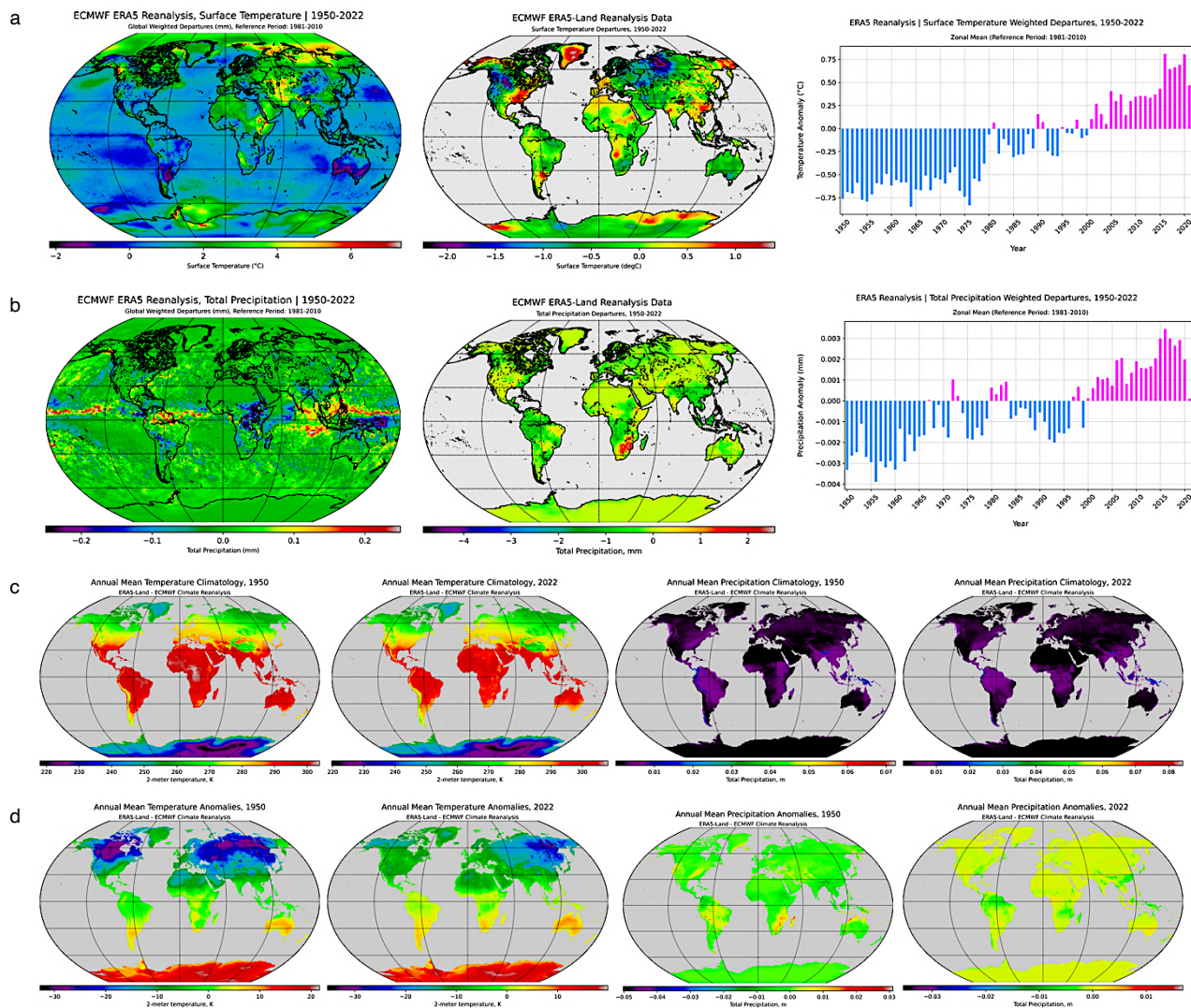
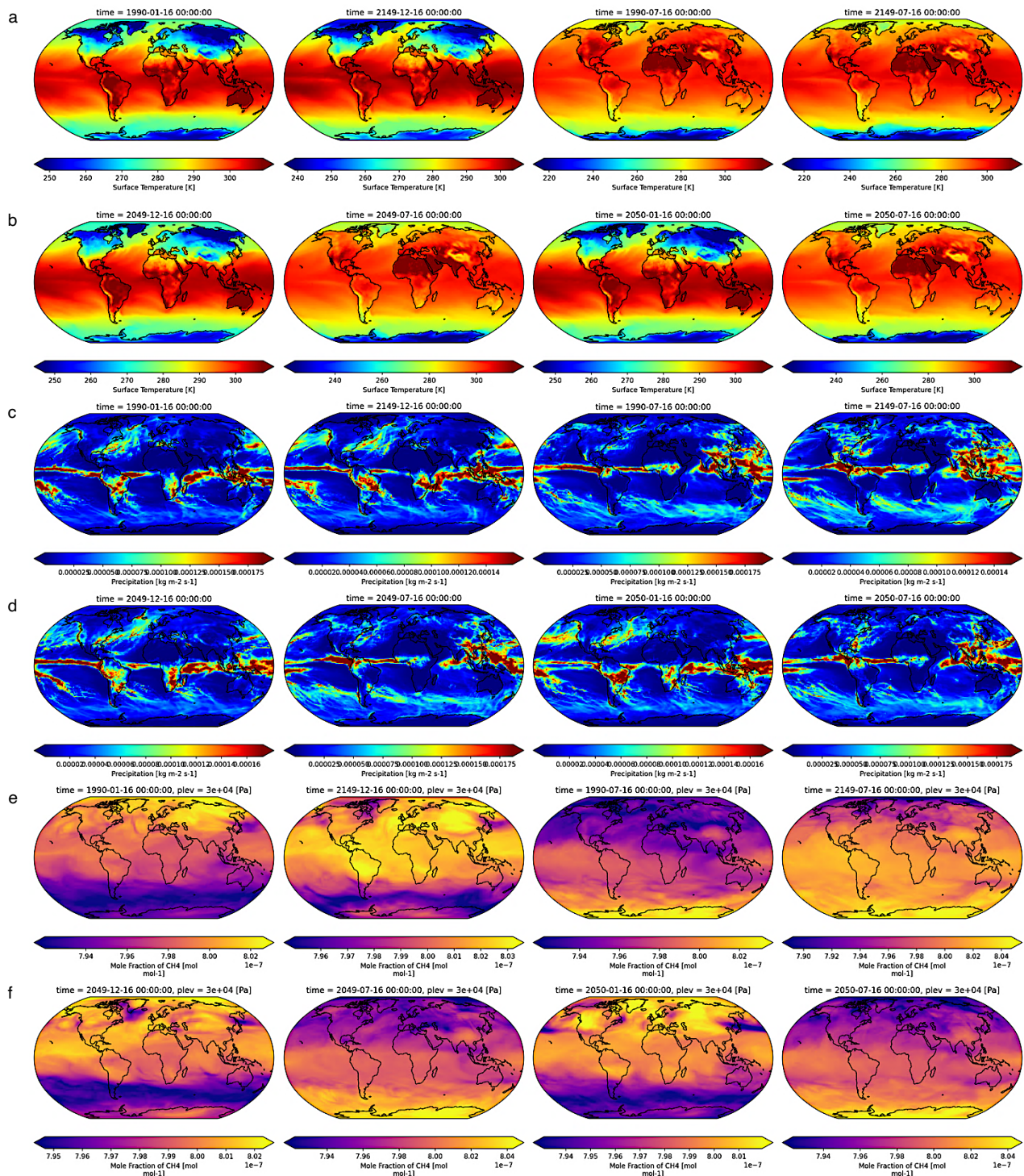


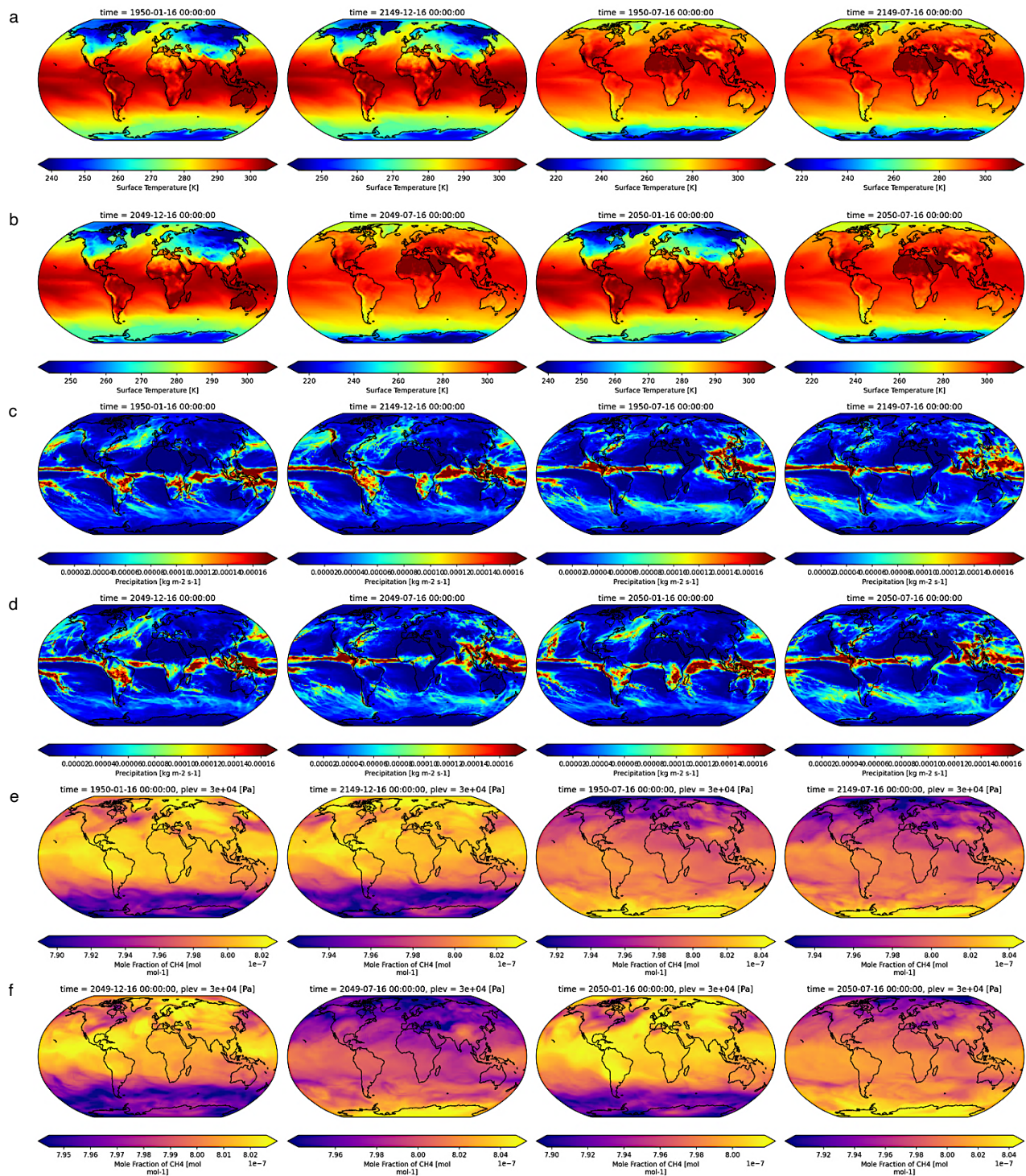
Supplementary Information



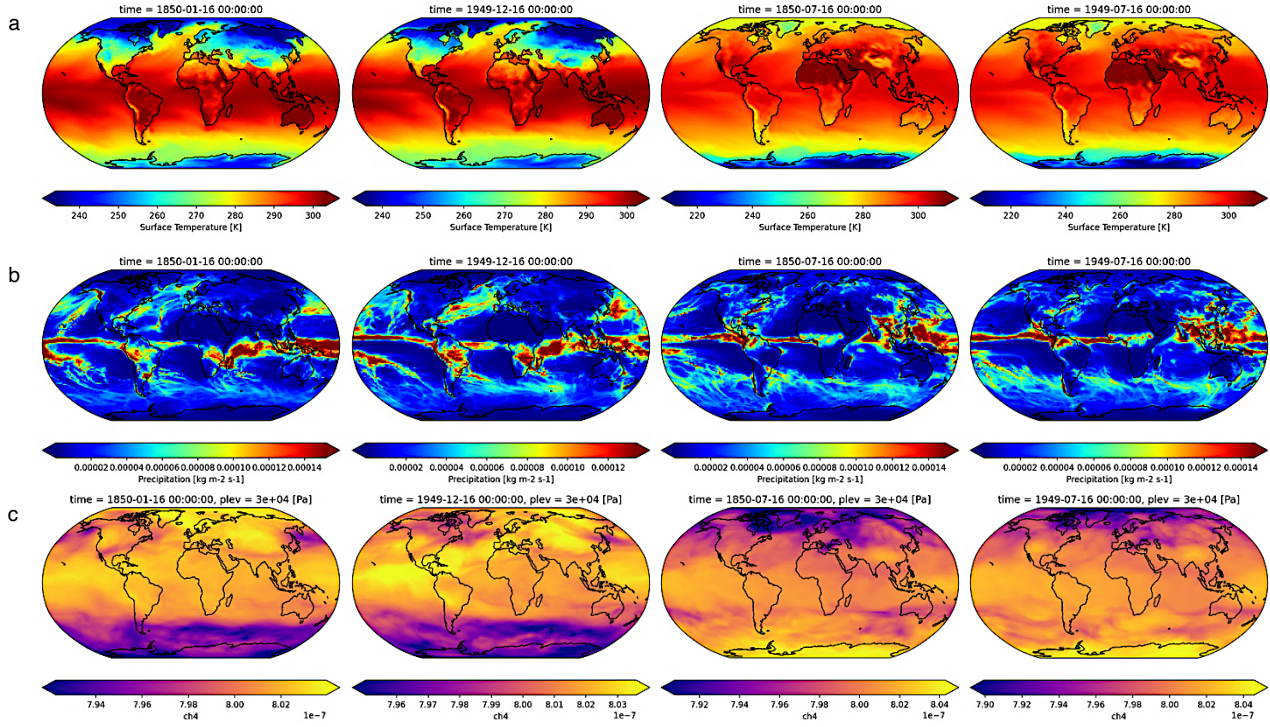
Supplementary Figure S1. Monthly mean 2-meter temperature, K (a) and total precipitation, m (b) derived from ERA5 reanalysis data were grouped by annual mean to determine global climatological variability from 1950-2022. Below these top rows of weighted departures are two underlying panels illustrating the spatiotemporal range and seasonal variability of 2-m temperature and total precipitation for this study (i.e., global 73-year monthly mean with gridded 0.1° resolution). The top underlying panel (c) displays these variables from ERA5-Land during the months of January 1950 and December 2022 while the bottom underlying panel (d) exhibits hot spot mobility (i.e., July 1950, July 2022). The statistical range and uncertainties are provided in S9.



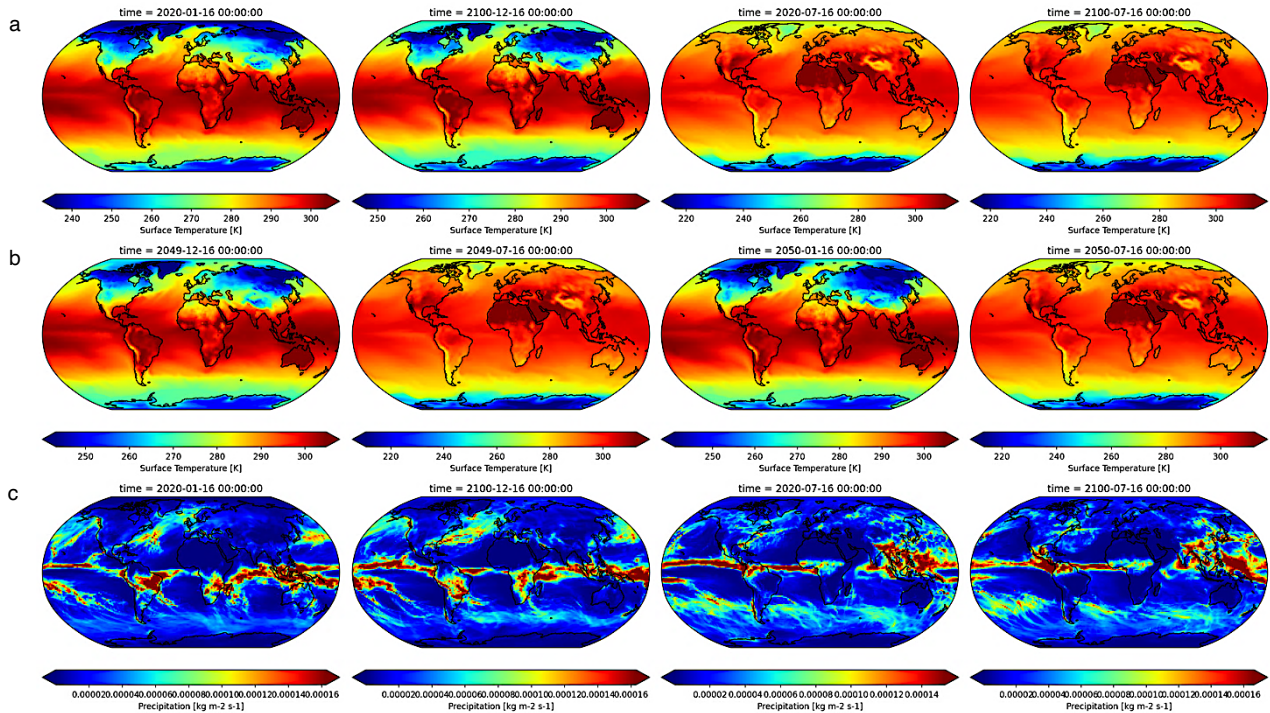
Supplementary Figure S2. The panels above illustrate a data subset of monthly mean variability of surface temperature (K), precipitation flux ($\text{kg m}^{-2} \text{s}^{-1}$), and $[\text{CH}_4]$ (mol mol^{-1} , 300 hPa) derived from the UKESM1-0-LL model (i.e., r1i1p1f2 ensemble member) for the CDRMIP experiments. These experiments are delineated by two sub-experiments (e.g., **1pctCO2-cdr**, **esm-1pct-brch-1000PgC**). These panels illustrate how each variable changes across interannual and seasonal time. For example, the 1pctCO2-cdr panels (**a**, **c**, **e**) depict how surface temperature, precipitation flux, and methane concentration evolve across the entire time series of the simulation during the winter and summer seasons in the Northern Hemisphere (1990-2149) while the underlying panels (**b**, **d**, **f**) illustrate the variables' evolution across one year (in this case, the middle of the time series: 2049) during the winter and summer seasons in the Northern Hemisphere. This pattern is observed for subsequent experiments and sub-experiments (i.e., *1pctCO2-cdr*: 1990-2149; *esm-1pct-brch-1000PgC*: 1950-2149). Additional maps and statistics between these bounds are provided in **S8** and **S10**.

