Spatiotemporal Characteristics Analysis of Tourism Climate Comfort in Xinjiang's Prefecture-Level Cities and Prefectures over the Past 30 Years: Postprint

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Abstract

Based on detailed climatic observation data collected from 105 national meteorological observation stations in Xinjiang during 1990–2020, this study employed three key indicators—the Temperature-Humidity Index (THI), Wind Chill Index (WCI), and Clothing Index (ICL)—to conduct a systematic evaluation and scientific analysis of tourism climate comfort and comfort periods across 15 prefecture-level cities and autonomous prefectures in Xinjiang. The results indicate: (1) The months with the highest tourism climate comfort throughout the year in Xinjiang are primarily concentrated in May–June and September. (2) According to the comprehensive tourism climate comfort index, the intra-annual variation of tourism climate comfort in Hami City, Altay Prefecture, Bortala Mongol Autonomous Prefecture, counties and cities directly under Ili Kazakh Autonomous Prefecture, and Kizilsu Kirghiz Autonomous Prefecture exhibits an inverted U-shaped pattern, whereas that in Urumqi City, Karamay City, Shihezi City, Turpan City, Changji Hui Autonomous Prefecture, Bayingolin Mongol Autonomous Prefecture, Tacheng Prefecture, Aksu Prefecture, Kashgar Prefecture, and Hotan Prefecture displays an M-shaped pattern. (3) Analysis of tourism comfort periods reveals that southern Xinjiang has the longest tourism comfort period, followed by northern Xinjiang, with eastern Xinjiang being relatively shorter. Specifically, Kashgar Prefecture and Hotan Prefecture have the longest tourism comfort period, extending from March to October; however, the duration of the comfort period is not the most critical factor constraining tourist flow, and inverse-comfort tourism situations may also occur.

Full Text

Preamble

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Spatio-temporal Characteristics of Tourism Climate Comfort in Xinjiang Prefectures and Cities over the Past 30 Years

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Abstract: Based on detailed climate observation data collected from 105 national meteorological observation stations in Xinjiang during 1990–2020, this study systematically evaluates and scientifically analyzes the tourism climate comfort and comfort periods across 15 prefectural-level cities in Xinjiang using three key indicators: the temperature and humidity index (THI), wind-cold index (WCI), and index of clothing (ICL). The results reveal: (1) According to the comprehensive tourism climate comfort index, the months with highest comfort in Xinjiang are primarily May, June, and September. (2) Hami City, Altay Prefecture, Bortala Mongol Autonomous Prefecture, counties and cities directly under Ili Kazakh Autonomous Prefecture, and Kizilsu Kyrgyz Autonomous Prefecture exhibit an inverted U-shaped annual variation in tourism climate comfort, while Urumqi City, Karamay City, Shihezi City, Turpan City, Changji Hui Autonomous Prefecture, Bayingol Mongol Autonomous Prefecture, Tacheng Prefecture, Aksu Prefecture, Kashgar Prefecture, and Hotan Prefecture show an M-shaped pattern. (3) Analysis of tourism comfort periods reveals that southern Xinjiang enjoys the longest comfort period, followed by northern Xinjiang, with eastern Xinjiang having the shortest. Kashgar Prefecture and Hotan Prefecture have the longest comfort periods, spanning March through October. However, the duration of the comfort period is not the most critical factor constraining tourist flow, as counter-comfort tourism scenarios sometimes occur.

Keywords: tourism climate comfort; spatio-temporal characteristics; temperature and humidity index; Xinjiang

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Introduction

Against the backdrop of global climate change, tourism—an industry deeply rooted in natural environments and climatic conditions—is increasingly revealing its high sensitivity and dependence on climatic factors. For tourists, climate significantly influences destination choices, while for destinations, favorable climatic conditions can promote tourism development and effectively boost the industry. Conversely, poor weather and climate conditions can affect local

tourism development and normal socioeconomic operations. To better guide tourist behavior and rationally plan regional tourism development, scholars have conducted considerable research on tourism climate comfort evaluation and model applications.

International research on climate and tourism began relatively early. Oliver established applied climatology, while David proposed the temperature and humidity index and wind-cold index, creating the foundation for applied meteorology. Subsequent scholars have conducted a series of effective studies using comfort evaluation models, with the temperature and humidity index and wind effect index being most widely applied. Wall further discussed the impact of climate change on global tourism flows. International climate and tourism research has focused primarily on how climate change affects tourism suitability, resources, and demand. For example, Aygün used regression models to explore the relationship between climate comfort and international tourist numbers, quantifying climate change impacts on Turkey' s international tourism industry. Maddison, based on extensive field surveys, concluded that climate change affects regional economic stability and tourist demand to a certain degree. Steiger argued that climate change would influence tourist decision-making.

