In this work, the authors present a long-term rice distribution dataset covering South and Southeast Asia at a five-year interval. The paddy flooding signals and vegetation indices are used to identify multi-paddy fields. The overall concept of the study is sound, and the manuscript is clearly written. However, several issues require further clarification and justification. My detailed comments are as follows:

Response to Reviewer

We sincerely thank the reviewer for their careful reading of our manuscript and for the constructive and insightful comments. These suggestions have been extremely helpful in improving the clarity, methodological transparency, and presentation quality of our work. Below, we provide point-by-point responses to each comment. All changes have been incorporated into the revised manuscript.

All revisions and responses are highlighted in blue font in the response letter. Modifications in the main manuscript are indicated using italicized text enclosed in quotation marks.

1. Issues related to figure presentation. It is recommended that Figure S1 be moved to the main text, as both readers interested in the methodology and potential data users would benefit from a clear visualization of the study area. In addition, representative remote-sensing image examples of rice fields should be included to better illustrate the spectral and phenological characteristics used for rice identification. Furthermore, Figure S3 lacks a legend, making it difficult for readers unfamiliar with rice phenology to distinguish between the two curves shown.

Response:
We thank the reviewer for these valuable suggestions regarding figure presentation and visualization.

First, following your recommendation, we have moved Figure S1 from the Supplementary Materials to the main text and now present it as **Figure 1**, providing a clearer and more immediate overview of the study area for both methodological readers and potential data users.

Second, to better illustrate the spectral and phenological characteristics used for rice identification, we have added representative remote-sensing examples from typical rice systems in South and Southeast Asia. Specifically, we now include time-series profiles and corresponding imagery examples for:

- the rice–wheat rotation system in northern India,

- single-season rice systems in Bangladesh, and
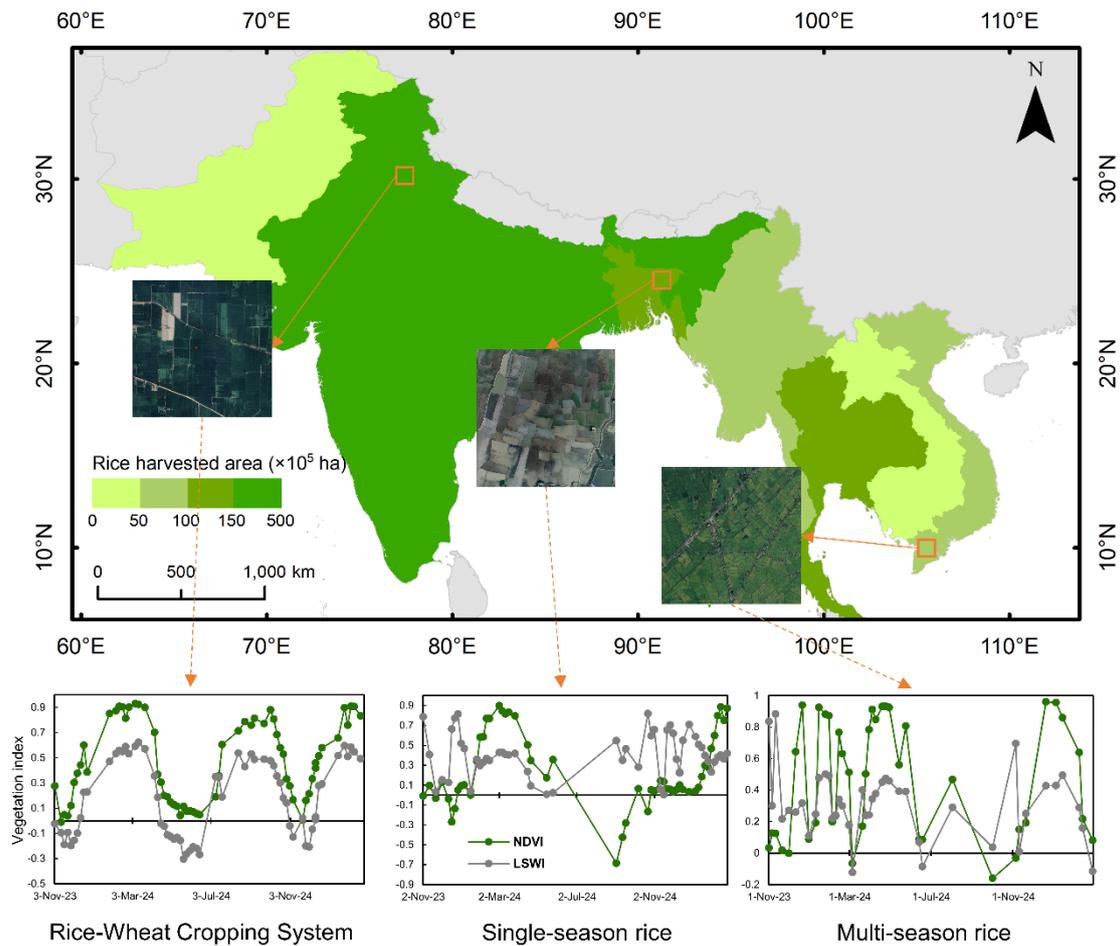
- multi-season rice systems in the Mekong Delta.

