

Table S1. The change of population density (2000, 2015, 2020) and built-up area (2000,2005, 2010) in the 10 mega-regions.

Pop Density (pop/km2)	2000	2015	2020
São Paulo	385.89	456.93	485.59
Jakarta	901.72	1089.47	1168.26
Mexico City	152.69	192.08	211.66
PRD	1016.96	1469.52	1669.82
Paris	484.66	534.86	555.45
Boston	463.07	502.18	517.50
Tokyo	417.35	421.38	423.24
Nile	1216.57	1602.97	1782.85
YRD	646.59	800.98	867.88
BU(km2)	2000	2005	2010
São Paulo	6412.64	6555.60	6762.73
Jakarta	7715.62	8418.48	8730.55
Mexico City	7768.11	8430.33	8812.25
PRD	4864.82	4886.15	5765.37
Paris	2861.03	3008.45	3674.53
Boston	15274.09	16039.94	17545.08
Tokyo	22540.03	23101.47	23446.72
Nile	3841.95	4048.64	5050.15
YRD	10549.52	13624.9	16199.55

Table S2. The Pearson correlation of UDI/LST pair from 2003 to 2020.

Year	Jakarta	Boston	São Paulo	PRD	Nile	Tokyo	Mexico City	Paris	YRD
2003	0.97*	0.95*	0.97*	0.99*	0.45	0.92*	0.91*	0.99*	0.84*
2004	0.97*	0.95*	0.97*	0.99*	0.50	0.92*	0.93*	0.99*	0.89*
2005	0.96*	0.95*	0.97*	0.99*	0.47	0.92*	0.90*	0.99*	0.96*
2006	0.97*	0.95*	0.98**	0.99*	0.50	0.92*	0.90*	0.99*	0.90*
2007	0.97*	0.96*	0.97*	0.99*	0.49	0.92*	0.91*	0.90*	0.94*
2008	0.97*	0.95*	0.97*	0.99*	0.51	0.92*	0.91*	0.99*	0.95*
2009	0.97*	0.95*	0.96*	0.99*	0.44	0.92*	0.90*	0.99*	0.94*
2010	0.95*	0.95*	0.96*	0.99*	0.44	0.91*	0.93*	0.99*	0.96*
2011	0.96*	0.95*	0.97*	0.98*	0.54	0.92*	0.90*	0.90*	0.97*
2012	0.97*	0.95*	0.96*	0.98*	0.48	0.92*	0.91*	0.90*	0.96*
2013	0.96*	0.95*	0.96*	0.97*	0.51	0.91*	0.92*	0.99*	0.97*
2014	0.96*	0.95*	0.96*	0.97*	0.56	0.91*	0.90*	0.99*	0.96*
2015	0.96*	0.95*	0.95*	0.95*	0.66	0.91*	0.91*	0.90*	0.96*
2016	0.89*	0.92**	0.91*	0.93*	0.80*	0.80*	0.88*	0.90*	0.95*
2017	0.94*	0.94*	0.95*	0.94	0.66	0.90*	0.91*	0.90*	0.97*
2018	0.94*	0.94*	0.95*	0.92*	0.63	0.88	0.93*	0.90*	0.95*
2019	0.94*	0.94*	0.94	0.95*	0.64	0.89	0.90*	0.90*	0.96*
2020	0.94*	0.94*	0.94	0.95*	0.63	0.89	0.90*	0.80*	0.95*

* Correlation is significant at the 0.01 level.

Table S3. The Pearson correlation of UDI/CHT pair from 2003 to 2020.

