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## Postprint: Spatial Distribution Pattern of Cultural Tourism in Xinjiang

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### Abstract

Cultural tourism space constitutes one of the significant research directions in contemporary culture-tourism integration studies. This research takes 2346 POI cultural tourism spatial points in Xinjiang as the study object, employs quantitative statistical analysis, and utilizes terrain elevation analysis, kernel density analysis, Thiessen polygon analysis, and standard deviational ellipse analysis within GIS spatial analysis software to visually reconstruct the spatial distribution pattern of cultural tourism in Xinjiang through graphical and textual visualization. The results indicate: (1) The spatial distribution of cultural tourism in Xinjiang adapts to natural geographical environmental characteristics, concentrating along riverbanks, valley zones, mountain vertical belts, and oasis buffer zones at desert edges. High kernel density areas exhibit distinct distribution features of macro-dispersion and micro-agglomeration, corridor patterns, clustered formations, and scattered distributions. (2) The spatial distribution demonstrates a north-dense, south-sparse pattern with east-west connectivity, wherein natural tourism space exerts a broader radiational influence range than humanistic tourism space. (3) Xinjiang's cultural tourism spaces are intrinsically connected; the interaction between humanistic tourism space and natural tourism space progressively transforms into resources, products, and imagery of cultural tourism space, with their mutual influence relationship gradually strengthening, thereby manifesting significant characteristics of inclusiveness, integration, and expansiveness. Based on these analytical results, optimization recommendations are proposed for the holistic, hierarchical, and diversified development research of Xinjiang's cultural tourism space.

## Full Text

### Spatial Distribution Pattern of Cultural Tourism in Xinjiang

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**Abstract:** Cultural tourism space represents a significant direction in contemporary research on culture-tourism integration. This study examines 2,346 cultural tourism point-of-interest (POI) locations in Xinjiang, employing quantitative statistical analysis and spatial analysis software to visualize the region's cultural tourism spatial distribution patterns through topographic elevation analysis, kernel density analysis, Tyson polygon analysis, and standard deviation ellipse analysis. The results reveal three key findings: (1) The spatial distribution of cultural tourism in Xinjiang adapts closely to natural geographic environmental characteristics, concentrating along riverbanks, valley zones, mountainous vertical belts, and oasis buffer zones at desert edges. High kernel density areas exhibit distinct patterns of large-scale dispersion with small-scale aggregation, ribbon-like connectivity, clustered blocks, and scattered distributions. (2) The distribution demonstrates a north-dense, south-sparse pattern with east-west connectivity, where natural tourism spaces exert broader radiational influence than humanistic tourism spaces. (3) Xinjiang's cultural tourism spaces form a continuous lineage, with interactions between humanistic and natural tourism spaces gradually transforming into resources, products, and images of cultural tourism space, thereby strengthening their interrelationships and demonstrating remarkable inclusiveness, integration, and expansiveness. Based on these findings, the paper proposes optimization strategies for holistic, hierarchical, and diversified development of Xinjiang's cultural tourism spaces.

**Keywords:** cultural tourism space; humanistic tourism; natural tourism; distribution pattern; Xinjiang

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## Introduction

Cultural tourism has emerged as a crucial tourism form and approach, serving as a key driver for high-quality tourism development across regions. By embedding unique local cultural meanings into tourism resources, projects, activities, and products, destinations not only enrich the soul and core of tourism but also enable culture to be more widely accepted, perceived, and experienced by visitors through tourism channels, facilities, and spaces. Research on cultural tourism space originated from “point-surface” integration studies and gradually extended to examine convergence between culture and tourism industries.

Scholars have explored relationship networks and integration pathways between culture and tourism from a “symbiosis” perspective, proposing theoretical frameworks for cultural tourism space that conceptualize it as a network of cultural-tourism relationships where people, society, and ecological environments interact.

