

# Spatial evolution model of tourist destinations based on complex adaptive system theory: A case study of Southern Anhui, China

YANG Zhongyuan<sup>1</sup>, YIN Min<sup>2</sup>, \*XU Jiangang<sup>2</sup>, LIN Wei<sup>3</sup>

1. School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing 210023, China;

2. School of Architecture and Urban Planning, Nanjing University, Nanjing 210093, China;

3. College of Forestry and Landscape Architecture, South China Agricultural University, Guangzhou 510640, China

**Abstract:** According to the complex adaptive systems theory, tourist destinations may be regarded as complex adaptive systems formed by multiple adaptive agent interactions and composed of an agent system, tourist attraction subsystem, tourist service facility subsystem, and external environment system. This paper explores the spatial evolutionary progress of the Southern Anhui tourist area. The period 1979 to 1990 comprised the formation stage of spatial agglomerates, during which tourist attractions centering on Huangshan Scenic Area and Jiuhuashan Scenic Area were gradually exploited and formed scale agglomeration; tourism spatial structure began to show the characteristics of agglomeration development, and Gini indexes of the number of tourists and tourism revenue increased significantly from 0.26 to 0.29, and from 0.33 to 0.35, respectively. From 1991 to 2008, the system experienced a growth stage in which Huangshan Scenic Area and Jiuhuashan Scenic Area were further developed with improved tourist service facilities. Rapid development of Xidi-Hongcun Scenic Area and establishment of Fantawild Tourist Area promoted the formation of more spatial agglomerates with larger scales; Gini indexes of the number of tourists and tourism revenue presented fluctuating changes, reaching low points of 0.15 and 0.25 in 2000 and 0.12 and 0.22 in 2007, respectively. From 2009 to the present day, the system has remained in a blowout-development stage, during which non-linear interactions among agents are strengthened; various emerging development factors generate cultural tourism, vacation tourism, rural tourism and other new tourism products jointly with traditional development factors. New tourism products form a large number of new spatial agglomerates that are interconnected, accelerating the spatial flow of tourists and tourism revenue and reducing the differences in tourism development levels within the region; Gini indexes of the number of tourists and tourism revenue declined steadily from 0.17 and 0.23 in 2009 to 0.12 and 0.15 in 2016.

**Keywords:** complex adaptive system theory; spatial structure of tourist destination; spatial agglomerates; Gini index; Southern Anhui tourist area

**Received:** 2018-06-20 **Accepted:** 2018-09-12

**Foundation:** National Natural Science Foundation of China, No.51278239

**Author:** Yang Zhongyuan (1987–), PhD, specialized in tourist destination system. E-mail: faye601@126.com

\***Corresponding author:** Xu Jiangang (1960–), Professor, E-mail: xjg129@sina.com

## 1 Introduction

The evolution of tourist destinations has always been an important aspect of study within tourism geography; its research objective is to explore and understand the development processes and characteristics of tourist destinations over a definite period of time (Chen *et al.*, 2011). The term “evolution” was derived from biology, originally referring to the phenomenon of generational change that organisms exhibit. Later, the concept of “evolution” was gradually applied to other disciplines, playing an especially vital role in the study of social phenomena. Continuous improvement of the social economy has brought tremendous change to modern tourism in both the operation mode and management mode of tourist destinations, as well as influencing how tourists travel (Lu *et al.*, 2016). The combined effects of these changes have driven the constant evolution of tourist destinations. Studying the evolutionary processes and characteristics of tourist destinations may allow examination of the basic laws of tourism development and illumination of the main problems existing in different development stages of tourist destinations. This contributes to identifying the future development trend and direction of tourist destinations and providing certain scientific guidance for the progress of tourist destinations.

Traditional theories of tourist destination evolution mainly focused on analyzing changes in tourist destination elements, such as the representative life cycle theory proposed by Butler that divides the evolutionary stages of tourist destinations according to change in the number of tourists (Bao, 1999). Many scholars carried out empirical research based on Butler’s life cycle theory to study the evolutionary characteristics of different types of tourist destinations (Lu, 1997; Agarwal, 2002; Yuval and Shaul, 2004; Wen, 2007; Luis and Gemma, 2011; Caldicott and Scherrer, 2013). Others utilized this theory to develop theoretical concepts and quantification methods of tourist destinations’ life cycles (Lundtorp and Wanhill, 2001; Shao and Gao, 2006; Yang, 2009; Zhang and Sun, 2012; Salvador, 2016). As the study of tourism evolution developed further, scholars gradually extended their attention to the development of tourist destinations to scenic spots, service facilities, transportation elements, land use, and other aspects while acknowledging that the traditional life cycle theory was no longer sufficient to explain evolutionary processes and mechanisms (Jin *et al.*, 2009; Bao *et al.*, 2010; Wang *et al.*, 2011; Ji *et al.*, 2012; Geng and Song, 2013; Yang and Lu, 2013; Liao *et al.*, 2014; Xi *et al.*, 2015; Wang *et al.*, 2016; Pagliara *et al.*, 2017; Hernandez *et al.*, 2017; Liu and Li, 2018). The advances of system sciences allowed scholars to successively apply general system theory, dissipative structure theory, and system dynamics theory to the study of tourist destination evolution in order to explain evolutionary processes and mechanisms based on the perspective of the system and explore the characteristics of tourist destination systems, such as integrity, organicity, dynamics, and non-equilibrium (Yang *et al.*, 2009; Lu and Bao, 2010; Liu *et al.*, 2013; Olmedo and Mateos, 2015). However, few analyzed the interaction of intra-systemic factors and most researches lacked theoretical models of the intra-systemic mechanism.

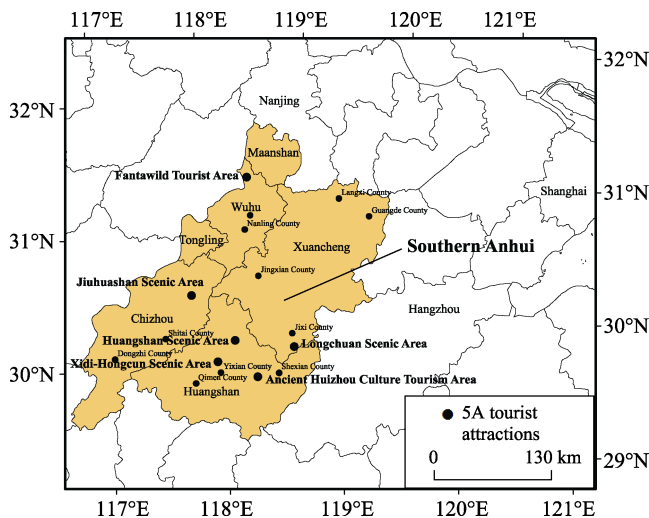
The Complex Adaptive System (CAS) theory is the third-generation system theory developed on the basis of the first-generation system theories (represented by general system theory and cybernetics) and second-generation system theories (represented by dissipative

structure theory, synergy theory, and related theories). Proposed by John Holland in the mid-1990s, it puts forward an “adaptive” view based on previous system theories and attributes systems’ presentation of various complex features to the adaptability of agents. This provided a new perspective for revealing the processes and mechanisms of the complex system of tourist destinations, as well as a scientific and theoretical method that is effective in analyzing the interrelationship between microscopic behaviors and macroscopic changes of systems. This paper utilizes complex adaptive system theory to explore the spatial structure evolution law and its influencing mechanisms in Southern Anhui tourist area.

## 2 Methodology and data sources

### 2.1 Case location

The Southern Anhui tourist area generally refers to a region to the south of the Yangtze River in Anhui Province, including Wuhu (excluding Wuwei County and Shenxiang Town of Yuanhe County), Maanshan (excluding Hexian County and Hanshan County), Tongling, Xuancheng, Chizhou (excluding the original Zongyang County of Anqing City) and Huangshan. It is a rare resource-rich area nationwide that possesses a multitude of high-quality tourism resources. Currently, there are six national 5A tourist attractions (Figure 1), two world heritage projects, five national nature reserves, and two state-list famous historical and cultural cities (Table 1). As a key tourism development area in China, it is domestically and internationally renowned for its beautiful natural scenery, time-honored history, and splendid culture; its development processes, patterns, and mechanisms reflect the development law of regional tourism to a certain extent. This paper analyzes the temporal organization and spatial processes of tourism development in the Southern Anhui tourist area and reveals its spatial evolution model in order to provide a theoretical reference for studying the spatial evolution model of regional tourism.



