

Article

The Spatial Differentiation of the Suitability of Ice-Snow Tourist Destinations Based on a Comprehensive Evaluation Model in China

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Abstract: Ice, snow, and rime are wonders of the cold season in an alpine climate zone and climate landscape. With its pure, spectacular, and magical features, these regions attract numerous tourists. Ice and snow landscapes can provide not only visually-stimulating experiences for people, but also opportunities for outdoor play and movement. In China, ice and snow tourism is a new type of recreation; however, the establishment of snow and ice in relation to the suitability of the surrounding has not been clearly expressed. Based on multi-source data, such as tourism, weather, and traffic data, this paper employs the Delphi-analytic hierarchy process (AHP) evaluation method and a spatial analysis method to study the spatial differences of snow and ice tourism suitability in China. China's ice and snow tourism is located in the latitude from 35°N to 53.33°N and latitude 41.5°N to 45°N and longitude 82°E to 90°E, with the main focus on latitude and terrain factors. A poor fit is concentrated at latitude 20.45°N to 35°N and longitude 100°E to 122°E; the difference is that the latitude is low and affected by the Japanese warm current. The analysis of the suitability of ice and snow tourism can be employed as a reference for the development of ice and snow tourism.

Keywords: suitability; ice-snow tourism; tourist destinations; comprehensive evaluation; spatial differentiation; China

1. Introduction

Ice-snow tourism includes activities that originated in nations located in cold climate zones. Ice-snow tourism is a type of ecological tourism and is the generic term for tourism that involves experiencing snow and ice culture based on the tourism resources of icy and snowy climates [1]. In recent years, China's economy has strengthened, and the concept of national leisure time has resulted in a boom in leisure tourism. The winter landscape is unique, and citizens throughout the nation have a seven-day holiday during the traditional Chinese "New Year (Spring Festival)". Therefore, an increasing number of people are choosing to travel during the winter season. An evaluation in the report by the National Tourism Administration indicates that 14.802 million tourists visited Jilin Province during the 2015 Spring Festival, an increase of 15.53% from the previous year, and 14.784 million tourists visited Liaoning Province, an increase of 11.7%. The total income from tourism was 10.38 billion RMB Yuan, an increase of 12.4%. The development of ice-snow tourism is robust and quick, which has led to general concern among government departments and the scientific community, and it has also become a popular research topic.

Ice and snow tourism belongs to the category of ecotourism; it is a type of tourism product in which the participation of snow and ice climate tourism resources is the main tourist attraction for experiencing an ice and snow culture. It is a highly participatory tourism product that is primarily divided into sightseeing (ice, snow, and rime), sports and leisure (skating, ice car, curling, skiing, snow ballet, and mountain snow), festivals, events (professional events and fun events), pleasure classes (ice and snow playground, snow recreation projects, ice recreation projects, etc.), performing arts, and other experience classes.

Currently, ice-snow tourism countries are principally concentrated on developments in Europe and North America, and it is generally studied from two perspectives, predictions of stationary analyses with correlated models and predictions of dynamic analyses with developing trends. May analyzed the environmental impact of the 1992 Winter Olympic Games, and Hudson [2] and Sharpley analyzed cases of international ski travel in a typical application of stationary analysis [3]. Dewar et al. used cross-cultural means to compare ice-snow tourism products in North America and Harbin [4]. Scott et al. analyzed the ski industry in Quebec in a typical application of dynamic analysis [5]. Considering climate change, Burakowski et al. performed a systematic analysis of the impact of winter temperatures on the winter tourism economy in the USA [6]. DemiRoglu et al. considered using three resorts as an example and analyzed the impact of climate on natural snowfall, artificial snow, and wind on snow and ice resorts [7]. Scott et al. analyzed ice and snow tourism from the perspective of the vulnerability of climate change [8].

Ice-snow tourism in China is mainly divided into seven perspectives: concept and connotation, resource development, ski touring, sustainable development, economic growth, marketing, and tourism position. This paper mainly studies regional ice-snow tourism; at present, most ice-snow tourism development occurs in the Heilongjiang and Jilin provinces. Zhang et al. combined the structure of the tourism market in Jilin, based on the resource advantages, and came up with a development strategy for ice-snow tourism in Jilin [9]. Huang analyzed the advantage of creating ice-snow tourism in Harbin, concluded that Harbin has extensive resources and brand advantages, and proposed a strategic plan for the construction of ice-snow tourism in Harbin [10].

The primary methods used in researching ice-snow tourism in China include an analytic hierarchy process (AHP), a strengths, weaknesses, opportunities, and threats (SWOT) analysis, and a data envelopment analysis (DEA). The results are predominantly concentrated on the development and efficiency of regional ice-snow tourism. The research subjects are primarily in Northeast China. The results are most plentiful in the Heilongjiang area, where the studied content is also the broadest. An analysis of relevant studies indicates that skiing is the key sports program to develop in domestic ice-snow tourism and that ski resorts and tourism will become an important trend in development [11].

Studies of ice-snow tourism have primarily focused on strategies for developing regional ice-snow tourism; there has been little planning, design, or research on the content of micro-level development strategies [12]. The theoretical study of ice-snow tourism lags behind the current development status of domestic ice-snow tourism, and there is a lack of comprehensive analysis on the temporal and spatial differentiation of the ice-snow tourism industry on a national scale. In this paper, we analyze the characteristics of the spatial and temporal differentiation of ice-snow tourism on a national scale from various perspectives to provide a new perspective on, and way of thinking about, the development of ice-snow tourism.

