How aerosols and greenhouse gases influence the diurnal temperature range

Camilla W. Stjern[1], Bjørn H. Samset[1], Olivier Boucher[2], Trond Iversen[3], Jean-François Lamarque[4], Gunnar Myhre[1], Drew Shindell[5], Toshihiko Takemura[6]

[1]CICERO Center of International Climate Research, Oslo, Norway

[2] Institut Pierre-Simon Laplace, Sorbonne Université / CNRS, Paris, France

[3] Norwegian Meteorological Institute, Oslo, Norway

[4] NCAR/UCAR, Boulder, USA

[5] Nicholas School of the Environment, Duke University, Durham, NC, USA

[6] Kyushu University, Fukuoka, Japan

Corresponding author: Camilla W. Stjern, camilla.stjern@cicero.oslo.no

Tables S1 – S8

Figure S1 – S5

Table S1: Multi-model median correlations (i.e., the median of the 9 individual model correlation coefficients) between changes in DTR and a selection of variables, for the global land region. Correlations are based on 50 yearly (the last 50 years of the 100-year simulations) values of seasonal, regional mean changes. The table only includes coefficients for relationships that were statistically significant ($p < 0.05$ by the Student's t-test) for at least 75 % of the models. Note that we also calculated correlations to surface evaporation, but as correlation coefficients were nearly identical to that of latent heat, it is not included here.

		Cloud cover	Latent heat	Sensible heat	Clear-sky downwelling SW radiation	All-sky downwelling SW radiation	All-sky downwelling LW radiation
CO2x2	DJF	-0.57	-0.39			+0.58	-0.33
	JJA	-0.60	-0.49	+0.58		+0.60	
BCx10	DJF	-0.52	-0.27			+0.67	-0.35
	JJA	-0.62	-0.46	+0.64		+0.64	
SO4x5	DJF	-0.50	-0.29		+0.42	+0.61	-0.42
	JJA	-0.67	-0.55	+0.68		+0.71	

Table S2: Like Table S1, for the USA region.

		Cloud cover	Latent heat	Sensible heat	Clear-sky downwelling SW radiation	All-sky downwelling SW radiation	All-sky downwelling LW radiation
CO2x2	DJF	-0.64	-0.30			+0.51	
	JJA	-0.74	-0.76	**+0.84**		**+0.83**	
BCx10	DJF	-0.67	-0.24			+0.63	-0.30
	JJA	-0.74	-0.74	**+0.88**		**+0.86**	
SO4x5	DJF	-0.56				+0.58	
	JJA	-0.78	-0.66	**+0.85**	+0.40	+0.80	

Table S3: Like Table S1, for the Europe region. Regionally averaged, DTR goes down in DJF for all drivers, consistently due to a stronger increase in T_{min} than in T_{max}. In JJA, DTR increases, due to a much stronger increase in T_{max} than in T_{min}. Cloud amounts go down in DJF and up in JJA.

		Cloud cover	Latent heat	Sensible heat	Clear-sky downwelling SW radiation	All-sky downwelling SW radiation	All-sky downwelling LW radiation
CO2x2	DJF	-0.51				+0.50	-0.50
	JJA	-0.77	-0.58	**+0.84**		**+0.80**	
BCx10	DJF	-0.53			+0.48	+0.57	-0.53
	JJA	-0.70	-0.57	+0.77		+0.77	
SO4x5	DJF	-0.38			+0.55	+0.51	-0.61
	JJA	-0.70		**+0.84**	+0.37	**+0.83**	

Table S4: Like Table S1, for the India region.

		Cloud cover	Latent heat	Sensible heat	Clear-sky downwelling SW radiation	All-sky downwelling SW radiation	All-sky downwelling LW radiation
CO2x2	DJF	-0.61	-0.54	+0.67	+0.68	**+0.82**	-0.66
	JJA	**-0.85**	-0.70	**+0.87**	+0.59	**+0.85**	-0.28
BCx10	DJF	-0.67	-0.66	+0.64	+0.56	+0.70	-0.67
	JJA	**-0.84**	-0.65	**+0.84**	+0.71	**+0.90**	-0.30
SO4x5	DJF	-0.67	-0.64	+0.75	+0.64	**+0.81**	-0.58
	JJA	**-0.83**	-0.78	**+0.87**	+0.76	**+0.89**	-0.63

Table S5: Like Table S1, for the China region.