**Figure 1** Location of Southern Anhui

**Table 1** Important tourism resources of Southern Anhui

Type	Name
5A tourist attractions	Huangshan Scenic Area
	Jiuhuashan Scenic Area
	Ancient Villages in Southern Anhui – Xidi and Hongcun (Xidi Scenic Area, Hongcun Scenic Area)
	Longchuan Scenic Area, Jixi County
	Ancient Huizhou Culture Tourism Zone (The Ancient City of Huizhou, Chengkan, Qiankou Private Residence, Tangmo, Tangyue Memorial Archway · Baojia Garden)
World heritage projects	Wuhu Fantawild Tourist Area (Fantawild Adventure, Fantawild Magic Kingdom, Fantawild Water Park, Fantawild Oriental Heritage)
	Mount Huangshan – cultural and natural heritage
	Ancient Villages in Anhui: Xidi, Hongcun – cultural heritages
National nature reserves	Tongling National Nature Reserve for River Dolphins
	Guniujiang National Nature Reserve
	Shengjin Lake National Nature Reserve
	Anhui National Nature Reserve for Chinese Alligators
	Anhui Qingliangfeng National Nature Reserve
State-list famous historical and cultural cities	Shexian County
	Jixi County

**2.2 Methodology**

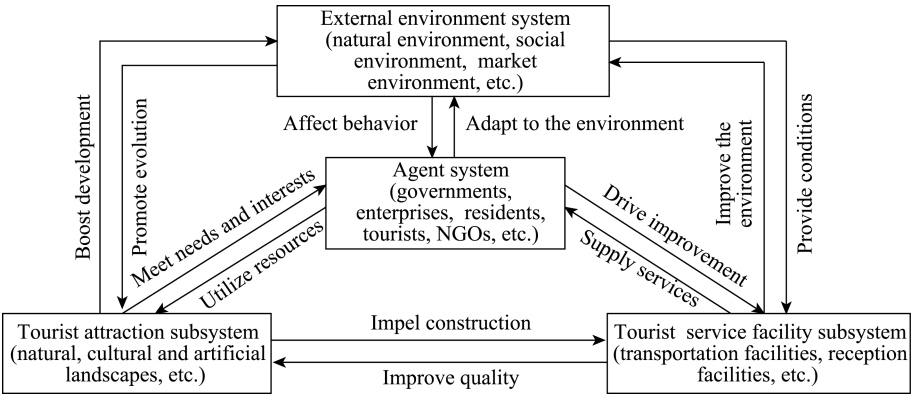
**2.2.1 Theoretical model**

The core idea of CAS (complex adaptive system) theory is that the dynamic nature of complex evolution of systems originates from the adaptability of intra-systemic individuals; these active and adaptable individuals are the agents of the system, which are the basic elements of CAS (Holland, 1992). The interactive mechanisms among various intra-systemic agents and between agents and the environment are fundamental catalysts of systemic evolution (Holland, 1992). CAS has seven basic characteristics: agglomeration, nonlinearity, flow, diversity, identification, internal modeling, and building blocks. The first four are the basic characteristics of CAS that function in adaptation and evolution; the latter three play a role in the interaction between individuals and the environment (Holland, 2000).

CAS theory is the theoretical basis of this paper. According to the general properties of the theory, tourist destination systems are considered complex adaptive systems formed by the interaction of multiple adaptive agents. The basic structures of such systems can be divided into an agent system, tourist attraction subsystem, tourism service facility subsystem, and external environment system (Figure 2). Serving as the leading system of tourist destination systems, the agent system exchanges materials, energy, and information with the tourist attraction subsystem, tourism service facility subsystem, and external environmental system to promote the development and evolution of tourist destinations.

The foundational notion of CAS theory is exemplified by the adaptive evolution of microscopic agents that promote the hierarchical differentiation and diversity of macroscopic systems and the spatial structure evolution of tourist destination systems can be understood

as the spatial effect caused by agents' adaptive behavior. Agents exert the "identification" function of tourist attractions, which stimulates the consumption behavior of tourists, promotes governments to formulate incentive policies and build tourism infrastructure, guides the behavior of enterprises, residents, and non-governmental organizations (NGOs), and impels the formation and development of spatial agglomerates by driving the spatial flow of tourists and the gathering of tourist facilities. Spatial agglomerates constitute different types and nodes of regional tourism development and the organic nodal links constitute the networks of regional tourism development. The formation and development of nodes and networks generate the flow of elements, including tourist flow, information flow, and capital flow. Among these elements, tourist flow comprises the foundation that further promotes the development of spatial agglomerates and the development of regional tourism networks.



**Figure 2** Structure model of a tourist destination system

During the evolution of tourist destinations, differences in the nature and extent of the roles of various agents lead to non-linear changes in the internal structure of tourist destination systems. This results in non-linear changes in the relationship between tourist destination systems and external environment systems, leading to the differential development of spatial agglomerates. In the meantime, diversified tourist attractions, tourist needs, and tourism products produce diverse spatial agglomerates and spatial networks. The behavioral law of agents that guides the formation and development of spatial agglomerates and spatial networks in tourist destinations reveals the basic spatial structural evolutionary mechanism within tourist destinations. As the basic spatial unit of tourist destination systems, the formation, development, combination, separation, competition, and cooperation of spatial agglomerates reflect the evolutionary characteristics and processes of tourist destinations' spatial structure (Table 2).

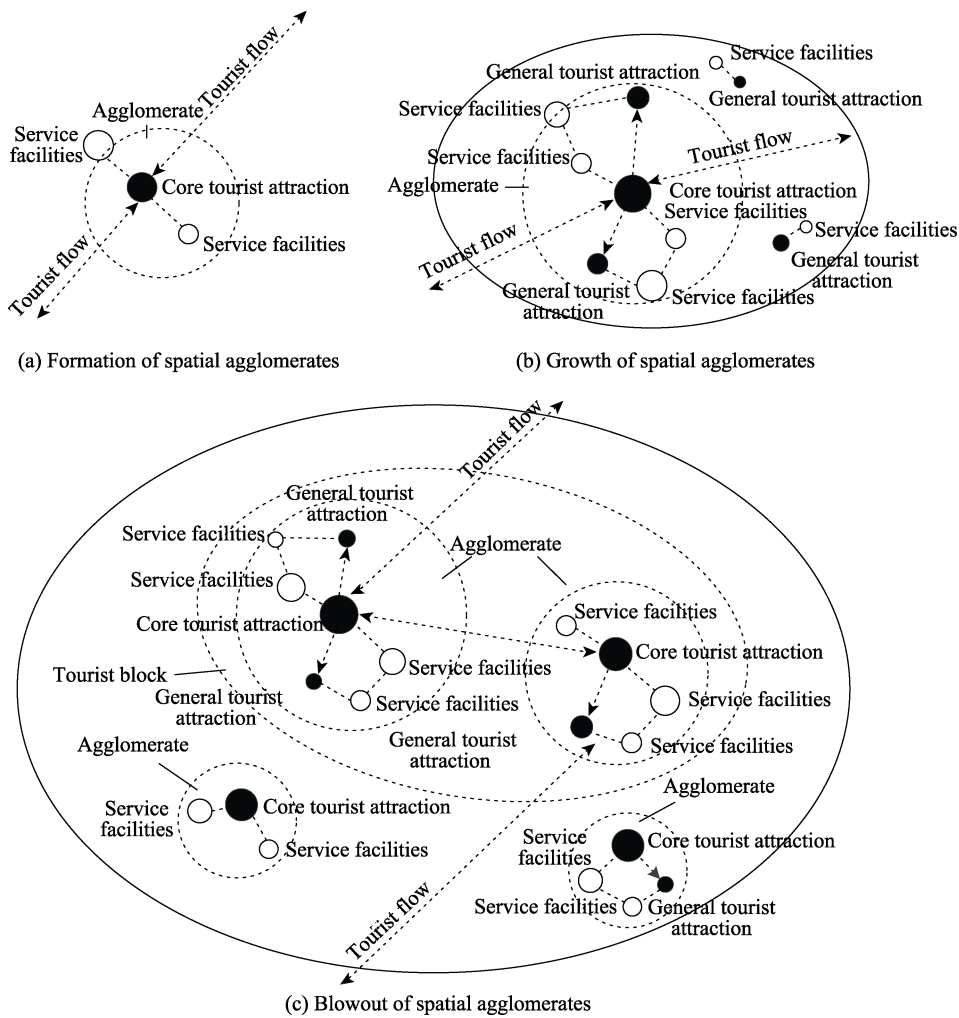
Agents constantly adapt to changes in their environmental system and adjust their behavior to generate a series of feedbacks that include increasing the quality and amount of tourist attractions for the purposes of strengthening the identification function of spatial agglomerates and improving the number, scale, and grade of spatial agglomerates. The formation and development of spatial agglomerates encourage the adaptive behavior of agents. Increasing numbers of agents participate in the renewal, replacement, and reorganization of internal elements of tourist destination systems. The behavior of microcosmic agents ultimately changes the structure of tourist destination systems as well as the exchange of materials and

information between tourist destination systems and external environmental systems. Thus, new characteristics of the spatial structure of tourist destination systems emerge.

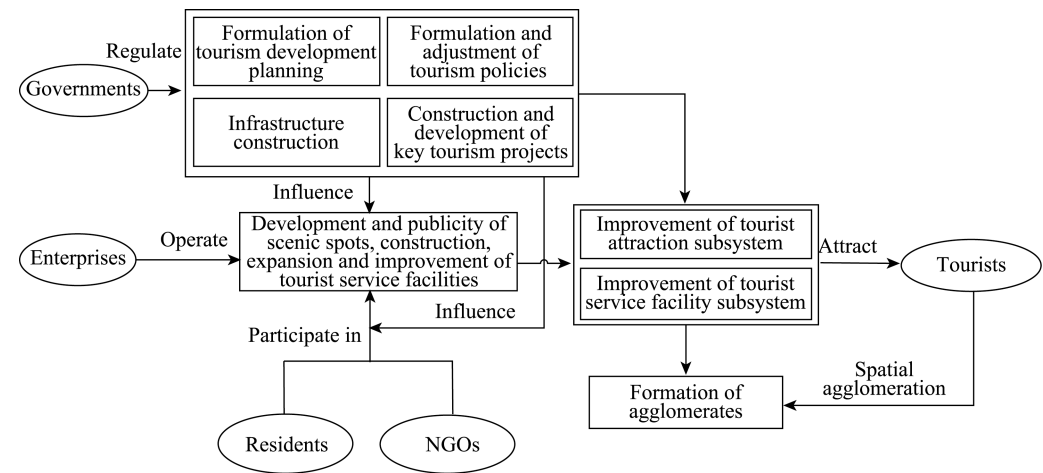
**Table 2** Basic characteristics of CAS and tourist destinations' spatial structure

