

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 #2

This paper assessed the land energy balance over East Asia with surface measurements, satellite estimations, reanalysis and CMIP6 products. The author found a substantially larger fraction of atmospheric shortwave radiation of 5.2% is reflected and a slightly smaller fraction of atmospheric shortwave absorption of 0.6%. The author also investigated the cloud radiative effects and found the presence of clouds results in a larger cooling effect on the climate system over East Asian land than that over globe. The author also pointed out the role of Tibet Plateau in both SW and LW radiation balance.

The paper addresses an important and interesting topic, and I believe that this paper have the potential to be of great value to the scientific community. However, I have several concerns as outlined below. After addressing these concerns, I believe the work would be a good fit for publication.

1. The topic of this paper is land energy balance over East Asia and the role of TP, aerosols and clouds. The author analyzed the cloud radiative effects in section5. However the author did not outlined the importance to study cloud radiative effects. I suggest to expand the discussion on the cloud radiative effects in introduction to emphasize the importance of authors analysis.

Reply: Really appreciate for the constructive suggestion. The discussion of cloud radiative effects in the introduction part is added as “Moreover, clouds play a key role in modulating global and regional energy budgets and hydrological cycles through increasing the reflected solar radiation and also the downward thermal

radiation, leading to a cooling and warming of climate system (Stephens, 2005; Wild et al., 2013a; Li et al., 2015; H. Wang et al., 2021).”.

References:

Li, J., and Mao, J.: A preliminary evaluation of global and East Asian cloud radiative effects in reanalyses, *Atmos. and Ocean. Sci. Lett.*, 8, 100-106, <https://doi.org/10.3878/AOSL20140093>, 2015.

Stephens, G. L.: Cloud feedbacks in the climate system: A critical review, *J. Climate*, 18, 237-273, <https://doi.org/10.1175/JCLI-3243.1>, 2005.

Wang, H., Zhang, H., Xie, B., Jing, X., He, J., and Liu, Y.: Evaluating the Impacts of Cloud Microphysical and Overlap Parameters on Simulated Clouds in Global Climate Models, *Adv. Atmos. Sci.*, <https://doi.org/10.1007/s00376-021-0369-7>, 2021.

Wild, M., Folini, D., Schär, C., Loeb, N., Dutton, E. G., and König-Langlo, G.: The global energy balance from a surface perspective, *Clim. Dynam.*, 40, 3107–3134, <https://doi.org/10.1007/s00382-012-1569-8>, 2013a.

2. This paper is lack of the discussion on the radiative effects of aerosols.

Reply: Yes, it is. Actually, it is not easy here to expand detailed discussion on the aerosol radiative effects. We only cited the most related reference documented by Wei et al. (2019), who provided the statistics of regional and global land mean AODs from MODIS aerosol products. On this basis, we tried to using the fact of more aerosol loadings over East Asian land to explain the potential causes contributing to the discrepancies in the estimated global and East Asian land energy budgets as shown in section 3.4.3.

Reference:

Wei, J., Peng, Y., Guo, J., and Sun, L.: Performance of MODIS Collection 6.1 Level 3 aerosol products in spatial-temporal variations over land, *Atmos. Environ.*, 206, 30–44, <https://doi.org/10.1016/j.atmosenv.2019.03.001>, 2019.

3. Why the surface sites are divided into rural/urban categories? Is this related to surface properties or aerosol or both? Please explain.

Reply: Yes, two factors of surface properties and aerosol emissions are certainly considered in choosing the rural and urban sites. Surface properties mainly influence reflected solar radiation at the surface by affecting their albedos, while aerosols can exert a strong influence on shortwave radiation. Considering the urbanization effect on surface solar radiation in China is still disputed (e.g., Wang et al., 2014; Imamovic et al., 2016), an attempt to quantify the anthropogenic influence on surface solar radiation through dividing surface sites into urban/rural categories is particularly necessary and meaningful in this case. Hopefully this in-depth exploration would also provide an opportunity to examine the performances of different products (such as satellite retrievals, climate models, and reanalysis) to derive surface solar radiation at urban/rural sites.

References:

Wang, K., Ma, Q., Wang, X., and Wild, M.: Urban impacts on mean and trend of surface incident solar radiation, *Geophys. Res. Lett.*, 41, 4664–4668, 2014.

Imamovic, A., Tanaka, K., Folini, D., and Wild, M.: Global dimming and urbanization: did stronger negative SSR trends collocate with regions of population growth? *Atmos. Chem. Phys.*, 16, 2719–2725, <https://doi.org/10.5194/acp-16-2719-2016>, 2016.

4. Table 1, the land-atmosphere net heat flux is worth known.

Reply: Referring to the published energy balance assessment papers (e.g., Wild et

al., 2015; Wild, 2020), all the estimated energy balance components as well as the CREs from the TOA, within the atmosphere, and at the surface under both all-sky and clear-sky conditions have been given in Table 1. Thanks for the suggestion.

References:

Wild, M.: The global energy balance as represented in CMIP6 climate models, *Clim. Dynam.*, 55, 553–577, <https://doi.org/10.1007/s00382-020-05282-7>, 2020.

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.

5. Table 2, 17.2 W m^{-2} could be a large difference, the percentage-wise is worth known.

Reply: Agreed. The largest percentages of SSR biases relative to their respective station-mean averages are estimated to be around 10% and 4% for all-sky and clear-sky conditions. Please see the updated caption of Table 2 in the revised manuscript.

6. Line602-613, “Comparisons.....OLR of 2.7%”, I suggest to show the spatial distribution of CRE from reanalysis or satellite estimations or CMIP6 over East Asia in section 5 and the spatial distribution of net heat flux (from ERA5 or CMIP6) to support this conclusion on the role of TP.

Reply: As the world’s largest and highest plateau, TP accounts for nearly one third of the East Asian land area, which shows lower water vapor content effects for shortwave radiation and weaker greenhouse effects for downward thermal radiation due to its orographic effect over East Asian land compared to the global

land estimates. Thus, I think it is not necessary to also give the detailed spatial distributions of CREs and net heat flux (I guess the 'net heat flux' here represents the surface net flux?) for the further explanation. Besides, the limited length of the article is also considered here. Thanks for the suggestion.