

Supplement of

Dependency of the impacts of geoengineering on the stratospheric sulfur injection strategy part 1: Intercomparison of modal and sectional aerosol module

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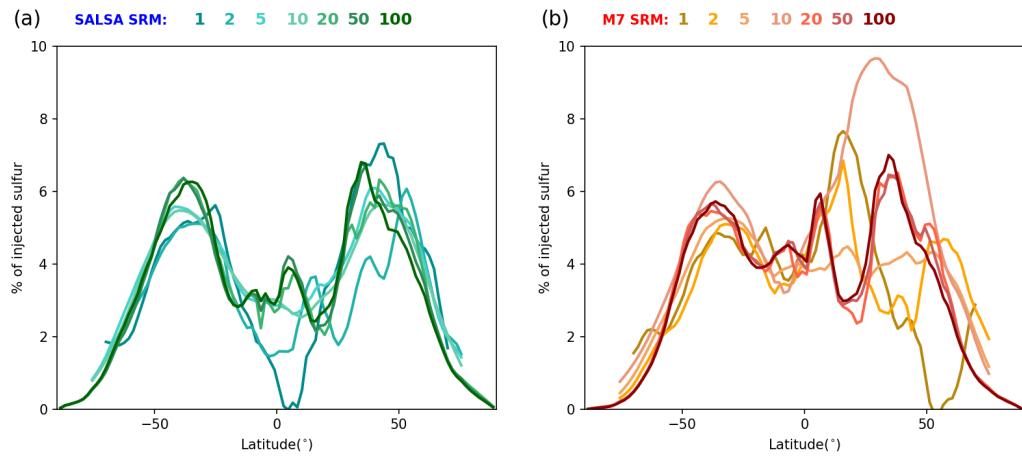


Figure S1: Relative zonal mean sulfate deposition in baseline scenarios simulated with a) SALSA and b) M7. Figure shows zonal running means of 21 latitudinal gridboxes for 1 Tg(S)/yr injection rate and running mean of 15 latitudinal gridboxes for 2, 5, 10 Tg(S)/yr injection rates.

Sulfate deposition fluxes

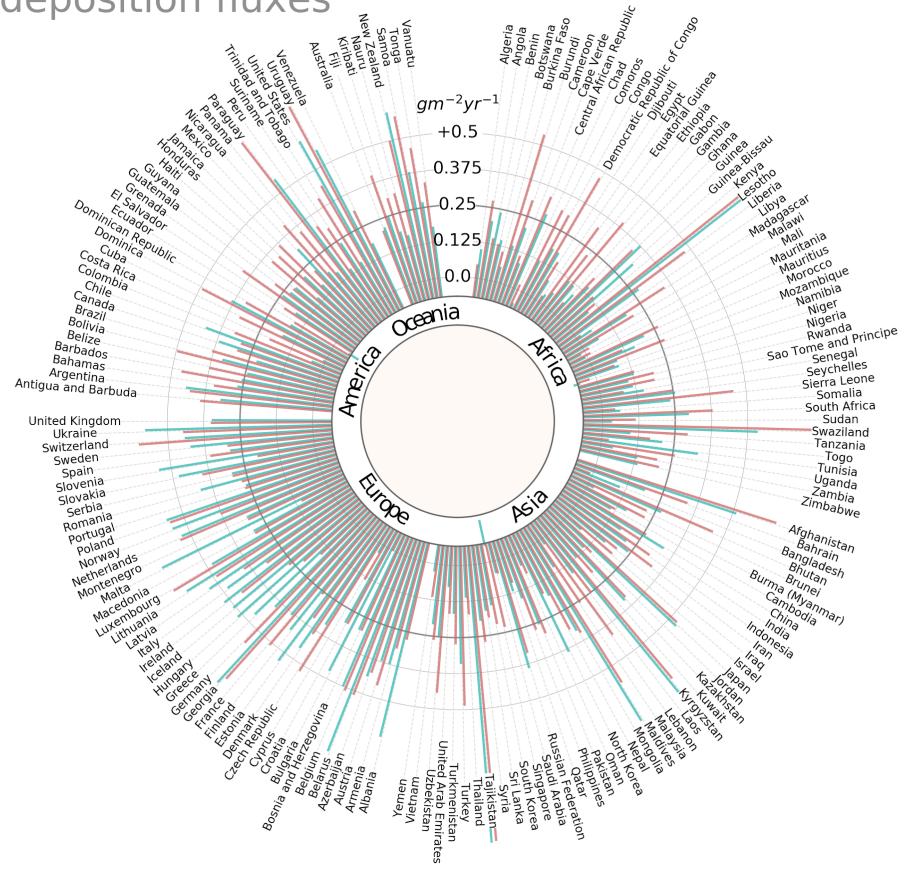


Figure S2: Deposited sulfate per country in baseline scenario with 50 Tg(S)/yr injection rate.
Blue bars show results simulated with SALSA and red bars are from simulations with M7.

