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Spatial Distribution Characteristics of PM_{10} in Pingshan District

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***Abstract*—This paper introduces the remote sensing and measured atmospheric monitoring points and analysis in Pingshan District of Shenzhen City. Remote sensing monitoring selects the mature extended dark pixel method to synthesize the PM10 diffusion distribution map of the main pollutants in Pingshan District in the past two years.**

Keywords—MODIS satellite remote sensing image, AOD-PM10 regression model, monitoring distribution

I. INTRODUCTION

For now, with the development of Chinese's economy, the environment pollution issue is getting worse. To take effective control to environment pollution, monitoring the atmospheric ambient is needed. In the process of atmospheric ambient monitoring, project selection, sample set, sample collection, monitoring project analysis and monitoring data management .etc project are needed. To ensure the effect of atmospheric ambient monitoring, the apply and point set method are required to research. Selecte the MODIS satellite remote sensing image data , and combined with the ground continuous monitoring data and meteorological data to synthesize the PM10 diffusion distribution map of the main pollutants in Pingshan District in the past two years.

II. DATA SOURCE

In this study, the mature extended dark pixel method was selected, and a look-up table was constructed in 6S mode to invert the aerosol optical thickness AOD in Pingshan District. Combined with the measured data of PM10 in the jurisdiction, the AOD-PM10 regression model of Pingshan District was established to invert the ground. PM10 concentration, and test the applicability of the model; on this basis, invert the concentration of each atmospheric pollutant. The specific research method is shown in Fig.1.

Aerosol concentrations can be described in both horizontal and vertical dimensions, namely Horizontal Meteorological Range(HMR) and Aerosol Optical Depth (AOD). Among them, AOD is one of the most important parameters of aerosol, it is an important physical quantity to characterize atmospheric turbidity, and it is also one of the key factors to determine the aerosol climate effect. MODIS channel I (0.620～0.670μm) and channel III (0.459～0.479μm) are located in the red and blue bands in the visible window of the atmosphere, and the channel width is narrow, the atmospheric gas absorption has little effect on aerosol remote sensing, and when using 6S mode performing radiation transmission calculation, it has the function of correcting the gas absorption and can be used for remote sensing of aerosol.

Atmospheric optical depth refers to the integral of the total extinction coefficient of the atmosphere to the atmospheric height. It is generally expressed by τ: the optical thickness in the atmosphere consists of three parts: the absorption optical depth caused by atmospheric molecules and atmospheric water vapor, and the scattering and absorption optical depth of the aerosol example, the physical meaning of the aerosol optical depth is the integral of the atmospheric extinction coefficient of the atmosphere in the vertical direction, and the value corresponds to the aerosol concentration at the height of the entire atmosphere. In this study, the MODIS data was used to invert the aerosol optical depth in Pingshan District, and the inversion experiment was carried out by means of the 6S radiation transmission mode and the extended dark pixel method.

