We first thank the very constructive comments of the reviewers. We have taken all the reviewers' 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 manuscript describes the land energy balance over East Asia with surface measurements, satellite estimations, reanalysis and CMIP6 products. The paper finds that the high aerosol loadings, clouds, and the Tibet Plateau over East Asia play vital roles in the regional shortwave budgets. the And Tibet Plateau is also responsible for the longwave budgets. The cloud radiative effects over East Asia are also assessed by this paper. The author pointed out that the presence of clouds results in a larger cooling effect on the land climate system over East Asian than that over globe. I believe that it is important to understand the land energy over East Asia. And this paper has the potential to be of great value to the scientific community.

Comments:

1. Line 155: "the first ensemble member" refers to the control member?

   Reply: No, "the first ensemble member" refers to the first ensemble member named r1i1p1f1 for each model. The CMIP6 "historical all forcings" experiments used in this study include several ensemble members for each radiative component, such as r1i1p1f1, r1i1p1f2 etc., and r1i1p1f1 is comprised of the largest available models.

2. Line 160: The link needs to direct to the right product

   Reply: Accepted. The link to ERA5 dataset is updated to a new link (https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels-monthly-means?tab=form). Thanks for your correction.

3. Line 162-163: It is better to use “as well as a higher vertical resolution with ?? levels”

   Reply: Accepted. This sentence is revised to “as well as a higher vertical resolution with 137 levels”.

4. Line 167-171: ERA5 has different performance at different locations. what about the bias of ERA5 over East Asia. Please point out the purpose of using ERA5 in this paper?

   Reply: ERA5 provides estimates of surface radiation fluxes with higher resolution compared to its predecessor ERA-Interim, and the accuracies of which should also be greatly improved because the new product assimilates more satellite signals and more station data. Compared to the satellite-derived product SARAH, ERA5 shows the smallest deviations for most Europe, Central Asia and South Africa in terms of surface irradiance, while the largest positive deviations are observed in the Tibetan Plateau and China. This overestimation in China is possibly related to an underestimation of clouds and anthropogenic aerosols as documented by Zhang et al. (2016). To sum up, the estimated surface irradiances from ERA5 are comparable with the corresponding satellite-based estimates over most inland regions with low occurrence of clouds (Urraca et al., 2018). However, for surface downward longwave radiation, Tang et al. (2021) pointed out that the accuracy of the ERA5 over land is higher than CERES-derived product on average against BSRN station data both at hourly and monthly time scales. Moreover, since the reanalyses assimilate the observed state of the atmosphere several times per day, they are considered as a useful source for the determination surface upward longwave radiation (Wild, 2017a). Thus, the purpose of using ERA5 in this paper is for the best estimations of the surface longwave radiation.

References:

Tang, W., Qin, J., Yang, K., Zhu, F., and Zhou, X.: Does ERA5 outperform satellite products in estimating atmospheric downward longwave radiation at the surface? Atmos. Res., 252, 105453, https://doi.org/10.1016/j.atmosres.2021.105453, 2021.

Urraca, R., Huld, T., Gracia-Amillo, A., Martinez-de-Pison, F. J., Kaspar, F., and Sanz-Garcia, A.: Evaluation of global horizontal irradiance estimates from ERA5 and COSMO-REA6 reanalyses using ground and satellite-based data, Sol. Energy, 164, 339–354, https://doi.org/10.1016/j.solener.2018.02.059, 2018.

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.

Zhang, X., Liang, S., Wang, G., Yao, Y., Jiang, B., Cheng, J.: Evaluation of reanalysis surface incident shortwave radiation products from NCEP, ECMWF, GSFC, and JMA, using satellite and surface observations. Remote Sens., 8 (3), 225, http://dx.doi.org/10.3390/rs8030225, 2016.

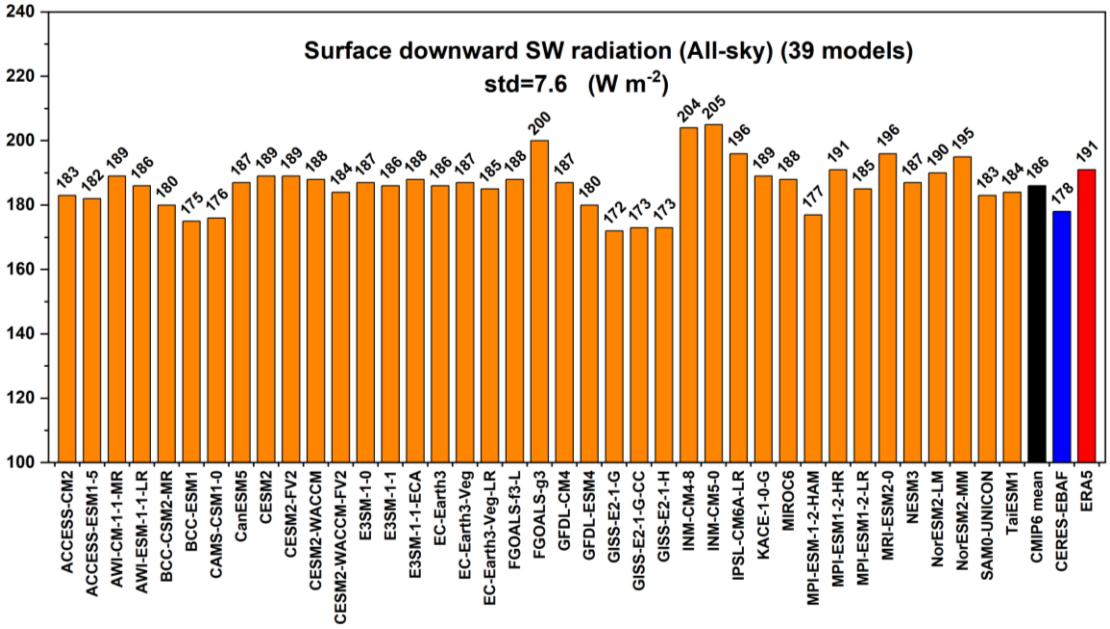
5. L195-200: Why the CIESM is kept in Figure 1, It does not have value for all conditions.

