International Journal of Geo-Information

MDPI

Article

Chinese Modern Architectural Heritage Resources: Perspectives of Spatial Distribution and Influencing Factors

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Abstract: Architectural heritage refers to buildings, complexes, and sites with historical, cultural, artistic, technological, and geographical values, including ancient buildings, historical buildings, places of interest, dwellings, and industrial sites. China's 20th-Century Architectural Heritage List is a state-level list that includes architecture of historical, cultural, technological, and artistic value in China in the 20th century. It is the carrier of the past century and the monument to witnessing the change in human knowledge, culture, technology, and even art. This list is from China, a country with a vast land area, a densely populated population, and numerous architectural relics. This study used ArcGIS to analyze 597 cases in 6 batches in China's 20th-Century Architectural Heritage List. Its spatial structure was studied by calculating the nearest neighbor index, Gini coefficient, imbalance index, and kernel density. The results showed that the distribution of the Chinese modern architectural heritage resources is cohesive and uneven in China. Next, the geographical detector model was used to analyze its influencing factors from the perspective of 12 factors. This study found that the spatial distribution of this type of resource was condensed. The provincial level showed a distribution pattern of seven centers with one core and multiple scattered points. Its distribution in 34 administrative regions is extremely uneven, with 57.29% being located in North and East China. It also focused on analyzing five influencing factors, namely, topography, regional status, culture and education, social and economic development level, and external contact. Exploring its spatial structure and influencing factors will not only enable a comprehensive understanding of the development context and current situation of 20th-century architectural heritage, but also provide a reference for its protection and sustainable use.

Keywords: China's 20th-century architectural heritage list; architectural heritage; geographical detector; Gini coefficient; influencing factor; nearest neighbor index; kernel density analysis; spatial distribution characteristics; imbalance index

Citation: Liao, Y.; Cenci, J.; Zhang, J. Chinese Modern Architectural Heritage Resources: Perspectives of Spatial Distribution and Influencing Factors. *ISPRS Int. J. Geo-Inf.* **2023**, *12*, 358. https://doi.org/10.3390/ijgi12090358

Academic Editor: Wolfgang Kainz

Received: 29 May 2023
Revised: 23 August 2023
Accepted: 30 August 2023
Published: 31 August 2023

1. Introduction

In China, the 20th century was the fastest-changing era [1]. China has completed the leap from traditional agriculture to modern industrial civilization, providing humanity with a rich and vivid cultural heritage [2]. As an important part of cultural heritage, architectural heritage is a witness and carrier of great changes that occurred in Chinese society in the 20th century [3]. It has become the crystallization and cultural portrayal of the wisdom of Chinese architecture in the past century, a rational, intuitive, and extensive presentation of the history of the 20th century, and an important basis for reshaping the continuity of urban history. We have looked back at the background of the development of China's 20th-Century Architectural Heritage (20CCAH) and its lineage. Overall, Chinese neoclassicism has always been at the forefront of 20CCAH for three reasons: firstly, China's concept of modernity and industrialization lagged behind that of the West by more than a century; secondly, there was a political need for the importation of Western culture; thirdly,

the Chinese upper classes' identify with the nation-state and have respect for traditional cultural symbols. In terms of time, in the early 20th century, in the concessions of Shanghai and other Chinese port cities, various architectural schools and their foreign products in the Western neoclassicism period also mostly became part of 20CCAH. By the middle of the 20th century, represented by the modern architectural heritage of Beijing's Tiananmen Square, the influence of Western neoclassical architecture was more clearly discernible in the architectural heritage model of China. It was not until the 1980s, when reform and opening up opened the door to the world and various architectural trends of the Western post-industrial era swarmed in, that China's architectural forms in the late 20th century stepped out of the neoclassical paradigm. Furthermore, the influences of modern-classical, late-modern, post-modern, and other Western architectural influences were presented in the form of China's on-the-ground architecture. China has a population of 1.412 billion, accounting for 17.90% of the global population [4]. There are 691 cities in China, with an urbanization rate of 65.22% in 2022 [5]. As a country with such a large population and number of cities, China's architectural heritage contains much cultural, historical, folk, religious, and other information, which also has important implications for other countries' cultural and historical studies [6]. Therefore, studying and protecting China's architectural heritage has important cultural, historical, and theoretical value for the world. The 20th-century architectural heritage is called the "mirror of the times" because it represents the main body of classic urban and rural architecture, and its preservation and protection are issues that must be faced in urban renewal initiatives [7]. All in all, conducting research on the spatial and temporal distribution of modern architectural heritage not only helps to protect and pass on historical and cultural heritage, and enhance the image and cultural quality of the city, but also provides a database for historical and social science research, promotes the development of the tourism industry and the cultural and creative industries, and strengthens social identity and cultural self-confidence. In order to improve the broad understanding of 20th-century architectural heritage and strengthen its survey and protection, in China, relevant departments and organizations have published a series of documents (Table 1) [8–10].

Table 1. The evolution of the main protection provisions of China's 20th-century architectural heritage.

Publisher	Date of Issue	Document	Connotation
CAE Academician Guoxin Ma	2004	List of China's 20th-century architectural heritage	Lists China's 20th-century architectural heritage and launches the first shot at protection
Wuxi China Cultural Heritage Protection Forum	2008	Suggestions on the Protection of Wuxi's 20th-century heritage	This means that the protection of 20th-century heritage has entered the overall planning of the Chinese government [8]
Ministry of Housing and Urban-Rural Development	2017	Circular No. 212	Requires historic building identification and listing, and the filing of buildings [9]
China National Development and Reform Commission, Ministry of Housing and Urban-Rural Development	2020	Notice on Further Strengthening the Management of Urban and Architectural Features	Highlights the need for architects and cultural heritage workers to make new contributions to heritage conservation and urban renewal in the 20th century [10]

As a non-renewable historical and cultural resource, scholars have been highly concerned about architectural heritage. In architectural research, the study of structural science delves into analyzing heritage structures, including those constructed with materials such as wood and brick [11]. This involves a range of methodologies, including ground laser scanning, static elastic–plastic analysis, limit analysis, multi-scale analysis, seismic vulnerability assessments, thermal effects, and structural safety monitoring [12]. In contrast, art research focuses on exploring the artistic value of architectural heritage, examining the use of artistic symbols, structural illustrations, and architectural colors as means of expression. Finally, research into architectural protection has been approached from various angles, including developing protection policies, exploring protection methods, valuing surveys,

utilizing digital technology, and applying urban renewal strategies [13–17]. However, fewer scholars have analyzed the spatial distribution of this kind of heritage resource in China. Analyzing the spatial distribution can facilitate the exploration of the distribution rules of different historical periods and architectural categories, which is significant for recognizing, protecting, and utilizing architectural heritage resources [18]. Unlike in previous studies, for the first time, this study divides 20CCAH into 6 major categories and 20 subcategories for targeted analysis. It is also a groundbreaking 20CCAH, based on the development of Chinese architectural trends, dividing the 20th century into nine time periods for targeted research. It is also the first time that topographic factors have been introduced to analyze their impact on the distribution of 20CCAH. The discussion section of this paper is more pioneering, following the current situation and introducing the influence of COVID-19 on the six-batch 20CCAH selection. Using ArcGIS spatial analysis tools, the spatial distribution characteristics of different types of architectural heritage were studied, revealing the influence of topography, regional status, culture and education, social and economic development level, and external contact. The 20th century was divided into nine periods, and the distribution hotspots and movement trends of various architectural heritages in China were analyzed.

2. Data Sources and Methods

2.1. Data Sources

The original data in this paper come from China's 20th-Century Architectural Heritage List (20CCAH-LIST), including six batches from 2016 to 2022, with a total of 597 data items, jointly issued by the Chinese Cultural Relics Association and the Chinese Institute of Architecture (Table 2). The analysis of the impact of topography factors on the distribution of 20CCAH is based on the original DEM data provided by GEBCO, which cover a global range and include land elevation and ocean depth data [19]. GEBCO raster data are a continuous global ocean and land terrain model that integrates datasets from many international and national data repositories, and regional surveying and mapping plans [20,21].

Table 2. Number of China's 20th-century architectural heritage catalogues in each batch.

Batch	Year	Annual Cases	Cumulative Cases
1	2016	98	98
2	2017	100	198
3	2018	100	298
4	2019	98	396
5	2020	101	497
6	2022	100	597

With the help of the coordinate picker (https://www.mapcoordinates.net/en, accessed on 2 November 2022) to obtain the geographical coordinates of each architectural heritage, a geographic database of 20CCAH was established. ArcGIS is a software tool primarily used for geographic information system (GIS) analysis and spatial data processing. ArcGIS supports the analysis of various types of spatial data and also has various types of tools that can reveal various relationships and trends in data through spatial analysis. ArcGIS spatial technology was used to spatially analyze the data and generate a geographical distribution map of 20CCAH (Figure 1) (the eight geographic divisions in the figure were obtained based on Table 3).

Figure 1. Geographical distribution of China's 20th-century architectural heritage.

Table 3. The distribution of China's 20th-century architectural heritage in eight geographical regions.

No.	Geographical Division	Amount	Proportion/%	Cumulative Proportion/%
1	Northeast Region	50	8.38	8.38
2	North China	213	35.68	44.05
3	East China	129	21.61	65.66
4	Central China	72	12.06	77.72
5	South China	52	8.71	86.43
6	Southwest China	55	9.21	95.64
7	Northwest China	23	3.85	99.50
8	Qinghai–Tibet Region	3	0.50	100.00

2.2. Research Methodology

2.2.1. Nearest Neighbor Index

The spatial distribution of point elements can be divided into three types: condensed, uniform, and random. The nearest distance of point elements with uniform distribution is the largest, followed by random distribution, and the condensed distribution is the smallest. Nearest distance is a geographical indicator indicating the proximity of point-like objects

in geographical space [22]. The nearest neighbor index can effectively reflect the spatial distribution characteristics of point-like elements [23]. The calculation method is the ratio of the actual nearest distance to the theoretical nearest distance (the theoretical value of random distribution). The formula is as follows:

$$R = \frac{\overline{r_1}}{\overline{r_E}} = 2\sqrt{D} = 2\sqrt{\frac{m}{A}} \quad (1)$$

where R is the nearest neighbor index, $\overline{r_1}$ is the actual nearest distance, $\overline{r_E}$ is the theoretical nearest distance, A is the region's area, m is the number of points, and D is the point density. When $R = 1$, it means the distribution of point elements in space is a random type; $R < 1$ means it tends to be agglomerative distribution; $R > 1$ means it tends to be uniform distribution; $R = 0$ means it is completely concentrated.

