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SUPPLEMENTARY INFORMATION

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Demographic controls of future global fire risk

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National Center for Atmospheric Research	CCSM4

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Table S2. Optimised SIMFIRE parameters and rules of assignment for land cover classes[*].

Parameter	*Land cover class*	*Value*	*Condition 1*	*Condition 2*	*Condition 3*
a_1	Cropland/Urban/Natural Vegetation Mosaic	0.110	Class not used		
a_2	Needleleaf forest	0.095	$f_s/f_w<0.8$ and $f\geq0.1$	$f_g/f<0.4$	$f_n/f\geq0.6$
a_3	Broadleaf forest	0.092	$f_s/f_w<0.8$ and $f\geq0.1$	$f_g/f<0.4$	$f_b/f\geq0.6$
a_4	Mixed forest	0.127	$f_s/f_w<0.8$ and $f\geq0.1$	$f_g/f<0.4$	$f_n/f<0.6$ or $f_b/f<0.6$
a_5	Shrubland	0.470	$f_s/f_w\geq0.8$	$\|\lambda\|\leq50°$	-
a_6	Savanna or Grassland	0.889	$f_s/f_w<0.8$ and $f\geq0.1$	$f_g/f\geq0.4$	-
a_7	Tundra	0.059	$f<0.1$ or $f_s/f_w\geq0.8$	$\|\lambda\|>50°$	-
a_8	Barren or Sparsely Vegetated	0.113	$f<0.1$	$\|\lambda\|\leq50°$	-
b	*Global*	0.905			
c	*Global*	0.860			
e	*Global* [km^2/inhabitants]	-0.0168			

f: potential FAPAR of all individuals within a grid cell
f_w: potential FAPAR of woody individuals within a grid cell.
f_s: potential FAPAR of woody individuals with less than 2 m height within a grid cell (shrubs).
f_g: potential FAPAR of all grasses within a grid cell
f_n: potential FAPAR of all needle-leaved individuals within a grid cell with at least 2 m height.
f_b: potential FAPAR of all broad-leaved individuals within a grid cell with at least 2 m height.
λ: geographical latitude of the centre of the grid cell.
[*] All conditions are to be met, unless marked "-"

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Table S3: Simulated burned area [10^6 km^2] for the globe or for densely populated areas for different world regions.

RCP	Population	Urbanization	Case	Total burned area			Only areas with > 30 inhab. / km^2		
				SSA[1]	ANL[2]	NEFA[3]	SSA	ANL	NEFA
-	Historical[4]		-	1748	885	797	101	55	13
4.5[5]	SSP5 (low)	SSP5 (fast)	1	1264	1001	892	92	53	15
	SSP2 (medium)	SSP5 (fast)	2	1172	975	898	118	56	18
	SSP2 (medium)	SSP2 (central)	3	1047	945	894	146	68	18
	SSP2 (medium)	SSP3 (slow)	4	941	911	890	179	80	18
	SSP3 (high)	SSP3 (slow)	5	837	867	894	194	76	21
8.5	SSP5 (low)	SSP5 (fast)	1	1227	1185	1013	78	61	19
	SSP2 (medium)	SSP5 (fast)	2	1142	1155	1019	104	64	22
	SSP2 (medium)	SSP2 (central)	3	1027	1121	1015	131	78	22
	SSP2 (medium)	SSP3 (slow)	4	929	1084	1009	162	92	23
	SSP3 (high)	SSP3 (slow)	5	831	1032	1016	174	87	25
4.5	Change of SSP5 to SSP2 population		2–1	-92	-26	5	26	3	3
	Change of SSP5 to SSP2 urbanisation		3–2	-125	-30	-3	28	12	0
	Change of SSP2 to SSP3 urbanisation		4–3	-107	-33	-5	33	13	0
	Change of SSP2 to SSP3 population		5–4	-103	-45	4	15	-4	3
8.5	Change of SSP5 to SSP2 population		2–1	-84	-30	6	26	3	4
	Change of SSP5 to SSP2 urbanisation		3–2	-115	-34	-5	26	14	-1
	Change of SSP2 to SSP3 urbanisation		4–3	-98	-38	-5	31	14	1
	Change of SSP2 to SSP3 population		5–4	-98	-51	6	12	-5	3

[1] Sub-Saharan Africa

[2] Asia-North Africa-Latin America-Caribbean

[3] North America-Europe-Former Soviet Union-Australia and New Zealand

[4] 1971-2000 average

[5] 2071-2100 average for RCP scenarios

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Table S4: Simulated global burned area [10^6 km^2] by period, RCP and SSP scenario; for ESM ensemble and for each ESM separately[(1)].

