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Understanding the trends in reflected solar radiation: a latitude- and month-based perspective

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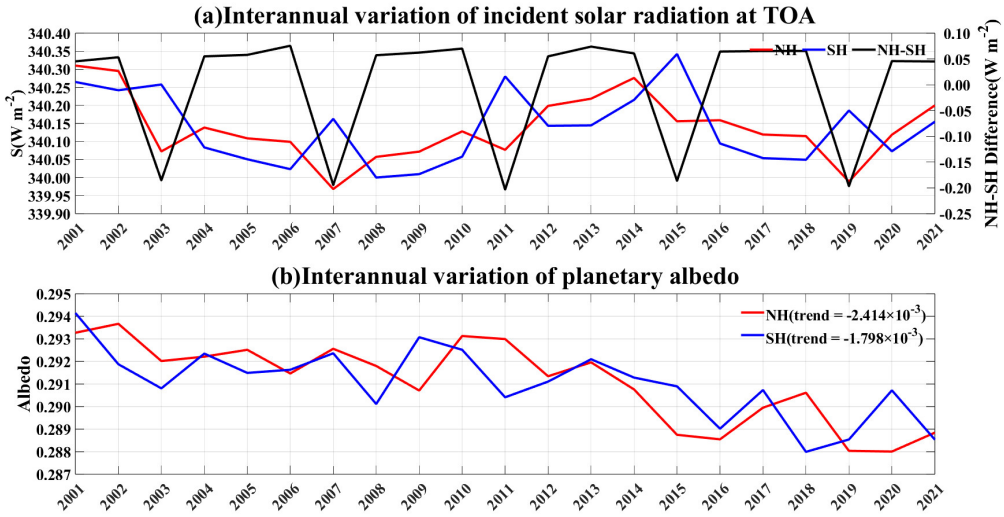

Figure S1: Interannual mean time series of (a) TOA incident solar radiation flux and (b) planetary albedo for the NH and SH during 2001-2021. The red line represents the NH, the blue line represents the SH and corresponds to the left y-axis. The black line in the diagram above represents the difference between the NH and SH and corresponds to the right y-axis. The trends marked passes the 99% significance test in units of decade^{-1}.

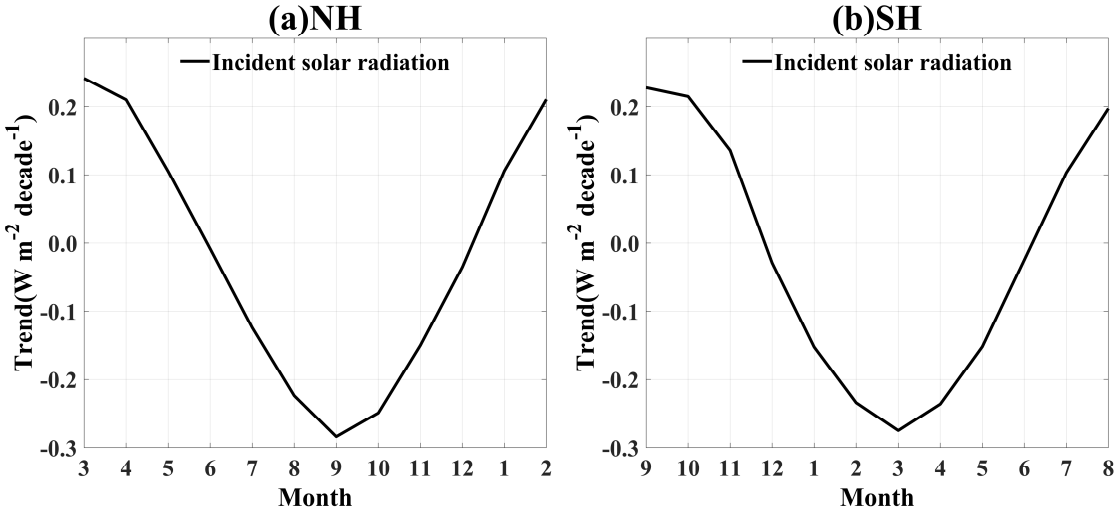

Figure S2: The hemispheric averaged trends in incident solar radiation at the top of atmosphere in (a) NH and (b) SH for different month from 2001-2021.