Domestic research has concentrated on regions rich in cultural and tourism resources, examining spatial structures of historical-cultural towns, coastal tourism spatial models, spatial differentiation of cultural tourism resources, survival patterns of intangible cultural heritage through “touristification,” and theoretical systems of cultural tourism space from industry convergence perspectives. International scholarship has focused primarily on the relationship between destination image space and tourist perception space, emphasizing concrete spatial entities related to tourism’s six elements. However, theoretical foundations remain underdeveloped, with no comprehensive theoretical system yet established; most studies are case-specific with limited generalizability.

Xinjiang’s unique geographic location, diverse ethnic composition, long historical traditions, and varied cultural tourism resources make it an important research subject. Current studies focus on regional red cultural tourism branding strategies, spatial distribution characteristics of intangible cultural heritage, spatiotemporal differences in culture-tourism industry synergistic development, spatial structure optimization of reclamation tourism, and temporal-spatial distribution of cultural heritage resources along the Silk Road. Research on Xinjiang’s cultural tourism space is essential for understanding formation characteristics and influencing factors, as well as for comprehending regional natural and human environmental evolution. It represents a critical 议题 for promoting high-quality culture-tourism integration and sustainable economic, cultural, and social development in Xinjiang. Despite abundant resources and strong development momentum, Xinjiang’s tourism routes suffer from low cultural added value, and the development paths and images of cultural tourism spaces require clarification, constraining high-quality development. This study reveals distribution characteristics and influencing factors of cultural tourism spaces, facilitating deeper understanding of their formation mechanisms and evolutionary processes, and providing a foundation for constructing strategic development systems to advance multi-level, spatiotemporal, and three-dimensional culture-tourism integration.

## 1. Study Area Overview

Xinjiang is situated in the hinterland of the Eurasian continent, in the north-western border region of China. It is the provincial-level administrative region with the longest land border, most neighboring countries, and largest area in China. Its mid-latitude location deep inland with scarce precipitation, combined with the special “three mountains surrounding two basins” geomorphic pattern, has nurtured a unique human environment and created diverse cultural tourism resources. With rapid regional economic and social development and increasing

influence of relevant policies and planning, the interrelationships among cultural tourism spatial resources, products, and images have strengthened. Areas with relatively developed economies, multi-ethnic integration, and concentrated populations demonstrate more developed cultural tourism industries, optimized talent attraction, resource development, industrial development, urbanization, rural governance, and ecological construction, reflecting the developmental laws of the “human-land relationship regional system.”

**Note:** This map is produced based on the standard map downloaded from the Standard Map Service website of Xinjiang Uygur Autonomous Department of Natural Resources, with approval number Xinjiang S(2021)023. The base map boundaries are unmodified. The same applies below.

[Figure 1: see original paper] Schematic diagram of the study area

## 2. Data and Methods

**2.1 Data Sources** The cultural tourism space locations in this study were obtained from Amap using Python web crawler technology through keyword searches, yielding 2,346 data points for Xinjiang (including the Xinjiang Production and Construction Corps). Considering Xinjiang’s vast territory, ethnic integration, cultural diversity, and abundant resources, the data were screened to exclude spaces under renovation, construction, or unrelated to cultural tourism. Nested data were merged (e.g., scenic spots merged into scenic areas), resulting in 2,346 valid data points. Search keywords included: “temple, monastery, Taoist temple, church, ancient city, ruins, beacon tower, grotto (Thousand Buddha Caves), rock painting, ancient tomb, palace, historic site” for historically memorial spaces; “museum, folklore museum, memorial hall” for heritage-transmitting spaces; “park, square” for culturally transformative spaces (specifically urban parks); “tourist scenic area (spot), resort, ski area, agritainment, ethnic garden” for recreational spaces; and “scenic spot” for aesthetically pleasing spaces. Spatial names and information were referenced from Xinjiang’s scenic area names, park and square names, museum names, site names, and temple names at various levels. Digital elevation model (DEM) data with 30m resolution were obtained from the National Geographic Information Resources Directory Service System.