Basic characteris- tic of CAS	Development state of tourist destination systems	Spatial evolution of tourist destinations
Agglomeration	Development of tourist attractions, construction of tourist facilities, and formation of agglomerates	Spatial agglomerates constitute different types and nodes of regional tourism development, and the organic links of nodes constitute the networks of regional tourism development
Identification	Establishment of core tourist attractions, response of tourism market, government guidance, and public participation.	The identification role of tourist attractions stimulates the consumption behavior of tourists, promotes governments to formulate relevant policies and build tourism infrastructure, guide the agglomeration of enterprises, residents, NGOs' behavior, and drives the formation and development of spatial agglomerates.
Flow	Tourist flow, information flow, capital flow and other element flows emerge with the formation and development of tourist destination systems, and tourist flow is the basis.	Flows promote the constant exchange of materials, information and energy among various components and subsystems of tourist destination systems and between tourist destination systems and external environmental systems, stimulate the absorption, transformation and metabolism of elements of tourist destination systems, and drive the formation and development of spatial agglomerates.
Non-linearity	Non-linearity of the interaction among various agents of tourist destination systems and between agents and the environment	During the evolution of tourist destinations, the differences in the nature and extent of the roles of various agents lead to non-linear changes in the internal structure of tourist destination systems. Consequently, it results in non-linear changes in the relationship between tourist destination systems and external environment systems, which further leads to the differential development of spatial agglomerates.
Diversity	Diversity of agents' behavior, diversity of tourist destination systems' elements and components, diversity of external environment systems	Diversified tourist attractions, tourist needs, and tourism products of tourist destination systems produce diverse spatial agglomerates and spatial networks.
Internal modeling	Specific behavioral norms and adaptation laws of agents	The behavioral law of agents guides the formation and development of spatial agglomerates and spatial networks of tourist destination systems, reflecting the basic mechanism of spatial structure evolution of tourist destinations.
Building block	Decomposition and reconstruction of structural elements and components of tourist destination systems	As the basic spatial unit of tourist destination systems, the formation and development, combination and separation, competition and cooperation of spatial agglomerates reflect the evolutionary characteristics and process of tourist destinations' spatial structure.

Based on the above theoretical analysis, the spatial evolutionary process of tourist destination systems can be categorized into stages. The spatial evolution process of a tourist destination system of this study is divided into three stages in terms of the formation and development of spatial agglomerates: formation stage of spatial agglomerates, growth stage of spatial agglomerates, and blowout stage of spatial agglomerates (Figure 3). The adaptive behavior of agents remains foundational throughout the entire evolutionary process, exhibiting different behavioral patterns (Figure 4).



**Figure 3** Spatial evolution model of a tourist destination system



**Figure 4** Adaptive behavioral patterns of agents

(1) Formation stage of spatial agglomerates: The tourist destination system uses its superior resource endowments to form a few core attractions with prominent positions and position them as conduits for the “identification” for the agglomeration of agents’ behavior. Governments’ adaptive behavior plays a leading role. According to their understanding of the external economic and social environment, governments at all levels formulate tourism development policies, build tourism facilities, and develop tourism marketing around core tourist attractions; governments also guide enterprises, residents, and NGOs to participate in construction, marketing, and other activities. Additionally, tourist flow exhibits as a “flowing” state with core tourist attractions as the main target, forming spatial agglomerates.

(2) Growth stage of spatial agglomerates: Governments pay more attention to providing effective tourism development policies and tourism facilities, cultivating tourism professionals, and shaping tourism brands. The behavior of enterprises plays an important role in promoting the construction of tourist destinations. Significant economic, social, and ecological benefits brought about by the development of tourist destinations stimulate the participation of residents and NGOs in the development of tourist destinations. The behavior of various agents gradually expands spatial agglomerates’ scale, improves their functional quality, and increases their number and types. Driven by the behavior of agents, the original tourist attractions undergo a scale increase and functional quality improvement that further attracts tourists and agglomerates tourist facilities, resulting in the rapid development of existing spatial agglomerates. In this way, other attractions with better resource endowments can also be further developed to create a growing number of new spatial agglomerates.

(3) Blowout stage of spatial agglomerates: First, agent behaviors spring out. New needs of tourists and new policies for tourism development come to the fore; new tourism enterprises, infrastructures, and tourism facilities emerge; and new participatory behaviors of residents and NGOs appear. Second, the interaction among agent behaviors is more effective. The emerging behavior of agents not only expands the original agglomerates’ size, but also enhances their function and quality. Moreover, more extensive tourism resources are employed more effectively, giving rise to new agglomerates. Agglomerates of different types, natures, and scales are organically combined to form a larger and higher-level agglomeration network that optimizes the spatial structure of the tourism system and enables the tourism system to emerge with new diversity characteristics.

### 2.2.2 Gini index

Employing the principles of CAS theory, spatial evolution characteristics of a tourist destination can be defined as the formation, growth, and blowout of spatial agglomerates (Figure 3). In this series of process, core indicators refer to changes in the number of tourists and tourism revenue. Therefore, tourist numbers and tourism revenue were chosen as the indicators to determine the specific development stage of tourist destinations.

Gini index is often used to determine the agglomeration degree of elements in geographical research. This paper also adopted the Gini index method to measure the agglomeration state of tourist numbers and tourism income. Specifically, it referred to the urban Gini index calculation method put forward by Alfred Marshall and the formula modified by Hu Xianyang *et al.* (2013) based on Marshall’s calculation method (Marshall, 1890) to finally obtain the following two formulas that measure the agglomeration degree in the Southern Anhui tourist area.



$$G = T / 2S(n-1) \quad (1)$$

$$G' = \frac{R}{2S'(n-1)} \quad (2)$$

As manifested in Formulas (1) and (2),  $G$  indicates the Gini indexes of tourist numbers;  $G'$  indicates the Gini index of tourism revenue;  $T$  is the sum of absolute values of the difference in number of tourists between each city in the region;  $R$  is the sum of absolute values of the difference in tourism revenue between each city in the region;  $S$  is the sum of number of tourists in these cities;  $S'$  is the sum of tourism revenue in these cities; and  $n$  refers to the number of cities in the tourism circle. Gini index has a value range of 0–1. The closer its value is to 0, the more dispersive the number of tourists or tourism revenue's distribution is; the closer its value is to 1, the more concentrated the number of tourists or tourism revenue's distribution is.

### 2.3 Data sources

Tourist numbers and tourism revenue in the cities involved in the study were obtained from the *Anhui Statistical Yearbook* from 1981 to 2017. Data of tourist numbers and tourism revenue at each scenic spot in various scenic areas were derived from the Anhui Provincial Commission of Tourism Development and various local tourism committees. Road and railway traffic route maps and tourist attraction distribution maps were excerpted from the *Anhui Tourist Traffic Map*. G-series high-speed rail traffic distributions were derived from the China High-speed Railway Network. Additionally, a few relevant data were obtained by referencing other literature, which will be explained in the following analysis.

## 3 The spatial evolution process and characteristics of the tourist destination system in Southern Anhui

Based on the evolutionary stages of tourist destination systems described by the above theoretical model, combined with the agglomeration degree reflected by tourism Gini indexes, the spatial evolution process of the Southern Anhui tourist area was divided into different time periods to further analyze the developmental characteristics of the tourist destination system. The results are shown in Table 3. An analysis was performed on the spatial evolutionary processes and characteristics of the tourist destination system in Southern Anhui by examining three different stages.

### 3.1 Formation of spatial agglomerates

The years 1978 to 1990, comprised the formation stage of spatial agglomerates of the tourist destination system in Southern Anhui. This stage was characterized by the agglomeration effects produced by development and utilization of tourist attractions. Additionally, Huangshan Scenic Area and Jiuhuashan Scenic Area became the core attractions of the tourist destination system in Southern Anhui, where tourist numbers and tourism revenue increased rapidly, thus influencing the formation of spatial agglomerates. The concentration of tourism development in the region was relatively high and tourism Gini indexes grew significantly.