2.2.2. Gini Coefficient

The Gini coefficient is an important method to study the spatial distribution of discrete regions in geography. It is used to compare the regional distribution differences in different research objects and then find the patterns of their geographical distribution changes [24]. This study used it to measure the spatial distribution of 20CCAH. The formula for calculating the Gini coefficient is as follows:

$$G = \frac{-\sum_{i=1}^{n} P_i \ln P_i}{\ln N} \quad (2)$$

$$c = 1 - G \quad (3)$$

where P_i is the proportion of the amount of 20CCAH in the ith region to the national total, N is the number of regions, and c is the uniformity of distribution. The Gini coefficient is between 0 and 1; the larger the coefficient, the higher the degree of concentration.

2.2.3. Imbalance Index

The imbalance index reflects the completeness or balance of the distribution of research objects at different levels or regions [25]. This study used it to measure the balanced distribution of 20CCAH. The imbalance index adopts the formula for calculating the concentration index in the Lorenz curve:

$$S = \frac{\sum_{i=1}^{n} Y_i - 50(n+1)}{100n - 50(n+1)} \quad (4)$$

where n is the number of provinces and regions, $n = 34$, and Y_i represents the number of heritages in the province, ranked i-th in descending order of heritage number. The imbalance index S is between 0 and 1; if 20CCAH is evenly distributed among the provinces and regions, $S = 0$; if the scenic spots are all concentrated in one province and region, $S = 1$.

2.2.4. Kernel Density Analysis

Kernel density analysis can express the spatial distribution density of 20CCAH. The spatial distribution characteristics of elements can be expressed through morphological features. Density analysis can clearly express the scattered or discrete characteristics of elements [26]. The kernel density analysis takes 20CCAH as the center of the circle and the input value as the search radius. The Rosenblatt–Parzen function estimates the probability of factor F's occurrence in the circle by counting the number of heritages. The formula is:

$$F(x) = \frac{1}{nh} \sum_{i=1}^{n} k\left[\frac{(x - x_i)}{h}\right] \quad (5)$$

where $k\left[\frac{(x-x_i)}{h}\right]$ denotes the kernel function, h denotes the search radius, $(x - x_i)$ denotes the distance from the estimated point x to the observed point x_i, and n denotes the amount of 20CCAH in the scale range.

2.2.5. Geographical Detector

The detector model is a tool for detecting spatial heterogeneity and revealing its driving force [27]. It can detect the relationship between influencing factors and geographical phenomena without any linear assumption, and its calculation process and results will not be affected by multivariable collinearity. In this study, the model is used to explore the explanatory power of different factors on the spatial differentiation of 20CCAH, measured by the q value. Assume that the study area is M, and the distribution density of 20CCAH is Y within the M range. Assume that there may be factors that affect the spatial distribution of 20CCAH, $x = \{x_i\}, i = 1, 2, \ldots, n$; n is the classification number of impact factors, and X_i represents the different classification of factors. In order to detect the spatial correlation between the influencing factor X and the 20CCAH density Y, the layer Y is overlapped with the layer where factor X is located. In each subregion of factor X, the discrete variance of Y is recorded as σ_i^2, the explanatory power q of the influencing factor X on the distribution density Y of 20CCAH is:

$$q = 1 - \frac{\sum_{i=1}^{n} N_i \sigma_i^2}{N\sigma^2} \tag{6}$$

where n is the number of subareas divided by the influencing factor X (number); N_i is the amount of 20CCAH in a certain subregion (place); N is the amount of 20CCAH in the whole region (place); σ_i^2 is the variance of 20CCAH density in a certain subregion; and σ^2 is the variance of 20CCAH density of various provinces. The value range of q is [0,1]. The larger the value of q, the greater the influence of the factor on the spatial distribution of 20CCAH, and vice versa, the weaker it is; if $q = 1$, the factor completely influences its spatial distribution, while if $q = 0$, the factor is irrelevant to its spatial distribution.

In this paper, we selected five major driving factors for the research object: topography, regional status, culture and education, social and economic development level, and external contact.

2.3. Research Design

We used ArcGIS and geographical detector software. ArcGIS is a series of client software, server software, and online geographic information system services developed and maintained by Esri. It has the characteristics of accurate analysis results, strong visual expression, support for scalability, and data sharing. Geographical detector is a statistical tool to detect the spatial differentiation of elements and reveal their driving force. It can analyze spatial heterogeneity and verify the reliability of results through the spatial autocorrelation test and other methods, which largely avoids the errors introduced in the process of spatial data analysis. During the research process, a coordinate picker was used to extract the longitude and latitude of spatial coordinates, as it has the characteristics of easy operation, rich data, a simple interface, global use, and being free of charge. DEM data provided by GEBCO were used, covering a global scale in 2022, including land elevation and ocean depth. This raster dataset has numerical units in meters, a spatial resolution of 15 arcseconds, and an accuracy equivalent to approximately 0.5 km. This study used spatial software and indices to study 20CCAH. Figure 2 shows a flowchart specific to the research method. The nearest neighbor index, Gini coefficient, and unbalanced index were used to distinguish the spatial distribution types and aggregation degree of 20CCAH. Kernel density analysis was used to analyze the spatial distribution of 20CCAH. Geographical detectors were used to measure the impact of specific factors on the distribution of 20CCAH.

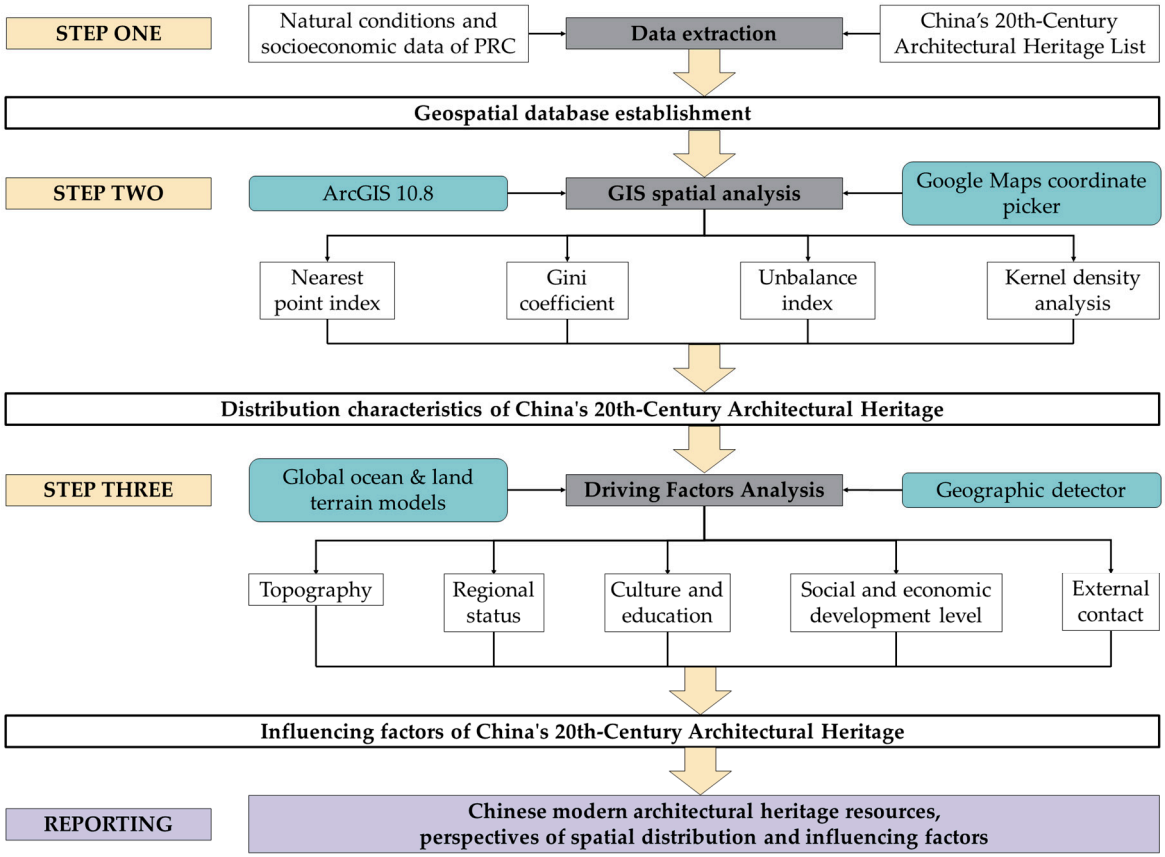

Figure 2. Flowchart of research methodology.

3. Results

3.1. Spatial Distribution Characteristics

3.1.1. Type of Spatial Distribution

From a macroscopic point of view, 20CCAH can be abstracted as point-like elements (using the main entrance of the 20th-century architectural heritage as the benchmark), which are discrete and distributed within the territory of China. According to Formula (1), the nearest neighbor index is a simple, intuitive, and effective spatial analysis method, which is applicable to many practical problems, including ecology, geography, urban planning, and other fields. The following calculation shows the closest approximation of the ideal random distribution of 597 20CCAH:

$$\overline{r_E} = \frac{1}{2\sqrt{n/A}} = \frac{1}{2\sqrt{597/9600000}} \approx 63.40(\text{km})$$

Based on the ArcGIS measurements, the actual nearest linear distance values r_1, i $(i = 0 \sim 508)$ between each sample heritage and its nearest sample heritage were obtained, and the average nearest distance was found:

$$\overline{r_1} = \frac{1}{597}\sum_{i=0}^{596} r_{1,i} \approx 21.02(km)$$

Therefore, $\overline{r_1} < \overline{r}_E$, and the nearest neighbor index $R = 21.02/63.40 \approx 0.33 < 1$, i.e., the distribution of 20CCAH is of the cohesive type.

3.1.2. Balanced Spatial Distribution

- Provincial level

The balance of 20CCAH was analyzed at the provincial level; as China is a country with a large population, vast territory, and imbalanced economic and social development levels, there are huge differences in economic development, human resources, natural resources, and other aspects between provinces [28]. Subregional exploration of the spatial distribution of 20CCAH can reveal the spatial distribution at a deeper level and this can be compared between different regions.

In this study, China is divided into eight geographical divisions, which are: Northeast Redin (Heilongjiang, Jilin, Liaoning), North China (Beijing, Tianjin, Hebei, Shanxi, Henan, Shandong), East China (Shanghai, Jiangsu, Zhejiang, Fujian), Central China (Anhui, Jiangxi, Hubei, Hunan), South China (Guangdong, Guangxi, Hainan, Hong Kong, Macau, Taiwan), Southwest China (Yunnan, Guizhou, Sichuan, Chongqing), Northwest China (Shaanxi, Gansu, Ningxia, Inner Mongolia, Xinjiang), and the Qinghai–Tibet Region (Qinghai, Tibet) [29]. The Gini coefficient now analyzes the amount of 20CCAH distributed in the eight geographical regions of China (Table 3) to determine the uniform distribution in the eight geographical regions of China.

