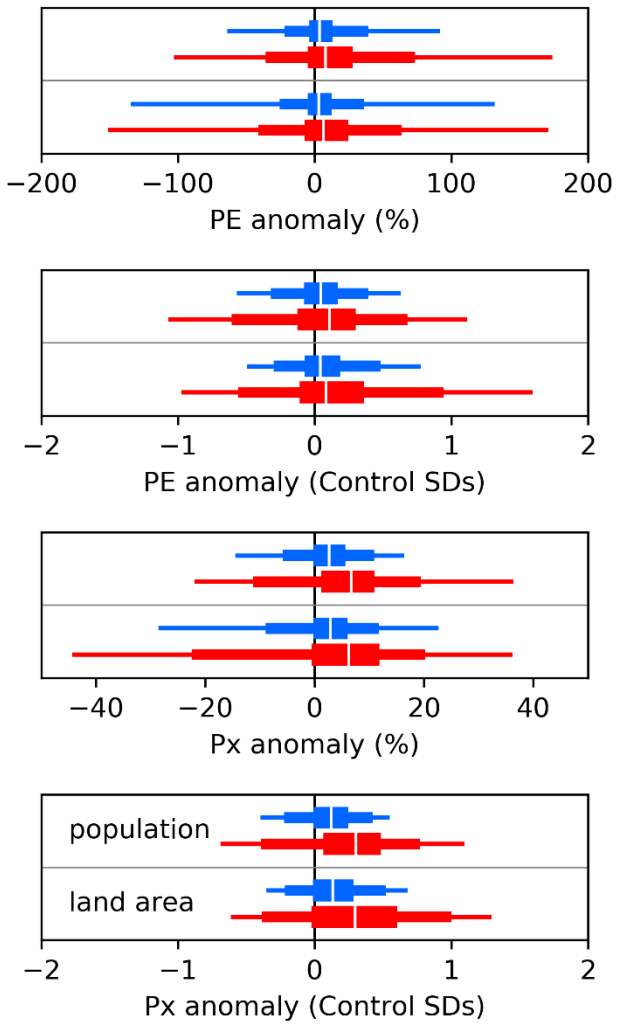
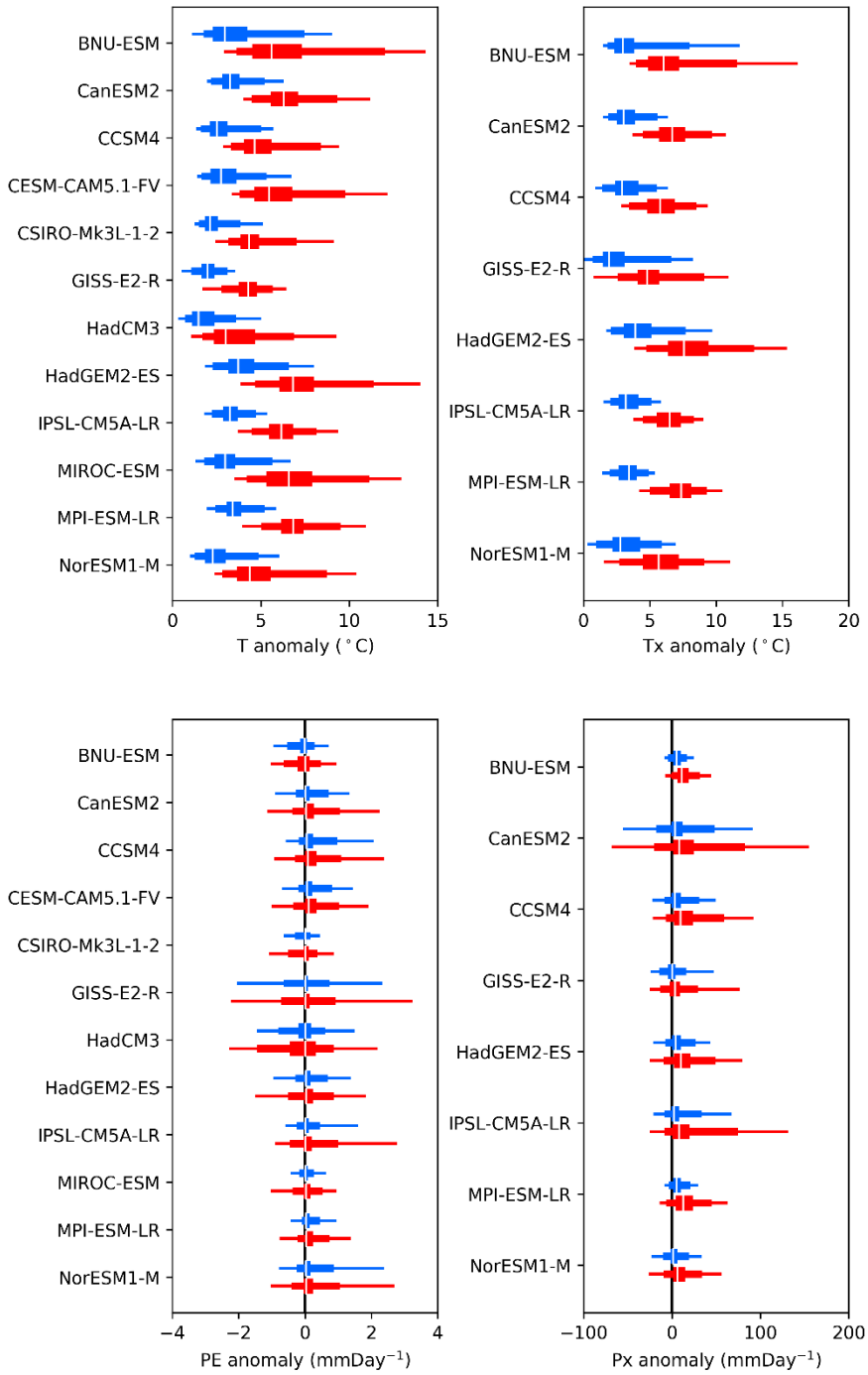
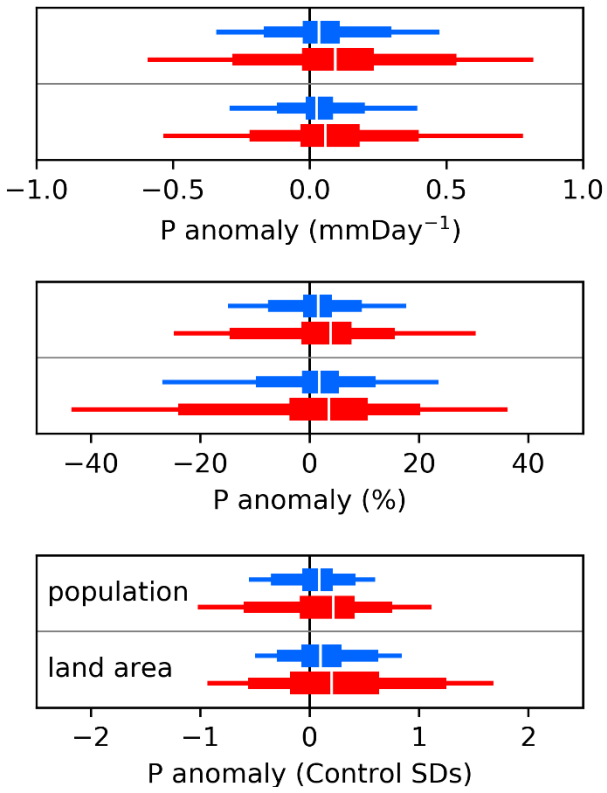
Extended Data



