

## Supplementary Materials

Table S1: Weather stations from Brazilian National Institute of Meteorology used in the present study, with the name, state, ID, geographical coordinates, altitude and percentage of missing data on air temperature (Temp.), sunshine hours (n), rainfall (Rain), relative humidity (RH) and wind speed (WS<sub>2m</sub>) in the period from 1980 to 2009.

Site, state	ID	Lat. (°)	Long. (°)	Alt. (m)	Temp.	n	Rain	RH	WS <sub>2m</sub>	Total
1-Pelotas, RS	RSPE	-31.78	-52.41	13	48.78	44.64	44.61	44.73	45.52	45.66
2-Cruz Alta, RS	RSCA	-28.63	-53.60	473	25.53	28.46	25.49	33.02	27.51	28.00
3-Campos Novos, SC	SCCN	-27.38	-51.20	947	25.18	27.67	25.31	26.18	25.62	25.99
4-Chapecó, SC	SCCH	-27.11	-52.61	679	21.14	22.18	20.94	22.22	21.73	21.64
5-Castro, PR	PRCA	-24.78	-50.00	1009	20.78	38.60	16.53	19.84	16.10	22.37
6-Londrina, PR	PRLO	-23.31	-51.13	566	19.71	48.41	18.63	33.38	31.05	30.24
7-Avaré, SP	SPAV	-23.08	-48.91	854	28.30	92.89	18.36	57.50	18.86	43.18
8-Franca, SP	SPFR	-20.58	-47.36	1026	0.91	4.02	0.03	0.05	0.00	1.00
9-Votuporanga, SP	SPVO	-20.41	-49.98	503	11.46	29.89	10.18	11.02	19.26	16.36
10-BambuÍ, MG	MGBA	-20.03	-45.00	661	20.96	14.16	13.45	14.08	13.54	15.24
11-Uberaba, MG	MGUB	-19.73	-47.95	737	21.00	22.88	20.63	21.38	20.96	21.37
12-Patos de Minas, MG	MGPM	-18.51	-46.43	940	22.39	25.84	22.24	22.44	22.21	23.02
13-Unai, MG	MGUN	-16.36	-46.88	460	10.06	18.88	9.67	10.21	9.63	11.69
14-Ivinhema, MS	MSIV	-22.30	-53.81	369	42.19	38.59	38.64	42.42	39.04	40.18
15-Paranaíba, MS	MSPA	-19.75	-51.18	331	32.12	25.71	25.42	32.94	25.30	28.30
16-Diamantino, MT	MTDI	-14.40	-56.45	286	17.69	62.10	10.50	47.80	29.92	33.60
17-Catalão, GO	GOCA	-18.18	-47.95	840	5.61	7.08	7.63	7.65	1.39	5.87
18-JataÍ, GO	GOJA	-17.91	-51.71	663	2.62	4.00	1.43	3.37	45.91	11.47
19-Brasília, DF	DFBR	-15.78	-47.92	1160	0.97	1.21	1.01	1.13	0.88	1.04
20-Bom Jesus da Lapa, BA	BABJ	-13.26	-43.41	440	27.54	31.01	27.27	28.03	28.32	28.43
21-Barreiras, BA	BABA	-12.15	-45.00	439	37.48	51.60	25.32	38.33	25.30	35.61
22-Barra, BA	BARR	-11.08	-43.16	402	29.31	28.49	27.60	27.67	28.86	28.39
23-Bom Jesus do Piauí, PI	PIBJ	-9.10	-44.11	332	11.54	14.39	11.84	26.75	29.07	18.72
24-Alto Parnaíba, MA	MAAP	-9.10	-45.93	285	7.63	8.84	3.08	20.50	21.52	12.31
25-Carolina, MA	MACA	-7.33	-47.46	193	5.25	6.43	4.44	16.68	16.24	9.81
26-Barra do Corda, MA	MABC	-5.50	-45.23	153	7.43	7.46	3.06	15.92	16.15	10.00
27-Taguatinga, TO	TOTA	-12.40	-46.41	604	8.31	14.98	15.26	15.87	4.49	11.78
28-Porto Nacional, TO	TOPN	-10.71	-48.41	239	9.97	23.83	10.91	19.50	5.66	13.97
29-Pedro Afonso, TO	TOPA	-8.96	-48.18	187	3.22	3.65	2.14	9.31	2.06	4.08
30-São Félix do Xingu, PA	PASF	-6.63	-51.96	206	31.12	31.82	29.11	42.17	31.97	33.24
31-Marabá, PA	PAMA	-5.36	-49.13	95	3.94	35.58	3.22	14.33	6.00	12.61

\*Lat. – latitude; Long. – longitude; Alt. – altitude

Table S2: Statistical performance of temperature-based solar radiation models in 31 Brazilian locations: Hargreaves (Ha), Hunt (Hu) and Annandale (An).