2. Data and Model

2.1. Data

To ensure comparability and objectivity of the results, we selected data from a cross-section for the same time period in 2016. Quantitative studies require that we unify the quantitative processing of the index data. The sources of data selected in this paper and the information contained in the data are shown in Table 1. All required data were preprocessed by making appropriate deletions,

checking for missing information before the data were used and unified to the same coordinate system for standardized treatment. Hong Kong, Macao, and Taiwan are not included in the data [13].

Table 1. Data sources and descriptions.

Data Source	Coverage Information
Data center of the Ministry of Environmental Protection of the People's Republic of China (http://datacenter.mep.gov.cn/index)	Data of national and regional forest coverage
China Meteorological Data Sharing Network (http://www.cma.gov.cn/2011qxfw/2011qsjgx/)	National and regional temperature and snow data (December to February) (756 basic stations and 112 radiation sites)
Statistical database on China's economic and social development	Data on the urban population, greenery, economy, traffic, and regional production
China Yearbook Database: China Tourism Yearbook (2016) and China City Statistics Yearbook (2016)	Survey on tourism in China, regional tourism, bulletins, policies, and regulations
National Tourism Bureau of the People's Republic of China: Report on the development of tourist attractions in China (2016)	Distribution of 5A scenic areas, star-level hotels, and travel agency information
National Geographic Information Bureau (http://www.sbsm.gov.cn/)	Remote sensing images (used for the extraction of snow area), administrative division and digital elevation data (unified to use the 1980 geodetic coordinate system of Xi'an and the Albers equal area conic projection)
China Traffic Atlas (plastic set) and Atlas of China's Transport Operation	Railway, road, and waterway networks and airports

2.2. Suitability Model

Suitability modeling identifies the optimal position for the specific object. Overlay analysis is one method used in suitability modeling; it applies a universal proportion to inputs of all types to create an integrated analysis [14,15]. The suitability model for ice-snow tourist destinations associates spatial attribute data and non-spatial attribute data based on graphic data and, therefore, quantitatively calculates spatial data, extracts an evaluation factor, and superimposes weighted elements. The process of spatial analysis to be studied primarily includes attribute associations, a spatial single-factor analysis, and a comprehensive superposition analysis [16]. That is, the dataset based on different factors is unified to the same level, and weights are assigned to the adaptive region to ensure that the process is scientific and objective [17]. We select the Z-score scoring method for standardized treatment of the original data to eliminate dimensional differences. We adopt the AHP method to obtain the scores and weights of different factors. The calculation method is based on Equations (1) and (2). We use Model Builder (ESRI, ArcGIS, Redlands, CA, USA) to obtain a comprehensive score and re-classify it. By adopting the multi-objective linear summation method, we calculate a comprehensive index for the suitability of ice-snow tourist destinations in coastal cities by summing the index scores and generating the corresponding regions to evaluate the spatial distribution of the results [18,19]. As the comprehensive index increases, the suitability of the analyzed ice-snow tourist destination increases [20]. The calculation method is shown in Equation (3). A specific diagram of the evaluation structure is shown in Figure 1.

$$A_i = \frac{\sum_{j=1}^n c_{ij}}{n} \quad (1)$$

where A_i is the score of the i th factor, c_{ij} is the experts' and scholars' score for the i th factor, i is the i th factor, j is the j th expert or scholar, and n is the number of experts and scholars.

$$B_n = \sum_{j=1}^m a_j b_n^j \quad (2)$$

where B_n is the weight of the objective layer, a_j are the weights of different factors in the field layer with respect to the objective layer, and b_n^j is the weight of the evaluation factor relative to the field layer.

$$S = \sum_{i=1}^m \left[\sum_{j=1}^n A_j \times b_n \right] \tag{3}$$

where S is the suitability index for a city as a tourist destination, A_j refers to the value of the index for the j th city, and b_n is the weight of the evaluation factor layer. Here, n and m refer to the number of indices in the factor and field layers, respectively, of the evaluation system.

$$W_i = \frac{1 - H_j}{n - \sum_{j=1}^n H_j} \tag{4}$$

$$W = n_1 \times B_n + n_2 \times W_i \tag{5}$$

where W_i is the entropy weight value, H_j is the corrected information entropy, and W is the comprehensive weight of each indicator. The reference coefficient is set to $n_1 = n_2 = 0.5$.

