Reviewer 2:

This study developed a global 1 km all-weather instantaneous and daily mean land surface temperature dataset. The structure of the manuscript is clear, and the contents are abundant. I think this manuscript can be published after major revisions.

Thank you very much for the meaningful and constructive comments. These comments are very valuable for us to improve our manuscript. We have read the comments carefully and tried our best to revise the manuscript. The responses of the comments are as follows:

1. Introduction. Authors should cite more recent literature from the past 3 or 5 years.

   Response:

   We sincerely appreciate the valuable comments. We have checked the literature carefully and added more recent references into the introduction part in the revised manuscript.

2. Lines 40-44. The authors mentioned that both satellite and station data are utilized in various fields, but only cited papers based on satellite data.

   Response:

   Thank you for your comment. Although the cited article is written as an overview of the application of MODIS LST data (Kappas and Phan 2018), it also mentioned the use of in situ data for product validation, which is the most popular use of station data. Besides, we have updated another article for station data, which mentioned the use for climate change (Auger et al. 2021). (Line 41)

3. Lines 51-60. The orbit gaps in MODIS data also result in data gaps.

   Response:

   Thanks for the reminder, there is indeed missing data in the instantaneous MODIS data caused by orbit gaps as you mentioned. However, orbit gap is relatively small and exists only at low and middle latitudes, as shown in Figure 15 in the revised manuscript. Absence due to cloud contamination is still the main factor for LST gaps.

4. Why not utilize land cover and vegetation index? Both variables are strongly correlated with land surface temperature.

Response:

Thank you very much for the comment. We agree that these parameters have an impact on LST. In this study, surface albedo data is included, which can characterise surface properties. Thus, we did not use land surface cover data. Vegetation-related indexes (eg. NDVI and LAI) were initially attempted to be added to the model. However, these covariates did not significantly improve the model accuracy, possibly due to the effect of the added top-of-atmosphere data. Therefore, they were not ultimately included in the model.

5. Section 2. The obtainable years for all data and the years of data used in this study were not mentioned.

Response:

Thank you for your suggestion. We have added the time information of all the data in the Table 1 in the revised manuscript. (Line 204)

6. The texts in some figures (e.g., Figure 1) are too small to be seen clearly. Response:

Response:

Thank you for the reminder. We have refined the Fig 1 and Fig 7 in the revised manuscript. (Line 214, Line 451)

7. Table 1. Please provide the access link for obtaining this data. It is suggested to include the data from Section 2.2 and 2.3 into Table 1.

Response:

Thank you for your suggestion. We have added the data link in the Table1. And the Section 2.1 and Section 2.2 were merged, the information of ERA5-land data was added into Table 1 (Line 204). However, due to the complex information of in situ measurements, the information is not include in Table 1. Thanks for your understanding.

8. Line 325. Resampling low-resolution data directly to high-resolution may affect the estimation of land surface temperature.

Response:

Thank you for the comment. There exists low-resolution data in the model inputs, such as ERA5-land LST with 9 km and DSR with 5 km. We dealt with the

data with resampling before they were used in the model construction. Besides, other data have the resolution of 1 km. From the validation results of the spatial details, as shown in Fig.13 and Fig.14 in the manuscript, the estimated LSTs show higher resolution than ERA5-land LST, and comparable to official MODIS LST. At present, the input coarse-resolution data has limited impact on the estimation results. In the future, we will further refine the model if higher resolution data becomes available.

9. Lines 323-334. Why are these two paragraphs nearly identical?

Response:

Thank you for your careful reading and reminder. We are sorry to make the mistake. And it has been modified in the manuscript. (Lines 330-335)

10. Line 352. Why does the data cover the time range from 2002 to 2018? The time range in abstract is from 2000 to 2020.

Response:

Thank you for your comment. It was mentioned that the dataset used for model training and validation range from the year 2002-2018 (Line 353). And the products were generated from 2000-2020 (Line 21, Line 658). The time ranges are for different data. For clarity, we've added a description at the beginning of the data section.(Lines 171-175)

11. Section 3.3. Could you please better clarify the novelty of and innovation of your method?

Response:

Thank you for your comment. We have modified the innovation in the introduction section. (Lines 142- 165)

12. Figures 4 and 6. Unit should be added. Figures 4-6. The legend should include the data.

Response:

Thank you for your careful reading and reminder. We have modified the figures in the revised manuscript.

13. Lines 421. This explanation is far-fetched. The reason might be the greater spatial

and temporal differences in daytime land surface temperature compared to nighttime land surface temperature.

Response:

Thank you for your comment. The possible influencing factors are varied. The higher spatiotemporal heterogeneity of the daytime is also one of the influencing factors, which we have modified in the revised manuscript. (Lines 414-415)

14. Lines 420 and 447. References should be added to support the explanation.

Response:

Thank you for your suggestion. We have added some references in the revised manuscript to support the explanation. (Lines 418- 447)

15. Section 4.2.3. Why not compared with other similar products developed in previous studies?

Response:

Thank you very much for the comment. The reason why there is no comparison with the developed all-weather LST is that the former data are not comparable. While there is a lot of research on all-weather LST estimation, most of them are algorithmic research or applied for regional generation. Limited research generates global-scale all-weather LST, whereas the spatial and temporal scales of the products are also inconsistent with the product in this study. For example, Zhang et al. (2022) generated a 1km seamless global LST product from MODIS data. However, the time of this product is unified to mid-daytime (13:30) and mid-nighttime (1:30), and the observation time of our instantaneous data varies within a certain range. Yao et al. (2023) produced a global seamless and high-resolution (30 arcsecond spatial resolution) temperature dataset, but with the temporal resolution of 8 days and monthly. Besides, Yu et al. (2022) and Hong et al. (2022) generated global all-weather instantaneous and daily mean LST products separately, but both with a spatial resolution of 0.05 °. Consequently, our product is not compared with these products.

References:

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Hong, F., Zhan, W., Göttsche, F.-M., Liu, Z., Dong, P., Fu, H., Huang, F., & Zhang, X. (2022). A global dataset of spatiotemporally seamless daily mean land surface temperatures: generation, validation, and analysis. *Earth System Science Data*, *14*, 3091-3113

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Zhang, T., Zhou, Y., Zhu, Z., Li, X., & Asrar, G.R. (2022). A global seamless 1 km resolution daily land surface temperature dataset (2003–2020). *Earth System Science Data, 14*, 651-664

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