		Cloud cover	Latent heat	Sensible heat	Clear-sky downwelling SW radiation	All-sky downwelling SW radiation	All-sky downwelling LW radiation
CO2x2	DJF	-0.78		+0.43	+0.53	**+0.87**	-0.39
	JJA	-0.75		+0.77		**+0.85**	
BCx10	DJF	-0.73		+0.31	+0.32	+0.75	
	JJA	-0.78		+0.70		**+0.86**	
SO4x5	DJF	-0.67				+0.79	
	JJA	-0.75		+0.77	+0.64	**+0.81**	-0.41

Table S6: Like Table S1, for the Arctic region, where DTR goes down for all drivers in DJF, while JJA responses are more varying (increasing DTR for CO_2, due to strong increase in T_{max}, but reducing for BC and SO_4 due to stronger increase in T_{min}).

		Cloud cover	Latent heat	Sensible heat	Clear-sky downwelling SW radiation	All-sky downwelling SW radiation	All-sky downwelling LW radiation
CO2x2	DJF			-0.39			
	JJA	-0.73	+0.52	+0.60		+0.77	
BCx10	DJF			-0.38			
	JJA	-0.76		+0.59		+0.72	
SO4x5	DJF						
	JJA	-0.77		+0.58		+0.70	

Table S7: Multi-model median cloud cover changes, normalized by global mean temperature change [% per K].

	CO2x2		BCx10		SO4x5	
	DJF	JJA	DJF	JJA	DJF	JJA
LND	+0.10	-0.35	-0.20	-1.13	+0.04	-0.41
USA	+0.15	-0.12	+0.44	-3.10	-0.26	-1.04
EUR	+0.10	-0.75	-0.85	-6.60	+0.45	-1.18
IND	-0.09	-0.0	-0.24	+5.65	-0.56	+2.16
CHI	+0.03	-0.29	+1.45	+0.71	-0.17	+0.15
ARC	+1.04	-0.51	+1.27	+0.71	+0.88	+0.55

Table S8: Multi-model median changes in downwelling clear-sky SW radiation at the surface, normalized by global mean temperature change [W/m2 per K].