Period	RCP	Population	Urbanization	Ensemble	MPI-ESM-LR	CCSM4	CSIRO-MK360	EC-EARTH	CNRM-CM5	GISS-E2-R	IPSL-MR	HADGEM2-ES
1971-2000	-	Historical	Historical	3.43	3.50	3.41	3.44	3.44	3.45	3.40	3.39	3.41
2071-2100	4.5	SSP5	SSP5	3.16	3.18	3.10	3.21	3.04	3.10	2.92	3.30	3.40
		SSP2	SSP5	3.05	3.07	3.00	3.08	2.92	2.99	2.82	3.20	3.30
		SSP2	SSP2	2.89	2.91	2.83	2.91	2.79	2.82	2.67	3.03	3.12
		SSP2	SSP3	2.74	2.76	2.68	2.76	2.65	2.70	2.54	2.87	2.96
		SSP3	SSP3	2.60	2.62	2.55	2.61	2.51	2.56	2.40	2.71	2.82
	8.5	SSP5	SSP5	3.42	3.54	3.42	3.46	3.27	3.27	3.06	3.63	3.75
		SSP2	SSP5	3.32	3.42	3.32	3.36	3.17	3.16	2.96	3.51	3.64
		SSP2	SSP2	3.16	3.24	3.19	3.19	3.01	3.03	2.82	3.36	3.48
		SSP2	SSP3	3.02	3.09	3.06	3.03	2.88	2.89	2.70	3.20	3.32
		SSP3	SSP3	2.88	2.95	2.92	2.87	2.73	2.76	2.58	3.05	3.17

[(1)] Numbers are shown in blue when future burned area is lower than recent.

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Table S5: Effect of modifications to SIMFIRE on selected results, using MPI-ESM-LR climate model output

			Globe		Areas with pop. dens.> 100/km^2		Areas with fire frequency > 0.01/yr	
Simulations	Period	Scenario	Burned area [10^6 km^2]		Burned area [10^3 km^2]		Inhabitants [Mio.]	
incr. at low pop. dens.[(1)] – standard	1901-1930	historical	-0.19	0%	0.0	0%	0	0%
	1971-2000		-0.16	0%	-0.4	0%	0	0%
	2071-2100	RCP4.5	-0.18	0%	-0.2	0%	-1	0%
		RCP8.5	-0.20	0%	0.1	0%	1	0%
MCD45[(2)] – standard	1901-1930	historical	-0.34	-6%	7.6	16%	-10	-6%
	1971-2000		-0.23	-2%	42.9	25%	-7	-2%
	2071-2100	RCP4.5	-0.17	12%	65.3	28%	71	12%
		RCP8.5	-0.26	11%	58.6	24%	68	11%

(1) Assuming increasing effect of population density on burned area below 0.1 inhabitants / km^2.

(2) SIMFIRE optimised against MODIS MCD45 global burned area product instead of GFED3.

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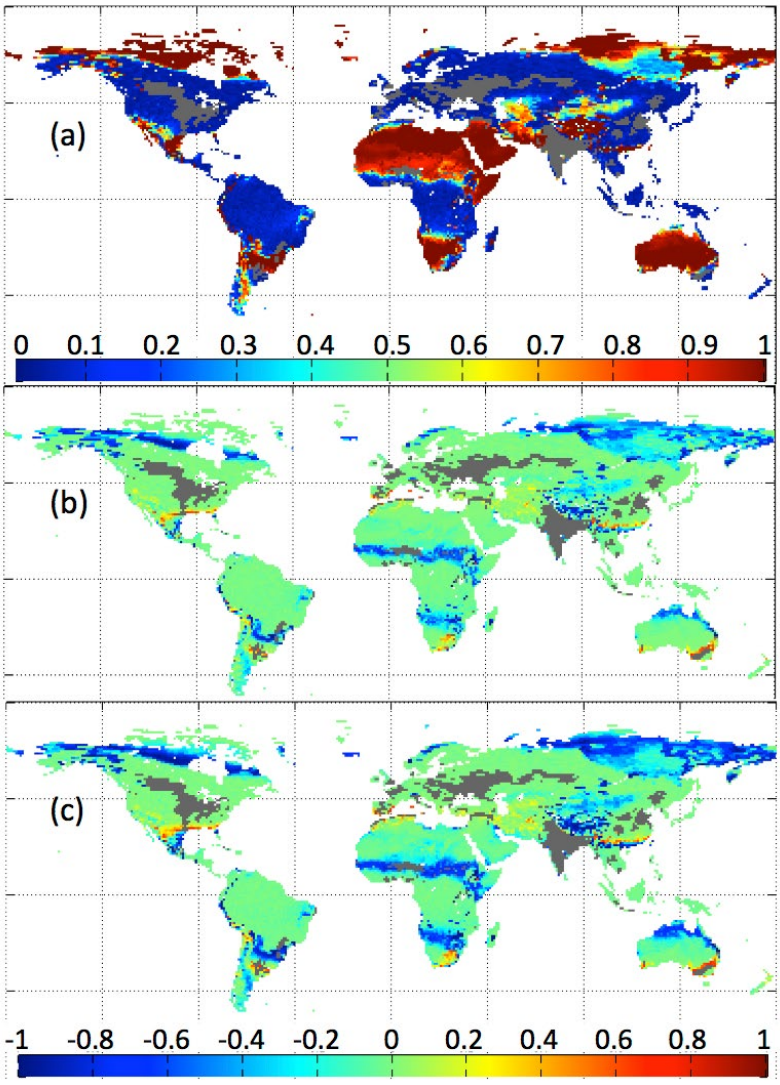