Year	Jakarta	Boston	São Paulo	PRD	Nile	Tokyo	Mexico City	Paris	YRD
2003	0.99*	0.87*	0.98*	0.99*	0.97*	0.97*	0.21	0.90*	0.80*
2004	0.96*	0.77*	0.98*	0.99*	0.97*	0.97*	0.58	0.70	0.88*
2005	0.92*	0.94*	0.97*	0.99*	0.96*	0.98*	-0.14	0.52	0.90*
2006	0.98*	0.94*	0.98*	0.99*	0.95*	0.95*	-0.07	0.68*	0.89*
2007	0.96*	0.93*	0.99*	0.98*	0.97*	0.95*	-0.16	0.47	0.93*
2008	0.97*	0.94*	0.98*	0.99*	0.98*	0.96*	0.24	0.47	0.98*
2009	0.98*	0.81*	0.98*	0.99*	0.99*	0.95*	-0.24	0.64	0.96*
2010	0.96*	0.92*	0.99*	0.99*	0.98*	0.95*	-0.39	0.73	0.95*
2011	0.98*	0.93*	0.98*	0.99*	0.99*	0.91*	-0.23	0.64	0.94*
2012	0.98*	0.94*	0.98*	0.99*	0.99*	0.94*	-0.17	0.71	0.98*
2013	0.96*	0.93*	0.97*	0.99*	0.99*	0.94*	0.13	0.65	0.99*
2014	0.95*	0.87*	0.97*	0.95*	0.99*	0.97*	0.09	0.67	0.97*
2015	0.97*	0.82*	0.97*	0.99*	0.99*	0.91*	-0.23	0.77*	0.99*
2016	0.91*	0.90*	0.91*	0.95*	0.98*	0.91*	0.06	0.75*	0.97*
2017	0.94*	0.84*	0.96*	0.97*	0.99*	0.96*	-0.21	0.63	0.99*
2018	0.94*	0.90*	0.97*	0.90*	0.99*	0.90*	-0.41	0.70	0.95*
2019	0.95*	0.88*	0.97*	0.87*	0.99*	0.93*	-0.60	0.79*	0.95*
2020	0.92*	0.87*	0.97*	0.98*	0.98*	0.95*	-0.28	0.69	0.96*

* Correlation is significant at the 0.01 level.

Table S4. The Pearson correlation of UDI/HWN90th pair from 2003 to 2020.

Year	Jakarta	Boston	São Paulo	PRD	Nile	Tokyo	Mexico City	Paris	YRD
2003	0.76*	0.86*	0.90*	0.94*	-0.73	0.95*	0.40	1.00*	0.78*
2004	0.88*	0.71*	0.92*	0.78*	-0.74	0.96*	0.07	0.90*	0.88*
2005	0.73*	0.87*	0.93*	0.88*	-0.72	0.97*	0.67	0.96*	0.96*
2006	0.79*	0.91*	0.88*	0.75*	-0.74	0.98*	0.26	0.94*	0.90*
2007	0.80*	0.91*	0.91*	0.89*	-0.71	0.98*	0.70	0.80*	0.97*
2008	0.82*	0.89*	0.92*	0.81*	-0.73	0.87*	-0.44	0.91*	0.94*
2009	0.90*	0.83*	0.78*	0.78*	-0.73	0.98*	0.72	0.94*	0.78*
2010	0.83*	0.93*	0.79*	0.59*	-0.75	0.98*	0.78*	0.94*	0.85*
2011	0.88*	0.89*	0.85*	0.77*	-0.76	0.97*	0.80*	0.82*	0.62*
2012	0.90*	0.90*	0.87*	NA	-0.75	0.97*	0.56	0.91*	0.81*
2013	0.87*	0.84*	0.86*	NA	-0.76	0.96*	0.67	0.87*	0.99*
2014	0.96*	0.76*	0.94*	0.63*	-0.77*	0.99*	0.48	0.77*	0.72*
2015	0.93*	0.87*	0.93*	0.75*	-0.49	0.96*	0.54	0.96*	0.98*
2016	0.83*	0.85*	0.89*	0.87*	-0.18	0.96*	0.44	0.76*	0.95*
2017	0.89*	0.82*	0.90*	0.68*	-0.27	0.98*	0.55	0.89*	0.99*
2018	0.92*	0.90*	0.85*	0.48*	-0.39	0.94*	0.17	0.92*	0.81*
2019	0.92*	0.81*	0.86*	NA	-0.34	0.92*	0.20	0.89*	0.91*
2020	0.81*	0.83*	0.89*	0.55*	-0.46	0.96*	0.84*	0.8*2	0.91*

* Correlation is significant at the 0.01 level.