## 2.2 Research Methods

**2.2.1 Kernel Density Analysis** Kernel density analysis calculates the density of point features or elements within a study area, enabling visual representation of distribution characteristics through spatial positioning. This study employs kernel density analysis to visualize the distribution of Xinjiang’s cultural tourism spaces. The calculation formula is:

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

where  $h$  is the threshold (bandwidth);  $f(x)$  is the kernel density value at spatial point  $x$ ;  $n$  is the number of spatial points;  $x_i$  is the distance from spatial point  $x$  to  $x_i$ ; and  $k$  is the spatial weight function.

**2.2.2 Tyson Polygon Analysis** Tyson polygons partition space such that polygon areas vary with the spatial distribution of point sets. This method analyzes the spatial relationships among cultural tourism spaces by examining distances between sample points within adjacent polygons and their spatial distribution patterns. The calculation formula is:

$$C = \frac{R}{\bar{S}} = \frac{\sqrt{\frac{\sum_{i=1}^n (S_i - \bar{S})^2}{n}}}{\bar{S}}$$

where  $C$  is the coefficient of variation;  $R$  is the standard deviation of polygon areas;  $S_i$  is the area of the  $i$ -th polygon;  $\bar{S}$  is the mean polygon area; and  $n$  is the number of polygons. When points are uniformly distributed, Tyson polygon areas show low variability and  $C$  values are low. Conversely, when points are densely clustered, polygon areas show high variability and  $C$  values are high.

**2.2.3 Standard Deviation Ellipse Analysis** Standard deviation ellipse analysis is a classical method for studying spatial distribution directionality and trend characteristics. It displays the spatial dispersion of point sets through basic parameters of spatial distribution ellipses, quantitatively explaining centralization, dispersion, directionality, and spatial morphology from a global spatial perspective. This study uses standard deviation ellipse analysis to create spatial direction and trend characteristic maps for Xinjiang's cultural tourism space distribution. The calculation formulas are:

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}, \quad \bar{y} = \frac{\sum_{i=1}^n y_i}{n}$$

$$\theta = \arctan \left( \frac{\sum_{i=1}^n (\bar{x} - x_i)^2 - \sum_{i=1}^n (\bar{y} - y_i)^2 + \sqrt{(\sum_{i=1}^n (\bar{x} - x_i)^2 - \sum_{i=1}^n (\bar{y} - y_i)^2)^2 + 4(\sum_{i=1}^n (\bar{x} - x_i)(\bar{y} - y_i))}}{2 \sum_{i=1}^n (\bar{x} - x_i)(\bar{y} - y_i)} \right)$$

$$\sigma_x = \sqrt{\frac{\sum_{i=1}^n ((x_i - \bar{x}) \cos \theta - (y_i - \bar{y}) \sin \theta)^2}{n}}$$

$$\sigma_y = \sqrt{\frac{\sum_{i=1}^n ((x_i - \bar{x}) \sin \theta + (y_i - \bar{y}) \cos \theta)^2}{n}}$$

where  $(x_i, y_i)$  are the coordinates of research element point  $i$ ;  $\theta$  is the rotation azimuth angle;  $n$  is the total number of research element points;  $\sigma_x$  and  $\sigma_y$  are the standard deviations along the x-axis and y-axis respectively; and  $\theta$  represents the rotation azimuth of the distribution pattern. The center point  $(\bar{x}, \bar{y})$  represents the centroid of the cultural tourism space distribution. The rotation azimuth angle indicates the main trend direction, while the standard deviation along the major axis reflects the dispersion degree along the main trend. The long axis direction represents where cultural tourism spaces are more concentrated, the short axis direction represents where they are sparse, and greater flatness indicates stronger directionality and more concentrated distribution along the long axis.

Classification statistics of spatial characteristics of cultural tourism in Xinjiang

Main spatial search keywords	Spatial characteristics
Temples, monasteries, Taoist temples, churches, ancient cities, ruins, beacon towers, grottoes (Thousand Buddha Caves), rock paintings, ancient tombs, palaces, historic sites	Historical memorial
Museums, folklore museums, memorial halls, art galleries, cultural centers	Heritage transmission
Parks (urban), squares	Cultural transformation
Tourist scenic areas (spots), resorts, ski areas, agritainment, ethnic gardens	Recreational entertainment
Scenic spots	Aesthetic pleasure