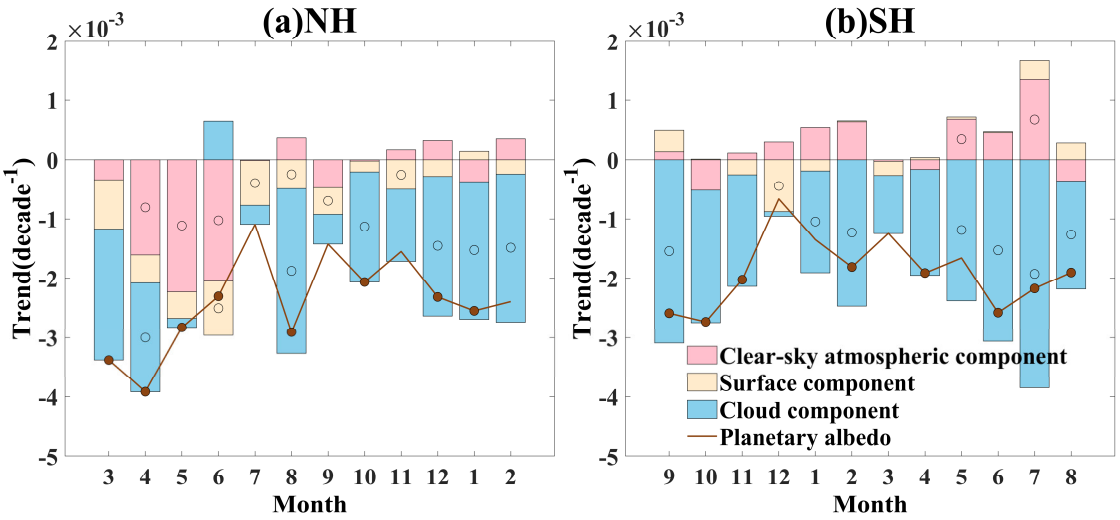

Figure S3: The hemispheric averaged trends in planetary albedo and its components in (a) NH and (b) SH for different month from 2001-2021. Pink, yellow and blue bars indicate trends in the clear-sky atmospheric component, surface component and cloud component, respectively. The brown line indicates the trend of planetary albedo. Dots of different colours indicate that the hemispheric averaged trend of the corresponding variable is significant at the 95% confidence level.

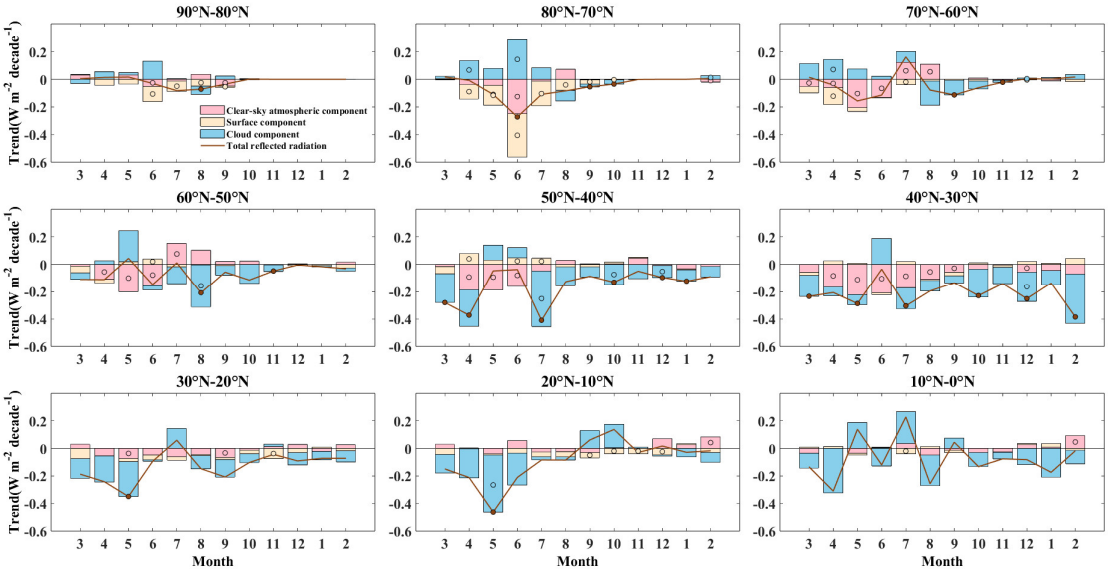

Figure S4: The zonal averaged trends in reflected solar radiation flux and its components in different latitudinal zones and months for the NH from 2001-2021. Pink, yellow and blue bars indicate trends in the clear-sky atmospheric component, surface component and cloud component, respectively. The brown line indicates the trend of total reflected solar radiation. Dots of different colours indicate that the zonal averaged trend of the corresponding variable is significant at the 95% confidence level.