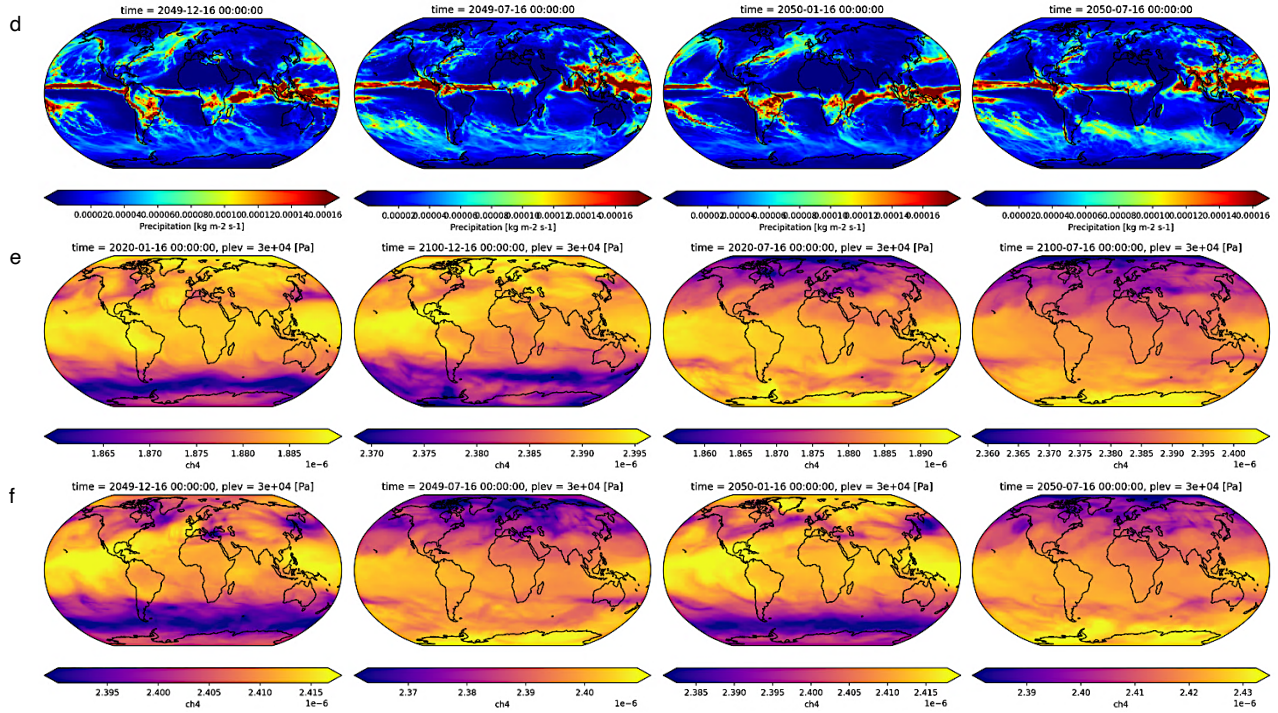


Supplementary Figure S3. The panels above illustrate a data subset of monthly mean variability of surface temperature (K), precipitation flux ($\text{kg m}^{-2} \text{s}^{-1}$), and $[\text{CH}_4]$ (mol mol^{-1} , 300 hPa) derived from the UKESM1-0-LL model (i.e., r1i1p1f2 ensemble member) for the CDRMIP experiments. These experiments are delineated by two sub-experiments (e.g., **1pctCO2-cdr**, **esm-1pct-brch-1000PgC**). These panels illustrate how each variable changes across interannual and seasonal time. For example, the esm-1pct-brch-1000PgC panels above (a, c, e) depict how surface temperature, precipitation flux, and methane concentration evolve across the simulated time series during the winter and summer seasons in the Northern Hemisphere (1950-2149) while the underlying panels (b, d, f) illustrate the variables' evolution across one year (middle of the time series: 2049) during the winter and summer seasons in the Northern Hemisphere. This pattern is observed for subsequent experiments and sub-experiments (i.e., *1pctCO2-cdr*: 1990-2149; *esm-1pct-brch-1000PgC*: 1950-2149). Additional maps and statistics between these bounds are provided in **S8** and **S10**.

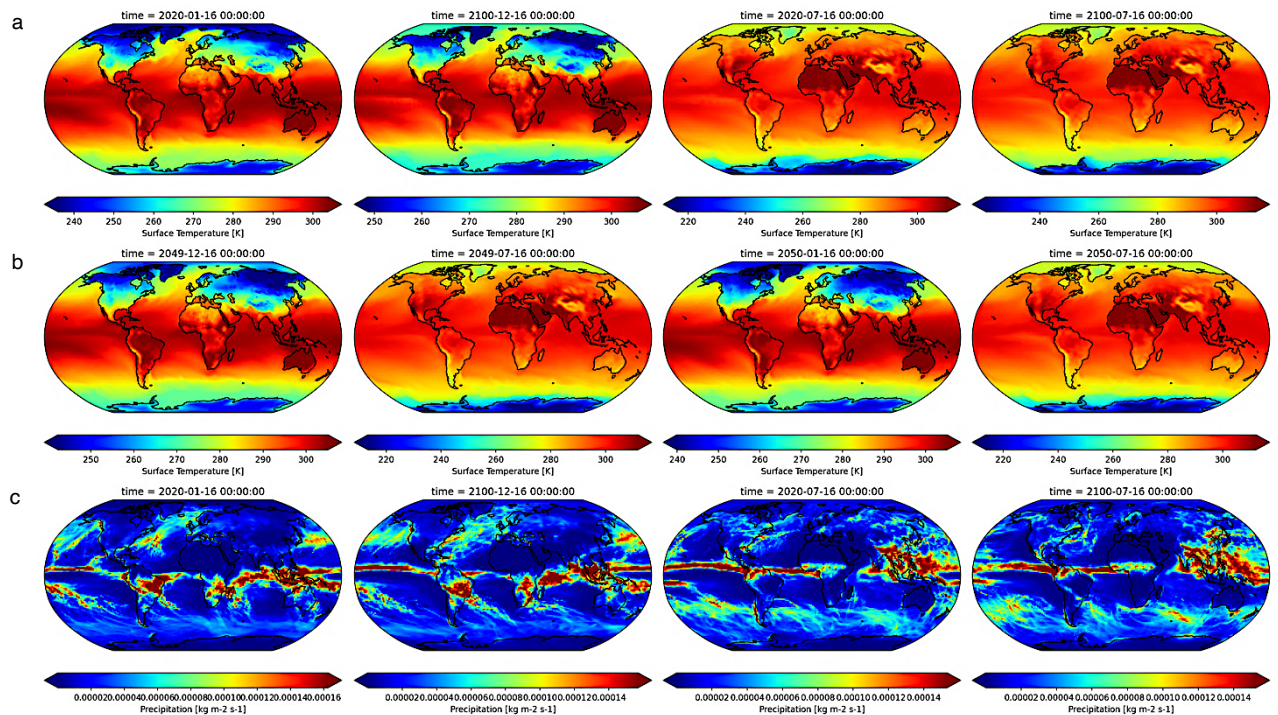


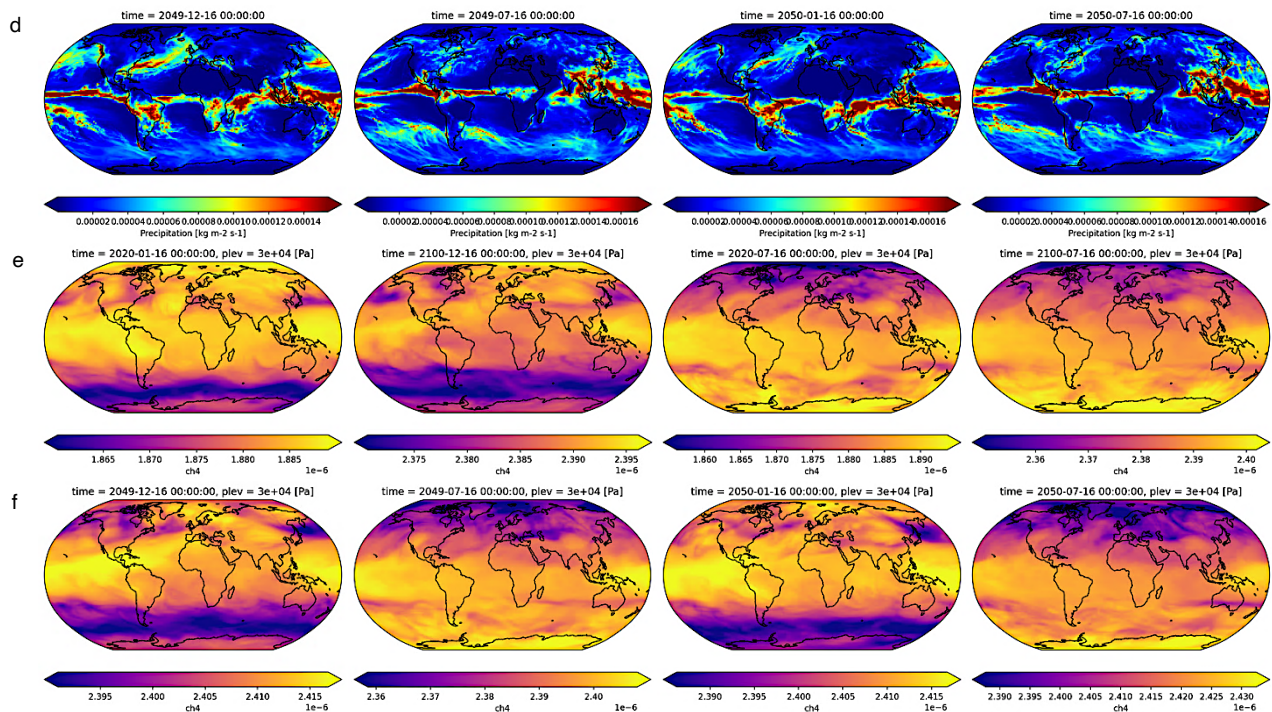
Supplementary Figure S4. The panels above illustrate a data subset of monthly mean variability of surface temperature (K), precipitation flux ($\text{kg m}^{-2} \text{s}^{-1}$), and $[\text{CH}_4]$ (mol mol^{-1} , 300 hPa) derived from the UKESM1-0-LL model (i.e., r1i1p1f2 ensemble member) for the GeoMIP experiments. These experiments are delineated by four sub-experiments (e.g., **G1**, **G6Solar**, **G6Sulfur**, **G7Cirrus**) and illustrate how each variable changes across interannual and seasonal time. For example, the **G1** panels above depict how surface temperature, precipitation flux, and methane concentration evolve across the entire time series of the simulation during the winter and summer seasons in the Northern Hemisphere (1850-1949). These patterns are observed for subsequent experiments and sub-experiments (i.e., **G1**: 1850-1949; **G6Solar**, **G6Sulfur**, **G7Cirrus**: 2020-2100). Additional maps and statistics between these bounds are provided in **S8** and **S10**.



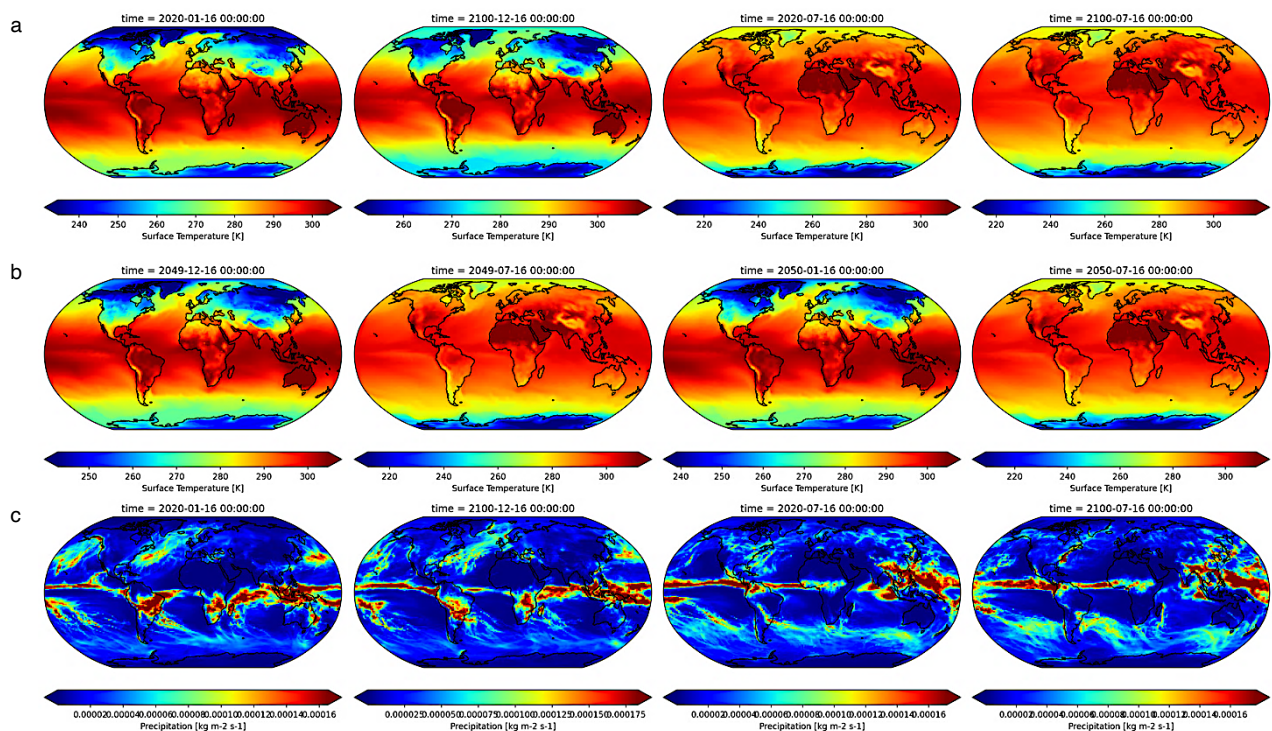


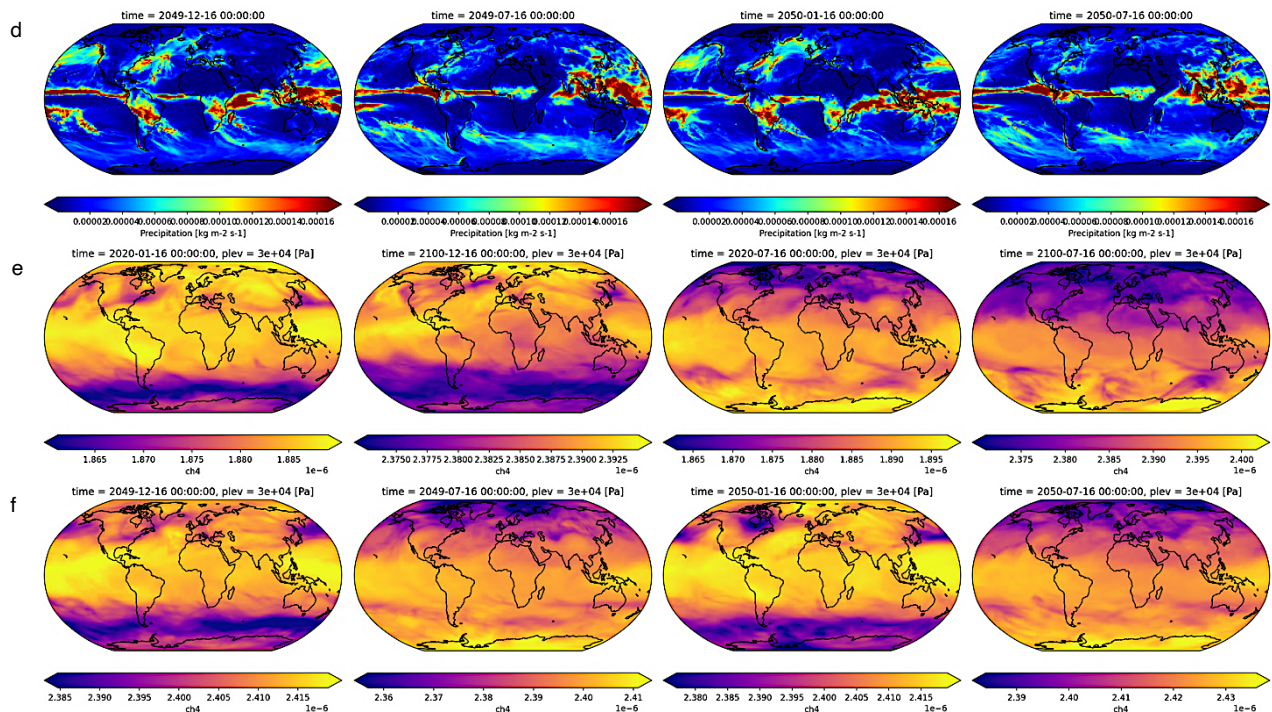
Supplementary Figure S5. The panels above illustrate a data subset of monthly mean variability of surface temperature (K), precipitation flux (kg m⁻² s⁻¹), and [CH₄] (mol mol⁻¹, 300 hPa) derived from the UKESM1-0-LL model (i.e., r1i1p1f2 ensemble member) for the GeoMIP experiments. These experiments are delineated by four sub-experiments (e.g., **G1**, **G6Solar**, **G6Sulfur**, **G7Cirrus**) and illustrate how each variable changes across interannual and seasonal time. For example, the **G6Solar** (a, c, e) depict how surface temperature, precipitation flux, and methane concentration evolve across the entire time series of the simulation during the winter and summer seasons in the Northern Hemisphere (2020-2100) while the underlying panels (b, d, f) illustrate the variables' evolution across one year (in this case, thirty years into the time series: 2049) during the winter and summer seasons in the Northern Hemisphere. This pattern is observed for subsequent experiments and sub-experiments (i.e., **G1**: 1850-1949; **G6Solar**, **G6Sulfur**, **G7Cirrus**: 2020-2100). Additional maps and statistics between these bounds are provided in **S8** and **S10**.