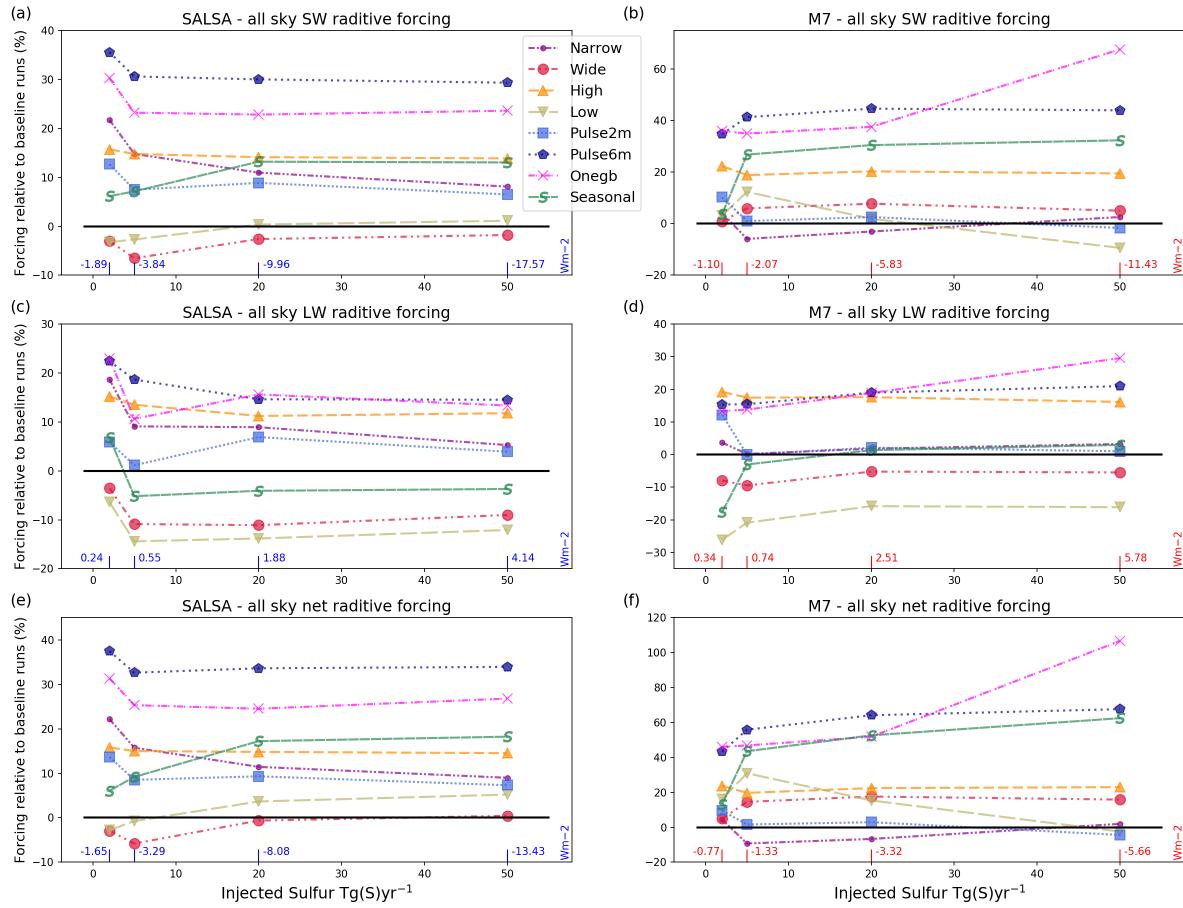


Figure S3. Relative global mean all-sky SW (a-b), LW (c-d) and net radiative forcing in sensitivity scenarios compared to baseline scenario with corresponding sulfur injection rate. Baseline values are shown at the bottom of each panel. SALSA results are shown in the left and M7 in right panels. Note different y-axes scale between the panels.

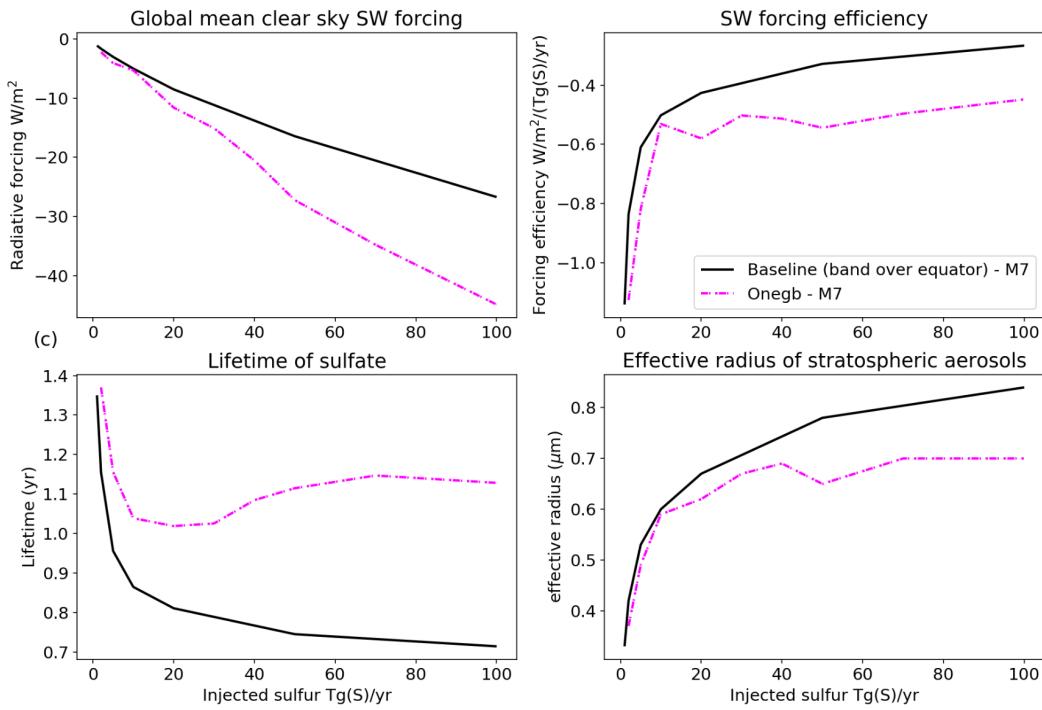


Figure S4. a) Global mean clear sky SW forcing and b) forcing efficiency, c) lifetime and d) effective radius of stratospheric aerosols (sulfate) in baseline and Onegb scenarios simulated with M7.

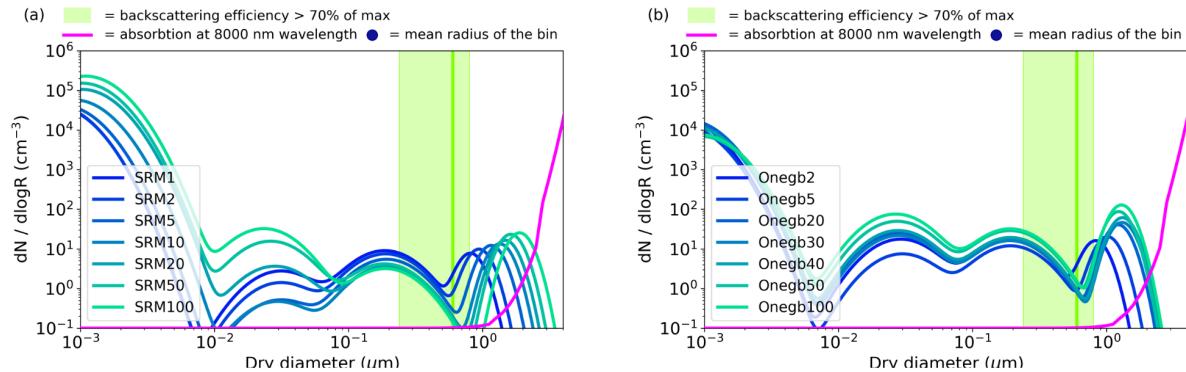


Figure S5. Average aerosol number size distribution at the Equator and at the 20-22 km altitude in a) Baseline and b) Onegb scenarios simulated with M7.