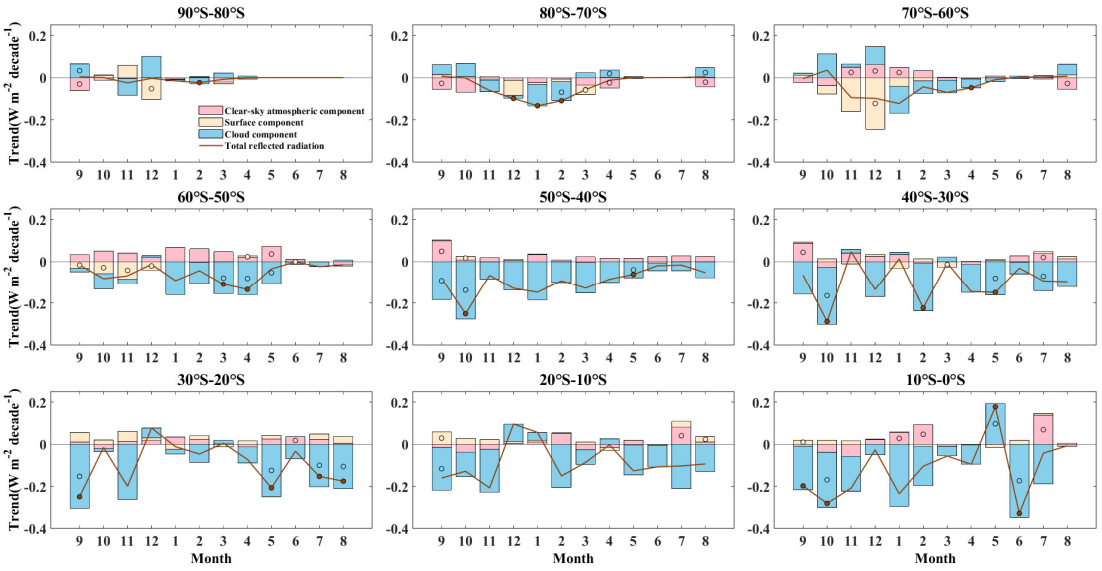

Figure S5: Same as Figure S4, but for the SH.

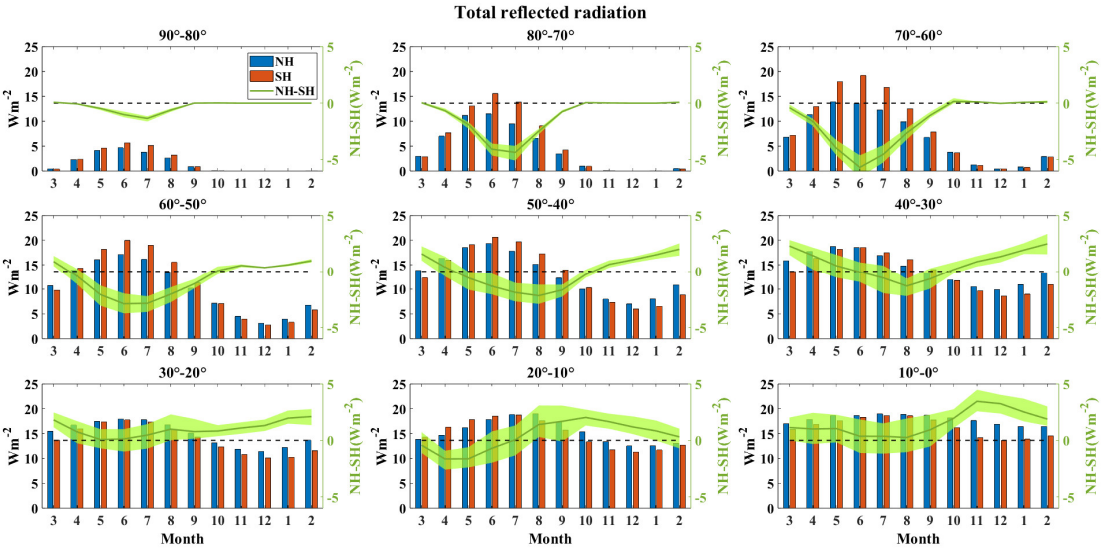

Figure S6: Annual cycle of the total RSR in different latitude zones and their hemispheric differences (NH-SH). The blue bars are for the NH, orange for the SH, corresponding to the left axis; the green line represents the inter-hemispheric difference, corresponding to the right axis, and the green shading indicates the difference spread in hemispheric difference for the corresponding month in the latitude zone during 2001-2021. The months are marked according to the NH, corresponding to the SH months of September, October, ..., January, February, …, and August.

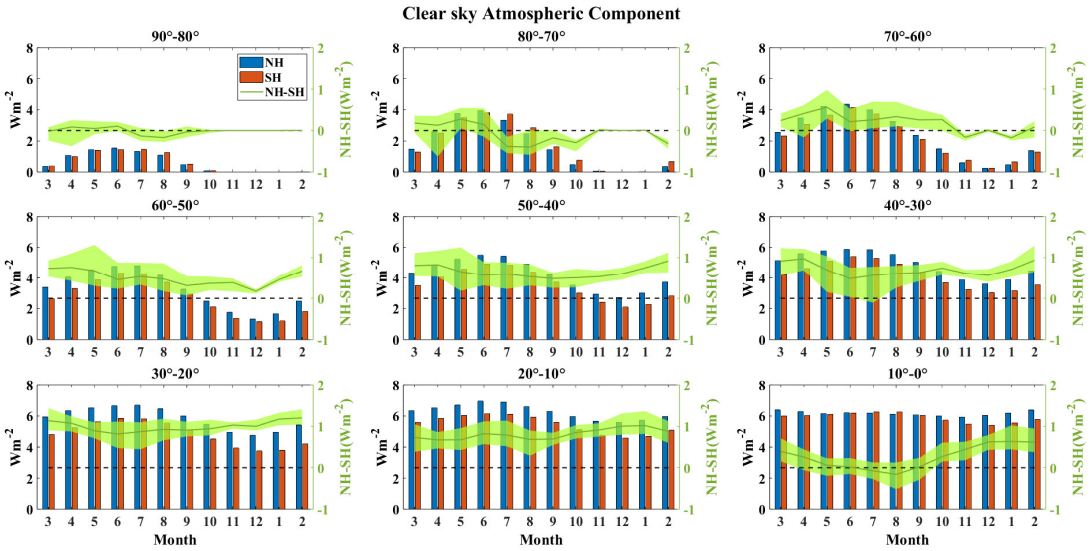

Figure S7: Same as Fig. S6, but for the clear-sky atmospheric component.

