Supporting Information for "Estimating Impacts and Trade-offs in Solar Geoengineering Scenarios With a Moist Energy Balance Model"

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Introduction Supplemental Table S1 lists the parameter values used in the EBM simulations. These values were kept fixed in all experiments, except for the simulations in which the ice-albedo feedback was disabled (see section 4 of main text for details). Supplemental Figure S1 shows the seasonal surface temperature responses of the EBM to a doubling of CO_2 and to the four strong SRM interventions. Supplemental Figure S2 shows the annual-mean MSE profile and annual-mean meridional MSE transport in the control simulation. Supplemental Figure S3 shows the seasonal surface temperature responses of the EBM to a doubling of CO_2 and to the four moderate SRM interventions. Supplemental Figure S4 repeats Figure 4 from the main text, but the simulations are performed with the ice-albedo feedback disabled.

Table S1. List of EBM parameters and default values

Parameter	Value
A	-290 $\mathrm{Wm^{-2}}$
B	1.8 $\mathrm{Wm^{-2}}$ $^{\circ}\mathrm{C}^{-1}$
C	9.8 W year $\mathrm{m^{-2}}$ $^{\circ}\mathrm{C}^{-1}$
Q	1360 $\mathrm{Wm^{-2}}$
γ	0.482
S_1	180 $\mathrm{Wm^{-2}}$
a_0	0.32
a_1	0.62
T_0	-11 °C
h_t	6 °C
L	2.5×10^6 J $\mathrm{kg^{-1}}$
c_p	1005 J $\mathrm{kg^{-1}}$$^{\circ}\mathrm{C}^{-1}$
D	0.25 $\mathrm{Wm^{-2}}$ $^{\circ}\mathrm{C}^{-1}$

