



The temporal and spatial distribution characteristics and influencing factors of tourist attractions in Chengdu-Chongqing economic circle

Gangmin Weng¹ · Hongyan Li¹ · Yan Li¹

Received: 8 November 2021 / Accepted: 28 April 2022 / Published online: 26 May 2022
© The Author(s) 2022

Abstract

Chengdu-Chongqing economic circle (hereinafter referred to as “Chengyu Region”) is a key construction region of China’s major development strategy. The development of regional tourism plays an important role in the optimization of regional economy and industrial structure. In this paper, ArcGIS 10.5 was used as the main analysis tool to analyze the temporal and spatial distribution of A-level tourist attractions in Chengyu Region, and makes factor analysis and interactive analysis on the factors affecting the distribution of tourist attractions by geographic detector model. The results show that: 1. The distribution of tourism attractions in Chengyu Region is mainly concentrated type, and the distribution of the natural landscape, cultural landscape, rural pastoral and modern entertainment in Chengyu Region are all concentrated type. 2. In terms of the distribution characteristics of kernel density, there is a significant deviation between the spatial distribution of A-level tourist attractions and tourism income in Chengyu Region. Through the analysis of the dynamic development of A-level tourist attractions in 2010, 2015 and 2021, tourism in Chengyu Region show a good situation of “driven by two cities and blooming in many places.” Among them, Chengdu and Chongqing have obvious advantages, and Yibin has become an important city second only to Chengdu and Chongqing. 3. In terms of spatial correlation, the spatial distribution of A-level tourist attractions in Chengyu Region has a significant spatial autocorrelation. The local spatial autocorrelation of A-level tourist attractions includes H–H (high-high), H–L (high-low) and L–H (low-high) clustering types. 4. In terms of influencing factors, traffic location, water system, topography and social and economic development level are the important factors affecting the spatial distribution of regional A-level tourist attractions. Among them, the level of social and economic development has the greatest impact on regional tourism. Finally, based on relevant theories, this paper puts forward countermeasures and suggestions for regional coordinated development, so as to guide the sustainable development and management innovation of regional tourism industry.

Keywords Chengdu-Chongqing economic circle · Tourist attractions · Spatial distribution · Sustainable development

✉ Hongyan Li
lihongyan@ysu.edu.cn

Extended author information available on the last page of the article

1 Introduction

In April 2016, the *Development Plan of Chengdu-Chongqing Urban Agglomeration* was officially approved. As the most economically and culturally developed region in western China, Chengdu-Chongqing urban agglomeration plays a "growth pole" and a practical and exploratory role in promoting the coordinated regional development of the whole country. In November 2018, the *Opinions of the Central Committee of the Communist Party of China and the State Council on Establishing a New Mechanism for More Effective Regional Coordinated Development* explicitly required that Chengdu and Chongqing be the center to lead the development of the Chengdu-Chongqing urban agglomeration and promote the integrated development of related sectors. In October 2020, the Political Bureau of the CPC Central Committee held a meeting to review the *Outline of the Plan for the Construction of Chengdu-Chongqing economic circle*, requiring Chengdu-Chongqing economic circle (hereinafter referred to as "Chengyu Region or region") to lead the construction of "Belt and Road," and actively participate in the double cycle of domestic and international economy. Whether in the development of the western region or in the Belt and Road Initiative, the Chengyu Region plays an important role with its special geographical location. As an important part of the national development strategy, the state has high hopes for the Chengyu Region. How to promote regional economic development and the integration of sectors requires cooperation and promotion between different urban areas, different departments and different industries in the region, and the tourism industry plays an important role. Chengyu Region is located in the western part of China, with a long history of development, strong cultural heritage, rich landscape resources and a broad tourism market. The development of tourism in the region is of great significance to the economic development and industrial structure optimization of Chengyu Region. As an important part of the tourism industry, tourist attractions are the basic material conditions for the development of regional tourism. The spatial structure of tourist attractions profoundly affects the development strategy of regional tourism and is the basis for directing the planning, development and management of regional tourism (Wang, 2008). In 1999, the China National Tourism Administration formulated "*Standard of rating for quality of tourist attractions*" as a quality certification system for tourist attractions. In 2003, the 1999 edition of "*Standard of rating for quality of tourist attractions*" was revised to form the current edition. The tourist attractions (hereinafter referred to as "A-level tourist attraction") in this standard refer to independently managed area with functions such as sightseeing, leisure and entertainment, as well as tourist facilities and services. The evaluation system was established in this standard to comprehensively evaluate the resource quality, development level and facilities of every attractions, and so on. Based on the evaluation results, the tourist attractions are classified into five levels: A, AA, AAA, AAAA and AAAAA (hereinafter referred to as "1A," "2A," "3A," "4A" and "5A"). If A tourist attraction is rated "5A," it means it has the most beautiful scenery, the best service and perfect facilities (National Tourism Administration, 2003). The spatial structure of tourist attractions in Chengyu Region has an important influence on whether the regional tourism industry can finally attain integrated development on the basis of cooperation. In order to achieve a long-term mechanism of overall planning and coordination of the regional tourism industry, the optimization of the spatial structure of regional tourist attractions is an important prerequisite (Zhang et al., 2021).

2 Literature review

The spatial pattern of tourist attractions reflects the relationship between the development of tourism and population (Wang et al., 2019), economy (Sun et al., 2021) and society (Stepchenkova & Park, 2021). Since the authentication system of A-level tourist attractions was launched in 1999, experts and scholars have conducted a lot of research on its certification standards (Hu et al., 2016), tourist attractions management (Ahn & Jeong, 2021), tourism development (Więckowski, 2021) and tourism attraction (Luo et al., 2021), and made many achievements. At present, most of the studies on spatial distribution of tourist attractions focus on few samples or small areas, or network analysis is performed using data from travel blogs, reviews or images on social media platforms (Sun et al., 2020; Shi et al., 2020; Jiang et al., 2021; G. S. Kim et al., 2021). In the past five years, the main research methods use neural network predictive model (Li, 2020) deep learning (Taecharunroj & Mathayomchan, 2019), gravity analysis (Zhang et al., 2022), cluster analysis (Duarte-Duarte et al., 2021), spatial measurement (Kim et al., 2022), social network analysis (Bustamante et al., 2019; Chung et al., 2020; Gan et al., 2021; Li & Weng, 2016) and so on. Besides, using the spatial distribution of tourist attractions, scholars also conducted the study of travel route recommendation (Castillo-Vizuete et al., 2021) and recommendation system construction (Abbasi-Moud et al., 2021). The spatial distribution of tourist attractions is mainly concentrated in aggregation and nonequilibrium (Zhang et al., 2020). Due to lack of research data or outdated data, some studies have lacked guidance and reference significance. In addition, the current economic situation and policy are complex and changeable, so relevant research should keep pace with the times.

This paper analyzes the spatial distribution of tourist attractions, and many studies are involved for the influence factors. Social and economic conditions, tourism resources, infrastructure construction, regional cultural influence, ecological environment carrying capacity, the tertiary industry development, tourism service level, life security system are the main driving factors affecting the tourism economy space differentiation (Usui et al., 2021). As the provincial capital city, Urumqi has the advantages in politics, economy, culture, transportation, geography and other aspects (Liu et al., 2022). On the macroscale, the cities with developed economy and mature tourism industry are more affected, but the impact difference in the scale is further expanded. On the microscale, cultural attractions or well-known attractions are much more affected than natural and religious attractions (Yang et al., 2021). Despite the importance of transportation for the shaping of tourism networks, the current research mainly focuses on urban daily travel behavior at the cost of tourism, which is regarded as a special behavior (Kirilenko et al., 2019; Qiu et al., 2021; Wang et al., 2021). Shi et al. (2020) think that the higher the glacier comprehensive potential index, the better the traffic conditions, the richer the glacial resources, the stronger the economic and social foundation, the closer the tourism market, the better the glacier area, and the richer the tourism resources. In this paper, the above research uses geographical detectors on the influence of landform characteristics, traffic, water system and county administrative center on the spatial distribution of tourist attractions, which mainly answers the question of the degree of influence and interaction.