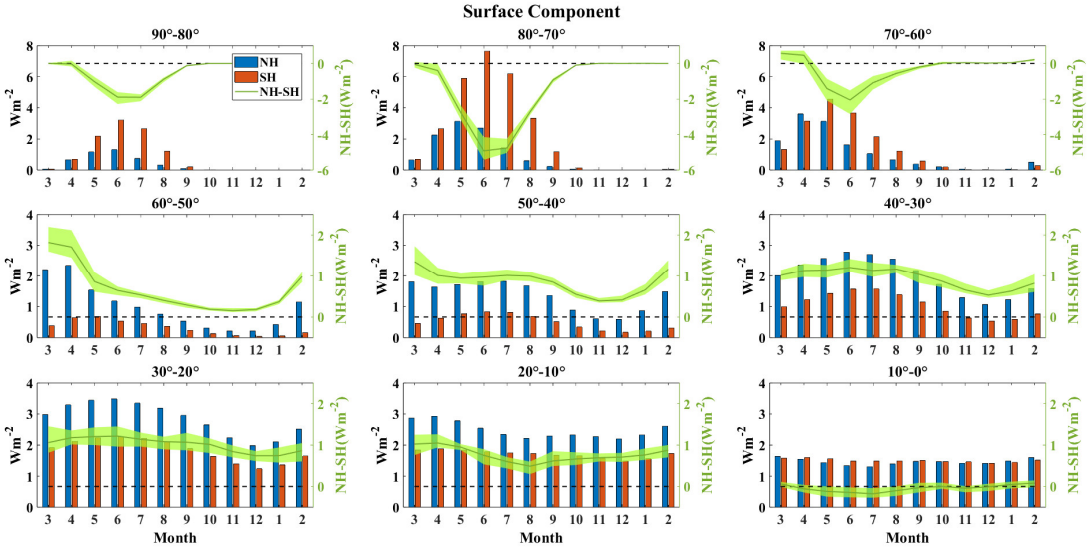

Figure S8: same as Fig. S6, but for surface component.

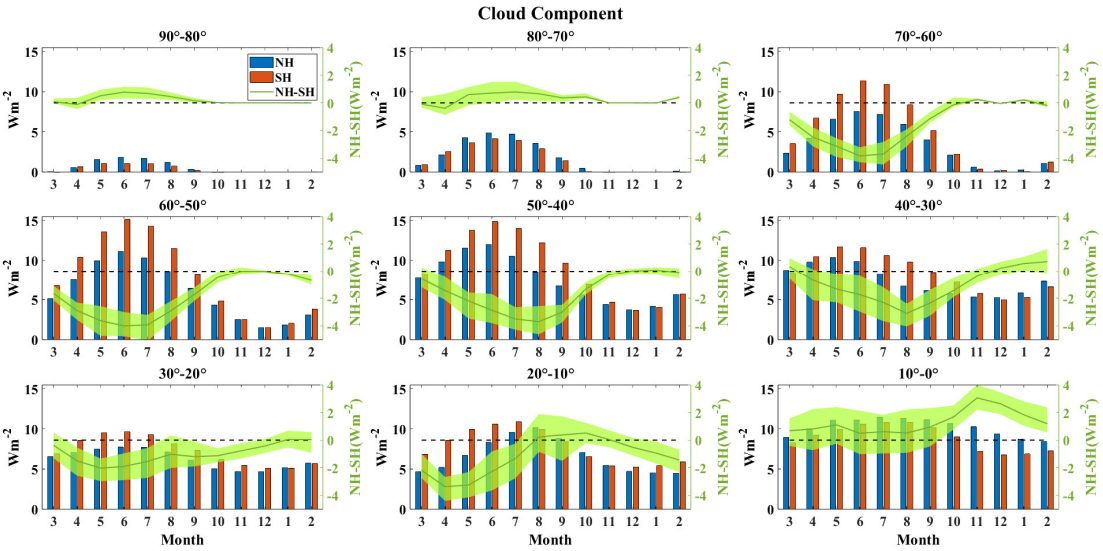

Figure S9: same as Fig. S6, but for cloud component.