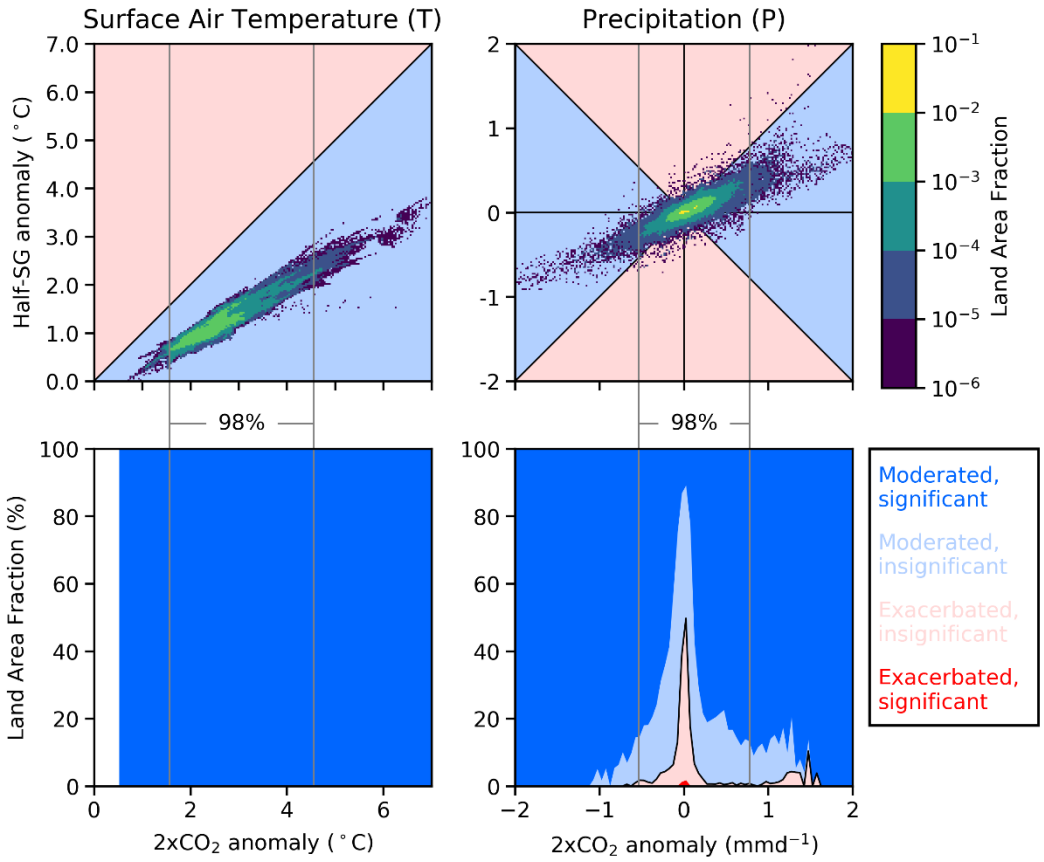
ED Figure 1. As Fig 1 but with PE and Px anomalies calculated as percentages of control values and as number of control standard deviations. The respective anomalies of each point were divided by the control standard deviation of that point to arrive at the Control SDs anomalies.