Figure S1: (a) Ensemble average of herbaceous fraction 1971-2000; (b) change in herbaceous fraction to 2071-2100 for RCP4.5, and (c) for RCP8.5. Grey areas excluded as dominated by agriculture.

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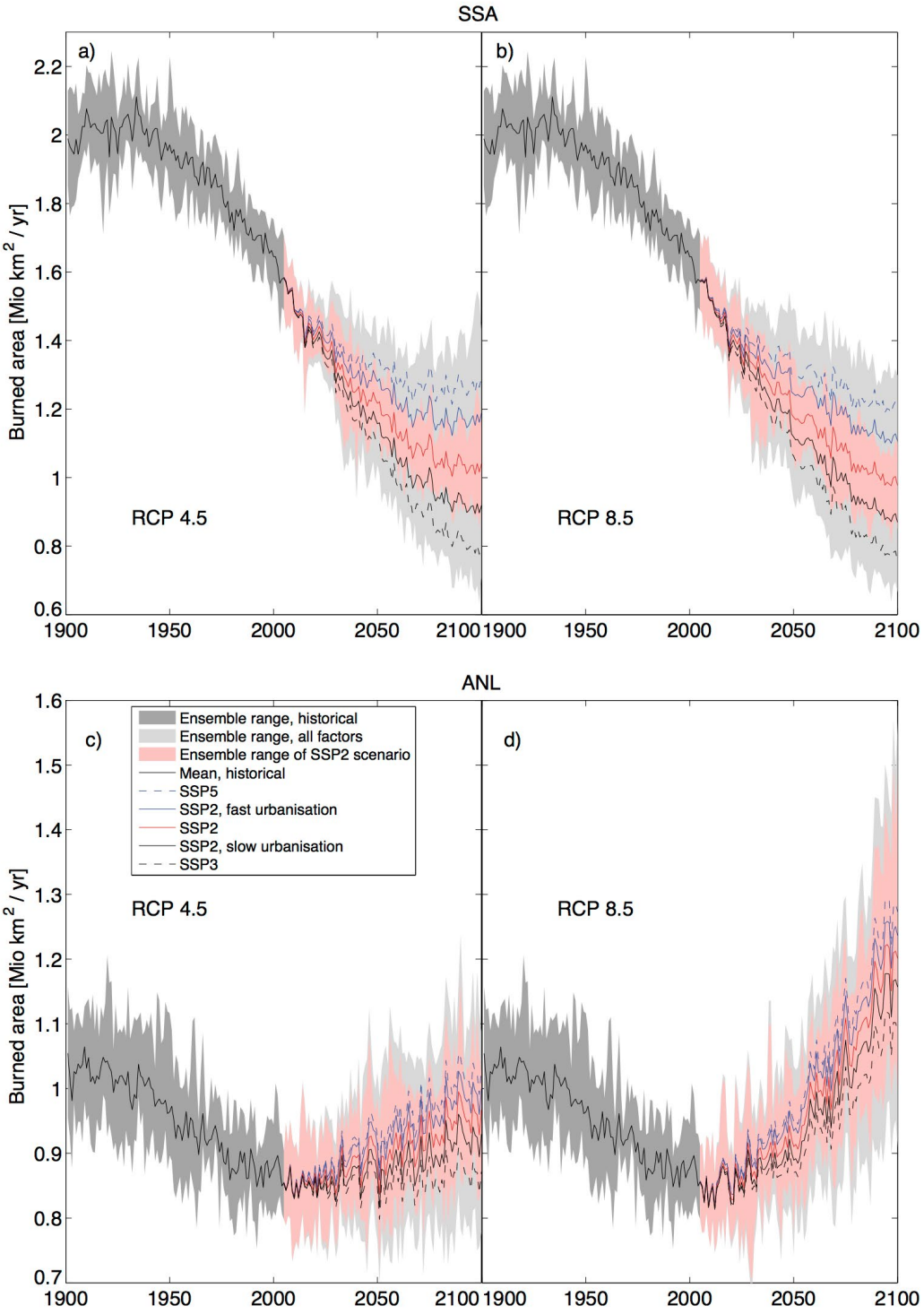

Figure S2: Ensemble mean and range of simulated burned area for Sub-Saharan Africa (a, b: SSA) and Asia-North Africa-Latin America and Caribbean (c, d: ANL), for RCP4.5 (a, c) and RCP8.5 (b, d).

