1 **Tropical Pacific Climate Variability under Solar Geoengineering: Impacts on ENSO**
2 **Extremes**

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14 **Supplementary**

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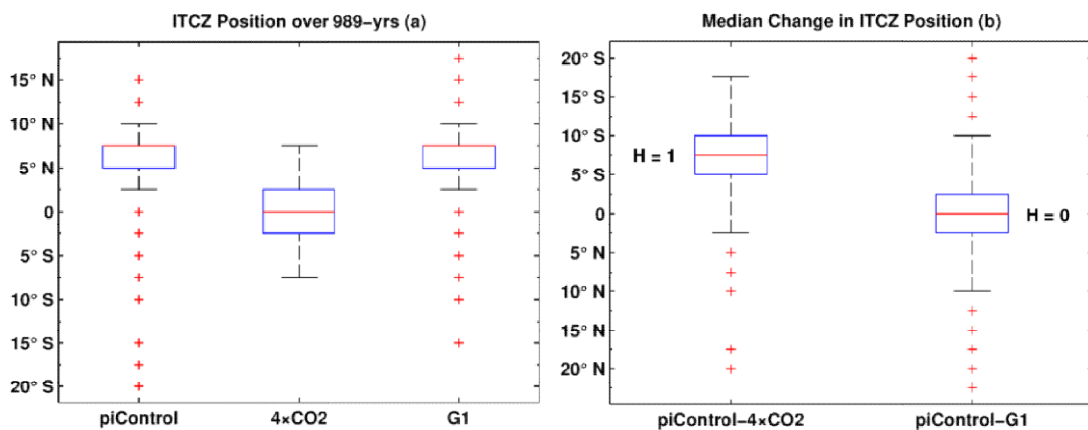
Figure S1. (a) Variability in ITCZ position over the simulated period for piControl, $4\times CO_2$,
and G1. The red lines show the media position (b) change in position of ITCZ relative to
piControl under $4\times CO_2$ and G1. The red lines show median change in position relative to
piControl. The ITCZ position is calculated by finding the latitude where maximum rainfall
occurs. H = 1 indicate that the change is statistically significant at 99 % cl using non-
parametric Wilcoxon rank sum test

