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# Spatial distribution characteristics and tourism response of intangible cultural heritage in coastal areas of China

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**The coastal regions of China are abundant in intangible cultural heritage (ICH) resources characterized by distinct maritime features. The comprehensive integration and development of these resources with tourism represent a critical strategy for the scientific protection and sustainable development of coastal ICH. This study examines the spatial distribution of ICH across China's coastal regions. It also establishes an evaluation system to measure tourism response levels toward coastal ICH and employs a GeoDetector model to identify influencing factors. The results indicate that: (1) Different types of ICH resources in coastal areas exhibit distinct spatial distribution patterns, with notable variations in their concentrations. Generally, the spatial distribution of ICH follows a multi-centered structure, exhibiting higher densities in the Yangtze River Delta, Pearl River Delta, and Yellow River Delta. (2) Regional disparities in tourism response levels toward ICH are evident in coastal regions, demonstrating a decreasing gradient from central areas toward the north and south. (3) The tourism response levels of ICH are primarily influenced by factors such as regional GDP, resident population, the tourism environment, and the number of ICH sites, with regional GDP identified as the most influential factor. These findings enhance the understanding of the current developmental status of ICH in China's coastal regions and highlight key distinctions from inland areas.**

**Keywords** Intangible cultural heritage, Coastal areas, Spatial distribution, Tourism response, Influencing factors

Since the late twentieth century, globalization and industrialization have posed significant threats to numerous traditional cultural expressions, thereby endangering cultural diversity and sustainable development. In response, UNESCO adopted the *Convention for the Safeguarding of the Intangible Cultural Heritage* in 2003, underscoring the critical importance of protecting and transmitting intangible cultural heritage (ICH) as an essential component of cultural diversity, social identity, and human creativity. As William Logan observes[1], ICH represents "heritage embodied in people rather than in inanimate objects," highlighting its inherently dynamic and human-centered characteristics.

In recent years, many countries have recognized ICH as a valuable resource for cultural tourism and explored innovative ways to safeguard it through tourism. Countries like Italy[2], the Netherlands[3], Bhutan[4], and India[5] have advanced ICH's sustainable development through initiatives involving festivals, handicrafts, and performing arts. China, after joining the Convention in 2004, has strengthened its legal framework, created a comprehensive ICH inventory, and introduced a representative inheritor system[6]. These efforts have bolstered national identity, supported the transmission of traditions, and promoted cultural vitality[7].

China's coastal regions, with their deep-rooted maritime cultural traditions, have given rise to a rich diversity of ICH forms, such as the Mazu belief system[8], fisherman's festivals[9], Qiong opera[10], embroidery[11], and shadow puppetry[12]. These cultural expressions hold significant historical, cultural, and economic value. However, the rapid pace of urbanization and marketization has posed serious challenges to coastal ICH, such as inadequate protection mechanisms, tensions between preservation and commercialization, and disruptions in intergenerational transmission[13,14]. Consequently, these cultural assets have not yet been effectively transformed into sustainable drivers of regional development.

The integration of culture and tourism presents new opportunities for the protection and promotion of ICH[15]. Tourism revitalizes ICH, increases public awareness, and enhances the uniqueness of destinations[16]. However,

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different ICH resources vary in their compatibility with tourism, with some enhancing a destination's appeal and others requiring alternative preservation strategies. This disparity is particularly pronounced in coastal cities, where the depth and extent of ICH–tourism integration differ markedly, and yet systematic identification and quantitative evaluation of these variations remain largely underexplored in existing research.

This study examines the development of ICH tourism in 63 coastal cities in China by establishing a multidimensional evaluation framework. It utilizes spatial analysis and the entropy-weighted Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) method to assess the responsiveness of ICH to tourism, and employs the Geodetector model to identify the key influencing factors. The study also offers policy recommendations for the integrated development of coastal ICH and tourism, providing a scientific basis for both ICH protection and tourism development practices.

## Literature review

The concept of heritage tourism emerged in the 1980s[17], and since then, research on ICH has undergone substantial evolution. Early studies primarily focused on defining ICH, exploring its spatial distribution, establishing safeguarding mechanisms[18,19], and developing evaluation systems[20,21]. Over time, however, the focus has shifted toward the integration of ICH with tourism and its potential to contribute to regional development[22,23]. As ICH tourism has expanded, the academic community has increasingly examined its role in cultural and economic revitalization.

While ICH and tourism are often viewed as mutually reinforcing[24,25], this general perspective tends to overlook regional variations in the contribution of ICH to tourism development. In China's coastal regions, significant disparities exist in both the tourism-promotion potential and the adaptability of ICH. As dynamic intersections of land and sea, these regions host unique maritime ICH and culturally diverse landscapes[26]. Consequently, developing ICH tourism strategies that are tailored to local conditions has become essential for the sustainable growth of cultural tourism in coastal areas.

### Spatial distribution characteristics of ICH

With the advancement of spatial analysis technologies, research on ICH has progressively shifted from qualitative descriptions to spatial pattern analysis and visual representation using Geographic Information Systems (GIS)[27,28]. By integrating social, cultural, and geographical data, spatial pattern analysis not only uncovers the distribution of ICH across regions[29] but also provides critical scientific support for policy-making, resource allocation, and public engagement[30,31].

In recent years, scholars have increasingly employed GIS and multi-indicator systems to investigate the spatial distribution of ICH and its tourism potential[32]. For instance, Mirtaghian Rudsari[33] and colleagues in Iran utilized GIS methods to reveal spatial imbalances in ICH. In Indonesia, Sobari[34] applied spatial autoregression models to explore the influence of cultural awareness on heritage recognition. In Chile, Nahuelhual[35] and others examined the spatial distribution and economic value of agricultural heritage, emphasizing the need for integrated preservation strategies to protect ICH.

Existing spatial studies on ICH cover a range of geographic scales and regional contexts. Some studies focus on the urban level, such as research on the ancient city of Nashik in India[36]and Ancud on Chile's Chiloé Island[34]. Others examine inland regions at the provincial[37,38] or national level[39], with case studies in Shanxi[40] and Chongqing[41] in China, as well as broader analyses covering all 34 provinces of Indonesia[33,34] and the entire territory of Iran[32]. Larger-scale interregional and basin-level analyses have also been conducted, such as those focusing on the Yangtze[42] and Yellow River basins[43]. These studies primarily concentrate on the distribution of ICH types, density characteristics, and spatial clustering patterns, providing a crucial foundation for understanding the macro-level spatial structure of intangible cultural heritage resources. However, most existing research tends to focus on inland regions, overlooking the unique cross-regional and cross-cultural characteristics of coastal ICH. This gap limits the applicability of findings for preserving, managing, and revitalizing coastal heritage, particularly as cultural-tourism integration accelerates in these areas[43,44].

### Tourism response of ICH

In recent years, there has been a growing body of research on ICH that explores the synergistic relationship between heritage transmission and tourism development[45]. Within this context, the concept of tourism responsiveness has emerged as a significant and novel area of inquiry[46]. In examining the transformation of cultural tourism in Central America, NIM Rodzi emphasized that the key to converting ICH resources into viable tourism products lies in their adaptability to tourist demands[15]. Consequently, the concept of "ICH tourism responsiveness" has garnered increasing scholarly attention.

Derived from the concept of "response" in physics, this notion—when applied to tourism studies—refers to the degree of adaptability and impact that heritage resources exhibit in relation to tourism development. In contrast to the traditional concept of tourism carrying capacity, which focuses on the pressures tourism exerts on the environment[47–51] and society[52–57], tourism responsiveness[58,59] emphasizes the reciprocal effects of tourism on the economic, cultural, and social structures of a destination[60,61]. This concept is increasingly used as a framework for assessing the tourism development potential of cultural resources[62,63].

The tourism responsiveness of ICH reflects its adaptability and value in supporting tourism development[64]. Coastal regions, endowed with rich natural and cultural resources, feature diverse maritime ICH with distinct regional characteristics and significant tourism potential[39]. When developed appropriately, these resources can be preserved and leveraged to foster local economic growth[65–67]. However, striking a balance between showcasing these resources and maintaining cultural authenticity presents challenges, as evidenced by Austrian studies on local ecological knowledge[68]. Therefore, analyzing the tourism responsiveness and spatial distribution of coastal ICH is essential for both advancing theoretical understanding and informing practical applications.

Studies evaluating tourism responsiveness typically employ indicators such as aesthetic appeal, cultural value, rarity, and abundance[69], alongside the destination's socioeconomic characteristics and market accessibility[70]. Research often categorizes ICH tourism potential into three key dimensions: resource attributes, destination conditions, and market factors[71]. These include aspects such as cultural value, uniqueness, preservation status, infrastructure, societal receptiveness, and market demographics[26,72]. Esfehani and Albrecht emphasize the importance of assessing both the adaptability of ICH to tourism and its compatibility with evolving market demands, offering a more comprehensive evaluation of how ICH resources integrate within tourism systems[73].

