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Supplement of

The climate effects of increasing ocean albedo: an idealized representation of solar geoengineering

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39 **Table S1.** Change in top-of-atmosphere net radiative flux (calculated as a difference
40 from piControl), averaged over years 11-50. Units are in W m^{-2}. In each box, the top
41 value is the global mean, the middle value is the land mean, and the bottom value is
42 the ocean mean.
43

	abrupt4xCO2	G1	G1ocean-Albedo
BNU-ESM	2.70	0.02	0.39
	3.01	1.11	8.68
	2.57	-0.43	-3.10
CanESM2	2.61	0.02	-0.21
	0.91	0.27	7.86
	3.36	-0.10	-3.72
CESM-CAM5.1-FV	2.63	-0.13	-1.43
	3.50	2.09	7.61
	2.27	-1.04	-5.14
CSIRO-Mk3L-1.2	2.63	0.12	0.02
	0.48	0.60	6.40
	3.53	-0.08	-2.64
EC-Earth	2.22	-0.20	-0.20
	0.36	0.04	5.75
	2.20	-0.22	-2.57
GISS-E2-R	2.45	-0.18	-0.05
	-0.71	-1.10	5.06
	3.75	0.21	-2.15
HadGEM2-ES	2.49	0.20	-0.07
	2.96	2.52	10.14
	2.31	-0.74	-4.18
IPSL-CM5A-LR	2.82	0.08	-0.07
	-0.09	0.12	6.65
	4.06	0.07	-2.93
MIROC-ESM	3.62	0.23	0.13
	2.78	-0.47	9.48
	3.63	0.23	0.11
MPI-ESM-LR	2.73	0.16	0.02
	1.28	1.86	8.92
	3.32	-0.53	-3.58
NorESM1-M	2.42	-0.01	-0.10
	3.64	1.49	8.23
	1.92	-0.62	-3.49
Model mean	2.67	0.03	-0.14
	1.65	0.77	7.71
	2.99	-0.30	-3.04

44

45 **Table S2.** Temperature trend for each model over years 11-50, as calculated by
46 ordinary linear regression. Units are in K per decade. In each box, the top value is
47 the global mean, the middle value is the land mean, and the bottom value is the
48 ocean mean.
49

	abrupt4xCO2	G1	G1ocean-Albedo
BNU-ESM	0.27	0.05	0.04
	0.28	0.09	0.06
	0.26	0.03	0.04
CanESM2	0.29	-0.04	-0.01
	0.32	-0.04	0.01
	0.27	-0.04	-0.02
CESM-CAM5.1-FV	0.22	-0.02	-0.01
	0.22	-0.04	-0.02
	0.22	-0.01	-0.01
CSIRO-Mk3L-1.2	0.24	0.02	-0.02
	0.26	0.02	-0.02
	0.23	0.01	-0.02
EC-Earth	0.26	-0.04	0.04
	0.29	-0.04	0.05
	0.25	-0.04	0.03
GISS-E2-R	0.10	0.01	-0.04
	0.09	0.01	-0.04
	0.11	0.01	-0.04
HadGEM2-ES	0.30	0.04	0.11
	0.36	0.06	0.14
	0.27	0.03	0.10
IPSL-CM5A-LR	0.38	0.02	-0.05
	0.44	0.03	-0.08
	0.35	0.02	-0.04
MIROC-ESM	0.34	0.02	-0.03
	0.40	0.03	-0.02
	0.34	0.02	-0.03
MPI-ESM-LR	0.22	0.03	0.02
	0.27	0.05	0.04
	0.20	0.02	0.01
NorESM1-M	0.19	-0.02	-0.06
	0.22	-0.04	-0.05
	0.17	-0.02	-0.06
Model mean	0.26	0.01	-0.00
	0.29	0.01	0.01
	0.24	0.00	-0.00

50

51 **Table S3.** Change (from piControl) in albedo as measured at the top of the
52 atmosphere, averaged over years 11-50 of simulation. Calculations are differences
53 in ratios of upward to downward shortwave radiative flux at TOA. Values in each
54 box are (in order) ensemble minimum, ensemble mean, and ensemble maximum.
55 All values are rounded to four decimal places.
56

