Reply to reviewer #1

This study, by integrating multiple existing high-resolution remote sensing products, achieved a high spatiotemporal accuracy accounting of the water footprint for major crops such as wheat, maize, rice, soybeans, and potatoes from 2001 to 2020. The overall writing logic of the paper is clear, and the scientific question is well-articulated. The research results hold certain value for data application in fields like agricultural water resource management. However, there are still deficiencies in the study's innovation, methodological explanation, and result description, which require further revision and improvement.

Response: We are grateful to the reviewer for the positive assessment of our manuscript and for the constructive comments on the research's innovation, methods, and manuscript writing. We have carefully addressed all comments and revised the manuscript accordingly. Detailed point-by-point responses are provided below, with our replies shown in blue and all revisions highlighted in red.

Specific comments:

Comment 1: Introduction: Are the daily-scale accounting results based entirely on daily-scale remote sensing products? And given that there are many studies on crop water footprint accounting, what are the other novel aspects of ChinaCropWF besides its daily resolution?

Response 1: Thank you for your comments. The remote sensing data used for ChinaCropWF are all daily-scale products, among which daily-scale crop phenology information is the most critical. This enables our method to quantify blue and green water consumption during crop growth with high precision, achieving a level of accuracy previously unattainable. Furthermore, based on the soil water balance method, this study also quantifies the water footprint required to address seasonal soil water shortages, thereby significantly improving the completeness and accuracy of crop water footprint accounting. In response to your comments, we have revised the manuscript accordingly. These advantages of ChinaCropWF are highlighted in Section 4.2 ("4.2.1 Phenology impacts on water footprint" and "4.2.2 Seasonal water shortages effects").

Comment 2: Methods: please check the equations in Figure 1, which should be consistent with those in 2.2.1

Response 2: Thank you for your comments. We noticed that the crop water footprint calculation formula in Section 2.2.1 was inconsistent with Figure 1, and we have now corrected this in the manuscript. The specific revisions can be found in lines 159-163 of the manuscript.

Comment 3: Methods: for wheat, if both spring and winter wheat were considered at the same time?

Response 3: Thank you for your comments. The daily-scale phenological data employed by ChinaCropWF explicitly differentiates spring wheat from winter wheat based on their growing periods. Accordingly, the subsequent water footprint accounting directly leverages this classification to dynamically characterize water use by crop type, eliminating the need for additional classification procedures.

Comment 4: Methods: How were evaporation and transpiration amounts calculated? They are not presented in the uploaded dataset.

Response4: Thank you for your comments. The PML-V2 remote sensing product used in this research contains both evaporation and transpiration data. By integrating it with crop growing periods, daily-scale evaporation and transpiration can be effectively distinguished. The methods section already describes the accounting of crop evaporation and transpiration. The specific revisions can be found in lines 126-128 of the manuscript.

Lines 126-128: "Furthermore, to accurately distinguish between evaporation and transpiration during crop growing seasons, this study separates the evaporation components (E_s and E_i) and the transpiration component (E_c) in the PML-V2 dataset."

Comment 5: Results: "3.1 Spatiotemporal evolution patterns of crop water footprint", why does potato show large interannual variations, with consecutive years being relatively similar?

Response 5: Thank you for your comments. We have conducted a comprehensive review of all potato-related basic data and identified and corrected the issues in the calculation process. The potato planting area in this research was derived from the SPAM dataset, which is updated every five or ten years. This inherent temporal resolution limitation may introduce uncertainties in the planting area estimation, thereby affecting the results. An explanation regarding this issue has already been provided in the methods section. The specific revisions can be found in lines 135-136 of the manuscript.

Lines 135-136: "Potato planting areas were sourced from the SPAM dataset (available at https://mapspam.info/), which is updated every five or ten years."

Comment 6: Results: Can the production water footprint go beyond the county scale to obtain higher-precision spatial data?

Response 6: Thank you for your comments. This study considers the city scale to be the most appropriate accounting scheme, based primarily on the following considerations. First, at the city level, a relatively well-developed statistical system comprehensively covers economic, social, and resource-environmental dimensions, facilitating the effective integration of research findings into local development planning and policy-making frameworks. Second, high-resolution data face practical limitations in terms of spatial coverage, temporal consistency, and data availability, which constrain the feasibility of more refined-scale analyses. Based on the above understanding, we have explained the relevant limitations in the discussion section and indicated that future research can be further conducted under conditions of improved data availability. See lines 396-398 of the manuscript for specific revisions.

Lines 396-398: "Finally, various remote sensing data products and statistical data exhibit inconsistencies in spatial and temporal resolutions, along with limitations in data accuracy, highlighting the need for further integration and refinement to support more detailed research."

Comment 7: Discussion: "4.2.1 Phenology impacts on water footprint" compares different phenological period product datasets. However, this section merely provides a simple comparison of accounting results and does not demonstrate the advantages of daily-scale accounting. Further analysis is recommended.

