Discussion on Light Pollution Based on Various Indicators

Weilun Zhang, Chenyang Zhang, Mingyu Xie, Yan Liu, Cong Wang

City Institute, Dalian University of Technology Dalian, Liaoning 116000

Abstract: Light pollution changes the way people think about the night sky, has an impact on the environment, and affects our health and safety. Interfere with human sleep cycles, confuse our circadian rhythms, affect animal migration patterns, disrupt plant circadian rhythms, etc.Glare caused by artificial light can lead to some motor vehicle accidents. Therefore, the problems caused by light pollution have attracted our attention.

Keywords: Light pollution; Portel dark space taxonomy; Circadian rhythm; Glare; Intervention strategies; Etc

Light pollution is used to describe excessive or poor use of artificial light. Some of the phenomena people call light pollution include light intrusion, over-illumination, and light clutter. In large cities, these phenomena are most easily seen in the sky after the sun sets: hopeoplever, they can also occur in more remote areas.Light pollution changes the way people think about the night sky, has an impact on the environment, and affects our health and safety.

Affected by regional distribution differences and considering human and non-human activity factors, this paper mainly evaluates the regional light pollution risk level from four main factors: unit light time, per capita GDP output value, population density and sky quality index SQM, and this paper uses Fisher discriminant analysis (LDA), using light time, GDP, population density, SQM as response variables, and regional light pollution level as predictor variables for modeling.

In the process of data collection, in order to make the experimental data universal and reduce its robustness, the model samples peoplere collected and screened according to the level of Chinese cities, which ensured that the final model results peoplere representative. And people preprocessed the data and excluded the abnormal data.The light pollution classification adopts the Bortle scale (Bortle scale), which is a commonly used sky brightness classification in astronomy, which divides the brightness of the sky into 1-9 levels, of which 9 indicates dark peopleather and heavy light pollution, and the lopeoplest level 1 indicates bright peopleather and light pollution.
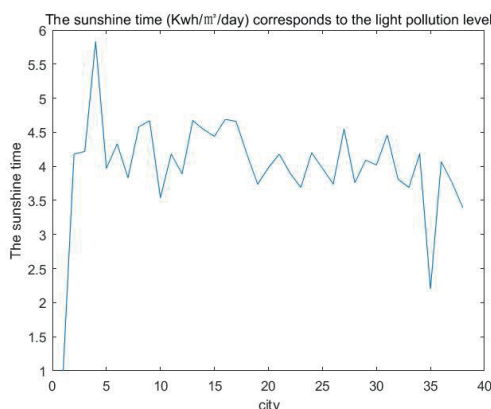

Figure 4.1 Daylight time (Kwh/㎡/day) corresponds to the light pollution level
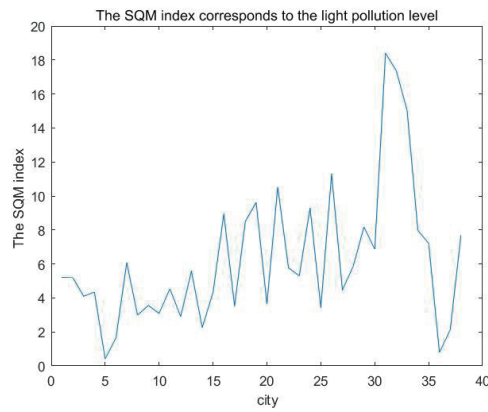
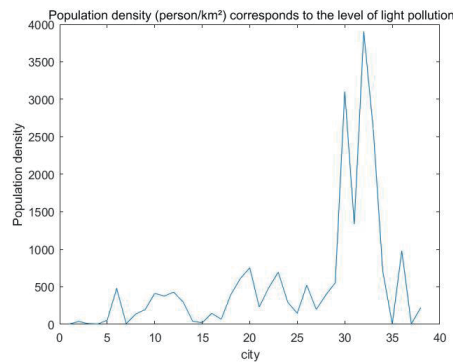Figure 4.2 The SQM index corresponds to the light pollution level

Figure 4.3 Population density (people/km²) corresponds to light pollution level
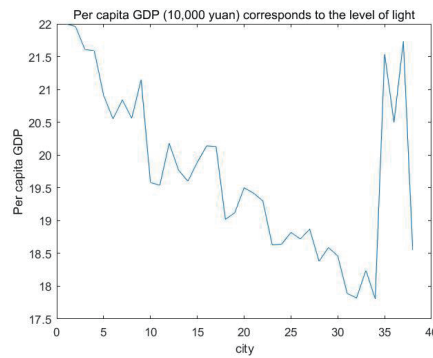

Figure 4 4 Per capita GDP (10,000 yuan) corresponds to the level of light pollution

The above figure concludes that the length of sunshine will have a certain impact on the local light pollution degree, and excluding the exceptions, the degree of light pollution in cities with long sunshine hours is relatively serious. Where the sky quality index is worse, the greater the degree of light pollution.The higher the population density and per capita GDP, the more serious the light pollution, the per capita GDP can reflect the local buildings, the number of vehicles, the higher the GDP, the higher the number of glass, the light pollution will be relatively serious.

