 2.1.1 (line 14-17 in page 4 in our discussion paper), the description about cloud and snow labeling here was removed to make the manuscript more concise.

Comments 38: page 13 which? u or o? or both?

Response: Understory LAI. It was specified.

Comments 39: page 13 how? is this really worth stating?

Response: This sentence was removed.

Comments 40: 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.

Response: This suggestion is very helpful. Figure 4 was redrawn with EBFs masked, and it will be presented using an entire page in the revision. Thank you.

Comments 41: page 13 Indicate the unmapped areas on the maps using (e.g.) gray, another unused color, or shading.

Response: EBFs areas in Figure 4 were labeled using another unused color in the revision. Thank you.

Comments 42: page 13 Previously, 50 - 70 N was described as "boreal".

Response: These are not the same region. In the previous paragraph, boreal forest zone (50°-70° N) is where forest understory mostly found. Here, we mean the regions where forest overstory show pronounced seasonal variations.

Comments 43: page 15 See the comment on Figure 4; in particular, indicate the un-mapped areas on the maps using (e.g.) gray, another unused color, or shading.

Response: Figure 5 was also redrawn with EBFs labeled with another unused color, and it will be presented using an entire page in the revision.

Comments 44: page 16 See the comment on Figure 4; in particular, indicate the un-mapped 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.

Response: According to the suggestions of Reviewer 1, who pointed out that Figure 6 is not very informative, Figure 6 and relevant text were removed in the revision.

Comments 45: page 16 using which flags? i.e., what was the source of the flags?

Response: Since the description about cloud and snow labeling have been presented in the end of section 2.1.1 (line 14-17 in page 4 in our discussion paper), this sentence was removed to make the manuscript more concise.

Comments 46: page 17 6 and 8 but not 10, as far as I can see.

Response: Yes, as you pointed out, small peaks of LAIo values were presented at 10 for ENFs and DNFs, not DBFs. These saturation values will be excluded in the revision, see details in response to comments 47.

Comments 47: 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.

Response: As it is pointed out, these peaks are artifacts for unrealistic retrievals. For the very dense canopy, the reflectance value is in the low end, for example, reflectance in the red band is very low due to extremely strong absorption of leaves. Thus, the calculated SR or RSR will be very high, which may result in unrealistic high LAI retrievals. At this minimum value, the LAI is set to the saturation value for the given cover type in the LAI algorithm. These saturation values will be excluded in the revision, and Figure 7a (Figure 6a in the revision) and relevant text were also revised accordingly.

Comments 48: page 17 Isn't this more a function of tree spacing rather than clumping?

Response: Yes, tree spacing is also an important factor. This sentence was revised. Thank you.

Comments 49: page 17 This is a description of methods (possibly re-stated).

Response: Here, the LAIu and LAIo were averaged for all pixels for specific forest type for each month in the northern hemisphere. This is a small procedure to generate the seasonal curves, so it is presented in the front of this section. This sentence was revised to be more clear.

Comments 50: page 19 Without knowing which one was subtracted, this does not mean anything.

Response: The description about the difference between the GLOBCARBON LAI and

the GLOBMAP LAIT (GLOBCARBON LAI minus GLOBMAP LAIT) was revised to be precise. And the difference between the GLOBCARBON LAI and the GLOBMAP LAIo (GLOBCARBON LAI minus GLOBMAP LAIo) was also specified.

Comments 51: page 20 Indicate the unmapped areas on the maps using (e.g.) gray, another unused color, or shading.

Response: EBFs in Figure 9 was also labeled using another unused color in the revision.

Comments 52: 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,

Response: This dataset generated by Kobayashi et al. (2010) was independent from ours, and it is also validated independently with in situ measurement at Spasskaya Pad experimental larch forest, Yakutsk, Russia (62.26° N, 129.62° E), and compared with MOD15 and CYCLOPES LAI products.

Comments 53: page 22 or just eastern Siberia? see line 3.

Response: Yes. It was corrected. Besides, captions of Figure 11 and Table 5 were also revised to be more precise.

Comments 54: page 22 A new forest understory LAI...

Response: Corrected.

Comments 55: page 22 Why? Why not include ENF?

Response: In Kobayashi et al. (2010), the larch pixels were identified with GLC2000 deciduous needleleaf class, and overstory and understory LAI values were only retrieved for these pixels. In our study, MODIS land cover products MCD12Q1 was used to identify forest types. In order to eliminate the effects of different land cover type on the comparison, the region that is given as deciduous needleleaf forests both by GLC2000 and MCD12Q1 were included in the comparison. The relevant description

was revised to be more clear.

Comments 56: page 24 These are encouraging results – you probably should state N as well.

Response: This suggestion is good. The numbers of field measurements of overstory and understory LAI were added in relevant descriptions and the caption of Figure 12 (Figure 11 in the revision).

Comments 57: page 26 BRDF, not scattering; I do not think that shadowing can be described as a "scattering effect".

Response: As you pointed out, this sentence is not clear. We tried to express that shadows from closed canopies make it difficult to observe the signals from understory. This sentence was revised to be more precise.

Comments 58: page 26 why? isn't a higher proportion of the understory illuminated in summer?

Response: In summer, the overstory canopy is generally denser than in spring and autumn, which makes it hard for light to penetrate to the forest floor. It is also difficult for sensors to capture signals of understory through such dense canopies. Thus, the retrievals in the spring and autumn should be more reliable than those in the summer.

Comments 59: 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.

Response: This sentence was revised to be more precise. And the use of "daily" was corrected throughout the paper. Thank you.

Comments 60: page 28 retrievals of what? surface reflectance?

Response: Understory LAI. It was specified.

Comments 61: page 28 in the northern hemisphere.

