

Supplementary Materials: Evolution of Brightness and Color of the Night Sky in Madrid

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Tables S1 to S5 summarize the statistics for observations after midnight in the Johnson B, V, and R photometric bands, including the color indexes' evolution. The table displays yearly values describing the data to show the time evolution. The columns are: year, the number of filtered observations (nobs), mean, standard deviation (std), variance, skewness, kurtosis, median, median absolute deviation (mad), and the interquartile range (iqr).

Table S1: Johnson B statistics

year	nobs	mean	std	variance	skewness	kurtosis	median	mad	iqr
2010	557	19.22	0.16	0.03	+0.52	+4.54	19.23	0.12	0.16
2011	2847	19.14	0.16	0.03	-0.52	+1.41	19.15	0.13	0.17
2012	4540	19.05	0.14	0.02	-0.75	+0.66	19.08	0.12	0.17
2013	3218	19.12	0.13	0.02	-1.06	+1.81	19.14	0.11	0.15
2014	2250	19.16	0.12	0.01	-1.04	+2.00	19.18	0.10	0.14
2015	2818	19.24	0.14	0.02	-0.97	+0.71	19.27	0.12	0.18
2016	1904	19.09	0.13	0.02	+0.15	+0.87	19.09	0.10	0.13
2017	4561	19.07	0.12	0.02	-0.70	+2.67	19.09	0.09	0.13
2018	2336	18.87	0.19	0.04	-1.56	+3.14	18.92	0.15	0.21
2019	2732	18.96	0.12	0.02	-1.66	+5.93	18.98	0.10	0.14
2020	348	18.81	0.15	0.02	-1.83	+5.10	18.84	0.10	0.14

Table S2: Johnson V statistics

year	nobs	mean	std	variance	skewness	kurtosis	median	mad	iqr
2010	557	17.90	0.13	0.02	-0.82	+0.86	17.91	0.12	0.16
2011	2842	17.78	0.23	0.05	-1.72	+3.86	17.82	0.18	0.24
2012	4540	17.81	0.18	0.03	-0.79	+0.41	17.85	0.14	0.22
2013	3218	17.91	0.15	0.02	-1.07	+1.87	17.94	0.13	0.18
2014	2250	17.89	0.15	0.02	-0.37	-0.19	17.89	0.15	0.21
2015	2818	18.03	0.17	0.03	-1.05	+1.36	18.07	0.15	0.22
2016	1903	17.90	0.15	0.02	-0.03	-0.42	17.89	0.16	0.21
2017	4562	17.95	0.15	0.02	-0.90	+1.63	17.98	0.15	0.22
2018	2376	17.78	0.25	0.06	-1.51	+2.49	17.84	0.19	0.28
2019	2725	17.93	0.14	0.02	-2.34	+12.14	17.95	0.12	0.16
2020	345	17.74	0.21	0.04	-1.25	+1.50	17.79	0.15	0.21

Table S3: Johnson R statistics

year	nobs	mean	std	variance	skewness	kurtosis	median	mad	iqr
2010	550	17.13	0.12	0.01	-0.93	+0.64	17.15	0.12	0.16
2011	2551	17.07	0.16	0.03	-0.51	-0.71	17.11	0.18	0.25
2012	4291	17.11	0.16	0.03	-0.51	-0.25	17.14	0.13	0.20
2013	3147	17.20	0.15	0.02	-0.66	+0.26	17.23	0.13	0.19
2014	2237	17.16	0.16	0.03	-0.30	-0.41	17.16	0.17	0.24
2015	2797	17.38	0.17	0.03	-0.89	+0.73	17.42	0.16	0.23
2016	1903	17.30	0.17	0.03	-0.12	-0.66	17.29	0.19	0.25
2017	4551	17.38	0.17	0.03	-0.58	+0.37	17.42	0.18	0.25
2018	2215	17.29	0.20	0.04	-0.58	-0.11	17.33	0.19	0.29
2019	2708	17.42	0.14	0.02	-1.07	+2.73	17.44	0.13	0.18
2020	334	17.25	0.21	0.05	-0.78	-0.30	17.28	0.21	0.26