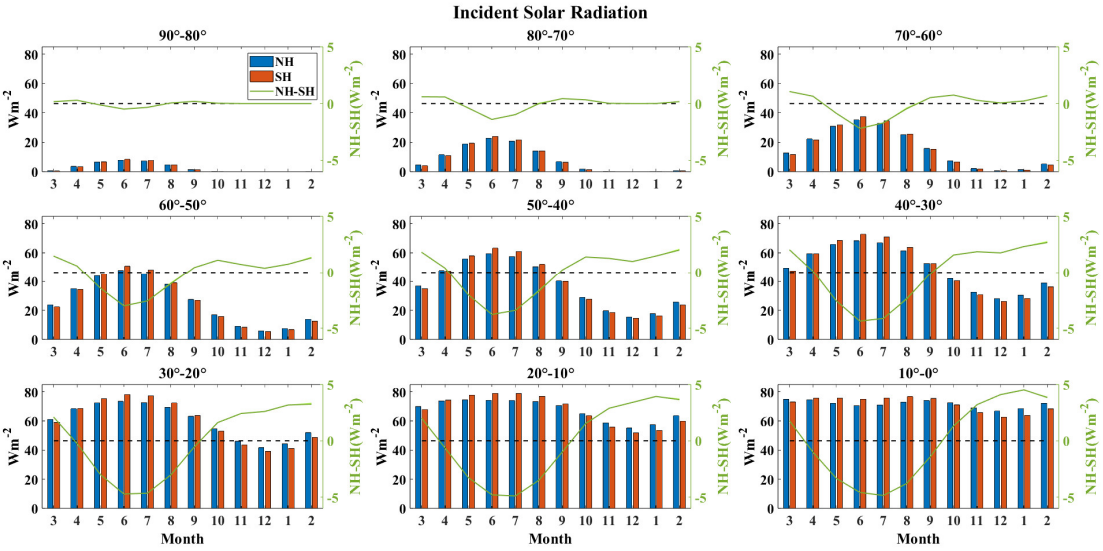

Figure S10: same as Fig. S6, but for incident solar radiation at the TOA.

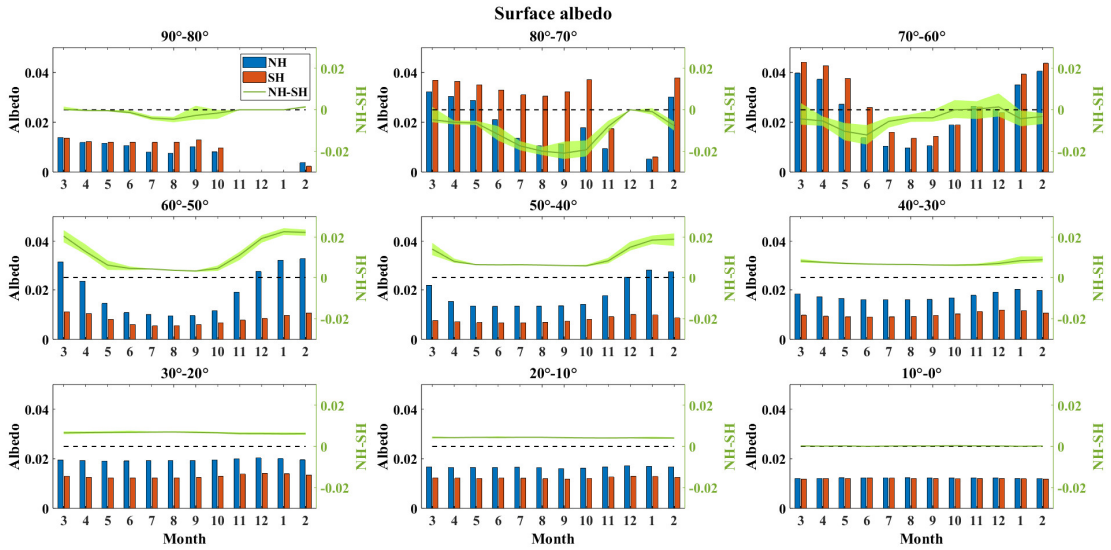

Figure S11: same as Fig. S6, but for surface albedo.