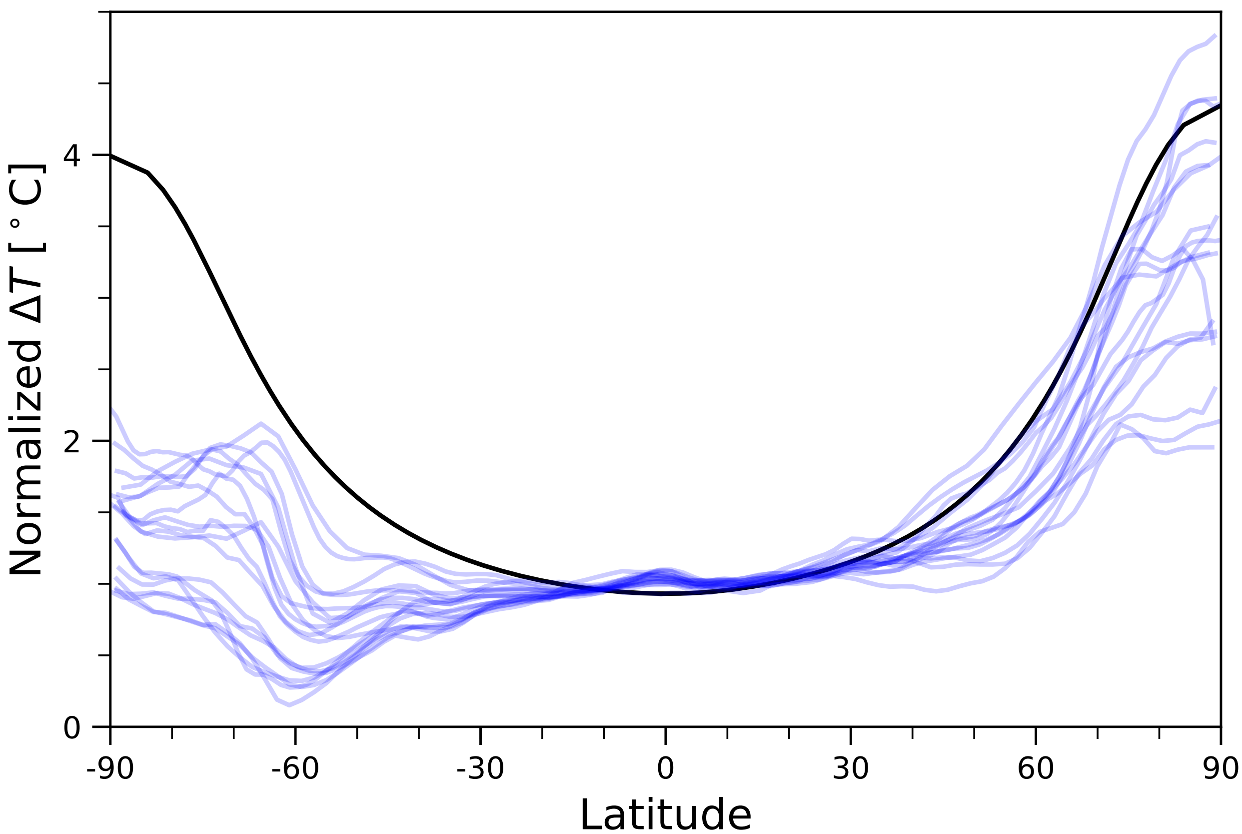

Figure S1. Equilibrated, annual-mean responses of the EBM's surface temperature to the radiative forcing from a doubling of CO_2 concentrations, normalized by the average tropical (30^{c}ircS to 30°N) response (black curve). Blue curves show the response in abrupt 4XCO_2 experiments with 18 CMIP5 models: BCC-CSM1-1, BNU-ESM, CanESM2, CNRM-CM5, CSIRO-Mk3-6-0, FGOALS-s2, GFDL-CM3, GFDL-ESM2G, GFDL-ESM2M, GISS-ESM-LR, HADGEM2-ES, INMCM4, IPSL-CM5A-LR, MIROC5, MPI-ESM-LR, MRI-cGCM3, NCAR-CCSM4 and NorESM1-M.

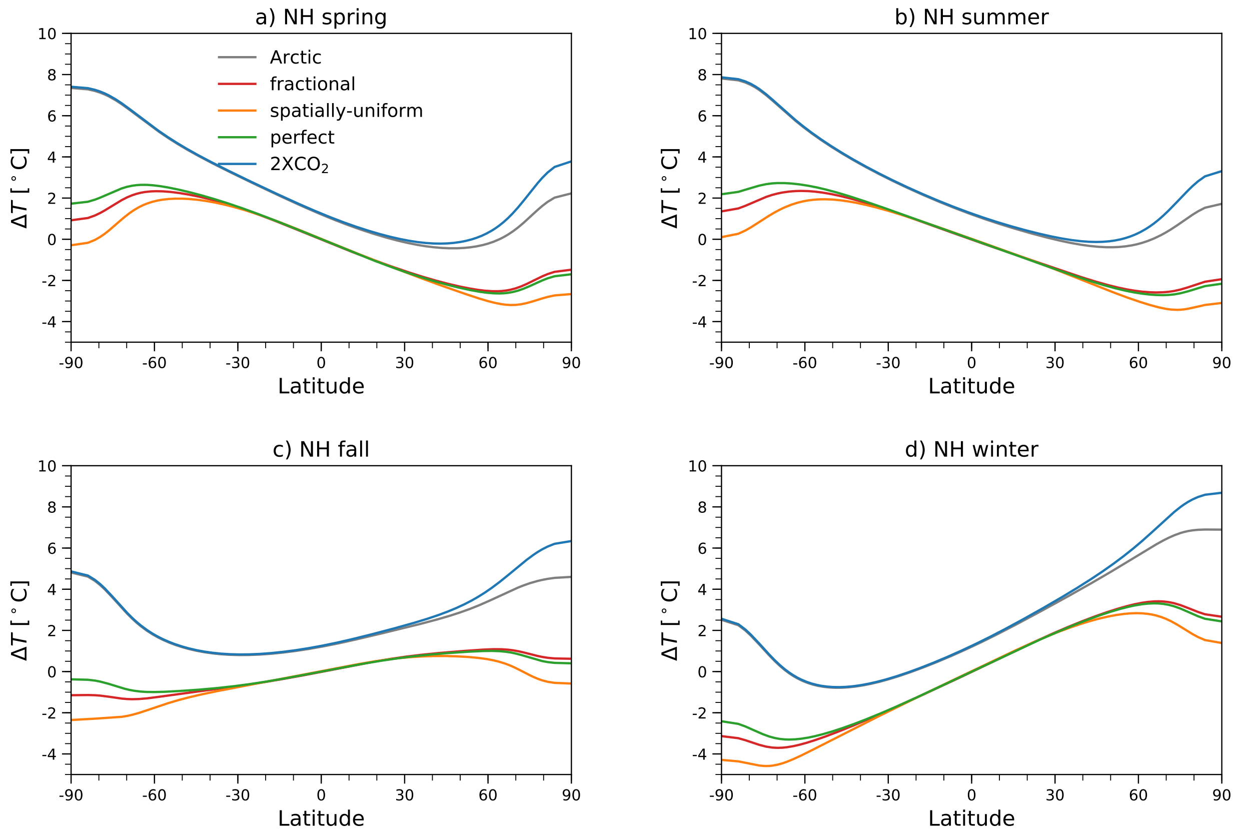

Figure S2. a) Equilibrated, northern hemisphere "spring" (days 0-90) responses of the EBM's surface temperature to the radiative forcing from a doubling of CO_2 concentrations (blue curve) and to the strong SRM interventions (green, orange, red and gray curves). b) Same as a) but for northern hemisphere "summer" (days 90-180). c) Same as a) but for northern hemisphere "fall" (days 180-270). d) Same as a) but for northern hemisphere "winter" (days 270-360).

