Response to Referee #1

We would like to thank the reviewer for the comments and suggestions, which help to improve the quality of our work. We have made revisions and have replied to all comments and suggestions. Please find a detailed point-by-point response to each comment.

Comment:

1. The study asserts a higher accuracy than that of satellite products but does not provide a comprehensive comparison with a broad range of such products. Moreover, the accuracy indicated by the data appears comparable to some recently developed satellite products (Li et al., 2021). It would be beneficial to acknowledge or ideally, compare with, notable satellite products like MCD18A1 (Wang et al., 2020), DSCOVER (Hao et al., 2020), and GeoNEX (Li et al., 2023). MCD18 is the official MODIS radiation dataset incorporating instantaneous direct and diffuse radiation estimations. DSCOVER provides daily scale estimates of the diffuse and direct components, while GeoNEX boasts the highest accuracy for estimating daily and monthly global radiation. Adding rRMSE as an extra matrix could further enhance intercomparison across studies.

Response:

According to the conclusion of Li et al. (2021), the CERES satellite radiation product generally performs better than those of CLARA, GLASS, BESS and MCD18, with relatively lower RMSE and rRMSE values, by validating against in situ measurements from 142 global sites. Meanwhile, Tang et al. (2019a) found that the accuracy of the ISCCP-HXG satellite radiation product is generally better than several global satellite radiation products, such as the CERES, GEWEX-SRB, and ISCCP-FD, by validating against in situ measurements from BSRN and CMA. In this study we found that the accuracy of our station-based estimates is significantly higher than that of the ISCCP-HXG satellite radiation product. Therefore, we will assume that our station-based estimates have a higher accuracy than the five global radiation products mentioned by Li et al. (2021). Of course, this speculation needs further verification with in-situ measurements collected in China, which would be our future work, since the main goal of this article is to establish a long-term station-based dataset of surface solar radiation in China, not to compare with as many satellite products as possible.

As for the other two satellite radiation products, DSCOVER and GeoNEX, we can't compare them with our station-based estimates because we only collected CMA radiation observations during the time period from 1993 to 2010, but the two satellite radiation products are available after 2015. In the future, we will collect CMA radiation observations after 2015 to validate these two satellite radiation products after quality control of the original radiation observations.

The rRMSE is indeed a good indicator that could further improve the comparability

between studies. Indeed, the metric rRMSE has been used in this paper (see Figure 3-8).

In fact, we have also found that the satellite products you mentioned above lack validation in China, which is worth doing in the future.

In response to your concerns, we will cite all the articles you mentioned, and will add some descriptions as "Especially, Li et al. (2023) produced a high-spatiotemporal-resolution radiation product based on the new generation of geostationary satellites from the United States and Japan, with accuracy higher than other existing satellite products" , "In addition, Hao et al. (2020) developed a global radiation product based on the unique Deep Space Climate Observatory (DSCOVR) satellite, whose orbit is at the Lagrange point", and "Therefore, we would expect our station-based estimates to be more accurate than the five global radiation products mentioned by Li et al. (2021), as CERES generally performs best among them. Of course, this speculation needs to be further verified with in-situ measurements collected in China in the future." in the appropriate places in the revised manuscript.

Reference:

1. Hao, D., Asrar, G. R., Zeng, Y., Zhu, Q., Wen, J., Xiao, Q., & Chen, M. (2020). DSCOVR/EPIC-derived global hourly and daily downward shortwave and photosynthetically active radiation data at 0.1°× 0.1° resolution. Earth System Science Data, 12(3), 2209-2221.

2. Li, R., Wang, D., & Liang, S. (2021). Comprehensive assessment of five global daily downward shortwave radiation satellite products. Science of Remote Sensing, 4, 100028.

3. Li, R., Wang, D., Wang, W., and Nemani, R.: A GeoNEX-based high-spatiotemporal-resolution product of land surface downward shortwave radiation and photosynthetically active radiation, Earth Syst. Sci. Data, 15, 1419–1436, https://doi.org/10.5194/essd-15-1419-2023, 2023.

4. Wang, D., Liang, S., Zhang, Y., Gao, X., Brown, M. G., & Jia, A. (2020). A new set of MODIS land products (MCD18): Downward shortwave radiation and photosynthetically active radiation. Remote Sensing, 12(1), 168.

Comment:

2. The products generated are site-based, implying discontinuity on a spatial scale. Figure 9 demonstrates numerous gaps in remote areas such as northwest China where active CSP are present. If there are minimal differences in accuracy and information between this station-based data and satellite products, the rationale for opting for station-based data needs to be more convincingly presented.

Response:

Good comment! Undoubtedly, station-based data have the advantage over satellite products of longer time series and higher accuracy, especially for direct radiation. It is true that our station-based products are spatially discontinuous, especially in northwestern China, which may introduce significant uncertainty when applied to the assessment of solar power system potential. However, the uncertainty caused by spatial discontinuity in flat areas would be relatively small, as the spatial

representation of a station on flat ground is generally larger than 25 km (Hakuba et al., 2013). Fortunately, most solar power systems are built on land with slopes of less than 3%. In contrast, applications over complex terrain will introduce large uncertainties. Combining station-based data with satellite products will be a good solution in the future to improve the accuracy of solar energy potential assessment.
The above description will be added into in the revised manuscript.

Hakuba, M.Z., Folini, D., Sanchez-Lorenzo, A., & Wild, M. (2013). Spatial representativeness of ground-based solar radiation measurements. Journal of Geophysical Research: Atmospheres, 118, 8585-8597, https://doi.org/10.1002/2017JD027261.

Comment:

3. The long term availability is the highlight of this datasets, but the potential applications of the long term solar radiation data is not explained in detail. The authors should elaborate on this point in the introduction and consider incorporating a more extended analysis of the three radiation variables within the manuscript.

Response:

Good comment! Some explanations of the potential applications of our developed long-term solar radiation data will be added into the revised manuscript as "This long-term dataset will contribute to the analysis of long-term variations in surface process simulations and solar energy applications, such as the assessment of solar energy potential, the determination of the optimal angle for solar PV panels and their long-term variation analysis, as well as the assessment of historical extreme events on solar energy systems."

Based on the three radiation variables, extended analyses, and potential applications, such as long-term simulations of land surface-related processes, climate change analysis and related solar energy applications, can be carried out, but this is beyond the aim and scope of this article, since the main aim of this article is to establish a long-term station-based dataset of surface solar radiation in China.

Comment:

4. Tables and equations should be improved aesthetically, possibly through the use of a LaTeX package.

Response:

Accepted！ Tables and equations will be improved in the revised manuscript.

Comment:

5. Please consider adopting color schemes that are accessible to readers with color vision deficiencies.

Response:

Accepted！ We will revise all Figures in the revised manuscript, and will adopt color schemes that are accessible to readers with color vision deficiencies.