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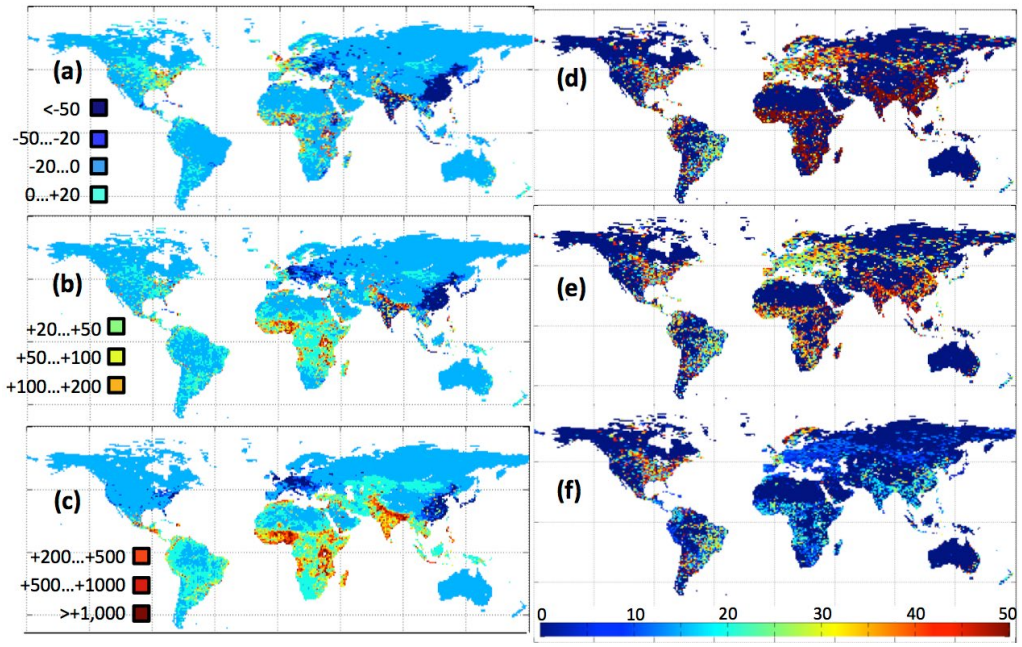

Figure S3: Absolute change in population density in people/km^2 (a-c) and change in percentage of urban population (d-f) between 2000 and 2100. (a, d) SSP5, (b, e) SSP2, (c, f) SSP3.

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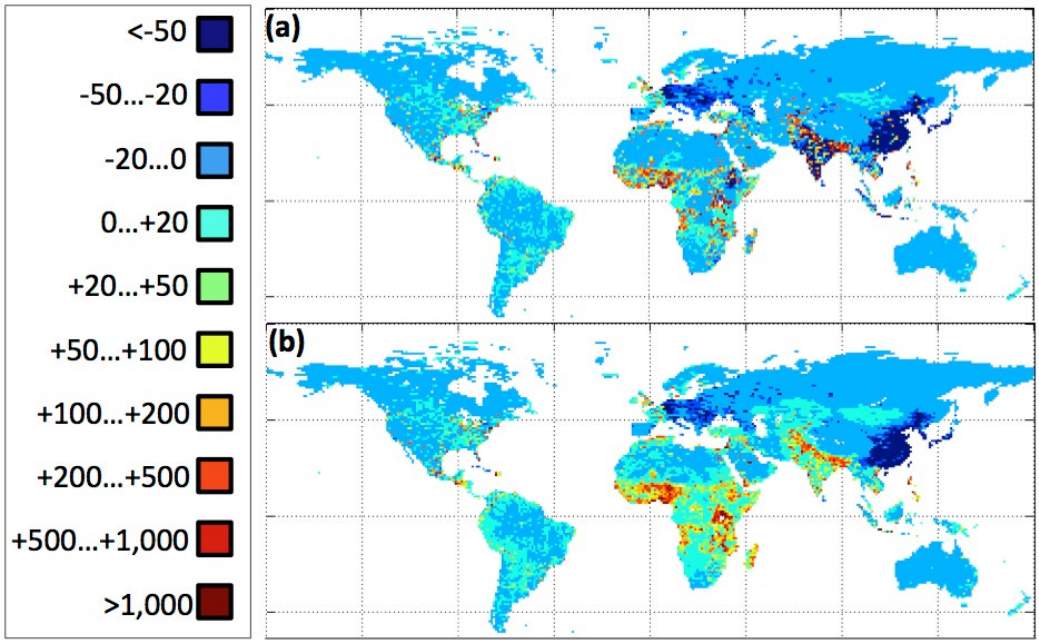

Figure S4: Change in population density from 2000 to 2100 in people per km^2 for SSP2 combined with (a) fast urbanization, (b) slow urbanisation.

