Response to the reviewers (#ESSD-2023-143)

Thanks for the positive comments from the Reviewers. The reviewers' requests are repeated below, in italics, and with our responses written below each suggestion. We have responded in full to each request.

Reviewer #3 (Remarks to the Author):

[*Reviewer #3* General Comments] *This manuscript generated an annual tree cover map product at a resolution of 4.77m using Planet and Sentinel-1 data in the period 2016-2021. In general, the research is significant and related-works are well investigated. However, there are still several issues that need to be clarified.*

[Response] We sincerely appreciate the reviewer's encouraging words and constructive comments. All issues have been adequately addressed both below and in the revised version of the manuscript.

[*Reviewer #3* Comment 1] *1. The author mentions that 1515 validation data are used, but the training data of the RF model is not clearly defined in this manuscript. The manuscript requires explicit definitions of training and validation samples.*

[Response] Thanks a lot for pointing this out.

The article is an extension of our published algorithms paper (Yang et al., 2023). The algorithms paper detail introduces definitions and the making of the training labels in Section 2.3.1.

We have also revised the text in Section 2.2 to clarify definitions and the making of the validation samples, i.e., "(Yang et al., 2023). However, despite the advancements in the Land Cover Land Use Change (LCLUC) community, a notable gap remains the absence of publicly available high-resolution (e.g., ≤10 m) tree cover/non-tree cover labels. The existing coarse-resolution labels for tree cover/non-tree cover can introduce considerable uncertainties when evaluating high-resolution tree cover maps. As a result, our ability to delve deeper into the accuracy of time-series tree cover map datasets was

hindered.

Following the methodology established by Yang et al. (2023), we undertook a rigorous process to generate a robust validation dataset for our study. Firstly, we randomly generated 1,515 points to ensure a representative sample of collected visual data, as illustrated in Fig. 1. Next, to classify these points as trees or non-trees, we enlisted four human interpreters and employed Planet Explorer within QGIS. Our approach involved visually identifying tree cover/non-tree cover pixels in the true color composite of Planet-NICFI imagery where the points were located. To ensure accuracy, we superimposed the 10 m tree height data, previously developed by Lang et al. (2022), onto the Planet-NICFI imagery. This step ensured that the labels adhered to the specified tree height criteria (i.e., ≥5 m). Subsequently, we thoroughly evaluated and refined the labels using Google Earth. To make time series tree cover/non-tree cover labels, we maintained the geographic location of the 1,515 points and changed the year of the Planet-NICFI imagery. The resulting labels encompassed data from the years 2016, 2017, 2018, 2020, and 2021. Comprehensive information about the validation dataset can be found in Table 1." (P6L116-P7L146 in the track version of the revised manuscript).

Reference:

Yang, Feng, Xin Jiang, Alan D. Ziegler, Lyndon D. Estes, Jin Wu, Anping Chen, Philippe Ciais, Jie Wu, and Zhenzhong Zeng. Improved fine-scale tropical forest cover mapping for Southeast Asia using Planet-NICFI and Sentinel-1 imagery. Journal of Remote Sensing (2023).

[*Reviewer #3* Comment 2] *2. In section 2.3, the author can complement some clear descriptions of how to make comprehensive use of Planet and Sentinel-1 data.*

[Response] Thanks a lot for the valuable comment.

We first adjusted Section 2.4 of the previous version to Section 2.3 naming Section 2.3.4. We have then revised the text in Section 2.3 to complement some clear

descriptions of our method, including comprehensive use of Planet and Sentinel-1 data.

These major revised texts are ""To acquire the time-series tree cover map dataset, our methodology involved a two-step process. Initially, we integrated our custom RF approach, implemented on Google Earth Engine (GEE), with a cloud-based machine learning platform. This combination enabled us to obtain semi-annual Planet-NICFI and Sentinel-1 imageries spanning the years 2016 to 2021, as illustrated in Fig. 2. Following data acquisition, we performed several post-processing steps to generate accurate tree cover map product for the SEA region. These steps included downloading the acquired data from the cloud platform to a local location, conducting mosaic operations, clipping relevant areas, applying projection transformations, and performing correlation statistics. By employing this comprehensive approach, we successfully produced a high-resolution tree cover map product." (P10L215-223 in the track version of the revised manuscript).

product. The generated tree cover map product is compared pixel by pixel with the tree cover/non-tree cover labels. We then obtained a confusion matrix, including true tree cover (TP), true non-tree cover (TN), false tree cover (FP), and false non-tree cover (FN). These four values are used …… based on Eqs. (1)-(4), respectively.

$$\text{User's accuracy (UA)} = \frac{TP}{TP + FP} \quad (1)$$

$$\text{Producer's accuracy (PA)} = \frac{TP}{TP + FN} \quad (2)$$

$$\text{Overall accuracy} = \frac{TP + TN}{TP + TN + FP + FN} \quad (3)$$

$$\text{F1 score} = \frac{2 \times UA \times PA}{UA + PA} \quad (4)$$

(P10L226-P11L242 in the track version of the revised manuscript)".