Table S5. The Pearson correlation of UDI/HWN97.5th pair from 2003 to 2020.

Year	Jakarta	Boston	São Paulo	PRD	Nile	Tokyo	Mexico City	Paris	YRD
2003	0.62	0.71	0.90*	0.85*	-0.74*	0.74*	-0.94	0.99*	0.76*
2004	0.80*	0.62	0.92*	0.69	-0.74*	0.82*	-0.68	0.88*	0.84*
2005	0.69	0.79*	0.93*	0.66	-0.72	0.92*	-0.04	0.92*	0.92*
2006	0.73	0.83*	0.88*	NA	-0.70	0.95*	-0.75	0.93*	0.87*
2007	0.73	0.81*	0.91*	0.83*	-0.74	0.85*	0.27	0.75*	0.93*
2008	0.71	0.78*	0.92*	0.67	-0.73	0.73*	-0.62	0.87*	0.91*
2009	0.77*	0.69	0.78*	0.59	-0.72	0.86*	-0.42	0.88*	0.69*
2010	0.78*	0.86*	0.79*	NA	-0.72	0.88*	0.65	0.93*	0.80*
2011	0.76*	0.81*	0.85*	0.65	-0.72	0.99*	0.18	0.72*	-0.20
2012	0.75*	0.83*	0.87*	NA	-0.73	0.95*	-0.06	0.88*	0.77*
2013	0.71	0.75*	0.86*	NA	-0.77*	0.89*	-0.14	0.81*	0.98*
2014	0.84*	0.63	0.94*	NA	-0.72	0.98*	-0.40	0.69*	0.67*
2015	0.78*	0.76*	0.93*	0.64	-0.66	0.97*	-0.37	0.91*	0.92*
2016	0.57	0.74	0.89*	0.71	-0.36	0.91*	0.53	0.69*	0.87*
2017	0.66	0.69	0.90*	0.69	-0.53	0.95*	0.11	0.95*	0.94*
2018	0.76*	0.79*	0.85*	0.46	-0.47	0.89*	-0.41	0.81*	0.67*
2019	0.72	0.67	0.86*	NA	-0.56	0.81*	-0.86*	0.83*	0.87*
2020	0.60	0.73*	0.89*	-0.63	-0.53	0.85*	-0.03	0.78*	0.84*

* Correlation is significant at the 0.01 level.

Table S6. The percolation results of UHI hotspot in three time periods.

	Time Period	X1	Y1	X2	Y2	Area(m ²)
Boston	2003-2008	24.00	0.96	32.00	0.04	165639.00
	2009-2014	23.00	0.98	29.00	0.11	167626.00
	2015-2020	25.00	0.98	32.00	0.04	167332.00
São Paulo	2003-2008	26.00	0.92	35.00	0.03	124579.00
	2009-2014	28.00	0.91	36.00	0.10	122001.00
	2015-2020	26.00	0.92	35.00	0.02	123493.00
Jakarta	2003-2008	26.00	0.82	37.00	0.01	124576.00
	2009-2014	25.00	0.84	35.00	0.01	126872.00
	2015-2020	24.00	0.86	34.00	0.02	130015.00
Tokyo	2003-2008	21.00	0.88	29.00	0.05	133909.00
	2009-2014	21.00	0.89	29.00	0.07	136091.00
	2015-2020	21.00	0.87	29.00	0.07	135481.00
Mexico City	2003-2008	23.00	0.94	36.00	0.08	408070.00
	2009-2014	23.00	0.92	37.00	0.02	401334.00
	2015-2020	24.00	0.94	40.00	0.04	408022.00
Nile	2003-2008	33.00	0.96	52.00	0.94	69655.60
	2009-2014	33.00	0.96	51.00	0.01	69291.30
	2015-2020	34.00	0.94	51.00	0.02	68143.50
Paris	2003-2008	23.00	0.92	28.00	0.09	60765.40
	2009-2014	22.00	0.97	26.00	0.13	63398.00
	2015-2020	29.00	0.90	36.00	0.05	58603.30
PRD	2003-2008	28.00	0.98	36.00	0.08	50036.60
	2009-2014	28.00	0.95	36.00	0.08	48782.70
	2015-2020	28.00	0.96	39.00	0.04	49124.80
YRD	2003-2008	28.00	0.98	33.00	0.05	269563.00
	2009-2014	28.00	0.97	34.00	0.05	271325.00

