Urban Air Quality Assessment Model Based on API Index

Juliao Qiu [1], Jing Chen [2]

[1] College of Oceanography and Meteorology, Guangdong Ocean University, Zhanjiang, Guangdong, 524088, China

[2] College of Computer and Data Engineering, Ningbo Institute of Technology, Zhejiang University, Ningbo, Zhejiang, 315100, China

Abstract

This paper analyzes the air pollution degree of the city, and uses the weight coefficient method to modify and improve the API standard. Based on the daily API index value of each city, the weight coefficient increases with the pollution level. The increase and the expansion of the number of severely polluted days on the degree of urban pollution make such an assessment more reasonable and scientific. In addition, this paper considers the seasonal variation of the degree of air pollution, and finally processes and calculates the data, and obtains the comprehensive ranking of the quarters and annuals of the pollution levels of the ten sample cities.

Keywords

Air quality; Evaluation model; API index; Seasonal.

1. Introduction

With the development of industry, many cities are currently subject to different levels of pollution, especially air pollution, which will directly cause harm to the human body. In recent years, although China's air pollution prevention and control work has achieved great results, due to various reasons, the situation facing China's atmospheric environment is still very serious. To realize the coordinated development of atmospheric environment and social economy, it is necessary to carry out research on the factors affecting urban environmental air quality and its impact mechanism, as well as the practical problems that need to be solved urgently to improve urban environmental quality.

2. Evaluation model establishment

The primary factor for establishing a city's air quality assessment model is whether the air quality in the area is harmful to people's health. The greater the concentration of pollutants, the greater the harm to people, so when setting the weighting factors of the stages, As the pollution level increases, the corresponding weight coefficient is also larger, and the weight is linearly related to the level. Secondly, before the pollution index does not reach the hazard value, such pollution may have potential harm to the environment. Therefore, the established evaluation model can neither ignore the serious pollution situation nor over-amplify these special conditions; neither can neglect the relatively small pollution. The situation does not allow these conditions to affect the determination of the degree of pollution. In summary, namely:

$$C=\frac{\sum_{i=1}^{n} I_i \times K_i}{n}$$

When solving, first calculate the pollution level of one grade in a quarter, and then calculate the degree of air pollution within one, and compare the pollution degree of each quarter. Finally, the degree of air pollution in all cities was evaluated according to different time periods.

2.1 Period-based pollution levels

Since the air pollution in the city will cause damage to people's health, the frequency of serious air pollution should not be too high. Calculate the pollution level of this level in the quarter based on the daily calculation of each level of each quarter. with:

$$I_{ij} = \sum_{h=1}^{t} I_{ijh}$$

2.2 Evaluation model based on quarterly and annual assessments

Under the premise of knowing the daily pollution index and the daily air quality level of each city, comprehensive consideration of various factors, using the level of pollution of each level that has been obtained every quarter, and comprehensive evaluation of a long-term area The severity of air pollution. Establish a quarterly model:

$$C_i = \frac{\sum_{i=1}^{5} I_{ij} K_i}{n}$$

$$K_i = \frac{i}{15} \text{ (i=1,2,3,4,5)}$$

In the above mathematical model: C_i indicates the degree of pollution in a quarter; n represents the total number of days in the quarter taken; based on this, an annual model is established:

$$C = \frac{\sum_{i=1}^{n} I_i \times K_i}{n}$$

$$K_i = \frac{i}{15} (i = 1,2,3,4,5)$$

3. Model solving

Since air pollution has a close relationship with the quarter, it compares the pollution level of the whole year, and also calculates the pollution degree ranking of each city in quarters, which is conducive to comprehensively judging the pollution level of each city. As shown in Table 1, it represents the pollution degree of each city in each quarter and year.

Table 1 Pollution degree of each city in each quarter and year

Pollution city	Chengdu	Hangzhou	Beijing	Shanghai	Guangzhou
First quarter	16.083	7.634	11.259	7.48	7.216
Second quarter	10.265	7.66	11.85	9.02	6.467
Third quarter	7.926	9.78	16.13	5.695	6.267
Fourth quarter	8.68	11.62	11.68	5.002	8.336
Overall	10.36	9.01	12.82	6.898	6.899
Pollution city	Lhasa	Urumqi	Zhengzhou	Wuhan	Xi'an
First quarter	2.36	28.41	12.04	9.293	14.69
Second quarter	2.67	11.53	9.94	7.41	14.77
Third quarter	7.346	8.826	13.78	11.9	9.8
Fourth quarter	7.053	11.86	12.405	13.22	12.32
Overall	4.81	13.113	11.976	10.244	12.7

According to the model established in this paper, the ranking of each city's quarterly and annual pollution levels from low to high can be obtained, as shown in Table 2.

Table 2 Final ranking results

Ranking	First quarter	Second quarter	Third quarter	Fourth quarter	Total ranking
1	Lhasa	Lhasa	Shanghai	Shanghai	Lhasa
2	Guangzhou	Guangzhou	Guangzhou	Lhasa	Shanghai
3	Shanghai	Wuhan	Lhasa	Guangzhou	Guangzhou
4	Hangzhou	Hangzhou	Chengdu	Chengdu	Hangzhou
5	Wuhan	Shanghai	Urumqi	Hangzhou	Wuhan
6	Beijing	Zhengzhou	Hangzhou	Beijing	Chengdu
7	Zhengzhou	Chengdu	Xi'an	Urumqi	Zhengzhou
8	Xi'an	Urumqi	Wuhan	Xi'an	Xi'an
9	Chengdu	Beijing	Zhengzhou	Zhengzhou	Beijing
10	Urumqi	Xi'an	Beijing	Wuhan	Urumqi

The pollution ranking model for each city is based on the api index, while the api index algorithm only takes the most polluting of the three pollutants, if the pollution level of the other two is close to the largest one. Item, the api index of the day cannot accurately reflect the true pollution level. Especially in most cases, the primary pollutant is respirable particulate matter, so that when sulfur dioxide or nitrogen dioxide is the primary pollutant, inhalable solid particles still exist, specifically the error is relatively large, because of the inhalable solid particles It is mainly purified by sedimentation by its own gravity. It takes a long time and does not change much in a short time. Therefore, in the cities where sulfur dioxide and nitrogen dioxide are the primary pollutants, the results of this evaluation model are Actual contamination levels may vary slightly.

4. Conclusion

In general, atmospheric pollution sources can be mainly divided into two categories: natural sources and anthropogenic sources. Anthropogenic sources include vehicles, ships, aircraft exhaust, industrial production emissions, residential and heating, and waste incineration. The city's development density, topography and meteorology are also important factors affecting air quality. The quality of urban air quality is closely related to the seasons and meteorological conditions. Therefore, this paper is divided into different regions and different seasons. The equivalent pollution load of all pollutants of a certain pollution source is arranged according to the numerical value. The percentage and cumulative percentage are calculated from small to large, and the pollutant with the cumulative percentage greater than 80% is determined as the main pollutants of pollution sources, that is, the main factors affecting urban air quality.

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