Chinese research on tourism climate began later but has developed rapidly. Lin Zhiguang's *Climate and Landscapes*, published in the 1980s, was China's earliest monograph introducing tourism and climate. With the development of machine learning and deep learning, scholars have used comfort evaluation models to conduct beneficial explorations of tourism climate comfort in Shanghai, Chongqing, Beijing, Guangdong, Ningxia, and other regions. Some scholars have also used the human body comfort index to evaluate comfort levels in Tibet, Shaanxi, the Qaidam Basin, and Chongqing from different perspectives. The research team represented by Ma Lijun and Sun Gennian has conducted more in-depth studies on tourism climate comfort, establishing new tourism climate comfort evaluation models based on multiple indicators. Using different methods and model mechanisms, they have explored the spatio-temporal variation patterns of tourism climate comfort and the relationship between climate comfort and tourist flow in eastern and central China, revealing the elasticity of tourism climate.

With the development of fuzzy mathematics, GIS technology, and Internet big data, research on tourism climate comfort in China has become more diversified. Feng Fenfen analyzed tourism climate comfort in East China, Nanyang City in Henan Province, and Qingyang City in Gansu Province. Wen Chun evaluated tourism climate resources and comfort in Bayingol Mongolian Autonomous Prefecture, Altay Prefecture, Urumqi City, Turpan City, and the Kanas scenic area. Tourism climate comfort evaluation constitutes an important component of tourism resource assessment, and scholars have provided scientific support for the sustainable development of destination tourism industries by exploring climate suitability in different tourism regions. However, most studies have focused on key tourist destinations, with relatively scarce research on tourism

climate comfort covering all 15 prefecture-level cities in Xinjiang, particularly comprehensive analyses based on long time series.

In summary, building upon previous research, this study utilizes climate statistics from 105 national meteorological observation points in Xinjiang, employing mathematical statistics methods to calculate and analyze monthly THI, WCI, and ICL values for 15 prefecture-level cities. Based on these calculations, we construct a comprehensive tourism climate comfort index to analyze the spatio-temporal characteristics of tourism climate comfort across these cities, aiming to provide a scientific basis for tourist travel planning and sustainable tourism development.

1 Data and Methods

1.1 Study Area Overview

Xinjiang is located deep in the Eurasian continent, far from the ocean. The Chinese character for "Xinjiang" (疆) vividly expresses the region' s "three mountains surrounding two basins" geomorphological characteristic. Taking the Tianshan Mountains as the boundary, northern Xinjiang includes Altay Prefecture, Tacheng Prefecture, Bortala Mongolian Autonomous Prefecture, counties and cities directly under Ili Kazakh Autonomous Prefecture, Karamay City, Shihezi City, Urumqi City, and Changji Hui Autonomous Prefecture. Southern Xinjiang includes Bayingol Mongolian Autonomous Prefecture, Kizilsu Kyrgyz Autonomous Prefecture, Aksu Prefecture, Kashgar Prefecture, and Hotan Prefecture. The Turpan-Hami Basin, surrounded by the eastern Tianshan Mountains and encompassing Turpan City and Hami City, is called eastern Xinjiang (Fig. 1). Xinjiang is rich in tourism resources, with northern Xinjiang featuring alpine grasslands, lakes, Gobi deserts, and forests, while southern Xinjiang is characterized by Silk Road culture and ethnic customs. Xinjiang has a typical temperate continental climate with large daily and annual temperature variations. The annual average temperature in northern Xinjiang ranges from 4–8°C, while in southern Xinjiang it is 10–13°C. Tourism development is thus susceptible to climatic constraints and exhibits strong seasonal characteristics.

Note: Based on the standard map with approval number GS(2020)1873 from the Ministry of Natural Resources Standard Map Service website, with no modifications to boundary lines. The same applies below.

[Figure 1: see original paper]

1.2 Data Sources

The meteorological data used in this study were obtained from the China Meteorological Data Network (http://data.cma.cn), including daily average temperature, relative humidity, and average wind speed from 105 national meteorological observation stations in Xinjiang from 1990 to 2020.