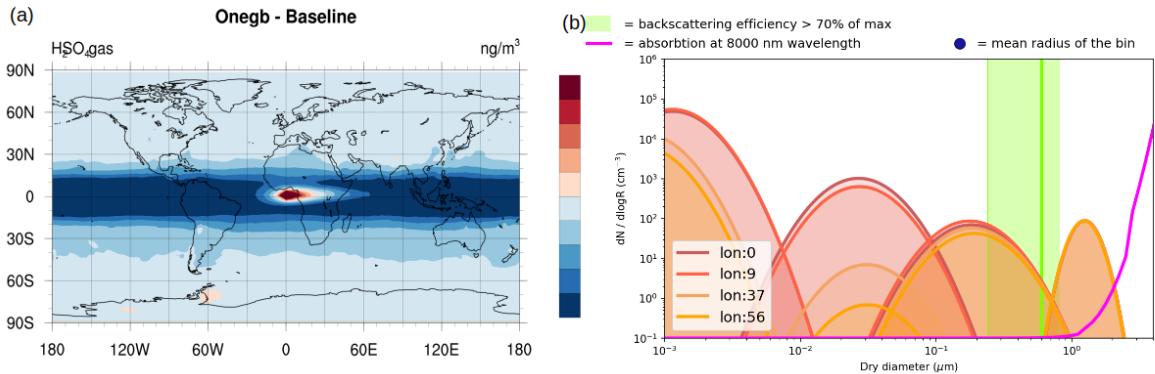


Figure S6. a) Difference in column sum of gaseous sulfuric acid concentration between Onegb and Baseline scenarios b) Number size distribution in Onegb scenario at the 20 km altitude over the Equator at different longitudes. Injections are taking place over the Prime meridian in Onegb scenario.

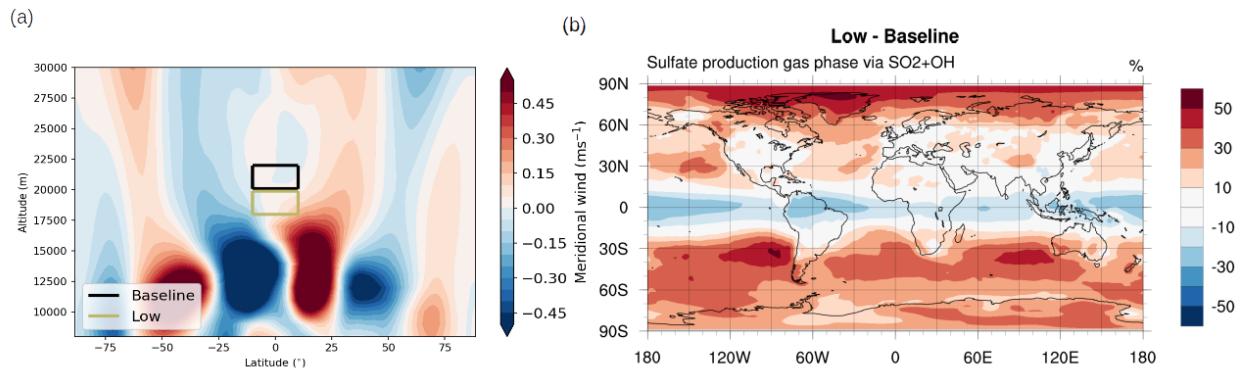


Figure S7. a) Mean meridional wind pattern in Baseline scenario with 5 Tg(S)/yr injection rate simulated with M7. b) Difference in Sulfate production via SO₂ and OH between Low and Baseline scenarios with 5 Tg(S)/yr injection rate simulated with M7.

