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Supplement of

Upper tropospheric ice sensitivity to sulfate geoengineering

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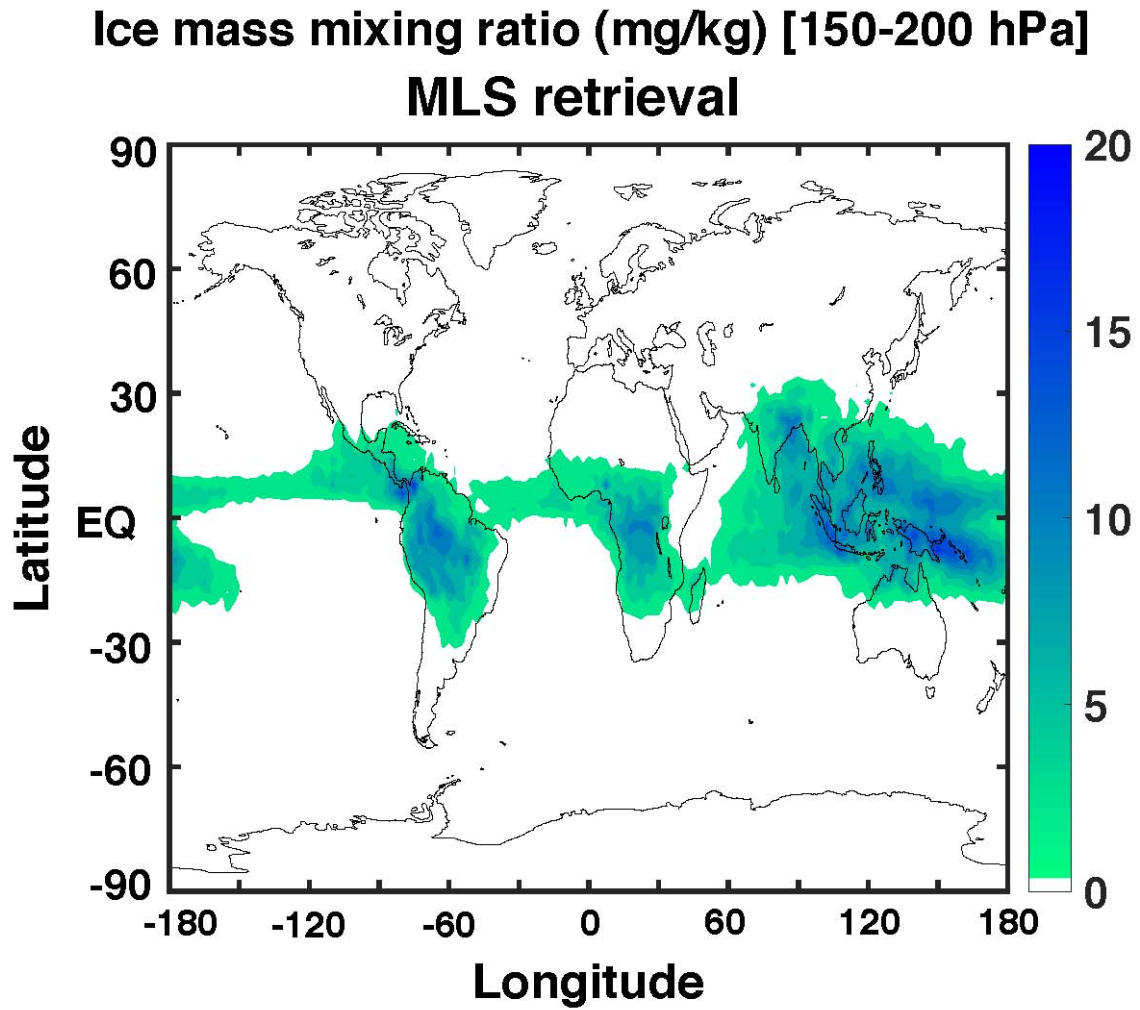


Figure S1. Lat/lon map of the ice mass mixing ratio (mg/kg-air) for the pressure layer 150-200 hPa from the MLS retrieval (Wu et al., 2008). Time average is on years 2004–2012.

