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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 greatly appreciate the constructive suggestions from the Reviewer #1, and provide the following responses:

General comments

Liu et al. present a global algorithm to separate under- and over-story Leaf Area Index (LAI) from forest (excluding the tropics). The resulting global LAI datasets are worthwhile and useful for other members in the community (e.g. modeling). Overall, the paper is well written, with clear articulation of the methods, and appropriate and clean visuals. Sometimes the text remains merely descriptive but that may be ok for an algorithm paper. One prerequisite for publication that is not fulfilled is that the authors should make their global datasets available for publication by posting them on a well-accepted data repository (e.g. ORNL DAAC).

Specific comments

Comments 1:

- Can you please make the data products available for further use by the scientific community?

Response:

Yes, the global datasets will be posted on http://globalmapping.org/, where also include other products developed by our group, such as our global long-term consistent GLOBMAP LAI dataset (Liu et al., 2012a).

Comments 2:

- It seems that only one field site with understory LAI was available for validation? Are there any other? With regard to all field sites (understory LAI, overstory LAI, NDVI understory), it would help the interpretation if the authors also shortly clarify how these field measurements were taken? For example, how was understory LAI derived in the field? Or how was understory NDVI derived? What was the instrumentation set-up?

Response:

Yes, there is only one field site available for understory LAI validation. There are few LAI measurements available for forest understory, making it challenging to directly validate the satellite retrievals. In fact, our best effects have been made to collect relative field data. Except for the Prince Albert National Park/Canada site used in the manuscript, we also collected understory LAI at several sites from published references, such as Gwangneung Experimental Forest/Korea (Ryu et al., 2014), Tower Hill Botanic Garden, Massachusetts/USA (Herwitz et al., 2004), Florida Georgia/USA (Peduzzi et al.,

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2010) and Mato Grosso/Brazil (Biudes et al., 2014). However, these measurements cannot be used for validation. The Gwangneung and Tower Hill Botanic Garden sites were measured in 2013 and 1994-1997, respectively, which is out of background reflectance observation period (2000-2010). The location of Florida Georgia site cannot be specified. The Mato Grosso/Brazil site is covered with the evergreen broadleaf forest, which was excluded in our study. Thus, only measurements at Prince Albert National Park/Canada site were used for understory LAI direct validation. Besides field understory LAI measurements, the field understory NDVI measurements at seven sites were also used to further evaluate derived understory LAI (Fig. 13).

The detailed description about the field measurements will be added in the revision.

Comments 3:

- Related to validation, when using the Kobayashi LAI dataset, was there any ground or field validation of the Kobayashi dataset?

Response:

The Kobayashi larch overstory LAI was compared with ground-based values observed at the Spasskaya Pad experimental larch forest, Yakutsk, Russia in 2000 (Kobayashi et al., 2010). These field measurements were also used in direct validation of our derived overstory LAI in section 3.7.

Comments 4:

- In terms of the paper structure: would it make sense to first present the validation results and then go on with the global overview?

Response:

It is more reasonable to present validation before dataset analysis for algorithm paper. This paper focuses on products rather than algorithm. For satellite products, the spatial distribution, seasonal variation and biome distribution could imply the reasonability of the dataset. Besides, the field measurements for validation are limited, although we tried our best efforts. So, we would like to present the global distribution (section 3.2), biome distribution (section 3.3) and seasonal variation (section 3.4) in the front of results, and section 3.5 (seasonal effects of the background reflectivity on the LAI retrieval) will be moved after the comparison and validation.

Comments 5:

- English language is generally ok, however in some cases the of the article ‘the’ is redundant. I have indicated some instances in the annotated pdf.

Response:

Thank you for your careful suggestions. The English language will be checked and further smoothed in the revision.

Comments 6:

- In the map figures (Figures 4, 5, 6, 9) it would help the presentation if there was a separate legend class for the EBFs that were masked out. Then the reader would immediately know which areas were excluded.

Response:

This suggestion is very good. We will mask out the EBFs in Figure 4, 5 and 9 in the revision. Figure 6 will be deleted according to your suggestions (Comment 7).

Comments 7:

- The latitudinal and longtitudinal transects (Figure 6) may not be useful especially since there is no coverage in the tropics. Maybe you could limit the latitudinal transect to the temperate and boreal biomes?

Response:

As you pointed out in the supplement, Figure 6 is not very informative. This figure and

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related description will be deleted in the revision.

Comments 8:

- In Figure 7a the frequency peaks at LAI of 6 (for DBF) and at LAI of 8 (for all forest types) seem very artificial. In the tekst you indeed mention that these peaks are there because of set saturation values. Is there a way to get rid of this artifact?

Response:

As it is pointed out, this saturation values 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.

Comments 9:

– This may be somewhat challenging but would make the product even more useful; is there a way to estimate pixel-based uncertainty? For example, by assigning uncertainties to all steps in the algorithm (e.g. biome-specific functions, choice of clumping index, uncertainties in MISR background reflectivity, etc.) in an error propagation exercise.

Response:

As the reviewer pointed out, pixel-based uncertainty could improve the usefulness of our product. It is a complex work to evaluate uncertainties in parameters generated from remote sensing observations quantitatively, especially at pixel level (e.g., Miura et al., 2000; Melin et al., 2016). Many factors may introduce uncertainties into the derived LAI datasets, such as LAI algorithm and inputs, mainly including MOD09A1 land surface reflectance, MISR forest background reflectance and clumping index. For biome-specific LAI algorithm, due to the complexity of radiative transfer process, there are many parameters describing leaf, canopy and soil background in radiative transfer models. As many of these parameters lack spatial distribution maps at regional and global scale, biome-specific method is widely used in LAI retrieval, and it is hard to evaluate algorithm uncertainties at pixel level. MOD09A1 land surface reflectance product is a key input. But many procedures that convert satellite measured digital counts to reflectance also result in uncertainties, such as reflectance calibration, atmospheric corrections and cloud mask, which is difficult to estimate at pixel-base. For MISR forest background reflectivity, since monthly values were calculated from multi-year valid observations and then used to correct the background effects of MODIS observations, its inter-annual variations may introduce uncertainties into LAI retrieval. Unfortunately, valid MISR observations are too scarce to evaluate these uncertainties (Liu et al., 2012b), and this is the reason that multi-year composition values were used. In this manuscript, we used spatial distribution, seasonal variation, biome distribution and direct validation with field measurements to evaluate the derived dataset. To make the paper more concise, the uncertainty evaluation will not be added. Relative discussion will be added in the revision.

Comments 10:

- In the Discussion section near the end it could be nice if the authors could highlight some areas of research that could directly benefit from their datasets.

Response:

This suggestion is very helpful. We will add discussion about possible application of our datasets in the revision.

Comments 11:

Technical corrections

Some small suggestions are made in the annotated pdf. Please also note the supplement to this comment: http://www.biogeosciences-discuss.net/bg-2016-448/bg-2016-

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448-RC1-supplement.pdf

Response:

Thank you for your careful suggestions. The manuscript will be revised according to your comments in the supplement. Table 3 will be removed.

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