**Table 3** Evolution characteristics and agent behaviors of the tourist destination system of Southern Anhui

Evolution characteristics		Blowout of spatial agglomerates	
Stage	Agent behavior	Formation of spatial agglomerates	Growth of spatial agglomerates
		1978–1990	1991–2008
Spatial evolution of the tourist destination system	Governments	<p>The spatial agglomerate centering on Huangshan Scenic Area and Jiu-huashan Scenic Area was initially formed.</p> <p>A small number of hotels and other service facilities were concentrated near Huangshan Scenic Area and Jiuhuashan Scenic Area.</p> <p>Tourists intensively converged to Huangshan Scenic Area and Jiu-huashan Scenic Area, and the number of tourists and tourism revenue achieved 323 thousand person-time and 3.46 million yuan, respectively.</p> <p>Tourism Gini indexes grew constantly.</p>	<p>Xidi, Hongcun and Fantawild Tourist Area became core tourist attractions and the number of spatial agglomerates increased to 4.</p> <p>The number of scenic areas increased: there were 30 national 4A and above grade tourist attractions, 2 of which were national 5A tourist attractions.</p> <p>The total highway mileage reached up to 771 km.</p> <p>Four star or above hotels amounted to 35.</p> <p>The number of tourists and tourism revenue rose to 37.1642 million person-time and 31.27854 billion yuan, respectively.</p> <p>Tourism Gini indexes presented a decline.</p>
			<p>The Ancient Huizhou Culture Tourism Zone, Jixi Longchuan Scenic Area, Taiping Lake Scenic Area, and Qiyunshan Scenic Area embrace a remarkable development; spatial agglomerates with different scales spring up.</p> <p>The number of scenic areas continues to increase: there are more than 100 national 4A and above grade tourist attractions, of which 6 are national 5A tourist attractions.</p> <p>The total highway mileage reaches up to 1427 km.</p> <p>Two high-speed rails and one international airport have been established.</p> <p>Four star and above hotels amount to 65.</p> <p>The number of tourists and tourism revenue rise to 212.202 million person-time and 198.64 billion yuan, respectively.</p> <p>Tourism Gini indexes decline steadily.</p>
Agent behavior	Governments	<p>In 1979, Deng Xiaoping inspected Huangshan and issued instructions to “promote the Huangshan brand out”.</p> <p>In 1982, Huangshan Scenic Area and Jiuhuashan Scenic Area became the first national parks in China.</p> <p>In 1990, Huangshan Scenic Area was successfully added into the world heritage list as a double heritage in culture and nature.</p>	<p>In 2000, the CPC Anhui Province Committee and the Anhui Provincial Government issued the Opinions on Accelerating the Development of Tourism Economy of “Two Mountains and One Lake”, which proposed to make Huangshan Scenic Area and Jiuhuashan Scenic Area the foci of tourism development in Southern Anhui.</p> <p>In 1994, Jiuhuashan Tiantai Cableway was built to connect the two scenic spots of Minyuan Garden and Tiantai.</p> <p>In 2000, the “Ancient Villages in Southern Anhui: Xidi-Hongcun” successfully applied for the world cultural heritage.</p>
			<p>The expressway network of tourist destinations in Southern Anhui is nearly complete.</p> <p>Construction of high-speed railways and airports has been strengthened.</p> <p>In 2010, the “Construction Project of Huizhou Cultural and Ecological Protection Experimental Area” declared by the Anhui Department of Culture was selected as one of the ten major “Innovation projects of national culture’s science and technology”.</p>

(To be continued on the next page)

(Continued)

Evolution characteristics		Blowout of spatial agglomerates	
Stage	Formation of spatial agglomerates	Growth of spatial agglomerates	
		1991–2008	2009 to present
Enterprises	Highways of Huangshan Hot Spring to Ciguang Pavilion, Hot Spring to Cloud Valley Temple, and Jiuhuashan Jiu-hua Street to Minyuan Garden were constructed. The tourist trail in Huangshan Scenic Area and Jiuhuashan Scenic Area was built. In 1986, the first tourist cableway in Huangshan Scenic Area – Cloud Valley Cableway was built.	Wuhu Yangtze River Bridge, Wuhu-Xuancheng Expressway, Nanjing-Wuhu Expressway, Huangshan-Hangzhou Expressway, Hefei-Tongling-Huangshan Expressway, Riverine Expressway (the section of Tongling to Chizhou) were successively completed in 2000, 2003, 2005, 2006, 2007, 2008. The Outline of the Eleventh Five-Year Plan for National Economic and Social Development of Wuhu City (2006–2010) proposed to promote the construction of theme parks of Wuhu Huaqiang Tourism City with the focus on large-scale entertainment tourism projects. The Overall Plan for Tourism Development of Wuhu City (2005–2020) proposed that, during the “Eleventh Five-Year Plan” period, Wuhu City strives to create four boutique areas in the north of the city, e.g. a dynamic tourist area with theme parks as the domination. Xidi Tourism Service Co., Ltd., Huangshan Tourism Development Co., Ltd., Jingyi Tourism Co., Ltd. and Jiuhuashan Tourism Development Co., Ltd. was founded in 1993, 1996, 1997, 2000, which expanded tourist facilities such as cableways, trails, communication network, power supply, catering and accommodation. In 2007, the first phase of the Wuhu Fantawild Tourist Area project – Fantawild Adventure was completed and open to the public. A large number of catering and accommodation enterprises settled around Fantawild Tourist Area.	In 2009, the establishment of Southern Anhui International Tourism Cultural Zone was approved by the Anhui Provincial Government. In March 2014, with the approval of the State Council, the Outline of Construction and Development Plan of Southern Anhui International Tourism and Culture Demonstration Zone was officially approved by the National Development and Reform Commission.
	Hotels were successively built and rebuilt.		A great number of hotels, restaurants, travel agencies and tourism enterprises emerge, forming a broader range of spatial agglomerates. Jiuhua Tourism Group built Dayuan Cultural Park Scenic Area; a series of leisure and holiday facilities were constructed in Taiping Lake Scenic Area. In March 2015, Anhui Jiuhuashan Tourism Development Co., Ltd. was listed for transactions on the Shanghai Stock Exchange.
			Tourist flow is in and out of Southern Anhui tourist destinations by means of expressways, G-series high-speed rails, air and the Yangtze River transportation.
Tourists	Yangtze River Channel, Anhui-Jiangxi Railway, National Highway 318 and 205 were mainly chosen to enter Huangshan Scenic Area and Jiuhuashan Scenic Area for sightseeing.	Taking highways as the main mode of transportation, tourists converged toward Southern Anhui along national highways and provincial highways. As the new agglomerate of Xidi-Hongcun formed, tourist flow gradually spread from Huangshan Scenic Area and Jiuhuashan Scenic Area to Xidi-Hongcun Ancient Villages	

(To be continued on the next page)

(Continued)

Evolution characteristics		Formation of spatial agglomerates		Growth of spatial agglomerates		Blowout of spatial agglomerates	
Stage		1978–1990		1991–2008		2009 to present	
Residents				Villagers of Xidi and Hongcun participated in the environmental improvement and facility construction in the scenic area, and a number of small and micro specialized enterprises with local characteristics were established, e.g., hotels, restaurants, shopping stores, etc.		More diversified tourism demands appear, changing from the original natural culture sightseeing to the pursuit of personalized and integrated tourism experiences that include sightseeing tours, cultural tourism, ecological tourism, holiday and leisure tourism, and rural tourism. More residents participate in the construction activities of tourism development, open various hotels and shops, and actively develop rural tourism.	
NGOs				The village committees of Xidi and Hongcun organized villagers to improve the environment for tourism development.		The Jiuhoa Buddhist Association participates in and organizes the construction of Jiuhuashan Dayuan Cultural Park. Village committees of Xidi-Hongcun and Ancient Huizhou Culture Tourism Zone organize villagers to participate in tourism construction.	

This stage occurred in the early phase of state reform and opening, during which the state attached great importance to and encouraged the development and utilization of the rich tourism resources in Southern Anhui. Meanwhile, the Anhui Provincial Government and local governments actively responded to the call of the state, focusing on building and publicizing a number of resource endowments such as Huangshan Scenic Area, Jiuhuashan Scenic Area, Qiyunshan Scenic Area, and Taiping Lake, as well as carrying out significant levels of work around infrastructure construction and scenic spot marketing (Table 3). Among these scenic spots, Huangshan Scenic Area and Jiuhuashan Scenic Area became the core attractions in the Southern Anhui tourist area with their unique natural scenery and humanistic characteristics, thus developing an important “identification” for the agglomeration of tourist flow. In particular, Huangshan Scenic Area not only occupies an important position in Southern Anhui, but is also highly influential across the country. In 1985, Huangshan Scenic Area was rated as one of the “Top Ten China Attractions”. In 1988, it was identified as the only key mountain tourist area in China. In 1991, Huangshan Scenic Area ranked third after Three Gorges Scenic Area and Guilin Lijiang Scenic Area among the top 40 national tourist attractions by the National Tourism Administration. Jiuhuashan, Huashan, and Songshan – also mountain-type scenic areas – were selected for data comparison in order to further examine the tourism development status of Huangshan Scenic Area. As shown in Table 4, the number of tourists in Huangshan Scenic Area is significantly higher than that in Jiuhuashan, Huashan, and Songshan scenic areas during the same period, which proves that Huangshan Scenic Area occupies a prominent place in national mountain-type scenic areas.

**Table 4** A contemporaneous comparison of number of tourists between Huangshan and other scenic areas

	Huangshan		Jiuhuashan		Huashan		Songshan
Year	1985	1990	1985	1990	1985	1990	1990
Number of tourists (ten-thousand person-time)	46	67	21	43.3	33.515	32.161	10

As shown in Figure 5, tourist numbers and total tourism revenue in Huangshan Scenic Area and Jiuhuashan Scenic Area escalated steadily during this period. The growth rate of number of tourists and tourism revenue rose sharply, indicating that tourist numbers and tourism revenue began to agglomerate in Huangshan Scenic Area and Jiuhuashan Scenic Area. According to Figure 6, from 1978 to 1990, Gini indexes of tourist numbers and tourism revenue increased from 0.26 and 0.33 to 0.29 and 0.35, respectively, which further indicates that this stage displayed a significant agglomeration effect.

During this period, the increase in the number of tourists visiting Huangshan Scenic Area and Jiuhuashan Scenic Area stimulated the adaptive behavior of enterprises, increasing the establishment of tourist enterprises such as hotels (guesthouses) around core tourist attractions. The number of hotels (guesthouses) around Huangshan Scenic Area and Jiuhuashan Scenic Area reached 7 and 2 in 1990, respectively.

Southern Anhui exhibited a low level of accessibility in this stage. Although there were water and land main lines like Yangtze River Channel, Anhui-Jiangxi Railway, and National Highways 318 and 205 passing through the region, accessing the area was still inconvenient due to low-graded transport lines with slow traffic speeds. At this time, all cities and scenic

areas relied mainly on highway traffic to connect with each other. However, the highway mileage and levels were low. Third and fourth-grade highways accounted for about 70%, which led to weak internal communication within the region (Lu, 1995) and poor mobility of tourists among various cities and scenic areas.