The factors influencing the tourism development potential of ICH are inherently multidimensional and complex. As a result, investigating the underlying mechanisms of ICH tourism responsiveness across different regions has become a critical focus of contemporary research[74]. By thoroughly exploring these influencing factors, researchers can uncover the intricate relationships between tourism responsiveness and various social, economic, and cultural variables[30]. These insights not only deepen our understanding of the spatial distribution patterns and developmental status of ICH tourism[31] but also provide a solid empirical foundation for the design of scientifically informed and context-specific heritage tourism development policies.

### Research gaps

While current studies provide valuable theoretical and methodological insights into the tourism response of ICH, several research gaps remain:

1. Research on the spatial patterns of ICH has primarily focused on the provincial or municipal level, with most studies examining the relationship between ICH and tourism in inland regions. In contrast, the spatial characteristics and tourism responsiveness of coastal ICH have been relatively underexplored. However, the economic, political, and cultural dynamics of coastal areas are profoundly influenced by their maritime environments, leading to development trajectories that differ significantly from those in inland cities and towns. As a result, the spatial attributes and manifestations of ICH in coastal regions follow distinct patterns that differentiate them from their inland counterparts. This highlights the urgent need for systematic research to identify and analyze the unique spatial features and tourism potential of coastal ICH resources.
2. Existing studies often employ quantitative methods such as regression analysis, entropy weight, and the Analytic Hierarchy Process to assess ICH tourism responsiveness. However, these approaches have limitations in developing context-sensitive, scientifically robust evaluation systems. Many studies do not fully incorporate key factors such as cultural resources, socioeconomic conditions, and tourism environments, which results in incomplete assessments[75,76]. Furthermore, the underlying mechanisms driving tourism responsiveness, particularly in coastal areas, remain largely underexplored[46]. While numerous studies focus on ICH distribution and concentration, few examine variations in tourism responsiveness or its spatial relationship with socioeconomic factors, especially in China's coastal regions, where systematic research on maritime cultural ICH is scarce. This gap undermines the effectiveness of cultural tourism strategies and the development of region-specific ICH policies.

### Research questions

This study aims to develop a multidimensional evaluation system to analyze the spatial distribution of ICH resources and their responsiveness to tourism in coastal cities across China. It investigates the compatibility between ICH resources and tourism development, as well as the underlying factors influencing this relationship. The research questions addressed in this study are as follows:

1. What is the spatial distribution of coastal ICH, and what are the tourism response levels in these coastal cities?
2. How do coastal cities vary in their ICH tourism response levels?
3. What are the factors influencing ICH tourism response levels in coastal areas?

## Materials

### Study area

Coastal areas are defined as regions possessing coastlines, encompassing both mainland and island shorelines. In China, coastal regions are classified into provinces, autonomous regions, and centrally administered municipalities according to primary administrative divisions. China's coastal regions consist of 14 provincial-level administrative units, including two island provinces—Hainan and Taiwan—alongside 53 coastal prefecture-level cities and 242 coastal districts and counties (see Fig. 1). Excluding Hong Kong, Macau, and Taiwan, the combined area of coastal provinces, regions, and cities exceeds 1.3 million square kilometers, representing approximately 15% of the nation's total land area. The strategic geographic positioning of these coastal locations facilitates external economic linkages, significantly contributing to their accelerated development relative to inland areas. Consequently, coastal regions consistently account for over 60% of China's national GDP. Their substantial populations and robust economic foundations have provided solid material support for the development of distinctive and flourishing historical and cultural identities.

This study includes all municipalities, prefecture-level cities, and directly administered counties situated along China's coastline. However, Taiwan, Hong Kong, and Macau have been excluded due to fundamental differences in their statistical frameworks and data collection methodologies for ICH, rendering them incomparable with those applied to the coastal cities of mainland China.

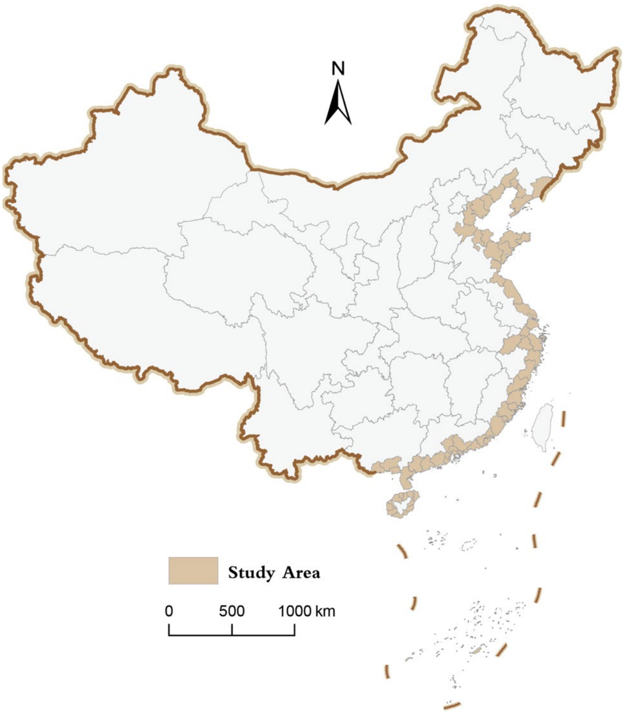


**Fig. 1**. Study area.

| Influencing factors | Paraphrasing | Data source |
|---|---|---|
| Heritage abundance | The quantity of intangible cultural heritage at all levels | The intangible cultural heritage List of the Cultural and Tourism Bureau |
| Spending power | Total population | Statistical yearbooks |
| Level of economic development | Per capita GDP | Statistical yearbook |
| Urbanization | Level of urbanization | Statistical yearbooks |
| Traffic environment | Highway network density | Statistical yearbooks |
| Government finance | Public finance expenditure | Statistical almanacs |
| Travel Resources | Number of tourist attractions | Statistical yearbooks |
| Level of tourism development | Total tourism revenue | Statistical yearbook |
| Key cultural relics under state protection | Number of key cultural relics under state protection | http://www.ncha.gov.cn/col/col2266/index.html |
| Famous village and town | National Historical and cultural town National historical and cultural village | http://www.ncha.gov.cn/col/col2266/index.html |
| Number of museums | Number of museums | http://www.ncha.gov.cn/col/col2266/index.html |
| Traditional village | Chinese Traditional Village | https://dmctv.cn/indexN.aspx?lx=sy |

**Table 1**. Data sources.

## Data sources

Key indicator data up to 2022 were collected by consulting statistical yearbooks from relevant provinces and cities, along with associated official websites. The collected data span multiple domains, including economics, culture, and tourism, and are summarized in Table 1. Furthermore, the gathered data underwent rigorous integration and processing procedures, including data cleaning, handling of missing values, outlier detection, and normalization, to ensure high data quality and reliability.

## Data availability statement

The datasets utilized in this study were compiled from the 2022 Statistical Yearbooks of various coastal provinces in China. These yearbooks are publicly available through the official websites of the respective provincial statistical bureaus, and links to the 2022 Statistical Yearbooks are provided in Table 2.

| Province | Website |
|---|---|
| Liaoning | https://www.ln.stats.gov.cn/tjsj/sjcx/ndsj/ |
| Hebei | https://tjj.hebei.gov.cn/hetj/tjsj/jjnj/ |
| Tianjin | https://stats.tj.gov.cn/TJTJJ434/TJCP574/TJTJNJ697/ |
| Shandong | https://tjj.shandong.gov.cn/col/col6279/index.html |
| Jiangsu | https://tj.jiangsu.gov.cn/col/col76362/index.html |
| Shanghai | https://tj.jiangsu.gov.cn/col/col76362/index.html |
| Zhejiang | https://tjj.zj.gov.cn/col/col1525563/index.html |
| Fujian | https://tjj.fujian.gov.cn/xxgk/ndsj/ |
| Guangxi | https://tjj.gxzf.gov.cn/tjsj/ |
| Hainan | https://stats.hainan.gov.cn/tjj/tjsu/ndsj/ |
| Guangdong | https://stats.gd.gov.cn/gdtjnj/index.html |

**Table 2**. Links to 2022 Statistical Yearbooks.

## Methods

In response to the strategic imperative for the sustainable development of ICH tourism in coastal regions, this study places coastal ICH as its central focus. The research aims to develop an evidence-based framework to effectively integrate ICH conservation with tourism development, ultimately promoting sustainable cultural-tourism synergy. To achieve these objectives, the following methodological approaches were implemented (see Fig. 2).