2015-2020	28.00	0.97	34.00	0.06	270811.00
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X1、X2、Y1、Y2 correspond to the X、Y values of thresholds in Percolation model.

Table S7. The percolation results of CHT hotspot in three time periods.

	Time Period	X1	Y1	X2	Y2	Area(m ²)
Boston	2003-2008	3.04	0.23	50.43	0.00	78850.70
	2009-2014	3.04	0.02	18.70	0.00	15704.90
	2015-2020	3.04	0.30	78.04	0.00	76534.10
São Paulo	2003-2008	3.74	0.24	42.86	0.02	48106.90
	2009-2014	1.98	0.64	65.93	0.02	89845.80
	2015-2020	3.96	0.50	52.97	0.03	73905.10
Jakarta	2003-2008	3.04	0.21	23.91	0.03	52694.50
	2009-2014	3.91	0.19	43.04	0.02	47528.60
	2015-2020	5.65	0.13	51.74	0.02	34249.50
Tokyo	2003-2008	14.01	0.03	89.87	0.00	29659.10
	2009-2014	4.74	0.05	89.87	0.00	46372.10
	2015-2020	5.82	0.07	80.82	0.01	42942.80
Mexico City	2003-2008	5.00	0.07	81.09	0.01	85478.00
	2009-2014	4.57	0.10	81.52	0.00	77611.50
	2015-2020	4.13	0.13	88.04	0.00	122591.00
Nile	2003-2008	38.90	0.86	100.00	0.02	62273.10
	2009-2014	44.18	0.87	98.02	0.02	62433.30
	2015-2020	45.93	0.86	98.02	0.02	62048.50
Paris	2003-2008	5.95	0.00	6.82	0.00	31.85
	2009-2014	5.00	0.00	6.04	0.00	154.24
	2015-2020	2.92	0.06	23.97	0.00	7352.77
PRD	2003-2008	9.38	0.39	84.01	0.04	24497.80
	2009-2014	24.95	0.09	76.97	0.04	12648.60
	2015-2020	11.09	0.42	81.02	0.16	26323.40
YRD	2003-2008	7.25	0.28	75.91	0.01	119707.00
	2009-2014	9.59	0.42	76.12	0.01	144619.00
	2015-2020	11.94	0.22	84.86	0.02	104568.00

X1、X2、Y1、Y2 correspond to the X、Y values of thresholds in Percolation model.

Table S8. The percolation results of HWN90th hotspot in three time periods.

	Time Period	X1	Y1	X2	Y2	Area(m ²)
Boston	2003-2008	1.93	0.60	32.20	0.01	146960.00
	2009-2014	1.90	0.49	22.72	0.01	119661.00
	2015-2020	1.88	0.74	22.70	0.00	147606.00
São Paulo	2003-2008	2.00	0.67	21.41	0.00	94646.90
	2009-2014	0.94	0.83	32.94	0.01	113624.00
	2015-2020	2.00	0.78	26.94	0.00	106972.00
Jakarta	2003-2008	2.03	0.23	20.93	0.01	63890.10
	2009-2014	2.03	0.20	19.02	0.00	49532.60
	2015-2020	3.11	0.04	9.93	0.01	27751.40
Tokyo	2003-2008	2.93	0.09	17.95	0.00	31268.20
	2009-2014	3.02	0.18	23.71	0.00	37715.30
	2015-2020	4.00	0.08	17.95	0.00	38071.70
Mexico City	2003-2008	2.00	0.51	31.93	0.01	263113.00
	2009-2014	2.00	0.40	31.93	0.01	245147.00