Supplementary Figure S6. The panels above illustrate a data subset of monthly mean variability of surface temperature (K), precipitation flux ($\text{kg m}^{-2} \text{s}^{-1}$), and $[\text{CH}_4]$ (mol mol^{-1} , 300 hPa) derived from the UKESM1-0-LL model (i.e., r1i1p1f2 ensemble member) for the GeoMIP experiments. These experiments are delineated by four sub-experiments (e.g., **G1**, **G6Solar**, **G6Sulfur**, **G7Cirrus**). These panels illustrate how each variable changes across interannual and seasonal time. For example, the **G6Sulfur** panels (**a**, **c**, **e**) depict how surface temperature, precipitation flux, and methane concentration evolve across the entire time series of the simulation during the winter and summer seasons in the Northern Hemisphere (2020-2100) while the underlying panels (**b**, **d**, **f**) illustrate the variables' evolution across one year (in this case, the first 30 years of the time series: 2049) during the winter and summer seasons in the Northern Hemisphere. This pattern is observed for subsequent experiments and sub-experiments (i.e., **G1**: 1850-1949; **G6Solar**, **G6Sulfur**, **G7Cirrus**: 2020-2100). Additional maps and statistics between these bounds are provided in **S8** and **S10**.

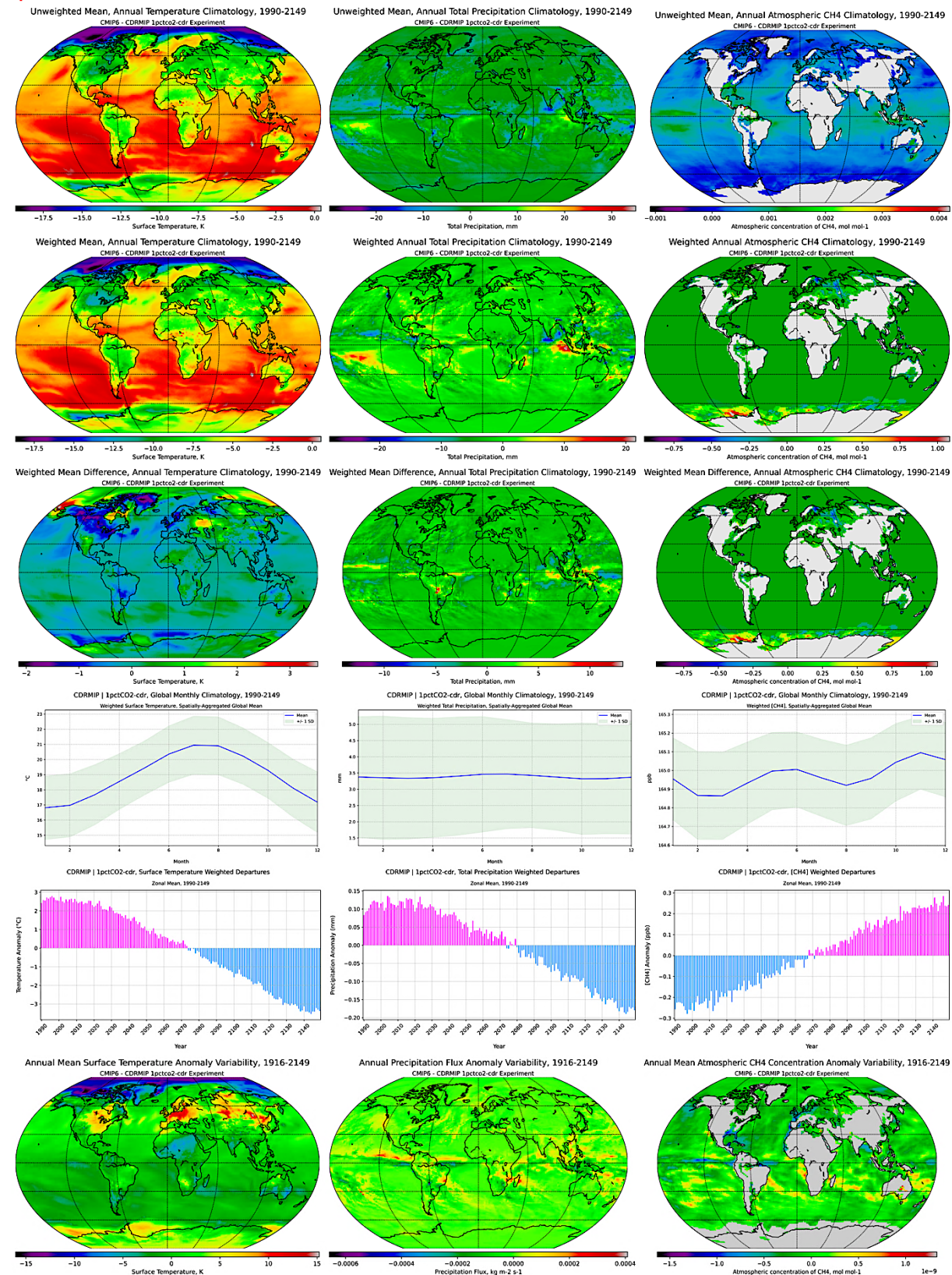




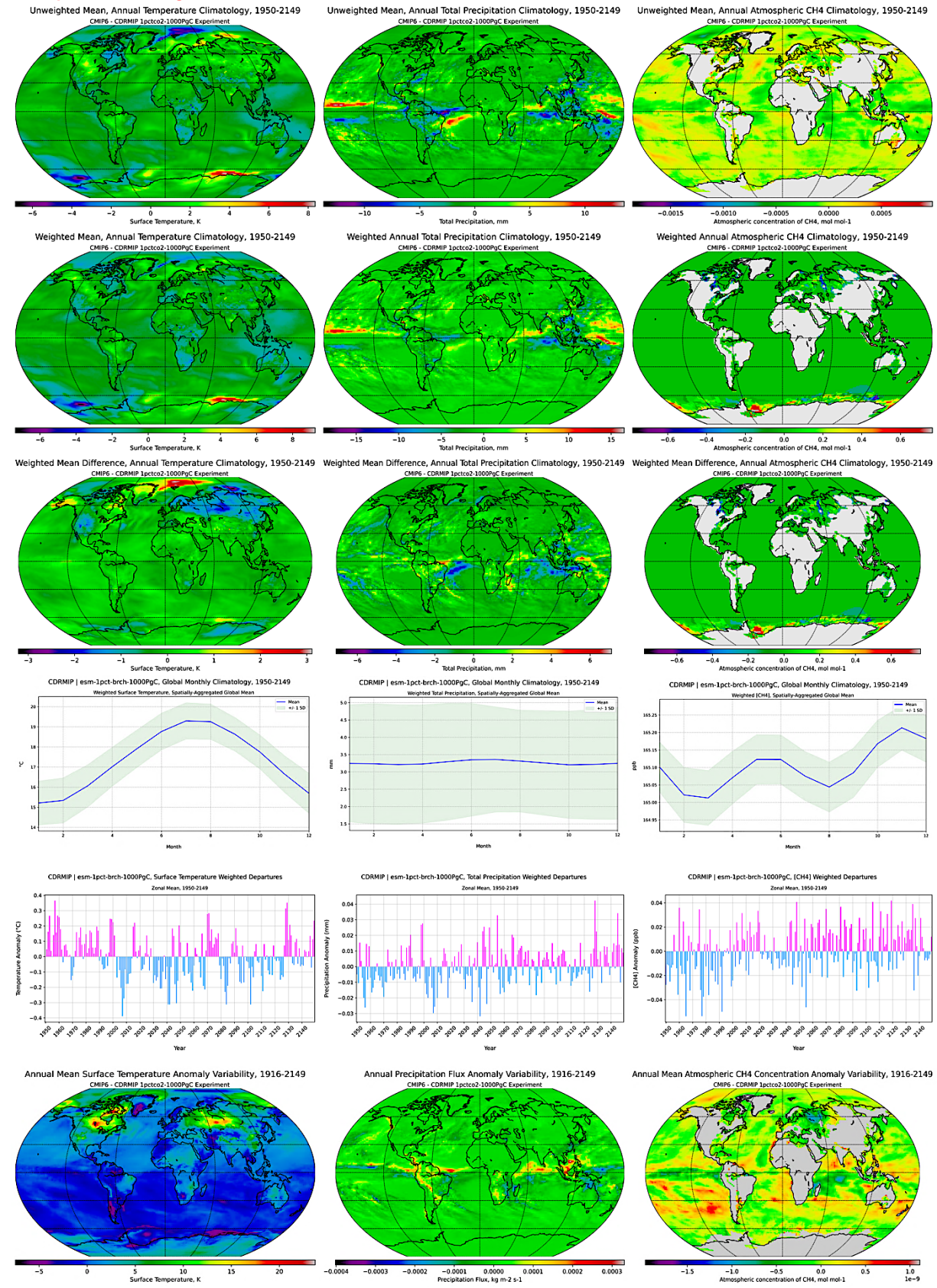
Supplementary Figure S7. The panels above illustrate a data subset of monthly mean variability of surface temperature (K), precipitation flux ($\text{kg m}^{-2} \text{s}^{-1}$), and $[\text{CH}_4]$ (mol mol^{-1} , 300 hPa) derived from the UKESM1-0-LL model (i.e., r1i1p1f2 ensemble member) for the GeoMIP experiments. These experiments are delineated by four sub-experiments (e.g., **G1**, **G6Solar**, **G6Sulfur**, **G7Cirrus**). These panels illustrate how each variable changes across interannual and seasonal time. For example, the **G7Cirrus** panels (**a**, **c**, **e**) depict how surface temperature, precipitation flux, and methane concentration evolve across the entire time series of the simulation during the winter and summer seasons in the Northern Hemisphere (2020-2100) while the underlying panels (**b**, **d**, **f**) illustrate the variables' evolution across one year (in this case, the first 30 years of the time series: 2049) during the winter and summer seasons in the Northern Hemisphere. This pattern is observed for subsequent experiments and sub-experiments (i.e., **G1**: 1850-1949; **G6Solar**, **G6Sulfur**, **G7Cirrus**: 2020-2100). Additional maps and statistics between these bounds are provided in **S8** and **S10**.

