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### **Supplemental Material**

#### **Evaluating the Association between Artificial Light-at-Night Exposure and Breast and Prostate Cancer Risk in Spain (MCC-Spain Study)**

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#### **Table of Contents**

**Table S1.** Distribution of potential breast and prostate cancer risk factors among the total non-shift workers MCC-Spain population, included in the indoor light-at-night (ALAN) model.

**Table S2.** Associations of Indoor and Outdoor artificial light-at-night (ALAN) with breast cancer among non-shift workers from Barcelona and Madrid (MCC-Spain) by menopausal status.

**Table S3.** Association of Indoor artificial light-at-night (ALAN) with breast and prostate cancer, in the total non-shift workers MCC-Spain population.

**Table S4.** Association of Indoor and Outdoor artificial light-at-night (ALAN) when sleeping, with breast and prostate cancer including shift workers MCC-Spain participants of Madrid and Barcelona.

**Table S5.** Association of Indoor artificial light-at-night (ALAN) with breast and prostate cancer, in the total non-shift workers MCC-Spain population by chronotype.

**Figure S1.** Classification of the ground level spectral type of the lamps using the green to the red bands (G/R) ratio, to estimate the ground based spectrum of the melatonin suppression index (MSI). The colours indicate the visual colour of the street lights with independently of the technology used: Red/diagonal lines: monochromatic orange lights, orange/dotted: no monochromatic orange lights, yellow/diagonal square net: very warm white lights, cyan/horizontal square net: white lights; dark blue/black circles with a white dot: white bluish lights; green/stars: greenish-white lights. CFL and FL are shown with the same symbol because they have the same spectral features. The diagonal line is the RANSAC linear fit to the points.

**Figure S2.** Relationship between the ratio of the photopic visual light over the green band fluxes detected from the ISS ( $V(\lambda)/G$ ) to the ratio of the green to the red bands (G/R) also detected from the ISS image to classify the lamp type. Colors indicate the visual color of the street lights independently of the technology used: red/diagonal lines: monochromatic orange lights, orange/dotted: no monochromatic orange lights, yellow/diagonal square net: very warm white lights, cyan/horizontal square net: white lights; dark blue/black circles with a white dot: white bluish lights; green/stars: greenish-white lights. The red line is a polynomial fit.

Table S1. Distribution of potential breast and prostate cancer risk factors among the total non-shift workers MCC-Spain population, included in the indoor light-at-night (ALAN) model.

Characteristic	Breast cancer		Prostate cancer	
	Controls N(%)	Cases N(%)	Controls N(%)	Cases N(%)
<b>Age (years); mean (SD)</b>	58.8 (12.6)	55.8 (11.8)	66.1 (8.3)	65.6 (7)
<b>Educational level</b>				
Less than primary school	213 (15.4)	158 (13)	125 (14.2)	111 (17.8)
Primary school	438 (31.6)	410 (33.6)	259 (29.5)	249 (40)
Secondary school	446 (32.2)	417 (34.2)	268 (30.5)	146 (23.4)
University	288 (20.8)	234 (19.2)	227 (25.8)	117 (18.8)
<b>Socioeconomic score<sup>a</sup></b>				
Low	392 (29.3)	357 (29.3)	231 (28.1)	246 (39.5)
Medium	711 (53.1)	675 (55.4)	424 (51.6)	300 (48.2)
High	237 (17.7)	187 (15.3)	166 (20.2)	77 (12.4)
<i>N missing values</i>	45	0	58	0
<b>Urban vulnerability; mean (SD)<sup>b</sup></b>	.5 (.2)	.5 (.1)	.5 (.2)	.5 (.2)
<b>BMI</b>				
<25	702 (50.7)	586 (48.1)	232 (26.4)	162 (26.0)
25-30	434 (31.3)	415 (34.0)	451 (51.3)	325 (52.2)
>=30	249 (18)	218 (17.9)	196 (22.3)	136 (21.8)
<b>Smoking (ever)<sup>c</sup></b>				
No	578 (41.8)	546 (44.9)	644 (73.3)	467 (75.0)
Yes	806 (58.2)	671 (55.1)	235 (26.7)	156 (25.0)
<i>N missing values</i>	1	2	0	0
<b>Family history of breast/prostate cancer</b>				
No	1255 (90.6)	1039 (85.2)	822 (93.5)	520 (83.5)
Yes	130 (9.4)	180 (14.8)	57 (6.5)	103 (16.5)
<b>Alcohol consumption; mean (SD)</b>	5.3 (8.6)	6.2 (11.3)	28.7 (32.0)	31.9 (35.4)
<i>N missing values</i>	183	189	99	79
<b>Chronotype</b>				
Morning type	529 (38.6)	442 (36.7)	430 (50.4)	311 (50.1)
Intermediate chronotypes	554 (40.4)	473 (39.2)	316 (37.0)	231 (37.2)
Evening type	289 (21.1)	291 (24.1)	108 (12.6)	79 (12.7)
<i>N missing values</i>	13	13	25	2
<b>Menopausal status</b>				
Premenopausal	391 (28.2)	441 (36.2)	NA	NA
Postmenopausal	994 (71.8)	778 (63.8)	NA	NA
<b>Participating centres</b>				
Madrid	302 (21.8)	259 (21.2)	256 (29.1)	213 (34.2)
Barcelona	268 (19.4)	214 (17.6)	320 (36.4)	205 (32.9)
Navarra	128 (9.2)	158 (13.0)	NA	NA
Guipuzcoa	176 (12.7)	141 (11.6)	NA	NA
Leon	152 (11.0)	157 (12.9)	NA	NA

