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Dataset Development of 697 Cultural Heritage Sites along the Beijing-Hangzhou Grand Canal

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Abstract: The Beijing-Hangzhou Grand Canal runs from Beijing in the north to Hangzhou in the south. It was first built during the Spring and Autumn Period, connected during the Sui Dynasty, prospered during the Tang and Song dynasties, and reached its peak during the Ming and Qing dynasties. It is the earliest, longest, and largest ancient canal in the world. Based on the cultural heritage sites of the Beijing-Hangzhou Grand Canal inscribed on the World Heritage List in 2014, the authors collected site information from official websites, including those of the State Council of China and the National Cultural Heritage Administration. A dataset of cultural heritage sites along the Beijing-Hangzhou Grand Canal was then developed. The dataset includes the sites' names, protection levels, heritage types, construction periods, and historical backgrounds of 697 cultural heritage sites, comprising 58 World Cultural Heritage sites, 200 National Cultural Heritage sites, and 439 Provincial Cultural Heritage sites. The dataset is archived in .xlsx and .shp formats, and consists of 22 data files with data size of 4.50 MB (compressed into one single file with 541 KB).

Keywords: Beijing-Hangzhou Grand Canal; cultural heritage site; world heritage

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Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2026.02.04.V1.

1 Introduction

The Beijing-Hangzhou Grand Canal is a major hydraulic engineering achievement created by ancient Chinese laborers. It is known for its early construction, large scale, and long waterway. As a living world-class cultural heritage, the Grand Canal records and carries the long history and rich civilization of the Chinese nation[1]. It is both an economic corridor linking northern and southern China and a cultural corridor that has transmitted cultural

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traditions for more than a millennium. The cultural heritage sites along the canal are "living fossils" of the evolution of Chinese civilization. They have important historical, scientific, and artistic value[2].

The Chinese government has attached great importance to the protection, inheritance, and use of Grand Canal cultural heritage. In February 2019, the Outline of the Grand Canal cultural protection, inheritance and utilization plan[3] was issued. The document called for deeper exploration of the cultural connotations of the Grand Canal. It also emphasized the establishment of a cultural heritage database and information management platform. In December 2019, the Ministry of Water Resources and the National Cultural Heritage Administration jointly issued the Special plan for Grand Canal cultural heritage protection and inheritance[4]. The plan required systematic work on the investigation, research, conservation, and exhibition of Grand Canal cultural heritage. In August 2021, the Leading Group for National Cultural Park Construction issued the Construction and protection plan for the Grand Canal National Cultural Park[5]. Its core tasks included building a cultural identity system for the Grand Canal, creating unified archives for cultural resources, promoting digital preservation, and developing visual, interactive, and immersive cultural outputs[6].

Since 2014, China has emphasized the systematic principle of "protecting, inheriting, and utilizing" cultural heritage on many occasions. These remarks cover cultural relics, historical and cultural cities, the Grand Canal, and revolutionary heritage. Under this guidance, conservation and research on Grand Canal cultural heritage in China have entered a new stage of deeper and more systematic integration. Government departments and local authorities have jointly promoted the investigation, evaluation, archiving, and digital preservation of Grand Canal cultural heritage. These efforts aim to support the integral and authentic protection of this large linear heritage system through systematic organization and scientific documentation.

Against this background, this dataset was developed. It systematically integrates information on cultural heritage sites along the Beijing-Hangzhou Grand Canal, with a focus on Jiangsu Province and other key canal sections. It covers hydraulic engineering heritage, such as waterways, sluices, dams, and docks; settlement heritage, such as ancient towns and villages; and related tangible cultural heritage, including government offices, granaries, guild halls, and stone inscriptions[7]. The dataset records key attributes of 697 cultural heritage sites, including site name, geographic coordinates, heritage type, historical period, and preservation condition. It provides reliable basic data for academic research, conservation planning, management decision-making, and public education. It also supports the analysis of the spatial distribution[8] and value characteristics of Grand Canal cultural heritage, as well as further conservation, research, and cultural inheritance.

2 Metadata of the Dataset

Table 1 presents the metadata of the Dataset of 697 cultural heritage sites along the Beijing-Hangzhou Grand Canal[9]. It includes the dataset name, authors, geographical region, year of the data, dataset files, etc.