   Reply: The reason for keeping the CIESM model in the figures is that this model has values for latent and sensible heat as presented in Figure S2 in supplemental material.

6. L195: Any comments on why some models have very large anomalies. For example, the canESM5 has very large anomalies for surface net SW for both All-sky & Clear sky, any possible reasons?

   Reply: As shown in the following figures, the large anomalies of surface net SW

radiation both under all-sky and clear-sky conditions for some models are highly related to their corresponding surface downward and upward SW radiation. For example, the large anomaly of all-sky surface upward radiation in canESM5 model compared to multi-model mean (-12 W m^{-2}) is the major contributor to the large anomaly in surface net SW radiation (Figure R1), which is possibly associated with its higher surface albedo compared to other CMIP6 models. For clear-sky conditions, both the much lower and higher surface downward and upward SW radiation (-14 and -11 W m^{-2}) compared to their multi-model means contributed to the large anomaly (-25 W m^{-2}) in surface net SW radiation (Figure R2). This is likely linked to the higher simulated aerosol loadings and surface albedo in canESM5 model with respect to the multi-model mean levels.



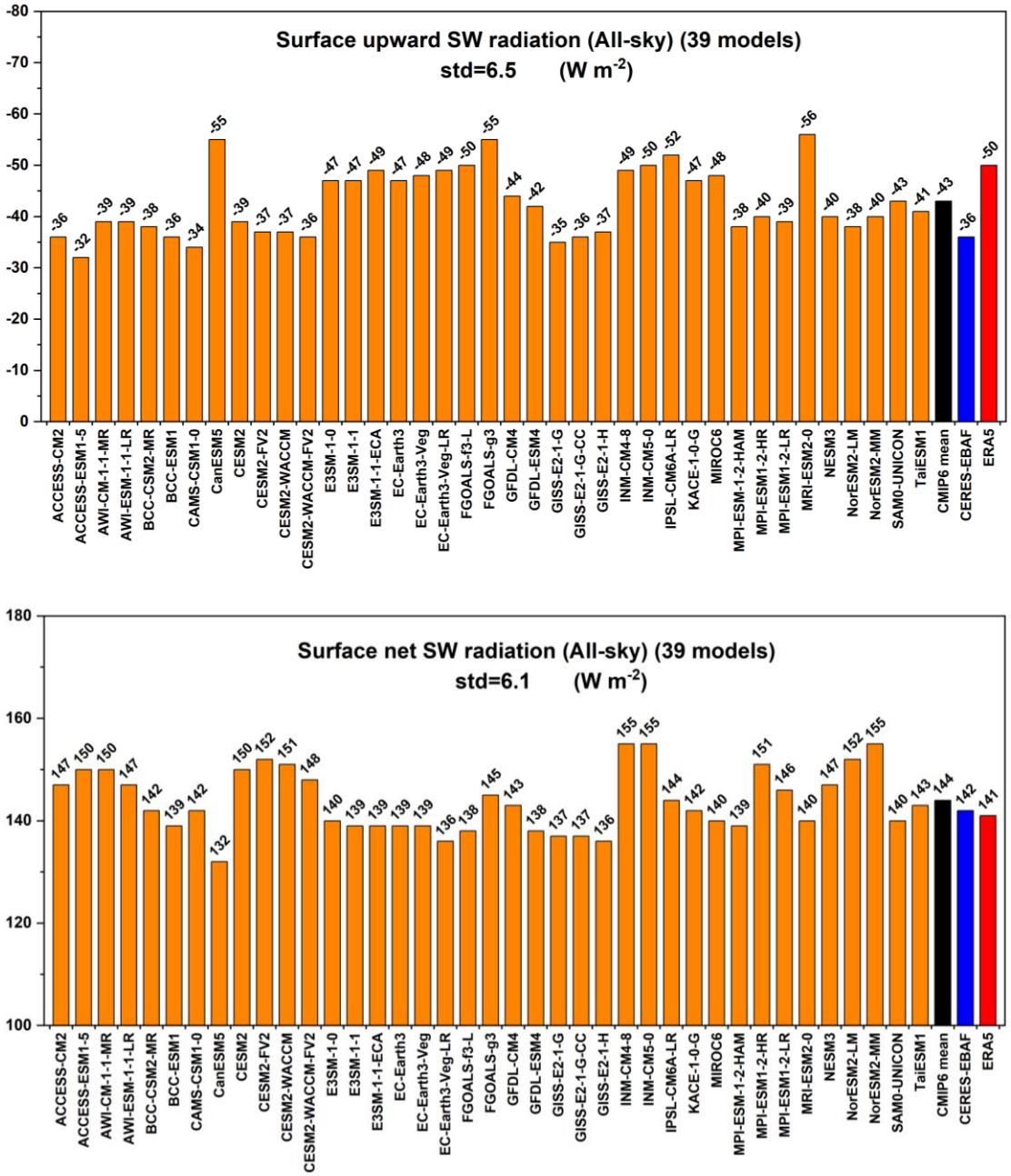
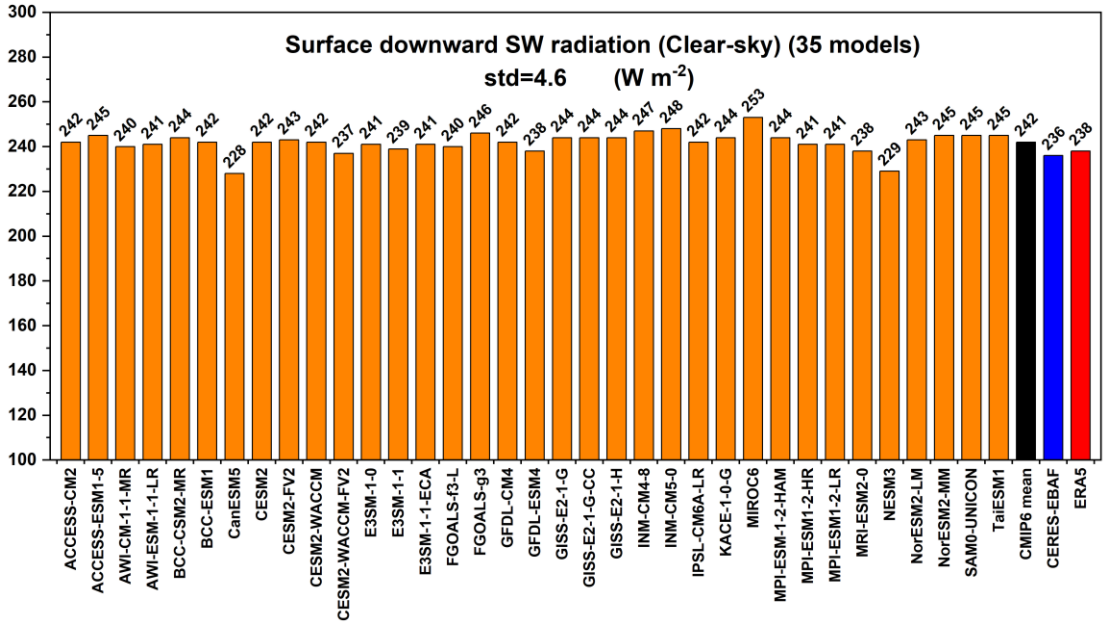
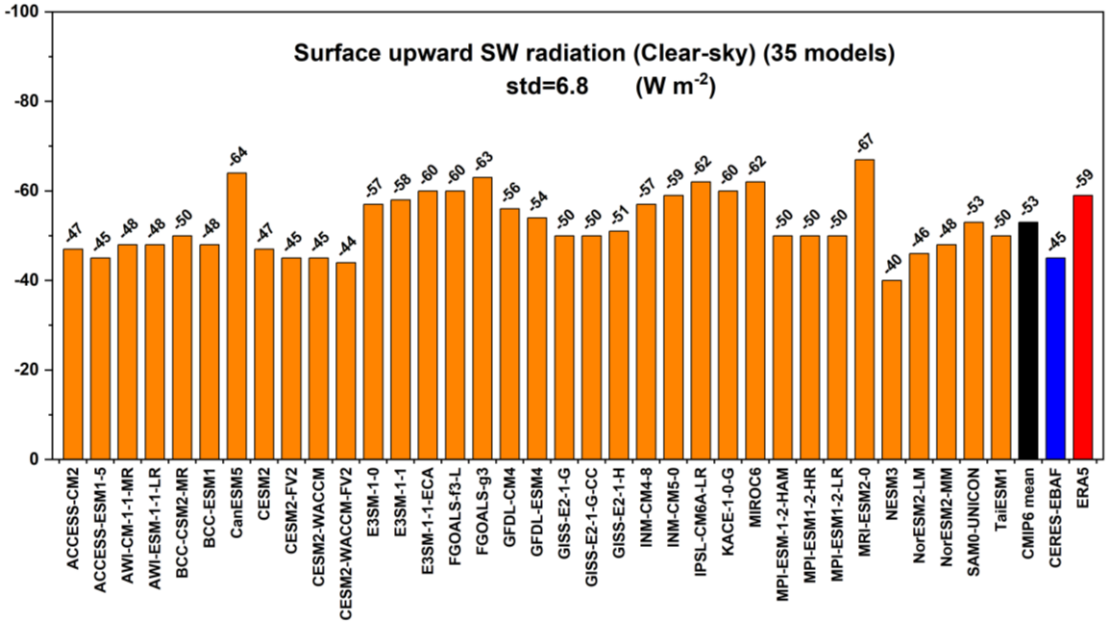