Asturias	90 (6.5)	48 (3.9)	36 (4.1)	7 (1.1)
Murcia	NA	NA	NA	NA
Huelva	55 (4.0)	73 (6.0)	44 (5.0)	28 (4.5)
Cantabria	128 (9.2)	100 (8.2)	108 (12.3)	84 (13.5)
Valencia	41 (3.0)	38 (3.1)	51 (5.8)	51 (8.2)
Granada	NA	NA	64 (7.3)	35 (5.6)
Girona	45 (3.2)	31 (2.5)		

<sup>a</sup>Socioeconomic score based on a combination of information on education of parents and on occupation and education of the subject

<sup>b</sup>Urban vulnerability index to measure socioeconomic status at area level coded from 0 to 1 (Ministry of Public Works, Spain 2001-2011)

<sup>c</sup>Smoking habits (ever smoked at least 100 cigarettes or 360 gr of tobacco vs. None)

NA: Not applicable

Table S2. Associations of Indoor and Outdoor artificial light-at-night (ALAN) with breast cancer among non-shift workers from Barcelona and Madrid (MCC-Spain) by menopausal status.

	Premenopausal			Postmenopausal			p-value <sup>b</sup>
	Controls N (%)	Cases N (%)	ORs (95%CI) <sup>a</sup>	Controls N (%)	Cases N (%)	ORs (95%CI) <sup>a</sup>	
Breast cancer (N)	112	136		378	244		
Indoor ALAN							
Ref= Total darkness	12 (10.7)	25 (18.4)	1.00	47 (12.4)	25 (10.2)	1.00	0.121
Almost dark	54 (48.2)	40 (29.4)	0.44 (0.18,1.06)	132 (34.9)	79 (32.4)	1.19 (0.66,2.13)	
Dim light	42 (37.5)	63 (46.3)	0.86 (0.36,2.06)	166 (43.9)	117 (48.0)	1.42 (0.79,2.54)	
Quite illuminated	4 (3.6)	8 (5.9)	0.80 (0.18,3.53)	33 (8.7)	23 (9.4)	1.31 (0.63,2.72)	
Outdoor ALAN-Visual Light							
Ref=1st tertile (lowest)	44 (39.3)	60 (44.1)	1.00	113 (29.9)	73 (29.9)	1.00	0.588
2 <sup>nd</sup> tertile	36 (32.1)	34 (25.0)	0.53 (0.27,1.02)	134 (35.4)	87 (35.7)	1.00 (0.66,1.51)	
3 <sup>rd</sup> tertile (highest)	32 (28.6)	42 (30.9)	0.53 (0.26,1.10)	131 (34.7)	84 (34.4)	1.00 (0.64,1.57)	
Outdoor ALAN-MSI (blue light)							
Ref=1st tertile (lowest)	38 (33.9)	48 (35.3)	1.00	126 (33.3)	78 (32.0)	1.00	0.761
2 <sup>nd</sup> tertile	42 (37.5)	40 (29.4)	0.62 (0.32,1.18)	132 (34.9)	76 (31.1)	0.97 (0.63,1.50)	
3 <sup>rd</sup> tertile (highest)	32 (28.6)	48 (35.3)	1.09 (0.57,2.09)	120 (31.7)	90 (36.9)	1.31 (0.84,2.03)	

a. Basic adjustment: age, centre and educational level.