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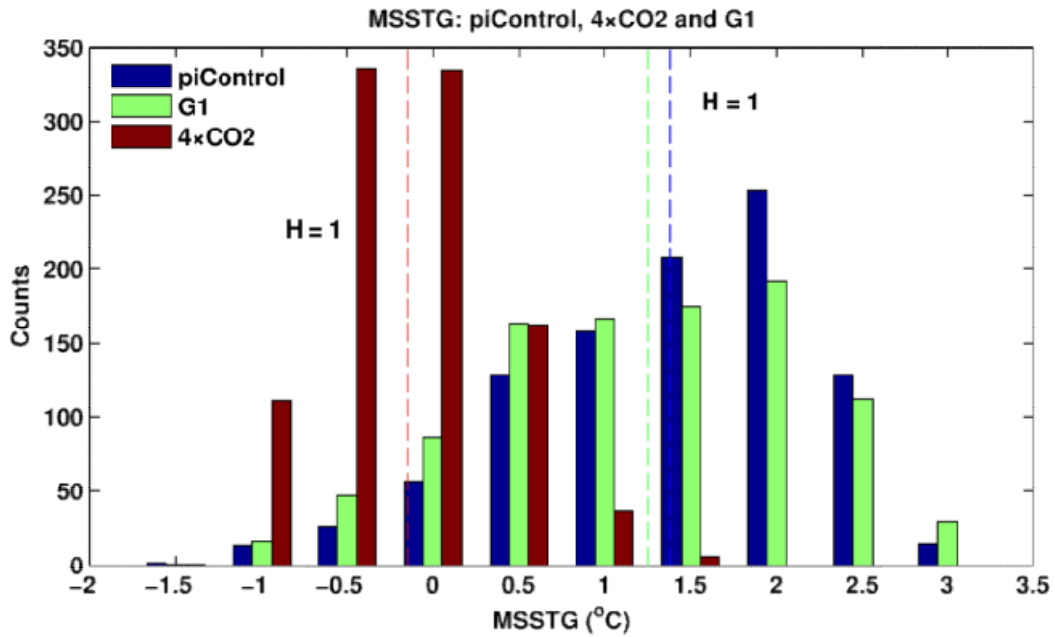
Figure S2. Histogram of MSSTG for piControl, 4×CO$_2$, and G1. The values are plotted at the centre of each bin with an interval of 0.5 ^{o}C. Blue, green, and red vertical lines indicate climatological mean values of MSSTG under piControl (1.38 ^{o}C), G1 (1.25 ^{o}C), and 4×CO$_2$ (-0.15 ^{o}C), respectively. H = 1 indicate that shift in mean is statistically significant at 99 % cl using non-parametric Wilcoxon rank sum test.
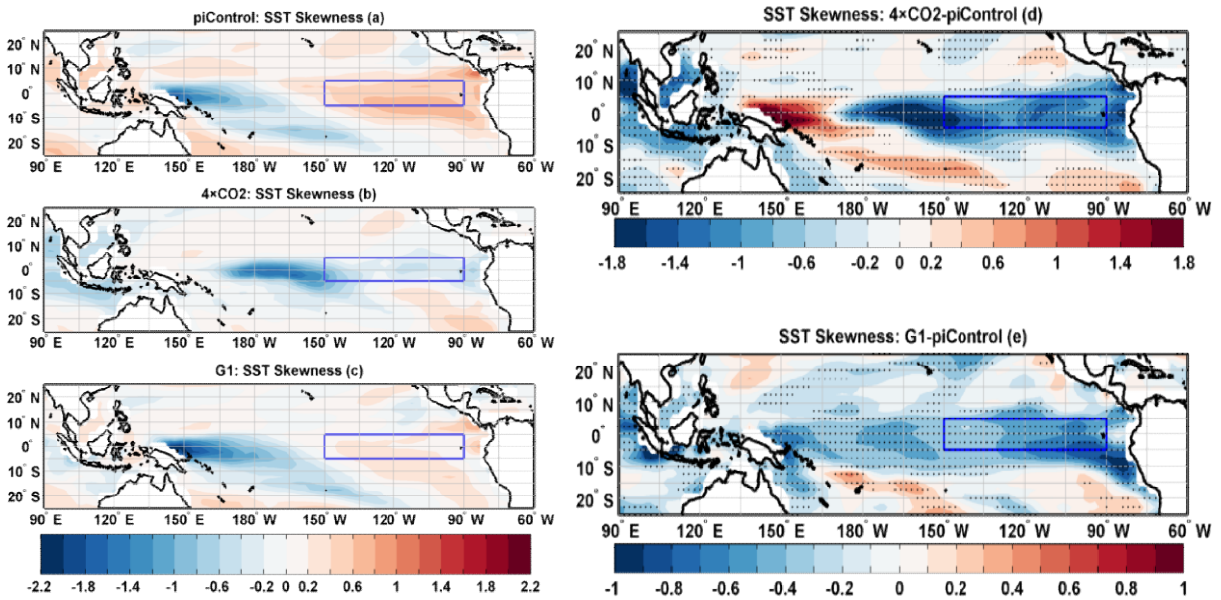
Figure S3. Quadratically detrended SST skewness for (a) piControl (b) 4×CO$_2$ (c) G1 (d) difference: 4×CO$_2$-piControl and (e) difference: G1-piControl. Stipples indicate grid points where difference is statistically significant at 95 % cl bootstrap method with 10,000 realizations.
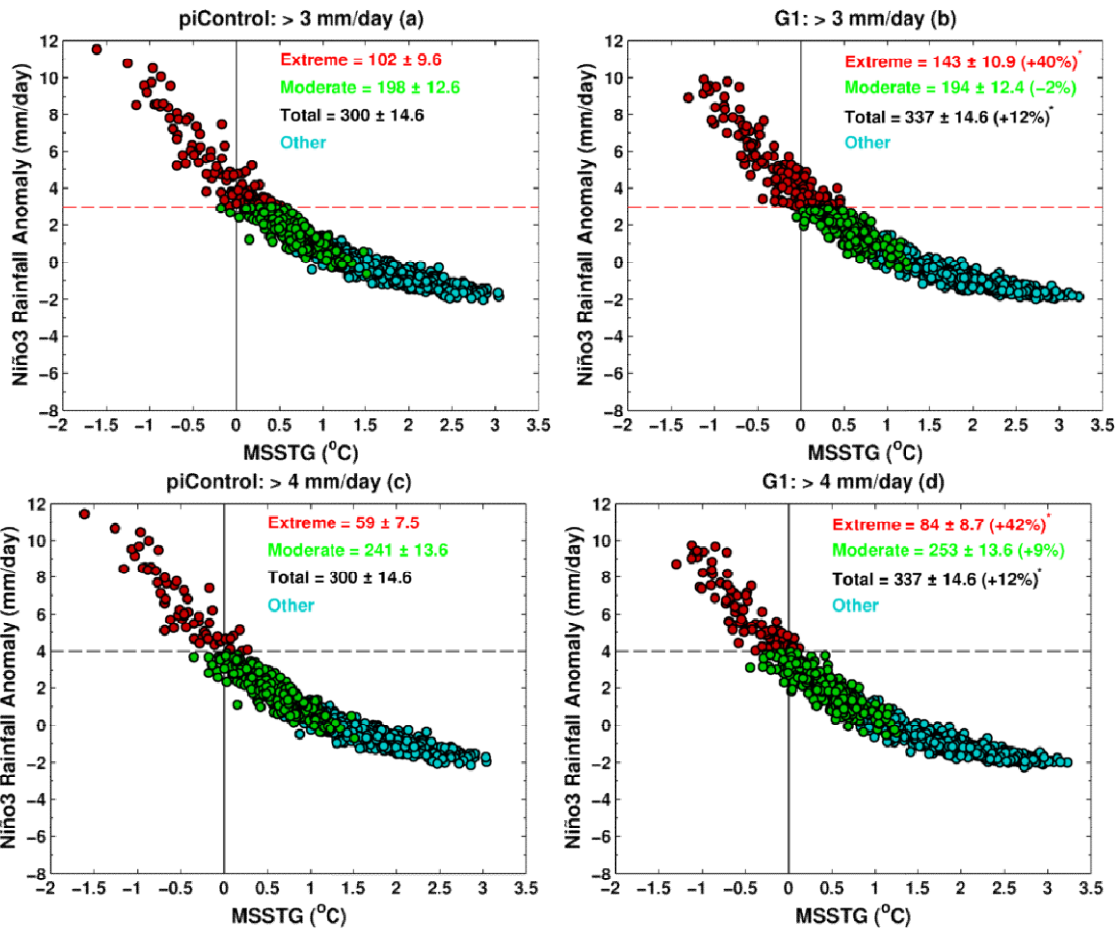
Figure S4. Simulated relationship between MSSTG and Niño3 rainfall when extreme El Niño is defined with Niño3 rainfall anomaly > 3 mm day^{-1} for (a) piControl and (b) G1. Simulated relationship between MSSTG and Niño3 rainfall when extreme El Niño is defined with Niño3 rainfall anomaly > 4 mm day^{-1} for (c) piControl and (d) G1. The dashed red (black) horizontal line indicates threshold anomaly of 3 (4) mm day^{-1}. See text for definition of moderate and total El Niño events. The asterisk indicates that the change in frequency is statistically significant at 99 % cl. Numbers with ± symbol indicate s.d. calculated with 10,000 bootstrap realisations.

