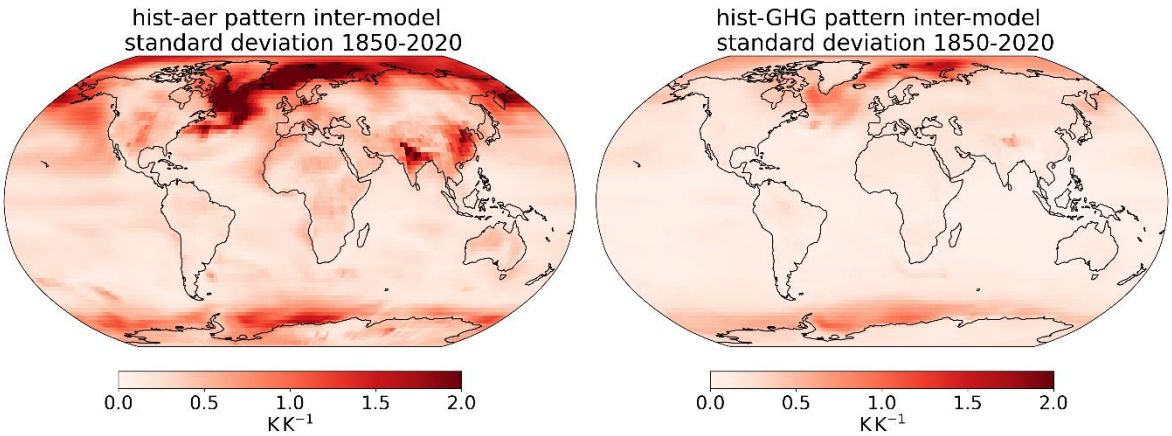
	hist-aer	hist-GHG
GFDL-ESM4	1	1
NorESM2-LM	3	3
FGOALS-g3	1	3
BCC-CSM2-MR	3	3
MIROC6	6	3
CanESM5	15	25
MRI-ESM2-0	5	5
ACCESS-ESM1-5	3	3
ACCESS-CM2	3	3
IPSL-CM6A-LR	10	10

Supplementary Table S1: the 10 ESMs used for the DAMIP analysis, and the number of members of each experiments. All ESMs with at least one member of the default initialisation, physics, and forcings (i1p1f1) in the cmip6-ng database were used.

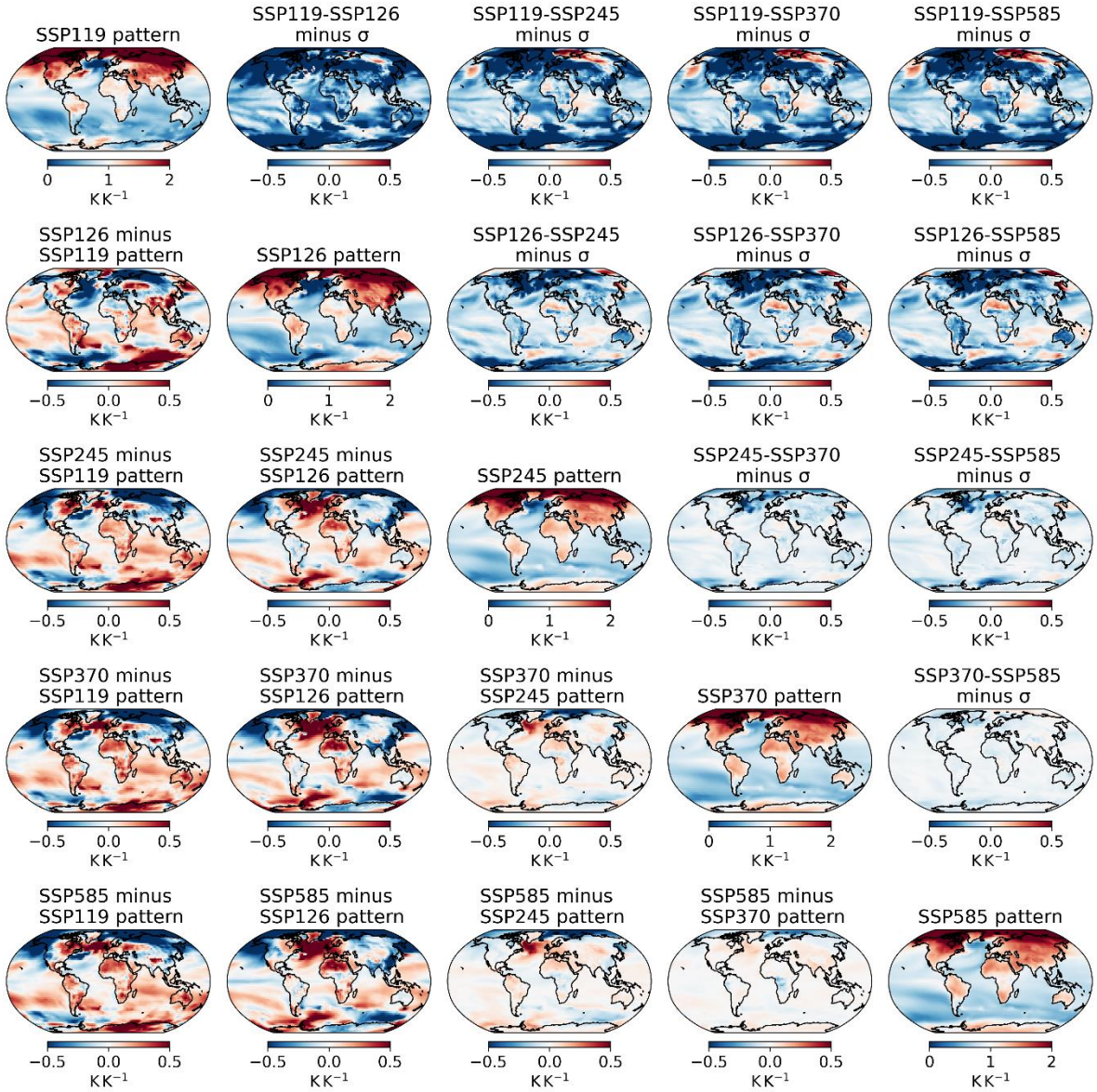
	SSP119	SSP245	SSP126	SSP370	SSP585
GFDL-ESM4	1	3	1	1	1
IPSL-CM6A-LR	6	11	6	11	6