3 Methods

3.1 Data Sources

The authors collected the list of Beijing-Hangzhou Grand Canal cultural heritage sites inscribed on the World Heritage List[11] in 2014. Official notices, documents released by the State Council of China, the National Cultural Heritage Administration, and several provincial cultural heritage authorities were used to obtain key site information. The

Table 1 Metadata summary of the Dataset of 697 cultural heritage sites along the Beijing-Hangzhou Grand Canal

Items	Description
Dataset full name	Dataset of 697 cultural heritage sites along the Beijing-Hangzhou Grand Canal
Dataset short name	HeritageSitesBHGC
Authors	Chen, Z. A., College of Civil and Transportation Engineering, Yangzhou University, 19952316609@163.com Lin, X. Y., College of Civil and Transportation Engineering, Yangzhou University, 19859905559@163.com Ye, P., College of Civil and Transportation Engineering, Yangzhou University, 007839@yzu.edu.cn He, J., Institute of Rural Revitalization (Central Jiangsu Development Research Institute), Yangzhou University, torchheju@outlook.com Yang, M., College of Civil and Transportation Engineering, Yangzhou University, emyangmeng@163.com
Geographical region	Areas along the Beijing-Hangzhou Grand Canal
Year	2025
Data format	.xlsx, .shp
Data size	4.50 MB
Data files	Information on 697 cultural heritage sites, including geo-location, site name, protection level, heritage type, construction period, and historical background
Foundations	National Natural Science Foundation of China (42501353, 42401291); Natural Science Foundation of Jiangsu Province (BK20230602); Ministry of Education of P. R. China (23YJCZH265)
Computing environment	ArcGIS 10.2
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	(1) *Data* are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use *Data* subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute *Data* subject to written permission from the GCdataPR Editorial Office and the issuance of a *Data* redistribution license; and (4) If *Data* are used to compile new datasets, the "ten percent principle" should be followed such that *Data* records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[10]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS, GEOSS, PubScholar, CKRSC, OARL

information included administrative division, geographic coordinates, heritage type, and historical period. ArcGIS was then used to visualize the spatial distribution of cultural heritage along the Beijing-Hangzhou Grand Canal[12]. Table 2 shows the issuing authorities, release dates, and numbers of published cultural heritage sites.

3.2 Technical Route

This study focused on the cultural heritage sites of the Beijing-Hangzhou Grand Canal. It followed the framework of "multi-source data collection-standardized processing-spatial integration". Data from 697 cultural heritage sites were systematically collected and processed. Official information released by the State Council of China, the National Cultural Heritage Administration, and other authorities was used as the main data source. Spatial coordinate services from the Amap Open Platform were used as supplementary sources. This approach ensured the authority, accuracy, and reusability of the dataset. The technical route included the following stages.

(1) Multi-source data collection and data processing

First, information on cultural heritage sites along the Beijing-Hangzhou Grand Canal was collected from authoritative sources. These sources included the official website of the National Cultural Heritage Administration, lists of cultural relic protection units issued by the State Council and relevant cultural heritage authorities, world cultural heritage

Table 2 Relevant official notices on the cultural heritage list of the Beijing-Hangzhou Grand Canal

Issuing authority	Title	Release date	Number of sites
UNESCO	Notice on the issuance of the World heritage list	2014.6	58
State Council of China	Notice on the issuance of the Outline of the Grand Canal cultural protection, inheritance and utilization plan	2019.2	188
Hebei Provincial Cultural Heritage Administration	Notice on the issuance of the Cultural heritage list of the Hebei section of the Grand Canal	2025.4	74
Shandong Provincial Cultural Heritage Administration	Notice on the issuance of the Grand Canal heritage protection plan of Shandong Province (2012–2030)	2022.4	152
Jiangsu Provincial Cultural Heritage Administration	Notice on the issuance of the Grand Canal cultural heritage protection, inheritance and utilization plan of Jiangsu Province	2021.5	372
Zhejiang Provincial Cultural Heritage Administration	Notice on the issuance of the Implementation plan for cultural heritage protection, inheritance and utilization of the Grand Canal in Zhejiang Province	2020.4	43
Anhui Provincial Cultural Heritage Administration	Notice on the issuance of the Implementation plan for cultural heritage protection, inheritance and utilization of the Grand Canal in Anhui Province	2020.6	43
Beijing Municipal Cultural Heritage Administration	Notice on the issuance of the Construction and protection plan for the Beijing Grand Canal National Cultural Park	2021.10	40
Tianjin Municipal Cultural Heritage Administration	Notice on the issuance of the Regulations on cultural heritage protection, inheritance and utilization of the Grand Canal in Tianjin	2025.1	29