Sites	Ha					Hu					An				
	r <sup>2</sup>	d	c	Bias (MJm <sup>-2</sup> d <sup>-1</sup> )	MAE	r <sup>2</sup>	d	c	Bias (MJm <sup>-2</sup> d <sup>-1</sup> )	MAE	r <sup>2</sup>	d	c	Bias (MJm <sup>-2</sup> d <sup>-1</sup> )	MAE
RSPE	0.73	0.90	0.77	-0.43	3.21	0.73	0.91	0.78	-0.61	3.17	0.73	0.90	0.77	-0.44	3.21
RSCA	0.77	0.93	0.81	-1.16	3.12	0.77	0.93	0.82	0.20	2.92	0.77	0.92	0.81	0.23	3.02
SCCN	0.71	0.91	0.76	0.42	3.03	0.71	0.91	0.77	0.48	3.02	0.71	0.90	0.76	0.18	3.09
SCCH	0.73	0.92	0.78	0.21	2.88	0.73	0.92	0.78	0.45	2.96	0.73	0.91	0.78	0.23	3.03
PRCA	0.67	0.89	0.72	0.14	2.13	0.67	0.89	0.73	0.39	1.89	0.67	0.88	0.72	0.17	1.90
PRLO	0.63	0.88	0.69	0.34	2.09	0.63	0.88	0.70	0.59	2.21	0.63	0.87	0.69	0.51	2.25
SPAV	0.58	0.85	0.65	-0.26	2.42	0.58	0.85	0.65	-0.14	2.48	0.58	0.85	0.65	-0.47	2.53
SPFR	0.59	0.72	0.58	-0.48	2.60	0.59	0.72	0.56	-0.28	2.58	0.59	0.76	0.58	-0.74	2.70
SPVP	0.60	0.84	0.66	-0.55	2.88	0.60	0.84	0.65	-0.23	3.13	0.60	0.85	0.66	-0.60	3.19
MGBB	0.56	0.83	0.60	-0.67	2.92	0.56	0.83	0.62	-0.67	3.02	0.56	0.80	0.60	-0.97	3.15
MGUB	0.54	0.82	0.60	-0.24	2.63	0.54	0.82	0.60	-0.10	2.91	0.54	0.82	0.60	-0.53	2.99
MGPM	0.62	0.77	0.62	0.43	2.60	0.62	0.77	0.60	0.61	2.92	0.62	0.79	0.62	0.09	2.96
MGUN	0.50	0.80	0.56	-0.39	2.23	0.50	0.80	0.57	-0.42	2.60	0.50	0.79	0.56	-0.67	2.67
MSIV	0.57	0.85	0.63	0.29	3.20	0.57	0.85	0.64	0.22	3.33	0.57	0.83	0.63	0.10	3.38
MSPA	0.55	0.85	0.61	-0.03	2.76	0.55	0.85	0.63	-0.01	2.90	0.55	0.83	0.61	-0.11	2.94
MTDI	0.51	0.68	0.50	0.29	2.80	0.51	0.68	0.48	0.25	2.89	0.51	0.70	0.50	0.09	2.86
GOCA	0.80	0.80	0.71	-0.31	2.57	0.80	0.80	0.72	-0.39	2.86	0.80	0.80	0.71	-0.83	2.96
GOJA	0.57	0.76	0.56	0.08	2.51	0.57	0.76	0.57	0.04	2.66	0.57	0.75	0.56	-0.29	2.70
DFBR	0.50	0.67	0.50	-0.11	3.03	0.50	0.67	0.47	0.15	3.11	0.50	0.71	0.50	-0.54	3.20
BABJ	0.75	0.72	0.63	-0.28	2.55	0.75	0.72	0.62	0.20	2.76	0.75	0.72	0.63	-0.07	2.81
BABA	0.65	0.82	0.64	0.02	2.30	0.65	0.82	0.66	0.07	2.45	0.65	0.80	0.64	-0.17	2.49
BARR	0.60	0.85	0.63	-0.05	1.95	0.60	0.85	0.65	-0.16	2.36	0.60	0.82	0.63	-0.43	2.49
PIBJ	0.33	0.44	0.31	-0.28	3.16	0.33	0.44	0.25	0.23	3.09	0.33	0.55	0.31	-0.21	3.33
MAAP	0.76	0.82	0.70	0.18	2.30	0.76	0.82	0.72	0.13	2.68	0.76	0.80	0.70	-0.04	2.72
MACA	0.51	0.80	0.56	0.39	3.04	0.51	0.80	0.57	0.48	3.08	0.51	0.78	0.56	0.39	3.09
MABC	0.54	0.72	0.46	-1.22	2.64	0.54	0.72	0.53	-1.02	2.85	0.54	0.63	0.46	-0.83	2.95
TOTA	0.57	0.73	0.56	-0.75	2.80	0.57	0.73	0.55	-0.61	3.08	0.57	0.75	0.56	-0.94	3.17
TOPN	0.63	0.83	0.62	-0.09	2.93	0.63	0.83	0.66	-0.05	3.05	0.63	0.78	0.62	-0.22	3.12
TOPA	0.71	0.84	0.68	-0.16	2.27	0.71	0.84	0.71	0.02	2.31	0.71	0.81	0.68	0.01	2.30
PASF	0.35	0.52	0.33	1.33	3.14	0.35	0.52	0.31	1.33	3.28	0.35	0.55	0.33	1.23	3.21
PAMA	0.55	0.79	0.54	-0.88	2.74	0.55	0.79	0.59	-0.75	3.02	0.55	0.73	0.54	-0.71	3.17
Mean	0.60	0.79	0.61	-0.14	2.69	0.60	0.79	0.62	0.01	2.82	0.60	0.79	0.61	-0.21	2.89

