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Temporal change and scene characteristics of Tang poetry cultural landscapes in the Jiangsu Yangtze region

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Article

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Temporal change and scene characteristics of Tang poetry cultural landscapes in the Jiangsu Yangtze region

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Abstract

Tang poetry contains rich place-name references, landscape imagery and cultural memory, offering insights into historical perceptions of space. We examine Tang poems from Jiangsu's Yangtze region using text mining, toponym verification, landscape-element coding, semantic co-occurrence networks, modularity clustering and $\log_2$(LQ) relative-intensity analysis. Of 1,333 valid records, 1,314 support four-period comparisons. Waterways, architecture, celestial and climatic imagery, and historical allusions predominate; element counts peak in the Middle Tang, while nostalgia rises in the Late Tang. Urban themes differ: Nanjing evokes former-capital memory; Suzhou, waterside excursions; Yangzhou, banquets and commerce; Zhenjiang, ferries and temples; Changzhou, local products and poetic composition; Wuxi, religious excursions. Five integrated scenes emerge: Elevated Viewing and Historical Reflection, River Travel and Farewell, Riverine Urban Landscapes, Urban Life and Commercial Exchange, and Religious Visits and Excursions. Findings inform cultural resource integration, poetry-based cultural mapping and digital presentation for the Jiangsu section of the Yangtze River National Cultural Park.

Keywords

Tang poetry; poetic cultural landscape; text mining; semantic network; cultural memory; integrated scenes; Jiangsu section of the Yangtze River

Introduction

Cultural landscapes embody social groups' understandings of natural environments, historical memory and local identity. Previous studies of cultural landscapes, associative cultural landscapes and landscape memory suggest that landscape meanings emerge from sustained relationships among people, nature, historical narratives, local experiences and cultural values [1–4]. Place-name references, landscape imagery, human activities and emotional expressions in literary texts document how people perceive, represent and understand places, providing valuable textual evidence for cultural landscape research [5,6]. From the perspective of literary geography, poetry can reveal relationships among place, memory, emotion, spatial experience and landscape values [5–7]. Poetic representations of natural and built environments, including mountains, rivers, walled cities, roads, temples, towers and ferry crossings, offer insights into historical human–environment relationships and local cultural perceptions [8].

Digital humanities methods have expanded the possibilities for analysing poetic texts. Text mining, natural language processing and GIS facilitate the identification and georeferencing of place-name references in literary texts, enabling their representation as spatial data [9]. Computational text analysis also supports the examination of thematic, behavioural and emotional patterns [10]. Complex-network approaches can model word co-occurrences and semantic relationships between text passages, revealing textual organisation and community structures [11,12].

Chinese classical poetry, particularly Tang poetry, has a rich tradition of geographical references and landscape descriptions. References to mountains, rivers, cities, bridges, temples, towers, ferry crossings and boats often occur alongside descriptions of travel, scenic ascents, farewells, reflection on the past, banquets, poetic composition and journeys by boat. Together, they connect natural environments, urban spaces, transport routes and personal emotions within place-specific poetic landscapes. In recent years, text mining of poetry has increasingly been used in cultural landscape research. Studies of the Tang Poetry Road in Eastern Zhejiang have combined text mining, GIS and semantic network analysis to investigate the spatial

distribution, scene clustering and formation mechanisms of poetic cultural landscapes [13,14]. Related studies have examined Tianmu Mountain, West Lake, Beijing's Western Hills, Mount Lushan, the middle and lower reaches of the Yellow River, and the Qiantang River using poetry-based or other historical-text analyses [15–20]. Together, these studies provide methodological references for identifying landscape elements, excursion activities and regional imagery. Research on the geographical distribution of Tang poetry, spatiotemporal patterns of emotion in Song ci, poetic soundscapes, the role of poetry in tourism and poetry-based cultural datasets further demonstrates the value of classical poetry for cultural geography and digital humanities research [21–25].

The Jiangsu section of the Yangtze River Basin lies in the lower reaches of the Yangtze River, connecting the Jianghuai and Jiangnan regions. Using present-day city boundaries as a geographical reference, Nanjing, Zhenjiang, Yangzhou, Suzhou, Wuxi and Changzhou exhibit different hydrological settings and historical transport conditions. Nanjing and Zhenjiang are closely associated with the main course of the Yangtze River, while Yangzhou is connected to the lower Yangtze transport network through canals and Jianghuai waterways. Suzhou, Wuxi and Changzhou are closely linked to the Taihu Lake basin, Jiangnan waterways and canal transport. Research comparing place names in Tang–Song poetry and contemporary online travelogues has examined their spatiotemporal distribution in Nanjing and the persistence of certain cultural landmarks across historical and contemporary texts [26]. Other studies have investigated Nanjing's historical cultural landscapes through late-Ming pictorial sources, focusing on landscape composition and relationships among landscape elements [27]. Research on toponymic cultural heritage in Jiangsu has examined its spatial distribution and associations with canals, historical cultural regions and other geographical factors [28]. Studies of Suzhou have explored the distribution of cultural heritage sites along canals, the relationship between the Grand Canal and urban development, and the evolution of garden landscapes from the Tang to the Qing dynasty [29–31]. Recent historical studies of the Grand Canal have further examined its influence on urban development and regional cultural exchange from the perspectives of dynastic and regional relationships and the development of canal towns [32,33]. Together, these studies provide a historical-geographical context for understanding urban spatial change in Jiangsu's lower Yangtze region. They also suggest that landscape

representations in Tang poetry should be examined in relation to different spatial settings, including the Yangtze River, canal nodes, the Taihu Lake basin and Jiangnan waterways.

The development of the Yangtze River National Cultural Park provides a new context for the systematic documentation, digital preservation and regional interpretation of cultural resources along the Yangtze River [34,35]. Previous studies have examined national cultural park management policies, the digital development of the Yangtze River National Cultural Park and spatiotemporal changes in poetic cultural landscapes, providing useful references for studying Yangtze cultural heritage through poetry [34–36]. Research on digital heritage interpretation and cultural route visualisation further suggests that digital technologies offer new ways to organise and present heritage information and to examine connections between historical places and collective memory [37,38].

Cities in the Jiangsu section of the Yangtze River Basin have diverse geographical and cultural features, including riverfront areas along the main course of the Yangtze River, canal transport, Jiangnan waterways, historic cities, commercial activities and religious excursions. Place names such as Jinling, Guangling, Jingkou, Wuzhong, Piling and Huishan appear in Tang poetry alongside descriptions of rivers, boat journeys, towers and pavilions, Buddhist and Daoist temples, city gates, poetic composition and historical memory. These references provide important textual clues for understanding the region's cultural landscapes. Previous studies have contributed to the identification of poetic cultural landscapes, the analysis of urban place names and the study of representative heritage sites, providing a basis for understanding local landscapes described in poetry. Building on this work, further comparisons can examine landscape elements, semantic clusters and scene characteristics across cities in the Jiangsu Yangtze region, including changes across the Early, High, Middle and Late Tang periods and differences in integrated scenes among Nanjing, Suzhou, Yangzhou, Zhenjiang, Changzhou and Wuxi.

Accordingly, this study combines Tang poetry data collection and processing, historical-to-modern place-name matching, toponym ambiguity checking, landscape-element coding, semantic co-occurrence network analysis, modularity clustering and $\log_2$(LQ) relative-intensity analysis (Fig. 1) to examine the composition of landscape elements, temporal changes, urban differences and integrated scenes represented in Tang poetry from the Jiangsu

Yangtze region. The study addresses three research questions: (1) How do landscape elements in Tang poetry vary across the Early, High, Middle and Late Tang periods? (2) How do semantic networks and landscape clusters differ among the six core cities of Nanjing, Suzhou, Yangzhou, Zhenjiang, Changzhou and Wuxi? (3) What integrated scenes can be identified in Tang poetic cultural landscapes, how are they distributed across periods and cities, and how do they relate to historical memory, waterborne transport, urban life and religious excursions? Through these analyses, this study examines the composition of landscape elements, urban differences and scene characteristics in Tang poetic cultural landscapes of the Jiangsu Yangtze region. The findings provide a textual basis for understanding the regional characteristics of Yangtze culture and informing the translation of poetic cultural heritage into design applications.

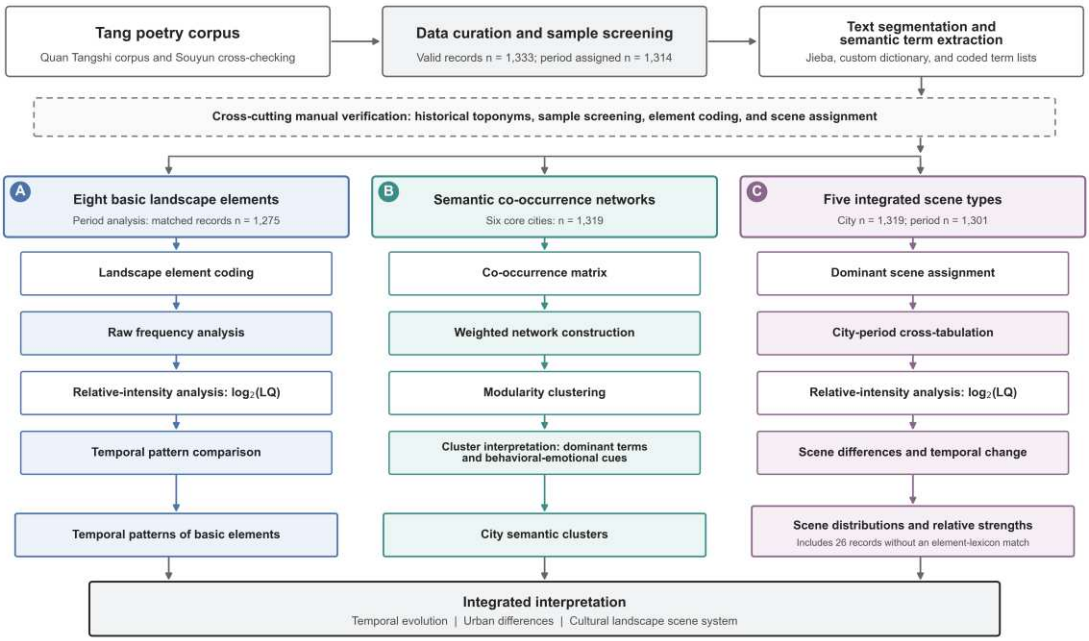


Fig. 1 | Research workflow for Tang poetic cultural landscape analysis.

Methods

Research area

The study area is the Jiangsu section of the Yangtze River Basin (Fig. 2). Located in the lower reaches of the Yangtze River, this section forms an important transition zone where the river changes from an inland river environment to a river–sea convergence zone. According to materials related to the development of the Jiangsu section of the Yangtze River National

Cultural Park, the Jiangsu reach of the Yangtze River is approximately 433 km long, with a total shoreline length of 1,169.9 km and abundant natural and cultural resources along its course.

In terms of administrative coverage, the study uses eight cities along the Yangtze River—Nanjing, Zhenjiang, Yangzhou, Taizhou, Changzhou, Wuxi, Suzhou and Nantong—as its basic analytical units. In terms of present-day geographical coverage, these eight prefecture-level cities associated with the Jiangsu section of the Yangtze River serve as the basic sampling units.

During the Tang dynasty, no administrative unit corresponded exactly to present-day Jiangsu Province. The area now comprising Jiangsu was broadly divided among Henan Circuit, Huainan Circuit and Jiangnan East Circuit. During the Sui and Tang dynasties, prefectures such as Jiangzhou, Runzhou, Yangzhou, Suzhou and Changzhou had been established within this area. Among historical place names, Jiangzhou, Jiangning and Jinling are mainly associated with present-day Nanjing; Runzhou, Jingkou and Dantu with Zhenjiang; Guangling and Jiangdu with Yangzhou; Wu, Gusu and Wu County with Suzhou; Piling and Yanling with Changzhou; and Huishan and Wuxi with Wuxi.

It should be noted that the term “Jiangsu section” in this study does not correspond directly to present-day administrative boundaries. Instead, the study area is defined primarily by references in poetic texts to the main course of the Yangtze River, riverside cities, sites along its banks, waterborne transport routes and associated cultural landscapes. Accordingly, historical place names from the Tang dynasty, their attribution to present-day cities and the context of individual poetic lines were examined together during data processing to minimise discrepancies between modern administrative divisions and Tang-period historical geography.

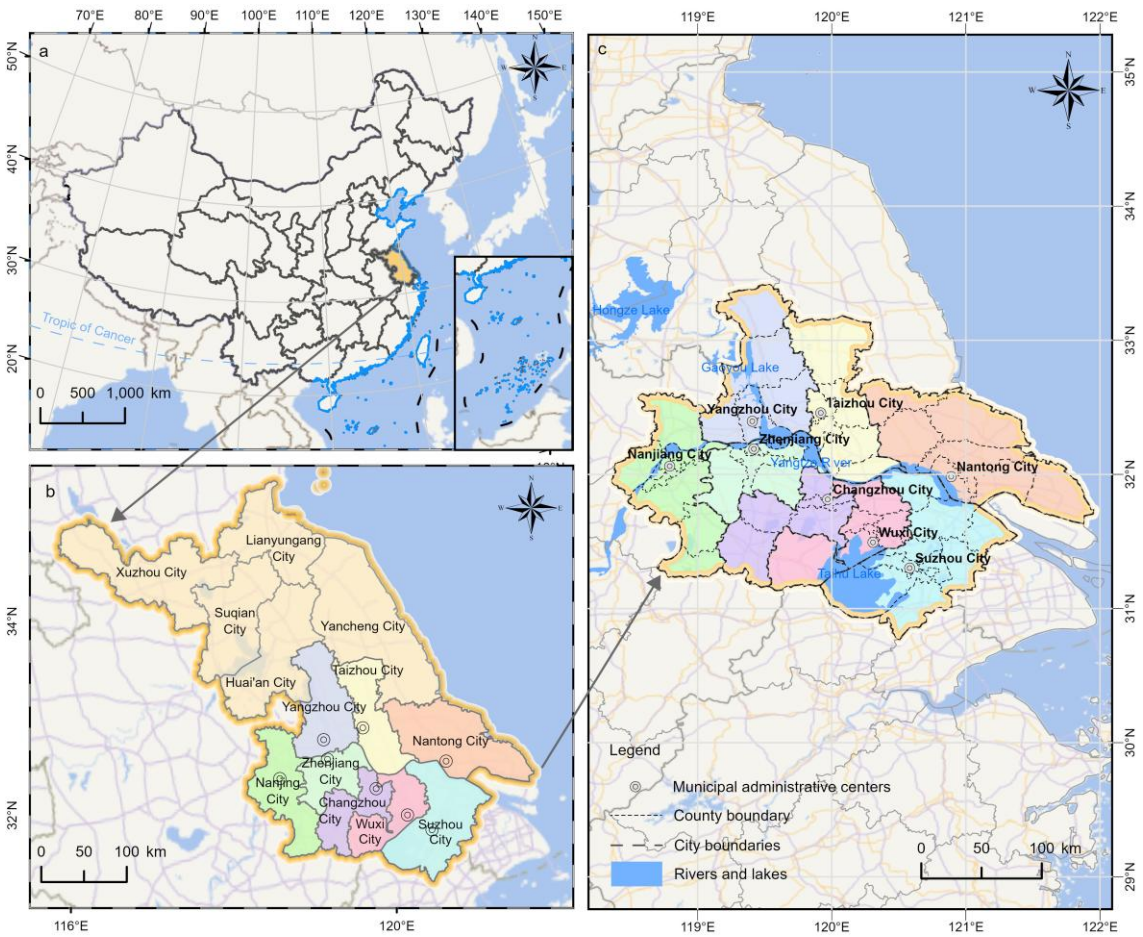


Fig. 2 | Study area, the Jiangsu section of the Yangtze River Basin.(The base map is from the 2024 standard map,http://bzdt.ch.mnr.gov.cn/index.html).