nomination documents, and related special planning documents. Key attributes were extracted. They included site name, batch number, protection level (such as national key cultural relic protection unit or provincial cultural relic protection unit), heritage type (such as sluice, dam, dock, warehouse, or bridge), construction period, historical background, associated historical events and figures, current preservation condition, and restoration record. Second, geocoding and reverse geocoding services from the Amap Open Platform were used to query locations and obtain coordinates. Longitude and latitude under the GCJ-02 were obtained for each site. Provincial-, municipal- and county-level administrative units were also recorded. This process established the initial link between attribute data and spatial data.

(2) Standardization and normalization of attribute data

Because data from different sources varied in naming conventions, recording granularity, and wording, the raw data were standardized. The process included 4 steps.

First, site names were standardized. The standard names published by the National Cultural Heritage Administration and the State Council were used as primary entries. Alternative names, including former names and common names, were unified. Authoritative references, such as the Atlas of Chinese Cultural Relics[13] and the Catalogue of Chinese Cultural Heritage[14], were used for cross-validation. Second, classifications and codes were standardized. Based on industry standards, including the Standards for defining protection boundaries of cultural relic protection units[15] and the Classification and codes of China's world cultural heritage[16], a standard classification system and coding rules were established for enumerated fields, such as heritage type and protection level. This step ensured consistency in data integration and retrieval. Third, historical periods and related events were normalized. Construction periods were recorded using a dual annotation method, with the Gregorian calendar as the main standard and dynastic chronology as supplementary information. Textual information, including historical background, associated historical events, and associated historical figures, was structurally extracted. Key information tags were then created to support later association queries and knowledge graph construction. Finally, preservation condition and restoration records were structured. Degree of damage was classified into 5 levels: intact, slightly damaged, moderately damaged, severely damaged, and site remains only. Key information from restoration records, including time,

responsible institution, and restoration content, was extracted to build a time-series maintenance archive.

(3) Spatial location calibration and administrative division association

Although Amap provided preliminary coordinates, spatial location calibration was still required. This step integrated multiple spatial data sources.

First, public map data at a scale of 1:1,000,000 released by the National Geomatics Center of China and the national administrative division query platform of the Ministry of Civil Affairs were used to match provincial-, municipal- and county-level administrative units.

Second, for sites with ambiguous or uncertain coordinates, manual interpretation and correction were conducted using historical maps, archaeological reports, and field investigation images. This process ensured that the spatial positioning accuracy could meet the needs of academic research and public services.

Third, the final coordinates were transformed into the WGS84 coordinate system and organized as point features. Each cultural heritage site was assigned a unique spatial identifier.

(4) Quality control and data publication

Cross-validation and sampling checks were applied throughout data processing. Key attributes, including protection level, historical period, and coordinates, were reviewed by multiple researchers. Consistency checks and logical corrections were also applied to textual information. The final dataset was released in open formats with detailed metadata documentation. The documentation includes field descriptions, collection standards, spatial reference, and usage license information. These measures improved data reliability and usability. Through this technical route, the study transformed multi-source heterogeneous information on Beijing-Hangzhou Grand Canal cultural heritage into a standardized, spatialized, and structured thematic database. The dataset provides a solid data foundation for cultural heritage conservation and management, academic research, and public digital services[17].

4 Data Results

4.1 Dataset Composition

The dataset contains information on 697 heritage sites and covers 7 provincial-level administrative regions in China. The core fields include heritage site name, administrative affiliation (province, city, and county), protection level, heritage type, geographic coordinates (WGS84 coordinate system), construction period, historical background, associated historical event, associated historical figure, degree of damage, and restoration record. These 14 attributes are shown in Table 3. The dataset provides a comprehensive record of the basic information and current preservation status of major cultural heritage sites along the Beijing-Hangzhou Grand Canal.