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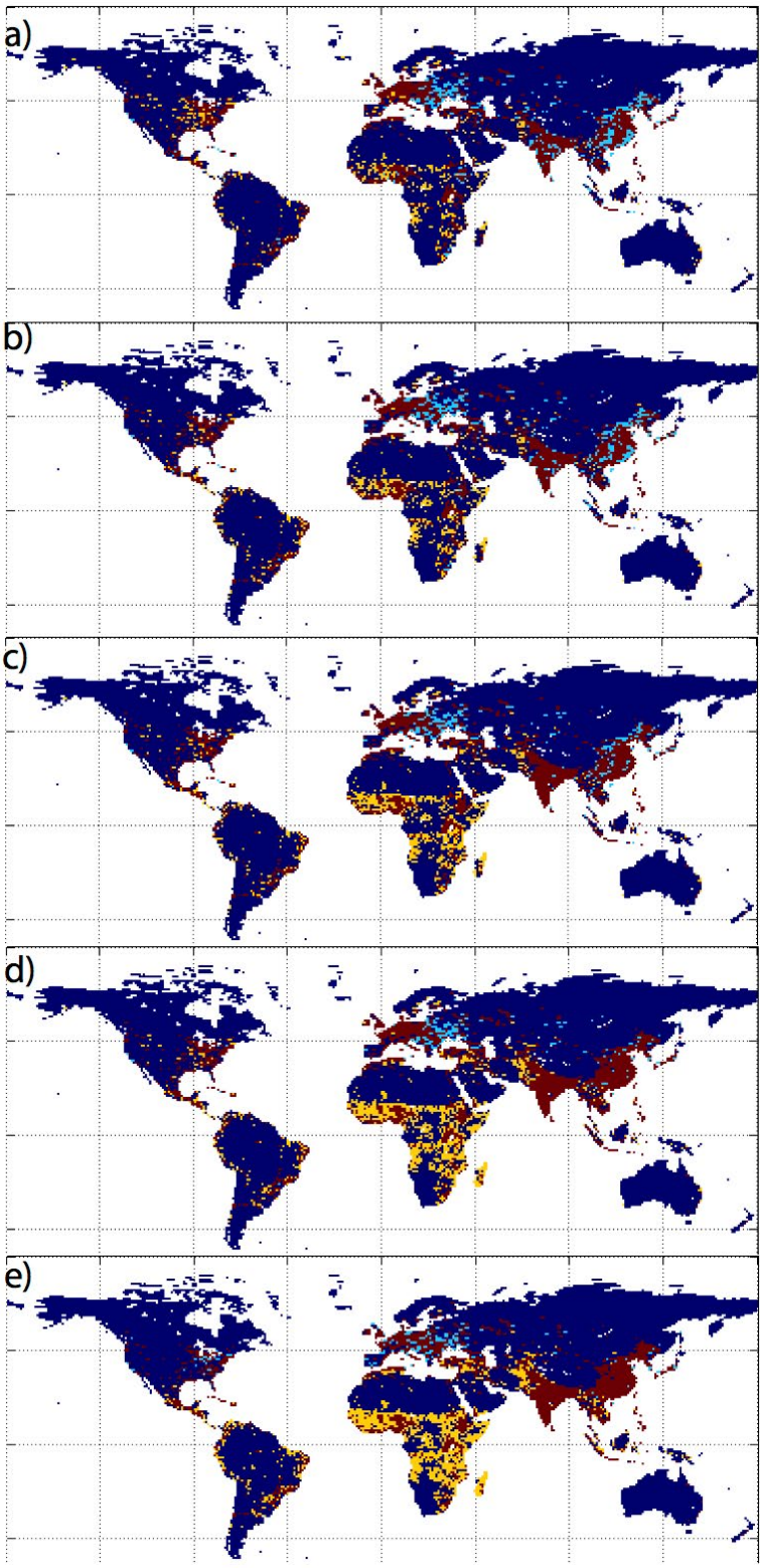

Figure S5: Densely populated areas (> 30 inhabitants/km^2) in 1971-2000 and 2071-2100 (dark red), new densely populated areas in 2071-2100 (yellow), and densely populated areas only in 1971-2000 (light blue). a) SSP5, b) SSP2 with fast urbanisation, c) SSP2, d) SSP2 with slow urbanisation, e) SSP3.