First, geospatial analytical methods, including spatial autocorrelation analysis and kernel density estimation (KDE), were systematically applied to quantify the spatial distribution patterns of ICH resources across coastal regions. The resulting spatial analyses were visualized using thematic maps and statistical diagrams generated through GIS. These cartographic representations facilitate the interpretation of ICH distribution characteristics, effectively highlighting concentration hotspots and dispersion trends within the study area[42,43].

Secondly, building upon established evaluation frameworks in cultural resource management, this study developed a multidimensional indicator system for assessing tourism responsiveness in coastal ICH through a three-phase Delphi refinement process. The resulting indicator system was subsequently applied to calculate tourism response levels for each coastal city. Given the substantial volume of data associated with each indicator, the Entropy-Weighted TOPSIS method was employed to assign appropriate indicator weights[77–79]. The Entropy-Weighted TOPSIS method leverages information entropy derived from each dataset to objectively determine indicator weights, assessing the significance of each indicator based on the degree of variation observed. The method then evaluates the quality of each assessed object by calculating its relative distance to positive and negative ideal solutions. This approach effectively minimizes the subjectivity inherent in manual weighting processes, thereby enhancing the objectivity and fairness of evaluation outcomes. Furthermore, it facilitates a comprehensive and balanced consideration of each indicator's strengths and weaknesses, resulting in a more robust and holistic evaluation.

Lastly, the GeoDetector method was employed to identify and analyze the factors influencing tourism response levels in coastal cities[80,81]. By utilizing differentiation and factor detection techniques within the GeoDetector framework, the explanatory power of various determinants affecting the tourism responsiveness of coastal ICH was assessed. Additionally, GeoDetector facilitated the evaluation of how interactions among these factors collectively influenced the explanatory strength regarding the dependent variable. Given the inherently complex and multifaceted nature of the mechanisms driving tourism responses in coastal ICH, characterized by intricate interactions among multiple variables, employing GeoDetector provided valuable insights into these dynamics, offering a novel perspective on the integrated development of coastal ICH tourism.

## Spatial distribution analysis

*Spatial variability*

The coefficient of variation (CV) is a statistical measure used to assess the spatial variability that eliminates the effect of units having different sizes from the mean. It is defined as:

$$\mathrm{CV} = \frac{\mathrm{SD}}{\overline{\mathrm{X}}}$$

where SD is the standard deviation of the dataset, $\overline{\mathrm{X}}$ is the mean of the dataset. A higher coefficient of variation indicates greater spatial difference in the dataset. In the context of spatial variability, it means that the distribution of the values across the region or area is more uneven or heterogeneous.

*Kernel density estimation*

A nuclear densitometer is a method employed to identify high and low-density regions of an event. KDE means that geographical events can occur anywhere in space, with the probability of occurrence varying across different areas. The higher the probability of an event occurring in a point-dense region, the lower the probability of an event occurring in a point-sparse region. The formula for KDE is:

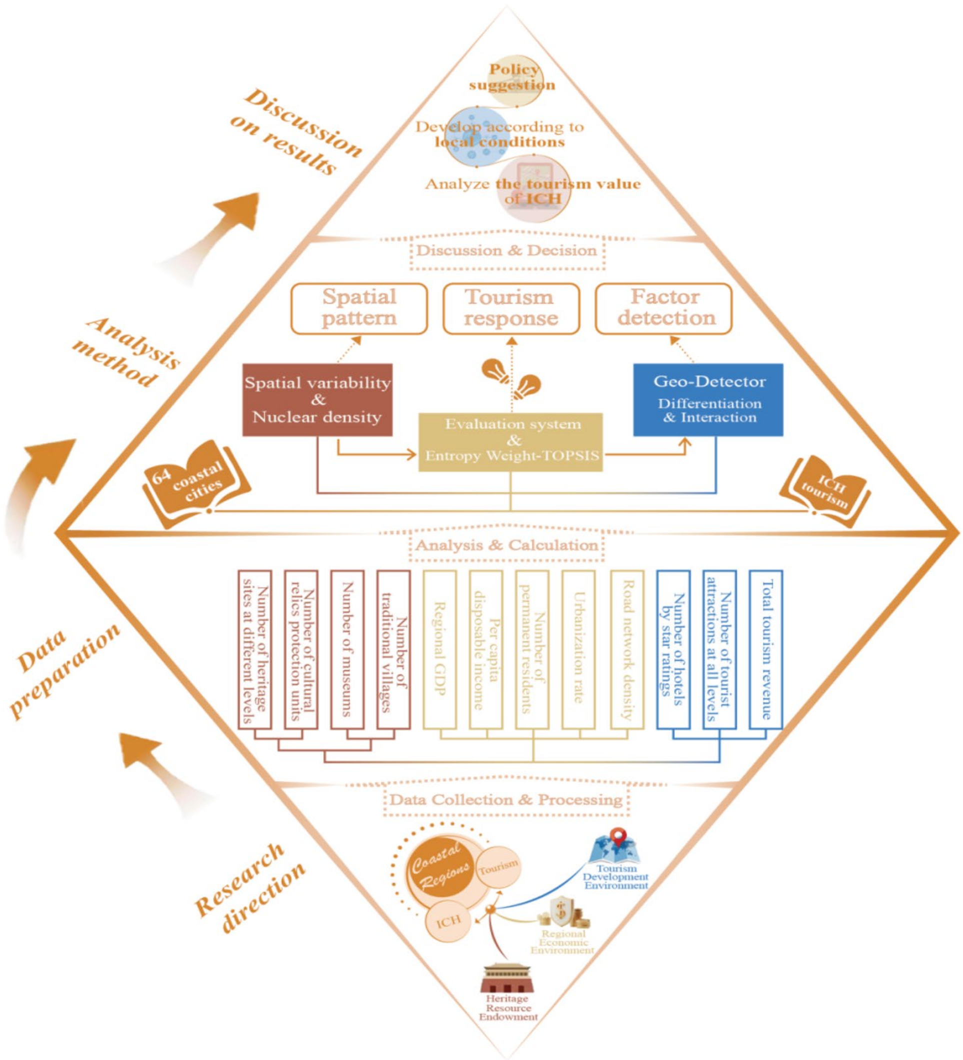


**Fig. 2**. Research framework.

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

where, $f(x)$ is the kernel function; h is bandwidth; $(x - x_i)$ represents the estimated distance from the x point to the ICH point.

## Entropy Weight -TOPSIS modeling analysis

*Entropy weight method*

1. Data standardization: It is assumed that there are m evaluation objects and n indicators to form the decision matrix:

$$X = \begin{pmatrix} x_{11} & \cdots & x_{12} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nn} \end{pmatrix}$$

where, $x_{ij}$ is the value of the i-th evaluation object on the j-th index. Then,

$$y_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)}$$

2. Calculate the entropy $e_j$ of the j-th index

$$e_j = -k\sum_{i=1}^{m} y_{ij}*\ln\left(y_{ij}\right)$$

$$\left(k = -\frac{1}{\ln(m)}\right)$$

3. Calculate the weight $w_j$ of the j-th index

$$w_j = \frac{1-e_j}{\sum_{j=1}^{n}(1-e_j)}$$

*TOPSIS method*

1. Determine the weighted decision matrix V, where $v_{ij} = w_{ij}*y$.
2. Determine the positive ideal solution $A^+$ and the negative ideal solution $A^-$:

$$A^+ = [\max(v_{1j}),\ \max(v_{2j}),\ \max(v_{3j})\ \ldots\ \max(v_{nj})]$$

$$A^- = [\min(v_{1j}),\ \min(v_{2j}),\ \min(v_{3j})\ \ldots\ \min(v_{nj})]$$

3. Calculate the distance $D^+$, $D^-$ of each index to the positive and negative ideal solution:

$$D_i^+ = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - A_j^+\right)^2}$$

$$D_i^- = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - A_j^-\right)^2}$$

4. Calculate the relative proximity C of each scheme to the ideal solution:

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-}$$

5. Rank the alternatives by relative proximity: Higher $C_i$ values indicate better alternatives.

*Evaluation index system*
ICH, as a crystallization of human practices in production and daily life and a significant vehicle for cultural transmission, exhibits considerable complexity in its formation, evolution, and preservation. Its development is influenced by various social factors, particularly economic constraints[82]. Recognizing the distinct value of ICH within tourism development and its potential for synergistic integration with other tourism resources, this study identifies three core dimensions for evaluation: heritage resource endowment, regional economic development environment, and tourism development environment[83].