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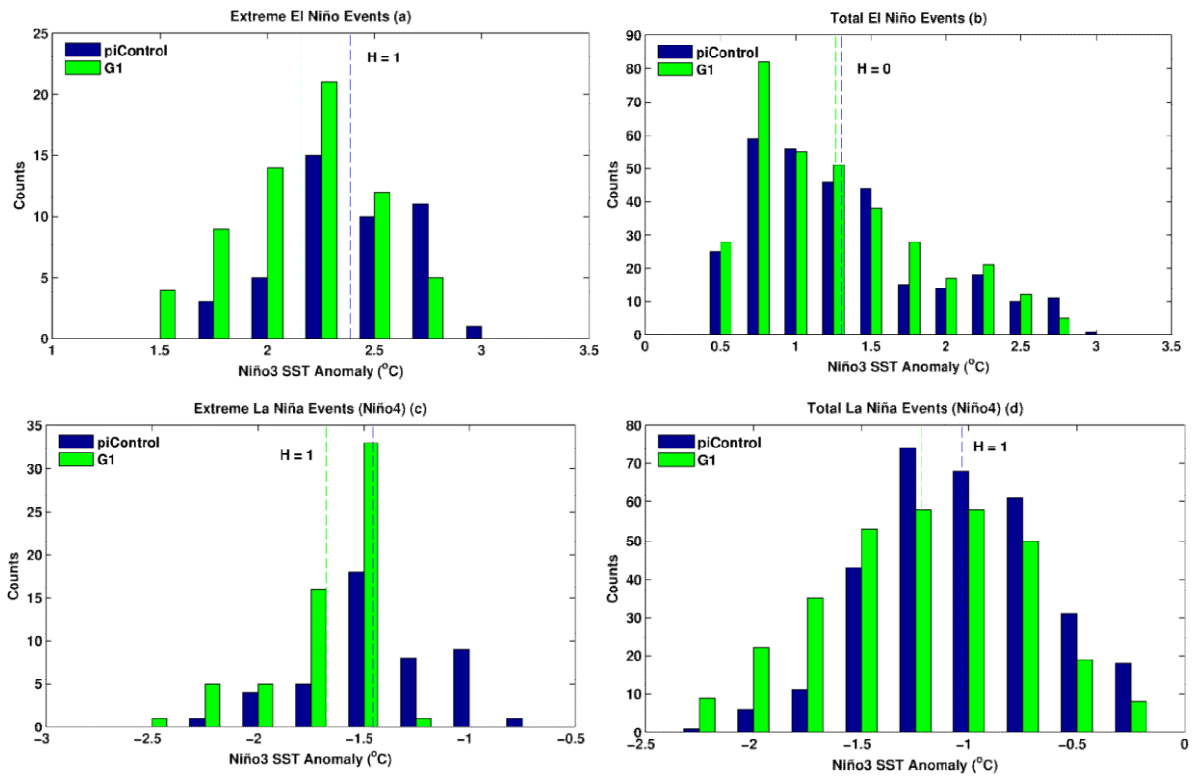
Figure S5. Histograms of quadratically detrended Niño3 SST anomalies calculated for (a) extreme El Niño events (b) total El Niño events (c) extreme La Niña events and (d) total La Niña events. Blue, and green vertical lines indicate mean values for piControl and G1, respectively. H = 1 indicate that shift in mean is statistically significant at 99 % cl using non-parametric Wilcoxon rank sum test.