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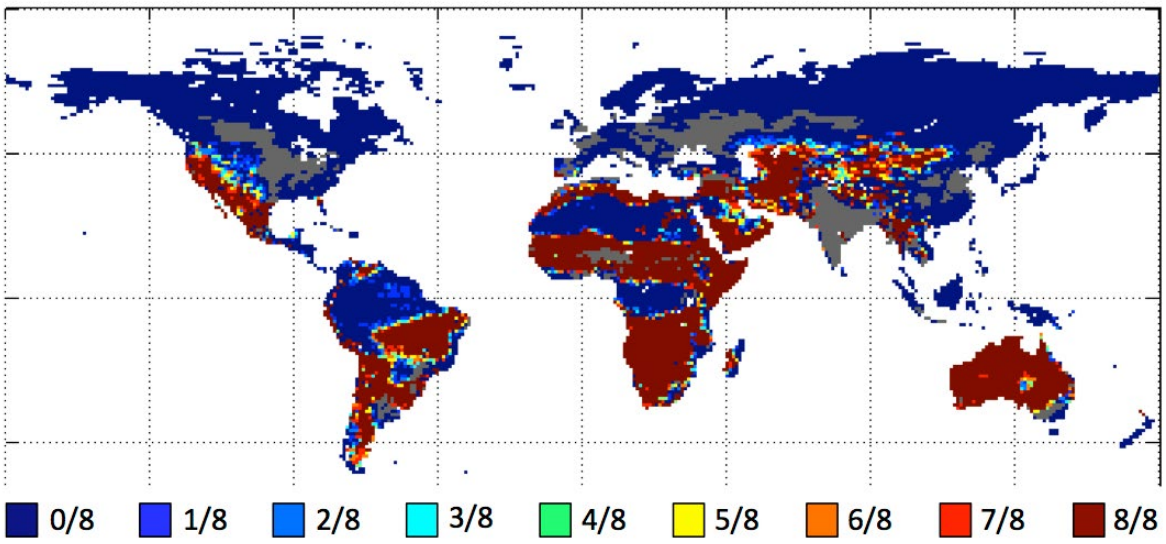

Figure S6: Fraction of ensemble members simulating grid cells as fire prone (fire frequency>0.01/yr). Grey areas excluded as dominated by cropland.

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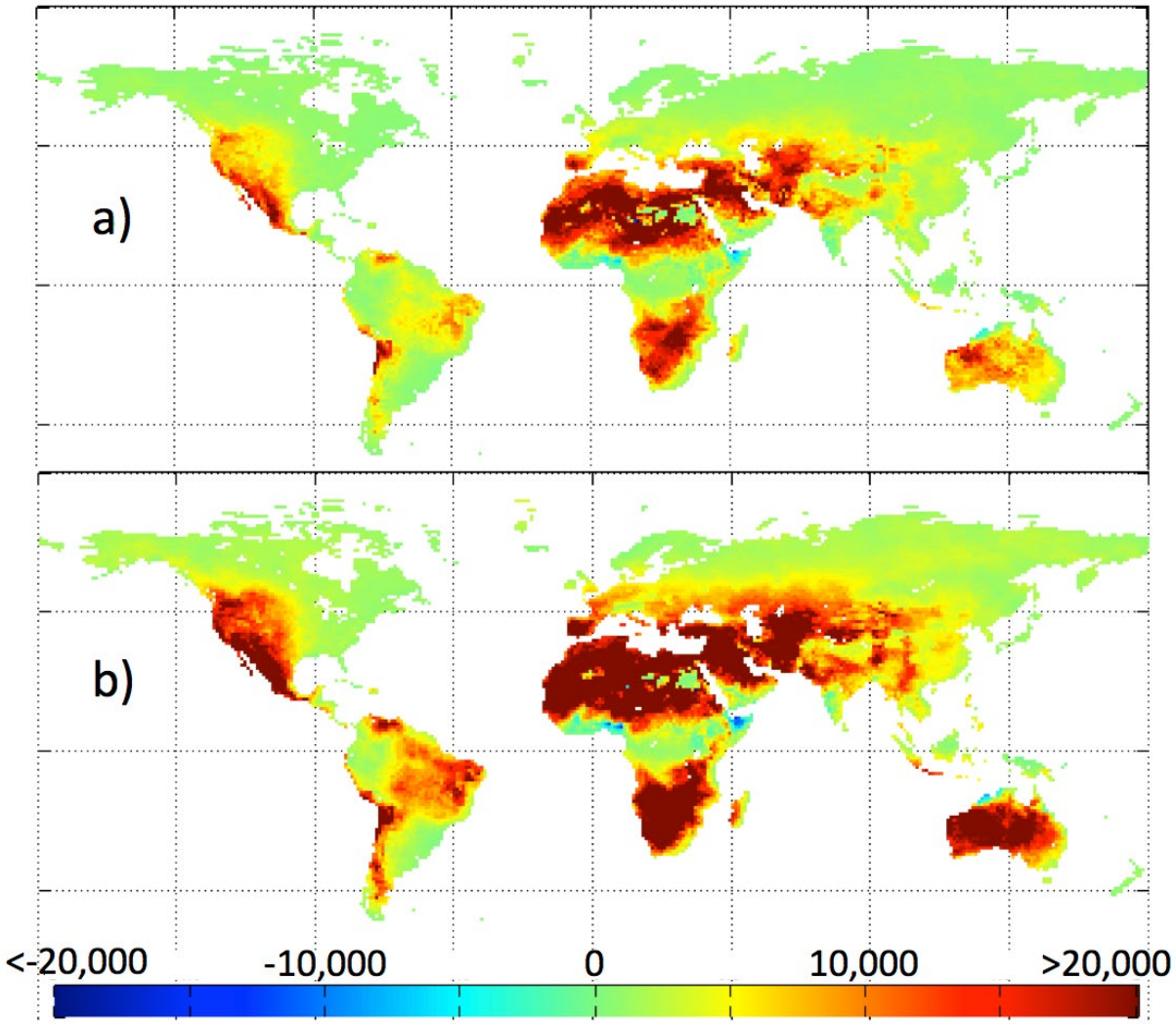