Figure 1. Distribution of rice harvested area in the study region of South and Southeast Asia (unit: ×10⁴ ha)

Accordingly, the main text has been revised to better align with the updated figure, as follows: *"Rice is the dominant crop in this region and exhibits the highest cropping intensity worldwide. The region also includes diverse rice production systems, such as the rice–winter wheat rotation system in northern India, flood-associated single-season rice cultivation in Bangladesh, and typical multi-season rice systems in the Mekong River Basin."*

In addition, we have added a legend to **Figure S2 (formerly Figure S3)** to clearly distinguish the LSWI and EVI curves, ensuring that readers unfamiliar with rice phenology can easily interpret the figure.
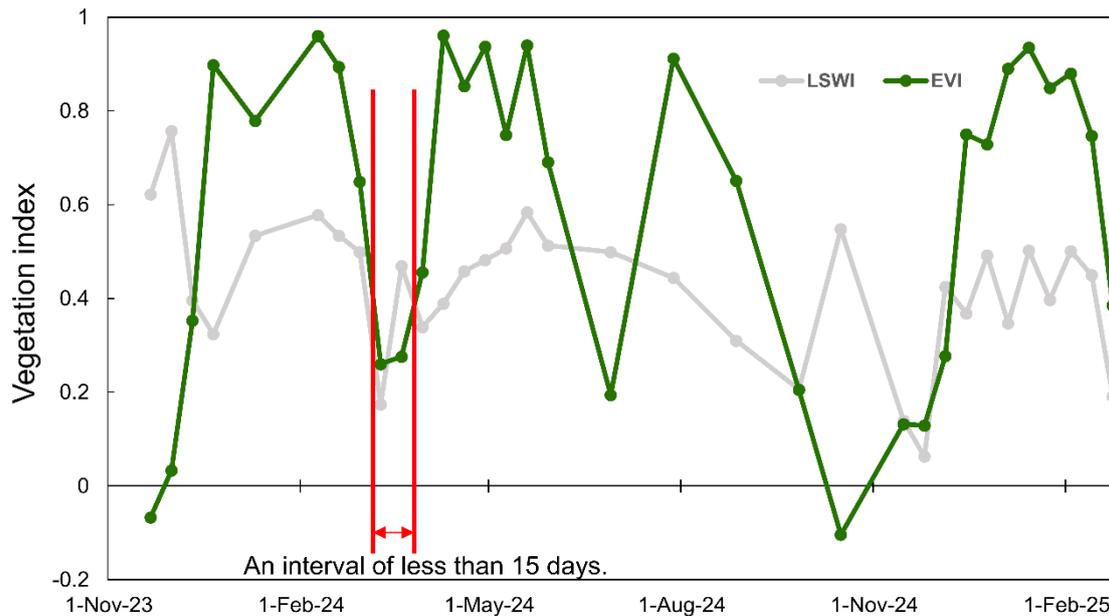
Figure S2. Time series of Land Surface Water Index (LSWI) and Enhanced Vegetation Index (EVI) for a representative rice pixel in the Mekong Delta, Vietnam, from November 2023 to February 2025 with a red vertical line indicating an interval of less than 15 days

2. Section 2 states that the data source is based on five-year median composite imagery. However, rice planting patterns in South and Southeast Asia may exhibit considerable interannual variability, including crop rotation and alternating cultivation of different crops. It is unclear whether compositing over five years could obscure such variability and potentially affect the reliability of rice mapping. Please provide quantitative or statistical evidence to demonstrate that the five-year compositing strategy does not significantly distort the spatial distribution of rice. Without such justification, the robustness of the mapping methodology and the reliability of the resulting dataset remain questionable.