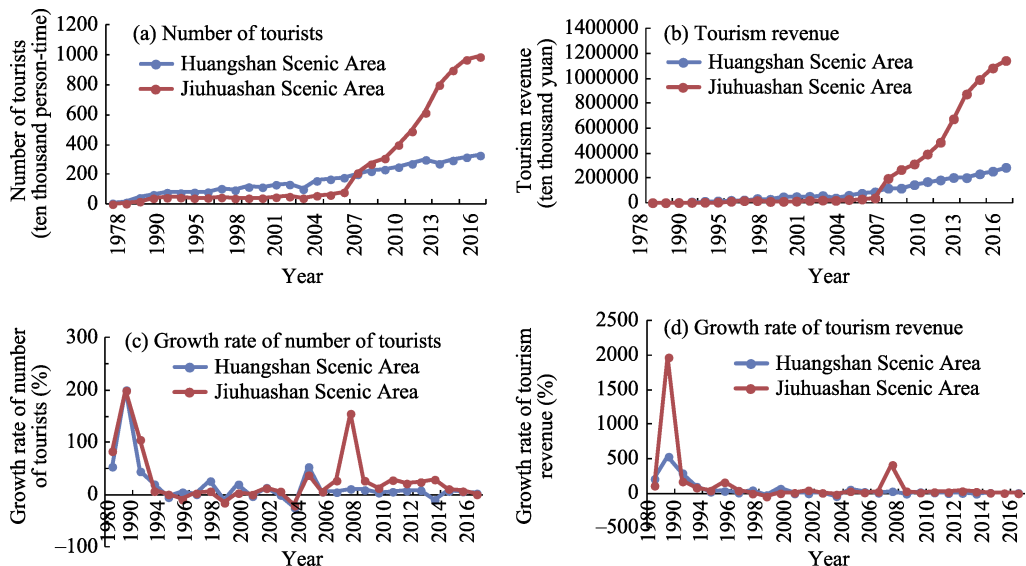


Figure 5 Change of tourism indicators in Huangshan Scenic Area and Jiuhuashan Scenic Area from 1978–2016

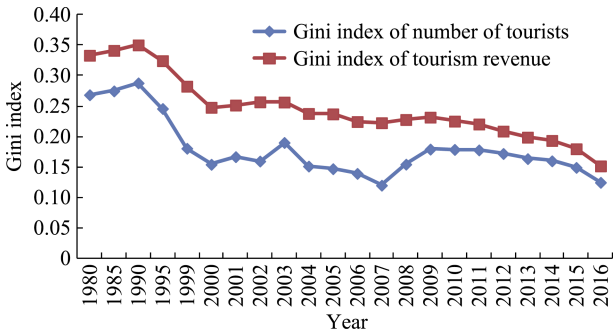


Figure 6 Variation trend of tourism Gini indexes in Southern Anhui tourist area during 1980–2016

3.2 Growth of spatial agglomerates

From 1991 to 2008, the tourist destination system of Southern Anhui entered the growth stage of agglomerates. This stage was primarily characterized by the fully-developed tourism of Southern Anhui, as exhibited by the further exploitation of tourist attractions, upgrading of tourism facilities in Huangshan Scenic Area and Jiuhuashan Scenic Area, establishment of Xidi-Hongcun Scenic Area and Wuhu Fantawild Tourist Area as new core tourist attractions, and increase of spatial agglomerates. Tourism development in the region tended to be balanced, spatial concentration gradually decreased, and tourism Gini indexes declined.

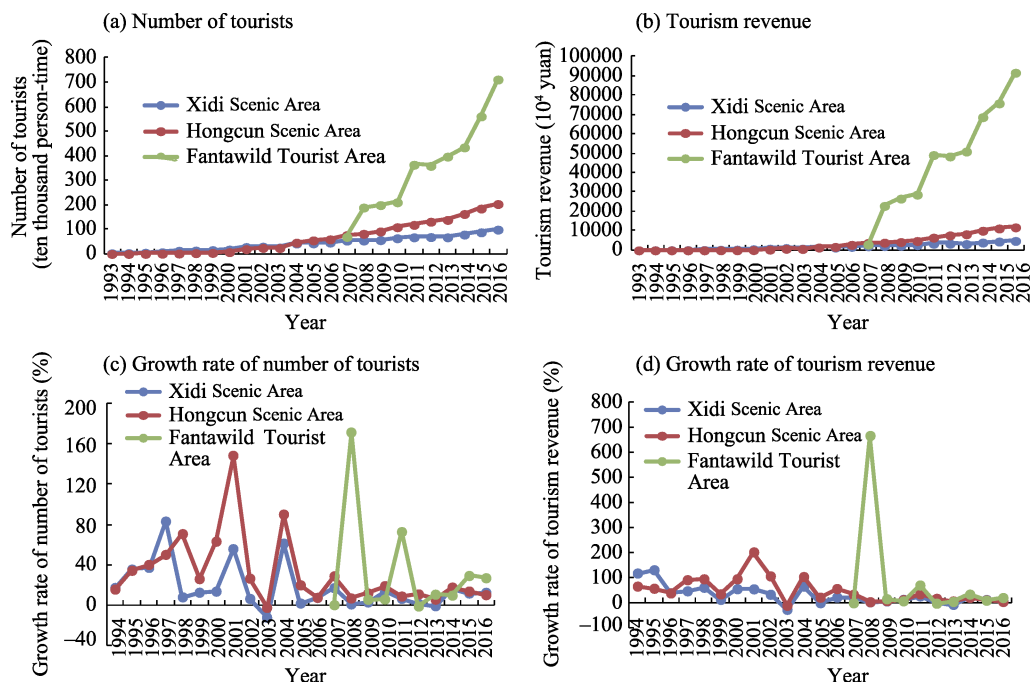
The beginning of the 1990s brought about improvements to national economic and social

development. The implementation of the new holiday system increased national tourism spending power and willingness to travel, providing a productive external environment for the development of the Southern Anhui tourist area.

Responding to changes in the external environment, governments at all levels enacted relevant policies and regulations to support tourism development and continuously strengthened infrastructure construction, which greatly improved the traffic environment in Southern Anhui during this period (Table 3). Under governmental guidance, the enthusiasm of enterprises was mobilized and they started to invest in more tourism construction activities. Huangshan Tourism Development Co., Ltd. and Jiuhuashan Tourism Development Co., Ltd. were established in 1996 and 2000, respectively. The two companies promoted the establishment of hotels, travel agencies, restaurants, and other tourist enterprises in scenic spots and surrounding areas while strengthening the construction of tourist facilities such as hotels and cableways (Table 3). In 2000, the CPC Anhui Province Committee and the Anhui Provincial Government accelerated the tourism development policy of “two mountains and one lake” to stimulate the rapid development of Huangshan Scenic Area and Jiuhuashan Scenic Area and strengthen their “identification” function. As shown in Figure 5, during this period, tourist numbers and total tourism revenue in the two scenic areas continued to increase. Despite the fluctuating growth rate of tourist numbers and tourism revenue, the overall growth remained positive, which shows that Huangshan Scenic Area and Jiuhuashan Scenic Area exhibited significant agglomeration effects.

While Huangshan Scenic Area and Jiuhuashan Scenic Area were developing day by day, Southern Anhui continued to exhibit the products of rich cultural tourism resources and the development of new tourist attractions, represented by Xidi and Hongcun Ancient Villages during this period. As early as the end of the 1980s, Xidi and Hongcun had begun to attract a small number of tourists with old-fashioned sightseeing and by virtue of their location advantage near Huangshan Scenic Area. Around 1990, a small quantity of family hotels and eateries appeared in Xidi and Hongcun, but there were no large-scale and specialized tourism service facilities; the phenomenon of “agglomeration” just began to appear at this time. In the mid-to-late 1990s, related enterprises began operating in Xidi and Hongcun, playing a leading role in promoting the development of the local tourism (Table 3). Residents benefited from tourism development and actively participated in its development (Table 3). In 2000, Xidi and Hongcun Ancient Villages were listed in the World Cultural Heritage List, becoming the first world cultural heritage sites among Chinese historical villages and local culture and the second world heritage sites in Southern Anhui tourist destinations. This success positioned Xidi and Hongcun as the new core tourist attractions that began to fulfil the “identification” role. As shown in Figure 7, tourist numbers and tourism revenue in Xidi and Hongcun began to increase slightly during this period; the growth rate of number of tourists and tourism revenue maintained a positive growth, indicating that number of tourists and tourism revenue began to gather in Xidi and Hongcun to form new spatial agglomerates. The exception to this positive growth is 2003, which may be explained by the regional effects of SARS.