	2015-2020	2.00	0.64	31.93	0.00	289830.00
Nile	2003-2008	0.88	0.82	52.97	0.16	61037.30
	2009-2014	0.88	0.78	49.89	0.15	58067.00
	2015-2020	0.88	0.82	41.10	0.16	59515.40
Paris	2003-2008	3.55	0.04	13.13	0.04	2974.46
	2009-2014	2.93	0.05	13.04	0.04	1478.22
	2015-2020	1.95	0.74	25.99	0.05	52299.60
PRD	2003-2008	3.99	0.03	21.82	0.00	10265.20
	2009-2014	8.87	0.00	16.94	0.00	805.86
	2015-2020	3.99	0.00	14.99	0.00	390.11
YRD	2003-2008	3.94	0.08	11.94	0.00	57841.00
	2009-2014	6.93	0.02	13.01	0.00	40427.30
	2015-2020	5.97	0.08	14.93	0.00	61261.50

X1、X2, Y1, Y2 correspond to the X, Y values of thresholds in Percolation model.

Table S9. The percolation results of HWN97.5th hotspot in three time periods.

	Time Period	X1	Y1	X2	Y2	Area(m ²)
Boston	2003-2008	1.94	0.52	31.43	0.00	115588.00
	2009-2014	1.94	0.13	18.88	0.00	67895.40
	2015-2020	1.94	0.46	13.88	0.01	107802.00
São Paulo	2003-2008	1.89	0.26	13.00	0.01	71965.70
	2009-2014	0.89	0.67	21.22	0.02	89011.30
	2015-2020	1.89	0.57	15.11	0.01	81537.20
Jakarta	2003-2008	2.07	0.13	12.17	0.00	33101.00
	2009-2014	1.96	0.10	13.37	0.00	23282.80
	2015-2020	4.13	0.01	8.15	0.00	5657.17
Tokyo	2003-2008	3.02	0.05	20.29	0.00	14901.80
	2009-2014	2.93	0.10	21.07	0.00	20782.30
	2015-2020	4.78	0.04	16.98	0.00	16282.00
Mexico City	2003-2008	2.00	0.41	27.88	0.00	202689.00
	2009-2014	2.00	0.25	23.06	0.00	150448.00
	2015-2020	2.00	0.50	27.88	0.00	234755.00
Nile	2003-2008	0.88	0.68	29.23	0.13	50176.90
	2009-2014	0.88	0.57	38.90	0.12	43044.40
	2015-2020	0.88	0.56	38.90	0.12	41751.30
Paris	2003-2008	1.98	0.00	3.71	0.00	115.39
	2009-2014	1.98	0.00	3.71	0.00	307.92
	2015-2020	1.98	0.37	21.97	0.00	33126.10
PRD	2003-2008	3.96	0.01	22.07	0.00	2769.73
	2009-2014	6.99	0.00	16.00	0.00	276.38
	2015-2020	3.96	0.00	11.84	0.00	91.55
YRD	2003-2008	3.84	0.05	13.01	0.00	32214.80
	2009-2014	7.89	0.01	13.01	0.00	12818.90
	2015-2020	6.72	0.05	21.00	0.00	37983.30

X1、X2, Y1, Y2 correspond to the X, Y values of thresholds in Percolation model.

Table S10. The correlation between UHI, UHW indicator and global mean temperature.