Response:

We greatly appreciate the reviewer's careful attention to the five-year compositing strategy, as this is indeed a critical aspect affecting the robustness of the final dataset.

Our decision to adopt a five-year median composite approach was primarily motivated by data availability constraints in tropical monsoon regions, particularly during the 1990s. Although annual rice mapping would be ideal, the number of valid Landsat observations within a single year—especially under persistent cloud cover across South and Southeast Asia—is often insufficient to reliably capture rice flooding signals and key phenological stages.

To explicitly address this concern, we have added a new analysis comparing rice mapping results derived from single-year imagery and multi-year composited imagery for the mid-1990s. As shown in **Figure 9**, rice maps generated using individual years (e.g., 1993, 1994, 1995, 1996, and 1997 separately) suffer from severe omission errors due to missing observations. In some regions, rice fields are barely detected in single-year results. In contrast, the five-year composite substantially improves spatial completeness and consistency, reducing uncertainty caused by observational gaps.

The main text has been revised accordingly, as follows: *"Another aspect that merits consideration is the effect of multi-year image compositing. As shown in the comparison with NESEA-Rice10 (Fig. 5), although both studies employ flooding-signal-based approaches, our results identify a larger number of rice pixels in some regions, mainly due to the increased availability of valid observations.*

This effect is particularly evident for the 1990s. As illustrated in Fig. 8, rice maps derived from single-year imagery show pronounced spatial instability, especially for 1995, owing to severe limitations in observation frequency. In contrast, the five-year composite produces a more spatially coherent and reliable rice distribution. Under such data-limited conditions, the uncertainty associated with single-year mapping exceeds the potential smoothing effect introduced by multi-year compositing."

Furthermore, as illustrated by the Landsat imagery shown in **Figure 9**, the spatial extent of flooding signals observed in August during 1993–1997 is consistent with the rice distribution captured in our corresponding rice product, providing additional qualitative support for the validity of the composite-based results.

Finally, we note that multi-year compositing has been widely adopted in other long-term land-cover and rice-mapping studies to address historical data limitations. For example, the **GLC_FCS30** global land-cover product employs five-year compositing to improve classification stability in early periods with sparse observations. Similarly, long-term rice mapping studies in Japan published in *ISPRS Journal of Photogrammetry and Remote Sensing* have adopted multi-year aggregation strategies to reconstruct historical paddy rice dynamics under limited data availability. These precedents support our conclusion that, under severe observational constraints, multi-year compositing introduces less uncertainty than single-year mapping.
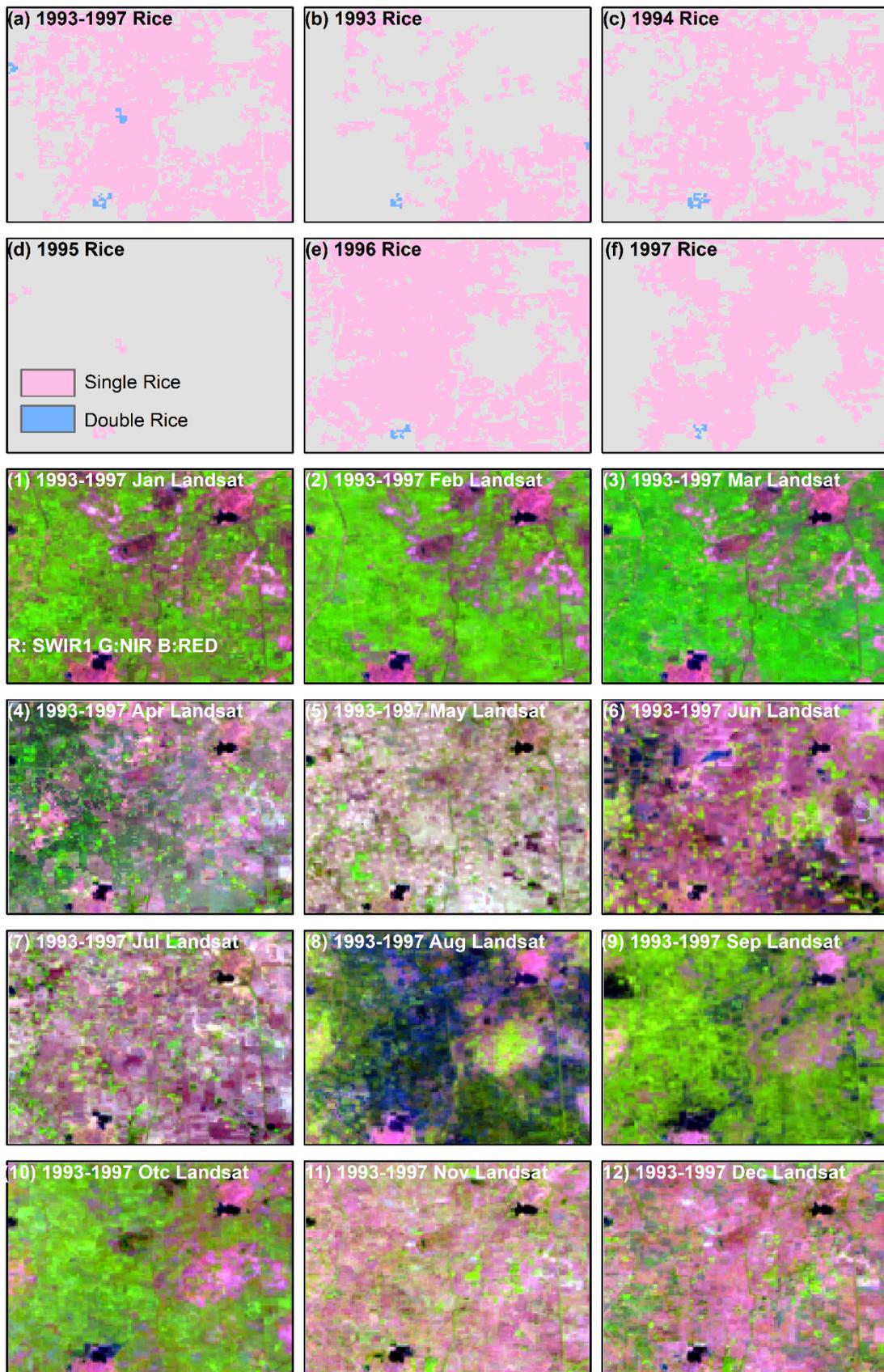
(a) 1993-1997 Rice
(b) 1993 Rice
(c) 1994 Rice
(d) 1995 Rice
(e) 1996 Rice
(f) 1997 Rice