Methodologically, this study carefully considered data from the Xinjiang Production and Construction Corps. Except for Shihezi City, other Corps cities under direct jurisdiction of the Corps were integrated into their respective autonomous prefecture-level cities for unified analysis. Given Shihezi City' s 特殊性—as Xinjiang' s first city implementing the Corps division-city integration system and following Xinjiang regional research management practices—this study decided to treat Shihezi City as parallel to the 14 prefecture-level cities. Therefore, the analysis scope covers 15 prefecture-level cities including Shihezi City, ensuring comprehensive and accurate research.

1.3 Methods

1.3.1 Temperature and Humidity Index The temperature and humidity index (THI) evolved from the effective temperature index and reflects the combined effect of temperature and humidity on heat exchange between the human body and surrounding environment:

$$THI = t - 0.55(1 - f)(t - 14.5)$$

where t is temperature (°C) and f is relative humidity (%).

1.3.2 Wind-Cold Index The wind-cold index (WCI) characterizes the relationship between temperature and wind speed under different environments and human heat loss rate and comfort status:

$$WCI = 9.0 + 10.9\sqrt{V} - V$$

where V is average wind speed ($\mathrm{m \cdot s^{-1}}$).

1.3.3 Index of Clothing The index of clothing (ICL) reflects how people can adapt to climate-induced discomfort through appropriate clothing choices. This index integrates temperature, wind speed, human metabolic rate, and solar radiation, and is widely applied in research:

$$ICL = \frac{33 - (0.62 + 19\sqrt{V} - V)(t - H + aR\cos\alpha)}{0.62 + 19\sqrt{V} - V}$$

where H is human metabolic rate ($\mathrm{W \cdot m^{-2}}$), set at 87 $\mathrm{W \cdot m^{-2}}$ for light activity levels in this study; coefficient a is set to 0.62 to quantify human absorption of solar radiation; R is solar radiation received per unit area on ground perpendicular to sunlight direction ($\mathrm{W \cdot m^{-2}}$); and α is solar altitude angle determined based on regional average conditions. Specifically, when latitude is β, the summer solar altitude angle is calculated as 90° - |β - 23°26 |, the winter formula is 90° - |β + 23°26 |, and the average solar altitude angle for spring and autumn is 90° - |β|.

1.3.4 Grading Standards for Each Index The grading standards for tourism climate comfort indices are based on extensive previous practice and existing literature. This study adopts domestic universal grading standards that categorize according to tourists' perceived conditions during outdoor activities. To facilitate convenient and precise statistical analysis and calculation of monthly tourism climate comfort across Xinjiang' s 15 prefecture-level cities, this study graded and assigned values to THI, WCI, and ICL, dividing them into five levels from "extremely uncomfortable" to "very comfortable" (Table 1). Tourism climate comfort is then determined by the sum (Y) of the three indices (Table 2).

2 Results and Analysis

Using daily average temperature, relative humidity, and average wind speed —the three indicators from Xinjiang' s surface climate observation data—this study calculated and analyzed the average monthly THI, WCI, and ICL values for each prefecture-level city from 1990 to 2020. Following the grading strategy in Table 1, the monthly tourism climate comfort evaluation results for each city were obtained.

2.1 Temperature and Humidity Index

Regarding the temperature and humidity index (Table 3), Altay Prefecture experiences comfortable conditions in June-July and relatively comfortable conditions in August, while other months are extremely cold and uncomfortable. Karamay City has high THI values in July-August, with obvious discomfort and unsuitable conditions for tourism activities, while June is comfortable. Changji Hui Autonomous Prefecture is comfortable in June-August and relatively comfortable in May and September, making these months suitable for tourism activities. Bayingol Mongolian Autonomous Prefecture is comfortable in June-August, but the hot climate causes stuffy discomfort, making it less suitable for tourism activities. Aksu Prefecture and Kashgar Prefecture are comfortable in June-August, relatively hot but acceptable in May and September, and extremely uncomfortable in other months. Kizilsu Kyrgyz Autonomous Prefecture has THI values above 60 in June-August, indicating good comfort and high suitability for tourism activities, while other months are uncomfortable or extremely uncomfortable. Hotan Prefecture is comfortable in June-August, relatively hot but acceptable in May and September, and unsuitable for tourism in other months. Tacheng Prefecture is very comfortable in June-August, comfortable in May and September, and uncomfortable or extremely uncomfortable in other months. Counties and cities directly under Ili Kazakh Autonomous Prefecture are comfortable in June-August, relatively comfortable in May and September, and unsuitable for tourism in other months.