According to Formulas (2) and (3), the Gini coefficient is a commonly used indicator for evaluating inequality, which can measure the degree of imbalance in the distribution of discrete variables. It has the characteristics of having quantifiable data, ease of calculation, and wide applicability. It is an effective indicator for analyzing the imbalance of 20CCAH distribution and has important application value in practical research. After calculation, $H = 1.746$, $H_m = 2.079$, $\text{Gini} = 0.840$, $C = 0.160$. So, the Gini coefficient (Gini) is 0.840, and distribution uniformity (C) is 0.160. The results show that 20CCAH is concentrated in eight geographical regions, with low distribution uniformity.

According to Formula (4), the imbalance index can objectively evaluate the uniform distribution of a certain area or object through quantitative measurement. It has the characteristics of objective measurement methods and easy interpretation of results, and is an effective indicator for analyzing the imbalance of 20CCAH distribution. After calculation, the imbalance index S = 0.576, indicating that the distribution of 20CCAH in 34 provinces and regions is uneven. According to the Lorenz curve (Figure 3) of 20CCAH in various provinces and regions, the amount of 20CCAH in Beijing, Jiangsu, Shanghai, Guangdong, Tianjin, Hubei, and Chongqing has reached more than half of the total number.

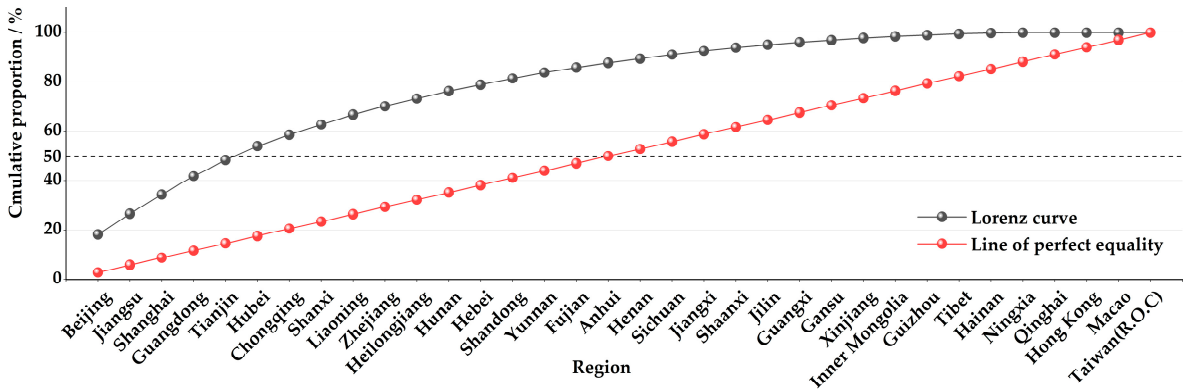

Figure 3. Lorenz curve of the number of China's 20th-century architectural heritage.

- Urban level

Analyzing the balance of 20CCAH at the urban level can provide us with a more systematic and comprehensive perspective. There are three types of cities in China: municipalities directly under the central government, provincial capital cities, and prefecture-level cities. A municipality directly under the central government is an organic city directly

under the jurisdiction of the Central People's Government, and its administrative status is the same as that of a provincial administrative region; the provincial capital city is the central city of a provincial administrative region; and the prefecture-level city is the opposite to a provincial capital city. It is a city in the provincial administrative region other than provincial capital cities. This is because municipalities directly under the central government have higher administrative authority and a more developed economy and culture compared to other levels. Relatively speaking, the administrative management of prefecture-level cities is more grassroots, and the type and scale of 20CCAH were also relatively small. Using the natural breakpoint method in the ArcGIS Reclassification Tool, the number of cities was divided into four levels (Table 4).

Table 4. Quantitative classification of China's 20th-century architectural heritage.

Quantity Level	Number of Heritage Sites	Tagging
1	7–109	Rich
2	3–6	Average
3	1–3	Few
4	1	Very few

From the perspective of quantity difference, the average value of level 1 is 56, which is higher than the average value of level 2; from the perspective of the difference in grade ratio, all municipalities directly under the central government are located at level 1, while levels 2 and 3 are composed of provincial capitals and prefecture-level cities, and level 4 contains only prefecture-level cities (Figure 4).

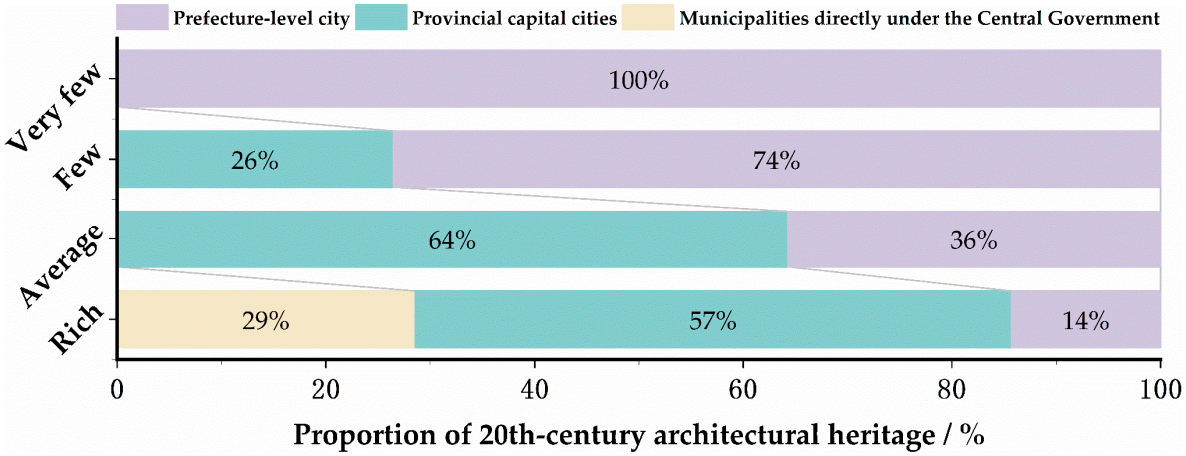

Figure 4. China's 20th-century architectural heritage is distributed in different levels of cities.

3.1.3. Spatial Distribution Density

According to Formula (5), the kernel density analysis uses the kernel function to calculate the probability density of each point and smooths it to obtain the global density distribution function. It has the characteristics of not requiring any pre-range conditions, smooth processing, and easy visualization. Using kernel density functions to analyze the spatial distribution density of 20CCAH is more effective than other functions. The method is as follows: Use the Density tool in the ArcGIS10.8 Toolbox to analyze the density of 597 20CCAH. Select Kernel; the search radius and output cell size are the default values, and the area units are square kilometers. The density values calculated according to the natural breakpoint classification method can be divided into four levels: core density, high density, medium density, and low density (Table 5). Finally, the spatial kernel density distribution of 20CCAH can be generated (Figure 5); 20CCAH is unevenly distributed and has obvious aggregation.

Table 5. Kernel density analysis of China's 20th-century architectural heritage.

Density Classification	Administrative Region	Amount	Kernel Density Zone
Core density	Beijing	109	20–50
High density	Jiangsu	50	6–20
	Shanghai	47	
	Guangdong	44	
	Tianjin	39	
	Hubei	34	
	Chongqing	27	
	Shaanxi	8	
Medium density	Shanxi	25	0.8–6
	Liaoning	24	
	Zhejiang	20	
	Heilongjiang	19	
	Hunan	18	
	Hebei	15	
	Shandong	15	
	Yunnan	15	
	Fujian	12	
	Anhui	11	
	Henan	10	
	Sichuan	10	
	Jiangxi	9	
	Jilin	7	
	Guangxi	6	
	Gansu	5	
	Xinjiang	5	
Low density	Inner Mongolia	4	0.2–0.8
	Guizhou	3	
	Tibet	3	
	Hainan	2	
	Ningxia	1	

"One kernel" refers to Beijing as the core, radiating to Tianjin and Hebei. The kernel density index of core density is greater than 20. "Seven centers" refer to Jiangsu as the center, radiating to Shanghai and Anhui; take Shanghai as the center and radiate to Zhejiang; take Guangdong as the center and radiate to Guangxi and Hainan; take Tianjin as the center and radiate to Hebei and Shanxi; take Hubei as the center and radiate to Hunan and Jiangxi; take Chongqing as the center and radiate to Sichuan; Shaanxi is a single central area. The kernel density index of the high-density region is between 6 and 20. "Multiple scattered points" refer to four scattered points in Inner Mongolia, Ningxia, Xinjiang, and Tibet. The kernel density index of medium and low density is between 0.2 and 6.

3.2. Space from Different Perspectives

3.2.1. Perspective of Different Historical Stages

Analyzing 20CCAH into different time periods can provide a more comprehensive and in-depth understanding of the changes and development of this architectural heritage in different historical backgrounds. Through this analysis method, we can better grasp the historical context and evolution trend in 20CCAH. This analysis is conducive to sorting out the development context, style direction, innovation, and development in architectural design of 20CCAH, as well as the influence of cultural exchanges between China and other countries. It also helps to position China in the history of world architectural development. Combining the Illustrated History of Modern Chinese Architecture and The History of Modern Chinese Architecture, we divided the 20th century into nine periods based on the different development stages of 20CCAH (Figure 6).