Heritage resource endowment is primarily determined by the quantity of ICH projects within a region and the availability of their tangible carriers. The regional economic development environment is characterized by factors such as the overall level of economic development, the degree of urban–rural integration, and residents' consumption capacity and potential. Meanwhile, the tourism development environment is shaped by transportation accessibility, the quality of tourism reception services, and the richness of other tourism resources. Drawing on these three dimensions and grounded in existing research, this study selects ten specific indicators (see Table 3) to construct a scientific and comprehensive evaluation framework[84,85].

## GeoDetector
According to the existing index system of the response level of ICH tourism, Geo-Detector is used to evaluate the explanatory power of different factors on the response level of ICH tourism in coastal areas, and the explanatory power is measured by the q value. The calculation formula is as follows:

$$q = 1 - \frac{\sum_{h=1}^{L}\sigma_h^2 N_h}{N\sigma^2}$$

where L (h = 1,2… L) represents the stratification of variable Y; N is the total number of units in the entire zone; $\sigma^2$ is the variance of Y values in the entire region; $N_h$ is the number of units in layer h; $\sigma_h^2$ is the variance of Y values in layer h. q represents the explanatory power of Y, and its value is strictly within the range of [0,1]. The higher the value of q, the better the independent variable X explains the dependent variable Y, and vice versa.

| Target layer | Guideline layer | Scheme layer | Scheme layer meaning |
|---|---|---|---|
| Tourism value of intangible cultural heritage | B1 Heritage resource endowment | C1 Heritage abundance | D1 Number of national heritage × 5 + number of provincial heritage × 3 |
| | | C2 Advantage of heritage resource combination | D2: Number of heritage conservation units + number of museums + number of famous villages |
| | B2 Regional economic development environment | C3 regional economic development level | D3: Gross Regional Product |
| | | C4: Consumption power | D4: disposable income per capita |
| | | C5 Consumption potential | D5: Number of permanent residents |
| | | C6 Urban and rural development level | D6: urbanization rate |
| | B3 Tourism developmental environment | C7 regional traffic level | D7: Density of road network |
| | | C8: Tourism reception service level | D8: Number of 3-star hotels x number of 3 + 4-star hotels x number of 4 + 5-star hotels × 5 |
| | | C9 Abundance of tourism resources | D9: Number of 5A tourist attractions × 5 + 4A-level tourist attractions × 4 + 3A-level tourist attractions × 3 |
| | | C10 Level of tourism development | D10: Total tourism revenue |

**Table 3**. Evaluation system of tourism response level.

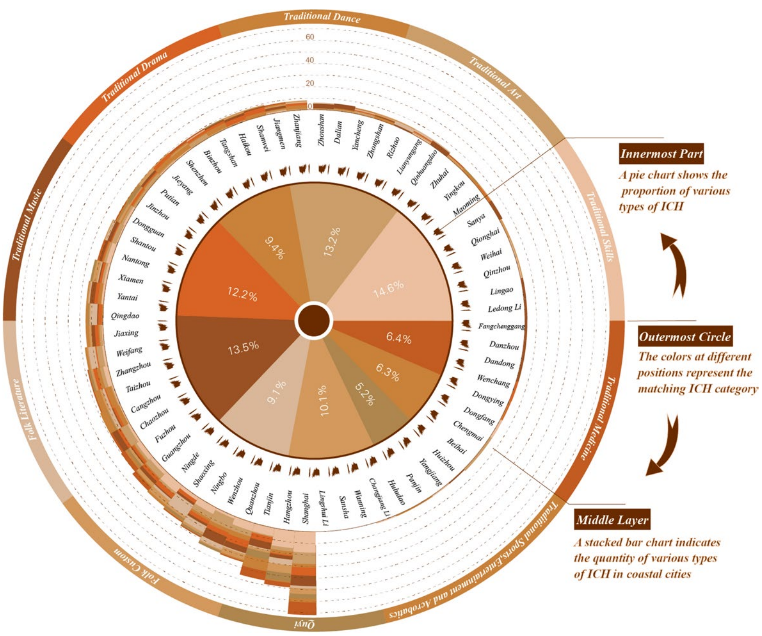


**Fig. 3**. Distribution of all kinds of ICH in coastal areas.

# Results
## Spatial distribution analysis of ICH in coastal areas
### *Distribution characteristics*
Coastal China encompasses a diverse array of ICH types, each exhibiting distinct spatial distribution patterns (Fig. 3). Traditional crafts, the largest category, account for 14.4% of all ICH types and are widely distributed, with notable concentrations in Quanzhou (18 sites), Tianjin (15), Hangzhou (7), and Shanghai (7). Traditional music, comprising 13.4%, is primarily clustered in Shanghai (9 sites), Wenzhou (8), and Tianjin (6). Traditional arts demonstrate focal concentrations in Shanghai and Chaozhou, each accounting for 10.5% of this category. Shanghai stands out as the principal ICH hub, hosting 26 traditional craft sites and 11 traditional medicine sites. In contrast, *quyi*—a genre of traditional Chinese narrative performance—represents the smallest category at 5.2%, with a predominant concentration in Hangzhou. Other types, including traditional dance, folk literature,

sports and acrobatics, and traditional medicine, exhibit relatively balanced but limited distributions across various cities.

*Spatial variation*
According to the analysis presented in Table 4, the overall average nearest neighbor ratio (ANN) for ICH is 0.197—substantially less than 1—indicating a highly clustered spatial distribution of ICH resources in China's coastal regions. The corresponding Z-score of − 41.96 and a P-value below 0.01 further confirm the statistical significance of this clustering pattern, suggesting that the likelihood of such a distribution occurring by random chance is less than 1%. Moreover, the ANN values for each ICH type are also below 1, demonstrating that the clustering tendency is consistent across different ICH categories, thereby reinforcing the conclusion of an overall clustered spatial distribution. Additionally, the CV for overall ICH stands at 1.179, highlighting a high degree of spatial heterogeneity among ICH resources across the coastal areas.

*Kernel density estimation*
As illustrated in Fig. 4, the KDE of various types of ICH reveals significant differences in clustering patterns across coastal regions, with each ICH type exhibiting a distinct spatial distribution model. This finding underscores the complexity and heterogeneity of ICH spatial distribution in coastal China, further highlighting the diverse cultural landscape shaped by region-specific historical, social, and economic factors.

*Quyi*, traditional music, and traditional crafts exhibit monocentric spatial distributions, with their concentrations almost exclusively located within the Yangtze River Delta and minimal secondary density elsewhere. In contrast, traditional sports and acrobatics exhibit bicentric patterns, with a primary core in the Yangtze River Delta and a secondary cluster in the Yellow River Delta. Folk literature, meanwhile, has its core in the Yangtze River Delta, with an additional concentration in the Shandong Peninsula. A tricentric spatial structure is evident in both folk customs and traditional medicine. Folk customs retain a primary hub in the Yangtze River Delta, supplemented by secondary concentrations in eastern Fujian and the Pearl River Delta. Traditional medicine also centers on the Yangtze Delta, while forming additional clusters in the Yellow River and Pearl River Deltas.

In contrast, traditional drama, dance, and fine arts exhibit a dual-core spatial structure, with co-dominant centers located in both the Yangtze River Delta and the Pearl River Delta, and a secondary nucleus in the Yellow River Delta. Collectively, these patterns form a regional macrostructure characterized by a dominant Yangtze River Delta core flanked by subordinate centers in the Yellow and Pearl River Deltas. In comparison, consistently sparse distributions are observed in Hainan Province, the Yancheng–Lianyungang corridor of northern Jiangsu, and non-metropolitan areas of Liaoning, where all ICH types show uniformly low densities.

*Findings of coastal ICH spatial pattern*
This spatial pattern suggests a potential correlation between ICH density and regional economic centrality. The dominance of Shanghai and the Yangtze River Delta as primary hubs aligns with their roles as major economic engines, while the emergence of secondary clusters in other key delta regions—the Pearl and Yellow River Deltas—further reinforces this association. Conversely, the consistently sparse distribution of ICH in economically peripheral areas such as Hainan Province, northern Jiangsu's Yancheng–Lianyungang corridor, and parts of Liaoning offers additional support for this correlation.