Chengyu Region is an important part of China's major national development strategy in 2016, which plays a driving role in Belt and Road construction. As an important part of regional economic construction, the development of tourism can play important role. The development of A-level tourist attractions reflects the development and management level of regional tourism resources, and the level of tourist attractions directly reflects the

recognition of the government and tourists of the tourist attractions. To a certain extent, the distribution of A-level tourist attractions can reflect the development of regional tourism. Therefore, the number and spatial distribution characteristics of A tourist attractions largely reflect the spatial structure of regional tourism (Getis & Ord, 2010). This paper collects the coordinate point data and rating time of A-level tourist attractions in 2021, analyzes the spatial distribution of A-level tourist attractions and influencing factors using ArcGIS10.5 and Geodetector, and optimizes the spatial structure of the unbalanced and insufficient tourism development, so as to provide theoretical support and practical reference for the comprehensive, coordinated and sustainable development of tourism in other regions in China.

3 Materials and methods

3.1 Study area

Chengyu Region refers to parts of Chongqing and Sichuan Province, with a geographical range of 101°56' ~ 109°15'E, 27°40' ~ 32°19'N, includes 15 cities in Sichuan Province, 27 districts (counties) in Chongqing and parts of 2 districts (counties) in Chongqing, covering a total area of 185,000 square kilometers, making it the most economically and culturally developed region in the western region. In addition, it is worth emphasizing that the Chengyu Region is not the whole area of Sichuan and Chongqing. We can see that the fringe of the region is divided off from Fig. 1, because some areas are relatively backward. In 2019, the total GDP of Chengyu Region reached about 7200.457 billion yuan, accounting for 7.32% of the national total GDP. Among them, the total tourism revenue reached about 16,581.1, accounting for 23% of the total regional GDP. By 2010, there were 130 A-level tourist attractions in Chengyu Region, 332 A-level tourist attractions in 2015, and 689 A-level tourist attractions in 2021. As of 2021, 689 A-level tourist attractions in Chengyu Region comprise 13 graded 5A, 273 graded 4A, 286 graded 3A, 113 graded 2A grade and 4 graded 1A.

3.2 Data source

Chengyu Region mainly includes parts of Sichuan Province and Chongqing. The data of Sichuan Province come mainly from Sichuan Department of Culture and Tourism, the end data are obtained through April 30, 2021. The data of Chongqing tourist attractions come mainly from Chongqing Tourism and Cultural Development Commission, and the end date is September 12, 2020. As all the A-level tourist attractions only have address information, the coordinate data are obtained through the Google Earth address. The rating time of each tourist attraction was obtained from regional statistical yearbook, or by grabbing national official website and regional official website. The data of tourist revenue are obtained from tourism statistical yearbook (2010, 2015 and 2021) of Sichuan Province and Chongqing.

In addition, POI is a short form of point of interest, which stands for one point. POIs stand for all points. The tourist attractions, no matter their size, are abstracted into a single point. And the POI mentioned in the article refers to tourist attractions. Classification methods refer to the *Classification of Tourist Attraction* released by China Tourist Scenic Spot Association in December 2019. Large categories divide A-level tourist attractions into natural landscape, cultural landscape, rural landscape and modern entertainment landscape.

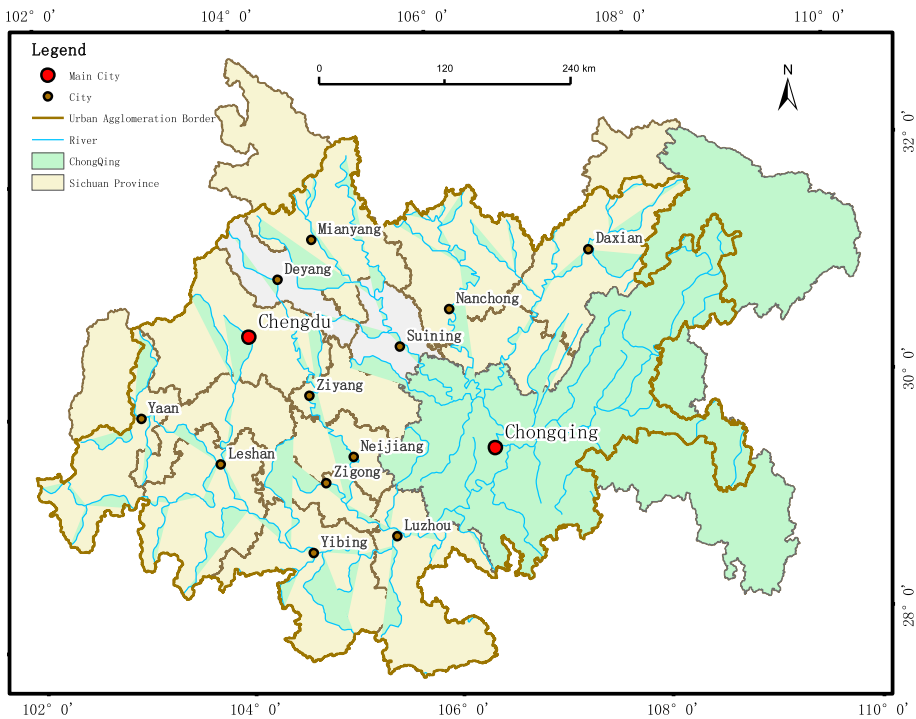


Fig. 1 Map of Chengyu Region

Vector data of administrative divisions, regional boundaries, rivers and roads are obtained from google Earth, and social and economic statistics are derived from the provincial and regional statistical Yearbook, statistical bulletin and relevant official websites.

4 Study methods

The research method mainly includes two aspects: The first is the analysis of the temporal and spatial distribution characteristics of A-level tourist attractions, including the kernel density analysis, nearest-neighbor distance analysis, spatial autocorrelation analysis and gravity center track analysis of A-level tourist attractions; the second is the analysis of the influencing factors of the spatial distribution of A-level tourist attractions, mainly using kernel density analysis and Geodetector.

4.1 Analysis of the kernel density

The kernel density analysis method is a spatial analysis method based on nonparametric density estimation that can further expand the information stored in the point elements into the plane, which is often used to detect local density changes in the dotlike sample distribution (Yu et al., 2015). The kernel density analysis method can clearly describe the spatial distribution

characteristics of tourist attractions in Chengyu Region and provide an intuitive reference for studying the overall layout of tourist attractions. The specific formula is as follows:

$$f(x) = \frac{1}{nh} \sum_{i=1}^n K \left(\frac{x - X_i}{h} \right) \quad (1)$$

In the formula, $f(x)$ is the kernel density value of the tourist attraction x to be evaluated, h is the search radius of point x and X_p is the tourist attraction within the search radius, $x - X_i$ is the relative distance from point x to X_i , K is the kernel density coefficient, n is the number of the tourist attractions, and the larger the value of $f(x)$, the higher the density of tourist attractions here.

4.2 Analysis of the nearest-neighbor distance

The POIs present a scattered distribution in the area. The nearest-neighbor distance is used to describe the proximity of point-like things in geographic space (Lin & Zheng, 2017). The research used the nearest-neighbor distance to measure the agglomeration trend of tourist attractions in Chengyu Region and distinguish the spatial distribution type of tourist attractions. The calculation formula is as follows:

$$R = \frac{\overline{r_1}}{r_E} \quad (2)$$

In the formula, R is the nearest-neighbor index, $\overline{r_1}$ is the theoretical average nearest-neighbor point distance of the POIs, and r_E is the actual average nearest-neighbor distance of the POIs. When $R = 1$, it means that the tourist attractions are distributed randomly; when $R < 1$, it means that the tourist attractions are concentration distribution; when $R > 1$, it means that the tourist attractions are in a uniform distribution.