EC-Earth3	51	22	7	7	58
FGOALS-g3	1	4	4	5	4
MIROC6	1	33	50	3	50
CanESM5	25	25	25	25	25
MRI-ESM2-0	5	5	5	5	5
EC-Earth3-Veg	3	5	5	4	5

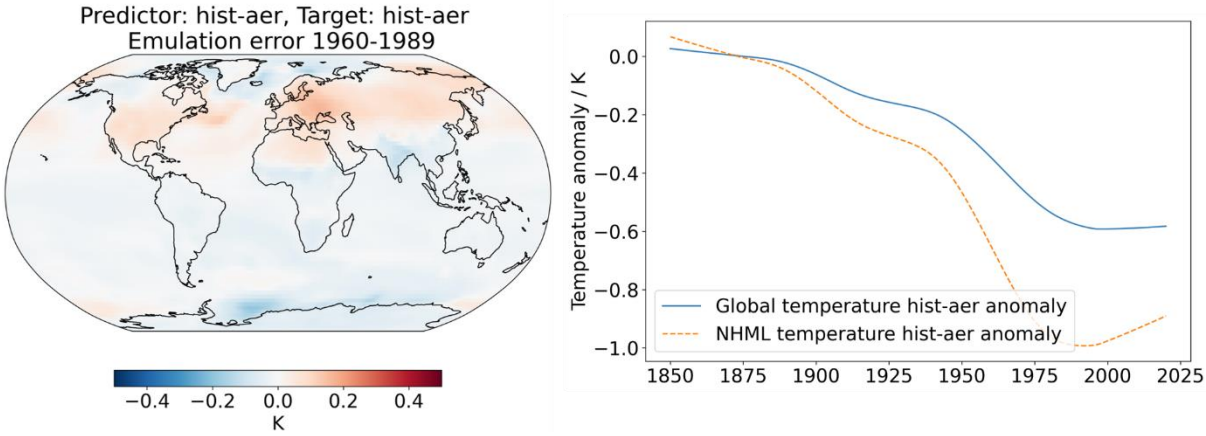
Supplementary Table S2: the eight ESMs used for the SSP analysis, and the number of members of each experiments. All ESMs with at least one member of the default initialisation, physics, and forcings (i1p1f1) in the cmip6-ng database were used.