In addition to the development and utilization of existing natural and cultural resources, Southern Anhui continued to be a site in which the application of modern technology created new tourist attractions, most prominently represented by Wuhu Fantawild Tourist Area. As



**Figure 7** Change of tourism indicators in Xidi, Hongcun, and Fantawild tourist areas during 1993–2016

early as the end of the 20th century, the triumph of Shenzhen Splendid China, China Folk Culture Village, and other scenic locations led to the sharp increase in construction of domestic theme parks. Under this new development trend, the Wuhu Municipal Government seized the opportunity to attract foreign businesses and investment, seeking a breakthrough in tourism development and industrial transformation. In 2004, the Wuhu Municipal Government and Shenzhen Huaqiang Holdings Limited reached a cooperation agreement that established a plan to build a boutique tourist area in Wuhu City, with large theme parks comprising the main body. In October 2007, the first phase of Wuhu Fantawild Tourist Area was finished for a soft opening. The tourist area was officially open in April 2008. During the May Day Holiday in 2008, visitors of Fantawild Adventure reached more than 60,000, with the number of receptions exceeding that of Huangshan Scenic Area and second only to that of Jiuhuashan Scenic Area. During the National Day Holiday in 2008, Fantawild Adventure received as many as 132,000 visitors. It can be observed from Figure 7 that tourist numbers and total tourism revenue in Fantawild Tourist Area began to increase gradually from 2007 to 2009; the growth rate of number of tourists and tourism revenue also increased significantly, reflecting that Fantawild Tourist Area began to exhibit an agglomeration effect and became a new spatial agglomerate.

According to the trend of tourism Gini indexes in Figure 6, Gini indexes of tourist numbers and tourism revenue fluctuated, and there were two low-value inflection points in 2000 and 2007, which correspond to the inclusion of Xidi and Hongcun in the World Heritage List and the opening of Fantawild Tourist Area, indicating that the formation of new spatial agglomerates caused the tourists and tourism revenue originally concentrated in Huangshan Scenic Area and Jiuhuashan Scenic Area to “diverge”. Hence, the spatial agglomeration degree of tourism elements in Southern Anhui tourist area began to decrease.



### 3.3 Blowout of spatial agglomerates

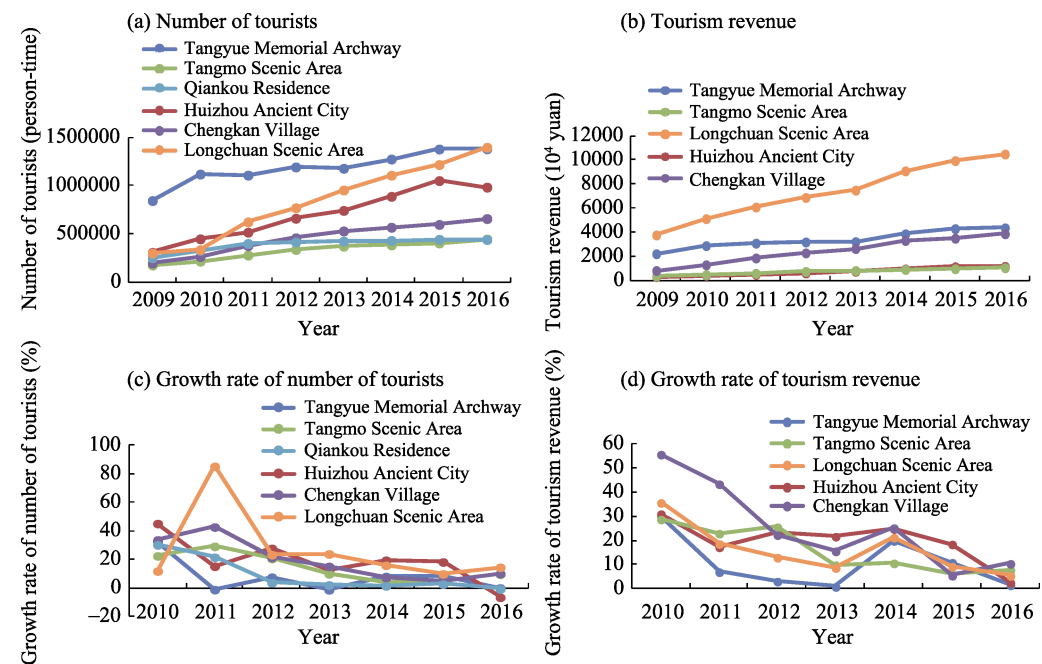
The third stage began in 2009 and extends to the present day. New tourist demands and new policies for tourism development emerge at the national macro-environmental level: new infrastructures and tourism facilities, scenic areas, tourism enterprises, and tourism products proliferate in the Southern Anhui tourist area. The development conditions become increasingly mature, agents of the system further adapt to various changes in the external environment, and the interaction among agents and between agents and the environment is enhanced (Figure 4). It is found that national income and the capacity for tourism consumption have increased, with per capita tourist spending reached nearly 900 yuan in 2017. The willingness to travel has also increased: the 2017 per capita travel rate was 371% compared to 140% in 2010. Tourism has become a daily demand for the public. While the proportion of sightseeing tours begins to decrease, the proportion of vacation and leisure tours grows steadily. Sightseeing, vacation, and leisure tours turn into the major purpose of the public travel. The diversified tourism market demands put forward new requirements for the development of Southern Anhui tourist area.

During this period, the rapid transit system in Southern Anhui was fully developed. The Anhui section of the South Yangtze River Expressway (Wuhu – Dongzhi), Jixi – Huangshan Expressway, Huangshan – Qimen – Jingdezhen Expressway, and the Xuancheng to Jixi section of Yangzhou – Jixi Expressway were successively completed in 2009, 2010, 2013, and 2014, forming a well-established expressway network system, where Huangshan City and Chizhou City are located at the convergence zone of several expressways. Chizhou Jiu-huashan Airport was opened to the public in 2013. The Hefei to Fuzhou section of Beijing – Fuzhou G-series High-speed Rail and Nanjing – Anqing G-series High-speed Rail were open to traffic in 2015, which have significantly improved the accessibility of inner and outer Southern Anhui, connected the Yangtze River Delta region and the customer market of surrounding cities, expanded the scale of tourist flow, and facilitated tourist flow into and out of Southern Anhui as well as internal flow within the region. In addition, Huangshan – Hangzhou G-series High-speed Rail that is expected to be open to traffic in December 2018, Shangqiu – Hefei – Hangzhou G-series High-speed Rail that is expected to be open to traffic in 2019, and some other G-series high-speed rails that are under construction and planning allow Southern Anhui to enter the era of rapid rail transit. The rail traffic represented by high-speed rail and inter-city railway leads to all-round improvement of the regional connectivity.

In addition to strengthening the construction of transportation infrastructure, governments actively respond to changes in external environment such as tourism demand and formulate and implement a series of policies to guide the transformation and upgrading of Southern Anhui tourist destinations (Table 3).

The development of cultural tourism has been promoted since 2009. In 2010, the *Construction Project of Huizhou Cultural and Ecological Protection Experimental Area* declared by the Anhui Department of Culture was selected as one of the ten major innovation projects of national culture's science and technology, which increases the influence of Huizhou culture. In 2011, Xidi and Hongcun were rated as National 5A tourist attractions, while the scale of tourist flow continued to grow (Figure 7). Meanwhile, a number of new Huizhou cultural tourist attractions emerged in Southern Anhui, including Huangshan City's Huizhou

Ancient City, Tangyue Memorial Archway: Baojia Garden, Tangmo, Qiankou Private Residence and Chengkan Scenic Area, and Jixi Longchuan Scenic Area; the scale of tourist flow increases each year (Figure 8). From the beginning of 2011, the Huangshan Municipal Government has integrated the five ancient tourist attractions of Huizhou Ancient City – including Tangyue Memorial Archway: Baojia Garden, Tangmo, and Qiankou Private Residence – to create the Ancient Huizhou Culture Tourism Zone. This zone was officially approved as the national 5A tourist attraction in 2014. Likewise, Jixi Longchuan Scenic Area was also approved as the national 5A tourist attraction in 2012. Overall, Huizhou cultural tourism plays a crucial role as the major brand of tourism in Southern Anhui.

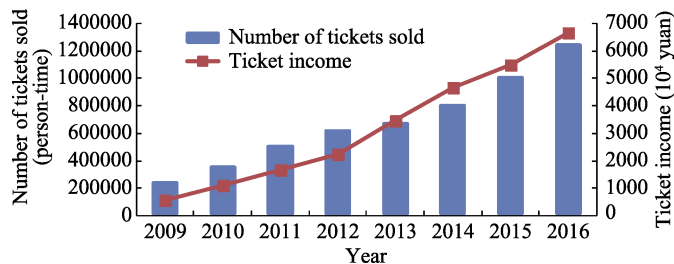


**Figure 8** Change of tourism indicators in various scenic spots of Ancient Huizhou Culture Tourism Zone and Jixi Longchuan Scenic Area during 2009–2016

Note: Because the entrance tickets of Qiankou Residence are free, there are no available tourism revenue data.

Jiuhuashan Buddhist cultural tourism and Qiyunshan Taoism cultural tourism developed rapidly as well. The opening of Jiuhuashan Dayuan Cultural Park reinforced the “identification” role of Jiuhuashan Scenic Area and boosted its function of gathering tourist flow. In 2012, Jiuhuashan Scenic Area received more than 6 million tourists and the tourist flow progressively increased during 2013–2016 (Figure 5). For the past few years, Qiyunshan Scenic Area’s scale of tourist flow and tourism revenue achieved rapid growth (Figure 9).