4.3 Spatial autocorrelation

The global spatial autocorrelation refers to the statistical correlation of spatial attributes distributed in different spatial locations within the study area (Lv & Cao, 2010). In general, the global spatial autocorrelation is measured with the help of the global spatial autocorrelation (Moran's I) (formula 3), reflecting the distribution characteristics of the spatial study elements within the study area (Liu et al., 2016). The local spatial autocorrelation (formula 4) used to represent the spatial distribution and interaction of A-level tourist attractions in Chengyu Region in different research units. The calculation formula is as follows:

$$I = \frac{\sum_{i=1}^n \sum_{j=1}^n (X_i - \bar{X})(X_j - \bar{X})}{S^2 \sum_{i=1}^n \sum_{j=1}^n W_{ij}} \quad (3)$$

$$I_i = \frac{X_i - \bar{X}}{S^2} \sum_{j=1}^n W_{ij} (X_j - \bar{X}) \quad (4)$$

In the formula, X_i and X_j represent the number of tourist attractions, respectively, in space units i and j ; W_{ij} is the spatial weight matrix; n is the number of spatial units in the area; $S^2 = \frac{1}{n} \sum_{i=1}^n (X_i - \bar{X})^2$, $\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$

4.4 Analysis of gravity center track

The gravity center refers to the action point of the resultant force produced by the gravity of each part of the object. The gravity model has been widely applied in many fields such as economy, industry, population, usually used to compare the change of the distribution of gravity center of the same kind of space elements or the space distribution of gravity center of different types of the elements (Sun et al., 2008; Zhao et al., 2010); the formula is:

$$O(X, Y) = \left[\frac{\sum_{i=1}^n A_i x_i}{\sum_{i=1}^n A_i}, \frac{\sum_{i=1}^n A_i y_i}{\sum_{i=1}^n A_i} \right] \quad (5)$$

In the formula, (x_i, y_i) represent geographic coordinates of tourist attractions; $O(X, Y)$ represent geographic coordinates of the spatial distribution center of tourist attractions. Further measuring the direction of space movement of gravity center (Zhao et al., 2010), the formula is:

$$D_{i-j} = R \times \sqrt{(y_i - y_j)^2 + (x_i - x_j)^2} \quad (6)$$

In the formula, θ is angle of movement of gravity center: Due east is 0° ; $0^\circ \sim 90^\circ$ is northeast; $90^\circ \sim 180^\circ$ is northwest; $-90^\circ \sim 0^\circ$ is southeast; $-180^\circ \sim -90^\circ$ is southwest. The distance of space movement of gravity center (Zhong et al., 2014) is given in the formula as follows:

$$D_{i-j} = R \times \sqrt{(y_i - y_j)^2 + (x_i - x_j)^2} \quad (7)$$

4.5 Geodetector

The Geodetector was originally based on the geographical perspective proposed by Wang (Wang & Xu, 2017). This study used the Wang's Geodetector model for calculation (Wang et al., 2016). An algorithm is about detecting the spatial difference of the influence factors on the dependent variables (Hu et al., 2020; J. Yang et al., 2019). The formula is:

$$q = 1 - \frac{\sum_{h=1}^L N_h \sigma_h^2}{N \sigma^2} \quad (8)$$

where the q value represents the influence degree of each detection factor on the distribution of A-level tourist attractions in Chengyu Region. L represents the variable stratification, that is, classification or partition; N_h and N represent the number of units in layer h and the entire region, respectively. σ^2 refers variance.

5 Results and analysis

5.1 The classification of A-level tourist attractions

This study is divided according to the scientific attributes of tourism resources, divided into natural landscape, cultural landscape, rural countryside and modern entertainment. This article mainly refers to “*the classification of tourist attractions*” released by China Tourism Scenic Spot Association in November 2020 and draws lessons from the research results of Guo Laixi and Li Donghua (Guo et al., 2000; Li et al., 2020). The A-level tourist attractions are systematically classified in Chengdu and Chongqing region. In the analysis process, among the natural landscape of tourist attractions, 10 of tourist attractions are distributed by wetland type. At the same time, it is not easy to define whether it is lake or river type, and wetland type is added. Among 15 5A-level tourist attractions, in addition to Deng Xiaoping hometown, Zhu De hometown, the campus of Chongqing GuangYi middle school is memorial tourist attractions, Langzhong ancient city is Historic site tourist attractions, and others are either the combination of mountain, water and forest or the combination of mountain, water and religious. The landscape of high-level tourist attractions is complex and diverse, giving a person comprehensive three-dimensional feeling.

In addition, the most of hot spring tourist attractions are the same of resort; industrial, popular science and production scenic spots are very similar. It is worth mentioning that the rural pastoral category is a new the type of scenic area category added to the classification of tourist attractions, accounting for 23.95% of A-level tourist attractions in the region. Under the background of the country vigorously advocating all-for-one tourism and rural tourism, Chengdu-Chongqing economic circle is the region with the most densely populated, concentrated industries and the highest urban density in the western region, and it is also a demonstration area for the national implementation of new urbanization. (Table 1) For Chengyu Region with strong historical and cultural heritage and local ethnic characteristics, rural tourism has become the characteristics of regional tourism.

5.2 The type of spatial distribution of A-level tourist attractions

As shown in Table 2., the distribution ratio of A-level tourist attractions in Chengyu Region is mainly counted. Since the number of 1A tourist attractions is few, it was eliminated in the research process. Only the distribution of 5A, 4A, 3A and 2A tourist attractions is counted, accounting for the ratio of the corresponding column (the level of tourist attractions). From the table, we can see that natural landscape and cultural landscape account for a relatively high in high-level tourist attractions, and these two tourist attractions play an important role in China’s tourism resources. Rural pastoral category is the type of tourist attractions gradually developed in the development process of China’s tourism industry and plays an important role in rural tourism, and accounts for a relatively high ratio of 3A and 2A tourist attractions. In this paper, the analyze tool of the average nearest proximity index is used to calculate the nearest proximity index of tourist attractions with different categories in Chengyu Region. The results are shown in Table 2., which shows that the overall distribution type of tourist attractions in Chengyu Region is the clustering type, forming a spatial agglomeration with Chengdu and Chongqing as the core.

Table 1 The number of various types of A-level tourist attractions

Scenic area category	Scenic area type	Number (A)	Total (A)	Occupy (%)
Natural landscape	Mountain type	95	217	31.49%
	Forest type	30		
	Lake type	38		
	River type	25		
	Marine type	1		
	Prairie type	3		
	Hot spring type	15		
	Wetland type	10		
Cultural landscape	Historic site type	68	260	37.74%
	Religious type	23		
	Intangible cultural heritage type	14		
	Industrial type	12		
	Popular science type	5		
	Memorial ground type	55		
	Cultural garden type	50		
	Resort type	19		
	Town type	14		
	Village type	33		
Rural landscape	Agricultural landscape type	84	165	23.95%
	Production land type	45		
	Homestay type	3		
	Theme park type	20		
Modern entertainment landscape	Cultural performing type	1	47	6.82%
	Shopping entertainment type	2		
	Cultural venue type	17		
	Characteristic block type	7		
	Total		689	100%

5.3 The kernel density analysis of A-level tourist attractions

In order to obtain the spatial distribution of A-level tourist attractions in Chengyu Region more intuitively, this paper used ArcGIS10.5 kernel density analysis tool to analyze the kernel density of A-level tourist attractions in Chengyu Region and divided them into 9 categories according to the natural breakpoint method to obtain the kernel density maps of different landscape types in Chengyu Region (Fig. 2). Finally, the kernel density distribution of scenic spots in Chengdu-Chongqing region is obtained, with Chengdu and Chongqing as the important core and some areas as the secondary core.