	CO2x2		BCx10		SO4x5	
	DJF	JJA	DJF	JJA	DJF	JJA
LND	-0.97	-1.05	-13.64	-20.63	+1.34	+2.96
USA	-1.18	-0.93	-10.15	-20.60	+1.82	+5.40
EUR	-0.79	-0.74	-10.88	-33.71	+1.90	+8.34
IND	-1.21	-1.49	-53.65	-43.68	+3.21	+4.92
CHI	-1.33	-1.16	-46.07	-49.48	+3.50	+9.23
ARC	-0.34	-1.21	-2.20	-11.50	+0.27	+0.47
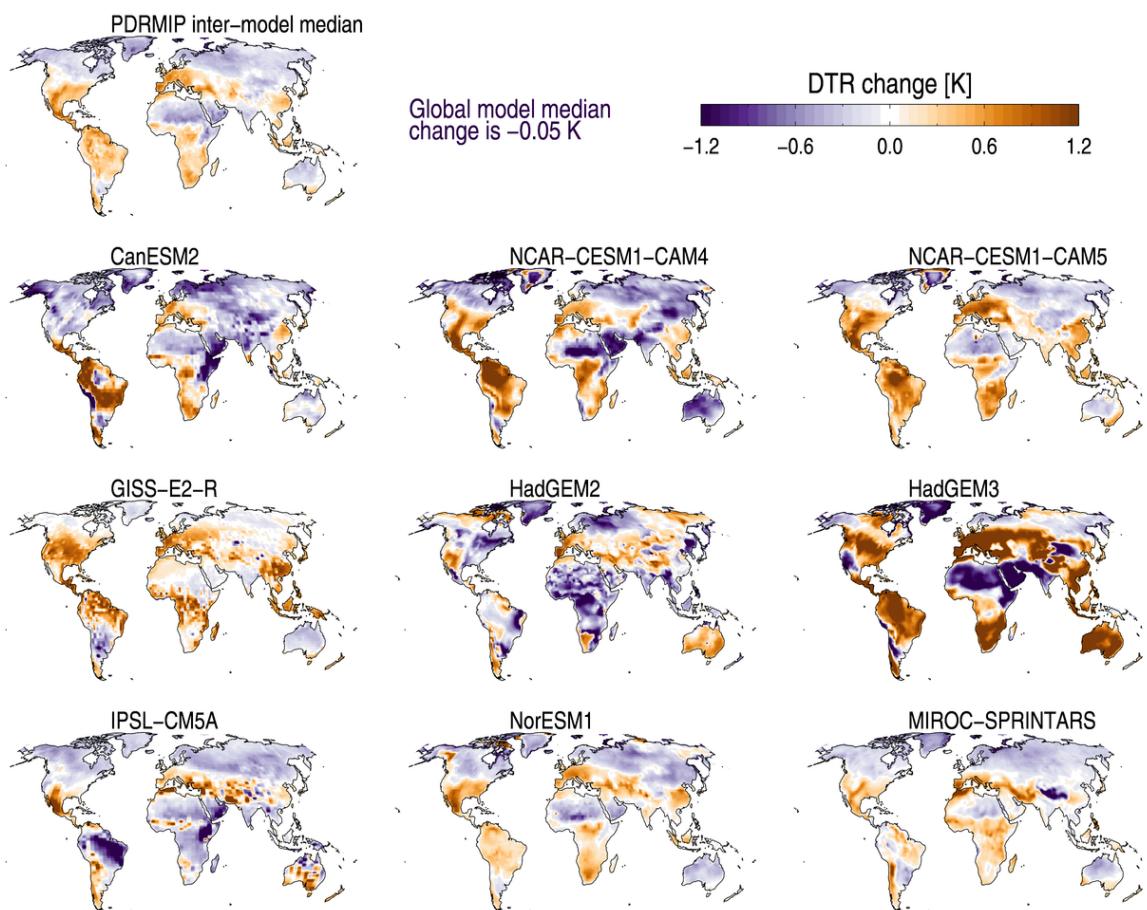
Figure S1: Annual mean DTR change (not normalized by global mean temperature