## Tourism response level

*The calculation of tourism response level*
Existing research has demonstrated that ICH, as a valuable cultural asset, plays a critical role in promoting the sustainable development of tourism[65–67]. To further examine the impact of coastal ICH on local tourism

| Indicators | Percentage of quantity (%) | Average nearest neighbor ratio (ANN) | z value | Coefficient of variation (CV) |
|---|---|---|---|---|
| Totality | 100 | 0.197 | − 41.96 | 1.179 |
| Traditional Skills | 14.6 | 0.336 | − 13.085 | 1.244 |
| Traditional Art | 13.2 | 0.317 | − 12.731 | 1.211 |
| Traditional Dance | 9.4 | 0.317 | − 10.778 | 1.284 |
| Traditional Drama | 12.2 | 0.296 | − 12.912 | 1.24 |
| Traditional Music | 13.5 | 0.183 | − 15.557 | 1.323 |
| Folk Literature | 9.1 | 0.414 | − 9.04 | 1.525 |
| Folk Custom | 10.1 | 0.404 | − 10.332 | 1.285 |
| Quyi | 5.2 | 0.371 | − 7.414 | 1.327 |
| Traditional Sports, Entertainment, and Acrobatics | 6.3 | 0.477 | − 6.713 | 1.223 |
| Traditional Medicine | 6.4 | 0.257 | − 9.641 | 1.132 |

**Table 4.** Spatial variability of ICH resources.

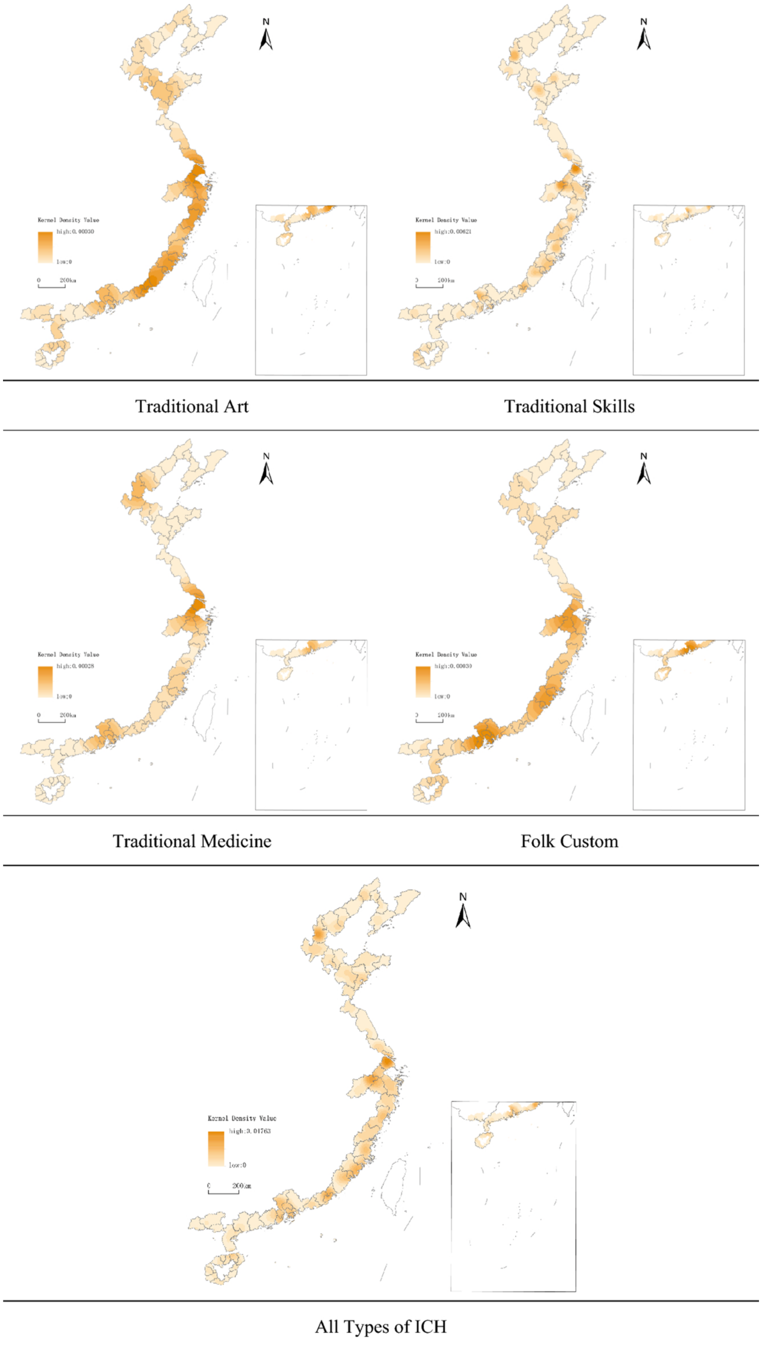


**Fig. 4**. Kernel density estimation of various types of ICH.

development, this study employs the entropy-weighted TOPSIS method to calculate the tourism response levels across 63 prefecture-level cities (including directly administered counties) along China's coastline. The final computed index weights are presented in Table 5, and the corresponding results are shown in Table 6.

Given the evident gradient in tourism response levels for ICH across coastal cities and the absence of substantial fluctuations in extreme values, this study adopts the natural breaks classification method to categorize response levels. Cities are grouped into five categories: extremely high response, high response, moderate response, low response, and extremely low response areas, as detailed in Table 7. The natural breaks method is particularly suitable for this dataset, as it effectively captures inherent patterns within the data and enhances the interpretability of the results.

Tourism response levels for coastal ICH exhibit pronounced regional disparities. High-response areas can be classified into two tiers: (1) extremely high-response zones, comprising five city units (7.93% of the total), and (2) second-highest response zones, including seven city units (11.11%), primarily concentrated in Fujian and Zhejiang provinces. In contrast, a significant proportion of city units—ranging from 36 to 60%—fall within the

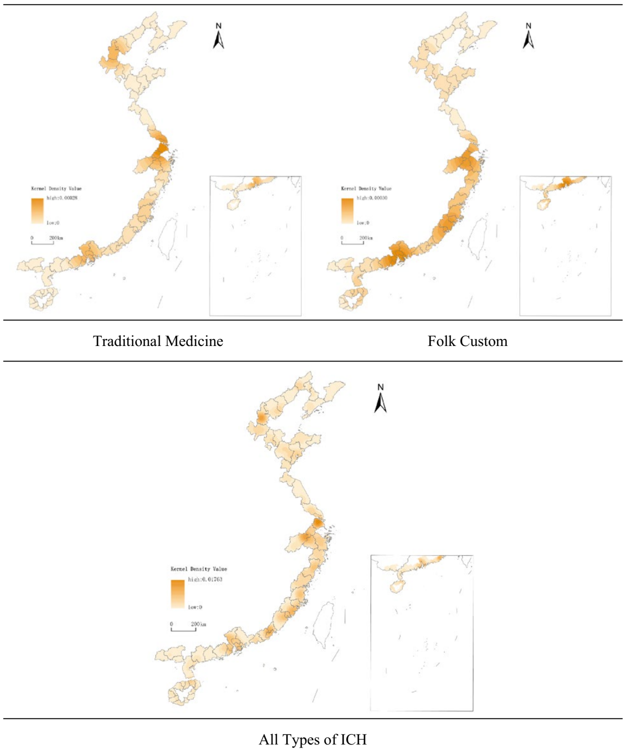


**Fig. 4.** (continued)

| Guideline layer | Scheme layer | Scheme layer meaning | Indicator weight |
|---|---|---|---|
| B1 Heritage resource endowment | C1 Heritage abundance | D1 Number of national heritage × 5 + number of provincial heritage × 3 | 0.1265 |
| | C2 Advantage of heritage resource combination | D2: Number of cultural relic conservation units + number of museums + number of villages | 0.1358 |
| B2 Regional economic development environment | C3 regional economic development level | D3: Gross Regional Product | 0.1582 |
| | C4: Consumption power | D4: disposable income per capita | 0.0686 |
| | C5 Consumption potential | D5: Number of permanent residents | 0.0968 |
| | C6 Urban and rural development level | D6: urbanization rate | 0.0196 |
| B3 Tourism development environment | C7 regional traffic level | D7: Density of road network | 0.0788 |
| | C8: Tourism reception service level | D8: Number of 3-star hotels x number of 3 + 4-star hotels x number of 4 + 5-star hotels × 5 | 0.0872 |
| | C9 Abundance of tourism resources | D9: Number of 5A tourist attractions × 5 + 4A-level tourist attractions × 4 + 3A-level tourist attractions × 3 | 0.0856 |
| | C10 Level of tourism development | D10: Total tourism revenue | 0.1428 |

**Table 5**. Index weights.

second-lowest or extremely low-response categories, with notable clustering observed in northern Shandong, southern Guangxi, and Hainan Province.