As is seen from Fig. 2a, the highest density of A-level tourist attractions in Chengyu Region is concentrated in the two core areas of Chengdu and Chongqing, and Yibin has a good momentum of tourism development, becoming the deputy core area of the region. Compared with nuclear density of Fig. 2b(natural landscape), Fig. 2c(cultural landscape), Fig. 2d(rural pastoral landscape), Yibin is very important area in the three types of landscapes, plus its important geographical location (located at the junction of Yunnan, Guizhou, Sichuan, interchange of Jinsha River, Minjiang River and Yangtze River),

Table 2 Type of spatial distribution of tourist attractions

Category	5A	4A	3A	2A	Average observed distance	Predicted mean distance	R	Spatial distribution type
Natural land- scape	9	103	74	29	13479.13	17036.48	0.7912	Clustering type
Occupy (%)	69.23	37.73	25.87	25.66				
Cultural land- scape	4	119	103	34	10956.87	15404.66	0.7113	Clustering type
Occupy (%)	30.77	43.59	36.01	30.09				
Rural landscape	0	34	88	42	13742.37	19731.59	0.6965	Clustering type
Occupy (%)	0.00	12.45	30.77	37.17				
Modern entertainment landscape	0	17	21	8	20301.16	26462.96	0.7672	Clustering type
Occupy (%)	0.00	6.23	7.34	7.08				
Total	13	273	286	113	6463.79	10048.08	0.6433	Clustering type
Occupy (%)	1.89	39.62	41.51	16.40				

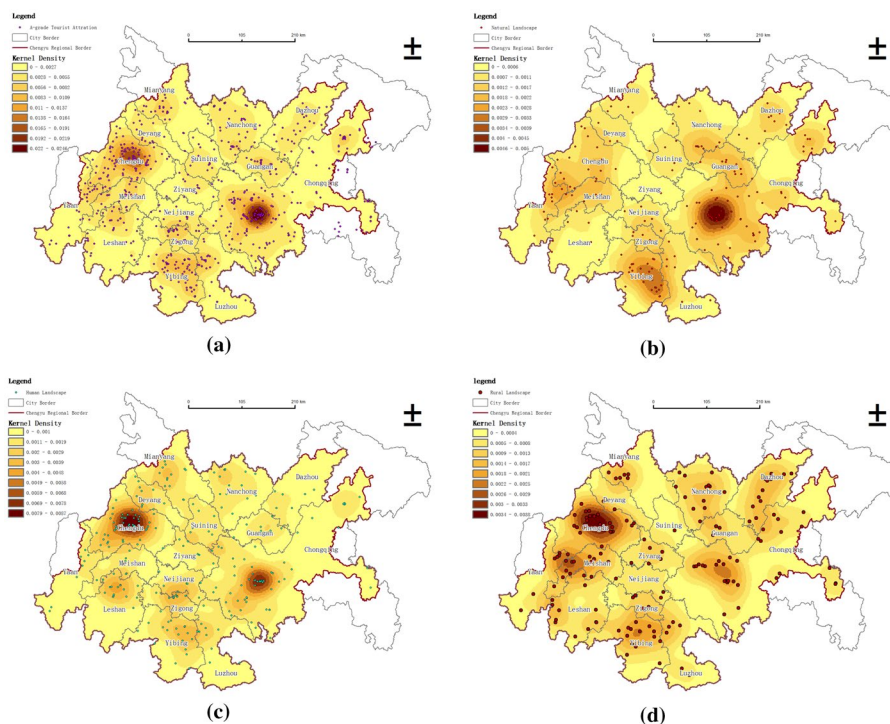


Fig. 2 The spatial kernel density analysis of various types of A-level tourist attractions

Table 3 The number of A-level tourist attractions in each statistical year

Statistical Year	5A	4A	3A	2A	1A	Total
2010	4	56	33	36	1	130
2015	11	156	97	66	2	332
2021	13	273	286	113	4	689

Yibin plays a important role in the development of tourism in Chengyu Region, Yibin, and Chengdu and Chongqing have formed a stable triangular structure as shown in Fig. 2b. Among the natural landscape tourist attractions, Chongqing, known for its "mountain city" and "fog capital," plus the important geographical location of the main stream of the Yangtze River, its natural landscape is in an absolute dominant position in the regional tourism industry. Figure 2c Chengdu-Chongqing cultural landscape, Chengdu and Chongqing are important cores. The south of Sichuan has advantage status of region, especially Leshan, Yibin, Zigong and Neijiang. Leshan is our country historical and cultural city, in the confluence of Dadu River, Qingyi River and Minjiang River, and famous Leshan Buddha is strong cultural heritage. Mianyang, Suining, Nanchong and Guang'an are located in the north of Chengyu Region. And the distribution of cultural landscape attractions in Chengyu Region is fully rolled out, and the development is relatively balanced. Among the rural pastoral scenic spots, Chengdu has become an absolute core city, with Ya'an, Leshan, Yibin, Chongqing downtown, Wanzhou district, Dazhou, Nanchong and Mianyang City forming a core arc.

5.4 Temporal and spatial evolution and kernel density analysis of a-level tourist attractions

In Table 3, and Fig. 3, the three statistical times, respectively, refer to the number of A-level tourist attractions by 2010, 2015 and 2021 in Chengyu Region.

The data of A-level tourist attractions in Chengyu Region in 2010, 2015 and 2021 are selected for kernel density analysis, which reveals the evolution law of spatial distribution kernel density of A-level tourist attractions in Chengyu Region. It can be seen from Fig. 3 that the spatial distribution kernel density of A-level tourist attractions in Chengyu Region has changed significantly. In 2010, two high-density areas in Chengyu Region were located in Chengdu and Chongqing, respectively, with obvious regional boundaries and relatively small spatial kernel density as a whole. In 2015, the high-density areas of A-level tourist attractions were still Chengdu and Chongqing, and the scope and density depth gradually expanded. The relatively high-density areas have changed, and the medium density areas located in Leshan, Yibin, Suining, Mianyang and Guang'an are growing. In 2021, two main core areas and multiple secondary core areas will be formed. The secondary core areas located in Leshan, Yibin, Suining, Mianyang and Guang'an are growing, forming an overall spatial layout of "one axis and multiple cores." The "one axis" is located on the connecting line between Chengdu and Chongqing, and the multiple cores are carried out around two main cores and one axis. It is worth noting that the development of Chongqing is in a strong position at the beginning and insufficient in the later stage.

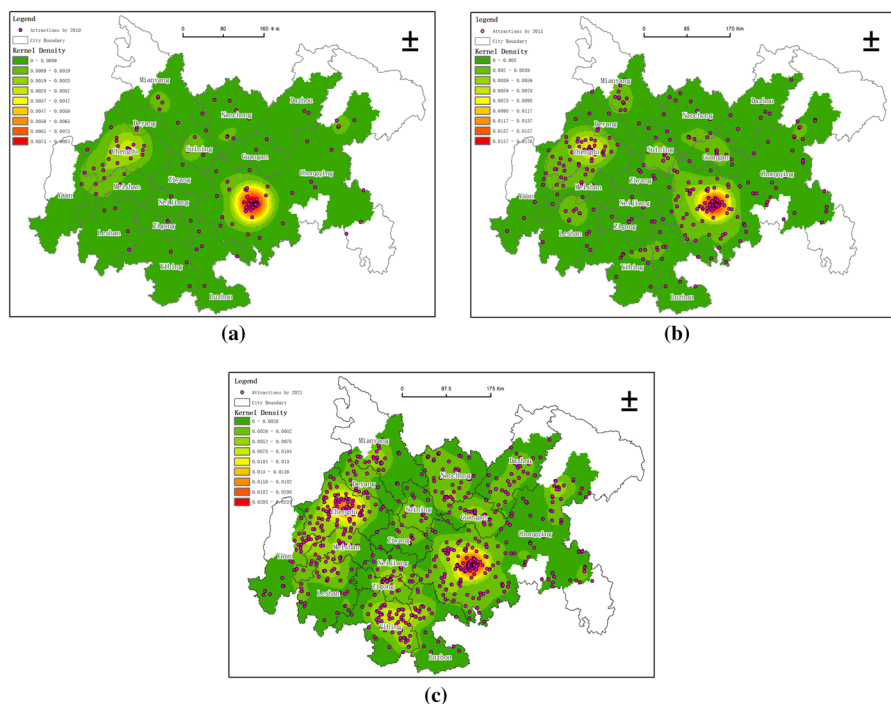


Fig. 3 The kernel density of A-level tourist attractions. **A** The kernel density of A-level tourist attractions in 2010. **B** The kernel density of A-level tourist attractions in 2015. **C** The kernel density of A-level tourist attractions in 2021

5.5 Comparative analysis of space–time movement of a-level tourist attractions and tourism revenue

5.5.1 Evolution of gravity center of A-level tourist attractions

According to the geographical coordinates of Chengyu Region, the tourism revenue of each city and the geographical coordinates of tourist attractions in 2010, 2015 and 2021, the geometric center of region, the gravity center of spatial distribution of A-level tourist attractions (hereinafter referred to as “gravity center of tourist attractions”) and the gravity center of tourism revenue, offset direction and offset distance are calculated, respectively, according to gravity center model of Eq. 5–7, as shown (Table 4.).

