Dear Editor and Reviewers,

Manuscript ID essd-2024-331 entitled "A 10 m Resolution Annual Rice Distribution Map of East Asia for 2023."

We would like to express our sincere gratitude to the editor and both reviewers for their constructive feedback and thorough review of our manuscript. We have carefully considered all suggestions and have made the corresponding revisions to the manuscript. In addition to addressing the reviewers' comments, we have also refined the overall language to enhance the quality of the paper, and redrawn some of the figures for greater clarity. Below, we provide detailed responses to each of the editor's and reviewers' comments, including clarifications where necessary. We hope these revisions address the concerns and uncertainties raised by the reviewers. In the manuscript and this file, the blue parts are revisions suggested by the reviewer #3, green parts for suggestions of reviewer #4 are highlighted in green, and to improve the readability and overall quality of the paper, additional modifications are marked in red.

Sincerely,

Zhang Hong
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Response to the Editor

Comments to the Author

Please address the reviewers' comments thoroughly and ensure that the formatting of both the data and the manuscript aligns with ESSD's requirements.

RESPONSE: Thank you very much for your valuable suggestions. We have thoroughly addressed all comments from the reviewers by providing detailed responses to each point and making corresponding revisions to the manuscript. Additionally, we have carefully reviewed the overall structure and formatting of the manuscript to ensure full compliance with ESSD's requirements.

We sincerely appreciate your guidance and have submitted the revised manuscript accordingly.

Response to Reviewer #2

RESPONSE: Thank you very much for recognizing our work and for your valuable feedback on our manuscript during the review process. Your constructive comments and insightful suggestions have significantly contributed to improving the quality of our study.

We sincerely appreciate your support and are grateful for the opportunity to have our manuscript reviewed by you. Your acceptance of our work is a tremendous encouragement to our team. Thank you once again for your time and effort.

Response to Reviewer #3

Comments to the Author

This study presents a valuable approach for high-resolution annual rice distribution mapping in East Asia using Google Earth Engine (GEE). The novel Synthetic Aperture Radar (SAR)-based Rice distribution Mapping Index (SRMI) and stacking-based optical-SAR adaptive fusion model demonstrate high accuracy and reliability, achieving an overall accuracy of 90.48%. The open access data and availability of the product on Zenodo promote further research and utilization. While the study's focus is on East Asia, exploring its adaptability to different regions and integrating additional data sources could further enhance its potential. Analyzing trends over multiple years would provide valuable insights into changes in rice production and its impact on food security and the environment.

The authors have also incorporated the previous reviewers' comments in the revision. I have some minor comments before its acceptance for publication.

RESPONSE: Thank you very much for your recognition and acknowledgment of our work. We greatly appreciate your positive evaluation and constructive suggestions, which have greatly contributed to improving the quality of our manuscript. We have carefully addressed all your comments and made corresponding revisions to further enhance the clarity and completeness of the paper.

1. Line 158-167: these detailed statements on the existing products can be removed to avoid repetition.

RESPONSE: Thank you very much for your suggestion. We have removed the detailed statements in Lines 158-167 to avoid repetition and improve the conciseness of the manuscript.

2. Figures: The manuscript still has too many figures. I suggest combining some, like Figures 8 and 9, Figures 19 and 20, etc.

RESPONSE: Thank you very much for your suggestion. We have carefully reviewed the figures and made adjustments as per your recommendation. Specifically, we have combined Figures 8 and 9 into a single figure (now Figure 8) and Figures 19 and 20 into another single figure (now Figure 19). The adjusted figures are as follows:

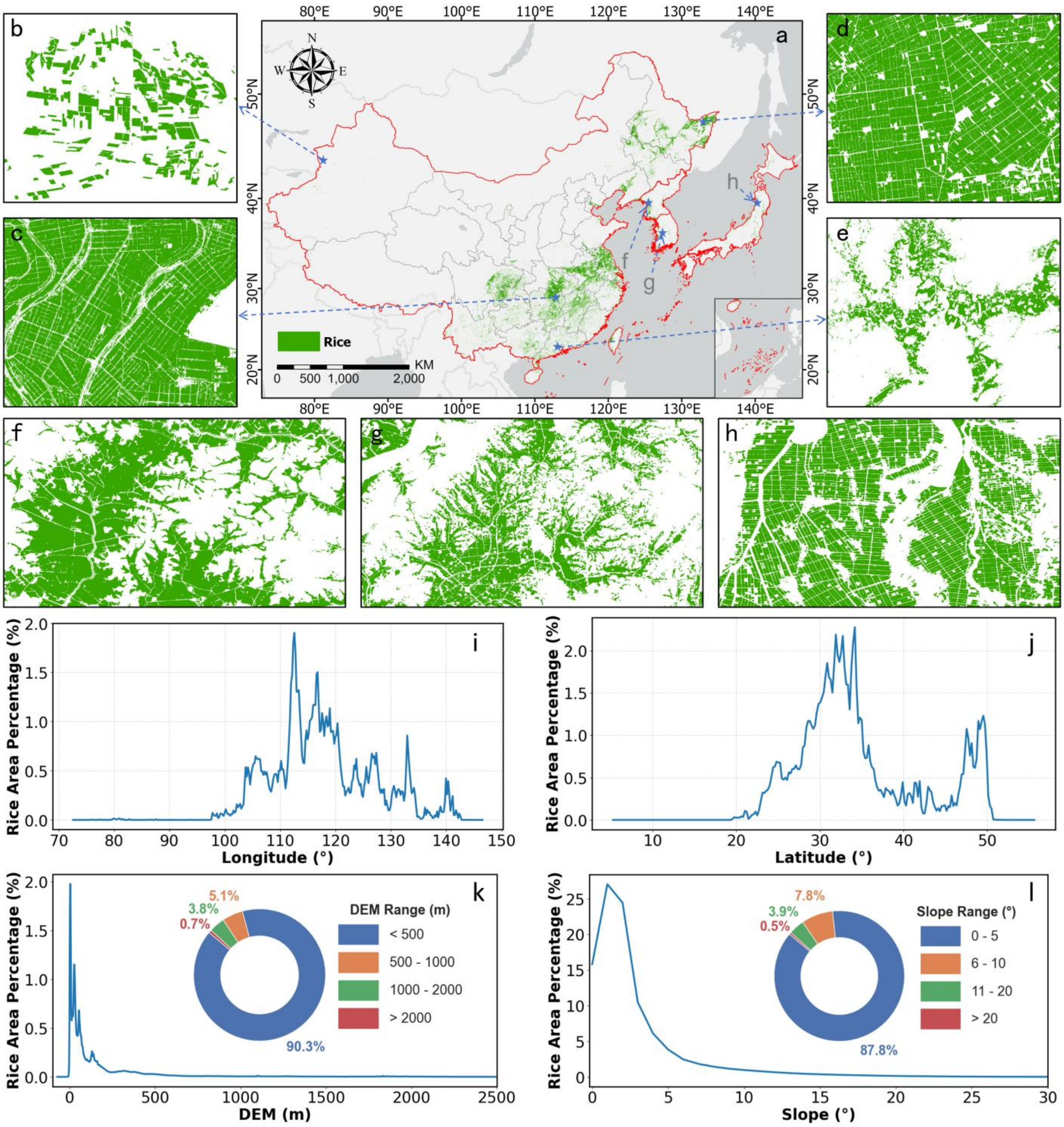

Figure 8. 2023 East Asia 10 m resolution rice distribution map (EARice10) and statistical analysis of rice area in different geographical regions: (a) full coverage of EARice10; (b)-(h) zoomed views of rice distribution in selected regions: (b) Xinjiang, China (provincial rice planting area less than 100,000 ha); (c) Heilongjiang, China (single-season rice region); (d) Hunan, China (mixed-season rice region); (e) Guangdong, China (double-season rice region); (f) the Democratic People's Republic of Korea (single-season rice region); (g) the Republic of Korea (single-season rice region); (h) Japan (single-season rice region); (i)-(l) Statistical analysis of rice area in different geographical regions: (i) Longitude; (j) Latitude; (k) DEM; (l) Slope.