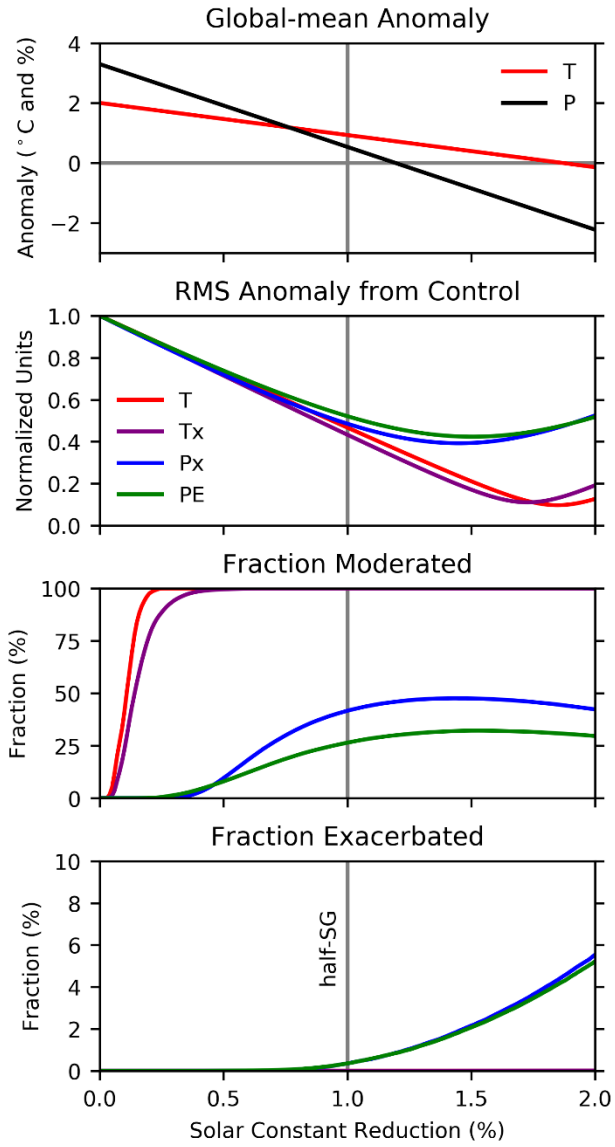
ED Figure 2. The distribution of 4xCO_2 and synthetic half-SG anomalies of the GeoMIP ensemble weighted by land area. The T and PE anomalies for 12 GeoMIP models and the Tx and Px anomalies for 8 GeoMIP models are shown as in Fig 1.



ED Figure 3. The distribution of precipitation anomalies (P) weighted by land area and by population. Results are shown with anomalies calculated in units of mmDay^{-1}, percentage change, and in terms of control standard deviations.