Response 7: Thank you for your comments. The data comparison in the table primarily reflects differences among various methods in terms of phenological temporal resolution. In contrast, the daily-scale data adopted in this research offer higher temporal resolution, enabling a more accurate depiction of crop growth processes. However, due to differences in underlying data sources and inconsistencies in yield results, the results presented in the table are for illustrative purposes only and are not suitable for in-depth analysis or comparison. Notably, we have already validated our results in Section 4.1 using other products, which further confirms the advantage of daily-scale data in terms of water footprint accounting. We have also revised this section to improve readability.

Technical corrections:

Comment 1: "2.1.4 Crop planting area" should refer to the crop phenology period.

Response 1: Thank you for your comments. We have revised the title to "2.1.4 Crop phenology".

Comment 2: "Author contributions: XW and EH the research" means "EH and XW wrote the original draft"?

Response 2: Thank you for your comments. Sure, XW and EH jointly conducted the research; simultaneously, EH and XW drafted the original manuscript.

We sincerely thank the reviewer for the thoughtful comments and suggestions, which have helped us improve both the manuscript and the dataset.

Reply to reviewer #2

This manuscript presents ChinaCropWF, a novel, high-resolution (1 km, daily) gridded dataset quantifying the blue and green water footprints of China's five major food crops (rice, maize, wheat, soybean, and potato) over two decades (2001–2020). The dataset is generated by integrating multi-source remote sensing products (precipitation, evapotranspiration, crop distribution, and phenology) within a soil water balance framework. The topic is highly relevant to the scope of Earth System Science Data, addressing critical gaps in agricultural water-use data. The construction of a daily-scale, 1-km resolution dataset represents a significant methodological advancement over existing monthly or growing-season products. The manuscript is well-structured, the methodology is sound, and the initial validation against field data and comparison with existing datasets demonstrate the product's value. However, several aspects require clarification and improvement before final publication to enhance the manuscript's clarity, robustness, and impact.

Response: Thank you very much for your approval of this manuscript. We have carefully and comprehensively revised the manuscript in accordance with comments. Detailed point-by-point responses are provided below, with our replies shown in blue and all revisions highlighted in red.

Specific Comments

Comment 1: The manuscript mentions using a "soil water balance method" to account for soil water variations (ΔS) and improve accuracy. However, the description is somewhat brief. Please provide a more detailed explanation of how ΔS (both blue and green components) is calculated and integrated daily. How is the soil profile characterized? What are the assumptions regarding runoff and deep percolation? A schematic diagram of the daily soil water balance model would be beneficial for readers.

Response 1: Thank you for your comments. To make the accounting method in the manuscript clearer and more explicit, we have added two parts. First, in the methods section of the manuscript, we included the formulas for calculating the water footprint resulting from seasonal soil water shortages (ΔS_{blue} for irrigation and ΔS_{green} for precipitation). The specific revisions can be found in lines 167-178 of the manuscript. Second, in the Supplementary Materials, we provide a detailed explanation of how to determine the additional water footprint required due to seasonal water shortages using the soil water balance method—specifically, the blue water supplemented by irrigation (ΔS_{blue}) and the green water supplemented by precipitation (ΔS_{green}). The outline is as follows: first, estimate the saturated soil water content; second, calculate the initial soil water content; third, solve for ΔS_{blue} and ΔS_{green} based on the soil water balance method. The soil profile references Shi et al. (2025), while deep percolation and other components are not considered in this study due to data limitations. Due to the extensive content, details are provided in the Supplementary Materials (S1.4). Additionally, a schematic diagram of the soil water balance method has been added to the Supplementary Materials (S1.4).

Comment 2: The authors acknowledge a key limitation: assuming a fixed relative soil moisture of 75% for non-rice crops to estimate initial soil water content. This is a significant simplification that could impact the accuracy of the water footprint, especially in water-stressed or highly variable environments. It is better to add a simple sensitivity analysis in the supplementary materials to show how varying this initial moisture assumption might affect the final water footprint estimates for a sample region or crop? This would provide valuable context for users of the dataset.

Response 2: Thank you for your comments. We fully recognize that setting the initial soil water content for non-rice crops as a fixed percentage of saturated water content is a simplification that may not fully capture the variability across different regions and years. To assess the potential impact of this assumption on the accounting results, we conducted a sensitivity analysis, which is detailed in the Supplementary Materials. Specifically, we selected wheat, maize, soybean, and potato, and recalculated the water footprint required at the initial growth stage by setting the initial soil water content to both 45% and 75% of saturated water content. The results were then compared against those obtained under the original assumption (60%). The results indicate that blue water footprint exhibits a higher sensitivity to changes in soil water content. Nevertheless, the overall spatial patterns remain stable, suggesting that our core conclusions are robust to this assumption. Furthermore, the results confirm that under seasonal water shortages, the additional water required by crops is primarily supplied by irrigation (i.e., blue water footprint). For further details, please refer to S2.5 of the Supplementary Materials.

Comment 3: In Figure 4(f), there is an abrupt change from 2015 to 2016. It is necessary to explain the causes, i.e. is it an actual occurrence, or is it caused by data uncertainty?

Response 3: Thank you for your comments. We have conducted a comprehensive review of all potato-related basic data and have identified and corrected the issues in the calculation process. Simultaneously, the relevant content of the manuscript has been revised.