change as in the main manuscript) for the CO2x2 experiment for all nine models.
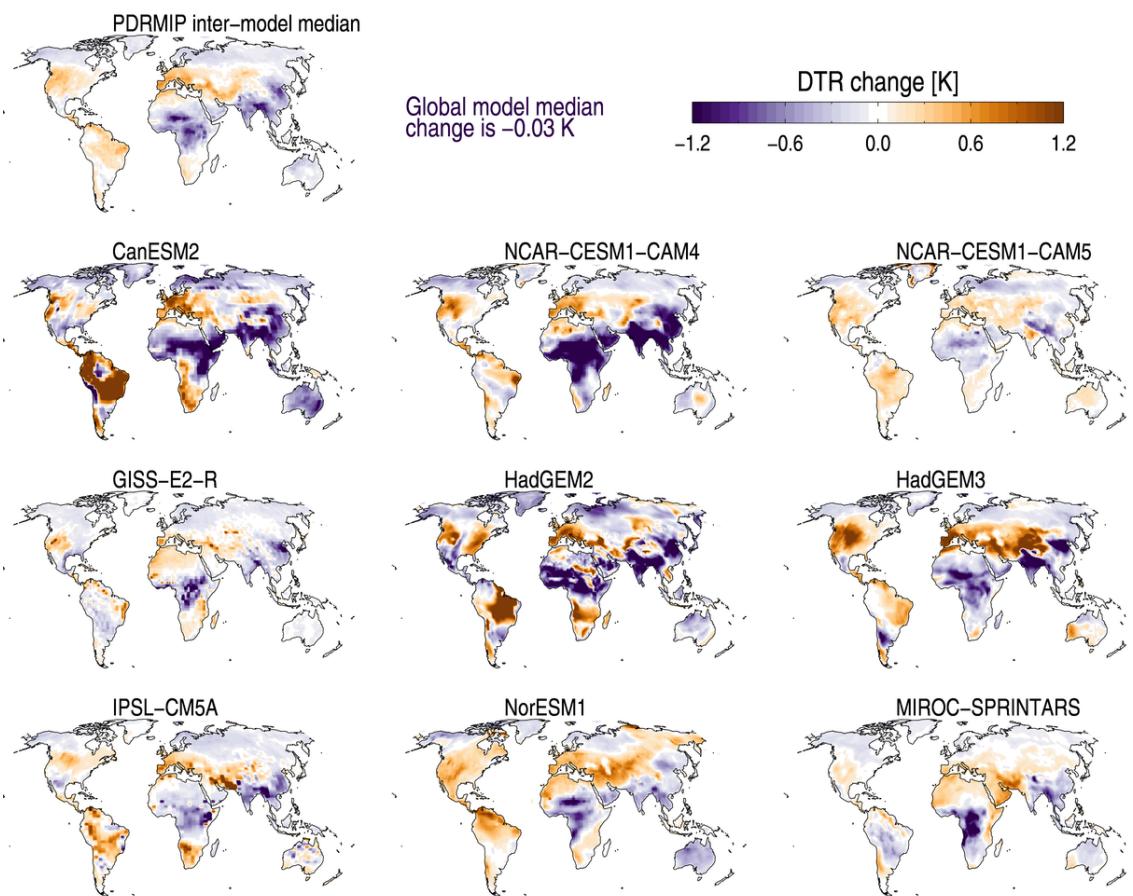
Figure S2: Annual mean DTR change (not normalized by the global mean temperature change as in the main manuscript) for the BCx10 experiment for all nine models.
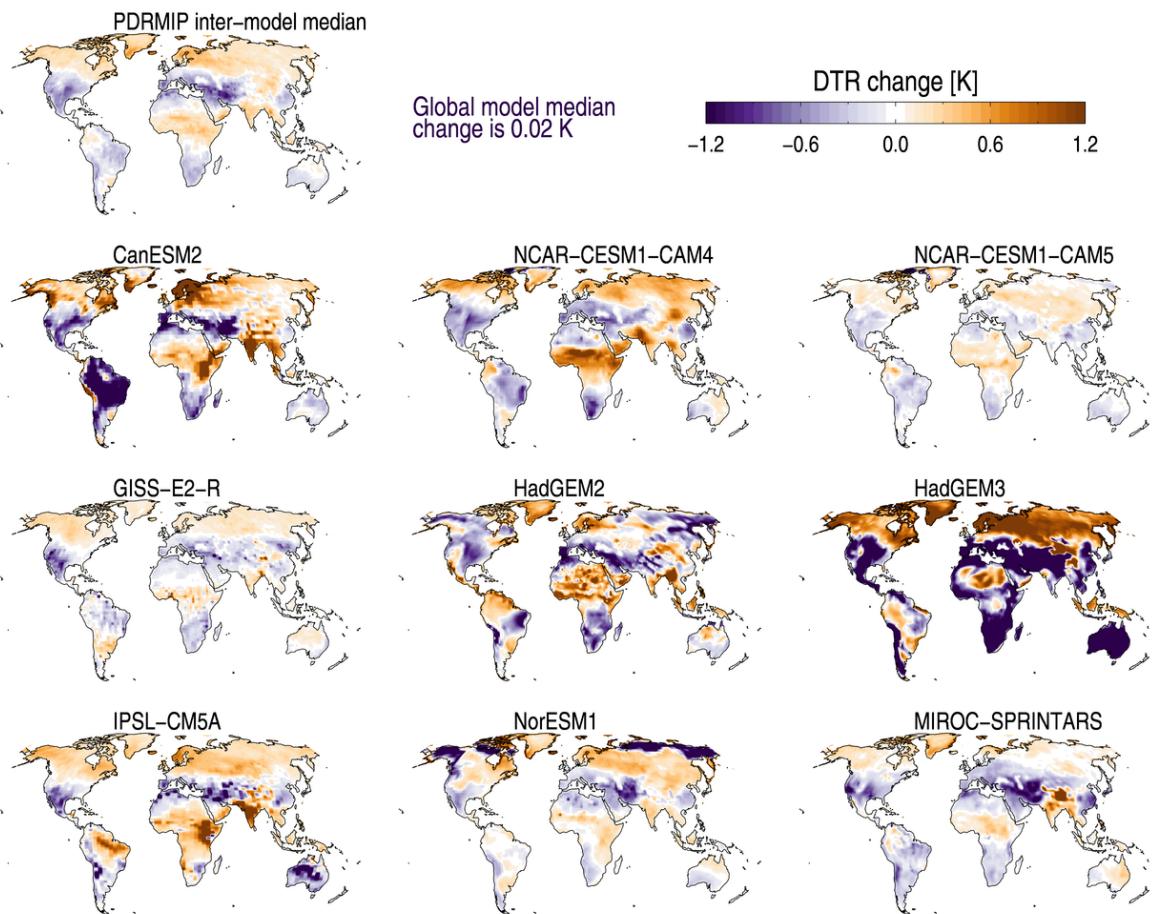
Figure S3: Annual mean DTR change (not normalized by the global mean temperature