Data source

Tang poems related to the Jiangsu section of the Yangtze River Basin were collected primarily from Quan Tangshi (Complete Tang Poems). The Souyun poetry database (https://www.sou-yun.cn/) was used for supplementary searches and textual verification. As a major collection of Tang poetry, Quan Tangshi provided the primary textual source for sample collection. Souyun was used to search poem titles, poetic lines, historical place names, alternative names and related works, and to check textual references where necessary.

Poetry records were selected according to three criteria. First, poem titles or lines had to contain historical place names, city aliases, identifiable landscape sites or references to waterways associated with the study area. Second, the poems had to describe or refer to relevant cultural landscapes, including rivers, riverbanks, ferry crossings, scenic mountains and waters, historical sites, religious places or urban activities. Third, geographical references were checked against historical place-name records and the context of individual poems to

establish their association with the study area.

Records with unclear geographical references, unresolved place-name ambiguities, or place names used only in official titles or general expressions were excluded or marked as non-core samples. Information about poets' biographies, official appointments and travel experiences was used as supporting evidence when checking geographical references and interpreting poem contexts.

The eight cities served as the initial geographical units for assigning poetry records. Following sample screening and place-name verification, relatively few valid records remained for Taizhou and Nantong. Subsequent comparisons of semantic networks and the relative intensity of integrated scenes therefore focused on six cities: Nanjing, Suzhou, Yangzhou, Zhenjiang, Changzhou and Wuxi. Valid records from Taizhou and Nantong were retained in the overall sample statistics to document geographical coverage. The number of records in each city is reported in the Results section.

Research methods

This study combines text mining, semantic co-occurrence network analysis and relative-intensity analysis to examine landscape elements, urban semantic clusters and integrated scenes represented in Tang poetry from the Jiangsu Yangtze region. The workflow comprises textual data processing, semantic term extraction, two-level coding, co-occurrence network construction, modularity clustering, scene classification and relative-intensity calculation.

Tang poetry text mining based on Jieba part-of-speech tagging

To identify terms relevant to landscape analysis, the cleaned poetry texts were segmented and part-of-speech tagged using the Python Jieba library. Regular expressions, the collections module and jieba.posseg were used for text processing, frequency counting and noun identification. A custom dictionary was applied to reduce segmentation errors involving historical place names, religious sites, allusions and compound landscape terms. Examples included Jinling, Stone City, Guangling, Jingkou, Huishan Temple and Bailuzhou. Function words, general personal references and terms with little relevance to landscape interpretation were subsequently removed. This stage produced 4,340 candidate noun types, including 686

single-character and 3,654 multi-character terms.

Before constructing the semantic networks, a second extraction procedure prioritised multi-character terms and supplemented them with single-character nouns. First, 687 predefined multi-character terms were matched in descending order of length to preserve compound expressions referring to places, landscapes, allusions and activities. Part-of-speech tagging was then applied to text positions not covered by these matches, and single-character terms tagged with a noun category beginning with n were extracted as supplementary terms. This procedure reduced the fragmentation of compound expressions while retaining single-character terms relevant to classical poetic imagery. The extracted terms were manually reviewed against poem titles, relevant lines, historical place-name contexts and surrounding text before landscape-element coding and scene classification.

Landscape elements and scene classification based on a two-level coding system

The study used a two-level coding system. The first level comprised eight categories of basic landscape elements: Sky and Climate, Mountains and Terrain, Rivers and Waters, Animals, Plants, Human Roles, Built Space and Allusive Memory. These categories were used to analyse element frequencies, co-occurrence patterns and relative intensity. Behavioural expressions, emotional terms and other contextual clues were also examined to interpret the meaning of semantic clusters and the activities associated with particular landscapes.

The second level comprised five integrated scene types: Elevated Viewing and Historical Reflection, River Travel and Farewell, Riverine Urban Landscapes, Urban Life and Commercial Exchange, and Religious Visits and Excursions. Scene classification was based on combinations of landscape elements, activities, emotions, poem titles, historical place names and allusions. When a poetry record contained evidence associated with more than one scene, its primary category was determined by the dominant meaning of the poem, while related scene associations were recorded as supplementary information. The judgement criteria for the five integrated scenes are shown in Table 1.

Table 1. Coding criteria for the five integrated scene types

Integrated scene type	Assignment criteria	Key landscape and contextual evidence

Integrated scene type	Assignment criteria	Key landscape and contextual evidence
Elevated Viewing and Historical Reflection	An elevated viewpoint or landmark is associated with former-capital memory, ruins, historical place names or literary allusions. Climbing or looking alone is insufficient without a historical-memory orientation.	Towers; pavilions; gates; Stone City; Guangling; Wucheng; rivers associated with historic sites or former-capital memory. Climbing, looking, remembering, nostalgia or sadness.
River Travel and Farewell	A water-route setting is linked to travel, departure, return, boat movement, correspondence, lodging or farewell.	Rivers; tides; ferries; boats; sails; shores; routes; river ports. Travelling, lodging, sending off, returning, longing or parting.
Riverine Urban Landscapes	Waterways, urban space, landforms, vegetation and climate elements jointly establish a spatial scene, provided that no stronger travel, farewell, commercial, religious or historical-memory orientation is present.	River–city and lake–city relations; mountains; bridges; islands; clouds; vegetation. Viewing, roaming or dwelling.
Urban Life and Commercial Exchange	Built-space references must co-occur with urban social interaction, exchange, literary sociability, markets or commerce. Architectural terms alone are insufficient.	City streets; taverns; social venues; towers; gates; roads. Singing, drinking, banqueting, meeting, poetic exchange, inscription or trading.
Religious Visits and Excursions	Religious spaces are associated with visits, excursions, meditation, inscriptions, religious textual transmission or contemplative experience. Religious allusions without an identifiable site or activity are not assigned to this scene; they are retained as allusive-memory evidence at the basic-element level or as supplementary context.	Temples; monasteries; monks; mountains; springs; steles; sacred sites. Visiting, meditation, inscription or contemplative feelings.

Note. Each poetry record was assigned to one primary scene type based on its dominant contextual meaning. When more than one scene was supported, secondary associations were recorded as supplementary information.

Construction of the semantic co-occurrence network

To identify the semantic combinations of poetic cultural landscapes in different cities, this paper builds a co-occurrence network of landscape semantic elements. Let the cleaned poem set be $D=\{d_1,d_2,\ldots,d_n\}$, and the landscape semantic element set be $V=\{v_1,v_2,\ldots,v_p\}$. If two elements v_i and v_j appear at the same time in the same poem or poem record, this is counted as one co-occurrence. The co-occurrence matrix $W=(w_{ij})$ is defined as follows:

$$w_{ij}=\sum_{d\in D}\chi(v_i\in d\wedge v_j\in d),\quad i\neq j$$

where $\chi(\cdot)$ is an indicator function, which equals 1 when the condition is met and 0 otherwise. Because the network is undirected, the matrix is symmetric and its diagonal elements are set to zero. The matrix W can be transformed into an undirected weighted network $G=(V,E,W)$: nodes represent landscape semantic elements, edges represent co-occurrence relations among elements, and edge weights represent co-occurrence frequency. Node size can be set by weighted degree. To avoid confusion with degree values in the modularity formula below, this study uses s_i to represent the weighted degree of node v_i, namely node strength:

$$s_i=\sum_{j=1}^{p} w_{ij}$$

where s_i represents the overall association strength between node v_i and other semantic elements. This index is used to identify core images or core semantic nodes in urban poetic landscapes.

Community clustering and modularity evaluation

According to the co-occurrence relations among landscape semantic elements in the cleaned poem records, the study built an undirected weighted co-occurrence matrix and imported it into Gephi 0.11.2 for network filtering, modularity calculation and visualisation. Gephi can be used for the exploration, analysis and visualisation of complex networks, while modularity evaluation and community detection provide a methodological basis for cluster division in semantic co-occurrence networks [39-42]. In the network, nodes represent landscape semantic elements, edges represent co-occurrence between two elements in the same poem or poem record, and edge weight represents co-occurrence frequency. Node size corresponds to weighted degree, line thickness corresponds to edge weight, and different colours represent modularity clusters.

Modularity clustering is used to identify closely connected semantic groups in poetic texts for the same city, while modularity Q measures the extent to which the network is divided into communities:

$$Q=\frac{1}{2m}\sum_{i,j}\left[w_{ij}-\frac{s_i s_j}{2m}\right]\delta(c_i,c_j)$$

where $2m=\sum_{i,j} w_{ij} = \sum_i s_i$; w_{ij} is the edge weight between node i and node j, s_i and s_j are the node strengths (weighted degrees) of the two nodes, m is the total edge weight counted once, and c_i and c_j indicate the communities of the nodes. The function $\delta(c_i,c_j)=1$ when the two nodes belong to the same community and 0 otherwise.

The network layout used the Fruchterman-Reingold force-directed algorithm [43]. This algorithm treats nodes as mutually repulsive points and edges as attractive links, and is used to show visual proximity among semantic clusters. Its typical repulsive and attractive functions can be expressed as follows:

$$f_r(d)=\frac{k^2}{d}, f_a(d)=\frac{d^2}{k}$$

where d is the distance between two nodes, and k is a scale constant related to the drawing area and number of nodes. The layout result does not represent real geographical distance. Node positions are the visual outcome of the global force equilibrium and should not be interpreted as direct measurements of pairwise co-occurrence strength. Pairwise association strength is determined by edge weight and represented by edge thickness.

Relative intensity index for city-scene differences

To compare the relative tendency of landscape elements or integrated scenes across different cities and periods, the study uses a smoothed location quotient to calculate relative intensity. Let n_{ij} be the count of category j in analytical unit i, $n_{i\cdot}$ be the total count across all categories in unit i, $n_{\cdot j}$ be the total count of category j across all analytical units, and $n_{\cdot\cdot}$ be the grand total. To reduce ratio fluctuation caused by zero values and small samples, a smoothing constant $\alpha=0.5$ is added. The smoothed location quotient is defined as follows:

$$LQ_{ij}=\frac{\frac{(n_{ij}+\alpha)}{(n_{i\cdot}+\alpha K)}}{\frac{(n_{\cdot j}+\alpha I)}{(n_{\cdot\cdot}+\alpha IK)}}$$

The base-2 logarithm is then calculated:

$$R_{ij}=log_2(LQ_{ij})$$

where K is the number of categories, I is the number of analytical units. For the eight basic landscape elements, counts refer to element occurrences and K=8; for the five integrated

scenes, counts refer to scene records and K=5. In the city comparison, I=6; in the four-period comparison, I=4. When $R_{ij}>0$, the relative share of category j in analytical unit i is higher than the overall smoothed reference distribution. When $R_{ij}<0$, it is lower than the overall smoothed reference distribution. When $R_{ij}=0$, it is equal to the overall smoothed reference distribution. For period change in key cities such as Nanjing, Yangzhou, Zhenjiang and Suzhou, the study further uses each city's own long-term scene structure as the baseline to compare scene tendencies across the Early, High, Middle and Late Tang periods. This index is used to judge whether a city in a given period tends more strongly toward a certain scene than its own long-term structure, and the related cross-tabulation results are used to explain internal period change within cities.

Results

Sample coverage and selection of core analytical cities

Following the review of ambiguous historical place names and reassessment of scene classifications, a total of 1,333 valid poetry records were retained across eight city units. Among these, 1,314 records could be assigned to one of the four Tang periods: Early Tang, High Tang, Middle Tang and Late Tang (Fig. 3). The records were predominantly concentrated in Nanjing, Suzhou, Yangzhou and Zhenjiang. Although Changzhou and Wuxi had fewer records, their poems contained identifiable references to local landscapes. Nantong and Taizhou contributed only a small number of records whose relevance to the study area and research scope was confirmed through contextual examination. These records were included in the overall sample coverage presented in Fig. 3 but excluded from the subsequent semantic network comparisons and relative-intensity analysis of integrated scenes for the six core analytical cities.

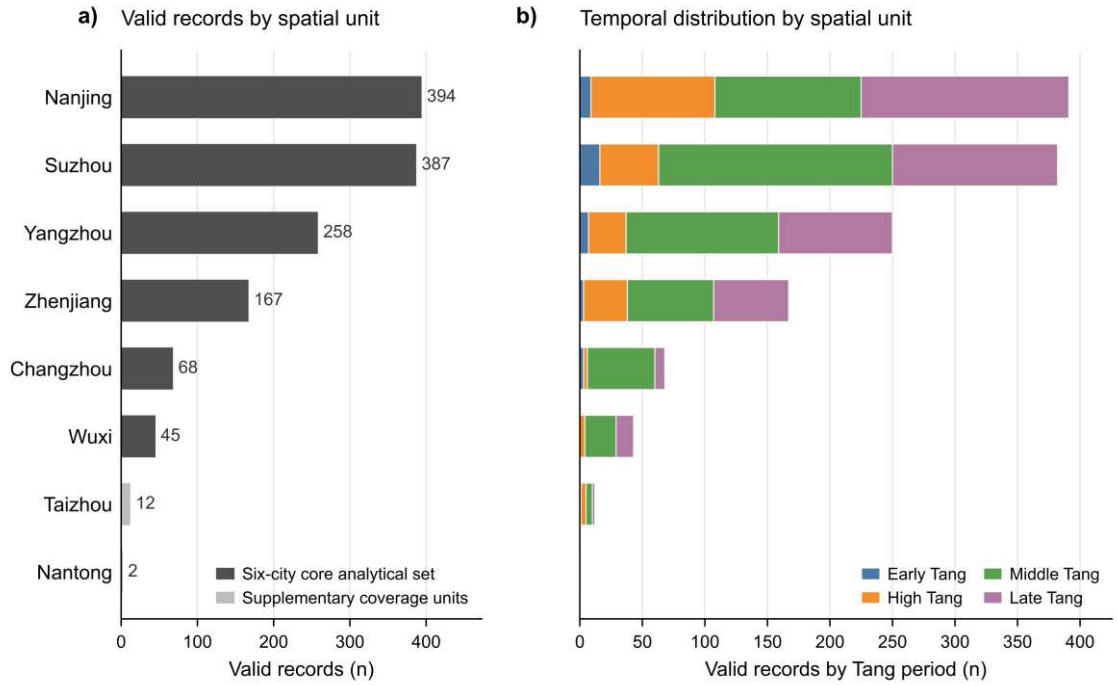


Fig. 3 | Sample coverage and period distribution of Tang poetry records.