ED Figure 4. The joint distribution of 2xCO_2 and half-SG surface air temperature (T) and precipitation (P) anomalies with results for the fraction of the land surface where half-SG exacerbates or moderates the climate trend. *Top, 2D-histograms show the distribution across the land area, excluding Greenland and Antarctica, of the 2xCO_2 and half-SG anomalies in precipitation. To generate the bins for the 2D-histogram the X and Y axes are divided into 200 intervals. The fraction of the land area with anomalies that fall into each bin are indicated by the colour scale, empty bins are not plotted. All points falling closer to the x-axis than the diagonal 1:1 lines see the magnitude of the trend reduced (moderated, blue background) by half-SG and all those above and below these lines see the magnitude of the trend increased (exacerbated, pink background). Note all points, including those that don't see significant change are plotted. Bottom, the fraction of the area in which the impacts of 2xCO_2 are exacerbated (red) or moderated (blue) by half-SG as a function of the 2xCO_2 anomaly. Bold colours indicate statistically significant results and pale colors indicate insignificant results.*



ED Figure 5. Performance of solar geoengineering as a function of solar constant reduction. Results for a range of solar constant reductions are shown for the HiFLOR model with values extrapolated by scaling the results of half-SG (1.0 %) and 2xCO_2 (see Methods). The panels show global-mean T and Precipitation (P) (a), Root Mean Square (RMS) anomaly with all variables normalized to 1 at 0 % (b); fraction moderated (c) and fraction exacerbated (d). Points are exacerbated when the absolute magnitude of the SG anomaly is statistically significantly greater (90% T-Test) than the 2xCO_2 anomaly, and vice versa for moderated (see Methods).

Climate Hazard	Relevant variables
Sea level rise and coastal flooding including storm surges	PDI
Extreme precipitation and inland flooding	Px
Novel hazards yielding systemic risks (electricity and water provision failure during extreme events)	Px, PDI
Increasing frequency and intensity of extreme heat, including urban heat island effect (human health)	Tx
Warming, drought, and precipitation variability (agricultural impact)	T, Tx, PE, Px
Drought (water scarcity and agricultural impact)	PE
Rising ocean temperature, ocean acidification, and loss of Arctic sea ice (ocean ecosystem impacts)	T
Rising land temperatures, and changes in precipitation patterns and in frequency and intensity of extreme heat (terrestrial ecosystem impacts)	T, Tx, PE

ED Table 1. The climate hazards for each of the key risks of climate change identified by the IPCC and the relevant variables assessed in this study. The list of climate hazards presented here are derived from Table TS3 of the Technical Summary of Working Group 2 to the 5th Assessment Report of the IPCC.

	Fraction Exacerbated				Fraction Moderated			
	HiFLOR	GeoMIP			HiFLOR	GeoMIP		
		Med	Min	Max		Med	Min	Max
T	0.0 %	0.0 %	0.0 %	0.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Tx	0.0 %	0.0 %	0.0 %	0.3 %	100.0 %	100.0 %	99.5 %	100.0 %
PE	0.6 %	1.9 %	0.2 %	5.7 %	20.9 %	25.0 %	17.9 %	52.8 %
Px	0.2 %	0.3 %	0.1 %	4.4 %	31.3 %	49.0 %	30.8 %	61.9 %

ED Table 2. As Table 1. but with results weighted by population (see Methods).

	Fraction Exacerbated					Fraction Moderated				
	Annual	Seasons				Annual	Seasons			
		DJF	MAM	JJA	SON		DJF	MAM	JJA	SON
T	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	100.0 %	99.9 %	100.0 %	99.9 %	100.0 %
Tx	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	100.0 %	98.1 %	98.9 %	97.1 %	99.4 %
PE	0.4 %	1.3 %	1.4 %	1.0 %	1.0 %	26.4 %	26.7 %	15.2 %	21.4 %	20.3 %
Px	0.4 %	0.9 %	0.7 %	0.7 %	1.0 %	41.6 %	28.1 %	25.7 %	20.1 %	20.5 %

ED Table 3. As Table 1. But for HiFLOR only with results calculated for each season separately.

	Simulated Half-SG		Synthetic Half-SG	
	Fraction Moderated	Fraction Exacerbated	Fraction Moderated	Fraction Exacerbated
T	100.0 %	0.0 %	100.0 %	0.0 %
Tx	100.0 %	0.0 %	100.0 %	0.0 %
PE	31.0 %	3.1 %	26.3 %	3.1 %
Px	44.5 %	3.8 %	40.2 %	2.2 %

ED Table 4. As Table 1. But for the simulated and linearly-scaled CESM simulations.

Model	Tx and Px
BNU-ESM	Yes
CanESM2	Yes
CCSM4	Yes
CESM-CAM5.1-FV	No
CSIRO-Mk3L-1-2	No
GISS-E2-R	Yes
HadCM3	No
HadGEM2-ES	Yes
IPSL-CM5A-LR	Yes
MIROC-ESM	No
MPI-ESM-LR	Yes
NorESM1-M	Yes

ED Table 5. Shows the GeoMIP models analyzed in this study and whether Tx and Px were available.