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Information geography: A new fulcrum of geographic ternary world

Guonian LÜ[1,2,3*], Linwang YUAN[1,2,3] & Zhaoyuan YU[1,2,3]

[1] *Key Laboratory of Virtual Geographic Environment, School of Geography, Nanjing Normal University, Ministry of Education, Nanjing 210023, China;*
[2] *Jiangsu Center for Collaborative Innovation in Geographical Information Resource Development and Application, Nanjing 210023, China;*
[3] *State Key Laboratory Cultivation Base of Geographical Environment Evolution (Jiangsu Province), Nanjing 210023, China*

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Abstract The development trend of ternary space requires the construction of the information space for information mapping, transmission and transformation of geographic elements and social-human elements. Relevant researches of information geography from the perspective of Geographic Information Science and human geography are reviewed in this paper, then the concept interpretation of information geography from the perspective of ternary space is proposed. It is presented in this paper that information geography can be constructed with a framework using seven geographic elements as the basic expressing dimensions and seven social-human elements as the basic aggregating core. Information geography analyzes spatio-temporal distribution, structural characteristics, evolution process and interactions of various elements in the information space. And it eventually realizes the actual description, multi-scenario simulation, multi-objective decision-making and multi-channel control of the physical world and the social-human world.

Keywords Information geography, Ternary space, Seven geographic elements, Seven social-human elements

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The development of computer technology and information technology promotes the formation of the information world, leading to the shaping of the ternary world (Zhou, 2015; Guo and Ying, 2017). The physical world is the first in the ternary world, which reflects the objective physical space. The second world is the social-human world that presents the spiritual civilization of human beings. And the last one is the information world that connects the physical world and the social-human world and reacts to the two. During the development of Geography, based on the basic theory of the ternary world, the connotation and denotation of Geography are extended, relevant theories and methodologies are constructed, and physical geography (with the physical world as the main research object) and human geography (with the human worlds as the main research object) are successively developed (Figure 1). For geographic research in the information world, the disciplines such as Cartography, Remote Sensing and Geographic Information System have been developed. The developments of these disciplines in the acquisition, storage, management, transmission, transformation, analysis, expression, and application of geographic information provide scientific and technical support for the entry of Geography into the information world. However, some fundamental issues like the mapping, expression, transmission, transformation of information in the information world have not been studied, indicating that information geography has not yet been constructed.

Several ideas of constructing information geography have

* Corresponding author (email: gnlu@njnu.edu.cn)

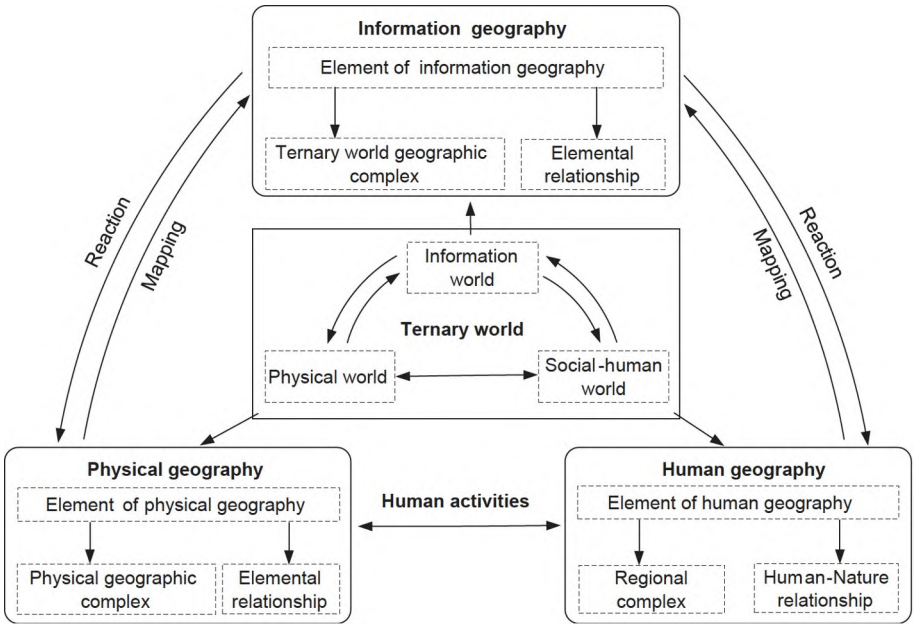

Figure 1 The discipline layout and interaction of geography in the ternary world.

been proposed from different perspectives. The essential problem of information geography, from the perspective of Geographic Information Science, is how to deal with geographic information by using theories, methodologies and technologies of Information Science (Chen, 1995; Graham et al., 2015; Liu, 2022). From the perspective of human geography, information geography studies the organization, production and transmission of information and communication, and the influence of information and communication technologies (ICTs) on regional economics, human communication, human migration and social relationship, whose research objects are ICTs, information communication network and its network space (Sun and Lu, 2006; Gao et al., 2019). However, the research objects of information geography should be informational elements. Specifically, how to map geographic and social-human elements to informational elements and how these researches affect physical geography and human geography are the fundamental issues of information geography (Li et al., 2022). Obviously, the above issues cannot be solved in the isolated information world. To obtain a more reasonable and more complete concept interpretation of information geography, we need to re-examine it from the perspective of the ternary world.