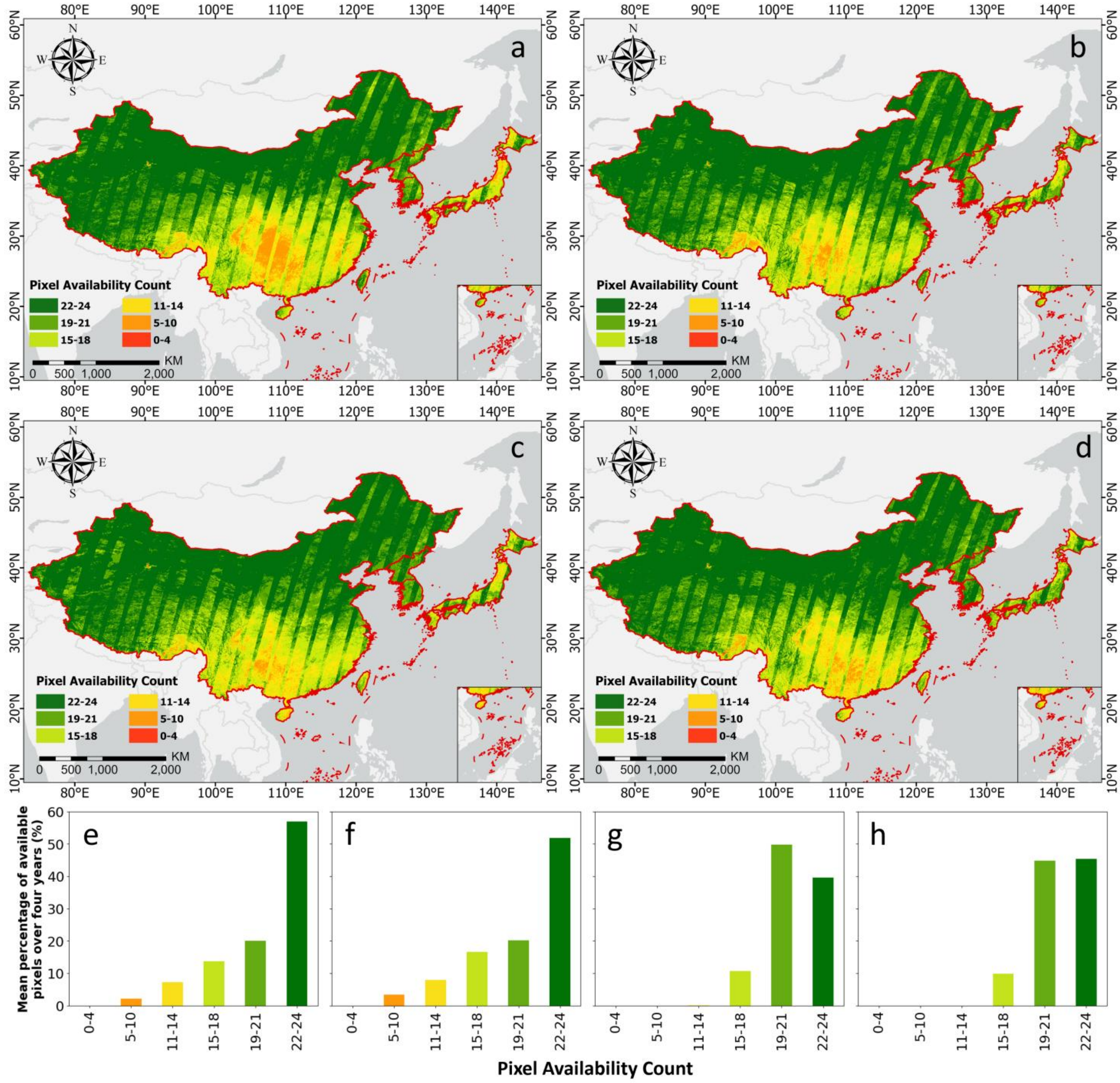

Figure 18. Number of cloud-free semi-monthly pixels from 2020 to 2023 and proportion of cloud-free semi-monthly pixel counts in different countries: (a)-(d) Number of cloud-free semi-monthly pixels from 2020 to 2023, where (a), (b), (c), and (d) represent 2020, 2021, 2022, and 2023, respectively; (e)-(h) Mean proportion of cloud-free semi-monthly pixel counts from 2020 to 2023 in different countries: (e) China, (f) Japan, (g) Republic of Korea, (h) Democratic People's Republic of Korea.

3. Figures 10-12: the official statistical data can be added to the bar charts for comparison.

RESPONSE: Thank you very much for your suggestion. We have added the official statistical data to the bar charts in Figures 9–12 in the manuscript to facilitate comparison. The updated figures are as follows:

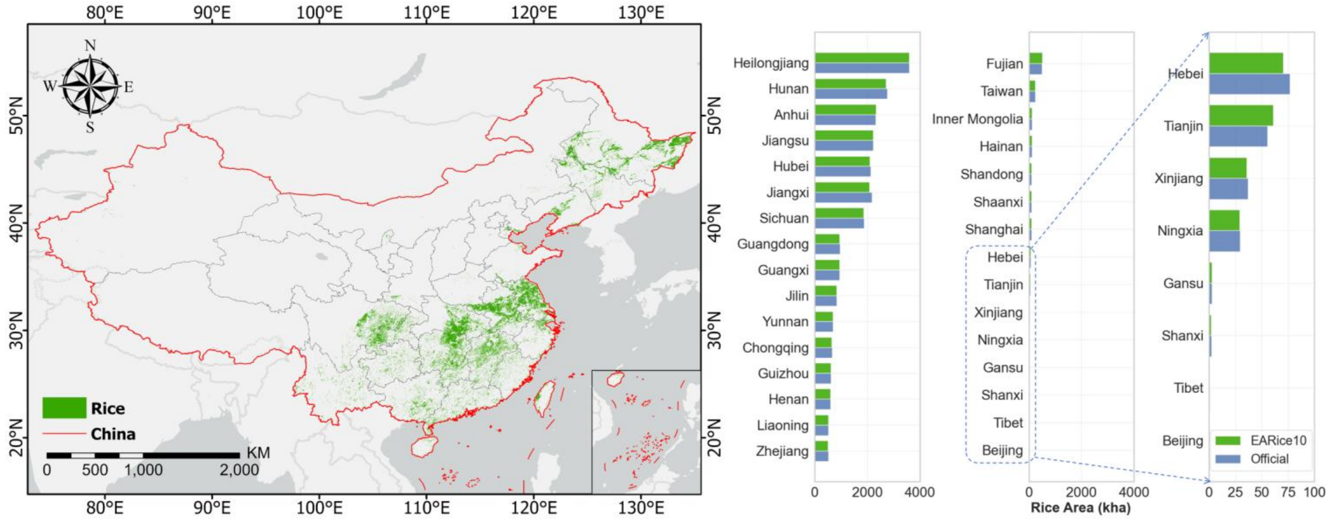

Figure 9. Ten-meter rice distribution map in China and provincial rice area statistics (2023).