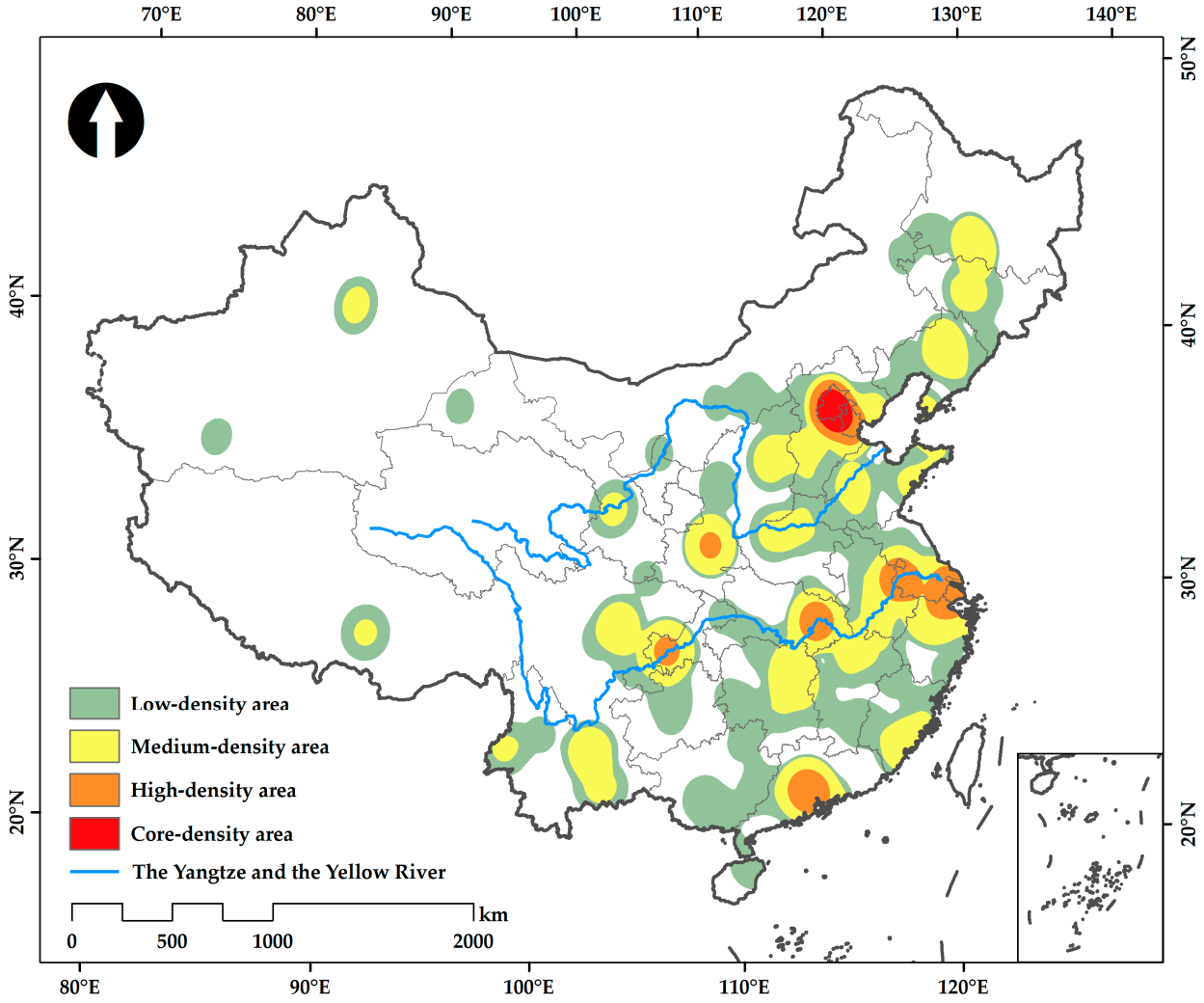

Figure 5. Kernel density distribution of China's 20th-century architectural heritage.

We established a database for 20CCAH within nine time periods; used the directional distribution tool in the ArcGIS10.8 toolbox, selected the standard deviation for the ellipse size, and left the others as default. Finally, we generated the directional distribution of 20CCAH within different periods (Figure 7).

From the perspective of different historical stages, the distribution of 20CCAH has a significant trend in spatial direction change, generating directional offset data (Figure 8). For example, the center of gravity of 20CCAH from 1900 to 1927 shifted 0.67° to the south and 1.15° to the east to obtain the center of gravity of 20CCAH from 1928 to 1937; the center of gravity of 20CCAH from 1928 to 1937 shifted 2.57° to the south and 7° to the west to obtain the center of gravity of 20CCAH from 1938 to 1948, and so on. In the 1930s, under the influence of Japan's invasion of China, the center of gravity of 20CCAH shifted westward; the establishment of The People's Republic of China in 1949 led to a change in the center of gravity of the distribution of 20CCAH, which shifted eastward to the north.

We created a database of 20CCAH within nine time periods and used the Create Tyson Polygon tool in the ArcGIS 10.8 toolbox to generate the spatial distribution of 20CCAH within different periods. By using the Tyson polygon and calculating the CV value, comparing the degree of aggregation of 20CCAH within the nine time periods is possible [30]. During 1900–1927, the distribution and concentration of 20CCAH was the largest (Table 6). The CV is the coefficient of variation, which is the ratio of the standard deviation to the mean, expressed as a percentage (%). Gathering provinces are those that are at the most central level after kernel density analysis, based on the experimental data.

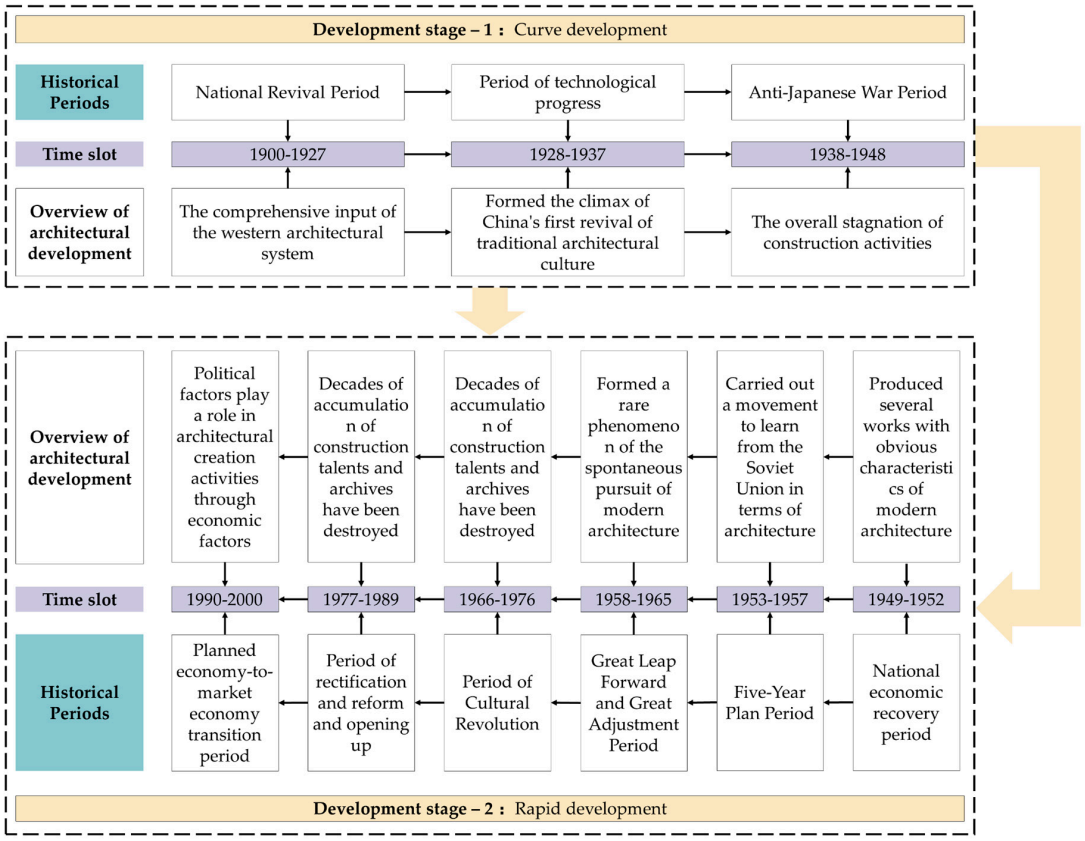

Figure 6. Nine periods based on the different development stages of China's 20th-century architectural heritage.

Table 6. Spatial agglomeration of China's 20th-century architectural heritage within nine time periods.

Time Slot	CV Value	Gathering Provinces
1900–1927	4.69	Beijing, Hebei, Guangdong, Hebei, Zhejiang, Jiangsu
1928–1937	3.73	Beijing, Hebei, Shanghai, Zhejiang, Guangdong, Hubei
1938–1948	2.52	Beijing, Shanghai, Chongqing, Hunan, Yunnan
1949–1952	2.33	Beijing, Shanghai, Guangdong
1953–1957	2.06	Beijing, Shanghai, Chongqing, Hubei, Shaanxi, Guangdong
1958–1965	2.73	Beijing
1966–1976	2.22	Beijing, Shanghai, Hubei,, Fujian, Hainan
1977–1989	2.10	Beijing, Shanghai, Guangdong, Hainan
1990–2000	1.33	Liaoning, Shanghai, Guangdong

3.2.2. Perspectives from Different Architectural Categories

Analyzing the distribution of different categories of 20CCAH can help to formulate more scientific and reasonable urban development plans and construction plans to better protect and utilize the cultural heritage. The functions of 20CCAH are divided into 6 categories and 20 subcategories (Table 7). Among them, educational buildings account for the highest proportion because they generally have historical, cultural, and social values.

For long-term use, they are designed with more durable materials and structures from the beginning, meeting the indicators of accessibility, visibility, usability, and relevance for declaring architectural heritage [31].

The statistical results show that the categories of science, education, and culture buildings (159) and infrastructure buildings (119) were the main types, accounting for 46.57% of 20CCAH. In the science, education, and culture buildings category, educational

buildings had the largest number (95), accounting for 59.75% of this category. Performance buildings (46) had the most infrastructure sites, accounting for 38.66% (Figure 9).

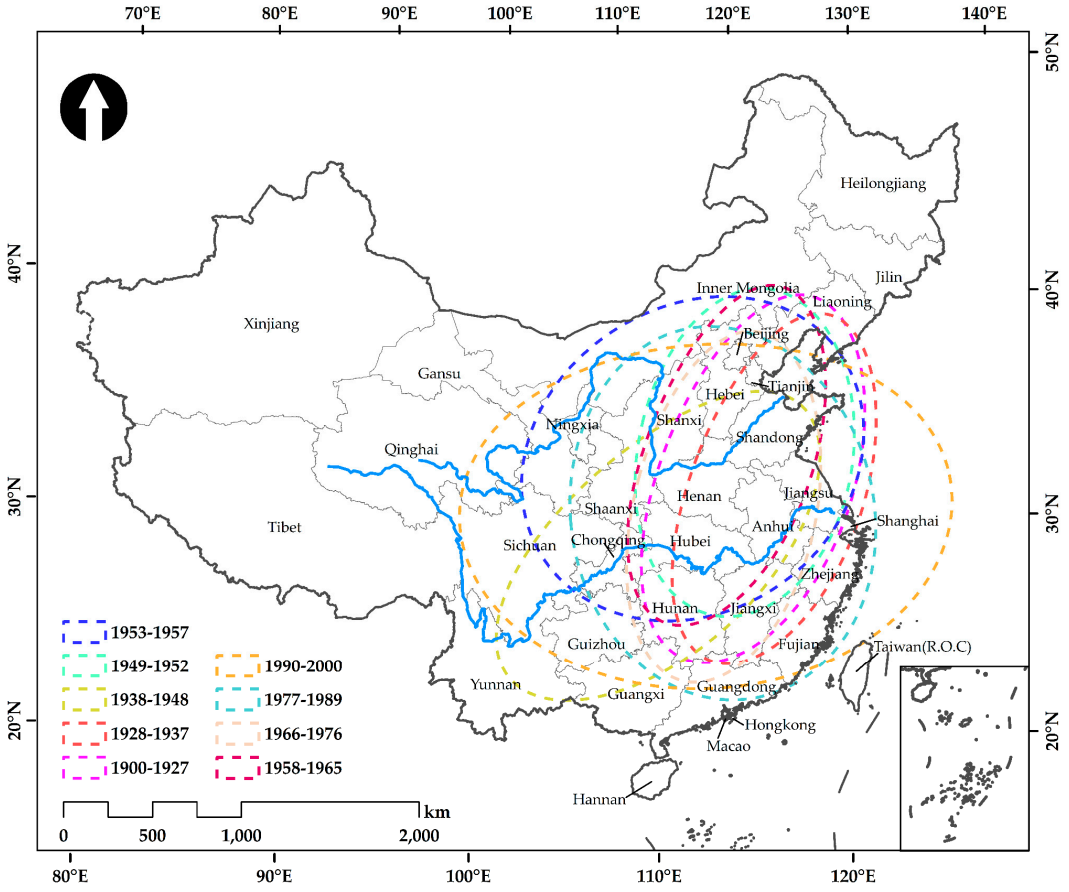

Figure 7. Directional distribution of China's 20th-century architectural heritage within nine time periods.