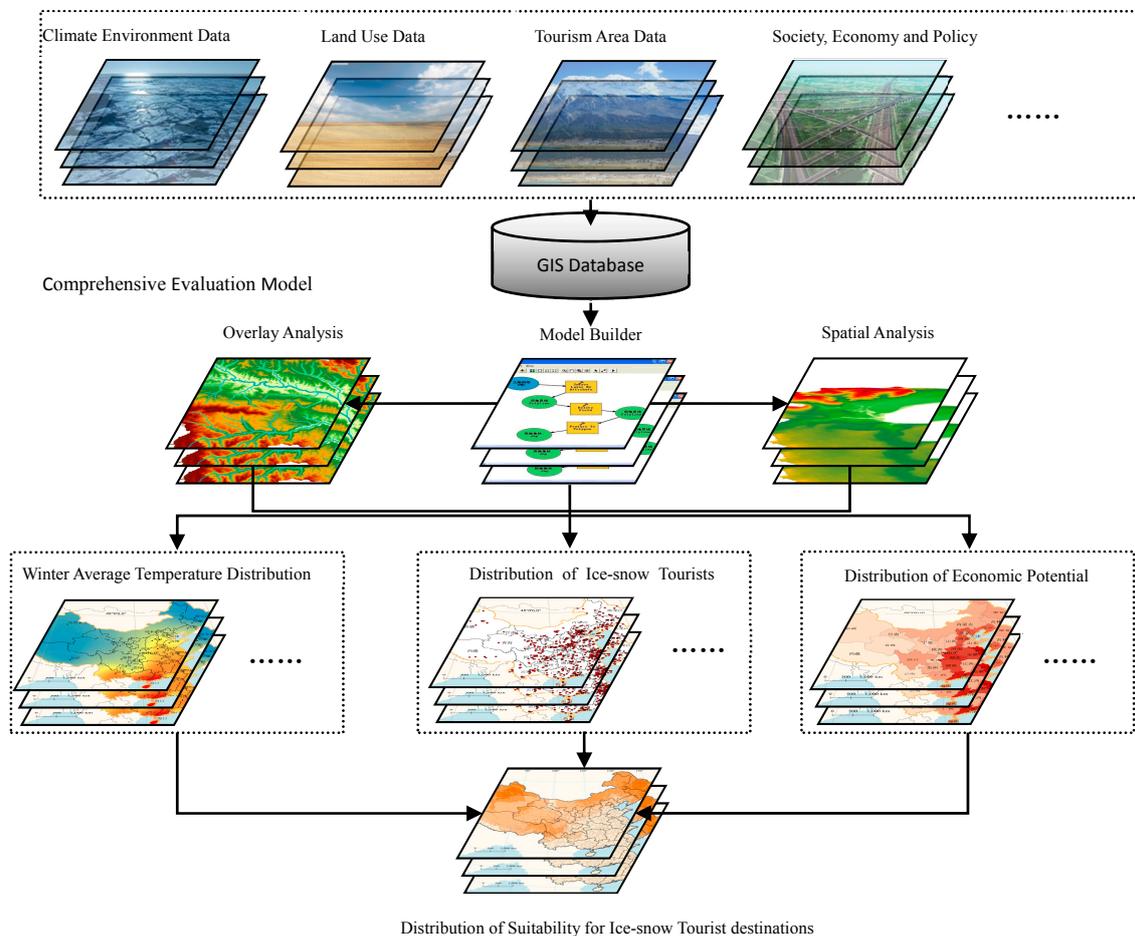


Figure 1. Technology roadmap.

Ice-snow tourism is a resource-oriented industry, and the development of ice-snow tourism depends rather strongly on the environmental basis of snow and ice resources [21]. Our study establishes an evaluation system for the comprehensive assessment from the three perspectives of industry resources, the state of development, and the potential for development, and it derives appropriate locations for ice-snow tourist destinations based on spatial overlap and the composite index [22]. The details of the evaluation system are presented in Table 2.

Table 2. System for evaluating the suitability of ice-snow tourist destinations.

Target Layer	Domain Layer	Factor Layer	Description	Methods of Calculation
Comprehensive index	Basic tourism resources index	Winter temperature	Regional average temperature in January is below $-6^{\circ}\text{C}\sim-15^{\circ}\text{C}$	$-6^{\circ}\text{C} \leq -[\text{average temperature in January}] \leq -15^{\circ}\text{C}$
		Elevation of snow line	Regional annual total amount of snow, coverage range, and terrain	[elevation] 4500 m
		Number of snow days	Range for permanent or stable snow	[number of snow days] ≥ 60 d
		Forest coverage	The forest coverage is higher than the average for the region	[forest coverage] = [green land area]/[regional land area] [forest coverage] \geq [average forest coverage in the province]
	Tourism development status index	Distribution of scenic areas	Spatial distribution of 5A tourism regions or scenic areas with primarily 4A grades	[density of scenic areas] = [number of scenic areas]/[regional land area]
		Tourism income level and reception trips	Proportion of the regional tourism income level relative to the total income level	[tourism income level] = [total sum of annual tourism income] [tourism reception trips] = [total sum of annual tourism reception trips]
	Tourism development potential index	Transportation accessibility	Weighted average accessibility	[weighted average accessibility] \geq [normal]
		Population size	Population size and density in cities and urban agglomerations	[population density] = [total population]/[land area]
		Economic level	Per capita GDP and growth velocity in cities and urban agglomerations	[economic development level] = f([per capita GDP], [GDP growth rate])