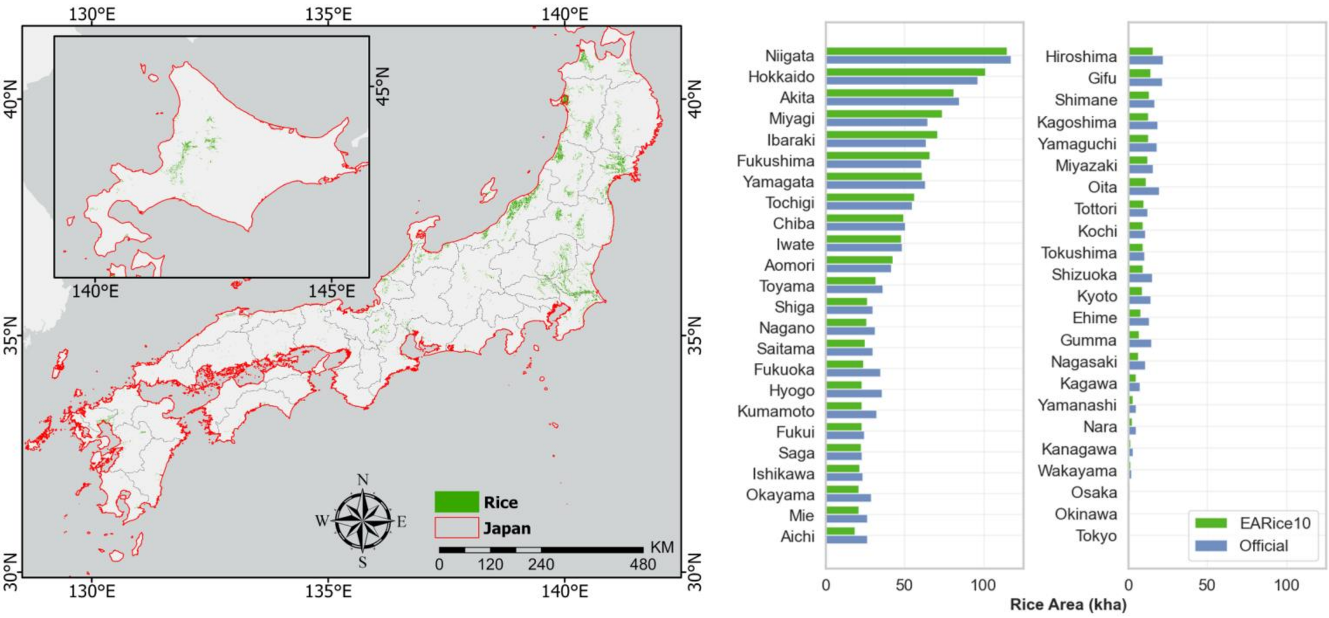

Figure 10. Ten-meter rice distribution map in Japan and provincial rice area statistics (2023).

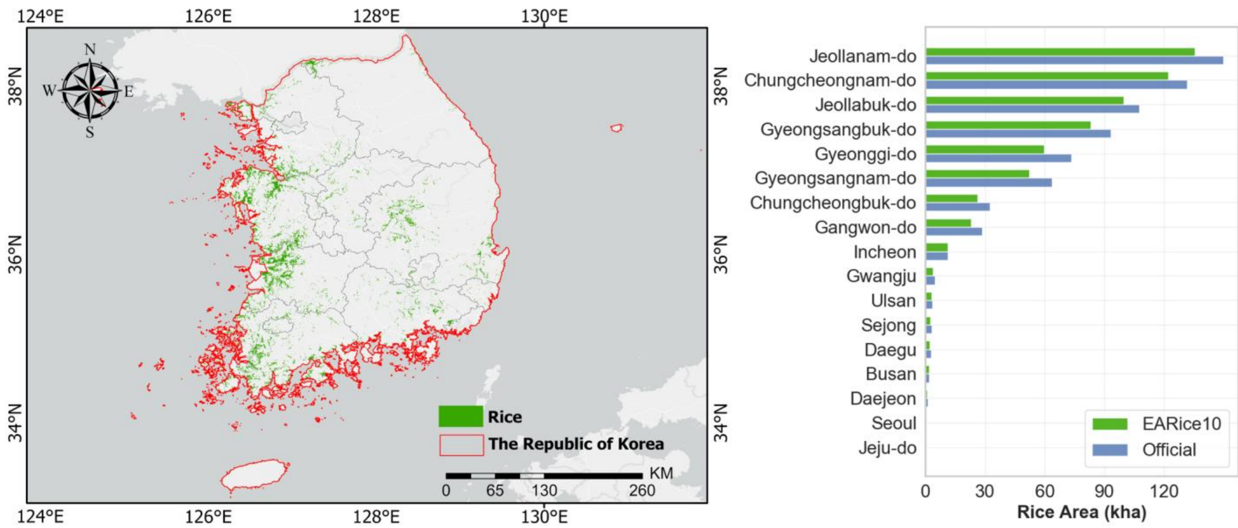

Figure 11. Ten-meter rice distribution map in the Republic of Korea and provincial rice area statistics (2023).