Figure R1. Annual land mean surface downward, upward, and net shortwave radiation (Units: W m^{-2}) under all-sky conditions over East Asia as simulated by various CMIP6 models (orange bars). The corresponding estimates from CMIP6 multi-model mean, CERES-EBAF and ERA5 are also presented in black, blue, and red bars.


Surface downward SW radiation (Clear-sky) (35 models)
std=4.6 (W m-2)
300
280
260
240
220
200
180
160
140
120
100
242 245 240 241 244 242 228 242 243 242 237 241 239 241 240 246 242 238 244 244 244 247 248 242 244 253 244 241 241 238 229 243 245 245 245 242 236 238
ACCESS-CM2
ACCESS-ESM1-5
AWI-CM-1-1-MR
AWI-ESM-1-1-LR
BCC-CSM2-MR
BCC-ESM1
CanESM5
CESM2
CESM2-FV2
CESM2-WACCM
CESM2-WACCM-FV2
E3SM-1-0
E3SM-1-1
E3SM-1-1-ECA
FGOALS-f3-L
FGOALS-g3
GFDL-CM4
GFDL-ESM4
GISS-E2-1-G
GISS-E2-1-G-CC
GISS-E2-1-H
INM-CM4-8
INM-CM5-0
IPSL-CM6A-LR
KACE-1-0-G
MIROC6
MPI-ESM-1-2-HAM
MPI-ESM1-2-HR
MPI-ESM1-2-LR
MRI-ESM2-0
NESM3
NorESM2-LM
NorESM2-MM
SAM0-UNICON
TaiESM1
CMIP6 mean
CERES-EBAF
ERA5