3. Research Results and Analysis

3.1. Environmental Resource Index

Ice-snow tourism is a resource-oriented industry, and the development of ice-snow tourism depends largely on resources [23]. China's total temperature, which indicates cold temperatures in the north and warm temperatures in the south, gradually reduce from south to north. The plains regions are warm, and the plateau regions are cold; the eastern average isotherms are approximately parallel to the west; and the latitude factors are significant. In the western region, the average isotherm is approximately parallel to the contour line and is significantly affected by terrain factors. The lowest point of the average temperature is observed in the Qinghai–Tibet Plateau, whereas the highest point of the average temperature is observed in the South China Sea (Xisha). An ice-snow tourist destination must have both a cold climate and appropriate terrain. The temperature ranges from -6°C to -15°C , as travelers can enjoy the fun of skiing, but also withstand the cold in this temperature range. If the temperature is too low and the snow is too hard, it will not be conducive to experiencing ice and snow tourism projects of the grade required for sports. As shown in Figure 2a, in regions with annual winter temperatures between -30°C and -18°C , it is easy to maintain a landscape that includes snow and ice features, which is conducive to the development of indoor and outdoor ice-snow tourism products. The regions in China that are well suited for ice-snow tourism based on the winter temperature index are predominantly concentrated in the areas of Heilongjiang, Jilin, Inner Mongolia, Xinjiang, Tibet, Qinghai, and Ningxia, with the key cold-temperature cities being Harbin (-7°C), Changchun (-24°C), Yinchuan (-18°C), and Hohhot (-19°C). The cities that are relatively unsuitable are the coastal cities in Southeast China, such as Sanya, Guangzhou, and Fuzhou.

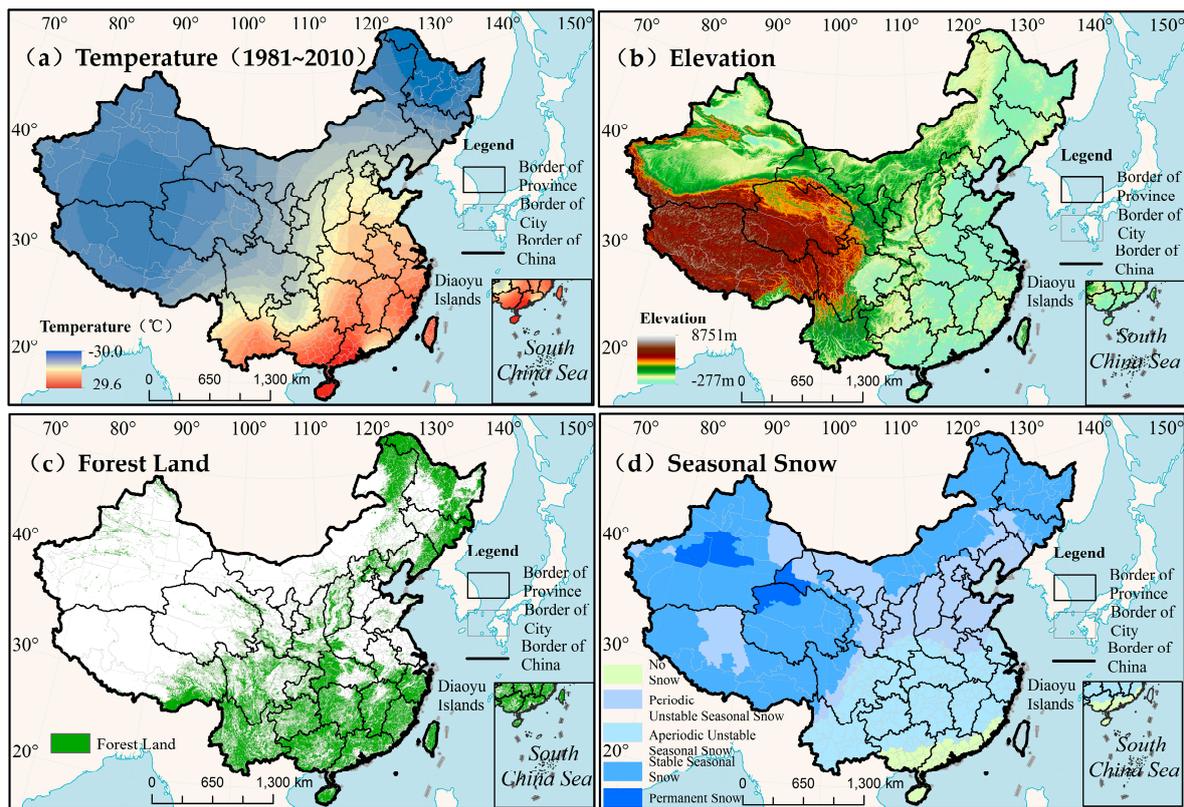


Figure 2. Resource and environment indicators of ice-snow tourist destinations.

China's overall terrain is high in the West and low in the East, showing a downward gradient, and this topography determines the flow direction of most rivers in China from west to east. As a result of the distribution of the ladder-like features, which causes a humid ocean air flow in the east, a gradual decline in westward precipitation is observed. The precipitation distribution causes differences in the water resources distribution. As shown in Figure 2b, the snow line in China tends to be low in the northeast and high in the southwest. The border areas in the western part of China are surrounded by snow-covered mountains. In more northern regions, the snow line is lower, and western regions are more arid and have a higher snow line. The northwestern area of Tibet has the highest elevation and the highest snow line in China. To develop appropriate tourism products, ice-snow tourism typically requires that the total hill and mountain area in the tourism region be greater than the plains area and the elevation be below 4500 m. Regions in China that are well suited for ice-snow tourism, based on the elevation of the snow line, are in the northeastern and northwestern parts of the country. In particular, the elevation of the snow line is relatively high in arid regions, such as Tibet, which is not suitable for most tourists, and the difficulties and cost of development in that region are relatively high. However, the region can be developed as a special ice-snow tourism product.