### 3. Results and Analysis

#### 3.1 Classification and Quantitative Distribution Characteristics

**3.1.1 Classification of Xinjiang's Cultural Tourism Spaces** Cultural tourism space elements are closely interrelated, with many spaces sharing both cultural and tourism characteristics. Classification primarily follows spatial formation time and resource representation. For instance, religious temples, urban parks, squares, museums, and ancient cities are humanistic tourism spaces that also preserve historical culture through long-term accumulation and inheritance, serving as important carriers of local historical memory and cultural continuity. According to spatiotemporal evolution attributes, these are classified as humanistic tourism-based spaces. Additionally, scenic spots, resorts, bazaars, forest parks, and ski areas also carry regional characteristics and inherit local culture,

but are classified as natural tourism-based spaces due to their primary function in tourism services. Accordingly, this study categorizes Xinjiang's cultural tourism spaces into humanistic tourism spaces and natural tourism spaces. Analysis of the Python-acquired data (including the Corps) reveals 1,048 humanistic tourism spaces and 1,298 natural tourism spaces.

**3.1.2 Quantitative Distribution Characteristics** From an administrative perspective, significant variation exists in cultural tourism space distribution across Xinjiang's prefectures, cities, and the Production and Construction Corps. The proportion of cultural tourism spaces from highest to lowest is: Urumqi City (18.03%), Ili Kazakh Autonomous Prefecture (10.53%), Bayingolin Mongol Autonomous Prefecture (9.93%), Kashgar Prefecture (8.82%), Tacheng Prefecture (7.97%), Altay Prefecture (6.91%), Xinjiang Production and Construction Corps (6.95%), Aksu Prefecture (6.91%), Turpan City (5.63%), Hami City (5.12%), Hotan Prefecture (4.65%), Karamay City (3.92%), Kizilsu Kirghiz Autonomous Prefecture (3.45%), Bortala Mongol Autonomous Prefecture (3.28%), and Changji Hui Autonomous Prefecture (1.96%). This distribution is significantly influenced by regional cultural tourism market development status, tourism resource endowment conditions, and economic radiation from administrative centers.

From a spatial type perspective, notable imbalance characterizes the distribution across regions, cities, autonomous prefectures, and the Production and Construction Corps. Urumqi City and the Xinjiang Production and Construction Corps have more natural tourism spaces than humanistic tourism spaces. Ili Kazakh Autonomous Prefecture, Bayingolin Mongol Autonomous Prefecture, Tacheng Prefecture, Altay Prefecture, Kizilsu Kirghiz Autonomous Prefecture, Turpan City, and Hami City have significantly more humanistic tourism spaces. Karamay City, Bortala Mongol Autonomous Prefecture, Changji Hui Autonomous Prefecture, Aksu Prefecture, Kashgar Prefecture, and Hotan Prefecture have relatively balanced numbers of both space types.

Spatial classification statistics of cultural tourism in Xinjiang

Category	Main spatial keywords	Quantity
Humanistic tourism space	Historical-cultural: temples, monasteries, Taoist temples, ruins, beacon towers, grottoes (Thousand Buddha Caves), ancient cities, palaces, ancient tombs, rock paintings, historic sites, art galleries, cultural centers, museums, folklore museums, memorial halls, parks (urban), squares	1,048

Category	Main spatial keywords	Quantity
Natural tourism space	Tourism-geographic: scenic areas (spots), scenic spots, resorts, forest parks, ecological parks, bazaars, ski areas, agritainment, ethnic gardens	1,298

[Figure 2: see original paper] Proportion of cultural tourism space in each region of Xinjiang

[Figure 3: see original paper] Quantitative distribution of cultural tourism space in each region of Xinjiang

### 3.2 Spatial Distribution Characteristics

**3.2.1 Humanistic Tourism Space Characteristics** Kernel density analysis of humanistic tourism spaces (Fig. 4) and Tyson polygon analysis (Fig. 5) show that high kernel density areas coincide with high Tyson polygon coefficient of variation areas. Humanistic tourism spaces primarily distribute along water systems in low-elevation valleys and oasis zones, closely proportional to transportation infrastructure density—more spaces appear where transportation networks are denser, with highest kernel densities at transportation hubs, indicating superior geographic locations and abundant natural resources. This “kernel density” level correlates significantly with regional human activity systems.