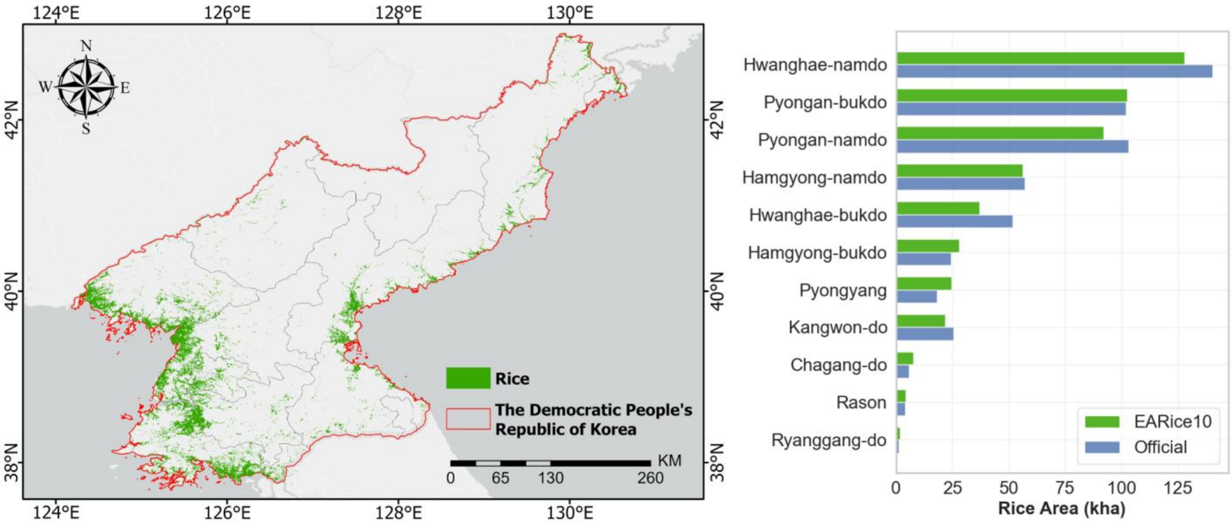

Figure 12. Ten-meter rice distribution map in the Democratic People's Republic of Korea and provincial rice area statistics (2023).

4. Line 303-308: these statements can be removed as well.

RESPONSE: Thank you very much for your suggestion. Following your recommendation, we have removed the statements in Lines 303–308 of the original manuscript to enhance conciseness.

Response to Reviewer #4

Comments to the Author

The manuscript has been greatly improved and is now in relatively good shape. I have a few minor questions.

RESPONSE: Thank you very much for your appreciation of our work. We sincerely appreciate your valuable suggestions, which have greatly contributed to enhancing the quality of our manuscript.

1. The font size in the figures is too small, particularly in scatter plots like Figure 15 and Figure 18. What does the "450" under Figure 15c represent?

RESPONSE: Thank you very much for your suggestion. Following your recommendation, we have redrawn Figures 15 and 18 from the original manuscript (now Figures 14 and 17 in the revised manuscript) and enlarged the font size to improve readability.

The number "450" under Figure 15c in the original manuscript was mistakenly introduced during the compilation of the four subfigures into a single figure. It holds no specific meaning and has been removed.

Once again, we sincerely appreciate your valuable feedback. The revised figures are as follows:

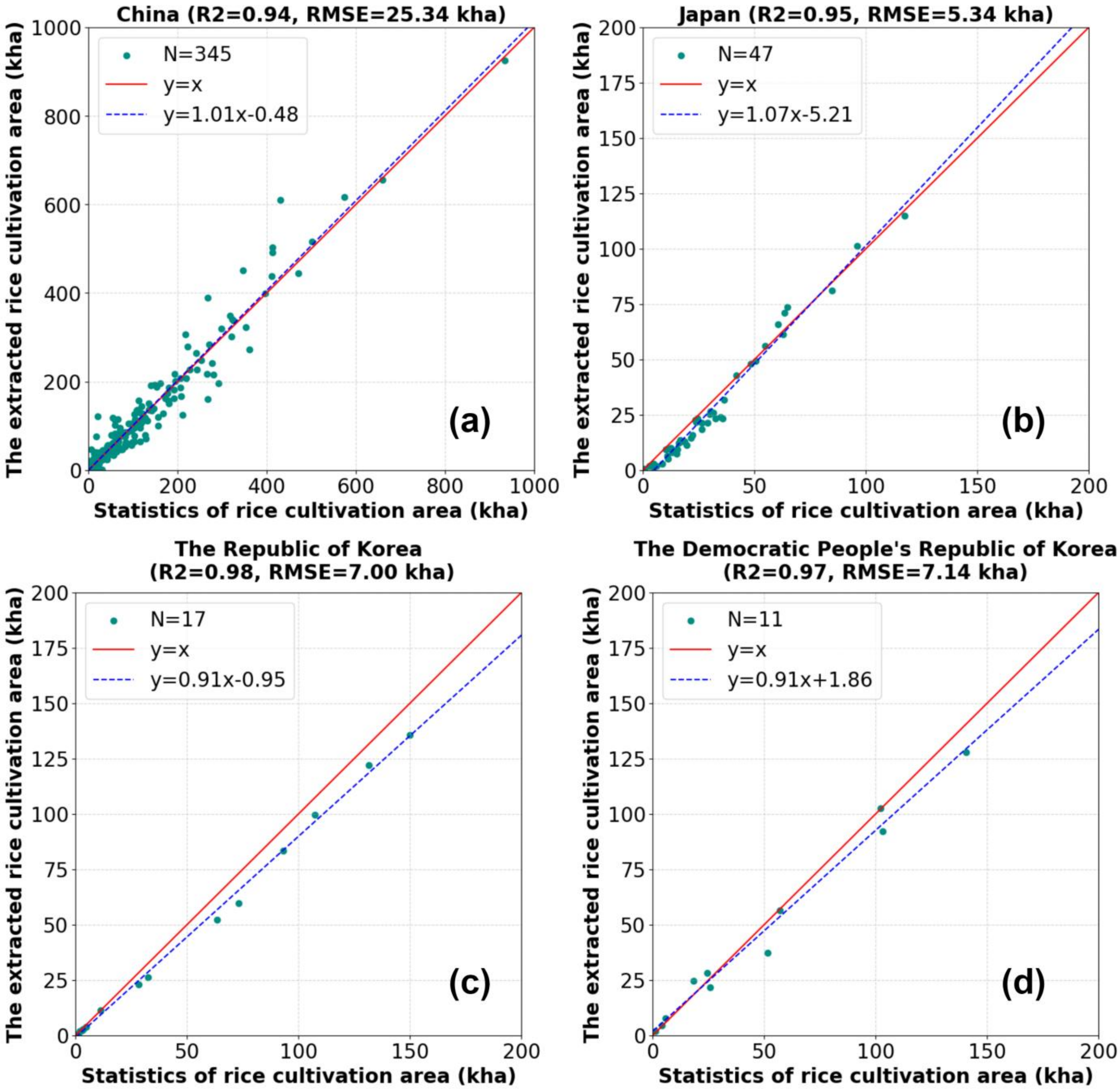

Figure 14. Comparison of the extracted rice area from the EARice10 with the rice area from statistical yearbooks at the administrative division scale: (a) municipal-level comparison in China; (b), (c), and (d) provincial-level comparisons in Japan, the Republic of Korea, and the Democratic People's Republic of Korea, respectively.