b. P-value for interaction (LRT)

Table S3. Association of Indoor artificial light-at-night (ALAN) with breast and prostate cancer, in the total non-shift workers MCC-Spain population

	<b>Controls</b>		<b>Cases</b>			
	<b>N (%)</b>	<b>N (%)</b>	<b>ORs (95%CI)</b>	<b>N (%)</b>	<b>N (%)</b>	<b>ORs (95%CI)</b>
<b>Basic adjustment (N)<sup>a</sup></b>	1385	1219		879	623	
Indoor ALAN						
Ref= Total darkness	196 (14.2)	168 (13.8)	1.00	151 (17.2)	91 (14.6)	1.00
Almost dark	534 (38.6)	448 (36.8)	1.06 (0.82,1.36)	369 (42.0)	218 (35.0)	0.96 (0.69,1.34)
Dim light	434 (31.3)	415 (34.0)	1.30 (1.00,1.69)	266 (30.3)	209 (33.5)	1.21 (0.85,1.71)
Quite illuminated	221 (16.0)	188 (15.4)	1.02 (0.76,1.36)	93 (10.6)	105 (16.9)	1.90 (1.27,2.85)
<b>Further adjustment (N)<sup>b</sup></b>	1334	1204		800	621	
Indoor ALAN						
Ref= Total darkness	182 (13.6)	165 (13.7)	1.00	123 (15.4)	90 (14.5)	1.00
Almost dark	519 (38.9)	444 (36.9)	1.02 (0.79,1.31)	343 (42.9)	218 (35.1)	0.92 (0.64,1.31)
Dim light	417 (31.3)	408 (33.9)	1.23 (0.94,1.61)	247 (30.9)	208 (33.5)	1.13 (0.79,1.64)
Quite illuminated	216 (16.2)	187 (15.5)	0.94 (0.70,1.27)	87 (10.9)	105 (16.9)	1.80 (1.18,2.76)

a. Basic adjustment: age, centre, educational level and menopausal status (in breast cancer).

b. Further adjustment: age, centre, educational level, SES, urban vulnerability index (UVI), body mass index (BMI), tobacco, family history of breast/prostate cancer and chronotype. Menopausal status (only breast cancer).

Table S4. Association of Indoor and Outdoor artificial light-at-night (ALAN) when sleeping, with breast and prostate cancer including shift workers MCC-Spain participants of Madrid and Barcelona.

<b>Basic adjustment<sup>a</sup></b>	<b>Breast Cancer (N=970)</b>			<b>Prostate Cancer (N=1189)</b>		
<b>Indoor ALAN</b>						
Ref= Total darkness	67 (12.3)	58 (13.7)	1.00	156 (22.6)	114 (22.8)	1.00
Almost dark	204 (37.4)	132 (31.1)	0.81 (0.51,1.29)	264 (38.3)	130 (26.0)	0.62 (0.43,0.88)
Dim light	228 (41.8)	194 (45.8)	1.10 (0.70,1.75)	226 (32.8)	182 (36.4)	0.98 (0.69,1.40)
Quite illuminated	47 (8.6)	40 (9.4)	0.90 (0.50,1.61)	43 (6.2)	74 (14.8)	2.25 (1.41,3.61)
<b>Outdoor ALAN-Visual Light<sup>b</sup></b>						
Ref=1st tertile (lowest)	181 (33.2)	143 (33.7)	1.00	199 (28.9)	198 (39.6)	1.00
2 <sup>nd</sup> tertile	182 (33.3)	142 (33.5)	1.07 (0.77,1.49)	240 (34.8)	156 (31.2)	0.66 (0.49,0.88)
3 <sup>rd</sup> tertile (highest)	183 (33.5)	139 (32.8)	0.93 (0.64,1.34)	250 (36.3)	146 (29.2)	0.59 (0.42,0.81)
<b>Outdoor ALAN-MSI (blue light)<sup>c</sup></b>						
Ref=1st tertile (lowest)	187 (34.2)	137 (32.3)	1.00	245 (35.6)	153 (30.6)	1.00
2 <sup>nd</sup> tertile	188 (34.4)	135 (31.8)	1.00 (0.71,1.41)	234 (34.0)	161 (32.2)	1.21 (0.89,1.65)
3 <sup>rd</sup> tertile (highest)	171 (31.3)	152 (35.8)	1.29 (0.91,1.83)	210 (30.5)	186 (37.2)	1.74 (1.27,2.38)

a. Basic adjustment: age, centre, educational level, night shift and menopausal status (in breast cancer) and mutually adjusted for light exposure variables.