First, the northern Xinjiang radiation area centered on Urumqi shows significantly higher kernel density values than other regions, with small Tyson polygon areas, high quantities, and high coefficient values, forming the core dense area of humanistic tourism spaces, including Changji Hui Autonomous Prefecture, Tacheng Prefecture, Ili Kazakh Autonomous Prefecture, and Altay Prefecture. Second, the core area extends southward with block-like characteristics in Bayingolin Mongol Autonomous Prefecture, Aksu City, Kashgar City, and Hotan City. Other areas like Hami City and Turpan City show scattered distributions. The distribution pattern is significantly influenced by regional historical population and economy, relying on sound infrastructure and concentrated consumer groups in historically rich and economically active areas such as Urumqi, Ili Kazakh Autonomous Prefecture, Kashgar Prefecture, and Bayingolin Mongol Autonomous Prefecture. Overall, northern Xinjiang shows relatively fewer but more densely dispersed spaces, while southern Xinjiang shows more numerous but widely dispersed spaces. Higher variation coefficients in northern Xinjiang indicate smaller influence radii, closer interrelationships, and more concentrated related services, with the opposite pattern in southern Xinjiang.

The flatness rate of the standard deviation ellipse for humanistic tourism spaces indicates directionality and centripetal force. The ellipse area ratio between hu-

manistic tourism space and overall cultural tourism space is 51.109:55.510, suggesting an aggregation trend with consistent northeast-southwest orientation. The rotation angle for humanistic tourism space is  $69.603^\circ$ , closely matching the  $69.046^\circ$  for overall cultural tourism space, demonstrating the crucial role of humanistic tourism spaces in Xinjiang's cultural tourism development. The long axis ratio is 6.461:6.833 and short axis ratio is 2.518:2.670, indicating that humanistic tourism spaces are more concentrated than natural tourism spaces. The centroid of humanistic tourism spaces ( $84.955^\circ\text{E}$ ,  $43.022^\circ\text{N}$ ) is very close to that of overall cultural tourism spaces ( $84.930^\circ\text{E}$ ,  $43.044^\circ\text{N}$ ), with minimal offset near Urumqi. This high congruence reflects that humanistic tourism spaces develop according to cultural, economic, and social demands, forming a north-high-south-low, east-dense-west-sparse pattern.

[Figure 4: see original paper] Distribution and kernel density analysis of humanistic tourism space in Xinjiang

[Figure 5: see original paper] Tyson polygon analysis of humanistic tourism space in Xinjiang

[Figure 6: see original paper] Elliptical analysis of spatial standard deviation of humanistic tourism space in Xinjiang

Comparative analysis of standard deviation ellipse parameters between humanistic tourism space and cultural tourism space in Xinjiang

Parameter	Humanistic tourism space	Cultural tourism space
Centroid	$84.955^\circ\text{E}$ , $43.022^\circ\text{N}$	$84.930^\circ\text{E}$ , $43.044^\circ\text{N}$

**3.2.2 Natural Tourism Space Characteristics** Natural tourism spaces primarily distribute along water systems and mountains in low-elevation valleys, canyons, Tarim Basin oasis corridors, and vertical natural landscape belts of the Tianshan, Altai, and Kunlun Mountains. They scatter abundantly as tourist scenic areas, scenic spots, resorts, and ecological parks based on unique natural geography, ecological environments, economic culture, and tourism resources. Distribution is more dispersed than humanistic tourism spaces, with lower dependence on economy and public services, closely related to Xinjiang's "large dispersion, small aggregation" tourism resource distribution characteristics.