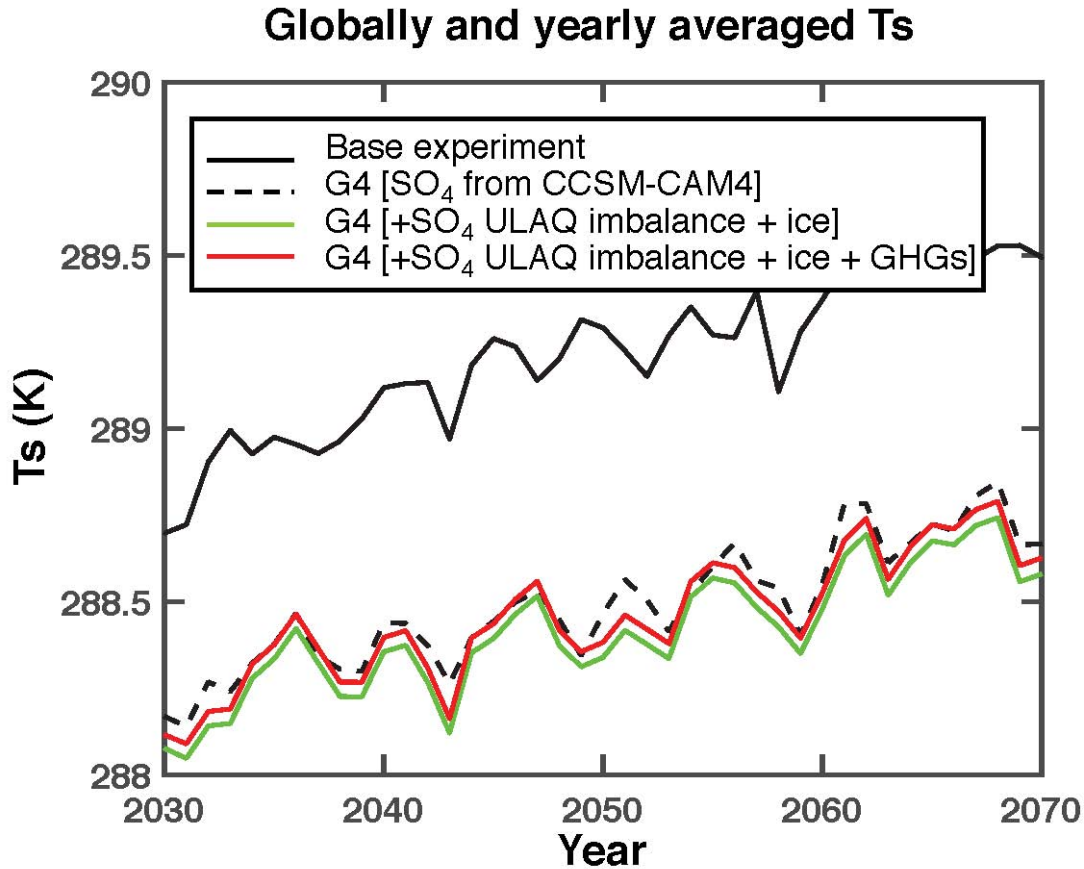


Figure S2. Time series of the globally and annually averaged surface temperature (K) in the ULAQ-CCM numerical simulations, under different conditions for the G4 perturbed case.

Table S1. Globally and time-averaged values of net radiative forcing per species (W/m^2), calculated in the ULAQ-CCM for the G4 experiment with respect to the RCP4.5 Base case. The time average is over years 2030–69. The first two columns show the net sulfate RF in the reference CCSM-CAM4 simulation and the ULAQ-CCM net sulfate RF due to imbalance with respect to CCSM-CAM4, respectively. The UT ice RF in the third column is discussed in more detail in section 3.2.2. RFs from gas species changes were discussed in [Pitari et al. \(2014\)](#) and [Visioni et al. \(2017b\)](#). All results are calculated at the tropopause with temperature adjustment and for all-sky conditions.

SO ₄ [CCSM- CAM4]	SO ₄ [ULAQ] [imbalance]	UT ice	O ₃	H ₂ O strat [TTL ΔT]	CH ₄	H ₂ O strat [CH ₄]	CO ₂ [CH ₄]	NET ULAQ	
								Par- ticles	Gases
-1.29	+0.12	-0.29	-0.034	+0.058	+0.114	+0.018	+0.010	-0.17	+0.16