In this paper, information geography is defined as a branch of science that studies the mapping of elements from the physical world and social-human world to information world, the transmission and transformation of informational elements, and the interaction between the information world and the other two worlds (Figure 2). On the one hand, information geography should undertake the physical and social-human geographic information transformed from the real world and the information is then stored, managed, expressed and analyzed in the form of a digital twin under a unified spatiotemporal framework. In order to realize the conversion of the physical and social-human geographic information to the information world, and the real-time or quasi real-time simulation of the entire life cycle of the real world, varied information carriers such as text, sound, graph, image, figure, equation and model are also formed through methodologies and technologies of Cartography, Remote Sensing, Geographic Information System, big data, Artificial Intelligence and modelling. On the other hand, human beings can display unlimited imagination and creativity in the scenario constructed in the virtual space of the information world. Taking specific objects or phenomena as targets, elements such as time, place, character, event, scene are aggregated based on particular organizing rules, which can realize the reconstruction of digital twins of the real world and eventually influence and change the physical world and social-human world through various information carriers such as text, sound, graph, figure, model, equation and image.

Information is not only the research object of information geography but also a link between the three worlds. In the ternary world, the physical world and social-human world interact in the information world through the mapping of various informational elements. Therefore, it is required to study the production, transmission, transformation, expression and application of geographic information in the ternary world, and construct the discipline system integrating physical geography, human geography and Information geo-

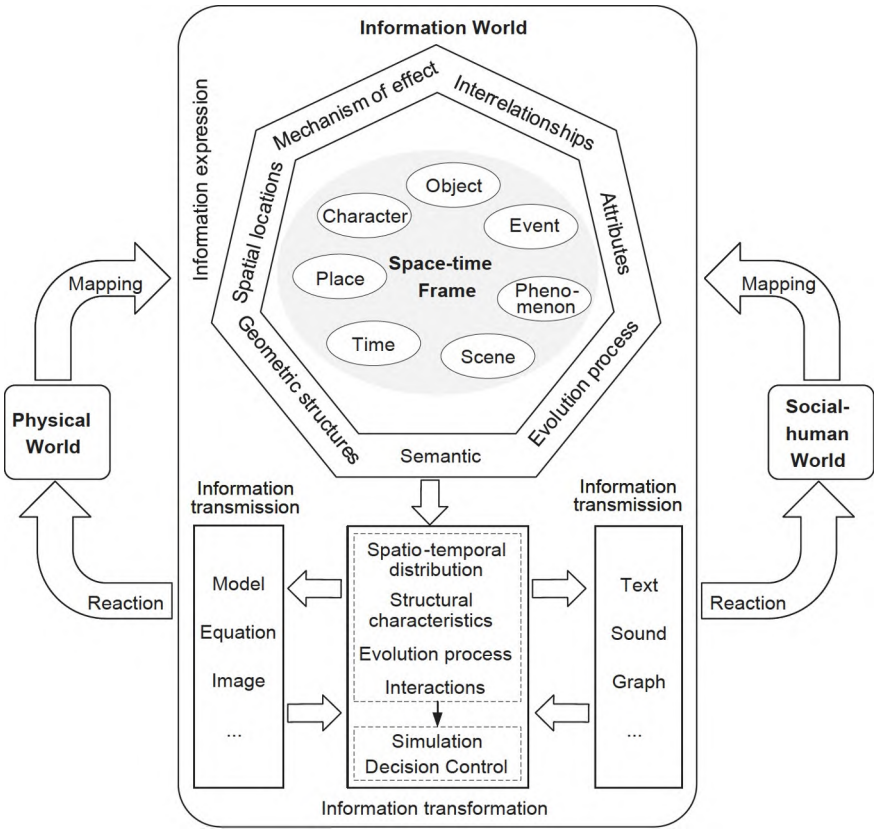

Figure 2 The expression, transmission and interaction of information elements in the ternary world.

graphy. However, information geography has been regarded as a transmitting medium or a data mining tool of geographic information for a long time, and the role as a fulcrum of the ternary world has not been fully exerted. Accordingly, it is necessary to construct the virtual space based on information infrastructure, data stream and information flow, to give full play to the ability of time-space compression and displacement of information in the virtual space. Moreover, based on the constructed virtual space, new geographic estimating models and cognitive patterns can be generated, and the virtual human, virtual community and virtual scenario is then created. Thus, the exploration of physical processes and human social patterns, and the reconstruction of the real world, can be realized. Specifically, the reconstruction of the real world in information space needs to construct a social information mapping method based on the seven elements of time, place, character, object, event, phenomenon and scene, and to construct a physical information mapping method based on the seven elements of spatial locations, mechanism of effect, semantic, geometric structures, evolution process, interrelationships and attributes (Lv et al., 2018). The research focus of information geography should be shifted from space and attributes to the analysis of spatio-temporal distribution, structural characteristic, evolution process and interaction of informational elements in geographic scenarios. Finally, the actual description, multi-scenario simulation, multi-objective decision-making and multi-channel control of the physical world and social-human world can be realized.

Human society has entered the ternary world that is composed of the physical world, the social-human world and the information world, promoting the situation of tripartite confrontation between physical geography, human geography and information geography. As a newly emerging subject, information geography should give full play to its role as a fulcrum in the ternary world. Specifically, it is required to construct the geographic informational space to realize the information mapping and react on the physical world and social-human world through the reconstruction, transmission and transformation of information. In this paper, the preliminary idea of constructing the information space from the perspective of seven geographic elements and seven social-human elements is presented. The spatio-temporal distribution, structural characteristic, evolution process and interaction of elements in information space are clarified to be the research focus of information geography. In conclusion, information geography is a branch of science that studies the actual description, multi-scenario simulation, multi-objective decision-making and multi-channel control of the physical world and social-human world.

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