b. Tertiles of visual for breast: 1st tert=[0.009-0.046]; 2nd tert=[0.046-0.071]; 3rd tert=[0.071-0.226]. Tertiles of visual for prostate: 1st tert=[0.002-0.0146]; 2nd tert=[0.046-0.072]; 3rd tert [0.072-0.226]

c. Tertiles of MSI for breast: 1st tert=[0.041-0.128]; 2nd tert=[0.128-0.163]; 3rd tert=[0.163-0.407]. Tertiles of MSI for prostate: 1st tert=[0.017-0.128]; 2nd tert=[0.128-0.160]; 3rd tert [0.160-0.414]

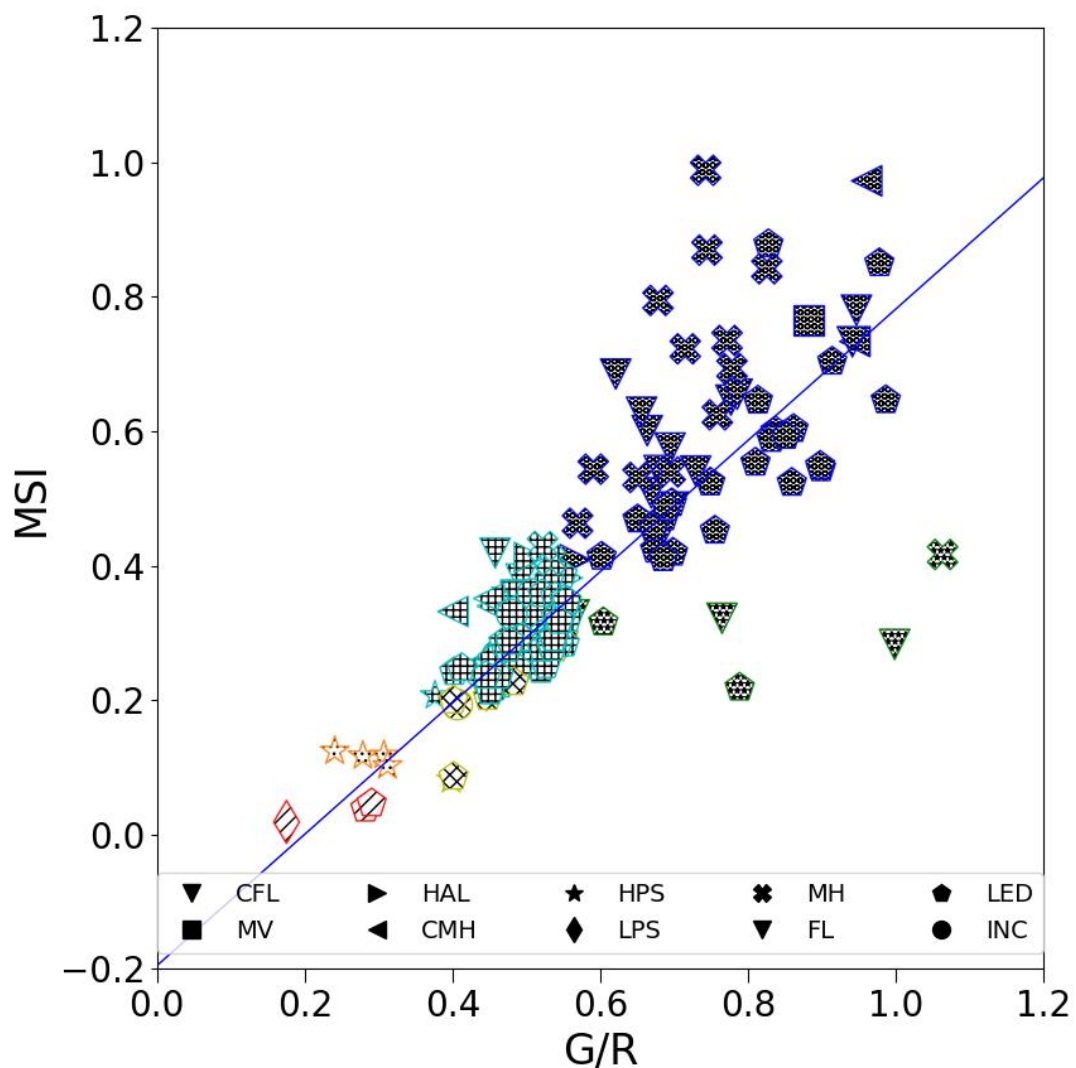
Table S5. Association of Indoor artificial light-at-night (ALAN) with breast and prostate cancer, in the total non-shift workers MCC-Spain population by chronotype