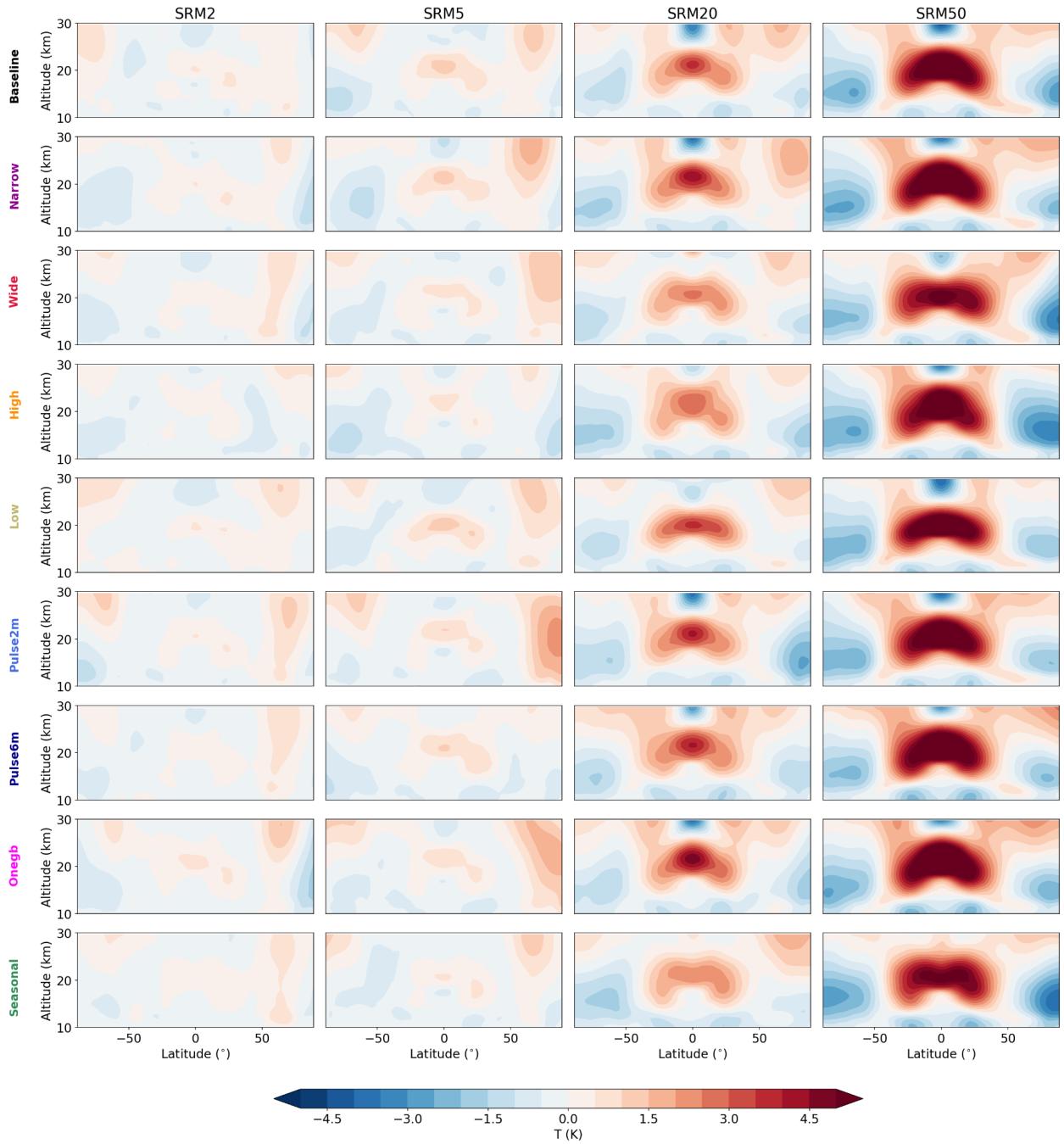


Figure S8. Temperature anomaly due to the stratospheric sulfur injection with different injection rates simulated with SALSA.

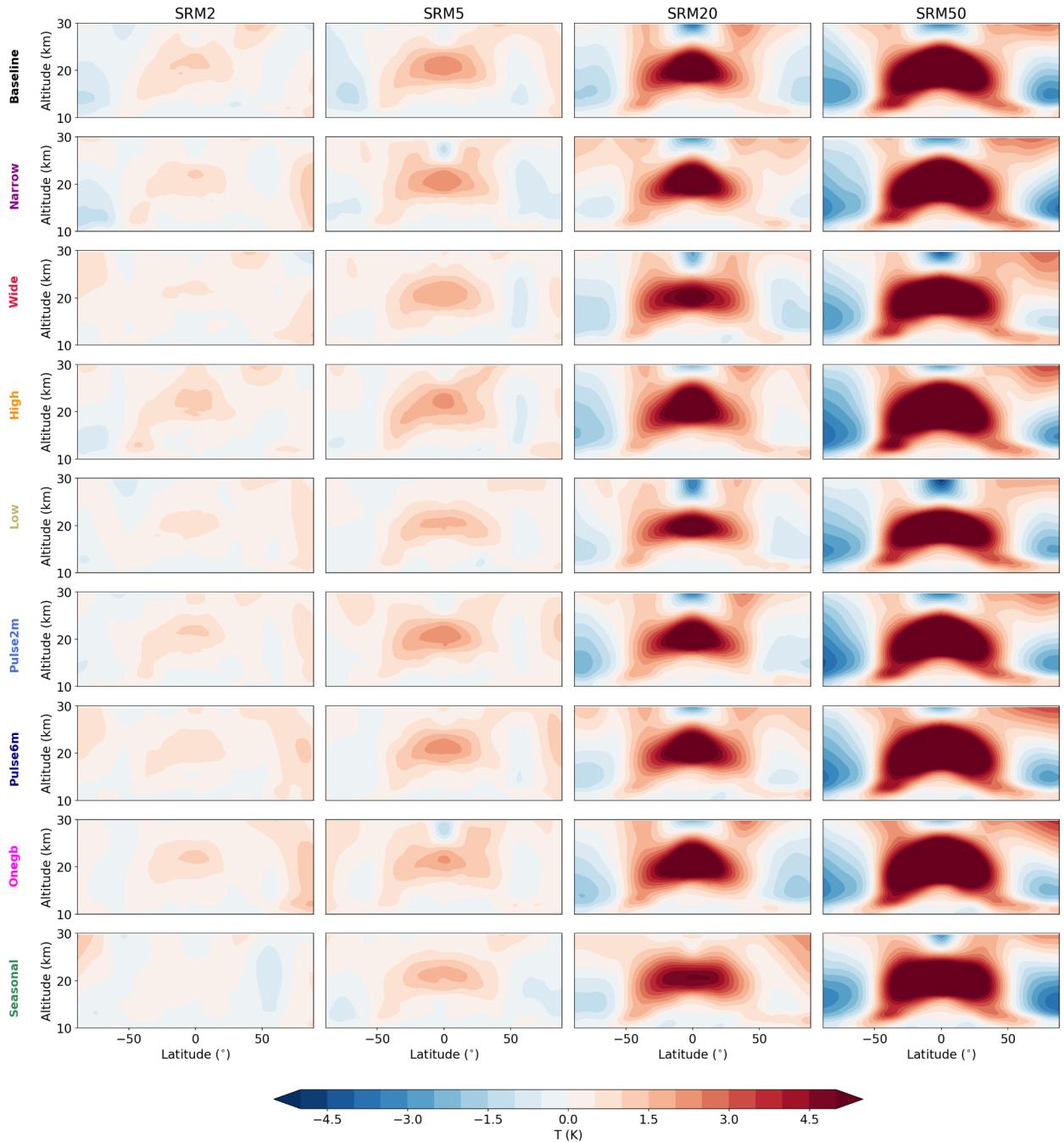


Figure S9. Temperature anomaly due to the stratospheric sulfur injection with different injection rates simulated with M7.