Figure 3a shows that the six core analytical cities accounted for 1,319 valid poetry records, including 394 from Nanjing, 387 from Suzhou, 258 from Yangzhou, 167 from Zhenjiang, 68 from Changzhou and 45 from Wuxi. Taizhou and Nantong contributed 12 and 2 records, respectively. As shown in Fig. 3b, records with identifiable chronological information were predominantly concentrated in the Middle and Late Tang periods. Nanjing, Suzhou, Yangzhou and Zhenjiang provided the largest samples for comparisons across the four periods, while Changzhou and Wuxi contributed additional evidence of local landscape characteristics. Accordingly, the analysis first presents the sample distribution across all eight cities before focusing on the six core analytical cities for semantic network analysis and integrated scene comparisons.

Period distribution and relative intensity of the eight basic landscape elements

Different statistical units were used at different stages of the analysis. Sample coverage was based on 1,333 valid poetry records from eight cities, of which 1,314 had identifiable Tang-period information. The analysis of the eight basic landscape elements was further restricted to the six core analytical cities, comprising 1,301 period-assigned records, of which 1,275 matched at least one basic landscape element and formed the statistical basis for Figs. 4 and 5. The remaining 26 records were retained for integrated scene classification because poem

titles, behavioural or emotional expressions, historical place names, allusions or contextual evidence supported a dominant scene assignment. The five integrated scene types were analysed using records assigned to the corresponding scene categories. Therefore, valid records, matched records, element occurrences and scene records represent different statistical units.

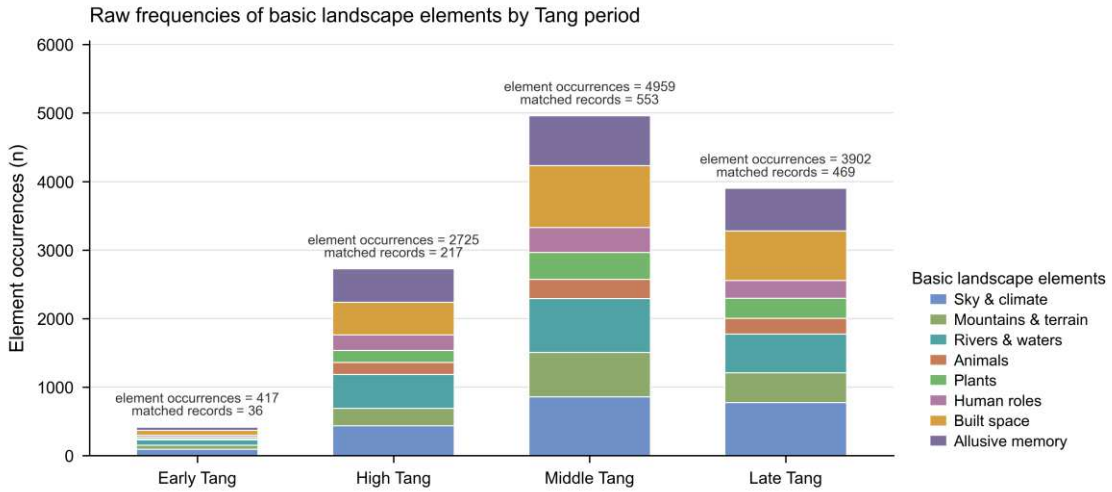


Fig. 4 | Raw frequencies of the eight basic landscape elements across four Tang periods.

Figure 4 presents the raw frequencies of the eight basic landscape elements across the four Tang periods. The Early Tang, High Tang, Middle Tang and Late Tang periods included 36, 217, 553 and 469 records containing identifiable landscape elements, respectively, corresponding to 417, 2,725, 4,959 and 3,902 element occurrences. The Middle Tang recorded the highest number of element occurrences, followed by the Late Tang, while the High Tang showed a substantial increase compared with the Early Tang. These results indicate that landscape elements were more extensively represented in the available poetic records from the Middle and Late Tang periods.

The composition of the eight landscape element categories varied across the four periods. In the Middle Tang, Built Space, Sky and Climate, Rivers and Waters, and Allusive Memory were the most frequently recorded categories, with 902, 858, 785 and 728 occurrences, respectively. These frequencies reflect the prominence of urban structures, seasonal and climatic conditions, waterways and historical allusions in poetic descriptions. A similar pattern was observed in the Late Tang, with 773 occurrences of Sky and Climate, 725 of Built Space, 622 of Allusive Memory and 566 of Rivers and Waters. During the High Tang, Rivers and Waters, Allusive

Memory and Built Space occurred at comparable frequencies of 493, 485 and 480, respectively. Although the Early Tang sample was relatively small, references to climatic conditions, waterways and urban structures were already present in its poetic landscape descriptions.

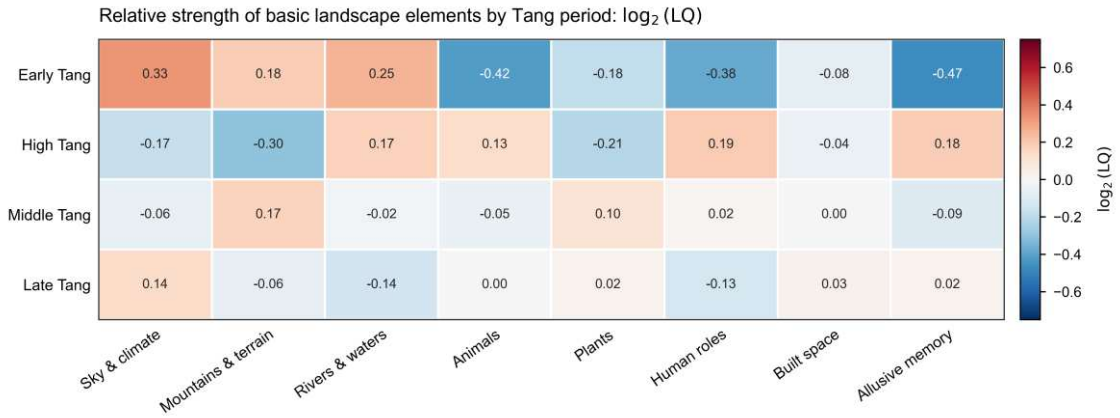


Fig. 5 | Relative intensity of the eight basic landscape elements across four Tang periods: $\log_2$(LQ).

Figure 5 presents the relative intensity of the eight basic landscape elements across the four Tang periods using $\log_2$(LQ). In the Early Tang, Sky and Climate, Rivers and Waters, and Mountains and Terrain showed positive relative intensity, with $\log_2$(LQ) values of 0.33, 0.25 and 0.18, respectively, indicating a relative emphasis on climatic conditions, waterways and landforms. During the High Tang, Rivers and Waters, Human Roles, Allusive Memory and Animals exhibited positive relative intensity, reflecting their greater relative representation in the landscape element composition of this period. In the Middle Tang, Mountains and Terrain and Plants were slightly above the overall reference distribution, alongside the frequent occurrence of Built Space and Rivers and Waters. In the Late Tang, Sky and Climate, Built Space and Allusive Memory maintained weak positive relative intensity, with historical place names, towers, city walls and seasonal conditions contributing to the representation of historical memory. Taken together, the raw frequencies and relative-intensity values reveal differences in both the frequency and composition of landscape elements across the four Tang periods, particularly the prominence of urban space and historical memory in the Middle and Late Tang.

Semantic networks and cluster structures of the six core analytical cities

Semantic co-occurrence analysis produced network and cluster maps of poetic landscapes for the six core analytical cities: Nanjing, Suzhou, Yangzhou, Zhenjiang, Changzhou and Wuxi

(Fig. 6). In these networks, node and label sizes correspond to weighted degree, edge thickness represents co-occurrence weight, and different colours distinguish modularity communities. Terms within the same community exhibit relatively close co-occurrence relationships, providing a basis for identifying semantic patterns in each city's poetic landscape. The relationships among single-character and multi-character terms in the dominant clusters were further examined alongside behavioural and emotional word frequencies to analyse landscape elements, activity patterns and emotional expressions (Figs. 7–12). The corresponding cluster summary tables present the core terms, principal landscape elements and scene orientations of the dominant and secondary clusters. As shown in Table 2, Suzhou, Nanjing, Yangzhou and Zhenjiang contain 277, 188, 182 and 129 nodes, respectively, with four modularity communities in each network. Changzhou and Wuxi have smaller networks, containing 31 and 30 nodes, respectively, with two communities each. These differences provide a basis for examining the semantic structures and landscape characteristics of the six cities.

Table 2. Network structure indicators for the six core analytical cities

Core analytical city	Number of poets	Number of valid records	Number of nodes	Number of clusters
Nanjing city	117	394	188	4
Suzhou city	129	387	277	4
Yangzhou city	107	258	182	4
Zhenjiang city	78	167	129	4
Changzhou city	34	68	31	2
Wuxi city	17	45	30	2

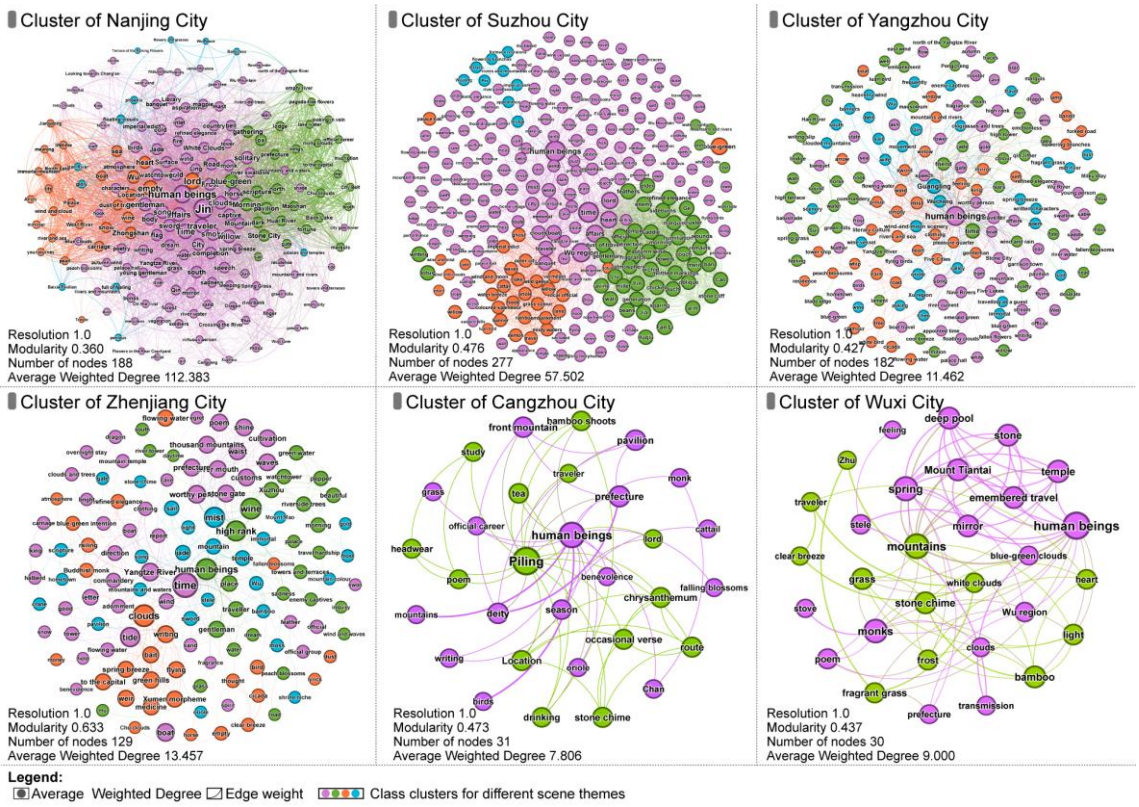


Fig. 6 | Semantic co-occurrence networks of the six core analytical cities.

The poetic landscape image of Nanjing

Nanjing's semantic network comprises four clusters (Table 3), of which C1 is the largest, containing 119 nodes. Within C1, behavioural terms are mainly associated with poetic composition, travel and social exchange, while emotional terms reflect recollection, sadness and loneliness. Specifically, terms such as mist, water, river, Yangtze River and river surface highlight riverside spaces and waterscapes. Traveller and road indicate movement and travel, while song and writing are associated with poetic composition and literary exchange. These terms form recurring combinations of imagery involving mist-covered waters, travel and poetic exchange. As a transport hub and a centre of literati interaction, Nanjing was frequently represented through travel, farewell and poetic activities, accompanied by feelings of nostalgia and solitude associated with journeys and prolonged stays away from home. Du Mu's "Mooring on the Qinhuai" (《泊秦淮》), particularly the lines describing mist over cold waters, moonlight on sandy banks and a boat moored near a riverside tavern, provides a literary example that can be considered alongside the terms mist, water, traveller and song in C1.

Nanjing's secondary clusters further highlight historical place names, waterways and

remnants of the former capital. C3 contains 31 nodes and is primarily associated with Elevated Viewing and Historical Reflection. Terms such as Stone City, city gate, Huai River, pavilion, sail and empty river establish spatial connections between the river and the remains of the ancient city, reflecting poetic memories of the rise and fall of the Six Dynasties capital. C4 comprises 27 nodes and is mainly associated with Riverine Urban Landscapes, with River Travel and Farewell as a secondary scene orientation. Zhongshan Mountain appears alongside terms such as travel dust, wine and boat, linking the riverside landscape with travel experiences and reflections on departure and return. C2 contains 11 nodes and features terms such as phoenix, floating clouds, Han River, Bailuzhou, Baixia Pavilion, Yuhuatai and Wu Palace. These terms connect historical landmarks with the architectural remains of the former capital, expressing poetic recollections of Nanjing's imperial past.