Surface upward SW radiation (Clear-sky) (35 models)
std=6.8 (W m-2)
-100
-80
-60
-40
-20
0
-47 -45 -48 -48 -50 -48 -64 -47 -45 -45 -44 -57 -58 -60 -60 -63 -56 -54 -50 -50 -51 -57 -59 -62 -60 -62 -50 -50 -50 -67 -40 -46 -48 -53 -50 -53 -45 -59
ACCESS-CM2
ACCESS-ESM1-5
AWI-CM-1-1-MR
AWI-ESM-1-1-LR
BCC-CSM2-MR
BCC-ESM1
CanESM5
CESM2
CESM2-FV2
CESM2-WACCM
CESM2-WACCM-FV2
E3SM-1-0
E3SM-1-1
E3SM-1-1-ECA
FGOALS-f3-L
FGOALS-g3
GFDL-CM4
GFDL-ESM4
GISS-E2-1-G
GISS-E2-1-G-CC
GISS-E2-1-H
INM-CM4-8
INM-CM5-0
IPSL-CM6A-LR
KACE-1-0-G
MIROC6
MPI-ESM-1-2-HAM
MPI-ESM1-2-HR
MPI-ESM1-2-LR
MRI-ESM2-0
NESM3
NorESM2-LM
NorESM2-MM
SAM0-UNICON
TaiESM1
CMIP6 mean
CERES-EBAF
ERA5

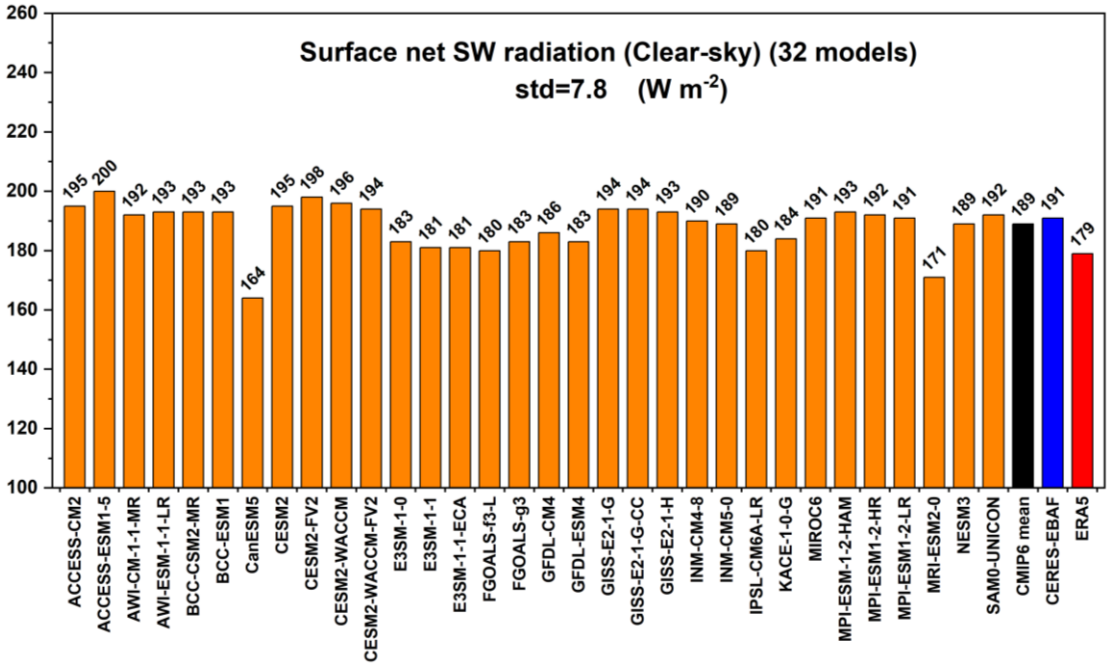


Figure R2. Same as figure R1, but for clear-sky conditions.

7. Line 252-254: The sample sizes of the rural/urban are not same. And if the sample size is very small, the statistics could be highly affected by extreme large/small values. It is better to give the percentage of rural/urban sites that have positive/negative bias.

   Reply: Thanks for the suggestion. We have updated Table 2 with their corresponding SSR bias percentages.

Station-mean SSR biases	All-sky			Clear-sky		
(Unit: W m^{-2})	all	urban	rural	all	urban	rural
CERES-EBAF	3.8 (2.3%)	4.2 (2.6%)	1.7 (0.9%)	0.4 (0.2%)	0.5 (0.2%)	-0.3 (-0.1%)
CMIP6	13.8 (8.3%)	15 (9.2%)	7.4 (4.1%)	9.1 (4%)	9.7 (4.3%)	6.4 (2.8%)
ERA5	16.5 (10%)	17.2 (10.5%)	12.7 (7%)	5.7 (2.5%)	6.2 (2.7%)	3.6 (1.5%)

8. Line 514-516: “All the uncertainty ranges …. for their TOA counterparts” This sentence is confusing, please reformat it.

   Reply: Accepted. This sentence is revised as “Apart from the TOA budget, all the rest uncertainty ranges are given by different data sources from various CMIP6 models, as well as the multi-model mean, CERES-, and ERA5-derived estimates.”

9. Line 572-573 “The above CRE estimates are compared to the corresponding estimates from different data sources” This sentence is confusing. I think that is "The above CRE best estimates are compared with the corresponding estimates from different data sources". Please pay attention to use the phrase of "compared to" & "compared with"

   Reply: Accepted. This sentence has been revised. Thanks for the suggestion.

10. Line 588-593: The same as figure 1, the CIESM does not have values for all conditions. Why it is kept in the figure 9?

    Reply: The reason for keeping the CIESM model in the figures is that this model has values for latent and sensible heat as presented in Figure S2 in supplemental material.