Table 7. Classification and number of China's 20th-century architectural heritage building.

Category	Amount	Subcategory	Amount
1. Industrial Buildings Category	37	1. Industrial Buildings Category	37
2. Living Buildings Category	72	2.1 Hotel Buildings	22
		2.2 Residential and Settlement Buildings	50
3. Commercial and Office Buildings Category architecture	117	3.1 Financial Buildings	17
		3.2 Government Office Buildings	43
		3.3 Commercial Buildings	59
4. Science, Education, and Culture Buildings Category architecture	159	4.1 Scientific Research Buildings	8
		4.2 Cultural Buildings	56
		4.3 Educational Buildings	95
5. Infrastructure Buildings Category	119	5.1 Medical Buildings	10
		5.2 Communication Buildings	14
		5.3 Sports Buildings	15
		5.4 Transportation Buildings	32
		5.5 Performance Buildings	46
6. Monumental Buildings Category	93	6.1 Natural Disaster Memorial Buildings	3
		6.2 Martyr Memorial Buildings	11
		6.3 Religious Buildings	16
		6.4 Celebrity Memorial Buildings	17
		6.5 Revolutionary Memorial Buildings	22
		6.6 Conference Memorial Buildings	24
Total	597	Total	597

Different types of 20CCAH present different distribution characteristics (Figure 10). According to the spatial distribution of 20CCAH, Beijing is at the core of No. 2–No. 5, as it is China's political, economic, and cultural center. No. 1 is concentrated in the Yangtze River Delta because of its superior geographical location, complete infrastructure, large market demand, and sufficient human resources and government support. No. 6 is concentrated in Shanghai and Wuhan. As one of the earliest open cities in China, many foreigners have left monumental buildings for Shanghai. Over the past 100 years, Wuhan has experienced many significant events and changes during the Revolution of 1911 and World War II, which have left many monumental buildings behind [32,33].

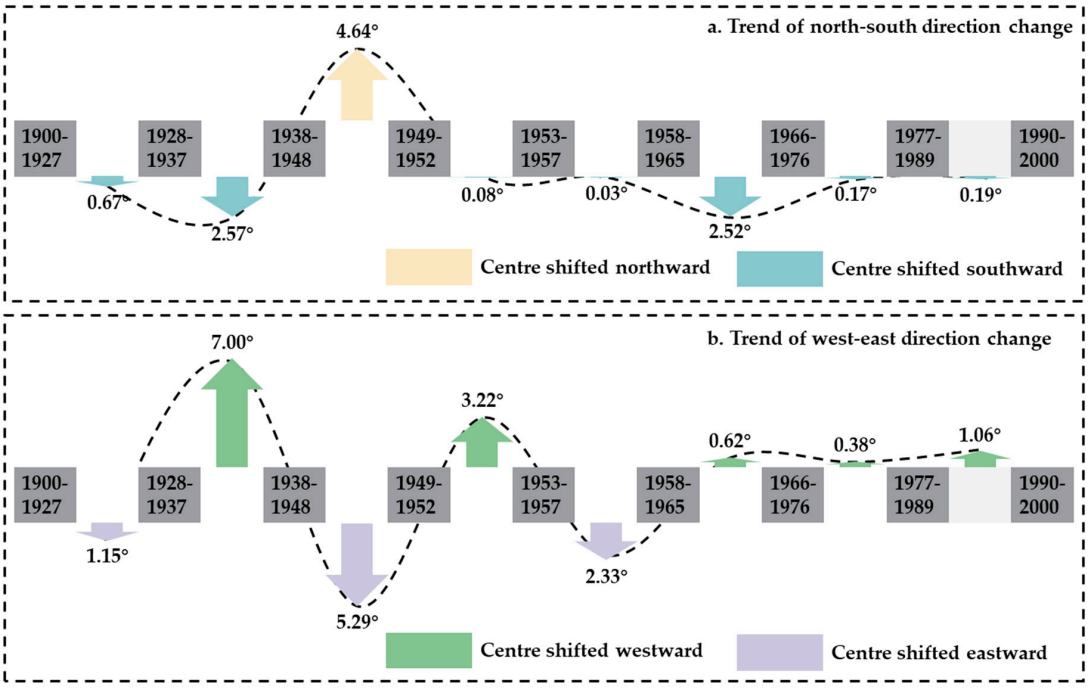

Figure 8. Deviation angle of China's 20th-century architectural heritage spatial direction in different historical stages.

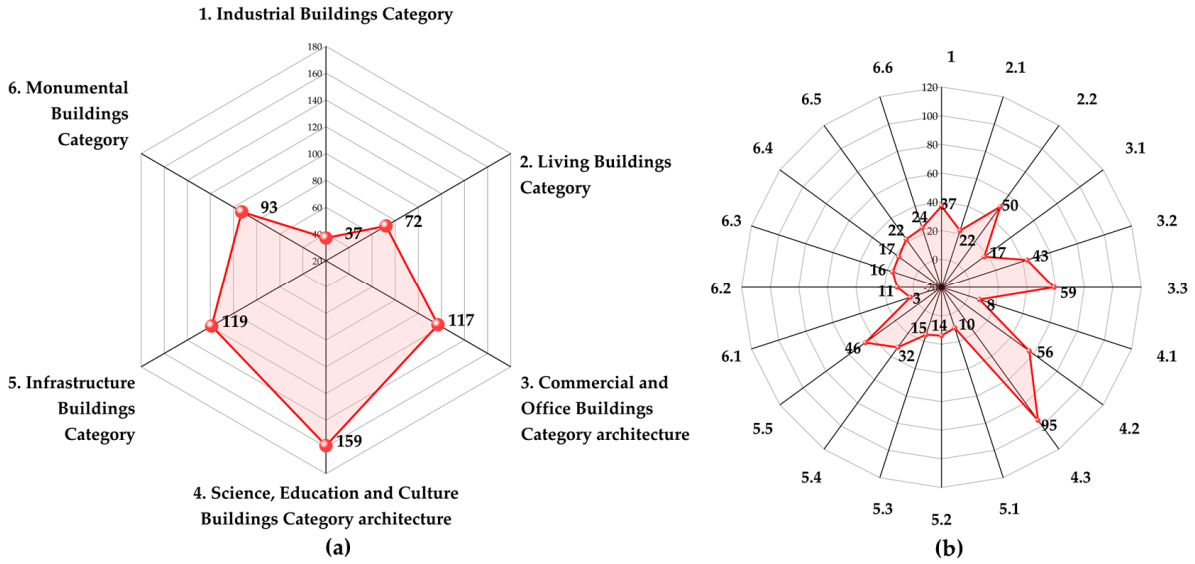

Figure 9. (**a**) Statistics on the categories of China's 20th-century architectural heritage. (**b**) Statistics on the subcategories of China's 20th-century architectural heritage.

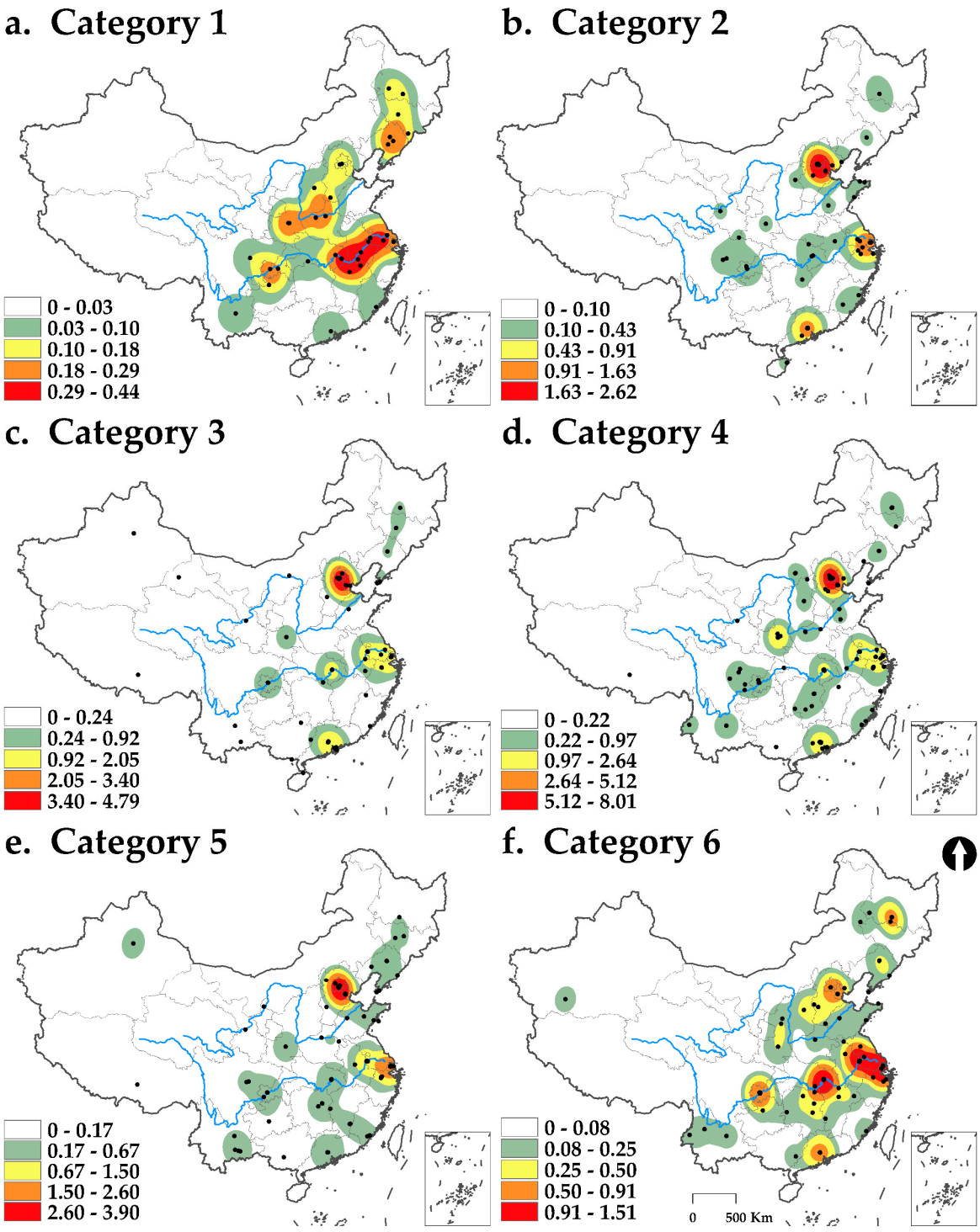

Figure 10. Kernel density distribution of different types of China's 20th-century architectural heritage.