Table 3. Semantic cluster summary for Nanjing

Cluster	Nodes n	Dominant semantic terms	Main element types
C1	119	song; mist; traveller; route; city wall; willow; water	Sky & climate; Rivers & waters; Human roles; Built space; Plants
C2	11	floating clouds; phoenix; tender feeling; Han River; Baixia Pavilion	Allusive memory; Built space; Rivers & waters; Sky & climate
C3	31	Stone City; gate; Qinhuai River; pavilion; sail; empty river	Rivers & waters; Built space; Allusive memory
C4	27	Zhongshan Mountain; Wu region; dust of travel; heart; wine; boat; West River; snow	Mountains & terrain; Rivers & waters; Built space; Allusive memory; Sky & climate

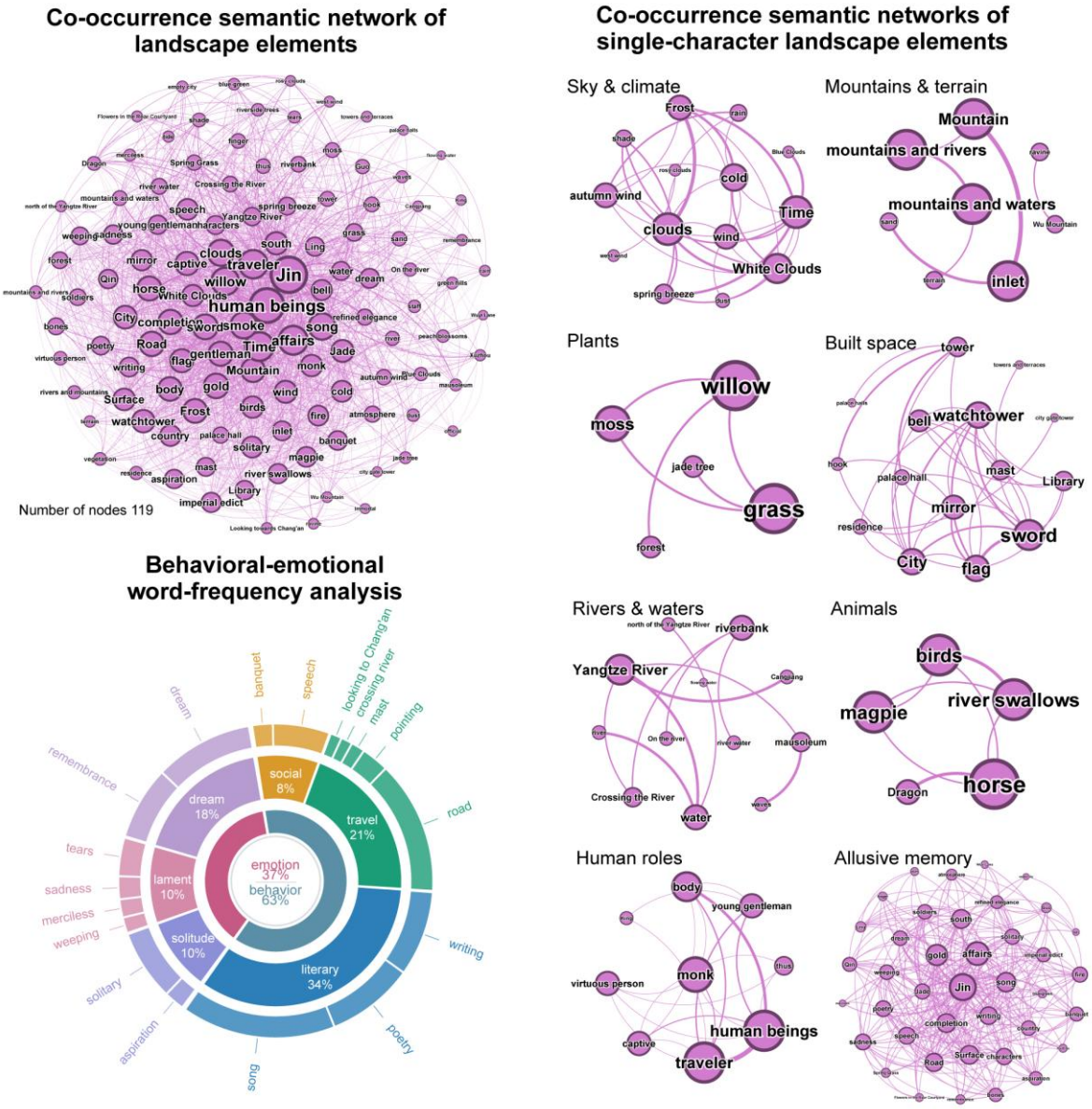


Fig. 7 | Semantic characteristics of the dominant cluster in Nanjing.

The poetic landscape image of Suzhou

Suzhou's semantic network comprises four clusters (Table 4), of which C1 is the largest, containing 185 nodes. Within C1, behavioural terms are mainly associated with drinking, meeting friends, travel and boat journeys, while emotional terms include heart, dream, weeping, frosty tears and loneliness. Terms such as Wu region, wind, clouds, traveller, temple and boat involve several landscape element categories, including Human Roles, Built Space, and Sky and Climate, reflecting descriptions of boat travel, temple visits and interactions among literati. As an important waterway hub in the Jiangnan region with an active religious culture, Suzhou was frequently represented through boat journeys, temple visits and literary exchanges. These

activities were accompanied by emotional expressions associated with staying in Jiangnan and visiting temples. Zhang Ji's "Night Mooring at Maple Bridge" (《枫桥夜泊》), which describes the setting moon, crows, frost, riverside maples, fishing lights, Hanshan Temple and the sound of bells reaching a traveller's boat, provides a literary example that can be considered alongside the terms traveller, temple and boat in C1.

Suzhou's secondary clusters further reveal landscape terms associated with historical sites, urban waterways and previous visits. C2 contains 51 nodes, including terms such as writing, literary refinement, autumn wind, officials, travel dust, Chiyizi, mountains and rivers, lotus and Huqiu. These terms connect historical allusions to the rivalry between Wu and Yue with Huqiu as a site of elevated viewing, reflecting poetic responses to the historical rise and decline of Gusu. C3 comprises 32 nodes, with terms such as lake, outer city, palace, oriole, willow and blue-green linking Plants, Built Space, and Rivers and Waters. These terms describe vegetation, birdsong and seasonal changes around lakes, gardens and palaces, reflecting the association between urban landscapes and seasonal variation in poetic descriptions. C4 contains 9 nodes, including garden, former visits, bridge, Wujiang, flowering branches, and mountains and rivers. These terms are associated with built environments, waterways and memories of previous visits. References to flowering branches near bridges in Wujiang and recollections of earlier visits evoke poets' memories of Suzhou's gardens and historical sites.

Table 4. Semantic cluster summary for Suzhou

Cluster	Nodes (n)	Dominant semantic terms	Main element types
C1	185	Wu region; wind; clouds; traveller; boat; temple	Allusive memory; Sky & climate; Human roles; Built space; Rivers & waters
C2	51	writing; elegant urban culture; autumn wind; dust of travel; Chiyizi; mountains and rivers	Allusive memory; Mountains & terrain; Sky & climate; Plants; Human roles
C3	32	lake; outer city; palace hall; oriole; willow; blue-green	Rivers & waters; Built space; Plants; Animals
C4	9	imperial park; former visits; bridge; Wujiang River; flowering branches; rivers and mountains	Built space; Rivers & waters; Plants; Mountains & terrain

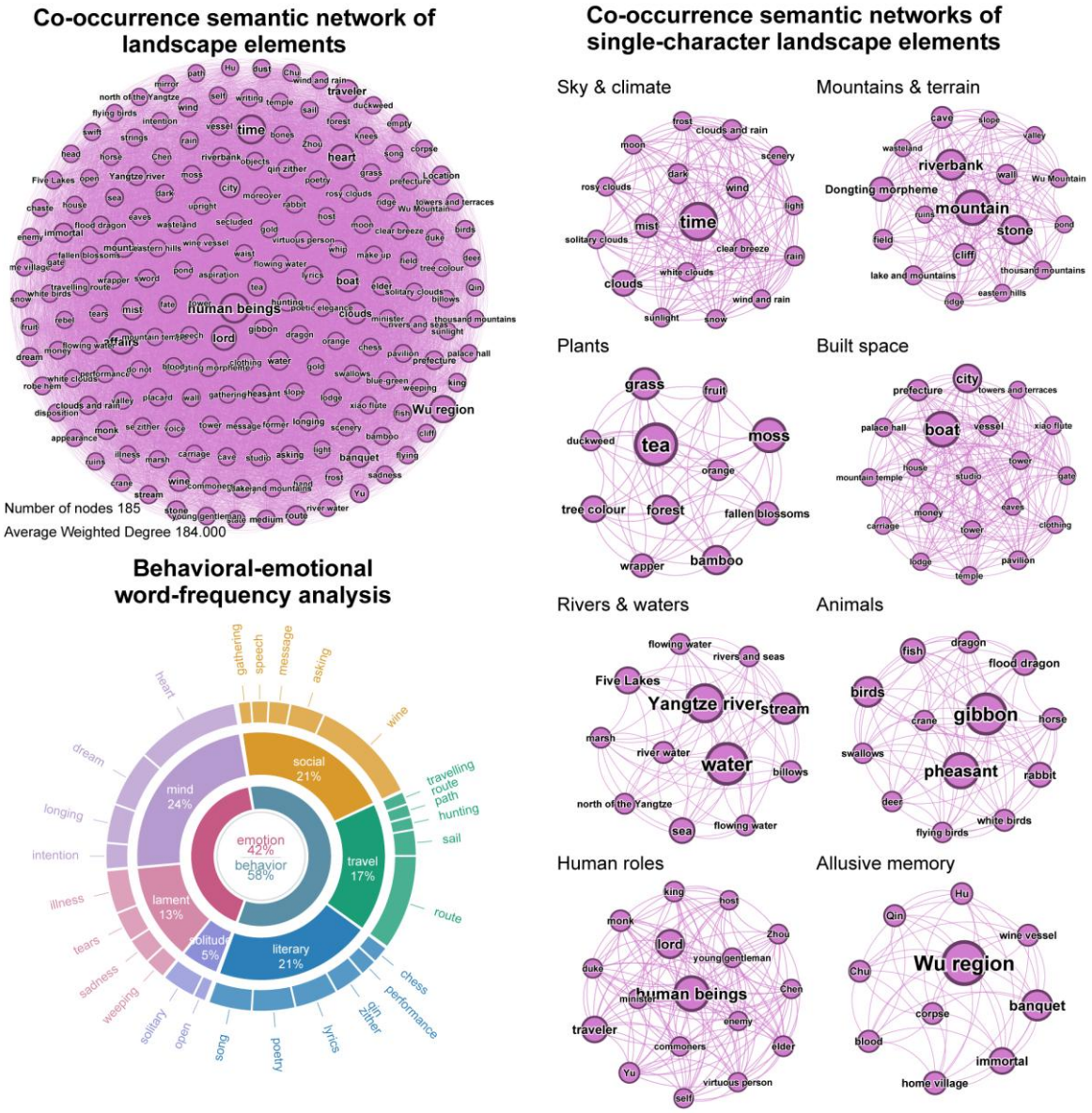


Fig. 8 | Semantic characteristics of the dominant cluster in Suzhou.

The poetic landscape image of Yangzhou

Yangzhou has four clusters (Table 5). C1 is the largest cluster, with 60 nodes. Action words mainly concern singing, writing, boat travel, banqueting and travel. Further analysis shows that elements such as traveller, song, tower, mountain, gate and boat link human roles, built space and rivers and waters. As a major north-south water and land transport hub and a place of literati exchange and farewell, Yangzhou's poetic writing is structured by tower viewing and boat farewell. Terms such as frost, autumn, plants, high rank and floating clouds add seasonal change to the scene of tower viewing and farewell.

Yangzhou's secondary clusters focus on historical place names, river water and urban night

scenes. C2 contains 52 nodes. Terms such as water, dream, willow, refined urban culture, feeling and river show that when poets revisited Yangzhou's former prosperous sites, they often used water, willow and dream images to express memory of earlier urban splendour. C4 contains 36 nodes. It falls on scenes of misty rain in Yangzhou's water lanes and urban social exchange. Images such as mist, fog, wind, boat, mirror, rain and road show movement through rainy water lanes and streets. They present Yangzhou's dense water network and frequent misty rain as a setting for boat farewell and urban exchange. C3 contains 34 nodes. Images such as Guangling, spring breeze, Wucheng, clouds, Qin and wine mainly come from allusive memory, sky-climate and mountains and terrain. More specifically, Guangling and Wucheng appear together as historical place names, linking Yangzhou's old names with memories of urban rise and decline and carrying poets' reflection on the changes of old Guangling.

Table 5. Semantic cluster summary for Yangzhou

Cluster	Nodes (n)	Dominant semantic terms	Main element types
C1	60	traveller; song; tower; mountain; gate; boat	Human roles; Built space; Rivers & waters; Mountains & terrain
C2	52	water; dream; willow; elegant urban culture; feeling; Yangtze River	Rivers & waters; Plants; Built space; Allusive memory; Human roles
C3	34	Guangling; spring breeze; Wucheng; clouds; Qin; wine	Allusive memory; Sky & climate; Mountains & terrain
C4	36	mist; wind; boat; mirror; rain; route	Sky & climate; Built space; Rivers & waters; Human roles

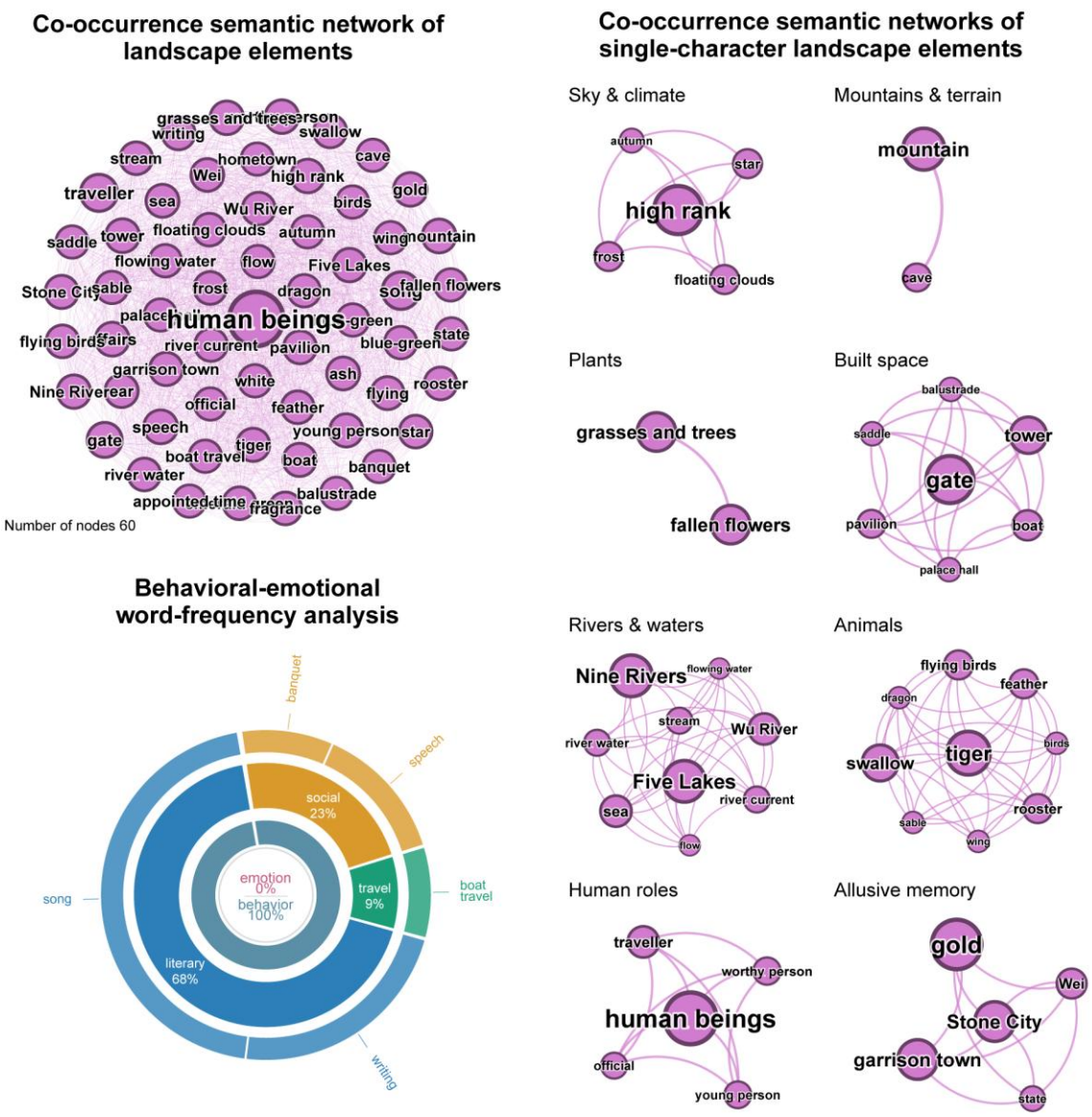


Fig. 9 | Semantic characteristics of the dominant cluster in Yangzhou.