Single Rice
Double Rice

(1) 1993-1997 Jan Landsat
(2) 1993-1997 Feb Landsat
(3) 1993-1997 Mar Landsat
R: SWIR1 G:NIR B:RED
(4) 1993-1997 Apr Landsat
(5) 1993-1997 May Landsat
(6) 1993-1997 Jun Landsat
(7) 1993-1997 Jul Landsat
(8) 1993-1997 Aug Landsat
(9) 1993-1997 Sep Landsat
(10) 1993-1997 Otc Landsat
(11) 1993-1997 Nov Landsat
(12) 1993-1997 Dec Landsat

Figure 9. Comparison of rice maps derived from single-year imagery and five-year composite imagery in the mid-1990s.

3. It is recommended that the process of collecting and labeling the sample point validation data be re-described and placed in Section 2. Describing point-based and statistic-based validation data in one section can improve readability.

Response:

We agree with the reviewer that reorganizing the validation description improves the overall readability of the manuscript.

In the revised version, we have moved and consolidated the description of sample collection, labeling, and validation procedures into **Section 2 (Materials and Methods)**. Specifically, point-based validation, comparisons with existing rice products, and validation against FAO statistical data are now described together in a unified subsection titled **"Accuracy assessment and comparisons"**.

The revised subsection reads as follows:

"2.4 Accuracy assessment and comparisons

Validation samples. Validation samples for 2024 were primarily derived through visual interpretation using multiple complementary data sources. First, false-color composites of Sentinel-2 imagery (R/G/B = SWIR1, NIR, RED) were generated to represent different rice growth stages……

Based on these two sets of composites, rice sample points were manually labeled and further cross-validated using ultra–high-resolution Google Earth imagery and the Global Geo-Referenced Field Photo Library…..