[*Reviewer #3* Comment 3] *3. The manuscript has made an evaluation of the forest cover products produced in terms of quantitative assessment and detailed comparison, and the analysis of the results is convincing. However, it lacks a complete display and*

description of the annual forest cover results in Southeast Asia.

[Response] The point is well taken!

Here we don't show a complete display of time series tree cover maps, mainly because:

- We have showed Southeast Asia tree cover map in 2019 in published algorithms article;
- We can't see detail time series changes in tree distribution when showing these SEA tree cover maps.

Thus, we have added two example time series tree cover maps for the mainland and maritime Southeast Asia locations from 2016 to 2019, respectively (Figs. R1 and R2), to allow the reader to visually assess our tree cover map product. Note that we have not shown the years 2020 and 2021 due to inconvenient visualization for monthly resolution Planet-NICFI imagery collected from QGIS. Compared to the original Planet-NICFI imagery, our mapped tree cover map product exhibits better accuracy. In addition, we have counted the time series of the area of tree cover maps during 2016-2021 (Fig. R3) and we showed a slight increase trend for the area of tree cover from 2016 to 2021.

We have added some descriptions in the revised manuscript, "We further visually compared our time-series tree cover map product with the original Planet-NICFI imagery during 2016-2019 (Figures 4-5). Note that we have not shown the years 2020 and 2021 due to inconvenient visualization for monthly resolution Planet-NICFI imagery collected from QGIS. In comparison, our tree cover map product showed better consistencies with Planet-NICFI imagery, such as roads, the spatial distribution pattern of tree cover, and non-tree cover. However, our tree cover product potentially exhibited salt and pepper salt and pepper phenomenon in some years (i.e., 2017 and 2018) due to the employment of the RF approach. In practical applications, we need to pay attention to this phenomenon. In addition, we counted the time series of the area estimates of tree cover maps during 2016-2021 and showed a slight increase trend from 2016 to 2021, which is in line with the area estimates of ESA tree cover for the years 2020 and 2021.

This may be due to forest restoration after the 2015 El Niño phenomenon (Wigneron et al., 2020), as well as the impact of expanded plantations (Xu et al., 2020(P13L288-P14L298 in the track version of the revised manuscript).