UKESM0-1-LL CDRMIP | Climatological Variability

1pctCO2-cdr

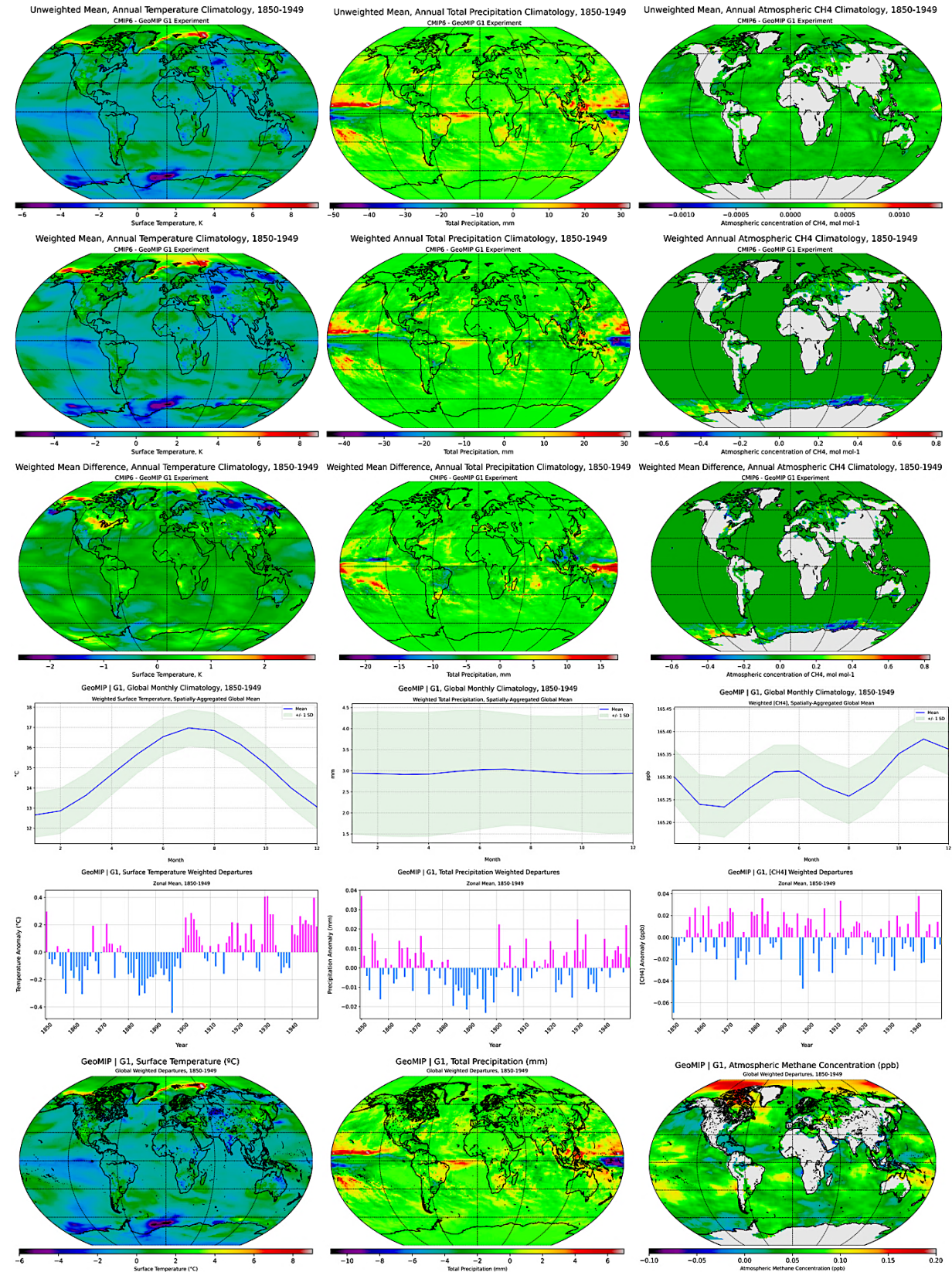


esm-1pct-brch-1000PgC

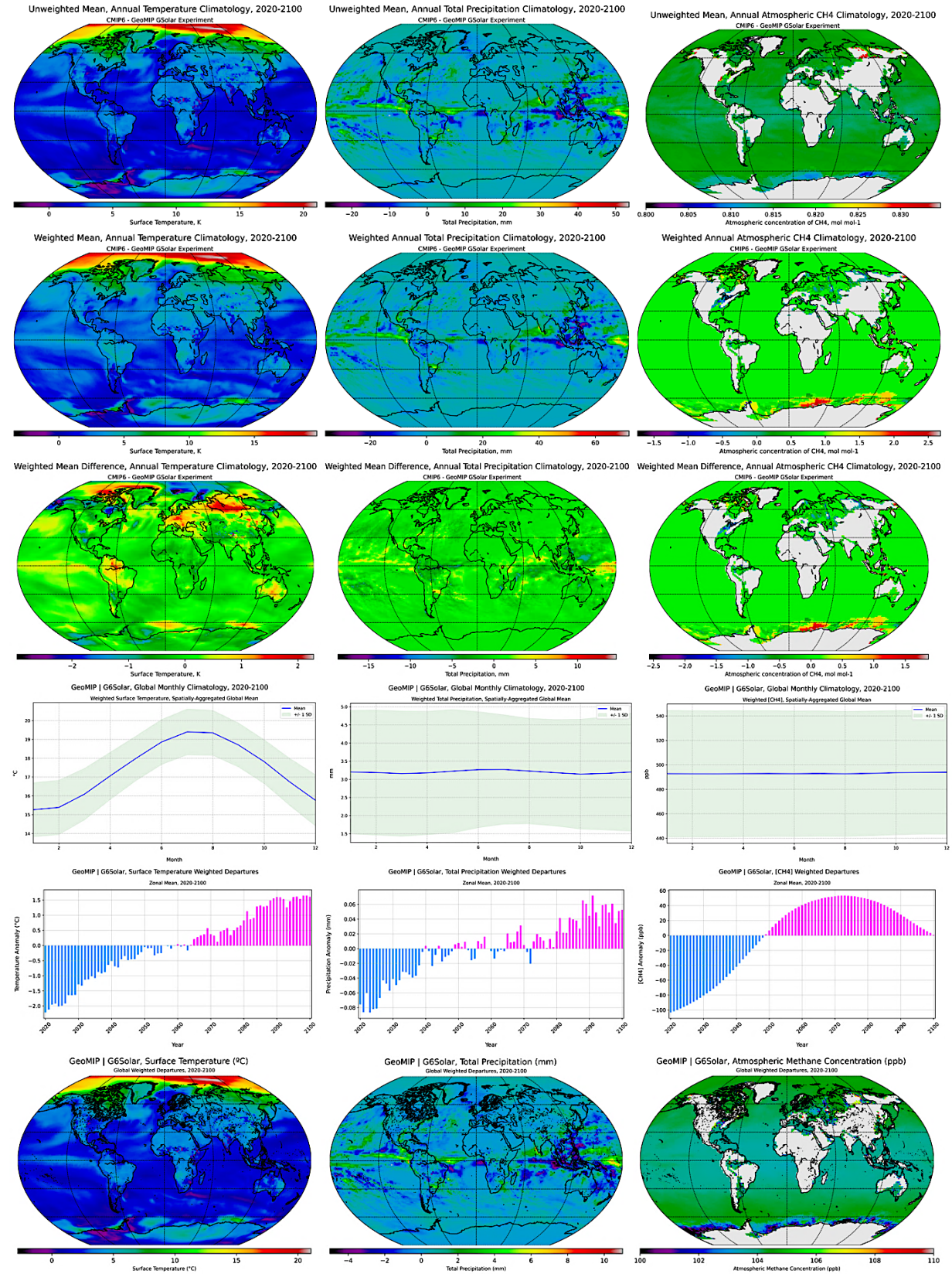


UKESM0-1-LL GeoMIP | Climatological Variability

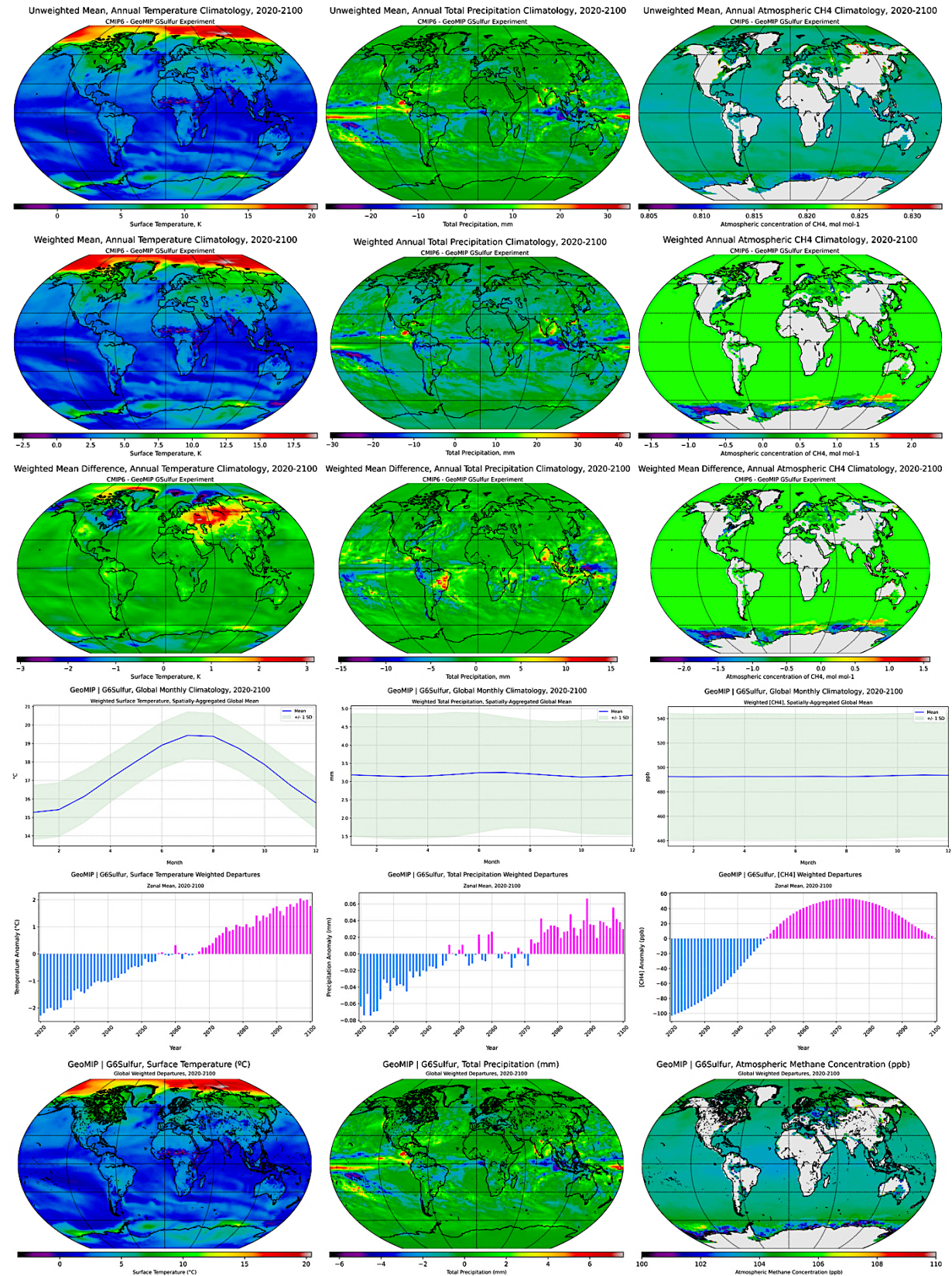
G1



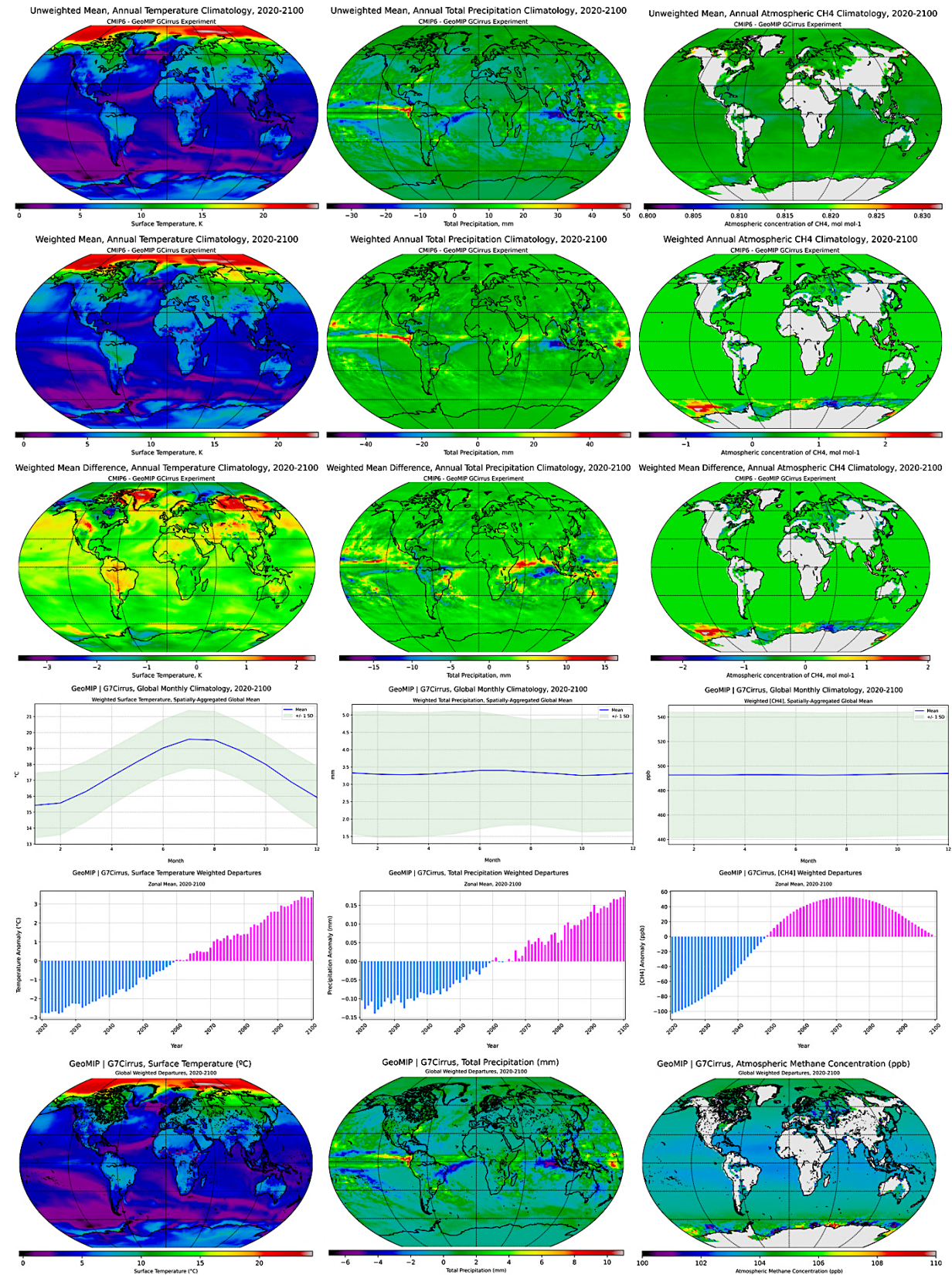
G6Solar



G6Sulfur

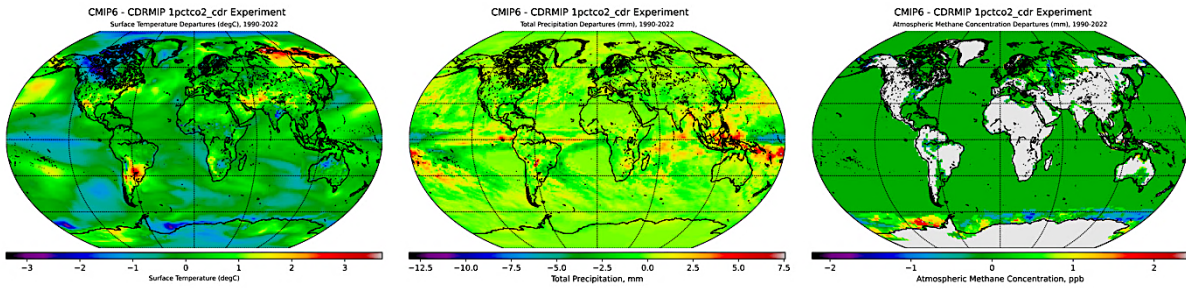


G7Cirrus

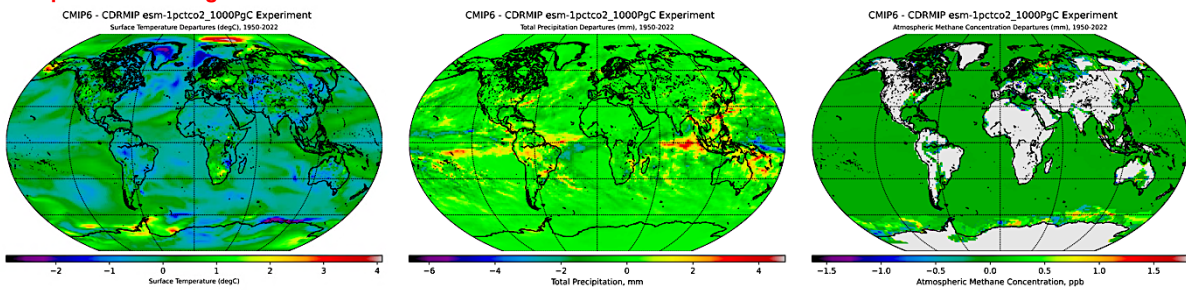


UKESM0-1-LL CDRMIP | Climatological Departures

1pctCO2-cdr

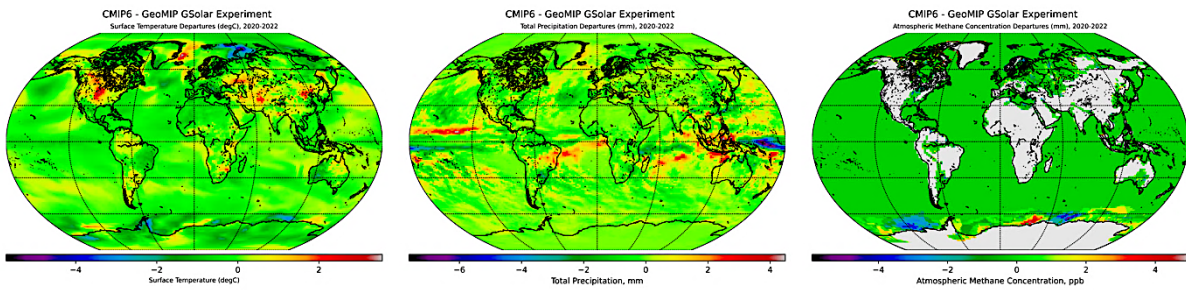


esm-1pct-brch-1000PgC

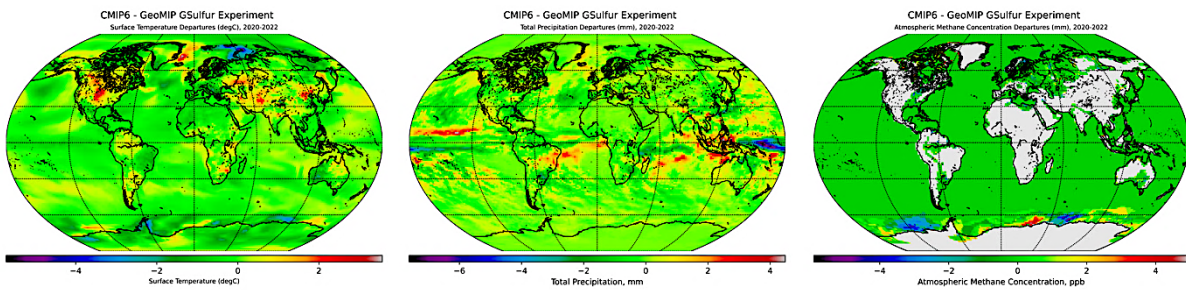


UKESM0-1-LL GeoMIP | Climatological Departures

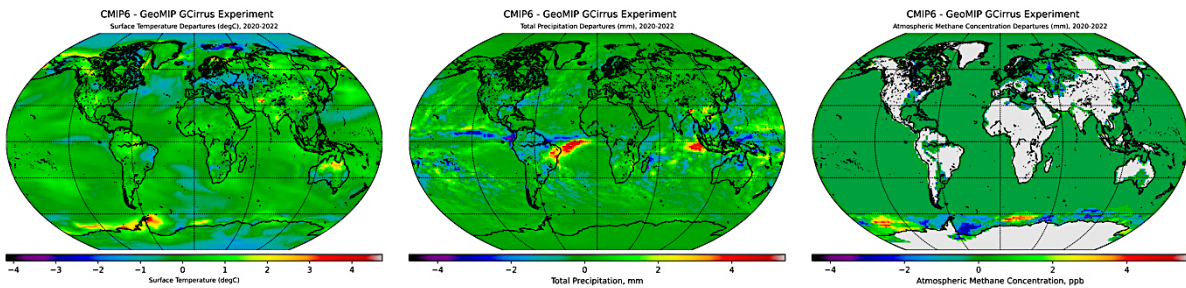
G6Solar



G6Sulfur



G7Cirrus



Supplementary Figure S8. The panels above illustrate unweighted, weighted, and differencing of annual climatological mean periodicity for surface temperature, total precipitation, and sub-tropospheric multilevel mean of $[\text{CH}_4]$ (300-1000hPa) across *two* CDRMIP and *four* GeoMIP scenarios generated by UKESM1-0-LL. The statistical range and uncertainties are provided in **S5**. The panels above displaying mitigation and intervention departures further expand on **Figure 2** in the manuscript and the previous climatological plots to display departure variabilities derived from these CMIP6 experiments constrained to the ERA5 observational record (i.e., 1pctCO2-cdr: 1990-2022; esm-1pct-brch-1000PgC: 1950-2022; G6Solar, G6Sulfur, G7Cirrus: 2020-2022).