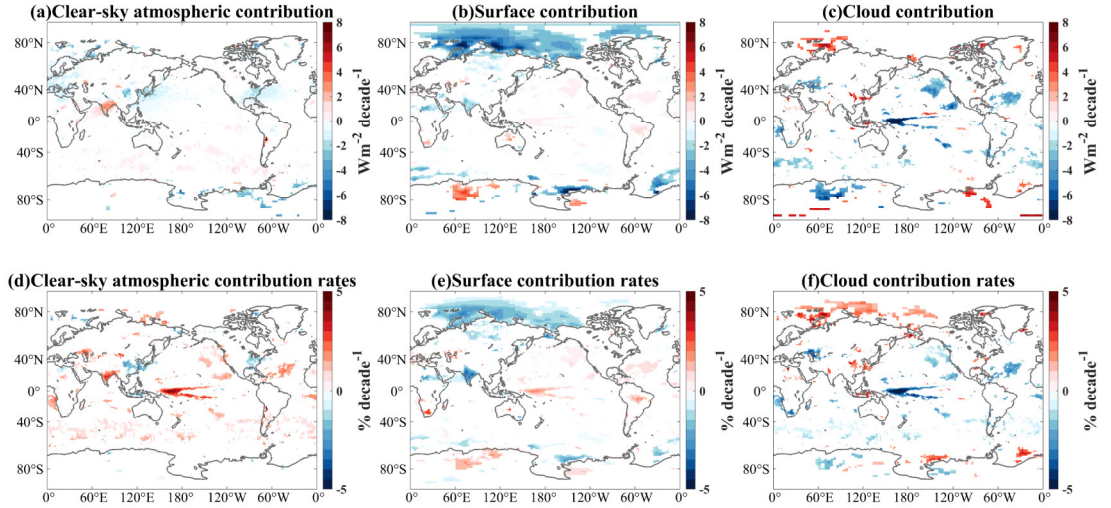

Figure S12: The spatial distribution of trends in long-term de-seasonalized monthly data for (a-c) reflected solar radiation and (d-f) the rate of contribution from the clear-sky atmospheric, surface, and cloud components from Mar./2001-Feb./2021. All points with colour pass the 95% significance test; non-significant trends are not marked.

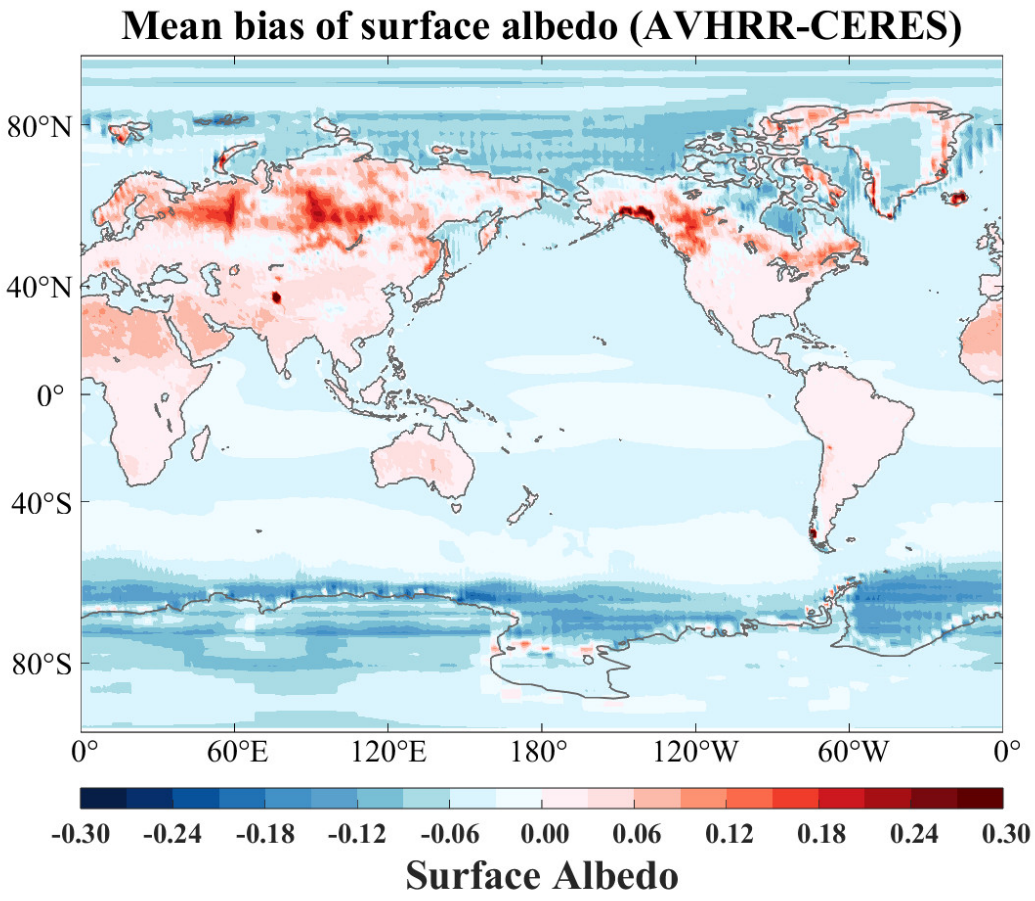

Figure S13: Global distribution of annual mean surface albedo bias between AVHRR and CERES from 2001-2015.

