Dear Referee #1:

Thank you very much for your positive and constructive comments. We have studied the valuable comments carefully and have made corrections which we hope can meet with approval. The point to point responds to the reviewer's comments are listed as following:

Comment#1:

(1) L85-86, duplicated word "Wei et al. Wei et al. (2019)"..

[Response to Comment#1]:

Thank you for your valuable advice. We have changed "Wei et al. Wei et al. (2019)" to "Wei et al. (2019)" in the revised manuscript.

Comment#2:

L90-91, "Qin et al.(2015) developed an efficient physical parameterization (EPP) for estimating GHI values using MODIS land and atmospheric products and evaluated the EPP model at 91 CMA stations in China. However, the spatial resolution (1◦x1◦) and spatial continuity of the estimation results by the EPP model could not meet the requirements of solar energy research, which requires SI records with high spatial resolution". You mean the spatial resolution of Qin et al. 2015 is 1◦x1◦?

[Response to Comment#2]:

Thank you very much for your valuable comments. We are deeply sorry for this careless mistake. We intended to express that the spatial continuity of the estimated results by EPP model could not meet the requirements of solar energy research, because there are many vacancies in MODIS Level2 land and atmosphere products. We have changed "the spatial resolution (1°×1°) and spatial continuity…with high spatial resolution" to "the spatial continuity…with high spatial continuity" in L90-91 in the revised manuscript.

Comment#3:

L138. How do you control of quality of CMA measurements?.

[Response to Comment#3]:

Thank you very much for your valuable suggestions for this manuscript. These CMA measurements used in this study have been checked manually using extreme value test and time consistency test method by China Meterological Administration (CMA). The quality control processes for solar irradiance measurements at CMA stations have also been conducted in this manuscript as follows: each measured GHI, DNI and DIF values should not exceed the solar irradiance at the top of the atmosphere at the same geographical location. Detail steps for controlling the data quality of solar irradiance measurements have been added in the revised manuscript.

Comment#4:

What's mean of the MBD in eq. (12)?.

[Response to Comment#4]:

Thank you very much for your valuable suggestions for this manuscript. We are sorry for this mistake. It's MAD (the relatively mean absolute bias error) not MBD. We have corrected this error in the revised manuscript.

Comment#5:

There are too many indicators (eq. 4-20) for accuracy evaluation, the authors should write some brief introduction for these indicators.

[Response to Comment#5]:

Thank you very much for your nice comment. We have briefly introduced these indicators in the revised manuscript. Meanwhile, we also paste the reference (Gueymard 2014) that described these indicators in detail in the revised manuscript. We are apologized that we could not describe the definition for each indicator, limited by the space of the article. We are sorry again for that. However, if you think this is a very important issue, we will write detail introduction of each indicator in the next round review.

Comment#6:

L226. "Xianghe stations" means Xianghe have more than one stations.

[Response to Comment#6]:

Thank you very much for your valuable suggestions for this manuscript. "Xianghe stations" have been changed into "Xianghe station" in the revised manuscript.

Comment#7:

Fig. 3. How many points used for evaluation of estimated hourly and daily GHI, DNI and DFI?.

[Response to Comment#7]:

Thank you very much for your comments. The number of the data sample for evaluating the estimated daily GHI, DNI and DIF is 129662. The number of the data sample for evaluating the estimated hourly GHI, DNI and DIF at Wuhan station and Xianghe station are 10032, 25819, respectively. The number of the data sample for evaluating the estimated hourly GHI at CERN stations is 3857998. The number of data samples have been described in the revised manuscript.

Comment#8:

Why there are few strange points in the Fig. 8?.

[Response to Comment#8]:

Thank you very much for your kind reminder. We are sorry for this mistake. There was a software failure when plotting the map. We have added a new corrected map in the revised manuscript.

Comment#9:

What's the MERRA official algorithm for estimating GHI? And why they daily GHI results with very high error (RMSE=85.78Wm-2) in Fig. 3.

[Response to Comment#9]:

Thank you for your nice comment on this manuscript. The MERRA-2 is produced with version 5.1.4 of the GEOS atmospheric data assimilation system. The key components of the system are the GEOS atmospheric model and the GSI analysis scheme. The Radiative transfer calculations necessary for the assimilation of satellite radiances in MERRA-2 are performed using the CRTM. Detail information for the official algorithm for calculating GHI could be found in an article named "The Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2)".

The very high error (RMSE=85.78Wm-2) for MERRA-2 GHI records in Fig. 3 is a combined result of multiple factors. The accuracy of the cloud effect on GHI may be the main reason, since cloud was considered to be the most uncertain factor for predicting surface solar irradiance, owing to the variation of the cloud shape, cloud type and cloud phase in various climatic zones and terrain features. The high errors of the GHI values derived from MERRA-2 are consistent with a known tendency for the GEOS-5 systems to underestimate mid-latitude continental cloud cover (Draper et al. 2018). Further studies should be conducted in future studies to found the limitation of accuracy of GHI records in MERRA-2. This explanation for the high errors of MERRA GHI records have been added in the revised manuscript.