Supplementary Table S9. Statistical range and uncertainties (i.e., array consists of maximum, minimum, mean, and standard deviation) characterizing ERA5 reanalysis for surface temperature (i.e., 2-m temperature) and total precipitation (i.e., precipitation flux conversion).

ERA5 (1950-2022)

2022-1950

t2m: 5.7529879130767085 -0.8811360992428092 1.9752304226185866 0.6495220419415263
t2m: 4.289691051564176 -5.297736721289027 -2.3000998747438834 1.5529297536092845
tp: 0.47032261446931906 -0.1752769390847946 0.030250386485429385 0.05693232510029357
tp: 0.3454867393261283 -1.3084734440745445 -0.0878972189236675 0.12280138872010357

2020

t2m: 307.83108579269197 220.80092943408545 269.1159287564262 24.543851147743716
t2m: 9.018253106167606 -8.238792232578476 0.36079879580315877 2.5018309438589075
tp: 84.2825034600132 0.00032242792259717934 1.6545719118002902 2.07538005880333
tp: 16.82704680112611 -35.39534676845597 -0.5580388034605489 1.0218159994712996

2021

t2m: 308.0434379693475 220.20740583817948 268.54282723126875 24.93263602629178
t2m: 15.0597389381891 -18.42225227889358 -0.5815889212281824 6.836374622025937
tp: 83.51805646813088 0.00032242792259717934 1.6236922476498061 2.075562189946307
tp: 17.698134033213755 -35.08348740509091 -0.5926589702536449 1.1009860257708688

2022

t2m: 308.26744811817525 219.72618245522338 268.81561873417047 24.538691757924887
t2m: 19.922146318870773 -35.40437607135095 -1.8355482265574015 11.989019870594198
tp: 65.96157199804085 0.00032242792259717934 1.3805132931951152 1.719782167358097
tp: 9.362460311245519 -35.84079433769381 -0.6285018979643006 1.2444634568444022

01-1950

t2m: 228.51229858398438-307.5559997558594±21.617855072021484 K
tp: 3.203749656677246e-07-0.030643612146377563±0.002764566335827112 kg/m2/s

12-2022

t2m: 233.15098571777344-307.9469299316406±20.660619735717773 K
tp: 3.203749656677246e-07-0.0159707460552454±0.0012844360899180174 kg/m2/s

07-1950

t2m: 204.5485076904297-311.5589599609375±29.935758590698242 K
tp: 3.203749656677246e-07-0.06878133863210678±0.003316747723147273 kg/m2/s

07-2022

t2m: 211.1563720703125-313.3802490234375±29.98736572265625 K
tp: 3.203749656677246e-07-0.043788108974695206±0.0029139514081180096 kg/m2/s

Supplementary Table S10. Summary of global mean temporal differencing from GeoMIP and CDRMIP simulations for global temperature, precipitation, and [CH₄] between 1850-2149 as well as ERA5 intercomparisons (i.e., 2020-2022).

CDRMIP

1pctCO2-cdr (1990-2022)

Global Mean Unweighted Climatology:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.023177	1.048671	-5.698181	-0.61554	0.028244	0.577286	4.557861
pr	27648.0	0.035525	1.375047	-11.723398	-0.259758	0.035589	0.332347	13.797261
[CH ₄]	20471.0	0.00522	0.004789	-0.031081	0.003048	0.005014	0.007604	0.050338

1990-2022 Global Mean Weighted Anomalies:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.010439	0.364954	-2.208643	-0.207492	0.016495	0.196683	1.865909
pr	27648.0	-0.024139	0.892175	-13.115819	-0.226207	-0.022235	0.174573	7.572504
[CH ₄]	20471.0	0.018024	0.250889	-2.219424	-0.005429	-0.003357	-0.00179	2.421398

1990-2022 Global Mean Variability, i.e., Departures:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.012738	0.723224	-3.390513	-0.390507	-0.006678	0.416588	3.707785
pr	27648.0	-0.088828	0.391346	-4.083315	-0.236756	-0.067029	0.059421	3.135133
[CH ₄]	27648.0	0.032564	0.233586	-2.499372	0.0	0.008577	0.013893	2.872295

1990-2149 Global Mean Unweighted Climatology:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-5.793418	3.822514	-19.284485	-7.215172	-4.679817	-3.153671	0.408447
pr	27648.0	0.011386	0.53667	-4.608737	-0.102322	0.012031	0.121141	4.67906
[CH ₄]	27648.0	0.017911	0.217788	-2.201776	0.0	0.001452	0.002636	2.426925

1990-2149 Global Mean Weighted Anomalies:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-1.90866	1.215711	-6.220518	-2.3839	-1.592867	-1.037156	0.180715
pr	27648.0	-0.263158	1.125369	-13.009727	-0.681221	-0.213951	0.15535	15.279872
[CH ₄]	20463.0	0.030915	0.014934	-0.035213	0.018138	0.032579	0.042703	0.07217

1990-2149 Global Mean Variability, i.e., Departures:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	3.884759	2.623778	-0.244731	2.1107	3.084	4.806996	13.07816
pr	27648.0	0.17433	0.781186	-12.228053	-0.102435	0.143284	0.449272	9.063509
[CH ₄]	20463.0	0.012578	0.269387	-2.545191	-0.030451	-0.024249	-0.01003	2.870715

esm-1pct-brch-1000PgC (1950-2022)

Global Mean Unweighted Climatology, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.082872	0.874013	-5.26593	-0.487221	0.002808	0.415283	4.279968
pr	27648.0	0.00103	0.873128	-7.893255	-0.258535	0.003309	0.280009	6.970575
[CH ₄]	20476.0	0.001284	0.003067	-0.031893	0.000099	0.001249	0.002726	0.039765

1950-2022 Global Mean Weighted Anomalies, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.03231	0.298552	-1.803879	-0.161224	0.006857	0.14409	1.568023
pr	27648.0	0.000733	0.329993	-3.617951	-0.093484	0.001616	0.094974	2.374716
[CH ₄]	27648.0	0.007417	0.155368	-1.630998	-0.000172	0.0	0.000518	1.80809

1950-2022 Global Mean Variability, i.e., Departures, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.050562	0.610185	-2.928398	-0.29056	0.005066	0.324058	4.094465
pr	27648.0	-0.000297	0.582513	-6.603907	-0.189054	0.000518	0.176089	4.799501
[CH ₄]	20476.0	0.009809	0.172072	-1.632356	-0.0023	-0.001191	-0.000266	1.815749

1950-2149 Global Mean Unweighted Climatology, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.23184	1.130141	-6.863373	-0.265579	0.213898	0.749405	8.346924
pr	27648.0	0.013971	0.950134	-7.470778	-0.259802	-0.000501	0.290361	7.382868
[CH ₄]	20487.0	0.002545	0.003336	-0.029325	0.001091	0.00257	0.00427	0.039617

1950-2149 Global Mean Weighted Anomalies, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.061461	0.347107	-2.45555	-0.102746	0.061266	0.227666	3.081162
pr	27648.0	0.003256	0.330694	-3.422654	-0.093091	-0.00087	0.1	3.001335
[CH ₄]	27648.0	0.001091	0.1689	-1.716789	0.0	0.000286	0.000988	2.514218

1950-2149 Global Mean Variability, i.e., Departures, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.170379	0.830929	-5.446333	-0.520247	-0.145663	0.1834	4.853626
pr	27648.0	-0.010714	0.664631	-5.403582	-0.195224	-0.000511	0.176503	5.218138
[CH ₄]	20487.0	-0.00129	0.187914	-1.728766	-0.003374	-0.00199	-0.000887	2.518652

GeoMIP

G1 (1850-1949)

Global Mean Unweighted Climatology, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.108962	1.280864	-6.338104	-0.755516	-0.209274	0.402477	9.412323
pr	27648.0	-0.031501	1.090529	-11.16434	-0.251884	-0.022054	0.208462	7.116072
[CH ₄]	20406.0	0.004054	0.003151	-0.018057	0.002414	0.003747	0.005283	0.057992

1850-1949 Global Mean Weighted Anomalies, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.009425	0.471955	-1.962601	-0.241937	-0.047993	0.146104	2.967475
pr	27648.0	-0.009747	0.320629	-3.233639	-0.090817	-0.006245	0.081783	2.305072
[CH ₄]	27648.0	0.002545	0.179914	-1.898179	0.0	0.001128	0.001876	2.198813

1850-1949 Global Mean Variability, i.e., Departures, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.099536	0.84688	-6.87261	-0.279951	0.165374	0.534542	4.37735
pr	27648.0	0.021754	0.812328	-5.795402	-0.134448	0.016256	0.170936	8.144423
[CH ₄]	20406.0	-0.00048	0.206331	-1.91082	-0.003629	-0.002364	-0.001364	2.200382

G6Solar (2020-2022)

Global Mean Unweighted Climatology, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.262796	0.845823	-4.798126	-0.202309	0.208984	0.657642	7.460419
pr	27648.0	0.015341	0.884663	-7.27153	-0.215107	0.012419	0.249917	10.992081
[CH ₄]	20458.0	0.222033	0.009948	0.086969	0.219688	0.222796	0.225838	0.381306

2020-2022 Global Mean Weighted Anomalies, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.098036	0.317064	-1.360164	-0.06059	0.064125	0.219238	2.075384
pr	27648.0	0.007359	0.279501	-2.925238	-0.077941	0.005866	0.092004	3.378692
[CH ₄]	27648.0	0.067408	0.491209	-5.709656	0.0	0.073729	0.075107	5.153769

2020-2022 Global Mean Variability, i.e., Departures, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.16476	0.595201	-5.713408	-0.443155	-0.131868	0.158046	3.56072
pr	27648.0	-0.007982	0.653122	-7.613389	-0.170958	-0.005401	0.155944	4.487143
[CH ₄]	20458.0	-0.135712	0.561079	-5.911922	-0.151542	-0.148678	-0.145772	4.953011

2020-2100 Global Mean Unweighted Climatology, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	3.820114	3.850293	-2.76062	1.668655	2.455017	4.131714	21.053375
pr	27648.0	0.128255	0.905848	-5.918912	-0.173363	0.096137	0.48727	11.726685
[CH ₄]	20428.0	6.495571	0.022227	6.407355	6.478699	6.495629	6.511049	6.667688

2020-2100 Global Mean Weighted Anomalies, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	1.274749	1.261635	-1.145708	0.556738	0.830794	1.406185	6.593097
pr	27648.0	0.045029	0.3465	-2.622354	-0.066172	0.029559	0.164689	5.256263
[CH ₄]	27648.0	1.575484	1.075168	-4.611958	0.0	2.146899	2.155072	7.11949

2020-2100 Global Mean Variability, i.e., Departures, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-2.545364	2.604515	-14.47845	-2.742388	-1.620583	-1.101486	1.614912
pr	27648.0	-0.083226	0.612151	-10.522869	-0.324232	-0.063237	0.117998	3.91492
[CH ₄]	20428.0	-4.368076	0.622754	-11.216104	-4.354615	-4.34309	-4.329992	0.64295

G6Sulfur (2020-2022)

Global Mean Unweighted Climatology, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.262796	0.845823	-4.798126	-0.202309	0.208984	0.657642	7.460419
pr	27648.0	0.015341	0.884663	-7.27153	-0.215107	0.012419	0.249917	10.992081
[CH ₄]	20458.0	0.222033	0.009948	0.086969	0.219688	0.222796	0.225838	0.381306

2020-2022 Global Mean Weighted Anomalies, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	0.098036	0.317064	-1.360164	-0.06059	0.064125	0.219238	2.075384
pr	27648.0	0.007359	0.279501	-2.925238	-0.077941	0.005866	0.092004	3.378692
[CH ₄]	27648.0	0.067408	0.491209	-5.709656	0.0	0.073729	0.075107	5.153769

2020-2022 Global Mean Variability, i.e., Departures, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	-0.16476	0.595201	-5.713408	-0.443155	-0.131868	0.158046	3.56072
pr	27648.0	-0.007982	0.653122	-7.613389	-0.170958	-0.005401	0.155944	4.487143
[CH ₄]	20458.0	-0.135712	0.561079	-5.911922	-0.151542	-0.148678	-0.145772	4.953011

2020-2100 Global Mean Unweighted Climatology, Surface Temperature:

	count	mean	std	min	25%	50%	75%	max
ts	27648.0	4.057496	3.915655	-3.403015	1.779564	2.608185	4.438026	20.421417
pr	27648.0	0.092967	0.930308	-6.459654	-0.215539	0.07837	0.470013	7.614714

[CH₄]20425.0 6.486563 0.023263 6.37514 6.472857 6.485466 6.498493 6.675865
 2020-2100 Global Mean Weighted Anomalies, Surface Temperature:
 count mean std min 25% 50% 75% max
 ts 27648.0 1.356493 1.301933 -1.050869 0.583419 0.881806 1.500661 6.408703
 pr 27648.0 0.03346 0.326965 -2.222875 -0.071276 0.028488 0.165338 3.126416
 [CH₄]27648.0 1.372074 1.174541 -4.431856 0.0 2.142589 2.150052 6.37611
 2020-2100 Global Mean Variability, i.e., Departures, Surface Temperature:
 count mean std min 25% 50% 75% max
 ts 27648.0 -2.701003 2.63522 -14.012714 -2.912111 -1.727099 -1.189088 2.378882
 pr 27648.0 -0.059506 0.653487 -5.294496 -0.314393 -0.051625 0.153691 4.33444
 [CH₄]20425.0 -4.632827 0.992854 -10.961793 -4.346088 -4.337328 -4.328534 -0.091165

G7Cirrus (2020-2022)

Global Mean Unweighted Climatology, Surface Temperature:
 count mean std min 25% 50% 75% max
 ts 27648.0 -0.009562 0.884537 -6.713715 -0.459358 -0.048676 0.459648 5.542419
 pr 27648.0 -0.014327 0.870916 -8.471943 -0.257546 0.007095 0.236292 7.127762
 [CH₄]20451.0 0.228912 0.010778 0.087743 0.223864 0.228962 0.232922 0.334846
 2020-2022 Global Mean Weighted Anomalies, Surface Temperature:
 count mean std min 25% 50% 75% max
 ts 27648.0 0.014544 0.318091 -1.996679 -0.134394 0.000139 0.158822 2.121763
 pr 27648.0 -0.002782 0.321056 -4.267036 -0.090448 0.004765 0.089188 3.357055
 [CH₄]27648.0 0.069738 0.509962 -4.260851 0.0 0.074571 0.076416 5.894766
 2020-2022 Global Mean Variability, i.e., Departures, Surface Temperature:
 count mean std min 25% 50% 75% max
 ts 27648.0 0.024106 0.633546 -4.172478 -0.308971 0.054983 0.352812 4.717036
 pr 27648.0 0.011545 0.60018 -4.771199 -0.153892 -0.002867 0.170754 5.452833
 [CH₄]20451.0 -0.141444 0.57797 -4.486471 -0.156554 -0.153506 -0.14877 5.652895
 2020-2100 Global Mean Unweighted Climatology, Surface Temperature:
 count mean std min 25% 50% 75% max
 ts 27648.0 6.11755 4.872776 -0.306274 3.175285 4.325737 6.697357 24.504852
 pr 27648.0 0.276896 1.09733 -8.133647 -0.112826 0.243819 0.702399 11.215437
 [CH₄]20418.0 6.468609 0.030577 6.364872 6.443661 6.467202 6.494901 6.659845
 2020-2100 Global Mean Weighted Anomalies, Surface Temperature:
 count mean std min 25% 50% 75% max
 ts 27648.0 2.028408 1.567186 -0.215712 1.067427 1.450554 2.28763 7.716184
 pr 27648.0 0.093117 0.411948 -3.936047 -0.044413 0.075149 0.236679 3.985607
 [CH₄]27648.0 1.515095 1.123882 -4.515269 0.0 2.132723 2.145498 7.572684
 2020-2100 Global Mean Variability, i.e., Departures, Surface Temperature:
 count mean std min 25% 50% 75% max
 ts 27648.0 -4.089142 3.321489 -16.791474 -4.448385 -2.859786 -2.103045 0.090563
 pr 27648.0 -0.183779 0.741335 -7.264271 -0.469847 -0.157762 0.083811 4.739193
 [CH₄]20418.0 -4.421664 0.780159 -10.963081 -4.343838 -4.322647 -4.306777 1.038614

Global mean temporal differencing, *1pctCO₂-cdr* (ts, pr, [CH₄])