	Global	Land	Ocean
abrupt4xCO2	-0.02	-0.03	-0.02
	-0.01	-0.02	-0.01
	0.00	0.00	0.00
G1	-0.01	-0.01	-0.01
	-0.01	-0.01	-0.01
	-0.00	0.00	-0.00
G1ocean-Albedo	-0.00	-0.03	0.01
	0.01	-0.01	0.02
	0.02	0.00	0.03

57

58 **Table S4.** Change (from piControl) in surface albedo, averaged over years 11-50 of
59 simulation. Calculations are differences in ratios of upward to downward
60 shortwave radiative flux at the surface. Values in each box are (in order) ensemble
61 minimum, ensemble mean, and ensemble maximum. All values are rounded to four
62 decimal places.
63

	Global	Land	Ocean
abrupt4xCO2	-0.04	-0.04	-0.03
	-0.02	-0.02	-0.02
	-0.01	-0.01	-0.00
G1	-0.01	-0.02	-0.01
	-0.00	-0.00	-0.00
	0.00	0.00	0.00
G1ocean-Albedo	0.03	-0.02	0.06
	0.06	-0.00	0.09
	0.09	0.00	0.13

64

65 **Table S5.** Change in surface air temperature (K) from piControl, averaged over
66 years 11-50 of simulation. Values in each box are (in order) ensemble minimum,
67 ensemble mean, and ensemble maximum. All values are rounded to four decimal
68 places.
69

	Global	Land	Ocean
abrupt4xCO2	2.79	4.04	2.28
	4.42	5.93	3.80
	5.29	7.30	4.65
G1	-0.31	-0.24	-0.38
	0.02	0.24	-0.07
	0.64	0.81	0.57
G1ocean-Albedo	-0.12	0.41	-0.33
	0.36	1.14	0.04
	1.20	1.83	0.95

70

71 **Table S6.** Change in TOA net radiative flux (W m^{-2}) from piControl, averaged over
72 years 11-50 of simulation. Values in each box are (in order) ensemble minimum,
73 ensemble mean, and ensemble maximum. All values are rounded to four decimal
74 places.
75

	Global	Land	Ocean
abrupt4xCO2	2.22	-0.66	1.92
	2.65	1.71	3.04
	3.62	3.64	4.01
G1	-0.20	-1.07	-1.03
	0.03	0.74	-0.26
	0.23	2.45	0.54
G1ocean-Albedo	-1.45	4.85	-5.11
	-0.14	7.22	-3.18
	0.39	9.73	-2.06

76

77 **Table S7.** Change in Horizontal Energy Transport (Section 3.3; W m^{-2}) from
78 piControl, averaged over years 11-50 of simulation.
79

	abrupt4xCO2	G1	G1ocean-Albedo
BNU-ESM	0.88	0.13	1.46
CanESM2	0.27	0.77	2.46
CESM-CAM5.1-FV	1.02	0.88	2.36
CSIRO-Mk3L-1.2	0.17	0.26	1.89
EC-Earth	0.09	0.43	2.02
GISS-E2-R	-0.21	0.72	1.35
HadGEM2-ES	0.84	1.03	2.54
IPSL-CM5A-LR	-0.04	0.82	1.80
MIROC-ESM	0.81	0.29	2.67
MPI-ESM-LR	0.35	0.99	2.45
NorESM1-M	1.07	0.92	3.21
Model mean	0.47	0.66	2.20

80

81   **Table S8.** Change in net shortwave radiative flux at the surface (W m^{-2}) from
82   piControl, averaged over years 11-50 of simulation. Values in each box are (in
83   order) ensemble minimum, ensemble mean, and ensemble maximum. All values are
84   rounded to four decimal places.
85

	Global	Land	Ocean
abrupt4xCO2	-2.17	-3.52	-3.06
	-0.28	1.56	-1.04
	1.86	4.12	2.01
G1	-6.41	-6.52	-6.69
	-5.00	-4.08	-5.38
	-4.01	-1.70	-3.65
G1ocean-Albedo	-9.87	-3.60	-13.01
	-7.83	-0.21	-10.97
	-6.07	2.79	-8.54

