Topic editor

Public justification (visible to the public if the article is accepted and published):

An additional reviewer was invited to evaluate the revised version of the manuscript. This new reviewer has provided a set of minor suggestions to further improve the clarity and quality of the paper. The authors are encouraged to carefully address these new comments and incorporate the necessary revisions to enhance the overall readability and scientific rigor of the manuscript.

We greatly appreciate the topic editor for his professional handling throughout the entire process. In this round of revision, we have carefully addressed these comments raised by the new reviewer. Some minor revisions have been made in the revised version and please see the itemized responses below. We hope that this version can reach the publishing level of ESSD.

Referee #4

This article presents a comprehensive study on generating the first global 500 m mean LIA (Mean Leaf Area) product using field measurements and remote sensing data. It can improve understanding of global LIA distribution and enhance applications in radiative transfer modeling, remote sensing, and land surface modeling.

The manuscript is well-structured, with clear objectives, thorough data collection, and robust analytical methods. The results are presented in a detailed and comprehensible manner. It is noted that this is the third revised version. Based on the authors' previous responses, they have generally addressed the reviewers' comments. I only have a few additional comments for consideration:

We thank the referee for the recognition and detailed comments which further improved the manuscript. We fully understand the referee's comments and have provided detailed explanations and revisions below.

1. Validation of G(0). In line 442, it states, "Fig. 14 shows that most of the reference G(0) values are greater than 0.50." However, it is not immediately clear from Fig. 14.

Indeed, the predicted G(0) values appear to be predominantly greater than 0.5. In Section 4.1, the authors suggest that this may be attributed to the CI values, which seems reasonable. However, if I understand correctly, the G(0) value is also influenced by the FVC (Fractional Vegetation Cover) value (BTW, I recommend that the authors define the concept of FVC in the manuscript). The effects of both CI and FVC contribute to the uncertainty in the validation results. Given that a significant finding of this study is that G(0) exceeds 0.5 in most cases, I suggest improvements could be made to this assessment.

Furthermore, the phrase "while the spherical distribution would underestimate the interception of radiation and rainfall (Figs. 9 and 11)" requires clarification, as the logic is not easily discernible from Figs. 9 and 11.

We thank the referee for the comments. In Fig. 14, it is not obvious that most of the reference G(0) values are greater than 0.50 because we show the validation compassion with an error bar for each site to better show the difference between different sites. The data statistics demonstrate that 72% of data points have G(0) values greater than 0.50.

In response to the comment, we have added the alternative form of Fig. 14 (Fig. R1) to the supplement and rephrased the original sentences in line 440.

In addition, most (72%) of the reference G(0) values are greater than 0.50 (Fig. S8),……