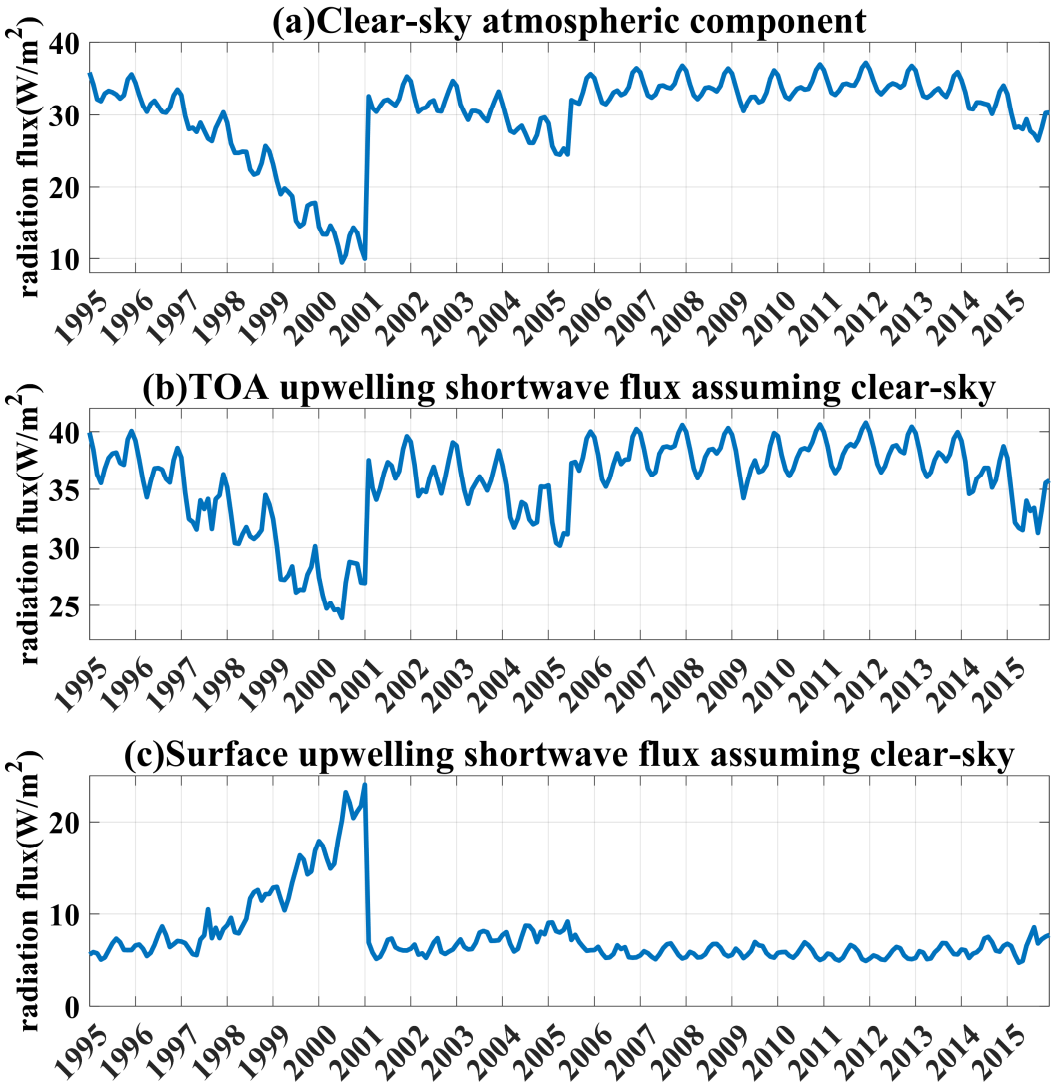

Figure S14: Monthly mean time series for clear-sky (a) the TOA atmospheric component, (b) the TOA upwelling shortwave flux and (c) the surface upwelling shortwave flux for a grid in the equatorial Pacific (179.5°E, 0.5°S) in AVHRR.

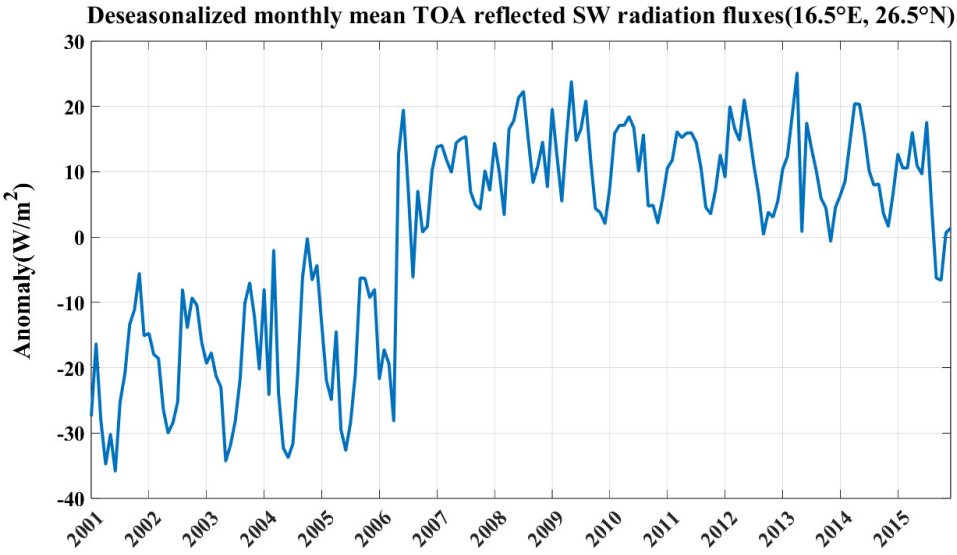

Figure S15: De-seasonalized monthly mean time series for TOA reflected solar radiation for an African grid (16.5°E, 26.5°N).