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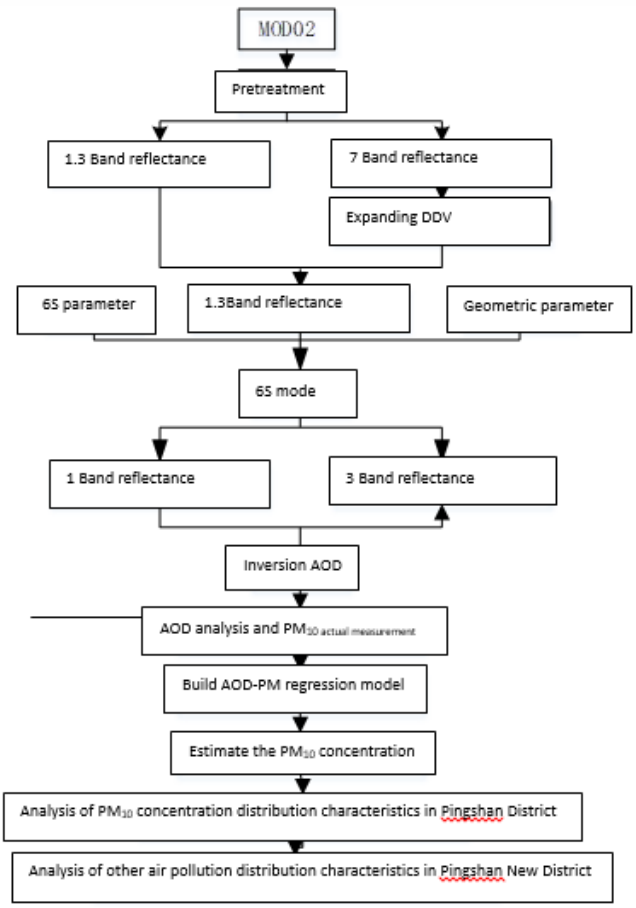
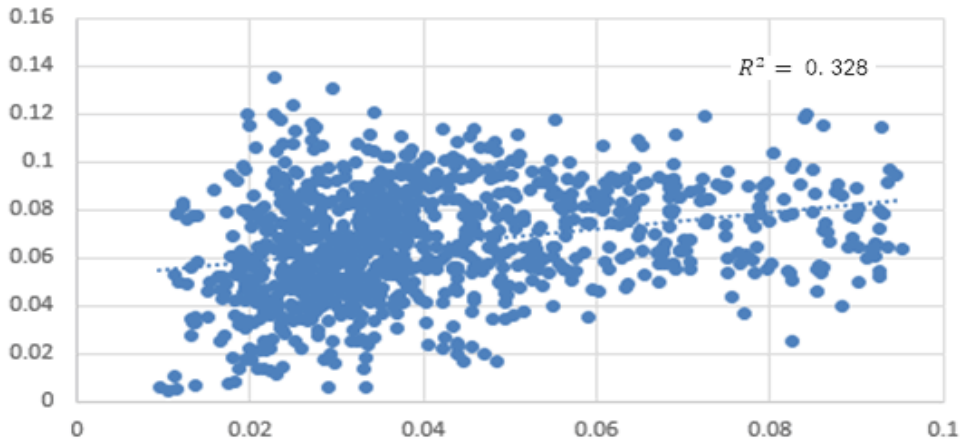


Fig. 1 Inversion of AOD technology based on remote sensing satellite imagery

A. AOD- PM_{10} Statistical Analysis of Modeling Data

Based on the modeling method introduced in the previous section, the PM10 concentration and the inversion of the MODIS 1km×1km AOD and PM10 concentrations in the Pingshan District from 2014 to 2015 were established and the vertical and humidity corrections were established. The aerosol relationship value is the AOD (SEC-RH) correlation, as shown in Fig.2.



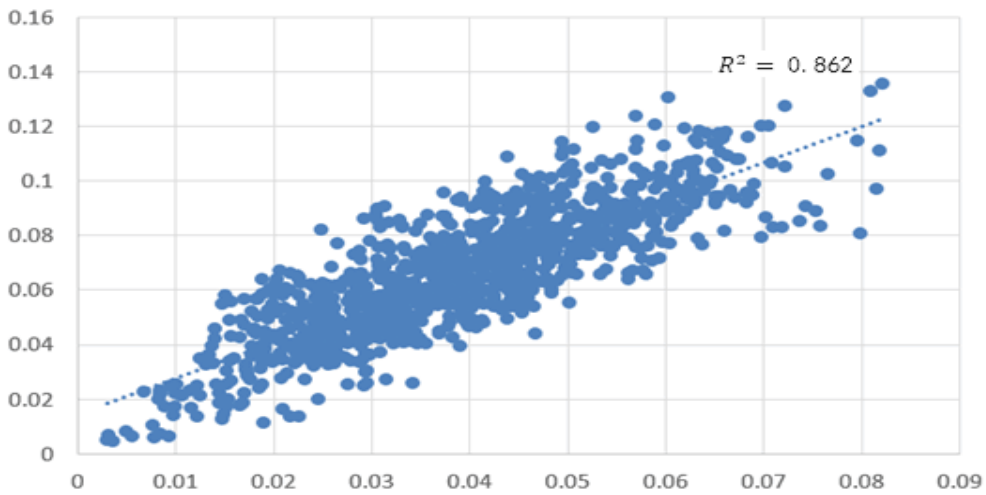


Fig. 2 Correlation between AOD and PM_{10} concentration PM_{10}

Fig.2 shows that the correlation coefficient between the AOD and PM10 actual monitoring values obtained by the inversion is 0.328, and the correlation coefficient between the AOD and PM2.5 concentration values after the correction and vertical and humidity correction data is 0.862, indicating The treated AOD is consistent with the trend of ground monitoring PM10 concentration.