Rice products and statistical data. To evaluate the reliability of our mapping results, we conducted spatial comparisons with several established rice mapping products, including: ……. "

4. When accessing the interactive map through Google Earth Engine (GEE), noticeable mosaic like artifacts appear in many mapped areas, and the boundaries between rice and cropland classes show poor spatial consistency. Please explain the potential causes of these mapping quality issues. In addition, I believe that a published dataset should not only demonstrate high accuracy in statistical metrics or sample-based validation, but should also provide sufficient spatial consistency and reliability to support downstream applications and reuse by the research community.
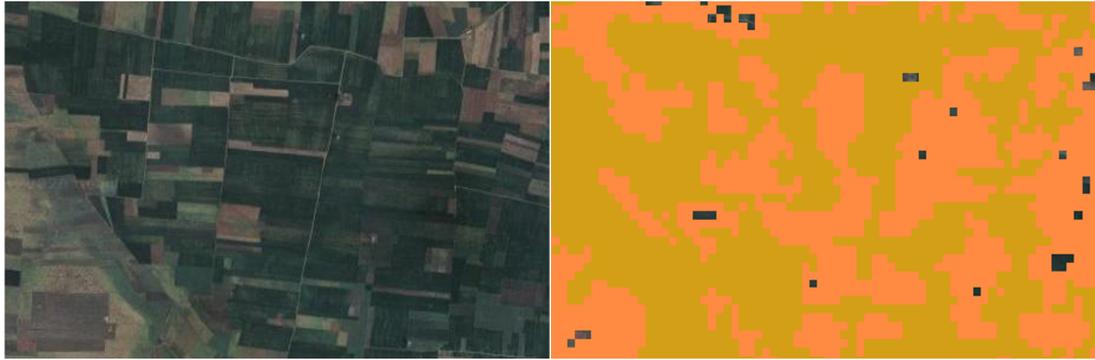
Figure C1 Imagery in 2024 and corresponding mapping results

Response:

We sincerely thank the reviewer for carefully examining the interactive GEE map and for raising concerns regarding spatial consistency, which we fully agree is essential for a published dataset.

First, we would like to clarify that the different colors displayed in the interactive map represent **rice cropping intensity** (i.e., the number of rice seasons per year), rather than different crop types. Thus, some visually abrupt color changes may reflect rice pixel-level differences in cropping intensity rather than classification noise.

Figure C1 Imagery in 2024 and corresponding mapping results

Single rice   **Double rice**

That said, we do not exclude the possibility of poor spatial consistency. Because the reviewer did not provide the exact geographic coordinates of Figure C1, we summarize the most likely causes as follows.

1. **Uneven observation frequency.**

Despite multi-year compositing, some pixels still have relatively few valid observations due to persistent cloud cover. As our algorithm strictly identifies pixels that exhibit flooding signals during crop growth cycles over multiple years, missing observations in certain seasons may lead to partial omission or uncertainty in cropping intensity

estimation.

2. **Spatial resolution and mixed-pixel effects.**
We provide an example from a rice-growing area in Kamphaeng Phet Province, Thailand. While our results show imperfect alignment with field boundaries when compared with ultra–high-resolution imagery, this limitation is inherent to 30-m Landsat data. In many parts of Southeast Asia, agricultural fields are narrow and fragmented, making it difficult for 30-m pixels to precisely delineate parcel boundaries. Mixed-pixel effects at field edges are therefore unavoidable and cannot be fully resolved given the spatial resolution of historical Landsat imagery.

Rice distribution   Ultimate high resolution imagery   Landsat imagery
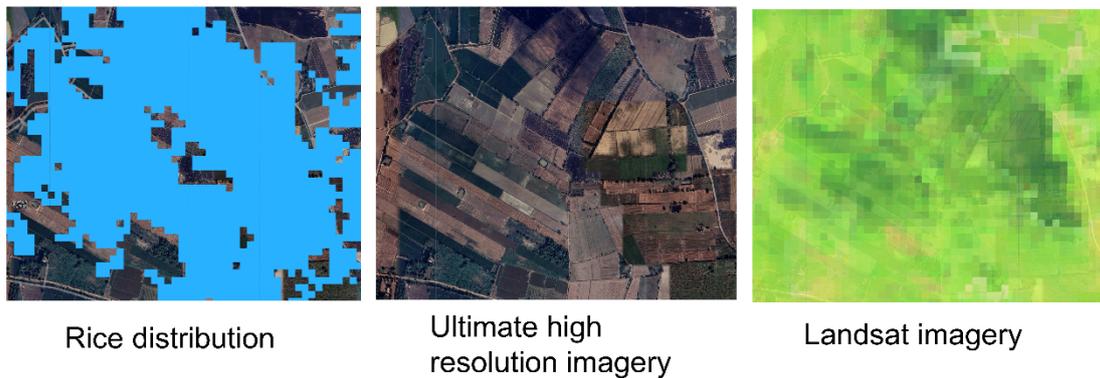
To further address this concern, we have added a comparative visualization in GEE that displays our product alongside other widely used rice datasets (e.g., NESEA-Rice10 and Open-SEA-Rice-10). This comparison demonstrates that, aside from expected differences arising from sensor type (optical vs. SAR) and rice system definitions (paddy vs. rainfed), our product exhibits comparable spatial consistency at both regional and local scales.