86

87   **Table S9.** Change in net longwave radiative flux at the surface (W m^{-2}) from
88   piControl, averaged over years 11-50 of simulation. Values in each box are (in
89   order) ensemble minimum, ensemble mean, and ensemble maximum. All values are
90   rounded to four decimal places.
91

	Global	Land	Ocean
abrupt4xCO2	4.22	1.80	4.53
	6.61	3.75	7.78
	8.63	6.31	9.80
G1	0.77	0.30	0.44
	1.27	1.54	1.17
	2.51	3.69	2.27
G1ocean-Albedo	1.02	-0.15	0.96
	2.57	2.05	2.78
	6.25	4.74	7.22

92

93 **Table S10.** Change in sensible heat flux from the surface to the atmosphere
94 (positive upward; W m^{-2}) from piControl, averaged over years 11-50 of simulation.
95 Values in each box are (in order) ensemble minimum, ensemble mean, and
96 ensemble maximum. All values are rounded to four decimal places.
97

	Global	Land	Ocean
abrupt4xCO2	-2.36	0.73	-4.46
	-1.14	3.85	-3.19
	0.14	6.64	-2.25
G1	-1.16	-1.73	-1.05
	-0.21	1.13	-0.76
	0.81	3.89	-0.28
G1ocean-Albedo	-1.85	-0.99	-2.20
	-0.20	2.87	-1.47
	1.05	6.00	-0.34

98

99 **Table S11.** Change in latent heat flux from the surface to the atmosphere (positive
100 upward; W m^{-2}) from piControl, averaged over years 11-50 of simulation. Values in
101 each box are (in order) ensemble minimum, ensemble mean, and ensemble
102 maximum. All values are rounded to four decimal places.
103

	Global	Land	Ocean
abrupt4xCO2	1.40	-4.75	3.93
	4.90	1.10	6.47
	7.24	6.50	8.38
G1	-5.99	-8.64	-4.89
	-3.57	-3.64	-3.55
	-1.23	1.12	-2.20
G1ocean-Albedo	-7.27	-6.47	-7.89
	-5.05	-1.01	-6.71
	-2.15	4.64	-4.95

104

105   **Table S12.** Change in ΔB (Equation 8; W m^{-2}) from piControl, averaged over years
106   11-50 of simulation. Values in each box are (in order) ensemble minimum,
107   ensemble mean, and ensemble maximum. All values are rounded to four decimal
108   places.
109

|	Global	Land	Ocean
abrupt4xCO2	2.17	-0.15	2.97
	2.57	0.20	3.44
	3.26	0.44	3.98
G1	-0.21	-0.12	-0.28
	0.05	-0.04	0.08
	0.29	0.04	0.39
G1ocean-Albedo	-0.29	-0.14	-0.37
	0.01	-0.01	0.02
	0.57	0.14	0.75

110

111 **Table S13.** Change in precipitation (mm day^{-1}) from piControl, averaged over years
112 11-50 of simulation. Values in each box are (in order) ensemble minimum,
113 ensemble mean, and ensemble maximum. All values are rounded to four decimal
114 places.
115

	Global	Land	Ocean
abrupt4xCO2	0.05	-0.08	0.09
	0.17	0.13	0.19
	0.28	0.24	0.33
G1	-0.21	-0.28	-0.19
	-0.12	-0.11	-0.13
	-0.06	-0.01	-0.07
G1ocean-Albedo	-0.26	-0.14	-0.36
	-0.19	0.05	-0.29
	-0.11	0.20	-0.22

116

117 **Table S14.** Change in evaporation (mm day^{-1}) from piControl, averaged over years
118 11-50 of simulation. Values in each box are (in order) ensemble minimum,
119 ensemble mean, and ensemble maximum. All values are rounded to four decimal
120 places.
121

	Global	Land	Ocean
abrupt4xCO2	0.05	-0.16	0.14
	0.18	0.04	0.23
	0.28	0.23	0.39
G1	-0.21	-0.30	-0.17
	-0.12	-0.13	-0.12
	-0.04	0.04	-0.08
G1ocean-Albedo	-0.25	-0.22	-0.27
	-0.18	-0.04	-0.23
	-0.07	0.16	-0.17