	Summer Daytime	Summer Night-time	CHT	HWN90th	HWN97.5th
BostonB	0.61*	0.51*	0.41*	0.54*	0.49*
BostonN	0.52*	0.52*	0.28*	0.47*	0.32*
YRDB	0.57*	0.49*	-0.61*	0.14*	0.18*
YRDN	0.12*	0.46*	-0.61*	0.24*	0.16*
TokyoB	0.46*	0.39*	0.47*	0.32*	0.37*
TokyoN	0.21*	0.35*	0.28*	0.37*	0.41*
ParisB	0.24*	0.25*	0.42*	0.07*	0.07*
ParisN	0.26*	0.20*	0.55*	0.13*	0.13*
PRDB	0.52*	0.44*	0.46*	-0.37*	-0.35*
PRDN	-0.59*	0.41*	0.40*	-0.27*	-0.33*
NileB	-0.07*	0.74*	0.62*	-0.26*	-0.38*
NileN	-0.40*	0.76*	0.05*	-0.51*	-0.60*
JakartaB	0.14*	0.70*	0.24*	-0.18*	-0.09*
JakartaN	-0.23*	0.61*	-0.04*	-0.19*	-0.16*
Mexico CityB	0.21*	0.60*	-0.28*	0.14*	0.16*
Mexico CityN	0.18*	0.35*	-0.22*	0.13*	0.15*
São PauloB	0.46*	0.53*	0.15*	-0.13*	-0.07*
São PauloN	0.32*	0.49*	-0.02*	0.01*	0.05*

* Correlation is significant at the 0.01 level.

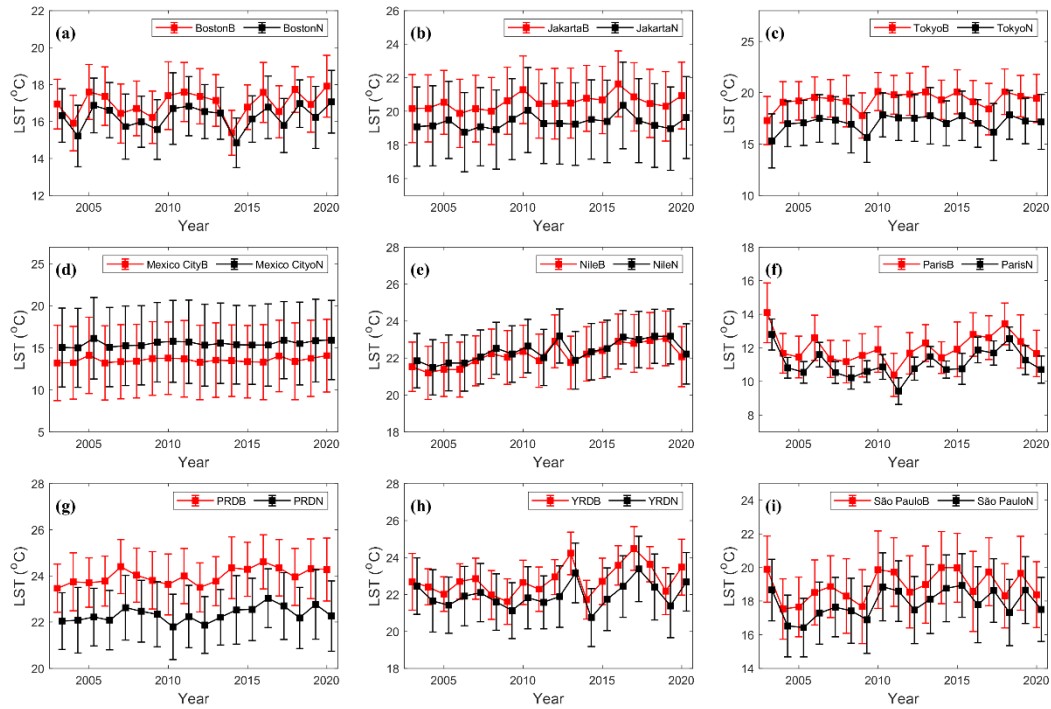


Figure S1. Time series of mean LST in the summer nighttime from 2003 to 2020 in the 9 megaregions in the built-up and non-built-up areas. Error bars are graphical representations of the standard deviation of mean LST in the mega-region (B = Built-up area, N = Non-built-up area).