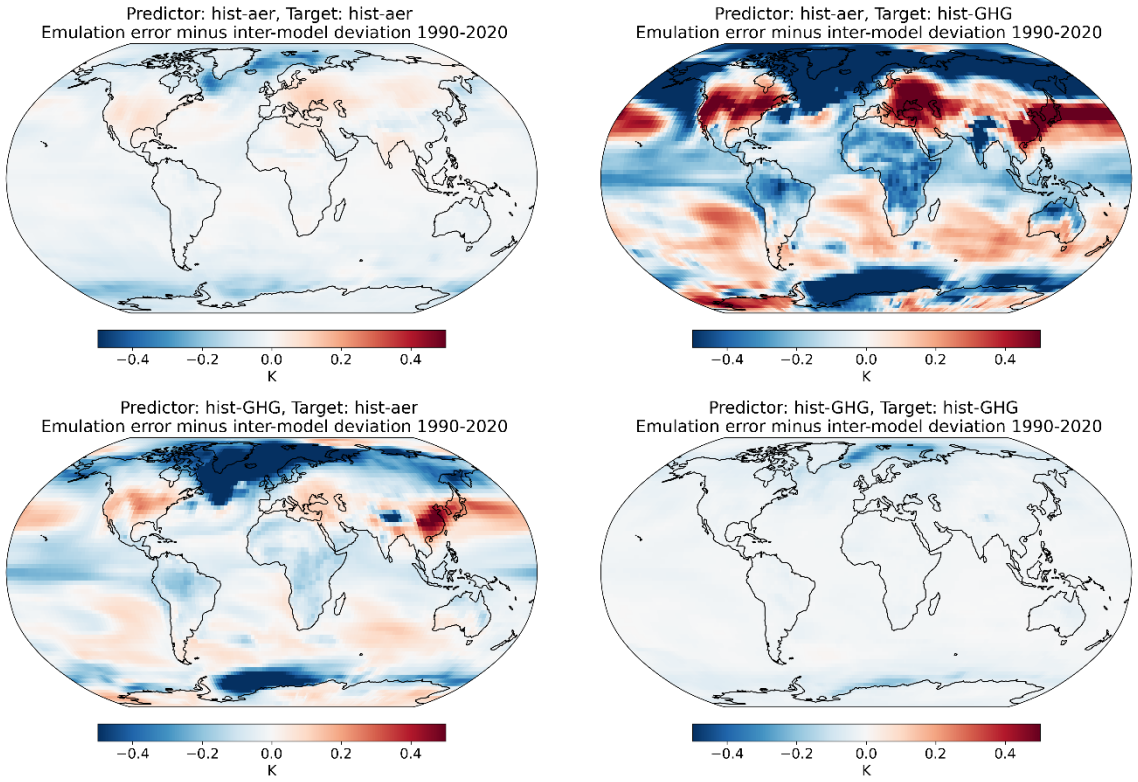
Supplementary Figure S1: inter-model standard deviation in the temperature response pattern in hist-aer and hist-GHG. Calculated between the 10 ESMs in Supplementary Table S1, with linear regression applied at each gridcell in MESMER.



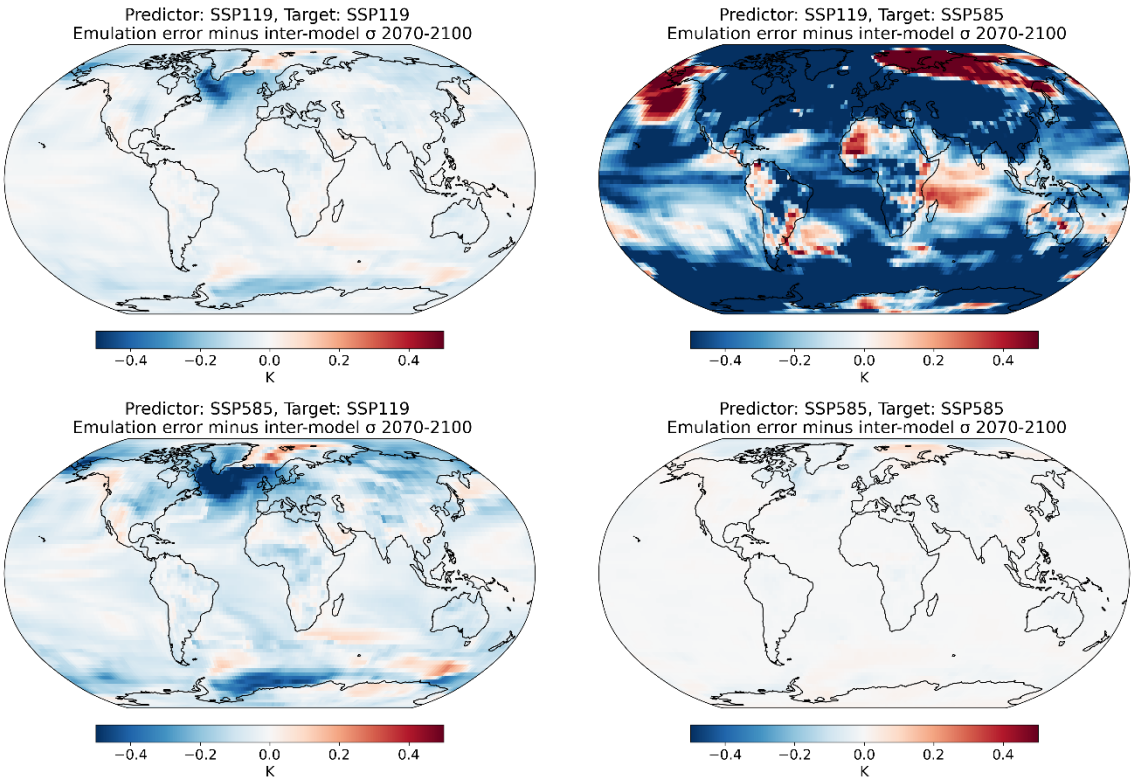
Supplementary Figure S2: as per Figure 3 but for all combinations of the five SSP scenarios analysed in this study. The diagonal shows the temperature patterns from each individual scenario. The bottom left section shows the pattern differences between each scenario pair. The top right section shows the magnitude of the difference minus the inter-model standard deviation, for each pair.