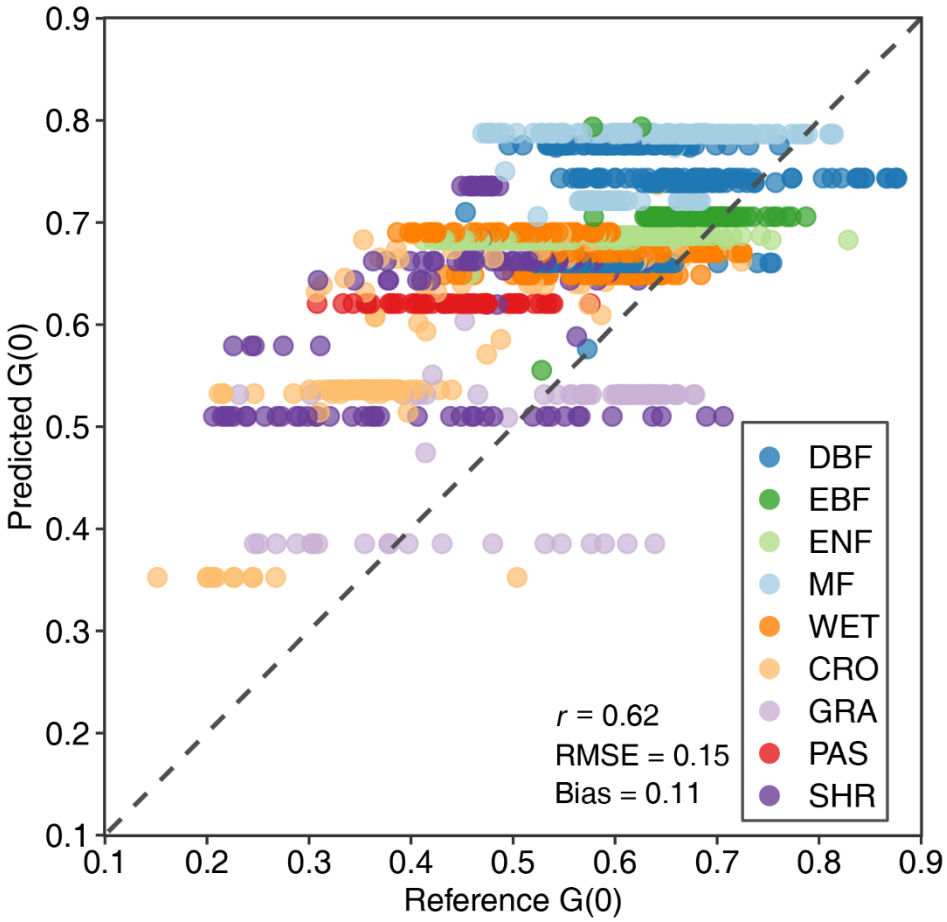

Fig. R1 Comparisons of G(0) derived from mean leaf inclination angle and high-resolution reference data for different plant functional types (see Fig. 2 for the acronyms).

In addition, the definition of FVC has been added to line 147. In this study, CI and FVC were used to derive high-resolution reference G(0) but not to predict the G(0) product. The CI angular effect may have caused the possible bias in the reference G(0) because it was ignored in calculating the reference G(0) (Eqs. (6) and (7)). In addition, the high-resolution FVC and LAI products may be influenced by woody materials that were included in the field measurements. We have discussed these points and added related sentences (line 396).

The woody materials may introduce biases into the reference G(0) as they were not separated in the high-resolution FVC and LAI products. The mixture of woody materials and leaves may have caused the underestimation of the reference G(0) because trunks usually have higher inclination angles (Liu et al., 2019).

The spherical distribution may underestimate the interception of radiation and rainfall because it overestimates LIA and underestimates G(0) for most conditions as shown in Figs. 9 and 11. We have rephrased the original sentences (line 440).

in this case, the spherical distribution would underestimate the radiation and rainfall interception because of the overestimated LIA and underestimated G(0) for most conditions (Figs. 9 and 11) (Stadt and Lieffers, 2000)

2. Lines 415-417: Please check the statements made here. They may not be suitable for all cases.

We agree with the reviewer that this statement is not rigorous. We have rephrased this sentence in a more rigorous manner (line 413).

Higher MLA generally means lower canopy interception and higher transmission for high solar altitude and more soil background can be detected in the nadir direction (Liu et al., 2012). This results in lower (higher) canopy NIR (red) reflectance because of the generally lower (higher) NIR (red) soil reflectance than that of the leaf components (Siegmund and Menz, 2005) and negative correlations between MLA and NIR reflectance and NDVI (Liu et al., 2012).

3. Lines 23-24: The phrase “is opposite” is not clear. And the unit for the RMSE value is missing.

The global G(0) distribution is out of phase with that of the MLA and we have rephrased that in the text. The G(0) is unitless and thus its RMSE has no unit.

4. Both Sections 2.1.1 and 2.1.2 reference Figure 1. However, there is a lack of necessary differentiation and explanation regarding this figure within the text and the figure itself.

Figure 1 includes all LIA field measurements with location information from TRY and literature and thus was refer in Sections 2.1.1 and 2.1.2. We have added the related explanation to this figure.

Figure 1. The locations of global leaf inclination angle measurements collected from TRY and the literature.

5. Lines 97-99: The description stating, "The LIA measurements in published literature were … from the literature (Fig. 1)" is overly simplistic. More detailed information should be provided to guide readers on how to access these measurements, thereby enhancing the credibility and reproducibility of the study.

We thank the referee for this point. We have added the necessary descriptions to line 96.

To fully utilize distributed and considerable LIA measurement data in the published literature, several keyword searches (leaf angle, leaf inclination angle, and leaf tilt angle) were performed in the Web of Science, Google Scholar, Google, and Chinese documentary databases.

6. Lines 142-143: The MCD15A2H product is stated to be available only from July 2002. Please clarify how data prior to July 2002 is obtained for this analysis.

Indeed, the MCD15A2H product is only available from July 2002. This study used the product since 2002. This product was only used for G(0) upscaling validation but not for MLA mapping. In addition, the multi-year average from 2002-2022 also reduces the impact of the lack of one year.

7. Section 2.2.2 - High-resolution Reference Data: It would be beneficial to move some of the descriptions from Section 2.4 to this section for a better logic, as it may not be easy for readers to follow otherwise.

We thank the referee for this comment. Following the comment, we have moved the high-resolution reference G(0) from Section 2.4 to Section 2.2.2 to enhance structural coherence.

8. Equation (3): This equation may require a citation to a relevant reference.

We have added a relevant citation for Equation (3).

The $G(\theta)$ value in the nadir direction ($\theta=0°$) was calculated using an analytical formula (Leblanc and Fournier, 2017).