Due to historical and natural geographical conditions, the distribution of forest resources in China is uneven. The northeast, southwest, and southeastern provinces have a greater number of forest resources. Differences in North China, the Central Plains and the northwest provinces are observed in the forest resources distribution [24]. As shown in Figure 2c, the spatial distribution of forests in China demonstrates that the southeastern and northeastern areas are significantly more forested than the northwestern plateau. The pattern of forest coverage in China has intertwined latitudinal, longitudinal and vertical zonal distributions. The regions that are well suited for ice-snow tourism based on forest coverage are in the southeast and northeast, where the landscape consists primarily of low and moderate hills, the annual rainfall is high, and the forest coverage is dense; these areas

include Daxinganling, Xiaoxing'anling, and the Changbai Mountains. The region that is relatively unsuitable is the inland area in Northwest China, which has the least amount of forest coverage.

According to the length of snow duration, the season is divided into permanent snow and winter season snow. Seasonal snow is divided into stable snow (more than two months) and unstable snow (less than two months). As shown in Figure 2d, permanent snow is sporadically distributed in alpine glaciers in the western mountains. The stable snow area is primarily north of Tianshan in Xinjiang, in Daxinganling in Northeast China, north of Xiaoxing'anling, east of the Changbai Mountains, and in the Tanggula and Bayanula Mountains in the Tibetan Plateau. Some areas in Southwest China, such as some of the plateaus or mountains in the northern part of Yunnan Province, have unique "spring snow" landscapes that exhibit vertical ecological landscapes characteristic of snowy regions, including glaciers, alpine areas, meadows, snow-covered mountains, and water. This type of area is well suited for ice-snow tourism based on the snow distribution index. The unsuitable snow lines are predominantly distributed north of 24°N latitude and the Nanling Mountains. Areas without snow include Fujian, Guangdong, Guangxi, the southern part of Yunnan Province (District), and Hainan Province. These areas are relatively unsuitable for ice-snow tourism.

3.2. Development Status Index

As shown in Figure 3a, among the 32 provinces, autonomous regions and municipalities in China, the regions in which the density of coastal scenic areas is greater than the number of inland scenic areas are Jiangsu Province, Zhejiang Province, Henan Province, and Guangdong Province; tourism is highly developed in these areas [25]. In particular, the 5A-level scenic areas for ice-snow tourism and the resources that influence ice-snow tourism are distributed in Heihe City, Harbin City, Mudanjiang City, and Mohe County in Heilongjiang Province, Changchun City and Jilin City in Jilin Province, Lijiang City in Yunnan Province, Altay County in the Xinjiang Autonomous Region, and Hulun Buir in Inner Mongolia. Those cities listed in Table 3 that have both high revenues from tourism and high rankings on the tourism reception scale include Harbin, Changchun, Hohhot, Urumqi, and Lhasa. Summarizing the information above reveals that Northeast China has formed an entirely integrated industry circle for ice-snow tourism and the region is the national leader in the development of multiple scenic areas involving ice and snow; its ice-snow tourism industry has a broad scope and significant influence, and its suitability according to the development status index for ice-snow tourism is the highest. The Beijing-Tianjin-Hebei, Inner Mongolia, Gansu, Ningxia, and Qinghai regions are comparatively unsuitable due to the lack of core scenic areas featuring snow and ice [26–28].

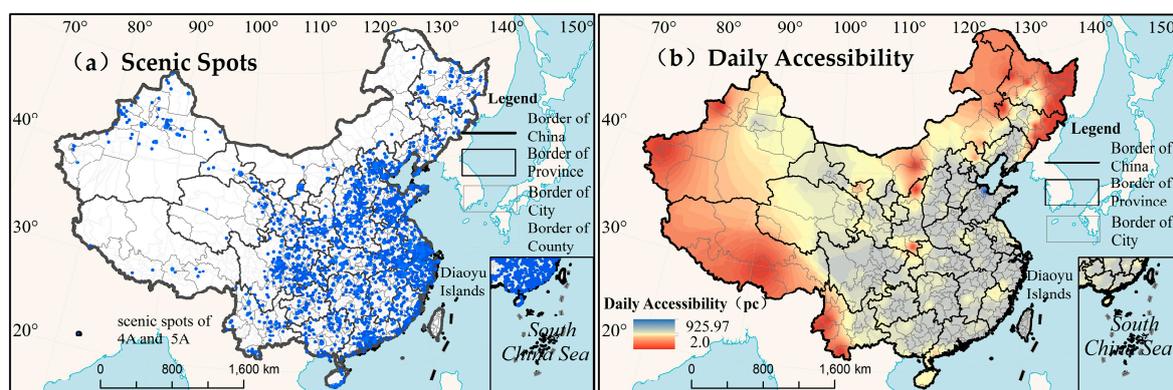


Figure 3. Indicators of current Chinese ice-snow tourism development.

Table 3. Statistical data on the development of tourism in China in 2016.