4.2 Data Results Analysis

4.2.1 Provincial-level Distribution

The heritage sites show clear clustering at the provincial level. Jiangsu Province has the largest number, with 550 sites, accounting for 78.9% of the total. These sites are mainly located in canal-side cities, including Suzhou (160 sites), Wuxi (86 sites), Yangzhou (79 sites), Changzhou (75 sites), Zhenjiang (49 sites), and Huai'an (38 sites). Shandong Province ranks second, with 56 sites, accounting for 8.03% of the total. Its sites are mainly concentrated in Liaocheng (19 sites), Jining (18 sites), and Tai'an (10 sites), all of which are important nodes along the Shandong section of the Beijing-Hangzhou Grand Canal. Zhejiang Province has 44 sites, accounting for 6.31% of the total. These sites are mainly

Table 3 Description of core fields in the dataset

Basic information	Item	Description	Example	Chinese field name	English field name
Serial number	Serial number	Cultural heritage records are assigned sequential identification numbers	1, 2, 3, ...	Seq_ID	ID
Administrative division	Provincial-level administrative region	The first-level administrative division where the heritage site is located	Jiangsu Province, Zhejiang Province, ...	Prov_CN	Prov_EN
	Municipal-level administrative region	The second-level administrative division where the heritage site is located	Hangzhou, Yangzhou, ...	Muni_CN	Muni_EN
	County-level administrative region	The third-level administrative division where the heritage site is located	Tianning District, Guangling District, ...	Coun_CN	Coun_EN
Heritage site name	Heritage site name	The official name of a cultural heritage site. It reflects the site's identity, attributes, location, and historical-cultural meaning	Slender West Lake, Geyuan Garden, ...	Heri_CN	Heri_EN
Protection level	Protection level	The legally valid protection grade assigned by an authoritative institution according to the value, importance, and rarity of the heritage	World Cultural Heritage site, National key cultural relics protection unit, Provincial-level cultural relics protection unit, ...	Prot_CN	Prot_EN
Heritage type	Heritage type	Ancient cultural sites, ancient tombs, ancient architecture, grotto temples, ancient stone carvings, ancient murals, important modern and contemporary historic sites, and representative architecture, etc.	Canal engineering heritage, ancient tombs, ancient sites, ...	Type_CN	Type_EN
Geographic coordinates	Longitude	The east-west position of a heritage site on the Earth's surface, usually expressed in decimal degrees	Longitude, latitude of a heritage site (WGS84 coordinate system)	经度 1	Long_1
	Latitude			纬度 1	Lat_1
Construction period	Construction period	The historical time or period when the main body of the heritage site was first built or established	Spring and Autumn Period, Han Dynasty, Qing Dynasty, Sui and Tang dynasties, ...	Cons_CN	Cons_EN
Historical background	Historical background	The historical context in which the heritage site was created, existed, and developed, including political, economic, and cultural conditions	Historical function and status of the heritage site, ...	Hist_CN	Hist_EN
Associated historical event	Associated historical event	Important historical events or activities closely related to the existence and value of the heritage site	Postal relay system, salt trade, canal governance, ...	Relae_CN	Relae_EN
Associated historical figure	Associated historical figure	Key historical figures who played important roles in the creation, development, protection, or historical evolution of the heritage site	Emperor Qianlong, Emperor Yang of the Sui Dynasty, ...	Relap_CN	Relap_EN
Degree of damage	Degree of damage	An assessment of the gap between the current physical condition of the heritage site and its complete or original condition	Wall peeling, partial foundation damage, ...	Degr_CN	Degr_EN
Restoration record	Restoration record	A chronological record of conservation, restoration, and intervention activities, including time, content, techniques, and methods	Site conservation in 2018; structural reinforcement in 2019, ...	Repa_CN	Repa_EN

distributed in Hangzhou (19 sites), Shaoxing (9 sites), and Jiaxing (3 sites). They are concentrated along the Jiangnan Canal and the East Zhejiang Canal (Figure 1). Heritage sites spanning multiple cities are counted in each city involved; therefore, the sum of city-level counts may exceed the provincial total.