As illustrated in Fig. 5, the spatial distribution of tourism response levels for ICH across coastal areas reveals a marked imbalance. Higher response levels are concentrated in the Yangtze River Delta, Pearl River Delta, the Beijing–Tianjin–Hebei economic zone, and other central coastal regions. In contrast, the southern and northern coastal areas display a clear downward trend in response levels, reflecting regional disparities in the integration of ICH with tourism development.

| City | Tourism response values | Rankings | City | Tourism response values | Rankings |
|---|---|---|---|---|---|
| Shanghai City | 0.7954 | 1 | Shantou | 0.1495 | 33 |
| Guangzhou City | 0.5728 | 2 | Weihai City | 0.1478 | 34 |
| Hangzhou City | 0.5667 | 3 | Jiangmen City | 0.1424 | 35 |
| Shenzhen | 0.5209 | 4 | Putian City | 0.1372 | 36 |
| Tianjin | 0.5177 | 5 | Qinzhou City | 0.1346 | 37 |
| Wenzhou City | 0.4432 | 6 | Haikou City | 0.1254 | 38 |
| Ningbo City | 0.3962 | 7 | Qinhuangdao City | 0.1185 | 39 |
| Quanzhou City | 0.3912 | 8 | Rizhao | 0.1129 | 40 |
| Qingdao City | 0.3869 | 9 | Binzhou City | 0.1122 | 41 |
| Ningde City | 0.3575 | 10 | Dongying City | 0.1094 | 42 |
| Fuzhou City | 0.3523 | 11 | Jinzhou City | 0.1048 | 43 |
| Taizhou City | 0.3383 | 12 | Sanya City | 0.1048 | 44 |
| Yantai City | 0.3148 | 13 | Beihai City | 0.1008 | 45 |
| Weifang City | 0.3052 | 14 | Chaozhou City | 0.0939 | 46 |
| Shaoxing | 0.2922 | 15 | Huludao City | 0.0928 | 47 |
| Dongguan City | 0.2873 | 16 | Yingkou City | 0.0911 | 48 |
| Nantong City | 0.2783 | 17 | Panjin City | 0.0900 | 49 |
| Zhangzhou City | 0.2726 | 18 | Shanwei City | 0.0765 | 50 |
| Xiamen City | 0.2655 | 19 | Yangjiang City | 0.0745 | 51 |
| Tangshan City | 0.2437 | 20 | Dandong City | 0.0732 | 52 |
| Jiaxing | 0.2398 | 21 | Fangchenggang City | 0.0677 | 53 |
| Dalian City | 0.2365 | 22 | Chengmai County | 0.0540 | 54 |
| Cangzhou City | 0.2363 | 23 | Wenchang City | 0.0526 | 55 |
| Zhoushan City | 0.2112 | 24 | Danzhou City | 0.0379 | 56 |
| Yancheng City | 0.2074 | 25 | Li Autonomous County, Changjiang | 0.0347 | 57 |
| Zhanjiang City | 0.2025 | 26 | Qionghai City | 0.0342 | 58 |
| Maoming City | 0.1775 | 27 | Dongfang City | 0.0298 | 59 |
| Lianyungang City | 0.1740 | 28 | Lingao County | 0.0233 | 60 |
| Huizhou City | 0.1716 | 29 | Wanning City | 0.0232 | 61 |
| Zhongshan City | 0.1632 | 30 | Ledong Li Autonomous County | 0.0200 | 62 |
| Jieyang City | 0.1606 | 31 | Lingshui Li Autonomous County | 0.0188 | 63 |
| Zhuhai City | 0.1534 | 32 | Sansha City | / | / |

**Table 6**. Tourism response level.

*Findings of tourism response level*

The results indicate that coastal cities exhibit markedly uneven capacities to leverage ICH for tourism development, closely mirroring existing regional economic hierarchies. The highest levels of responsiveness are concentrated exclusively in leading economic hubs, forming high-response zones that align with advanced levels of economic development. A pronounced gradient of responsiveness radiates outward from these core areas, with mid-tier coastal cities displaying moderate levels of utilization, while extensive stretches of the coastline remain in low-response conditions. This pattern underscores that the development of ICH tourism is more strongly correlated with regional economic capacity than with the sheer abundance of heritage resources.

## Influencing factors of tourism response levels

This study employs the GeoDetector method to systematically examine the underlying drivers of coastal ICH tourism responsiveness, with a particular focus on quantifying the interactive effects among contributing factors.

*Single factor influence*

GeoDetector analysis (Table 8) confirmed that all examined factors exert statistically significant explanatory power ($p < 0.05$) on coastal ICH tourism response levels. Among these, regional GDP (D3) demonstrated the strongest explanatory capacity ($q = 0.84$), followed by resident population (D5, $q = 0.78$). Indicators related to the tourism environment also exhibited high explanatory power ($q > 0.70$), highlighting the importance of supporting infrastructure and services. Heritage endowment factors further contributed to competitiveness, particularly through marine-oriented ICH resources such as fishing traditions and associated cultural facilities, including

| Response categories | City (county) | Account for the percentage |
|---|---|---|
| Extremely high response area | Shanghai, Guangzhou, Hangzhou, Shenzhen, and Tianjin | 7.93% |
| Second-highest response district | Wenzhou, Ningbo, Quanzhou, Qingdao, Ningde, Fuzhou, Taizhou | 11.11% |
| Moderate response area | Weifang, Shaoxing, Dongguan, Nantong, Zhangzhou City, Xiamen, Tangshan, Jiaxing, Dalian, Cangzhou City, Zhoushan City, Yancheng City, Zhanjiang City | 20.63% |
| Sub-low response district | Maoming, Lianyungang, Huizhou, Zhongshan, Jieyang, Zhuhai, Shantou, Weihai City, Jiangmen City, Putian City, Qinzhou City, Haikou City, Qinhuangdao City, Rizhao City, Binzhou City, Dongying City, Jinzhou City, Sanya City, Beihai City, Chaozhou City, Huludao City, Yingkou, Panjin City | 36.50% |
| Very low response area | Shanwei City, Yangjiang City, Dandong City, Fangchenggang City, Chengmai County, Wenchang City, Danzhou Changjiang Li Autonomous County, Qionghai City, Dongfang City, Lingao County, Wanning City, Ledong Li Autonomous County, Lingshui Li Autonomous County | 23.83% |

**Table 7**. Response level classification of coastal cities.

museums and heritage sites. In contrast, the urbanization rate (D6) displayed relatively weak explanatory power ($q < 0.50$), suggesting a limited role in shaping ICH tourism responsiveness.

*Dual factor interaction*

Interaction detection analysis revealed significant non-linear enhancement effects among heritage resource endowments, the economic development environment, and the tourism development environment on coastal ICH tourism responsiveness. All factors exhibited stronger explanatory power in pairwise combinations than when assessed individually (Fig. 6), with heritage resource endowment showing the most pronounced interactive effects, demonstrating coefficients exceeding 0.9 when paired with economic or tourism indicators. Complementary correlation analysis of operational variables (D1–D10) further confirmed substantial pairwise associations, ranging from 0.434 (D6–D7) to 0.960 (D3–D8). Notable patterns included: (1) exceptionally strong correlations between D2–D5 (0.948), D3–D8 (0.960), and D9–D10 (0.921); (2) the weakest associations observed between D4–D10 (0.513) and D6–D7 (0.434); (3) consistently high correlations for D3 across all variables (each exceeding 0.844); and (4) a marked clustering effect among D7–D10 (all values > 0.74) relative to D1–D4.

*Findings of influencing factors*

The tourism response to coastal ICH is shaped by synergistic interactions between heritage resources and contextual factors, rather than by isolated variables. These elements mutually reinforce each other. The spatial distribution and density of heritage resources significantly influence tourism response patterns, with resource-rich areas—such as the Yangtze River Delta and the Pearl River Delta—tending to show higher levels of tourism development. On the other hand, the advancement of tourism infrastructure and services directly facilitates the transmission and evolution of ICH. The economic returns generated through tourism provide critical support for the systematic protection and sustainable utilization of heritage resources, thereby enhancing their visibility and increasing the availability of tangible carriers for cultural transmission.

## Discussion

### Comparison with existing studies on inland areas

Coastal regions exhibit certain parallels with inland and border areas in terms of the spatial distribution and tourism responsiveness of ICH, reflecting the widely recognized principle that regional economic development underpins both heritage allocation and tourism performance. However, coastal areas also display distinct characteristics that differentiate them from inland models, thereby contributing to the refinement and expansion of contemporary theoretical frameworks related to ICH tourism.