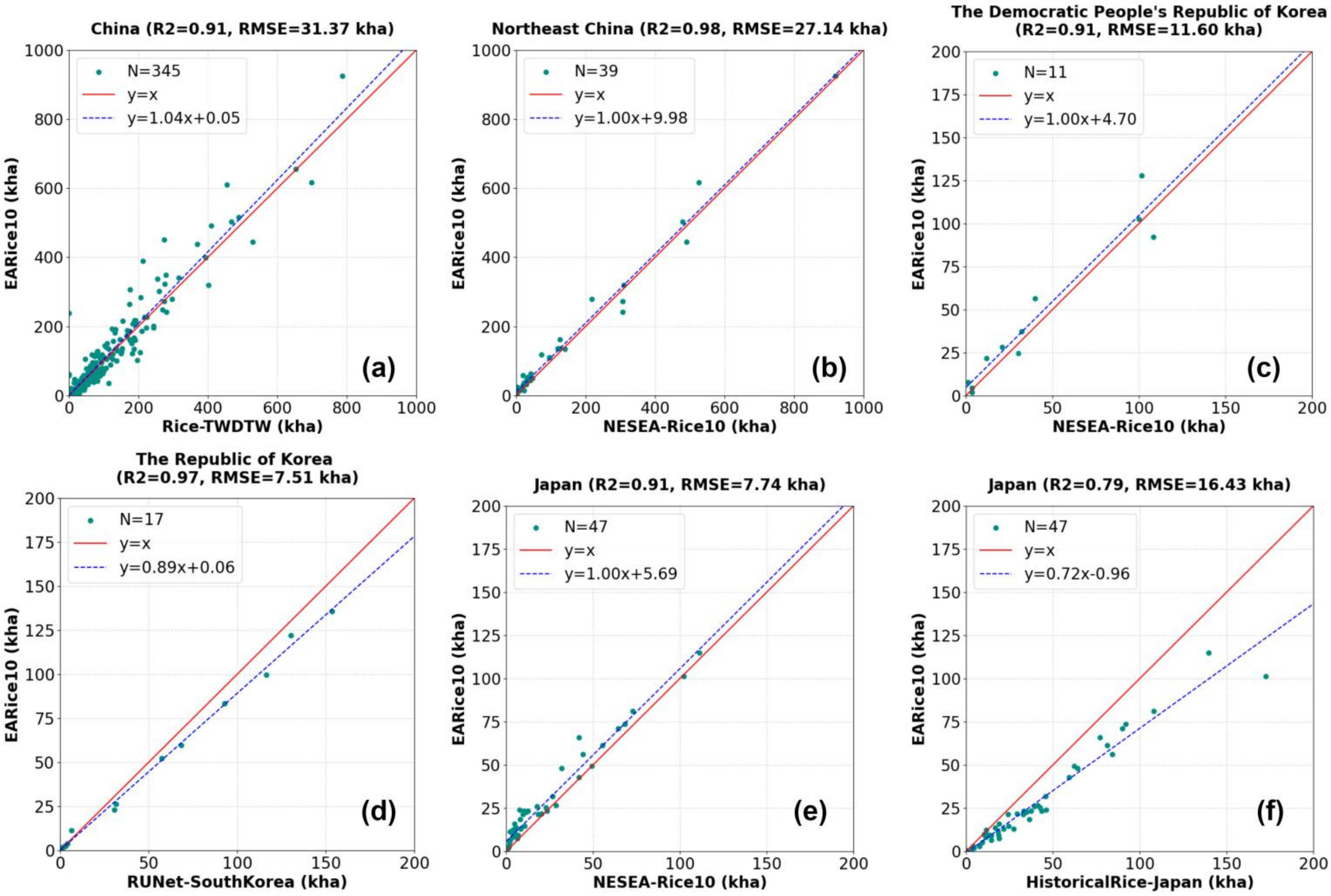

Figure 17. Comparison between EARice10 and existing datasets from different countries' administrative regions.

2. It was reported that direct seeding is adopted in rice paddies in East Asia. Does the model capture such areas?

RESPONSE: Thank you very much for your comment. Our proposed model is capable of accurately identifying areas of direct-seeded paddy rice cultivation, as explained in detail below.

In East Asia, rice is primarily grown in paddy fields, with transplantation and direct seeding being the most common cultivation methods. Unlike transplantation, direct seeding omits the process of transplanting seedlings. However, both methods share a common feature: flooding during the early stages of rice cultivation (Guo et al., 2019; Li et al., 2019). By detecting flooding signals during the early stages of rice growth, which typically correspond to the sowing and transplanting periods for transplanted rice, remote sensing imagery can effectively distinguish paddy rice fields from other land covers (Dong et al., 2016; Han et al., 2021; Han et al., 2022). The sowing and transplanting periods for transplanted rice span a relatively long period, during which flooding signals from concurrently planted direct-seeded rice can also be detected. Therefore, the sowing and transplanting window for transplanted rice can be utilized to simultaneously identify both transplanted and direct-seeded rice.

Our proposed method is based on the early-stage flooding signals characteristic of paddy rice. Specifically, for optical data, Sentinel-2 imagery was utilized to detect flooding signals during the sowing and transplanting periods using the LSWI and EVI indices, which were then used to generate optical-based rice candidate areas. These indices have been widely applied in large-scale rice mapping studies across Asia and have demonstrated high classification accuracy (Xiao et al., 2005; Xiao et al., 2006; Dong et al., 2016). Meanwhile, SAR data, with its all-time, all-weather operational capabilities, was combined with phenological information to achieve high-accuracy rice mapping independently (Zhan et al., 2021; Xu et al., 2023). By analyzing the minimum backscatter coefficient (σ_{min}^{0}), a key statistical parameter during the rice phenological period, flooding signals were effectively captured. Building on this parameter and integrating additional statistical features, we developed the SAR-based Rice Mapping Index (SRMI), a novel index specifically designed to identify SAR-based rice candidate areas.

To minimize uncertainties introduced by relying on a single data source, we integrated rice candidate areas derived from both optical and SAR data and implemented strict sample selection criteria to construct the training sample set (as described in Equation (9)). Subsequently, we developed and trained an optical-SAR adaptive fusion model by stacking multiple Random Forest classifiers to fully exploit the complementary strengths of SAR and optical data, resulting in a high-accuracy paddy rice distribution map. Using an independent validation sample set comprising 91,320 samples, we conducted a comprehensive evaluation of rice mapping accuracy across various regions in East Asia (as shown in Figure 13), confirming the reliability of our proposed method.

As shown in Figure 13, in provinces with higher proportions of direct-seeded rice, such as Zhejiang, Hubei, and Guangdong in China (Sha et al., 2019), the EARice10 dataset achieved user and overall accuracies exceeding 88%, highlighting the reliability of our method in identifying direct-seeded rice.