Breast cancer	Morning chronotype (N=971)			Neither Chronotype (N=1027)			Evening Chronotype (N=580)		
	Controls	Cases	ORs (95%CI)	Controls	Cases	ORs (95%CI)	Controls	Cases	ORs (95%CI)
	N (%)	N (%)		N (%)	N (%)		N (%)	N (%)	
Indoor ALAN									
Ref= Total darkness	71 (13,4)	57 (12,9)	1.00	82 (14,8)	65 (13,7)	1.00	40 (13,8)	45 (15,5)	1.00
Almost dark	194 (36,7)	154 (34,8)	1.04 (0.68,1.59)	219 (39,5)	184 (38,9)	1.24 (0.83,1.84)	117 (40,5)	106 (36,4)	0.77 (0.46,1.31)
Dim light	184 (34,8)	166 (37,6)	1.33 (0.86,2.06)	169 (30,5)	155 (32,8)	1.41 (0.93,2.15)	78 (27,0)	87 (29,9)	1.03 (0.59,1.82)
Quite illuminated	80 (15,1)	65 (14,7)	1.00 (0.61,1.64)	84 (15,2)	69 (14,6)	1.09 (0.68,1.75)	54 (18,7)	53 (18,2)	0.85 (0.47,1.56)
<b>Prostate cancer</b>	<b>Morning chronotype (N=741)</b>			<b>Neither Chronotype (N=547)</b>			<b>Evening Chronotype (N=187)</b>		
Indoor ALAN									
Ref= Total darkness	69 (16,0)	44 (14,1)	1.00	41 (13,0)	34 (14,7)	1.00	33 (30,6)	12 (15,2)	1.00
Almost dark	183 (42,6)	112 (36,0)	0.89 (0.55,1.44)	149 (47,2)	79 (34,2)	0.71 (0.40,1.25)	31 (28,7)	27 (34,2)	3.42 (1.29,9.07)
Dim light	133 (30,9)	110 (35,4)	1.18 (0.72,1.93)	94 (29,7)	77 (33,3)	0.99 (0.54,1.83)	32 (29,6)	21 (26,6)	2.67 (0.98,7.27)
Quite illuminated	45 (10,5)	45 (14,5)	1.74 (0.96,3.15)	32 (10,1)	41 (17,7)	1.56 (0.77,3.13)	12 (11,1)	19 (24,1)	6.21 (2.01,19.21)

a. Basic adjustment: age, centre, educational level and menopausal status (in breast cancer).