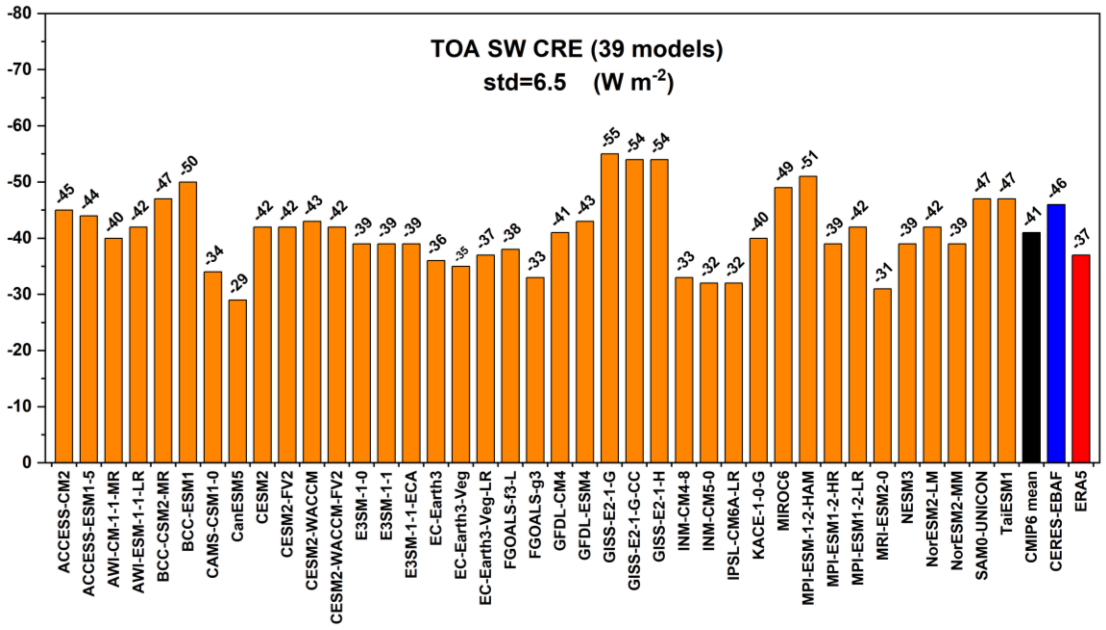
Response to Anonymous Referee #2

The authors have addressed my comments, and the revised version reads much better.

One minor question:

1. Based on the results of Fig9, it is recommended to answer the following two questions：why GISS-E2-1-G, KACE-1-0-G show the maximum negative anomalies? Why INM-CM4-8 has the maximum positive anomalies?

Reply: As shown in the following figures, the large negative TOA SW CRE in GISS-E2-1-G model contributes to the maximum negative TOA net CRE (Figure R1), while both large negative SW and LW CREs within the atmosphere result in the maximum negative atmospheric CREs in the model (Figure R2). The large negative and positive SW CREs within the atmosphere are the major contributors to the maximum negative and positive atmospheric net CREs in KACE-1-0-G and INM-CM4-8 models (Figure R2), respectively. The smallest negative SW CRE at the surface in KACE-1-0-G model is the major cause for the minimum negative surface net CRE among the models (Figure R3). The reasons for the large discrepancies in the above models are highly related to these models' representations of aerosol and clouds as well as the surface albedo.