Ranking	Province (Municipalities \ Autonomous Region)	Total Tourism Revenue (Billion)	Year-on- Year Growth (%)	Ranking	Province (Municipalities \ Autonomous Region)	Total Tourism Revenue (Billion)	Year-on- Year Growth (%)
1	Guangdong	11560	11.50	16	Liaoning	4225	12.50
2	Jiangsu	10263	13.40	17	Guangxi	4191	28.80
3	Zhejiang	8093	13.40	18	Fujian	3935	25.30
4	Shandong	8031	13.70	19	Shanghai	3820	9.00
5	Sichuan	7706	24.10	20	Shaanxi	3813	26.78
6	Henan	5764	14.47	21	Tianjin	3100	10.90
7	Guizhou	5027	43.00	22	Jilin	2897	25.15
8	Beijing	5021	9.00	23	Inner Mongolia	2715	20.28
9	Jiangxi	4993	37.27	24	Chongqing	2645	17.50
10	Anhui	4932	20.00	25	Heilongjiang	1603	17.76
11	Hubei	4870	13.00	26	Xinjiang	1401	37.00
12	Yunnan	4726	44.10	27	Gansu	1220	25.00
13	Hunan	4707	26.79	28	Hainan	670	16.97
14	Hebei	4655	35.60	29	Tibet	331	17.30
15	Shanxi	4247	23.19	30	Qinghai	310	25.10

As shown in Figure 3b, traffic accessibility has significant influence on the selection of ice-snow tourism destinations [29]. The amount of time spent on the road traveling determines the overall convenience of a tourist destination. The accessibility discussed in this paper includes traditional railroads, high-speed railroads, airports, highways, and ports, and the daily accessibility is used as an index in the analysis. Since four hours is generally considered to be a comfortable length of time to travel by these transportation methods, four hours is used as the range in the calculations. Northwest China and some areas of Northeast China are considered to be poorly accessible, but the coastal areas and North China are otherwise considered to be accessible. Representative regions that are easily accessible and considered suitable are Beijing, Tianjin, Harbin, Changchun, Shenyang, Changsha, Shanghai, Wuhan, Urumqi, and Hohhot. Representative regions that are difficult to access and considered unsuitable are Kashgar, Lhasa, Qiqihar, and Yichun [30].

3.3. Industry Potential Index

Population size and economic level are important indices for evaluating the potential for regional tourism industries. Statistics on the population and GDP from 2016 for each Chinese city with level 5A ice-snow scenic areas are presented in Table 4. Based on Figure 4a,b, the economy is considered developed in the ten major urban agglomerations in China, where the population is dense, the per capita GDP is high, and the tourism industry has high potential. However, in addition to the ten major urban agglomerations, the central part of Hunan Province, centered at Changsha-Zhuzhou-Xiangtan, the central part of Jilin Province, centered at Changchun and Jilin City, the central and northern parts of Heilongjiang Province, centered at Harbin, the Beibu Bay urban agglomeration centered at Nanning and the northern slopes of the Tianshan Mountains, centered at Urumqi, all have the potential to develop new, relatively large-scale urban agglomerations. The population scale and per capita disposable income are relatively high in these areas, which can help in the development of ice-snow tourism. In particular, central Jilin, the northern part of Heilongjiang and the Tianshan Mountains in Urumqi, which are regions with abundant resources for ice-snow tourism, are considered suitable for industry development. Economic development in these regions is stable, which is in compliance with the national development strategy, and the ice-snow tourism industry has a high potential for development [31,32].

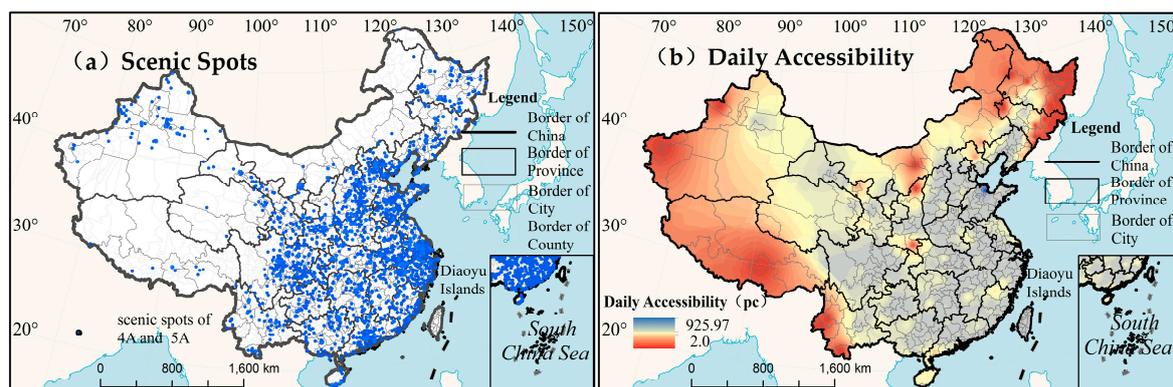


Figure 4. The ice-snow tourism potential index for China.

Table 4. Statistical data on the population and economies of major ice-snow tourism provinces (autonomous regions) and cities (autonomous prefectures).