122

123 **Table S15.** Change in precipitation minus evaporation (mm day^{-1}) from piControl,
124 averaged over years 11-50 of simulation. Values in each box are (in order)
125 ensemble minimum, ensemble mean, and ensemble maximum. All values are
126 rounded to four decimal places.
127

|	Global	Land	Ocean
abrupt4xCO2	-0.06	-0.01	-0.09
	-0.01	0.09	-0.05
	0.00	0.20	-0.01
G1	-0.01	-0.05	-0.04
	-0.00	0.02	-0.01
	0.00	0.11	0.01
G1ocean-Albedo	-0.19	-0.18	-0.19
	-0.02	0.09	-0.06
	0.00	0.18	-0.01

TOA Net Flux (W/m2)
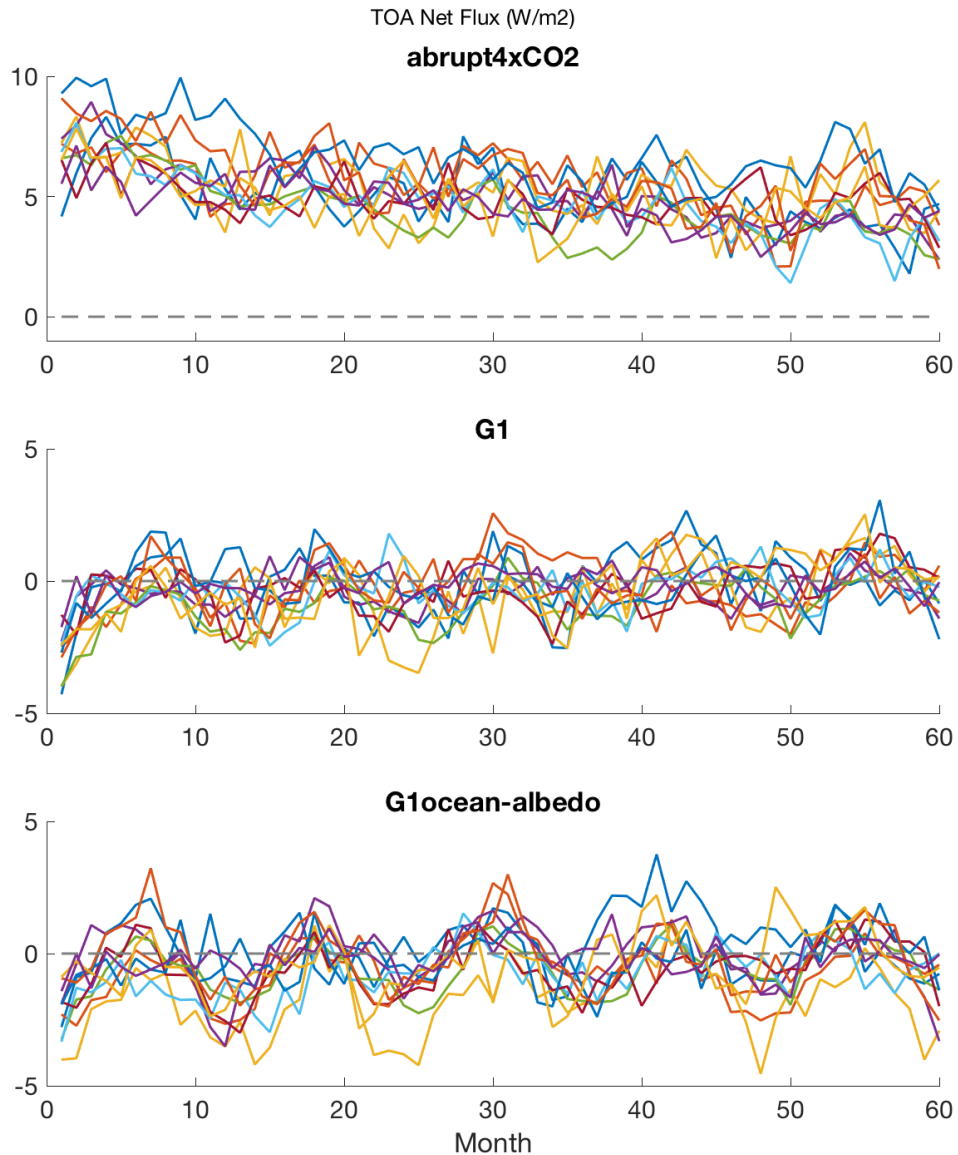
128
129
130   **Figure S1.** Top-of-atmosphere net radiative flux change (W m⁻²) in the
131   abrupt4xCO2 (top), G1 (middle), and G1ocean-albedo (bottom) experiments. Each
132   color represents a different model. All values are subtracted month-by-month from
133   the corresponding months of the preindustrial control simulation for the first 60
134   months (5 years) of simulation.
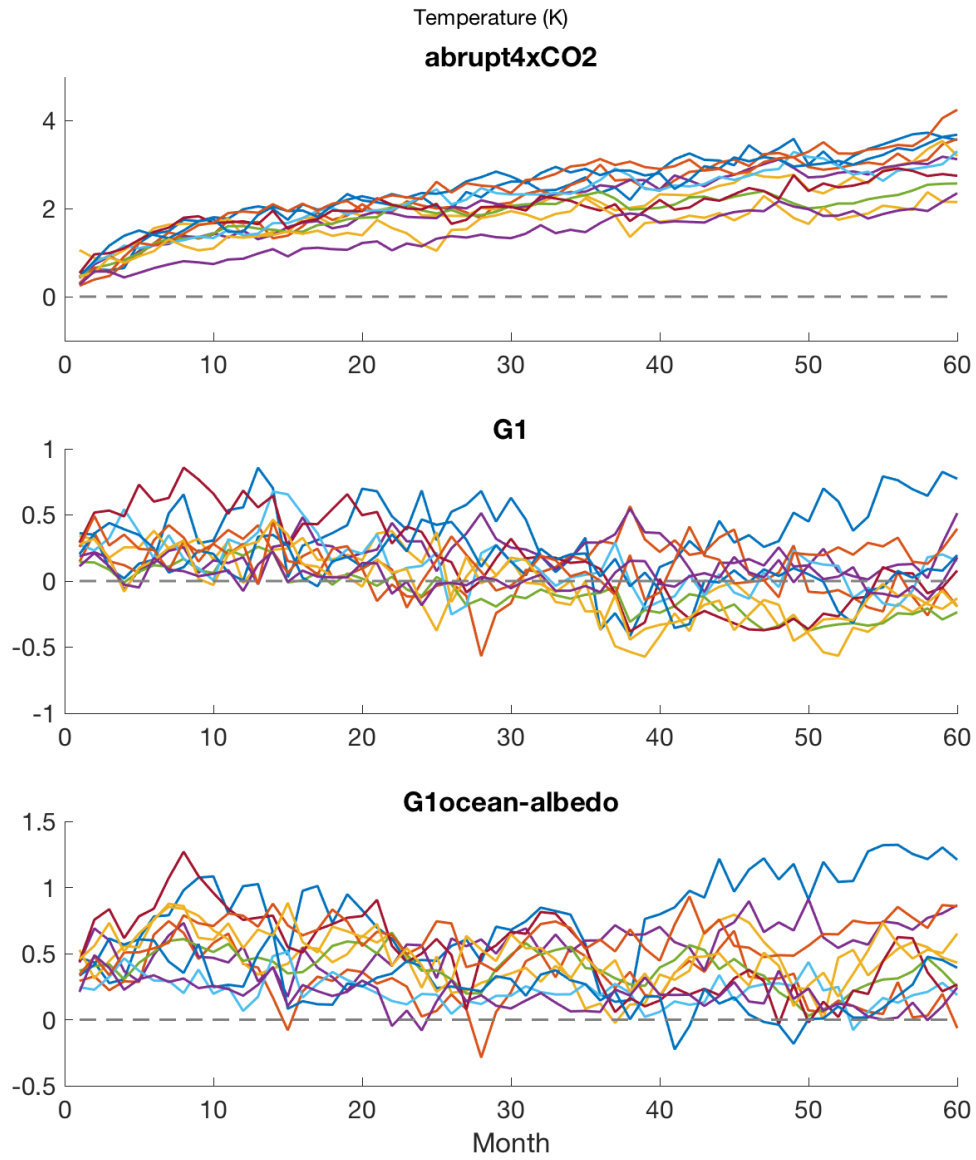
135
136
137 **Figure S2.** As in Figure S1 but for global mean temperature change (K).