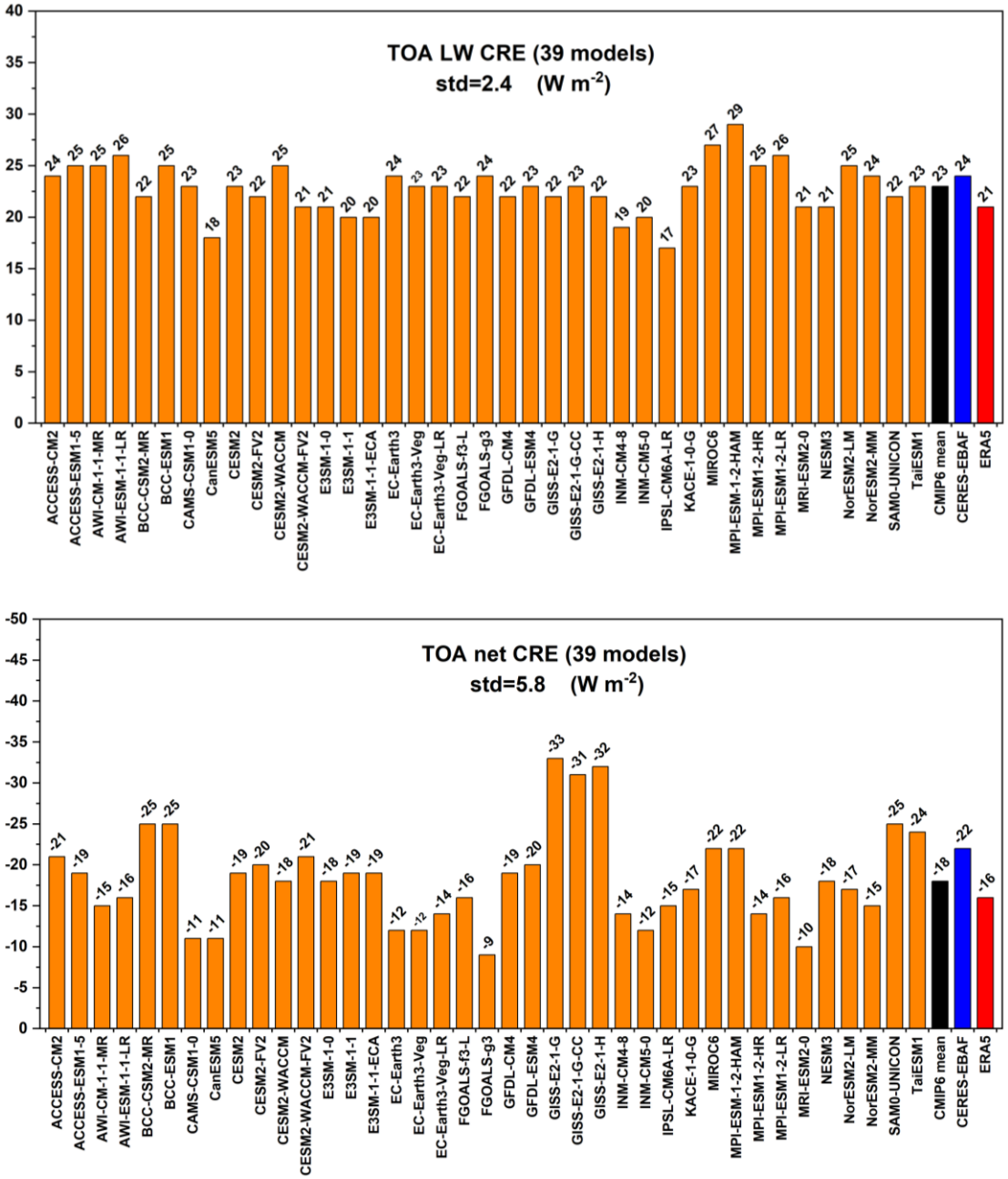
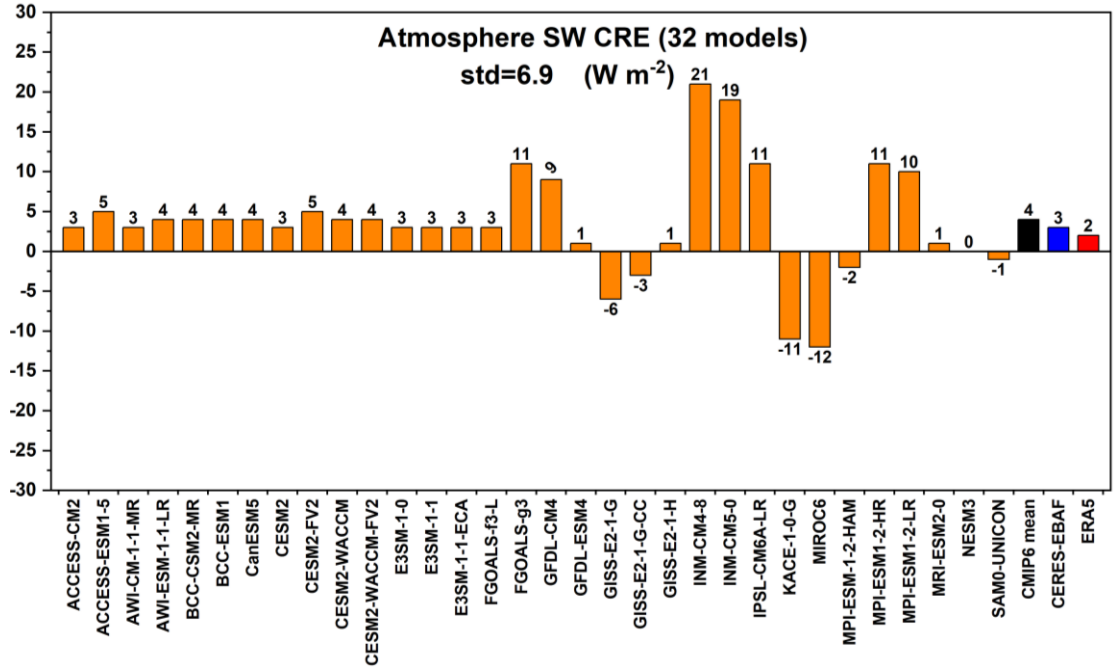
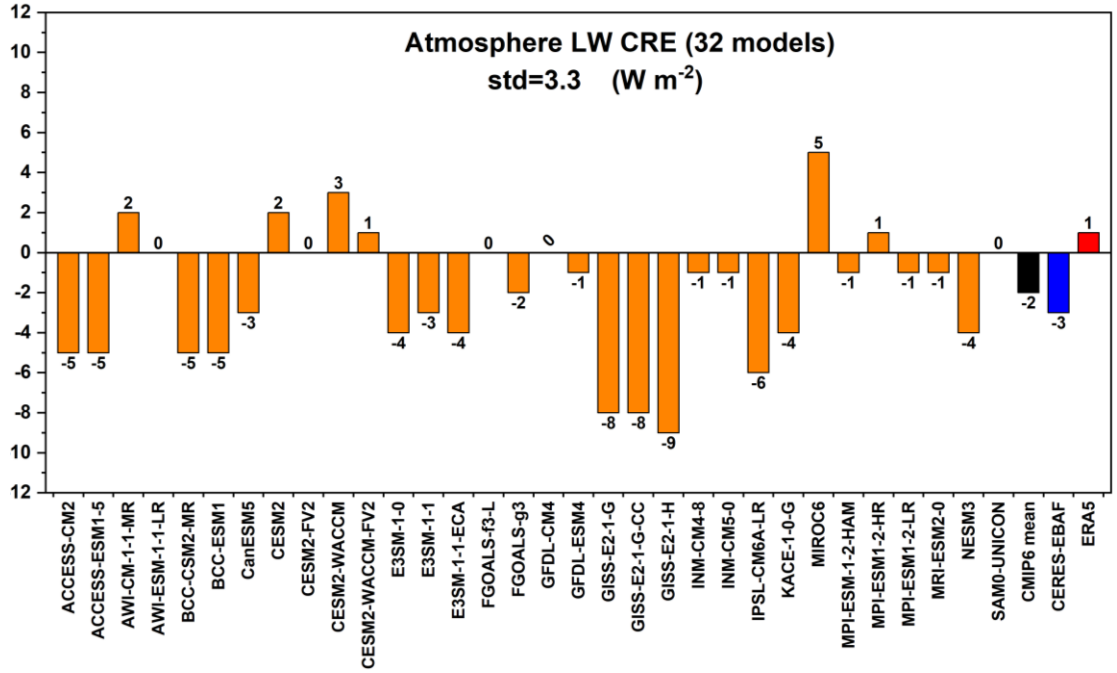