Coastal Province (Direct-Controlled Municipality, Autonomous Region)	Major Ice-Snow Tourism City	Total Population ($\times 10,000$)	Population of Urban Area ($\times 10,000$)	Per Capita GDP (RMB Yuan)
Heilongjiang Province	/	3833	3155.4	42,928
	Harbin	944.4	427.5	50,423
	Heihe	171.5	21.0	22,654
	Mudanjiang	259.8	89.0	46,953
Jilin Province	/	2475.9	863.3	54,997
	Changchun	754.8	363.4	66,443
	Yanbian Chao Autonomous Prefecture	218.6	139.1	24,900
Xinjiang	/	298.1	292.0	40,569
	Changji Hui Autonomous Prefecture	169.4	/	72,261
Yunnan Province	/	2864.0	639.8	28,918
	Lijiang Naxi Autonomous Prefecture	119.5	15.1	21,908

4. Results and Discussion

4.1. Results

Since ice-snow tourism is an environment-oriented tourism product, its seasonality is strongly correlated to latitude; therefore, as shown in Figure 5 and Table 5, we identify those regions of China that are well suited to ice-snow tourism to be predominantly concentrated at latitudes between 35°N and 53°N . Due to terrain, some of the regions considered suitable are located at latitudes between 41°N and 45°N and longitudes between 82°E and 90°E . Due to the low latitude and the influence of the Kuroshio Current (a warm ocean current), regions at a latitude of 20°N – 35°N and longitude of 100°E – 122°E are considered unsuitable; such representative regions include the Yangtze River Delta, the Pearl River Delta, the Shandong Peninsula urban agglomeration, the mid-Southern Liaoning urban agglomeration, the Central Plains urban agglomeration, the urban agglomeration in the middle reaches of the Yangtze River, the urban agglomeration on the west side of the Taiwan Strait, the Sichuan-Chongqing urban agglomeration, and the Guanzhong urban agglomeration.

In Xinjiang and Tibet, snow and ice are abundant and lasting. However, the regional population density is small, and the tourism industry is underdeveloped. Moreover, snow and ice are largely distributed along the plateau and in the mountains, where traffic accessibility is relatively poor. The challenges facing ice-snow tourism industry exploration and development are great, although there is ample opportunity to provide unique ice-snow tourism that is stimulating and challenging. In regions with positive development trends in the tourism industry that are otherwise unsuited to

ice-snow tourism, only large cities, such as Shanghai and Shenzhen, can provide indoor ice-snow tourism using technological innovation.

In Inner Mongolia, which is a suitable ice-snow tourism destination, especially in the eastern area, the area available to visitors is vast, and the snow and ice resources are richly endowed by nature. This region also has a landscape that includes mountains and forests and is easily accessible to traffic, which makes it very easy to provide a package of ice-snow tourism opportunities. It is appropriate to creatively develop ice-snow tourism, improve the quality of service provided, and construct ski venues and sightseeing areas for ice-snow tourists. In the Beijing-Tianjin-Hebei area, the economy is developed and population density is high. Therefore, the potential for developing an ice-snow tourism industry is high, given the market demand, advantageous location with respect to traffic, and the availability of artificial resource development techniques. By adopting a method that combines natural ice-snow tourism with artificial ice-snow tourism products, profits can be increased in the ice-snow tourism industry.

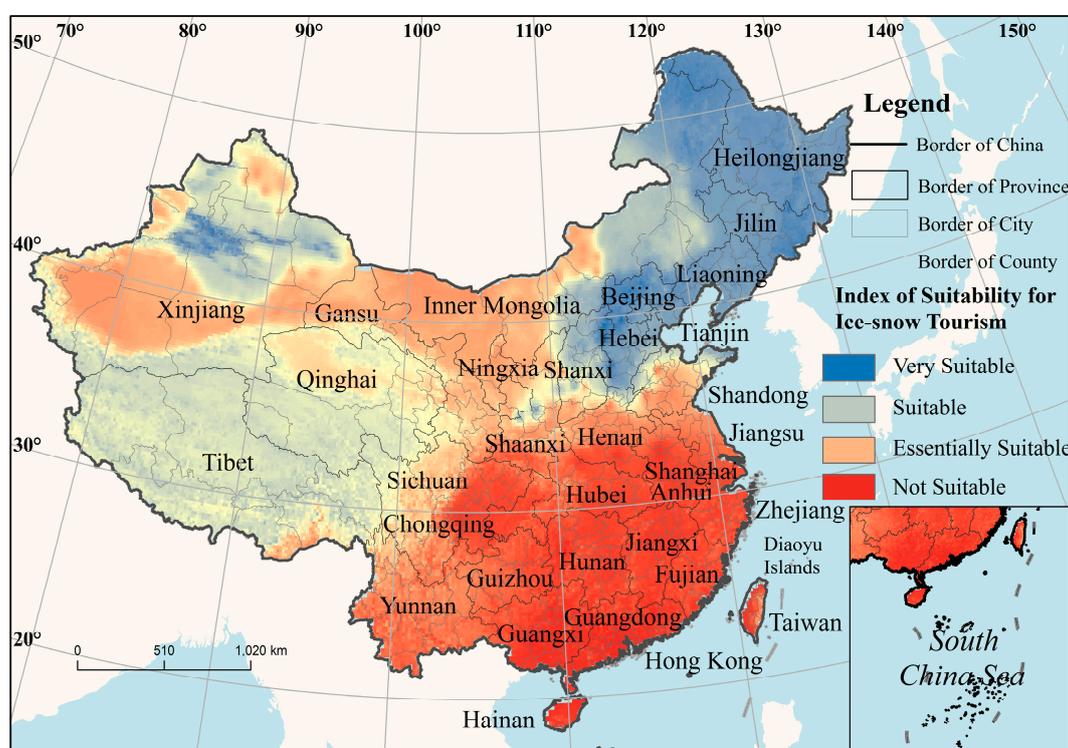


Figure 5. Suitability grades for ice-snow tourist destinations in China.