Table S4: B-V Color Index statistics

year	nobs	mean	std	variance	skewness	kurtosis	median	mad	iqr
2010	535	1.30	0.13	0.02	+0.05	+0.33	1.30	0.11	0.15
2011	2665	1.33	0.15	0.02	-0.05	-0.25	1.32	0.15	0.20
2012	4532	1.24	0.13	0.02	+0.83	+1.39	1.22	0.10	0.13
2013	3216	1.21	0.11	0.01	+0.41	+2.19	1.20	0.08	0.12
2014	2246	1.27	0.10	0.01	-0.08	-0.24	1.27	0.11	0.15
2015	2818	1.21	0.10	0.01	+0.86	+1.77	1.20	0.08	0.11
2016	1903	1.19	0.10	0.01	-0.05	-0.16	1.19	0.10	0.13
2017	4538	1.12	0.11	0.01	+0.96	+1.34	1.09	0.09	0.14
2018	2277	1.07	0.12	0.01	+0.92	+2.02	1.06	0.10	0.15
2019	2687	1.03	0.07	0.01	+1.05	+6.72	1.02	0.06	0.08
2020	327	1.07	0.11	0.01	+0.00	-1.28	1.08	0.15	0.20

Table S5: V-R Color Index statistics

year	nobs	mean	std	variance	skewness	kurtosis	median	mad	iqr
2010	535	0.78	0.05	0.01	-0.47	+1.18	0.78	0.05	0.07
2011	2665	0.77	0.05	0.01	-0.29	-0.34	0.78	0.05	0.08
2012	4532	0.73	0.04	0.02	+0.55	+1.45	0.73	0.03	0.04
2013	3216	0.72	0.03	0.01	+0.31	+2.30	0.72	0.02	0.03
2014	2246	0.73	0.03	0.01	-0.18	+1.19	0.73	0.03	0.04
2015	2818	0.66	0.03	0.01	+0.55	+1.23	0.66	0.03	0.04
2016	1903	0.60	0.03	0.01	-0.01	-0.44	0.60	0.03	0.04
2017	4538	0.58	0.04	0.01	+0.87	+1.82	0.57	0.03	0.05
2018	1508	0.55	0.05	0.01	+1.85	+7.74	0.54	0.04	0.06
2019	2277	0.52	0.03	0.01	+2.20	13.73	0.51	0.03	0.03
2020	327	0.52	0.05	0.01	+0.58	+0.86	0.52	0.07	0.09

From Table S1 to Table S5, we tabulated the yearly median values of night sky brightness after midnight for the whole period studied. For the year 2015 (when a significant streetlight retrofit took place) we found ($B = 19.27 \pm 0.12$, $V = 18.07 \pm 0.15$, and $R = 17.42 \pm 0.16$) mag/arcsec². Regarding the color indexes $B-V = 1.20 \pm 0.08$ and $V-R = 0.66 \pm 0.03$. We also report a difference in magnitude before the streetlight retrofit in 2015, $B_{2015} - B_{2011} = 0.12$ mag/arcsec² and after the streetlight retrofit $B_{2019} - B_{2015} = -0.29$ mag/arcsec².

We report streetlight transition values yearly because streetlight retrofits are performed progressively throughout the year, meaning yearly data captures the meaningful changes that occur due to streetlight retrofits in that period. An important process to keep in mind is that Madrid's streetlight retrofit is an ongoing process, and we detected further changes to the night sky brightness in 2016. Table S6 shows yearly SQM statistics for night sky brightness after midnight and Table S7 shows yearly TESS statistics for night sky brightness after midnight.

Table S6: SQM Statistics for Data After Midnight

year	nobs	mean	std	variance	skewness	kurtosis	median	mad	iqr
2013	21313	18.40	0.15	0.02	-1.41	4.21	18.43	0.15	0.21
2014	21604	18.44	0.14	0.02	-0.87	1.70	18.46	0.12	0.17
2015	10573	18.77	0.11	0.01	-1.79	6.27	18.18	0.10	0.14
2016	19055	18.57	0.12	0.01	-0.82	2.05	18.59	0.12	0.18
2017	33496	18.59	0.39	0.15	-2.21	4.41	18.72	0.18	0.26
2018	16653	18.65	0.25	0.06	-2.79	10.32	18.72	0.13	0.22
2019	26761	18.65	0.12	0.01	-1.56	4.70	18.68	0.09	0.13

Table S7: TESS Statistics for Data After Midnight

year	nobs	mean	std	variance	skewness	kurtosis	median	mad	iqr
2016	14221	18.43	0.21	0.04	-3.09	13.05	18.47	0.12	0.16
2017	44765	18.34	0.29	0.08	-2.29	5.84	18.40	0.15	0.20
2018	23483	18.24	0.30	0.09	-1.93	3.56	18.33	0.15	0.21
2019	33977	18.24	0.20	0.04	-2.81	10.06	18.30	0.10	0.15