4.2.2 Core Distribution at the City Level

At the city level, several high-density heritage clusters can be identified (Figure 2). Yangzhou in Jiangsu Province has 79 heritage sites, mainly in Guangling District, Gaoyou City, Hanjiang District and Jiangdu District. Representative sites include Geyuan Garden, Yucheng Post Station, and Shaobo Ancient Embankment. The sites include hydraulic structures, such as Liubao Water Release Sluice, and salt merchant residences, such as LU Shaoxu Salt Merchant Residence. They reflect Yangzhou's role as the "First City of the Canal" and its water transport and salt industry culture. Wuxi in Jiangsu Province has 86 heritage sites, mainly in Liangxi District, Yixing City, Xishan District, Jiangyin City, and Binhu District. Representative sites include XU Xiake's Former Residence and Qingshantang Stone Carvings, and Jichang Garden. The sites include grotto temples and stone carvings, such as the Guoshan Stele; ancient bridges and roads; and former residences of notable figures, such as the Former Residence of XUE Fucheng. They reflect Wuxi's identity as a canal alley and Jiangnan water port, as well as its shipping trade and water-town culture. Suzhou in Jiangsu Province has 160 heritage sites, mainly distributed in Gusu District, Wuzhong District, Wujiang District, Changshu City, Kunshan City, Taicang City, and other areas. Representative sites include the Suzhou section of the Jiangnan Canal, Baodai Bridge, and Panmen. These sites feature hydraulic facilities, such as ancient towpaths, and historic cultural districts, such as the Shantang River and Pingjiang Street areas. They show Suzhou's historic water-city layout and commercial prosperity. Liaocheng in Shandong Province has 19 heritage sites, mainly in Dongchangfu District, Linqing City, and Yanggu County. Representative sites include Liaocheng Shanxi–Shaanxi Guild Hall and Tuqiao Sluice Site. The sites include hydraulic remains, customs ruins, and ancient city structures. They reflect Liaocheng's identity as an ancient canal metropolis and its canal trade and urban culture. Jining in Shandong Province has 18 heritage sites concentrated in Wenshang County, Yanzhou City, Jiaxiang County, Rencheng District, Jinxiang County, Sishui County, Zoucheng City and Weishan County. Hydraulic engineering works, such as the Nanwang Hub and Wenshang Ten Mile Lock, are its core features. These sites highlight Jining's key role as the "water ridge" of the Grand Canal. Hangzhou in Zhejiang Province has 19 heritage sites in Gongshu District, Shangcheng District, Linping District, Binjiang District, Xiaoshan District, Fuyang District, and Tonglu County. Representative sites include Fuyi Granary, Xixing Guotanghang Wharf in Hangzhou, and the Qiaoxi Historic Cultural District. They reflect Hangzhou's functions as the canal terminus for storage, defense, and commerce. Beijing has 10 heritage sites, mainly in Tongzhou District, Dongcheng District, and Xicheng District. Representative sites include Tongzhou Randeng Pagoda, Tongyun Bridge, Zhangjiawan Town Wall Ruins, and the Tomb of LI Zhuowu. They reflect Beijing's role as the capital terminus of the canal and as the

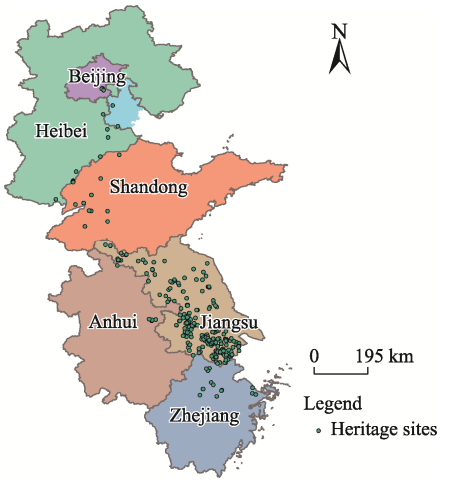


Figure 1 Detailed distribution map of heritage sites

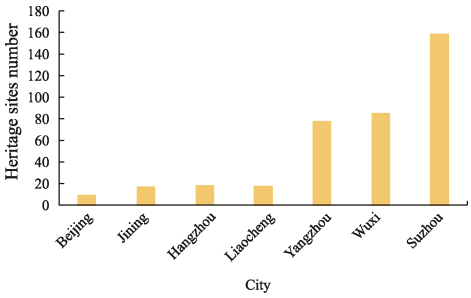


Figure 2 Core distribution of heritage sites at the city level

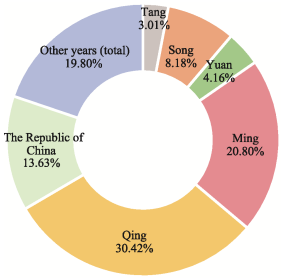


Figure 3 Distribution of heritage sites by construction period

central hub of imperial grain transport.