2.2 Wind-Cold Index

From the wind-cold index perspective (Table 3), Altay Prefecture experiences cold winds due to its high latitude, with only June–August providing comfortable winds. Karamay City and Shihezi City have comfortable winds in June–August, relatively warm winds in May and September, and slightly cold or cold winds in other months. Urumqi City, Bortala Mongol Autonomous Prefecture, Tacheng Prefecture, and counties and cities directly under Ili Kazakh Autonomous Prefecture have comfortable winds in June–August, suitable for tourism activities, while other months have cool or cold winds. Turpan City has cool or slightly cold winds in May and September, warm winds in June–August, and slightly warm winds in April and October, but significant hot wind sensations in July–August. Hami City has comfortable winds in June–August, suitable for tourism activities, and cool or cold winds in other months. Changji Hui Autonomous Prefecture has comfortable winds in June–August, relatively warm winds in May and September, and cool or cold winds in other months. Bayingol Mongolian Autonomous Prefecture frequently experiences cool winds in May and September, gentle comfortable winds in June–August, comfortable winds in July, warm winds in August, and cool or cold winds in other months. Aksu Prefecture and Hotan Prefecture have comfortable and warm winds in June–August, with comfortable winds concentrated in June–July and warm winds in August, while other months have cool or cold winds. Kizilsu Kyrgyz Autonomous Prefecture experiences cool winds or cold winds year-round, with no comfortable or warm winds. Kashgar Prefecture has comfortable winds in June–August, relatively warm winds in May and September, and cool or slightly cold winds in other months.

2.3 Index of Clothing

Regarding the index of clothing (Table 3), Urumqi City has a clothing comfort period concentrated in May–September. Altay Prefecture, Hami City, and Kizilsu Kyrgyz Autonomous Prefecture have clothing comfort periods mainly in June–August. Karamay City, Shihezi City, and Aksu Prefecture have clothing comfort periods in June–September. Turpan City has a clothing comfort period in May–September, with a longer uncomfortable period. Changji Hui Autonomous Prefecture and Tacheng Prefecture have clothing comfort periods in June–September. Bayingol Mongolian Autonomous Prefecture and Kashgar Prefecture have comfort periods concentrated in June–August. Hotan Prefecture has a clothing comfort period in June–September.

2.4 Comprehensive Tourism Climate Comfort Index Analysis

Based on the grading scheme and assignment standards in Table 1, the comprehensive tourism climate comfort index was calculated and visualized, with results shown in Figure 2. According to the comprehensive tourism climate comfort index, Altay Prefecture is comfortable in June–August and relatively comfortable in May and September, making it very suitable for tourism ac-

tivities. January–February and November–December are extremely cold with lowest tourism suitability, but due to its unique location in the world-class ice and snow sports golden latitude belt of the Altai Mountains, with long snow seasons, heavy snowfall, and deep snow cover, the area' s mountains and forests 反而适宜开展冰雪旅游活动. The annual variation of the comprehensive tourism climate comfort index shows an inverted U-shaped pattern, with June–August being most suitable for tourism activities.

Hotan Prefecture experiences hot summers, little winter snowfall, and long frost-free periods. According to the comprehensive index, June–September are comfortable or relatively comfortable with good tourism suitability, while other months are relatively uncomfortable or uncomfortable with poor tourism suitability, showing an overall inverted U-shaped pattern. Karamay City has cold winters and hot summers, with maximum temperatures of 27–29°C and minimum temperatures of -15 to -16°C. The comprehensive tourism climate comfort index shows a clear inverted U-shaped pattern, with June–September having high comfort and good tourism suitability, while other months are relatively uncomfortable or uncomfortable.

Tacheng Prefecture shows an obvious inverted U-shaped pattern in its comprehensive tourism climate comfort index, with June–September suitable for tourism activities, high comfort index values, and good tourism suitability, while other months are relatively uncomfortable or uncomfortable. Urumqi City has comfortable or relatively comfortable climate in June–September, relatively uncomfortable conditions in May and October, and uncomfortable conditions in other months with poor tourism suitability. Shihezi City has hot, brief summers and long, cold winters, with annual maximum temperatures appearing in July. The comprehensive index variation shows that June–September climate feels relatively comfortable or comfortable with good tourism suitability, while other months are relatively uncomfortable or uncomfortable, showing an obvious inverted U-shaped pattern.