R²=0.12 to 0.74

R²=0 to 0.27

R²=0 to 0.19
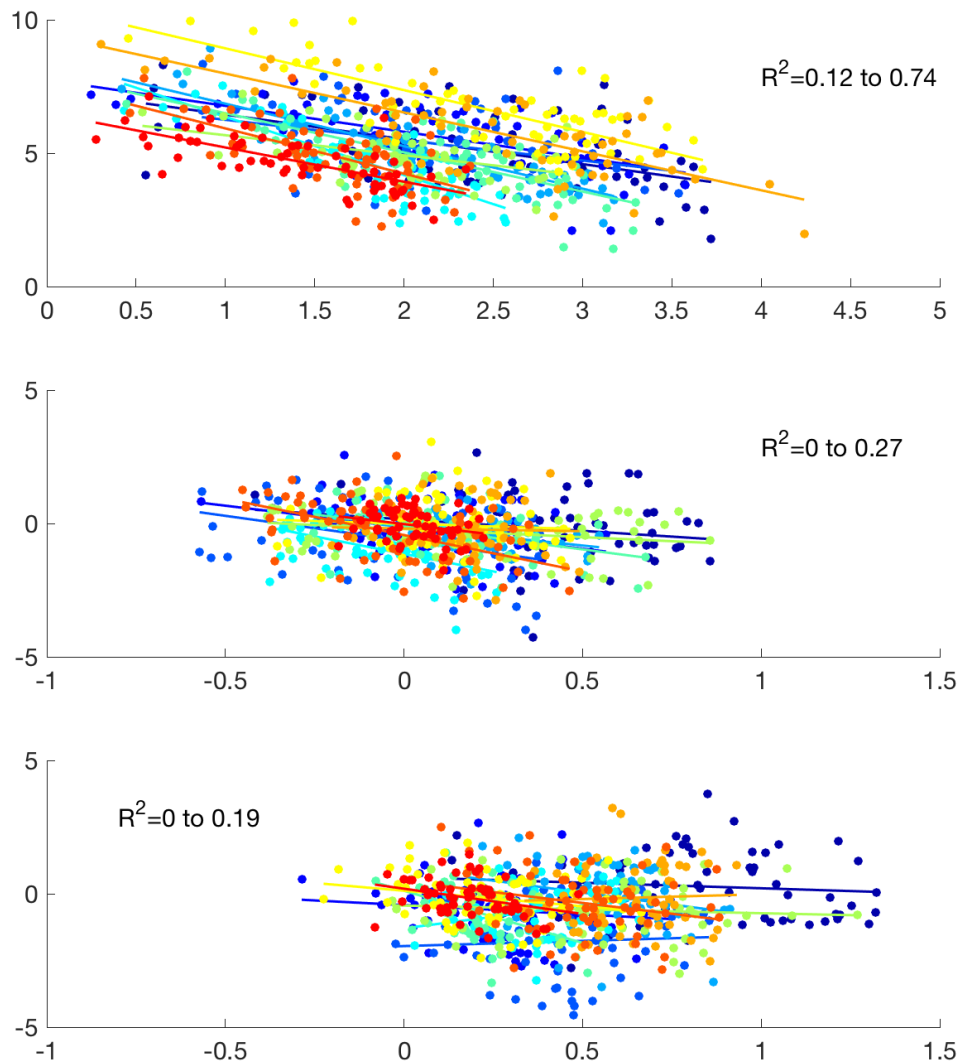
138
139
140 **Figure S3.** Gregory plots (Gregory et al., 2004), as described in Section 3.2 of the
141 main text. Top panel corresponds to abrupt4xCO2, middle panel corresponds to G1,
142 and bottom panel corresponds to G1ocean-albedo. All values are monthly averages
143 over the first five years of simulation, essentially scatter plots of the values in
144 Figures S1 (net TOA radiative flux change; y-axis in this figure) and S2 (global mean
145 temperature change; x-axis in this figure). Each color represents a different model.
146 Lines are obtained through ordinary least squares regression through the points of
147 the same color. R^2 ranges indicate the minimum and maximum R^2 value among the
148 model ensemble in each panel.