The spatial distribution patterns of ICH in coastal regions differ markedly from those observed in land border areas, reflecting fundamentally distinct developmental drivers. In coastal zones, ICH concentrations are closely aligned with economic and tourism dynamics, particularly evident in high-density clusters situated in economically advanced delta regions such as the Yangtze River Delta, Pearl River Delta, and Yellow River Delta. This spatial configuration is rooted in longstanding maritime trade traditions, sustained population mobility, and ongoing processes of economic globalization. In contrast, land border regions exhibit strong correlations between ICH distribution and key demographic-economic variables—namely, the proportion of ethnic minority populations (as the primary determinant), GDP per capita, and population density[86]. These factors produce unique spatial patterns characterized by pronounced ethnic homogeneity, in which traditional performing arts (e.g., music and dance) and craft practices function as essential vehicles for cultural identity

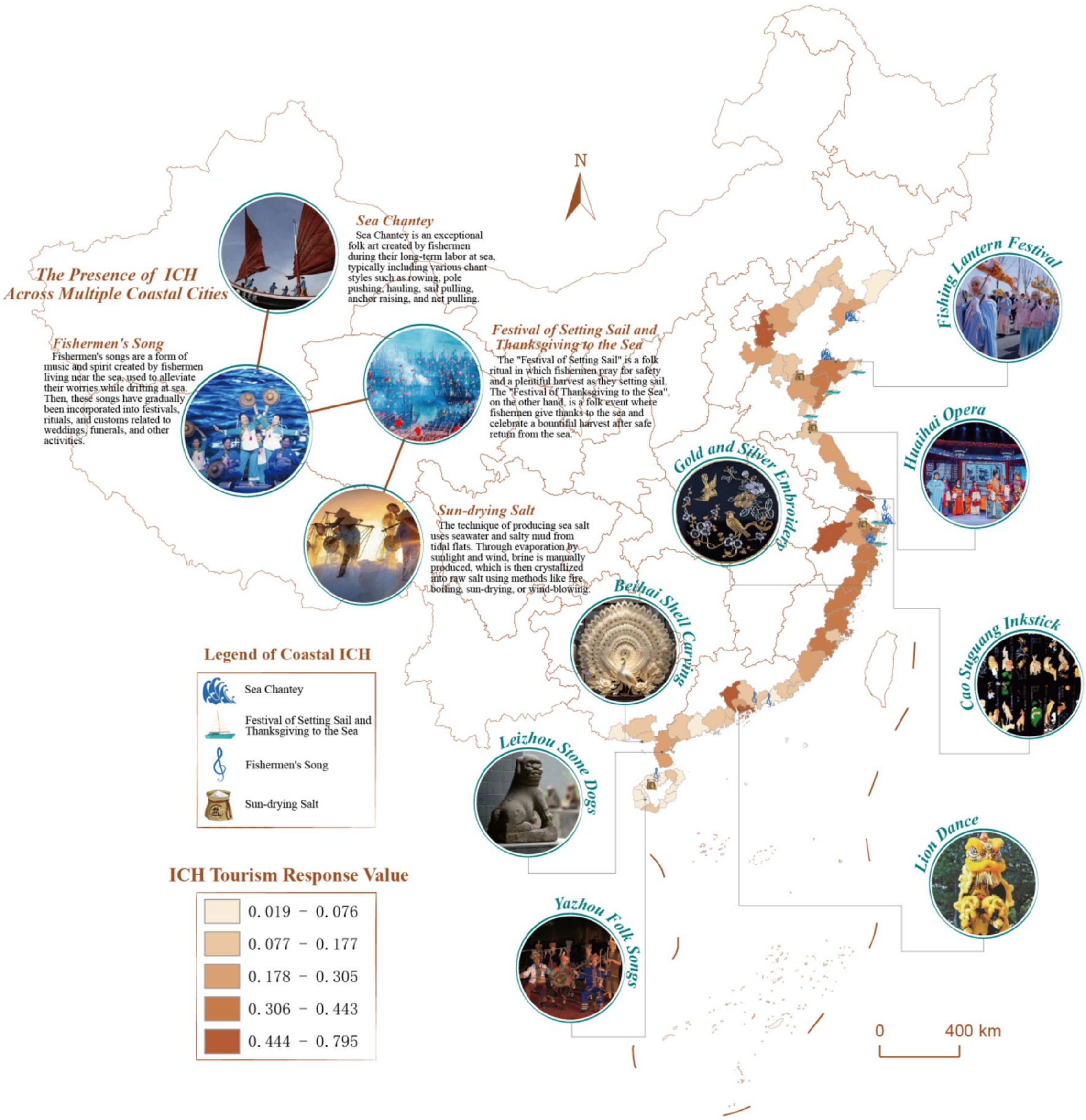


**Fig. 5**. Spatial distribution of tourism response level of ICH in coastal cities.

| Factors | q | p |
|---|---|---|
| D1 | 0.7246 | 0.000 |
| D2 | 0.7168 | 0.000 |
| D3 | 0.8445 | 0.000 |
| D4 | 0.5128 | 0.000 |
| D5 | 0.7842 | 0.000 |
| D6 | 0.4339 | 0.000 |
| D7 | 0.6585 | 0.000 |
| D8 | 0.7453 | 0.000 |
| D9 | 0.7275 | 0.000 |
| D10 | 0.7416 | 0.000 |

**Table 8**. Drivers of Coastal ICH Distribution.

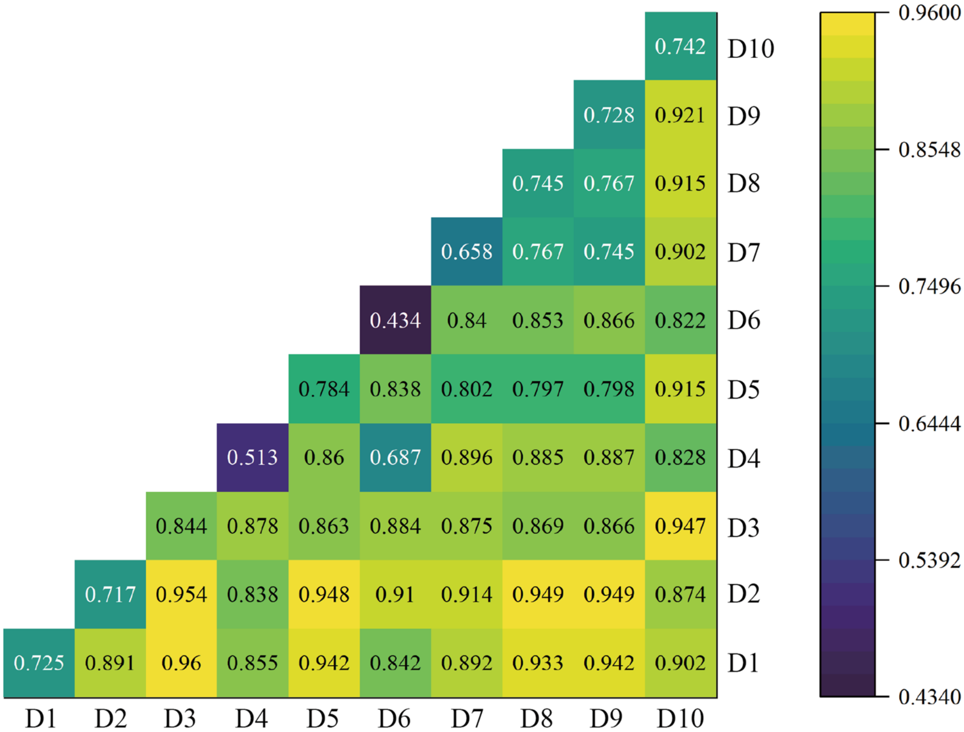


**Fig. 6**. Interactive detection of the influencing factors on the ICH spatial distribution.

transmission. Unlike the economically driven distribution seen in coastal regions, ICH clusters in border areas reflect complex interdependencies among urban form, cultural practice, and demographic structure, largely shaped by the historical formation of ethnic enclaves.

The spatial patterns observed in coastal regions align with Petronela's framework[87], which emphasizes the role of economic centrality in the preservation of ICH. Petronela argues that wealthier, more developed regions provide the necessary infrastructure for safeguarding cultural heritage, a concept that mirrors Central Place Theory[88–90]. This theory underscores the centrality of economic hubs in the distribution of resources, including cultural assets. The observed correlation between heritage density and economic centrality further illustrates how economic development acts as a driving force behind cultural preservation efforts.

In terms of tourism response, coastal areas, unlike inland and border regions, are more strongly influenced by economic development levels[41,54,65,66]. As a result, the development of ICH tourism in coastal regions shows a clear correlation with economic prosperity. Regions with earlier economic development, more developed infrastructure, and higher levels of tourism resource development tend to attract greater numbers of tourists and investment. In contrast, ICH resources in inland areas are primarily centered around agricultural cultures, ethnic minority traditions, and traditional religious practices.

These differences highlight the underlying mechanisms governing ICH resource distribution and inform the need for differentiated conservation strategies. Coastal areas should focus on integrating ICH within tourism-driven economic frameworks, while border regions require targeted efforts to safeguard ethnic minority traditions, complemented by strategic cultural tourism initiatives.