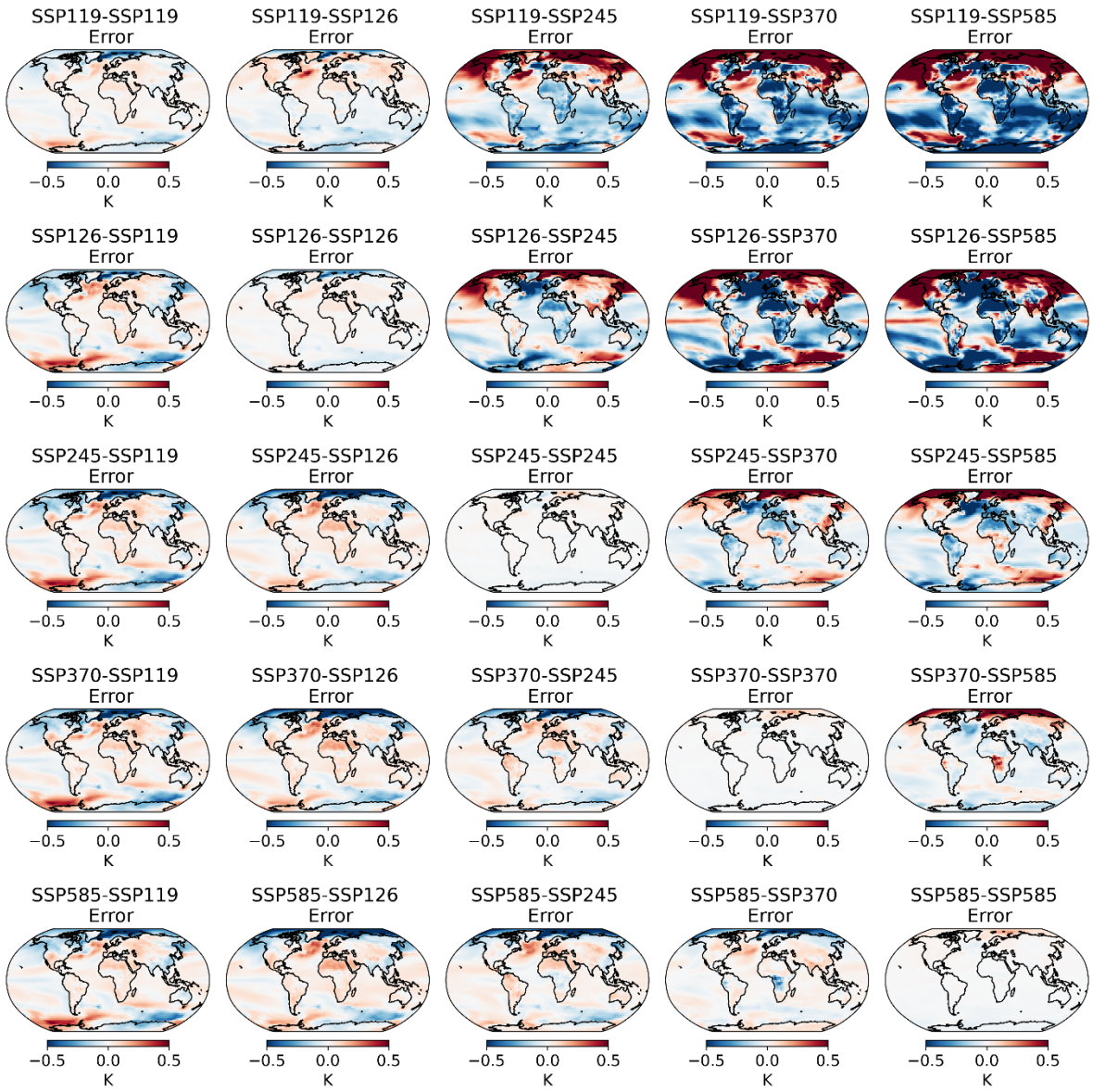
Supplementary Figure S3: hist-aer self-emulation error in 1960-1989 (left) and timeseries of global and NHML hist-aer temperature response (right). Both plots are averaged across all 10 ESMs used for the DAMIP analysis.