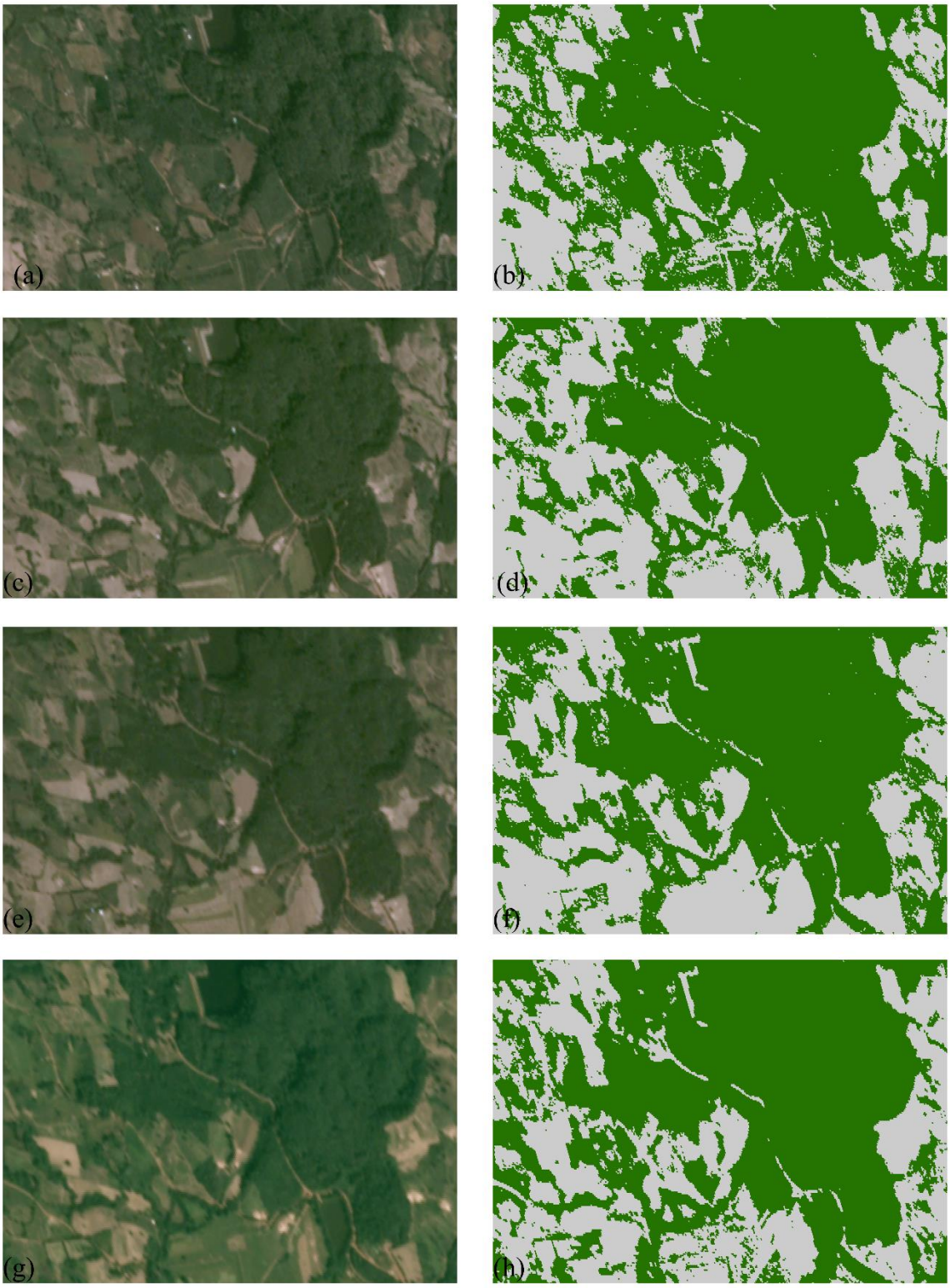

Fig. R1 Time series of the derived tree cover maps for the selected mainland Southeast

Asia area (100.301°-100.322°E, 18.400°-18.409°N). (a) and (b), (c) and (d), (e) and (f), and (g) and (h) indicate 2019, 2018, 2017, and 2017, respectively.