B. AOD-PM_{10} Regression Model

According to the 2012-2014 ground monitoring PM2.5 concentration and AOD construction regression model is:

$$\Psi=0.4537*\Xi+0.0293 \qquad (P^2=0.862) \qquad (1)$$

Wherein:Ψ is $PM_{2.5}$'s inversion concentration:Ξ is AOD(SEC-RH)'s value:

C. PM_{10} Estimated Result Verification

According to the established AOD and PM10 regression model, the PM10 concentration values of Pingshan District from 2014 to 2015 are analyzed with the corresponding ground monitoring values. See Fig.3 for details. According to the statistical results, the error between the estimation result and the actual monitoring value is between -0.081 and 0.041, and the average error is 0.015, and the error is small.

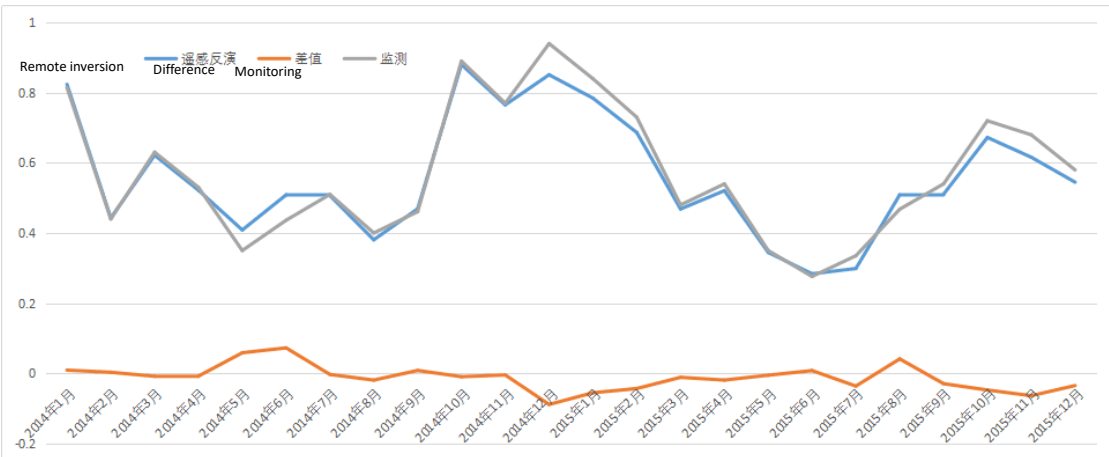


Fig. 3 Error analysis of PM_{10} estimation results

In order to further study the relationship between PM10 and ground monitoring based on AOD inversion, the correlation analysis is carried out, as shown in Fig.4. According to the statistical results, there is a good correlation between the inversion value and the actual monitoring value, and the correlation is 0.872, which indicates that the PM10 concentration based on AOD inversion is consistent with the measured PM10 concentration in this study, which shows that it is based on AOD inversion. The PM10 concentration estimation results have higher reliability. It is concluded that MODIS L1B data can meet the requirements of regional PM10 estimation, which can make up for the lack of spatial distribution of air pollution monitoring stations, and provide a new way to evaluate regional particulate matter pollution status. method.