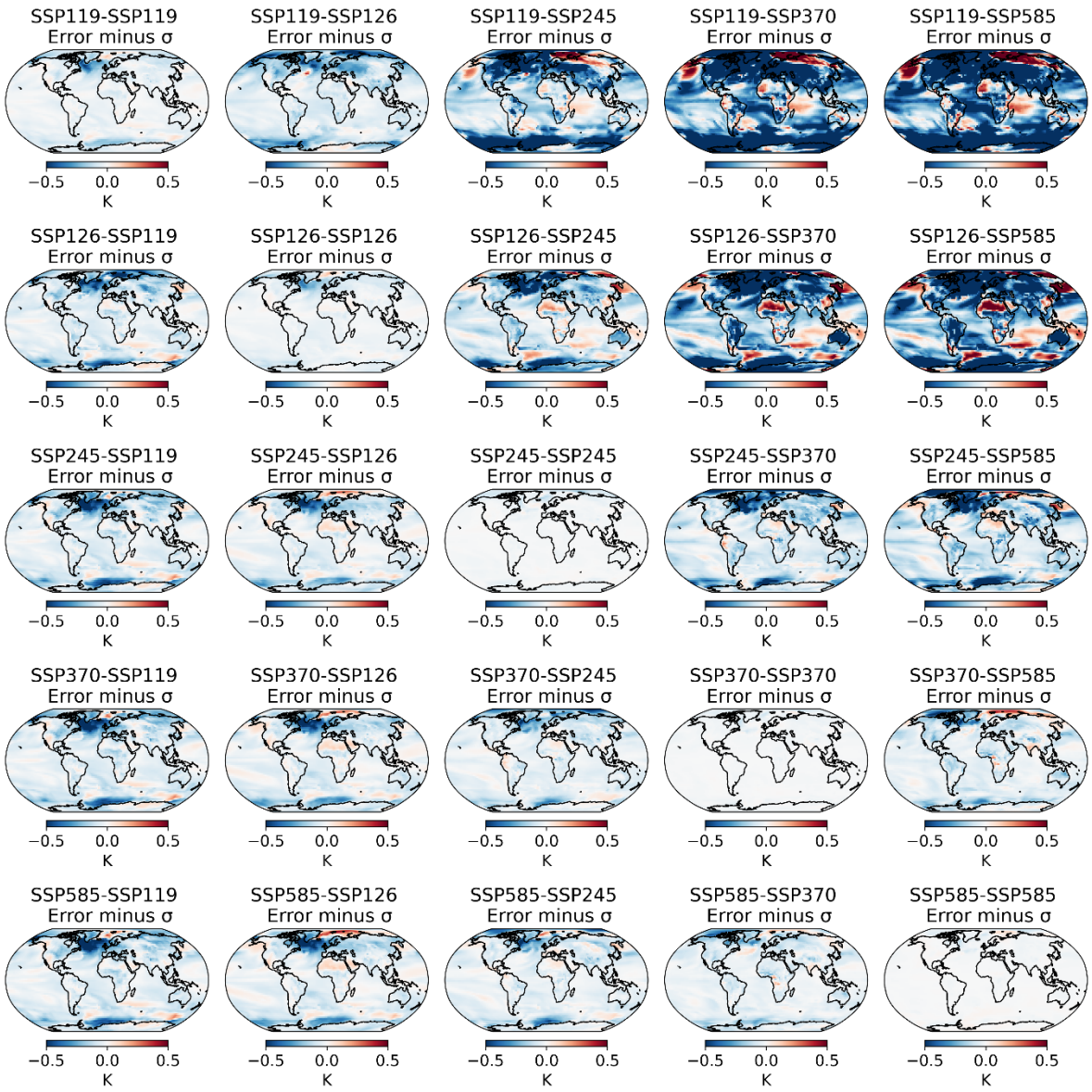
Supplementary Figure S4: Magnitude of the 1990-2020 DAMIP multi-model mean pattern scaling errors as shown in Figure 4, minus the inter-model standard deviation in these errors.