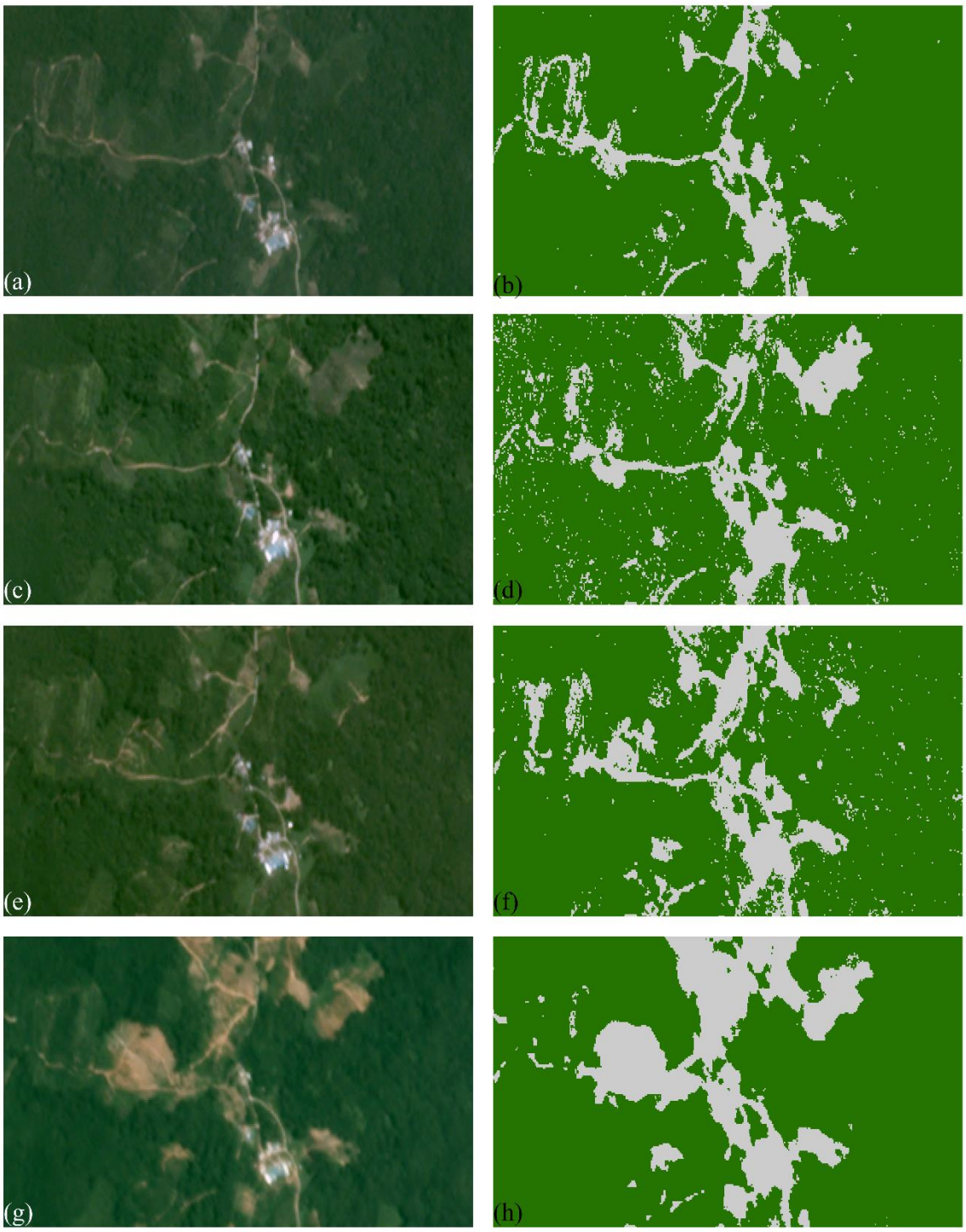

Fig. R2 Time series of the derived tree cover maps for the selected maritime Southeast Asia area (111.789°-111.806°E, 2.032°-2.040°N). (a) and (b), (c) and (d), (e) and (f), and (g) and (h) indicate 2019, 2018, 2017, and 2017, respectively.

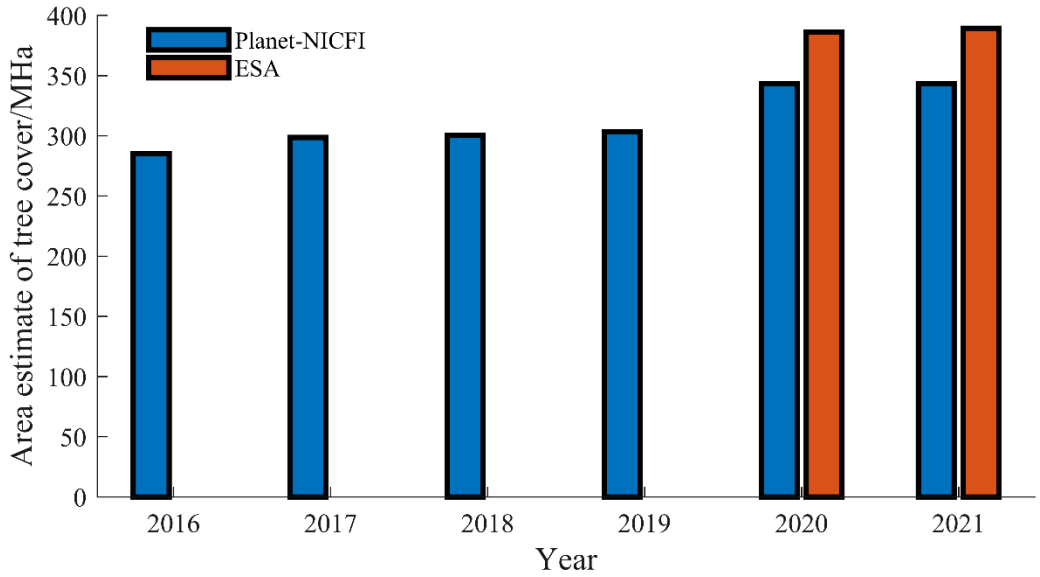

Fig. R3 Area dynamics change of tree cover maps for Planet-NICFI and ESA from 2016 to 2021.