On the whole (Fig. 4), the gravity center of tourist attractions in Chengyu Region is inconsistent with that of tourism revenue. The gravity center of tourist attractions tends to shift from north to south and from east to west, and the gravity center of tourism revenue tends to shift from south to north, from east to west and then to east. The offset directions of the two are inconsistent, and the offset amplitude is small.

Compared with the geometric center, the gravity center of tourism revenue is west, and the gravity center of tourist attractions is southwest. The development of tourist attractions reflects the degree of regional investment in tourism construction. From the analysis, it can

Table 4 Gravity center of tourist attractions and tourism revenue in 2010, 2015 and 2021

Statistical Year	2010	2015	2021	
Gravity center of tourist attractions	Longitude	105.6583	105.6125	105.4656
	Latitude	30.0599	30.03304	30.01137
	Offset distance (m)		5323.7	14,371.1
	Offset direction		West by south 41°	West by south 14°
Gravity center of tourism revenue	Longitude	105.584813	105.584813	105.60685
	Latitude	30.193779	30.193779	30.203258
	Offset distance(m)		13,499.6	2367.1
	Offset direction		West by north 17°	East by north 27°

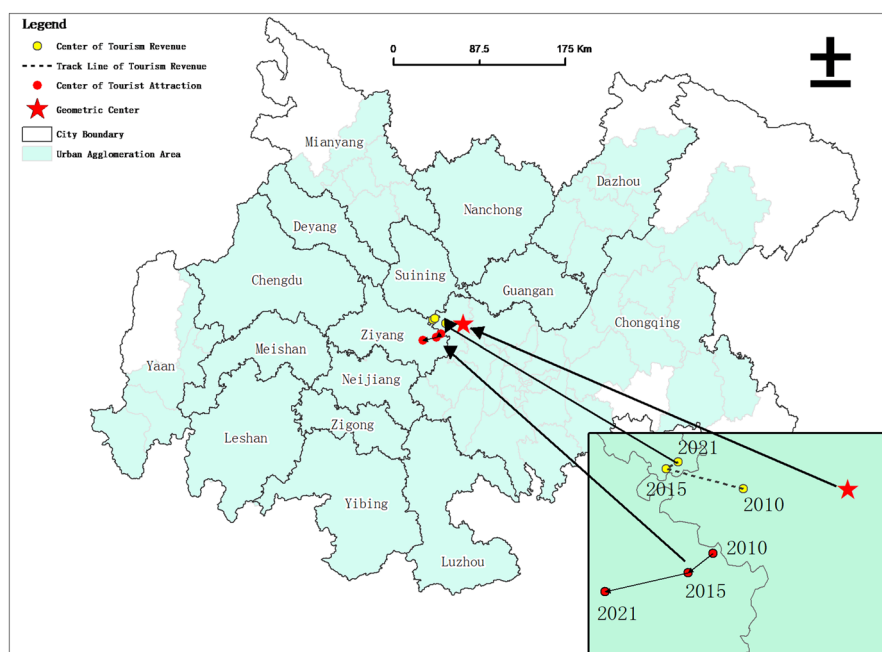


Fig. 4 Evolution track of gravity center of tourist attractions and tourism revenue

be seen that there is an obvious mismatch and inconsistent trend between input and output in Chengyu Region.

5.5.2 Spatial differentiation of gravity center

Through the evolution track and process change gravity center of tourist attractions in Chengyu Region (Fig. 4), it can be seen that the tourist attractions and tourism revenue have both similarities and obvious differences in space. The same points are mainly

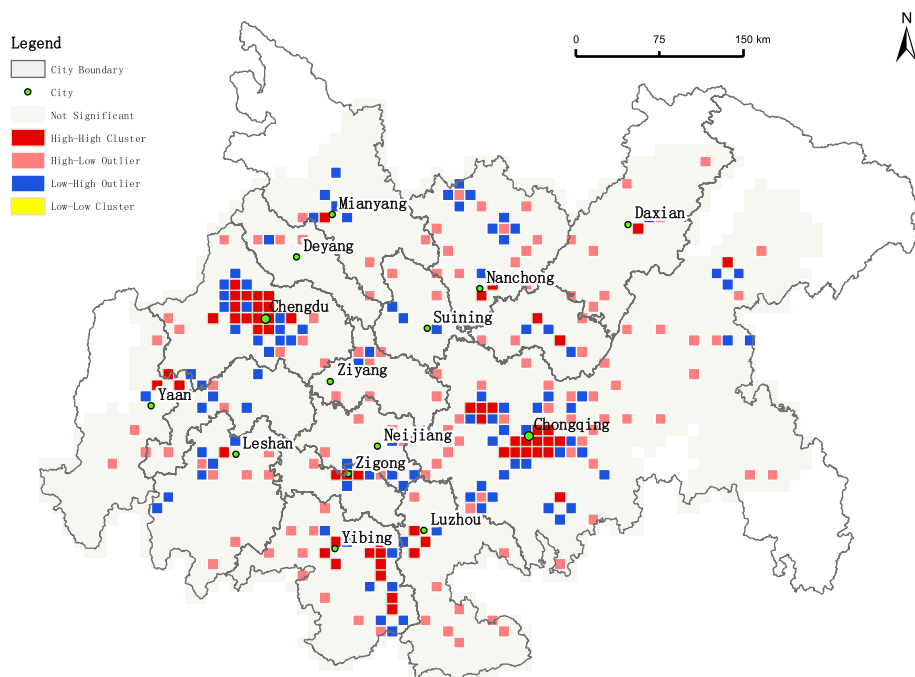


Fig. 5 The local Moran's I of A-level tourist attractions

reflected in: First, they always deviate from the geometric center and are always in the western part of the geometric center, which shows that the tourism construction in Chengyu Region is gradually developing to the West. At the same time, the benefits brought by tourism investment are also apparent in the western part; second, the horizontal migration speed is significantly faster than the vertical migration speed, indicating that the late development advantage of western tourism is obvious, which proves that the national policy has an obvious driving effect on the tourism development of Chengyu Region.

The differences are obvious, which are mainly reflected in: First, in terms of location, the gravity center of tourist attractions and the gravity center of tourism revenue in Chengyu Region are always in different positions, with tourism revenue developing towards the northwest and tourist attractions developing towards the southwest. The speed of change is also different. The development of tourism revenue first accelerates and then slows down, indicating that after 2010, with the improvement of people's living standards, people's tourism demand is also expanding rapidly. The change of tourist attractions first slow down and then accelerate, indicating that the construction of tourist attractions is in the stage of accelerated development. China's tourism industry has accelerated construction and achieved good development in the past decade.

5.6 Spatial autocorrelation analysis of tourist attractions in chengyu region in 2021

With the help of the fishing net creation tool under ArcGIS10.5 spatial analysis, a 10 km*10 km uniform grid with Chengyu Region is constructed, and each grid forms an

evaluation unit (Fig. 5). Use spatial autocorrelation tools to analyze the spatial correlation of geographical elements (Tourist Attractions in Chengyu Region in 2021). Moran's I is selected as the global indicator to show the global spatial distribution features of the region. The value range of Moran's I is $[-1, 1]$. When Moran's I is greater than 0, there is a positive spatial correlation. The closer the value is to 1, the more obvious the agglomeration in the spatial distribution of regions with higher or lower development levels of tourism urbanization. In contrast, when the value is closer to -1 , it indicates that the spatial difference in the development level of tourism urbanization between the city and the surrounding cities is large. When Moran's I is equal to 0, it means that there is no spatial autocorrelation (S. Zhang et al., 2019). By spatial autocorrelation analysis tool of ArcGIS10.5, the results show that the value of Moran's I is 0.238982 (Z -score = 15.596254, P -value = 0). The result indicates that the spatial distribution of A-level tourist attractions is obvious the agglomeration in Chengdu-Chongqing region. In general, the local spatial distribution of research objects is divided into four types: H-H (high-high), H-L (high-low), low L-L (low-low) and L-H (low-high). The significant local spatial autocorrelation of A-level tourist attractions in Chengdu-Chongqing region includes H-H (high-high), H-L (high-low) and L-H (low-high) (Fig. 3).