Figure R1. Annual land mean SW, LW, and net (SW+LW) CREs (Units: W m^{-2}) at the TOA over East Asia as simulated by various CMIP6 models (orange bars). The corresponding estimates from CMIP6 multi-model mean, CERES-EBAF and ERA5 are also presented in black, blue, and red bars.


Atmosphere SW CRE (32 models)
std=6.9 (W m-2)
ACCESS-CM2
ACCESS-ESM1-5
AWI-CM-1-1-MR
AWI-ESM-1-1-LR
BCC-CSM2-MR
BCC-ESM1
CanESM5
CESM2
CESM2-FV2
CESM2-WACCM
CESM2-WACCM-FV2
E3SM-1-0
E3SM-1-1
E3SM-1-1-ECA
FGOALS-f3-L
FGOALS-g3
GFDL-CM4
GFDL-ESM4
GISS-E2-1-G
GISS-E2-1-G-CC
GISS-E2-1-H
INM-CM4-8
INM-CM5-0
IPSL-CM6A-LR
KACE-1-0-G
MIROC6
MPI-ESM-1-2-HAM
MPI-ESM1-2-HR
MPI-ESM1-2-LR
MRI-ESM2-0
NESM3
SAM0-UNICON
CMIP6 mean
CERES-EBAF
ERA5


Atmosphere LW CRE (32 models)
std=3.3 (W m-2)
ACCESS-CM2
ACCESS-ESM1-5
AWI-CM-1-1-MR
AWI-ESM-1-1-LR
BCC-CSM2-MR
BCC-ESM1
CanESM5
CESM2
CESM2-FV2
CESM2-WACCM
CESM2-WACCM-FV2
E3SM-1-0
E3SM-1-1
E3SM-1-1-ECA
FGOALS-f3-L
FGOALS-g3
GFDL-CM4
GFDL-ESM4
GISS-E2-1-G
GISS-E2-1-G-CC
GISS-E2-1-H
INM-CM4-8
INM-CM5-0
IPSL-CM6A-LR
KACE-1-0-G
MIROC6
MPI-ESM-1-2-HAM
MPI-ESM1-2-HR
MPI-ESM1-2-LR
MRI-ESM2-0
NESM3
SAM0-UNICON
CMIP6 mean
CERES-EBAF
ERA5

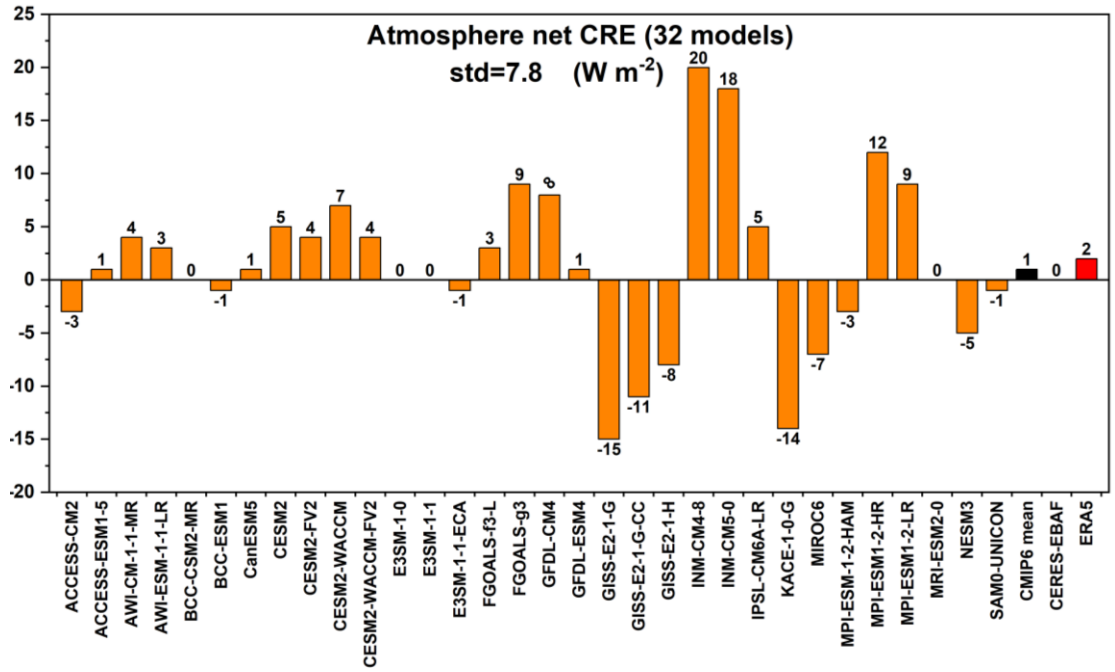
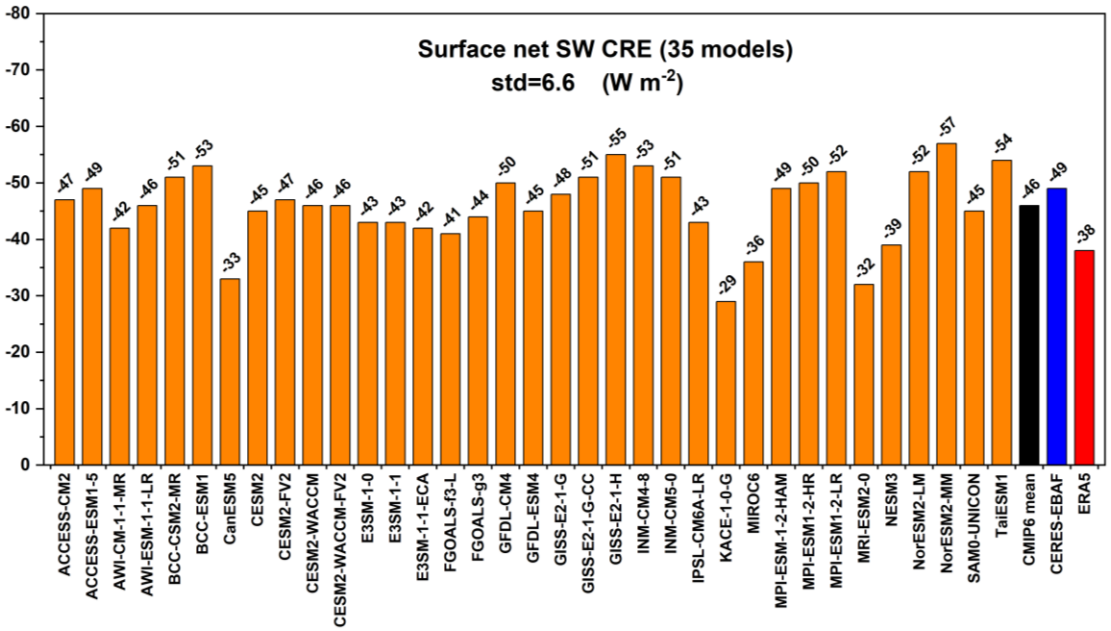