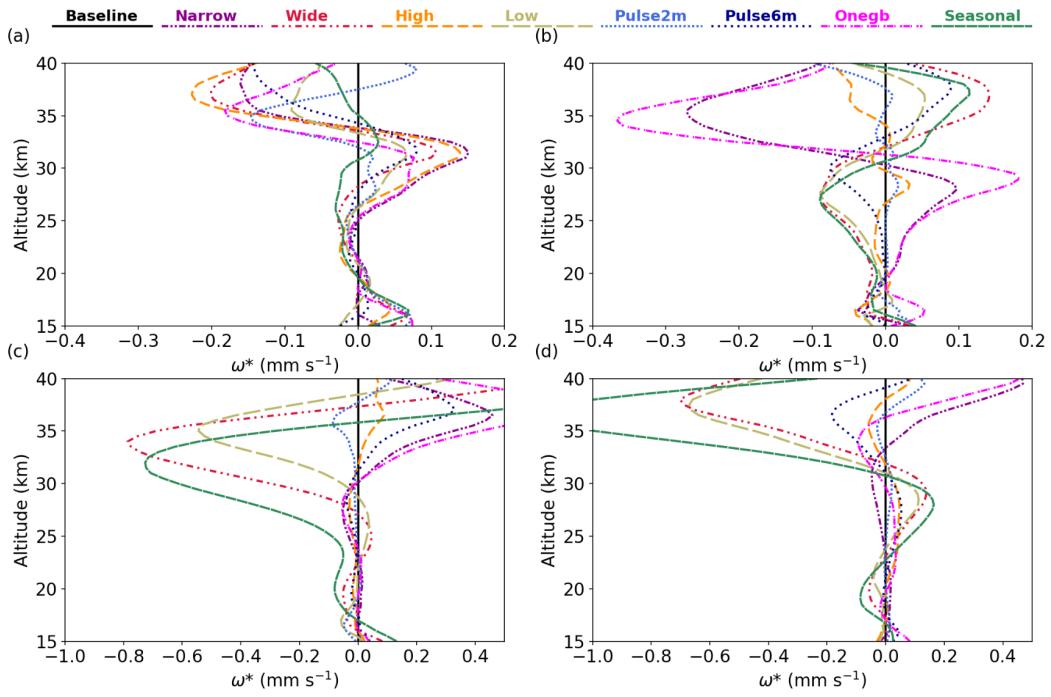


Figure S10. Residual vertical velocity in the tropics for different injection strategies compared to baseline scenario of corresponding injection rates (a-b 5 Tg(S)/yr and c-d 50 Tg(S)/yr) for SALSA (a,c) and M7 (b,d).

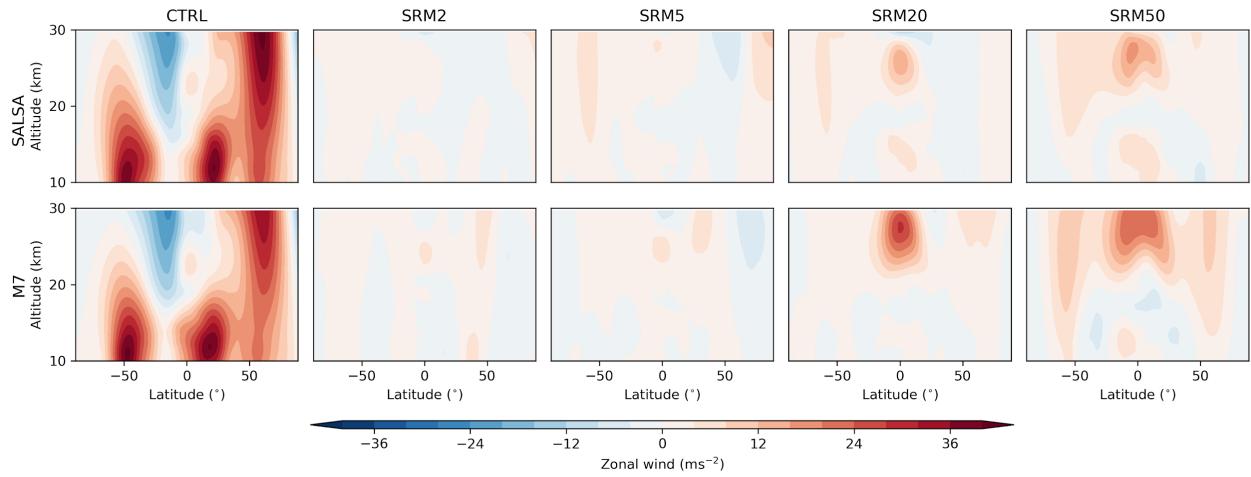


Figure S11. Zonal mean zonal wind (m/s) in CTRL scenarios and wind anomaly compared to CTRL in stratospheric sulfur injection scenarios in December-January-February

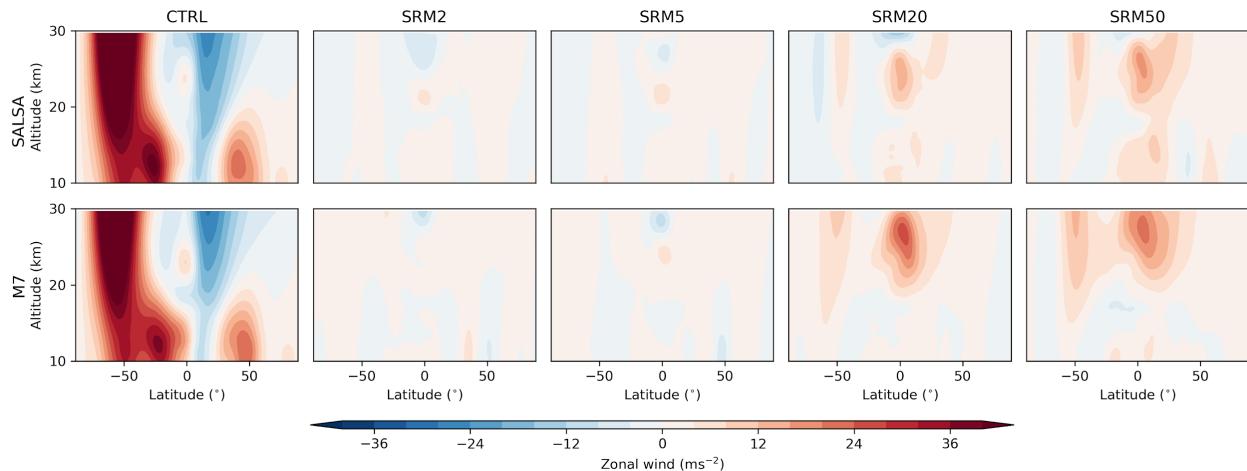


Figure S12. Zonal mean zonal wind (m/s) in CTRL scenarios and wind anomaly compared to CTRL in stratospheric sulfur injection scenarios in June-July-August