H-H type represents that both the development level of tourist attractions in a grid unit scenic area and tourist attractions in its surrounding grid are high, which shows the diffusion effect in the spatial correlation. In Chengdu-Chongqing region, H-H type areas are scattered in Dazhou district and Wanzhou district of Chongqing, Leshan, Mingshan district of Ya'an, Zigong, Luzhou, Nanchong, Fucheng district of Mianyang which have sporadic small area distribution. The districts of Jiangbei, Yuzhong, Nan'an, Jiulongpo, Dadukou of Chongqing, Chengdu, Yibin are contiguously distributed in a larger area. In these areas, the popularity and market share of scenic spots are high, which drives the development of surrounding areas and forms a good interaction. The distribution of the H-L area in Chengdu-Chongqing region is relatively scattered, accounting for a relatively high proportion which accounts for 43.42% of the significant local spatial autocorrelation areas. The H-L type indicates that the development level of the central tourist attractions is good, and the development level of the surrounding grid tourist attractions is weak, showing the effect of polarization in the spatial correlation. The L-H area belongs to the transition area in the spatial correlation. It can be seen from Fig. 3 that the H-H area in Chengdu-Chongqing region is mostly accompanied by L-H area around, which shows that the development of regional tourist attractions shows a rapid development momentum.

Overall, the spatial correlation of A-level tourist attractions in Chengdu-Chongqing region is mainly negative correlation, with H-L grid unit accounting for 43.42% of significant local spatial autocorrelation; L-H grid unit accounting for 35.23% of significant local spatial autocorrelation; and positive correlation type H-H accounting for 21.35% of significant local spatial autocorrelation.

Table 5 Detection results of the spatial evolution influencing factors of A-level tourist attractions

	X_1	X_2	X_3	X_4
q statistic	0.098	0.036	0.150	0.335
p value	0.000	0.000	0.000	0.000

6 Influencing factors of spatial distribution of a-level tourist attractions

Many scholars have discussed the influencing factors of the spatial distribution of tourist attractions in different regions. Referring to the existing research results and combined with the actual situation of the spatial distribution of tourist attractions in Chengyu Region, this study believes that topography (DEM), transportation (distance from the nearest traffic), water system (distance from the nearest water system) and socioeconomic development level (distance from the administrative center of county) have a significant impact on the spatial distribution of regional socioeconomic. In order to verify this conclusion, this paper analyzes the correlation between the spatial distribution of regional tourist attractions (Tourist Attractions in Chengyu Region in 2021) and DEM(X_1), water system (X_2), transportation (X_3) and socioeconomic development level (X_4).

6.1 Factor detection spatial distribution of A-level tourist attractions

It can be seen from Table 5. that the four driving factors selected in this paper have significant effects on the spatial distribution of tourist attractions (P value < 0.001), among which the factor of socioeconomic development level has the greatest impact on the spatial distribution of tourist attractions. The data we selected here are the geographical location of the administrative center of county in Chengyu Region, which is the political, economic, cultural and population center of the region. It shows that the current spatial distribution of tourist attractions is highly dependent on regional population and economy. The situation was built 20 years ago by relying on natural resources, and human endowment has fully stimulated people's innovation ability, optimized the industrial structure and opened a new situation for the development of tourism. The second is transportation. As an important factor affecting the development of tourism, transportation plays a great role in affecting the spatial distribution of tourist attractions and plays an important role in this study (Q value = 0.150). Landform and water system are also the key factors affecting the spatial distribution of A-level tourist attractions.

6.2 Interaction detection spatial distribution of a-level tourist attractions

Interaction detection identifies the interaction of different explanatory variables and evaluates whether the joint action of the two factors will increase or weaken the explanatory power of the dependent variable, or whether the influence of the factors on the dependent variable is independent of each other. Through interaction detection, the results are shown in Table 6. which shows that the interaction of any two variables on the spatial distribution of regional A-level tourist attractions is greater than the independent effect of one variable.

Table 6 Interaction detection of influencing factors of A-level tourist attractions

	X_1	X_2	X_3	X_4
X_1	0.098			
X_2	0.133	0.036		
X_3	0.219	0.181	0.150	
X_4	0.398	0.367	0.428	0.335

7 Conclusions and suggestions

7.1 Conclusions

On the whole, the distribution of A-level tourist attractions in Chengyu Region is mainly on the agglomeration type. It mainly takes Chengdu and Chongqing as the main core and Yibin city as the secondary core. Natural landscape tourist attractions are mainly distributed in the Yangtze River basin and area with higher elevation on the edge of region. The natural landscape, cultural landscape, rural landscape and modern entertainment in A-level tourist attractions in Chengyu Region all show agglomeration types.

In terms of kernel density characteristics, there are significant differences in kernel density distribution of A-level tourist attractions in Chengyu Region, and Chengdu and Chongqing have obvious advantages, which are both at the core of the kernel density analysis of tourist attractions classification. In terms of the development of A-level tourist attractions, Yibin has become the second most important city after Chengdu and Chongqing. The important geographical location and unique natural environment resources make Yibin an important core of the region. There is a significant deviation between the spatial distribution of A-level tourist attractions and tourism income in Chengyu Region. Through the analysis of the dynamic development of A-level tourist attractions in 2010, 2015 and 2021, tourism in Chengyu Region shows a good situation of "driven by two cities and blooming in many places." Among them, Chengdu and Chongqing have obvious advantages, and Yibin has become an important city second only to Chengdu and Chongqing.

In terms of spatial correlation, the spatial distribution of a-level tourist attractions in Chengdu-Chongqing Region has significant spatial autocorrelation. The local spatial autocorrelation of A-level tourist attractions in Chengdu-Chongqing Region is significant, including H-H (high-high), H-L (high-low) and L-H (low-high) clustering types. The positive spatial autocorrelation was only H-H (high-high) type, which was mainly distributed in Chengdu, Chongqing and Yibin, accounting for 21.35% of the local spatial autocorrelation significant areas. There are two types of negative spatial autocorrelation, which are H-L (high-low) and L-H (low-high). The distribution of negative spatial autocorrelation was scattered, accounting for 78.65% of the significant regions of local spatial autocorrelation.

Impact factors of the distribution of A-level tourist attractions in Chengdu-Chongqing region mainly include traffic, river system, topography and social and socioeconomic development level; tourism resources endowment is the important basis of development of A-level tourist attractions in Chengyu Region. The traffic location is an important factor affecting the development of A-level tourist attractions, and social and economic development level is the important metric of regional tourism development. In addition, due to the unavailability of data, the detection of influencing factors lacks the analysis of time dimension. More accurate and profound research can be carried out in the follow-up.

7.2 Theoretical and policy contribution

The huge economic impact of tourism has triggered a series of studies. However, previous studies usually only provide specific results (i.e., a narrow scope of sample region and the geographical location is inaccurate, which is limited by the geographical location of the tourist attractions and the availability of the rated years of tourist attractions). Therefore, in order to solve the problem of narrow geographical scope, this study selected 16 cities and related areas in Sichuan Province and Chongqing, assigned the rating time of each tourist attraction, and analyzed the time dimension. This paper analyzes the temporal and spatial distribution characteristics of tourist attractions, matches them with regional tourism income and reveals the deviation between investment and income distribution of tourist attraction. At the same time, the development autocorrelation of tourist attraction is analyzed by using Moran's I. This paper attempts to study the influencing factors of the spatial distribution of tourist attractions (social development level, transportation, water system and topography) by using geographic detector. The results show that the four influencing factors have a significant impact on the spatial distribution of tourist attractions, among which the social development level has the greatest impact. It can be seen that after the full developed of natural resources and historical and cultural resources, the future tourism development will focus on construction of social humanity tourist attractions.