4. Analysis of Influencing Factors

4.1. Selection of Influencing Factors

The spatial distribution pattern of 20CCAH is affected by many factors. Based on the characteristics of 20CCAH, we summarized the direction of thinking of five major influencing factors from the objective topography, politics, culture, economy, and transportation, thinking out of the box in these five general directions. Ultimately, this study selected 12 indicators from 5 dimensions, including topography, regional status, culture

and education, socioeconomic development level, and external relations, as the influencing factors (Table 8) [34].

Table 8. Selection of influencing factors.

Criterion Layer	Factor Layer	Indicator Interpretation
T1: Topography	X1: Slope	The slope of each point
	X2: Relief	The relief of each point
	X3: Altitude	The altitude of each point
T2: Regional status	X4: Historical position	Times of being an ancient capital
	X5: Political status	Administrative division
T3: Culture and education	X6: Historical and cultural deposits	The number density value of key cultural relics protection units in China
	X7: Education level	Number of universities
T4: Social and economic development level	X8: Population density	The ratio of urban population to an area
	X9: Urbanization level	Population urbanization rate
	X10: GDP per capita	GDP per capita
T5: External contact	X11: Traffic location	Transport hub level
	X12: Highway network density	The ratio of total mileage to an area of an urban highway

4.2. Cause Analysis

According to Formula (6), geographical detector is a method for detecting the spatial heterogeneity of geographic elements and revealing their influencing factors. It can detect both numerical and deterministic data, as well as the interaction between two factors on the dependent variable. The main influencing factors of the spatial distribution pattern of 20CCAH are measured by geographical detectors (Table 9).

Table 9. Detection results of influencing factors of geographical detectors.

Criterion Layer	Factor Layer	q Statistic	*p*-Value
T1: Topography	X1: Slope	0.476	0.007 *
	X2: Relief	0.466	0.008 *
	X3: Altitude	0.459	0.009 *
T2: Regional status	X4: Historical position	0.162	0.383
	X5: Political status	0.623	0.000 *
T3: Culture and education	X6: Historical and cultural deposits	0.743	0.000 *
	X7: Education level	0.704	0.000 *
T4: Social and economic development level	X8: Population density	0.638	0.000 *
	X9: Urbanization level	0.724	0.000 *
	X10: GDP per capita	0.805	0.000 *
T5: External contact	X11: Traffic location	0.508	0.003 *
	X12: Highway network density	0.599	0.000 *

Note: * distribution is a significant correlation between *p*-value and 1% level quotient.

4.2.1. Topography

- Slope
- Using the slope analysis tool in ArcGIS 10.8, we extracted Chinese DEM data for slope analysis, and overlaid them on 20CCAH. Then, we used the value extraction to point the tool to obtain slope values for 597 20CCAH. By analyzing the data at all points, it was found that all 20CCAHs are in low sloping areas (0–15°), of which 570 are in flat sloping areas (0–5°), accounting for approximately 95%.
- This is because, in areas with smaller slopes, the terrain conditions are good and easy for architecture development and maintenance, the construction cost of architecture is low, and its stability is better. For example, the second Workers' Cultural Palace in Tianjin (Figure 11) [35], built at the lowest slope, is located on Guanghua Road in

Hedong District, Tianjin, at a height comparable to the surrounding Hongyun Avenue and Xinxin Avenue, with no significant difference in slope.

Figure 11. Tianjin Second Workers' Cultural Palace.

- Relief
- This study used Chinese DEM data and the ArcGIS 10.8 spatial analysis tool Neighborhood Analysis to extract the maximum and minimum altitudes in the analysis window (containing the entire territorial scope of the Government of the People's Republic of China). Next, it used a raster calculator tool to calculate their differences to generate a topographic map (Figure 12b). Then, it used the value extraction point tool to obtain the undulation values of 597 20CCAH. By analyzing the data from all points, it was found that the undulation of all 20CCAHs was less than 500 m, with 446 sites located in plain areas (<30 m), accounting for approximately 75%. This map shows that 20CCAH is concentrated in low-value areas with undulating terrain, gradually decreasing from low to high.

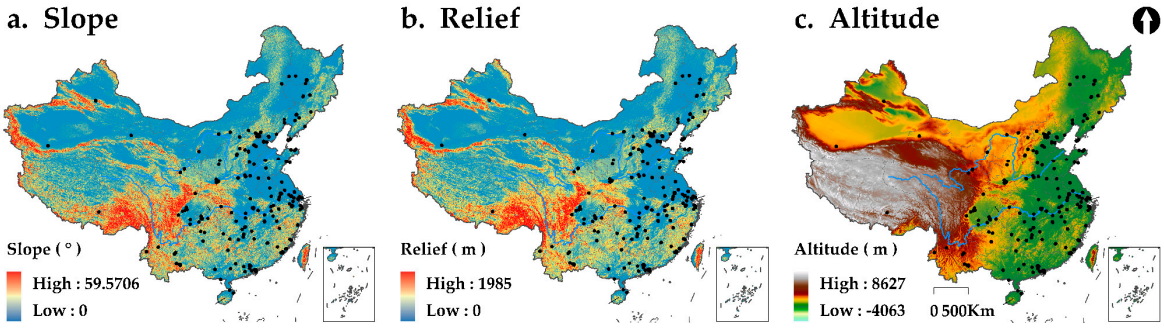

Figure 12. Spatial relationships between China's 20th-century architectural heritage distribution and topography factors.

- The undulation affects the location of 20CCAH and limits population distribution, road traffic, economic development, and cultural exchange, which profoundly impacts the spatial distribution of 20CCAH.
- Altitude

- Altitude is an important factor affecting the distribution of 20CCAH and an important indicator for quantitative studies. By using the ArcGIS 10.8 Surface Analysis Slope tool, we reclassified the DEM data in China using the natural break method and overlaid them on 20CCAH (Figure 12c). The map layout shows that, in general, 20CCAH is located at low and medium altitudes. Statistics revealed 542 20CCAHs below the average altitude range of China, accounting for approximately 91% of them. The higher the altitude, the lower the amount of 20CCAH, and the distribution of 20CCAH negatively correlates with the altitude.
- At higher altitudes, the terrain is usually complex, and the architecture requires more civil engineering and infrastructure investment, resulting in higher construction and maintenance costs. Furthermore, due to the relatively fragile ecological environment in high-altitude areas, people are more inclined to establish these areas as natural reserves to protect local biodiversity and ecosystems [36–38].

4.2.2. Regional Status

- Historical position
- The impact of historical position on the spatial distribution of 20CCAH is 0.162, which has almost no impact. This is because whether ancient times served as capitals did not significantly impact the rapid development in the 20th century, such as Shanghai, Shenzhen, and Tianjin. Even if their historical position was not high, it did not affect their rapid development in the 20th century (data source: http://114.xixik.com/chinese-dynasties/, accessed on 10 November 2022).
- Political status

Since ancient times, the political status of a city has had a close relationship with its development [39]. The cities with high political status include Beijing, Tianjin, Shanghai, and Chongqing. These four cities are also the dense distribution areas of 20CCAH.

As the capital of China, Beijing has been the center of China and the center of foreign exchange since the Yuan Dynasty, attracting many economic resources and foreign investment [40]. As the "wartime capital" during the Anti-Japanese War, Chongqing was the political, military, economic, and cultural center of the rear area. It later became the capital of the Republic of China [41–43]. To adapt to the work of government agencies, many architectures were built at this time (data source: https://www.gov.cn/guoqing/2005-09/13/content_5043917.htm, accessed on 2 November 2022).

4.2.3. Culture and Education

- Historical and cultural deposits

Architectural heritage is a rational and intuitive presentation of history [44]. Beijing has the largest historical and cultural heritage distribution, followed by Henan, Shaanxi, Jiangsu, Jiangsu, Chongqing, Zhejiang, and Sichuan.

Among them, Beijing has 126 key cultural relic protection units in China, ranking first in the country. The Red Mansion of Peking University (Figure 13) [45] is not only the first batch to be included in the 20CCAH List but also the first batch to be included in China's key cultural relics protection units. It is at No. 29, Wusi Avenue, Dongcheng District, Beijing, China. It is one of the old buildings of Peking University and one of the main venues of the May Fourth Movement [46]. It is now the Lu Xun Museum in Beijing (the Memorial Hall of the New Cultural Movement in Beijing) and the Memorial Hall of the Early Revolutionary Activities of the CPC in Beijing (data source: https://en.wikipedia.org/wiki/Major_Historical_and_Cultural_Site_Protected_at_the_National_Level, accessed on 5 November 2022).

Figure 13. The Red Mansion of Peking University.

- Education level

The more frequent the economic and cultural exchanges, the more architectural heritages are built in areas with higher educational levels [47].

Beijing, Wuhan in Hubei, and Guangzhou in Guangdong are the cities that have a dense high-level educational institutions distribution [48]. Among them, Beijing has 92!universities, ranking first in the country. These three cities are also areas with relatively dense 20CCAH (data source: http://www.moe.gov.cn/jyb_xxgk/s5743/s5744/A03/202206/t20220617_638352.html, accessed on 5 November 2022).

4.2.4. Social and Economic Development Level

- Population density

The population density factor and the urbanization rate factor reflect the intensity of human activities [49]. This study found that the interpretation of the population density factor on the spatial distribution of 20CCAH is 0.638. Among them, Shanghai, Beijing, and Tianjin have the highest population density. Densely populated areas require more residential, commercial, and public facilities to meet the needs of daily life and work [50].