https://zz-cloud-storage-and-computing.projects.earthengine.app/view/comparea

5. The qualitative comparison results presented in Figures 4, 5, and S2 do not include corresponding remote-sensing images, making it difficult to visually assess the reliability of the mapping outcomes. Moreover, the figures mainly show large-scale regional patterns, while finer spatial details are not adequately displayed. It is recommended to include zoomed-in comparisons with reference imagery to better demonstrate the spatial accuracy and consistency of the rice mapping results.

Response:
We appreciate this important suggestion and agree that the qualitative comparison figures can be substantially improved by incorporating reference imagery and finer spatial details.

In the revised manuscript, we have comprehensively redesigned the comparison figures as follows:

1. **Figure 4** has been updated to include both regional-scale comparisons and field-scale zoom-ins. The rightmost panels now include corresponding Sentinel-1 and Landsat imagery using appropriate false-color composites to visually validate the rice mapping results.
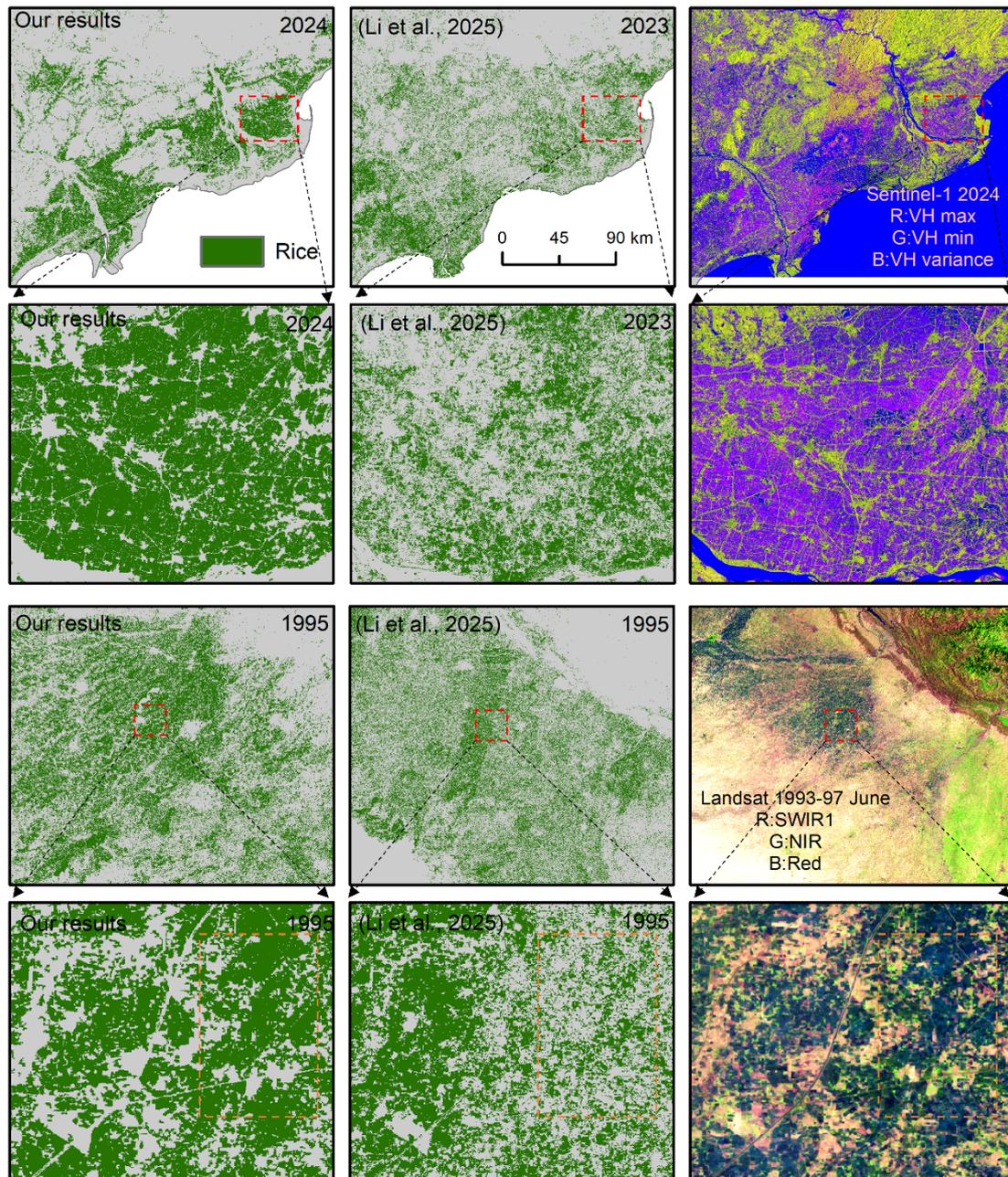