Table S1: CCHZ-DISO system with different calculation indicators

(a) Interannual hemispheric asymmetry

	Temporal-NCC	NAE	NRMSE	DISO
CERES	1.00	0.00	0.00	0.00
AVHRR	0.95	0.20	0.21	0.29
ISCCP	0.58	0.41	0.42	0.72
MERRA-2	0.00	1.00	1.00	1.73
ERA5	0.76	0.48	0.48	0.71

(b) Interannual hemispheric asymmetry

	Temporal-NCC	NSTD	Centered-NRMS	DISO
CERES	1	0.52	0.00	0.00
AVHRR	0.95	1.00	0.37	0.61
ISCCP	0.58	0.81	0.76	0.92
MERRA-2	0.00	0.25	1.00	0.44
ERA5	0.76	0.00	0.51	0.77

(c) Interannual hemispheric asymmetry

	Temporal-NCC	NAE	NRMSE	Spatial-NCC	DISO
CERES	1.00	0.00	0.00	0.00	0
AVHRR	0.95	0.20	0.21	0.84	0.33
ISCCP	0.58	0.41	0.42	0.81	0.75
MERRA-2	0.00	1.00	1.00	0.00	2.00
ERA5	0.76	0.48	0.48	0.63	0.81

Table S2: CCHZ-DISO system with metrics of NCC, NAE and NRMSE for interannual hemispheric asymmetry of total RSR and its components

(a) Interannual hemispheric asymmetry for total RSR

	Temporal-CC (NCC)	AE (NAE)	RMSE (NRMSE)	DISO
CERES	1.00 (1.00)	0.00 (0.00)	0.00 (0.00)	0.00
AVHRR	0.96 (0.95)	0.53 (0.20)	0.56 (0.21)	0.29
ISCCP	0.71 (0.58)	1.08 (0.41)	1.14 (0.42)	0.72
MERRA-2	0.32 (0.00)	2.64 (1.00)	2.69 (1.00)	1.73
ERA5	0.84 (0.76)	1.26 (0.48)	1.28 (0.48)	0.71

(b) Interannual hemispheric asymmetry for clear-sky atmospheric component

	Temporal-CC (NCC)	AE (NAE)	RMSE (NRMSE)	DISO
CERES	1.00 (1.00)	0.00 (0.00)	0.00 (0.00)	0.00
AVHRR	-0.52 (0.00)	1.53 (1.00)	1.68 (1.00)	1.73
ISCCP	0.34 (0.56)	0.31 (0.20)	0.41 (0.24)	0.54
MERRA-2	0.67 (0.78)	0.67 (0.44)	0.70 (0.42)	0.64
ERA5	0.03 (0.36)	1.09 (0.71)	1.13 (0.67)	1.17

(c) Interannual hemispheric asymmetry for surface component

	Temporal-CC (NCC)	AE (NAE)	RMSE (NRMSE)	DISO
CERES	1.00 (1.00)	0.00 (0.00)	0.00 (0.00)	0.00
AVHRR	0.65 (0.53)	2.57 (1.00)	2.57 (1.00)	1.49
ISCCP	0.25 (0.00)	1.09 (0.42)	1.14 (0.44)	1.17
MERRA-2	0.81 (0.75)	1.43 (0.56)	1.43 (0.56)	0.82
ERA5	0.80 (0.73)	1.06 (0.41)	1.07 (0.42)	0.65

(d) Interannual hemispheric asymmetry for cloud component

	Temporal-CC (NCC)	AE (NAE)	RMSE (NRMSE)	DISO
CERES	1.00 (1.00)	0.00 (0.00)	0.00 (0.00)	0.00
AVHRR	0.54 (0.37)	1.57 (0.46)	1.72 (0.50)	0.92
ISCCP	0.86 (0.81)	0.32 (0.09)	0.44 (0.13)	0.25
MERRA-2	0.27 (0.00)	3.40 (1.00)	3.45 (1.00)	1.73
ERA5	0.86 (0.81)	1.23 (0.36)	1.26 (0.37)	0.55

Table S3: Trends in TOA reflected solar radiation and its components in the northern hemisphere (NH) and southern hemisphere (SH) for different datasets during March 2001-February 2016

	Total RSR		Clear-sky atmosphere		Surface		Cloud	
	NH	SH	NH	SH	NH	SH	NH	SH
CERES	-0.59	-0.34	0	0.04	-0.16	-1.49	-0.45	-0.48
AVHRR	-0.29	-0.1	0.27	0.56	-0.32	-1.5	-0.23	-0.49
ISCCP	0.59	0.36	-0.08	0.01	0.14	-1.21	0.53	0.44
MERRA-2	0.75	0.84	-0.08	0.24	-0.18	-1.25	1.01	0.61
ERA5	-0.1	0.29	-0.13	0.07	-0.20	-1.58	0.24	0.13

Note: Red values indicates trend is significant at the 95% confidence level.