Comment 4: The authors stated “As of 2024, these crops were cultivated on a total of 119.3 Mha in China, with maize, rice, wheat, soybean, and potato accounting for 44.7, 29.0, 23.6, 10.3, and 3.2 Mha, respectively, collectively representing 92.9% of the total sown area.” When calculating the area proportion (92.9%), it is necessary to consider the multiple cropping scenarios of these five major crops.

Response 4: Thank you for your comments. Upon verification, this issue was found to stem from a terminological discrepancy in translation—specifically, the misinterpretation of "sown area" as "cultivated area". The originally cited data represent "sown area", as sourced from the China Statistical Yearbook—a highly authoritative and reliable source. In agricultural statistics, the term "sown area" inherently accounts for multiple cropping. Therefore, the resulting proportion of 92.9% represents the share of these five major crops in the total national sown area. The specific revisions can be found in lines 87-89 of the manuscript.

Lines 87-89: "As of 2024, the national sown area for food crops was 119.3 Mha, with maize, rice, wheat, soybean, and potato accounting for 44.7, 29.0, 23.6, 10.3, and 3.2 Mha, respectively, collectively representing 92.9% of the total sown area."

Comment 5: Lines 242-244: a reference should be given for the explanation “evaporation peaked during 2002-2005, coinciding with a weakened East Asian summer monsoon”.

Response 5: Thank you for your comments. To enhance the rigor and academic precision of the manuscript, we have revised the relevant content to avoid specific mechanistic descriptions, such as "weakened East Asian summer monsoon". This modification ensures that the discussion remains more generalizable and objective. The specific revisions can be found in lines 267-269 of the manuscript.

Lines 267-269: "Second, a peak in evaporation occurred during 2002-2005, followed by a peak in transpiration during 2017-2019. This sequential pattern is indicative of a fundamental shift in the primary drivers of water loss, from atmospheric factors to vegetation processes."

Comment 6: Line 15: The ranking of total water footprints is given as "rice > maize > wheat > soybean > potato". Consider adding a brief note on why potato's range is so wide (0.15-11.31 Gm^3) – is it due to data limitations or actual variability?

Response 6: Thank you for your comments. We have conducted a comprehensive review of all data. The relevant datasets have now been updated, and the issue has been fully resolved. The specific revisions can be found in lines 17-19 of the manuscript.

Lines 17-19: "Our dataset shows the total crop water footprints ranked as rice (145.55±20.56 Gm^3) > maize (120.39±29.78 Gm^3) > wheat (55.06±7.88 Gm^3) > soybean (35.00±4.19 Gm^3) > potato (7.23±0.74 Gm^3)."

Comment 7: Line 350-355: In addition to remote sensing uncertainties, consider briefly mentioning the uncertainty introduced by using different data sources for crop planting areas for different crops and how this might affect the consistency of the final product.

Response 7: Thank you for your comments. The crop planting area data used in this research are derived from multiple sources, and the heterogeneity of these data sources introduces additional uncertainty. Specifically, discrepancies in statistical definitions, spatial resolution, and temporal baselines across different data sources can directly undermine the consistency of the final product in terms of spatial alignment, temporal comparability, and attribute logic. Such inconsistencies could introduce systematic bias when making cross-crop comparisons of water footprints, thereby affecting the overall consistency and comparability of the ChinaCropWF dataset. Future research would benefit from employing consistent, high-resolution crop distribution data (e.g., crop mapping products derived from unified remote sensing classification standards), which would help mitigate such uncertainties and enhance the robustness and reliability of the results. Accordingly, we have incorporated this discussion into the revised manuscript. The specific revisions can be found in lines 390-392 of the manuscript.

Lines 390-392: "Furthermore, the use of multi-source datasets for crop planting area introduces inherent uncertainties due to discrepancies in statistical definitions, spatial resolutions, and temporal update frequencies."

Comment 8: The meanings of some abbreviations are unclear, such as Rice-LR, Rice-SR&ER. In addition, figures need to be self-explanatory; some figures require more detailed explanations, such as Figures 3 and 4.

Response 8: Thank you for your comments. First, we conducted a systematic review of the entire manuscript, with a focus on supplementing and standardizing the abbreviations used throughout the text to ensure terminological accuracy and consistency. Second, we provided detailed descriptions for each figure and table to facilitate readers' understanding of the graphical content and its relevance to the research topic. Due to the extensive nature of the revisions, the specific modifications are detailed in the manuscript.

We sincerely thank the reviewer for the thoughtful comments and suggestions, which have helped us improve both the manuscript and the dataset.

References

Wei, S., Dai, Y., Liu, B., Zhu, A., Duan, Q., Wu, L., Ji, D., Ye, A., Yuan, H., Zhang, Q., Chen, D., Chen, M., Chu, J., Dou, Y., Guo, J., Li, H., Li, J., Liang, L., Liang, X., Liu, H., Liu, S., Miao, C., and Zhang, Y.: A China data set of soil properties for land surface modeling, JAMES, 5, 212–224, https://doi.org/10.1002/jame.20026, 2013.