Since Shanghai became a port city in the mid-19th century, the focus of China's foreign trade has rapidly shifted from Guangzhou to Shanghai, which has promoted Shanghai's economic development and urban construction, becoming the first super city in China with a population of over 2 million and retaining a large number of cultural and entertainment architectures (data source: https://www.gov.cn/xinwen/2021-05/11/content_5605779.htm, accessed on 6 November 2022).

- Urbanization level

The urbanization level factor reflects the degree of population aggregation in urban areas [51]. The acceleration of urbanization and the expansion of urban scale will affect the distribution of 20CCAH. In the 1930s, Shanghai, Beijing, and Tianjin had the highest urbanization level [52]. With the increase in urbanization, the economic scale of cities has

also increased, requiring more office, commercial, and industrial architectures to support economic development.

As a city with a high urbanization level, Shenzhen has become a new type of immigrant city in China since its establishment in 1979. The late 1980s were the fastest period of urban construction in Shenzhen, and 20CCAH was built during this period (data source: http://www.stats.gov.cn/sj/ndsj/, accessed on 2 November 2022).

- GDP per capita

GDP per capita is an effective tool to grasp the operation of the regional macro-economy, which objectively reflects the level and degree of social development. The results show that the explanatory power of per capita GDP to the spatial distribution of 20CCAH is 0.805. Beijing, Shanghai, and Shenzhen have a high per capita GDP, and their 20CCAH is abundant.

As the fastest developing city in China after the reform and opening up, Shenzhen has built commercial and office architectures such as the International Trade Center Building, Shenzhen Nanhai Hotel, and Diwang Building to meet the needs of economic development (data source: http://www.stats.gov.cn/sj/ndsj/, accessed on 4 November 2022).

4.2.5. External Contact

- Traffic location

Traffic location guarantees and supports the development of the urban economy, society, and culture. Superior traffic location creates conditions for cultural exchange, urban construction, etc. Traffic location factors impact the type, quantity, and degree of architectural heritage protection. The results indicate that the explanatory power value of the impact of traffic location factors on the spatial distribution of 20CCAH is 0.508. Traffic location shows a positive correlation with the distribution of 20CCAH.

The degree of transportation convenience directly affects the scope of cultural exchange and the speed of cultural diffusion in cities. The commemorative architectural heritage of church architectures, auditorium architectures, and other types is largely influenced by cultural diffusion and dissemination processes. The higher the level of traffic location, the higher the degree of openness of the city to the outside world, and the more frequent crowd activities, increasing the demand for commercial, industrial, and living facilities, promoting the construction of residential architectures, commercial and government architectures, industrial architectures, etc.

Tianjin has been thriving since ancient times due to water transportation. In the 19th century, it was designated as a trading port and became an important gateway for the capital to the northeast and Shanghai directions. In the 20th century, it further developed into an international hub city with high levels of international exchanges. The gathering of numerous cultures has promoted the prosperity and development of Tianjin's architectural industry, retaining different historical buildings such as the Xikai Church, Xinhua Trust Bank Building, and the former site of Beiyang University (data source: http://www.stats.gov.cn/sj/ndsj/, accessed on 7 November 2022).

- Highway network density

The highway network is one of the important infrastructures of the modern economy, which is crucial for promoting economic growth and regional connections. The developed highway transportation has created conditions for cultural exchange, urban construction, and other aspects which impact the type, quantity, and degree of architectural heritage protection. The explanatory power of the impact of the highway network density on the spatial distribution of 20CCAH is 0.599. The highway network density shows a positive correlation with the distribution of 20CCAH.

The density of the highway network directly affects the scope of urban cultural exchange and the speed of cultural dissemination. Cultural diffusion and dissemination largely influence the commemorative architectural heritage of church architectures, hall architectures, and other types. A high-density highway network attracts a larger population and more commercial activities, meaning more convenient transportation and a wider market. Therefore, in areas with high-density highway networks, architectures are usually more concentrated and rise to meet the needs of population and economic development.

As one of the first cities to open up in China, many foreign firms opened branches in Shanghai in the early 20th century as transportation and trade flourished. Therefore, many architectural heritages are concentrated in the Huangpu River, the Bund area, the Nanjing Road Business District, and other areas in the center of Shanghai, including the Bund building complex, the Oriental Pearl TV Tower Shanghai Radio and Television Tower, Broadway Tower, and East China Power Building (data source: http://www.stats.gov.cn/sj/ndsj/, accessed on 9 November 2022).

5. Discussion

In recent years, the volume of 20CCAH listed in the 20CCAH List has increased significantly, closely related to the deepening understanding of the value of architectural heritage in China. Currently, the registered heritage is very unbalanced in spatial structure and type. For example, the sixth batch (2022) of 20CCAH produced by the promotion shows characteristics different from those of the past: since the COVID-19 pandemic in 2020, the promotion of the 20CCAH project has attracted great attention from the Committee's consultants and experts to Wuhan, a "heroic city" (Figure 14).

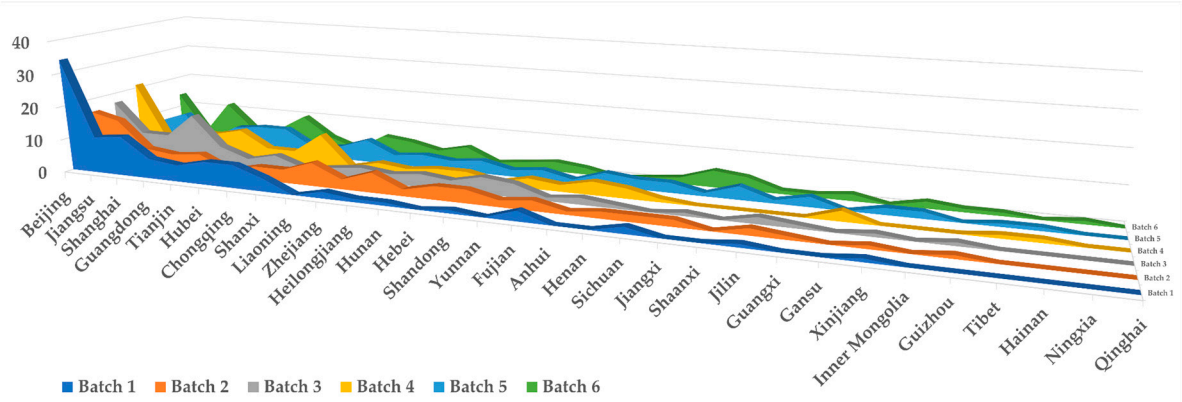

Figure 14. Stacking a map of each batch of China's 20th-century architectural heritage in each province.

Drawing on the international mainstream experience, the protection, management, and redevelopment of 20CCAH still faces many challenges. In the future, scholars can study the following aspects:

1. Scholars can study the architectural style of 20CCAH and the reasons for its formation.
2. Scholars can study the main spatiotemporal evolution trajectories of various styles of architecture and speculate on the reasons for and impact of spatiotemporal evolution on future architectural styles in China.
3. Scholars can further study the impact of the tourist market, policy support, and other factors on the spatial distribution of 20CCAH.
4. Scholars can consider the uniqueness of different types of 20CCAH, as well as sudden factors such as war and natural disasters, and further study the influencing factors and mechanisms of the spatial distribution of different types of 20CCAH.

6. Conclusions

This study used GIS and geographical detector to study 20CCAH. Based on exploring their spatial distribution characteristics, this study analyzed the influencing factors and draws the following conclusions:

1. The spatial pattern of 20CCAH is condensed. At the provincial level, there is a distribution pattern of one core, seven centers, and multiple scattered points; from the city level, 20CCAH exhibits significant differences in quantity similar to cliffs, and hierarchical differences similar to stairs. Furthermore, 20CCAH covers many types, divided into 6 main categories and 20 subcategories. In terms of main categories, it is mainly composed of scientific, educational, and cultural buildings; commercial and office buildings; and infrastructure buildings. In terms of subcategories, the number of educational buildings, commercial buildings, and cultural buildings is the largest. Beijing, the Yangtze River Delta region, Shanghai, and Wuhan are gathering places for six different types of architectural heritage.
2. The spatial distribution of 20CCAH is influenced by various factors. Good topography conditions are conducive to the discovery, construction, and protection of 20CCAH. The level of regional status affects the development, economic activities, and cultural inheritance of cities, leading to the emergence of various types of buildings such as commerce, education, and culture. Historical and cultural heritage is the foundation of 20CCAH, and the profound historical and cultural heritage makes 20CCAH more attractive to civilization and education. The level of social and economic development plays a decisive role in the construction, utilization, protection, and development of 20CCAH. The degree of external contact affects the convenience of building use, providing an auxiliary role for cultural exchange and economic development.

This study analyzed the spatial differentiation characteristics of 20CCAH. It revealed the influencing factors of spatial distribution from five aspects: topography, regional status, culture and education, social and economic development level, and the degree of external relations, providing some reference for the protection and utilization of 20th-century architectural heritage.

The 20CCAH is a precious aspect of human wealth that combines historical, architectural, and environmental values. It witnesses major historical events of the 20th century, reflects the history of China in the 20th century, and embodies the spirit of cities. This study helps us further understand the development history and characteristics of 20CCAH and provides a reference for today's architectural design and planning. Secondly, it can better protect and inherit the precious 20CCAH, promoting cultural diversity and exchange. Finally, this is also an important record and reflection of China's 20th-century history and culture, which can help to improve people's understanding of history and culture.

Author Contributions: Conceptualization, Jiazhen Zhang; methodology, Jiazhen Zhang; software, Yidan Liao; data curation, Jeremy Cenci; writing—original draft preparation, Yidan Liao; writing—review and editing, Yidan Liao; visualization, Jeremy Cenci; project administration, Jiazhen Zhang. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Xintian, Y. Harmonious World and China's Road of Peaceful Development. *China Int'l Stud.* **2007**, *6*, 11.
2. Jin, B. *China's Path of Industrialization*; Springer: Berlin/Heidelberg, Germany, 2020.
3. Feng, R.; Ma, T. Research on the Protection of Modern and Contemporary Urban Industrial Architecture Heritage in Shanxi. In Proceedings of the 3rd International Conference on Architecture: Heritage, Traditions and Innovations (AHTI 2021), Moscow, Russia, 9–10 March 2021; pp. 214–223.