2020-2050: -1.233±0.204 K, -2.996E-07±1.963E-07 kg m⁻² s⁻¹ (-0.00945±0.00619 m), 8.471E-10±2.601E-10 mol mol⁻¹
 2020-2100: -3.706±0.37164 K, -1.850E-06±3.742E-07 kg m⁻² s⁻¹ (-0.0584±0.0118 m), -1.763E-09±6.410E-12 mol mol⁻¹
 2020-2149: -5.536±0.478 K, -3.059E-06±4.366E-07 kg m⁻² s⁻¹ (-0.0965±0.0138 m), 2.237E-09±1.110E-10 mol mol⁻¹
1pctCO₂-cdr divergence from ERA5 (2020-2022) ; net positive, simulations higher than observed
 2020: 8.402±0.155 K, 1.062±0.0146 m
 2021: 8.687±0.314 K, 1.065±0.0137 m
 2022: 8.792±0.444 K, 1.074±0.0128 m
 Unweighted Mean (1990-2149): 0.408447265625, -19.28448486328125, -5.7934184074401855, 3.822444438934326
 Weighted Mean (1990-2149): 0.5421455578926384, -18.661555363581726, -5.72597861448471, 3.647067632781256
 Weighted Mean Difference (1990-2149): 3.529090294471075, -2.141268607897672, 0.06744005400174458, 0.5450907544946663
 Unweighted Mean (1990-2149): 35.07643214278396, -29.865084762931012, -0.6041045757101652, 2.5833478958832194
 Weighted Mean (1990-2149): 21.591012305544226, -28.12094137658351, -0.6117383940736973, 2.695069559775592
 Weighted Mean Difference (1990-2149): 13.198013502018156, -14.05919292895333, -0.00763381836353203, 1.0687307283570386
 Unweighted Mean (1990-2149): 0.0006177425384521484, -0.0007447004318237305, 0.00012713531032204628, 0.000123656471259892
 Weighted Mean (1990-2149): 0.4985108818176832, -0.36544634268956067, 0.004390018885853363, 0.06570206700495722
 Weighted Mean Difference (1990-2149): 0.49861828938756847, -0.36578430102543713, 0.0042628835755313165, 0.0657222865881532

04-1990

204.742919921875-321.72021484375+-22.66111183166504 K
 1.9558227921327026e-14-0.0006887685740366578+-4.461673597688787e-05 kg/m2/s
 7.840443458917434e-07-7.997751367838646e-07+-2.4018924627000615e-09 mol mol-1
 09-2149
 202.695068359375-317.582275390625+-23.34175682067871 K
 0.0-0.0005224779015406966+-3.6334586184239015e-05 kg/m2/s
 7.927865226520225e-07-8.046150128393492e-07+-1.79276682388263e-09 mol mol-1

07-1990

207.530517578125-327.26220703125+-23.30927848815918 K
0.0-0.0012689726427197456+-4.761806849273853e-05 kg/m2/s
7.901552976363746e-07-8.037637257984898e-07+-3.0359974534377443e-09 mol mol-1

07-2050

210.1552734375-326.115234375+-22.35935401916504 K
8.891218111154592e-14-0.0012860239949077368+-4.623917629942298e-05 kg/m2/s
7.882658792368602e-07-8.048638733271218e-07+-3.122753167161818e-09 mol mol-1

07-2149

206.849609375-322.87109375+-23.399436950683594 K
0.0-0.0010115463519468904+-3.915578781743534e-05 kg/m2/s
7.856259571781266e-07-8.055839657572506e-07+-3.6850287266076975e-09 mol mol-1

1pctCO2-cdr (1990-2149)

0.40844727 -19.284485 -5.7934184 3.8224444
15.228577 -16.05896 -0.04006513 4.0665245
35.07643308982534 -29.865083319820325 -0.6041046236652688 2.5833479783888733
80.86490364007231 -130.3552994504571 -0.021595800526569602 6.865288105679079
0.0006177231171022868 -0.000744732460589148 0.0001271365258348478 0.00012365319643214967
0.0005636552486976143 -0.0009426773885934381 -8.308864420103479e-05 0.00011840941491203516

2020

318.21384 222.49937 285.4927 19.807375
32.648956 -20.24028 1.9866103 8.660753
77.59392009345147 0.002522389071952414 6.697759550627111 5.748383569605824
172.51054835417924 -33.77301551682769 0.12112061823537038 6.957179621819688

2021

318.12125 221.54572 285.55685 19.695389
25.508453 -23.01587 1.9493586 8.115177
67.36574032923805 0.003986680297884959 6.719557737562595 5.8865801783779395
273.58924193342904 -36.595252250268494 0.1049477444057801 7.2681439989949315

2022

318.67673 223.7512 285.6688 19.639034
16.88919 -22.594376 0.9720249 5.8591332
61.92285210807931 0.008480501259422249 6.756644960677357 5.671708934110115
278.2131532945161 -42.525487609277924 0.21888140083388383 7.045914333331276

Global mean temporal differencing, esm-1pct-brch-1000PgC (ts, pr, [CH₄])

2020: -0.0139±0.179 K, 9.456E-08±5.134E-08 kg m⁻²s⁻¹ (0.00298±0.00162 m), -3.904E-10±6.874E-10 mol mol⁻¹

2021: -0.103±0.292 K, 5.387E-08±8.229E-08 kg m⁻²s⁻¹ (0.00170±0.00260 m), 1.029E-11±5.0325E-10 mol mol⁻¹

2022: 0.267±0.245 K, 1.974E-07±4.0134E-08 kg m⁻²s⁻¹ (0.00623±0.00127 m), -1.178E-10±2.285E-10 mol mol⁻¹

1pctCO2-brch_1000Pg divergence from ERA5 (2020-2022) ; net positive, simulations higher than observed

2020: 4.377±0.00577 K, 0.981±0.0225 m

2021: 4.367±0.169 K, 0.983±0.0196 m

2022: 4.244±0.0286 K, 0.982±0.0227 m

Unweighted Mean (1950-2149): 8.346923828125, -6.863372802734375, 0.23184040188789368, 1.1301201581954956

Weighted Mean (1950-2149): 9.24348645332526, -7.366649138621767, 0.18438347418423695, 1.041301987661304

Weighted Mean Difference (1950-2149): 3.110204452123412, -3.208327073317321, -0.04745691280249553, 0.48967979787769933

Unweighted Mean (1950-2149): 13.541440746803119, -13.702683913025385, 0.025625160413089793, 1.7426758586828

Weighted Mean (1950-2149): 16.514883189024324, -18.83319526373954, 0.01791887719366045, 1.819612754862845

Weighted Mean Difference (1950-2149): 7.104609983739517, -7.0861258043286774, -0.007706283219429333, 0.7691239584085764

Unweighted Mean (1950-2149): 0.0002205371856689453, -0.0005371570587158203, -2.7697571567841806e-05, 9.090901585295796e-05

Weighted Mean (1950-2149): 0.43199492297273334, -0.6482165824734647, -0.002376362154501111, 0.0711326167521978

Weighted Mean Difference (1950-2149): 0.4320567925940102, -0.6480281125866849, -0.0023486645823269396, 0.07112810734999647

esm-1pct-brch-1000PgC (1950-2149)

8.346924 -6.863373 0.2318404 1.1301202

23.712494 -7.461792 1.17438 3.3544137

13.541440746803119 -13.702683913025387 0.02562516797251873 1.7426758291622175

52.462559546713706 -63.591642623495815 0.013660874406036897 5.238533827321763

0.00022064796212362123 -0.0005370316102926154 -2.7695709246822187e-05 9.090737576600282e-05

0.0007515707238781033 -0.0005073991360404762 7.060760053023696e-05 0.00013401598120132974

2020

314.134 217.7654 281.42453 20.694773

19.426453 -21.090973 0.51207167 6.1376896

42.410944534662235 0.0024387939981064316 4.951283765369418 4.368508862911831

59.9642582799322 -42.88640674952436 -0.13672558376202143 3.909569685277178

2021

314.22568 216.07695 281.2647 20.926254

29.625854 -31.646088 -0.102988034 9.935618

53.16690906610845 0.0029905889241593347 4.957853776962033 4.362500380916549

41.641097834062336 -43.60817175770375 -0.03622898232300319 4.128383471684334
2022
313.82602 217.64838 281.27322 20.783867
31.57573 -33.699585 -1.2444232 10.786984
39.65323693797591 0.0016684744077198714 4.944948397047968 4.319483985253914
123.0215184371825 -43.51234044786075 -0.17156795659150761 4.992418979229078
04-1950
202.441650390625-317.4267578125±23.5616397857666 K
2.006510652075022e-10-0.0006685320404358208±3.674322215374559e-05 kg/m2/s
7.884201522756484e-07-8.022286124287348e-07±2.8473214896962418e-09 mol mol-1
09-2149
210.460205078125-317.882568359375±21.932052612304688 K
6.746834042803415e-19-0.0010640010004863143±3.983677379437722e-05 kg/m2/s
7.927232559268305e-07-8.044111723393144e-07±1.984335140647886e-09 mol mol-1
07-1950
204.66015625-324.414794921875±23.42343521118164 K
0.0-0.0009296879870817065±4.3190462747588754e-05 kg/m2/s
7.87314036188036e-07-8.048619974942994e-07±3.177283769417727e-09 mol mol-1
07-2050
195.08642578125-325.03955078125±24.18147087097168 K
5.807336261738523e-19-0.0010181732941418886±4.2237599700456485e-05 kg/m2/s
7.879941108512867e-07-8.055588978095329e-07±3.274191362478973e-09 mol mol-1
07-2149
203.047119140625-324.170654296875±22.988292694091797 K
0.0-0.0010530151193961501±4.186889054835774e-05 kg/m2/s
7.891068776189059e-07-8.04976934887236e-07±2.74305578251699e-09 mol mol-1
Global mean temporal differencing, G1 (ts, pr, [CH₄])
1850-1949: 0.057±2.465 K, -2.890E-07±1.145E-06 kg m⁻² s⁻¹ (-0.00912±0.000788 m), 8.096E-10±1.215E-09 mol mol⁻¹
Global mean temporal differencing, ERA5-Land (t2m, pr)
1950-2022: 1.521±0.790 K, -0.000356±0.000664 m
Unweighted Mean (1850-1949): 18.65985107421875, -6.6298828125, 3.010899543762207, 2.990464687347412
Weighted Mean (1850-1949): 17.185121193910277, -7.191177759415098, 3.1580565051588687, 3.2457767728641946
Weighted Mean Difference (1850-1949): 3.332212399213745, -3.0153276492387135, 0.14715677651188408, 0.6717275067334034
Unweighted Mean (1850-1949): 38.16706216457533, -48.87759916418872, 1.1981097488409502, 4.953806897256722
Weighted Mean (1850-1949): 49.73414845773223, -45.56925065591993, 1.2203820760987558, 4.802313723211707
Weighted Mean Difference (1850-1949): 14.888099048056786, -18.508106778098355, 0.02227232725780539, 2.1716581444733536
Unweighted Mean (1850-1949): 0.00023186206817626953, -0.0006031990051269531, 2.999165008077398e-05, 9.181116911349818e-05
Weighted Mean (1850-1949): 0.4485957364091191, -0.6149216279184727, -0.009888012240622726, 0.08407917600051527
Weighted Mean Difference (1850-1949): 0.44876322546093794, -0.614787279049149, -0.009473824764332176, 0.08475911416324765

G1 (1850-1949)

1949-1850
9.412323 -6.3381042 -0.108961634 1.2808412 K
20.963318 -11.10437 0.7280122 2.9848113 K
32.46707434009295 -50.937297657947056 -0.14372449020356726 4.9754476407542825 mm/year
119.00549213751219 -195.93174126930535 -0.10281617472287508 10.26718840803369 mm/year
0.0002738952389336191 -0.0001883713593997527 7.770533717865735e-05 9.167109869812062e-05 ppb
0.0004439400527189718 -0.00047731077756907325 -0.00013398128903552295 0.00012422511075360632 ppb

01-16-1850

224.941-313.003±21.854 K
0.0-0.0005885828286409378±3.699109220178798e-05 kg/m2/s
7.904876611064537e-07-8.046321795518452e-07±3.373388901550811e-09 mol mol-1

12-16-1949

221.33447265625-314.247314453125±23.58716583251953 K
0.0-0.0004951477749273181±3.653763633337803e-05 kg/m2/s
7.826599244253885e-07-8.028972047213756e-07±4.0309857674003524e-09 mol mol-1
07-16-1850

205.4189453125-315.447265625+-24.642765045166016 K
0.0-0.0003871596127282828+-3.5975939681520686e-05 kg/m2/s
7.857978516767616e-07-8.022411179808842e-07+-3.564930572963476e-09 mol mol-1
07-16-1949

206.640380859375-315.527587890625±23.385026931762695 K
1.7278284358823726e-10-0.00044085702393203974±3.4888293157564476e-05 kg/m2/s
7.806740995874861e-07-8.029044806789898e-07±4.506939266235577e-09 mol mol-1

Global mean temporal differencing, G6Solar (ts, pr, [CH₄])

2020-2050: 1.956±0.123 K, 8.815E-07±1.567E-08 kg m⁻² s⁻¹ (0.0278±0.000495 m), 5.325E-07±5.781E-09 mol mol⁻¹
2020-2100: 3.860±0.415 K, 1.504E-06±1.012E-07 kg m⁻² s⁻¹ (0.0475±0.00319 m), 5.064E-07±1.0131E-09 mol mol⁻¹
2020-2149: 3.663±1.700 K, 9.9250E-07±6.972E-07 kg m⁻² s⁻¹ (0.0313±0.0220 m), 5.0387E-07±3.701E-09 mol mol⁻¹

G6Solar divergence from ERA5 (2020-2022; ts, pr); net positive, simulations higher than observed

2020: 2.158±0.363 K, 0.939±0.01845 m

2021: 2.417±0.0887 K, 0.934±0.0208 m

2022: 2.579±0.117 K, 0.945±0.0256 m

Unweighted Mean (2022-2100): 21.053375244140625, -2.7606201171875, 3.8201136589050293, 3.8502237796783447

Weighted Mean (2022-2100): 19.779290614984006, -3.4371243990385096, 3.8242477916697606, 3.784835124075674

Weighted Mean Difference (2022-2100): 2.277925148988402, -2.972496619591368, 0.004134197888324729, 0.5012914426831239

Unweighted Mean (2022-2100): 53.502982980717206, -27.005036671471316, 0.5851653048145632, 4.132856458824483

Weighted Mean (2022-2100): 71.94510292723024, -35.89346500792235, 0.6163377207933741, 4.742636953983363

Weighted Mean Difference (2022-2100): 29.04633413821174, -37.02575497376388, 0.031172415978810843, 2.0578449311843006

Unweighted Mean (2022-2100): 0.8201470375061035, 0.8062567710876465, 0.8158894181251526, 0.0011335986200720072

Weighted Mean (2022-2100): 2.505405697559417, -0.6696084643548461, 0.8571784362522196, 0.22520932615306488

Weighted Mean Difference (2022-2100): 1.6897576186409602, -1.4855948592370485, 0.0412890026050242, 0.2254657277780886

G6Solar (2020-2100)

2100-2020

21.053375 -2.76062 3.8201137 3.8502238

28.983154 -19.676636 1.8363327 5.7837286

53.50298441480845 -27.005036671471316 0.5851653370882559 4.132856650903705

131.56281957635656 -179.2058777064085 0.03334301920006055 13.699744602490682

0.8201468340303109 0.8062567712840972 0.8158894224834512 0.0011335973366666252

-0.0013461349226417951 -0.0027626583687379025 -0.002162276125705631 0.0002878252175486651

2020

312.0897 214.84517 279.1992 21.54364

29.768387 -32.298706 -1.9339583 10.838376

114.53957138000987 0.016108380901158625 11.75489458910306 10.453359265375184

160.66970913670957 -114.0954620030243 -0.2226888257155224 11.689728765850305

2021

311.82837 215.17204 279.2966 21.388828

15.53038 -32.688477 -2.68862 8.606188

130.81604811013676 0.007707955448310599 11.706619492542814 10.287034079738078

115.31466901651584 -114.35621420969255 -0.22171514498268152 12.29618659344851

2022

311.97815 216.26387 279.462 21.367653

12.227325 -21.423431 -2.414644 5.473577

121.70504844398238 0.01549647069225557 11.824887563489028 10.340828993503237

109.54380553448573 -114.52197221224196 -0.19729151790670585 11.719777996768244

01-16-2020

224.422607421875-313.29541015625±22.02272605895996 K

0.0-0.0004869145923294127±4.029420961160213e-05 kg/m2/s

1.8549417291069403e-06-1.8913696067102137e-06±8.05834421413465e-09 mol mol-1

12-16-2049

223.510009765625-314.107177734375±23.46244239807129 K

0.0-0.00039029066101647913±3.993293648818508e-05 kg/m2/s

1.8534568653194583e-06-1.891708052426111e-06±9.031675851645105e-09 mol mol-1

07-16-2020

205.342041015625-315.804931640625±24.446327209472656 K

0.0-0.00036569582880474627±3.805842425208539e-05 kg/m2/s

1.8466594156052452e-06-1.892464752017986e-06±1.0087182644724635e-08 mol mol-1

07-16-2049

201.957275390625-315.775146484375±23.620498657226562 K

0.0-0.0005317333852872252±3.605760866776109e-05 kg/m2/s

1.8370983525528572e-06-1.8920970887847943e-06±9.060248551406858e-09 mol mol-1

01-16-2050

228.35546875-316.243408203125±19.707077026367188 K

0.0-0.00037196598714217544±4.24424943048507e-05 kg/m2/s

2.3765639980410924e-06-2.4197720449592452e-06±9.82951586792069e-09 mol mol-1

12-16-2100

227.86083984375-317.28125±21.869150161743164 K

0.0-0.0006244184332899749±4.091666778549552e-05 kg/m2/s

2.3725699520582566e-06-2.41916654886154e-06±1.1169563052249032e-08 mol mol-1

07-16-2050

209.9697265625-316.44482421875±23.751188278198242 K

0.0-0.0012091739336028695±4.0607799746794626e-05 kg/m2/s

2.3713996597507503e-06-2.4216292331402656e-06±1.2222725054300554e-08 mol mol-1

07-16-2100

203.137939453125-317.88623046875±23.75113296508789 K

0.0-0.0004017853061668575±3.728265073732473e-05 kg/m2/s

2.369341927987989e-06-2.4242172003141604e-06±1.099573943008636e-08 mol mol-1

Global mean temporal differencing, G6Sulfur (ts, pr, [CH₄])