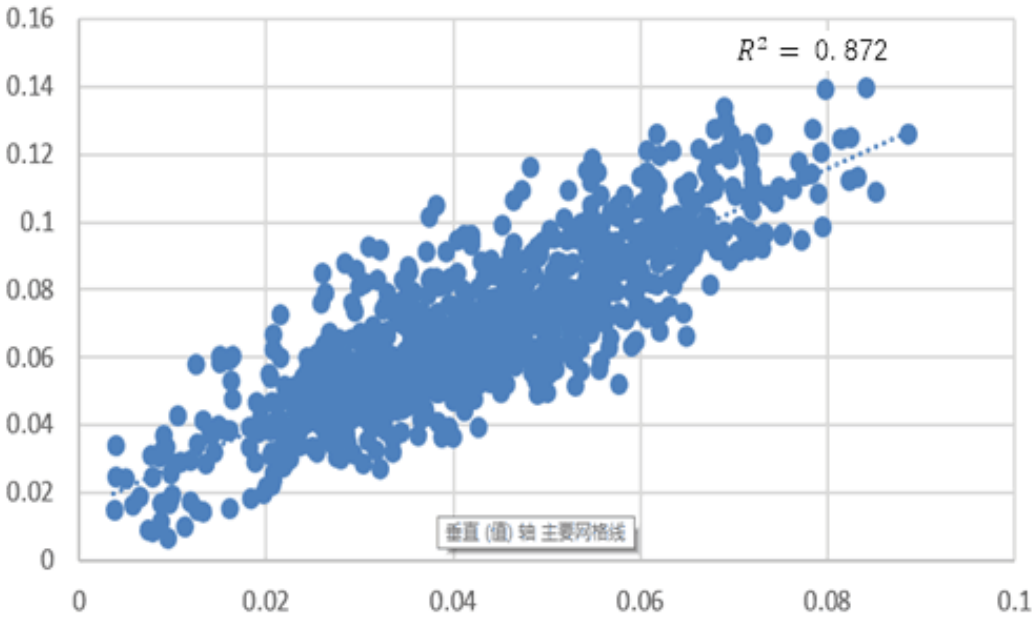


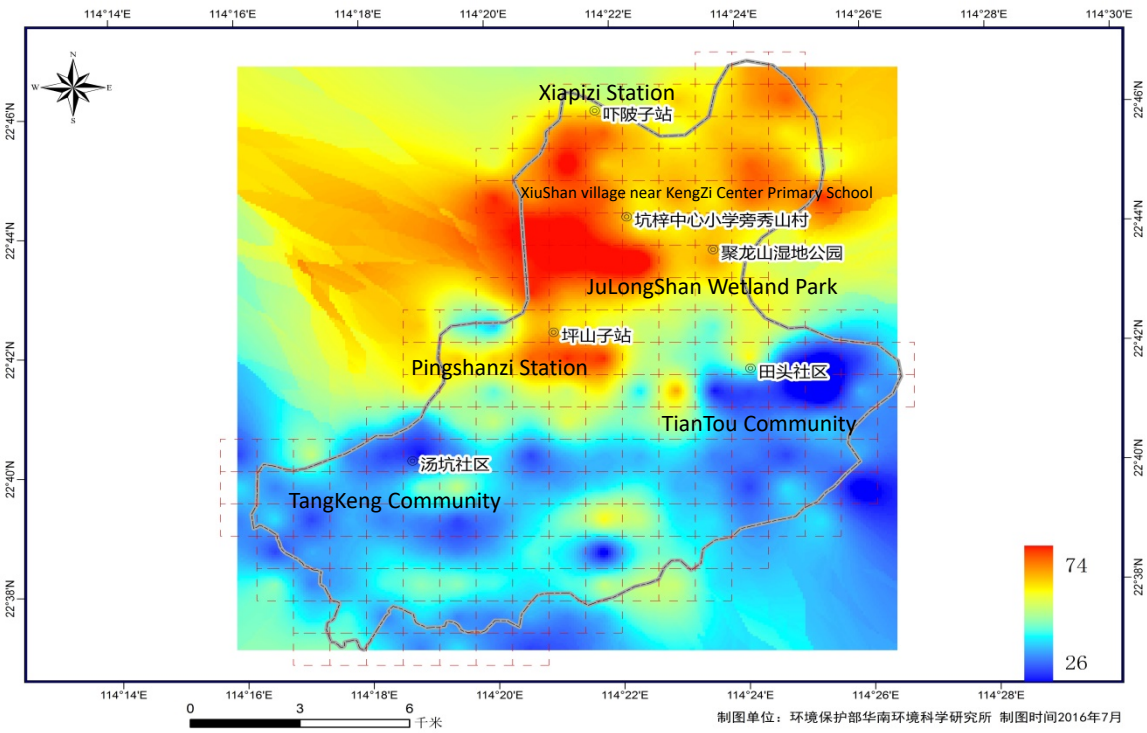
Fig. 4 Scatter plot between PM_{10} monitoring values and regression model estimates

III. Spatial Distribution Characteristics of PM10 in Pingshan District

Based on the linear relationship between MODIS satellite remote sensing image and PM10, this study estimates the PM10 concentration of the relevant spatial location by inversion of AOD product data in MODIS satellite remote sensing in the past 2 years. Based on this, analyze the Seasonal and spatial distribution characteristics of PM2.5 diffusion in Luohu District.