In addition, the another purpose of this study is to provide empirical enlightenment for policy makers to seek the spatial layout of tourism development in a competitive environment and realize the coordinated and sustainable development of regional tourism. In addition to the suggestions given in the specific results, we also describe the practical guidance from a macroperspective. First, it implements the tourism strategy of high-quality and coordinated development. From the "dual-core and multi-center" model of the spatial structure of tourist attractions in Chengyu Region, it can be inferred that the central cities such as Leshan, Yibin and Guang'an have significantly weakened the agglomeration trend of the whole region, but there are still differences with Chongqing and Chengdu. Therefore, the formulation of regional tourism policies in the future should fully consider the spatial characteristics of unbalanced development, strengthen the thinking of "one game of chess," and strive to achieve regional multi objectives, such as inclusive development, differentiated development, and realize the comprehensive, coordinated and high-quality development of tourism in Chengyu Region. Secondly, it is imperative to speed up the development of tourism in the east and north of Chongqing. The results show that compared with the tourism core circle, the main urban area of Chongqing has developed rapidly. The early development is better than other urban areas in Chengyu Region. In the later construction, except Dazhou and Wanzhou, other areas are relatively weak. These areas further improve the supporting comprehensive urban and tourism infrastructure on the basis of consolidating and optimizing the existing advantages, and the optimization and upgrading of tourism products to gradually enhance the carrying capacity.

Secondly, as Sichuan and Chongqing belong to independent administrative divisions, they have received many constraints in the interconnection of tourism economic construction. The imbalance of tourism development in Chengdu-Chongqing Region is due to the boundary of administrative regions restricts. Breaking administrative barriers, strengthening regional integration adjustment and promoting regional coordinated development are the current problems to be solved in the region.

At present, Chengdu, Chongqing and the area between them have a good development; the same as the south of Chengdu-Chongqing Region is also developing in a good direction. In view of the development of regional tourism industry, it is necessary to focus on

the northern Chengdu-Chongqing area and the northeast corner of Chengdu-Chongqing Region (districts and counties under Chongqing). To build chengdu-Chongqing double-city economic circle, we should not only concentrate on the two ends, but also take the middle. While making Chongqing and Chengdu two "polar core cities" bigger and stronger, we also need several "central city points" to support and enhance coordinated regional development. It is suggested to focus on the development of rural tourism, in view of the regional characteristics, and the scenic spots of village type and production area type should be built.

Data availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest The authors declare that they have no conflicts of interest.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Abbasi-Moud, Z., Vahdat-Nejad, H., & Sadri, J. (2021). Tourism recommendation system based on semantic clustering and sentiment analysis. *Expert Systems with Applications*, 167, 114324. <https://doi.org/10.1016/j.eswa.2020.114324>
- Ahn, D., & Jeong, N. (2021). A Longitudinal study on tourist behavior to set the management direction of gwanghallu garden. *Journal of East Asian Landscape Studies* <https://doi.org/10.51549/JORAL.2021.15.3.021>.
- Bustamante, A., Sebastia, L., & Onaindia, E. (2019). Can tourist attractions boost other activities around? A data analysis through social networks. *Sensors*, 19(11), 2612. <https://doi.org/10.3390/s19112612>
- Castillo-Vizueté, D., Gavilanes-Montoya, A., Chávez-Velásquez, C., Benalcázar-Vergara, P., & Mes-tanza-Ramón, C. (2021). Design of nature tourism route in chimborazo wildlife reserve, ecuador. *International Journal of Environmental Research and Public Health*, 18(10), 5293. <https://doi.org/10.3390/ijerph18105293>
- Chung, M. G., Herzberger, A., Frank, K. A., & Liu, J. (2020). International tourism dynamics in a globalized world: a social network analysis approach. *Journal of Travel Research*, 59(3), 387–403. <https://doi.org/10.1177/0047287519844834>
- Duarte-Duarte, J. B., Talero-Sarmiento, L. H., & Rodríguez-Padilla, D. C. (2021). Methodological proposal for the identification of tourist routes in a particular region through clustering techniques. *Heliyon*, 7(4), e06655. <https://doi.org/10.1016/j.heliyon.2021.e06655>
- Gan, C., Voda, M., Wang, K., Chen, L., & Ye, J. (2021). Spatial network structure of the tourism economy in urban agglomeration: A social network analysis. *Journal of Hospitality and Tourism Management*, 47, 124–133. <https://doi.org/10.1016/j.jhtm.2021.03.009>
- Getis, A., & Ord, J. K. (2010). The Analysis of spatial association by use of distance statistics. In: L. Anselin & S. J. Rey (Eds.), *Perspectives on Spatial Data Analysis*. Springer https://doi.org/10.1007/978-3-642-01976-0_10.
- Guo, L. X., Wu, B. H., Liu, F., & Fan, Y. Z. (2000). Study on the tourist resources classification system and types evaluation in China. *Acta Geographica Sinica*, 03, 294–301.

- Hu, Y. N., Mei, L., & Chen, Y. (2016). Quality Assessment and spatial feature of portal websites in China's 5A rated tourism attraction. *scientia geographica Sinica*, 36 (04), 548 – 554. <https://doi.org/10.13249/j.cnki.sgs.2016.04.008>
- Hu, M., Xu, C., & Wang, J. (2020). Spatiotemporal analysis of men who have sex with men in mainland China: social app capture-recapture method. *JMIR MHealth and UHealth*, 8(1), e14800. <https://doi.org/10.2196/14800>
- Jiang, W., Xiong, Z., Su, Q., Long, Y., Song, X., & Sun, P. (2021). Using geotagged social media data to explore sentiment changes in tourist flow: a spatiotemporal analytical framework. *ISPRS International Journal of Geo-Information*, 10(3), 135. <https://doi.org/10.3390/ijgi10030135>
- Kim, G. S., Chun, J., Kim, Y., & Kim, C.-K. (2021). Coastal tourism spatial planning at the regional unit: identifying coastal tourism hotspots based on social media data. *ISPRS International Journal of Geo-Information*, 10(3), 167. <https://doi.org/10.3390/ijgi10030167>
- Kim, Y. R., Liu, A., Stienmetz, J., & Chen, Y. (2022). Visitor flow spillover effects on attraction demand: A spatial econometric model with multisource data. *Tourism Management*, 88, 104432. <https://doi.org/10.1016/j.tourman.2021.104432>
- Kirilenko, A. P., Stepchenkova, S. O., & Hernandez, J. M. (2019). Comparative clustering of destination attractions for different origin markets with network and spatial analyses of online reviews. *Tourism Management*, 72, 400–410. <https://doi.org/10.1016/j.tourman.2019.01.001>
- Li, D. H., Zhang, X. Y., Lu, L., Zhang, X., & Li, L. (2020). Spatial distribution characteristics and influencing factors of high-level scenic spots in the Yellow River Basin. *Economic Geography*, 40 (05), 70 – 80. <https://doi.org/10.15957/j.cnki.jjdl.2020.05.008>
- Li, L., & Weng, G. (2016). An integrated approach for spatial analysis of the coupling relationship between tourism footprint and environment in the Beijing-Tianjin-Hebei region of China. *Asia Pacific Journal of Tourism Research*, 21(11), 1198–1213. <https://doi.org/10.1080/10941665.2015.1130161>
- Li, X. (2020). Space-time distribution model of visitor flow in tourism culture construction via back propagation neural network model. *Personal and Ubiquitous Computing*, 24(2), 223–235. <https://doi.org/10.1007/s00779-019-01342-w>
- Lin, G. H., & Zheng, S. (2017). Research on distribution characteristic of tourism resource in Beijing-Tianjin-Hebei region based on poi big data. *Fujian Journal of Agricultural Sciences*, 32 (06), 676 – 684. <https://doi.org/10.19303/j.issn.1008-0384.2017.06.019>
- Liu, J., Wang, J., & Xi, Yi-Dan. (2016). The evaluation, pattern evolution and its influencing factors of the quality of tourism economic growth in China. *Business and management journal*, (08), 160–173. <https://doi.org/10.19616/j.cnki.bmj.2016.08.013>
- Liu, H., Hasan, M., Cui, D., Yan, J., & Sun, G. (2022). Evaluation of tourism competitiveness and mechanisms of spatial differentiation in Xinjiang. *China. PLOS ONE*, 17(2), e0263229. <https://doi.org/10.1371/journal.pone.0263229>
- Luo, Y., Zhang, X., Qin, Y., Yang, Z., & Liang, Y. (2021). Tourism attraction selection with sentiment analysis of online reviews based on probabilistic linguistic term sets and the IDOCRIW-COCOSO Model. *International Journal of Fuzzy Systems*, 23(1), 295–308. <https://doi.org/10.1007/s40815-020-00969-9>
- Lv, T., & Cao, Y. H. (2010). Construction of spatial autocorrelation method of spatial-temporal proximity and its application: Taking regional economic disparity in the Yangtze River Delta as a case study. *Geographical Research*, 29(02), 351–360.
- National Tourism Administration (2003). GB/T 17775–2003. General administration of quality supervision, inspection and quarantine of the People's Republic of China.
- Qiu, Y., Yin, J., Zhang, T., Du, Y., & Zhang, B. (2021). Spatiotemporal dynamic analysis of a-level scenic spots in Guizhou Province. *China. Isprs International Journal of Geo-Information*, 10(8), 568. <https://doi.org/10.3390/ijgi10080568>
- Shi, J., Xin, L., & Liu, Y. (2020). Simulation of tourists' spatiotemporal behaviour and result validation with social media data. *Transportation Planning and Technology*, 43(7), 698–716. <https://doi.org/10.1080/03081060.2020.1805544>
- Stepchenkova, S., & Park, H. (2021). Authenticity orientation as an attitude: Scale construction and validation. *Tourism Management*, 83, 104249. <https://doi.org/10.1016/j.tourman.2020.104249>
- Sun, G. N., Yang, R., & Yao, H. (2008). Study on the regional structure change of chinese inbound tourism based on the gravity model. *Journal of Arid Land Resources and Environment*, 07, 150–157.
- Sun, Y., Duru, O. A., Razzqa, A., & Dinca, M. S. (2021). The asymmetric effect eco-innovation and tourism towards carbon neutrality target in Turkey. *Journal of Environmental Management*, 299, 113653. <https://doi.org/10.1016/j.jenvman.2021.113653>
- Sun, Y., Shao, Y., & Chan, E. H. W. (2020). Co-visitation network in tourism-driven peri-urban area based on social media analytics: A case study in Shenzhen. *China. Landscape and Urban Planning*, 204, 103934. <https://doi.org/10.1016/j.landurbplan.2020.103934>