2020-2050: 1.732±0.120 K, 7.524E-07±6.422E-08 kg m⁻²s⁻¹ (0.0237±0.00203 m), 5.321E-07±5.643E-09 mol mol⁻¹

2020-2100: 4.092±0.268 K, 1.102E-06±1.998E-07 kg m⁻²s⁻¹ (0.0348±0.00630 m), 5.043E-07±1.0647E-09 mol mol⁻¹

2020-2149: 4.146±1.748 K, 7.333E-07±6.956E-07 kg m⁻²s⁻¹ (0.23±0.022 m), 5.031E-07±3.807E-09 mol mol⁻¹

G6Sulfur divergence from ERA5 (2020-2022) ; net positive, simulations higher than observed

2020: 2.0545±0.417K, 0.938±0.0183 m

2021: 2.409±0.174K, 0.935±0.0232 m

2022: 2.633±0.103K, 0.945±0.0245 m

Unweighted Mean (2022-2100): 20.421417236328125, -3.40301513671875, 4.057496070861816, 3.9155845642089844

Weighted Mean (2022-2100): 19.226108648838192, -3.1526066706730944, 4.069480183797005, 3.905727597642513

Weighted Mean Difference (2022-2100): 3.1542514898838476, -3.0683280749198616, 0.01198408534044557, 0.5819015363113317

Unweighted Mean (2022-2100): 34.74213461850013, -29.47217267792439, 0.42416113553820944, 4.24445294169777

Weighted Mean (2022-2100): 42.792818397320566, -30.425601371839896, 0.45799041988943123, 4.475253116769259

Weighted Mean Difference (2022-2100): 15.70354017638704, -15.249165870717164, 0.03382928435122175, 1.9972006114718206

Unweighted Mean (2022-2100): 0.8198468685150146, 0.8071184158325195, 0.8159751892089844, 0.0009287006105296314

Weighted Mean (2022-2100): 1.976949767396992, -1.6685957342267501, 0.7359987108873995, 0.3424062360804935

Weighted Mean Difference (2022-2100): 1.1626616280537303, -2.488442602741765, -0.07997644192239424, 0.3424616267620572

G6Sulfur (2020-2100)

2100-2020

20.421417 -3.4030151 4.057496 3.9155846

26.552216 -11.699921 1.9785419 5.803853

34.74213390145451 -29.47217267792439 0.42416116775712 4.244452970851853

125.99118005018681 -169.84970580087975 0.08634939565297373 12.05141016325797

0.8198466798603475 0.807118210104818 0.8159750375398289 0.0009287046263128927

-0.0006872910489619243 -0.0030839655664749444 -0.0021255297206757007 0.0003572483705527318

2020

312.0897 214.84517 279.1992 21.54364

29.768387 -32.298706 -1.9339583 10.838376

114.53957138000987 0.016108380901158625 11.75489458910306 10.453359265375184

160.66970913670957 -114.0954620030243 -0.2226888257155224 11.689728765850305

2021

311.82837 215.17204 279.2966 21.388828

15.53038 -32.688477 -2.68862 8.606188

130.81604811013676 0.007707955448310599 11.706619492542814 10.287034079738078

115.31466901651584 -114.35621420969255 -0.22171514498268152 12.29618659344851

2022

311.97815 216.26387 279.462 21.367653

12.227325 -21.423431 -2.414644 5.473577

121.70504844398238 0.01549647069225557 11.824887563489028 10.340828993503237

109.54380553448573 -114.52197221224196 -0.19729151790670585 11.719777996768244

01-16-2020

224.422607421875-313.29541015625±22.02272605895996 K

0.0-0.0004869145923294127±4.029420961160213e-05 kg/m2/s

1.8549417291069403e-06-1.8913696067102137e-06±8.05834421413465e-09 mol mol-1

12-16-2049

223.510009765625-314.107177734375±23.46244239807129 K

0.0-0.00039029066101647913±3.993293648818508e-05 kg/m2/s

1.8534568653194583e-06-1.891708052426111e-06±9.031675851645105e-09 mol mol-1

07-16-2020

205.342041015625-315.804931640625±24.446327209472656 K

0.0-0.00036569582880474627±3.805842425208539e-05 kg/m2/s

1.8466594156052452e-06-1.892464752017986e-06±1.0087182644724635e-08 mol mol-1

07-16-2049

201.957275390625-315.775146484375±23.620498657226562 K

0.0-0.0005317333852872252±3.605760866776109e-05 kg/m2/s

1.8370983525528572e-06-1.8920970887847943e-06±9.060248551406858e-09 mol mol-1

01-16-2050

227.87353515625-317.32763671875±20.587783813476562 K

0.0-0.0004659414989873767±4.104889740119688e-05 kg/m2/s

2.381212425461854e-06-2.4183723326132167e-06±8.768786585733324e-09 mol mol-1

12-16-2100

225.9873046875-315.73681640625±22.335716247558594 K

0.0-0.0007029568660072982±4.104017716599628e-05 kg/m2/s

2.3625430003448855e-06-2.4185635538742645e-06±1.1565217228337588e-08 mol mol-1

07-16-2050

210.225830078125-316.939453125±24.01727867126465 K

1.5865552144625483e-12-0.00039953915984369814±3.888294304488227e-05 kg/m2/s

2.368085688431165e-06-2.422058742013178e-06±1.1346044992421866e-08 mol mol-1

07-16-2100

200.665283203125-318.53515625±24.00969886779785 K
0.0-0.0005253570852801204±3.85176062991377e-05 kg/m2/s
2.3423758648277726e-06-2.4250948627013713e-06±1.1661165366660953e-08 mol mol-1

Global mean temporal differencing, G7Cirrus (ts, pr, [CH₄])

2020-2050: 1.822±0.250 K, 4.580E-07±9.510E-08 kg m⁻²s⁻¹ (0.0145±0.00300 m), 5.317E-07±5.676E-09 mol mol⁻¹
2020-2100: 5.956±0.652 K, 3.105E-06±4.376E-07 kg m⁻²s⁻¹ (0.0980±0.0138 m), 5.043E-07±1.237E-09 mol mol⁻¹
2020-2149: 6.171±1.830 K, 2.834E-06±8.674E-07 kg m⁻²s⁻¹ (0.0894±0.0274 m), 5.012E-07±3.553E-09 mol mol⁻¹

G7Cirrus divergence from ERA5 (2020-2022) ; net positive, simulations higher than observed

2020: 1.693±0.493 K, 0.962±0.0237 m

2021: 1.789±0.163 K, 0.949±0.0282 m

2022: 1.668±0.470 K, 0.954±0.0249 m

Unweighted Mean (2022-2100): 24.504852294921875, -0.3062744140625, 6.117550373077393, 4.872687339782715

Weighted Mean (2022-2100): 23.148553310296506, -0.6471354166666288, 6.085225440271673, 4.701473442415247

Weighted Mean Difference (2022-2100): 2.377748929537262, -3.566216102013186, -0.03232492618298134, 0.5877193442977913

Unweighted Mean (2022-2100): 51.17042066267459, -37.10976405272959, 1.2633365523410882, 5.006477359255156

Weighted Mean (2022-2100): 54.552996777762864, -53.874643419322425, 1.2745400411396, 5.638442145951234

Weighted Mean Difference (2022-2100): 16.64847988896117, -19.38760910220831, 0.011203488798511763, 2.320458305375489

Unweighted Mean (2022-2100): 0.8194067478179932, 0.8112325668334961, 0.815943717956543, 0.00064078503055498

Weighted Mean (2022-2100): 2.2623090379534583, -1.2840152926167856, 0.7630643587008671, 0.309557673930315

Weighted Mean Difference (2022-2100): 1.4473590486346106, -2.1033340714413313, -0.05643228784609796, 0.31872073855968724

G7Cirrus (2020-2100)

2100-2020

24.504852 -0.3062744 6.1175504 4.8726873

26.563354 -12.642517 1.7803327 5.6040597

35.07643308982534 -29.865083319820325 -0.6041046236652688 2.5833479783888733

80.86490364007231 -130.3552994504571 -0.021595800526569602 6.865288105679079

0.8194066604119143 0.8112324740068287 0.8159436727055435 0.0006407819100884282

-0.0005888200576009694 -0.0025850458769127722 -0.0019972788050104384 0.00044479350003179263

2020

311.71982 211.97246 278.69254 22.089354

31.968246 -29.823456 -1.6260794 11.202155

95.62395947577897 0.0026064804458769686 12.015312652511057 10.884601975703845

121.8963791616261 -95.59392386872787 -0.27481055833504797 12.078579021908808

2021

311.14743 213.34126 278.69907 21.845228

16.504318 -32.028168 -3.0442839 9.264615

96.7816439748276 0.006257265016529345 11.908155203491333 10.781591918566846

127.41072387434542 -95.59706739673857 -0.35452156241717603 12.65052616072353

2022

311.1509 212.90099 278.68295 21.834364

11.452484 -23.218872 -2.5767858 5.83559

122.04468714189716 0.048495117528091214 11.94994462239265 10.907714507266064

176.21323904022574 -95.00984144979157 -0.21951625735709968 12.804253571812296

01-16-2020

221.55224609375-312.59033203125±22.36570930480957 K

0.0-0.0004232828796375543±4.138949589105323e-05 kg/m2/s

1.8570963220554404e-06-1.891432361844636e-06±7.992407624612952e-09 mol mol-1

12-16-2049

223.333740234375-315.8701171875±24.707462310791016 K

0.0-0.0003819393750745803±4.102327875443734e-05 kg/m2/s

1.8553952259026119e-06-1.891346187221643e-06±8.434410503355139e-09 mol mol-1

07-16-2020

203.1162109375-315.990478515625±25.265811920166016 K

0.0-0.0005060018156655133±4.0503502532374114e-05 kg/m2/s

1.8538701169745764e-06-1.8917705801868578e-06±8.588823874333684e-09 mol mol-1

07-16-2049

197.941162109375-317.235107421875±24.534944534301758 K

4.726481962161622e-15-0.0003933878615498543±3.83148217224516e-05 kg/m2/s

1.8507734012018773e-06-1.892854356810858e-06±8.003977924886385e-09 mol mol-1

01-16-2050

225.444091796875-315.814208984375±19.997631072998047 K

0.0-0.00041070859879255295±4.0865976188797504e-05 kg/m2/s

2.3665888875257224e-06-2.420822056592442e-06±1.2646581559749848e-08 mol mol-1

12-16-2100

222.44921875-315.15869140625±22.527421951293945 K

0.0-0.0005562490550801158±4.2523130105109885e-05 kg/m2/s

2.3649699869565666e-06-2.421753151793382e-06 $\pm$ 1.379514547039662e-08 mol mol⁻¹
07-16-2050
205.47216796875-318.391357421875 $\pm$ 24.171062469482422 K
0.0-0.0004051446449011564 $\pm$ 3.9349142753053457e-05 kg/m2/s
2.350074510104605e-06-2.4222479169111466e-06 $\pm$ 1.3173967694513067e-08 mol mol⁻¹
07-16-2100
198.047119140625-316.99755859375 $\pm$ 24.452295303344727 K
1.4117432223237358e-10-0.00045719504123553634 $\pm$ 3.7564834201475605e-05 kg/m2/s
2.3602428882441018e-06-2.4264134026452666e-06 $\pm$ 1.3059297643280843e-08 mol mol⁻¹

ERA5 v. Model Intercomparisons

IpctCO2-cdr (1990-2022)

- Unweighted differencing v. ERA5 data (Climatologies)
ts: 12.113 $\pm$ 0.166°C, pr: 2.929 $\pm$ 0.030 mm day⁻¹
- Weighted differencing v. ERA5 data (Anomalies)
ts: 4.161 $\pm$ 0.054°C, pr: 0.980 $\pm$ 0.010 mm day⁻¹

esm-1pct-brch-1000PgC (1950-2022)

- Unweighted differencing v. ERA5 data
ts: 7.712 $\pm$ 0.175°C, pr: 2.685 $\pm$ 0.024 mm day⁻¹
- Weighted differencing v. ERA5 data
ts: 2.741 $\pm$ 0.058°C, pr: 0.900 $\pm$ 0.008 mm day⁻¹

G6Solar (2020-2022)

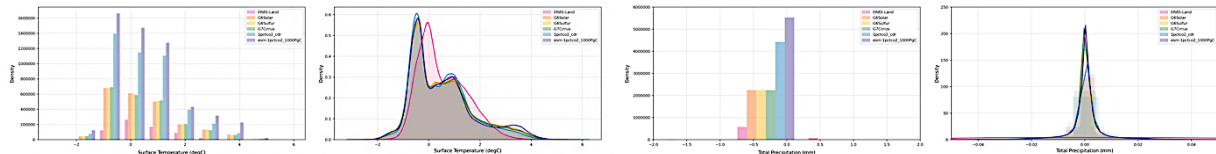
- Unweighted Differencing v. ERA5 Data
ts: 5.534 $\pm$ 0.152°C, pr: 2.627 $\pm$ 0.072 mm day⁻¹
- Weighted Differencing v. ERA5 Data
ts: 1.981 $\pm$ 0.038°C, pr: 0.877 $\pm$ 0.025 mm day⁻¹

G6Solar (2020-2022)

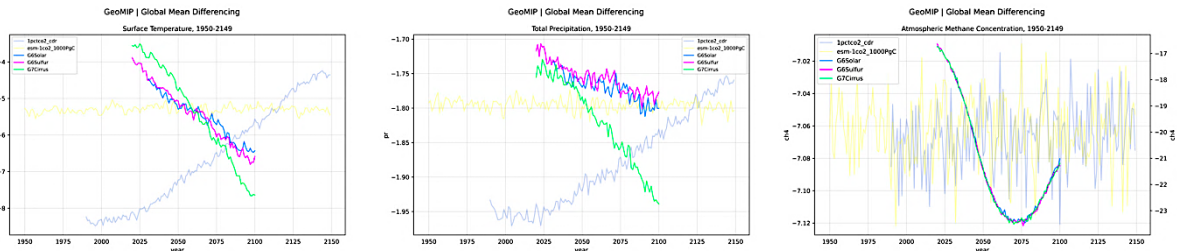
- Unweighted Differencing v. ERA5 Data
ts: 5.534 $\pm$ 0.152°C, pr: 2.62707326 $\pm$ 0.0722895
- Weighted Differencing v. ERA5 Data
ts: 1.981 $\pm$ 0.038°C, pr: 0.877 $\pm$ 0.025 mm day⁻¹

G7Cirrus (2020-2022)

- Unweighted Differencing v. ERA5 data
ts: 4.982 $\pm$ 0.107°C, pr: 2.678 $\pm$ 0.066 mm day⁻¹
- Weighted Differencing v. ERA5 data
ts: 1.792 $\pm$ 0.028°C, pr: 0.893 $\pm$ 0.023 mm day⁻¹



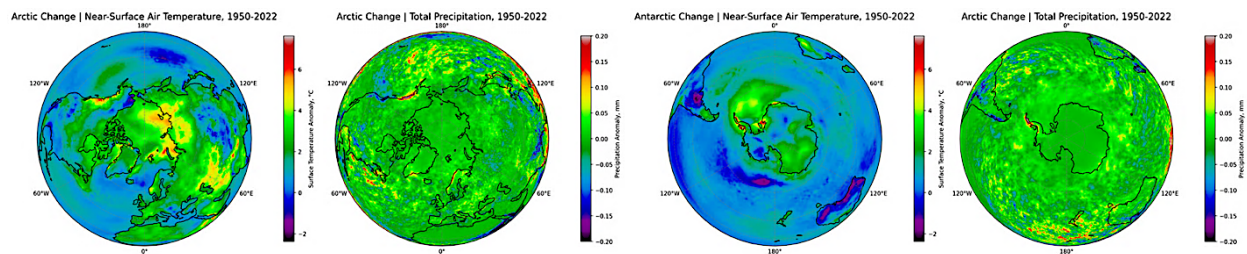
Intercomparisons of ERA5 and CMIP6 experiments and corresponding histogram and kernel density functions displaying surface temperature and total precipitation departures.