The poetic landscape image of Zhenjiang

Zhenjiang's semantic network comprises four clusters (Table 6), of which C1 is the largest, containing 47 nodes. The behavioural terms in C1 mainly include those related to letters, poetry, communication, lodging, farming and transportation. Further examination reveals that terms such as river, wind, tide, boat, letter and writing are closely associated with waterborne travel and communication. Located at the junction of the Yangtze River and the Grand Canal, Zhenjiang was an important hub for waterborne and overland transportation between northern and southern China. Accordingly, boat travel and correspondence frequently appear in poetic descriptions of the region. Wang Wan's "Below Beigu Mountain" (《次北固山下》), which

describes rising tides, broad riverbanks, a sail suspended in a favourable wind and a letter sent towards Luoyang, provides a literary example corresponding to the terms tide, wind, sail and letter in C1. In addition, terms such as wind, snow, fragrance and cloud-covered trees contribute seasonal and climatic details to descriptions of travel along the river.

C4 contains 29 nodes, with terms such as wine, traveller, water, high rank, towers and terraces, and dream. Here, high rank refers to aspirations for official advancement, reflecting poets' feelings about living away from home and changes in their official careers while viewing the river. C3 comprises 27 nodes, including clouds, green hills, birds, writing, cicadas and spring breeze. These terms reflect seasonal and natural imagery, through which poets expressed personal emotions and reflections on history. C2 contains 26 nodes and is primarily associated with temple and mountain landscapes around Jinshan and Maoshan. Built Space, Allusive Memory, and Mountains and Terrain are the most prominent landscape element categories in this cluster. Terms such as mist, temple, mountain, jade, sail and pavilion reflect landscape features described in poems about visits to temples in the Jinshan and Maoshan areas.

Table 6. Semantic cluster summary for Zhenjiang

Cluster	Nodes (n)	Dominant semantic terms	Main element types
C1	47	Yangtze River; wind; tide; vessel; letter	Rivers & waters; Built space; Sky & climate
C2	26	mist; temple; mountain; jade; sail; pavilion	Built space; Mountains & terrain; Sky & climate; Allusive memory
C3	27	clouds; green hills; bird; writing; cicada; spring breeze	Sky & climate; Animals; Mountains & terrain; Allusive memory
C4	29	wine; traveller; water; high rank; towers and terraces; dream	Human roles; Built space; Rivers & waters; Sky & climate

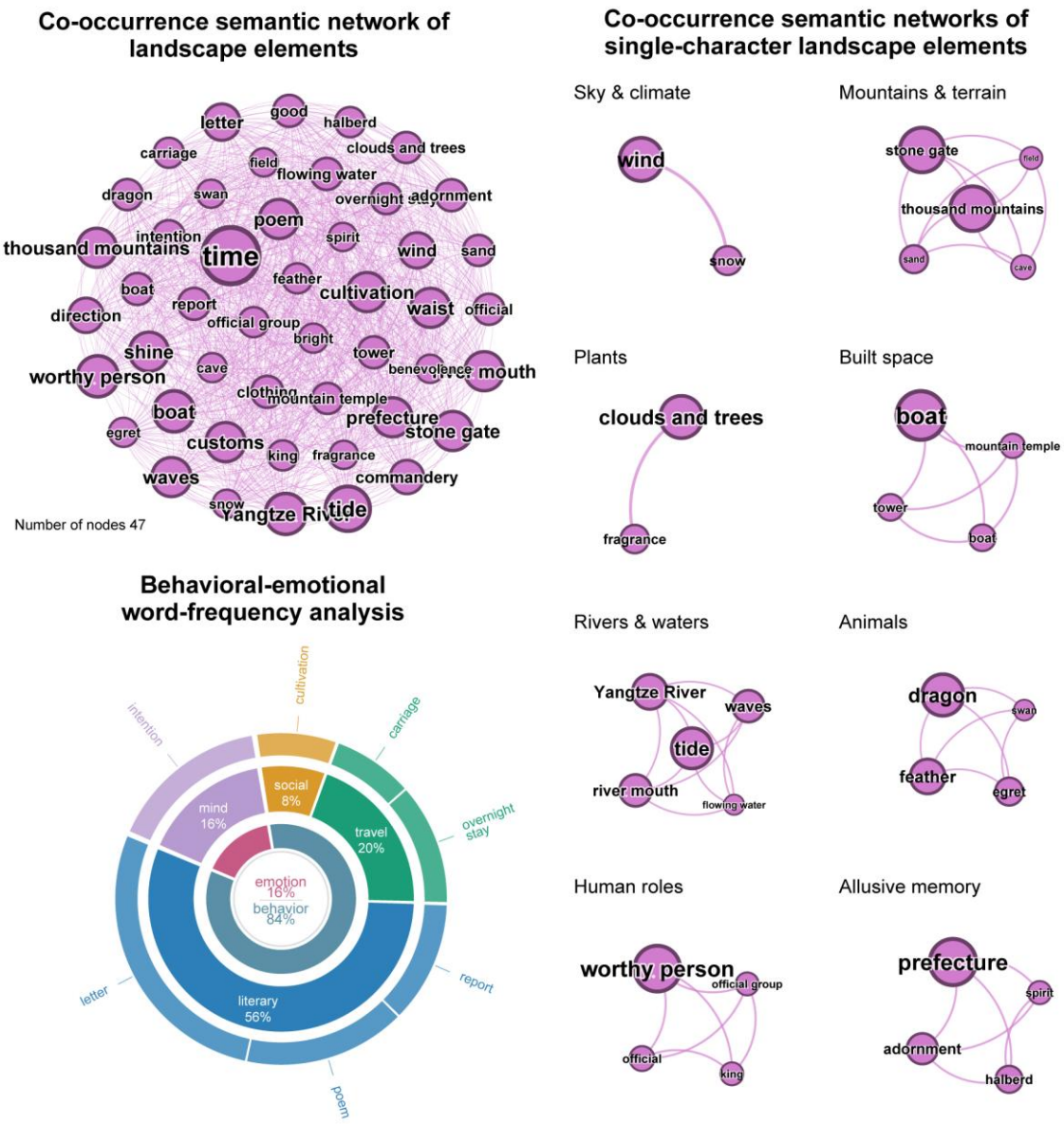


Fig. 10 | Semantic characteristics of the dominant cluster in Zhenjiang.

The poetic landscape image of Changzhou

Changzhou's semantic network comprises two clusters (Table 7), with C1 containing 17 nodes. The behavioural terms in C1 are mainly associated with writing. Terms such as prefecture, pavilion, mountain and front mountain describe built environments and mountainous landscapes, while deity, Chan and benevolence introduce religious and ethical allusions. Natural elements are represented by birds, orioles, falling flowers, grass and cattail, alongside references to monks and officials. Together, these terms reflect the presence of mountainous landscapes, architectural spaces, religious references and human activities in Changzhou's poetic descriptions.

C2 contains 14 nodes, with core terms including lord, tea, poetry, stone chime, bamboo shoots and traveller. Associated behavioural terms include poetry, drinking, play, learning and travel. Bai Juyi's "Hearing at Night of the Banquet at the Tea Mountain Border Pavilion of Jia of Changzhou and Cui of Huzhou" (《夜闻贾常州、崔湖州茶山境会亭欢宴》) describes a nighttime banquet at Tea Mountain, accompanied by music and references to the boundary between the two prefectures. This poem can be considered alongside the terms Piling, tea and lord in C2. As an important tea-producing area during the Tang dynasty, Changzhou was associated with tea drinking, tea gifting and poetic exchanges among literati, which are reflected in the semantic characteristics of this cluster.

Table 7. Semantic cluster summary for Changzhou

Cluster	Nodes (n)	Dominant semantic terms	Main element types
C1	17	prefecture; deity; bird; mountain; pavilion; writing; monk	Built space; Human roles; Allusive memory; Mountains & terrain; Animals
C2	14	Piling; tea; poetry; stone chime; bamboo shoots; route	Allusive memory; Plants; Built space; Human roles

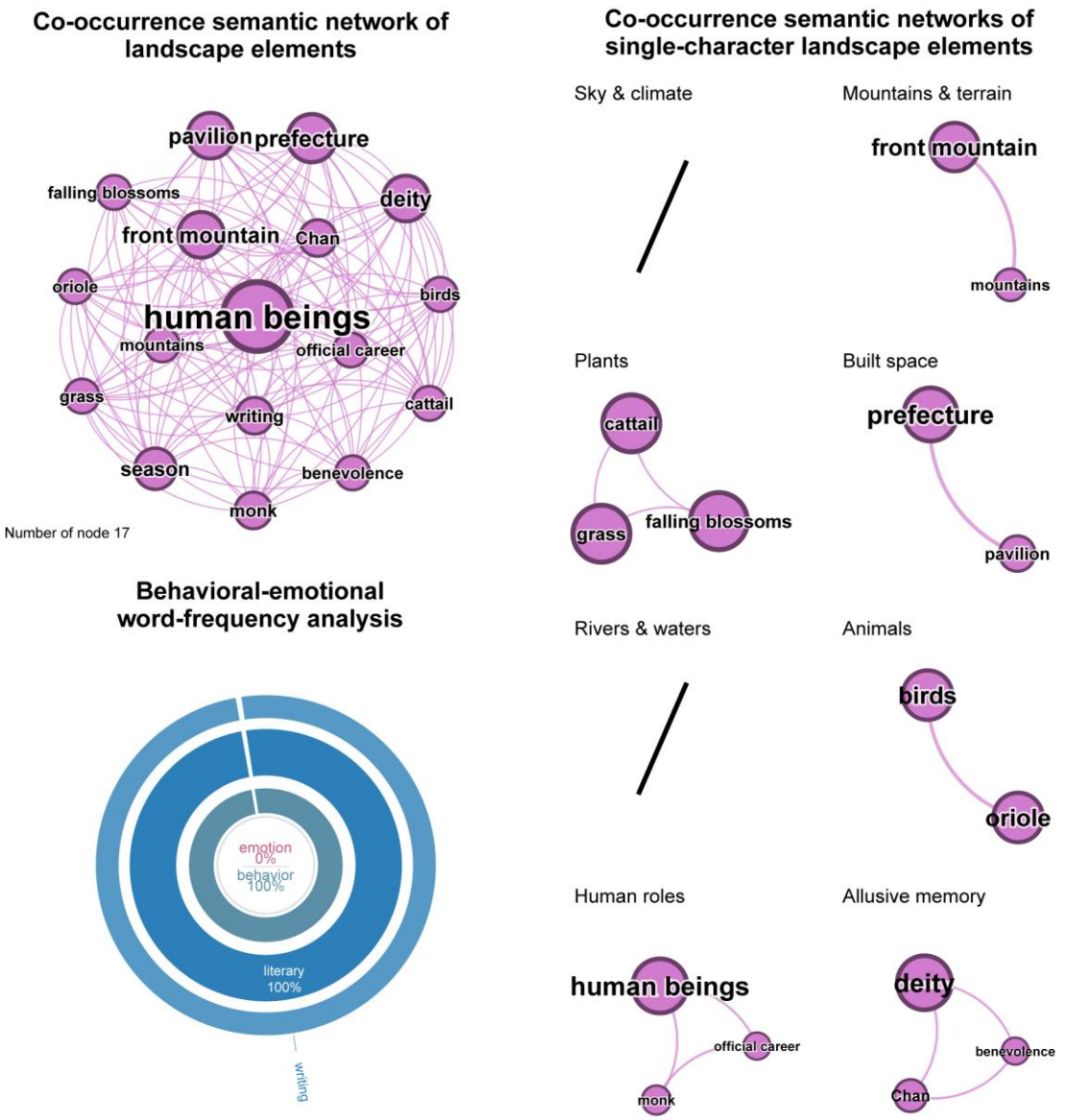


Fig. 11 | Semantic characteristics of the dominant cluster in Changzhou.

The poetic landscape image of Wuxi

Wuxi's semantic network comprises two clusters (Table 8), with C1 containing 18 nodes. The behavioural terms in C1 mainly relate to poetic inscription, textual transmission and previous visits, while terms such as yi (意) reflect emotional responses associated with excursions and poetic composition. Terms such as temple, spring, monk, stele, stone and pool are associated with mountain temples, springs and religious activities. Clouds, blue clouds and Tiantai introduce atmospheric imagery and historical or religious allusions, while poetry, transmission and former visits relate to poetic inscription, the circulation of texts and memories of previous visits. "Miscellaneous Song on the Flowing Spring of Huishan Temple in Wuxi"

(《杂言无锡惠山寺流泉歌》) describes a spring within a mountain temple setting and the continuous sound of flowing water, likened to resonant metal and jade. These descriptions highlight the relationship between the temple, spring, mountain and auditory experience. Visits to Huishan Temple, observations of springs and rocks, encounters with monks, and poetic inscriptions further reflect the connections between religious excursions and textual memory.

C2 contains 12 nodes. Terms such as white clouds, clear breeze, frost and mountain describe the natural landscape of the mountainous area, while fragrant grass, bamboo and grass represent plant elements. Traveller, heart and stone chime are associated with travel experiences, emotional expressions and sounds from temple settings. The co-occurrence of white clouds, clear breeze, fragrant grass, bamboo, stone chime and traveller-related expressions indicates that this cluster is mainly associated with landscapes surrounding mountain temples and the emotional experiences of travellers.