Table 5. Rating assessment based on the suitability index for ice-snow tourism in China.

Suitability Grade for Ice-Snow Tourism	Spatial Distribution
Very suitable for ice-snow tourism	Central area of Heilongjiang Province, central and eastern areas of Jilin Province, western and northern areas of Liaoning Province, Beijing, Tianjin, Hebei Province, region near the Tianshan Mountains in Xinjiang
Suitable for ice-snow tourism	Tibet, most of Qinghai, central and northern areas of Xinjiang, eastern area of Inner Mongolia
Moderately suitable for ice-snow tourism	Gansu, Ningxia, western and southern areas of Xinjiang, western area of Inner Mongolia and northern area of Sichuan
Not suitable for ice-snow tourism	Southeastern area of China and areas without periodic, stable snowfall

4.2. Conclusions

This study investigates the spatial difference of the suitability of snow and ice tourism destinations to facilitate tourism projects of all types of tourism in China, according to the inherent resources. The development of appropriate tourism projects aims to improve the competitiveness of tourism and extend the life cycle of a scenic area. The tourism market is multi-level, exhibits a diversified development trend, and includes static and dynamic tourism participatory tourism changes, and ice and snow eco-tourism. According to the resources and development status and the potential to analyze appropriate development methods, the research is based on the comprehensive analysis of the ice and snow tourism industry foundation, the development state and the development potential, to determine the spatial difference of the suitability of China's ice and snow tourism destination. Conclusions of the research are as follows:

- (1) Taking into account the three factors, which are dependent on the city + tourist area development model, which considers the difference between the dependence on ice and snow resources and the status of urban development considerations, China's ice and snow tourism destination is better suited to the Heilongjiang region in Jilin central city, Xinjiang and some cities in Hebei Province; Harbin (longitude 125°42'–130°10', latitude 44°04'–46°40'), Changchun (longitude 124°18'–127°02', latitude 43°05'–45°15'), Changji Hui Autonomous Prefecture (east longitude 86°24'–87°37', latitude 43°06'–45°20') and Zhangjiakou (longitude 113°50'–116°30', latitude 39°30'–42°10'). China's ice and snow resources are limited to the northeastern region of ice and snow tourism development in the scale and impact of a leading position. The resources and environmental advantages of an outstanding ice and snow tourism industry development is substantial.
- (2) The snow and ice resources and the development of an urban development status has improved with the potential for the development of cities in the western region of China. Tibet (longitude 78°25'–99°06', latitude 26°44'–36°32'), Qinghai (east longitude 89°41'–103°07', latitude 31°41'–39°07') and other places have stable ice and snow resources but a small scale and underdeveloped economy. The Inner Mongolia 97°21'–126°07', latitude 37°41'–53°38') area's mountains and rivers are rich in forest resources, have unique winter snow and ice resources, and have a long period of snowfall; this city can easily implement ice and snow tourism projects.
- (3) Northern China does not have sufficient snow and ice resources. As the center of the social and economic advantages of its ice and snow tourism industry, the city of Beijing has to rely on market demand, traffic location advantages and artificial development technology, which occupy a relatively small part of the snow and ice market share. Tourism development and the potential of the large southeast and coastal cities, which do not have snow and ice tourism resources and are not suitable for outdoor snow and ice tourism projects, are lacking. Individual large cities have to consider the cost and effectiveness of the construction of urban artificial ice and snow and snow and ice leisure travel.

4.3. Discussion

Ice-snow tourism in China can be developed by depending on the distribution of snow and ice in the northern area of China and the plateau area [33]. Due to differences in natural resource availability and cities with snow and ice resources, the potential for the development of ice-snow tourism in different parts of China is variable. Northeast China possesses many ice-snow tourism resources, including lake water, mountains, and an ice and snow art museum. The ice-snow tourism industry in Northwest and Southwest China is primarily dependent on its snow-capped mountains and ecological experience opportunities. In the regions that are most suitable for the development of ice-snow tourism in China [34], Northeast China is the core region for ice-snow tourism. The ice-snow tourism area of Harbin is concentrated on the Sun Island Scenic Area, which connects the two-way Wudalianchi Scenic Area in Heihe and the Jingpo Lake Scenic Area in Mudanjiang, where the development

of comprehensive ice-snow tourism with major ice and snow festivals and minor geological and lake tours occur. The Changchun-Yanji ice-snow tourism area has developed ice-snow tourism by integrating it with sightseeing, entertainment, and sport. The Tianshan Tianchi Scenic Area in the Changji Hui Autonomous Prefecture in Xinjiang is the center of ice-snow tourism in Northwest China; there, one ice-snow tourism product is slowly being developed. A rather unique ice-snow tourism destination in China is the Yulong Snow Mountain Scenic Area in Naxi Autonomous County in Lijiang, where ice-snow tourism has been developed based on the area's snow and ice resources and vertical ecology; it is part of a tourism circle that contains many cultural and natural scenic locations in the surrounding area.

However, for the present study, because of the data collection process, the selection of an evaluation index and relevant statistics are subject to the issues of comparability, and the objectivity and accuracy of the quantitative analysis results are subject to certain constraints. For example, some data, such as temperature distribution, are obtained using spatial interpolation, and there are some deviations from the actual data. Therefore, quantitative studies of the spatial heterogeneity of the suitability of ice-snow tourism destinations require further scientific improvement.

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