Table S3: Statistical performance of temperature-based solar radiation models in 31 Brazilian locations: Bristow-Campbell (BC) e Donatelli-Campbell (DC).

Sites	BC					DC				
	r <sup>2</sup>	d	c	Bias (MJm <sup>-2</sup> d <sup>-1</sup> )	MAE	r <sup>2</sup>	d	c	Bias (MJm <sup>-2</sup> d <sup>-1</sup> )	MAE
RSPE	0.69	0.90	0.75	-0.68	3.30	0.66	0.88	0.72	-1.31	3.56
RSCA	0.77	0.93	0.81	-1.16	3.14	0.76	0.93	0.80	-0.89	3.12
SCCN	0.72	0.92	0.78	0.42	2.85	0.70	0.91	0.76	0.34	3.03
SCCH	0.73	0.92	0.79	0.21	2.85	0.72	0.92	0.78	0.29	2.88
PRCA	0.68	0.90	0.75	0.14	1.83	0.64	0.89	0.71	0.34	2.13
PRLO	0.70	0.91	0.76	0.34	1.88	0.67	0.90	0.73	0.48	2.09
SPAV	0.63	0.88	0.70	-0.26	2.29	0.60	0.87	0.68	-0.21	2.42
SPFR	0.56	0.85	0.64	-0.48	2.40	0.41	0.79	0.51	-0.54	2.60
SPVP	0.65	0.88	0.71	-0.55	2.85	0.64	0.89	0.71	-0.46	2.88
MGBB	0.65	0.87	0.70	-0.67	2.62	0.61	0.86	0.67	-0.98	2.92
MGUB	0.63	0.89	0.70	-0.24	2.45	0.62	0.88	0.69	-0.30	2.63
MGPM	0.61	0.87	0.68	0.43	2.38	0.53	0.84	0.61	0.34	2.60
MGUN	0.63	0.88	0.70	-0.39	2.10	0.61	0.88	0.68	-0.57	2.23
MSIV	0.58	0.86	0.66	0.29	3.12	0.59	0.87	0.66	0.16	3.20
MSPA	0.55	0.85	0.63	-0.03	2.76	0.57	0.87	0.66	-0.12	2.76
MTDI	0.54	0.81	0.59	0.29	2.65	0.48	0.81	0.56	0.08	2.80
GOCA	0.79	0.93	0.82	-0.31	2.38	0.69	0.91	0.75	-0.49	2.57
GOJA	0.58	0.83	0.63	0.08	2.40	0.59	0.85	0.66	-0.11	2.51
DFBR	0.53	0.84	0.61	-0.11	2.72	0.47	0.82	0.56	-0.13	3.03
BABJ	0.73	0.85	0.73	-0.28	2.64	0.72	0.85	0.72	-0.08	2.55
BABA	0.69	0.87	0.73	0.02	2.20	0.65	0.88	0.71	-0.01	2.30
BARR	0.68	0.89	0.74	-0.05	1.95	0.68	0.90	0.74	-0.14	1.95
PIBJ	0.32	0.62	0.35	-0.28	3.14	0.26	0.64	0.32	-0.13	3.16
MAAP	0.72	0.88	0.75	0.18	2.19	0.70	0.89	0.75	-0.02	2.30
MACA	0.54	0.86	0.63	0.39	2.85	0.49	0.82	0.58	0.21	3.04
MABC	0.52	0.81	0.59	-1.22	2.58	0.51	0.83	0.59	-1.05	2.64
TOTA	0.66	0.88	0.72	-0.75	2.52	0.63	0.88	0.70	-0.83	2.80
TOPN	0.65	0.88	0.71	-0.09	2.72	0.57	0.87	0.66	-0.28	2.93
TOPA	0.69	0.90	0.75	-0.16	2.12	0.68	0.90	0.75	-0.20	2.27
PASF	0.36	0.69	0.41	1.33	3.03	0.31	0.60	0.33	1.26	3.14
PAMA	0.59	0.86	0.66	-0.88	2.58	0.55	0.86	0.64	-0.86	2.74
Mean	0.62	0.86	0.68	-0.14	2.56	0.59	0.85	0.66	-0.20	2.70