- Taecharungroj, V., & Mathayomchan, B. (2019). Analysing tripadvisor reviews of tourist attractions in Phuket, Thailand. *Tourism Management*, 75, 550–568. <https://doi.org/10.1016/j.tourman.2019.06.020>
- Usui, R., Funck, C., & Adewumi, I. B. (2021). Tourism and counterurbanization in a low-amenity peripheral Island: A longitudinal study at yakushima island in Kagoshima. *Japan. Sustainability*, 13(16), 8822. <https://doi.org/10.3390/su13168822>
- Wang, D. G. (2008). Spatial structure of tourism resources in the tourism region of Hulun Buir-Aershan. *Arid Land Geography*, 03, 456 – 463. <https://doi.org/10.13826/j.cnki.cn65-1103/x.2008.03.026>.
- Wang, F., Liu, Z., Shang, S., Qin, Y., & Wu, B. (2019). Vitality continuation or over-commercialization? Spatial structure characteristics of commercial services and population agglomeration in historic and cultural areas. *Tourism Economics*, 25(8), 1302–1326. <https://doi.org/10.1177/1354816619837129>
- Wang, J. F., & Xu, C. D. (2017). Geodetector: Principle and prospective. *Acta Geographica Sinica*, 72(01), 116–134.
- Wang, J.-F., Zhang, T.-L., & Fu, B.-J. (2016). A measure of spatial stratified heterogeneity. *Ecological Indicators*, 67, 250–256. <https://doi.org/10.1016/j.ecolind.2016.02.052>
- Wang, S. J., Xie, J., & Zhou, L. Y. (2020). China's glacier tourism: Potential evaluation and spatial planning. *Journal of Destination Marketing & Management*, 18, 100506. <https://doi.org/10.1016/j.jdmm.2020.100506>
- Wang, Y., Chen, H., & Wu, X. (2021). Spatial structure characteristics of tourist attraction cooperation networks in the yangtze river delta based on tourism flow. *Sustainability*, 13(21), 12036. <https://doi.org/10.3390/su132112036>
- Więckowski, M. (2021). How border tripoints offer opportunities for transboundary tourism development. *Tourism Geographies*, pp. 1–24. <https://doi.org/10.1080/14616688.2021.1878268>.
- Yang, J., Song, C., Yang, Y., Xu, C., Guo, F., & Xie, L. (2019). New method for landslide susceptibility mapping supported by spatial logistic regression and GeoDetector: A case study of Duwen Highway Basin, Sichuan Province, China. *Geomorphology*, 324, 62–71. <https://doi.org/10.1016/j.geomorph.2018.09.019>
- Yang, T. T., Ruan, W. Q., Zhang, S. N., & Li, Y. Q. (2021). The influence of the COVID-19 pandemic on tourism demand for destinations: An analysis of spatial heterogeneity from a multi-scale perspective. *Asia Pacific Journal of Tourism Research*, 26(7), 793–810. <https://doi.org/10.1080/10941665.2021.1919160>
- Yu, W. H., & Ai, T. H. (2015). Network Kernel Density Estimation for the Analysis of Facility POI Hot-spots. *Acta Geodaetica Et Cartographica Sinica*, 44(01), 82–90.
- Zhang, K., Su, X. L., Su, K. H., & Wang, Y. (2021). Research on spatial differentiation of tourism resources in Beijing, Tianjin and Hebei based on POI big data. *Areal Research and Development*, 40 (01), 103–108 + 114.
- Zhang, C., Weng, S., & Bao, J. (2020). The changes in the geographical patterns of China's tourism in 1978–2018: Characteristics and underlying factors. *Journal of Geographical Sciences*, 30(3), 487–507. <https://doi.org/10.1007/s11442-020-1739-2>
- Zhang, S., Zhong, L., Ju, H., & Wang, Y. (2019). Land border tourism resources in china: spatial patterns and tourism management. *Sustainability*, 11(1), 236. <https://doi.org/10.3390/su11010236>
- Zhang, Y., Li, X., & Robert, Cárdenas, D. A., & Liu, Y. (2022). Calculating theme parks' tourism demand and attractiveness energy: a reverse gravity model and particle swarm optimization. *Journal of Travel Research*, 61(2), 314–330. <https://doi.org/10.1177/0047287520977705>
- Zhao, X. F., Huang, X. J., Zhang, X. Y., Lu, R. C., & Li, H. (2010). Evolution of economic and COD, SO₂, TSP emission gravity centers in Jiangsu province. *Resources and Environment in the Yangtze Basin*, 19(03), 225–230.
- Zhong, J. T., Mi, W. B., Hou, J. W., Ma, Z. N., & Wu, X. Y. (2014). Regional differences and spatial pattern since reform and opening up in ningxia-based on the evolutionary character and the coupling relationship of gravity center of population, economic and grain. *Economic geography*, 34(05), 14–20+47. <https://doi.org/10.15957/j.cnki.jjdl.2014.05.005>.

Authors and Affiliations

Gangmin Weng¹ · Hongyan Li¹  · Yan Li¹

Gangmin Weng
shanhai@ysu.edu.cn

Yan Li
68113033@qq.com

¹ School of Economics and Management, Yanshan University,
Qinhuangdao City, Hebei Province 066004, China