Huizhou cultural tourism and religious cultural tourism have become the major brands of tourism in Southern Anhui. The Anhui Provincial Government approved the establishment of Southern Anhui International Tourism and Culture Demonstration Zone in 2009 to further promote the development of tourism in Southern Anhui. In March 2014, with the approval of the State Council, the *Outline of Construction and Development Plan of Southern Anhui International Tourism and Culture Demonstration Zone* was approved by the National Development and Reform Commission, requiring that the demonstration zone would be built as



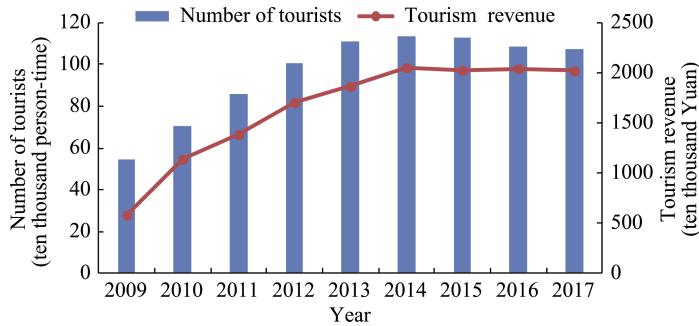
**Figure 9** Number of tickets sold and ticket income in Qiyunshan Scenic Area during 2009–2016

a world-class tourist destination. As core regions of the demonstration zone, the tourism development of Huangshan City and Chizhou City has increased to the national level and provided a demonstration for national tourism development.

The development of ecological tourism has been stimulated. Southern Anhui is situated within a favorable ecological environment and is filled with abundant ecological tourism resources. Chizhou City became the first national ecological economic demonstration zone in China in 1996 and Huangshan City was selected as one of the first national ecological civilization demonstration zones in 2014. Before 2016, there were a total of 5 national nature reserves in Southern Anhui, including Guniujiang National Nature Reserve (Qimen County, Shitai County), Qingliangfeng National Nature Reserve (Jixi County, Shexian County), National Nature Reserve for River Dolphins (Tongling City, Chizhou City), Shengjin Lake National Nature Reserve (Dongzhi County), National Nature Reserves for Chinese Alligators (Xuanzhou District of Xuancheng City, Guangde County, Langxi County, Jingxian County, and Nanling County), and more than 10 provincial nature reserves including Mount Shili Nature Reserve and Jiulongfeng Nature Reserve. High-quality ecological resources have been effectively utilized and transformed into high-grade tourism resources. Ecological scenic areas share more than half of the existing national 4A and above grade tourist attractions in Southern Anhui, which indicates the rise of ecological tourism.

The natural and cultural environment in Southern Anhui provides a solid foundation for the development of vacation and leisure tourism that allowed for the establishment of a number of high-grade leisure and holiday tourist destinations such as Taiping Lake Scenic Area, East Huangshan Holiday Resort, Fengle Lake, Xinhui Tiandi: Ravishing Hot Spring, and Xin'an River Waterfront Tourism Area. Taking Taiping Lake Scenic Area as the representative, Crowne Plaza Hotels & Resorts, International Centre for Bamboo and Rattan, Dingxiang Garden Centre, and other leisure and holiday facilities have been constructed in recent years, which optimizes the tourism product system and drives the development of leisure and holiday tourism of Taiping Lake (Figure 10).

The development of rural tourism has been accelerated. The natural environment and historical culture in Southern Anhui have formed a local space with unique natural and humanistic customs. It has become a hot spot for rural tourism, providing the foundation for the emergence of a number of high-quality rural tourist attractions. Before 2016, there were approximately 850 provincial star-rated “agritainment” establishments in Southern Anhui tourist area, including 445 four-star and above star-rated “agritainment” establishments that form an agglomeration.



**Figure 10** Change of number of tourists and tourism revenue in Taiping Lake during 2009–2017

The development of tourism is encouraged throughout the entire region. Since the approval of the *Outline of Construction and Development of Plan of Southern Anhui International Tourism and Culture Demonstration Zone*, the demonstration area has continuously promoted resource integration, launching a series of tourism boutique routes that include the “Two Mountains and One Lake” Green Tour, World Heritage Tour, Famous City-Lake-Mountain Tour and so forth. A variety of unique cultural tourism products such as the Huizhou Folk Custom Tour, Huizhou Celebrity Hometown Tour, Riverine Wetland Tour, and Xin’an River Landscape Gallery Tour. Beyond that, the construction of tourism infrastructures has been accelerated, including the provision of tourist traffic signs on national and provincial highways and arterial traffics. The development of wisdom tourism has vigorously carried forward. A total of 87 national 4A tourist attractions in the demonstration area are connected to the Anhui Tourism Monitoring Center and all tourism departments in the demonstration area are connected to the “Wanyoutong” tourism platform in Anhui Province, which created the four-level linkage among province, cities, counties and scenic areas. WiFi has begun to be implemented at 4A and above grade tourist attractions, four-star and above tourist hotels, and five-star “agritainment” establishments in the demonstration area. Through these interactions, the tourism pattern of Southern Anhui has begun to take shape.

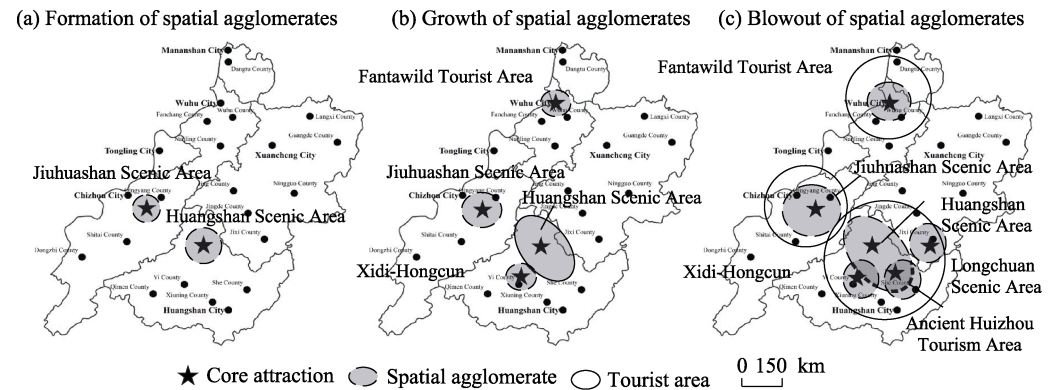
Diversified tourism products attract more tourists and adapt to the market demand. By taking advantage of development opportunities, the tourism enterprise development is promoted, creating the environment in which hotel-oriented tourism enterprises consistently flourish. Before 2016, there were almost 150 star-rated hotels in Southern Anhui tourist area, 65 of which are rated at four stars or above. As a result, the tourism service capacity in this area has been significantly enhanced.

New types of tourism products form a vast number of new spatial agglomerates that are interconnected to generate an agglomeration network. Elements are continuously exchanged between the nodes in the agglomeration network, accelerating the spatial flow of elements such as tourists and tourism revenue and further reducing the differences between various tourist destinations. As presented in Figure 6, Gini indexes of tourist numbers and tourism revenue both present a continuous downward trend after 2009, which reflects the diminishing gap between the distribution of tourist numbers and economy in the inner region of Southern Anhui and the gradual balancing trend of the tourism developmental level at all the tourist destinations.

Along with the development of the agglomeration network, the original core agglomerates, such as Huangshan Scenic Area, Jiuhuashan Scenic Area, Xidi-Hongcun Scenic Area, and

Fantawild Tourist Area, have underwent heightened development; their status as core agglomerates has been further strengthened. The Xihai Grand Canyon area was developed in Huangshan Scenic Area to expand the tourism capacity of the scenic area and rebuilt the Beihai Hotel, Xihai Hotel, Cloud Valley Temple, and Jade Screen Tower Cableway to enhance the reception capacity and turnover capacity of the scenic area. Dayuan Cultural Park elevates the influence of Buddhist culture and tourism in Jiuhuashan Scenic Area. Furthermore, Wuhu Fantawild Tourist Area has added several projects such as Fantawild Water Park and Fantawild Oriental Heritage to enrich and diversify its theme, attracting an increasing number of tourists (Figure 7).

Agents of the tourist destination system in Southern Anhui actively respond to changes in the external environment; the interactions among various agents and between agents and the environment are reinforced (Figure 3), which stimulates the blowout of new features in the system and the exploitation and utilization of tourist attractions in Southern Anhui. Moreover, the products of cultural tourism, rural tourism, ecological tourism and vacation tourism are developed based on the sightseeing tour products, which profoundly affect the spatial structure of tourist destinations in Southern Anhui (Figure 11) and the formation of a networked tourism spatial structure.



**Figure 11** Evolution diagram of tourism spatial structure of Southern Anhui

#### 4 Conclusions

(1) The evolution of the complex system of tourist destinations is a process of constant agglomeration and recombination of all intra-systemic elements and components that are generated from the interactions of multiple agents such as governments, enterprises, residents, NGOs, and tourists. The interactions between subsystems such as the tourist attraction subsystem, tourism service facility subsystem and external environmental system are also integral to the evolutionary processes of this complex system. Tourist attractions are the key identification factors that promote the behavioral agglomeration of agents. Changes in number and type of tourist attractions affect changes in the functional mechanism of the identification, which drives changes in tourist behavior, orientation of government policies, and investment and operation mode of enterprises. It facilitates the exchange of materials and information between all intra-systemic components and between systems and their external environments, thereby generating “flow” effects. Tourist flow is the most important

“flow” component of tourist destinations; the “flow” effect allows systems to continuously absorb new development elements that stimulate the further agglomeration and recombination of the primary elements of tourist destination systems and form the building block mechanism.

Under the function of the internal modeling of agent behavior, the adaptive differences of each agent result in the differences in government policy effect, corporate investment benefit, activity of residents and NGOs, and tourist demand preference. These differences will be inevitably projected into certain spaces that lead to internal polarization and external growth of the spatial structure of tourist destinations generating spatial agglomerates of various scales, grades, and types and forming the building block mechanism of spatial organization.

