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Sulfur deposition changes under sulfate geoengineering conditions: quasi-biennial oscillation effects on the transport and lifetime of stratospheric aerosols

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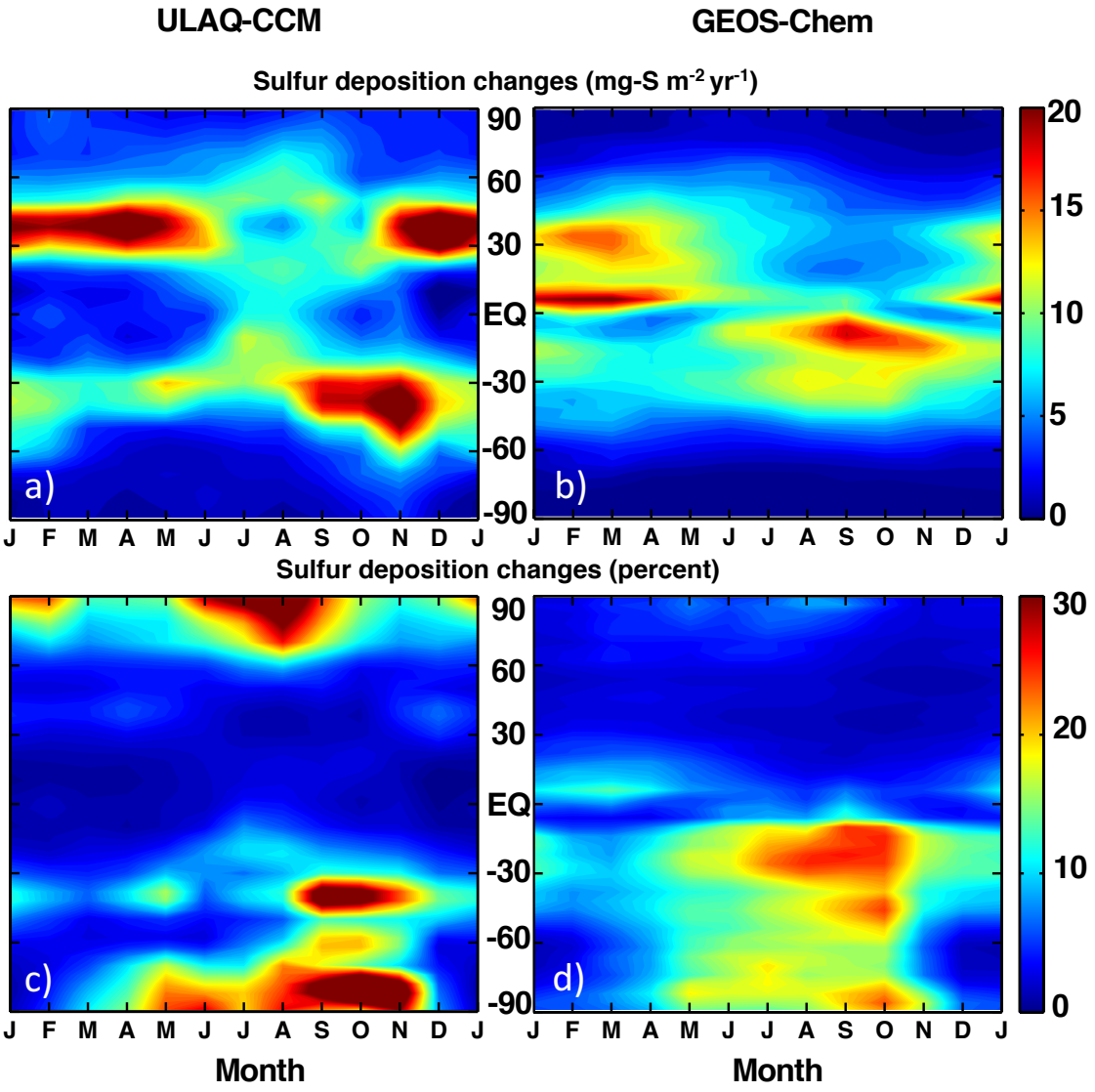

Figure S1. Zonally averaged sulfur deposition flux changes (G4-Base), as a function of latitude and months, for ULAQ-CCM in panels (a,c) (years 2030-2039) and GEOS-Chem in panels (b,d) (years 2000-2005). Panels (a,b) show absolute changes (mg-S m^{-2} yr^{-1}); panels (c,d) show percent changes with respect to the Base case.