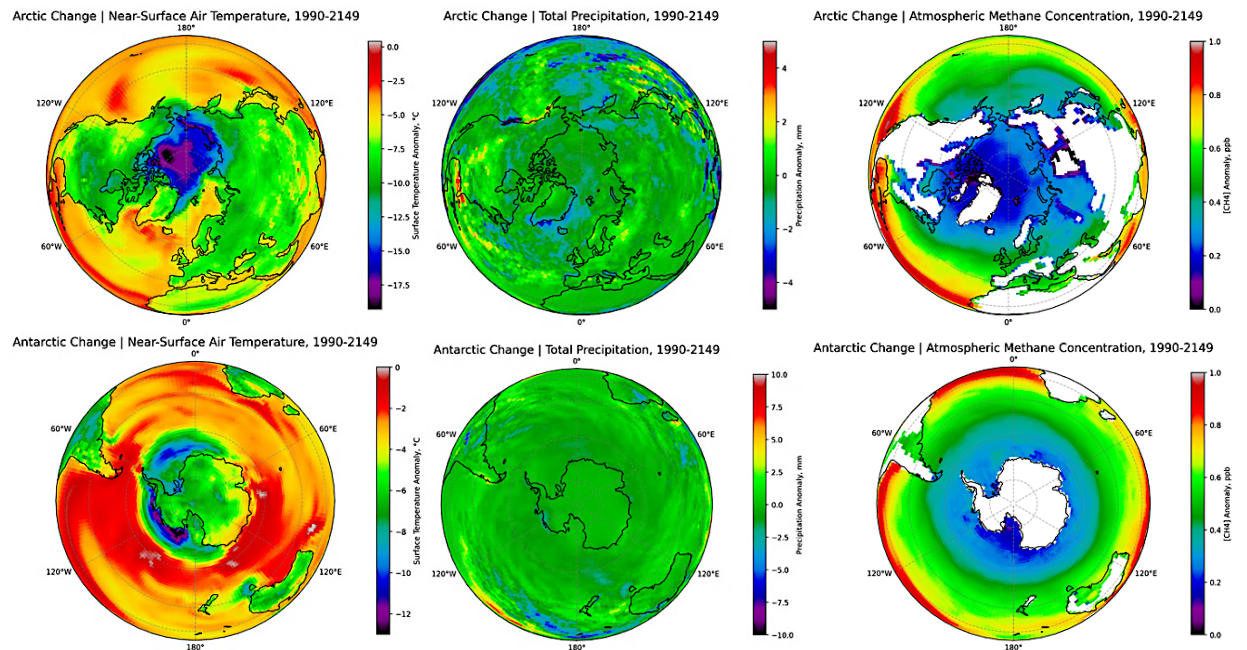
The following compilation represents global weighted means of mean differencing by spatially weighting anomalies, subtracting unweighted climatologies, and applying a global mean operation across each experimental set and variable. The following list iterates through the observation and simulation datasets (i.e., ERA5 reanalysis data, mitigation and intervention experiments) and corresponding global mean values and standardized metrics (i.e., standard deviation) for surface temperature, total precipitation, and atmospheric methane concentration observations and predictions.

- ERA5, t2m: 0.177 $\pm$ 0.590, 0.004 $\pm$ 0.175 mm day⁻¹
- *IpctCO2-cdr*, ts: -6.600 $\pm$ 13.640°C, pr: -1.879 $\pm$ 1.625 mm day⁻¹, [CH₄]: -7.067 $\pm$ 0.614 ppb
- *esm-1pct-brch-1000PgC*, ts: -5.294 $\pm$ 13.958°C, pr: -1.795 $\pm$ 1.584 mm day⁻¹, [CH₄]: -7.063 $\pm$ 0.602 ppb
- *G6Solar*, ts: -3.273 $\pm$ 14.440°C, pr: -1.603 $\pm$ 1.439 mm day⁻¹, [CH₄]: -7.052 $\pm$ 0.575 ppb
- *G6Sulfur*, ts: -5.392 $\pm$ 13.906°C, pr: -1.756 $\pm$ 1.510 mm day⁻¹, [CH₄]: -21.143 $\pm$ 2.927 ppb
- *G7Cirrus*, ts: -5.370 $\pm$ 14.222°C, pr: -1.821 $\pm$ 1.640 mm day⁻¹, [CH₄]: -21.147 $\pm$ 2.930 ppb

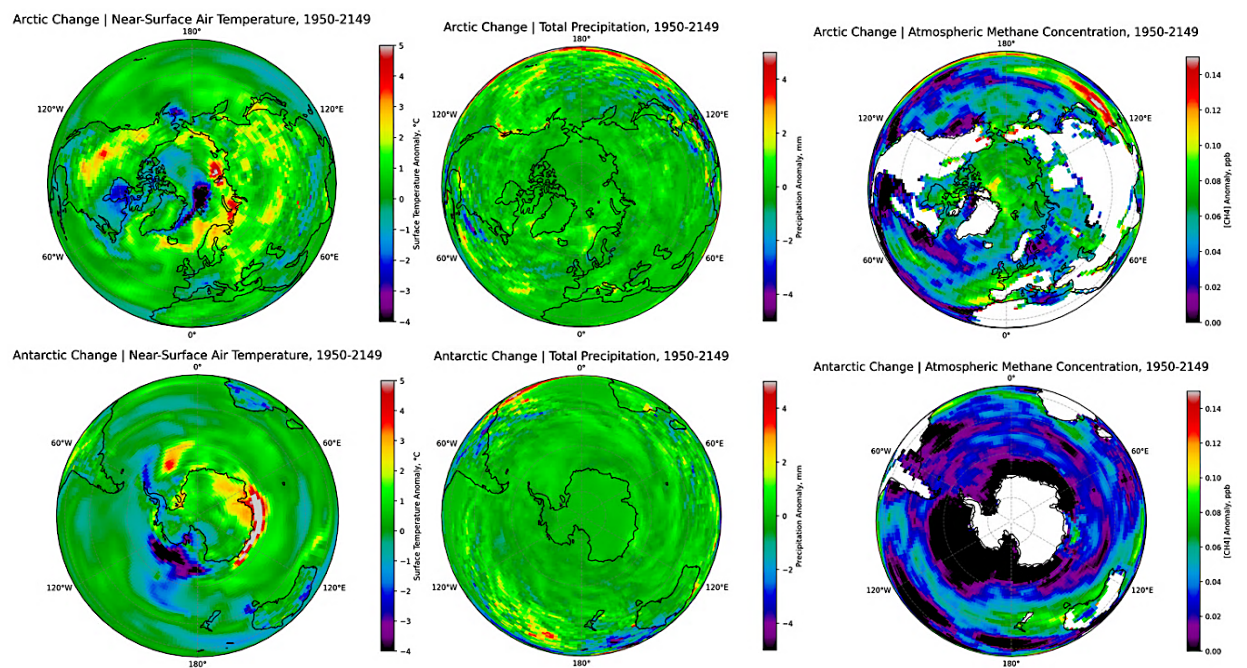
ERA5



1pctCO2-cdr

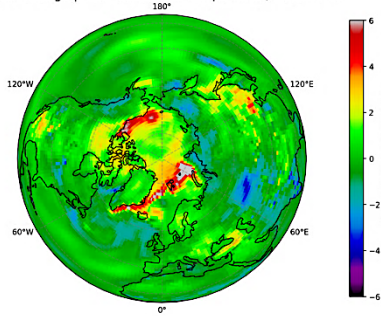


esm-1pct-brch-1000PgC

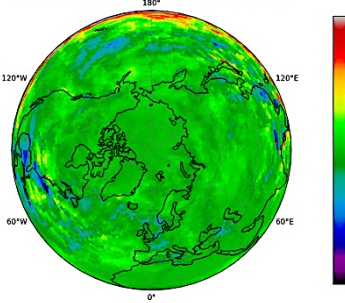


G1

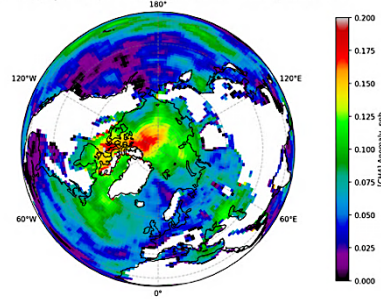
Arctic Change | Near-Surface Air Temperature, 1850-1949



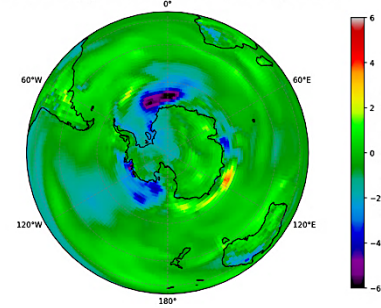
Arctic Change | Total Precipitation, 1850-1949



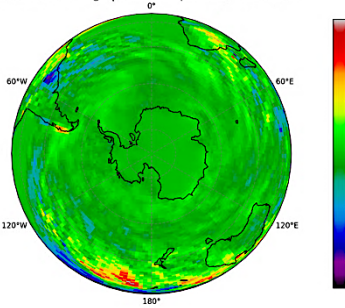
Arctic Change | Atmospheric Methane Concentration, 1850-1949



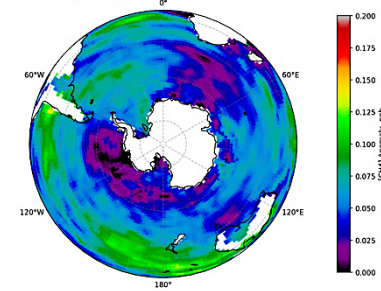
Antarctic Change | Near-Surface Air Temperature, 1850-1949



Antarctic Change | Total Precipitation, 1850-1949

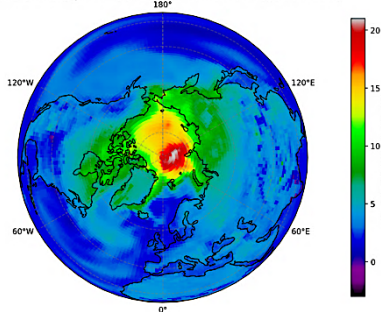


Antarctic Change | Atmospheric Methane Concentration, 1850-1949

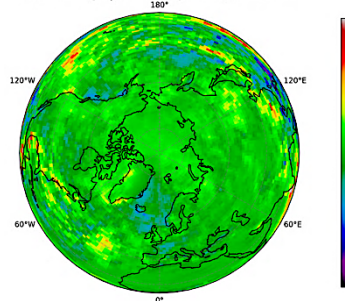


G6Solar

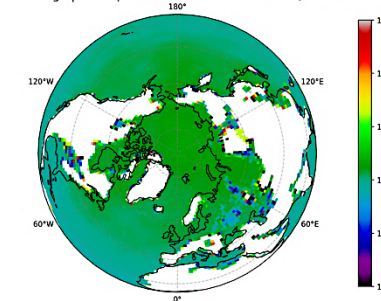
Arctic Change | Near-Surface Air Temperature, 2020-2100



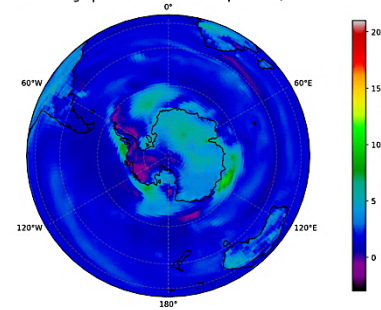
Arctic Change | Total Precipitation, 2020-2100



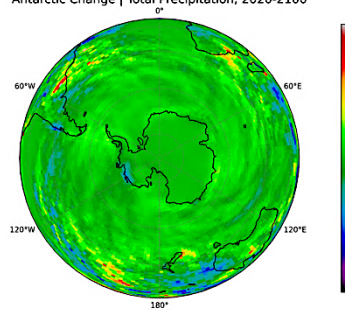
Arctic Change | Atmospheric Methane Concentration, 2020-2100



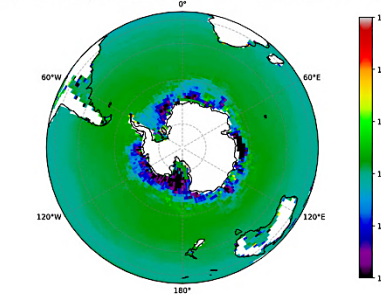
Antarctic Change | Near-Surface Air Temperature, 2020-2100



Antarctic Change | Total Precipitation, 2020-2100

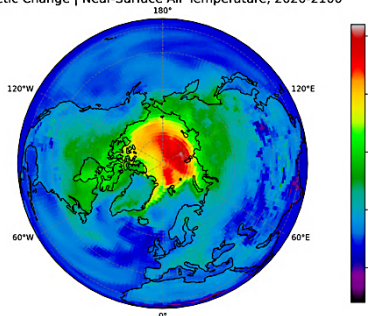


Antarctic Change | Atmospheric Methane Concentration, 2020-2100

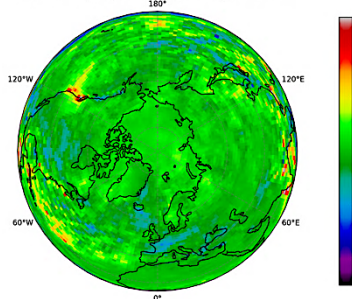


G6Sulfur

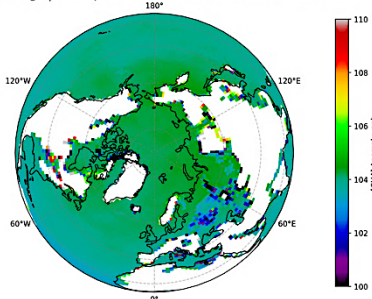
Arctic Change | Near-Surface Air Temperature, 2020-2100



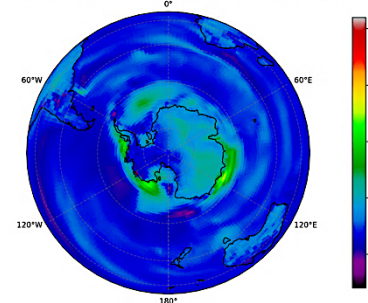
Arctic Change | Total Precipitation, 2020-2100



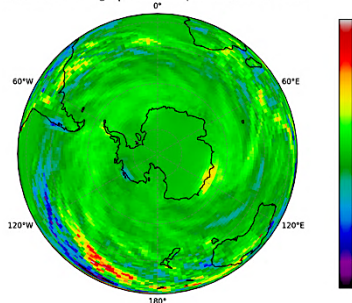
Arctic Change | Atmospheric Methane Concentration, 2020-2100



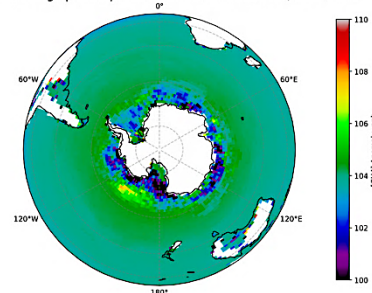
Antarctic Change | Near-Surface Air Temperature, 2020-2100



Antarctic Change | Total Precipitation, 2020-2100

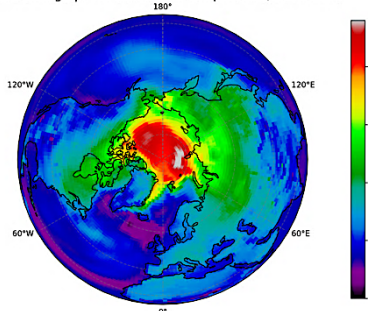


Antarctic Change | Atmospheric Methane Concentration, 2020-2100

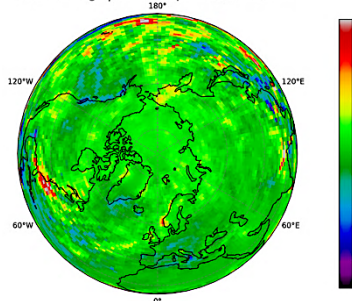


G7Cirrus

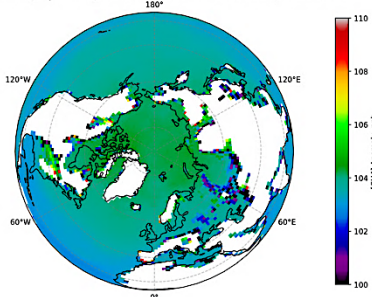
Arctic Change | Near-Surface Air Temperature, 2020-2100



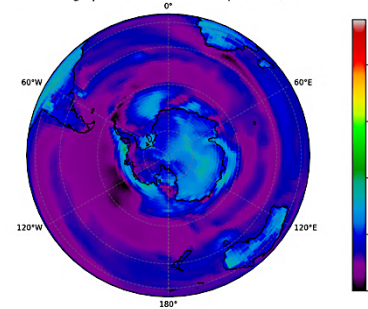
Arctic Change | Total Precipitation, 2020-2100



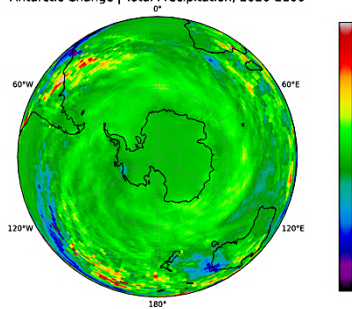
Arctic Change | Atmospheric Methane Concentration, 2020-2100



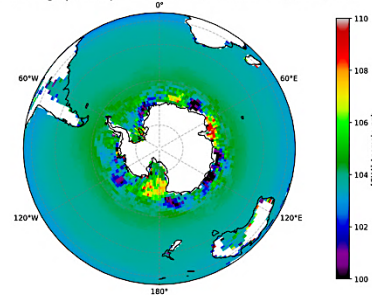
Antarctic Change | Near-Surface Air Temperature, 2020-2100



Antarctic Change | Total Precipitation, 2020-2100



Antarctic Change | Atmospheric Methane Concentration, 2020-2100



Supplementary Figure 11. Illustrations of circumpolar amplification in observational, mitigation, and intervention scenarios.