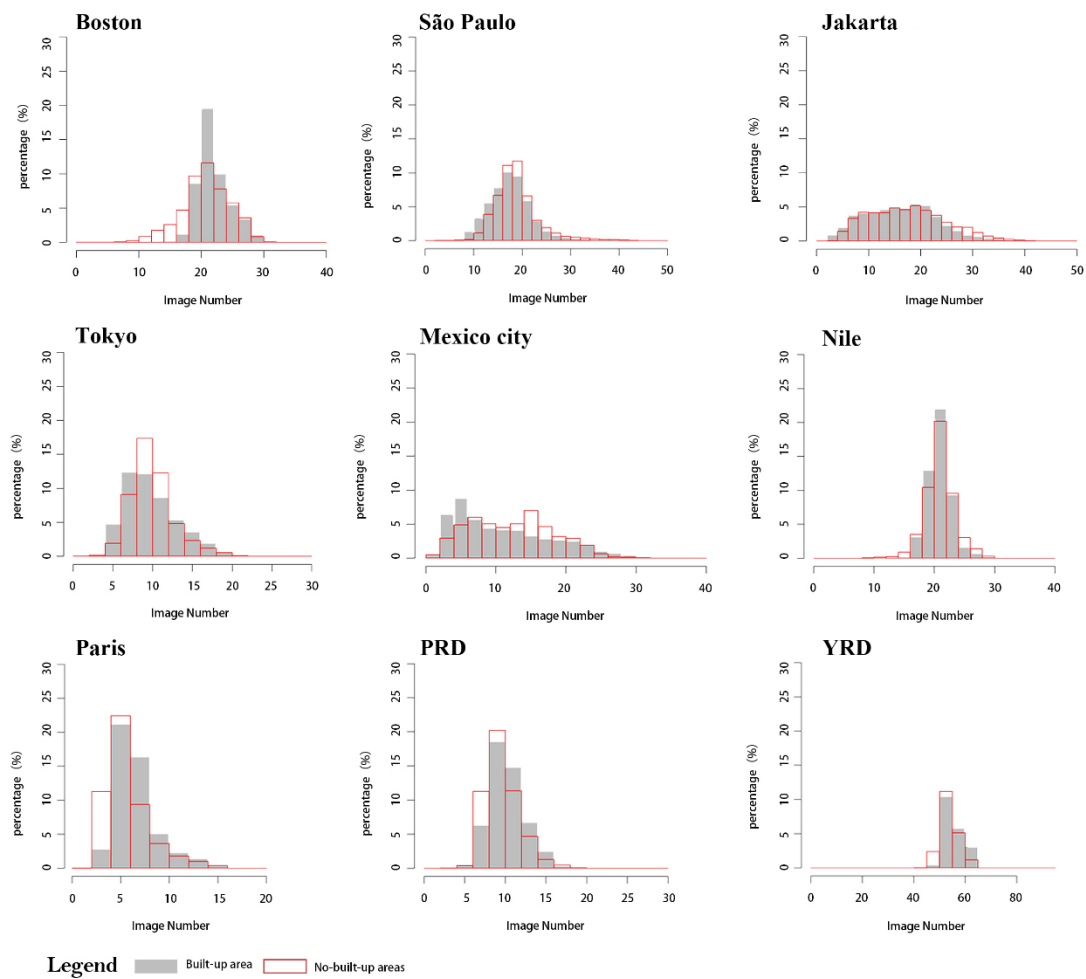


Figure S2: Histogram of mean MODIS LST data available at summer time in the built-up and non-built-up areas