In conclusion, the proposed method effectively captures the distribution of paddy rice cultivated through both transplantation and direct seeding, offering a robust solution for high-accuracy paddy rice mapping.

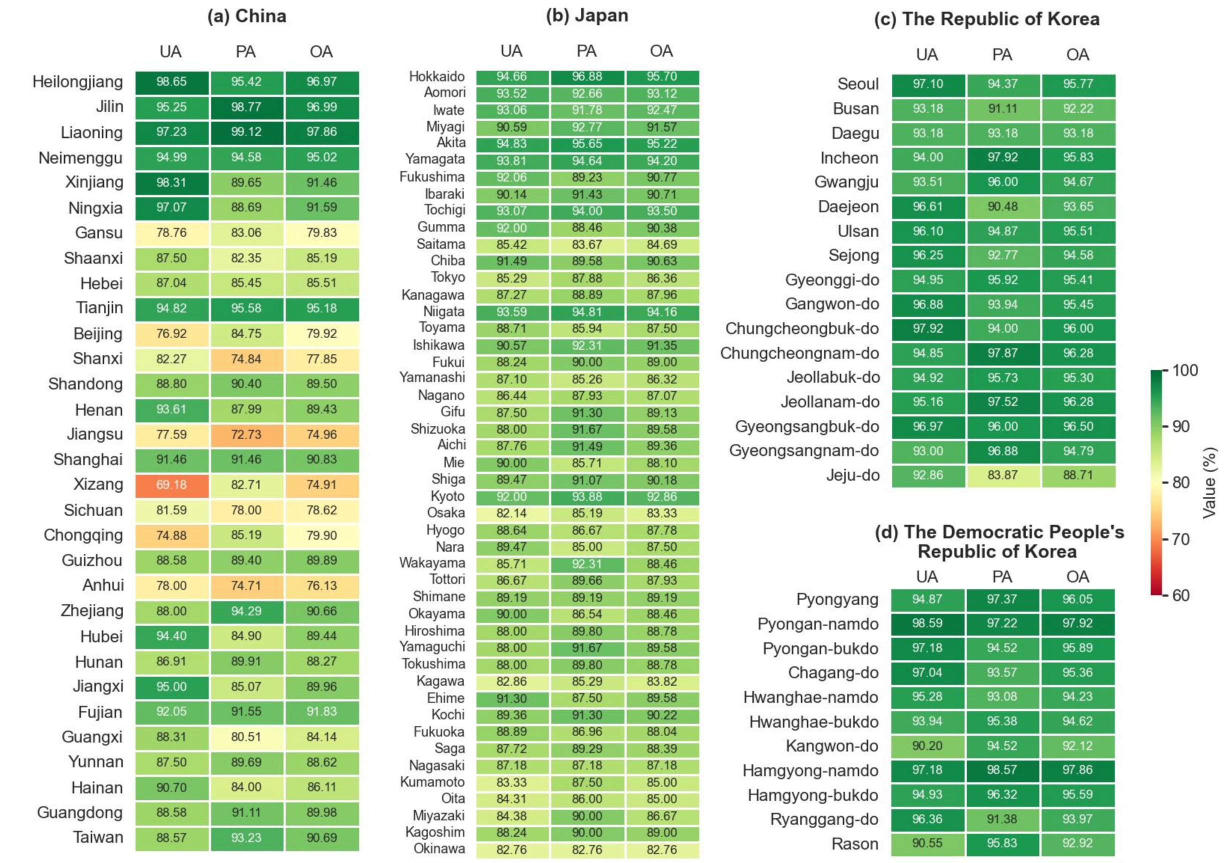

Figure 13. Provincial-level confusion matrix metrics for the EARice10 based on validation sample set

3. Regarding the validation in Figure 15, I believe the reported statistical data represent the planted area, which may differ slightly from the double-cropped area derived from the map. Did you consider the double-cropped area in the validation figure?

RESPONSE: Thank you very much for your comment. We acknowledge that our previous description might not have been sufficiently detailed. In the validation figure, we have considered the planted areas of double-cropped rice. The statistical yearbooks report the planted areas for early, middle, and late rice, where middle rice corresponds to single-season rice, while early and late rice belong to double-season rice systems.

Since the rice area derived from the EARice10 map represents the annual rice distribution, for double-cropped rice regions, we used the maximum value between the planted areas of early and late rice as the official statistical data to ensure a reasonable comparison with the EARice10-derived rice area.

Thank you again for your suggestion. We have clarified this point in the manuscript as follows:

Line 344, Page 21

...Notably, the EARice10 reflects the annual distribution of rice, whereas the statistical yearbooks report the planted areas for early, middle, and late rice, with middle rice being single-season rice and early and late rice classified as double-season rice systems. Therefore, for double-season rice areas, we used the maximum value between early and late rice as the official statistical data to ensure a reasonable comparison...

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