Figure R2. Same as figure R1, but for CREs within the atmosphere.



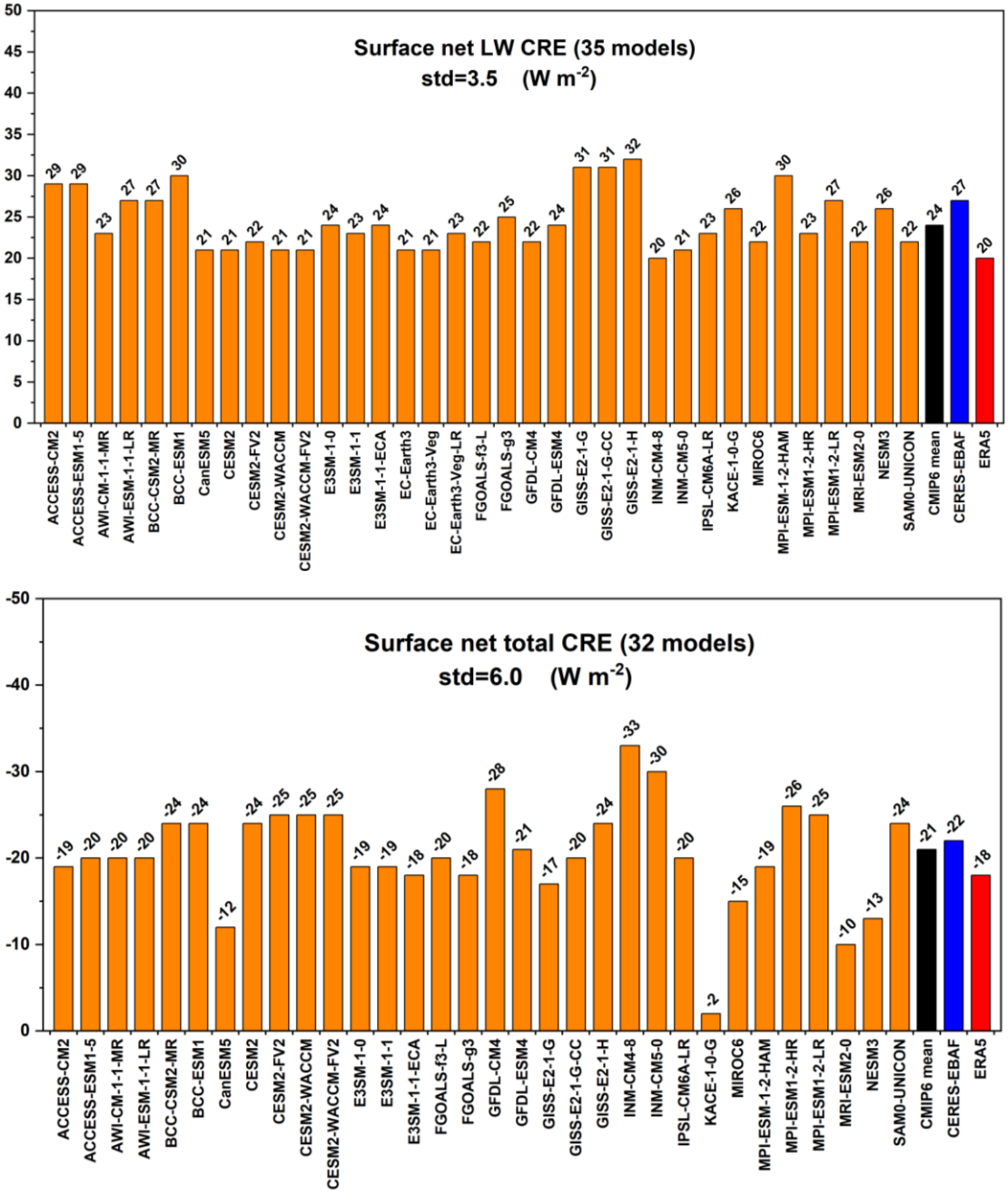


Figure R3. Same as figure R1, but for CREs at the surface.