4.2.3 Distribution by Construction Era

The construction periods of the heritage sites span multiple historical stages, from prehistoric and pre-Qin periods to the Ming and Qing dynasties and modern times. Sites dating to the Ming and Qing dynasties account for the largest share of the dataset (Figure 3). Tang Dynasty sites total 21, accounting for 3.01% of the dataset. They are mostly early canal infrastructure projects, such as Ningbo Sanjiangkou in Zhejiang, which was built during the Tang Dynasty, and Baodai Bridge in Jiangsu, built during the Yuanhe period of the Tang Dynasty. Song Dynasty sites total 57, accounting for 8.18%. They are mainly related to canal dredging and embankment construction, such as Shaobo Ancient Embankment in Jiangsu, which was built in the Song, and Water Level Stele, built during the Southern Song Dynasty. Yuan Dynasty sites total 29, accounting for 4.16%. They are related to the full connection of the Beijing-Hangzhou Grand Canal, such as the Jingmen Upper and Lower Sluices in Shandong and the Suqian section of the Middle Canal in Jiangsu. Ming Dynasty sites total 145, accounting for 20.80%. This period marked a peak in canal construction. The sites mainly include hydraulic hubs, such as Qingkou Hub in Jiangsu and Nanwang Hub in Shandong, and embankment works, such as the brick embankment of the canal in Wenshang County, Shandong Province. Qing Dynasty sites total 212, accounting for 30.42%. Canal-related heritage and ancient buildings are the most common types in this period. This indicates active canal construction and broader architectural development. Ancient tombs are also common, suggesting notable burial-related cultural activities. Republic of China sites total 95, accounting for 13.63%, which are relatively numerous.

5 Discussion and Conclusion

This dataset systematically organizes the basic information of 697 heritage sites along the Beijing-Hangzhou Grand Canal. It covers spatial distribution, functional types, historical background, and preservation condition. It clearly shows the overall characteristics of Grand Canal cultural heritage. At the provincial level, the sites are highly concentrated in Jiangsu Province, followed by Shandong and Zhejiang. This pattern reflects Jiangsu's central role in the Grand Canal heritage system. At the city level, Suzhou, Wuxi, Yangzhou, and other cities form several dense heritage clusters. These clusters reflect diverse functions, including grain transport and salt industry culture, water-town commerce, hydraulic hubs, and the grain transport functions of capital cities. In terms of construction period, sites from the Song Dynasty account for 8.18%. During the Ming and Qing dynasties, the total amount of heritage accounted for 51.22%, while during the Republic of China period, it accounted for 13.63%. This reflects the cultural accumulation of the Grand Canal during its heyday in the Ming and Qing dynasties and its continued development in modern times.

The dataset also shows a strong coupling between heritage distribution and canal function. The spatial distribution of heritage sites closely corresponds to the Grand Canal system of "grain transport corridor-hydraulic node-commercial city". The seven core cities—Suzhou, Wuxi, and Yangzhou in Jiangsu Province; Liaocheng and Jining in Shandong Province; Hangzhou in Zhejiang Province; and Beijing—contain 56.10% of all heritage sites. These cities were all key hubs of canal transportation. For example, Yangzhou functioned as a salt transport center, while Jining served as a water regulation center. This distribution confirms the interactive relationship that "the canal shaped cities, and cities preserved heritage". It

also provides a spatial basis for coordinated regional heritage conservation.

This dataset supports research on the spatial distribution of Grand Canal cultural heritage and the formulation of conservation strategies. It also provides a reference for cross-regional collaborative heritage management and cultural inheritance. Future studies may further incorporate heritage monitoring data to improve the dataset's dynamic updating capacity and application value.

Author Contributions

Chen Z. A. and Lin, X. Y. contributed to the overall design of the dataset. Ye, P. and He, J. collected and processed the heritage site data. Yang, M. designed the models and algorithms. Chen Z. A., He, J., and Ye, P. verified the data. Lin, X. Y. and Yang, M. wrote the data paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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