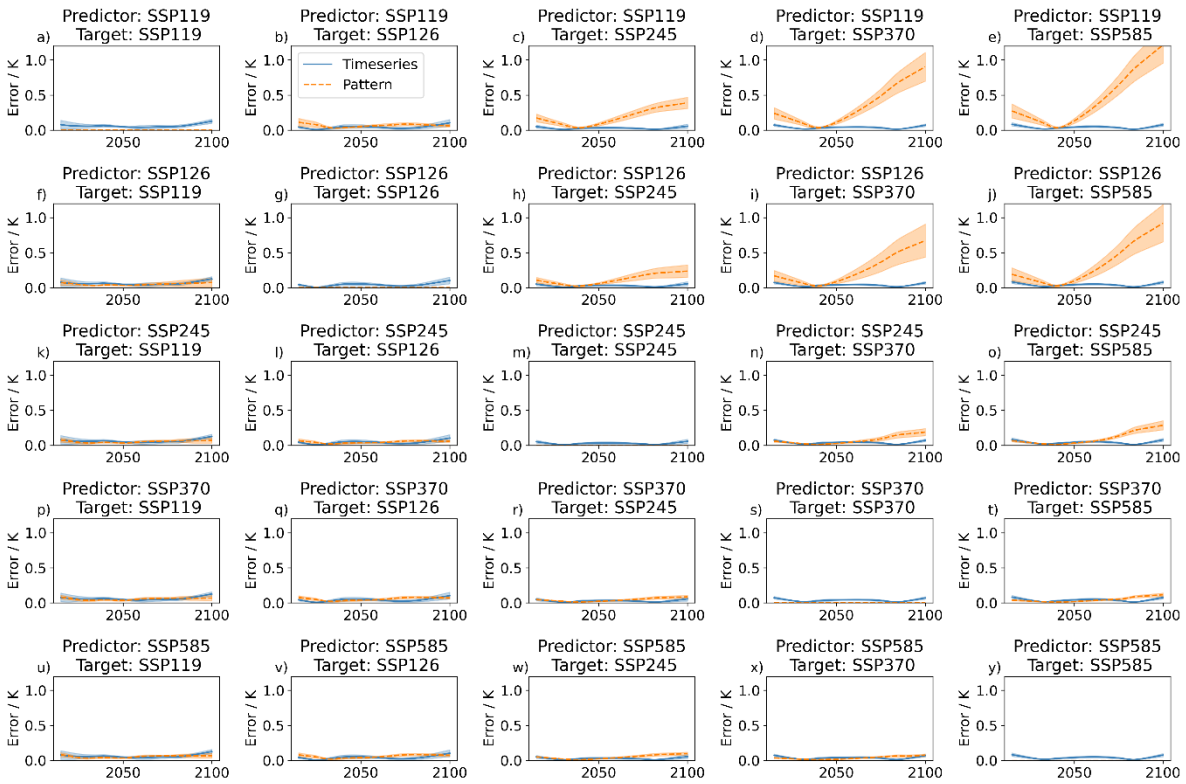
Supplementary Figure S5: 2070-2100 SSP multi-model mean pattern scaling errors as shown in Figure 5, minus the inter-model standard deviation in these errors.



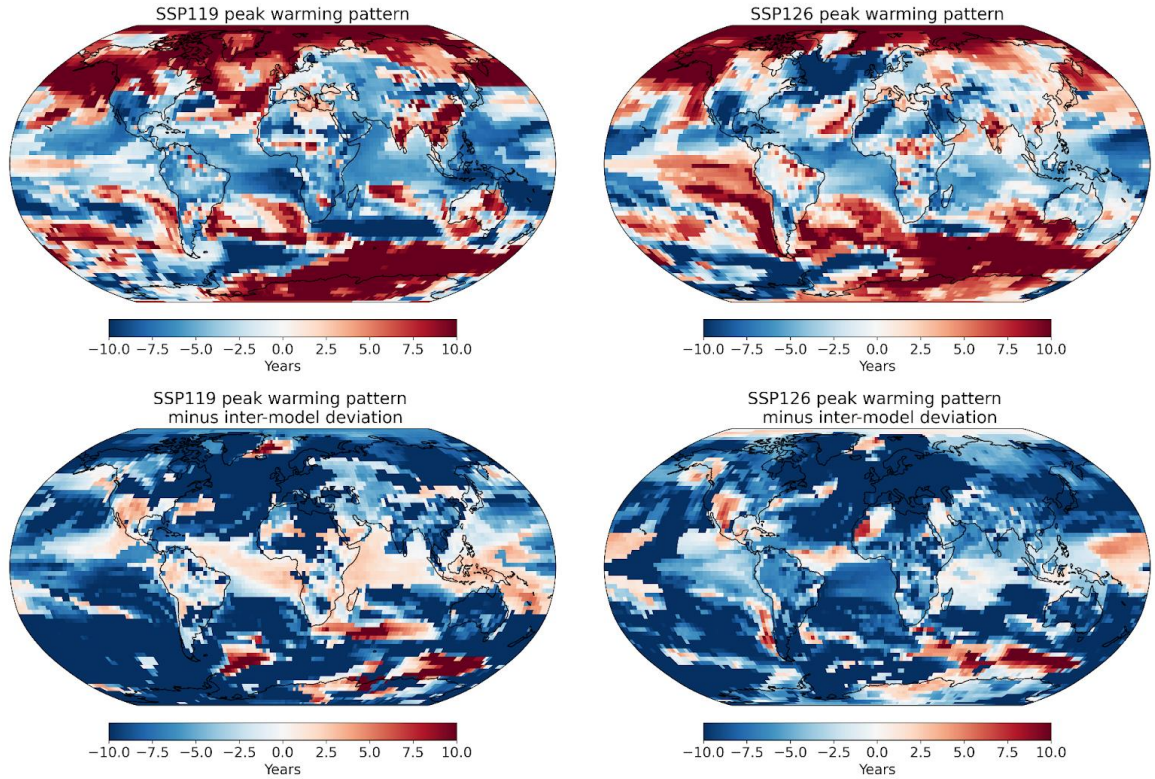
Supplementary Figure S6: As Figure 5 of the main text, but for every pair of the five SSP scenarios analysed here.