## Recommendations

Based on the analysis in this study, we propose the following policy recommendations to support the protection and development of ICH in coastal areas:

1. **Differentiated Strategies for High-Density ICH Zones:** Coastal ICH conservation and development require tailored strategies that align with regional resource-context configurations. For high-density ICH areas with strong tourism responses, it is essential to implement integrated heritage-tourism ecosystems through systematic spatial planning. ICH elements should be embedded within existing attraction infrastructure, linking heritage with industries such as culinary arts, performing arts, and wellness. Regional thematic circuits should be established to consolidate dispersed heritage assets into synergistic clusters. For example, Ningbo could integrate narrative arts (Walk-Books), Yue Opera, and traditional crafts (gold/silver embroidery, Yue kiln ceramics) into unified visitor experiences. This approach not only converts heritage value into sustainable revenue streams but also ensures the maintenance of authenticity, creating feedback loops that support inheritor communities without compromising cultural integrity.
2. **Strategic Niche Development for Sparse ICH Areas:** Regions with limited heritage resources but high tourism potential should prioritize strategic niche development. High-potential ICH elements should be identified and marketed as distinctive cultural assets, leveraging existing tourism infrastructure to enhance their

visibility. For example, Zhanjiang's stone dog tradition—a syncretic Han-Vietnamese cultural artifact with ritual significance—could be developed as a cultural IP foundation through digital interpretation and media adaptation, similar to successful heritage commodification models. This focused development prevents the dilution of resources while creating a competitive edge.

3. **Foundational Capacity Building for Low-Density and Low-Response Areas:** Areas with both low ICH density and low tourism response require fundamental capacity building. Dedicated documentation systems and support mechanisms for inheritors should be established before tourism integration, with a focus on endangered practices such as the textile traditions of Ledong Li Autonomous County. Concurrently, basic tourism infrastructure should be developed to pave the way for future growth. Phased evaluation protocols should be implemented to determine when specific ICH projects reach viability thresholds for controlled tourism activation, ensuring that preservation always precedes commercialization.

## Limitations

This study acknowledges several methodological and data-related constraints that define the scope of its conclusions.

Firstly, the exclusion of Taiwan, Hong Kong, and Macau creates a gap in the analysis of broader coastal heritage dynamics. This exclusion is not due to a lack of significant ICH in these regions—examples include Hong Kong's Cheung Chau Jiao Festival (a UNESCO-listed event), Macau's Patuá theatre, and Taiwan's Beiguan music traditions—but rather stems from the fundamental differences in their ICH statistical frameworks and data collection methodologies compared to those used for mainland Chinese coastal cities. The inability to integrate data from these regions, which are categorized using distinct methods, limits the capacity to incorporate them into quantitative models assessing cross-regional cultural flows, especially in areas like the Pearl River Delta, where such interactions have historically been significant.

Secondly, the data from 2022 was selected as it represents the most recent comprehensive assessment of China's national-level intangible cultural heritage, marking a critical point in the study of ICH. Moreover, the data is sourced from publicly available government records, ensuring both credibility and a high level of accuracy.

Thirdly, the entropy-weighted TOPSIS method was employed to provide a data-driven, objective weighting of indicators for assessing tourism response levels, yielding quantifiable and replicable results. While this method has inherent limitations, such as its potential sensitivity to extreme values in smaller samples, our normalization procedures and repeated validation ensured the absence of such outliers in the dataset. As a result, these limitations did not prevent the derivation of valid spatial patterns or rankings, which highlight significant disparities, such as the dominant response levels in cities like Shanghai, Guangzhou, Hangzhou, Shenzhen, and Tianjin.

While spatial techniques such as the ANN ratio and KDE effectively identified clustering patterns, scale sensitivity presented a significant challenge. Specifically, ANN calculations were vulnerable to boundary delineation effects in fragmented coastal zones, such as Jiangsu's discontinuous shoreline. To address this issue and ensure the robustness of our findings, we conducted multi-scale validation by replicating the analyses at both the provincial and prefectural levels. This approach consistently reinforced our conclusions, confirming the reliability of the results.

## Conclusion

This study examines the spatial configuration of ICH in China's coastal regions, while also evaluating regional variations in tourism responsiveness. The research focuses on three key dimensions: the spatial distribution patterns of coastal ICH resources, regional disparities in tourism response intensity, and the factors influencing the performance of ICH tourism.

The study employs various spatial analysis techniques, including nearest neighbor analysis, kernel density estimation, and spatial variation analysis, to investigate the spatial distribution of coastal ICH. It then applies the entropy-weighted TOPSIS method for mathematical modeling and quantitative analysis of tourism response levels. Finally, GeoDetectors and two-factor analysis are utilized to explore the underlying mechanisms influencing the factors that affect ICH tourism response levels.

This study identifies a distinct spatial pattern in China's coastal ICH, with the Yangtze River Delta—centered on Shanghai—emerging as the primary hub, flanked by secondary clusters in the Pearl River and Yellow River Deltas. Notably, this distribution reflects strong path dependence on regional economic centrality, as ICH density correlates positively with economically advanced zones and declines markedly in peripheral areas such as Hainan and northern Jiangsu. Tourism responsiveness exhibits pronounced spatial inequality, forming concentrated high-response zones (e.g., Shanghai, Guangzhou, Hangzhou) and displaying a steep gradient of decline from central to northern and southern coastal regions. GeoDetector analysis identifies regional GDP as the most influential determinant ($q > 0.4$), significantly surpassing the explanatory power of heritage abundance, population size, and tourism environment, underscoring the central role of economic infrastructure in the commodification and development of ICH.

Theoretically, these findings contribute to coastal heritage research by introducing a resource-context synergy framework. This framework argues that ICH tourism responsiveness arises from the interaction between heritage endowment, regional economic capacity, and tourism infrastructure, rather than heritage abundance alone. It helps explain why economically peripheral regions with rich ICH resources, such as Ledong County's textile traditions, often experience low levels of tourism integration. Practically, the results call for differentiated development strategies: high-response hubs (e.g., Shanghai) should drive premium experiential tourism through the integration of heritage and services; mid-response corridors (e.g., Yantai-Lianyungang) require optimized synergies between infrastructure and institutions to unlock heritage potential; and low-response areas (e.g., Hainan counties) must focus on safeguarding cultural assets through inheritor support before initiating controlled tourism development. These spatially-targeted approaches balance cultural preservation with sustainable tourism development, offering a replicable model for the revitalization of coastal heritage worldwide.

Future research should focus on three critical areas: (1) developing frameworks for optimizing the performance of ICH tourism, (2) formulating spatially differentiated policy frameworks for the integration of coastal ICH and tourism, and (3) elucidating the causal mechanisms by which macroeconomic factors (e.g., GDP) influence heritage tourism dynamics. Emphasis should be placed on exploring the strategic alignment between heritage conservation and regional economic modernization, as well as identifying sustainable pathways for coastal ecosystem development through ICH tourism.

## Data availability

The datasets used in this study were compiled from the 2022 Statistical Yearbooks of the following coastal provinces in China. These yearbooks are publicly accessible through the respective provincial statistical bureaus' official websites: Table 2. Links of 2022 Statistical Yearbooks ProvinceWebsite Liaoning https://www.ln.stats.gov.cn/tjsj/sjcx/ndsj/ Hebeihttps://tjj.hebei.gov.cn/hetj/tjsj/jjnj/ Tianjin https://stats.tj.gov.cn/TJTJJ434/TJCP574/TJTJNJ697/ Shandong https://tjj.shandong.gov.cn/col/col6279/index.html Jiangsu https://tj.jiangsu.gov.cn/col/col76362/index.html Shanghai https://tj.jiangsu.gov.cn/col/col76362/index.html Zhejiang https://tjj.zj.gov.cn/col/col1525563/index.html Fujian https://tjj.fujian.gov.cn/xxgk/ndsj/ Guangxihttps://tjj.gxzf.gov.cn/tjsj/ Hainanhttps://stats.hainan.gov.cn/tjj/tjsu/ndsj/ Guangdong https://stats.gd.gov.cn/gdtjnj/index.html.

Received: 1 April 2025; Accepted: 7 August 2025
Published online: 17 August 2025

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## Author contributions

L.X., T.F., L.J. completed the drafting and data analysis of the manuscript text. They collaborate to design and produce effective graphics and illustrations to effectively communicate research findings and supporting textual content. J.T. supervised the writing of the three. He provided valuable feedback that enhanced the clarity and coherence of the paper. Each author has read and approved the final version of the manuscript submitted for publication. It should be noted that L.X., T.F., L.J. contribute the equally to the work.

## Funding

It is worth noting that this study was financially supported by the Undergraduate Training Programs for Innovation and Entrepreneurship of Wuhan University (Grant ID: S202510486157).

## Competing interests

The authors declare no competing interests.

## Additional information

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