Turpan City has annual monthly average temperature peaks in July and minimum values in January. The comprehensive tourism climate comfort index is highest in June–September, making it most suitable for tourism activities, while May and October are relatively comfortable and suitable for tourism, with other months being uncomfortable and unsuitable. Hami City' s annual monthly average temperature peaks in July at 32–33°C and minimum values in January. The comprehensive tourism climate comfort index shows an overall M-shaped pattern, with June–September having relatively high comfort suitable for tourism activities, while May and October are relatively comfortable and other months are uncomfortable and unsuitable.

Changji Hui Autonomous Prefecture has large climate variations, with annual monthly average temperature peaks in July at 24–25°C and minimum values in January at -13 to -14°C. The annual variation of the comprehensive tourism climate comfort index shows an obvious M-shaped pattern, with June–August being comfortable or relatively comfortable and suitable for tourism activities,

while May and September are relatively uncomfortable and other months are uncomfortable. Bortala Mongol Autonomous Prefecture has comfortable or relatively comfortable tourism climate in June–September, suitable for tourism activities, while other months are relatively uncomfortable or uncomfortable.

Kashgar Prefecture has annual monthly average temperature peaks in July and minimum values in January. The annual variation of the comprehensive tourism climate comfort index shows an obvious M-shaped pattern, with June–September being comfortable or relatively comfortable and suitable for tourism activities, while May and October are relatively comfortable and other months are uncomfortable. The prefecture boasts strong historical depth and diverse, brilliant culture that complements its long comfort period, making it an excellent destination for experiencing Silk Road culture and ethnic characteristic tourism.

[Figure 2: see original paper]

2.5 Analysis of Tourism Climate Comfort Periods in Xinjiang' s 15 Prefecture-Level Cities

Table 4 details the distribution characteristics of tourism climate comfort periods across Xinjiang' s prefecture-level cities. Notably, when the comfort index reaches "comfortable" or "relatively comfortable" levels, it is defined as a tourism climate comfort period. As shown in Figure 3, Altay Prefecture has a 3-month comfort period concentrated in summer. In northern Xinjiang, Bortala Mongol Autonomous Prefecture, Karamay City, and Shihezi City have 4-month comfort periods; Tacheng Prefecture, counties and cities directly under Ili Kazakh Autonomous Prefecture, and Urumqi City have 5-month comfort periods, all concentrated in May–September. Among these, Ili Kazakh Autonomous Prefecture' s counties and cities are richest in tourism resources, known as "Jiangnan beyond the Great Wall" and "wetlands in inland arid areas," representing Xinjiang' s strongest tourism resource advantage region. The prefecture' s tourism products highly match its climate comfort period, with new business forms such as leisure vacations, health tourism, outdoor leisure sports, and mountain summer 避暑旅游 flourishing.

Changji Hui Autonomous Prefecture and eastern Xinjiang' s Turpan City and Hami City have 3-month tourism climate comfort periods, relatively shorter. Changji is suitable for spring-summer tourism, but July is too hot for activities. Turpan is suitable for spring-autumn tourism, with comfort periods concentrated in April–May and September–October, while hot summers make July–August unsuitable. Hami's tourism comfort period concentrates in May–September. Bayingol Mongolian Autonomous Prefecture has a 4-month comfort period; Aksu Prefecture has 5 months, concentrated in spring, summer, and autumn; Kizilsu Kyrgyz Autonomous Prefecture' s comfort period concentrates in June–August. Southern Xinjiang' s Kashgar Prefecture and Hotan Prefecture have the longest tourism climate comfort periods, reaching 8 months from March to October.

Overall, Xinjiang' s tourism climate comfort periods are longest in southern Xinjiang, intermediate in northern Xinjiang, and shortest in eastern Xinjiang. However, climate comfort is no longer the core constraint on tourist flow, as counter-comfort tourism situations sometimes emerge. Typical cases are Altay Prefecture and Turpan City. Despite Altay' s short comfort period, it possesses high-quality winter ice and snow tourism resources, a long snow culture tradition, and complete infrastructure, making it a national-level ski resort. According to the *China Ice and Snow Tourism Development Report (2023)*, Altay was selected as one of the "Top 10 Ice and Snow Tourism Cities in 2023," ranking third. By October 2023, Altay' s winter tourist flow had exceeded 6 million 人次, with ice and snow tourism and related businesses leading the industry. Although Turpan is extremely hot in summer with a short comfort period, its tourism resources are highly attractive, and the summer tourism market is booming. Many tourists specifically visit Turpan to experience the "extreme heat" and "furnace" sensation. The Flaming Mountain scenic area in Turpan receives over 2,000 daily visitors during summer, and the city accumulated 22.3727 million tourists from June to August 2023. These examples demonstrate that comfort period length is not the most critical factor constraining tourist flow.