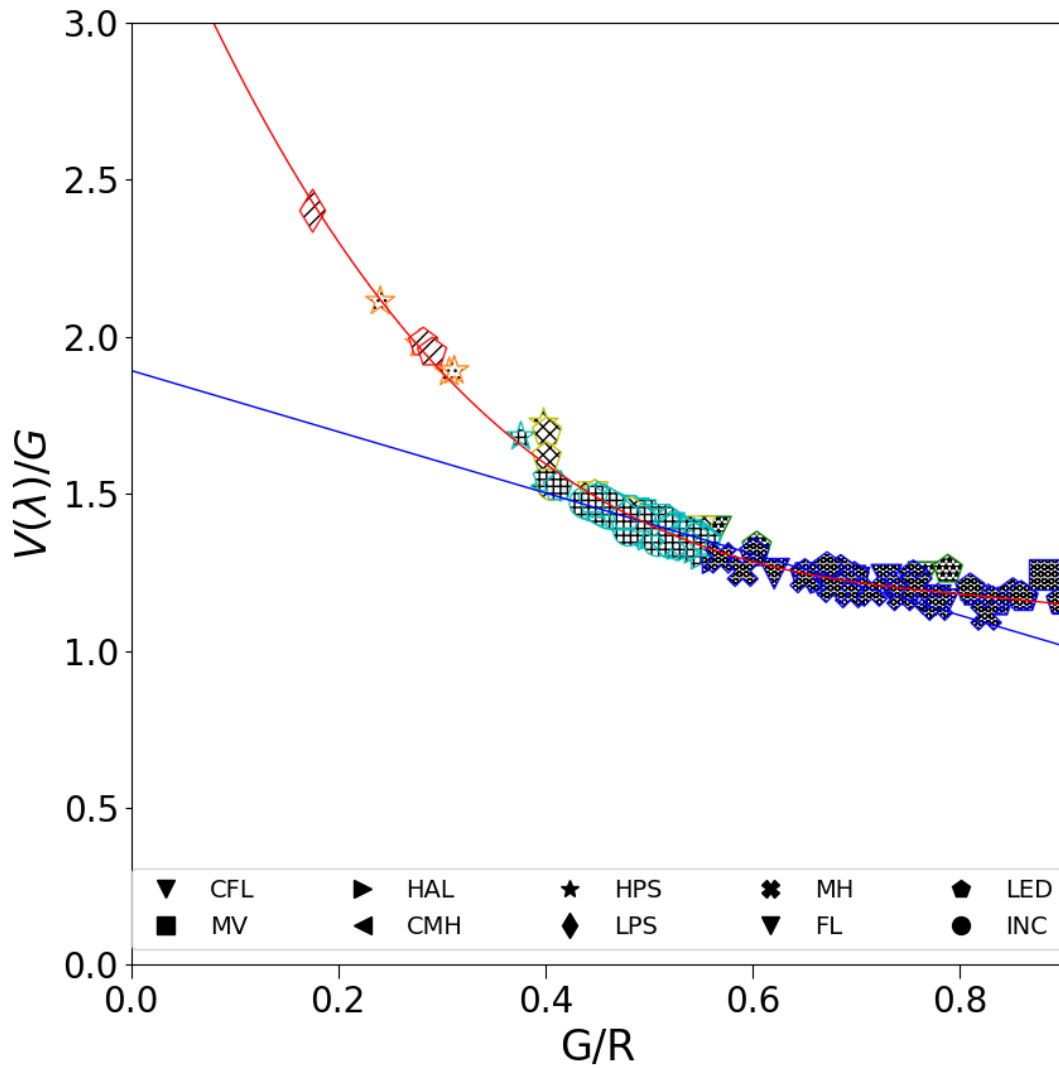


**Figure S1.** Classification of the ground level spectral type of the lamps<sup>a</sup> using the green to the red bands (G/R) ratio, to estimate the ground based spectrum of the melatonin suppression index (MSI). The colours indicate the visual colour of the street lights with independently of the technology used: Red/diagonal lines: monochromatic orange lights, orange/doted: no monochromatic orange lights, yellow/diagonal square net: very warm white lights, cyan/horizontal square net: white lights; dark blue/black circles with a white dot: white bluish lights; green/stars: greenish-white lights. CFL and FL are shown with the same symbol because they have the same spectral features. The diagonal line is the RANSAC linear fit to the points.



a. Different types of lamps used in the analysis: CFL=Compact Fluorescent; MV= Mercury Vapor; HAL= Halogen; MH= Metal Halide; CMH= Ceramic Metal Halide; FL=Fluorescent; LED = LED; INC = Incandescent; HPS = High Pressure Sodium; LPS = Low Pressure Sodium

**Figure S2.** Relationship between the ratio of the photopic visual light over the green band fluxes detected from the ISS ( $V(\lambda)/G$ ) to the ratio of the green to the red bands ( $G/R$ ) also detected from the ISS image to classify the lamp type. Colors indicate the visual color of the street lights independently of the technology used: red/diagonal lines: monochromatic orange lights, orange/dotted: no monochromatic orange lights, yellow/diagonal square net: very warm white lights, cyan/horizontal square net: white lights; dark blue/black circles with a white dot: white bluish lights; green/stars: greenish-white lights. The red line is a polynomial fit.



a. Different types of lamps used in the analysis: CFL=Compact Fluorescent; MV= Mercury Vapor; HAL= Halogen; MH= Metal Halide; CMH= Ceramic Metal Halide; FL=Fluorescent; LED = LED; INC = Incandescent; HPS = High Pressure Sodium; LPS = Low Pressure Sodium