Kernel density analysis (Fig. 7) and Tyson polygon analysis (Fig. 8) reveal that high kernel density areas coincide with high coefficient of variation areas, showing "multi-core, multi-center, multi-point" characteristics that indicate richness, integration, and expansiveness of tourism resources. These spaces show weaker dependence on infrastructure and public services, with stronger correlations to geographic environment, natural resources, and ethnic customs. Highest kernel densities appear in areas with superior natural geography, distinctive ethnic features, and active socioeconomies. The northern Xinjiang "multi-core, multi-center" belt-shaped distribution shows significantly higher kernel density values,

with small Tyson polygon areas, high quantities, and high coefficient values, forming core dense areas including Tianshan Tianchi, Turpan Grape Valley, Ili Naraty, and Kanas. Southern Xinjiang shows “multi-point” block patterns such as Kashgar Ancient City, Bayinbuluke, Puzhejin Poplar Forest, and Bosten Lake 5A-level scenic areas.

The flatness rate of the standard deviation ellipse indicates that natural tourism spaces show a diffusion trend, with an ellipse area ratio of 61.547:55.510 compared to overall cultural tourism spaces. Both orientations are northeast-southwest, with rotation angles of  $68.319^\circ$  for natural tourism spaces and  $69.046^\circ$  for overall cultural tourism spaces, confirming their important role. The long axis ratio is 6.833:6.461 and short axis ratio is 2.867:2.670, indicating greater dispersion of natural tourism spaces. The centroid of natural tourism spaces ( $84.896^\circ\text{E}$ ,  $43.076^\circ\text{N}$ ) shows greater offset from the overall cultural tourism centroid ( $84.930^\circ\text{E}$ ,  $43.044^\circ\text{N}$ ) than humanistic tourism spaces, reflecting broader spatial radiation and influence due to rich tourism resources and active markets.

[Figure 7: see original paper] Distribution and kernel density analysis of natural tourism space in Xinjiang

[Figure 8: see original paper] Tyson polygon analysis of natural tourism space in Xinjiang

[Figure 9: see original paper] Elliptical analysis of spatial standard deviation of natural tourism space in Xinjiang

Comparative analysis of standard deviation ellipse parameters between natural tourism space and cultural tourism space in Xinjiang

Parameter	Natural tourism space	Cultural tourism space
Centroid	$84.896^\circ\text{E}$ , $43.076^\circ\text{N}$	$84.930^\circ\text{E}$ , $43.044^\circ\text{N}$

**3.2.3 Overall Cultural Tourism Space Characteristics** The distribution of Xinjiang’s cultural tourism spaces closely conforms to the region’s “three mountains surrounding two basins” topographic pattern, concentrating in valleys and oasis edges with greater concentration in northern than southern Xinjiang. The pattern shows large-scale dispersion coexisting with small-scale aggregation, with southern Xinjiang displaying obvious ribbon-like distribution along Tarim Basin oasis edges. Both northern and southern Xinjiang’s relatively concentrated areas prominently follow transportation routes and water systems, conforming to regional human-land relationship system patterns. Influencing factors reflect both “human” will mapping and the dual orientation of spiritual and material aspects. More active populations, cultures, and economies correspond to more developed cultural tourism spaces. Transportation elements guarantee point-line-area connectivity for these spaces, indicating that infrastructure

development remains a major practical constraint, particularly for southern Xinjiang regions with poor transportation accessibility where overall advantages of cultural tourism resources are difficult to fully realize.

The ellipse area ratio between humanistic tourism space (51.109) and natural tourism space (61.547) shows natural tourism spaces' obvious diffusion trend, completely surrounding humanistic tourism spaces, both oriented northeast-southwest. The rotation angles of  $69.603^\circ$  for humanistic and  $68.319^\circ$  for natural tourism spaces are basically consistent, indicating both play important roles. The long axis ratio of 6.461:6.833 and short axis ratio of 2.518:2.867 show natural tourism spaces' greater dispersion. The different centroid positions ( $84.955^\circ\text{E}$ ,  $43.022^\circ\text{N}$  for humanistic vs.  $84.896^\circ\text{E}$ ,  $43.076^\circ\text{N}$  for natural) reflect differences in historical culture, ethnic customs, tourism development conditions, and exploitation levels.