[Figure 3: see original paper]

3 Discussion

This study selected meteorological observation data from 1990–2020 at 105 national meteorological stations in Xinjiang, using THI, WCI, ICL, and the comprehensive tourism climate comfort index to evaluate and analyze tourism climate comfort and comfort period length across 15 prefecture-level cities. Comparing our results with other studies: our findings on Ili Kazakh Autonomous Prefecture' s counties and cities are basically consistent with Bai Ting' s evaluation of Ili River Valley tourism climate comfort; they largely align with Wen Chun' s evaluation of Bayingol Mongolian Autonomous Prefecture, though that study focused on counties within the prefecture and identified comfort periods mainly in May–September, while we consider Bayingol' s comfort period (including relatively comfortable) as June–September, possibly because May' s higher THI causes extreme discomfort. Our results are basically consistent with Wu Lei' s analysis of Turpan' s tourism climate comfort, both concluding Turpan' s comfort period (including relatively comfortable) is May–October. They also align with Cao Kaijun' s evaluation of Altay Prefecture, both identifying Altay' s comfort period as June–September.

Comparative studies with neighboring provinces show different calculation methods for climate comfort. Some studies on Tibet used physiological temperature to analyze spatio-temporal distribution characteristics, while this study uses THI, WCI, ICL, and the comprehensive index. In terms of results, Lhasa and Nyingchi' s optimal tourism periods are June–September, consistent with the comfort periods of Bortala Mongolian Autonomous Prefecture, Karamay City, and Aksu Prefecture in our study. Yu Xinran analyzed climate comfort

changes in Gansu Province using similar methods but focused on interannual variation characteristics, while this study emphasizes spatio-temporal features. Yang Litao evaluated tourism climate comfort in Inner Mongolia using THI and wind effect index, concluding that western and southeastern Inner Mongolia have longer comfort periods of 4–5 months, similar to Kashgar and Hotan prefectures in Xinjiang (8 months).

Xinjiang' s prefecture-level cities differ significantly in altitude, geographic location, and climatic conditions. This study lacks comprehensive consideration of altitude, sunshine hours, and UV intensity, as well as research on how drought and heavy rainfall/snowfall disasters affect tourism climate comfort. Therefore, more refined tourism climate comfort evaluation and analysis represent future research priorities.

4 Conclusions

1) The months with highest comprehensive tourism climate comfort index in Xinjiang are primarily concentrated in May, June, and September, while the lowest months are concentrated in January, February, and December.

2) In northern Xinjiang, Altay Prefecture, Bortala Mongolian Autonomous Prefecture, and counties and cities directly under Ili Kazakh Autonomous Prefecture, plus Kizilsu Kyrgyz Autonomous Prefecture in southern Xinjiang and Hami City in eastern Xinjiang, the comprehensive tourism climate comfort index shows an inverted U-shaped pattern. In southern Xinjiang' s Bayingol Mongolian Autonomous Prefecture, Aksu Prefecture, Kashgar Prefecture, and Hotan Prefecture, plus northern Xinjiang' s Urumqi City, Karamay City, Shihezi City, Changji Hui Autonomous Prefecture, Tacheng Prefecture, and eastern Xinjiang' s Turpan City, the comprehensive tourism climate comfort index shows an M-shaped pattern.

3) The distribution of tourism climate comfort periods in Xinjiang is longest in southern Xinjiang, intermediate in northern Xinjiang, and shortest in eastern Xinjiang. Southern Xinjiang, especially Kashgar and Hotan prefectures, has comfort periods reaching 8 months. Most northern Xinjiang regions have 4–5 months, with only Altay Prefecture and Changji Hui Autonomous Prefecture having 3-month periods. Eastern Xinjiang' s Turpan City and Hami City have the shortest comfort periods at 3 months. However, comfort period length is not the core factor constraining tourist flow, as counter-comfort tourism situations sometimes occur, such as Altay' s winter ice and snow tourism and Turpan' s summer "extreme heat experience" tourism.

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Note: Figure translations are in progress. See original paper for figures.