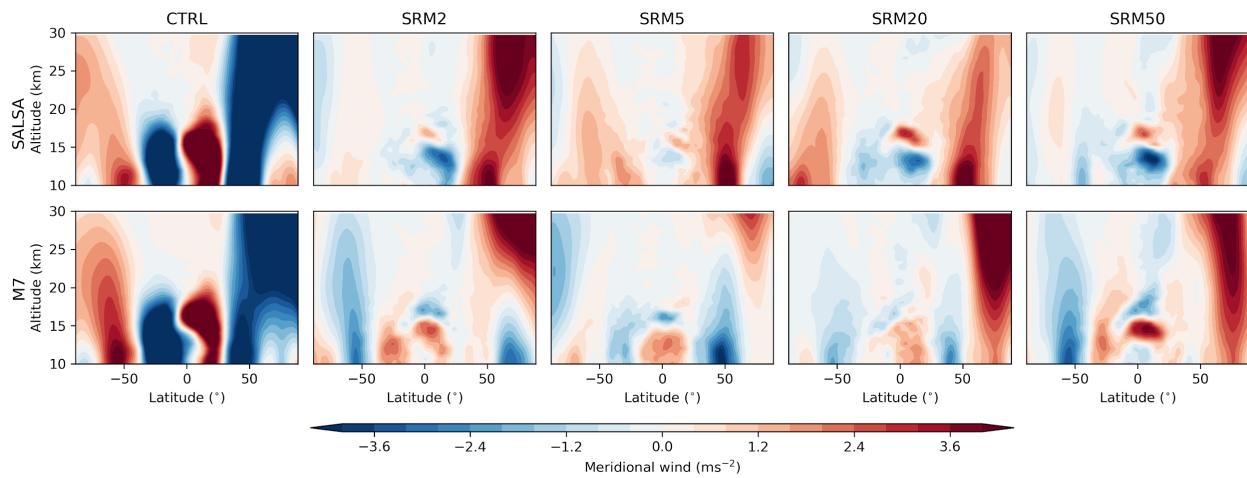


Figure S13. Zonal mean meridional wind (m/s) in CTRL scenarios and wind anomaly compared to CTRL in stratospheric sulfur injection scenarios in December-January-February

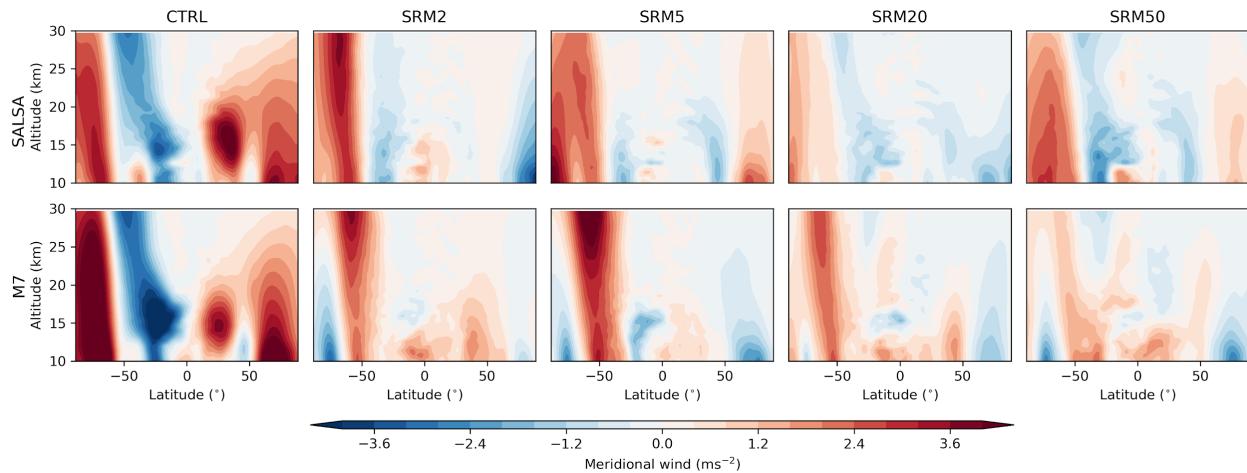


Figure S14. Zonal mean meridional wind (m/s) in CTRL scenarios and wind anomaly compared to CTRL in stratospheric sulfur injection scenarios in June-July-August

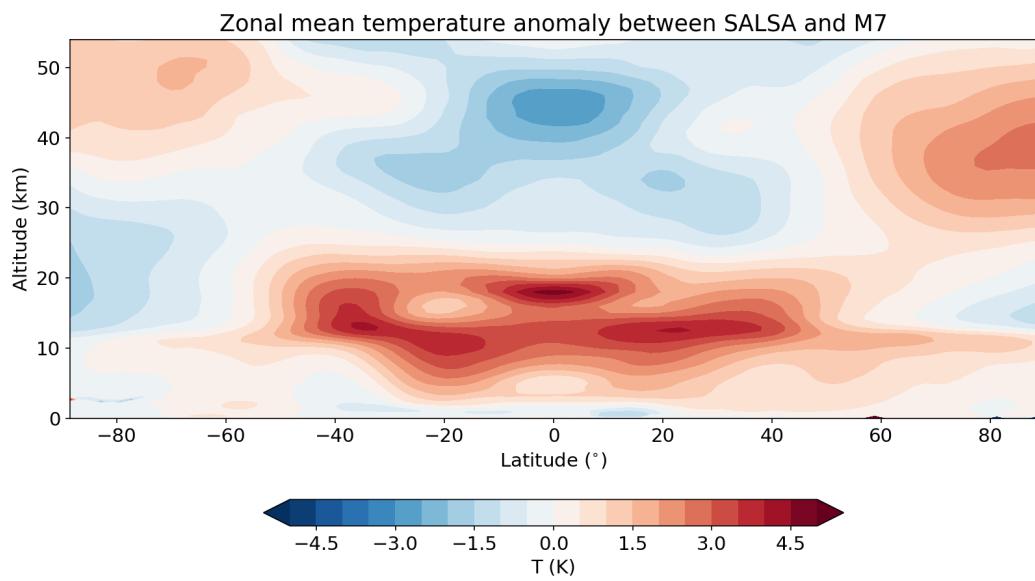


Figure S15. Zonal mean temperature difference between CTRL scenarios simulated with SALSA and M7.