[Figure 10: see original paper] Distribution and kernel density distribution of cultural tourism space in Xinjiang

[Figure 11: see original paper] Elliptical analysis of spatial standard deviation of cultural tourism space in Xinjiang

Comparative analysis of standard deviation ellipse parameters between humanistic tourism space and natural tourism space in Xinjiang

Parameter	Humanistic tourism space	Natural tourism space
Centroid	$84.955^\circ\text{E}$ , $43.022^\circ\text{N}$	$84.896^\circ\text{E}$ , $43.076^\circ\text{N}$

## 4. Conclusions and Recommendations

### 4.1 Conclusions

- (1) Xinjiang's cultural tourism space distribution demonstrates strong adaptation to natural geographic environmental characteristics, concentrating along riverbanks, valley zones, mountainous vertical belts, and oasis corridor buffer zones at Tarim Basin desert edges. High kernel density areas exhibit distinct patterns of large-scale dispersion with small-scale aggregation, ribbon connectivity, clustered blocks, and scattered distributions, closely related to administrative evolution and ancient Silk Road development factors beyond natural environment alone.
- (2) The distribution shows relative imbalance with north-dense, south-sparse, east-west connectivity characteristics, where natural tourism spaces exert broader radiational influence than humanistic tourism spaces. Economic construction, transportation facilities, climate environment, and development status contribute to more humanistic tourism spaces in northern Xinjiang and 交错 distribution of both space types in southern Xinjiang with strong interdependence.

- (3) Xinjiang's cultural tourism spaces form a continuous lineage, with interactions between natural and humanistic tourism spaces gradually transforming into cultural tourism resources, products, and images, strengthening their interrelationships and demonstrating remarkable inclusiveness, integration, and expansiveness.

## 4.2 Recommendations

- (1) **Promote holistic development of cultural tourism spaces.** Integrating culture and tourism to create uniquely charming cultural tourism experiences has become a new requirement for tourism development in the new era. Xinjiang's cultural tourism spaces show scattered ribbon and block distributions with overall north-dense, south-sparse, east-west connectivity patterns. Southern Xinjiang possesses rich humanistic tourism resources, yet tourism cultural symbols in both northern and southern Xinjiang have not formed commercial value, remaining in a naive natural-humanistic cognitive state lacking stronger driving forces for human-land harmony. This results in insufficient north-south integration and attraction, often leading to northward-only travel patterns. Therefore, forming an effectively connected, normalized holistic tourism system with differentiation and standardization is essential for substantive resource development in southern Xinjiang and spatial optimization. This can rely on the deep transformation of "origin-based" tourism employment models, adapting to local conditions through industrial-commercial transformation and expanded exploration to broaden tourism subjects and stimulate regional resonant development.
- (2) **Deepen hierarchical optimization of cultural tourism spaces.** The relative imbalance in Xinjiang's cultural tourism space type distribution—with more natural tourism spaces in northern Xinjiang and 交错 distribution in southern Xinjiang—stems from insufficient economic development and tourism exploration. Therefore, optimization research is urgently needed. First, focus on foundational construction through government guidance, industry planning, local characteristic development, regular maintenance and updating, natural landscape development, and cultural symbol connotation building. Second, ensure service construction by enriching and standardizing public service facilities, content, and systems along routes through joint investment from government, banks, and society. Finally, deepen cultural space construction by transforming natural and humanistic elements: ribbon patterns should integrate natural-humanistic spaces, block patterns should form specific natural or humanistic spaces, and physical spaces should be rationally positioned while cultural spaces highlight regional ethnic characteristics based on the consciousness of the Chinese national community to create commercial value, promote people-land harmony, and achieve sustainable development.
- (3) **Enrich diversified research on cultural tourism spaces.** POI data

effectively reflects Xinjiang's cultural tourism spatial distribution patterns and characteristics, providing important reference for future route design and high-quality integrated development. However, this study primarily analyzed resource types, quantities, and spatial distribution patterns without comprehensively examining spatiotemporal evolution, structure, scale, and other multi-angle, multi-level systematic factors. Future research should continue diversified investigations to form an effective industry-academia-research circulation system.

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