Table 8. Semantic cluster summary for Wuxi

Cluster	Nodes (n)	Dominant semantic terms	Main element types
C1	18	monk; spring; temple; clouds; stele; stone	Human roles; Allusive memory
C2	12	white clouds; mountain; fragrant grass; frost; traveller; bamboo	Sky & climate; Plants; Human roles

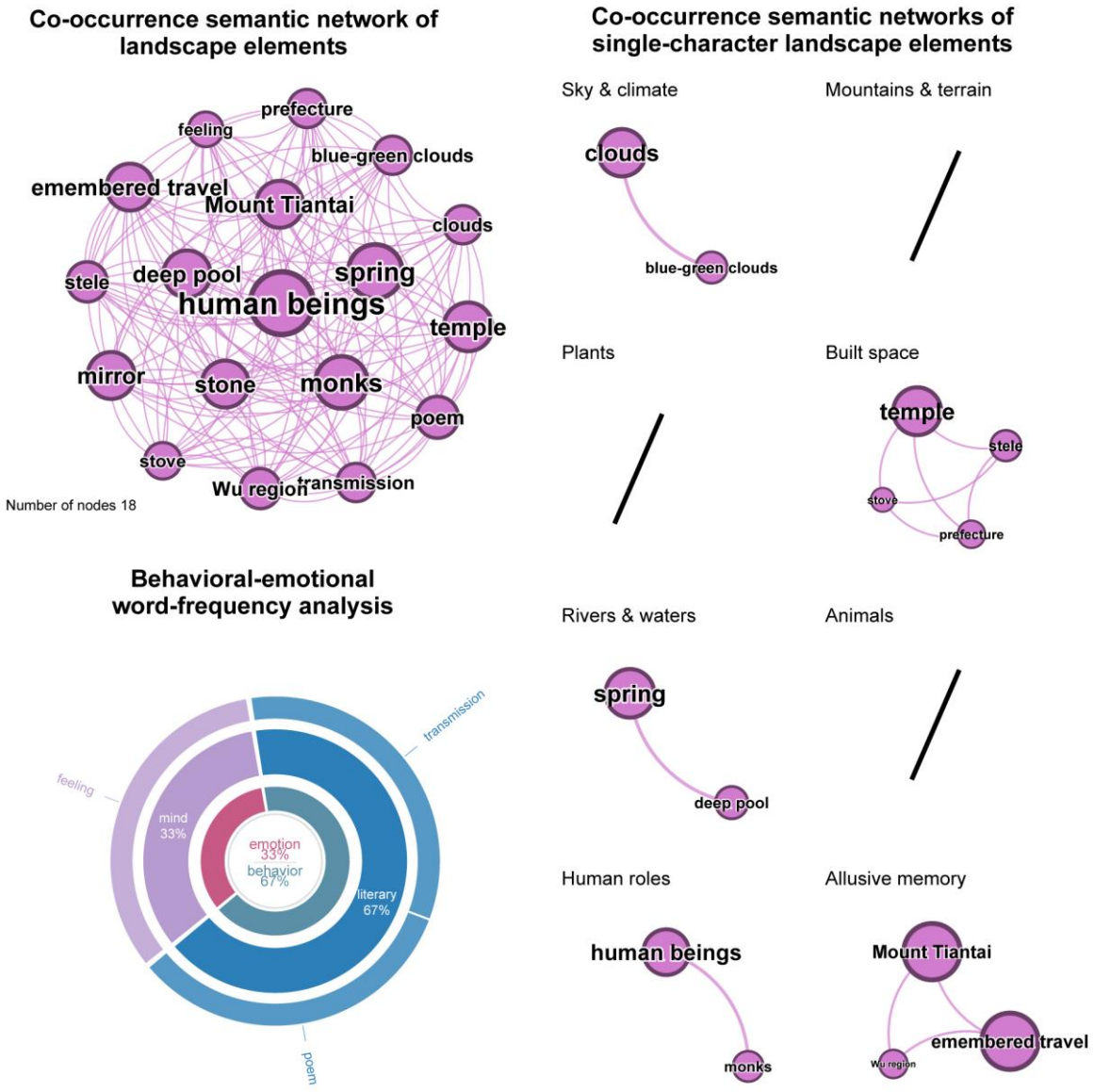


Fig. 12 | Semantic characteristics of the dominant cluster in Wuxi.

Temporal change and urban differentiation of the five integrated scenes

Comparison of city clusters and summary of five scene types

The city-level semantic clusters were examined in relation to the five integrated scene types. These cluster-level associations were used to interpret, rather than determine, the primary scene assigned to each poetry record. The supporting clusters and representative semantic evidence for each scene type are presented in Table 9. Overall, Elevated Viewing and Historical Reflection is mainly associated with historical place names of former capitals and historical sites. River Travel and Farewell is characterised by boats, ferry crossings and travel-related

terms. Riverine Urban Landscapes is associated with cities, water bodies, bridges, gardens and plant imagery. Urban Life and Commercial Exchange is linked to urban buildings, singing, wine, tea-related activities and everyday urban life. Religious Visits and Excursions is associated with temples, monks, springs, mountains, and the sounds of bells and stone chimes.

Table 9. Correspondence between the five integrated scene types and city semantic clusters

Integrated scene type	Supporting clusters	Semantic evidence and cues
Elevated Viewing and Historical Reflection	Nanjing C2, C3; Suzhou C2, C4; Yangzhou C1, C3; Zhenjiang C3, C4; Wuxi C1 (a)	Former-capital sites and historical references, including Phoenix Terrace, Stone City, Guangling, Wucheng, Jingkou and Huqiu; elevated viewing, poetic inscriptions and nostalgia.
River Travel and Farewell	Nanjing C1, C4; Suzhou C1 (a); Yangzhou C1, C4; Zhenjiang C1; Changzhou C2 (a); Wuxi C2 (a)	Rivers, boats, ferries, sails, tides and travellers; waterborne movement, correspondence, lodging and farewell.
Riverine Urban Landscapes	Nanjing C2 (a), C3 (a), C4; Suzhou C1, C3, C4; Yangzhou C1 (a), C4 (a); Zhenjiang C1 (a), C2 (a), C3 (a); Wuxi C2	Rivers, lakes, bridges, gardens, mountains, clouds and vegetation; viewing, roaming and spatial relationships between waterways and urban environments.
Urban Life and Commercial Exchange	Nanjing C1; Suzhou C2 (a), C3 (a); Yangzhou C2, C4 (a); Zhenjiang C4 (a); Changzhou C2	Towers, streets, marketplaces, tea, poetry and wine; banqueting, literary exchange, poetic gifting and urban sociability.
Religious Visits and Excursions	Suzhou C1 (a); Zhenjiang C2; Changzhou C1 (a); Wuxi C1	Temples, monks, springs, mountains, bells, steles and Chan-related terms; religious excursions, meditation and poetic inscriptions.

Note. Unmarked entries indicate stronger cluster-level associations, whereas (a) denotes an additional association. Because a semantic cluster may contain poetry records assigned to different primary scenes, cluster–scene correspondence is not one-to-one. Primary scene types were assigned to individual poetry records.

Period changes in the five integrated scene types

Figure 13a illustrates the differences in the distribution of the five integrated scene types across the four Tang periods. The Early Tang contains 38 scene records, including 19 Riverine Urban Landscapes records, 8 River Travel and Farewell records, 7 Elevated Viewing and Historical Reflection records, and 4 Urban Life and Commercial Exchange records. During this period, poetic landscapes were mainly associated with rivers, mountains, city walls and views encountered during travel. River systems and urban place names had already become part of the region's poetic landscape descriptions.

The High Tang contains 218 scene records, including 86 River Travel and Farewell records,

53 Elevated Viewing and Historical Reflection records, 53 Riverine Urban Landscapes records, 17 Urban Life and Commercial Exchange records, and 9 Religious Visits and Excursions records. During this period, river-based travel, urban landscapes and historical reflection were all prominently represented. Poetic landscape descriptions in the Jiangsu section of the Yangtze River increasingly connected river systems, human movement, urban locations and historical place names.

The Middle Tang has the largest number of scene records, with 574 in total, including 181 River Travel and Farewell records, 166 Riverine Urban Landscapes records, 103 Elevated Viewing and Historical Reflection records, 73 Urban Life and Commercial Exchange records, and 51 Religious Visits and Excursions records. All five scene types are well represented during this period, reflecting the prominence of river-based travel, urban landscapes, historical memory, everyday social interactions and visits to religious sites in the poetic landscape descriptions.

The Late Tang also has a substantial number of scene records, with 471 in total, including 139 Riverine Urban Landscapes records, 136 Elevated Viewing and Historical Reflection records, 98 River Travel and Farewell records, 54 Religious Visits and Excursions records, and 44 Urban Life and Commercial Exchange records. Compared with the Middle Tang, Elevated Viewing and Historical Reflection becomes more closely comparable to Riverine Urban Landscapes in terms of record counts. References to former-capital ruins, historical place names, towers, city walls and reflections on the past become increasingly prominent in the poetic landscape descriptions of this period.

These temporal differences are further reflected in the landscape nodes and behavioural terms identified in the poetic records. In the Middle Tang, place names and landscape references such as Stone City, Changmen, Gao Bridge, Huqiu, Piling tea and Huishan spring temple occur frequently alongside terms associated with boats, bridges, towers, tea-related activities, poetic inscriptions and memories of previous visits. These associations correspond to the concurrent prominence of Riverine Urban Landscapes, River Travel and Farewell, Elevated Viewing and Historical Reflection, and Urban Life and Commercial Exchange. In the Late Tang, references to Qinhuai, Jiankang, Stone City, Wujiang, Jingkou and Huishan appear alongside night mooring, cold water, temple bells, travel and memories of former capitals.

These associations reflect the historical and retrospective themes represented in Elevated Viewing and Historical Reflection and Riverine Urban Landscapes.

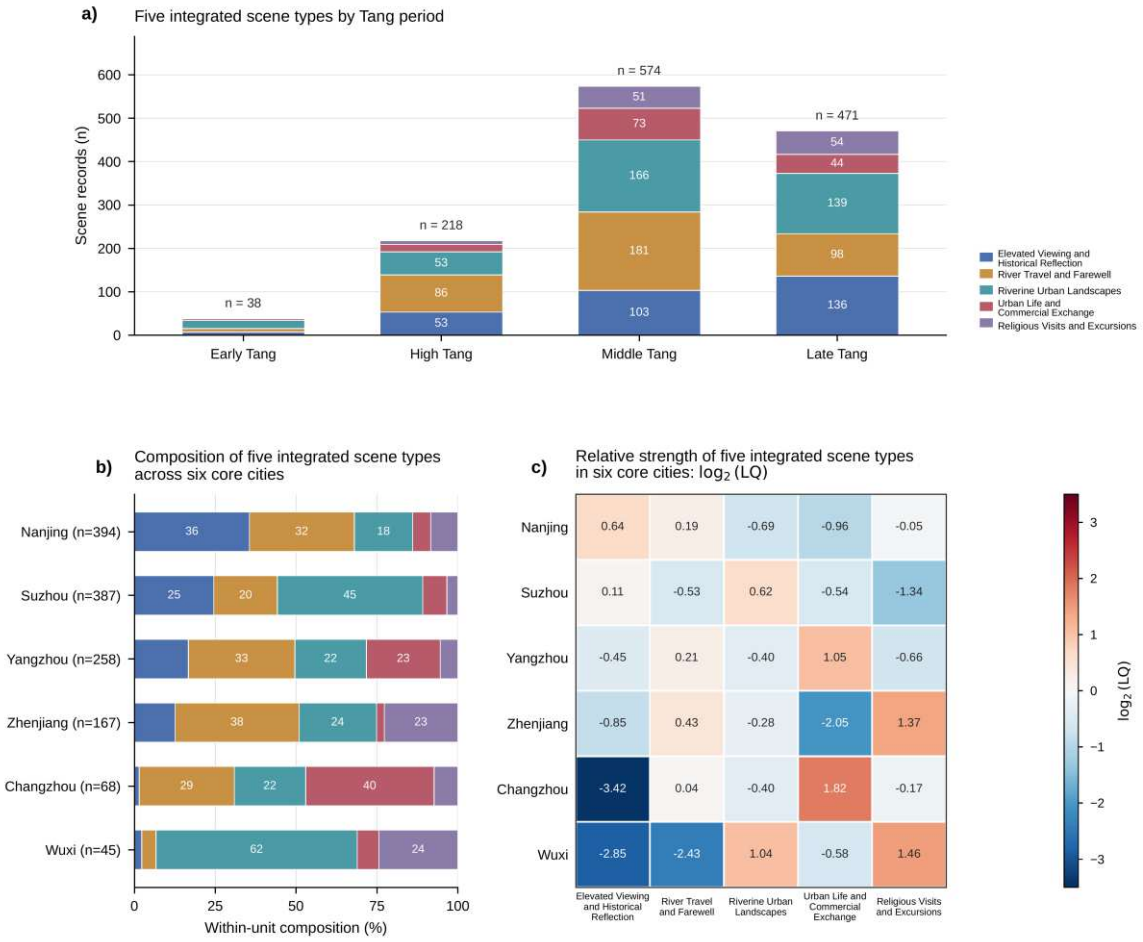


Fig. 13 | Temporal change and urban differentiation of the five integrated scene types.

Urban differentiation of the five integrated scene types

Figure 13b shows the proportions of the five integrated scene types across the six core analytical cities. In Nanjing, Elevated Viewing and Historical Reflection and River Travel and Farewell account for 35.53% and 32.49%, respectively. Suzhou is predominantly characterised by Riverine Urban Landscapes (44.96%). In Yangzhou, River Travel and Farewell accounts for 32.95%, followed by Urban Life and Commercial Exchange (22.87%). Zhenjiang is mainly represented by River Travel and Farewell (38.32%) and Religious Visits and Excursions (22.75%). Urban Life and Commercial Exchange accounts for 39.71% in Changzhou, while Riverine Urban Landscapes (62.22%) and Religious Visits and Excursions (24.44%) are prominent in Wuxi. These distributions broadly correspond to the dominant terms and spatial imagery identified in the city-level semantic clusters. Nanjing is associated with former-capital

memory and night mooring on the Qinhuai River; Suzhou with the water-city landscapes of the Wu region; Yangzhou with waterway travel and urban activities; Zhenjiang with ferry crossings and mountain temples; Changzhou with tea-related poetic exchanges; and Wuxi with the springs and temples of Huishan.

Figure 13c presents the relative intensity of the five integrated scene types across the six core analytical cities using $\log_2$(LQ). Positive values are observed for Elevated Viewing and Historical Reflection in Nanjing, Riverine Urban Landscapes in Suzhou, and Urban Life and Commercial Exchange in Yangzhou and Changzhou. In Zhenjiang, positive relative intensity is mainly associated with Religious Visits and Excursions and River Travel and Farewell, while Wuxi shows positive values for Riverine Urban Landscapes and Religious Visits and Excursions. These results provide a comparative perspective on the scene characteristics identified through city-level semantic clustering, revealing distinct scene orientations among the six cities within the poetic landscape of the Jiangsu section of the Yangtze River.

Urban differentiation is also reflected in the combinations of representative landscape nodes. In Nanjing, Qinhuai, Stone City and Zhongshan Mountain are associated with former-capital memory and poetic descriptions of waterfront landscapes. In Suzhou, Changmen, Wujiang, bridges, gardens and Huqiu are linked to excursions through the water-city landscape. In Yangzhou, Guangling, long streets, marketplaces, towers and pavilions, and boat travel are associated with urban social interactions. In Zhenjiang, Jingkou, Beigu Mountain, Jinshan Mountain and river tides connect ferry crossings with mountain temples. Changzhou and Wuxi exhibit more concentrated local themes associated with tea culture in Piling and the springs and temples of Huishan, respectively.

Historical geographical links of the five integrated scene types

Scene 1: Elevated Viewing and Historical Reflection in Nanjing

Nanjing's prominence in Elevated Viewing and Historical Reflection may be related to the contrast between its status as a capital during the Six Dynasties and its subsequent status as an ordinary county during the Tang dynasty. Following the fall of the Six Dynasties, the palaces of the former capital were razed to the ground. Li Bai and other poets turned to the ruins of Jinling

as subjects of historical reflection. Li Bai wrote, “吴宫花草埋幽径，晋代衣冠成古丘”, describing the overgrown paths of the former Wu palaces and the ancient burial mounds associated with the Jin dynasty. During the Middle Tang, Liu Yuxi’s “Reflections on the Past at Jinling” (《金陵怀古》) and “Five Poems on Jinling” (《金陵五题》) associated historical sites such as Stone City, Zhuque Bridge and Wuyi Lane with images of wild grass, sunset and tides striking an empty city. His observation, “兴废由人事，山川空地形”, further expressed the relationship between human affairs and the rise and fall of dynasties, suggesting that geographical advantages alone could not determine their fate. These poetic descriptions can be compared with recurring terms such as Stone City, empty river, pavilion and sail in Nanjing’s semantic clusters. In Late Tang poetry, Jinling was associated with concerns about the decline of the age, providing a historical context for understanding the concentration of Elevated Viewing and Historical Reflection in Nanjing during this period. Suzhou shows a weak positive relative intensity for this scene ($\log_2(LQ) = 0.11$), while Yangzhou exhibits a negative value ($\log_2(LQ) = -0.45$). In comparison, Nanjing has a more pronounced positive value ($\log_2(LQ) = 0.64$), making it the most representative city for Elevated Viewing and Historical Reflection.