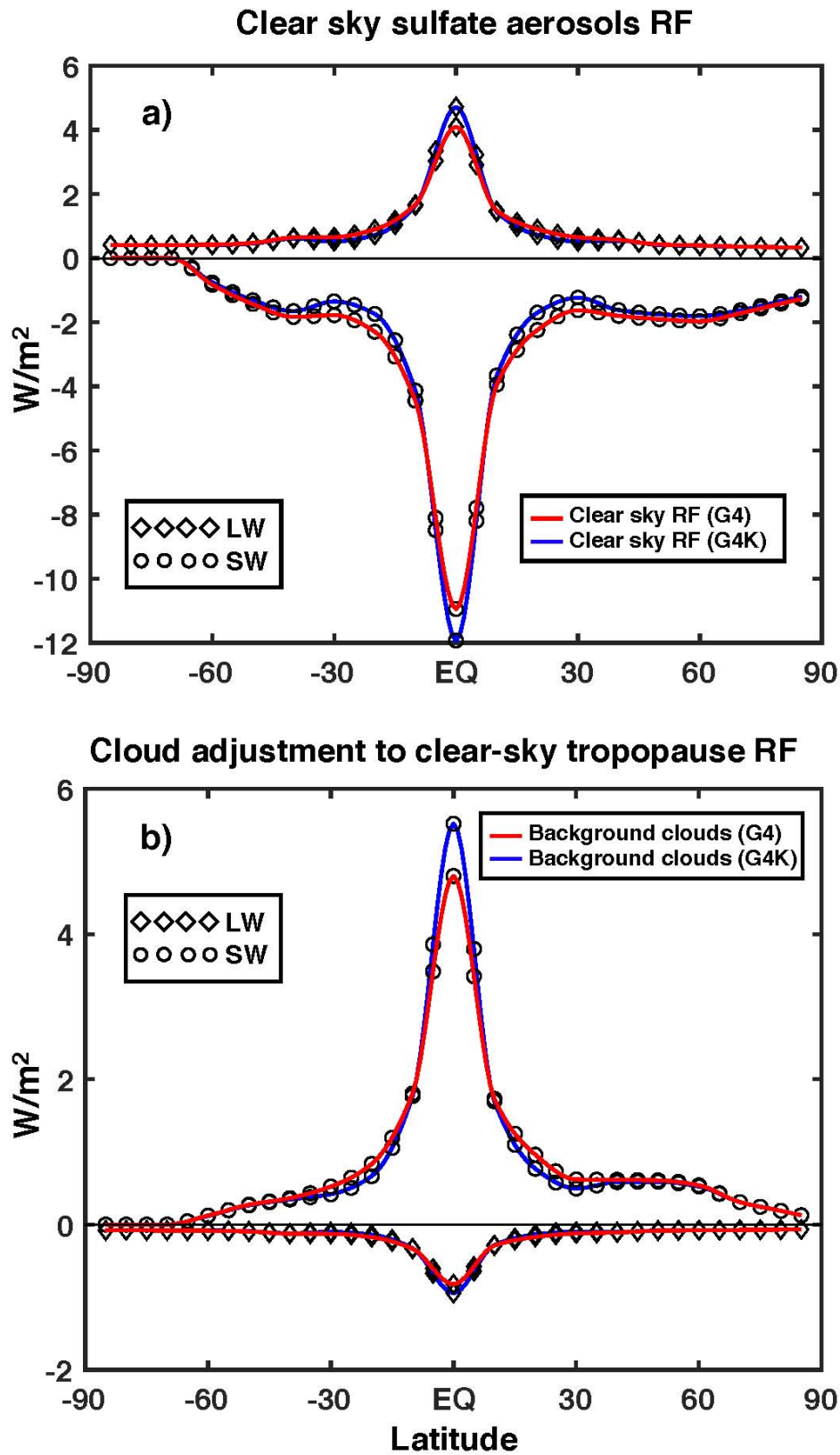


Fig. S3. Panel (a): zonally averaged clear sky tropopause and temperature adjusted RF due to SG aerosols (W/m^2), as a function of latitude (time average 2030-69). Panel (b): zonally averaged SW and

LW cloud adjustments to the clear-sky SG aerosol RF (W/m^2), as a function of latitude (time average 2030-69); adjustments are due to (passive) background clouds. See legends for line meaning. The slightly lower near-equatorial values of G4 RFs, with respect to G4K values, reflect the slightly smaller AOD change (see [Table 3](#)), which is in turn produced by the increasing tropical aerosol confinement in G4 with respect to G4K (see discussion relative to [Fig. 9](#)).