change as in the main manuscript) for the SO4x5 experiment for all nine models. Note that as SO_4 cools the climate, normalization by the global mean temperature change turns the sign of the DTR change expected from an increase in SO_4. An increase in SO_4 causes, e.g., reduced DTR over China and increased DTR over India, as seen in the maps above, but opposite to the signals seen in the maps of the main manuscript.
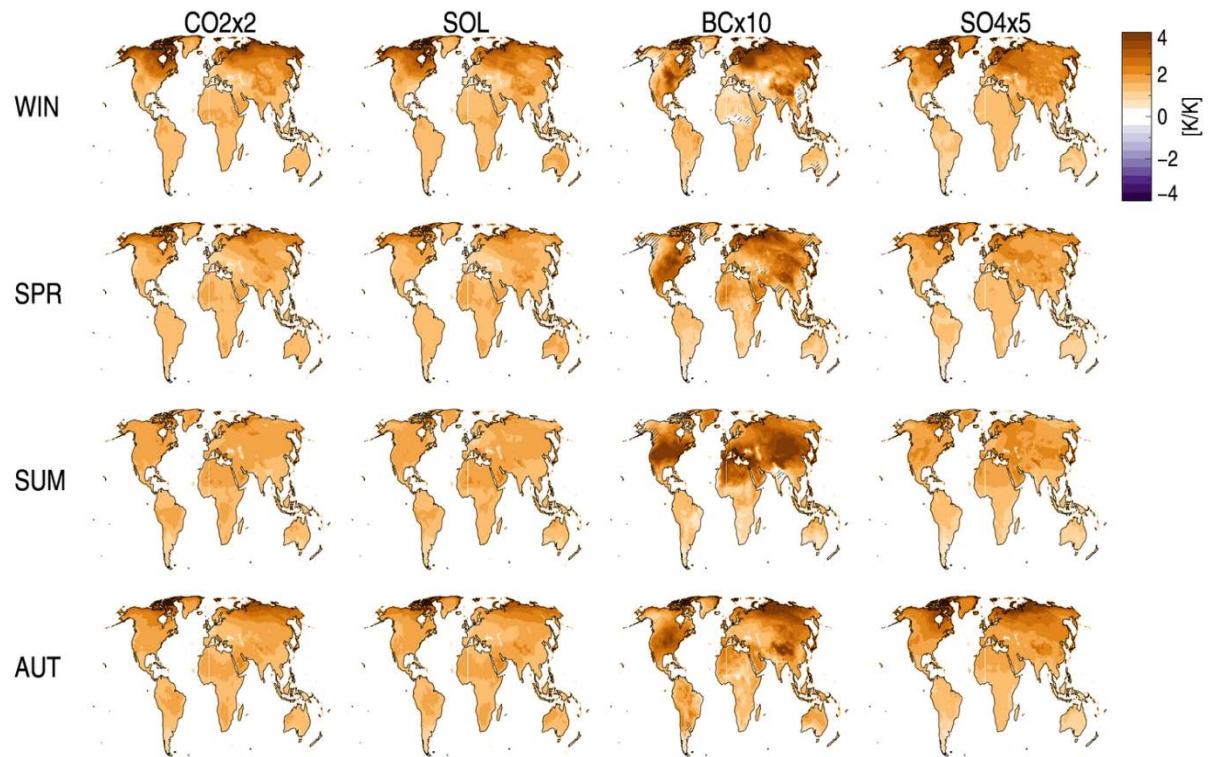
Figure S4: Multi-model median change in Tmin for the different seasons and drivers, normalized by the global mean temperature change for each model and driver.
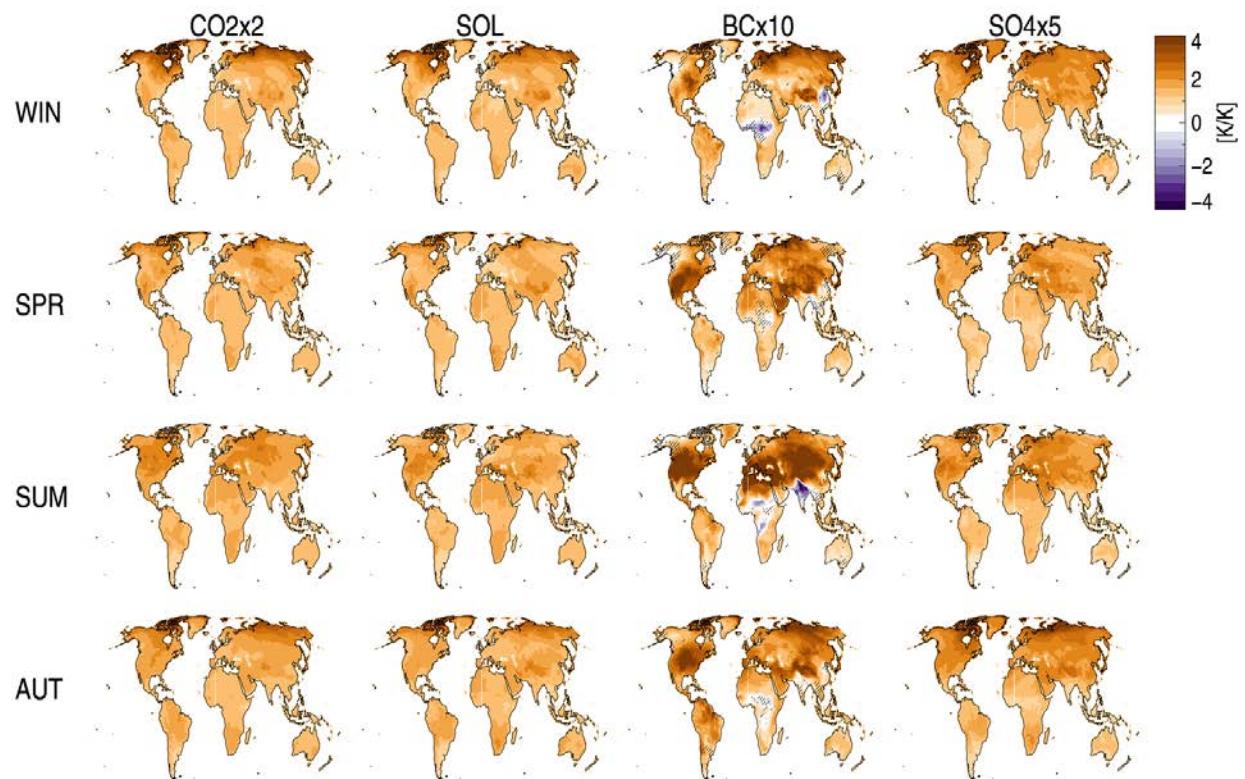
Figure S5: Multi-model median change in Tmax for the different seasons and drivers, normalized by the global mean temperature change for each model and driver.