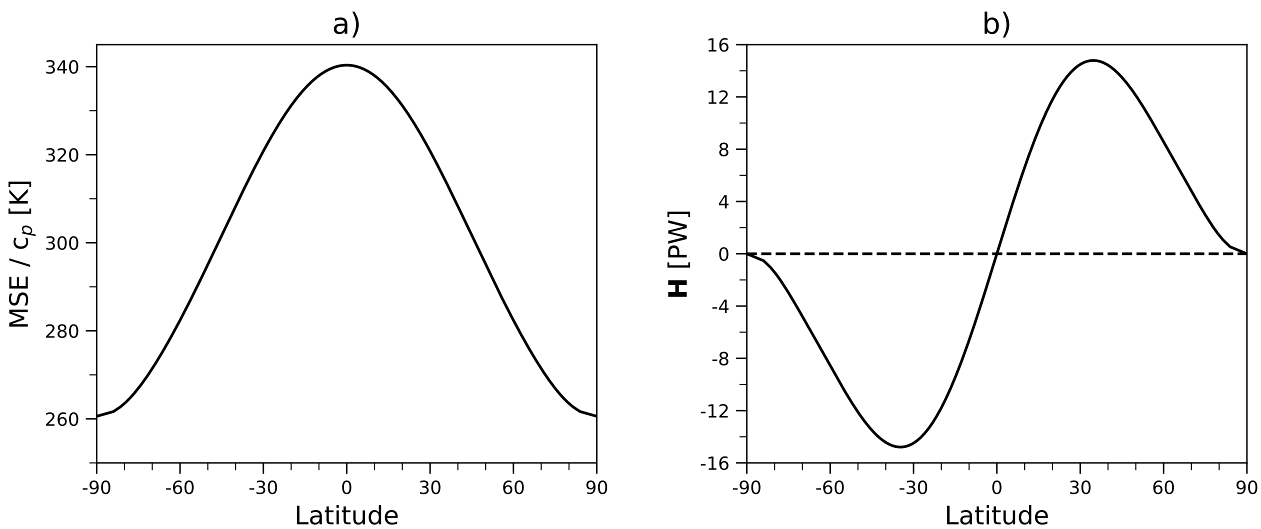

Figure S3. a) Annual-mean MSE profile in the control simulation of the EBM. b) Annual-mean meridional MSE transport in the control simulation of the EBM.