Figure 5. Comparison of rice distribution maps: Our Results compared to Li et al. (2025) for South Asia (1995, 2024)

2. **Figure 5** presents a comparative analysis of single- and multi-season rice field distribution in Southeast Asia. To avoid excessive visual complexity, we have added a new supplementary figure focusing specifically on field-level details. This figure demonstrates strong spatial agreement between our results and Open-SEA-Rice-10 at the parcel scale, particularly for multi-season rice systems, while also highlighting omission errors in some single-year optical products (e.g., NESEA-Rice10) caused by data availability limitations.

Single rice

Multiple rice

(a2) (a3) (a4)

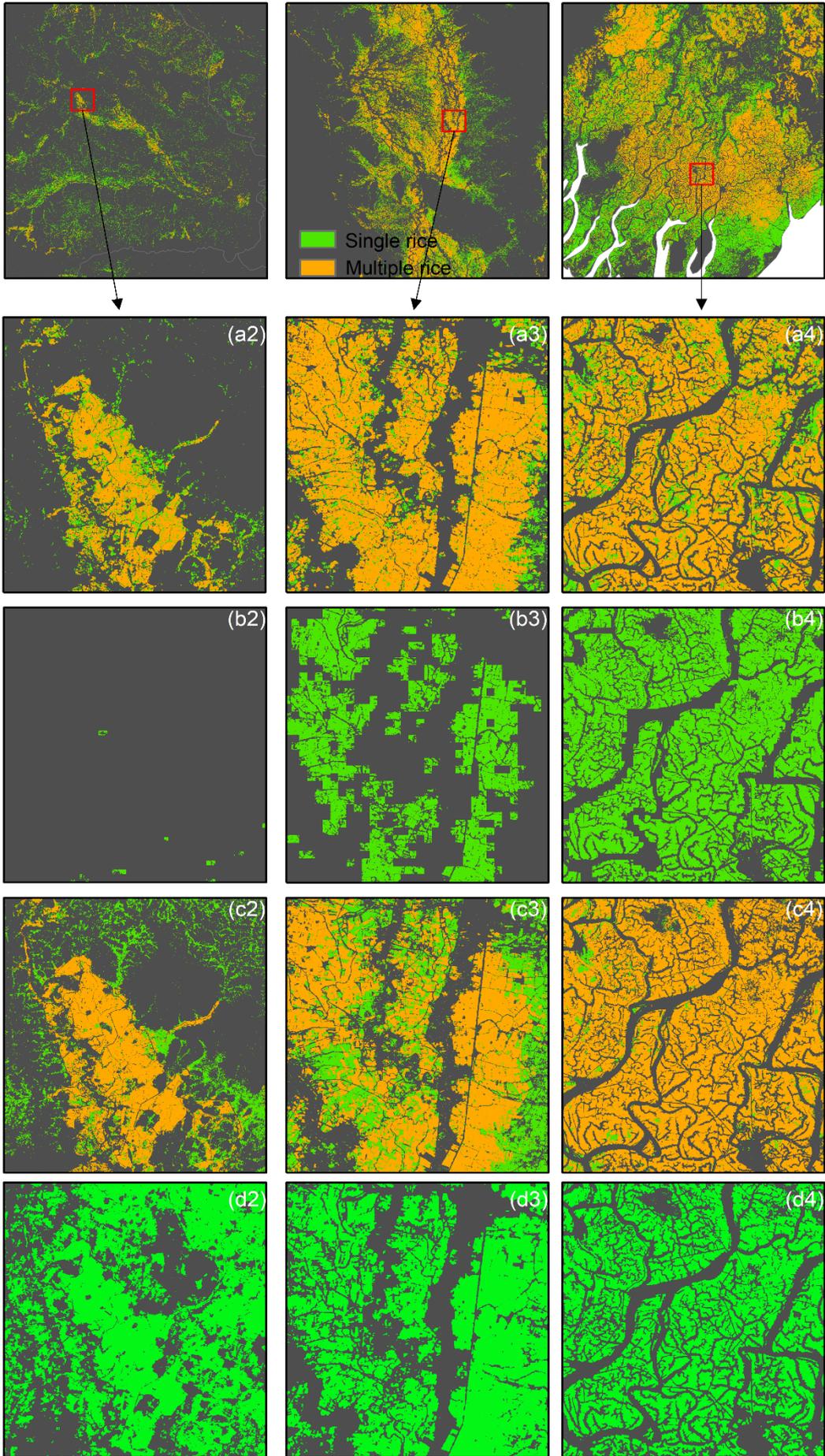(b2) (b3) (b4)