Scene 2: Riverine Urban Landscapes — Suzhou’s Water-City Structure

Suzhou’s sustained prominence in Riverine Urban Landscapes may be related to its rising economic status after the Middle Tang. During his tenure as prefect of Suzhou, Bai Juyi described the city in an official memorial as the largest among the prefectures of Jiangnan, with substantial military forces and the highest tax revenue. Its prosperity was also reflected in the description “人稠过杨府，坊闹半长安”, suggesting a population exceeding that of Yangzhou and urban districts as bustling as those of Chang’an. These descriptions can be considered alongside Suzhou’s urban structure, characterised by parallel waterways and roads. Liu Yuxi’s line “二八城门开道路” refers to the city’s eight pairs of water and land gates. During his tenure, Bai Juyi also supervised the dredging of waterways and the construction of a road connecting Changmen and Huqiu, providing historical context for the recurring appearance of these locations in Suzhou’s semantic clusters. Bai Juyi’s lines

“水国多台榭，吴风尚管弦，每家皆有酒，无处不过船” describe a water-based urban environment characterised by pavilions, music, wine and boat travel, while Du Xunhe’s “人家尽枕河，水港小桥多” highlights riverside residences, waterways and small bridges. These poetic descriptions indicate the prominence of waterways, bridges and boats in representations of Suzhou during the Middle and Late Tang periods. Although Wuxi has a higher $\log_2$(LQ) value for this scene (1.04), its sample size is relatively small. Suzhou has a $\log_2$(LQ) value of 0.62, with the proportion of Riverine Urban Landscapes remaining between 38.3% and 44.9% from the High Tang to the Late Tang. The proportion reaches 68.8% in the Early Tang, although this is based on a smaller sample. Given its larger number of records and more substantial support from city-level semantic clusters, Suzhou is a more suitable representative city for interpreting Riverine Urban Landscapes.

Scene 3: Urban Life and Commercial Exchange — Waterway Transport and Local Products

Changzhou exhibits the highest relative intensity for Urban Life and Commercial Exchange ($\log_2$(LQ) = 1.82), followed by Yangzhou ($\log_2$(LQ) = 1.05). While Changzhou’s association with this scene is mainly related to local products, Yangzhou is more closely associated with regional commerce and transportation. Terms such as towers and pavilions, singing, wine, long streets, marketplaces and boat travel reflect the connections between waterway transport and urban social interactions. Zhang Hu’s lines “十里长街市井连，月明桥上看神仙” describe streets lined with marketplaces and urban activities under moonlight, while Wang Jian’s “夜市千灯照碧云，高楼红袖客纷纷” portrays a bustling night market illuminated by numerous lamps. These poetic descriptions highlight the prominence of nighttime urban activities and commercial entertainment in representations of Tang-dynasty Yangzhou. In Changzhou, historically known as Piling, the commercial associations are more closely related to local products. Bai Juyi’s “Hearing at Night of the Banquet of Prefects Jia of Changzhou and Cui of Huzhou at the Tea Mountain Border Pavilion”
(《夜闻贾常州、崔湖州茶山境会亭欢宴》) refers to the prefect of Changzhou and a gathering at Tea Mountain. Although Changzhou shows a higher relative intensity for this scene than Yangzhou, its number of records is considerably smaller, with 3 records in

Changzhou and 18 in Yangzhou during the Late Tang. This indicates that Urban Life and Commercial Exchange accounts for a more concentrated share of Changzhou's poetic corpus, despite its smaller number of records.

Scene 4: Religious Visits and Excursions — Zhenjiang and Wuxi

Both Zhenjiang and Wuxi exhibit relatively high intensities of Religious Visits and Excursions ($\log_2(LQ) = 1.37$ and 1.46, respectively), although their landscape imagery differs. During the Tang dynasty, Jinshan Temple in Zhenjiang was situated in the middle of the Yangtze River. The lines "树影中流见，钟声两岸闻" describe tree shadows visible from the river and temple bells audible from both banks, reflecting the temple's riverside setting and its buildings arranged along the mountain slopes. In contrast, Huishan Temple in Wuxi was located at the foot of an inland mountain. Poems by Middle Tang poets such as Huangfu Ran, Ruobing and Li Shen frequently referred to spring water appreciation and quiet contemplation. Zhenjiang's religious landscape was therefore closely associated with mountain temples along the Yangtze waterway, while Wuxi's poetic descriptions placed greater emphasis on spring-temple environments and contemplation within mountainous forests. In the study sample, 47.4% of Zhenjiang's Religious Visits and Excursions records (n = 38) contain terms associated with rivers, boats or tides, while only 7.9% contain terms such as springs, bamboo or fragrant grass. By comparison, 9.1% of Wuxi's Religious Visits and Excursions records (n = 11) contain river-, boat- or tide-related terms, whereas 54.5% contain references to springs, bamboo or fragrant grass.

Scene 5: River Travel and Farewell within the Yangtze–Grand Canal waterway network

River Travel and Farewell is not dominated by a single city. During the Late Tang, Nanjing (34.7%), Suzhou (22.4%), Yangzhou (21.4%) and Zhenjiang (18.4%) show a relatively balanced distribution of this scene type. This spatial pattern corresponds to the waterway network formed by the convergence of the Yangtze River and the Grand Canal in Jiangsu. Nanjing and Zhenjiang were situated along the Yangtze River, Yangzhou was located near the connection between the Grand Canal and the river, and Suzhou, Changzhou and Wuxi were linked along the Jiangnan Canal. Together, these six cities formed interconnected nodes within the Yangtze–Grand Canal waterway system. Wang Wan's "Below Beigu Mountain"

(《次北固山下》) includes the lines “潮平两岸阔，风正一帆悬”, depicting a river journey near Beigu Mountain in Zhenjiang, with broad riverbanks and a sail raised in a favourable wind. Li Bai’s “Three Poems in Farewell to Yin Shu, No. 2” (《送殷淑三首·其二》) includes the lines “白鹭洲前月，天明送客回”, describing a farewell near Bailuzhou in Jinling at daybreak. Although the two poems differ in location and subject, they illustrate river travel and farewell as related themes within the poetic landscapes of the region. The distribution of this scene type reveals its cross-city characteristics and its spatial correspondence with the historical Yangtze–Grand Canal waterway network.

Credibility assessment of the five integrated scene classification

To assess the reliability of the five integrated scene classification, 100 poems were selected from the final scene dataset using stratified sampling, with 20 poems drawn from each scene type. Three experts with backgrounds in literary geography, Tang poetry studies and cultural landscape research were invited to independently classify the poems. To minimise the influence of place-name cues, the experts assigned a primary scene category based on poem texts from which lines containing place names had been removed. Agreement among the three experts was high, with Fleiss’ $\kappa = 0.853$. Pairwise agreement was also assessed using Cohen’s κ, yielding values of 0.987 between Experts 1 and 2, 0.780 between Experts 1 and 3, and 0.793 between Experts 2 and 3. Of the 100 sampled poems, 83 received identical classifications from all three experts, while a majority judgement was reached for every sample. The final scene classification showed an observed agreement of 91.0% with the expert majority judgements, with Cohen’s $\kappa = 0.884$. These results indicate a high level of agreement between the five integrated scene classification and independent expert assessments. The validation design and results are summarised in Table 10.

Table 10. Expert validation of the five integrated scene categories

Validation item	Result	Interpretation
Validation sample	100 poems; 20 poems per integrated scene type	Stratified validation sample covering the five categories
Expert agreement	Fleiss’ $\kappa = 0.853$	High consistency among the three expert judgements

Validation item	Result	Interpretation
Pairwise agreement	κ = 0.987 / 0.780 / 0.793	Cohen's κ for Expert 1 and 2, Expert 1 and 3, and Expert 2 and 3
Complete agreement	83 / 100 records	All three experts selected the same category
Final classification vs. expert majority	Observed agreement = 91.0%; Cohen's κ = 0.884	High agreement between the final scene table and expert majority judgement
Revision principle	Majority judgement and contextual audit	Disagreements were checked against poem title, full text, scene evidence, and place-name context

Note. To minimise place-name cues, lines containing place names were removed from the sampled poems before expert classification.

A Relational Typological System of Tang Poetic Cultural Landscapes in the Jiangsu Section of the Yangtze River

Figure 14 integrates the preceding results on sample coverage, basic landscape elements, city-level semantic clusters and the five integrated scene types into a relational framework. The six core analytical cities are represented as city nodes, while the five integrated scene types serve as connecting hubs. City types reflect the typological characteristics emerging from the combination of multiple scene relationships. While Fig. 13 focuses on temporal changes in record counts, urban composition and relative intensity, Fig. 14 further illustrates the connections among scene types and how different cities are incorporated into the regional Tang poetic cultural landscape system through combinations of multiple scenes.

The five integrated scene types are interconnected through shared landscape elements and semantic associations. The connection between Riverine Urban Landscapes and Elevated Viewing and Historical Reflection is primarily reflected in the co-occurrence of river systems, mountainous terrain, city walls, towers and historical place names. Terms such as Qinhuai, Stone City and Zhongshan Mountain in Nanjing; Wujiang, bridges, gardens and former visits in Suzhou; Guangling and Wucheng in Yangzhou; and Jingkou, Beigu and river mouths in Zhenjiang refer to specific geographical locations and spatial features. These terms also frequently occur alongside references to rivers, towers, pavilions, wind, moonlight and past events. Their co-occurrence indicates that spatial elements such as rivers, city walls, mountains and towers provide the physical settings for elevated viewing, distant observation and

historical reflection. Terms associated with Elevated Viewing and Historical Reflection further connect these riverine urban landscapes with historical place names, ruins and memories of the past.

The relationship between River Travel and Farewell and Urban Life and Commercial Exchange is primarily reflected in terms associated with boats, roads, ferry crossings, towers and pavilions, wine, songs, writing and travellers. In the semantic clusters of Nanjing, Yangzhou and Zhenjiang, terms such as traveller, road, boat, vessel, sail, ferry crossing, lodging, letter and poetry frequently co-occur with references to towers, wine, songs, writing, lamps, marketplaces and urban buildings. Waterway travel in these records is associated with movement between locations, as well as farewell, poetic composition, correspondence, banqueting and urban social interactions. In particular, towers, songs and boats in Yangzhou; the Qinhuai waterfront, taverns and poetic composition in Nanjing; and river mouths, boats, lodging and letters in Zhenjiang illustrate the close relationship between travel activities and urban social interactions.

The relationship between Religious Visits and Excursions and Riverine Urban Landscapes is primarily reflected in terms associated with mountain temples, springs, steles, monks, bells and stone chimes, clouds and poetic inscriptions. In Zhenjiang, terms such as Jinshan, temple, stele, Buddhist scripture and stone chime; in Wuxi, Huishan, spring, temple, monk, stele and pool; and in Changzhou, mountain, pavilion, monk, Chan and stone chime illustrate the connections between religious spaces and natural landscapes. Similar associations are also found in clusters from Suzhou and Nanjing, where references to temples and monks occur alongside mountains and waters. The co-occurrence of terms such as temple, spring, mountain, cloud, bamboo, moss and stone chime connects religious excursions with landscape viewing, auditory experiences of flowing springs and poetic composition. These relationships are particularly evident in Wuxi's spring-temple imagery and Zhenjiang's mountain-temple imagery. Religious Visits and Excursions thus acquire distinctive spatial characteristics through their natural settings, while terms such as poetry, stele, transmission and former visits further associate these landscapes with literary inscriptions and memories of earlier visits.

Table 11 summarises the period totals of the five integrated scene types and their Late Tang distribution across the six core cities. River Travel and Farewell and Riverine Urban

Landscapes reached their highest counts in the Middle Tang, with 181 and 166 records, respectively, accompanied by increases in Urban Life and Commercial Exchange and Religious Visits and Excursions. In the Late Tang, Elevated Viewing and Historical Reflection increased to 136 records and was concentrated in Nanjing, Suzhou and Yangzhou. River Travel and Farewell remained distributed across Nanjing, Suzhou, Yangzhou and Zhenjiang, while Religious Visits and Excursions were led by Zhenjiang and Nanjing. These results indicate a Middle Tang emphasis on waterway travel and urban interactions and a Late Tang strengthening of historical memory.

Overall, Fig. 14 illustrates how the five integrated scene types collectively form a relational typological system of Tang poetic cultural landscapes. Riverine Urban Landscapes provide the spatial relationships within the region, while River Travel and Farewell connects waterway transportation with human movement. Urban Life and Commercial Exchange incorporates towers and pavilions, banqueting and poetic composition, while Elevated Viewing and Historical Reflection brings historical place names, ruins and memories of the past into poetic landscape representations. Religious Visits and Excursions further connects natural environments with spiritual activities through mountain temples, springs, monks and inscriptions. The combinations of these scene types across different cities collectively constitute the relational typological system of Tang poetic cultural landscapes in the Jiangsu section of the Yangtze River.

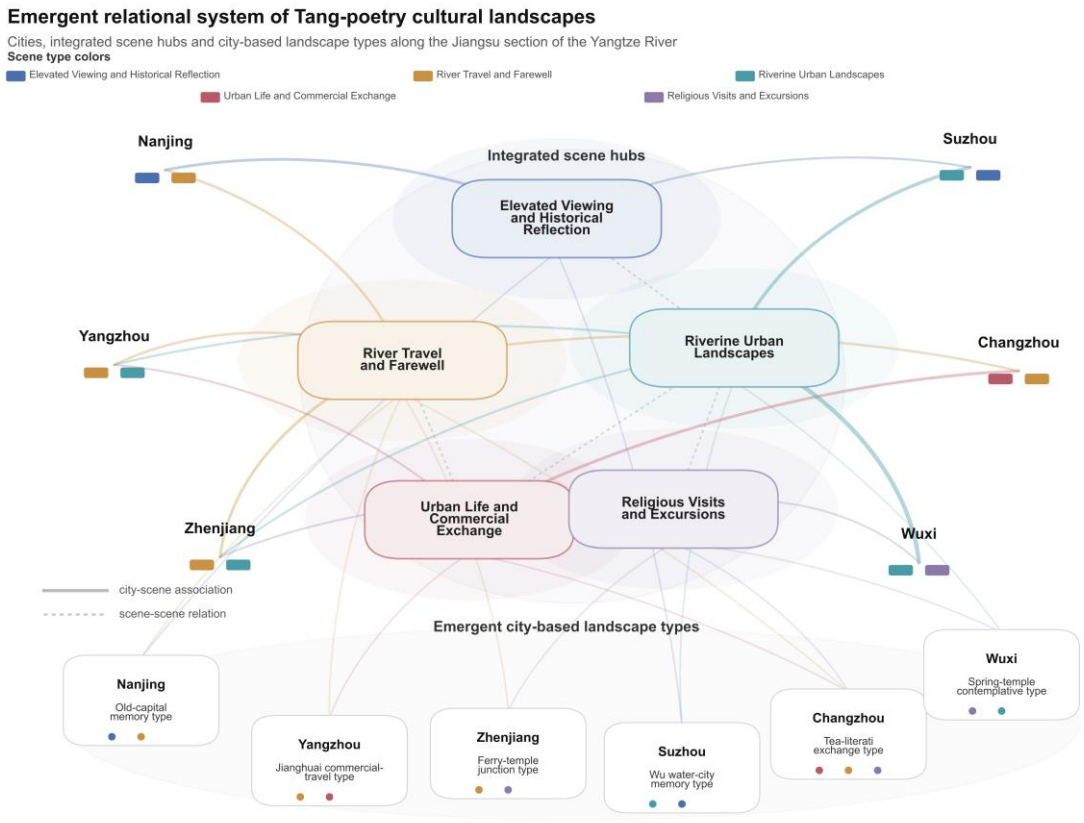


Fig. 14 | Integrated relational system of Tang poetic cultural landscapes in the Jiangsu section of the Yangtze River.

