We first thank the very constructive comments of the reviewer. We have taken all of reviewer's comments into consideration and revised the manuscript accordingly. All the changes have been tracked in the revised manuscript. Our detailed responses are as follows.

Response to Anonymous Referee #1

This paper investigated the land energy balance over East Asia using several data, like surface observation data, satellite data, reanalysis data, and CMIP data. Results are interesting and indicate that a larger shortwave radiation of 5.2% is reflected and smaller shortwave absorption of 0.6% is estimated. In addition, cloud radiation effects (shortwave, longwave at the surface, atmosphere, and TOA) are also evaluated. Overall, this manuscript is clear. This study is of great significance to improve the new understanding of energy balance in East Asia. However, there are several issues that need to be taken care of before this paper becomes acceptable for publication.

Specific comments:

1. In Figure 6, the surface energy is not balanced due to the lack of sensible heat flux and latent heat flux values.

   Reply: The cloud-free energy budget shown in Figure 6b is not balanced because it is not the one that Earth would achieve in equilibrium when no clouds could form. It rather represents the mean fluxes as determined solely by removing the clouds but otherwise retaining the entire atmospheric structure. This enables the quantification of the effects of clouds on the Earth energy budget and corresponds to the way clear-sky fluxes are calculated in climate models. Thus, the cloud-free energy budget is not closed and therefore the sensible and latent heat fluxes are not quantified in Figure 6b. Please see the more comprehensive explanation in the revised manuscript.

2. In Figure 7, the Spatial distributions of annual mean SSR biases derived from CERES, CMIP6 and ERA5 are both overestimated in the high value region, please try to explain the reason.

   Reply: I think this is not a common phenomenon only occurred over high value regions or in clear-sky conditions. It is very likely related to aerosols in clear-sky conditions, which is possibly attributed to the CMIP6 models' capabilities to represent the aerosol properties and retrieval algorithms of aerosols in satellite data over TP region.

3. The radiative effects and radiative forcing of aerosols are rarely discussed in this paper. How to distinguish the radiative effects of clouds and aerosols under the All-sky situation?

   Reply: We used to distinguish the radiative effects of clouds and aerosols based on the surface solar radiation (SSR) under all-sky, clear-sky, all-sky-no-aerosol, and clear-sky-no-aerosol conditions derived from CERES SYN1deg product. Generally, clouds and aerosols dominate the all-sky SSR, whereas aerosols play a vital role in the clear-sky conditions. Please refer to Wang et al. (2021) for more detailed explanation on how to distinguish contributions from aerosols and clouds. Actually, it is not easy to distinguish the radiative effects of clouds and aerosols during the analysis of all-sky energy balance budget. We dealt with this here by combing the potential factors affecting the corresponding radiation components and their observational fact over East Asian and global land to determine the possible reasons for the discrepancies between them. This is shown in section 3.4.3 in the revised manuscript.

   Reference:

Wang, Q., Zhang, H., Yang, S., Chen, Q., Zhou, X., Shi, G., Cheng, Y., and Wild, M.: Potential driving factors on surface solar radiation trends over China in

recent years, Remote Sens., 13, 704, https://doi.org/10.3390/rs13040704, 2021.

4. The authors emphasize that the fewer low clouds due to the TP are very likely the causes for the smaller fraction of East Asian land surface downward longwave radiation. Is the conclusion that there are fewer low clouds over the TP consistent with the actual situation?

   Reply: Yes, it is. Please also see Figure S4 in the supplementary material, where the global distribution of land mean total and low cloud fraction (CF) during 2010-2014 derived from CERES_SSF1deg Ed4.1 product is also displayed. The corresponding area-weighted averages over East Asian land and global land are 56.3% and 55.2%, as well as 10.5% and 14.2%, respectively, suggesting a slightly more total CF of 1.1% and fewer low CF of 3.7% over East Asian land compared to the global land.

5. L573, why do you select ERA5 surface LW radiation as the reference? Why not choose CERES-EBAF as the reference?

   Reply: Renalyses take into account possibly the best available estimates of atmospheric temperature and humidity profiles at high temporal frequency in their radiative transfer calculations, which further contributes to an accurate determination of the surface thermal radiation (Wild, 2017a). Wild et al. (2015) also reported that the best estimate of the downward thermal radiation is very close to the corresponding estimate of ERA-Interim reanalysis based on the various CMIP5 models and surface observational sites. However, the energy fluxes at the Earth surface cannot be directly measured from space, but have to be inferred from the measurable TOA signals using additionally empirical or physical models to remove atmospheric perturbations. Thus, they don't have the same accuracy as the TOA fluxes. Also, satellite-derived records of surface fluxes may also suffer from

potential inhomogeneities due to changes in satellites, viewing geometries, inaccurate positioning, or sensor degradation, particularly in the earlier records.

References:

Wild, M.: Progress and challenges in the estimation of the global energy balance, AIP Conference Proceedings, 1810, 20004, https://doi.org/10.1063/1.4975500, 2017a.

Wild, M., Folini, D., Hakuba, M. Z., Schär, C., Seneviratne, S. I., Kato, S., Rutan, D., Ammann, C., Wood, E. F., and König-Langlo, G.: The energy balance over land and oceans: an assessment based on direct observations and CMIP5 climate models, Clim. Dynam., 44, 3393–3429, https://doi.org/10.1007/s00382-014-2430-z, 2015.

6. It is better to introduce relative research (e.g., Li et al., Xu et al., Letu et al. 2022) in the introduction part.

Li, M., Letu, H., Peng, Y., Ishimoto, H., Lin, Y., Nakajima, T. Y., ... & Shi, J. (2022). Investigation of ice cloud modeling capabilities for the irregularly shaped Voronoi ice scattering models in climate simulations. Atmospheric Chemistry and Physics, 22(7), 4809-4825.

Xu, J., Liang, S., & Jiang, B. (2022). A global long-term (1981–2019) daily land surface radiation budget product from AVHRR satellite data using a residual convolutional neural network. Earth System Science Data, 14(5), 2315-2341.

Letu, H., Nakajima, T. Y., Wang, T., Shang, H., Ma, R., Yang, K., ... & Shi, J. (2022). A new benchmark for surface radiation products over the East Asia–Pacific region retrieved from the Himawari-8/AHI next-generation geostationary satellite. Bulletin of the American Meteorological Society, 103(3), E873-E888.

Reply: Thanks for the good suggestion. Some of the related publications are cited in the end of the manuscript for possible comparisons in the future. The sentence is added as “For example, newly published surface radiation products with high resolutions based on satellite datasets (e.g., Letu et al., 2022; Xu et al., 2022) are expected to make sense in improving the accuracy of the regional/global surface radiation budget studies.”.