(c2) (c3) (c4)

(d2) (d3) (d4)

Figure S5. Field-scale comparison of rice distribution maps corresponding to Figure 5. Panel labels are consistent with those in Figure 5.

3. For **Figure S2**, in addition to the original country-scale comparison for Vietnam, we now include zoomed-in comparisons over the Mekong Delta and the Red River Delta, together with corresponding Sentinel-1 SAR imagery. These comparisons show strong consistency between our mapped rice areas and radar-derived flooding signals.
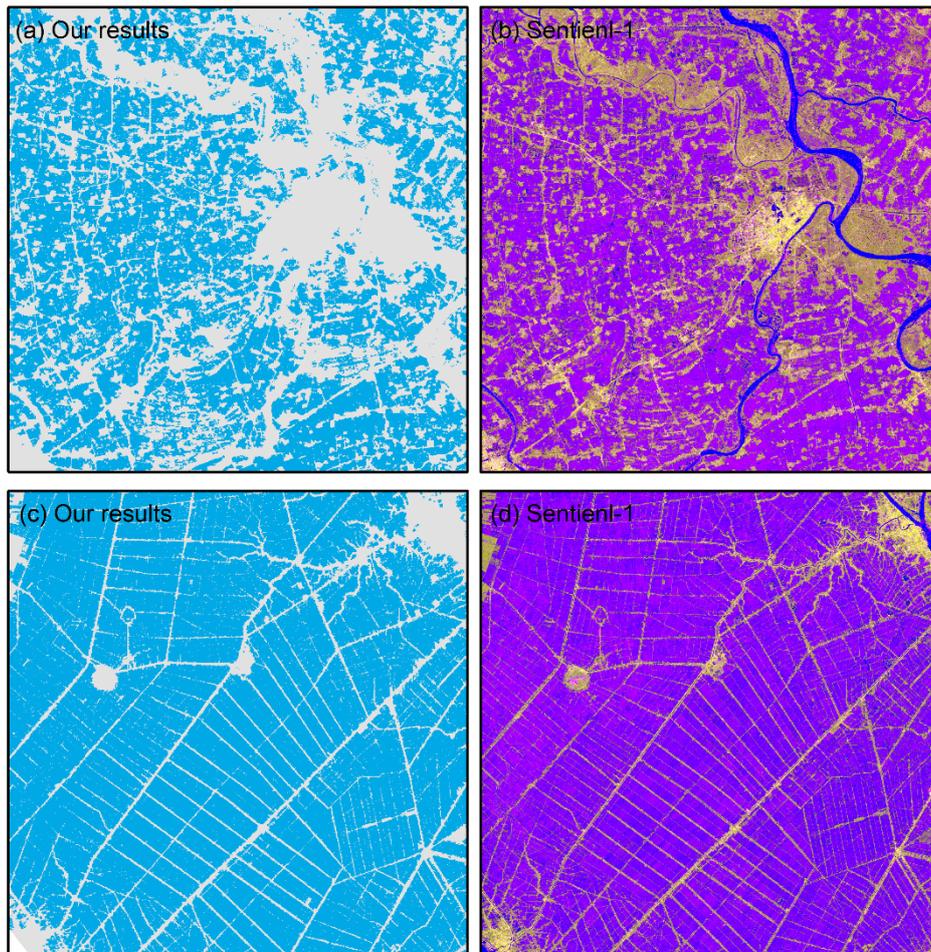

Figure S3. Spatial comparison of rice distribution maps and reference imagery over selected regions in Vietnam, highlighting consistency between optical- and SAR-based rice detection.

Closing statement

Once again, we sincerely thank the reviewer for the thoughtful and detailed comments. We believe that the revisions made in response to these suggestions have significantly

strengthened both the manuscript and the released dataset, and we are grateful for the opportunity to improve our work.