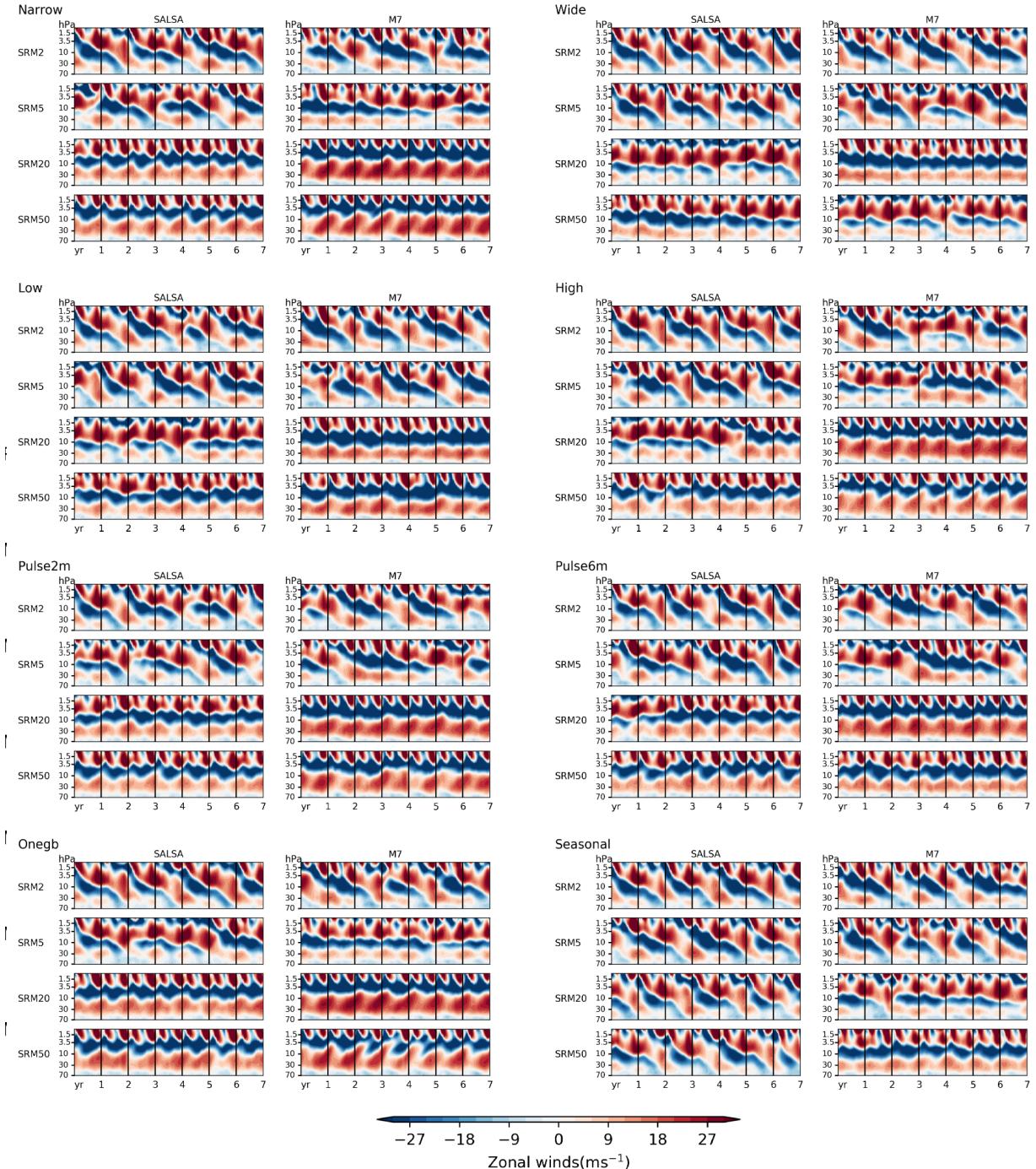


Figure S13. Zonal mean zonal wind (m/s) at the Equator for simulated stratospheric sulfur injection scenarios with different injection rates.

Table S1: Global mean All-sky and Clear-sky radiative forcing in the simulated stratospheric sulfur injection scenarios.

All-sky SW	All-sky	TOA SW	W/m2						All-sky	TOA LW	W/m2					All-sky	TOA net	W/m2					
Tg(S)/yr	1	2	5	10	20	50	100		1	2	5	10	20	50	100		1	2	5	10	20	50	100
SALSA Baseline	-1.17	-1.89	-3.84	-6.24	-9.95	-17.57	-27.27		0.12	0.24	0.55	01.01	1.88	4.14	7.55		-1.05	-1.65	-3.29	-5.23	-8.07	-13.43	-19.72
SALSA Narrow		-2.3	-4.41		-11.05	-19			0.28	0.6		02.04	4.36				-2.02	-3.81		-9.01	-14.64		
SALSA Wide		-1.83	-3.58		-9.7	-17.26			0.23	0.49		1.67	3.77				-1.6	-3.09		-8.03	-13.49		
SALSA High		-2.19	-4.41		-11.36	-20			0.27	0.62		02.09	4.62				-1.92	-3.79		-9.27	-15.38		
SALSA Low		-1.83	-3.73		-9.99	-17.77			0.22	0.47		1.62	3.64				-1.61	-3.26		-8.37	-14.13		
SALSA Pulse2m		-2.13	-4.13		-10.84	-18.72			0.25	0.55		02.01	4.31				-1.88	-3.58		-8.83	-14.41		
SALSA Pulse6m		-2.56	-5.01		-12.94	-22.71			0.29	0.65		2.15	4.74				-2.27	-4.36		-10.79	-17.97		
SALSA Onegb		-2.48	-4.73		-12.23	-21.73			0.29	0.6		2.17	4.7				-2.19	-4.13		-10.06	-17.03		
SALSA Seasonal		-2.03	-4.11		-11.27	-19.86			0.26	0.52		1.8	3.99				-1.77	-3.59		-9.47	-15.87		
M7 Baseline	-0.76	-1.1	-2.07	-3.4	-5.84	-11.44	-18.78		0.2	0.34	0.74	1.34	2.51	5.78	10.78		-0.56	-0.76	-1.33	-2.06	-3.33	-5.66	-8
M7 Narrow		-1.16	-1.95		-5.66	-11.74			0.35	0.74		2.56	5.96				-0.81	-1.21		-3.1	-5.78		
M7 Wide		-1.12	-2.2		-6.3	-12.02			0.31	0.67		2.38	5.47				-0.81	-1.53		-3.92	-6.55		
M7 High		-1.35	-2.46		-7.03	-13.66			0.4	0.87		2.95	6.71				-0.95	-1.59		-4.08	-6.95		
M7 Low		-1.14	-2.34		-5.95	-10.38			0.25	0.59		2.12	4.85				-0.89	-1.75		-3.83	-5.53		
M7 Pulse2m		-1.22	-2.1		-6	-11.24			0.38	0.74		2.57	5.83				-0.84	-1.36		-3.43	-5.41		
M7 Pulse6m		-1.49	-2.93		-8.45	-16.45			0.39	0.85		2.99	6.99				-1.1	-2.08		-5.46	-9.46		
M7 Onegb		-1.51	-2.8		-8.04	-19.19			0.38	0.84		2.99	7.49				-1.13	-1.96		-5.05	-11.7		
M7 Seasonal		-1.15	-2.63		-7.62	-15.15			0.28	0.72		2.54	5.95				-0.87	-1.91		-5.08	-9.2		
Clear-sky SW	Clear-sky	TOA SW	W/m2						Clear-sky	TOA LW	W/m2					Clear-sky	TOA net	W/m2					
Tg(S)/yr	1	2	5	10	20	50	100		1	2	5	10	20	50	100		1	2	5	10	20	50	100
SALSA Baseline	-1.68	-2.72	-5.55	-8.97	-14.2	-24.88	-38.34		0.14	0.29	0.65	1.21	2.25	4.97	09.06		-1.54	-2.43	-4.9	-7.76	-11.95	-19.91	-29.28
SALSA Narrow		-3.32	-6.33		-15.67	-26.7			0.34	0.71		2.45	5.24				-2.98	-5.62		-13.22	-21.46		
SALSA Wide		-2.7	-5.28		-14.19	-25.33			0.28	0.58		2	4.54				-2.42	-4.7		-12.19	-20.79		
SALSA High		-3.14	-6.3		-16.22	-28.23			0.33	0.75		2.51	5.58				-2.81	-5.55		-13.71	-22.65		
SALSA Low		-2.74	-5.56		-14.5	-25.46			0.27	0.56		1.93	4.35				-2.47	-5		-12.57	-21.11		
SALSA Pulse2m		-3.07	-5.98		-15.44	-26.48			0.3	0.66		2.41	5.17				-2.77	-5.32		-13.03	-21.31		
SALSA Pulse6m		-3.72	-7.23		-18.43	-31.96			0.35	0.77		2.59	5.72				-3.37	-6.46		-15.84	-26.24		
SALSA Onegb		-3.57	-6.83		-17.34	-30.47			0.35	0.72		2.61	5.67				-3.22	-6.11		-14.73	-24.8		
SALSA Seasonal		-3.02	-6.09		-16.52	-28.67			0.31	0.62		2.16	4.81				-2.71	-5.47		-14.36	-23.86		
M7 Baseline	-1.14	-1.67	-3.05	-5.02	-8.53	-16.43	-26.7		0.24	0.41	0.89	1.61	03.03	6.95	12.93		-0.9	-1.26	-2.16	-3.41	-5.5	-9.48	-13.77
M7 Narrow		-1.72	-2.85		-8.22	-16.89			0.43	0.9		03.07	7.2				-1.29	-1.95		-5.15	-9.69		
M7 Wide		-1.72	-3.31		-9.36	-17.57			0.37	0.81		2.88	6.6				-1.35	-2.5		-6.48	-10.97		
M7 High		-2.01	-3.61		-10.19	-19.6			0.5	01.05		3.58	8.12				-1.51	-2.56		-6.61	-11.48		
M7 Low		-1.74	-3.55		-8.85	-15.12			0.3	0.71		2.55	5.83				-1.44	-2.84		-6.3	-9.29		
M7 Pulse2m		-1.8	-3.1		-8.79	-16.19			0.45	0.89		3.1	07.03				-1.35	-2.21		-5.69	-9.16		
M7 Pulse6m		-2.23	-4.34		-12.26	-23.42			0.47	01.03		3.62	8.46				-1.76	-3.31		-8.64	-14.96		
M7 Onegb		-2.25	-4.09		-11.6	-27.21			0.46	01.01		3.61	09.09				-1.79	-3.08		-7.99	-18.12		
M7 Seasonal		-1.78	-4		-11.33	-22.12			0.32	0.87		03.08	7.22				-1.46	-3.13		-8.25	-14.9		