Figure S7: Change in average annual maximum Nesterov Index for ensemble mean from 1971-2000 to 2071-2100. a) RCP4.5; b) RCP8.5.

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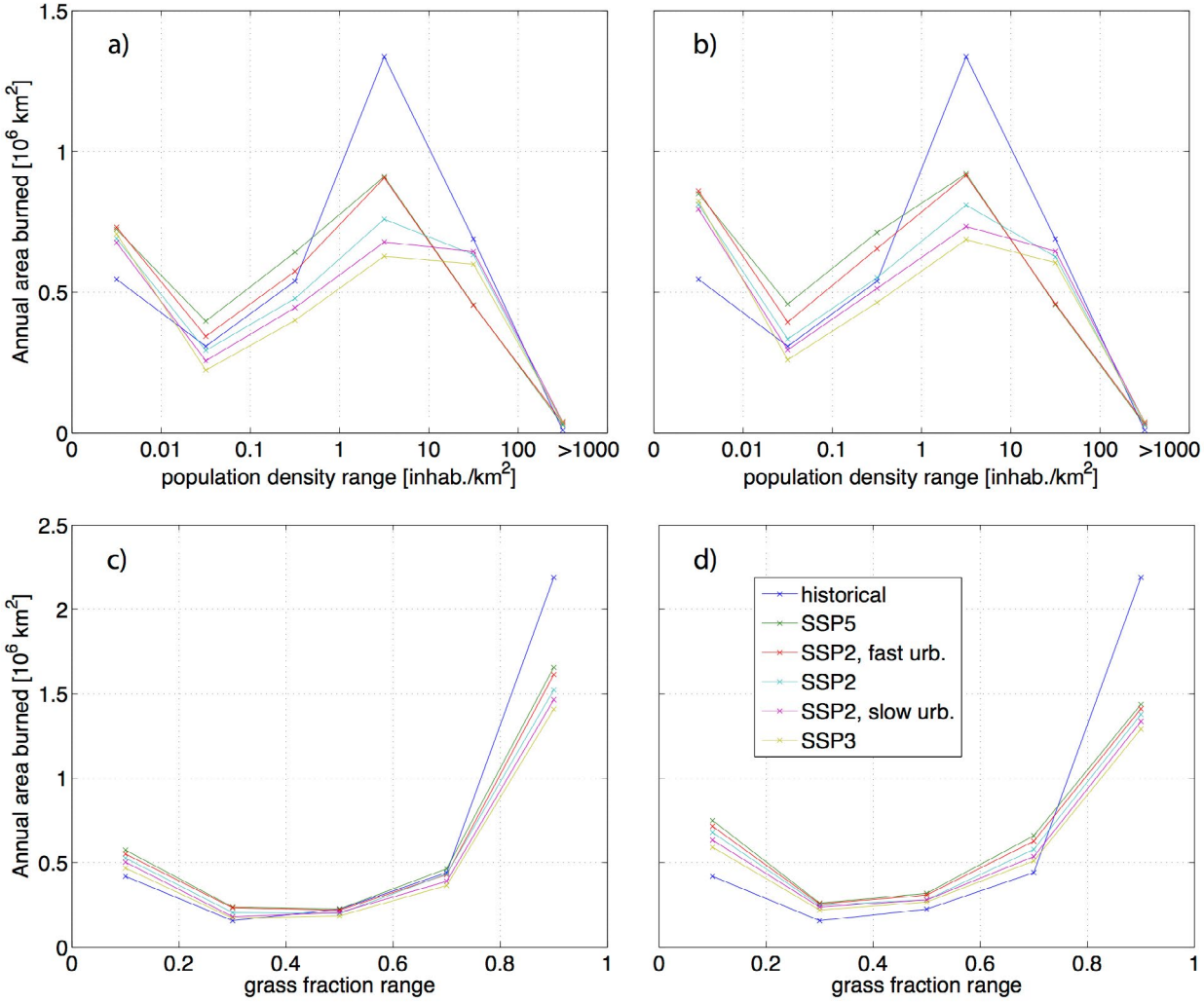

Figure S8: Histograms of burned area by ranges of population density (a, b), or by ranges of grass fraction of total vegetation (c,d) for historical period (1971-2000), and for different SSP population and urbanisation scenarios for the period 2071-2100. Ensemble averages for RCP4.5 (a, c) or RCP8.5 (b, d).