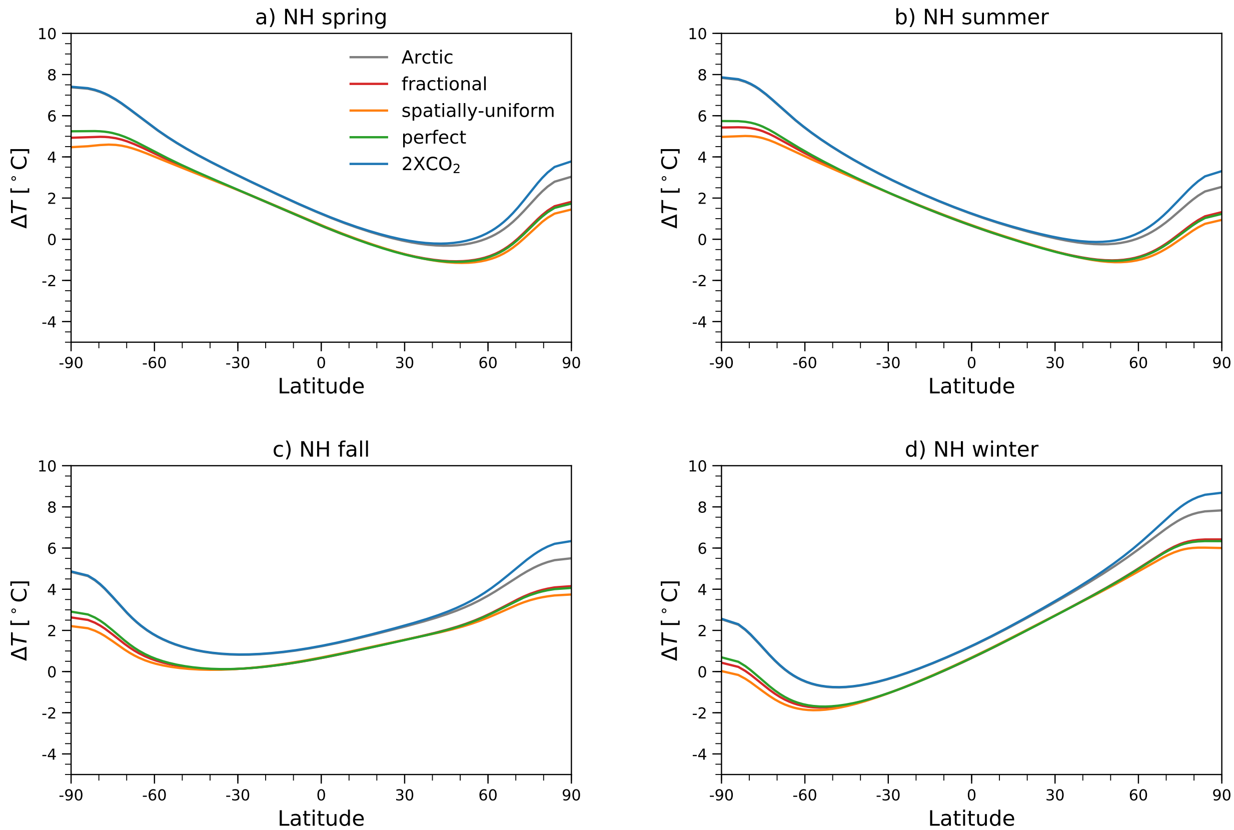

Figure S4. a) Equilibrated, northern hemisphere "spring" (days 0-90) responses of the EBM's surface temperature to the radiative forcing from a doubling of CO_2 concentrations (blue curve) and to the moderate SRM interventions (green, orange, red and gray curves). b) Same as a) but for northern hemisphere "summer" (days 90-180). c) Same as a) but for northern hemisphere "fall" (days 180-270). d) Same as a) but for northern hemisphere "winter" (days 270-360).

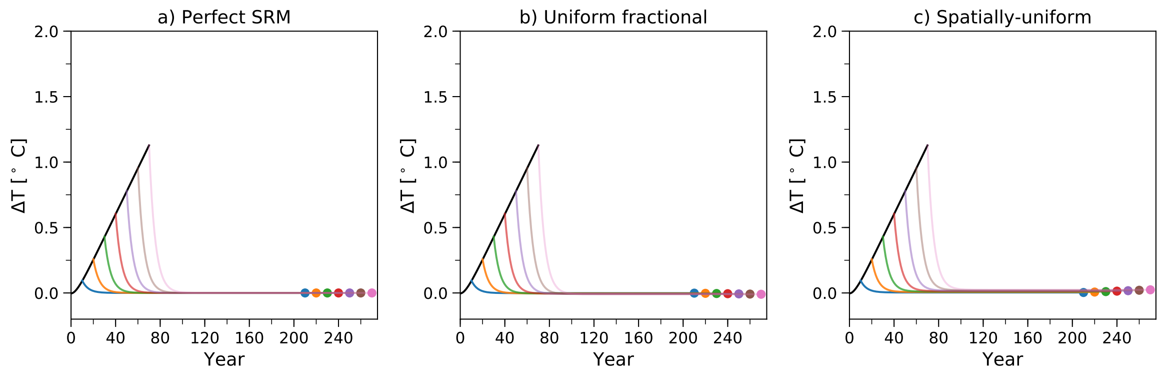

Figure S5. a) Annual and global-mean temperature response for an EBM simulation with the ice-albedo feedback disabled, and in which the forcing is linearly increased with time, reaching a value equal to a doubling of CO_2 after 70 years (black curve). The colored curves show mean temperatures during branching simulations in which perfect SRM is implemented every ten years. The round markers show the global-mean temperature response after the SRM has been implemented for 200 years. b) Same as panel a) but the uniform fraction SRM is implemented every ten years, with the same global-mean insolation reduction as in the corresponding perfect SRM branching simulations. c) Same as panel a) but the spatially-uniform SRM is implemented every ten years, with the same global-mean insolation reduction as in the corresponding perfect SRM branching simulations. Note that the warming is weaker in this simulation because of the lack of ice-albedo feedback. Retuning the EBM so that the response is stronger in this set-up does not affect the conclusions of the hysteresis experiments.