A. Interannual Variation Characteristics of PM_{10} Mean Spatial Distribution in Recent 2 Years

According to Fig.5, the interannual variation of PM10 mean spatial distribution in Pingshan District during the two years from 2014 to 2015 is reflected.



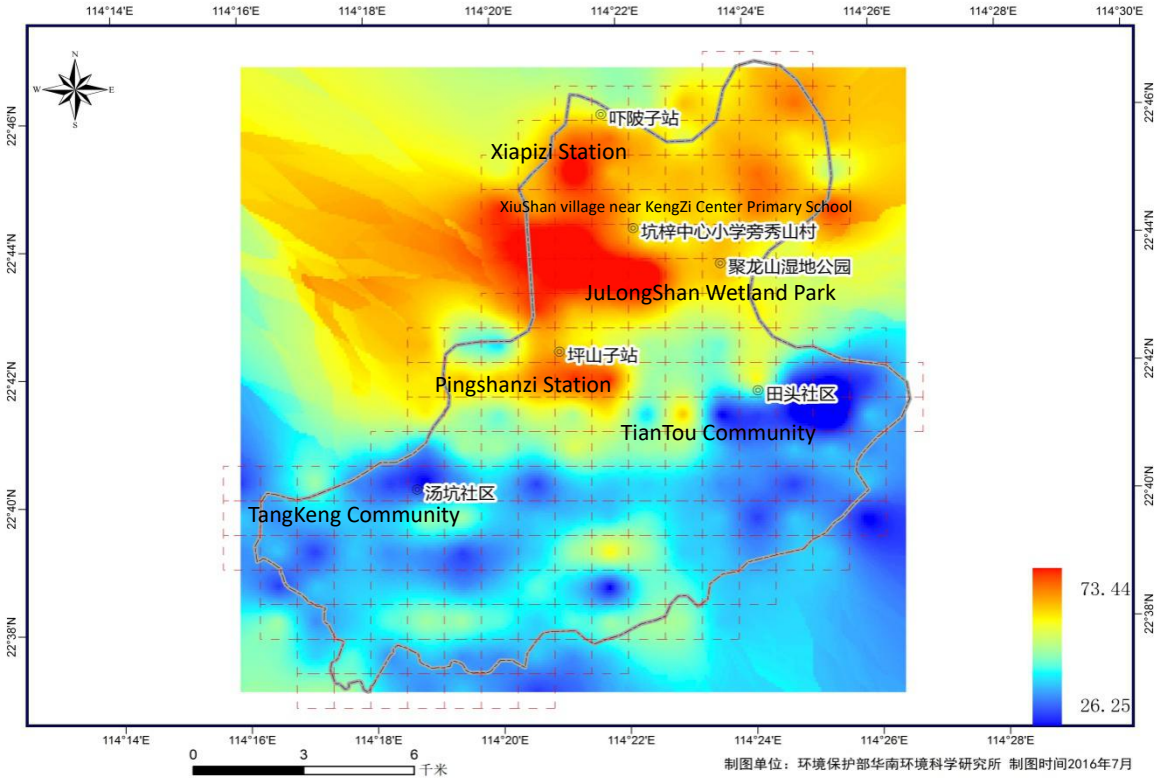


Fig. 5 Statistics of interannual variation of $PM_{2.5}$ concentration in Pingshan District, 2014-2015

According to the inversion estimation results, the PM10 concentration in Pingshan District under 2015 is lower than that in 2014. From the perspective of spatial distribution, the concentration of PM10 in the north of Pingshan District is higher than that in the south. The distribution of PM10 concentration is consistent with the scope of the built-up area and the road network. Most of the mountains, waters and development zones in Pingshan District are mainly concentrated in the southern part of the area. The industrial pollution source and built-up area are located in the north area. Therefore, the pollution distribution characteristics of PM10 in Pingshan District are basically consistent with the scope of the built-up area and the industrial pollution layout.