Table 11. Temporal distribution and Late Tang urban composition of the five integrated scene types

Integrated scene type	Scene records by period (Early / High / Middle / Late, n)	Late Tang city distribution (n)
Elevated Viewing and Historical Reflection	7 / 53 / 103 / 136	Nanjing 75; Suzhou 35; Yangzhou 20; Zhenjiang 5; Wuxi 1
River Travel and Farewell	8 / 86 / 181 / 98	Nanjing 34; Suzhou 22; Yangzhou 21; Zhenjiang 18; Changzhou 2; Wuxi 1
Riverine Urban Landscapes	19 / 53 / 166 / 139	Suzhou 58; Nanjing 30; Yangzhou 27; Zhenjiang 13; Wuxi 10; Changzhou 1
Urban Life and Commercial Exchange	4 / 17 / 73 / 44	Yangzhou 18; Suzhou 10; Nanjing 8; Zhenjiang 4; Changzhou 3; Wuxi 1
Religious Visits and Excursions	0 / 9 / 51 / 54	Zhenjiang 20; Nanjing 19; Suzhou 7; Yangzhou 5; Changzhou 2; Wuxi 1

Note. Values are scene-record counts for the six core analytical cities (n = 1,301). Cities with zero Late Tang records are omitted.

Discussion

Overall, place names, landscape terms, behavioural terms and emotional expressions in

Tang poetry provide a textual basis for identifying cultural landscapes in the Jiangsu section of the Yangtze River Basin. Among the eight basic landscape element categories, Rivers and Waters, Built Space, Sky and Climate, and Allusive Memory consistently account for relatively high proportions across the four Tang periods. These elements co-occur with references to travel, poetic composition, farewell, lodging, banqueting, correspondence, memories of dreams and melancholy. Word-frequency analysis identifies recurring landscape elements in the texts, while semantic co-occurrence networks further reveal the relationships among these elements. Such relationships connect physical spaces with poets' journeys, social interactions and emotional expressions, extending cultural landscape identification from the extraction of individual landscape terms towards an integrated analysis of landscape, behaviour and emotion. Accordingly, cultural landscapes represented in Tang poetry can be understood as textual structures shaped by physical spaces, human activities and emotional memories.

These findings are consistent with existing research in literary geography and poetic cultural landscapes [5–8]. Previous studies on the Road of Tang Poetry in Eastern Zhejiang, Tianmu Mountain and West Lake have employed text mining, GIS and semantic network analysis to investigate landscape imagery, excursion activities and cultural memory in classical poetry [13–16]. Building on this work, the present study incorporates six core cities in the Jiangsu section of the Yangtze River Basin into a common analytical framework. By examining semantic associations among landscape elements, human activities and emotional expressions, it further identifies distinctive urban landscape characteristics and relationships among integrated scene types. These findings demonstrate the potential of poetic texts for comparing urban landscapes and examining regional cultural landscape connections at the river-basin scale.

Temporal comparisons indicate that poetic landscape records in the study sample were concentrated in the Middle and Late Tang periods, although the composition of scene types differed between them. During the Middle Tang, references to waterway travel, urban interactions and riverine urban landscapes were particularly prominent, with all five integrated scene types well represented. In the Late Tang, records of Elevated Viewing and Historical Reflection approached those of Riverine Urban Landscapes, while historical place names, ancient city ruins and retrospective emotions became more prominent within the scene

structure. These differences suggest that temporal changes in Tang poetic cultural landscapes involved variations in both the number of records and the composition and cultural meanings of landscape scenes. Comparing integrated scene types across periods therefore provides further insight into the changing thematic emphasis of poetic landscape representations.

These temporal differences can be considered in relation to the historical development of the Jiangnan region during the middle and later Tang periods. From the Middle Tang onward, Jiangnan became increasingly important in fiscal, transportation and cultural activities, while poets travelled between lower Yangtze cities for official appointments, demotion, excursions and social interactions. The Yangtze River, canal routes and the Jiangnan waterway network provided transportation routes for these activities and spatial settings for poetic representations of river travel, farewell, lodging and poetic composition. The prominence of historical memory in Late Tang poetry can also be associated with retrospective consciousness, images of former capitals and reflections on historical rise and decline. Historical place names such as Stone City, Qinhuai and Phoenix Terrace in Nanjing; Beigu and Jinshan in Zhenjiang; and Guangling and Jiangdu in Yangzhou occur alongside references to elevated viewing, remembrance and historical reflection. The relative prominence of different scene types can thus be interpreted in the context of regional transportation, poets' movements and historical memory, although the specific relationships between these historical factors and changes in poetic records require further examination using historical sources.

The city-level clustering results further highlight the importance of historical place names and allusive memory in shaping poetic representations of urban landscapes. This pattern is particularly evident in Nanjing, where historical place names such as Stone City, Phoenix Terrace and Wuyi Lane are semantically associated with rivers, towers, ruins, elevated viewing, remembrance and melancholy. These associations connect specific urban spaces with reflections on the past. Previous research on Nanjing place names has shown that place names in Tang and Song poetry are closely related to the city's historical and cultural development and can be used to examine their spatiotemporal distribution and cultural significance [26]. Research on Nanjing's historical cultural landscapes has also examined the accumulation and reinterpretation of urban space over time [27]. Considered alongside the present findings, these studies suggest that historical place names serve both spatial and mnemonic functions in poetic

texts. Similar relationships are found in Suzhou, Zhenjiang and Yangzhou, although historical place names in each city form different semantic combinations with landscape elements, activities and emotions. Research on toponymic cultural heritage in Jiangsu has identified close relationships between place names, physical geography, historical cultural regions and regional development conditions [28]. The present results further indicate that these semantic associations contribute to distinctive representations of urban landscapes and historical memory.

The landscape characteristics of individual cities also reflect relationships among geographical settings, historical functions and poets' activities. River mouths and ferry crossings in riverside cities are frequently associated with boat travel, farewell and lodging, while bridges, boats and gardens in water-network cities are more closely connected with excursions and social interactions. Former-capital ruins are associated with Elevated Viewing and Historical Reflection, whereas mountain temples, springs and rocks are linked to temple visits, inscriptions and contemplation. Although the six core cities differ in their landscape elements and semantic clusters, the five integrated scene types provide common dimensions for comparison. Each city exhibits distinctive combinations of scene types while participating in a regional poetic cultural landscape system through semantic associations involving historical memory, waterway travel, urban interactions and religious excursions. This relational structure extends the analysis beyond the identification of individual urban landscape characteristics towards an examination of relationships among cities, providing a regional framework for understanding cultural connections within the Jiangsu section of the Yangtze River Basin.

River Travel and Farewell is particularly indicative of cross-city connections within Tang poetic cultural landscapes. This scene type is widely represented in Nanjing, Yangzhou, Suzhou and Zhenjiang, where recurring terms associated with boat travel, farewell, travel routes, lodging and correspondence reflect shared representations of waterway movement and social interactions among poets. From a historical geographical perspective, the Yangtze River, canal routes, the Taihu Lake system and the Jiangnan waterway network formed an interconnected regional transportation system [32,33]. Previous studies of the Road of Tang Poetry in Eastern Zhejiang have combined poetic texts, poets' itineraries and transportation

networks to examine the formation and characteristics of poetic cultural routes [13,14]. Research on Suzhou's canal heritage and Jiangnan canal cities has also identified relationships between waterway transportation and the development of urban cultural landscapes [29,30,32,33]. Compared with riverside cities such as Nanjing and Zhenjiang, Suzhou, Wuxi and Changzhou had more indirect connections with the main course of the Yangtze River, with regional transportation links involving the Taihu Lake system, Jiangnan waterways and canals. Examining the Jiangsu section within this interconnected waterway system therefore helps explain how cities in different geographical settings share related landscape scenes. Nevertheless, the cross-city distribution of poetic scenes primarily reflects shared landscape experiences represented in texts; specific poets' travel routes require further verification through biographical records and historical geographical evidence.

Differences in the number of poetic records must also be considered when comparing cultural landscapes across cities. Nanjing, Suzhou, Yangzhou and Zhenjiang have relatively large numbers of valid records and therefore tend to dominate absolute-frequency analyses, whereas the smaller samples from Changzhou and Wuxi may obscure locally distinctive themes. To complement absolute-frequency analysis, this study introduces the location quotient (LQ) and its logarithmic transformation to compare the relative concentration of integrated scene types within individual cities. Previous regional studies have demonstrated the usefulness of location quotients for identifying relative concentrations and local specialisation within a broader distribution [44,45]. The results for Changzhou and Wuxi illustrate the additional insights provided by this approach. Urban Life and Commercial Exchange in Changzhou has a $\log_2(LQ)$ value of 1.82, the highest for this scene type among the six core cities. In Wuxi, Riverine Urban Landscapes and Religious Visits and Excursions have positive $\log_2(LQ)$ values of 1.04 and 1.46, respectively. These findings correspond to the semantic clusters associated with tea-related exchanges and local products in Changzhou, and Huishan springs, temples and religious excursions in Wuxi. They indicate that cities with relatively few records may nevertheless exhibit a pronounced concentration of particular local themes. Combining absolute frequencies with LQ-based relative intensity allows cities to be compared in terms of both record volume and internal scene composition, reducing the dominance of high-frequency cities in regional analysis. However, LQ measures relative concentration

within the study sample, and values calculated from small samples are more sensitive to individual records. Such findings therefore require interpretation alongside poetic contexts and additional historical sources.

These findings provide a textual basis for identifying cultural heritage resources in the Jiangsu section of the Yangtze River Basin and informing the development of the Yangtze River National Cultural Park. Previous studies of national cultural parks have emphasised the systematic integration, holistic conservation and digital interpretation of cultural resources [34,35], while recent research has examined the spatiotemporal evolution and formation of poetic cultural landscapes within the Yangtze River Basin [36]. By analysing relationships among the eight basic landscape element categories, city-level semantic clusters and five integrated scene types, this study organises place names, landscapes, human activities and emotional memories dispersed across poetic texts into an interconnected regional structure. The five scene types reflect distinctive local landscape characteristics while establishing cross-city associations through shared spatial and behavioural elements, providing a basis for classifying and interpreting cultural resources across the region. From a design perspective, this relational scene system could inform the organisation of cross-city cultural maps, interactive digital interfaces, thematic routes and exhibition narratives [37,38], allowing cities to express their distinctive poetic landscape characteristics within a shared Yangtze cultural framework. These applications have the potential to reduce homogeneity in cultural heritage interpretation and strengthen the representation of regional cultural connections. Their practical feasibility, however, requires further assessment of heritage conservation conditions, historical route evidence, spatial accessibility, public needs and local management requirements.

This study has several limitations. First, the dataset was primarily compiled from the Quan Tangshi and digital poetry databases. Variations in author attribution, textual versions and poem titles may affect the extraction of landscape terms and subsequent statistical results. Second, historical place names in Tang poetry include alternative names, abbreviated forms, generic references and names shared by different locations. Although the study used historical-to-modern place-name matching, contextual examination of poetic lines and ambiguity checks to reduce misclassification, some historical geographical interpretations

remain uncertain. In addition, the numbers of valid records differ across cities, requiring caution when interpreting LQ values for smaller samples from Changzhou and Wuxi. Semantic co-occurrence analysis and scene clustering can reveal landscape associations represented in poetic texts, but their ability to reconstruct specific historical transportation routes, changes in urban space and poets' activities remains limited by the available textual evidence and analytical methods.

Future research could incorporate poetry from the Song, Yuan, Ming and Qing dynasties, alongside travel accounts, local gazetteers, historical maps, visual materials and inscriptions, to construct a longer-term cultural landscape database for the Jiangsu section of the Yangtze River Basin and examine the continuity and transformation of landscape representations across historical periods. Further integration of historical GIS, poets' itineraries and waterway transportation networks could support more detailed analyses of routes and nodes associated with River Travel and Farewell, Elevated Viewing and Historical Reflection, and Religious Visits and Excursions. In cultural heritage interpretation, semantic networks, LQ-based analyses and the integrated scene system could be developed into digital maps, interactive visualisations and cross-city thematic routes, with their effectiveness assessed through practical applications. Overall, by examining landscape elements, temporal changes, urban differentiation and relationships among integrated scene types, this study establishes a relational scene framework connecting six core cities. This framework provides a textual basis for understanding the regional characteristics and cultural connections of Tang poetic cultural landscapes in the Jiangsu section of the Yangtze River Basin, while offering a foundation for cultural heritage resource integration and design-oriented interpretation.

Ethics statement

This study was based on the analysis of historical literary texts and did not involve human biological materials, animal experiments or the collection of identifiable personal data. Three experts participated in an independent validation exercise involving the classification of historical poem excerpts. Only anonymised classification results were used to assess the consistency of the integrated scene classification.

Data availability

The primary textual data analysed in this study were derived from Quan Tangshi (Complete Tang Poems), with supplementary textual verification conducted using the Souyun poetry database (https://www.sou-yun.cn/). The processed datasets supporting the findings of this study, including cleaned poetry records, historical toponym verification, landscape-element coding, integrated scene classifications, semantic network data, expert-validation results and source data underlying the figures, are available from the corresponding author upon reasonable request. Access to third-party textual materials is subject to applicable terms of use.

Code availability

The custom Python scripts used for data cleaning, text segmentation, semantic term extraction, co-occurrence network construction, statistical analysis and figure generation are available from the corresponding author upon reasonable request. Gephi 0.11.2 was used for semantic network analysis, modularity clustering and visualisation.

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Author contributions

W.M. conducted the data collection, historical toponym verification, text mining, landscape-element coding, semantic network analysis, integrated scene classification and statistical analysis, and prepared the figures, tables and original manuscript draft. J.Y. supervised the research, provided methodological guidance, and critically reviewed and revised the manuscript. Both authors reviewed and approved the final manuscript.

Competing interests

The authors declare no competing interests.

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