1 **Tables**

2 **Table S1.** Mean SST (°C) and rainfall (mm day^{-1}) climatology over tropical Pacific (25° N-
3 25° S; 90° E-60° W)

Experiment	Mean ± standard Error	Difference w.r.t. piControl	Std. Dev. 10,000 Realizations	~ Change w.r.t. piControl (%)
piControl	26.52* (4.32)*		0.009 [0.0042]	
4×CO$_2$	30.42* (4.53)*	+3.9 (+0.21)		+15* (+5)*
G1	26.22* (4.09)*	-0.30 (-0.23)		-1* (-5)*

4 Key: SST (Rainfall); *99 % cl; **95 % cl

6 **Table S2.** Meridional SST Gradient (MSSTG)

Experiment	Mean (°C)	Difference w.r.t. piControl (°C)	Std. Dev. 10,000 Realizations (°C)	~ Change w.r.t. piControl (%)
piControl	1.38*		0.0265	
4×CO$_2$	-0.15*	-1.53		-111*
G1	1.25*	-0.13		-9*

7 Key: *99 % cl; **95 % cl

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9 **Table S4.** Total number of El Niño events (SST > 0.5 s.d.)

Experiment	Amplitude (°C)	Difference w.r.t. piControl (°C)	Std. Dev. 10,000 Realizations (°C)	~ Change w.r.t. piControl (%)
piControl	300 (380) [312]		14.6 (15.4) [14.7]	
G1	337 (430) [352]	37 (50) [40]		+12** (+13*) [+13**]

10 Key: Niño3 (Niño4) [Niño3.4]; *99 % cl; **95 % cl

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12 **Table S5.** La Niña events

Experiment	Index < -1.75 ±s.d. with 10,000 realizations	-1 > index > -1.75 ±s.d. with 10,000 realizations	-0.5 > index > -1 ±s.d. with 10,000 realizations	Index < -0.5 ±s.d. with 10,000 realizations	~ Change in Extreme La Niña Events w.r.t. piControl (%)
piControl	8±2.8 (46±6.5) [16±3.9]	158±11.4 (145±11.1) [155±11.5]	183±12.3 (122±10.3) [179±12.1]	349±15 (313±14.6) [350±15.2]	
G1	40 (61) [38]	156 (130) [163]	170 (121) [156]	366 (312) [357]	+400* (+32)** [+138]*

13 Key: Niño3 (Niño4) [Niño3.4]; *99% cl; **95% cl

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