(2) The spatial structure of tourist destinations reflects their spatial development, which undergoes a complex evolutionary process, beginning with the formation of spatial agglomerates to their growth and eventual blowout. The adaptive mechanism of agents is the key driving force for the evolution of systems. At the formation stage of spatial agglomerates, governments served as a crucial guiding role, establishing the “identification” of tourist destinations and motivating enterprises to invest in building tourist attractions, tourism infrastructure, and service facilities. During the growth stage of spatial agglomerates, governments enabled enterprises to exert more active roles through the macro-level guidance tools of policies and planning. Concurrently, the role of market demand gradually became prominent and the development model of tourist destinations became more diversified and flexible following the joint effects of market mechanisms and government regulations. At the blow-out stage of spatial agglomerates, governments primarily formulate regional and industrial development policies, strengthen the establishment of major infrastructure, such as transport infrastructure, and provide more favorable policy and infrastructure environments for the development of tourist destinations. Moreover, market effect is more active. Tourist destination systems not only provide economic benefit, but also provide great social, cultural, and ecological benefit, which further satisfies the interest appeal of different agents and motivates agents to participate more actively in the development of tourist destinations. Simultaneously, diversified tourism products and spatial agglomerates emerge, and the numerous and diversified spatial agglomerates form a tourism network through interaction.

(3) As tourist destination systems mature, the differences between levels of development within the system continuously diminish until tourist flow and tourism revenue reach a relative equilibrium within the system. As a result, spatial agglomeration of the system languishes continually, and tourism Gini indexes exhibit the trend of gradual decline.

(4) Optimizing and improving tourist destination systems requires coordinating the internal and external development elements and establishing a benign development mechanism among various elements. On one hand, it is necessary to explore potential advantages of the resources of tourist destinations and enhance the capability of transportation and other infrastructures for the purpose of producing more development and improvement opportunities for tourist destinations; on the other hand, it is crucial to comply with economic and social development at home and abroad, clarify the positioning and targeting of regional tourism development, set and implement relevant policies, guide the development of tourist destinations, and promote the networking development and global evolution of tourist destinations.

(5) Research on the developmental processes and mechanism of tourist destination sys-

tems – based on the theory of complex adaptive systems – is still in an early stage and faces certain limitations. Regrettably, an effective quantitative measure of the nonlinear interaction of intra-systemic elements has not been adopted. In the case that interaction forces among components of the complex system of tourist destinations are quantized, it is believed that the developmental characteristics of systems at different evolutionary stages can be identified more accurately and objectively. Based on a comprehensive analysis of development status and future predictable development conditions, future development trends were analyzed. It was found that some uncertain factors still exist that may affect the future trend analysis but these factors do not influence the judgment of the overall development trend.

## References

- Agarwal S, 2002. Restructuring seaside tourism: The resort life cycle. *Annals of Tourism Research*, 29(1): 25–55.
- Bao J, Lu L, Ji Z H, 2010. Tourism transportation optimization and tour route designing of north Anhui Province based on the Kruskal algorithm of graph theory. *Human Geography*, 25(3): 144–148. (in Chinese)
- Bao J G, Chu Y F, 1999. *Tourism Geography*. Beijing: Higher Education Press, 106–108. (in Chinese)
- Caldicott R, Scherrer P, 2013. The life cycle of Caravan Parks in Australia: The case of northern New South Wales. *Australian Geographer*, 44(1): 63–80.
- Chen H, Lu L, Zheng S T, 2011. The tourism spatial pattern evolution of the Pearl River Delta. *Acta Geographica Sinica*, 66(10): 1427–1437. (in Chinese)
- China National Tourism Administration. <http://www.cnta.gov.cn/>.
- Geng H, Song Z L, 2013. Exploration of public facility configuration of small resource based tourist towns. *City Planning Review*, 37(3): 54–58. (in Chinese)
- Hernandez J M, Gonzalez M C, 2017. An evolving model for the lodging-service network in a tourism destination. *Physica A-Statistical Mechanics and Its Applications*, 482: 296–307.
- Holland J H, 1992. *Adaptation in Natural and Artificial Systems: An Introductory Analysis with Applications to Biology, Control, and Artificial Intelligence*. Cambridge Massachusetts: The MIT Press.
- Holland J H, 1996. *Hidden Order: How Adaption Builds Complexity*. Zhou X M, Han H trans., 2011. Shanghai: Science and Technology Education Press, 5–7. (in Chinese)
- Hu X Y, Ma J, Kou Y Z, 2013. Evolution and spatial characteristics of tourism scale distribution in Xi'an tourism destination circle. *Economic Geography*, 33(6): 188–192. (in Chinese)
- Huang J F, Lu L, 2015. The paradigm transformation of space in tourism destination from perspective of production of space: A new paradigm of space based on emergence of space. *Scientia Geographica Sinica*, 35(1): 47–55. (in Chinese)
- Ji X F, Liang F W, Chen F, 2012. The analysis of tourism transportation network layout and optimizing countermeasures in Yunnan province. *Economic Geography*, 32(11): 52–57. (in Chinese)
- Jin C, Lu Y Q, Zhang L *et al.*, 2009. An analysis of accessibility of scenic spots based on land traffic network: A case study of Nanjing. *Geographical Research*, 28(1): 246–257. (in Chinese)
- Liao Z X, Jin M Z, Ren P Y *et al.*, 2014. Research on scenic spot's sustainable development based on a SD model: A case study of the Jiuzhai Valley. *Sustainability*, 6(7): 4632–4644.
- Liu C L, Yan Q, Luo J, 2013. System dynamics simulation on the coupling of economy resources environment system in Wuhan metropolitan region. *Geographical Research*, 32(5): 857–869. (in Chinese)
- Liu X, Li J, 2018. Host perceptions of tourism impact and stage of destination development in a developing country. *Sustainability*, 10(7): 1–15.
- Lu L, 1995. A study on the distribution of south Anhui tour section. *Scientia Geographica Sinica*, 15(1): 88–95. (in Chinese)
- Lu L, 1997. A study on the life cycle of mountain resorts: A case study of Huangshan Mountain and Jiuhuashan

- Mountain. *Scientia Geographica Sinica*, 17(1): 63–69. (in Chinese)
- Lu L, Bao J, 2010. The course and mechanism of evolution about Qiandao Lake based on the theory of dissipative structure. *Acta Geographica Sinica*, 65(6): 755–768. (in Chinese)
- Lu L, Bao J, Huang J F *et al.*, 2016. Recent research progress and prospects in tourism geography of China. *Journal of Geographical Sciences*, 26(8): 1197–1222.
- Lu L, Tian N, Yu H *et al.*, 2015. The evolution process and mechanism of Taiping Lake in Anhui province. *Journal of Natural Resources*, 30(4): 604–616. (in Chinese)
- Luis G, Gemma C, 2011. Life cycle, stages and tourism history: The Catalonia (Spain) experience. *Annals of Tourism Research*, 38(2): 651–671.
- Lundtorp S, Wanhill S, 2001. The resort lifecycle theory: Generating processes and estimation. *Annals of Tourism Research*, 28(4): 947–964.
- Marshall A, 1890. Principles of Economics. London: Macmillan Publishers.
- Olmedo E, Mateos R, 2015. Quantitative characterization of chaordic tourist destination. *Tourism Management*, 47: 115–126.
- Pagliara F, Mauriello F, Garofalo A, 2017. Exploring the interdependences between High Speed Rail systems and tourism: Some evidence from Italy. *Transportation Research Part A-Policy and Practice*, 106: 300–308.
- Salvador G A, 2016. Geographic information system (GIS) analysis of impacts in the tourism area life cycle (TALC) of a Mediterranean resort. *International Journal of Tourism Research*, 18(2): 186–196.
- Shao X L, Gao J, 2006. Actuality and prospect of study on tourism area lifecycle. *Tourism Tribune*, 21(6): 76–82. (in Chinese)
- Statistics Bureau of Anhui Province, 1981–2017. Statistical Yearbook of Anhui Province. Beijing: China Statistics Press. (in Chinese)
- Wang D G, Wang L, Chen T *et al.*, 2016. HSR mechanisms and effects on the spatial structure of regional tourism in China. *Journal of Geographical Sciences*, 26(12): 1725–1753.
- Wang X C, Ye W H, Meng D, 2011. Exploration of coastal region tourism facilities evaluation system: Shenzhen Dapeng Peninsula example. *Planners*, 27(1): 106–115. (in Chinese)
- Wen T, 2007. Analysis of the life cycle of Mt. Danxiashan World Geopark. *Economic Geography*, 27(3): 496–501. (in Chinese)
- Xi J C, Wang X G, Kong Q *et al.*, 2015. Spatial morphology evolution of rural settlements induced by tourism: A comparative study of three villages in Yesanpo tourism area, China. *Journal of Geographical Sciences*, 25(4): 497–511.
- Yang C Y, 2009. Construction of tourism destination state forecasting model and case study. *Resources Science*, 31(6): 1015–1021. (in Chinese)
- Yang C Y, Huang Z F, Mao W D, 2009. On the schools, courses and prospect of complex system evolution theory in tourism areas. *Human Geography*, 24(3): 66–71. (in Chinese)
- Yang Z Y, Lu S, 2013. The impacts of traffic improvements on spatial structure of regional tourism: Case of southern Anhui. *Scientia Geographica Sinica*, 33(7): 806–814. (in Chinese)
- Yuval K, Shaul K, 2004. Stochastic multivariable approach to modelling tourism area life cycles. *Tourism and Hospitality Research*, 5(3): 235–253.
- Zhang J Z, Sun G N, 2012. Life cycle and upgrade of Shanxi's mansion as a tourist destination: Taking Qiao's Grand Compound as an example. *Geographical Research*, 31(11): 2104–2114. (in Chinese)