Table S4: Annual changes of maximum, minimum and mean air temperature and rainfall projected by seven global climate models (GCMs), in 31 Brazilian locations for mid-century (2040-2069), under an intermediate (RCP4.5) and high (RCP8.5) emission scenarios, when compared to the historical climate (1980-2009).

Site	RCP4.5				RCP8.5			
	Temperature (°C)			Rain (%)	Temperature (°C)			Rain (%)
	Maximum	Minimum	Mean		Maximum	Minimum	Mean	
RSPE	1.11	1.32	1.22	11.23	1.64	1.89	1.77	14.28
RSCA	1.47	1.52	1.50	8.62	2.06	2.28	2.17	7.98
SCCN	1.60	1.57	1.59	6.52	2.16	2.22	2.19	9.60
SCCH	1.76	1.65	1.71	5.12	2.37	2.38	2.38	7.84
PRCA	1.92	1.70	1.81	3.22	2.52	2.46	2.49	8.38
PRLO	2.08	1.71	1.90	1.97	2.69	2.62	2.66	3.94
SPAV	1.88	1.68	1.78	0.82	2.52	2.39	2.46	3.54
SPFR	2.11	1.84	1.98	-2.00	2.82	2.62	2.72	1.22
SPVO	2.27	1.85	2.06	-1.23	2.92	2.75	2.84	5.78
MGBA	1.97	1.62	1.80	-3.27	2.65	2.38	2.52	0.53
MGUB	2.17	1.83	2.00	-3.74	2.83	2.62	2.73	0.87
MGPM	2.15	1.91	2.03	-9.09	2.83	2.67	2.75	-2.43
MGUN	2.12	1.87	2.00	-10.66	2.82	2.64	2.73	-7.60
MSIV	2.28	1.92	2.10	1.47	2.96	2.74	2.85	4.19
MSPA	2.27	1.91	2.09	-1.07	2.92	2.68	2.80	6.52
MTDI	2.39	2.02	2.21	-4.92	3.10	2.88	2.99	1.84
GOCA	2.21	1.93	2.07	-7.27	2.86	2.68	2.77	-1.70
GOJA	2.31	1.92	2.12	-8.03	3.01	2.67	2.84	-0.39
DFBR	2.13	1.89	2.01	-9.88	2.86	2.65	2.76	-6.48
BABJ	1.94	1.57	1.76	-15.39	2.56	2.20	2.38	-11.72
BABA	2.07	1.80	1.94	-18.18	2.81	2.56	2.69	-16.52
BARR	1.91	1.72	1.82	-17.51	2.61	2.39	2.50	-16.23
PIBJ	1.95	1.87	1.91	-16.37	2.69	2.70	2.70	-20.83
MAAP	1.97	1.76	1.87	-14.18	2.72	2.50	2.61	-20.83
MACA	2.02	1.84	1.93	-10.83	2.78	2.69	2.74	-16.39
MABC	1.82	1.72	1.77	-12.20	2.57	2.49	2.53	-15.70
TOTA	2.08	1.88	1.98	-15.22	2.84	2.66	2.75	-13.94
TOPN	2.09	1.87	1.98	-14.88	2.89	2.72	2.81	-16.19
TOPA	2.08	1.90	1.99	-15.03	2.85	2.66	2.76	-13.52
PASF	2.15	2.01	2.08	-7.32	3.02	2.86	2.94	-11.87
PAMA	1.93	1.84	1.89	-12.22	2.77	2.66	2.72	-18.70
Mean	2.01	1.79	1.90	-6.18	2.70	2.56	2.63	-4.34