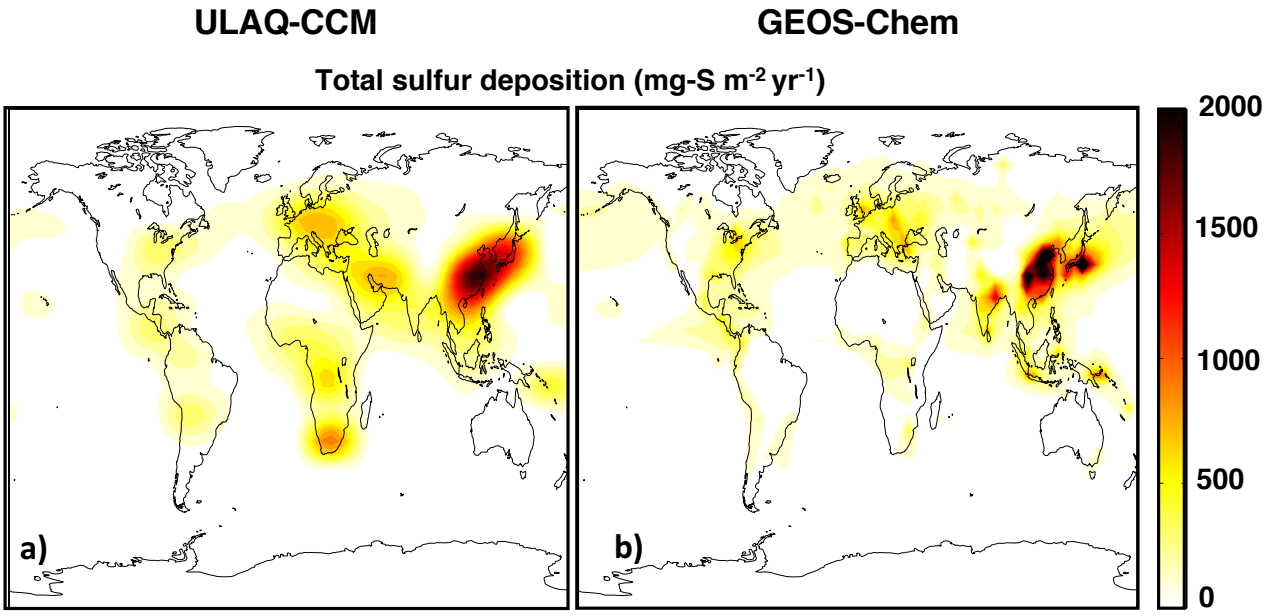

Figure S2. Annually averaged sulfur deposition flux (Base), as a function of latitude and longitude, for ULAQ-CCM in panels (a) (years 2030-2039) and GEOS-Chem in panels (b) (years 2000-2005). These values have been used to calculate all percent changes in the manuscript.

Table S1. Area integrated sulfur deposition changes for continental regions in the geoengineering G4 case, with respect to the unperturbed Base case: ULAQ-CCM [2030-2039]; GEOS-Chem [2000-2005]. The last two columns show the increased sulfur changes due to geoengineering per unit of Tg-S injection. The standard deviation in each region represents the inter-annual variability due to the QBO.

Region	GEOS-Chem [G4-Base] (Tg-S/yr)	ULAQ-CCM [G4-Base] (Tg-S/yr)	GEOS-Chem [G4-Base] (%)	ULAQ-CCM [G4-Base] (%)	GEOS-Chem [G4-Base] (10^{-3} Tg-S/yr) per unit Tg-S injection	ULAQ-CCM [G4-Base] (10^{-3} Tg-S/yr) per unit Tg-S injection
Antarctica	0.010 ± 0.003	0.03 ± 0.01	7.1 ± 0.7	8.2 ± 0.6	3 ± 1	8 ± 2
Oceania	0.20 ± 0.02	0.34 ± 0.02	6.9 ± 0.7	10.6 ± 0.6	58 ± 6	88 ± 7
South America	0.20 ± 0.03	0.28 ± 0.05	7.9 ± 1.2	10.1 ± 1.7	52 ± 6	66 ± 14
Africa	0.44 ± 0.07	0.08 ± 0.05	11.0 ± 1.8	2.1 ± 1.3	106 ± 14	17 ± 9
Asia	0.32 ± 0.03	0.48 ± 0.19	1.5 ± 0.2	2.7 ± 1.1	78 ± 9	123 ± 47
North America	0.21 ± 0.01	0.42 ± 0.02	2.8 ± 0.1	5.5 ± 0.3	52 ± 4	105 ± 12
Europe	0.12 ± 0.01	0.17 ± 0.06	1.6 ± 0.2	2.5 ± 0.9	28 ± 3	36 ± 14
Total Land	1.5 ± 0.5	1.8 ± 0.9	3.4 ± 1.4	4.7 ± 1.9	377 ± 145	443 ± 238

Table S2. As in S1, but for the oceans.

Region	GEOS-Chem [G4-Base] (Tg-S/yr)	ULAQ-CCM [G4-Base] (Tg-S/yr)	GEOS-Chem [G4-Base] (%)	ULAQ-CCM [G4-Base] (%)	GEOS-Chem [G4-Base] (10^{-3} Tg-S/yr) per unit Tg-S injection	ULAQ-CCM [G4-Base] (10^{-3} Tg-S/yr) per unit Tg-S injection
Southern Ocean	0.01 ± 0.01	0.02 ± 0.01	3.8 ± 0.8	7.7 ± 1.8	2 ± 1	4 ± 1
South Indian	0.37 ± 0.11	0.41 ± 0.05	10.9 ± 1.3	12.2 ± 3.3	90 ± 11	101 ± 23
South Pacific	0.70 ± 0.32	0.63 ± 0.17	14.2 ± 2.7	12.2 ± 3.3	171 ± 28	159 ± 34
South Atlantic	0.36 ± 0.13	0.13 ± 0.03	11.9 ± 2.6	5.8 ± 1.5	86 ± 17	32 ± 12
North Indian	0.12 ± 0.04	0.13 ± 0.03	5.0 ± 0.8	4.3 ± 1.6	32 ± 26	34 ± 5
North Pacific	0.67 ± 0.48	0.63 ± 0.21	5.0 ± 1.3	6.8 ± 2.1	159 ± 97	156 ± 47
North Atlantic	0.26 ± 0.05	0.20 ± 0.03	6.8 ± 0.5	5.2 ± 0.9	61 ± 12	49 ± 6
Arctic Ocean	0.01 ± 0.01	0.03 ± 0.01	2.3 ± 0.3	14.7 ± 2.2	2 ± 1	8 ± 3
Total Ocean	2.5 ± 1.1	2.2 ± 1.2	7.7 ± 2.4	7.8 ± 2.9	603 ± 281	543 ± 269