4. Duan, L.; Liu, Z.; Yu, W.; Chen, W.; Jin, D.; Feng, Y.; Wang, Y.; Liu, J.; Zhou, H.; Sun, S. The provincial trend of population aging in China–based on population expansion forecast formula. *J. Comput. Methods Sci. Eng.* **2022**, *22*, 349–359. [CrossRef]
5. Li, J.; Shi, J.; Duan, K.; Li, H.; Zhang, Y.; Xu, Q. Efficiency of China's urban development under carbon emission constraints: A city-level analysis. *Phys. Chem. Earth Parts A/B/C* **2022**, *127*, 103182. [CrossRef]
6. Ahmad, Y. The scope and definitions of heritage: From tangible to intangible. *Int. J. Herit. Stud.* **2006**, *12*, 292–300. [CrossRef]
7. Amit-Cohen, I. Synergy between urban planning, conservation of the cultural built heritage and functional changes in the old urban center—The case of Tel Aviv. *Land Use Policy* **2005**, *22*, 291–300. [CrossRef]
8. Zhang, S. The preservation of 20th-century architectural heritage in China: Evolution and prospects. *Built Herit.* **2018**, *2*, 4–16. [CrossRef]
9. Zhang, P.; Xiang, M.; Zhang, T.; Yao, Y. Study on Comprehensive Value of Industrial Heritage in Yuejin Road Historic District Based on GIS Technology. *Open J. Soc. Sci.* **2021**, *9*, 440–454. [CrossRef]
10. Duan, J.; Lan, W.; Jiang, Y. An evaluation approach to spatial identity in historic urban areas from a humanistic perspective. *Front. Archit. Res.* **2022**, *11*, 806–814. [CrossRef]
11. Soliman, E.M. Blessed fate: The study on how heritage churches resist natural calamities. In Proceedings of the Iop Conference Series: Earth and Environmental Science, Moscow, Russia, 9–10 March 2019; p. 012063.
12. Deodatis, G.; Ellingwood, B.R.; Frangopol, D.M. *Safety, Reliability, Risk and Life-Cycle Performance of Structures and Infrastructures*; CRC Press: Boca Raton, FL, USA, 2014.
13. Jiang, W.; Zhang, F.; Lin, Q.; Li, Q. Application of Sensing Technology in the Protection of Architectural Heritage: A Review. In Proceedings of the 2021 IEEE International Conference on Artificial Intelligence and Computer Applications (ICAICA), Dalian, China, 28–30 June 2021; pp. 654–658.
14. Zhang, X.; Zhi, Y.; Xu, J.; Han, L. Digital Protection and Utilization of Architectural Heritage Using Knowledge Visualization. *Buildings* **2022**, *12*, 1604. [CrossRef]
15. Wang, X.; Zhang, J.; Cenci, J.; Becue, V. Spatial distribution characteristics and influencing factors of the world architectural heritage. *Heritage* **2021**, *4*, 2942–2959. [CrossRef]
16. Zhang, J.; Cenci, J.; Becue, V.; Koutra, S. The Overview of the Conservation and Renewal of the Industrial Belgian Heritage as a Vector for Cultural Regeneration. *Information* **2021**, *12*, 27. [CrossRef]
17. Zhang, J.; Cenci, J.; Becue, V.; Koutra, S.; Liao, C. Stewardship of Industrial Heritage Protection in Typical Western European and Chinese Regions: Values and Dilemmas. *Land* **2022**, *11*, 772. [CrossRef]
18. Li, M.; Wu, B.; Cai, L. Tourism development of World Heritage Sites in China: A geographic perspective. *Tour. Manag.* **2008**, *29*, 308–319. [CrossRef]
19. Weatherall, P.; Marks, K.M.; Jakobsson, M.; Schmitt, T.; Tani, S.; Arndt, J.E.; Rovere, M.; Chayes, D.; Ferrini, V.; Wigley, R. A new digital bathymetric model of the world's oceans. *Earth Space Sci.* **2015**, *2*, 331–345. [CrossRef]
20. Eakins, B.W.; Grothe, P.R. Challenges in building coastal digital elevation models. *J. Coast. Res.* **2014**, *30*, 942–953. [CrossRef]
21. GEBCO Compilation Group (2022) GEBCO_2022 Grid. Available online: https://www.bodc.ac.uk/data/published_data_library/catalogue/10.5285/e0f0bb80-ab44-2739-e053-6c86abc0289c (accessed on 12 December 2022).
22. Zhang, J.; Cenci, J.; Becue, V.; Koutra, S. Research of the industrial heritage category and spatial density distribution in the Walloon region, Belgium, and Northeast China. In *Structural Studies, Repairs and Maintenance of Heritage Architecture XVII & Earthquake Resistant Engineering Structures XIII*; WIT Press: Southampton, UK, 2021; p. 285.
23. Gong, G.; Wei, Z.; Zhang, F.; Li, Y.; An, Y.; Yang, Q.; Wu, J.; Wang, L.; Yu, P. Analysis of the spatial distribution and influencing factors of China national forest villages. *Environ. Monit. Assess.* **2022**, *194*, 428. [CrossRef]
24. Zhan, Z.; Cenci, J.; Zhang, J. Frontier of Rural Revitalization in China: A Spatial Analysis of National Rural Tourist Towns. *Land* **2022**, *11*, 812. [CrossRef]
25. Yuan, D.; Wu, R.; Li, D.; Zhu, L.; Pan, Y. Spatial Patterns Characteristics and Influencing Factors of Cultural Resources in the Yellow River National Cultural Park, China. *Sustainability* **2023**, *15*, 6563. [CrossRef]
26. Zhang, J.; Cenci, J.; Becue, V.; Koutra, S. Analysis of spatial structure and influencing factors of the distribution of national industrial heritage sites in China based on mathematical calculations. *Environ. Sci. Pollut. Res.* **2022**, *29*, 27124–27139. [CrossRef]
27. Chen, J.; Xu, C.; Lin, S.; Wu, Z.; Qiu, R.; Hu, X. Is There Spatial Dependence or Spatial Heterogeneity in the Distribution of Vegetation Greening and Browning in Southeastern China? *Forests* **2022**, *13*, 840. [CrossRef]
28. Qu, G.; Li, J. *Population and the Environment in China*; Lynne Rienner Publishers: Boulder, CO, USA, 1994.
29. Xie, Y.; Meng, X.; Cenci, J.; Zhang, J. Spatial pattern and formation mechanism of rural tourism resources in China: Evidence from 1470 national leisure villages. *ISPRS Int. J. Geo-Inf.* **2022**, *11*, 455. [CrossRef]
30. Zhou, Z.; Zhang, S.; Xiong, K.; Li, B.; Tian, Z.; Chen, Q.; Yan, L.; Xiao, S. The spatial distribution and factors affecting karst cave development in Guizhou Province. *J. Geogr. Sci.* **2017**, *27*, 1011–1024. [CrossRef]
31. Cassar, M. Sustainable heritage: Challenges and strategies for the twenty-first century, APT bulletin. *J. Preserv. Technol.* **2009**, *40*, 3–11.
32. Ren, X. Forward to the past: Historical preservation in globalizing Shanghai. *City Community* **2008**, *7*, 23–43. [CrossRef]
33. Mitter, R.; Moore, A.W. China in World War II, 1937–1945: Experience, memory, and legacy. *Mod. Asian Stud.* **2011**, *45*, 225–240. [CrossRef]

34. Anqi, D.; Cenci, J.; Zhang, J. Links between the pandemic and urban green spaces, a perspective on spatial indices of landscape garden cities in China. *Sustain. Cities Soc.* **2022**, *85*, 104046.
35. Available online: http://www.ftutj.cn/2022/08/11/64030.html (accessed on 1 March 2023).
36. Baddoo, N. Stainless steel in construction: A review of research, applications, challenges and opportunities. *J. Constr. Steel Res.* **2008**, *64*, 1199–1206. [CrossRef]
37. Moraes, A.G.d.L.; Bowling, L.C.; Zeballos-Velarde, C.R.; Daneshvar, F.; Watkins, A.H.; Cherkauer, K.A. Terrain sensitive climate mapping for the Arequipa Department in Peru. *Int. J. Climatol.* **2023**, *43*, 76–98. [CrossRef]
38. Li, X.-l.; Brierley, G.; Shi, D.-j.; Xie, Y.-l.; Sun, H.-q. Ecological protection and restoration in Sanjiangyuan national nature reserve, Qinghai Province, China. In *Perspectives on Environmental Management and Technology in Asian River Basins*; Springer: Dordrecht, The Netherlands, 2012; pp. 93–120.
39. Frank, A.G. The development of underdevelopment. In *Promise of Development*; Routledge: Abingdon, UK, 2018; pp. 111–123.
40. Wei, Y.D.; Yu, D. State policy and the globalization of Beijing: Emerging themes. *Habitat Int.* **2006**, *30*, 377–395. [CrossRef]
41. Yue, L.; Maria, G.-B.; Sandra, G. Simulacra heritagization: The Minyuan stadium in Wudadao, Tianjin. *J. Tour. Cult. Chang.* **2019**, *17*, 55–68. [CrossRef]
42. Olds, K. Globalizing Shanghai: The 'global intelligence corps' and the building of Pudong. *Cities* **1997**, *14*, 109–123. [CrossRef]
43. Li, D. *Echoes of Chongqing: Women in Wartime China*; University of Illinois Press: Champaign, IL, USA, 2010.
44. Vit-Suzan, I. *Architectural Heritage Revisited: A Holistic Engagement of Its Tangible and Intangible Constituents*; Routledge: Abingdon, UK, 2016.
45. Available online: https://baijiahao.baidu.com/s?id=1703712668601275141&wfr=spider&for=pc (accessed on 2 February 2023).
46. Wang, J. *Beijing Record: A Physical and Political History of Planning Modern Beijing*; World Scientific: Singapore, 2011.
47. Bendix, R. Heritage between economy and politics: An assessment from the perspective of cultural anthropology. In *Intangible Heritage*; Routledge: Abingdon, UK, 2008; pp. 267–283.
48. Borsi, M.T.; Mendoza, O.M.V.; Comim, F. Measuring the provincial supply of higher education institutions in China. *China Econ. Rev.* **2022**, *71*, 101724. [CrossRef]
49. Fang, L.; Wang, L.; Chen, W.; Sun, J.; Cao, Q.; Wang, S.; Wang, L. Identifying the impacts of natural and human factors on ecosystem service in the Yangtze and Yellow River Basins. *J. Clean. Prod.* **2021**, *314*, 127995. [CrossRef]
50. Carmona, M. *Public Places, Urban Spaces: The Dimensions of Urban Design*; Routledge: Abingdon, UK, 2010.
51. Zhu, C.; Zhang, X.; Zhou, M.; He, S.; Gan, M.; Yang, L.; Wang, K. Impacts of urbanization and landscape pattern on habitat quality using OLS and GWR models in Hangzhou, China. *Ecol. Indic.* **2020**, *117*, 106654. [CrossRef]
52. Fei, W.; Zhao, S. Urban land expansion in China's six megacities from 1978 to 2015. *Sci. Total Environ.* **2019**, *664*, 60–71. [CrossRef] [PubMed]