Table S2: Effective radius, sulfate burden and lifetime of stratospheric sulfate aerosols in the simulated stratospheric sulfur injection scenario.

	Effective	radius of	stratos.	aerosols	(um)			Sulfate	burden	Tg(S)					Lifetime of	injected	sulfate					
Tg(S)/yr	1	2	5	10	20	50	100	1	2	5	10	20	50	100	1	2	5	10	20	50	100	
SALSA Baseline	0.24	0.29	0.36	0.42	0.49	0.58	0.65	1.4	2.45	5.66	10.32	18.92	41.3	76.33	1.40	1.23	1.13	01.03	0.95	0.83	0.76	
SALSA Narrow		0.28	0.36		0.51	0.6			2.82	6.25		20.82	44.33			1.41	1.25		01.04	0.89		
SALSA Wide		0.26	0.33		0.44	0.53			2.32	5.17		17.91	39.62			1.16	01.03		0.90	0.79		
SALSA High		0.29	0.37		0.49	0.59			2.84	6.43		21.46	47.22			1.42	1.29		01.07	0.94		
SALSA Low		0.24	0.3		0.42	0.51			2.24	05.07		17.04	37.99			1.12	01.01		0.85	0.76		
SALSA Pulse2m		0.28	0.36		0.5	0.58			2.67	5.96		20.28	43.56			1.34	1.19		01.01	0.87		
SALSA Pulse6m		0.26	0.34		0.48	0.57			3.1	6.82		22.99	50.62			1.55	1.36		1.15	01.01		
SALSA Onegb		0.27	0.35		0.5	0.59			2.94	6.53		22.28	49.6			1.47	1.31		1.11	0.99		
SALSA Seasonal		0.24	0.31		0.42	0.52			2.54	5.76		19.96	44.28			1.27	1.15		1.00	0.89		
M7 Baseline	0.33	0.42	0.53	0.6	0.67	0.78	0.84	1.35	2.31	4.78	8.65	16.22	37.27	71.47	1.35	1.16	0.96	0.87	0.81	0.75	0.71	
M7 Narrow		0.43	0.55		0.7	0.78			2.25	4.61		16.13	38.58			1.13	0.92		0.81	0.77		
M7 Wide		0.38	0.47		0.6	0.71			2.24	4.83		16.57	37.58			1.12	0.97		0.83	0.75		
M7 High		0.44	0.54		0.67	0.77			2.59	5.53		19.63	45.02			1.30	1.11		0.98	0.90		
M7 Low		0.3	0.38		0.56	0.71			02.01	4.42		14.4	31.2			01.01	0.88		0.72	0.62		
M7 Pulse2m		0.42	0.53		0.67	0.79			2.34	4.84		16.46	37.3			1.17	0.97		0.82	0.75		
M7 Pulse6m		0.38	0.47		0.59	0.69			2.71	06.03		21.03	49.72			1.36	1.21		01.05	0.99		
M7 Onegb		0.37	0.49		0.62	0.65			2.74	5.78		20.38	55.74			1.37	1.16		01.02	1.11		
M7 Seasonal		0.35	0.42		0.54	0.62			2.43	5.43		18.99	44.74			1.22	01.09		0.95	0.89		