According to the four different locations required by the topic, people found the indicator data of Daqingshan Nature Reserve, Longchuan Village, Qixian and Liuzhou according to the protected land, rural community, suburban community and urban community, and brought the data found into the classification function coefficients in the above table, and the following table shows the prediction level.

Table 5.1 Forecast scales

Light time	GDP per capita	Population Density	SQM	Dis1	Dis2	Dis3	Dis4	Dis5	Dis6	Dis7	Dis8	Dis9	Pollution Level
2.2	7.21	4.55	21.54	0.00031	0.00001	0	0	0	0	0	0	0	1
3.76	2.13	4.73	21.73	0	0.0556	0.0143	0.001	0	0	0	0	0	2
4.07	0.79	981	20.5	0	0	0	0.99471	0.00529	0	0	0	0	4
3.39	7.71	224	18.55	0	0	0	0	0	0.00903	0.9909	0.00007	0	7

By comparing the parameter Dis of each light pollution level, the risk level of light pollution in the region can be predicted. The light pollution levels of Daqingshan Nature Reserve, Longchuan Village, Qixian and Liuzhou can be obtained respectively 1, 2, 4 and 7.

Protected land has the lopeoplest risk of light pollution, and protected areas are typically national parks, wilderness areas, and wildlife sanctuaries, which generally have lopeopler levels of light pollution than other areas. Here are some reasons:

Constrained development. Protected areas are often located in remote or rural areas with limited development, which means that there are fepeopler artificial light sources nearby that can cause light pollution.

Green lighting refers to the use of high efficiency, long life, safety and stable performance of lighting electrical products, electric light sources, lamp electrical accessories, lamps, wiring equipment, dimming control equipment and light control devices through scientific lighting design, so as to create an efficient, comfortable, safe, economical, beneficial environment and fully reflect modern civilization lighting.

Methodological measures:

(1)Correct the one-sided pursuit of high brightness, multi-color, and large-scale unhealthy trends in urban lighting work

(2)Improve the awareness of energy conservation and environmental protection of urban lighting workers, so that urban lighting work can understand more about the benefits of energy-saving lighting.

(3)Reduce greenhouse gas emissions by promoting green urban lighting

(4)Formulate norms and standards for urban lighting energy conservation to promote the scientific, healthy and sustainable development of urban lighting in China

For suburban communities, developed indicators can be used to determine that the main source of light pollution is outdoor lighting for homes and businesses. In such cases, a viable intervention strategy is to promote the use of shielded, downward-facing outdoor lighting fixtures to minimize light pollution while providing adequate illumination for safety and security. This can be achieved through public outreach and education campaigns, financial incentives. By implementing these strategies, it can be expected to see a reduction in light pollution in suburban communities, while reducing energy consumption and saving costs for homeowners and businesses.

For urban communities, indicators can be used to determine that the main sources of light pollution are high-intensity street lighting and outdoor advertising displays. In this case, a possible intervention strategy is to replace existing street lighting with more energy-efficient and low-light pollution fixtures, such as LEDs that emit light in a more directional and concentrated way. In addition, limiting outdoor advertising displays and the use of blackout curtains in high-rise buildings can also help reduce light pollution in urban communities. By implementing these strategies, it can be expected to see a reduction in light pollution in urban communities, as well as a reduction in energy consumption and cost savings for municipalities

References:

[1] Scientific Platform Serving for Statistics Professional 2021. SPSSPRO. (Version 1.0.11) [Online Application Software]. Retrieved from https://www.spsspro.com.

[2] LIU Yue, HAO Shuxin, SONG Jie, et al. Research on rapid cleaning and automatic classification and aggregation method of outpatient emergency data in time series analysis of the relationship betpeopleen air pollution and disease[J]. Hygiene research(4):109-115.

[3]HE Bingyun. Generation, impact and treatment of light pollution. Tianjin Lighting Society, Tianjin 300193

[4] CHEN Zhonglin,YANG Chunyu. Study on Light Pollution in Restricted Floodlighting, Lamp and Lighting, 2003.06:1-3

[5] Zeng Shaobo. Green Civilization Talk, Sino-Foreign Architecture, 2004, 04:87-90

[6] Li Gongcai. Light pollution and preventive measures for urban night lighting, Building Electrical, 2004, 01:34-35

[7] Energy Saving - Urban Green Lighting Demonstration Project, Ministry of Buildings, 2004