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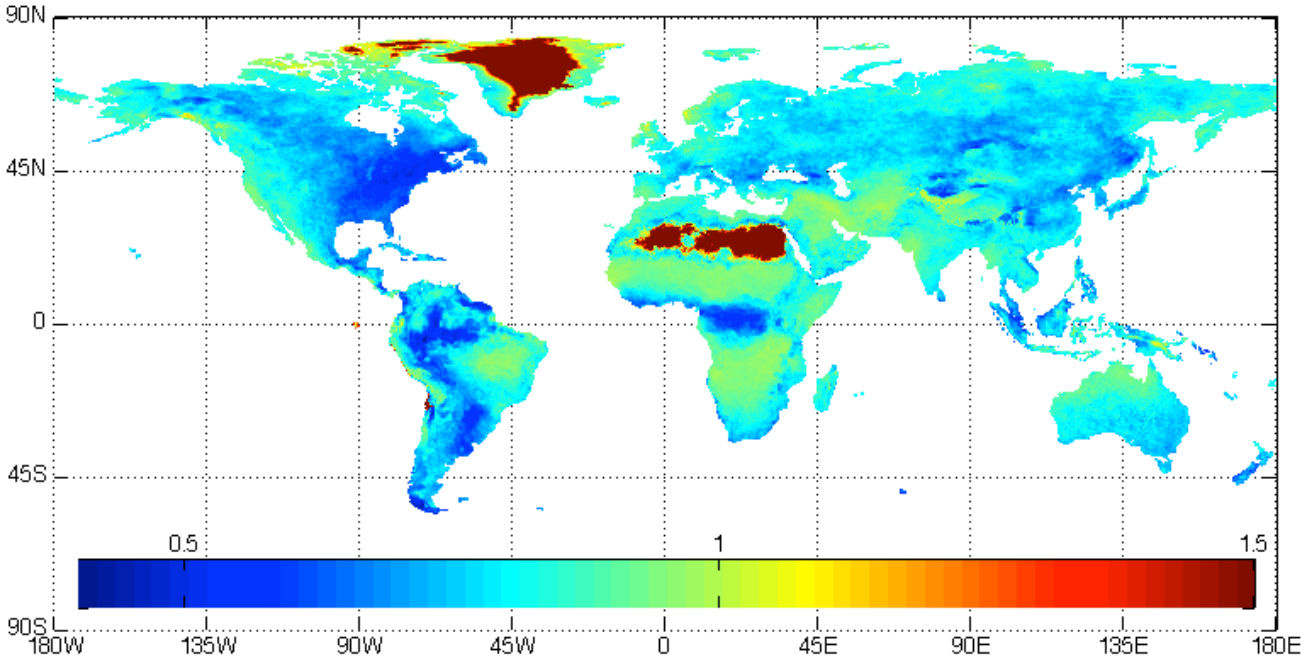

Figure S9. Mean ratio of observation-based divided by generated annual maximum Nesterov Index.

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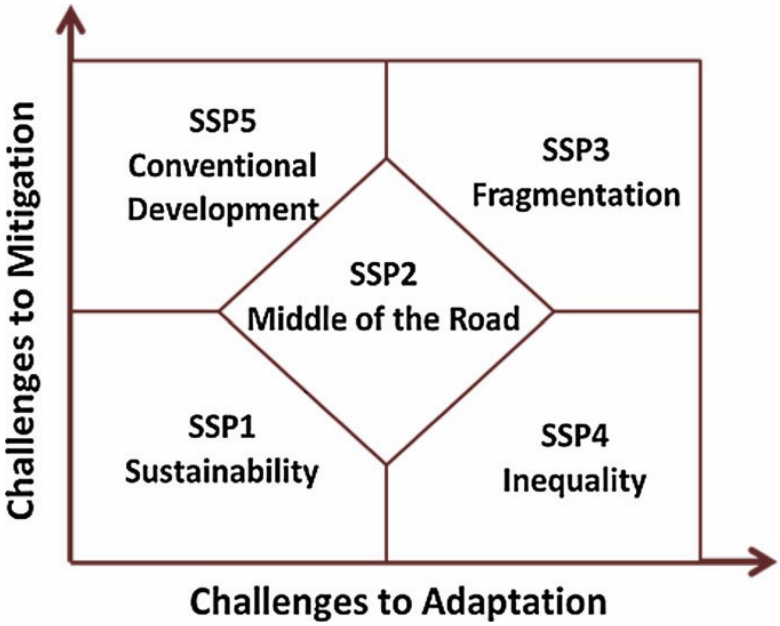

Figure S10. The Shared Socioeconomic Pathways as a means of identifying challenges to confronting climate change. Source: Jiang (2014) [Ref. 19].

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