Table S5: Annual changes of maximum, minimum and mean air temperature and rainfall projected by seven global climate models (GCMs), in 31 Brazilian locations for end-of-century (2070-2099), under an intermediate (RCP4.5) and high (RCP8.5) emission scenarios, when compared to the historical climate (1980-2009).

Site	RCP4.5				RCP8.5			
	Temperature (°C)			Rain (%)	Temperature (°C)			Rain (%)
	Maximum	Minimum	Mean		Maximum	Minimum	Mean	
RSPE	1.61	1.81	1.71	9.72	2.98	3.38	3.18	18.08
RSCA	2.08	2.05	2.07	4.57	3.73	3.96	3.85	13.38
SCCN	2.08	2.04	2.06	7.95	3.79	3.92	3.86	19.38
SCCH	2.28	2.15	2.22	4.11	4.14	4.20	4.17	14.10
PRCA	2.42	2.16	2.29	5.52	4.27	4.21	4.24	13.76
PRLO	2.56	2.18	2.37	1.08	4.58	4.38	4.48	9.03
SPAV	2.36	2.10	2.23	1.68	4.34	4.12	4.23	8.84
SPFR	2.60	2.30	2.45	-1.12	4.76	4.60	4.68	-0.72
SPVO	2.75	2.32	2.54	-0.64	4.99	4.55	4.77	3.45
MGBA	2.47	2.08	2.28	-2.82	4.53	4.08	4.31	-2.78
MGUB	2.63	2.34	2.49	-2.42	4.84	4.53	4.69	-1.10
MGPM	2.64	2.36	2.50	-6.92	4.81	4.46	4.64	-8.07
MGUN	2.62	2.33	2.48	-9.63	4.78	4.37	4.58	-12.92
MSIV	2.83	2.38	2.61	-1.91	5.11	4.65	4.88	2.38
MSPA	2.74	2.38	2.56	0.13	5.03	4.48	4.76	4.88
MTDI	2.94	2.50	2.72	-5.03	5.28	4.74	5.01	-3.94
GOCA	2.69	2.39	2.54	-6.02	4.91	4.51	4.71	-5.54
GOJA	2.84	2.41	2.63	-6.94	5.13	4.51	4.82	-5.89
DFBR	2.64	2.33	2.49	-9.56	4.84	4.43	4.64	-13.26
BABJ	2.33	1.88	2.11	-12.65	4.28	3.82	4.05	-24.18
BABA	2.59	2.27	2.43	-15.44	4.69	4.35	4.52	-26.60
BARR	2.38	2.11	2.25	-18.16	4.34	4.11	4.23	-31.46
PIBJ	2.48	2.37	2.43	-17.01	4.56	4.51	4.54	-27.76
MAAP	2.48	2.19	2.34	-13.44	4.59	4.30	4.45	-30.17
MACA	2.54	2.34	2.44	-19.98	4.76	4.62	4.69	-29.57
MABC	2.42	2.15	2.29	-21.97	4.44	4.16	4.30	-29.87
TOTA	2.62	2.34	2.48	-10.37	4.78	4.52	4.65	-21.15
TOPN	2.62	2.34	2.48	-12.53	4.93	4.60	4.77	-20.95
TOPA	2.62	2.36	2.49	-9.73	4.80	4.53	4.67	-21.34
PASF	2.77	2.56	2.67	-16.06	5.24	4.93	5.09	-26.82
PAMA	2.56	2.32	2.44	-21.62	4.78	4.47	4.63	-30.53
Mean	2.52	2.25	2.39	-6.68	4.61	4.35	4.48	-8.62