Supplementary Figure S7: As Figure S5, but for every pair of the five SSP scenarios analysed here.

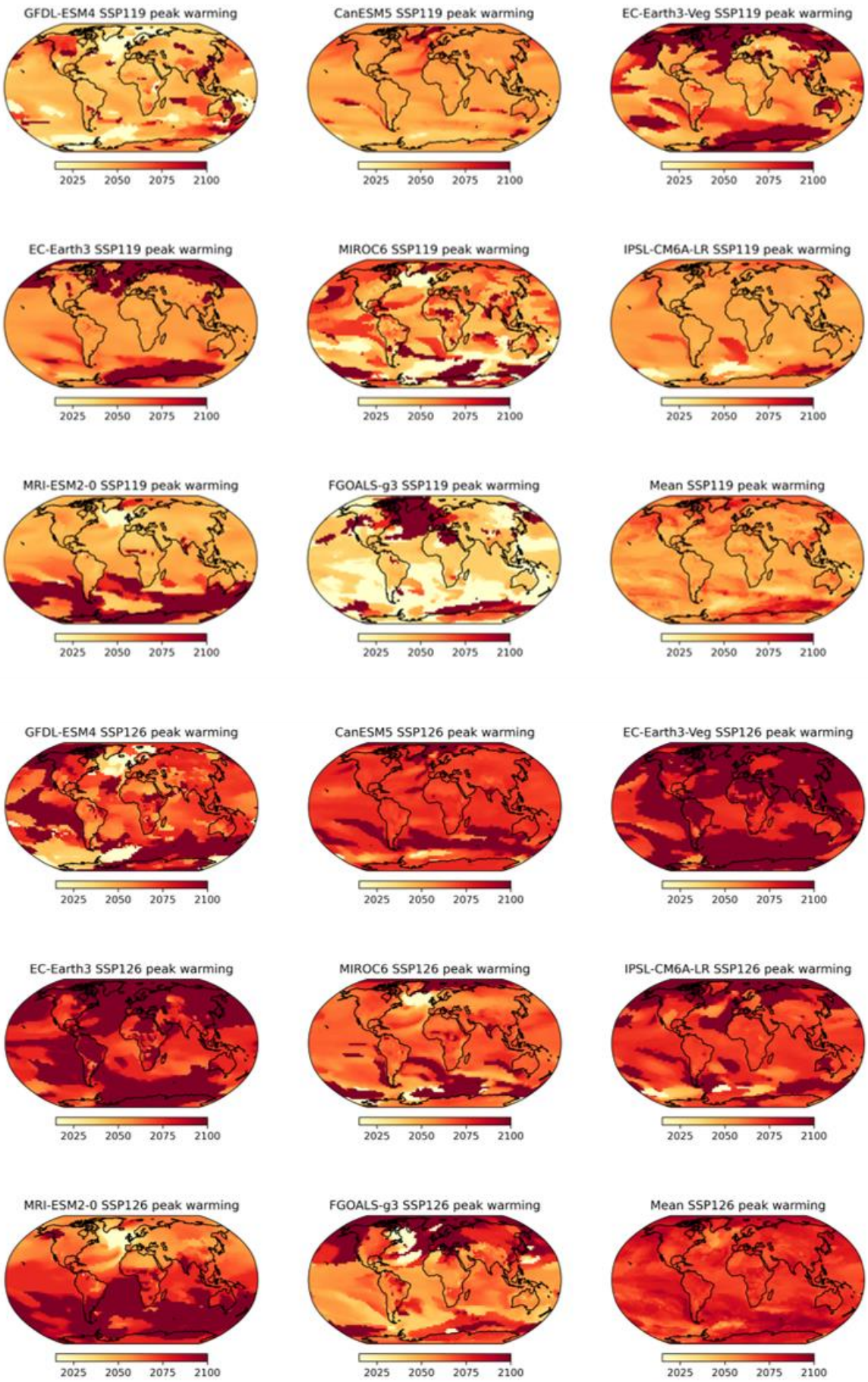


Supplementary Figure S8: as Figure 6 in the main text but for every pair of the five SSP scenarios and with identical scales to allow for comparison of error magnitudes between pairs of scenarios.

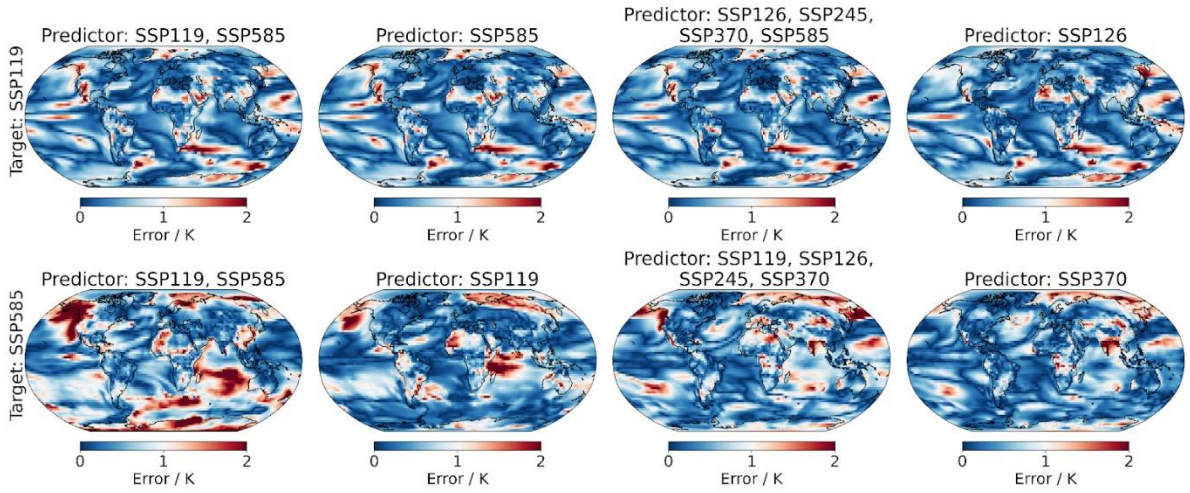


Supplementary Figure S9: deviation in local peak warming year from global average (of local warming year) averaged across 8 ESMs in SSP119 (top left) and SSP126 (top right), and the magnitude of this deviation minus one inter-model standard deviation (bottom). Note that the

deviation is with respect to the global weighted average of the local peak temperature year, not the peak year of the global average temperature, which are not necessarily the same.


GFDL-ESM4 SSP119 peak warming
CanESM5 SSP119 peak warming
EC-Earth3-Veg SSP119 peak warming
EC-Earth3 SSP119 peak warming
MIROC6 SSP119 peak warming
IPSL-CM6A-LR SSP119 peak warming
MRI-ESM2-0 SSP119 peak warming
FGOALS-g3 SSP119 peak warming
Mean SSP119 peak warming
GFDL-ESM4 SSP126 peak warming
CanESM5 SSP126 peak warming
EC-Earth3-Veg SSP126 peak warming
EC-Earth3 SSP126 peak warming
MIROC6 SSP126 peak warming
IPSL-CM6A-LR SSP126 peak warming
MRI-ESM2-0 SSP126 peak warming
FGOALS-g3 SSP126 peak warming
Mean SSP126 peak warming
2025 2050 2075 2100

Supplementary Figure S10: peak warming year - calculated as the peak in the LOWESS-smoothed timeseries at each gridcell - in each of the eight ESMs studied in the SSP analysis here, along with the multimodal year, for SSP119 (top) and SSP126 (bottom).



Supplementary Figure S11: magnitude of 2070-2100 pattern scaling errors divided by the inter-model variability in the errors, when projecting SSP119 (top) and SSP585 (bottom) for patterns using four sets of predictors - see main text for details.