B. Quarterly Variation Characteristics of PM_{10} Mean Spatial Distribution in Recent 2 Years

According to Fig.6, the seasonal variation of PM10 mean spatial distribution in Pingshan District during the two years from 2014 to 2015 is reflected. From the inversion estimation results, the PM10 concentration in the Pingshan District under the statistical data series in the past two years is the highest in the fourth quarter, followed by the first and third quarters, and the lowest in the second quarter. According to the above research results, the PM10 concentration is closely related to the humidity and wind speed in meteorological conditions, and has a negative correlation. The meteorological data from the two monitoring sites of Pingshan and Frightened show that the humidity and wind speed are the highest in the second quarter. This is consistent with the quarterly variation of the PM10 concentration inversion results. In terms of spatial distribution, the first and third quarter changes of PM10 concentration distribution are basically consistent with the interannual variation.

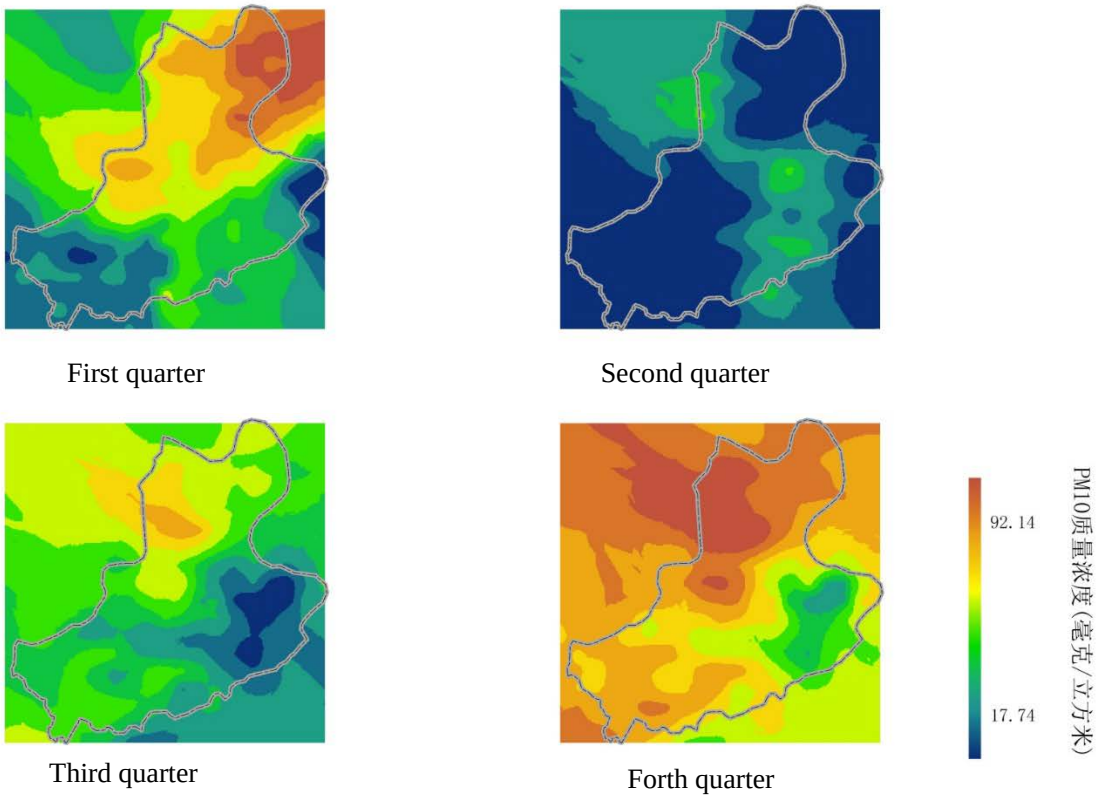


Fig. 6 Quarterly variation of PM_{10} concentration in Pingshan District from 2014 to 2015

IV. Conclusion

This paper introduces the remote sensing and measured atmospheric monitoring points and analysis in Pingshan District of Shenzhen City. the pollution distribution characteristics of PM10 in Pingshan District are basically consistent with the scope of the built-up area and the industrial pollution layout., the first and third quarter changes of PM10 concentration distribution are basically consistent with the interannual variation.

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