Response: Since it is specified to the boreal forest zones, we do not repeat it to make the paper concise.

Comments 62: 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?

Response: According to this suggestion, this sentence was removed, and Conclusions section was rewritten.

Comments 63: page 28 This just repeats material from the results.

Response: These sentences were removed, and Conclusions section was rewritten.

Comments 64: page 28 This seems very repetitive: try to state things once, in the most appropriate section.

Response: These sentences were removed to make it concise. Thank you.

Comments 65: 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)?

Response: This suggestion is very helpful. It was added. Thank you.

Technical Corrections

Please see the attached annotated PDF for context.

Comments 66: page 1 (. . .and also remote sensing of forest canopies by inversion of canopy reflectance models).

Response: Corrected.

Comments 67: page 2 A global wall-to-wall. . .. [indefinite article missing]

Response: Corrected.

Comments 68: page 2 Please give the full product name as well as the code.

Response: The full product name of MOD15 was added.

Comments 69: page 2 ...using a combination of... [rather than "combining"]?

Response: Corrected.

Comments 70: page 2 LAI was also estimated... [definite article not required]

Response: Corrected.

Comments 71: page 2 ; this means. . ..

Response: Corrected.

Comments 72: page 2 a global...

Response: Corrected.

Comments 73: page 3 Pisek and Chen, 2009),

Response: This reference was checked.

Comments 74: page 3 near-infrared [capitalization is not necessary]

Response: Corrected.

Comments 75: page 3 , making the assumption that understory conditions remain stable over the period.

Response: Corrected.

Comments 76: page 3 "accounted for" more appropriate than "corrected"?

Response: Corrected.

Comments 77: page 3 Methods ["Data" is usually a subset of "Methods"]

Response: Corrected.

Comments 78: page 3 Please give the name as well as the code. Also, move this sentence down, to where this product is described.

Response: The name of MCD12Q1 was added, and this sentence was moved down.

Comments 79: page 4 Please define all acronyms on first use.

Response: All acronyms of IGBP was added.

Comments 80: page 4 on

Response: Corrected.

Comments 81: page 4 of Jiao et al. (2014). [must be specific]

Response: Added.

Comments 82: page 4 This or: This MISR-based...or: The Jiao et al. (2014)... [otherwise the language impies that this forest background reflectivity data set is a MISR product]

Response: "The" was changed to "This".

Comments 83: page 4 What does this mean: on a geographic grid, perhaps?

Response: Yes, it was corrected.

Comments 84: page 4 resampled (or reprojected) to a geographic grid – not "pre-processed to the geographic coordinate"

Response: Corrected to "reprojected".

Comments 85: page 4 strictly speaking, a geographic grid holds data that are not "projected", so "geographic reference system" might be more appropriate.

Response: Corrected.

Comments 86: page 4 Define acronym on first use: MODIS Bidirectional Reflectance Distribution Function (BRDF)

Response: Corrected.

Comments 87: page 7 "Methods" should be the overarching heading for section 2. This section might be better headed with "Calculation of LAI".

Response: Since our method estimates the forest overstory and understory LAI rather than calculates them precisely, the heading of this section was revised to "Estimation of LAI". The heading of section 2 was changed to "Methods".

Comments 88: page 7 Citations required.

Response: Citations of RSR (Brown et al., 2000) and SR (Jordan, 1969) were added.

Comments 89: page 10 repetition typo?

Response: LAIT is short for GLOBMAP LAIT. This sentence was revised to be clearer.

Comments 90: page 11 reference Eq. (4) and (5) here please.

Response: Added.

Comments 91: page 11 show?

Response: Corrected.

Comments 92: page 12 Figure

Response: According to Biogeosciences manuscript preparation guidelines, the abbreviation "Fig." should be used when it appears in running text (http://www.biogeosciences.net/for_authors/manuscript_preparation.html).

Comments 93: page 12 maps, for each month from January 2010.

Response: Corrected.

Comments 94: page 12 the

Response: Corrected.

Comments 95: page 13 for 2010.

Response: Figure 4 shows the monthly LAIu maps by averaging valid retrievals from 2000 to 2010 for each month. The caption of this figure was revised to be more precise.

Comments 96: page 13 (Figure 5).

Response: Added.

Comments 97: page 14 Figure 5 needs to go above this text, not below it; Figure 6 is two pages away.

Response: Figure 5 was moved above this paragraph in the revision.

Comments 98: page 19 typo. : GLOBCRABON should read GLOBCARBON.

Response: Corrected.

Comments 99: page 20 typo.

Response: Corrected.

Comments 100: page 21 based on data from 2008 to 2010.

Response: Corrected.

Comments 101: page 23 The axes on plot (a) should be rescaled to match the range of values (about 0 - 1).

Response: The axes were rescaled.

Comments 102: page 23 or just eastern Siberia?

Response: Corrected.

Comments 103: page 26 species names in italics please.

Response: Corrected.

Comments 104: page 26 The quality. . .

Response: Corrected.

Comments 105: page 27 A combination...

Response: Corrected.

Comments 106: page 27 check "daily"

Response: Corrected.

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

References: Brown, L. J., Chen, J. M., Leblanc, S. G., and Cihlar, J.: A shortwave infrared modification to the simple ratio for LAI retrieval in boreal forests: An image and model analysis, Remote Sens. Environ., 71, 16–25, 10.1016/s0034-4257(99)00035-8, 2000.

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for monitoring seasonality in the overstory leaf area index of Siberian larch forest, J. Geophys. Res.-Biogeosci., 115, 10.1029/2009jg000939, 2010.

Thank you for your insightful suggestions.

Yang Liu, Ronggao Liu, Jan Pisek, and Jing M. Chen

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